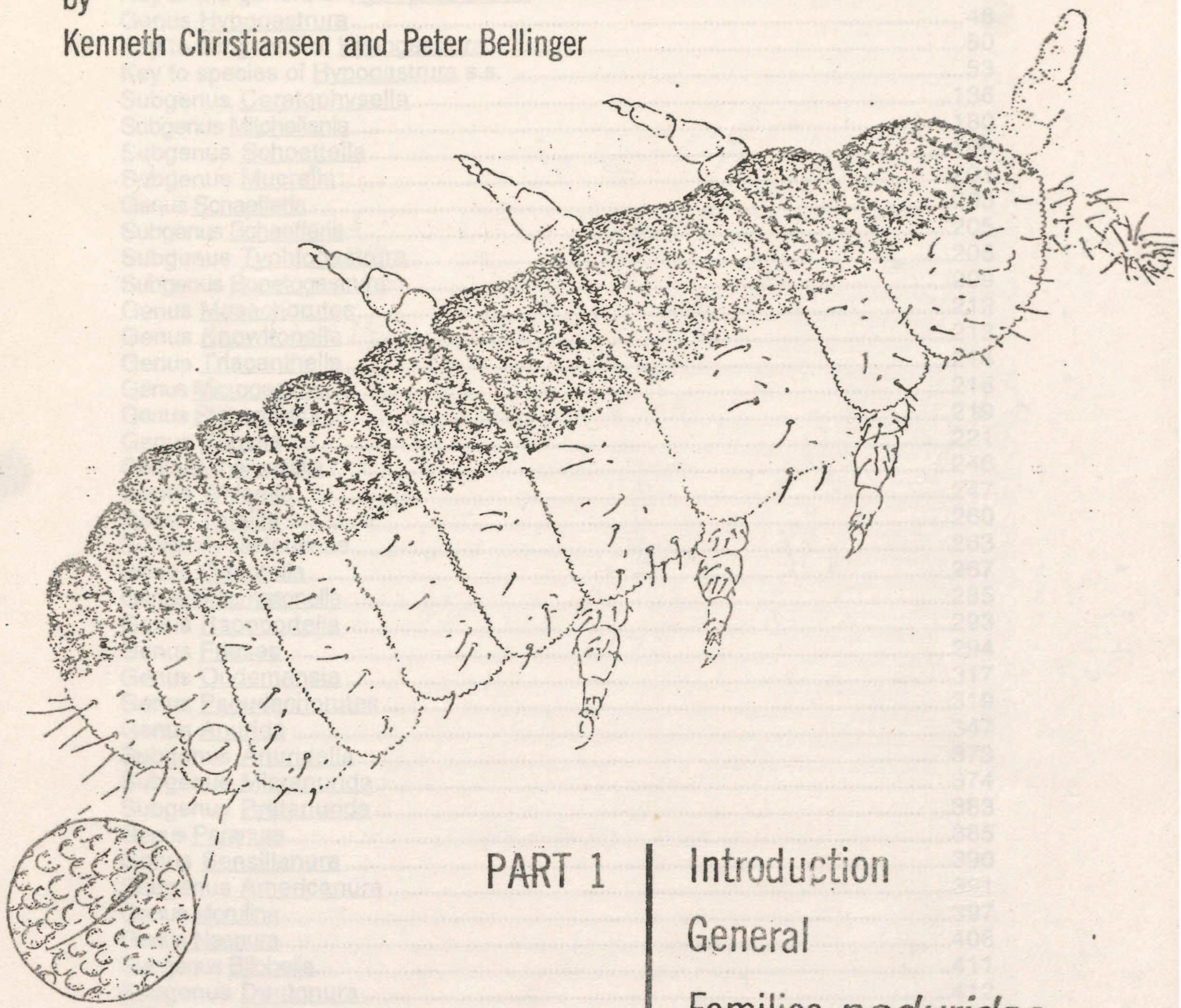
THE COLLEMBOLA OF NORTH AMERICA

NORTH OF THE RIO GRANDE

A taxonomic analysis
by
Kenneth Christiansen and Peter Bellinger



PART 1 | Introduction
General
Families *poduridae*
and *hypogastruridae*

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Preface to First Edition

Ever since we began our own work on Collembola, we have been frustrated by the difficulty or impossibility of identifying Nearctic species. Only one book (Gisin, 1944) has ever attempted to include keys to all North American species; except for a key to genera (Scott, 1961), all other publications on North American Collembola have been devoted to particular geographic regions (e.g. Mills, 1934) or particular genera or families (e.g. Folsom, 1937), and the most useful of these are now seriously out of date.

We have prepared this manual in the hope that it will simplify problems of identification for taxonomists and ecologists interested in Collembola. We must emphasize that it is not to be regarded as a monographic revision. Although we have found it necessary to describe a considerable number of new species and propose a few names for taxa at higher levels, and have made use of new or previously neglected characters in the classification of some genera, lack of material and time have prevented us from extending original work beyond that which seemed necessary and adequate for species recognition, or from making any fundamental revision in the higher classification.

It has seemed preferable to us to include the descriptions of some new entities in this work rather than omitting them entirely or delaying publication of this manual for an indefinite time until descriptions could appear elsewhere. .....While separate publication of new descriptions would be preferable, we believe that the amount of comparative information presented here will compensate to some extent for descriptions which may be less complete than those we would normally present.

The geographic area covered is limited to the North American continent north of the Mexican boundary, and adjacent islands. The Mexican boundary is not faunistically significant, but does represent a natural, though imperfect, limit to our knowledge of distribution of most groups of Collembola. Greenland is excluded, since its known fauna is included in Gisin's Collembolenfauna Europas.

An attempt has been made to place all specific names which have been applied to Nearctic Collembola. Because of totally inadequate early descriptions, and the omission even in some recent descriptions of characters we use in species separation, some of these have merely been assigned to the proper genus as uncertain species, while a few cannot be placed even this closely. All these names are included in the index.

So far as possible, the identity of Nearctic species has been verified by examination of type specimens, as indicated in the keys and text. For species whose types are lost, inaccessible, or in too poor condition for proper study, we have had to rely on published descriptions, topotypical material, specimens determined by other specialists, or a combination of these; we have attempted to indicate all cases in which the identity of the species is still in question.

We have been fortunate in being able to study a very large amount of material in addition to that in our own collections. We acknowledge with thanks the loan of material from the United States National Museum; the Museum of Comparative Zoology, Harvard; the Illinois State Natural History Survey; the California Department of Agriculture; the University of Minnesota; Nova Scotia Museum; Royal Ontario Museum; and Michigan State University.

Many colleagues have been kind enough to send us collections of Collembola; among these, we wish to acknowledge especially the loans made by R.F. Wilkey, F. Cancellare, J.W. Hart, V. Landwehr, G. Lippert, D. Voegtlin, S. French, D. Lowrie, L. Pedigo, V. Marshal, W.R. Richards, J. Lussenhop, G. Benham, and F. Ford. Dr. H.G. Scott kindly provided us with type specimens of some of the species he described.

Because so many Collembola are reputed to be holarctic in distribution, we made an effort to compare Nearctic with European and Japanese material. We owe special thanks to colleagues who provided us with facilities and gave us access to collections in their care: Dr. R. Yosii (Kyoto), Dr. C. Delamare Deboutteville (Brunoy), Dr. Willem Ellis (Amsterdam), Dr. Romano Dallai (Siena), Mr. Peter Lawrence (London), Dr. P. Cassagnau (Toulouse).

Part of our material has been determined be other specialists, and some sections of the manual have been greatly improved by their revisional work, both published and unpublished: Dr. M.M. da Gama (Coimbra) - Xenylla; Mr. A. Fjellberg (Bergen) - Isotoma; Dr. J.M. Thibaud (Brunoy) - Schaefferia (s.l.); M.L. Deharveng (Toulouse) - Uzelia and Tetracanthella; Mr. R.J. Snider (East Lansing) - Bourletiella and Sminthurus. Other colleagues have assisted us by supplying material for comparison, checking determinations, and critically reviewing sections of the manuscript: M.J.-M. Betsch (Sminthuridae), Dr. Z. Massoud (Neanurinae), Dr. J.-M. Thibaud (Hypogastrurinae), Dr. J. Rusek (Tullbergia), Dr. N. Poinsot-Balaguer (Isotomurus). In acknowledging our debt to these colleagues, we wish to emphasize that they are not responsible for errors, nor for the classification we follow, which in some cases differs from their recommendations.

Technical assistance in the course of this study has been provided by many students at Grinnell. Two of these, Ann Baker Grow and Bruce Tucker, supervised much of the work of this project. Ms. Teresa deGroh was responsible for the preparation of the manuscript for duplication. Other students who assisted for major periods are: Jean Allan, Allan Camp, Diane Christiansen, Carl Johnson, Barbara Leslie, Jeanette Mulcahy, Linda Sanders, Todd Scheuer, Jan Sharp, Jane Tomlinson, Joel Weichsel, and Martha Wolf. Ms. Phyllis Hotchkin and Ms. Kathi Mitchell typed most of the manuscript.

The preparation of this manual was supported by Grants no. 37677 and 73-06852 from the National Science Foundation. Support for the senior author's work was also obtained through an institutional grant by the Sloan Foundation to Grinnell College. The junior author also wished to acknowledge previous grant support from the Nuffield Foundation, the American Philosophical Society, and the San Fernando Valley State College Foundation, for background studies which

contributed to the preparation of the Manual. Reduplication of the work was made possible through a grant of $7,000 from Grinnell College.

Preface to Second Edition

The original version of this monograph was completed twenty years ago, although for a variety of reasons publication was delayed. Since then there have been important contributions to knowledge of the Collembola of North America, as well as revisional studies on the world fauna which have advanced our understanding of relationships. In addition, we have discovered a number of errors, both trivial and serious, in the text and figures. As a result the original work has lost some of its value. It seems appropriate that we attempt, while we are still able, to bring this work up to date.

A complete revision would be ideal, but we found that we were not prepared to face so major an undertaking. We have instead chosen to insert genera and species recorded or described from North America since the original edition in the tables and keys, and to include illustrations of the species. We have also included, in the tables only, distinct species which we have seen but for which material or time is presently inadequate for a formal description, and species under study by several of our colleagues whose descriptions are unlikely to be published before this manuscript is finished; in this case we refer to the species by a letter designation only, to avoid technical validation of inadequately described taxa. We have described a number of new species , in considerably greater detail than we did in the first edition.

While our views on classification have not changed, it has seemed appropriate to bring that used here into accordance with general practice in certain respects. We have corrected one egregious error (treatment of Crossodonthina as a senior synonym of Morulodes). In several cases in which the classification of Gisin assigned species to genera on the basis of superficial similarity, we have separated them (Folsomina, Hydroisotoma). Revisional studies on Neanurinae have clarified the position of some species and required a different arrangement of subgenera. The groups formerly placed as subfamilies of Entomobryidae have been given family status, which seems fully justified on the basis of the ease with which they can be distinguished from Entomobryidae s.str. and the likelihood that several of them are actually more closely related to Isotomidae.

The identity of certain species left unassigned originally has been clarified (e.g. Mackenziella psocoides). On the other hand, we prefer not to follow the trend to splitting well-known taxa, as evidenced by the fragmentation of the family Sminthuridae and the genera Onychiurus and Tullbergia. In the case of the onychiurids, recent revisions have come to divergent conclusions. We have had the benefit of examining material from a number of additional institutions: the Academy of Natural Sciences, Philadelphia; the University of Vermont; the University of California, Riverside; and the Bishop Museum, Honolulu.

As with our first version, a number of people assisted us with taxonomic problems. We would like to extend particular thanks to Arne Fjellberg, Mikhail Potapov, R.J. Snider, and J.M. Thibaud. The senior author would also like to thank Cato Holler, David Hubbard, Jerry Lewis and James Reddell who sent large amounts on interesting and new cave material. He would also like to thank the many students who helped in the preparation of this revision. In particular he would like to thank Jeff Brown, Gretel Kiefer, Carmen Nuñez, Lisa Dorn and David Cavins for their valuable help. In addition a number of Grinnell secretaries have aided our work. In particular we would like to thank Valerie McKee and Paul Crawford and Vicki Wade whose help has been essential.

This work was made possible by a number of research grants from Grinnell College.

The advent of e-mail and Internet connections has made a number of resources available. The world list of Collembola and their distributions can be obtained from:http://www.geocities.com/~fransjanssens/ The interactive key and identification of the species of Pseudosinella can be obtained from: http://www.geocities.com/~fransjanssens/projects/pseudkey.htmCollembola. References published during 1995-97 are now available at the following address: http://www.rdg.ac.uk/AcaDepts/sa/AMS/staff/hopkin/collpaps.html . The Catalog of the Neotropical Collembola is now at the following address: http://mayaweb.upr.clu.edu/artssciences/cjs/neotrcat.htm.

We have not included new records of species recorded in the first edition. Those in our collection can be obtained from CHRISTAK@AC.GRIN.EDU if the species of interest and localities already recorded in CONANRG are individually listed by the inquirer. Information concerning the Collembolist Network can be obtained from the same address.

Characteristics of Collembola

The Order Collembola includes small, permanently wingless, insect-like arthropods with characteristic abdominal appendages. They are commonly placed in the Class Insecta, Subclass Apterygota, and this position may be retained for convenience; but there are good reasons for regarding them as constituting an entirely separate group, coordinate to Insecta and such myriapod classes as Chilopoda and Symphyla.

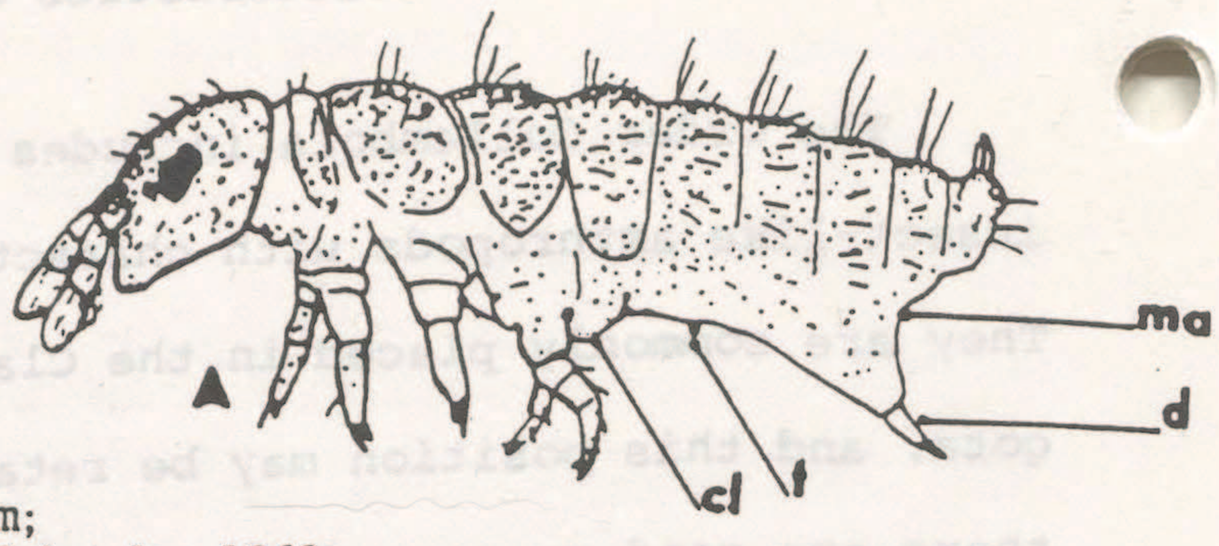
Collembola (Fig. 1, A-C) resemble typical insects in having a distinct head with one pair of segmented antennae, a thorax with three segments and three pairs of walking legs, and a segmented abdomen without such legs. The abdomen, however, consists of six segments, while all true insects have more abdominal segments at least in embryonic stages. The mouthparts correspond to those of insects, but the mandibles and maxillae are concealed by, and the labium fused with, folds continuous with the wall of the head capsule. A superficially similar entognathous condition is also found in Protura (with no antennae) and Entotrophi (with many-segmented antennae), both of which have more than six abdominal segments.

A distinctive feature of the Collembola is the collophore, or ventral tube, a cylindrical midventral appendage on the first abdominal segment with paired eversible vesicles at its tip. Most Collembola, in addition, have appendages with single basal segments and paired distal rami on the third and fourth abdominal segments: these are used in springing.

Other useful recognition points are the four-segmented antennae; the presence of a maximum of eight stemmata in each eye patch; the presence of only a single leg segment (tibiotarsus) beyond the

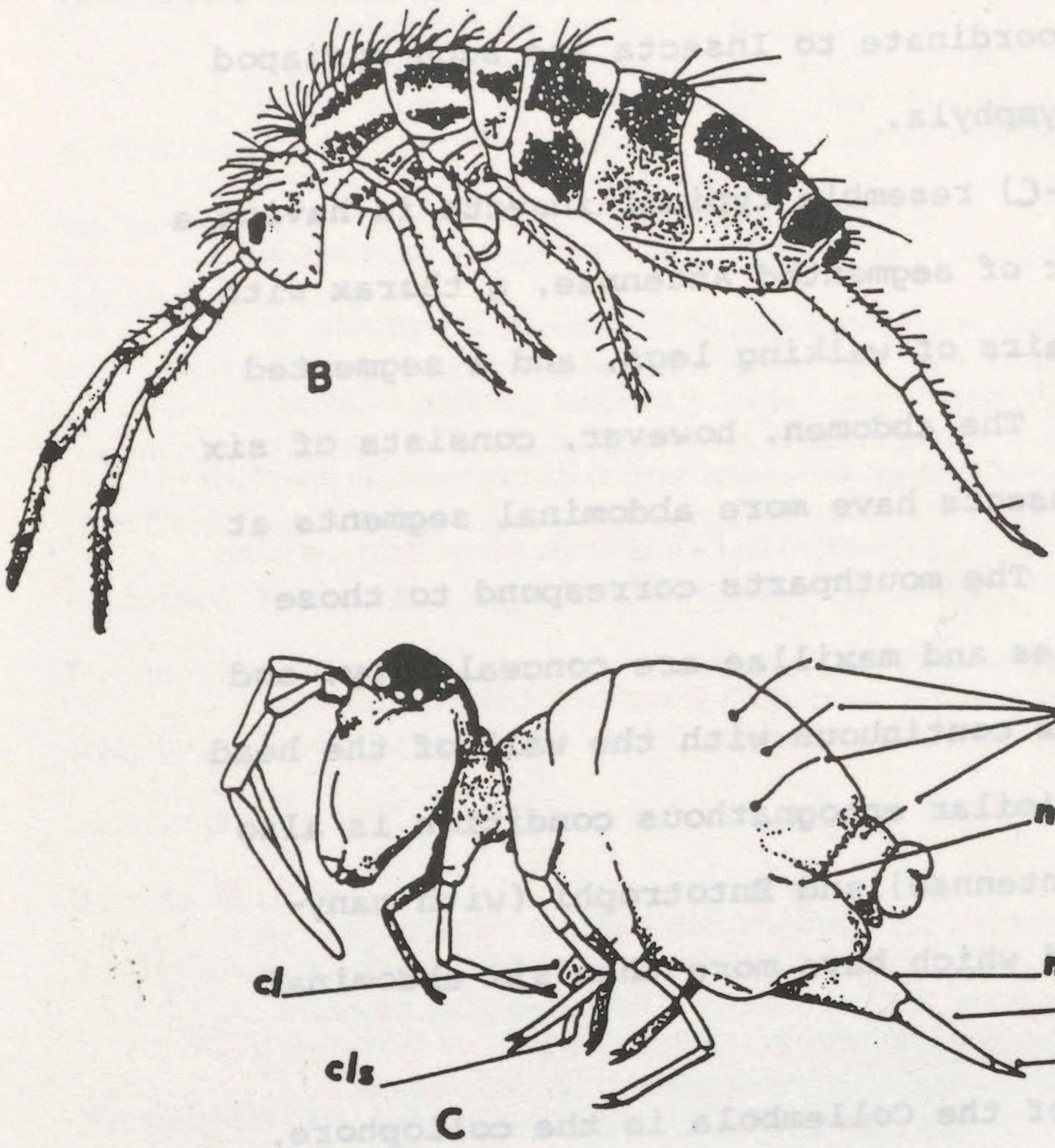
Types of Collembola

A) Hypogastrura armata (Arthropleona, Poduromorpha). cl, ventral tube; d, dens; ma, manubrium; t, tenaculum. After Stach, 1955.



B) Orchesella ainsliei (Arthropleona, Entomobrypmorpha). After Folsom, 1924.

C) Generalized sminthurid (Symphypleona). b, bothrotricha; cl, corpus of collophore; cls, collophore sacs; d, dens; ma, manubrium; mu, mucro; n, neosminthuroid seta. After Richards, 1968.



"knee"; and the single median claw or unguis (a smaller, median, ventral unguiculus is also found in most Collembola).

Some other small arthropods commonly found in the soil might be confused with Collembola at first glance, since the distinctive characters of the latter are not always evident on superficial examination. Groups which might be mistaken for Collembola, with obvious distinguishing characters, are listed below.

Group	Resembles	Distinctive features
Acarina (Fig. 2A)	various Collembola	no antennae; four pairs of legs (rare exceptions)
First instar Diplopoda (Fig. 2B)	poduromorphs	no collophore, no legs on segment behind head; large mandibles are usually visible on sides of head
First instar Pauropoda (Fig. 2C)	poduromorphs	branched antennae; no legs on segment behind head
Protura (Fig. 2D)	Tullbergia etc.	no antennae; anteriorly projecting appendages are first pair of legs
wingless Homoptera (Fig. 2E)	poduromorphs, sminthurids	more than six abdominal segments; combination of long outstanding antennae and no furcula
wingless Corrodentia (Fig. 2F)	sminthurids	more than six abdominal segments; vertical head and long antennae but no furcula

FIGURE 2

Representatives of soil arthropod groups sometimes confused with Collembola

A) Oribatid mite; from Barnes.

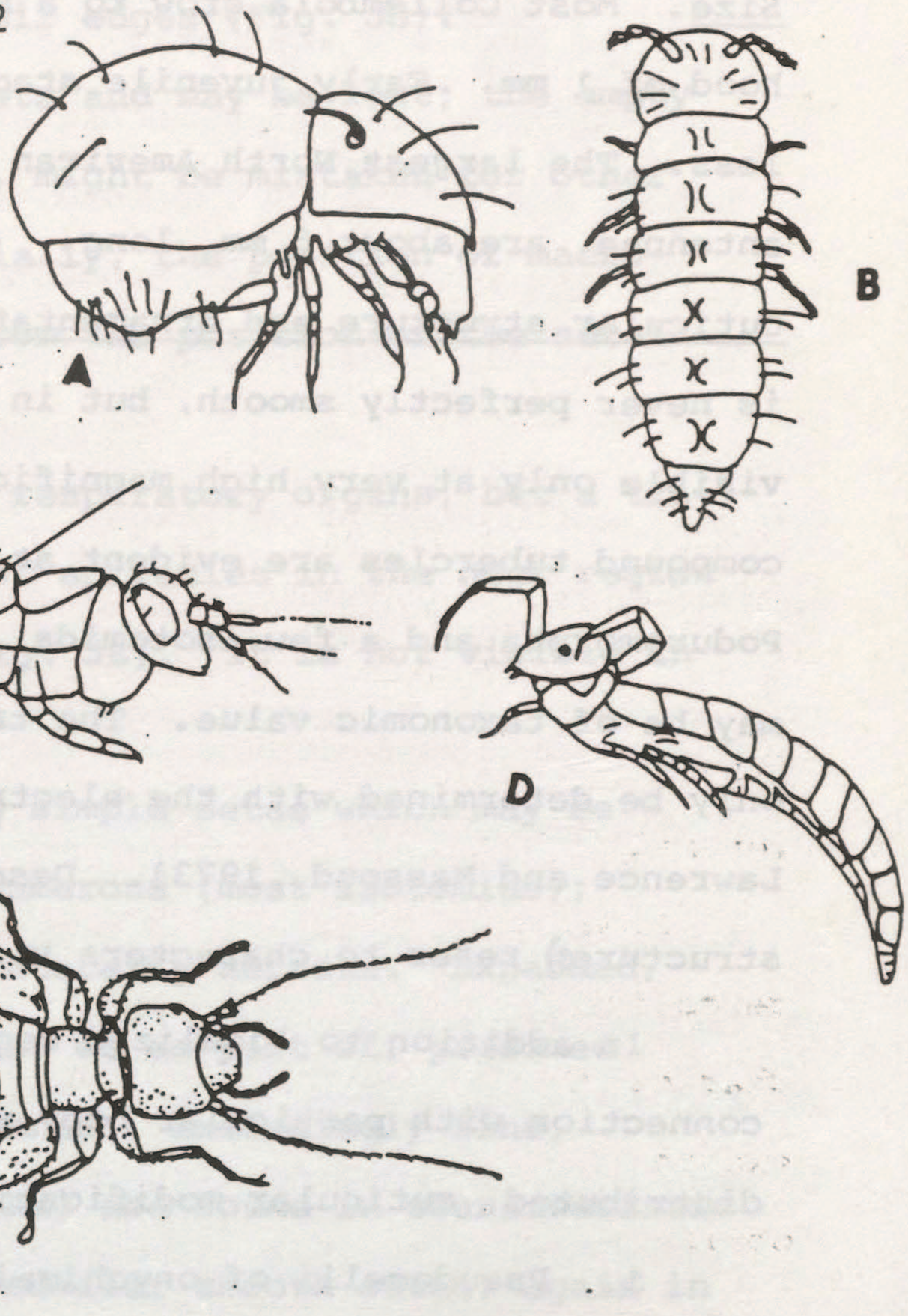
B) First instar millipede; from Barnes.

C) First instar pauropod; from Lawrence.

D) Proturan; from Lawence.

E) Aphid; from Imms

F) Psocid; from Little.



Classification and identification of Collembola are based almost entirely on the external morphology and mouthpart structure. Some recent work (e.g. Cassagnau, 1971; Bretfeld, 1970) suggests that cytology and behavior may also be useful in studies of higher classification and phylogeny; but such characters, like those of the internal anatomy, are unlikely to be used for species identification, since the techniques required conflict with observation of external features. The internal structure and embryonic development have been studied in only a few genera. An excellent recent review of general morphology and biology of Collembola is that of Schaller (1970). Functional morphology associated with locomotion has been studied by Manton (1972).

Size. Most Collembola grow to a maximum length in the neighborhood of 1 mm. Early juvenile stages may be 1/4 mm. long or even less. The largest North American species, measured without the antennae, are about 6 mm. long.

Cuticular structure and ornamentation. The cuticle of Collembola is never perfectly smooth, but in many species granulation is visible only at very high magnification. Granules and simple or compound tubercles are evident at moderate magnifications in Poduromorpha and a few isotomids, and their size and distribution may be of taxonomic value. The true structure of the cuticle can only be determined with the electron microscope (see, for example, Lawrence and Massoud, 1973). Descriptions given here (as for other structures) refer to characters visible with the light microscope.

In addition to localized sense organs, described below in connection with particular body regions, characteristic, generally distributed, cuticular modifications occur in certain groups:

1. Pseudocelli of onychiurids (Fig. 3A). These are thin-

walled circular or oval structures, surrounded by cuticular rings and with characteristic patterns of ornamentation, which are believed to permit controlled release of repellent body fluids as a defense against predators. Their number and distribution have been used as taxonomic characters.

2. Pseudopores of entomobryids (Fig. 3B). Circular clear areas in the integument of tergites and manubrium, of unknown function. They serve as useful landmarks in connection with the distribution of specialized setae.

3. Smooth areas in granulate cuticles, such as the "foveae" of Hypogastrura (Fig. 3C). These occur in characteristic positions; they may represent points of muscle attachment.

4. Sensory fields of Neelidae. These are found in characteristic positions on the head, thorax, and abdomen, and when best developed, have modified setae at their edges (Fig. 3D).

Ordinary setae are set in sockets and may be lost; the empty sockets, particularly of large setae, might be mistaken for other structures. In Entomobryidae, especially, the position of macrochaetae is often determinable only from the position of the setal sockets.

Most Collembola have no special respiratory organs, but a tracheal system opening through a pair of spiracles in the neck region has been described for Sminthurus (Fig. 3E). It is not visible in routinely fixed specimens.

Clothing. Most commonly of tapering simple setae which may be sparse (most poduromorphs) to very numerous (most isotomids); some of these may be knobbed or unilaterally serrate. Expanded, blunt, thin-walled setae are found as, or as part of, presumed sense organs, especially on the antennae. Exceedingly fine, elongate, ciliate setae (bothriotricha) are found in characteristic positions on many Entomobryomorpha; similar smooth setae, again in

characteristic positions (Fig. 1C), are characteristic of all Sminthuridae. Enlarged, conical setae, frequently set on projecting papillae, are found on posterior abdominal segments of many Poduromorpha and a few Isotomidae (anal spines, fig. 3F, 3G), and exceptionally on other parts of the body.

In Entomobryidae, many or most of the simple setae are replaced by flattened scales and/or by densely ciliate setae which may be apically enlarged; individuals may have a variety of different setal types (Fig. 3B).

The chaetotaxy, especially the positions of specialized setae or of simple setae on body regions where they are not too numerous, may be useful in specific separation; certain genera are characterized by the presence or absence of scales or bothriotricha. There is a good deal of individual variation in chaetotaxy. Illustrations in this book are ordinarily taken from single specimens, and features not specially mentioned in the text, keys or species tables are not to be regarded as necessarily consistent or diagnostic.

Color and pattern. The pigments of Collembola are located in epidermal cells beneath the cuticle. Pigments of almost any color

FIGURE 3

Cuticular modifications of Collembola.

A) Part of head of Onychiurus affinis, showing simple postantennal organ, three pseudocelli of antennal base, and granular cuticle. After Stach, 1955.

B) Part of thoracic tergite of Lepidocyrtus sp., showing pseudopore, macrochaetae, bothriotricha, specialized microchaetae, and scales.

C) Fifth abdominal tergite of Hypogastrura sp., showing granular cuticle, setae, and foveae (f). After Yosii, 1962.

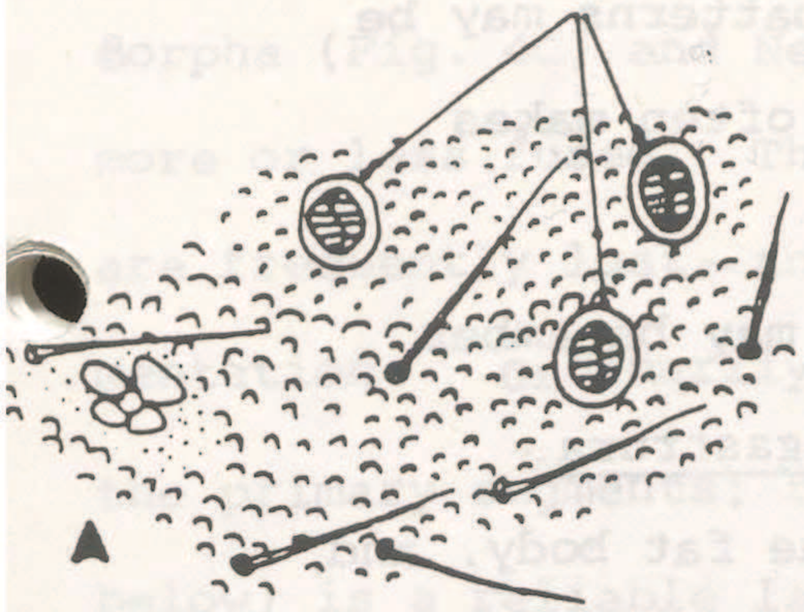
D) Sensory field of Megalothorax with associated setae and sensillae. After Bonet, 1948.

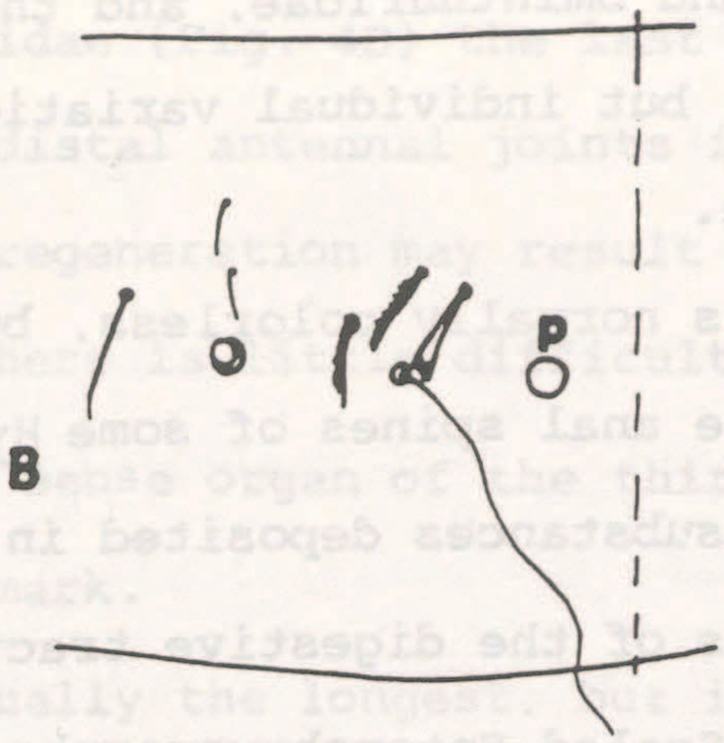
E) Tracheal system of Sminthurus viridis. After Davies, 1927.

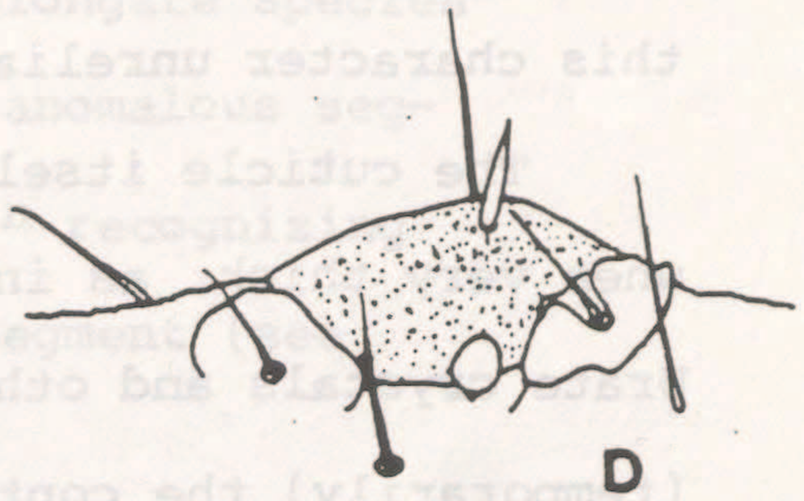
F) Anal spine and adjacent knobbed seta of Friesea claviseta. After Stach, 1955.

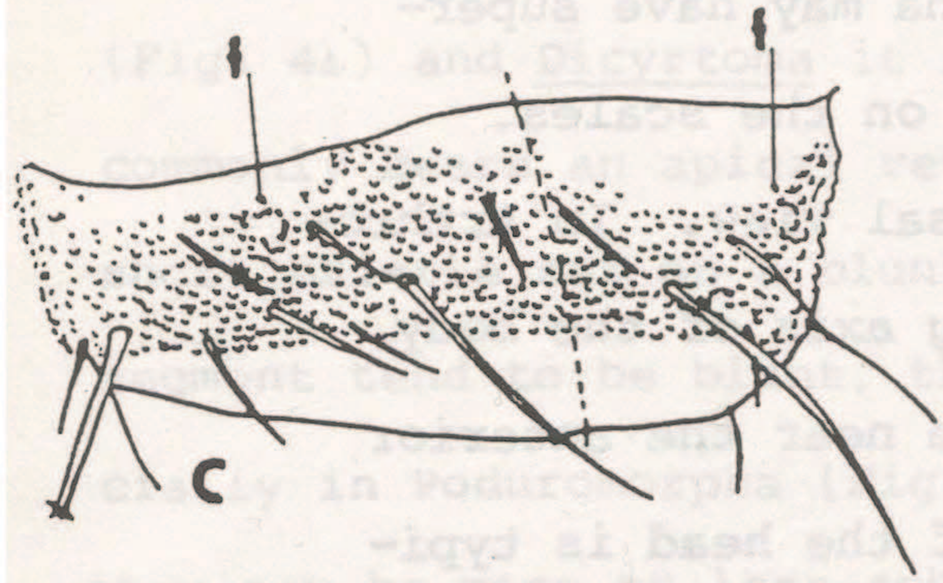
G) Anal spines of Tetracanthella arctica. After Folsom, 1937.

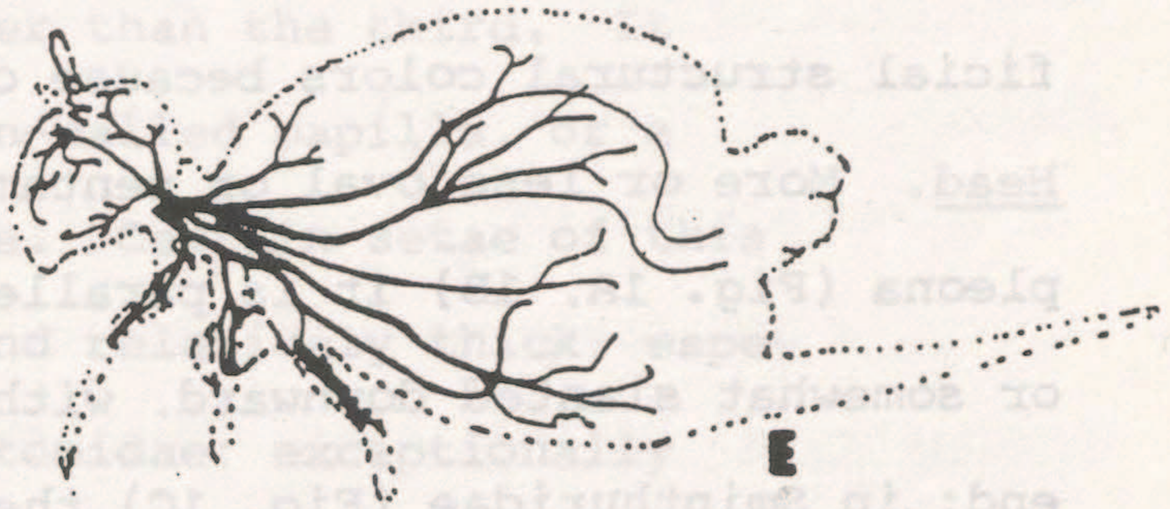
H) Base of dens of Tomocerus flavescens, showing spine-like setae. After Stach, 1955.

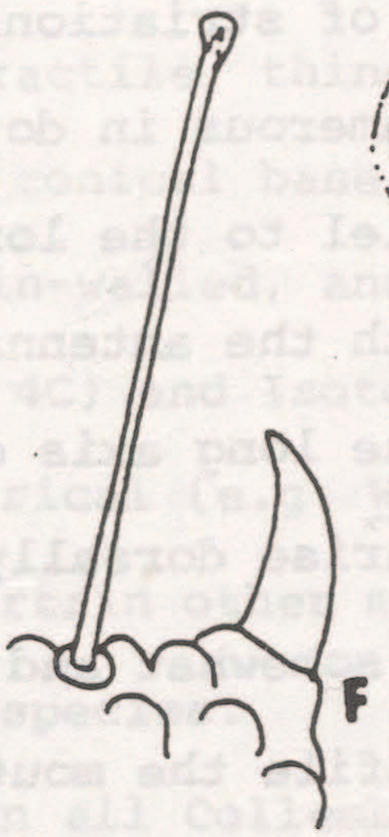


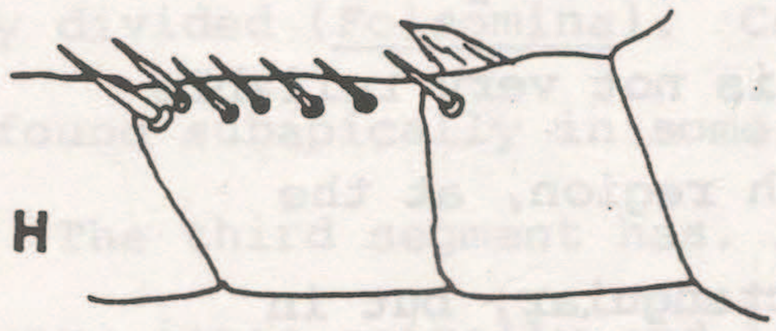


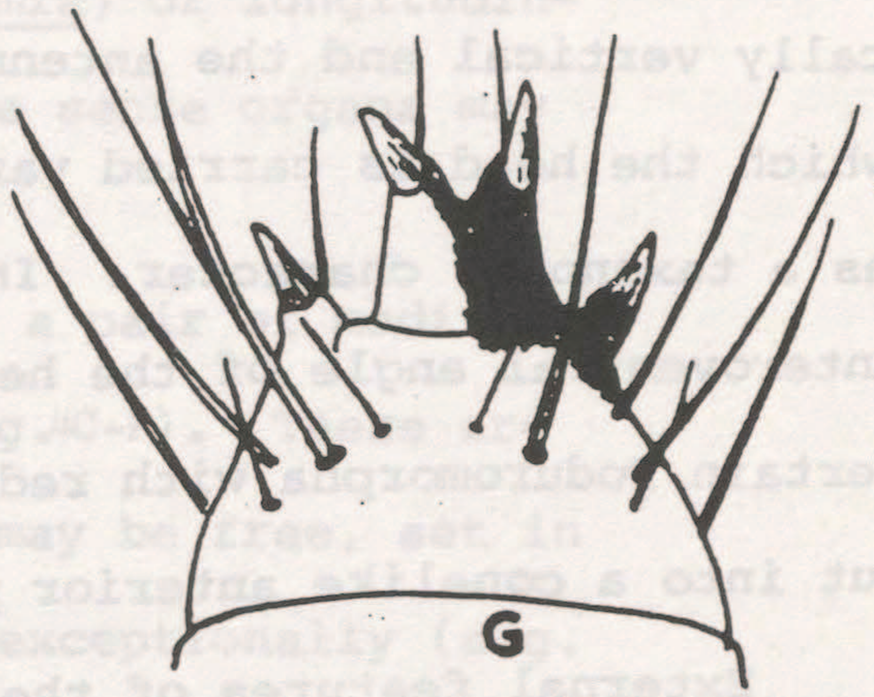












may be present, but the commonest are blues and browns. The familiar blue pigment of Collembola is an indicator, turning red in alkaline conditions (for example, in potassium hydroxide). The red or orange pigment of some living Neanurinae is soluble in alcohol, so that preserved specimens are colorless.

Most species are uniformly colored, or mottled because of irregular pigment distribution, with a tendency toward darker dorsal and lighter ventral coloration. Development of color is definitely dependent on light in many species, where animals reared in darkness (as in caves) are pale. Color also increases in depth and extent with age. Strikingly patterned species occur, espe-

cially in Entomobryidae and Sminthuridae, and the patterns may be useful in identification, but individual variation often makes this character unreliable.

The cuticle itself is normally colorless, but may be amber when very thick, as in the anal spines of some Hypogastrura. Urate crystals and other substances deposited in the fat body, and (temporarily) the contents of the digestive tract contribute to the pattern of animals. Scaled Entomobryomorpha may have superficial structural colors because of striations on the scales.

Head. More or less oval or pentamerous in dorsal view. In Arthropleona (Fig. 1A, 1B) it is parallel to the long axis of the body or somewhat slanted downward, with the antennae near the anterior end; in Sminthuridae (Fig. 1C) the long axis of the head is typically vertical and the antennae arise dorsally. The angle at which the head is carried varies somewhat and is not very reliable as a taxonomic character. In profile the mouth region, at the anteroventral angle of the head, is usually rectangular, but in certain Poduromorpha with reduced mouthparts this region is drawn out into a conelike anterior projection.

External features of the head, besides those noted below, are the maxillary palps, papillae with apical bristles between the antennae and mouth region (these are usually hard to see), and the ventral groove, running from the mouth region posteriorly to the ventral tube.

Antennae. These have four primary segments, each with its own musculature (in true insects there are only three such segments). (Fig. 1A,C). In Tomocerus (Fig. 4A), a few other Entomobryomorpha, and many Sminthuridae (Fig. 4B) the last joint or last two joints are divided into a few or many subsegments; in adult Orchesella (Fig. 1B) and Heteromurus the first, or first two, joints are divided into two subsegments. On the other hand, in some Poduro-

morpha (Fig. 4C) and Neelidae (Fig. 4D) the last two joints are more or less fused. The distal antennal joints in elongate species are frequently lost, and regeneration may result in anomalous segmentation. Ordinarily there is little difficulty in recognizing the primary segments; the sense organ of the third segment (see below) is a reliable landmark.

The last joint is usually the longest, but in Tomocerinae (Fig. 4A) and Dicyrtoma it is much shorter than the third. It commonly bears an apical retractile, thin-walled papilla, or a short bristle set on a blunt conical base. Certain setae of this segment tend to be blunt, thin-walled, and relatively thick, especially in Poduromorpha (Fig. 4C) and Isotomidae; exceptionally they may be more or less spherical (e.g. Willemia) or longitudinally divided (Folsomina). Certain other minute sense organs may be found subapically in some species.

The third segment has, in all Collembola, a pair of modified sensory setae apically and laterodorsally. (Fig.4C-F). These are blunt, thin-walled, and relatively thick, and may be free, set in individual depressions or a common groove, or exceptionally (e.g. Sminthurus, Fig. 4E) entirely concealed in separate pockets. Usually a pair of "guard setae", which may themselves be modified, are located beside and just behind the organ. Sensillae like those of the sense organ may also be found ventrally on this segment, or on more basal segments, always free. In Onychiuridae, especially in Onychiurus, the sensillae and guard setae are highly modified and protected by an integumentary fold which may be thrown into conspicuous papillae (Fig. 4F).

In males of Sminthurides the second and third antennal segments are strikingly modified (Fig. 4G); their shape and specialized setae allow them to be used in clasping the female antennae.

Postantennal organ. In most Poduromorpha, Isotomidae, Oncopodura, and juvenile Tomocerus, this organ is found between the antennal base and the eye region. A modified seta in the same position (Fig. 5A) in some sminthurids may be homologous. The organ in its simplest form is a rounded or oval vesicle (Fig. 5B); in isotomids it may also be elongate and parallel sided, divided by a partial transverse partition, or have strikingly thickened borders (e.g. Micrisotoma). In most Poduromorpha (Fig. 3A, 5C) and in Harlomillsia the organ has a number of more of less separate lobes (up to more than 100 in some Morulina). The lobes are uniform in structure and arranged in a circle, oval, or rosette, or (some Hypogastrura, Harlomillsia - Fig. 5D) characteristically different in form and arrangement. Most onychiurids have a postantennal organ consisting of many tubercles arranged in two parallel rows in a groove (Fig. 5E); the tubercles may be simple or secondarily vesiculate.

FIGURE 4

Antennal structure.

A) Antenna of Tomocerus flavescens. After Stach, 1955.

B) Head and antenna of Sminthurus medialis. After Betsch, 1965.

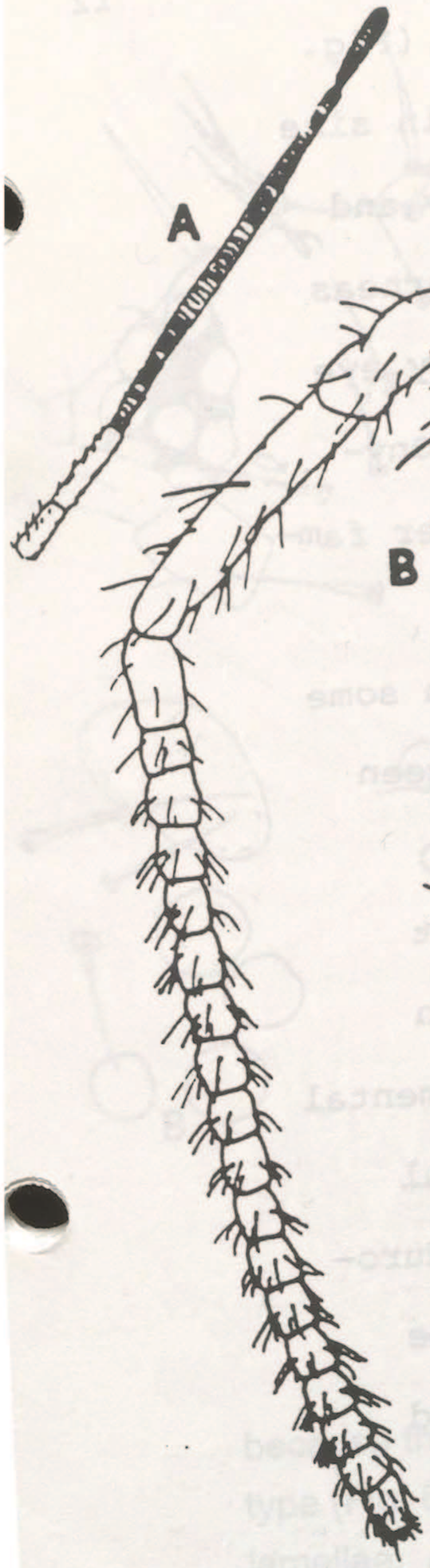
C) Last three antennal segments of Anurida pygmaea. After Stach, 1955.

D) Last two antennal segments of Megalothorax. After Bonet, 1948.

E) Sense organ of third antennal segment of Sminthurus sp. After Richards, 1968.

F) Sense organ of third antennal segment of Onychiurus schoetti. After Stach, 1955.

G) Second and third antennal segments of male Jeannenotia stachi. After Betsch and Massoud, 1970.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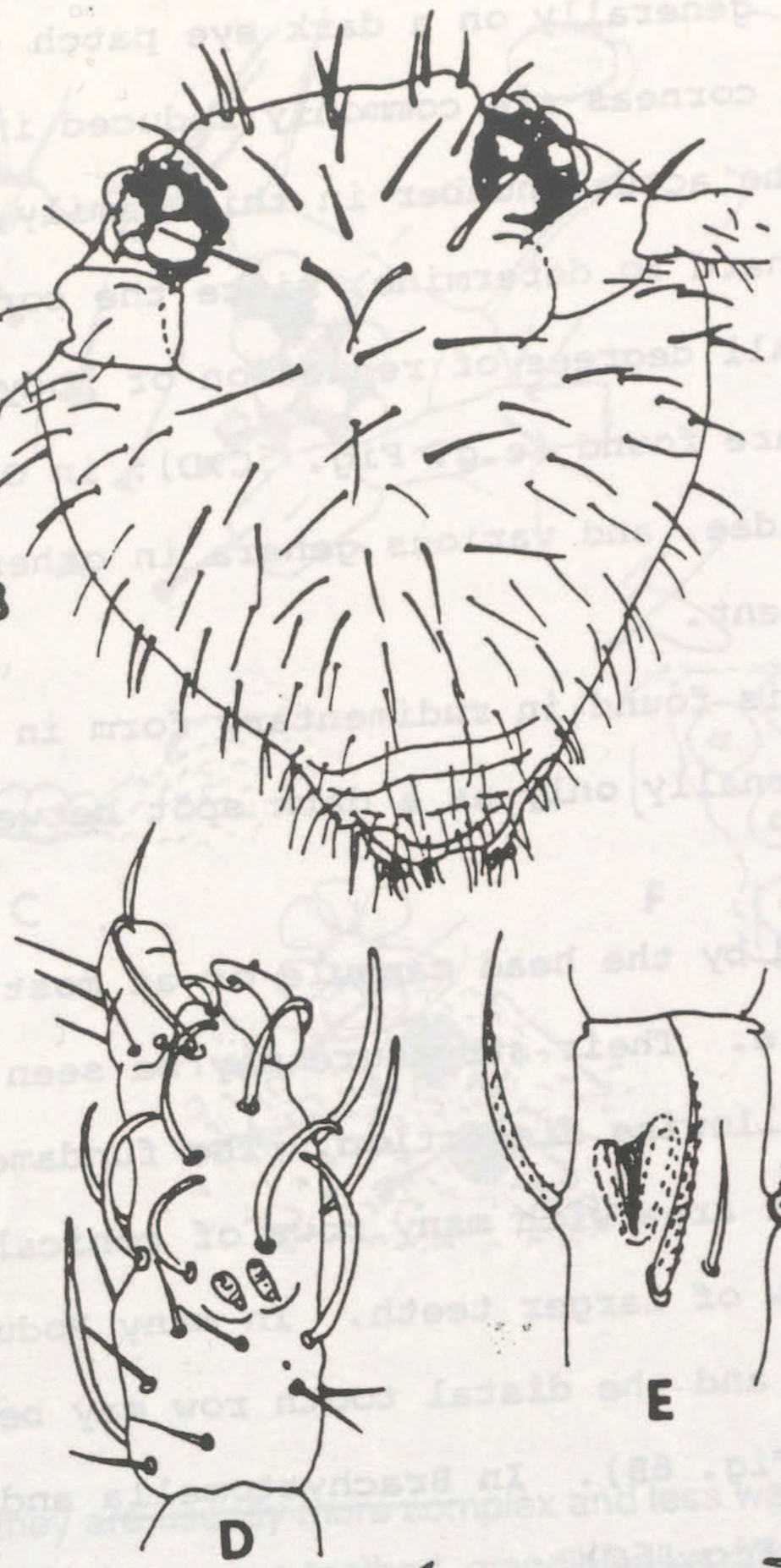
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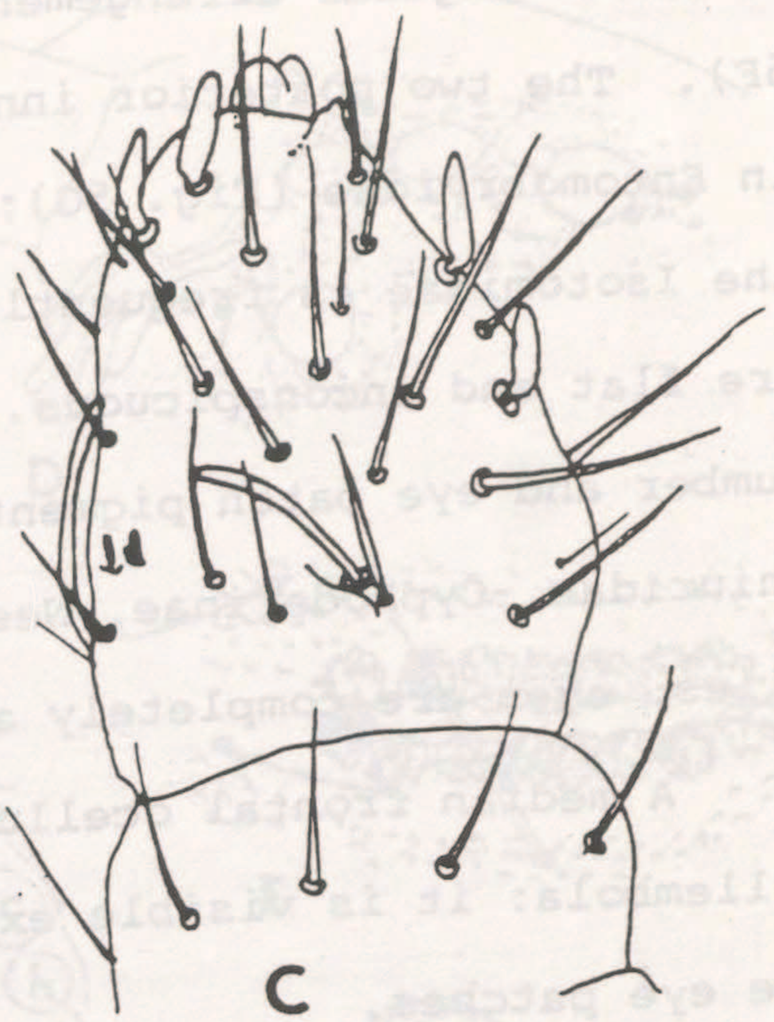
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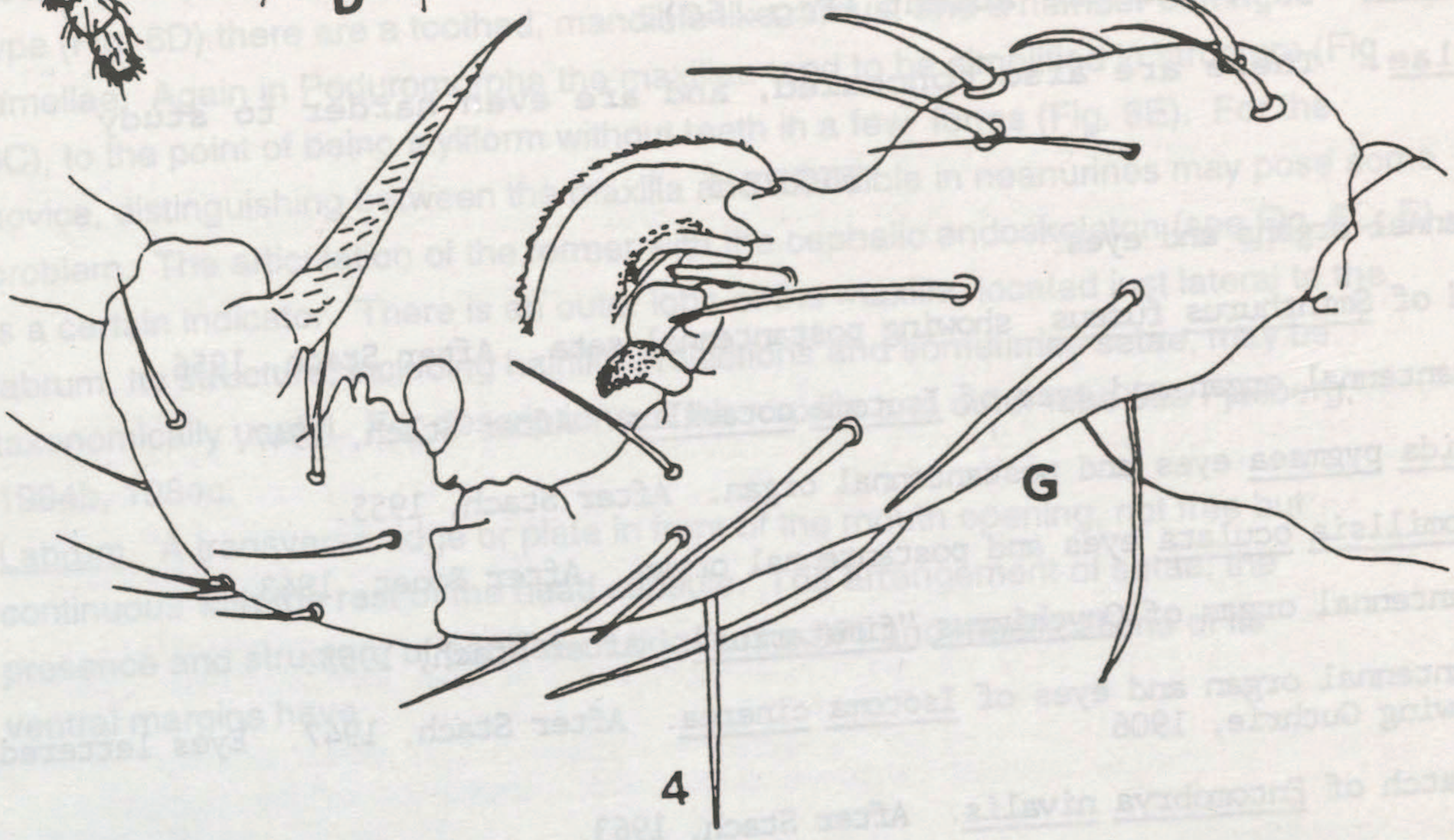
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Eyes. These consist of a maximum of eight corneas, in a more or less rectangular arrangement, generally on a dark eye patch (Fig. 5F). The two posterior inner corneas are commonly reduced in size in Entomobryidae (Fig. 5G); the actual number in this family and the Isotomidae is frequently hard to determine, since the corneas are flat and inconspicuous. All degrees of reduction of body eye number and eye patch pigment are found (e.g. Fig. 5C,D); in Onychiuridae, Cyphoderinae, Neelidae, and various genera in other families, eyes are completely absent.

A median frontal ocellus is found in rudimentary form in some Collembola; it is visible externally only as a dark spot between the eye patches.

Mandibles. These are concealed by the head capsule or at most exserted so the tips are visible. Their structure may be seen only in cleared specimens or following dissection. The fundamental type (Fig. 6A) has a basal molar area with many rows of conical teeth, and a disjunct distal row of larger teeth. In many Poduromorpha the molar plate is lost, and the distal tooth row may be reduced (Fig. 6E) or modified (Fig. 6B). In Brachystomella and Odontella mandibles are absent (Fig. 6C).

Maxillae. These are also concealed, and are even harder to study

FIGURE 5

Postantennal organs and eyes.

A) Head of Sminthurus fuscus, showing postantennal seta. After Stach, 1956.

B) Postantennal organ and eyes of Isotoma notabilis. After Stach, 1947.

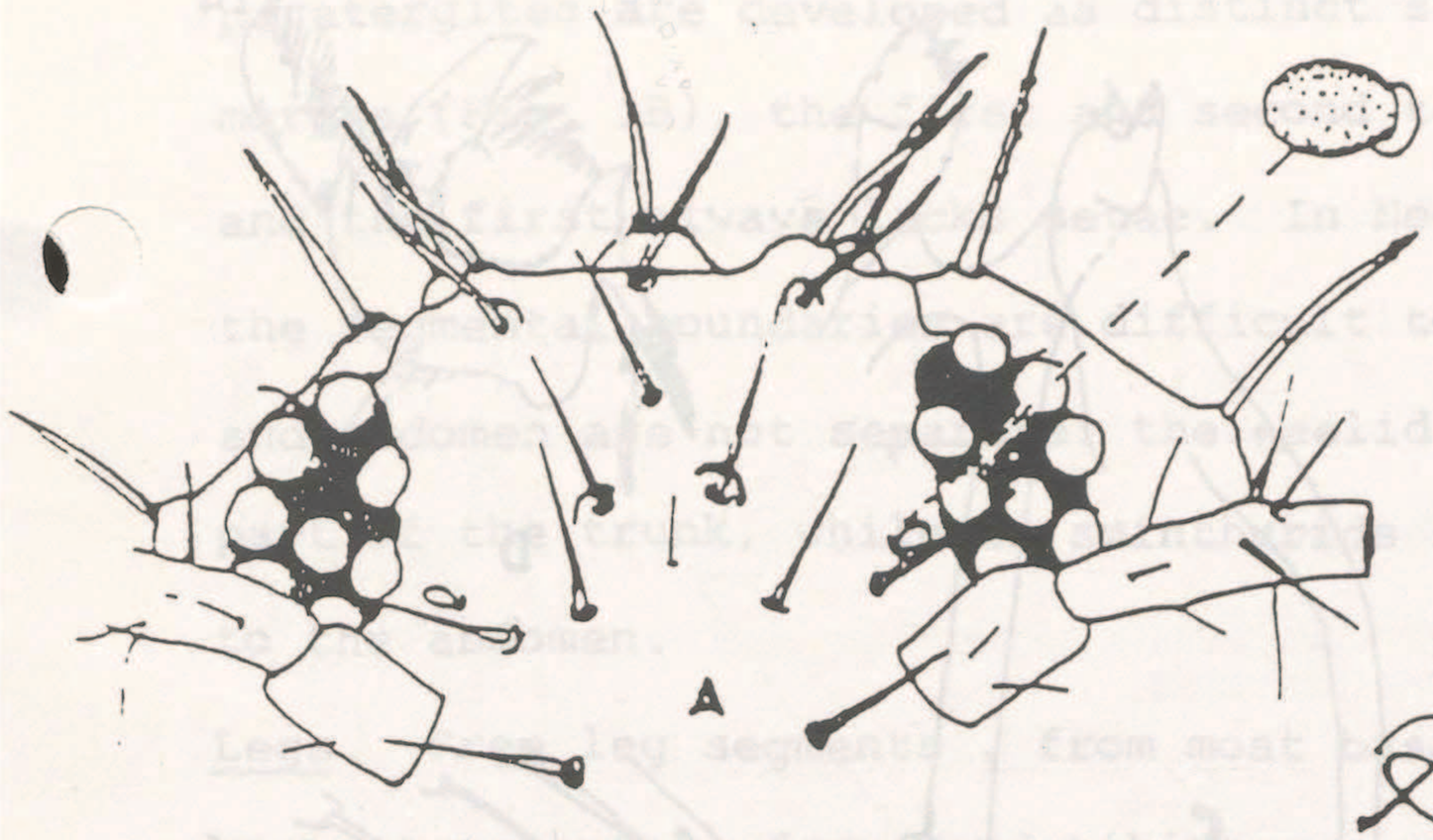
C) Anurida pygmaea eyes and postantennal organ. After Stach, 1955.

D) Harlomillsia oculata eyes and postantennal organ. After Bonet, 1943.

E) Postantennal organ of Onychiurus "fimetarius". After Stach, 1955.

F) Postantennal organ and eyes of Isotoma cinerea. After Stach, 1947. Eyes lettered following Guthrie, 1906

G) Eye patch of Entomobrya nivalis. After Stach, 1963.



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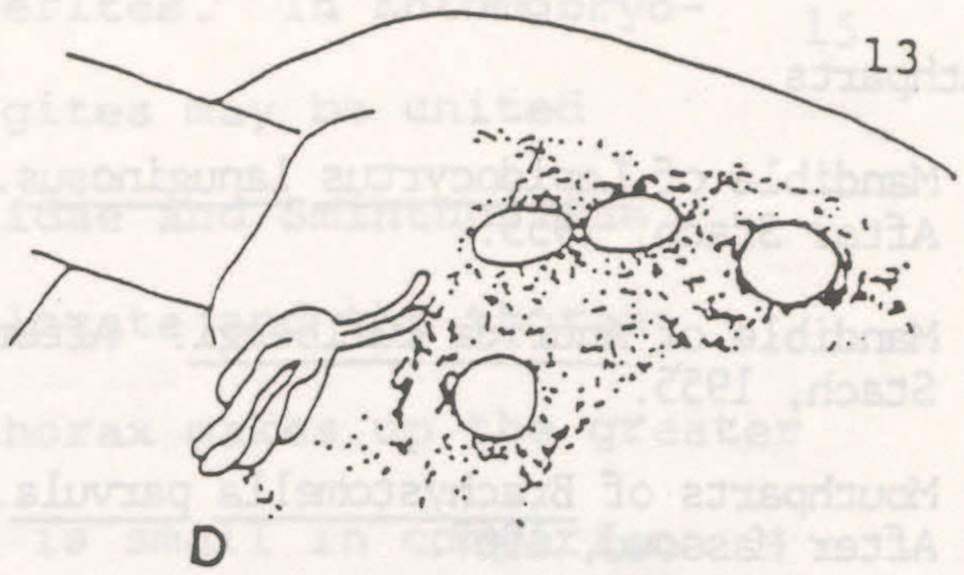

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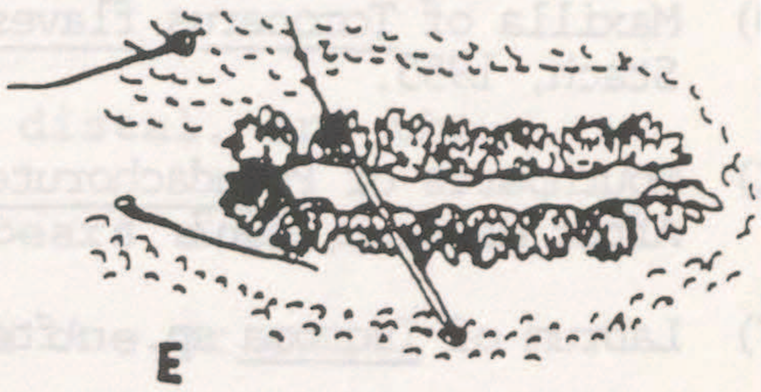

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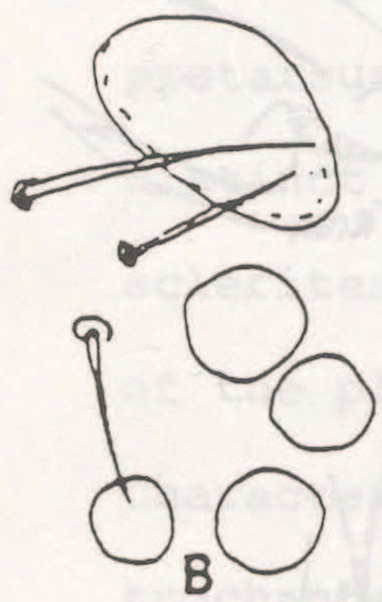

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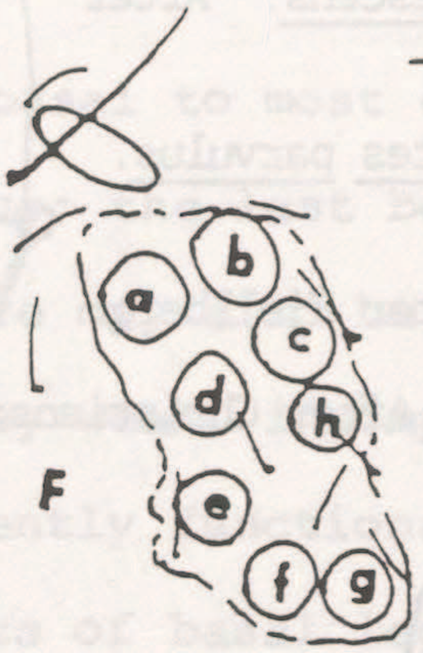

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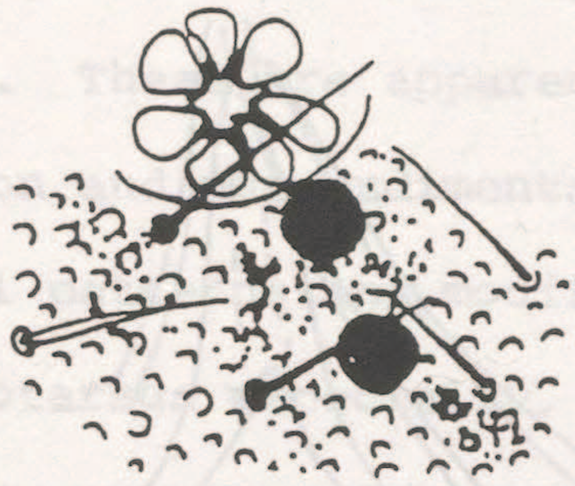

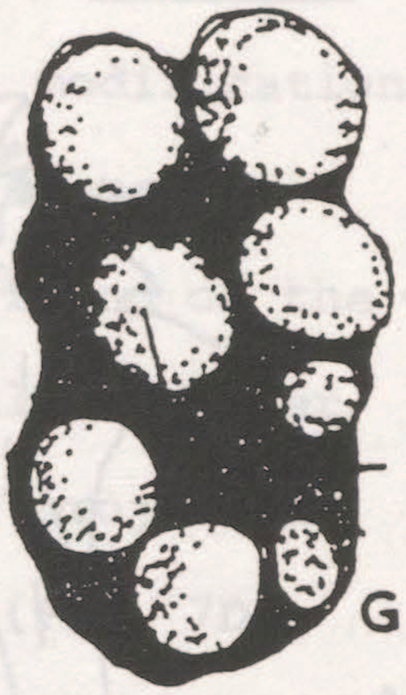

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because they are usually more complex and less well sclerotized. In the generalized type (Fig. 6D) there are a toothed, mandible-like ramus, and a number of fringed lamellae. Again in Poduromorpha the maxillae tend to be simplified in structure (Fig. 6C), to the point of being styliform without teeth in a few forms (Fig. 6E). For the novice, distinguishing between the maxilla and mandible in neanurines may pose some problem. The articulation of the former with the cephalic endoskeleton (see Fig. 6C, E) is a certain indicator. There is an outer lobe of the maxilla, located just lateral to the labrum. Its structure, including hairlike projections and sometimes setae, may be taxonomically useful. For descriptions of the maxilla and outer lobe see Fjellberg, 1984b, 1984c.

Labrum. A transverse ridge or plate in front of the mouth opening, not free but continuous with the rest of the head capsule. The arrangement of setae, the presence and structure of papillae or ridges (fig. 6F) and modifications of its ventral margins have

FIGURE 6

Mouthparts.

A) Mandible of Lepidocyrtus lanuginosus. After Stach, 1955.

B) Mandible of Anurida tullbergi. After Stach, 1955.

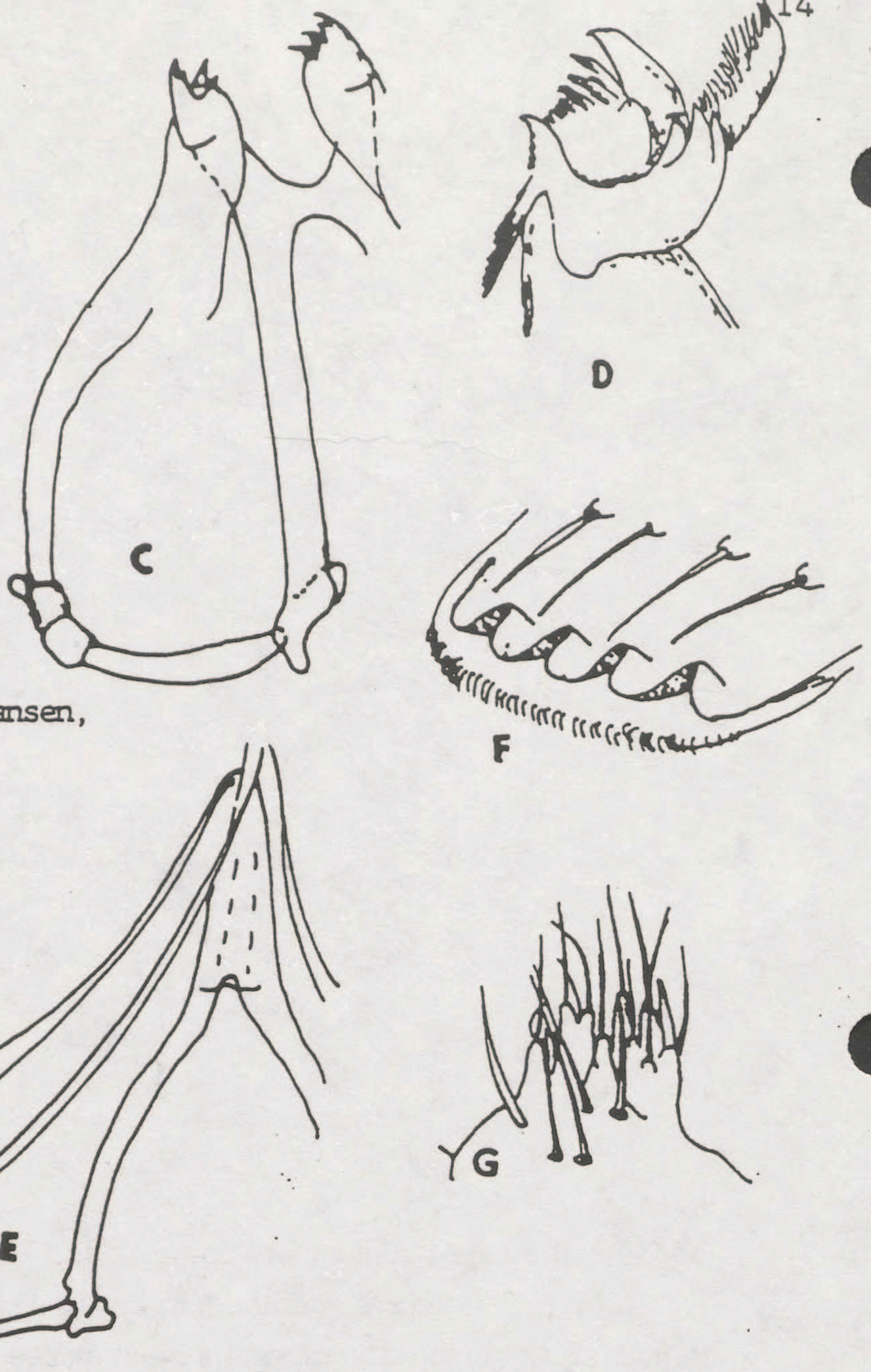
C) Mouthparts of Brachystomella parvula. After Massoud, 1967.

D) Maxilla of Tomocerus flavescens. After Stach, 1955.

E) Mouthparts of Pseudachorutes parvulus. After Massoud, 1967.

F) Labrum of Isotoma sp. After Fjellberg.

G) Labium of Entomobrya sp. After Christiansen, 1958.



been found useful in classification in a few genera. The labrum is best seen in a ventral view of the head; it is not easy to locate.

Labium. A complex group of seta-bearing papillae, apparently representing the palpal region, may be seen just before the mouth (Fig. 6G). Certain setae on the apex of base may be taxonomically useful (Entomobrya, Lepidocyrtus). In some Poduromorpha again the labium is extremely simplified.

Thorax. The three segments have distinct, seta-bearing tergites in Poduromorpha (Fig. 1A); in many of these, intercalated lateral

paratergites are developed as distinct sclerites. In Entomobryomorpha (Fig. 1B), the first and second tergites may be united and the first always lacks setae. In Neelidae and Sminthuridae the segmental boundaries are difficult to locate and the thorax and abdomen are not separate; the neelid thorax makes up the greater part of the trunk, while in sminthurids it is small in comparison to the abdomen.

Legs. Free leg segments , from most basal to most distal, are the coxa, trochanter, femur and tibiotarsus; the last bears a small pretarsus with one or two claws. There may also be one or two distinct subcoxal regions, indicated by weak, incomplete external sclerites (Fig. 7A). These are apparently functional modifications of the pleural region and not rudiments of basal leg segments. Characteristic setal patterns and modified setae are found on the trochanter and tibiotarsus expecially, and occasionally on other leg segments, in many groups. One or more long setae projecting dorsally over the unguis may be called tenent hairs (Fig. 7D). The term is used here for the longest apical dorsal seta, which may be acuminate, blunt, or clavate, and for additional blunt or clavate setae, which are usually dorsolateral in position.

Unguis. This is the upper claw, which is universally present. It is dorsally convex and tapering, and in the simplest form (some Poduromorpha and Isotomidae - Fig. 7B) almost featureless. Commonly the unguis is variously lamellate, with the lamellae ending in free teeth (dorsal, lateral, and ventral); in entomobryids there are two ventral tooth-bearing lamellae (Fig. 7C). The structure and position of the teeth is of taxonomic importance. In certain Isotomidae and Sminthuridae there is a dorsal inflated sheath or tunica (Fig. 7D), and/or lateral basal toothed lamellae or pseudonychia.

FIGURE 7

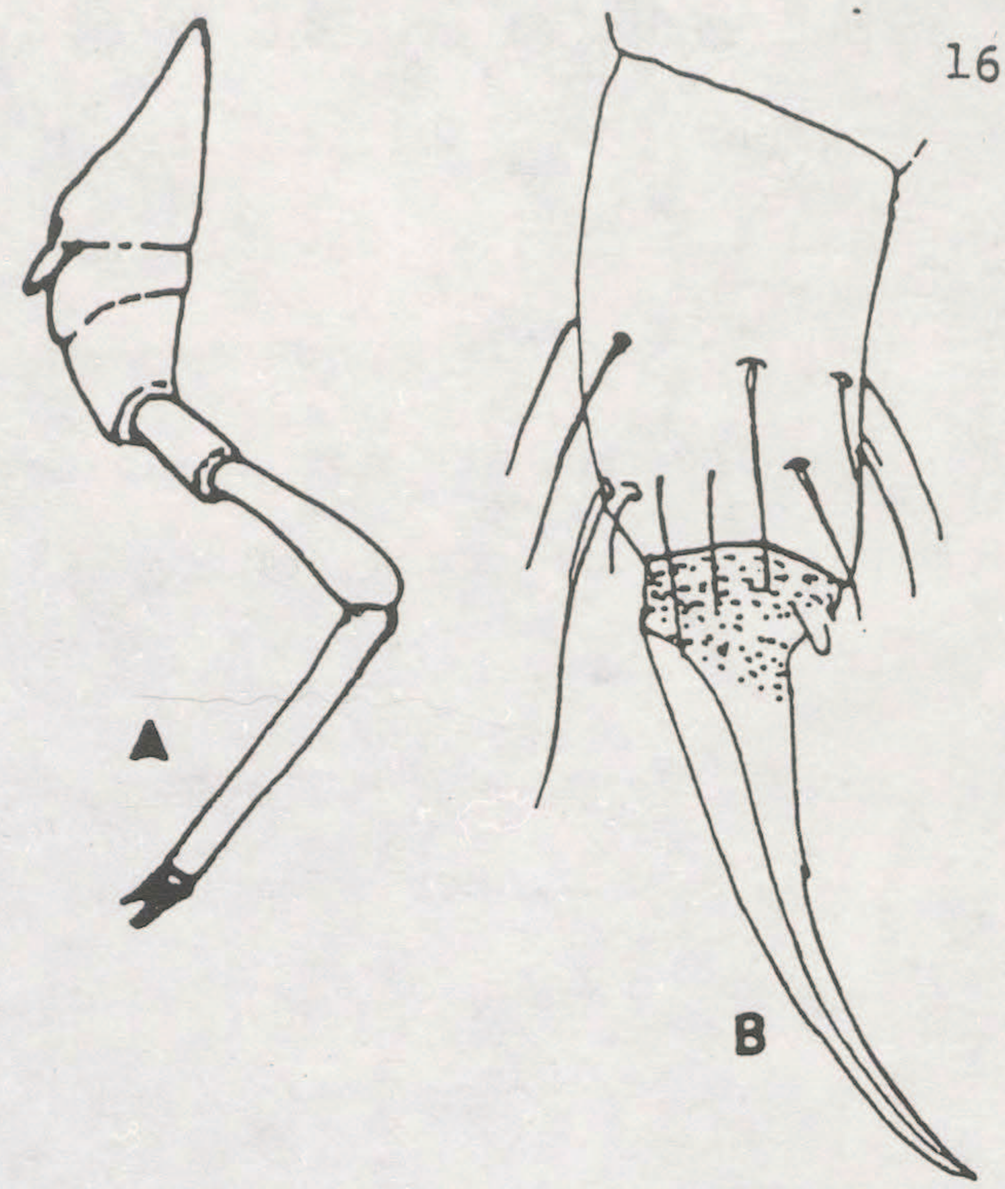
Legs.

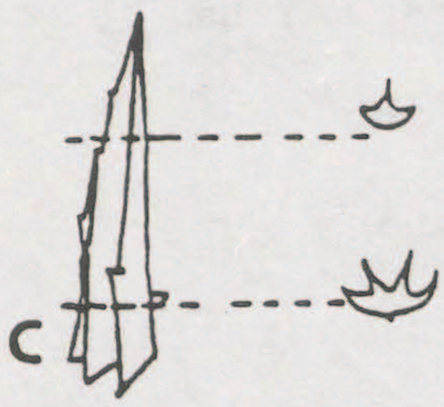
A) Generalized leg of sminthurid. After Richards, 1968

B) Tibiotarsus, pretarsus, and unguis of Podura aquatica. After Stach, 1955.

C) Idealized structure of entomobryid unguis. After Christiansen, 1958.

D) Foot of idealized sminthurid. After Richards, 1968.







Unguiculus or Empodial appendage. A ventral, lanceolate process extending from the pretarsus, usually narrower and shorter than the unguis, with two to four lamellae which may bear characteristic teeth; frequently one of these projects as an elongate apical filament. It is greatly reduced or absent in some Poduromorpha and Isotomidae. (Fig. 7B).

Abdomen. This is typically divided into six segments. These may all be more or less similar in length (e.g. Isotomidae - Fig. 8A - whence the name of the family) and of uniform diameter (e.g. Tullbergia). Generally, however, the region bearing the furcula and containing its muscles is wider and longer than other segments; in many Entomobryidae the fourth abdominal segment is much longer than the others (Fig. 8B). The segments are most distinct in Entomobryomorpha, which have imbricate tergites. In Poduromorpha, segments are separated by constrictions, but these intersegmental membranes are little weaker than the sclerites and may be most

easily recognized in mounted specimens by their finer granulation and/or lack of setae. The abdominal segments of Neelidae, and the first four abdominal segments of Sminthuridae, are coalesced without indication of segmental boundaries; the last two segments ("lesser abdomen" - Fig. 1C) of sminthurids are generally set off from the rest of the abdomen but are sometimes fused with each other. The last two or three abdominal segments of some Isotomidae may be fused (Folsomia, Fig. 8C).

The first, third, and fourth abdominal segments have characteristic appendages (see below). The genital opening is on the fifth segment in the form of a transverse slit (Fig. 8D) in females and a longitudinal slit on a papilla (Fig. 8E) in males; the setae of the genital area may be of taxonomic value (as in Entomobrya). The anal opening on the sixth segment is terminal or ventral and triradiate, bounded by dorsal and ventrolateral sclerites. The setae of this region are also taxonomically useful. In most sminthurids, the ventrolateral valves of females bear characteristic "subanal appendages" (Fig. 8F), and modifications on the dorsal valve are also known (e.g. the "clasping organ" of male Bourletiella Fig. 8G).

Ventral tube (Collophore). A circular or cylindrical appendage of the first abdominal segment, with a pair of apical eversible vesicles. In Poduromorpha (Fig. 9A) the organ is very short; in Entomobryomorpha (Fig. 1B, 9B) it may project very noticeably but the vesicles are inconspicuous. The ventral tube of Sminthuridae commonly has vesicles which may be everted to considerable lengths, even to the point of meeting over the back. They are smooth in many sminthurids, but in Sminthurinae and Dicyrtominae are covered with hemispherical papillae (Fig. 9C). The number and arrangement of setae on the base of the collophore are occasionally useful for specific determinations (e.g. in Hypogastrura).

FIGURE 8

Abdominal structure.

A) Folsomides segmentation. After Stach, 1947.

B) Lepidocyrtus cyaneus segmentation. After Gisin, 1960.

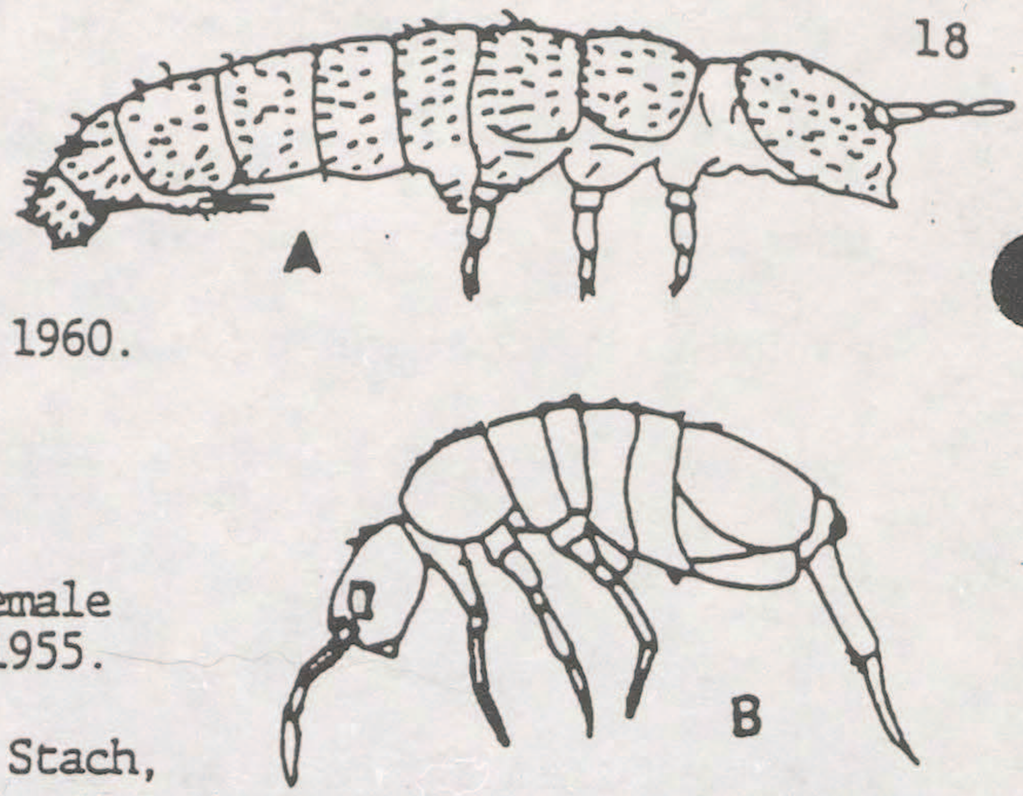
C) Posterior abdominal segments of Folsomia. After Folsom, 1937.

D) Ventral view of abdomen of Folsomides, showing female genital opening. After Cassagnau and Delamare, 1955.

E) Male genital opening of Anurida maritima. After Stach, 1949.

F) Anal region of female Sminthurus medialis, showing genital opening and subanal appendages. After Betsch, 1965.

G) Dorsal abdominal organ of male Bourletiella. After Richards, 1968.



Tenaculum. A midventral appendage of the third abdominal segment, having a single basal piece ("corpus") usually with one or more setae, and two divergent distal pieces ("rami") with a series of teeth on their outer surfaces (Fig. 9D). The rami fit between the bases of the dentes and hold the furcula in place against the abdomen. Typically there are four teeth on each ramus, but this number may be reduced in species in which the furcula is also reduced. In sminthurids (Fig. 9E) the corpus is more complex in form and projects between the rami; the number of tenacular teeth is often reduced and their form is modified, though all sminthurids have a well-developed furcula. The number of tenacular setae is taxonomically useful in some families.

Furcula. A midventral appendage of the fourth abdominal segment; in many Entomobryomorpha it is displaced backward and appears to arise from the fifth segment (Fig. 1B), but its muscle attachments show that this position is secondary. It consists of a single basal manubrium and two distal dentes, each ending in a mucro (Fig. 9C). The inner bases of the dentes may bear strong ridges with which the teeth of the tenaculum engage. In Oncopodurinae (Fig. 9F), Tomocerinae (Fig. 3H), Neelidae (Fig. 9G), and Poduridae, the dentes are subsegmented; in Neelidae special anterior processes on the manubrium and dentes form a secondary articulation between these parts. The relative lengths of segments, the structure of the dens and mucro, and the distribution of simple and modified setae on the furcula provide useful taxonomic characters. Distal modifications of the posterior face of the manubrium have recently been found to provide characters of systematic importance in Isotomidae (Fig. 9H). In Poduromorpha and Isotomidae the furcula may be reduced or absent; intermediate stages of reduction generally involve fusion or loss of distal parts first (Fig. 9I). Even when no appendage is visible,

the position of the furcula may be indicated by a transverse fold or groove (e.g. in Onychiurus - Fig. 9J).

Distribution and Habitats

Collembola may be found in any atmospheric habitat, though their occurrence on running water or on the surface of the ocean is accidental. They range to the vicinity of both poles (to 83° South latitude in Antarctica) and to at least 21,000 feet elevation. Some species are adapted for permanent existence on glaciers or snow fields. The greatest number and variety of species are found in or in contact with soil, especially where organic matter is abundant. A few species (e.g. Podura aquatica) live normally on the surface of small bodies of water. Others are confined to marine littoral zones, living on intertidal rocks or in air-filled spaces in intertidal sand or gravel (e.g. Entomobrya laguna, Archistoma spp., Anurida maritima). Most are intolerant of desiccation, and in dry habitats the only species likely to be found on the surface or in vegetation are scaled or bristly entomobryids, whose clothing provides a dead air space which reduces water loss, and some large sminthurids. In desert regions the only species live in protected microhabitats (e.g. Isotoma gandhi Rapoport Rubio, under plants in the Atacama Desert) or deep in the soil (Tullbergia, Mohave Desert); desert forms sometimes move freely over the desert floor during cold nights when evaporation is low (personal observation). In damp environments, on the other hand, species elsewhere restricted to the soil or litter may occur on the surface or even well up into trees. The group may be considered preadapted for cave life and is well represented in caves, but comparatively few species (mostly belonging to a few genera of Poduromorpha, Entomobryidae, and Sminthuridae) are troglobites.

We are making no attempt in this manual to give a complete account of biology of Collembola, but it is desirable to call attention to some features of the life history which urgently need further study. Information on the biology of most species of Collembola is nonexistent or at most anecdotal; some important contributions are noted below under the species descriptions, and similar studies of other species would be valuable.

Development is direct; newly emerged individuals differ from adults in size, in body proportions, usually in the absence of pigment or its restriction to the eye patches, and in lacking a genital aperture, but in most species juveniles and adults are otherwise similar. The most notable exception is Tomocerus, whose juveniles have a postantennal organ and isotomid-like proportions.

FIGURE 9

Abdominal appendages.

A) Ventral tube of Xenyllodes armatus, ventral view. After Massoud, 1967.

B) Tomocerus flavescens, ventral tube, anterior view. After Stach, 1955.

C) Sminthurus viridis, showing exserted ventral tube vesicles, with a portion of one vesicle enlarged. After Stach, 1955.

D) Tenaculum of Proisotoma rainieri, lateral view. After Folsom, 1937.

E) Tenaculum of two types of sminthurids, showing modification of teeth. After Richards, 1968.

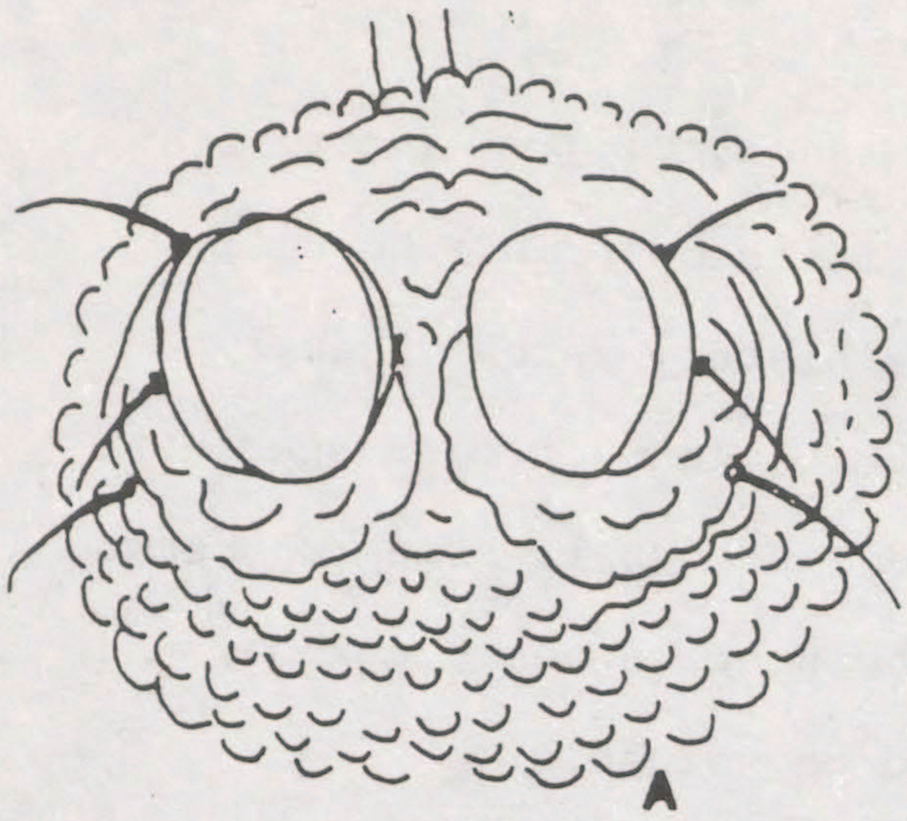
F) Dens and mucro of Harlomillsia oculata, outer view. After Bonet, 1943.

G) Apex of manubrium and basal dental subsegment, Megalothorax minimus, showing articular processes. After Bonet, 1948.

H) Isotoma anglicana, apex of venter of manubrium After Haarløv, 1957.

I) Furcula of Friesea claviseta, lateral view. After Stach, 1955.

J) Furcal rudiment of Onychiurus duodecimpunctatus. After Hammer, 1953.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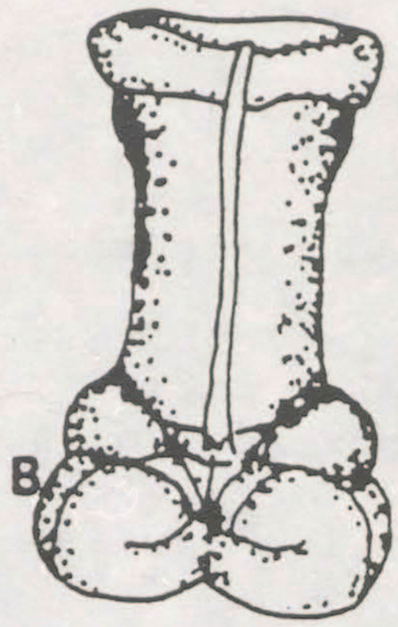
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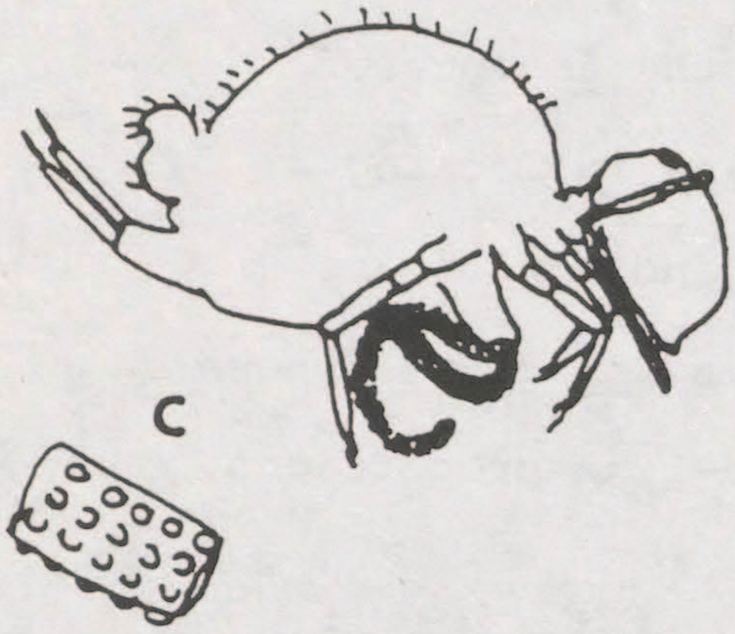
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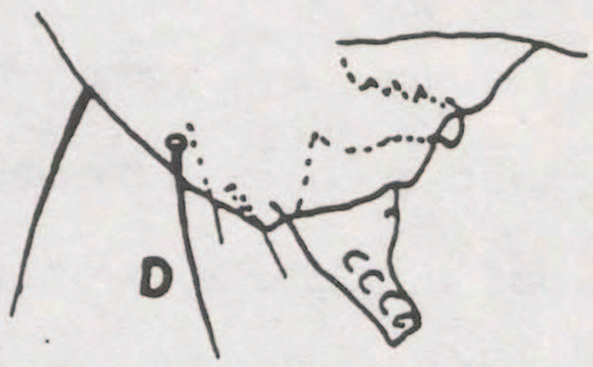
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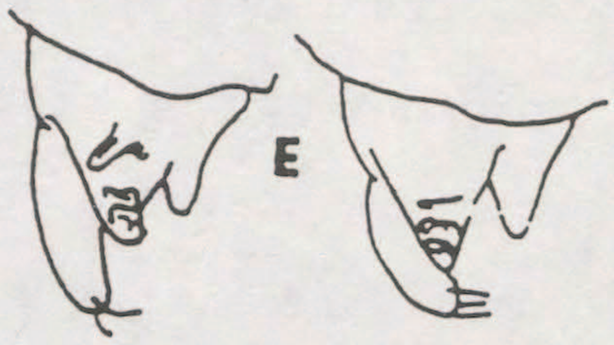
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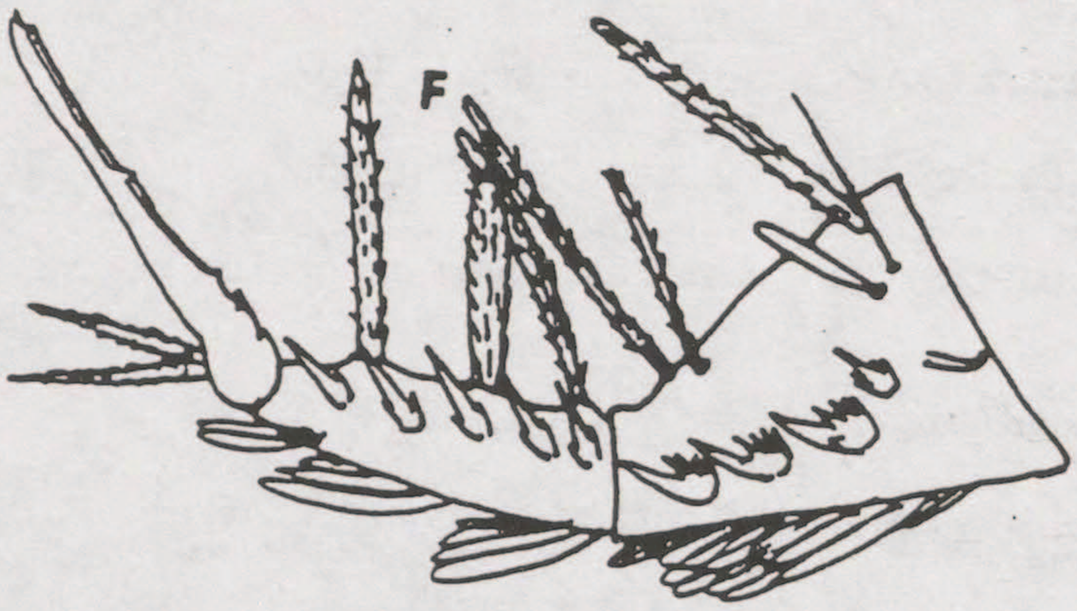
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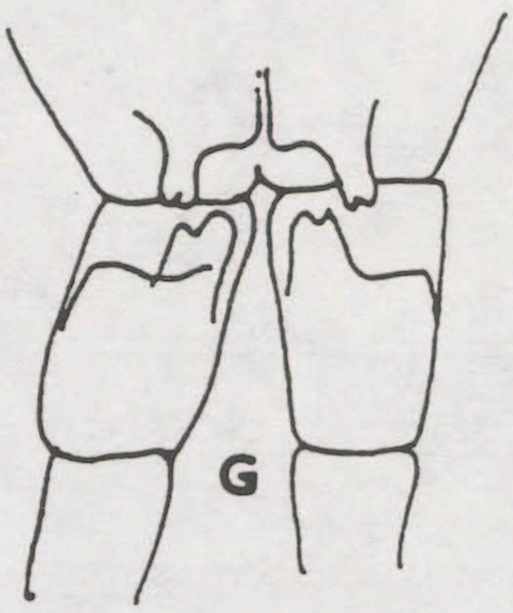
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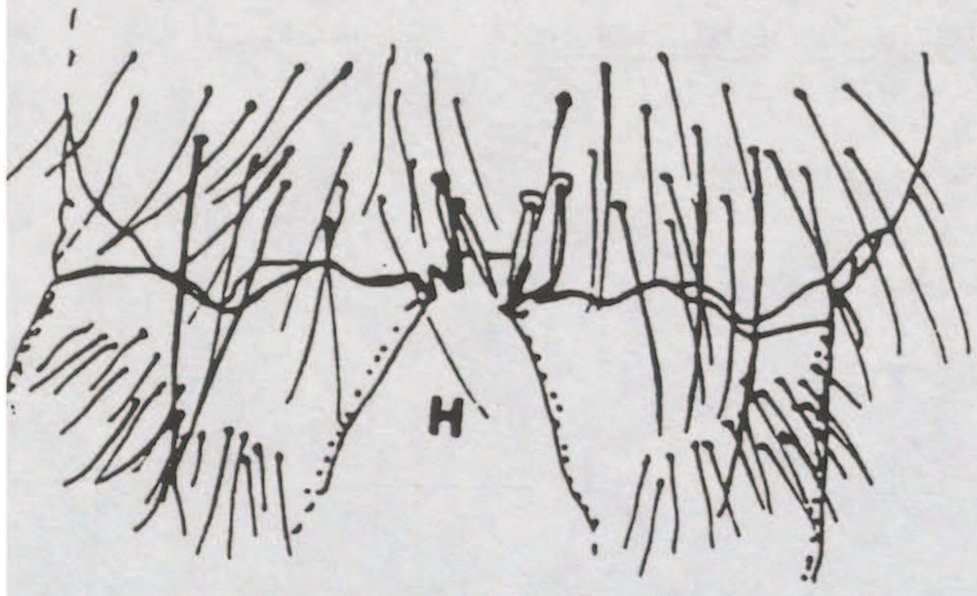
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particularly of the antennae; these have erroneously been regarded as constituting an aberrant genus (Architomocerura) of Isotomidae. Certain specialized structures, especially those confined to one sex (e.g. subanal appendages or clasping antennae in sminthurids) may appear only in later instars.

Development is not necessarily continuous. Growth is interrupted in cold seasons. Eggs or immature stages may survive dry periods in a form of diapause. In a few genera this diapause is associated with regressive modification of the mouthparts and digestive tract and sometimes with striking external modifications, expecially those involving appearance or distortion of anal spines ("Spinisotoma" form of Isotoma spp.; "Ancistracanthella" form of Hypogastrura purpurescens; Fig. 10A.- D). It may be difficult to determine the species of which such ecomorphs are modifications without biological studies of living animals.

Collembola molt throughout life; the number of instars ranges from two (males of Sphaeridia) to fifty or more (Orchesella). Growth evidently continues at a decreasing rate after sexual maturity. In adults it appears that sexual activity is usually restricted to alternate instars.

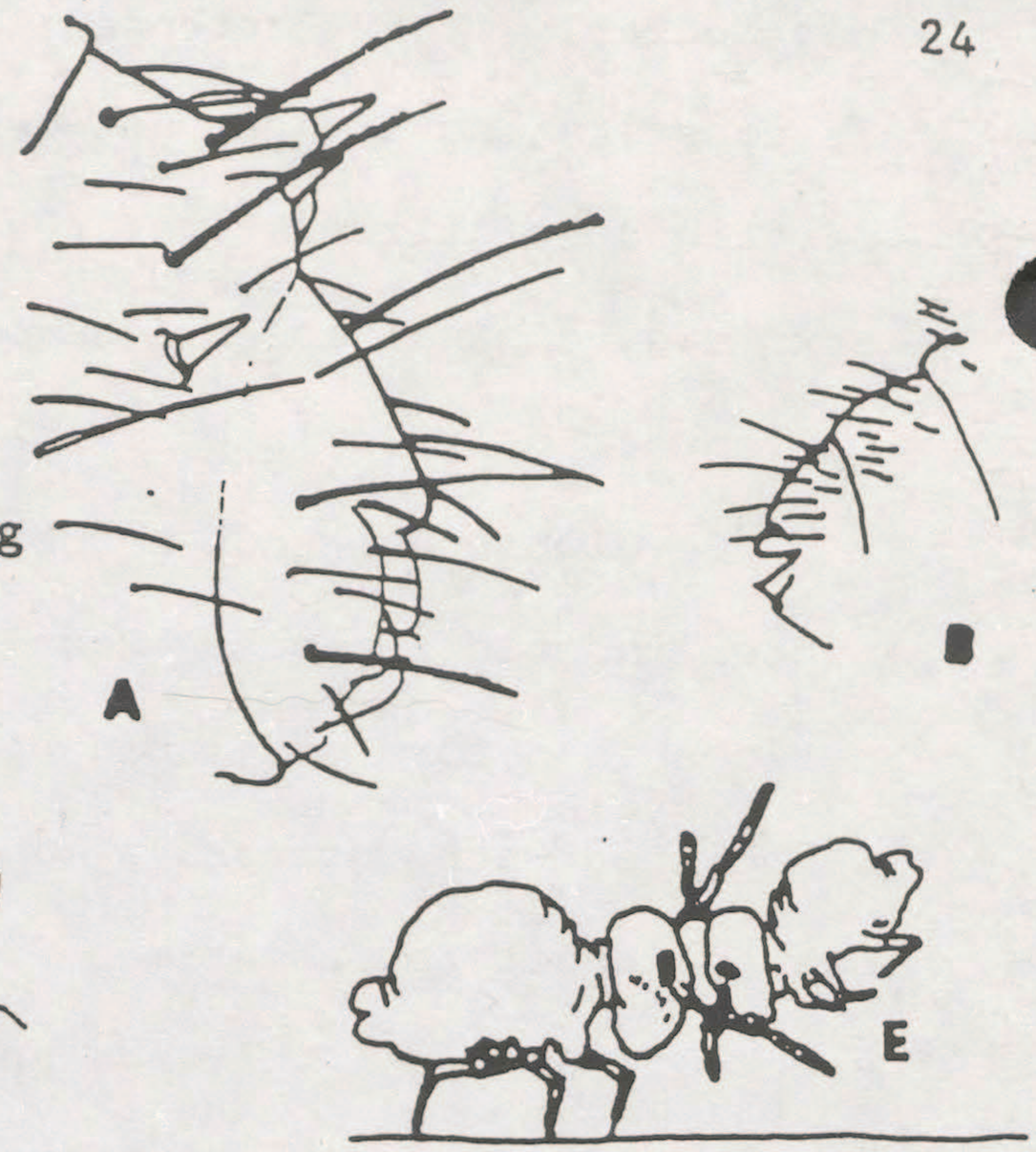
Sperm transfer is indirect, with the exception of Sphaeridia and perhaps some littoral species. Males deposit stalked or sessile spermatophores which are picked up by females, and usually no contact between the sexes is involved. In Podura and some sminthurids there is definite pair formation and a more or less intricate courtship behavior. This may involve prolonged association between the sexes, as in Sminthurides, whose males use their clasping antennae to grasp those of females and are carried by the latter, sometimes for days (Fig. 10C). In Bourletiella, complex subgenus-specific pairing behavior has recently been discovered (Bretfeld, 1970). Males of some species have been seen to eat old spermato-

FIGURE 10

A,B) Last two abdominal segments of Isotoma: "Spinisotoma" ecomorph compared to normal condition. After Stach, 1947.

C,D) Hypogastrura purpurescens anal spines: normal and "Ancistracanthella" ecomorph. After Cassagnau, 1961.

E) Sminthurides aquaticus: male (right) clasping female antennae. After Handschin, 1926.



phores which they encounter, and both male and female may feed on the sperm droplet during the courtship of Bourletiella.

The chromosome number in Collembola is small (5-8 pairs), and most have an XY sex control mechanism. Multifactorial sex determination, exclusively maternal, has been reported in Sminthurides aquaticus (Anders, 1959). Most species are bisexual, but parthenogenesis is known to occur exceptionally or regularly in about a dozen species. Many tissues of Collembola show endopolyploidy. Giant chromosomes as complex as those of larval Diptera are found in the salivary glands of a few Neanurinae.(Cassagnau, 1971b).

Techniques

Collecting. Collembola may be collected from almost any habitat. A white enamel pan is a very useful implement; it may be used as a beating tray for sticks, small stones, plant material, etc., or it may be pushed through low vegetation so that springtails jump into it, or it may be held next to vertical surfaces from which springtails are dislodged by blowing or otherwise. Collembola

may be collected from the pan, or from other objects, by inducing them to jump into a vial (this is time-consuming and risky but produces the best specimens); or they may be picked up in the end of a wet, fine brush and transferred to fixative; or they may be collected in an aspirator. (Caution; Collembola have been recorded living in the frontal sinuses of a collector following intensive use of an aspirator; the inner end of the tube leading to the mouthpiece should be covered with bolting silk or a squeeze bulb should be substituted for mouth suction).

Hand collecting is satisfactory for large, common species, but much greater numbers and a greater variety may be obtained by automatic collection with a Tullgren funnel. This is simply a funnel with a screen on which soil, moss, or debris may be places; a screen over the top prevents escape of the animals, a light hung above the funnel illuminates, warms, and dries the material; and a vessel containing preservative below the funnel collects animals as they escape. For general collecting, a large funnel of sheet metal or plastic is satisfactory, and smaller models can be improvised from cardboard or other materials. For quantitative analysis of the soil fauna many refinements have been proposed (see, for example, Murphy, 1962); optimum techniques vary with the substrate, the objective of the study, and the species being collected.

The Tullgren technique is unsatisfactory for fine-grained materials such as mineral soil, which pass through the screen as easily as the animals do. Collembola may be extracted from such material by flotation; a sample is immersed in water or salt solution and stirred, and animals float to the surface and may be picked off. A modification of this technique is useful for the interstitial fauna of beaches: a pit dug just above the wave line fills

with water, and Collembola and other animals can be collected from the water with a fine-meshed dip net. Refinements of the flotation technique have also been proposed for large-scale collection, but they tend to yield damaged material because of abrasion by the mineral particles.

The cuticle of Collembola is hydrophobic; specimens float not only on water but on alcohol and even, for a time, on pure ether. Specimens collected in alcohol may deteriorate before the alcohol penetrates them. Rusek (1975) recommends using 95% alcohol and boiling the catch in a water bath for a few minutes; this dissolves the hydrophobic layer of the cuticle and causes specimens to sink, and also clears the fat body, which sometimes obscures surface structures. A more convenient procedure is to use a collecting fluid in which specimens sink at once. The most satisfactory is von Torne's medium: 1000 cc. isopropyl alcohol, 30 cc. glacial acetic acid, 3 cc. 40% formol. This is a modification of Gisin's fixative, in which the isopropyl alcohol is replaced by 750 cc. 95% ethyl alcohol and 250 cc. ethyl ether; the latter is also an excellent fixative, but much more volatile and unsatisfactory for use with a Tullgren funnel. Specimens should be transferred from these fixatives to permanent preservatives after a few days; if they are kept in cotton-stoppered vails immersed in fixative, excess fixative may be poured off and the entire vial transferred to the new fluid. For storage, isopropyl alcohol (70-95%); may be used since specimens harden and deteriorate in ethanol; 80-95% ethanol is preferable to weaker solutions. A small amount of glycerine (1-2%) should always be added to protect specimens in case the alcohol evaporates.

Identification. Sorting and preliminary determinations may be carried out in alcohol, using a hand lens or (preferably) a

dissecting microscope with a magnification range of 5-30X. A fine pipette, or a matchstick with 3-4 eyelashes glued to the end, or a flattened, curved insect pin many be used for transferring specimens.

Identification of species almost always requires high magnification (400X or more) of cleared specimens; a good compound microscope is essential, and phase contrast equipment is desirable. The characters in the keys and descriptions are those visible with such equipment; the scanning electron microscope reveals more detail, but in general such details are neglected here.

Specimens must usually be cleared for study in temporary mounts, and some specimens, particularly those which are heavily pigmented, may need stronger clearing than is provided by the mounting medium. Useful clearing agents are the following:

1. Potassium hydroxide. Solutions should be no stronger than 5%, and should be used, with care, for brief periods only. In addition to clearing, this reagent converts the common blue pigment of Collembola to a paler red pigment. Specimens should be transferred to alcohol or water for examination as soon as they are cleared; distilled water has the advantage of expanding KOH-cleared specimens. Prolonged exposure to this reagent causes destructive alteration of the cuticle. Specimens should not be transferred directly from KOH to an acidic medium such as the following.

2. Lactic acid. This is an excellent clearing agent and specimens tolerate prolonged exposure to it. Lactic acid expands specimens, especially if the preparation is warmed gently; freshly collected specimens sometimes explode under these conditions, and are better examined in a mixture of equal parts of lactic acid and glycerine.

3. Liquid of Marc André: 30 cc. distilled water, 40 cc. chloral hydrate, 30 cc. glacial acetic acid. This is comparable in its action to lactic acid, and is more compatible with immediate mounting in Hoyer's medium. Fresh specimens tend to burst in this fluid also, and the clearing process must be watched carefully. Prolonged treatment may damage cuticular structures.

4. Bleaches. Snider (1967) recommends clearing in 5.25% sodium hypochlorite for study of chaetotaxy in Lepidocyrtus, and this medium will also clear very heavily pigmented specimens which cannot be made transparent in other ways. The action is very rapid and destructive to cuticle; 3-5 minutes exposure is adequate, and thorough rinsing in distilled water is essential following bleaching. This is a technique of last resort, to be avoided if other methods can be used.

Cleared specimens may be examined, entire or dissected, in temporary mounts. Since observation from all sides may be necessary, and since the weight of a cover slip may prevent this by crushing or flattening the animal, it is desirable to use a depression slide with a cover slip half covering the depression, or a cover slip supported at the corners by "feet" of soft plasticene. Either method allows rotation of the specimen. Resolution is more satisfactory, and orientation of the specimen for study under oil immersion is easier, with the supported coverslip, but plasticene sometimes reacts with the clearing medium, resulting in contamination of the specimen's surface.

Permanent preservation. No simple method is fully satisfactory. Alcoholic collections may be kept in tightly stoppered vials or in cotton-stoppered tubes kept in sealed jars (baby-food jars are surprisingly reliable). Only constant vigilance, however, will prevent damage resulting from evaporation of the alcohol. Some

types of rubber stoppers deteriorate, especially if exposed to light, and the products contaminate specimens.

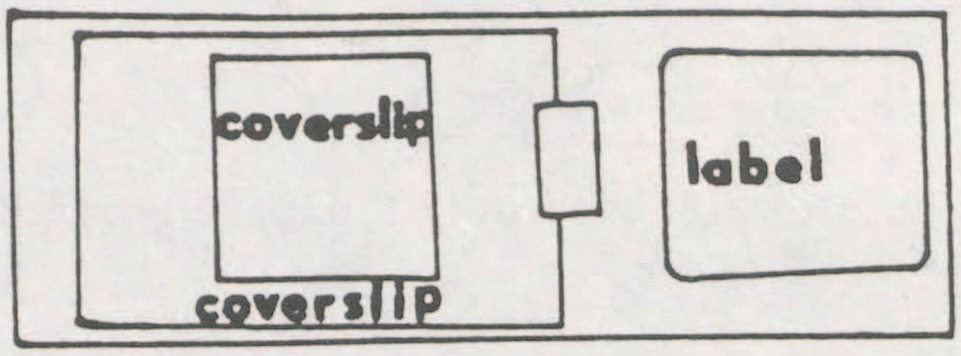
Slide-mounted specimens are convenient for reexamination, but because of the fixed orientation, some characters will almost certainly be obscured. Most truly permanent mounted media, such as balsam, have a refractive index so close to that of cuticle that taxonomic characters become invisible. Excellent preparations may be made by the procedures described by Wilkey (1962), but the required clearing, dissection, staining, and dehydration are time-consuming.

Media which permit mounting directly from alcohol or clearing agents are convenient. Gisin (1960) recommends mounting in lactic acid and ringing the cover slip; preparations of this sort which we have seen are excellent, but the procedure is difficult and permanence is uncertain. Various polyvinyl alcohol-lactophenol media give very clear mounts, which, however, tend to shrink badly after the first few weeks; these cannot be recommended.

Best results are probably obtainable with Hoyer's (deFaure's) mounting medium, especially if medium is 50 cc distilled water, 200 g chloral hydrate, 40 cc. glycerin, 20 g gum arabic; the fluid should be filtered through glass wool after all components have dissolved. Slides should be cured in an oven at 45-60° C for 24 - 36 hours, or allowed to harden naturally (which may require weeks for thick preparations). Permanent mounts should be in euparal or a similar medium.

A particularly convenient method is shown in Fig. 11. The cover slips may be inverted to permit study of the lower surface of specimens. A drop of immersion oil on the slide will hold the cover slip in place temporarily.

Specimens should have been in preservative for at least two weeks before mounting in Hoyer's, since fresh specimens are likely



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to explode. It is desirable to mount several specimens to show both dorsal and lateral views. At least one mounted specimen of pigmented forms should not be cleared so thoroughly that the pigment distribution cannot be seen.

Culture. Many more observations of living specimens are needed. Collembola of many species are easily kept in captivity, provided the temperature and particularly the humidity are adequately controlled. Convenient culture chambers may be made of glass vials with plaster of paris bottoms, or glass tubes set in plaster of paris blocks; the plaster is moistened to provide a humid atmosphere without free water droplets, which can trap small specimens. Use of short vials or tubes with cover glass tops, and addition of small amounts of charcoal to the plaster, facilitate observation. Most species apparently can be conditioned to behave normally under observation by rearing in continuous light. Baker's yeast is a suitable food, though some species, such as Poduromorpha with reduced mouthparts, may require special diets.

Classification. While the major divisions of Collembola are generally agreed upon, there is no consistency in recent literature in the treatment or rank of categories at lower levels. The most complete classification available is that of Salmon (1964), which however, differs radically from that of other authors. There are excellent recent reclassifications of Neanurinae by Massoud (1967) and Sminthuridae by Richards (1968), but no comparable treatment

of other groups. The higher classification of the order will be stabilized only following revisional work on a world-wide basis. For the relatively simple North American fauna, we prefer a conservative classification, even to the point of neglecting some well-founded recent modifications (e.g. the subordinal separation of Neelidae and Sminthuridae by Massoud (1971)). We follow the generic concepts and higher classification of Gisin (1960), except when, as noted below, recent discoveries or the somewhat different nature of the European and American fauna make changes desirable.

In following this conservative classification, we are relying on the following general considerations:

1. The principle reason for classifying organisms is to provide a framework of reference, for the convenience of biologists in general. Convenience is best served by a stable classification. Ultimately we believe that a classification which is in general accord with phylogeny is likely to be the most stable and therefore most convenient. At the present time the best basis we have for phylogenetic reconstruction is morphological similarity. In the present, imperfect state of our knowledge, classification reflecting such inferred relationships is subject to modification, and stability is a goal for the future. However:

a) We do not believe it is either possible or necessary to construct a classification which completely reflects phylogeny, even if the phylogeny is known.

b) We do not believe that major alterations of the classification are justified except on the basis of compelling morphological evidence, including characters previously studied as well as those newly discovered.

c) Inflation of categories creates confusion and inconvenience for the nonspecialist, while providing no significant advan-

tage for the specialist which could not be provided instead by the use of intermediate categories such as tribes, subgenera, and species groups.

d) The erection of new categories should be undertaken only (1) when an organism does not fit into an existing category at that level without significantly altering its definition, or (2) as part of a general, preferably worldwide, reclassification of a whole group, in which the definitions of all included taxa are re-examined.

e) The custom (regrettably followed in the past by some of our most distinguished and honored colleagues) of naming new categories on the basis of published descriptions and not on study of actual specimens, is undesirable and should be abandoned completely. Too many genera of Collembola have been erected on the basis of erroneous species descriptions.

f) Any attempt to fit the species of Collembola into a rigid biological species mold is unwarranted at the present time. The nature of the data presently available limits our species determinations to morphological criteria.

2. The separation of two species into two distinct genera, or even subgenera, contrary to existing procedure, is not justified merely by the existence of differences between them which are greater than those between members of other species pairs in the same (classical) genus Only if the entire genus is revised is the erection of additional higher categories permissible, and even then maintenance of the existing concept of the genus, with finer classification indicated by subgenera and species groups, is to be preferred.

3. The reorganization of existing genera on the basis of newly deduced phylogeny (for example, according to presumed "non-

adaptive" characters) is undesirable unless the evidence is compelling and at least the majority of species in the "classical" genus can be fitted into the new system. Pseudosinella species are probably derived convergently from several Lepidocyrtus species; but the retention of Pseudosinella in the usual sense is preferable at present to reclassifying the reduced-eye species with their presumed 16-eye relatives, since the phylogeny can only be deduced incompletely at present (nonadaptive characters such as chaetotaxy are still unknown for many named species in both genera). Some groups treated as genera in this work are almost certainly polyphyletic, like Pseudosinella, but we do not believe that the evidence we have justifies their fragmentation at this time.

In accordance with these principles, we are proposing in this work only 3 new genera and subgenera, all for species whose combinations of characters exclude them from any existing genera as presently defined. We recognize as distinct species those groups of individuals which show consistent, and usually coordinated, differences in structure from other members of the genus. In borderline cases, for example where very similar but not identical forms occur in geographically distant localities, we have made arbitrary decisions, treating such forms as specifically distinct or as mere infraspecific variants depending on such factors as the nature of the differences and the abundance of material. Individual specimens, or forms represented only by poor material, are generally mentioned only in connection with the most similar species, or in the discussion of the genus.

There are certainly many more species of Collembola still to be discovered in North America. Indeed as indicated above we examined over 30 such forms in this study which we did not describe due to insufficient material. We recognize that our placement of

many forms may prove to be inaccurate, when more material and better information become available.

Use of the Manual.

Arrangement. All taxa we recognize as occurring in the Nearctic region are defined, and all are included in keys except for a few species whose occurrence or validity is doubtful. Determination based on the keys should be checked by comparison with the tables of characters of genera or species (when these are provided), and especially with the descriptions and figures of species.

Terminology. All descriptive terms whose meaning is not perfectly clear are included in the glossary. The principal morphological features of Collembola are described in the introductory section on morphology of Collembola (above); other taxonomically important characters are discussed in the accounts of the groups in which they are used.

The meaning of most descriptions of position will be clear. The terms "outer", "inner", "anterior" and "posterior", with reference to parts of the legs, presume that they are extended straight laterally, with the "knee" (articulation between femur and tibiotarsus) uppermost. "Dorsal" and "ventral" surfaces of the furcula refer to the appendage as it projects posteriorly; "anterior" and "posterior", to its surfaces when it projects ventrally at right angles to the body axis.

"Length" means the middorsal length, in millimeters, of adult specimens, measured without the antennae. Other measurements are given in micra. Most absolute measurements are of limited value because of age differences in size, but relative lengths of parts, while somewhat variable, frequently provide useful characters.

Formulas used in describing chaetotaxy, pseudocellar distri-

bution, and similar characters are described in connection with the groups in which these characters are used.

Keys. All keys are strictly dichotomous. In the species keys, symbols before couplets have the following significance: **, type(s) seen; *, specimens seen; Δ, Nearctic records are dubious. At the end of most keys are the names of species which have not been included in the key, with the reason for their omission (e.g. extralimital species, those assigned to other genera, and synonyms).

Tables. These summarize the distinctive features of the genera of some families or subfamilies, and the species of some genera. Symbols regularly used in the tables have the following significance: +, present; -, absent; +,-, present or absent; ±, more or less (intermediate condition); >, larger than; <, smaller than; ( ), exceptional condition. Certain special symbols are defined in the tables in which they are used.

References. The authorship and year of publication of all taxa, and all papers referred to in the text, is given; complete citations may be found in the bibliography. In the accounts of species, the reference immediately following each name is to the book or article, with the page number, where the original description appeared; the genus in which the species was originally described, if different from our assignment, is included in parentheses. References following that to the original description are to later papers containing useful additional description or figures.

Species descriptions. An attempt has been made to standardize the descriptions, particularly within each genus. The general order of characters is: color and pattern; individual characters, from anterior to posterior, and, on legs and furcula, from basal to distal; setal characters; integumental structure; secondary sexual characters; total length. Characters which are universal in the genus or higher

category, as mentioned in the descriptions of these taxa, or which are clearly stated in species tables, are generally not repeated in the species descriptions.

Distribution. Under each species description, "Localities" means type localities and those for specimens which we have seen: to save space, we give only the state or province and the county, parish, or individual locality, in alphabetical order at both levels. Full data are, however, given for the type collections of species described as new here. "Additional records" are taken from the literature; state and provincial records are given in alphabetical order. These records are not complete, and are intended only to give an idea of the probable distribution of the species; not more than one record (usually the earliest) is given for each state from which we have seen no specimens, and we have frequently omitted published records which are known or believed to be incorrect because of taxonomic changes subsequent to publication of the records.

Key to Families of Collembola

1) At least abdominal segements 2-4 separated by dorsal sutures; or furcula rudimentary (Figures 12 A & B)..... 2
1') At least abdominal segments II-IV dorsally fused; all furcal segments distinct (Figure 12C)..... 10

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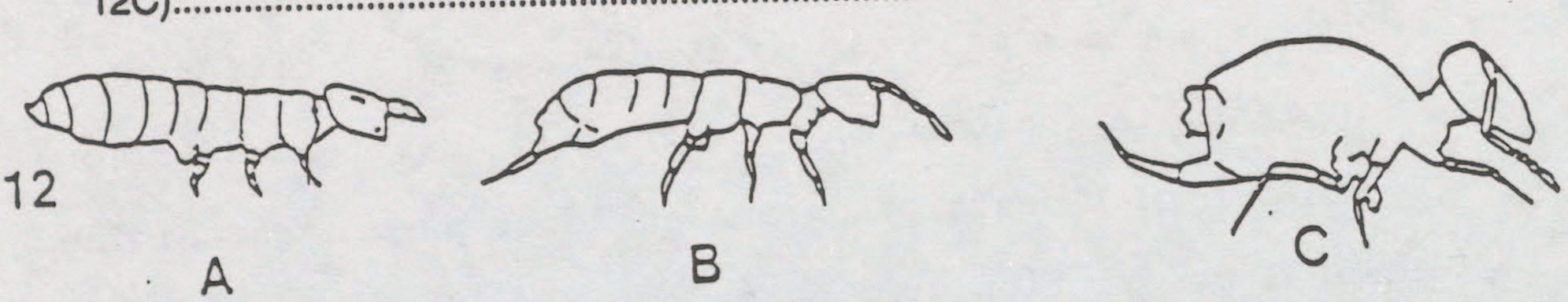

2) First thoracic segment dorsally distinct and with dorsal setae (Figure 13A) (Section Poduromorpha)..... 3
2') First thoracic segment without dorsal setae and frequently not visible dorsally (Figure 13B) (Secton Entomobryomorpha)..... 5

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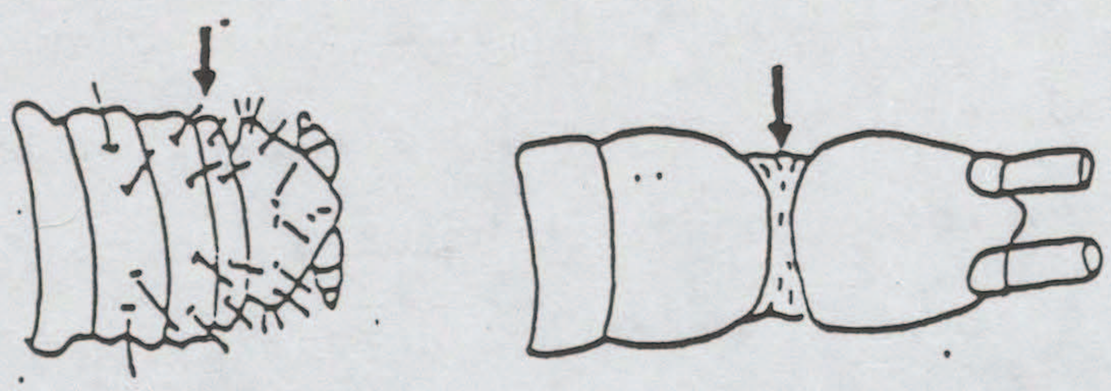

3) Dentes more than 3 times as long as manubrium, with distal rings of granules (Figure 14A) ..... Poduridae
3') Dentes absent or relatively shorter and not ringed (Figure 14B) 4

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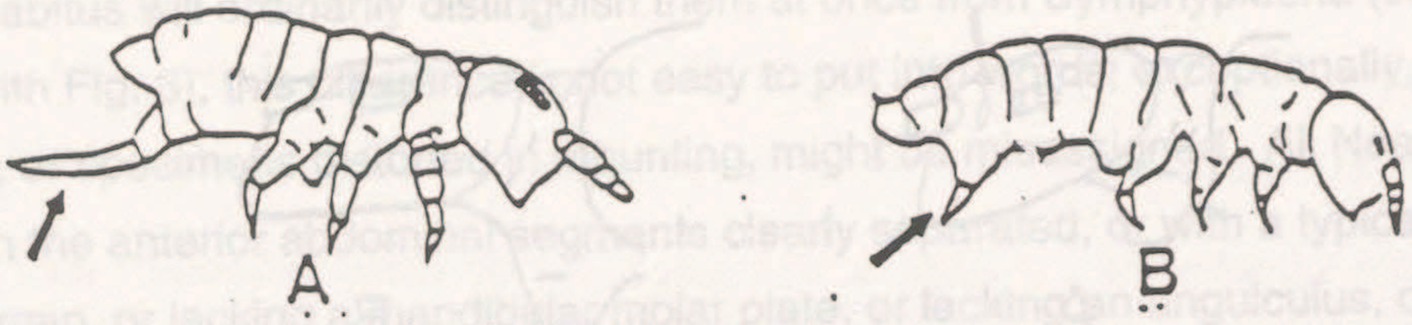

4) Pseudocelli present, at least on antennal base (Figure 15) or dorsum of fifth abdominal segment ..... Onychiuridae
4') Pseudocelli absent ..... Hypogastruridae[1]

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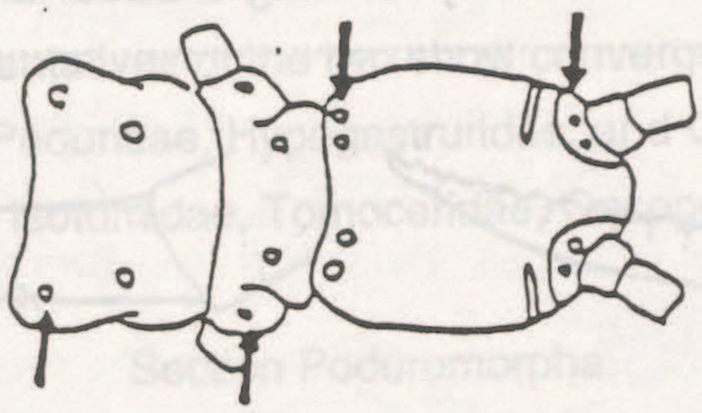
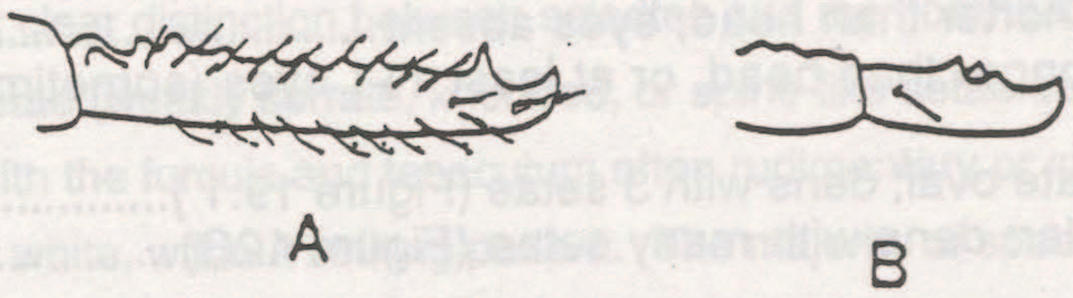


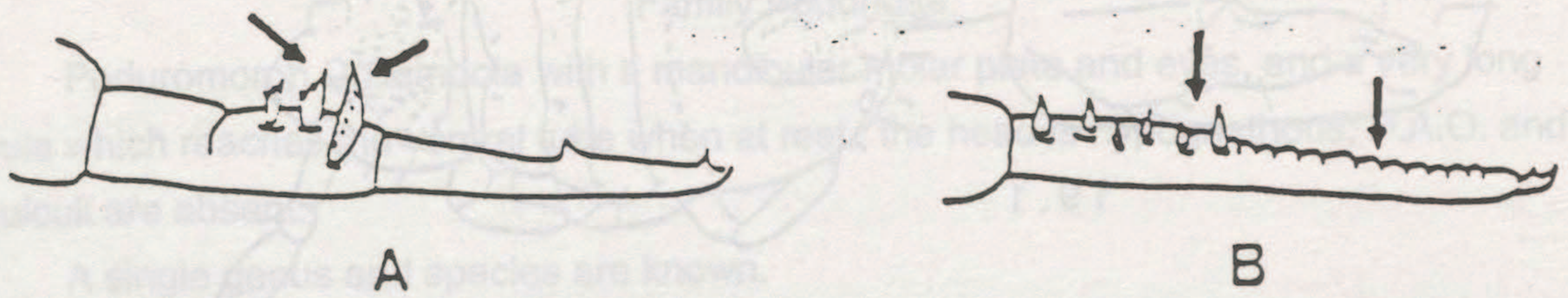
5) Mucro hairy (Figure 16A); fourth antennal segment shorter than third; body scaled ..... Tomoceridae[2]
5') Mucro with at most 1-2 setae (Figure 16B); fourth antennal segment at least as long as third; scales present or absent 6

16



6) Dentes with dentate spines (Figure 17A); mucro subequal in length to dens or longer ..... Oncopoduridae
6') Dental spines simple (rarely) (Figure 17B) or absent; mucro usually much shorter than dens 7

17



[1] Sensiphorura (Onychiuridae) will run here; see key to genera of Hypogastrurinae

[2] First instar specimens of many species of Tomocerus lack both these features and will key out to Isotomidae.

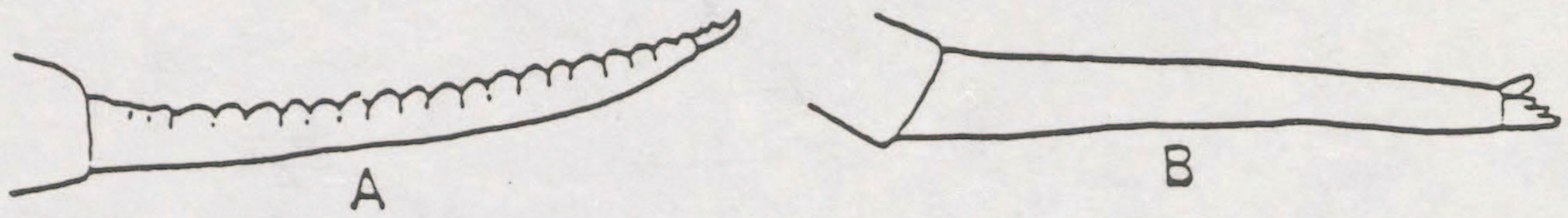
7) P.A.O. present (Figure 18A) or (3 species) absent and setae at most unilaterally ciliate .....Isotomidae
7') P.A.O. absent (Figure 18B); some setae multilaterally ciliate 8

18



8) Dens dorsally crenulate and curving upward, basally in line with manubrium (Figure 18A .....Entomobryidae
8') Dens not crenulate, straight and usually forming a basal angle with manubrium (Figure 19B) 9

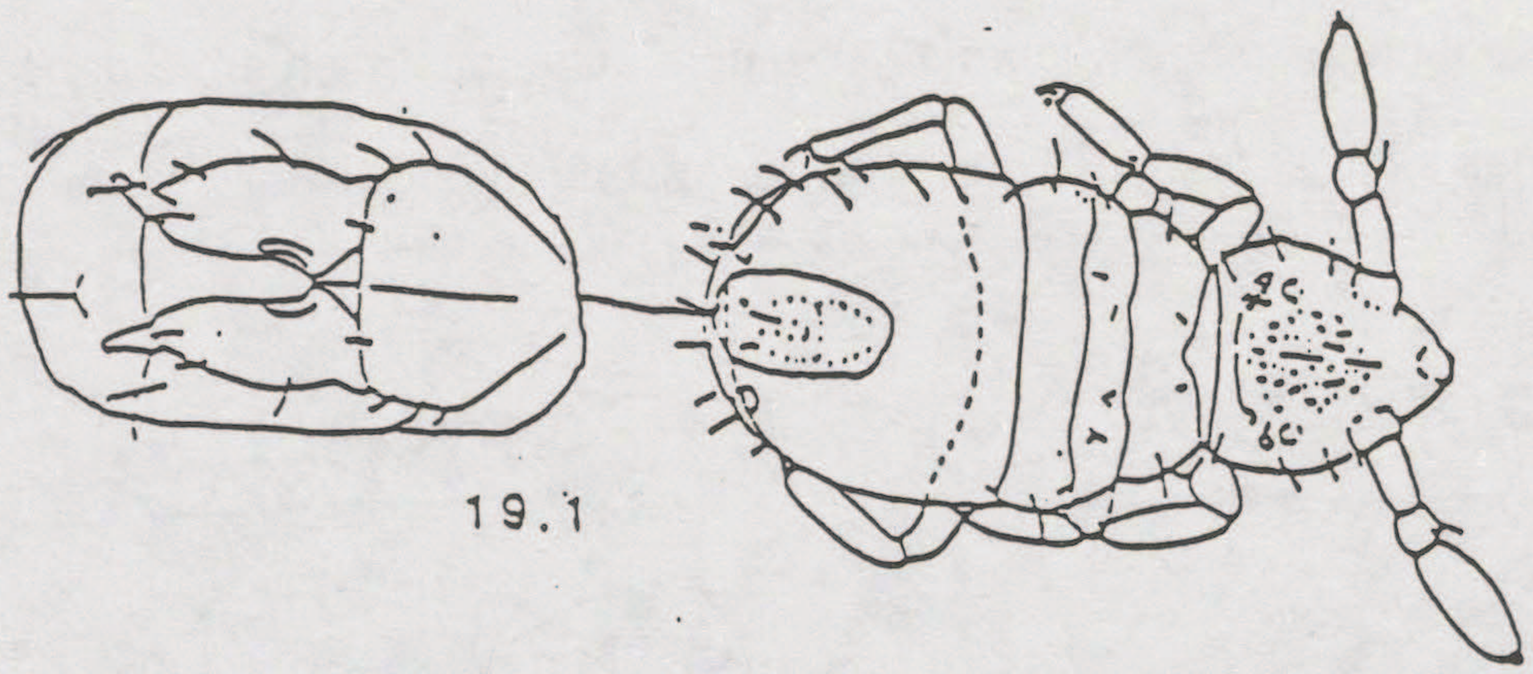
19



9) Eyes and pigment absent; dens with large dorsal scales and without apical lobe .....Cyphoderidae
9') Eyes and pigment present; dens without dorsal scales and with apical lobe (Figure 19B) ..... Paronellidae

10) Antennae shorter than head; eyes absent.....Neelidae
10') Antennae longer than head, or at least 1+1 eyes (sometimes unpigmented) 11

11) Body elongate oval; dens with 3 setae (Figure 19.1).....Mackenziellidae
11') Body globular; dens with many setae (Figure 12C).....Sminthuridae



19.1

Suborder Arthropleona

This suborder includes the so-called "linear" Collembola. It contains the great majority of species of springtails. The Arthropleona are extremely diverse in structure, and while the differences in habitus will ordinarily distinguish them at once from Symphypleona (compare Figs. 1 and 2 with Fig. 3), this difference is not easy to put into words; exceptionally, extreme juvenile stages, or specimens distorted in mounting, might be misassigned. All Nearctic Collembola with the anterior abdominal segments clearly separated, or with a typical postantennal organ, or lacking a mandibular molar plate, or lacking an unguiculus, or with the furcula reduced (segments not clearly separated) or absent, or with the mucro much shorter than the dens, are Arthropleona.

The Arthropleona may be divided into two sections, which are almost certainly natural divisions, though some representatives of the two show convergent resemblance. The divisions are Poduromorpha, including Poduridae, Hypogastruridae, and Onychiuridae, and Entomobryomorpha, including Isotomidae, Tomoceridae, Oncopoduridae, Entomobryidae, Paronellidae and Cyphoderidae.

Section Poduromorpha

This includes Arthropleona with setae on the first thoracic tergite. Only this character will surely distinguish all species from some superficially similar Isotomidae. However, any Arthropleona with the last two antennal segments more or less fused, or without a molar plate on the mandible, belongs here. In general, the species have a weakly sclerotized, granulate or tuberculate integument without clear distinction between sclerites and membranes; relatively sparse chaetotaxy of simple setae (weakly serrate, knobbed, or spine-like setae occur); relatively short appendages, with the furcula and tenaculum often rudimentary or absent. The color is usually brown, blue, or white, without striking pattern. The majority of species are found in litter, soil, or caves.

Of the three families recognized here, the Poduridae are very distinct in structure and habitat. The Onychiuridae are similar in many respects to the Hypogastrurinae, but may almost always be distinguished by the pseudocelli and the sense organ of the third antennal segment.

Family Poduridae

Poduromorph Collembola with a mandibular molar plate and eyes, and a very long furcula which reaches the ventral tube when at rest. the head is hypognathous; P.A.O. and unguiculi are absent.

A single genus and species are known.

Genus Podura Linnaeus, 1758

Type species: P. aquatica Linnaeus, 1758

Podura aquatica Linnaeus, 1758 Fig. 20

Refs.: Systema Naturae, ed. 10:609; Folsom, 1916.

Syn.: P. granulata MacGillivray, 1893, Canad. Ent. 25:316; f. mimula Maynard, 1951, Collembola of New York: 25.

Description

Color: blackish blue with reddish brown appendages, or entirely reddish brown. Antennae shorter than head; fourth segment with 2 apical papillae but without blunt setae. Eyes 8+8, with anterior 2 slightly larger than others. Tenent hair acuminate. Unguis elongate, with inner tooth. All abdominal segments distinctly separated. Ventral tube with 4+4 - 5+5 distal setae. Tenaculum without setae, with 4+4 teeth. Manubrium without ventral setae. Dens 2.5 to over 3 times as long as manubrium, with setae only on dorsal surface; with a weak transverse suture at 2/5 of their length; superficially granulate, with the granules forming transverse rings apically. The dentes diverge strongly and then converge apically. Mucro 3/5 as long as hind unguis, complexly lamellate and granulate. Integument coarsely granulate. All body setae acuminate and smooth. Maximum length 1.3 mm.

Remarks

This is perhaps the best known and most distinctive of all species of Collembola. Its normal habitat is the surface of standing water, but we have 1 record from soil, where its occurrence is presumably accidental.

Localities: We have scattered collections acrosss the country from Massachusetts to California. Published records include Alaska and the Canadian arctic archipelago at one extreme and Louisana at the other. It is to be expected in any part of North America where standing fresh water occurs regularly.

Biology: Richard, 1973

FIGURE 20

Podura aquatica

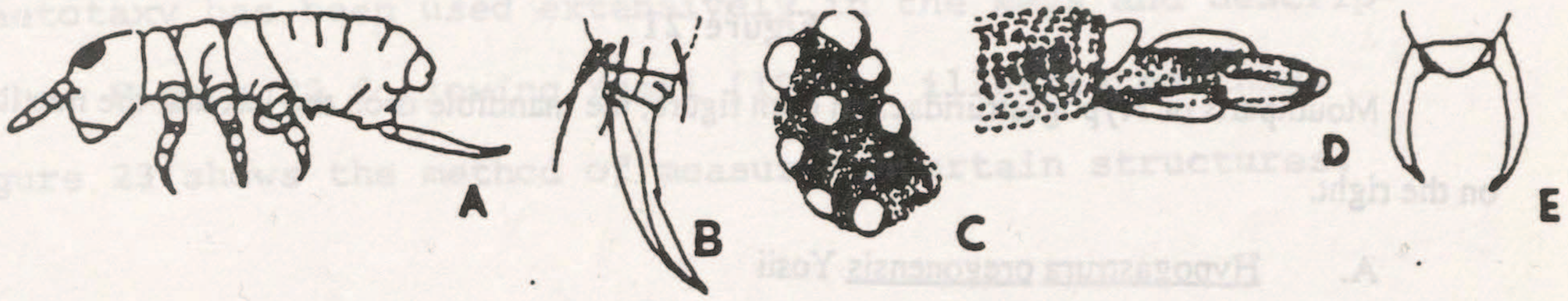
A) Habitus, from Gisin, 1960.

B) Hind foot, from Folsom.

C) Eyes, from Folsom.

D) Mucro and apex of dens, from Folsom.

E) Dorsal view of abdomen end and extended furcula, after Gisin, 1960.



Family Hypogastruridae

Poduroid Collembola with the furcula short or absent, the third antennal segment sense organ simple, and typical pseudocelli lacking. The mouthparts vary in structure in this family more than in any other Collembola; see Fig. 21. The furcula, when extended posteriorly, never in Nearctic genera reaches beyond the end of the abdomen; this character distinguishes the family from all other Collembola except Onychiuridae and some Isotomidae. In addition to pseudocelli and a complex third antennal segment sense organ, almost all onychiurids have a long, parallel-sided P.A.O. with many tubercules in a grove, whereas the P.A.O. in Hypogastruridae, if present, is rounded or oval and usually has few tubercles. All isotomids with a short furcula may be distinguished from any similar hypogastrurid by the absence of setae on the prothoracic tergum, and from almost all hypogastrurids by the P.A.O. in the form of a single vesicle.

There are 2 subfamilies of Hypogastruridae, which may be distinguished as follows:

Mandible with a basal molar plate (Fig. 21A) -- Hypogastrurinae

Mandible absent or without a molar plate (Fig. 21B,C) -- Neanurinae

The molar plate (see figures in key to genera of Hypogastrurinae) is easily seen in well cleared specimens of most genera; the two genera in which it is weakly sclerotized differ from all Neanurinae in having conspicuous, lamellate unguiculi.

Figure 21

Mouthparts of Hypogastruridae. In each figure, the mandible is on the left and the maxilla on the right.

A. Hypogastrura oregonensis Yosii

B. Neanura muscorum (Templeton) after Massoud

C. Anurida amorita Folsom

Subfamily Hypogastrurinae

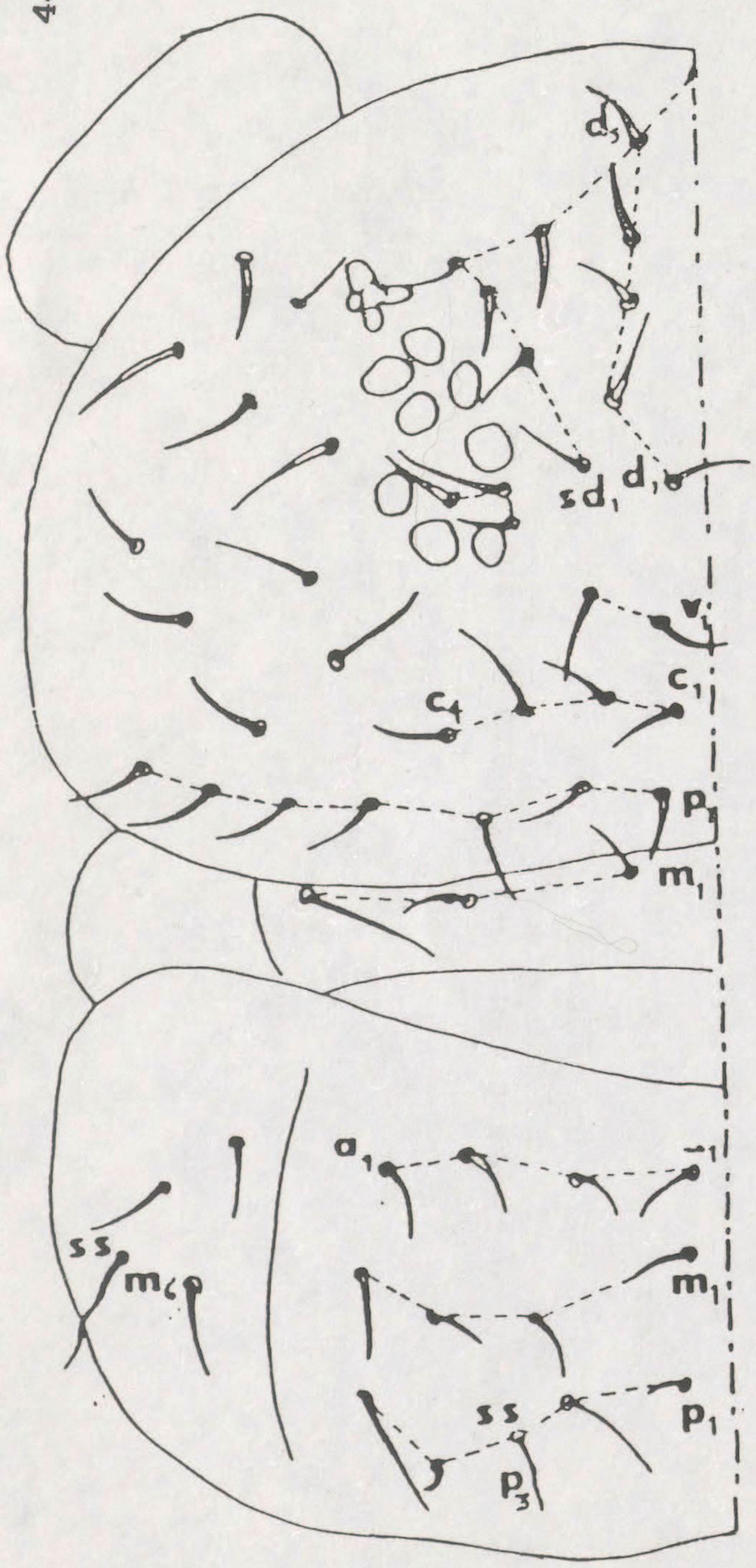
Aside from the mandibular molar plate, the characteristics of representatives of this family are diverse; eyes, P.A.O., unguiculus, furcula, and pigment all vary from well developed to absent. Most species have 2 (rarely 3) anal spines set on papillae, which will further distinguish them from Neanurinae except for some species of Odontella, Friesea, and Oudemansia. Chaetotaxy has been used extensively in the keys and descriptions; Figure 22, following Yosii (1960), illustrates this. Figure 23 shows the method of measuring certain structures.

FIGURE 22

Chaetotaxy in the Hypogastrurinae. In all figures a=anterior setal row, m=median setal row, p=posterior setal row; s.s.=sensory seta (a seta clearly more slender and flexible than the others). In figures of the head region c=cervical setal row, d=dorsal setal file, sd=subdorsal setal file, v=vertical setal row.

A. Actual chaetotaxy in Hypogastrura (Ceratophysella) bengtssoni. After Thibaud, 1967.

B. Idealized chaetotaxy. After Yosii, 1960.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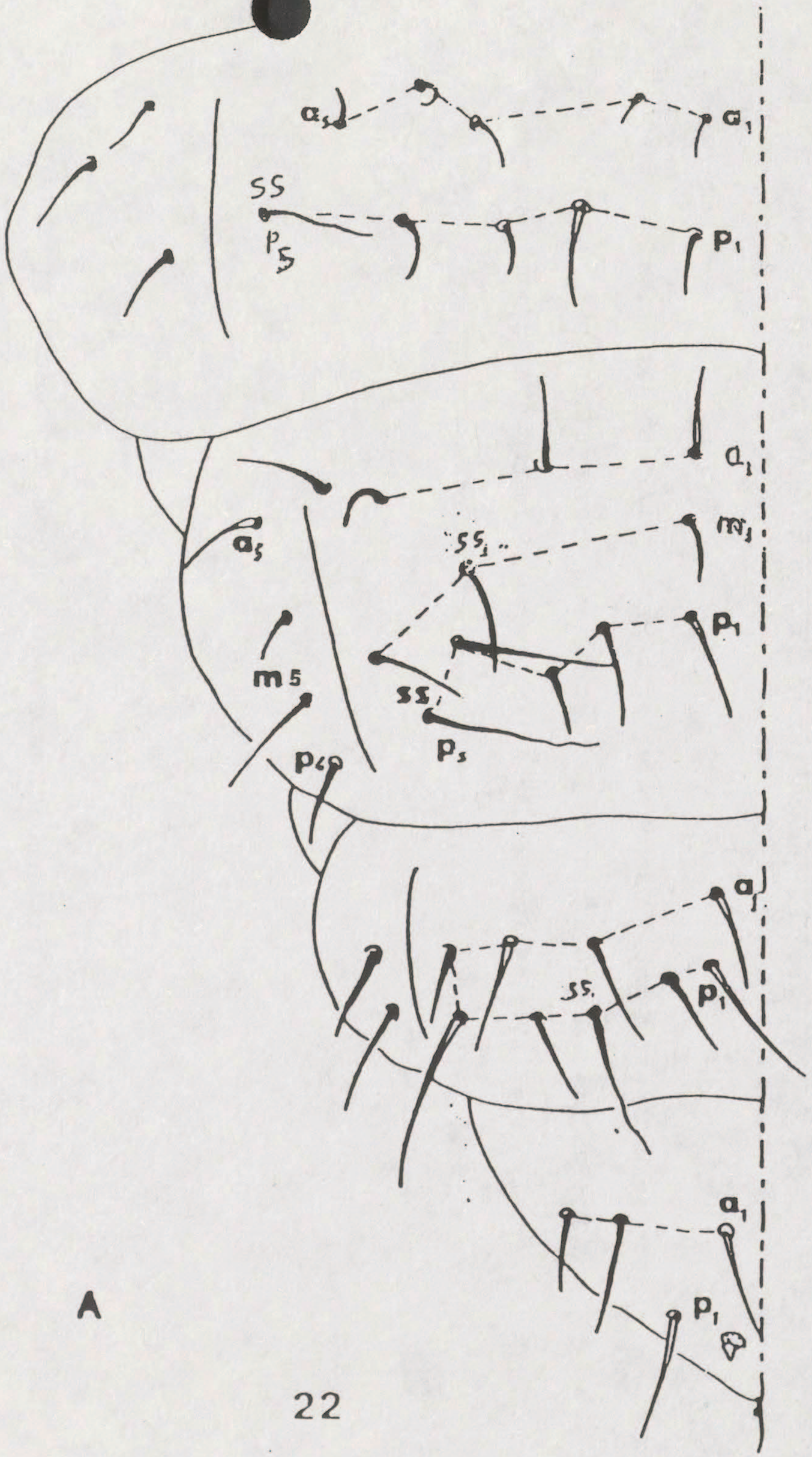
A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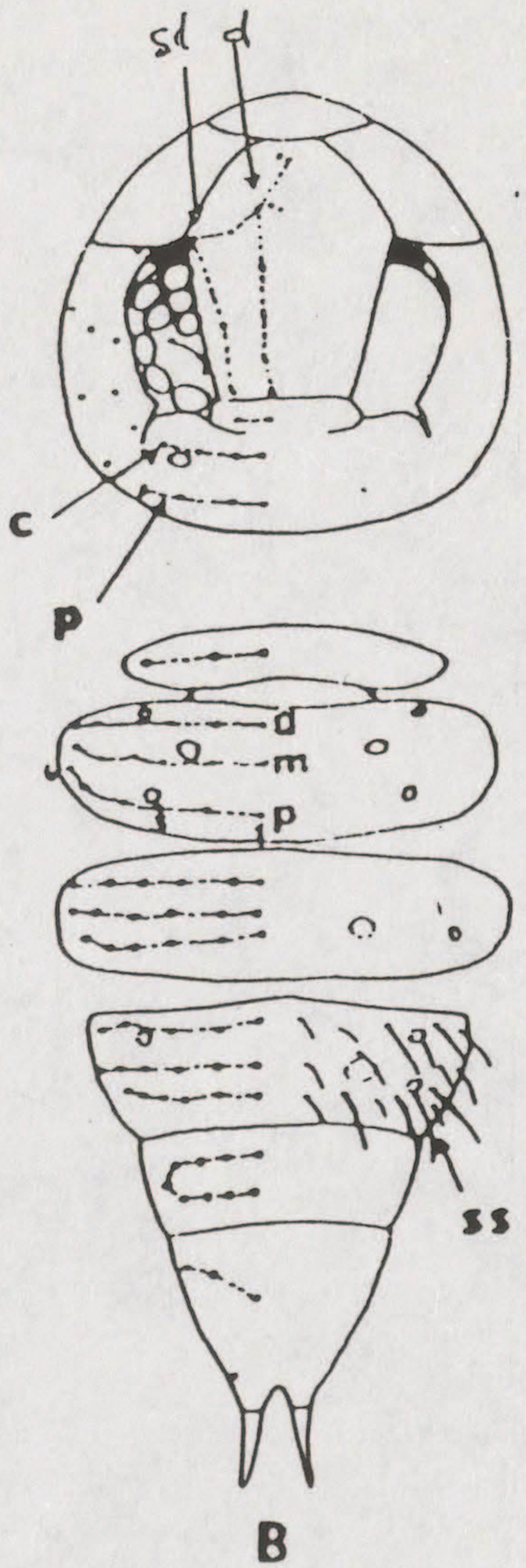
sd
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B

Figure 23

Major organs measured in Hypogastrurinae and mode of measurement shown by broken lines.

A. Foot Complex

B. End of abdomen and anal spine (seen from side)

C. Furcula (seen from above)

D. Furcula (seen from side)

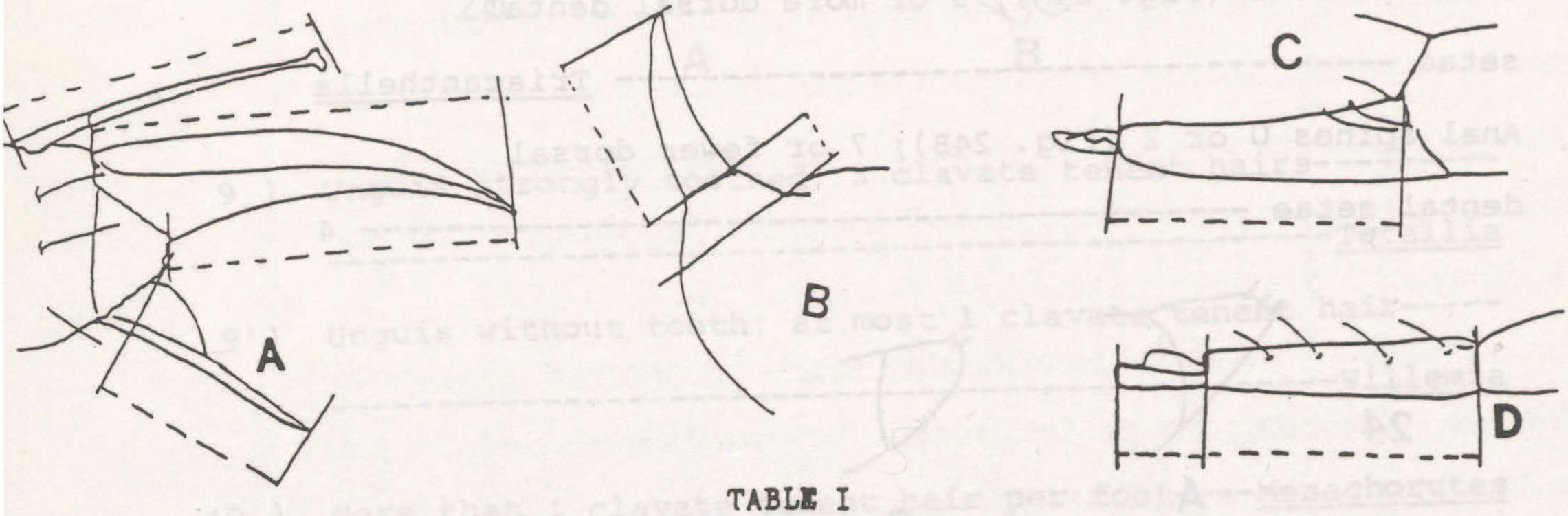


TABLE I

Characteristics of Nearctic Genera of Hypogastrurinae

Genus	Eyes per Side	P.A.O. Lobes	Unguiculus	Clavate Tenent Hairs	Furcula	Tenacular Teeth	Body Pigment
Acherontiella	0	0	-	1-2	-,+	0-3	-
Hypogastrura	8	3-5	+,-	0-4(+)	+	3-4	+(-)
Knowltonella	8	1	-	4	-	-	+
Mesachorutes	0	4-6	+	2(4)	+	3	-
Microgastrura	6	4	+	-,+	+	4	+
Schaefferia	2-6	3-5	+	-	+	3-4	-,+
Stenogastrura	8	1	+	1	+	3	+
Tafallia	0	5-9	-	3	-	-	-
Triacanthella	8	4	+	1	+	3	-
Willemia	0	(3)-15	(-),+	-,(+)	-	-	-
Xenylla	4-5	-	-	1-4	-,+	0-3	+

Symbols in parentheses represent exceptional conditions.

Key to Nearctic Genera of Hypogastrurinae

1) P.A.O. absent ---------- 2

1') P.A.O. present ---------- 3

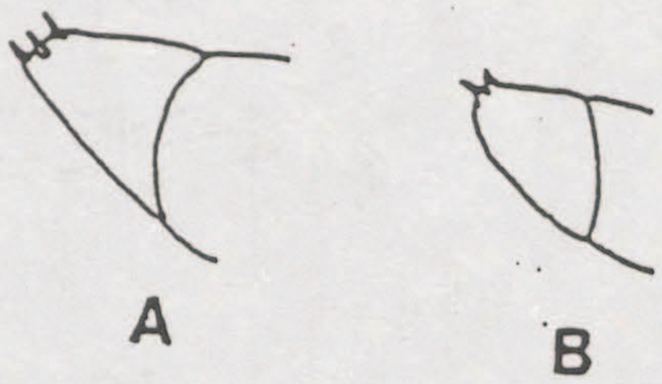
2) 4 - 5 eyes per side ---------- Xenylla

2') Eyes absent ---------- Acherontiella

3) Anal spines 3 (Fig. 24A); 9 or more dorsal dental setae ---------- Triacanthella

3') Anal spines 0 or 2 (Fig. 24B); 7 or fewer dorsal dental setae ---------- 4

24



4) Eyes 8 + 8 ---------- 5

4') Eyes 6 + 6 or fewer ---------- 7

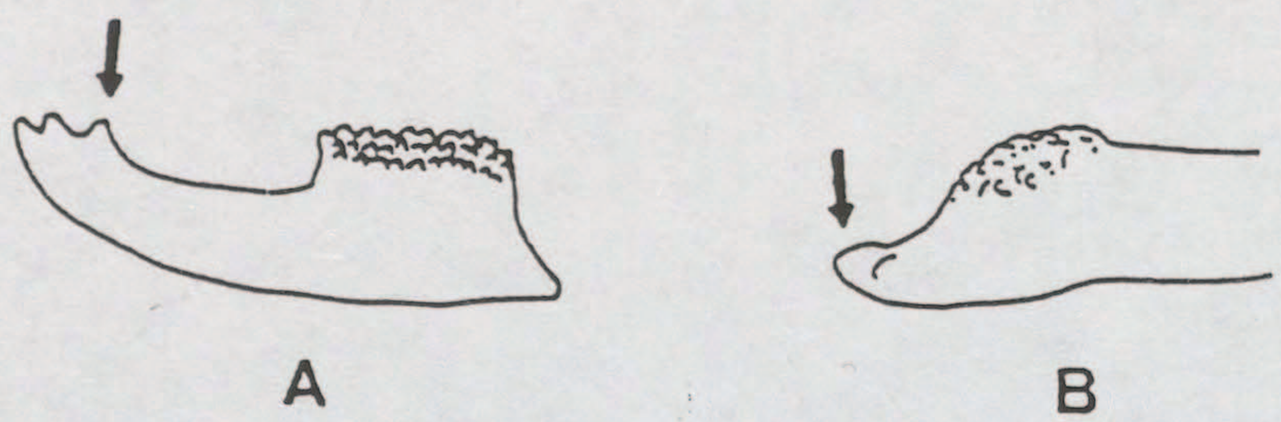
5) Furcula absent ---------- Knowltonella

5') Furcula present ---------- 6

6) Mandible with apical teeth (Fig. 25A); P.A.O. lobed ---------- Hypogastrura

6') Mandible without apical teeth (Fig. 25B); P.A.O. simple ---------- Stenogastrura

25

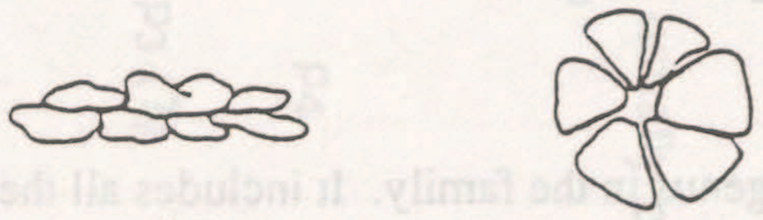


7) Furcula absent ---------- 8

7') Furcula present ---------- 10

8) P.A.O. elongate with 2 rows of oblong tubercles (Fig. 26A)----------Sensiphorura (Onychiuridae)

8') P.A.O. circular with triangular tubercles (Fig. 26B)----9



26

A B

9) Unguis strongly toothed; 3 clavate tenent hairs---------- Tafallia

9') Unguis without tooth; at most 1 clavate tenent hair----- Willemia

10) More than 1 clavate tenent hair per foot----Mesachorutes

10') 1 acuminate or clavate tenent hair per foot----------10

11) Mandible with strong molar plate and several apical teeth (Fig. 25A)---------- Schaefferia

11') Mandible with weak molar plate and at most 1 apical tooth (Fig. 27)---------- Microgastrura



27

Genus Hypogastrura Bourlet, 1839

Synonym: Achorutes of American authors, not Templeton

Type species: Achorutes viaticus Tullberg, 1872

This is by far the largest genus in the family. It includes all the poduroids with a well developed molar plate on the mandible, 8 +8 eyes all equally distinct, a P.A.O., and all segments of the furcula present. In addition, all nearctic members except for a few known or probable ecomorphic forms have two anal spines. The maximum number of dental setae is 7. The tenaculum has 3 + 3 or 4 + 4 teeth.

There are six subgenera: Schoettella, Mitchellania, Ceratophysella, Knowltonella, Mucrella, and Hypogastrura s. str. The species will be keyed under each subgenus. A key to the subgenera and a comparative table are given here.

TABLE II
Distinguishing Features of the Subgenera of Hypogastrura s.l.

	ss on thoracic segment II	Unguiculus	P.A.O.	Setae on area verticalis	Anal spines inner unguis	Teeth on tenaculum
Mitchellania	usually p_4 rarely p_3	lamellate 1/5 - 1/3 inner unguis	4 lobes, posterior 2 usually encircle accessory boss	2 + 2	5/4 - 2/1	4 + 4
Ceratophysella	usually p_3	with one exception (?) lamellate, 1/5 to longer than unguis	4 lobes, transversely elongate	2 + 2	1/2 - 3/1	4 + 4
Knowltonella*	p_4	absent	4 weak lobes	2+2	2/3	no tenaculum
Schoettella	p_3 (?)	absent or minute (<1/10 unguis)	4-lobed boss (-8 lobes)	2 + 2	1/10 - 1/3	3 + 3
Hypogastrura	p_4 or p_5	varied, >1/16 inner unguis	3 - 5 subequal lobes	2 + 2 or 1 + 1	1/8 - 2/3	3 + 3 or 4 + 4
Mucrella	p_4	lamellate 1/2 - 3/4 inner unguis	4 - 7 lobes, subequal to anterior more elongate	2 + 2	(0)1/5 - 1/4	4 + 4

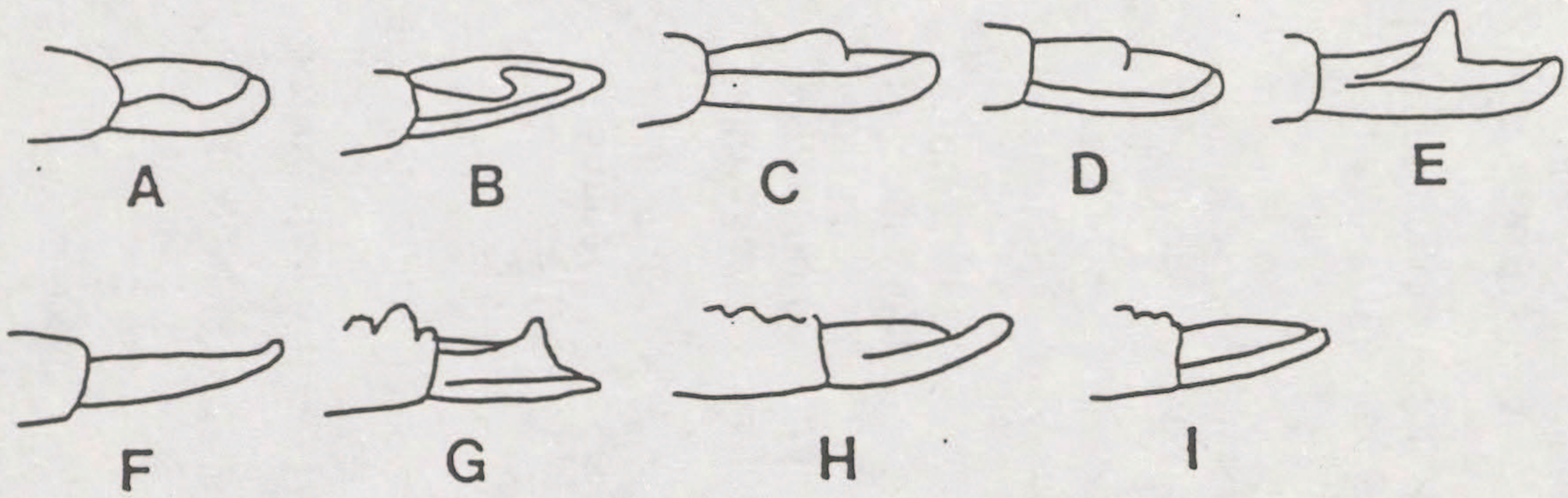
* Fjellberg (1991) considers this a subgenus of Schoettella (treated as a genus).

Key to the Nearctic subgenera of Hypogastrura

1) Furcula absent----------Knowltonella
1') Furcula present----------2

2) Unguiculus well developed , at least 1/6 as long as inner unguis----------3
2') unguiculus absent or less than 1/10 inner unguis--Schoettella

3) Mucro spoon shaped with lateral lobe or spine (figure 29 A-E)*----------5
3') Mucro varied but never spoon shaped (figure 29 F-I)----4



29

4) Maxilla with lamella 4 rounded, shorter than and hidden by lamella 5 (figure 29.1 A)----------Mucrella**
4') Maxillary lamella hook-like,strong, reaching beyond tip of lamella 5 (figure 29.1B)----------Hypogastrura S.S.



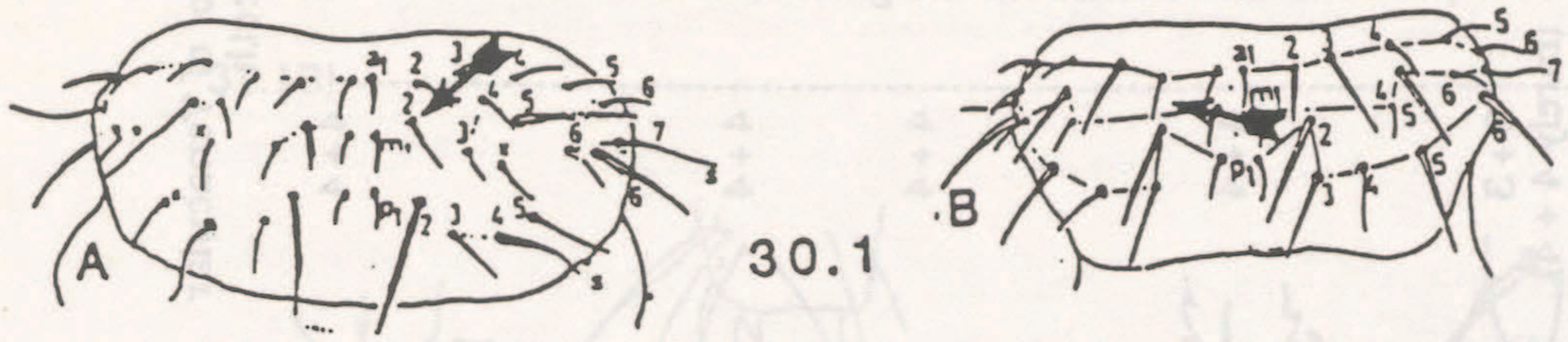
29.1

* One nearctic species of Ceratophysella (glancei) lacks a spoon shaped mucro. It will be keyed out in both Ceratophysella and Hypogastrura.

** Mucrella is a junior subjective synonym of Proxenyllodes Denis (Type species folsomi = acuminata Cassagnau).

5) Seta M_2 present on thoracic segment 2 (figure 30.1A), posterior lobes of P.A.O. usually curved around boss (figure 28). ---------- ----------Mitchellania

5') Seta M_2 absent on thoracic segment 2 (figure 30.1B), posterior lobes of P.A.O not curved around boss-----Ceratophysella



30.1

Subgenus Hypogastrura s.str.

Synonyms: Schoturus MacGillivray, 1893, type species: Podura nivicola Fitch, 1846; Neogastrura Stach, 1949a, type species: Achorutes viaticus Tullberg, 1872; Anachorutes Bagnall, 1949c, type species: Achorutes tigrina Harvey, 1900; n.syn.; Biacanthella Scott, 1961b, type species: B. neomexicana Scott, 1961b

The members of this subgenus are those forms having a well developed unguiculus, with the P.A.O. lobes short and rounded and never surrounding an accessory boss, and without an eversible sac between the third and fourth antennal segments; in all forms seen, s.s. on the second thoracic segment is p_4. The mucro is variously shaped, but never has the form characteristic of Ceratophysella and Mitchellania.

This is by far the most varied subgenus, and following Yosii (1960) in part we have broken it into a series of species groups; however, rather than using features of chaetotaxy, which are incompletely known for many species, we have divided the subgenus on the basis of features of the foot complex and dentes. The table below summarizes the divisions.

TABLE III

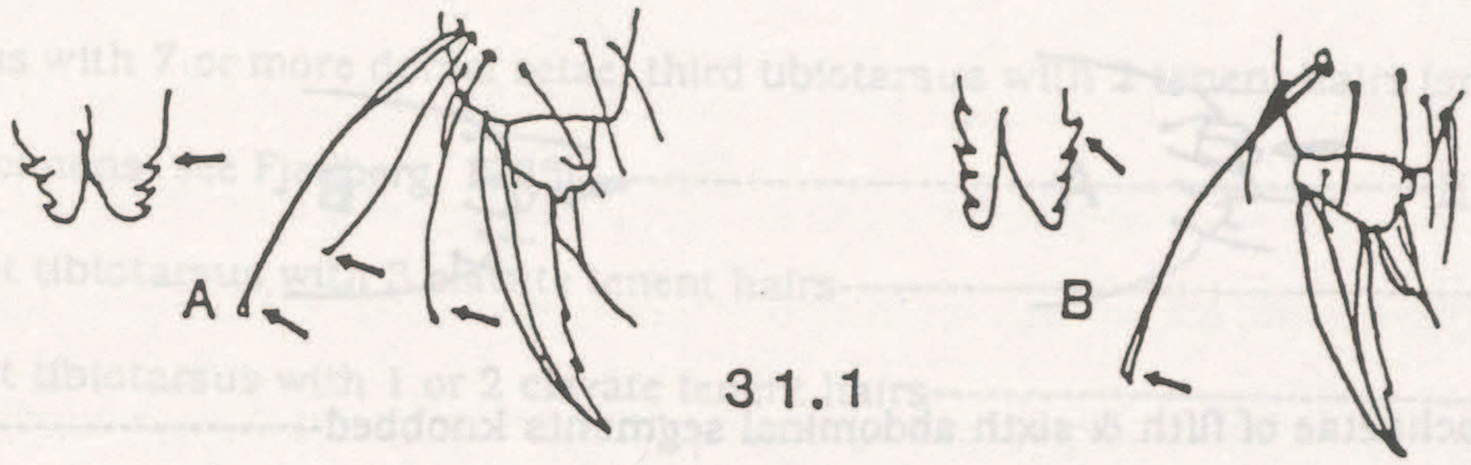
Species Groups in Nearctic Hypogastrura s. str.

Species Group Name	No. of Tenacular Teeth	No. of Tenent Hairs/Foot	Tenent Hair Type	Dental Granulations	Type of First Unguiculus	Setae of Area Verticalis
manubrialis (arctandria, brevispina, christianseni, devia, essa, manubrialis, matura, pannosa, promatro, ripperi, tigrina, utahensis)	4+4	1	Clavate (Acuminate)	Fine to Moderate	Acuminate	2+2
nivicola (harveyi, nivicola, simsi tooliki	4+4	1 (+)	Clavate	Conical, Thornlike	Lamellate*	1+1 or 2+2
packardi (copiosa, funesta, fjellbergi macrotuberculata, madera, packardi, sparta)	4+4	1	Clavate	Fine to Moderate	Lamellate	1+1 or 2+2
trybomi (ireneae, lima, maynardi, oregonensis, trybomi)	4+4	1	Acuminate	Coarse to Fine, Rounded	Lamellate	2+2
viatica (alta, antra, bulba, concolor, distincta, gami, helena, humi, itaya, litoralis, perplexa, purpurescens, sensilis, tullbergi, viatica)	3+3 (rarely 4 + 4)	2-4 (rarely only 1 clear)	Clavate	Fine to Moderate	Lamellate	2+2

Characters in parentheses represent exceptional conditions. *acuminate in one summer form

1) Tenaculum with 3 + 3 teeth and/or more than 1 long clavate tenent hair per foot (viatica group) (Figure 31·1A)----------2

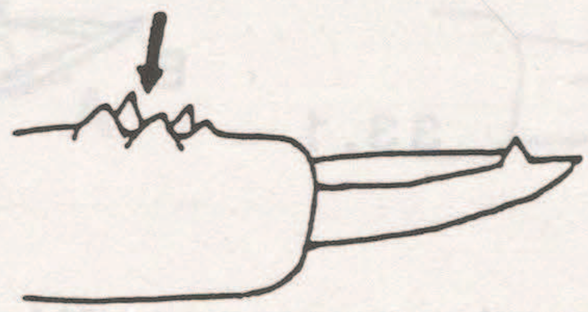
1') Tenaculum with 4 + 4 teeth; 1 long clavate tenent hair or none per foot (Figure 31.1B)----------19



31.1

* 2) Dens with high, conical, sharply pointed tubercles; median tenent hair much longer and thicker than other (Figure 47)-(see Waltz & Hart, 1985)---
----------H. packardi (winter form, includes notha)

2') Dens without such tubercles; tenent hairs similar in length & thickness----------3



47

3) With 1 or more supplementary peg-like setae on third antennal segment (Figure 31)----------4

3') Without supplementary peg-like setae on third antennal segment----------5



31

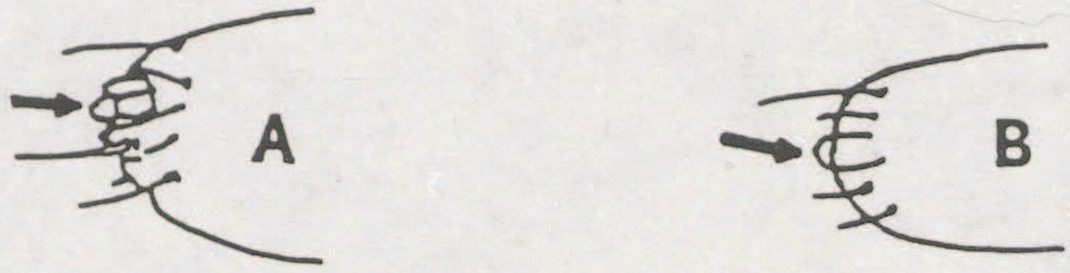
* 4) Length of mucro more than 3 times its greatest depth----------H. tullbergi (=spitsbergensis of CONANRG)

4') Length of mucro less than 3 times its greatest depth----------H. sensilis

** 5) Apical bulb of fourth antennal segment strongly trilobed (Figure 32A)----H. bulba

5') Apical bulb unlobed or apically indented (Figure 32B)----------6

32

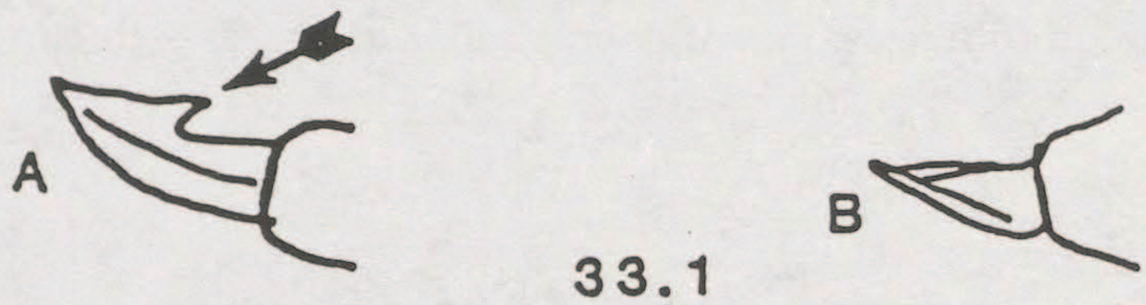


6) Macrochaetae of fifth & sixth abdominal segments knobbed----------7

6') Macrochaetae of fifth and sixth abdominal segments acuminate----------8

* 7) Mucro with distinct, usually retrograde tooth at half its length (Figure 33.1A)------ ----------H. distincta

* 7') Mucro without distinct subapical tooth (Figure 33.1B)----------H. itaya



33.1

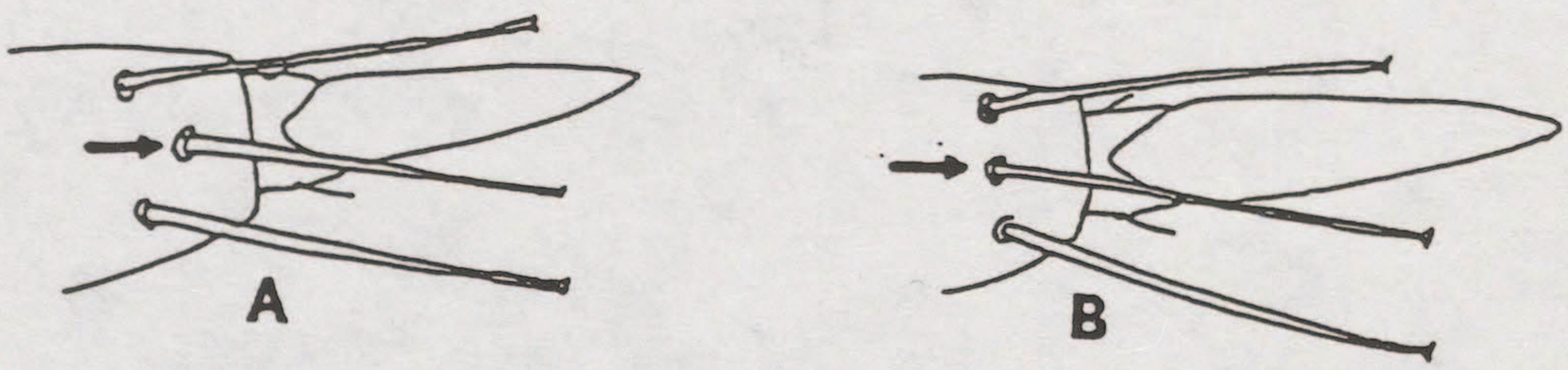
** 8) Unguiculus subequal to or longer than inner unguis----------H. alta

8') Unguiculus distinctly shorter than inner unguis----------9

* 9) Median tenent hair much below level of others (Figure 34A)--------H. purpurescens

9') Median tenent hair at or above level of others (Figure 34B)----------10

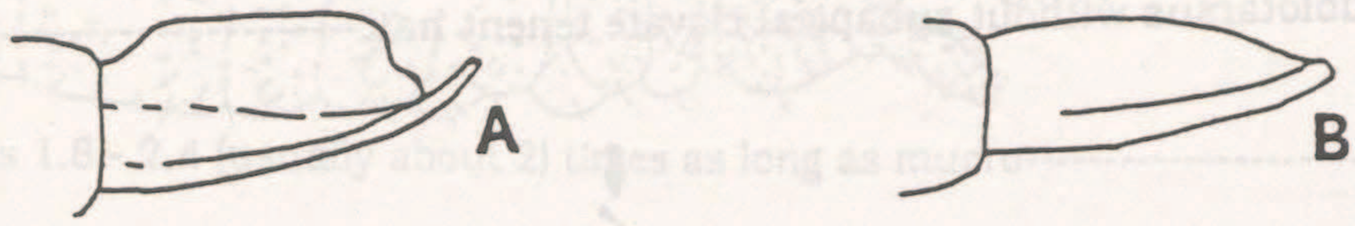
34



10) Mucro with lamella 1/2 as deep as long (Figure 35A)----------11

10') Mucro with lamella 1/3 or less as deep as long (Figure 35B)----------12

35



*11) Dens with 5 dorsal setae; third tibiotarsus with 3 tenent hairs----------H. viatica

11') Dens with 7 or more dorsal setae; third tibiotarsus with 2 tenent hairs (small specimens, see Fjellberg, 1985)----------H. sensilis

12) First tibiotarsus with 3 clavate tenent hairs----------13

12') First tibiotarsus with 1 or 2 clavate tenent hairs----------15

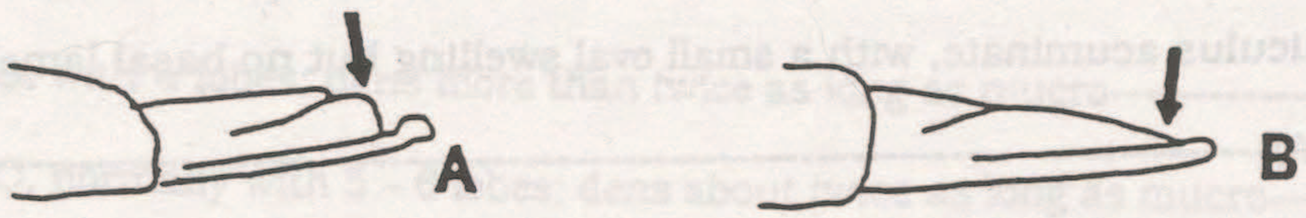
*13) Anal spines more than 1/3 as long as inner unguis----------H. humi

13') Anal spines less than 1/3 as long as inner unguis----------14

*14) Mucronal lamella apically truncate (Figure 36A)----------H. gami

*14') Mucronal lamella apically confluent with base (Figure 36B)----------H. perplexa

36

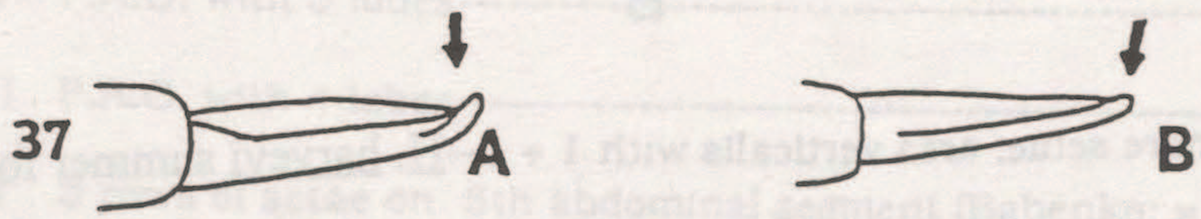


15) Apex of mucro upturned (Figure 37A)----------H. concolor

(=tullbergi of CONARG)

15') Apex of mucro straight (Figure 37B)----------16

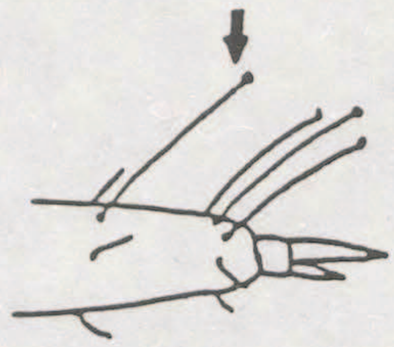
37



* 16) Third tibiotarsus with clearly clavate subapical tenent hair (Figure 38)----------

----------H. perplexa

16') Third tibiotarsus without subapical clavate tenent hair----------17



38

**17) Longest clavate tenent hair on third tibiotarsus more than 1.3 times as long as next longest hair----------H. antra

**17') Longest clavate tenent hair on third tibiotarsus 1.2 or less times as long as next longest----------18

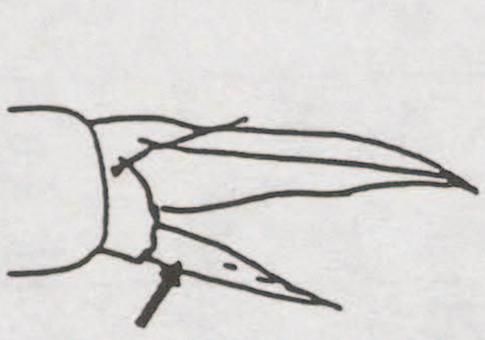
**18) Inner edge of unguis more than 2.5 times as long as anal spine----------H. helena

* 18') Inner edge of unguis less than twice as long as anal spine----------H. litoralis

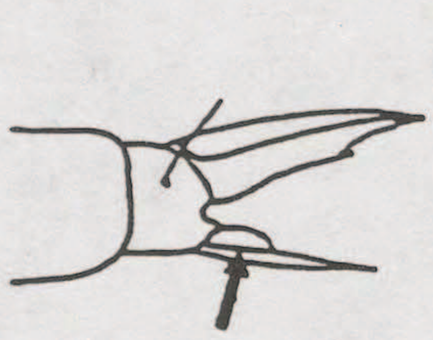
19) First unguiculus acuminate, with a small oval swelling but no basal lamella (Figure 39A)----------20

19') First unguiculus lamellate (Figure 39B)----------33

39



A



B

**20) Ventral tube with 8 or more setae; area verticalis with 1 + 1--H. harveyi summer form

20') Ventral tube with 4 + 4 setae; area verticalis with 2 + 2----------21

21) Th. II-Abd. III with lateral tubercles (Figure 39.1)------H. arctandria Fjellberg 1988c

21') Th. II-Abd. III without lateral tubercles----------22



39.1

22) Dens 1.8 - 2.4 (usually about 2) times as long as mucro----------23

22') Dens 2.5 - 5.0 (usally about 3) times as long as mucro----------26

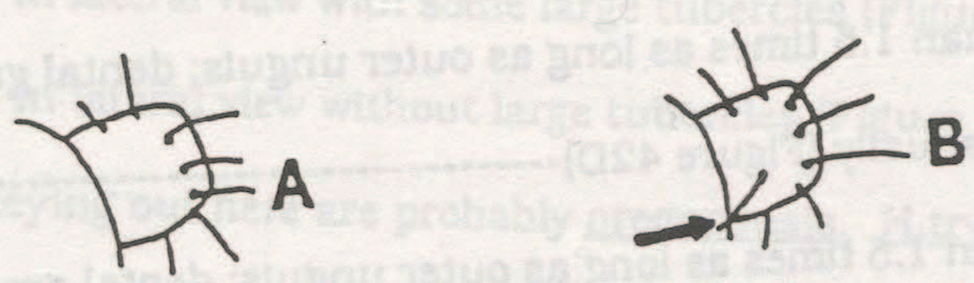
** 23) P.A.O. more than 2.5 times the diameter of the nearest eye----------H. brevispina

23') P.A.O. less than 2.2 times the diameter of the nearest eyes----------24

* 24) First antennal segment with 7 setae, i.e. supplementary "p" seta absent (Figure 40A)----------H. manubrialis

24') 1st antennal segment with 8 setae; supplementary"p"seta present(Figure 40B)--25

40



* 25) P.A.O. with 4 lobes; dens more than twice as long as mucro----------H. matura

**25') P.A.O. normally with 5 - 6 lobes; dens about twice as long as mucro---------H. essa*

**26) Dens about 5 times as long as mucro; P.A.O. of a single (?) tubercle--------H. tigrina

26') Dens 4 times as long as mucro or less; P.A.O. of 3 -4 lobes----------27

* 27) P.A.O. with 3 lobes----------H. utahensis

27') P.A.O. with 4 lobes----------28

**28) 3 rows of setae on 5th abdominal segment (Babenko: = vernalis)--H. christiansenI

28') 2 rows of setae on fifth abdominal segment----------29

* H. essa may be a synonym of pannosa (Fjellberg 1985a) but the P.A.O. generally separates the two forms. The latter species may be a synonym of assimilis (Babenko, pers. Comm.).

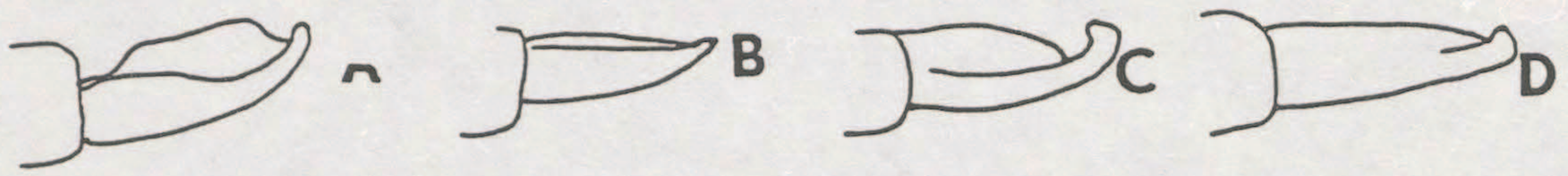
29) Anterior lobes of P.A.O. longer than posterior lobes (Figure 41A)----------30

29') Anterior and posterior lobes of P.A.O. subequal (Figure 41B)----------31

41 

*30) Mucro in side view with large lamella (Figure 42A)----------H. ripperi

30') Mucro in side view with small lamella (Figure 42B)----------H. promatro

42 

**31) Mucro in side view with broad lamella; uniform blue-black----------H. devia

31') Mucro (side view) with small lamella(Figure 42C or 42D)gray to dark blue--------32

*32) Tenent hair more than 1.5 times as long as outer unguis; dental granulations fine; mucro narrowed gradually (Figure 42D)----------H. matura

*32') Tenent hair less than 1.5 times as long as outer unguis; dental granulations coarse; mucronal lamella abruptly narrowed (Figure 42C)----------H. pannosa

33) Tenent hair acuminate----------34

33') Tenent hair clavate----------41

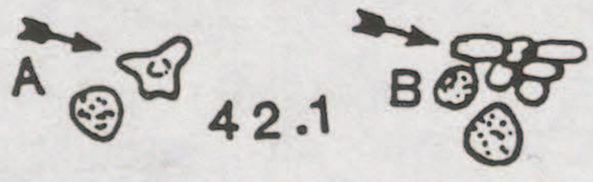
34) Mucro less than 1/3 as long as dens----------35

34') Mucro more than 1/3 as long as dens----------36

35) P.A.O. lobes blunt and hardly developed (Figure 42.1A)----------

----------H. (Mucrella) hibernica Fjellberg 1987c

35') P.A.O. lobes elongate (Figure 42.1B)----------H. (Ceratophysella) gibbosa

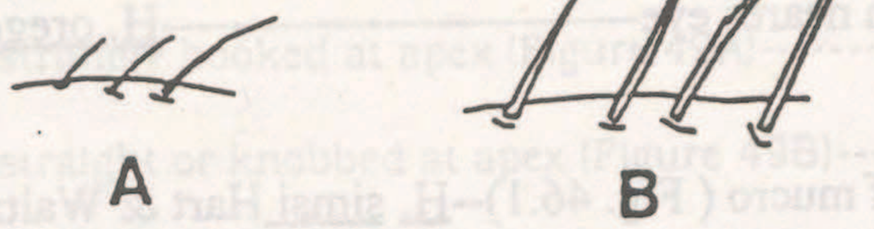


42.1

36) Body setae short and curving (Figure 43A)----------37
(some oregonensis will run here)

36') Body setae straight, long, and spinelike (Figure 43B)----------38

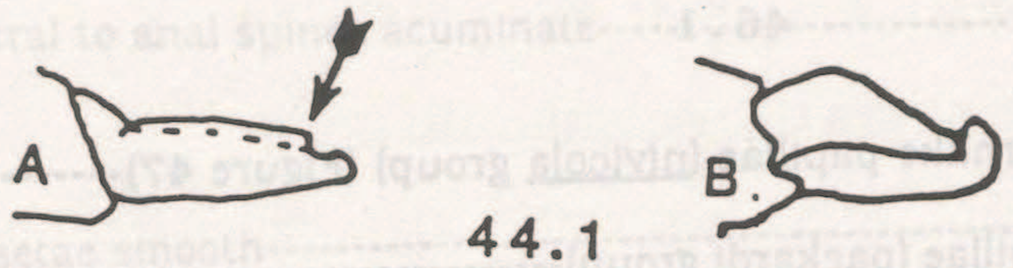
43



37) Mucro with angular lateral lamella (Figure 44.1A)----------

----------H. (Mucrella) denali Fjellberg1985

37') Mucro without angular lateral lamella (Figure 44.1B)----------H. maynardi



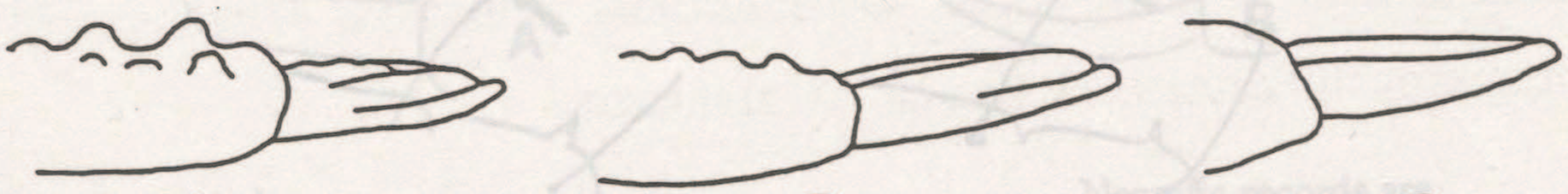
44.1

38) Apex of dens in lateral view with some large tubercles (Figure 45A, B)----------39

38') Apex of dens in lateral view without large tubercles (Figure 45C)---------H. tryboml

(specimens keying out here are probably oregonensis. H.tryboml may not occur in the Nearctic - see Fjellberg 1985).

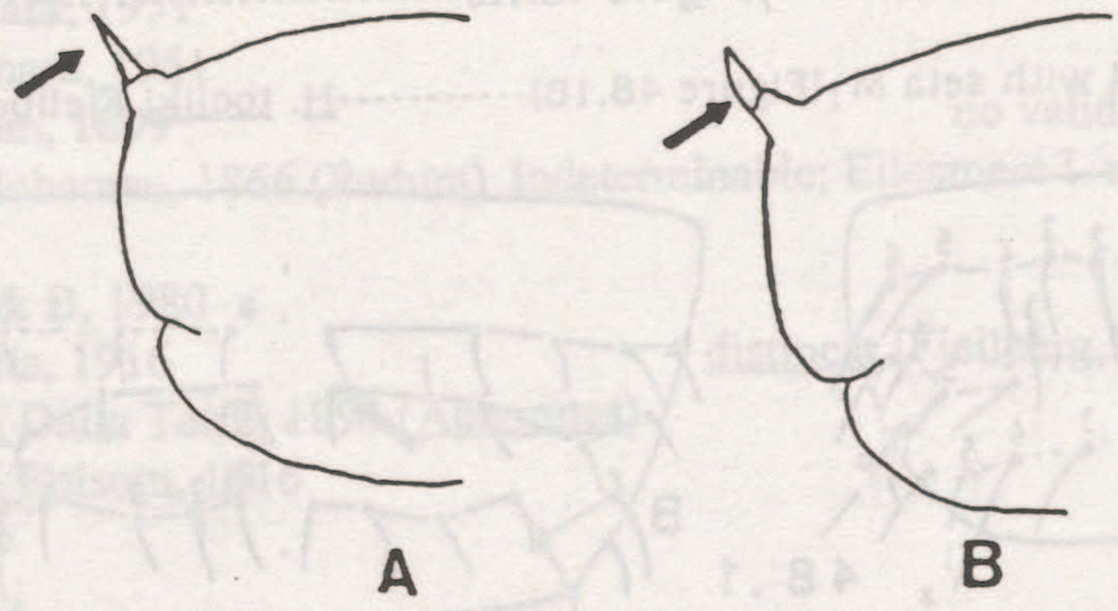
45



**39) Anal spines more than 1.5 times as long as papillae (Figure 46A)----------H. lima

39') Anal spines shorter than or subequal to papillae (Figure 46B)----------40

46

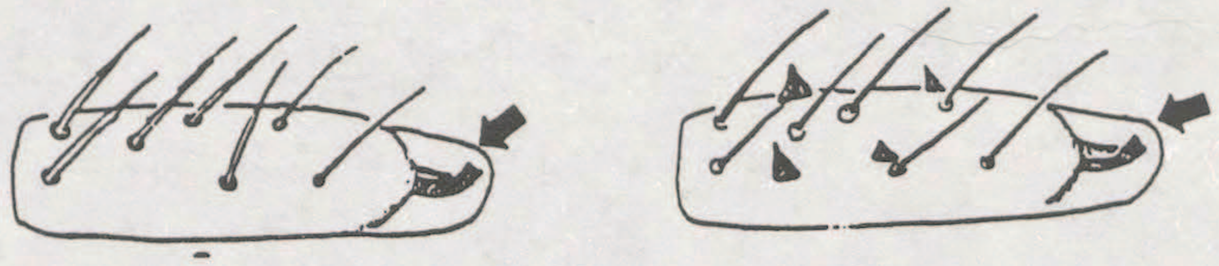


*40) P.A.O. about twice as long as nearest eye----------H. irenae

*40') P.A.O. only slightly longer than neares eye----------H. oregonensis

41) Dens projecting beyond apex of mucro (Fig. 46.1)--H. simsi Hart & Waltz 1995

41') Dens not projecting beyond apex of mucro----------42



46.1

42) Dens with striking thornlike papillae (nivicola group) (Figure 47)----------43

42') Dens without clear papillae (packardi group)---------- 46

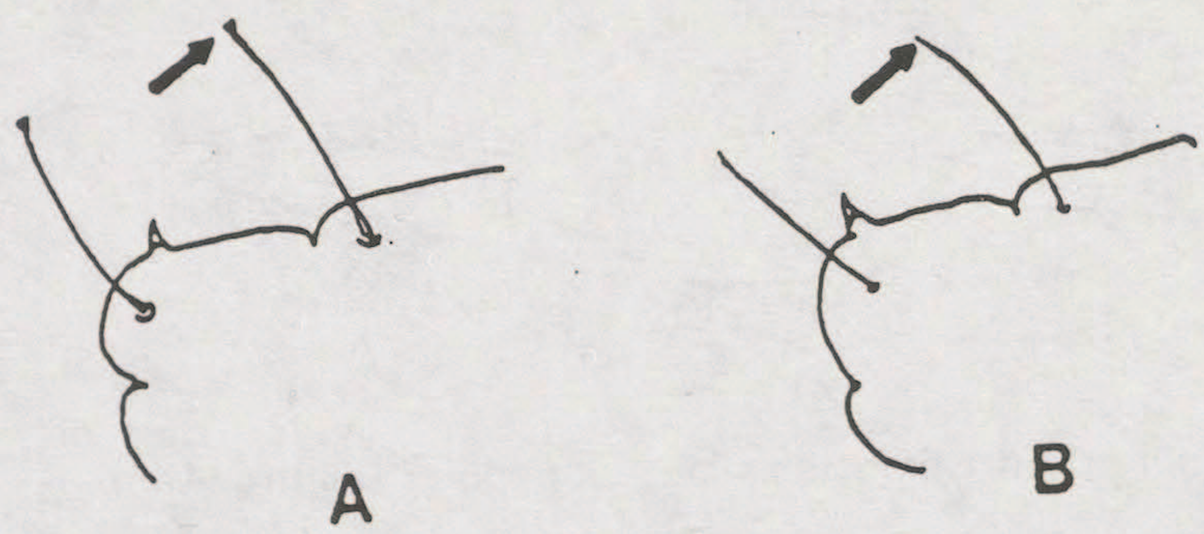
** 43) Length of anal spines at least 1/2 length of inner unguis----------H. harveyi

43') Length of anal spines less than 1/2 that of inner unguis----------44

**44) With capitate abdominal setae (Figure 48A)----------packardi (winter form)

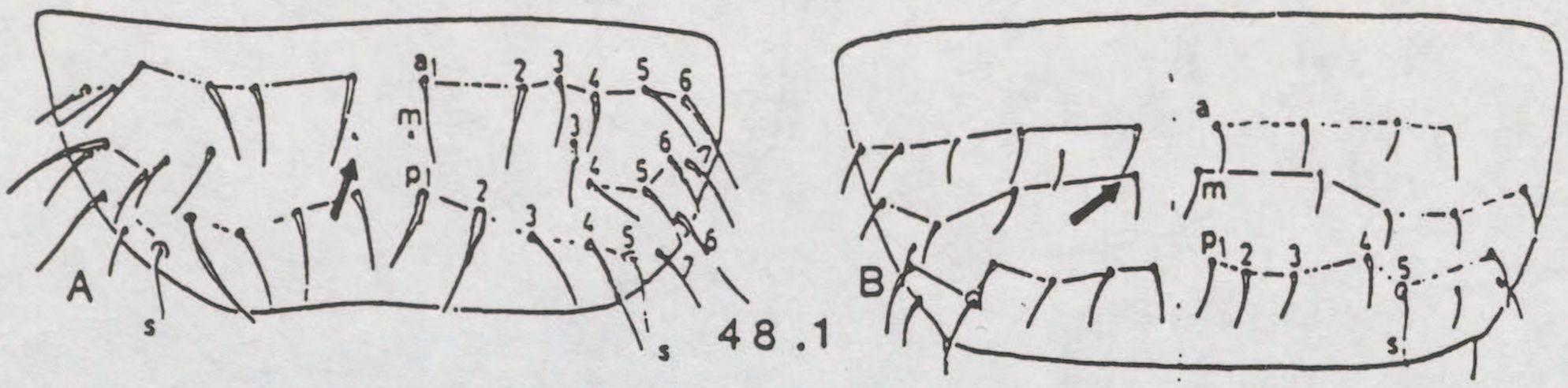
44') Without capitate abdominal setae (Figure 48B)---------- 45

48



45) Abdominal segment 4 without seta M_1 (Figure 48.1A)----------H. nivicola

45') Abdominal segment 4 with seta M_1 (Figure 48.1B)----------H. tooliki Fjellberg 1985



48.1

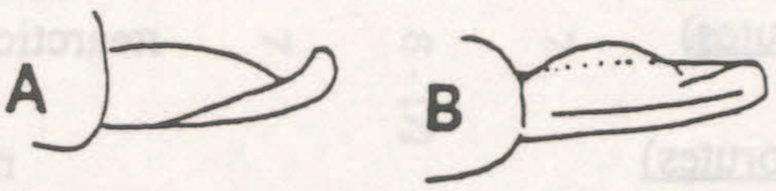
46) P.A.O. smaller than nearest eye---------- 47

46') P.A.O. subequal to or larger than nearest eye---------- 48

47) Mucro strongly hooked at apex (Figure 49A)----------H. macrotuberculata

47') Mucro straight or knobbed at apex (Figure 49B)----------H. copiosa

49



48) Setae lateral to anal spines knobbed (Figure 48A)----------H. packardi

48') Setae lateral to anal spines acuminate---------- 49

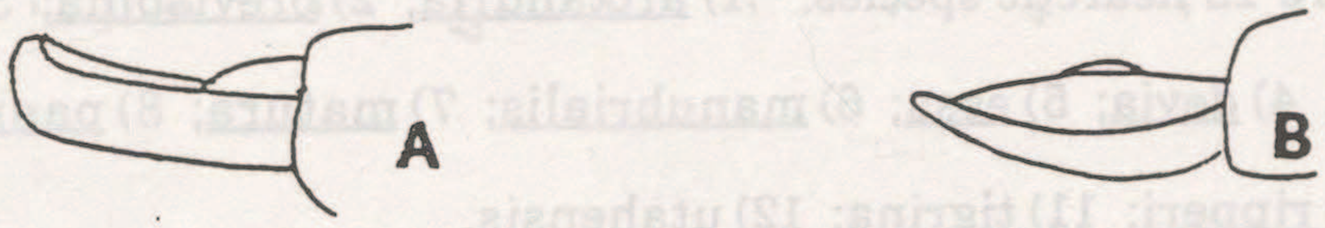
49) All body setae smooth----------H. funesta

49') Some body setae serrate---------- 50

50) Mucro trough-shaped (Figure 50A)----------H. madera

50') Mucro lamellate (Figure 50B)----------H. sparta

50



Not included in key

Nearctic records are

albamaculata Scott, 1960 Xenylla, =pallescens?]

assimilis Krausbauer, 1898 (Achorutes) valid name for devia, essa, & pannosa?

dentata Folsom, 1902 = packardi

diversiceps Lintner, 1896 = nivicola

**essa C & B, 1980 = assimilis?

furcata Maynard, 1951 = packardi

**gigas Maynard, 1951 = copiosa

gracilis Folsom, 1899 no valid nearctic record

hyperborea Boheman, 1866 (Podura) indeterminable; Ellesmere I. record may be a Ceratophysella

**indiana C & B, 1980 = harveyi

itaya Kinoshita, 1916 = distincta [Fjellberg,1985;Babenko,1994]

macgillivrayi Dalla Torre, 1895 (Achorutes) = Proisotoma

macgillivrayi Folsom, 1916 = perplexa

montana Maynard, 1951	= maynardi
neomexicana Scott, 1961 (Biacanthella)	= oregonensis?
notha Macnamara, 1922 (Achorutes)	= packardi (winter form)
pannosa Macnamara, 1922	= assimilis
punctata Coleman, 1941 (Achorutes)	indeterminable, types lost
reticulata Börner, 1909	no valid nearctic record
schneideri Schaeffer, 1896 (Achorutes)	nearctic record = copiosa
schoetti Reuter, 1895 (Achorutes)	nearctic record = matura
socialis Uzel, 1891 (Achorutes)	nearctic records = nivicola
spitsbergensis Stach, 1962	= tullbergi
theeli Tullberg, 1876 (Achorutes)	no valid nearctic record
thomomys Chamberlain, 1943 (Achorutes)	= Mesachorutes
** ulmea Maynard, 1951	= copiosa
vernalis Carl, 1901 (Achorutes)	no valid Nearctic record

Hypogastrura (H.) manubrialis group

In addition to the characters in Table III, members of this group have the P.A.O. usually distinctly larger than nearest eye; anal spines always small; apical bulb of fourth antennal segment always present and single; and ventral tube with 4 + 4 setae.

There are 12 nearctic species:" 1) arctandria; 2) brevispina; 3) christianseni; 4) devia; 5) essa; 6) manubrialis; 7) matura; 8) pannosa; 9) promatro; 10) ripperi; 11) tigrina; 12) utahensis.

Remarks

This is a singularly difficult group. The European forms of the group are also very confusing (see Gisin, 1952). The key in its present form is highly problematic. A table to some of the significant features of the group is given below. One notable omission from the key is H. assimilis. Babenko (pers. communication) believes that both H. essa and H. pannosa are synonyms of this species. Further study is needed to clarify this question.

TABLE IV

Summary of Specific Characteristics of Nearctic Members of the Hypogastrura manubrialis Group

species	P.A.O./ nearest eye	dental setae	mucro/ dens	anal spines/ inner unguis	anal spines/ papillae	M setae, abd. 5	M_2 setae, abd. 4	M_3 setae, abd. 4	tenent hair/outer unguis	P.A.O. lobes (normal)
AA. (Texas)	1.6/1-2.0/1	7	1/2.3-1/3	1/2.5-1/3	-	-	-	+	10/15-10/11	4
arctandria	1.5/1	7	1/2.5-1/3	1	?	-	-	+	8/10?	(3)4(5)
BB. (Alberta)	5/11-5/8	7	-2/5	-2/7	-11/9	-	-	+	10/13-10/12	4
brevispina	2.6/1-3/1	6 or 7	-1/2.1	1/4	3/1	-	?	?	-	4 (5)
christianseni	7/5	6	1/2.9-1/3.3	1/3.5	-	+	-	+	7/6-10/9	4
devia	2/1-3/2	7	1/2.5-1/3.2	1/3-1/4	3/2-2/1	-	+	+	--10/9	4
essa	3/2	6-(7)	1/1.8-1/2.2	1/7-1/4	3/2-2/1	-	-	+-	11/9	5-6
manubrialis	2/1	7	1/1.8-1/2.1	1/5-1/7	-	-	-	+	-	4
matura	2/1	?	1/2.3-1/2.6	1/4?	-?	-?	+?	+?	8/5	4
pannosa	8/5	7	1/3-1/2.2	1/3.7	-	-	+-	+	5/4	4
promatro	2/1	7	1.3(?)	1/4-1/3	-	?	?	?	10/11	4
ripperi	2/1	7	1/3	1/5-1/3	3/1-2/1	-	-	+	--3/4	4(5)
tigrina	1/3	5	1/2.4-1/3	1/6-1/7	-	-?	?	?	4/3-5/3	0
utahensis	5/4	6/7	1/3	1/3	3/2	+	-	+	11/9	3

Numbers in parentheses represent exceptional conditions

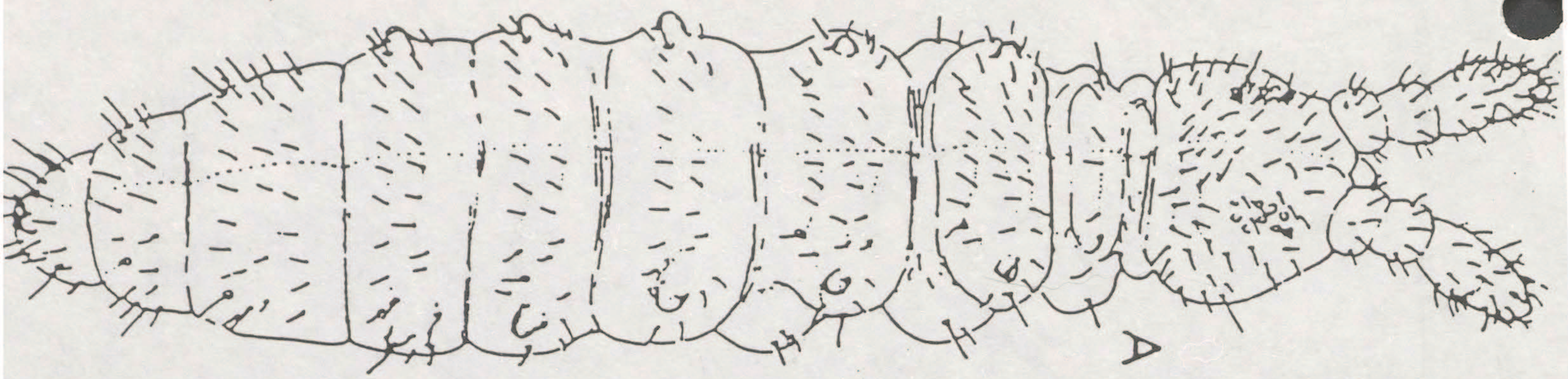


Figure 50.1 A-E. Hypogastrura arctandria. Fjellberg. A. Dorsal chaetotaxy. B. Right maxilla. C. Right P.A.O. and ocelli. D. Tip of right foreleg. E. Right dens and mucro, lateral and ventral. After Fjellberg 1988

Hypogastrura (H.) brevispina (Harvey), 1983 Fig. 51

Refs.: Ent. News 4: 182 (Achorutes); Folsom, 1916

Description

Color: cream yellow above, with pale purple patches and streaks; dorsum with several interrupted stripes. P.A.O. with elongate elliptical lobes, 2.6 times as long as nearest eye. Dens about 2 times as long as mucro. Anal spines 1/4 - 2/5 as long as inner unguis and 3 times papillae. Supplementary p seta present on antennal segment 4. Fifth abdominal segment lacking m setae. Maximum length: 1.60 mm.

If we rely on Folsom's description, this species is clearly separable from all others of the group by the large and unusually shaped P.A.O. In a number of respects it resembles the form we have identified as ripperi; however the extreme size of the P.A.O. and the relative sizes of the mucro and dens justify their separation at present. Two type specimens were seen but they showed little detail.

Type locality: Orono, Maine

Additional records: : California (D.B. Scott, 1942); Michigan (Snider, 1967); , New York (Maynard, 1951); North Carolina (Wray, 1967).

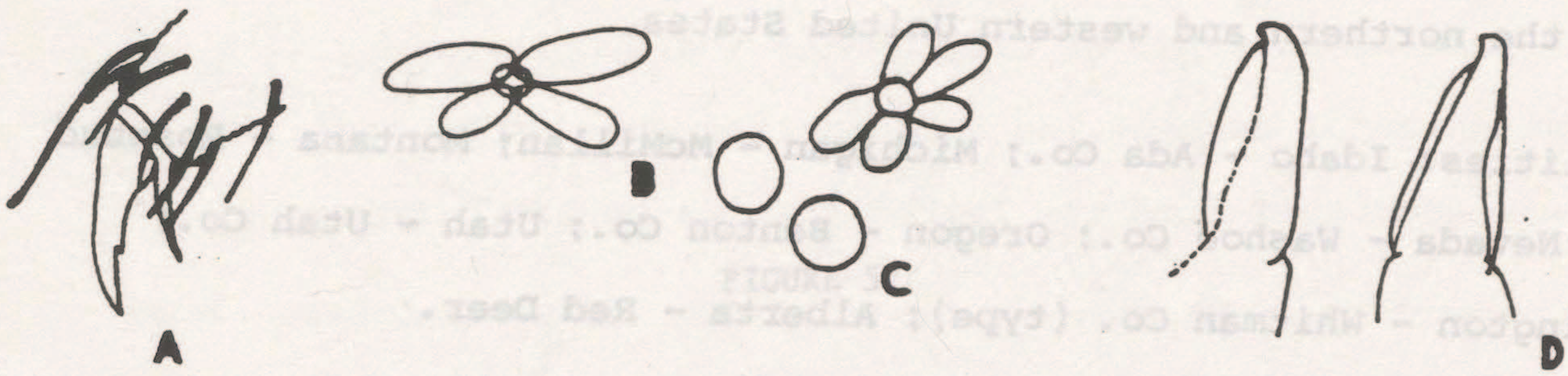


FIGURE 51

B) Postantennal organ.

C) Postantennal organ and eyes.

D) Mucrones.

Hypogastrura (Hypogastrura) brevispina

All figures after Folsom.

A) Forefoot complex.

Hypogastrura (H.) christianseni Yosii, 1960 Fig. 52

Ref.: Am. Midl. Nat. 64: 269

Description

Color: blackish gray to blue-black, paler ventrally. Fourth antennal segment with 6 - 8 blunt setae. Supplementary "p" seta

lacking on first antennal segment. P.A.O. about 7/5 as large as nearest eyes. Dens 2.9 - 4.0 times as long as mucro. Anal spines 1/3 - 1/5 inner unguis and subequal to or slightly smaller than papillae. Integument uniformly granulate, granules 6 - 8 micra in diameter. All body setae acuminate. Fifth abdominal segment with 1 (rarely 2) pairs of m setae. Maximum length 2.4 mm.

Remarks

The fifth abdominal segment chaetotaxy serves to separate this species from all forms of the group except utahensis. The P.A.O. and position of the fifth abdominal segment m setae distinguish these two species. The only records of christianseni to date are from the northern and western United States.

Localities: Idaho - Ada Co.; Michigan - McMillan; Montana - Rosebud Co.; Nevada - Washoe Co.; Oregon - Benton Co.; Utah - Utah Co.; Washington - Whitman Co. (type); Alberta - Red Deer.

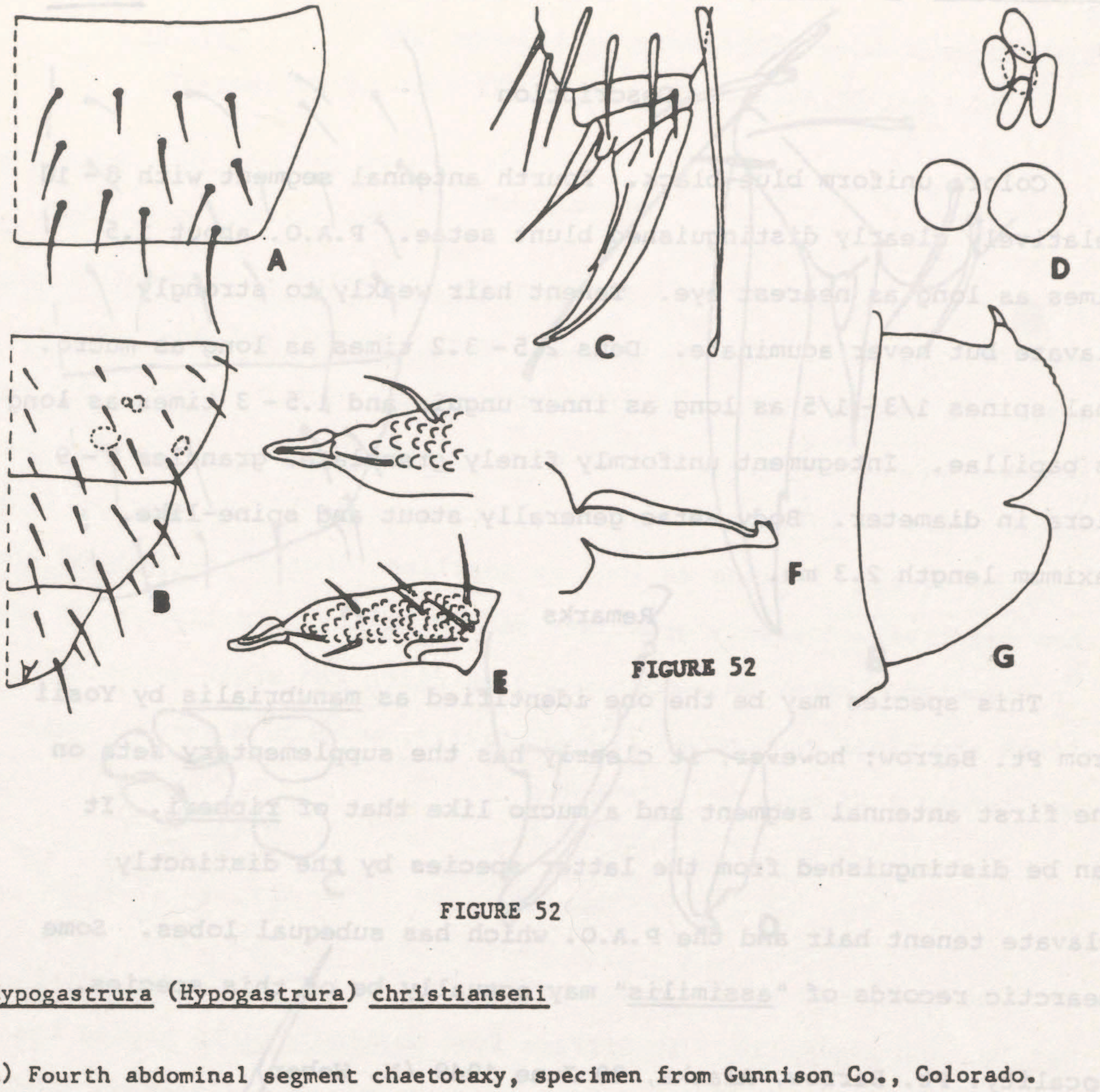


FIGURE 52

FIGURE 52

Hypogastrura (Hypogastrura) christianseni

A) Fourth abdominal segment chaetotaxy, specimen from Gunnison Co., Colorado.

B) Chaetotaxy, after Yosii.

C) Foot complex, after Yosii.

D) Postantennal organ and nearest eye, after Yosii.

E) Mucrones and dens, after Yosii.

F) Mucro, specimen from Utah Co., Utah.

G) Lateral view of sixth abdominal segment, after Yosii.

Description

Color: uniform blue-black. Fourth antennal segment with 8 - 10 relatively clearly distinguished blunt setae. P.A.O. about 1.5 times as long as nearest eye. Tenent hair weakly to strongly clavate but never acuminate. Dens 2.5 - 3.2 times as long as mucro. Anal spines 1/3 - 1/5 as long as inner unguis and 1.5 - 3 times as long as papillae. Integument uniformly finely granulate, granules 7 - 9 micra in diameter. Body setae generally stout and spine-like. Maximum length 2.3 mm.

Remarks

This species may be the one identified as manubrialis by Yosii from Pt. Barrow; however, it clearly has the supplementary seta on the first antennal segment and a mucro like that of ripperi. It can be distinguished from the latter species by the distinctly clavate tenent hair and the P.A.O. which has subequal lobes. Some nearctic records of "assimilis" may actually be of this species.

Type locality: Pt. Barrow, Alaska, 30 June 1949 (N. Weber).

FIGURE 53

Hypogastrura (Hypogastrura) devia

All figures of types.

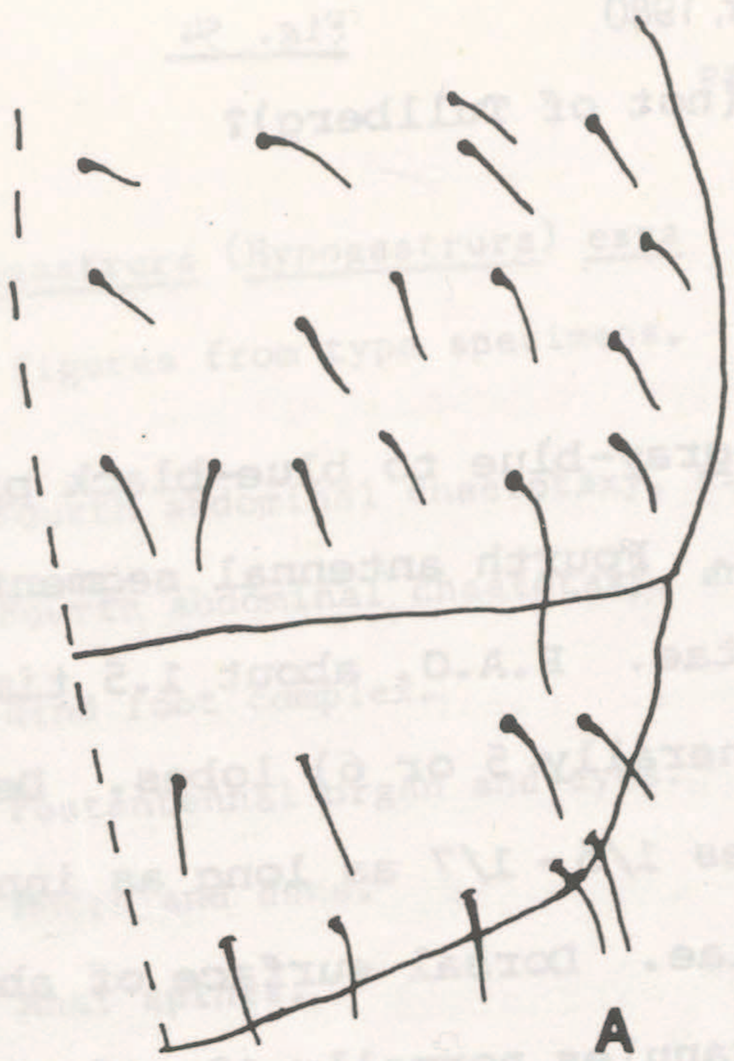
A) Chaetotaxy of right side of fourth and fifth abdominal segments.

B) Hind foot complex.

C) Postantennal organ and nearest eyes.

D) Mucrones.

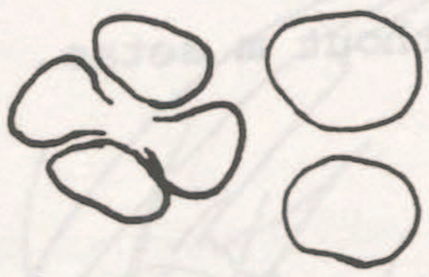
E) Dens and mucro.



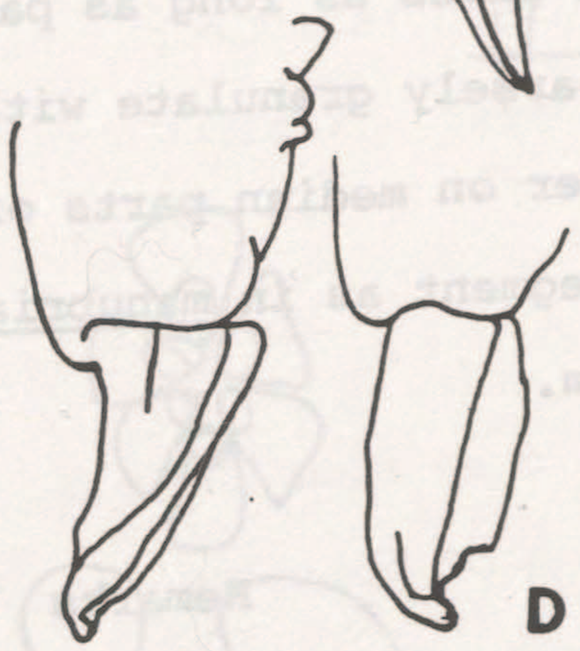
A



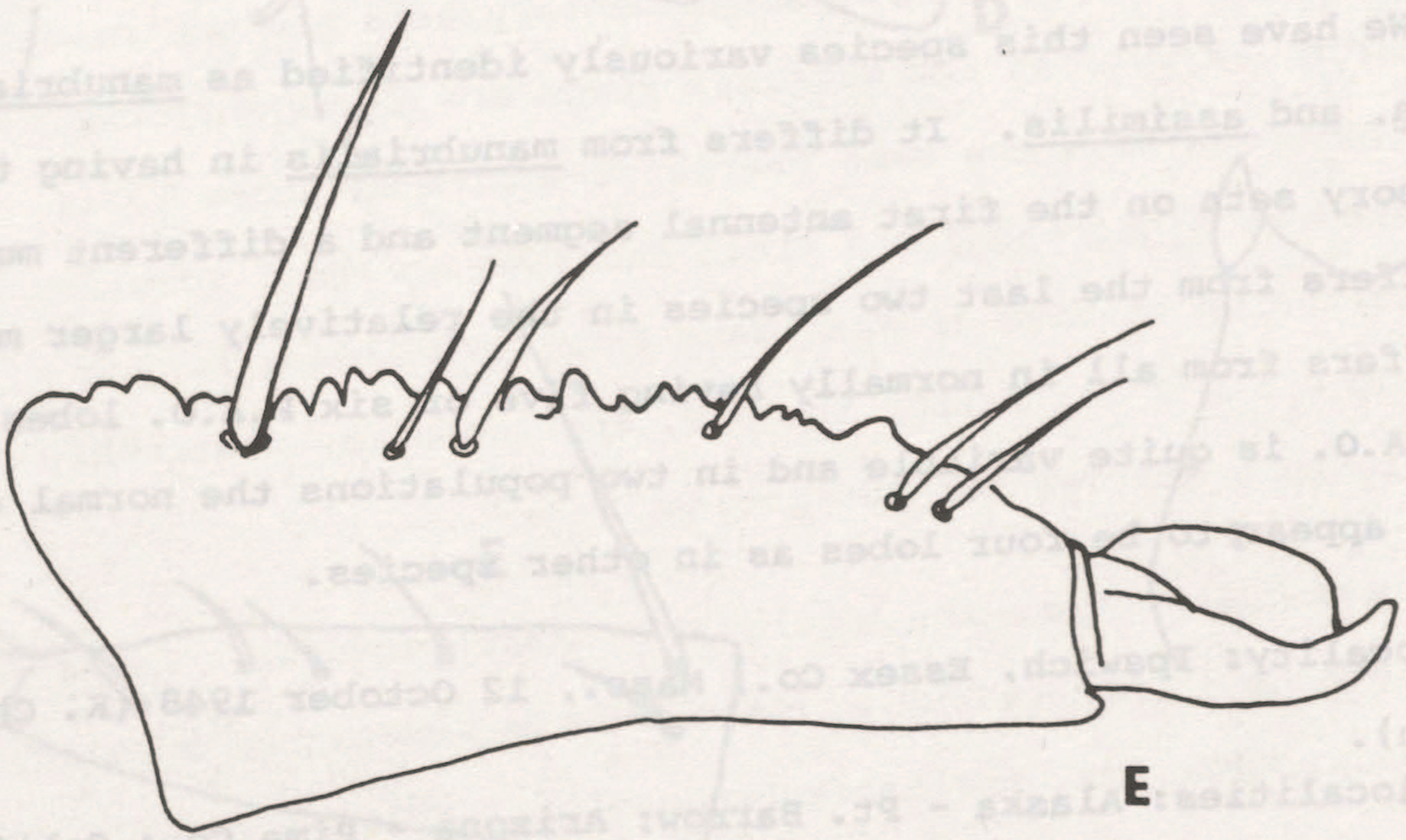
B



C



D



E

Hypogastrura (H.) essa, Christiansen & Bellinger, 1980 Fig. 54

Syn.: manubrialis of Maynard, 1951 (not of Tullberg)?

Description

Color: background dull yellow with gray-blue to blue-black pigment heavily speckled over body and head. Fourth antennal segment with 6 - 8 weakly differentiated blunt setae. P.A.O. about 1.5 times as long as nearest eye and with 3 - 6 (generally 5 or 6) lobes. Dens about twice as long as mucro. Anal spines 1/5 - 1/7 as long as inner unguis and 1.5 - 2 times as long as papillae. Dorsal surface of abdomen relatively coarsely granulate with granules normally 10 - 16 micra in diameter, larger on median parts of fifth and sixth segments. Fifth abdominal segment as in manubrialis, without m setae. Maximum length 1.55 mm.

Remarks

We have seen this species variously identified as manubrialis, matura, and assimilis. It differs from manubrialis in having the accessory seta on the first antennal segment and a different mucro. It differs from the last two species in the relatively larger mucro. It differs from all in normally having five or six P.A.O. lobes. The P.A.O. is quite variable and in two populations the normal condition appears to be four lobes as in other species.

Type locality: Ipswich, Essex Co., Mass., 12 October 1948 (K. Christiansen).
Other localities: Alaska - Pt. Barrow; Arizona - Pima Co.; California - Los Angeles Co., Sacramento Co., Tulare Co.; Illinois - Davies Co.; Iowa - Powesheik Co.; Kansas - Harrington.

FIGURE 54

Hypogastrura (Hypogastrura) essa

All figures from type specimens.

A) Fourth abdominal chaetotaxy, right side.

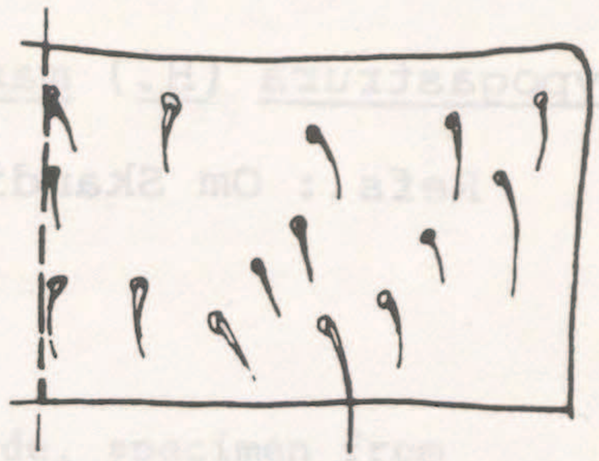
B) Fourth abdominal chaetotaxy, another specimen.

C) Hind foot complex.

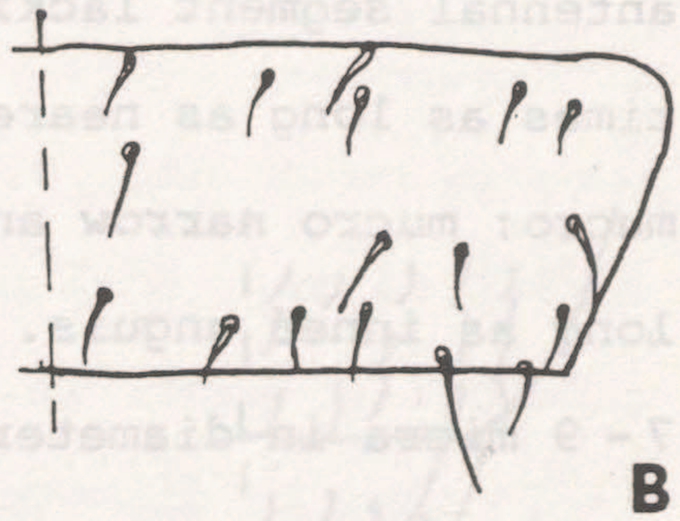
D) Postantennal organ and eyes.

E) Mucro and dens.

F) Anal spines.



A



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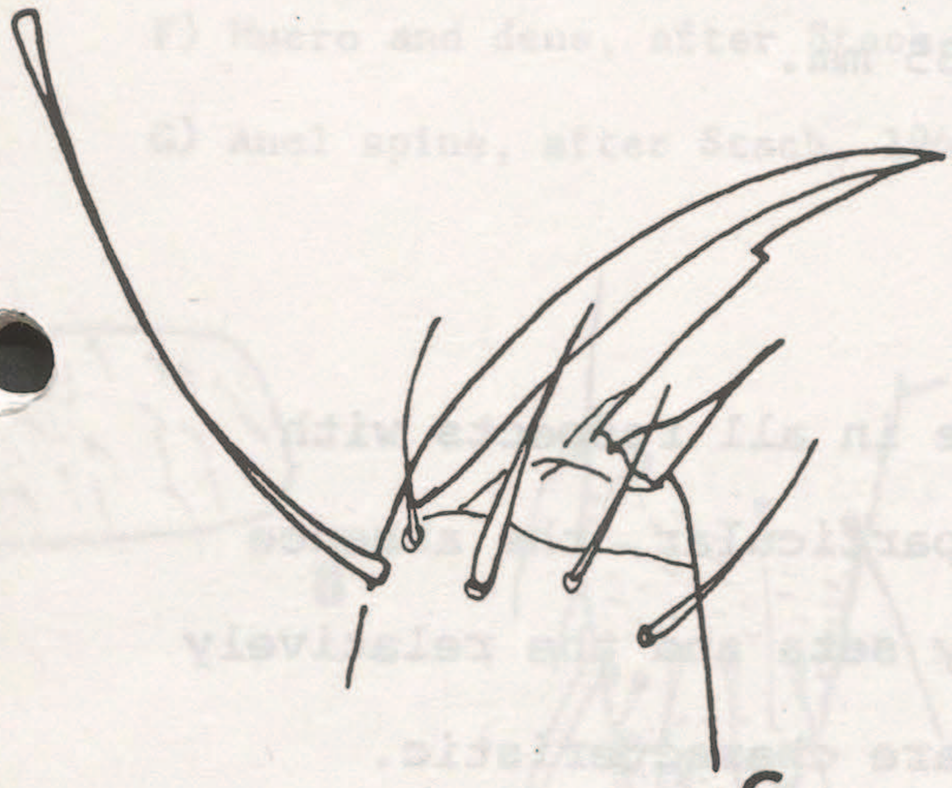

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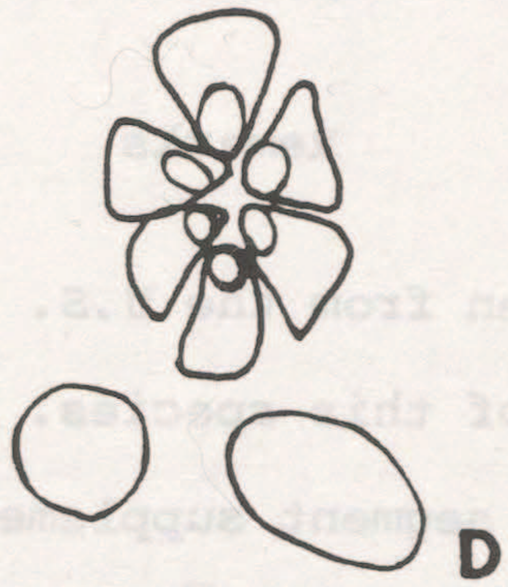

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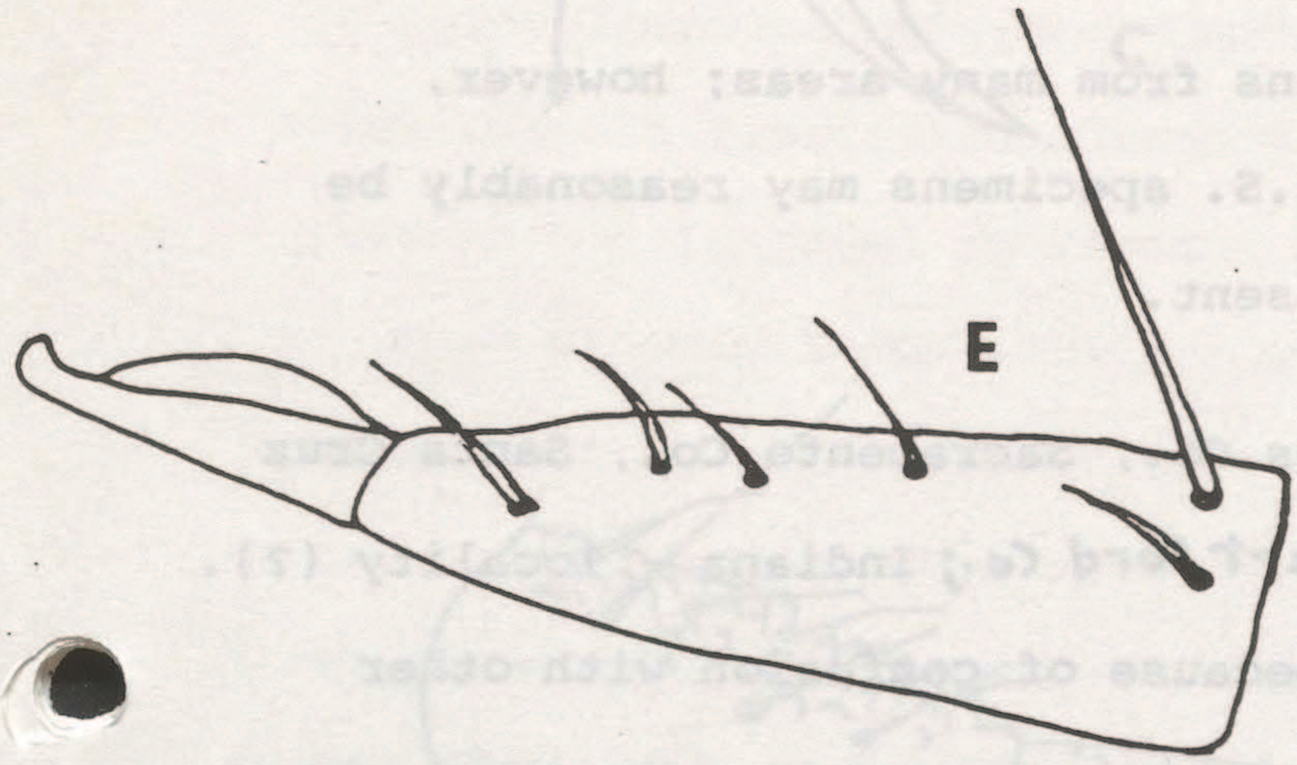

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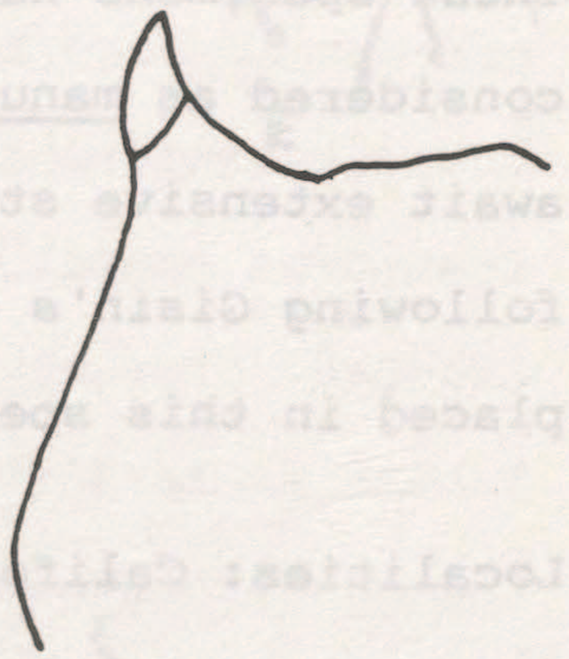


F

Hypogastrura (H.) manubrialis Tullberg, 1869 Fig. 55

Refs.: Om Skandinaviska Podurider: 9 (Achorutes); Gisin, 1952, 1960

Description

Color: gray-blue, red-violet, or dark blue with paler color below. Fourth antennal segment with 6 - 9 blunt setae. First antennal segment lacking supplementary seta. P.A.O. about two times as long as nearest eyes. Dens about 2 times as long as mucro; mucro narrow and sharply pointed. Anal spines 1/5 - 1/7 as long as inner unguis. Integument uniformly granulate, with granules 7 - 9 micra in diameter. Maximum length 1.85 mm.

Remarks

The specimens seen from the U.S. agree in all respects with Gisin's redefinition of this species. In particular, the absence of the first antennal segment supplementary seta and the relatively large mucro as well as the mucronal shape are characteristic. These specimens have the same labral structure as those Yosii considered as manubrialis. A final decision on their identity will await extensive studies of specimens from many areas; however, following Gisin's definition the U.S. specimens may reasonably be placed in this species for the present.

Localities: California - Los Angeles Co., Sacramento Co., Santa Cruz Co., Tulare Co.; Connecticut - Hartford Co.; Indiana - locality (?). Published records are unreliable because of confusion with other species.

FIGURE 55

Hypogastrura (Hypogastrura) manubrialis

A) Fourth and fifth abdominal segment chaetotaxy, right side, specimen from Stanislaus Co., California.

B) Second thoracic segment chaetotaxy, specimen from Sacramento Co., California.

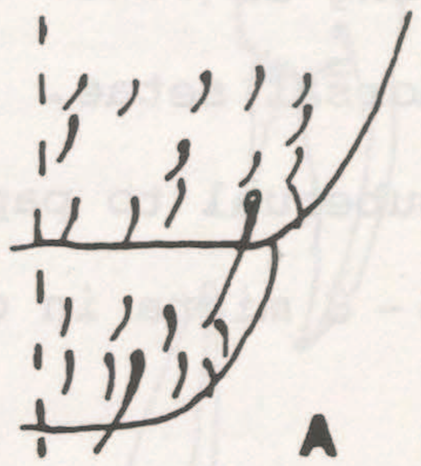
C) Hind foot complex, after Stach.

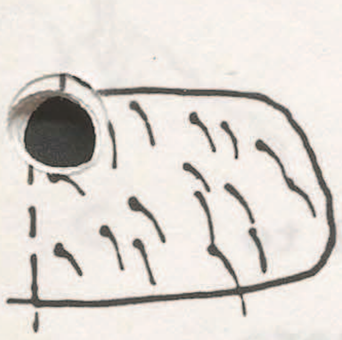
D) Eyes and postantennal organ, after Stach, 1949a.

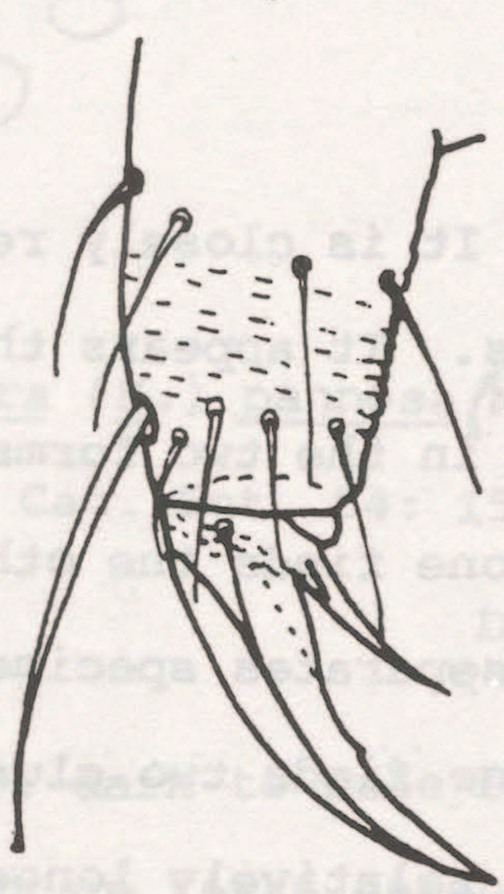
E) Antennal apex, after Stach, 1949a.

F) Mucro and dens, after Stach, 1949a.

G) Anal spine, after Stach, 1949a.

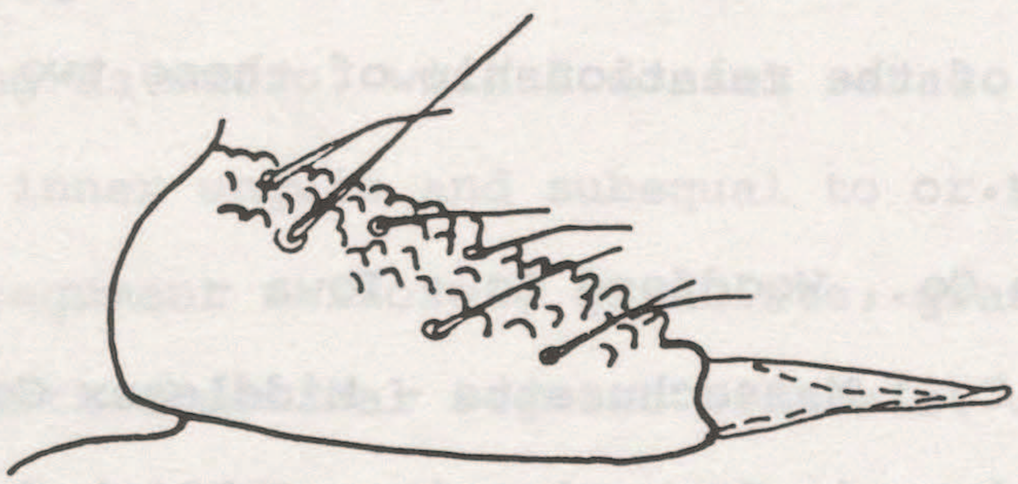














Hypogastrura (H.) matura (Folsom), 1916 Fig. 56

Ref.: Proc. U.S. Natn. Mus. 50: 481 (Achorutes)

Syn.: Achorutes schoetti of Guthrie, 1903, not of Reuter

Description

Color: gray-blue to grayish, paler underneath. Fourth antennal segment with 8 blunt setae. Accessory seta present on first antennal segment. P.A.O. about 2 times as long as nearest eye, with subequal lobes. Tenent hair prominent, at least 1.5 times as long as outer unguis. Dens 2.5 times as long as mucro, with 7 dorsal setae. Anal spines about ¼ as long as inner unguis and subequal to papillae. Integument uniformly granulate, granules 6 - 8 micra in diameter. Maximum length 1.9 mm.

Remarks

This is a most problematic species. It is closely related to pannosa and in fact may well be synonymous. It appears that there are two phenotypes, which are quite mixed in the two forms. If one separates the two on any one feature one finds the others present in both forms. Generally if one separates specimens on the relative length of the tenent hair, one finds two clusters of features: dental tubercles smaller, mucro relatively longer, color grayish, s.s. on fourth abdominal segment p_4 (matura); or dental tubercles larger, mucro relatively shorter, color blue, s.s. p_5 (pannosa). Final determination of the relationship of these two forms will require further study.

Localities: Illinois - Champaign Co., Woodford Co.; Iowa - Poweshiek Co.; Kansas - Douglas Co.; Massachusetts - Middlesex Co.; Minnesota; Missouri - Perry Co. (cave); Pennsylvania. Published records dubious. Biology: Christiansen, 1967.

FIGURE 56

Hypogastrura (Hypogastrura) matura

A) Dorsal chaetotaxy, right side, fourth abdominal segment, specimen from Middlesex Co., Massachusetts.

B) Hind foot complex, after Folsom.

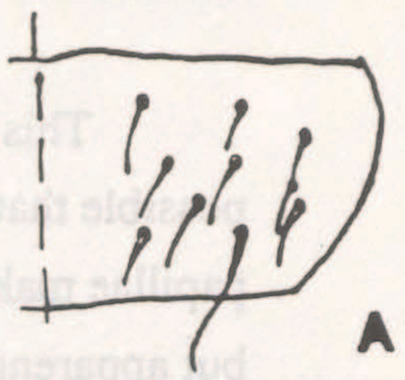
C) Apical bulb of fourth antennal segment, specimen form same locality as A.

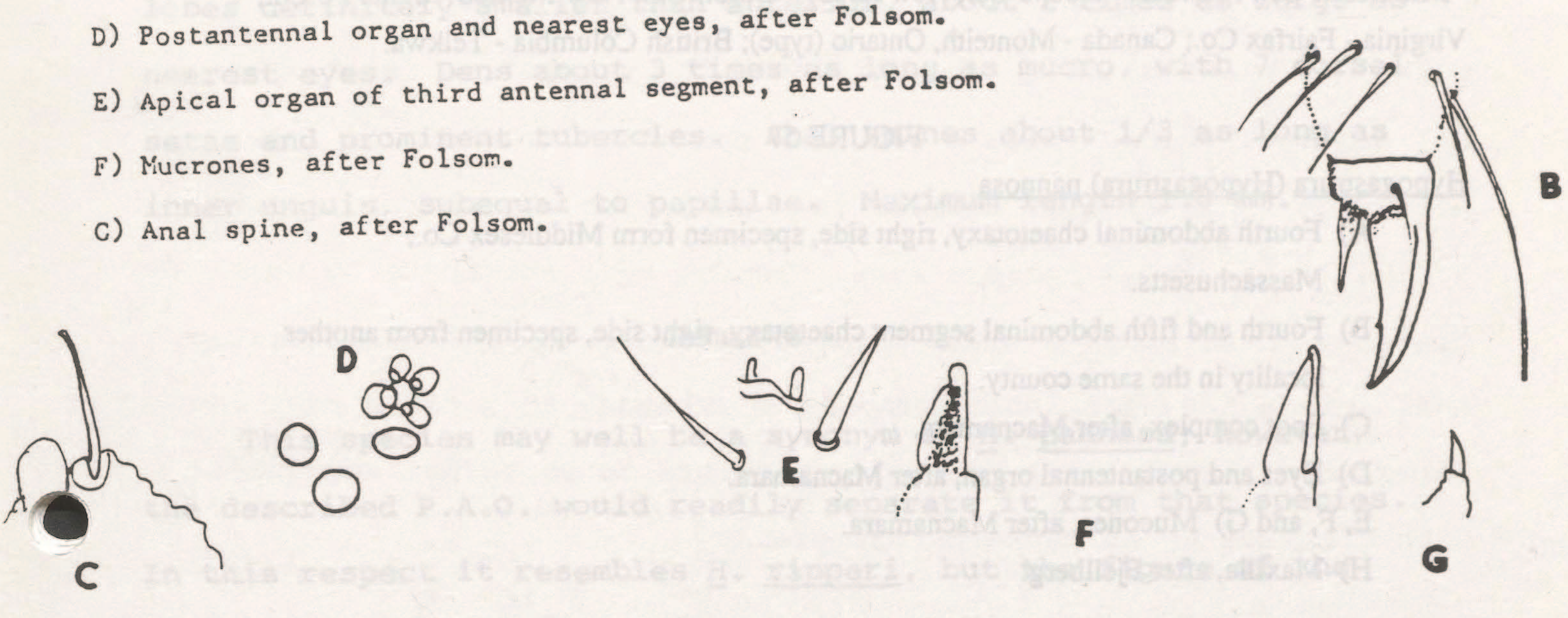
D) Postantennal organ and nearest eyes, after Folsom.

E) Apical organ of third antennal segment, after Folsom.

F) Mucrones, after Folsom.

G) Anal spine, after Folsom.





Hypogastrura (H.) pannosa (Macnamara), 1922 Fig. 57

Ref.: Can. Ent. 54: 153 (Achorutes)

Description

Color: dark to pale blue, underparts paler. Accessory seta "p" present on first antennal segment. P.A.O. with lobes subequal and about 8/5 as large as nearest eyes. Tenent hair about 1¼ as long as outer unguis or a little shorter. Dens 2.4 - 3 times as long as mucro, with 7 dorsal setae. Anal spines 1/3 - 1/5 as long as inner unguis and subequal to or slightly smaller than papillae. Integument uniformly granulate, granules 7 - 8 micra in diameter. Fourth abdominal segment with s.s. usually p_5. Fifth abdominal segment without m setae. Long setae anteriorly rough or very weakly serrate. Maximum length 2.3 mm.

Remarks

This species may well be a synonym of matura (see remarks under that species). It is also possible that this is the same as essa; however, the mucronal form and subequal anal spines and papillae make this unlikely. H. pannosa resembles the European H. vernalis (Carl) very closely, but apparently differs in chaetotaxy (Gama, 1964). One New Jersey specimen has 5 P.A.O tubercles.

Localities: Alaska - Pt. Barrow; Iowa - Powesheik Co.; Kentucky - Woodford Co.; Massachusetts - Middlesex Co.; Missouri - Boone Co.; New Jersey - Union Co.; New Mexico - Sante Fe Co.; Virginia - Fairfax Co.; Canada - Monteith, Ontario (type); British Columbia - Telkwa.

FIGURE 57

Hypogastrura (Hypogastrura) pannosa

A) Fourth abdominal chaetotaxy, right side, specimen form Middlesex Co., Massachusetts.

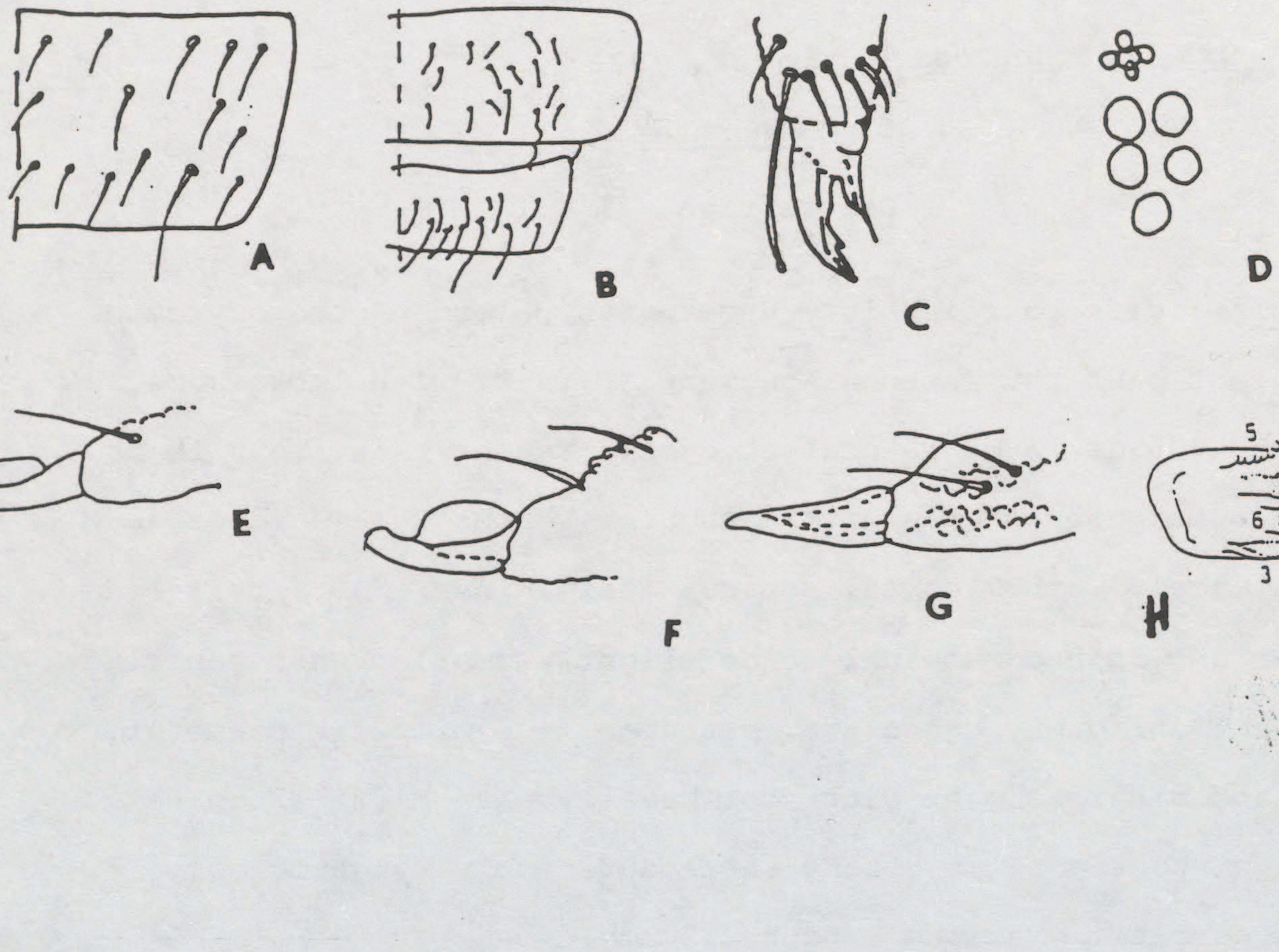
B) Fourth and fifth abdominal segment chaetotaxy, right side, specimen from another locality in the same county.

C) Foot complex, after Macnamara.

D) Eyes and postantennal organ, after Macnamara.

E, F, and G) Mucones, after Macnamara.

H) Maxilla, after Fjellberg.



Hypogastrura (H.) promatro (Wray), 1950 Fig. 58

Ref.: Bull. Brooklyn ent. Soc. 45: 94 (Achorutes)

Description

Color: light grayish to grayish blue; sometimes grayish red, speckled with reddish purple around spots. P.A.O. with posterior lobes definitely smaller than anterior, about 2 times as large as nearest eyes. Dens about 3 times as long as mucro, with 7 dorsal setae and prominent tubercles. Anal spines about 1/3 as long as inner unguis, subequal to papillae. Maximum length 1.0 mm.

Remarks

This species may well be a synonym of H. pannosa; however, the described P.A.O. would readily separate it from that species. In this respect it resembles H. ripperi, but the figure of the mucro is very different from the mucro of ripperi.

Localities: Idaho - Franklin Co.; Utah - Logan.

FIGURE 58



Hypogastrura (Hypogastrura) promatro

All figures after Wray.

A) Foot complex.

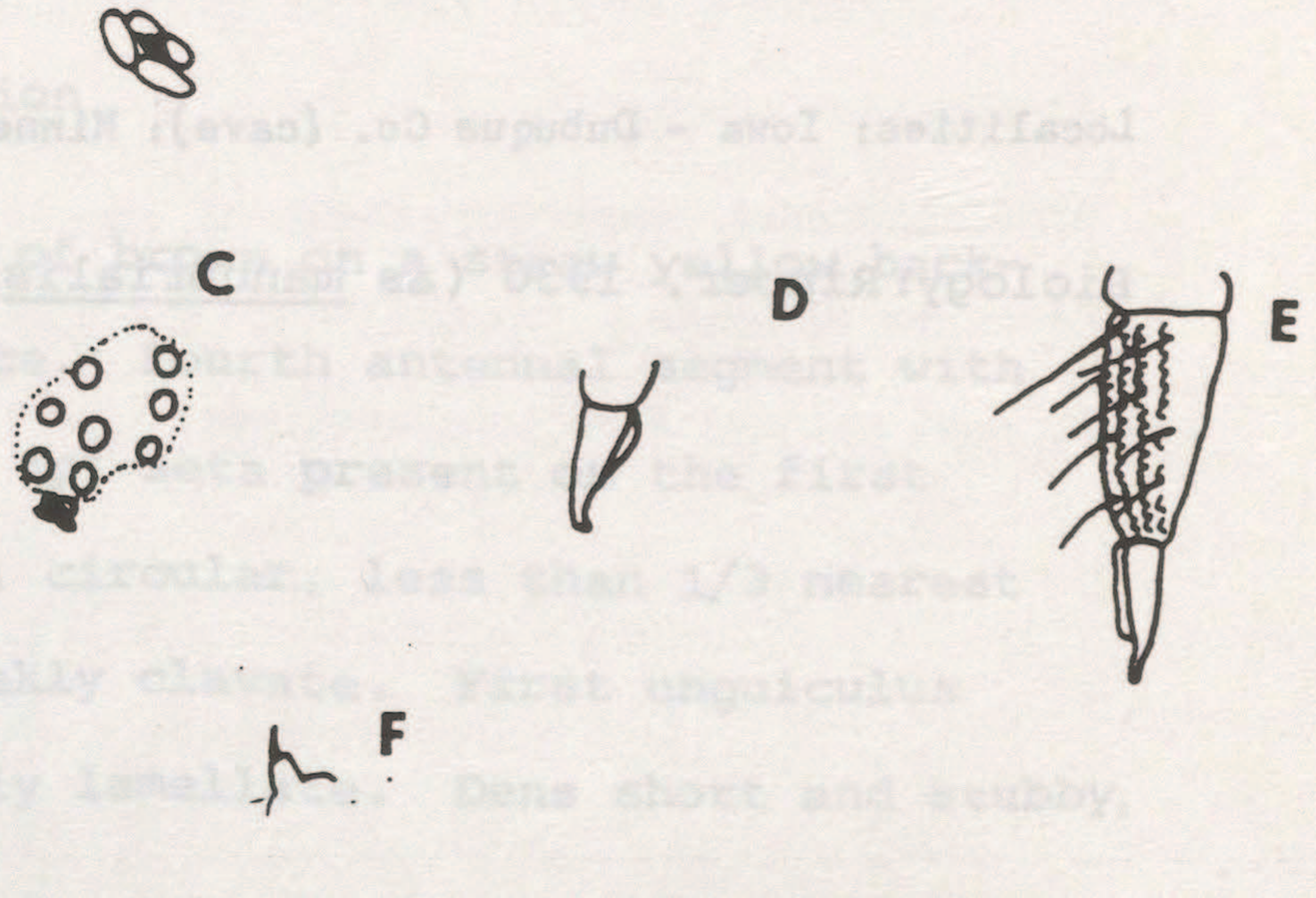
B) Postantennal organ.

C) Eyes and postantennal organ.

D) Mucro.

E) Mucro and dens.

F) Anal spine.



Hypogastrura (H.) ripperi Gisin, 1952 Fig. 59

Ref.: Mitt. schweiz. ent. Ges. 25: 12

Syn.: assimilis of Stach, 1949a, not Krausbauer

Description

Color: gray-blue, paler ventrally. Fourth antennal segment with 5 - 7 blunt setae. Accessory seta "p" present on first antennal segment. P.A.O. with 4 (in U.S. specimens commonly 5) lobes; posterior lobes clearly smaller than anterior; whole organ about 2 times as large as nearest eyes. Tenent hair acuminate to weakly clavate. Dens about 3 times as long as mucro, with 7 dorsal setae. Anal spines 1/4 - 1/3 inner unguis and subequal to 3 times papillae. Integument clearly more coarsely granulate on posterior segments, with granules 8 - 16 micra in diameter.

Remarks

This species as redefined by Gisin (1952) has been identified by many as H. assimilis. It is a well-marked form. It resembles H. devia in many respects (see remarks under that species) but is easily distinguished by the color.

Localities: Iowa - Dubuque Co. (cave); Minnesota - St. Paul.

Biology: Ripper, 1930 (as manubrialis).

FIGURE 59

Hypogastrura (Hypogastrura) ripperi

A)Abdominal segments 4 - 6, After Fjellberg 1985

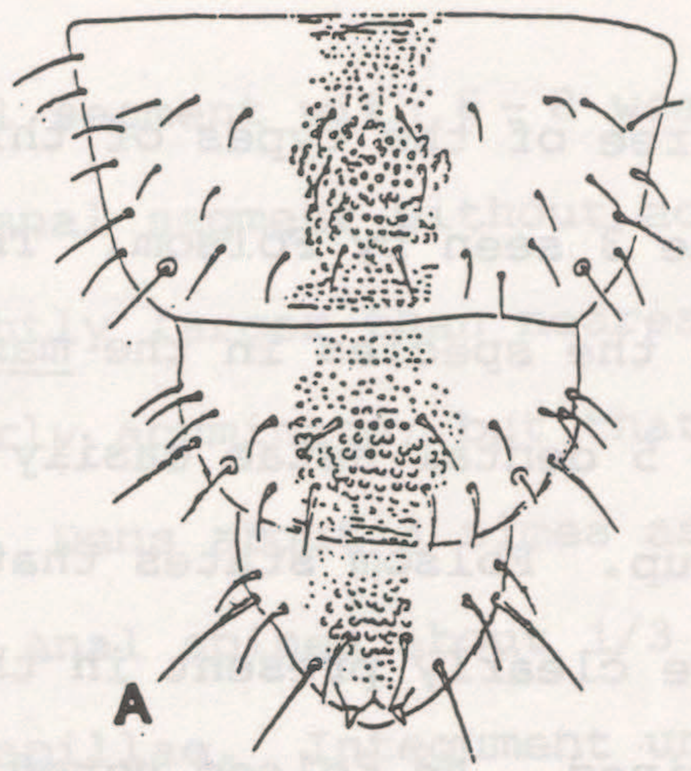
B) Hind foot complex, after Stach.

C) Eyes and postantennal organ, after Stach.

D) Mucrones, after Stach.

E) Dens and mucro, after Stach.

F) Anal spine, after Stach.



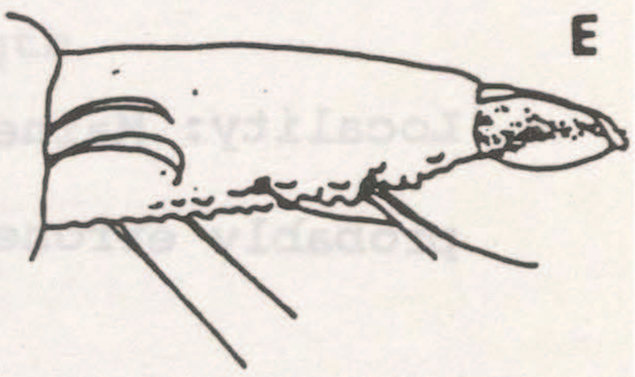












Hypogastrura (H.) tigrina (Harvey) 1900 Fig. 60

Refs.: Ent. News 11: 552 (Achorutes), Folsom, 1916

Description

Color: mottled with patches of brown on a straw yellow background, giving a banded appearance. Fourth antennal segment with 6 - 7 blunt setae. Supplementary "p" seta present on the first antennal segment. P.A.O. simple, circular, less than 1/3 nearest eye in diameter. Tenent hair weakly clavate. First unguiculus acuminate, second and third weakly lamellate. Dens short and stubby,

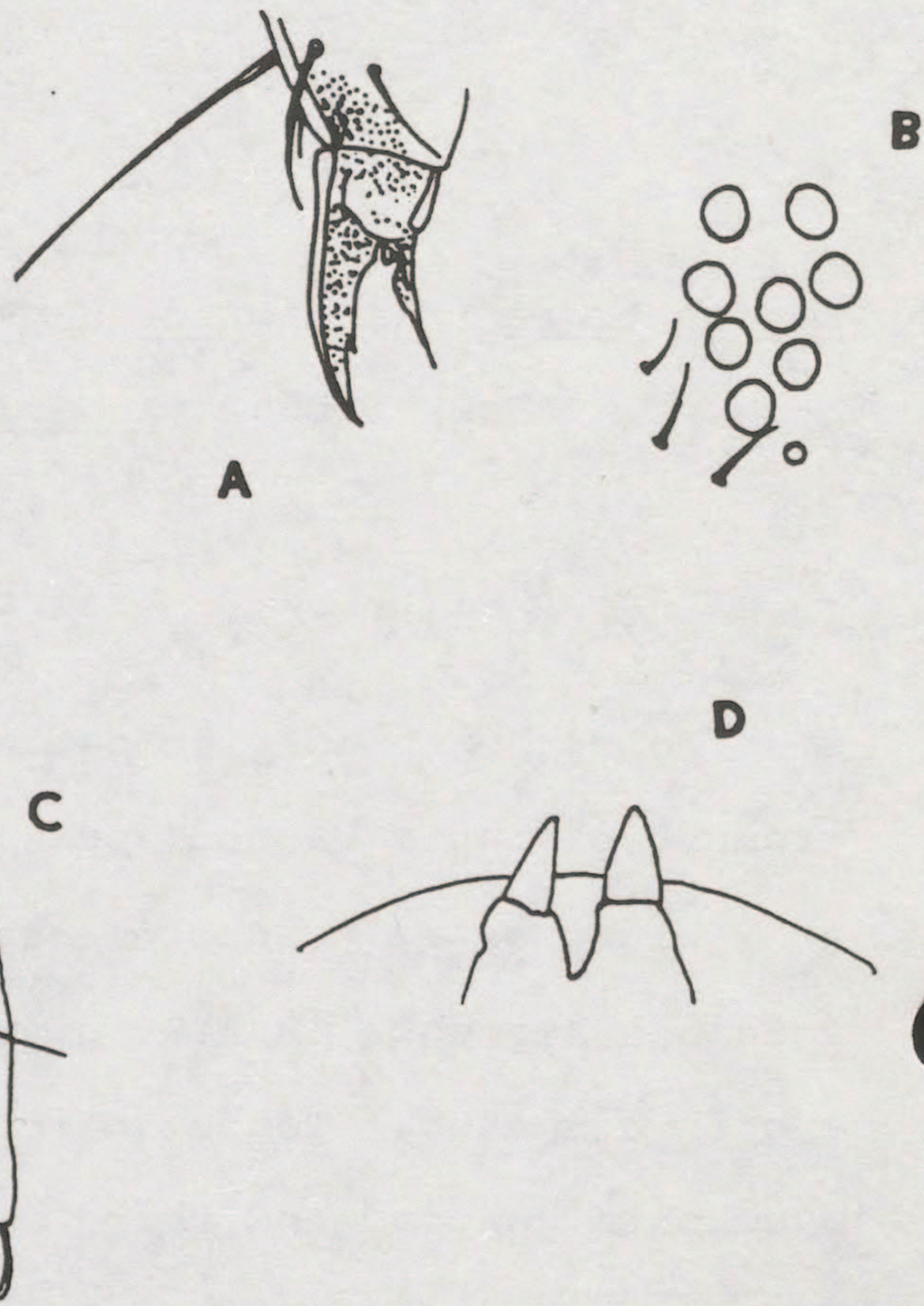
with coarse dorsal humps and 5 dorsal setae; about 5 times as long as mucro. Anal spines minute, subequal to papillae. Body clothed with long stiff setae. Length 1.3 mm.

Remarks

Three of the types of this species were examined - undoubtedly the same 3 seen by Folsom. The first unguiculus is clearly acuminate, placing the species in the manubrialis group. The peculiar P.A.O. and the 5 dental setae easily distinguish it from other species of the group. Folsom states that anal spines are absent; however, they are clearly present in the two types in which this area can be examined. As Folsom noted, the P.A.O. is visible on only 1 specimen. More material will be required before it can be ascertained whether this is a universal feature of the species.

Locality: Maine - Poronal (types). Other published localities are probably erroneous.

FIGURE 60



Hypogastrura (Hypogastrura) tigrina

Figures A-C after Folsom.

A) Forefoot complex.

B) Postantennal organ and eyes.

C) Mucro and dens.

D) Anal spines, from type specimen.

Hypogastrura (H.) utahensis (Wray), 1953 Fig. 61

Ref.: Nature Notes, Raleigh 1:4 (Achorutes)

Description

Color: pale green. Fourth antennal segment with 6 - 8 weakly differentiated blunt setae. First antennal segment without accessory "p" seta. P.A.O. of 3 lobes, slightly larger than nearest eye. Unguiculus of first two feet clearly acuminate, but that of third pair of legs has a small lamella. Dens about 3 times as long as mucro, with 6 - 7 dorsal setae. Anal spines about 1/3 inner unguis in length and subequal to papillae. Integument uniformly granulate; granules 7 - 9 micra in diameter. Chaetotaxy of fifth abdominal segment with one or two *m* setae present, placed between the normal files (see figure A). Maximum length 1.45 mm.

Remarks

The specimens which have been seen agree well with the figures and description of the mucro and dens as well as the general ratios. The unusual P.A.O. makes it very probable that they are the same species. This character, the chaetotaxy of the fifth abdominal segment, and the lack of the first antennal segment p seta make this a well-marked form. It . close to christianseni but differs in the P.A.O. and the peculiar possession of small lamellae on the third pair of unguiculi.

Localities: Utah - Ogden (type); Canada - British Columbia.

FIGURE 61

Hypogastrura (Hypogastrura) utahensis

A) Chaetotaxy, right side of fourth and fifth abdominal segments, specimen from British Columbia.

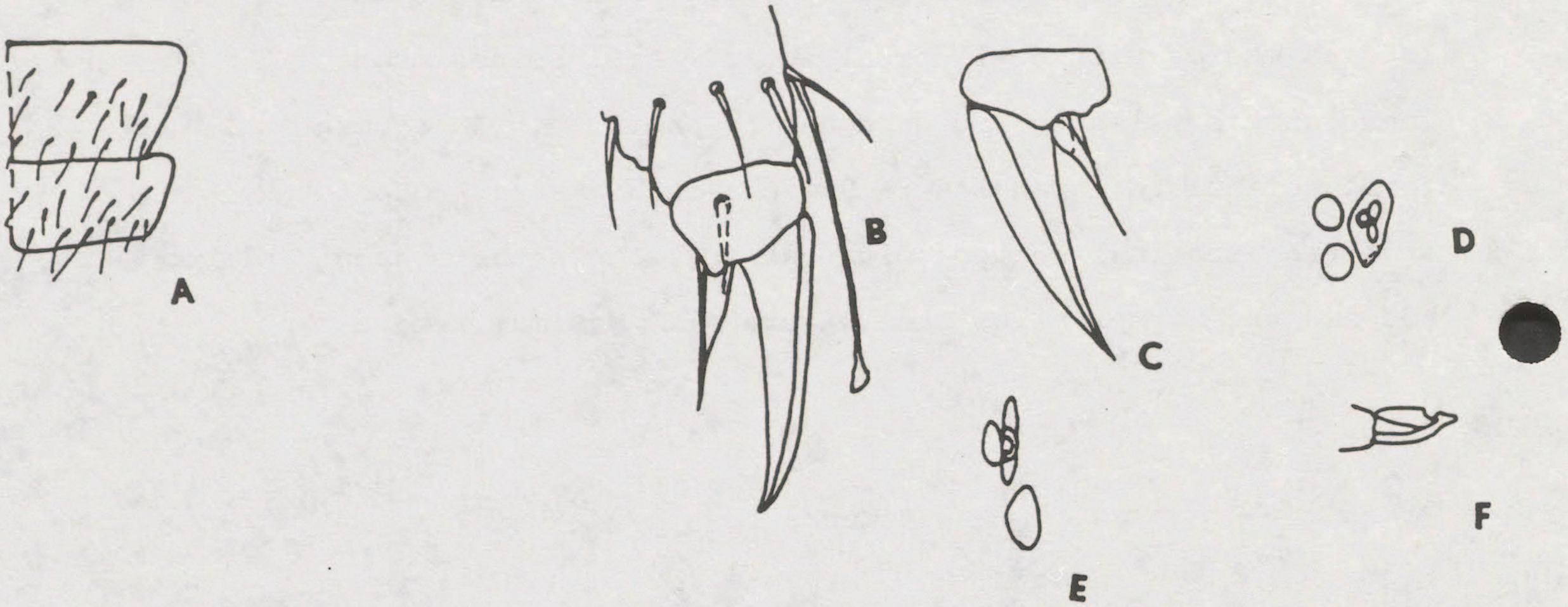
B) Hind foot complex, specimen from British Columbia.

C) Front unguis and unguiculus, specimen from British Columbia.

D) Postantennal organ, specimen from British Columbia.

E) Postantennal organ and eye, after Wray.

F) Mucro, after Wray.



Hypogastrura (H.) nivicola group

In addition to characters in Table III, members of this group have an unlobed apical antennal bulb, well developed fourth antennal segment, blunt setae, P.A.O. 4-lobed and smaller than nearest eye, dens 4 - 5 times as long as mucro, and (usually) blue-black color.

There are 4 nearctic species: 1) harveyi; 2) nivicola (both with winter and summer forms) 4) simsi & 5) tooliki (with possible winter and summer forms).

Hypogastrura (H.) harveyi (Folsom) 1902 Fig. 62

Refs: Psyche, Camb. 9:321 (Achorutes); Folsom 1916, Maynard , 1951; Yosii, 1962, Hart & Waltz, 1995.

Syn: Hypogastrura indiana C. & B. 1980, Hart & Waltz, 1995

Description

Color dark blue to black, sometimes with paler appendages, 4th antennal segment with 11-13 blunt setae (winter form) and 8 in summer form. PAO four (rarely 5) lobed and ≈ half (winter form) to 4/5 (summer form) as long as nearest eye. Tenent hair ≈ 5/3 as long as inner unguis with (summer form) subapical clavate hairs . Ventral tube with 10 + 10 - 14 + 14 setae. Dens 4 -5 times as long as mucro with 6 - 7 dorsal setae and prominent conical tubercles in winter form. Anal spines 1/2 - 2/3 as long as inner unguis, ≈ 3 times as long as papillae in winter form and slightly longer in summer form. Area verticalis with 1 + 1 setae. All setae smooth, long body setae truncate to clavate. Maximum length 2.6 mm.

Remarks

This is a very well marked species. The relatively long anal spines distinguish it from other members of the nivicola group. The summer form , originally described as H. indiana, differs in having the unguiculi acuminate and lacking the conical dental tubercles; it is keyed out separately above. H. harveyi has been regarded as a synonym of European H. frigida (Axelson), which has 5 knobbed tenent hairs and other differences .

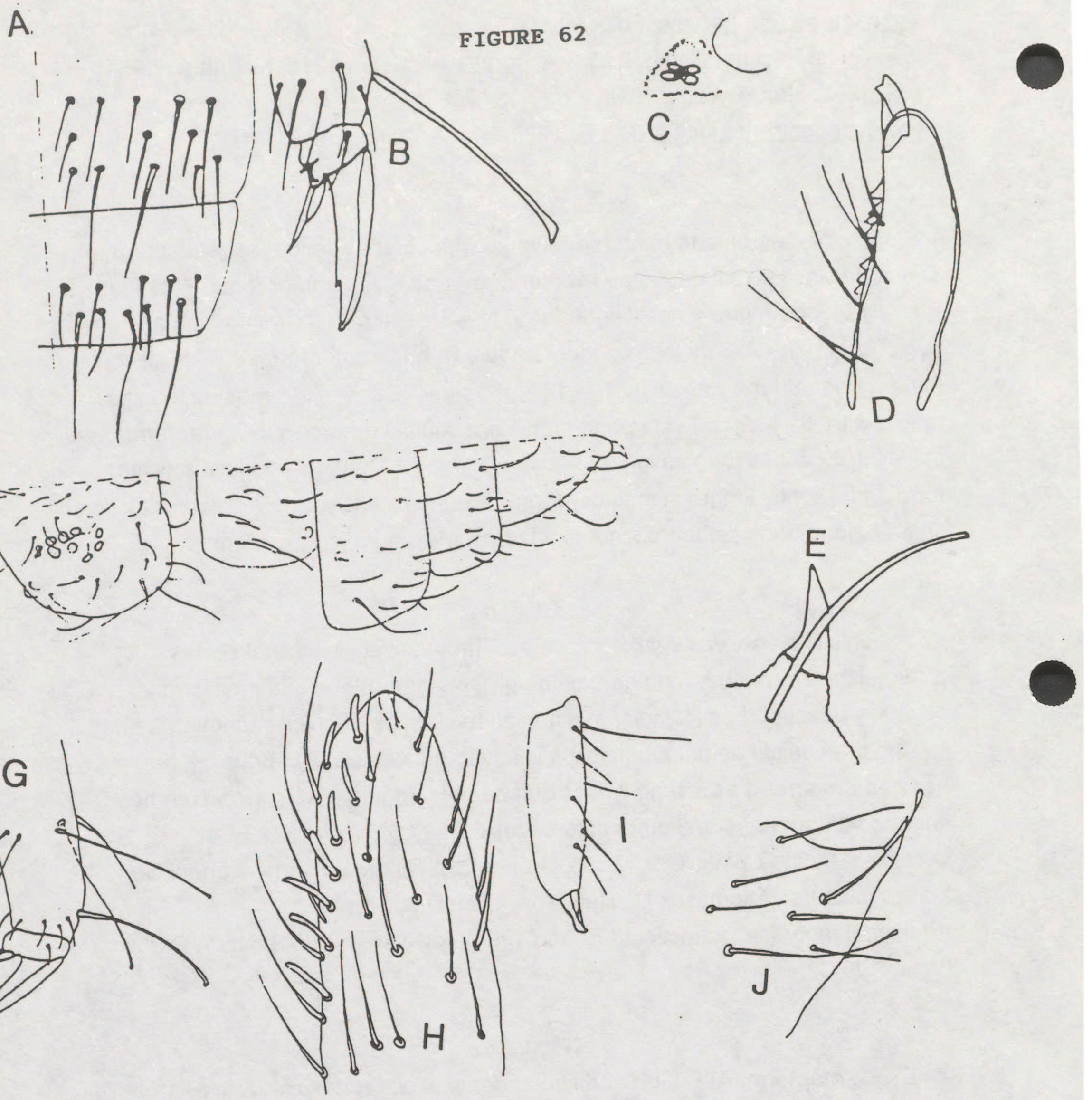
Localities: Indiana Wells Co.; Maine - Penobscot Co.; Maryland - Arundel Co.; Massachusetts - Middlesex C.; New York Tompkins Co.;

Additional records Connecticut (Britton 1920); Iowa Mills, 1934); North Carolina (Wray 1967).

Figure 62

A - E = winter form. A) Fourth and fifth abdominal chaetotaxy, specimen from Quebec; B) Hind foot complex, after Folsom; C) Eye & PAO, after Yosii; D) Mucro and dens, after Folsom; E) Anal spine and seta. after Folsom; F - J = summer form, from types of H. indiana F) Chaetotaxy left side, head, second thoracic segment and last three abdominal segments; G) Hind foot complex; H) Fourth antennal segment; I) Mucro and dens; J) Apex of sixth abdominal segment.

FIGURE 62



Hypogastrura (H.) nivicola (Fitch), 1846 Fig. 63

Refs.: Amer. Q. J. agric. Sci. 5: 283 (Podura); Folsom, 1916 (as socialis); Yosii, 1960

Syns.: diversiceps Lintner, 1896, Rep. injur. Ins. N.Y. 11: 253; socialis of American authors.

Description

Color: deep blue-black (winter and some summer forms) to medium blue with paler underparts (some summer forms). Fourth antennal segment with 5 - 8 blunt setae. P.A.O. four-lobed, about 3/4 as long as nearest eye, with posterior lobes usually smaller than anterior. Tenent hair 1.2 - 1.5 times as long as inner unguis. Ventral tube with 6 + 6 - 11 + 11 setae. Dens 4 - 5 times as long as mucro, with 7 dorsal setae and 3 - 12 prominent conical papillae. Mucro boat-shaped, with or without apical tooth. Anal spines minute, less than 1/4 as long as inner unguis and about 2 times as long as papillae. Area verticalis with 1 + 1 setae. All body setae acuminate. Maximum length: summer form 2.1 mm.; winter form 2.7 mm.

Remarks

This species appears to have two seasonal forms: one found from November to May which is always blue black, has prominent dental papillae and a projecting tooth on the mucro; and a second, found from May to November, which is blue black or blue and has no apical tooth on the mucro and smaller dental papillae. It is possible that these represent two species, but their occurrence makes it more probable that they are ecomorphs of the same form. This has usually been regarded as synonymous with the European socialis (Uzel), but Stach, 1949a, has questioned their identity, and recent descriptions by Dallai (1970) give evidence that they are actually distinct; socialis has 2 + 2 setae on the area verticalis.

Distribution: widespread in the northern half of the United States and in Alaska and Canada; south to North Carolina, Tennessee, Utah, and northern California. Biology : Lyford 1975

FIGURE 63

Hypogastrura (Hypogastrura) nivicola

A) Chaetotaxy of right side, fourth abdominal segment, summer form, specimen from York Co., Maine.

B) Chaetotaxy, winter form, right side, after Yosii.

C) End of abdomen, after Folsom.

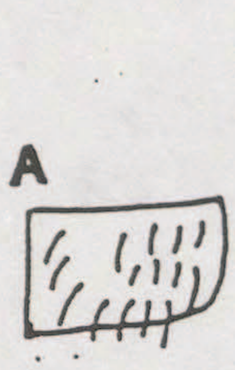
D) Hind foot complex, after Folsom.

E) Eye and postantennal organ, after Folsom.

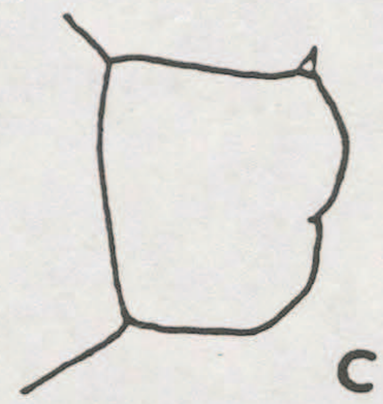
F) Mucro and dens, summer form, specimen for York Co., Maine.

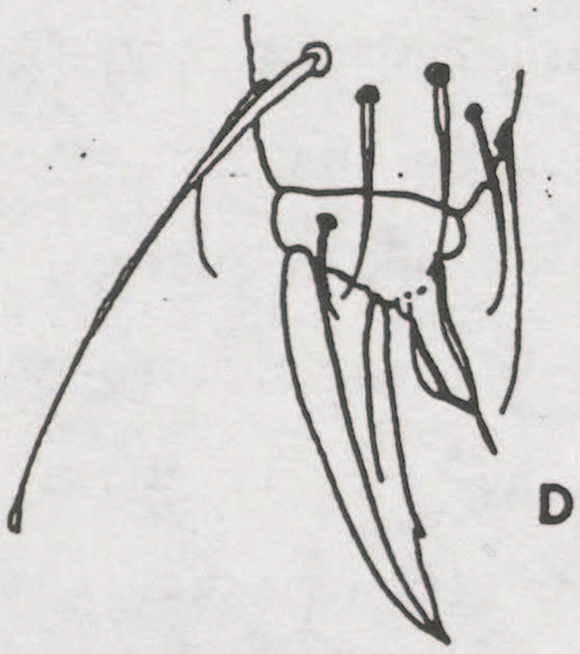
G) Mucro and dens, winter form, after Folsom.

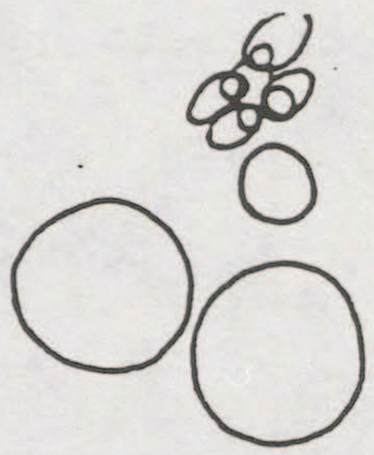
H) Chaetotaxy, fourth abdominal segment, after Fjellberg.

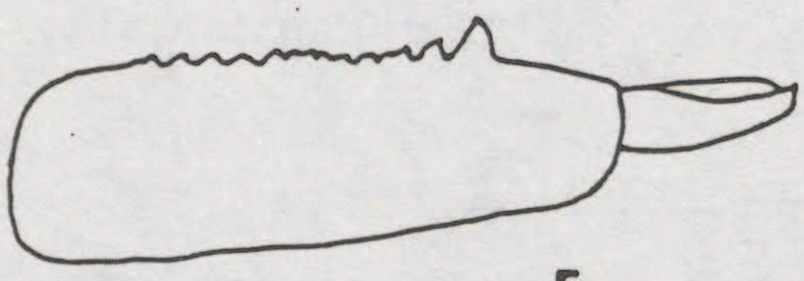


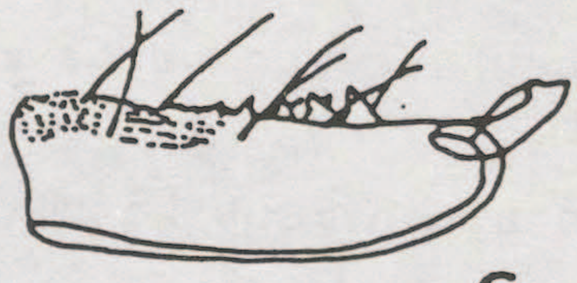


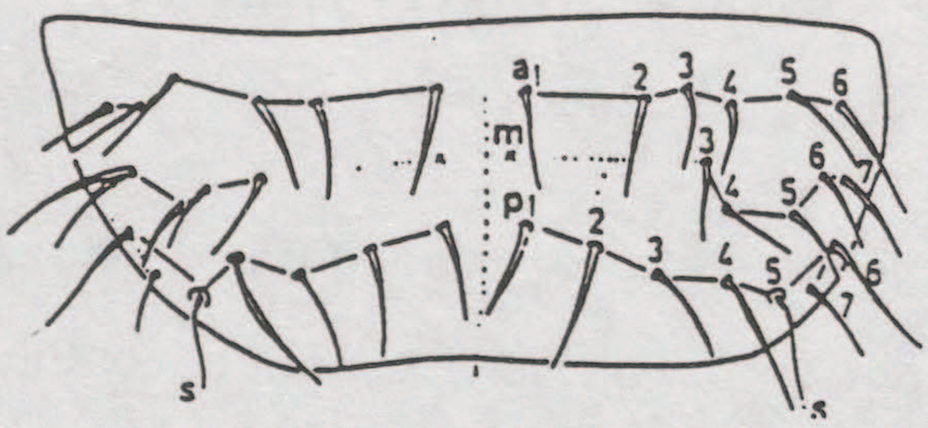






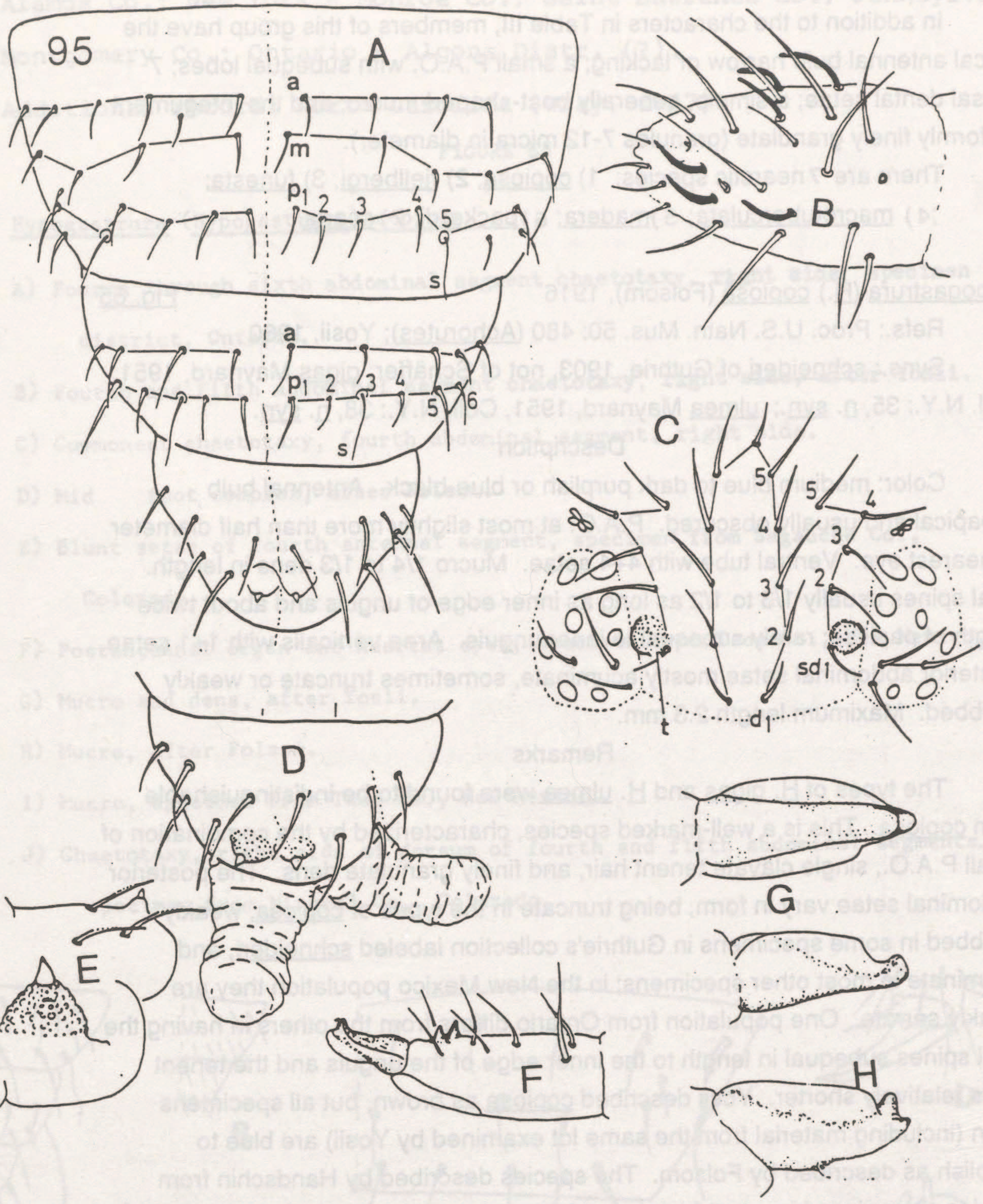






H

Figure 63.1



H. s.str. tooliki: A) Chaetotaxy Abd. 4-6; B) Left ant. segment 4 , sensillae darkened; C) Chaetotaxy of central part of head; D) Abd. 6 with extruded anal sacs; E) Abd. 6 with anal spine and spine enlarged; F) Dens and mucro; G) Left mucro summer form; H) Left mucro supposed winter form. After Fjellberg 1985

Hypogastrura (H.) packardi group

In addition to the characters in Table III, members of this group have the apical antennal bulb narrow or lacking; a small P.A.O. with subequal lobes; 7 dorsal dental setae; a simple, generally boat-shaped mucro; and the integument uniformly finely granulate (granules 7-12 micra in diameter).

There are 7 nearctic species: 1) copiosa; 2) fjellbergi; 3) funesta; ;4) macrotuberculata; 5) madera; 6) packardi; 7) sparta.

Hypogastrura (H.) copiosa (Folsom), 1916 Fig. 65

Refs.: Proc. U.S. Natn. Mus. 50: 480 (Achorutes); Yosii, 1960

Syns.: schneideri of Guthrie, 1903, not of Schäffer; gigas Maynard, 1951, Coll. N.Y.: 35, n. syn.; ulmea Maynard, 1951, Coll. N.Y.: 38, n. syn.

Description

Color: medium blue to dark purplish or blue-black. Antennal bulb subapical and usually obscured. P.A.O. at most slightly more than half diameter of nearest eye. Ventral tube with 4+4 setae. Mucro 1/4 to 1/3 dens in length. Anal spines usually 1/3 to 1/2 as long as inner edge of unguis and about twice length of papillae; rarely subequal to inner unguis. Area verticalis with 1+1 setae. Posterior abdominal setae mostly acuminate, sometimes truncate or weakly knobbed. Maximum length 2.3 mm.

Remarks

The types of H. gigas and H. ulmea were found to be indistinguishable from copiosa. This is a well-marked species, characterized by the combination of small P.A.O., single clavate tenent hair, and finely granulate dens. The posterior abdominal setae vary in form, being truncate in the types of copiosa, weakly knobbed in some specimens in Guthrie's collection labeled schneideri, and acuminate in most other specimens; in the New Mexico population they are weakly serrate. One population from Ontario differs from the others in having the anal spines subequal in length to the inner edge of the unguis and the tenent hairs relatively shorter. Yosii described copiosa as brown, but all specimens seen (including material from the same lot examined by Yosii) are blue to purplish as described by Folsom. The species described by Handschin from Mexico as copiosa is something else, perhaps a member of the trybomi group.

Localities: California - Sonoma Co.; Colorado - Mineral Co., Saguache Co.; Iowa - Story Co.; Minnesota (type); New Mexico - Los Alamos Co.; New York - Monroe Co., Saint Lawrence Co.; Pennsylvania - Montgomery Co.; Ontario - Algona Distr. (?).

Additional record: North Carolina (Wray, 1967).

FIGURE 65

Hypogastrura (Hypogastrura) copiosa

A) Fourth through sixth abdominal segment chaetotaxy, right side, specimen from Algona district, Ontario.

B) Fourth and fifth abdominal segment chaetotaxy, right side, after Yosii.

C) Commonest chaetotaxy, fourth abdominal segment, right side.

D) Mid foot complex, after Folsom.

E) Blunt setae of fourth antennal segment, specimen from Sagauche Co., Colorado.

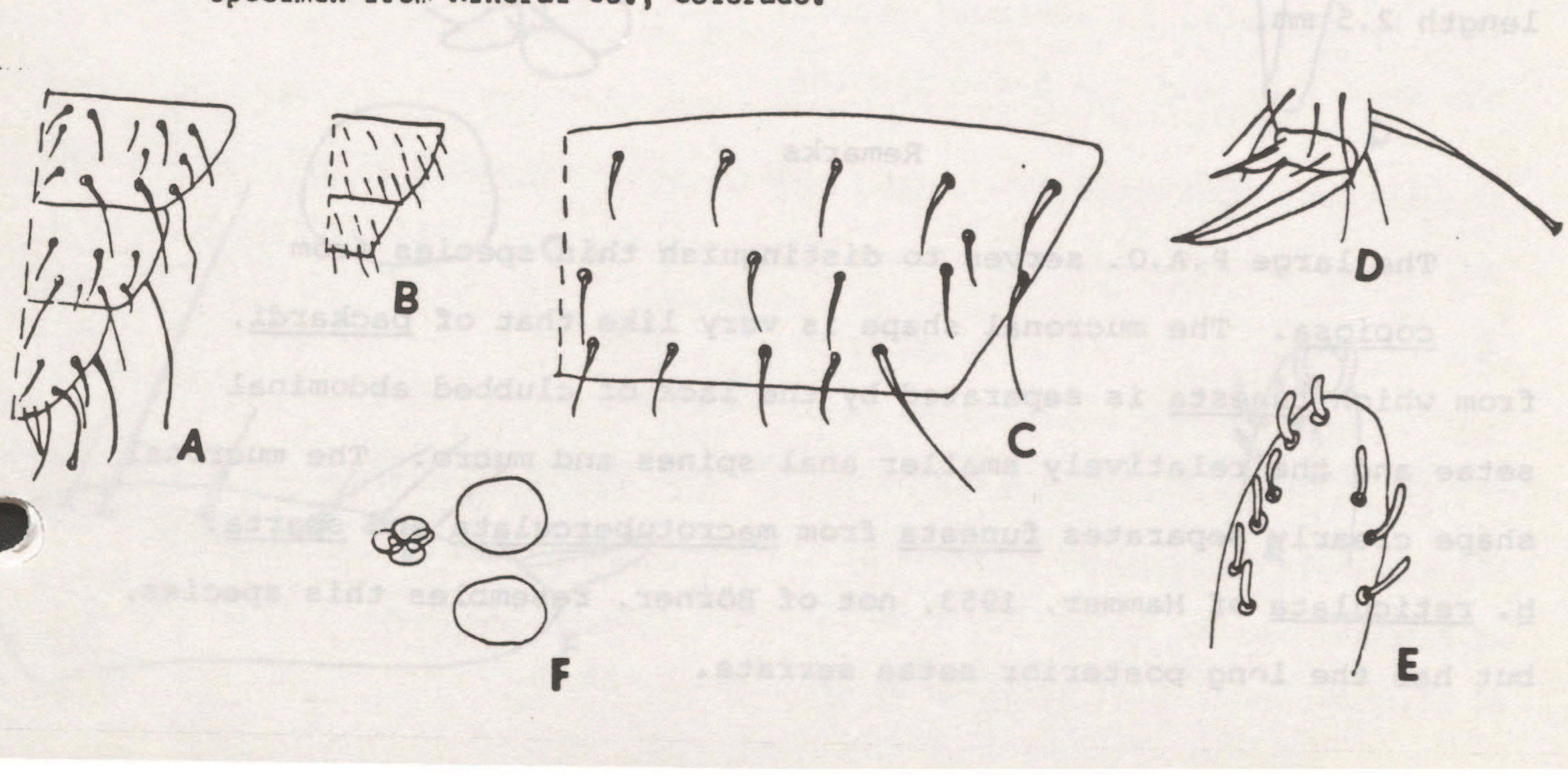
F) Postantennal organ and nearest eyes, specimen from Taos Co., New Mexico.

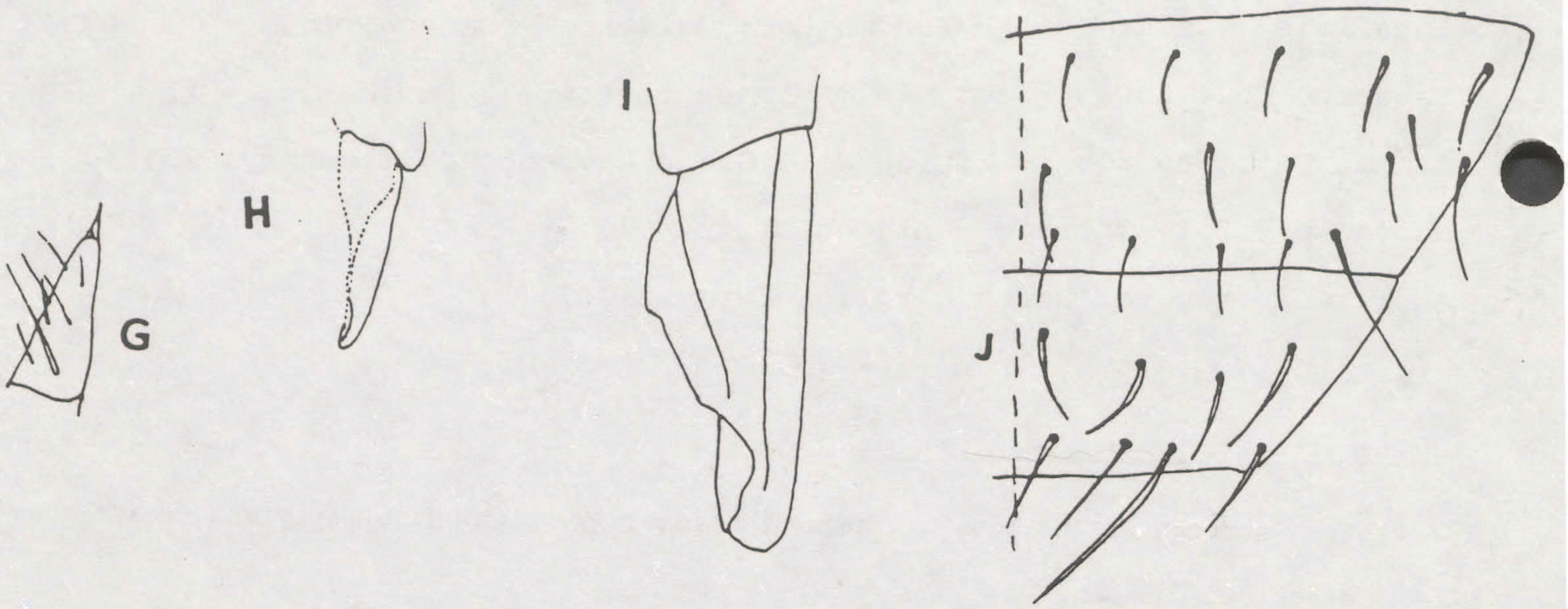
G) Mucro and dens, after Yosii.

H) Mucro, after Folsom.

I) Mucro, specimen from Taos Co., New Mexico.

J) Chaetotaxy, right side of dorsum of fourth and fifth abdominal segments, specimen from Mineral Co., Colorado.





Hypogastrura (H.) funesta, Christiansen & Bellinger, 1980 Fig. 66

Description

Color: blue-black. Fourth antennal segment with apical bulb simple and often obscure, and with 5 - 6 blunt setae. P.A.O. subequal to or slightly larger than largest neighboring eye. Ventral tube with 6 + 6 setae. Mucro about 1/6 dens in length. Anal spines 1/4 - 1/5 as long as inner unguis, and slightly longer than papillae. Area verticalis with 1 + 1 setae. All body setae acuminate. Maximum length 2.5 mm.

Remarks

The large P.A.O. serves to distinguish this species from copiosa. The mucronal shape is very like that of packardi, from which funesta is separated by the lack of clubbed abdominal setae and the relatively smaller anal spines and mucro. The mucronal shape clearly separates funesta from macrotuberculata and sparta. H. reticulata of Hammer, 1953, not of Börner, resembles this species, but has the long posterior setae serrate.

Type locality: Summit Lake, Mt. Evans, Clear Creek Co. Colorado, 12,740 feet, under sticks along shore of lake, 10 July 1950 (K. Christiansen).

Additional locality: Colorado - Gunnison Co.

Hypogastrura (Hypogastrura) funesta

FIGURE 66

All figures of type specimens.

A) Dorsal chaetotaxy, last three abdominal segments, right side.

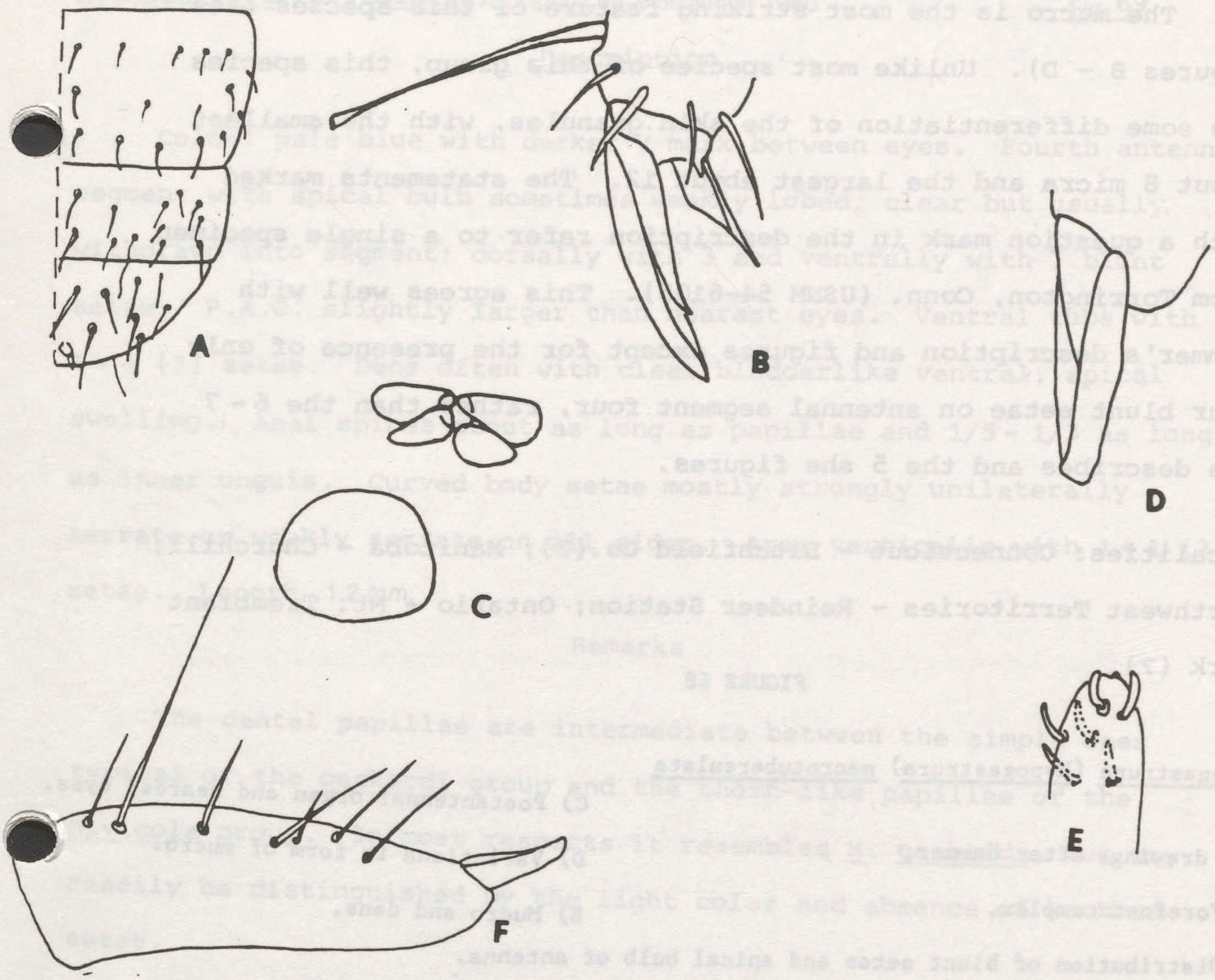
B) Hind foot complex.

C) Postantennal organ and nearest eye.

D) Mucro, from an angle.

E) Blunt setae of fourth antennal segment.

F) Dens and mucro, from side.



Hypogastrura (H.) macrotuberculata (Hammer), 1953 Fig. 68

Ref.: Acta arct. 6: 13

Description

Color: purplish to violet pigment on yellow background, sometimes spotted with red. P.A.O. about 3/4 as long as largest n neighboring eye. Ventral tube with 4+4 setae (?). Mucro .23-.28 as long as dens. Anal spines .22-.28 as long as inner unguis, subequal to papillae. Area verticalis with 2+2 setae (?). Maximum length (Hammer) 1.2 mm; (observed) .9 mm.

Remarks

The mucro is the most striking feature of this species (see figures B - D). Unlike most species of this group, this species has some differentiation of the skin granules, with the smallest about 8 micra and the largest about 12. The statements marked with a question mark in the description refer to a single specimen from Torrington, Conn. (USNM 54-6105). This agrees well with Hammer's description and figures except for the presence of only four blunt setae on antennal segment four, rather than the 6-7 she describes and the 5 she figures.

Localities: Connecticut - Litchfield Co.(?); Manitoba - Churchill; Northwest Territories - Reindeer Station; Ontario - Mt. Tremblant Park (?).

FIGURE 68

Hypogastrura (Hypogastrura) macrotuberculata

All drawings after Hammer.

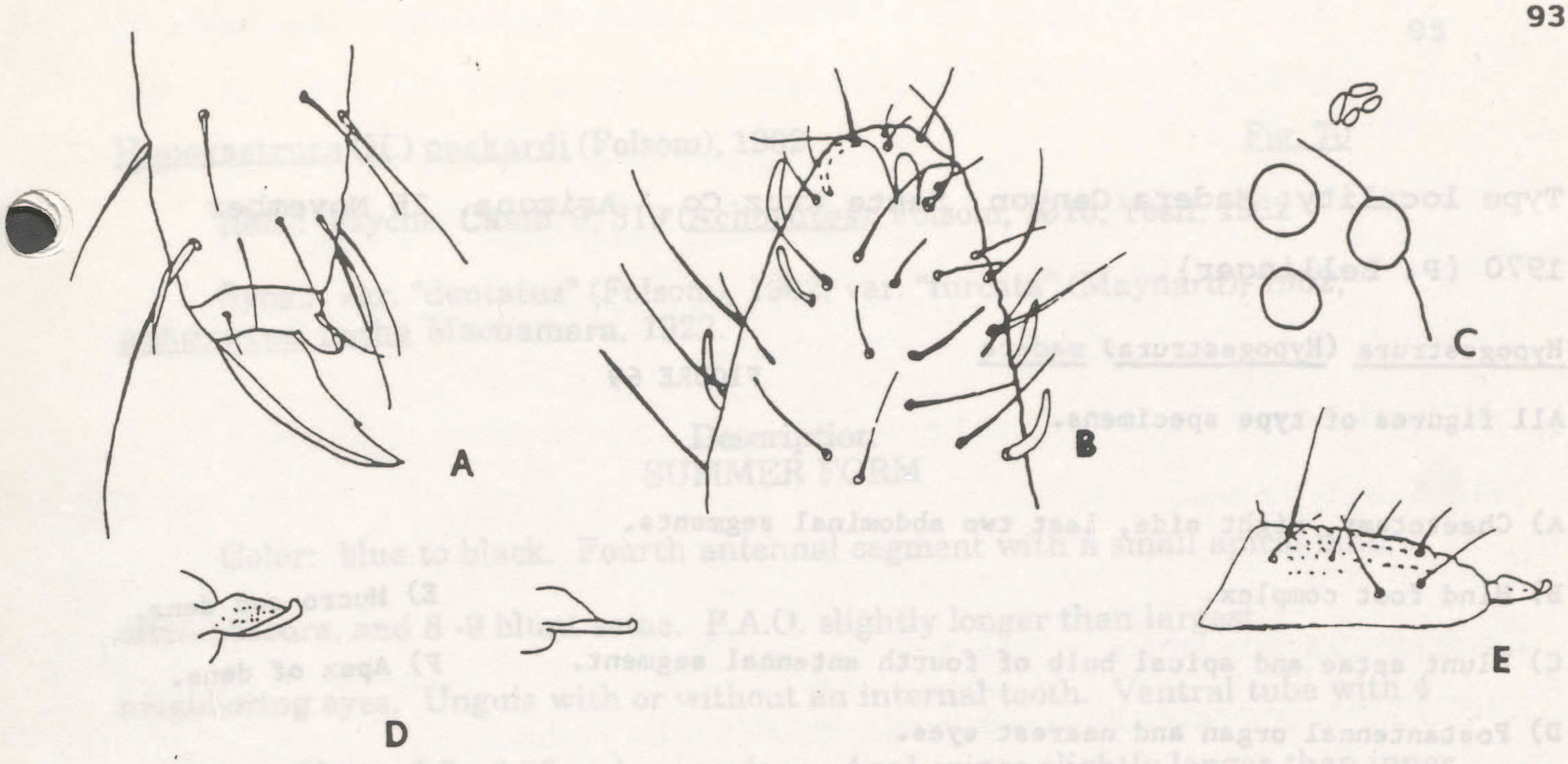
A) Forefoot complex.

B) Distribution of blunt setae and apical bulb of antenna.

C) Postantennal organ and nearest eyes.

D) Variations in form of mucro.

E) Mucro and dens.



Hypogastrura (H.) madera, Christiansen & Bellinger, 1980 Fig. 69

Description

Color: pale blue with darker V mark between eyes. Fourth antennal segment with apical bulb sometimes weakly lobed, clear but usually withdrawn into segment; dorsally with 3 and ventrally with 7 blunt setae. P.A.O. slightly larger than nearest eyes. Ventral tube with 4+4 (?) setae. Dens often with clear bladderlike ventral, apical swelling. Anal spines about as long as papillae and 1/5 - 1/3 as long as inner unguis. Curved body setae mostly strongly unilaterally serrate or weakly serrate on all sides. Area verticalis with 1+1 (?) setae. Length 1.2 mm.

Remarks

The dental papillae are intermediate between the simple ones typical of the packardi group and the thorn-like papillae of the nivicola group. In most respects it resembles H. packardi, but may readily be distinguished by the light color and absence of knobbed setae.

Type locality: Madera Canyon, Santa Cruz Co., Arizona, 25 November 1970 (P. Bellinger).

Hypogastrura (Hypogastrura) madera

FIGURE 69

All figures of type specimens.

A) Chaetotaxy, right side, last two abdominal segments.

B) Hind foot complex.

C) Blunt setae and apical bulb of fourth antennal segment.

D) Postantennal organ and nearest eyes.

E) Mucro and dens.

F) Apex of dens.

Hypogastrura (H.) packardi (Folsom), 1902 Fig. 70

Refs.: Psyche, Camb. 9; 319 (Achorutes); Folsom, 1916; Yosii, 1962

Syns.: var. "dentatus" (Folsom), 1902; var. "furcata" (Maynard), 1952; Achorutes notha Macnamara, 1922.

Description

SUMMER FORM

Color: blue to black. Fourth antennal segment with a small apical bulb, often obscure, and 8 -9 blunt setae. P.A.O. slightly longer than largest neighboring eyes. Unguis with or without an internal tooth. Ventral tube with 4 + 4 setae. Mucro 0.2 - 0.25 as long as dens. Anal spines slightly longer than inner unguis and 1.5 - 2 times as long as papillae. Area ventricalis with 2 + 2 setae. Clubbed setae prominent on posterior abdominal segments; typical specimens have many abdominal setae ciliate. Maximum length 2.4 mm.

WINTER FORM

P.A.O. subequal in length to nearest eye, of 4 lobes, posterior lobes shorter than anterior. Large tenent hair about 2.5 times inner unguis; small setae of apex of tibiotarsus weakly clavate. Four to six large conical dental papillae. Anal spines about 2/5 inner unguis in length and subequal to papillae. Maximum length 1 mm.

Remarks

This is a well-marked species, although the intense pigmentation makes examination of some crucial features difficult. There is considerable variation in the structure of the mucro and the ciliation on the setae. Waltz and Hart discovered that H. notha was in fact a winter form of H. packardi.

Localities: Widely distributed east of the Mississippi, form Kentucky to southern Canada; Iowa - Story Co., Butler Co., Clayton Co.; Maine - Penobscot Co.; Maryland - Cecil Co.; Ontario Renfrew Co.; Quebec.

Additional records: Utah (Wray and Knowlton, 1963), Indiana (Waltz and Hart, 1989), Illinois (Graves, 1950).

Figure 70

Hypogastrura (Hypogastrura) packardi--Summer Form

A) Posterior abdominal chaetotaxy, left side after Yosii.

B) Hind foot complex, after Yosii.

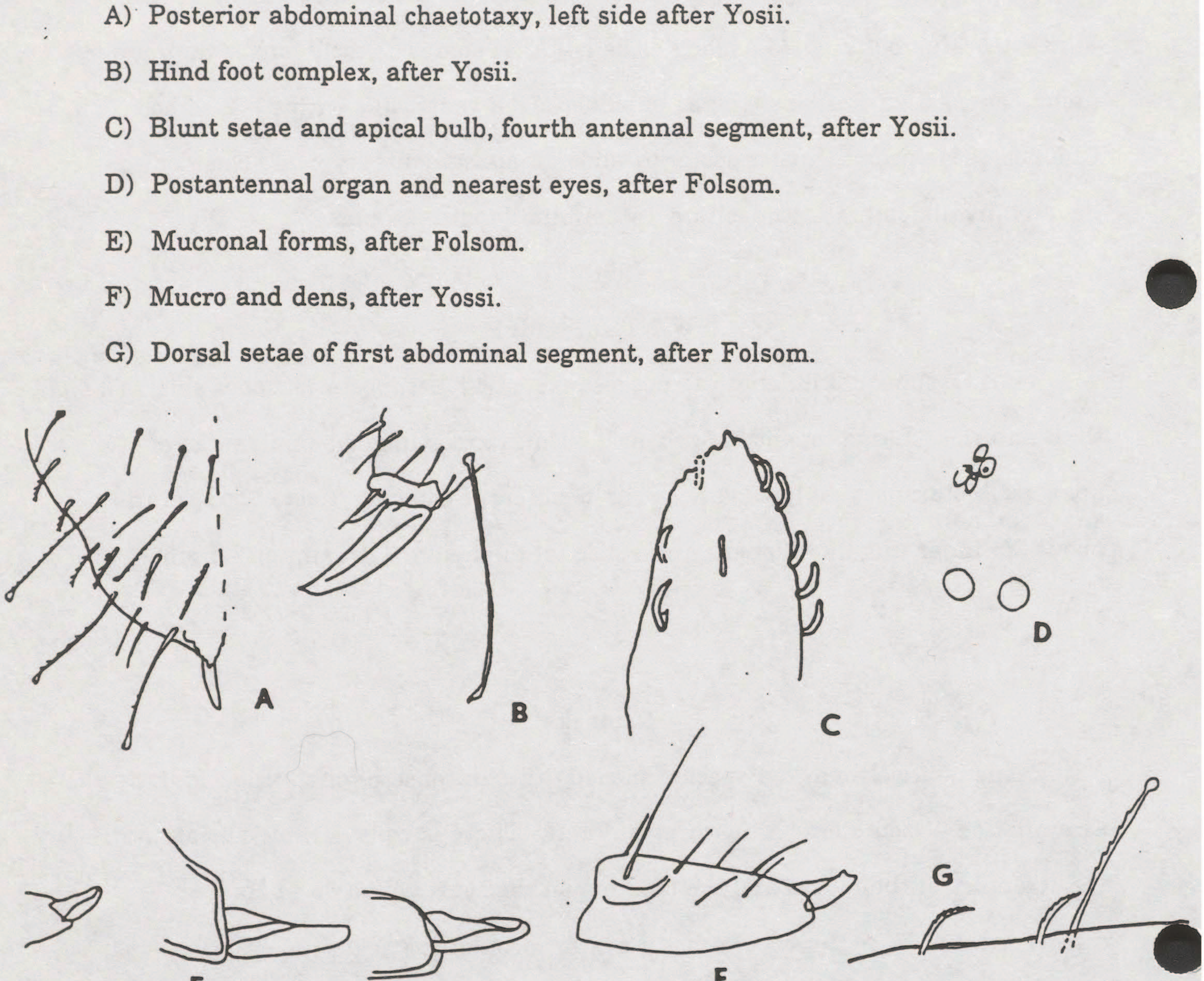
C) Blunt setae and apical bulb, fourth antennal segment, after Yosii.

D) Postantennal organ and nearest eyes, after Folsom.

E) Mucronal forms, after Folsom.

F) Mucro and dens, after Yossi.

G) Dorsal setae of first abdominal segment, after Folsom.

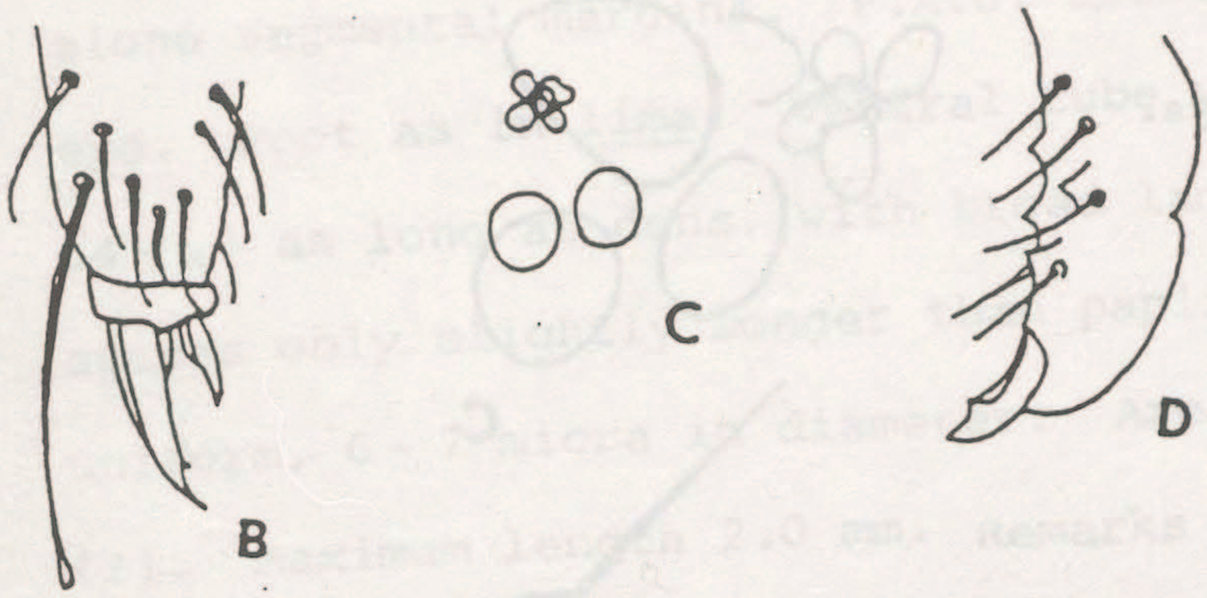


A) Profile of last two abdominal segments, specimen from Maryland.

B) Hind foot complex, after Macnamara.

C) Postantennal organ and eyes, after Macnamara.

D) Mucro and dens, after Macnamara.



Hypogastrura (H.) sparta, Christiansen & Bellinger, 1980 Fig. 71

Description

Color: unknown. Fourth antennal segment with apical bulb narrow but clear; dorsally with four long blunt setae, ventrally with two long and two short; blunt setae poorly differentiated from acuminate setae. P.A.O. about as long as largest neighboring eye. Ventral tube with 4+4 aetae. Mucro .4- .5 as long as dens. Anal spines .3- .5 as long as inner unguis and subequal to papillae or slightly shorter. Granulation of integument very uniform, on dorsum of abdomen 7- 8 micra in basal diameter. Area verticalis with 2+2 setae. All body setae acuminate; some are serrate. Maximum length 1.8 mm.

Remarks

A well-marked species. One clearly abnormal specimen has 3 anal spines.

Type locality: Spartanburg, South Carolina, well water, 23 November 1940 (C.B. Waller) (U.S. National Museum, 40-21887).

FIGURE 71

Hypogastrura (Hypogastrura) sparta

All figures of holotype.

A) Dorsal chaetotaxy of right side of fourth and fifth abdominal segments.

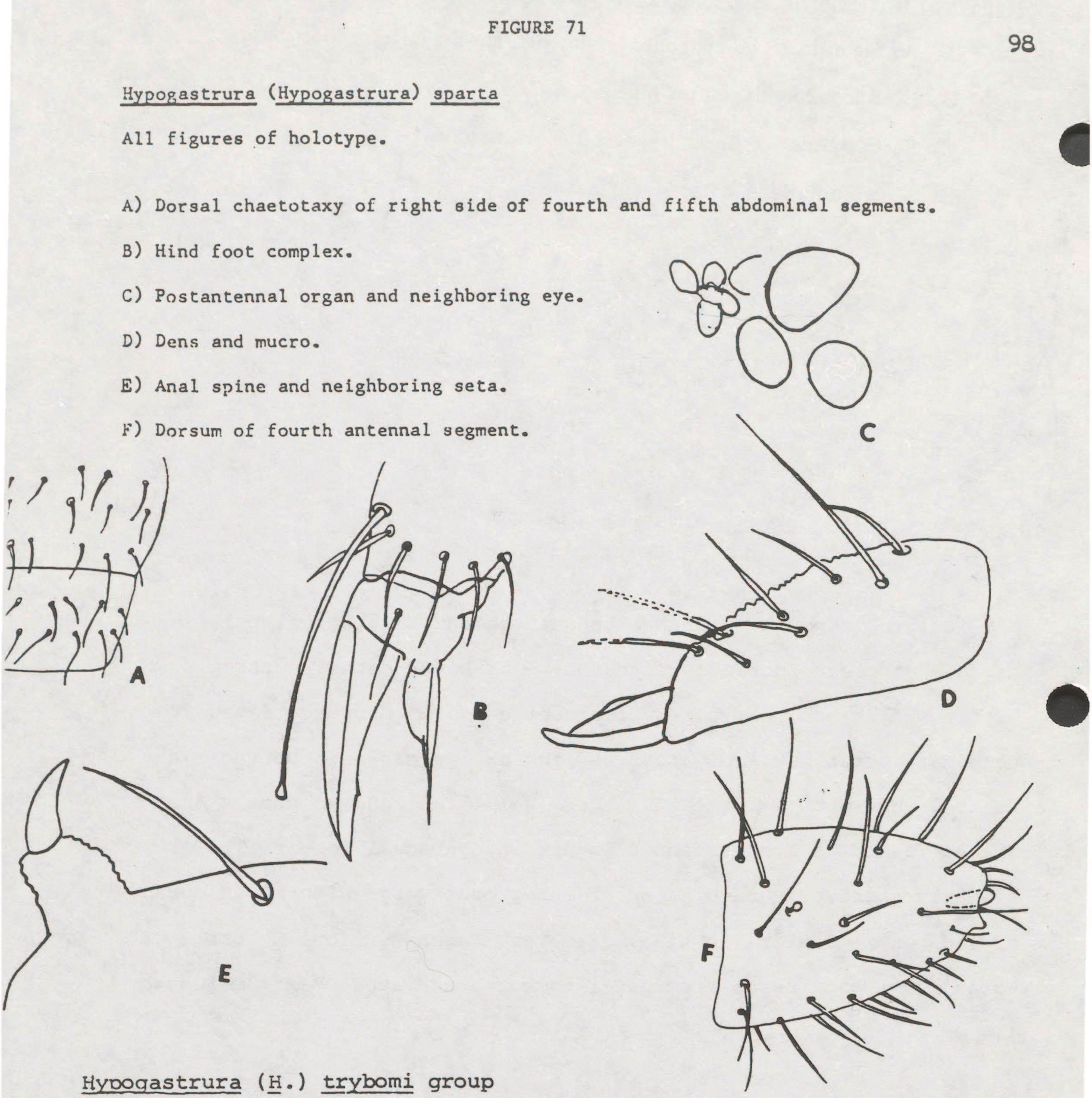
B) Hind foot complex.

C) Postantennal organ and neighboring eye.

D) Dens and mucro.

E) Anal spine and neighboring seta.

F) Dorsum of fourth antennal segment.



Hypogastrura (H.) trybomi group

In addition to the characteristics in Table III, members of this group have a small P.A.O. with subequal lobes; a simple, lamellate mucro; and relatively small anal spines.

There are 5 nearctic species: 1) ireneae; 2) lima; 3) maynardi; 4) oregonensis; 5) trybomi.

Hypogastrura (H.) ireneae (Wray) 1953

Ref.: Nature Notes, Raleigh, N.C. 1: 2 (Achorutes)

Description

Color: background pale yellow speckled with reddish, light along segmental margins. P.A.O. about twice as large as nearest eye. Foot as in lima. Ventral tube with 4+4 setae (?). Mucro .4- .5 as long as dens, with broad lamella ending sharply. Anal spines only slightly longer than papillae. Abdominal granules uniform, 6- 7 micra in diameter. Area verticalis with 2+2 setae (?). Maximum length 2.0 mm. Remarks

The items in the description above entered with (?) are based on Alaskan specimens identifiable as this species. This species is very close to lima, but the absence of clearly larger tubercles near the end of the dens, the relatively smaller anal spines, the different fourth abdominal segment chaetotaxy, and the color indicate that they are different.

Localities: Alaska - Anaktuvuk (uncertain); North Carolina - Cumberland Co. (type).

FIGURE 72

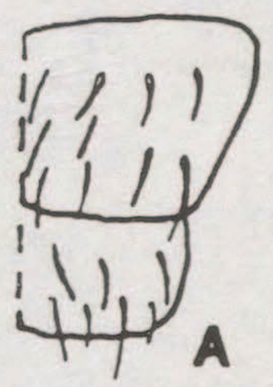
Hypogastrura (Hypogastrura) ireneae

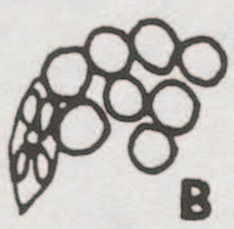
A) Chaetotaxy, right side, fourth and fifth abdominal segments, specimen from Alaska.

B) Postantennal organ and eyes after Wray.

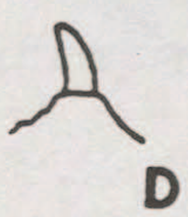
C) Mucro and dens, modified from Wray.

D) Anal spine, after Wray.









Hypogastrura (H.) lima, Christiansen & Bellinger, 1980 Fig. 73

Description

Color: background yellow with specks of blue pigment variously arranged in lines over dorsum. Apical bulb of antenna well-developed, single; blunt setae of fourth antennal segment poorly differentiated, curved, and 7 - 8 in number. Ventral surface of segment with a "file" organ similar to that of some Ceratophysella, consisting of about 20 setae. Ventral tube with 4 + 4 setae. Dens with distinctly larger granules near apex. Mucro from 1/2 to 5/9 as long as dens. Anal spines 1/3 to 2/5 as long as inner unguis and 1 1/2 to 2 times as long as papillae. Granulation of dorsum relatively uniform; granule diameter about 5 - 9 micra. Body setae very stiff and straight, tapering at tips. Area verticalis with 2 + 2 setae, outer pair much larger than inner. Maximum length 1.7 mm.

Remarks

This well-marked species could only be confused with oregonensis Yosii, and can easily be separated from that species by the smaller papillae of the anal spines and by the mucrones. This may be a synonym of H. maynardi, but the mucro, dens and body setae are strikingly different from Maynard's figures and description for that species.

Type locality: Bunnel Hill, Blue Ridge Mts., Susquehanna Co., Pennsylvania; Tullgren extract of mixed deciduous and hemlock duff, 16 June 1950 (K. Christiansen).

Other localities: Maryland - Green Ridge Mt.; New York - Orange Co., Rensselaer Co.

Hypogastrura (H.) maynardi n.n. Fig. 74

Syn.: Hypogastrura montana Maynard 1951, Collembola of New York: 201; nec Achorutes montanus Becker 1905 n.comb.

Description

Color: background cream, with specks of blue pigment. Fourth antennal segment with 7 blunt setae. Unguis with inner tooth beyond midpoint. Anal spines about 1/2 as long as inner unguis and about 2 1/2 times as long as papillae. Body setae of "short curving simple setae intermixed with long slender hairs."

Remarks

Maynard's figures and descriptions leave this form in doubt. He describes the anal spines as having papillae "nearly one half the length of the spines", but figures papillae about 1/3 the length of the spine. Unless his description of the clothing is completely erroneous, this character distinguishes maynardi from lima, which also occurs in New York.

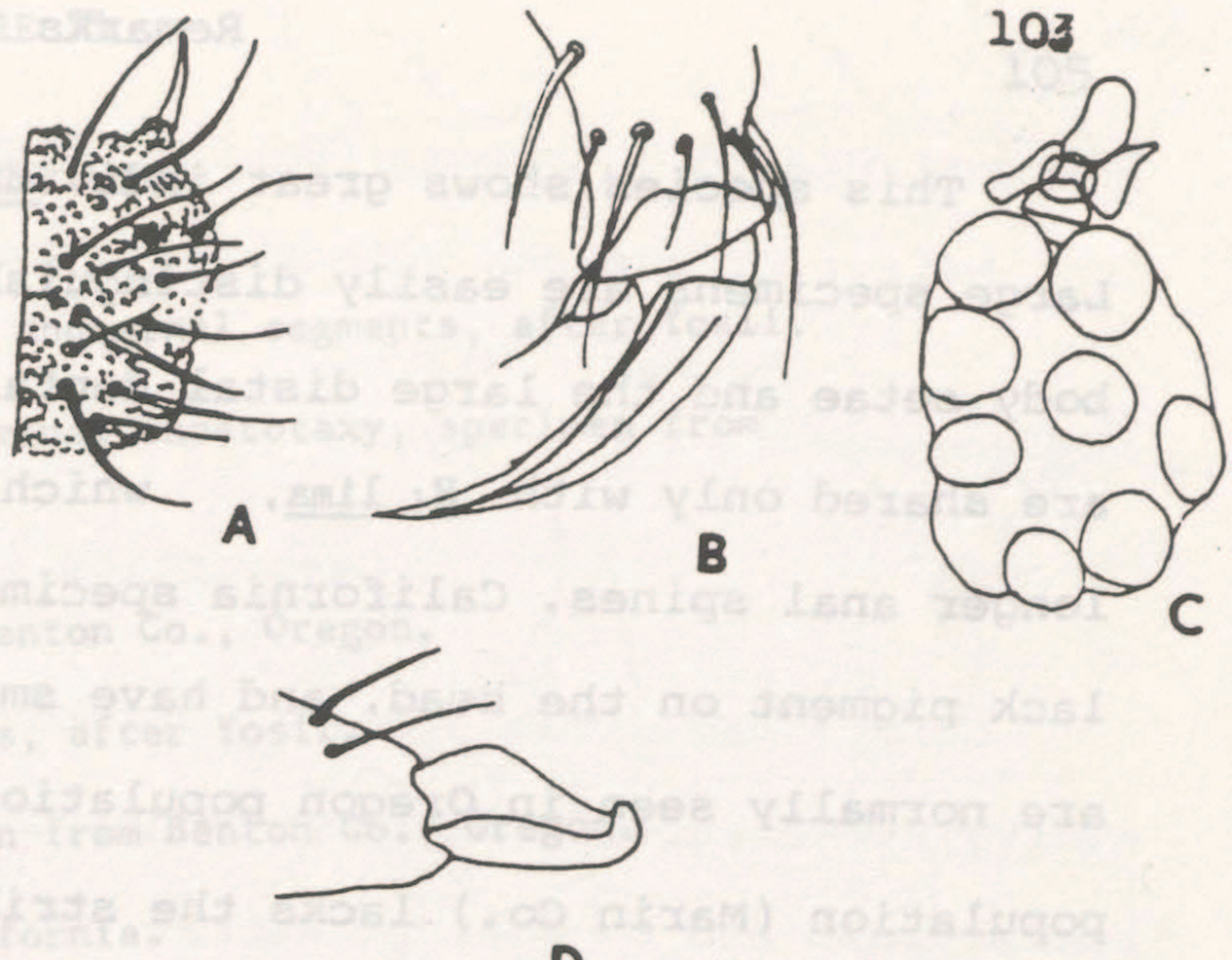
It is possible that this species is actually a Ceratophysella.

Locality: New York - Oswegatchie (type).

Additional records: Connecticut (Bellinger, 1954); Michigan (Snider, 1967).

The first record at least is dubious.

FIGURE 74



Hypogastrura (Hypogastrura) maynardi

All figures after Maynard.

A) End of abdomen.

B) Foot complex.

C) Postantennal organ and nearest eyes.

D) Mucro.

Hypogastrura (H.) oregonensis Yosii, 1960 Fig. 75

Ref.: Am. Midl. Nat. 67: 276

Syn.: Biacanthella neomexicana (Scott), 1961b (?)

Description

Color: background brownish yellow with scattered blue pigment, darker on head. Fourth antennal segment with clear but narrow end bulb deeply withdrawn into pit; blunt setae 7-9, not clearly differentiated from acuminate setae. P.A.O. about as long as nearest eye. Ventral tube with 4+4 setae. Mucro more than half as long as dens. Anal spines generally less than 1/3 as long as inner unguis and subequal to or shorter than papillae. Integument finely to moderately coarsely granulate; largest granules on posterior abdominal segments 19 micra, smallest 7 micra in diameter. Area verticalis with 2+2 setae. Most body setae stout and straight, tapering only at the tip. Abdominal chaetotaxy extremely variable. Maximum length 2.7 mm.

This species shows great individual and geographic variation. Large specimens are easily distinguished by the heavy, straight body setae and the large distal dental granules; these characters are shared only with H. lima, which has a different mucro and longer anal spines. California specimens generally are smaller, lack pigment on the head, and have smaller dental papillae than are normally seen in Oregon populations. In addition, one California population (Marin Co.) lacks the striking spine-like setae on the fifth and sixth abdominal segments. It is possible that the California forms represent a separate species, but their general similarity to Oregon material and the extreme variability in this group makes it seem inadvisable to separate them at present. Biacanthella neomexicana (Scott) is a Hypogastrura. Paratypes we have seen belong to the trybomi group and very likely to this species, but their juvenile condition makes determination uncertain.

Localities: California - Marin Co., Sacramento Co., San Diego Co., Santa Cruz Co.; Idaho - Twin Falls Co.; Montana - Flathead Co.; Oregon - Benton Co. (type); Washington - Walla Walla Co.

FIGURE 75

Hypogastrura (Hypogastrura) oregonensis

A) Chaetotaxy, right side, last three abdominal segments, after Yosii.

B) Alternative condition, fourth abdominal chaetotaxy, specimen from Benton Co., Oregon.

C) Hind foot complex, specimen from Benton Co., Oregon.

D) Postantennal organ and nearest eyes, after Yosii.

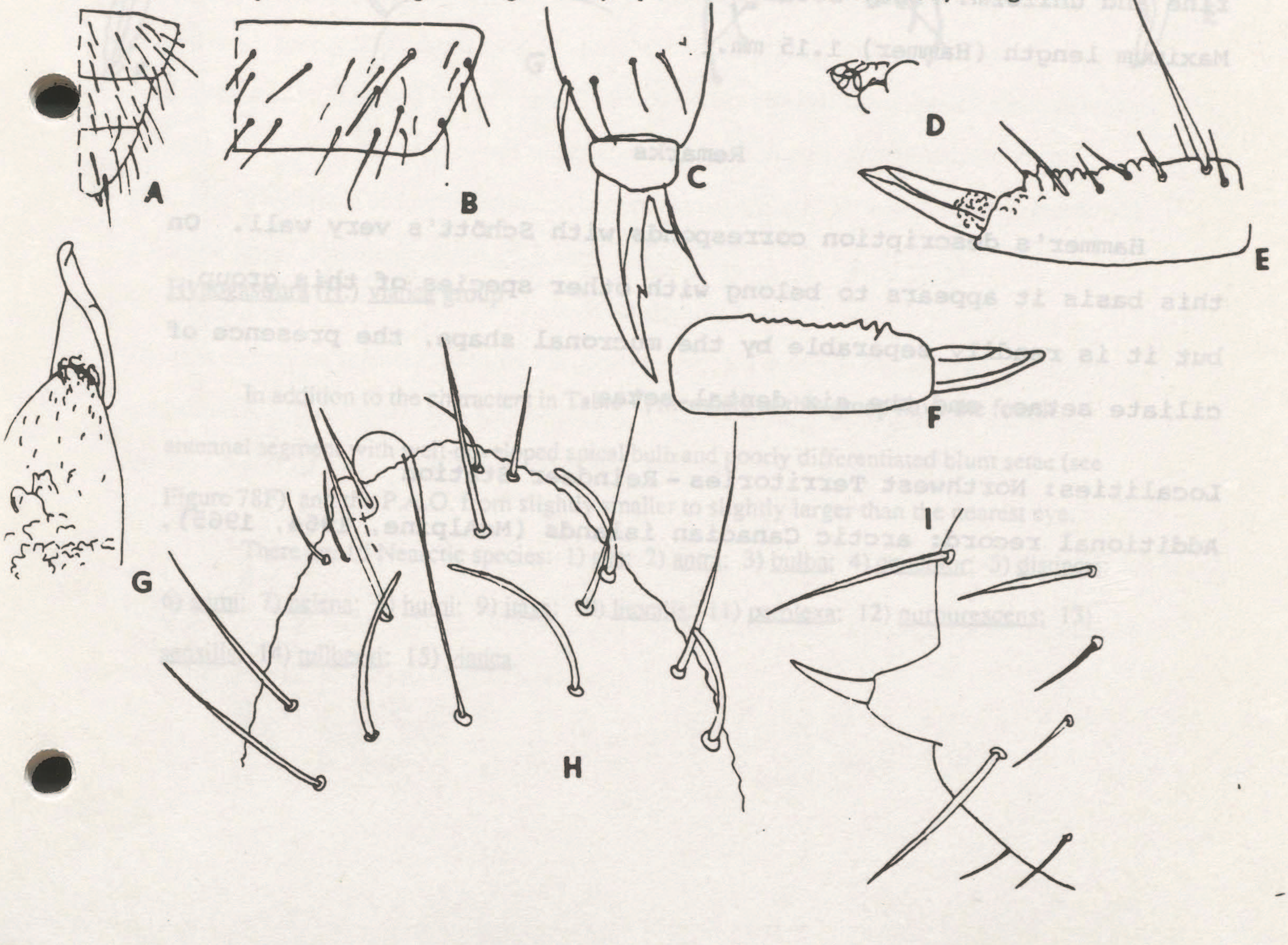
E) Mucro and dens, from side, specimen from Benton Co., Oregon.

F) Mucro and dens, specimen from California.

G) Mucro and apex of dens, seen from above, specimen from Benton Co., Oregon.

H) Dorsum of apex of antenna, specimen from California.

I) Anal spine and neighboring setae, specimen from Benton Co., Oregon.



Hypogastrura (H.) trybomi (Schött), 1893 Fig. 76

Refs.: K. svenska VetenskAkad. Handl. 25(11): 82 (Achorutes);
Hammer, 1953

Description (after Hammer)

Color: background yellow with mottled purple pigment giving a spotty appearance. Fourth antennal segment with well-developed apical bulb and 6 - 8 blunt hairs. P.A.O. subequal to largest neighboring eye. Dens finely granulate dorsally. Mucro about 3/8 as long as dens. Anal spines slightly less than half as long as inner unguis and subequal to papillae. Integumentary granulations fine and uniform. Body setae stout; many unilaterally ciliate. Maximum length (Hammer) 1.15 mm.

Remarks

Hammer's description corresponds with Schött's very well. On this basis it appears to belong with other species of this group, but it is readily separable by the mucronal shape, the presence of ciliate setae, and the six dental setae.

Localities: Northwest Territories - Reindeer Station

Additional record: arctic Canadian islands (McAlpine, 1964, 1965).

FIGURE 76

Hypogastrura (Hypogastrura) trybomi

All figures after Hammer.

A) Fifth abdominal segment, lateral side.

B) Third thoracic segment in profile.

C) Tibiotarsus and foot complex.

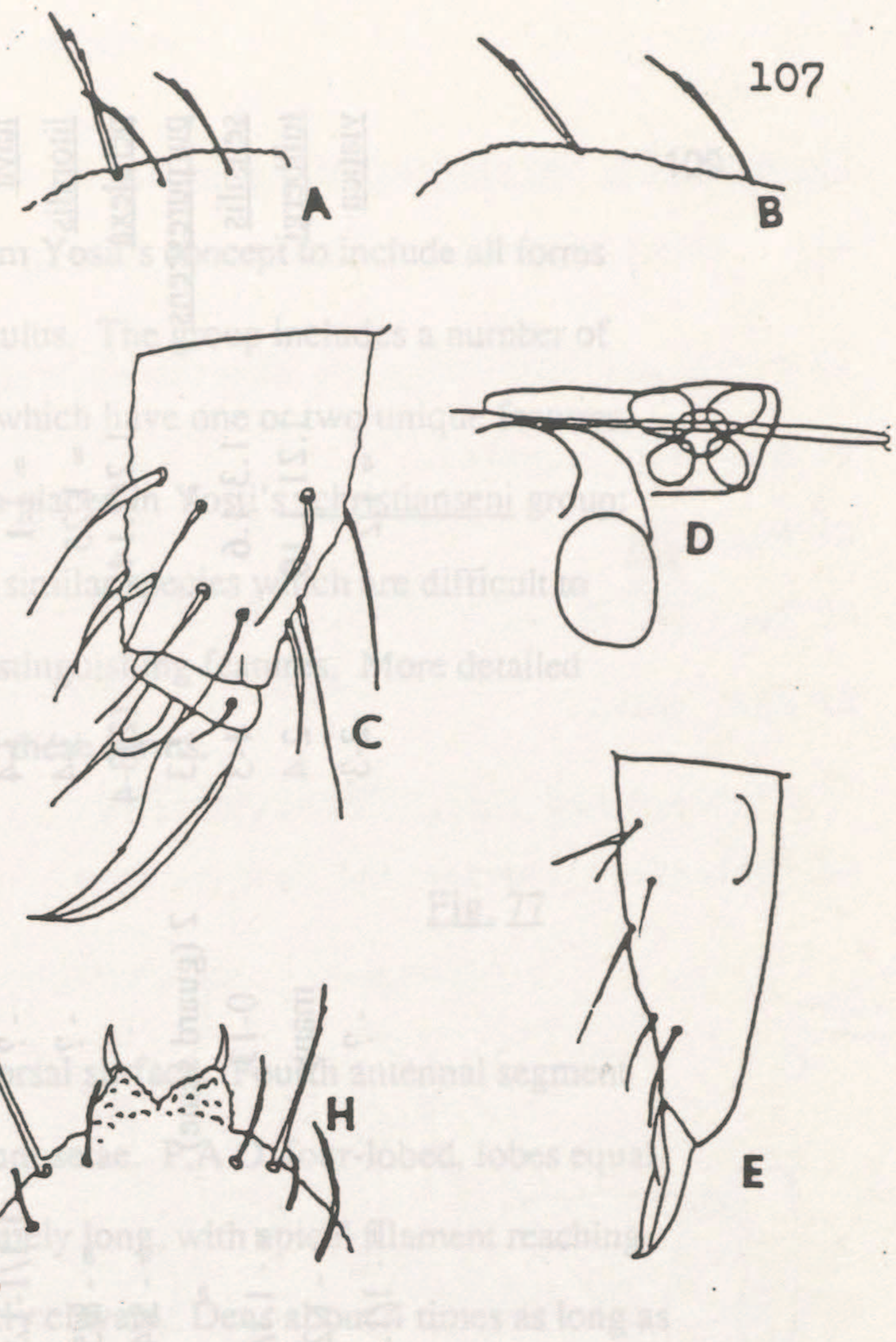
D) Postantennal organ and nearest eyes.

E) Dens and mucro.

F) Mucro, from above.

G) Anal papilla, spine, and neighboring setae.

H) Anal papillae and spines, seen from above.



Hypogastrura (H.) viatica group

In addition to the characters in Table V, members of this group have the fourth antennal segment with well-developed apical bulb and poorly differentiated blunt setae (see Figure 78F), and the P.A.O. from slightly smaller to slightly larger than the nearest eye.

There are 15 Nearctic species: 1) alta; 2) antra; 3) bulba; 4) concolor; 5) distincta; 6) gami; 7) helena; 8) humi; 9) itaya; 10) litoralis; 11) perplexa; 12) purpurescens; 13) sensilis; 14) tullbergi; 15) viatica.

TABLE V
Characteristics of Nearctic Species of Hypogastrura viatica Group

Species	Longest Tenent Hairs / Next Longest	No. of Tenent Hairs	Suppl. 3rd Ant. Spines	P.A.O. / Eye	Anal Spines / Outer Unguis	Clavate Subapical Tenent Hair	Blunt or Knobbed Body Setae	Mucro / Dens
alta	≈ 1.1	2-3	-	≈	≈ 1/5	-	-	≈ 1/4
antra	≈ 1.4	2-3	2 (guard setae)	1 1/10-3/2	≈ 1/4	-	-	1/3.4-1/4
bulba	≈ 1.3	2-3	-	≈	≈ 1/4	-	-	1/3-1/3.5
sp. CC (Iowa)	1.1-1.2	2-3	2 (guard setae)	6/5-7/6	1/6-1/5	-	-	1/3.5-1/4
concolor	≈ 1.15	2-4	2 (guard setae)	≈	≈ 1/4 ?	?	-	1/4-1/3
sp. DD (Missouri)	1.5-1.9	1-2	2 (guard setae)	5/4-1/1	1/4-1/3	-	-	≈ 1/3
distincta	≈ 1.1	3-4	-	≈	≈ 1/3	+	+	1/3-1/4
gami	≈ 1.2	3-4	2 (guard setae)	3/2	1/4-1/5	+	-	1/3.5
helena	≈ 1.2	2-3	-	8/9-3/4	1/3-1/4	-	-	1/4
humi	≈ 1.1	3-4	2 (guard setae)	1+	1/3-1/2	+	-	1/4-1/5
itaya	≈ 1.1	3-4	- ?	1.1/1-1.5/1	1/3-1/4	+	+	≈ 1/3
litoralis	≈ 1.25	3-4	- ?	≈ - 8/5	1/3-1/2	-	-	
perplexa	1.2-1.14	(2)3-4	-	≈ - 5/4	1/4-1/3	+ or -	-	1/4-1/3
purpurescens	≈	2-3	2 (guard setae)	≈	≈ 1/4	-	-	1/3-1/2.5
sensilis	1.3-1.6	1-3	0-13	≈ - 1.1/1	≈ 1/6	-	-	≈ 1/3
tullbergi	1.21-1.10	2-4	many	≈ - 1.2	1/3-1/2	-	-	≈ 1/4
viatica	≈ 1.2	2-3	- ?	≈ - 1/1.1	1/4-2/7	-	-	1/3-2/5

Remarks

The definition of this group has been expanded from Yosii's concept to include all forms with multiple tenent hairs and a clearly lammellate unguiculus. The group includes a number of readily separable forms such as **tullbergi** and bulba which have one or two unique features. In addition, it contains three forms which would have been placed in Yosii's christianseni group; alta, distincta, and itaya. There are also a number of very similar species which are difficult to separate. Table V indicates some of their common and distinguishing features. More detailed study will probably show considerable synonymy among these forms.

Hypogastrura (H.) alta, Christiansen & Bellinger, 1980 Fig. 77

Description

Color: medium blue, irregularly dispersed over dorsal surface. Fourth antennal segment with prominent projecting simple apical bulb and four blunt setae. P.A.O. four-lobed, lobes equal in size; organ subequal to nearest eyes. Unguiculus extremely long, with apical filament reaching or exceeding apex of unguis. Tenent hairs 2 - 3 - 3, weakly clavate. Dens about 4 times as long as mucro, with 4 or 5 dorsal setae. Anal spines about 1/4 inner unguis. Integument uniformly granulate. Chaetotaxy of fourth abdominal segment as in perplexa. Fifth abdominal segment with 3 rows of setae. Maximum length: 2.3 mm.

Remarks

The fifth abdominal segment chaetotaxy is quite variable, but three rows of setae always appear in at least one file. Seat a_2 and/or a_3 may be absent. The greatly elongate unguiculus places this species close to tullbergi, but it differs in the dens and chaetotaxy. Both these features also separate this from humi.

Type locality: Monarch Pass, Gunnison Co., Colorado, 12,000 feet, scrub spruce community, in moss and grass, 7 July 1950 (K. Christiansen).

FIGURE 77

Hypogastrura (Hypogastrura) alta

All figures of type specimens.

A) Fifth abdominal segment chaetotaxy, right side.

B) Hind foot complex.

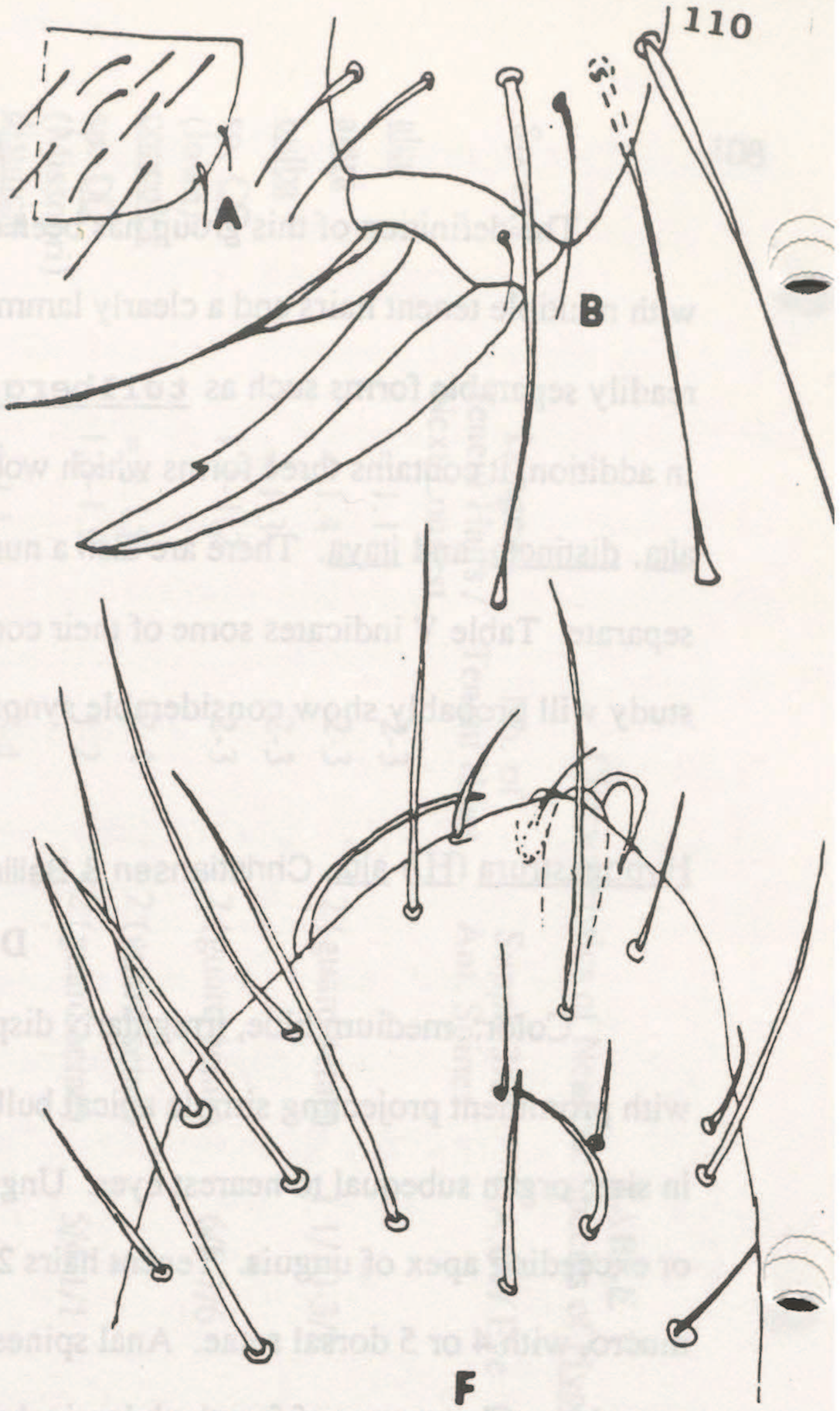
C) Mucro.

D) Dens and mucro.

E) Anal spine.

F) Dorsal surface of apex of antenna.

G) Postantennal organ and nearest eyes.



Hypogastrura (H.) antra, Christiansen & Bellinger, 1980 Fig. 78

Description

Color: pale blue punctate pigment limited to tergites. Fourth antennal segment with clear unlobed apical bulb and 4 blunt setae. P.A.O. 1.1 - 1.5 times size of nearest eyes. Tenent hairs 2 - 3 - 3, with smaller tenent hairs very feebly clavate. Anal spines .32 - .37 inner unguis and slightly longer than papillae. Integument uniformly granulate. All body setae acuminate and slender. Seta M_3 on abdominal segment four present or absent. Maximum length 2 mm.

The extremely weakly clavate smaller tenent hairs serve to separate this from other species of the group. Since these can easily be overlooked the species might be placed in the packardi group by mistake. Not only the tenent hairs but all other features indicate that it belongs in the viatica group. It resembles H. aequepilosa (Stach), 1949a, but differs in chaetotaxy and the absence of a subapical tenent hair on the fourth pair of legs.

Type locality: Hicksey Cave, Jackson Co., Kentucky, Tullgren extract of Neotoma nest (S. Peck).

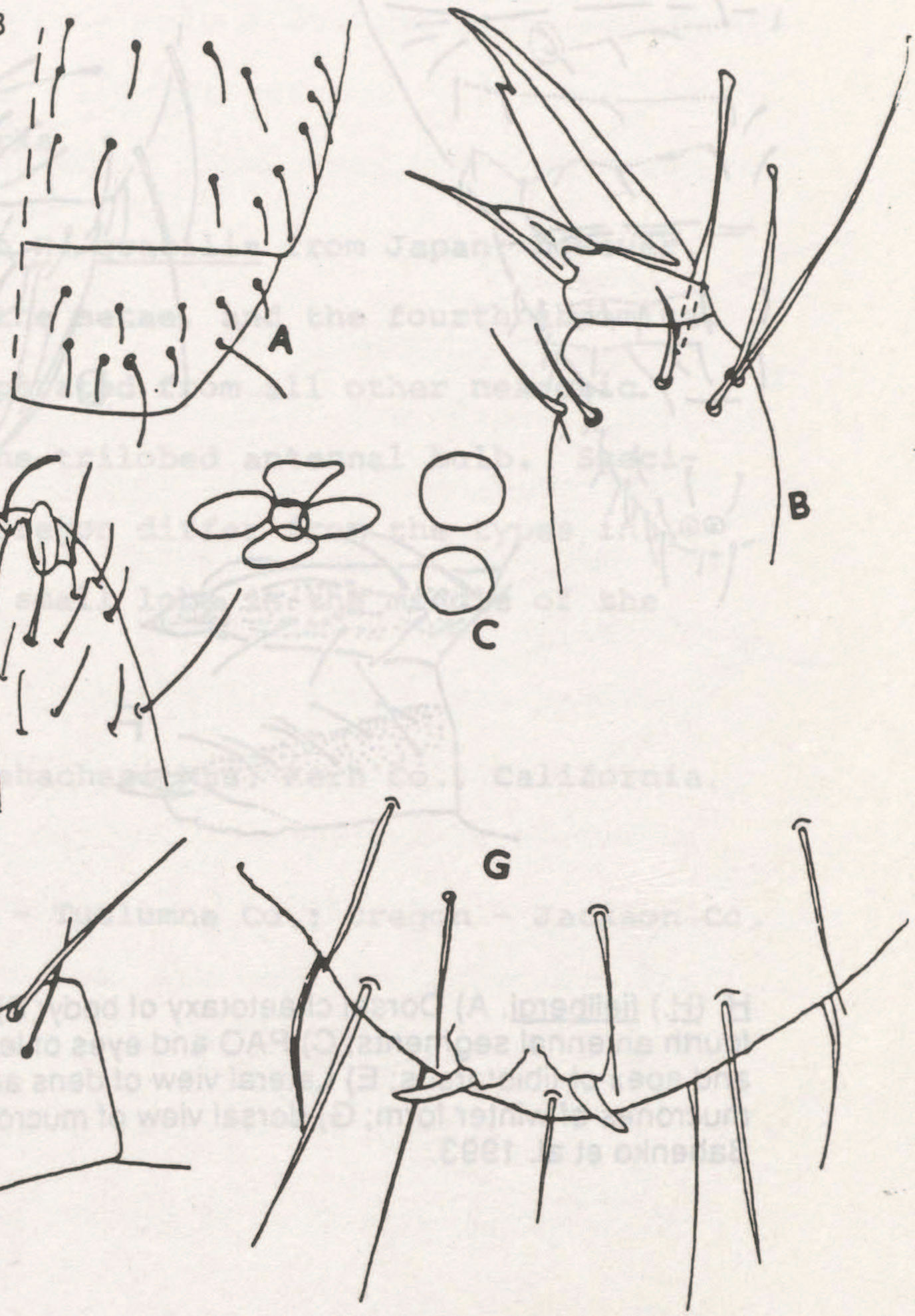
Additional localities: Yarberry Cave, Woodford Co., Kentucky.

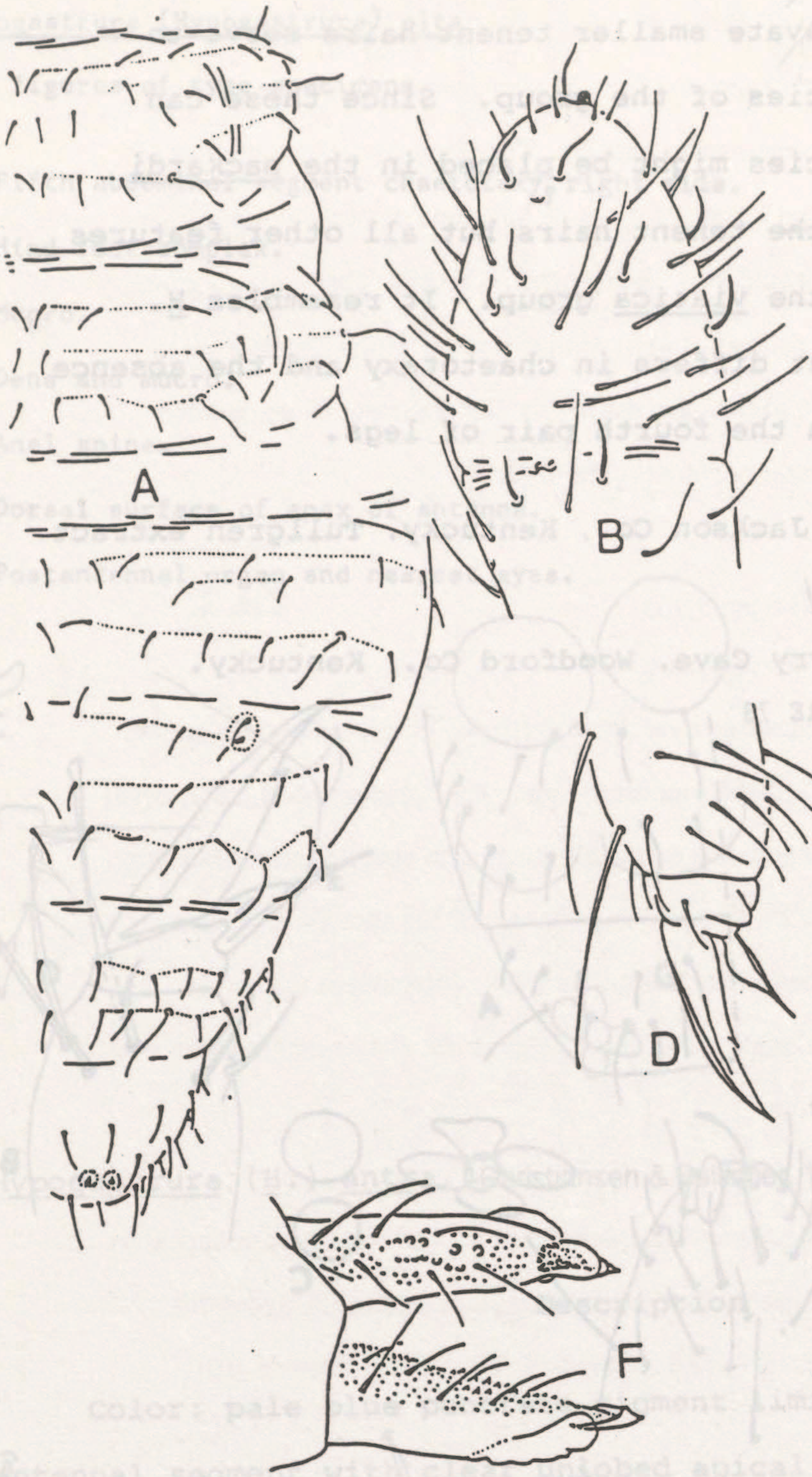
FIGURE 78

Hypogastrura (Hypogastrura) antra

All figures of type specimens.

A) Chaetotaxy of right side of fourth and fifth abdominal segments.
B) Hind foot complex.
C) Postantennal organ and nearest eyes.
D) Mucro and dens.
E) Dorsum of apex of antenna.
F) Venter of same.
G) Dorsum of apex of abdomen.





H. (H.) fjellbergi. A) Dorsal chaetotaxy of body; B) Dorsum of apex of third and fourth antennal segments; C) PAO and eyes of left side; D) Hind foot complex and apex of tibiotarsus; E) Lateral view of dens and mucro; F) Dentes and mucrones of winter form; G) dorsal view of mucro and dens normal form. After Babenko et al. 1993.

Hypogastrura (H.) bulba, Christiansen & Bellinger, 1980 Fig. 79

Description

Color: uniform dark blue, paler on legs. Fourth antennal segment with 2 - 3 curved blunt setae, very similar to acuminate ones; apical bulb trilobed. P.A.O. subequal to nearest eyes. Tenent hairs 2 - 3 - 3 or 3 - 3 - 3. Dens 3 - 3.5 times as long as mucro. Anal spines a little less than 1/3 as long as inner unguis and 1.5 - 2 times as long as papillae. Skin granulations uniformly fine. Longest setae of body heavy, spine-like and sparsely ciliate. Maximum length 2.3 mm.

Remarks

This species is very close to H. gracilis from Japan; however, it differs strikingly in size of the setae, and the fourth abdominal segment chaetotaxy. It can be separated from all other nearctic members of the viatica group by the trilobed antennal bulb. Specimens from the Tehachapi Mts. and Oregon differ from the types in having 2 - 3 - 3 tenent hairs and a small lobe in the middle of the mucro.

Type locality: Paradise Valley, Tehachapi Mts; Kern Co., California, 9 May 1960 (W.R. Icenogle).

Additional localities: California - Tuolumne Co.; Oregon - Jackson Co.

FIGURE 79

Hypogastrura (Hypogastrura) bulba

All figures from types.

A) Chaetotaxy of right side of fifth abdominal segment.

B) Hind foot complex.

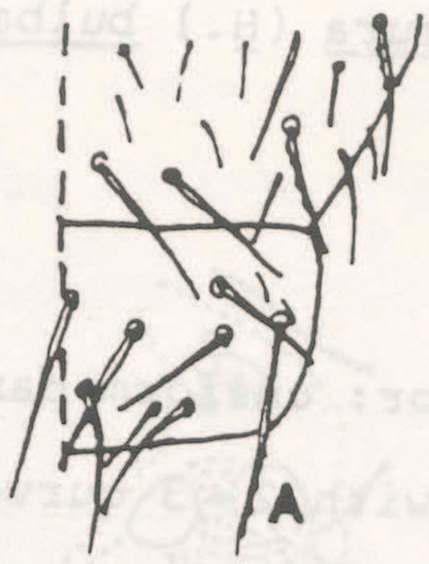
C) Mucro.

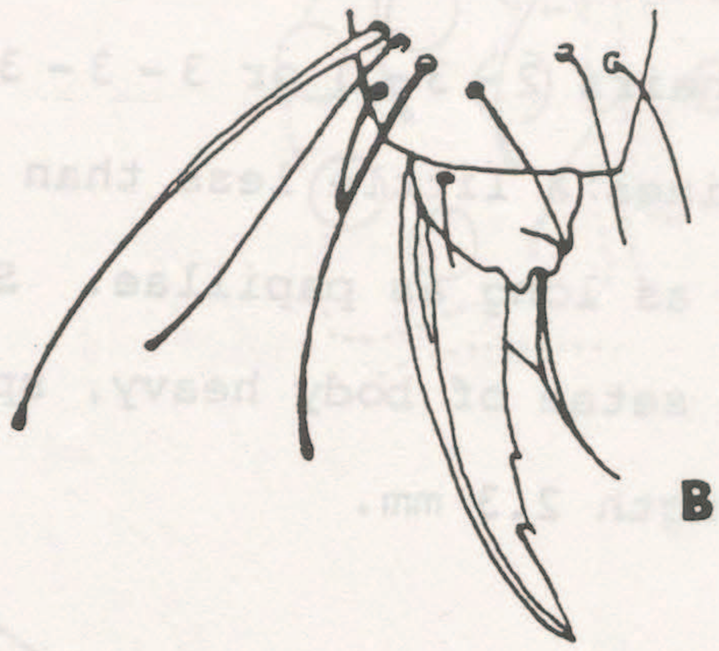
D) Apex of antenna.

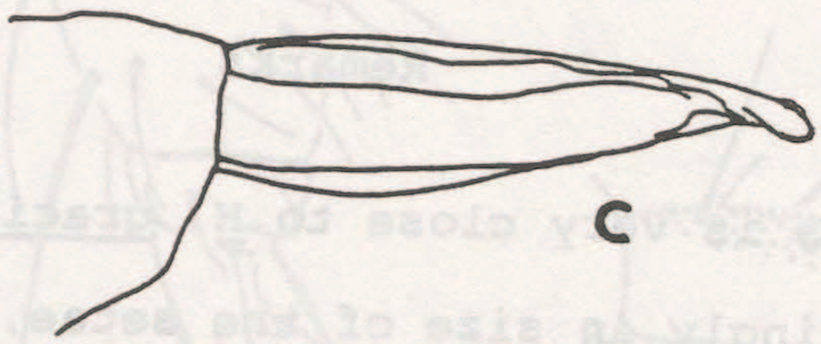
E) Dens and mucro.

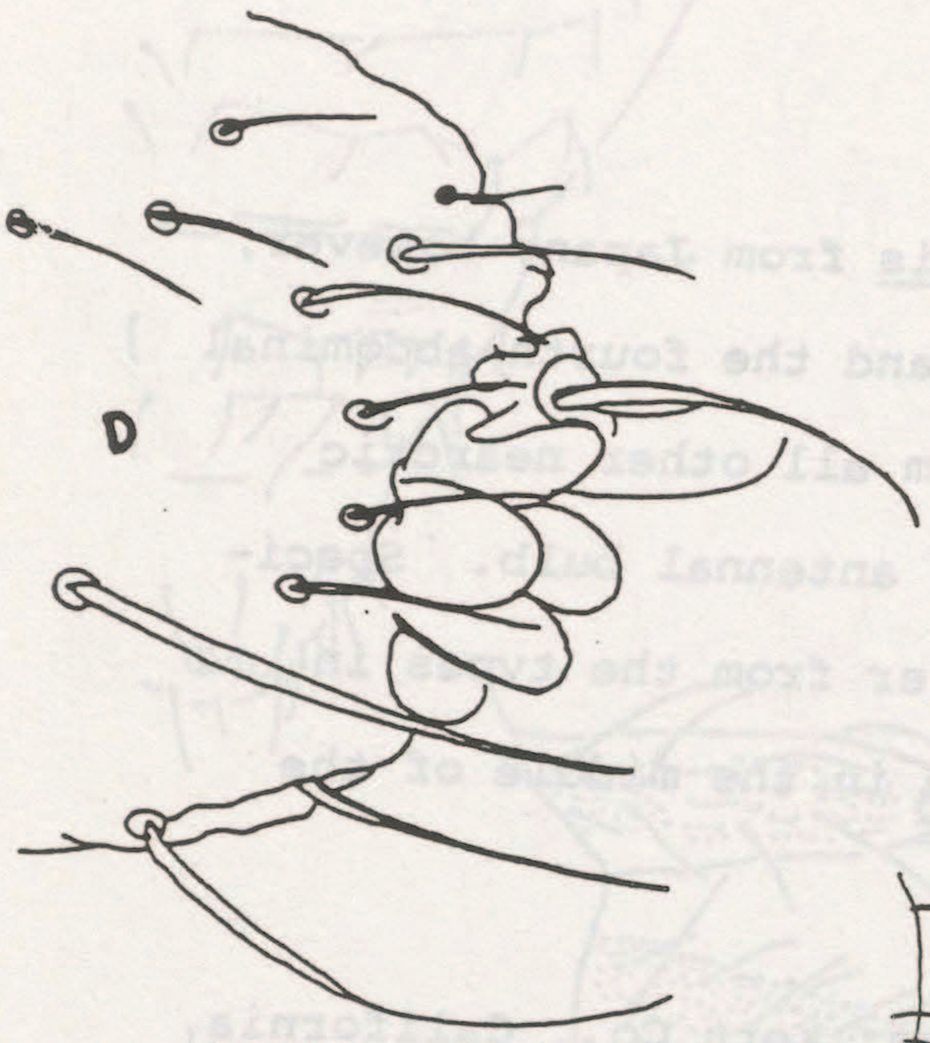
F) Postantennal organ and nearest eyes.

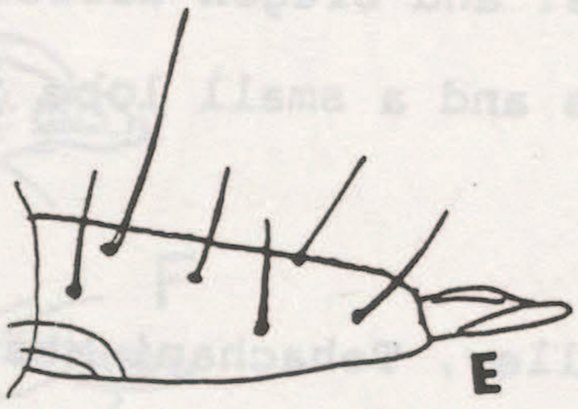
G) Last abdominal segment, from side.

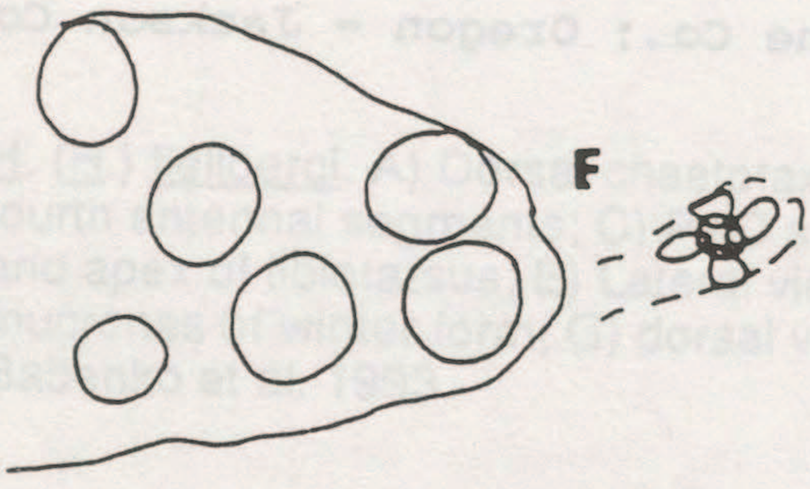


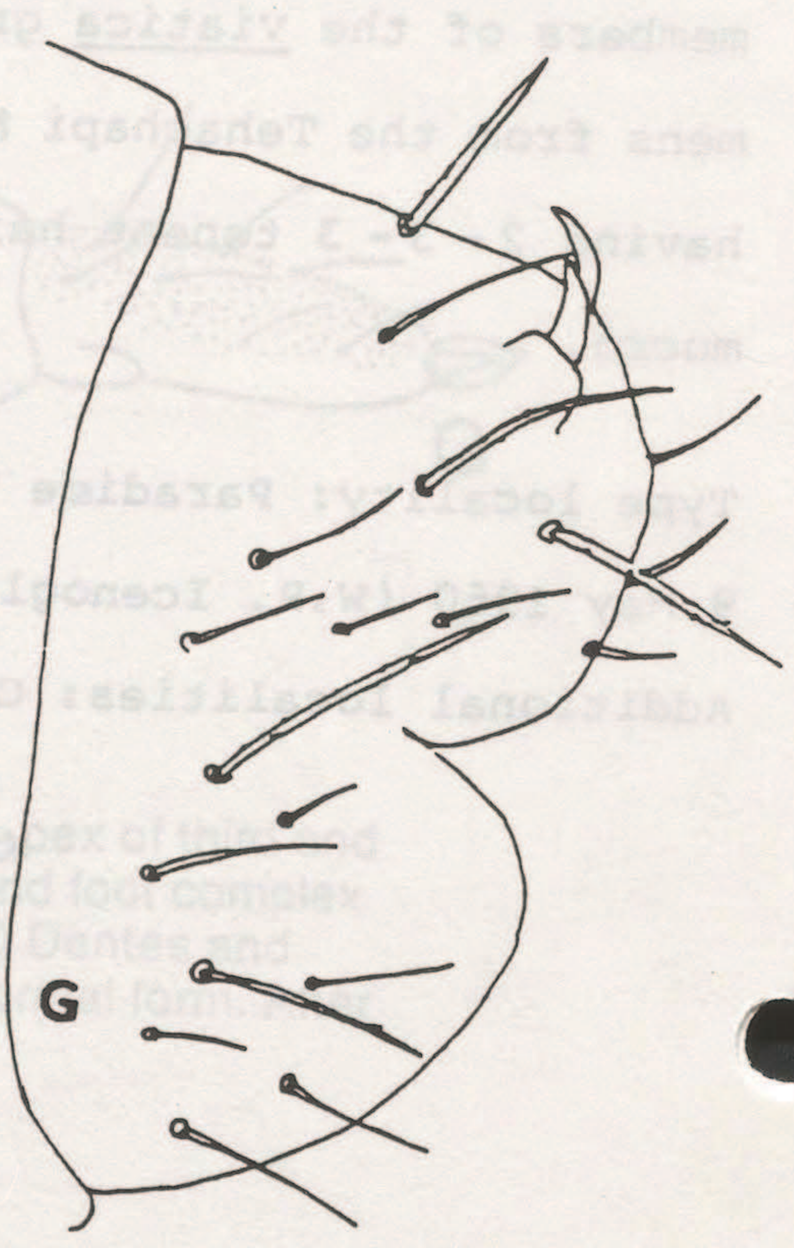












Hypogastrura (H.) distincta (Axelson), 1902 Fig. 80

Refs.: Meddn. Soc. Fauna Flora fenn. 28: 104 (Achorutes);

Palissa, 1964

Description

Color: gray-blue to violet. Fourth antennal segment with unlobed apical bulb and 3 - 4 weakly differentiated blunt setae. P.A.O. subequal to nearest eye. Tenent hairs 3 - 3 - 4. Dens 3 - 4 times as long as mucro, with 5 dorsal setae. Anal spines about half as long as inner unguis and slightly longer than papillae. Skin granules somewhat coarser on dorsum of fifth and sixth abdominal segments, 7 - 12 micra in diameter. Longest setae on fifth and sixth abdominal segments strikingly knobbed at tips. Maximum length 2.1 mm.

Remarks

The identity of the nearctic specimens with the European species is somewhat in doubt. European distincta is described as having relatively longer anal spines and 3 - 4 tenacular teeth. However, the unique mucro, clubbed abdominal setae, and dental shape justify placing American and European specimens in the same taxon pending further study. The nearctic specimens have the christianseni type chaetotaxy on the fifth abdominal segment. Considerable confusion exists in the literature of this species. Palissa mentions the subapical tenent hair of the third leg, and says the tenaculum has 3 + 4 teeth. Linnaniemi and Stach say thereare 4 + 4; but Yosii (Nepal material) says there are 3 + 3 teeth.

Localities: California - San Luis Obispo Co.; Iowa - Story Co.

FIGURE 80

Hypogastrura (Hypogastrura) distincta

A) Chaetotaxy of right side of fourth and fifth abdominal segments, specimen from Shell Beach, California.

B) Hind foot complex, specimen from Shell Beach, California.

C) Postantennal organ and eyes, after Axelson.

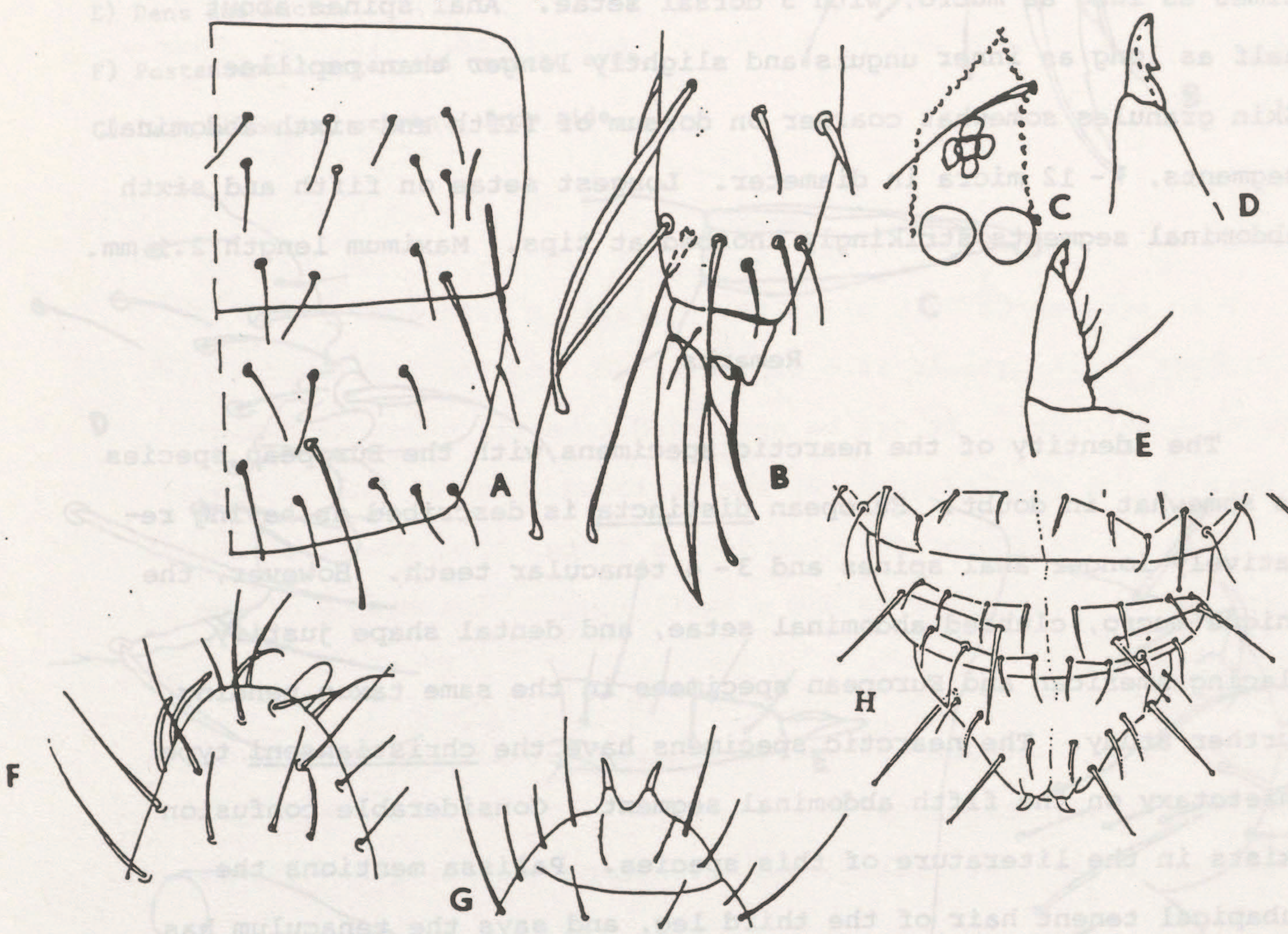
D) Mucro, after Axelson.

E) Dens and mucro, after Axelson.

F) Apex of antenna, after Axelson.

G) Apex of abdomen, after Axelson.

H) Posterior chaetotaxy, after Fjellberg.



Hypogastrura (H.) gami (Wray), 1952 Fig. 81

Ref.: Bull. Brooklyn ent. Soc. 47: 98 (Achorutes)

Description

Color: yellowish background with blotchy blue pigment. Apical antennal bulb clear and unlobed; three poorly differentiated blunt setae on fourth antennal segment. P.A.O. distinctly larger than nearest eyes. Tenent hairs 3 - 3 - 4. Dens 3.5 - 4 times as long as mucro; mucro with abruptly ending lamella and straight ventral margin. Anal spines 1/4 - 1/3 as long as inner unguis, 1.5 - 2 times as long as papillae. Integument uniformly finely granulate. General chaetotaxy as in perplexa. Maximum length observed 1.6 mm.

Remarks

This species may well be a synonym of H. perplexa; however, the peculiar mucro, somewhat larger P.A.O. and longer unguiculus (see Table V) justify separation until larger series are examined. Some specimens from Illinois have the fifth abdominal segment much more coarsely granulate than the other segments.

Localities: Illinois - Putnam Co. (type); North Carolina - Watauga Co.; Pennsylvania - Centre Co.; Washington - Puyallup(?).

FIGURE 81

Hypogastrura (Hypogastrura) gami

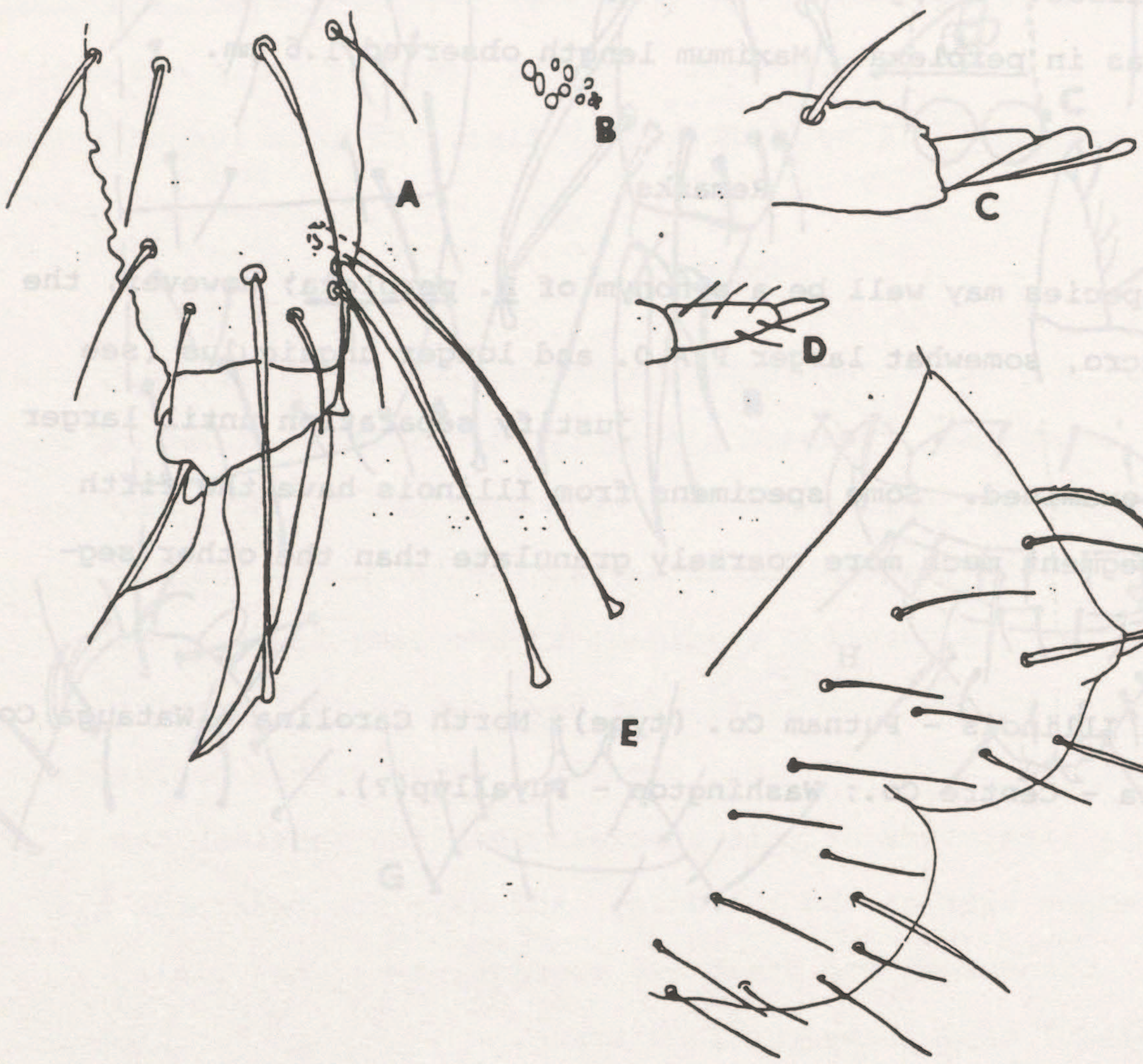
A) Hind foot complex, specimen from Watauga Co., North Carolina.

B) Postantennal organ and eyes, after Wray.

C) Mucro, specimen from Watauga Co., North Carolina.

D) Dens and mucro, after Wray.

E) Sixth abdominal segment, specimen from Watauga Co., North Carolina.



Hypogastrura (H.) helena, Christiansen & Bellinger, 1980 Fig. 82

Description

Color: mottled blue pigment on a white background, paler ventrally. Fourth antennal segment with clear unlobed apical bulb and 4 -5 weakly differentiated curved blunt setae. P.A.O. distinctly smaller than nearest eyes. Tenent hairs 2 - 3 - 3. Mucro about 1/4 as long as dens. Anal spines 2/5 - 1/3 as long as inner unguis, almost twice as long as papillae. Integument uniformly granulate, granules 5 -8 micra in diameter on dorsum of abdomen.

Remarks

This species is closely related to H. humi, but can usually be distinguished by the shorter unguiculus and small P.A.O. (see Table V), as well as by the chaetotaxy of the fifth abdominal segment and the tenent hairs of the forefoot. Some of the Virginia cave specimens have only the median tenent hair clearly clavate and have the posterior lobes of the P.A.O. distinctly smaller than the anterior lobes. It can be distinguished from other species of the group by the absence of a subapical clavate tenent hair on the third tibiotarsus. The specimens from Alaska have a different chaetotaxy and may be misplaced here.

Type locality: Mt. St. Helena, Napa Co., California, 3 February 1959 (Schuster).

Additional localities: Alaska - Pt. Barrow; Virginia - Warren Co. (cave)

Hypogastrura (Hypogastrura) helena

All figures of types.

A) Chaetotaxy of right side of fourth and fifth abdominal segments.

B) Hind foot complex.

C) Hind foot tenent hairs, from outside.

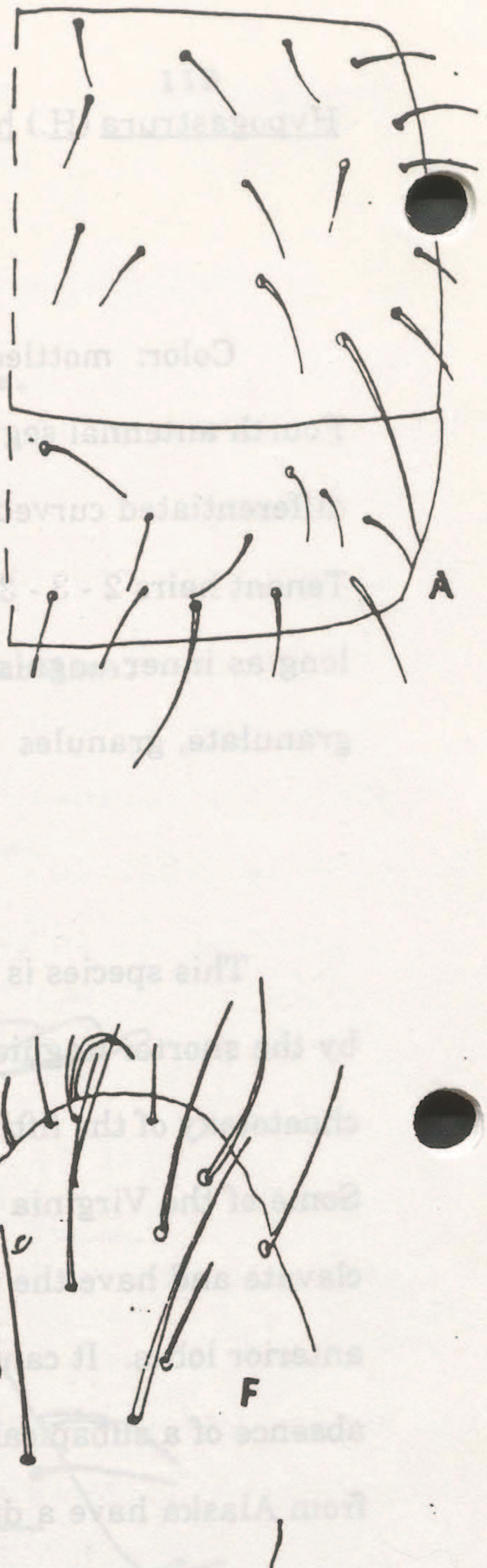
D) Postantennal organ and nearest eyes.

E) Dens and mucro.

F) Dorsum of apex of antenna.

G) Venter of same.

H) Apex of abdomen.



Hypogastrura (H.) humi (Folsom), 1916 Fig. 83

Refs.: Proc. U. S. Natn. Mus. 50: 489 (Achorutes); Salmon, 1974

Description

Color: purple to blue pigment on yellow ground; overall appearance purple to green, pale beneath. Apical antennal bulb clear, unlobed. P.A.O. slightly larger than nearest eyes, four-lobed. Tenent hairs 3 - 3 - 4, with subapical hair on third pair of legs varying from strongly clavate to unclear. Dens 4 - 5 (Folsom: 3) times as long as mucro. Anal spines 2/5 - 1/2 length of inner unguis and 1.5 - 2 times as long as papillae. Integument finely uniformly granulate. Abdomen 5 with s.s. usually p_2, rarely p_3. Maximum length 1.75 mm.

Remarks

This is a most difficult species to identify. It is only poorly distinguished from several others (see Table V) and appears to be quite variable. Specimens from Maryland and Pennsylvania usually have chaetotaxy as figured, but exceptional animals are quite different. Alaskan records of humi may be perplexa (Fjellberg 1995). More extensive collections must be examined to see whether this is a geographically variable species or a group of several similar species.

Localities: Alaska - Pt. Barrow; Connecticut - Litchfield Co.; Illinois - Urbana (type); Maine - Knox Co.; Maryland - Price Georges Co.; New Hampshire - Cheshire Co.; Pennsylvania - Huntingdon Co.

Published records, form far northern Canada to Oklahoma and California, are suspect because of the number of similar species which have been discovered recently.

FIGURE 83

Hypogastrura (Hypogastrura) humi

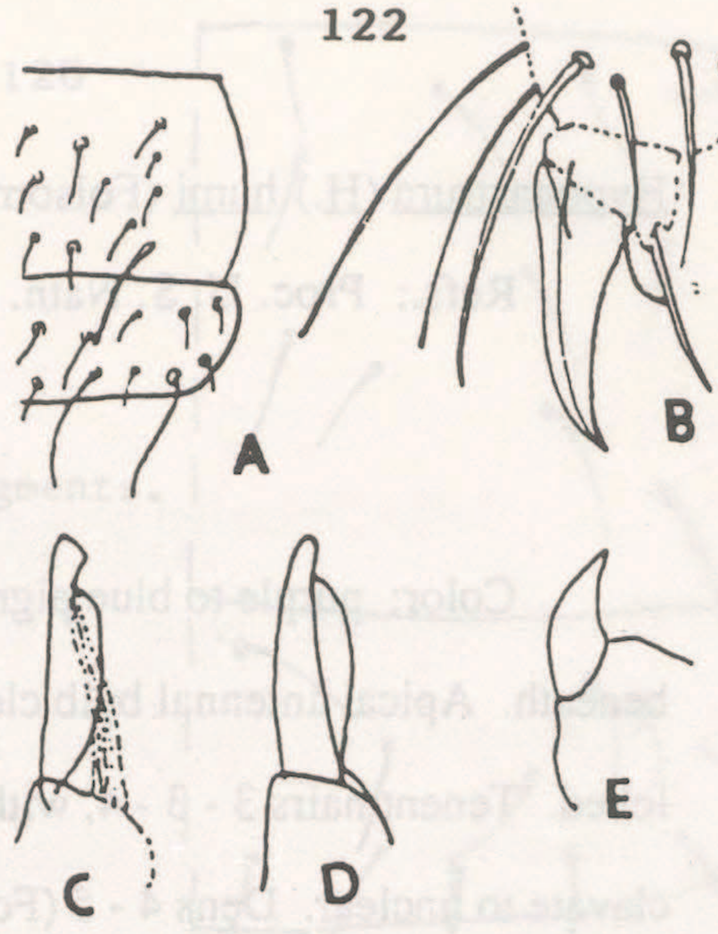
A) Chaetotaxy of right side of fourth and fifth abdominal segments, specimen from Beltsville, Maryland.

B) Foot complex, after Folsom.

C & D) Mucrones, after Folsom.

E) Anal spine, after Folsom.

F) Eyes and postantennal organ, left side, after Folsom.



Hypogastrura (H.) itaya Kinoshita , 1916

Refs.: Zool. Mag., Tokyo 28: 456; Yosii, 1960

Fig. 84

Description

Color: background yellow, with gray or blue-gray pigment in patches. Fourth antennal segment with clear single apical bulb and 3 - 4 poorly differentiated blunt setae. P.A.O. slightly larger to 1.5 times as large as nearest eyes. Tenent hairs 3 - 3 - 4. Unguiculus with striking apical filament, 1/2 - 3/4 as long as inner unguis. Anal spines about half (Yosii: 1/3) as long as inner unguis and 1.5 times as long as papillae. Integumentary granules somewhat larger on posterior abdominal segments; range of dorsal abdominal granules 7 - 12 micra. Longest setae of last three abdominal segments clearly knobbed. Fifth abdominal segment with M_2 setae.

Remarks

This striking species is closely related to H. distincta, but has a very different mucro. Two of the series from North America were taken from cultivated flowers, and may have been introduced . The U.S. specimens differ from the Japanese forms described by Yosii in having a smaller P.A.O. and longer unguiculi.

Localities: California - San Francisco; Indiana - Lawrence Co.; Texas - Laredo.

FIGURE 84

Hypogastrura (Hypogastrura) itaya

A) Fourth and fifth abdominal segment chaetotaxy, after Yosii.

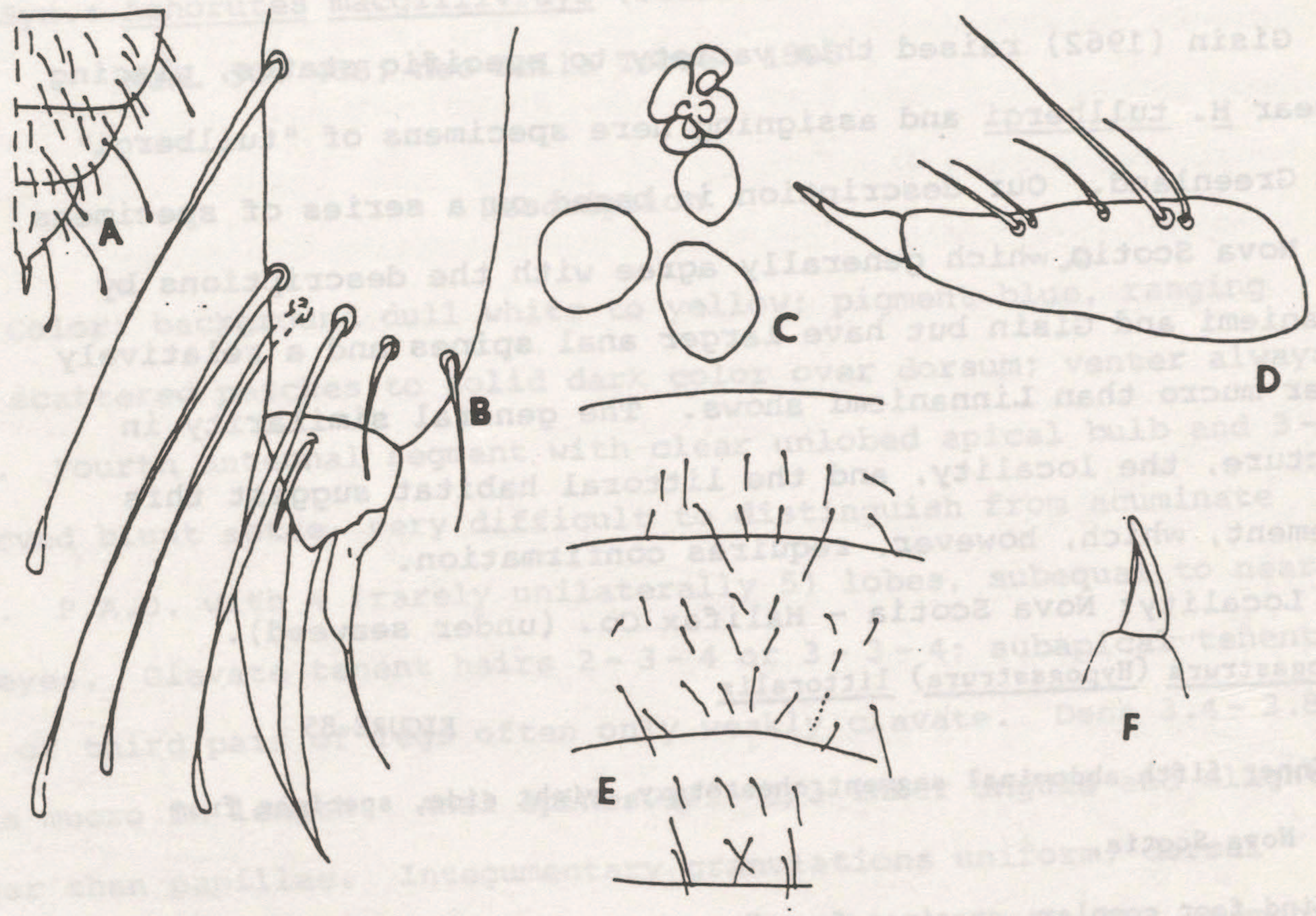
B) Foot complex, specimen from San Francisco.

C) Postantennal organ and eyes, specimen from San Francisco.

D) Mucro and dens, specimen from San Francisco.

E) Median dorsal chaetotaxy, third through fifth abdominal segments, same specimen.

F) Mucro from above, specimen from same collection.



Hypogastrura (H.) litoralis (Linnaniemi), 1909 Fig. 85.

Refs.: Acta Soc. Fauna Flora fenn. 33(2): 16 (Achorutes), as "purpurascens" var.; Gisin, 1962

Description

Color: black to dark blue or violet, with paler intersegmental membranes and scattered spots. Fourth antennal segment with unlobed apical bulb. P.A.O. varied; usually with 4 similar lobes, but sometimes with 5, the 2 anterior lobes larger. Tenent hairs 2-3-3. Ventral tube with 4+4 setae. Tenaculum with 3+3 teeth. Dens 2 1/2 to 3 times as long as mucro, with 6 dorsal setae. Anal spines between 1/3 and 1/2 as long as inner edge of unguis. Chaetotaxy not clearly seen, but large setae all acuminate; smaller posterior setae slightly serrate. Maximum length 1.5 mm.

Remarks

Gisin (1962) raised this variety to specific status, placing it near H. tullbergi and assigning here specimens of "tullbergi" from Greenland. Our description is based on a series of specimens from Nova Scotia which generally agree with the descriptions by Linnaniemi and Gisin but have larger anal spines and a relatively longer mucro than Linnaniemi shows. The general similarity in structure, the locality, and the littoral habitat suggest this placement, which, however, requires confirmation.

Locality: Nova Scotia - Halifax Co. (under seaweed).

Hypogastrura (Hypogastrura) littoralis

FIGURE 85

A) Inner fifth abdominal segment chaetotaxy, right side, specimen from Nova Scotia.

B) Hind foot complex, specimen from Nova Scotia.

C) Postantennal organ and nearest eyes, left side, after Linnianemi.

D) Mucro and dens, specimen from Nova Scotia.

E) Profile of posterior end of abdomen, specimen from Nova Scotia.

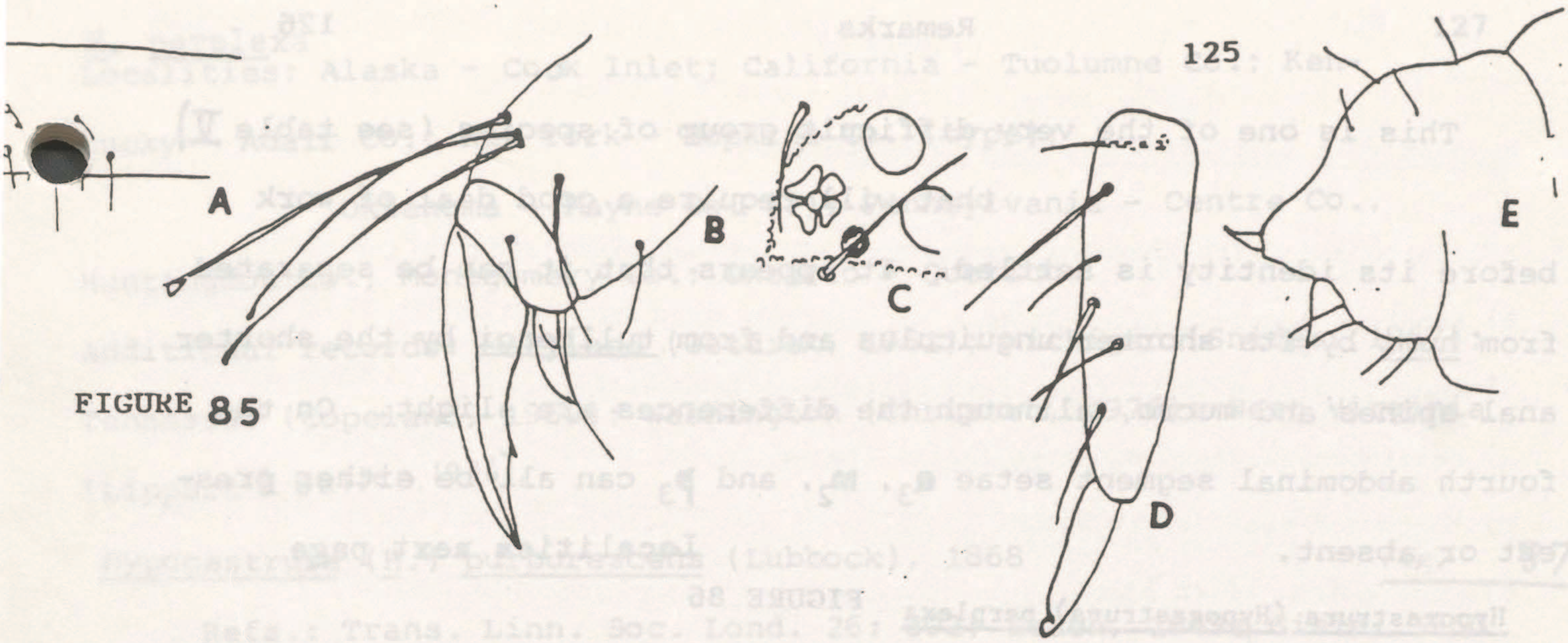


FIGURE 85

Hypogastrura (H.) perplexa n.n. Fig. 86

Ref.: Salmon, 1974

Syn.: Achorutes macgillivrayi (Folsom) 1916, Proc. U.S. natn. Mus. 50: 488; nec Dalla Torre, 1895

Description

Color: background dull white to yellow; pigment blue, ranging from scattered patches to solid dark color over dorsum; venter always pale. Fourth antennal segment with clear unlobed apical bulb and 3-4 curved blunt setae, very difficult to distinguish from acuminate ones. P.A.O. with 4 (rarely unilaterally 5) lobes, subequal to nearest eyes. Clavate tenent hairs 2-3-4 or 3-3-4; subapical tenent hair of third pair of legs often only weakly clavate. Dens 3.4-3.8 times mucro in length. Anal spines 1/5-1/3 inner unguis and slightly larger than papillae. Integumentary granulations uniform; dorsal abdominal granules 6-8 micra in diameter. Fourth abdominal segment chaetotaxy extremely variable. Maximum length 1.7 mm.

This is one of the very difficult group of species (see table V) that will require a good deal of work before its identity is settled. It appears that it can be separated from humi by its shorter unguiculus and from tullbergi by the shorter anal spines and mucro, although the differences are slight. On the fourth abdominal segment setae a_3, m_2, and p_3 can all be either present or absent. Localities next page

FIGURE 86

Hypogastrura (Hypogastrura) perplexa

A) Fourth and fifth abdominal segment chaetotaxy of right side, composite, from two type specimens.

B) Foot complex, after Folsom.

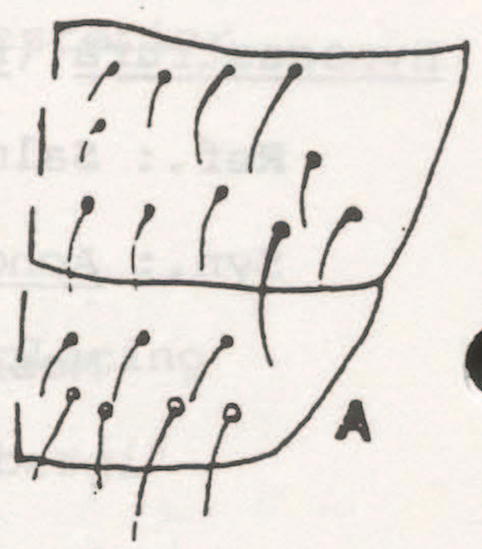
C) Mucro, after Folsom.

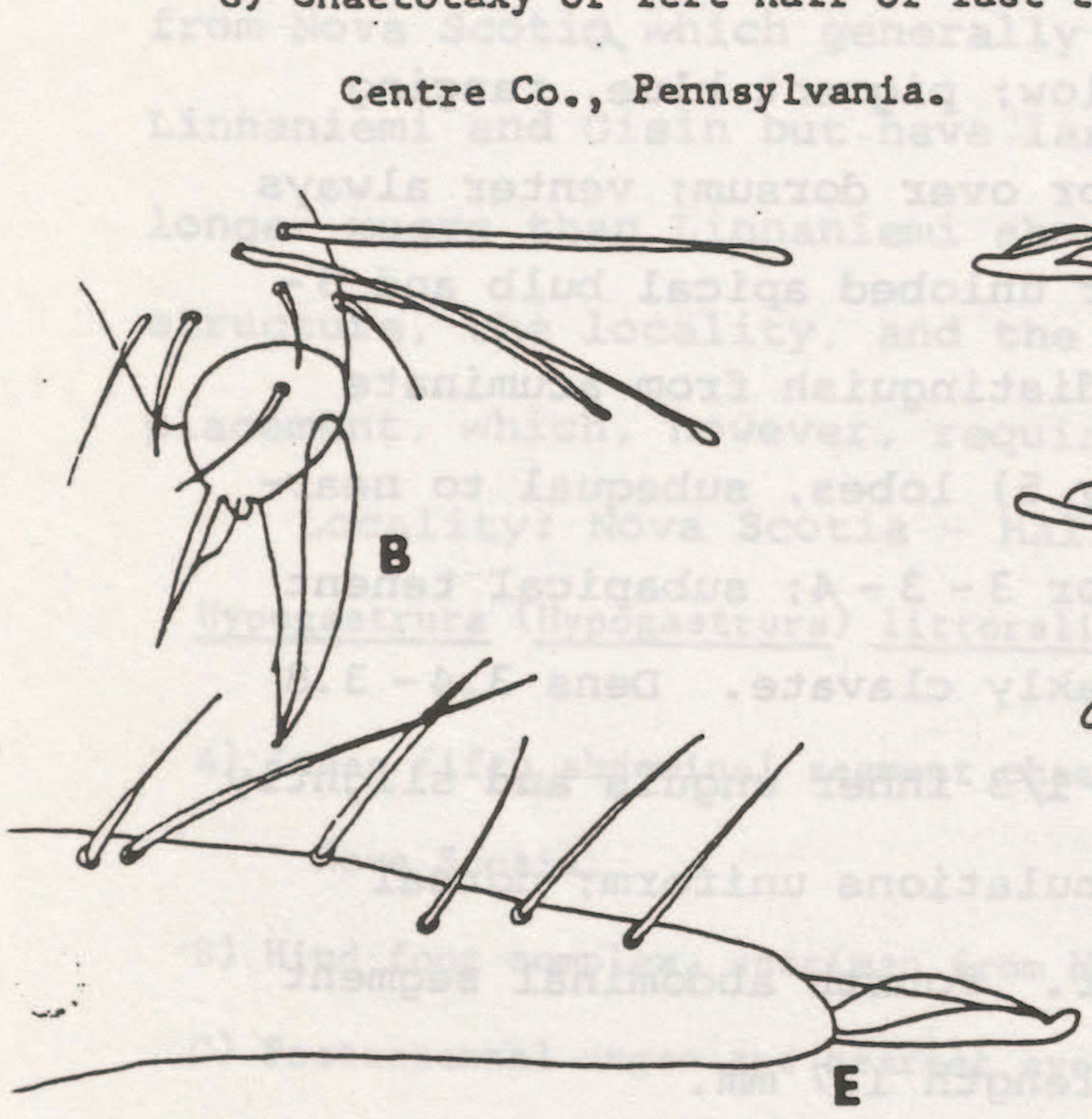
D) Mucrones, two type specimens.

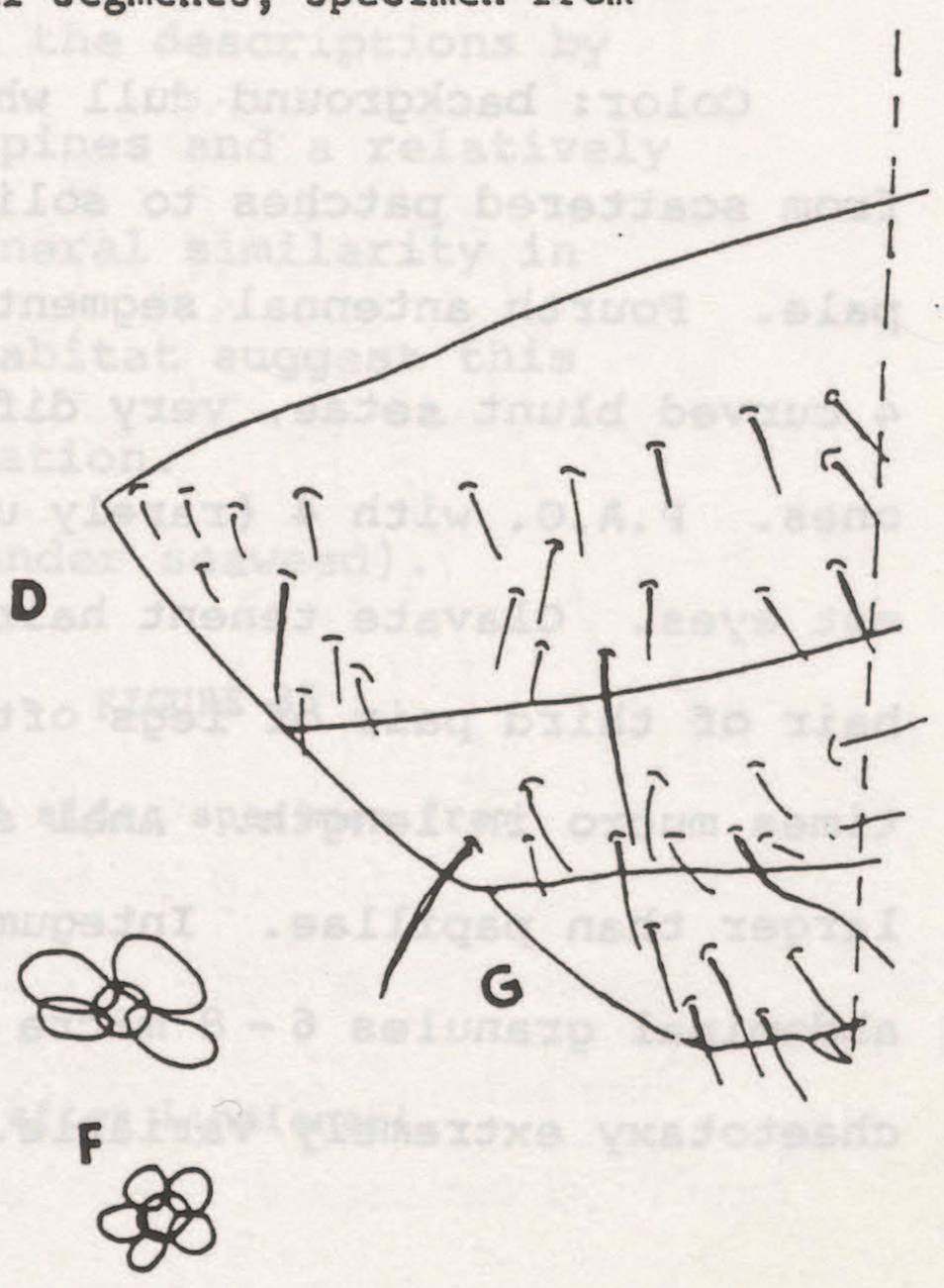
E) Dens and mucro, specimen from Centre Co., Pennsylvania.

F) Postantennal organs, after Folsom.

G) Chaetotaxy of left half of last three abdominal segments, specimen from Centre Co., Pennsylvania.







H. perplexa
Localities: Alaska - Cook Inlet; California - Tuolumne Co.; Kentucky - Adair Co.; New York - Hopkins Co. (type);
Oklahoma - Payne Co. (?); Pennsylvania - Centre Co., Huntingdon Co., Montgomery Co.; Ontario - Quetico.

Additional records: Maryland (Ostdiek, 1961); Michigan (Snider, 1967); Tennessee (Copeland, 1960); Washington (Christen, 1976); West Virginia (Lippert & Butler, 1976).

Hypogastrura (H.) purpurescens (Lubbock), 1868 Fig. 87

Refs.: Trans. Linn. Soc. Lond. 26: 302; Stach, 1949a; Gisin, 1960

Description

Color: irregularly mottled, reddish brown to gray-blue. Fourth antennal segment with clear simple apical bulb and 4 - 5 slightly differentiated blunt setae. P.A.O. subequal to nearest eyes. Tenent hairs 2 - 3 - 2 or 2 - 3 - 3, with middle hair well below level of other two. Tenaculum with 3 - 4 teeth. Dens 2.5 - 3 times as long as mucro, with 7 dorsal setae. Anal spines about 1/3 inner unguis and subequal to papillae. Integument uniformly finely granulate. Body setae slender and acuminate; smaller abdominal setae sometimes sparsely unilaterally ciliate. Maximum length 2.0 mm.

Remarks

Nearctic specimens resemble the European descriptions closely, though some differ in having four tenacular teeth (as in some British specimens, according to Lawrence). The species shows remarkable ecomorphosis, and the "simoneti" ecomorph, originally placed in a separate genus, has been found in Massachusetts. The species is probably introduced in the United States.

Localities: Connecticut - New Haven; Massachusetts - Cambridge; Texas - Brownsville, in plant material in quarantine from Mexico.

Biology: Strebel, 1928, 1932, Ecomorphosis: Cassagnau, 1955, 1958a.

FIGURE 87

Hypogastrura (Hypogastrura) purpurescens

A) Fourth and fifth abdominal segment chaetotaxy of right side, after Gisin.

B) Forefoot complex, after Stach.

C) Tenent hairs of hind foot, from outside, after Stach.

D) Postantennal organ and eyes, after Stach.

E) Mucro and dens, after Stach.

F) Anal spine, after Stach

G) Anal spines, "simoneti" ecomorph, after Gisin.

H) Apex of antenna, after Stach.

I) Postantennal organ variations, after Stach.

Hypogastrura (H.) sensilis (Folsom), 1919 Fig. 88

Ref.: Rep. Can. arct. Exped. 3(A): 5 (Achorutes)

Description

Color: uniform dark blue. Apical organ of third antennal segment with numerous peglike setae. P.A.O. slightly larger than nearest eyes. Only one long clearly knobbed tenent hair per foot; all remaining distal foot setae short, curved and weakly clavate. Tenaculum with 3 + 3 teeth. Dens 3 times as long as mucro; latter as long as third unguiculus. Anal spines about 1/5 as long as inner unguis and 3 times as long as papillae. Chaetotaxy of many small curving and a few moderate sized stout setae. Maximum length 2.0 mm.

Remarks

This species may well be synonymous with spitsbergensis, or with tullbergi, but the described differences in tenent hairs and unguiculus justify separation of these forms at present. Valpas, 1967, from mounted specimen of unknown origin, says tenent hairs are as in tullbergi. It is possible that he had a specimen of the latter from Hammer, identified as sensilis but perhaps referable to spitsbergensis (see there).

Type locality: Bernard Harbor, N.W.T., Canada.

Additional records: N. Alaska (Weber, 1949, 1950); N. Canada (Hammer, 1953a).

FIGURE 88

Hypogastrura (Hypogastrura) sensilis

All figures after Folsom.

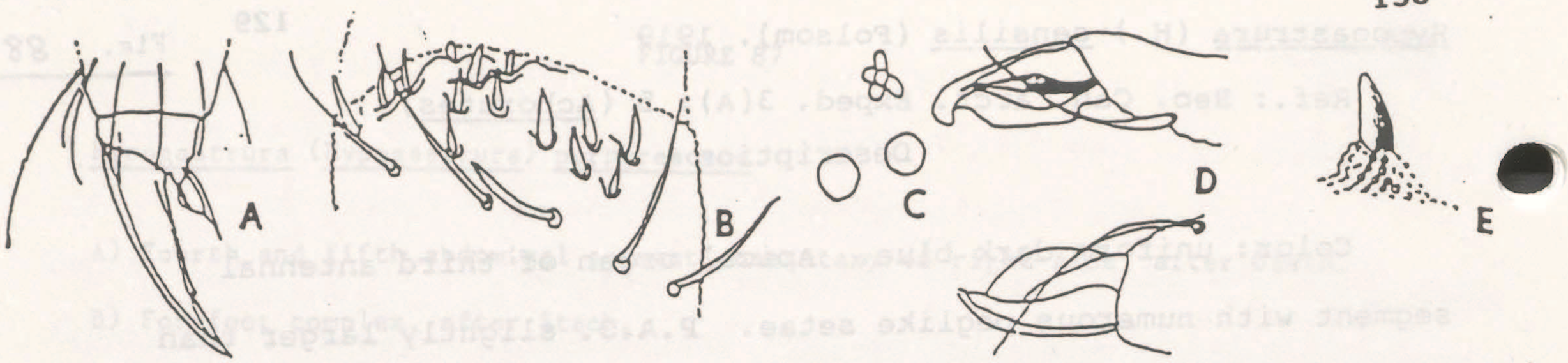
A) Hind foot complex.

B) Apex, third antennal segment.

C) Postantennal and nearest eyes.

D) Two different forms of mucrones.

E) Anal spine.



Hypogastrura (H.) tullbergi (Schäffer), 1900 Fig. 89

Ref: Fauna arct. 1:244 n.n. for Achorutes dubius Tullberg nec Templiton

Syn.: Hypogastrura spitsbergensis (Stach), 1982.

Description

Color: uniform blue- or violet-black. Fourth antennal segment with clear apical bulb but without (Stach) differentiated blunt setae. Third antennal segment with numerous apical peg-like setae as in sensilis. P.A.O. subequal to nearest eyes. Unguis with small inner tooth. Unguiculus about 2/3 as long as inner unguis, with small clear lamella. Dens 4-4.2 times as long as mucro. Anal spines 1/3-1/2 inner unguis and about 1.5 times papillae. Chaetotaxy of mostly short spine-like setae; extremely variable on fourth abdominal segment, with A_3, M_2, and M_3 all variable in position and sometimes absent. Maximum observed length 1.8 mm.

Remarks

Fjellberg, 1985, redescribed this speces from types, established the synonymy, and distinguished it from sensilis and concolor. This species is sharply distinguished from concolor by the presence of spine-like setae on the apex of the third antennal segment. In this respect, it resembles sensilis, which has a broader mucro and 7-9 rather than 5-6 dental setae. This is the species called spitsbergensis in the original version.

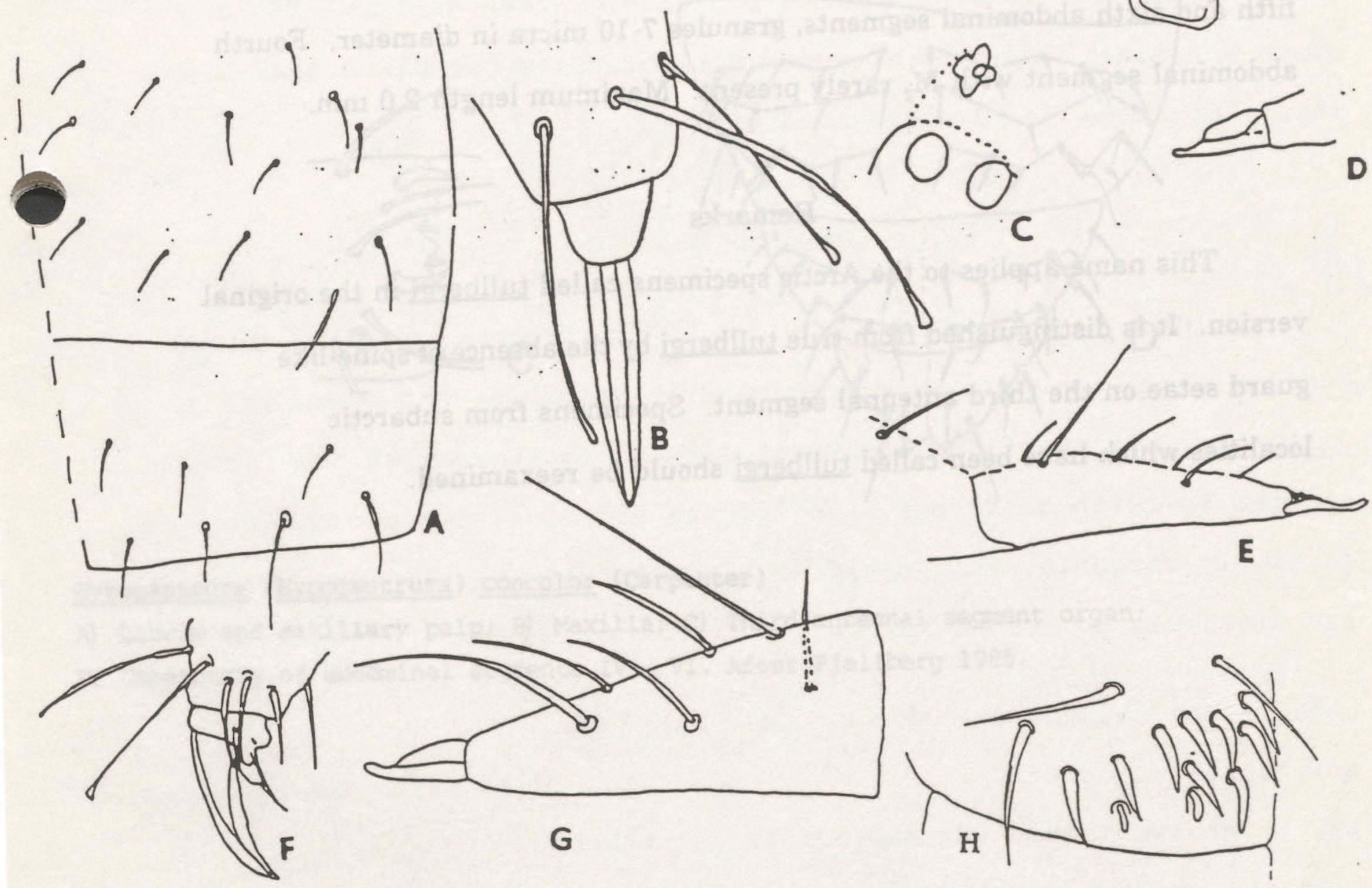
Localities: Alaska - Pt. Barrow.

FIGURE 89

Hypogastrura (Hypogastrura) tullbergi

A) Fourth and fifth abdominal segment chaetotaxy of right side, specimen from Alaska.
B) Tenent hairs, hind foot, specimen from Pt. Barrow, Alaska.
C) Postantennnal organ and nearest eyes, after Stach.
D) Mucro, specimen from Pt. Barrow, Alaska.
E) Mucro and dens, after Stach.
F) Hind foot complex, specimen from Pt. Barrow, Alaska.
G) Mucro and dens, same specimen.
H) Apex third anterior segment, after Fjellberg.
I) Maxilla, after Babenko





Hypogastrura (H.) concolor (Carpenter), 1900 Fig. 90

Ref: Sci. Proc. R. Dublin Soc. (2)9:272, as Achorutes tullbergi

Description

Color: dark gray-blue, paler ventrally. Fourth antennal segment with clear, simple apical bulb and four weakly differentiated blunt setae. P.A.O. subequal to nearest eyes, with posterior lobes clearly smaller than anterior. Tenent hairs 2-3-4 or 2-3-3. Unguiculus about half as long as inner unguis. Dens 2.5-3 times mucro. Anal spines about 1/3-1/2 as long as inner unguis and slightly longer than papillae. Integument slightly more coarsely granulate on fifth and sixth abdominal segments, granules 7-10 micra in diameter. Fourth abdominal segment with M_2 rarely present. Maximum length 2.0 mm.

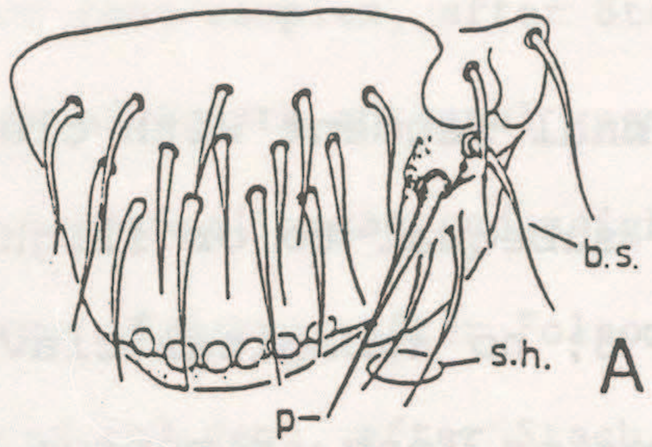
Remarks

This name applies to the Arctic specimens called tullbergi in the original version. It is distinguished from true tullbergi by the absence of spine-like guard setae on the third antennal segment. Specimens from subarctic localities which have been called tullbergi should be reexamined.

Localities: California - Sonoma Co., Illinois - Cook Co.

Additional Records: Kentucky (Lesshafft, 1977); Alaska (Fjellberg, 1985); New York (Maynard, 1951); N. Canada (Hammer, 1953a).

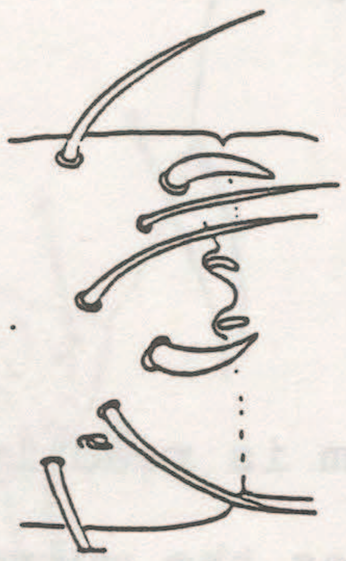
Figure 90



A



B



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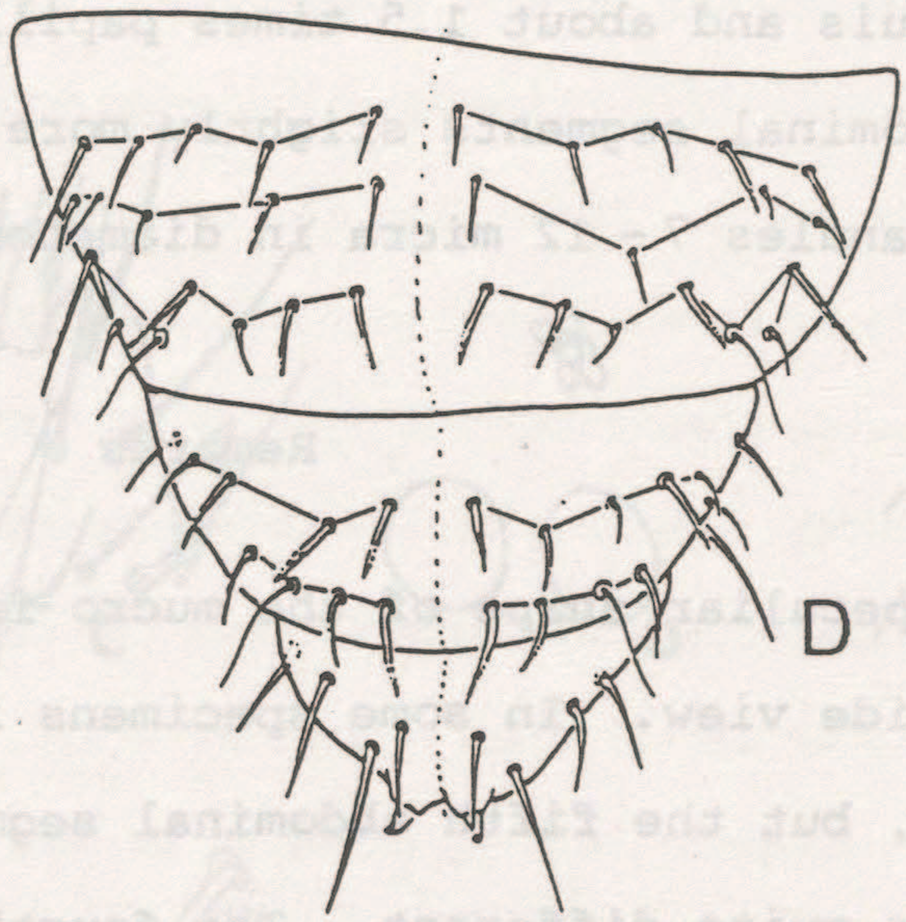


D

Hypogastrura (Hypogastrura) concolor (Carpenter)

A) Labrum and maxillary palp; B) Maxilla; C) Third antennal segment organ; D) Chaetotaxy of abdominal segments IV - VI. After Fjellberg 1985.

Hypogastrura (H.) viatica (Tullberg), 1872 Fig. 91

Refs: K. svenska VetenskAkad. Handl. (2) 10 (10): 50 (Achorutes); Stach, 1949a.

Description

Color: blue-violet to black. Fourth antennal segment with clear unlobed apical bulb and 4 blunt setae. P.A.O. subequal to or slightly smaller than nearest eyes. Tenent hairs 2 - 3 - 3; no subapical clavate hair on third pair of legs. Dens 2.5 - 2.9 times as long as mucro; mucro with broad basal lamella. Anal spines 1/3 - 2/5 as long as inner unguis and about 1.5 times papillae. Integument of fifth and sixth abdominal segments slightly more coarsely granulate than elsewhere; granules 7 - 12 micra in diameter.

Remarks

The peculiar shape of the mucro in this form is readily identified in side view. In some specimens it resembles the mucro of distincta, but the fifth abdominal segment chaetotaxy of the latter species is quite different. The fourth abdominal segment chaetotaxy is highly variable, frequently with erratically placed setae which are difficult to orient in rows.

Localities: California - Fresno Co., Kings Co.

Additional records: Utah (Wray and Knowlton, 1953); arctic Canada (Hammer, 1953a, and others).

(see figure 91 next page)

FIGURE 91

Hypogastrura (Hypogastrura) viatica

A) Posterior abdominal chaetotaxy of right side, after Gisin.

B) Hind foot complex, after Stach.

C) Apex of fourth antennal segment, blunt setae darkened, after Stach.

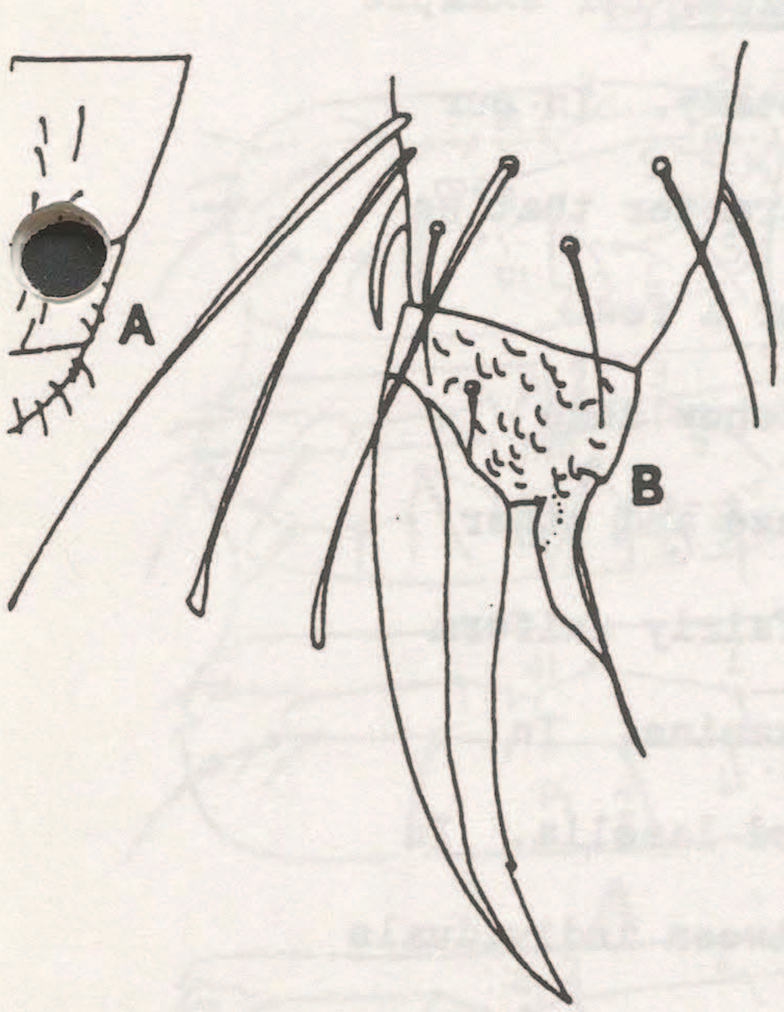
D) Postantennal organ and neighboring eyes, after Stach.

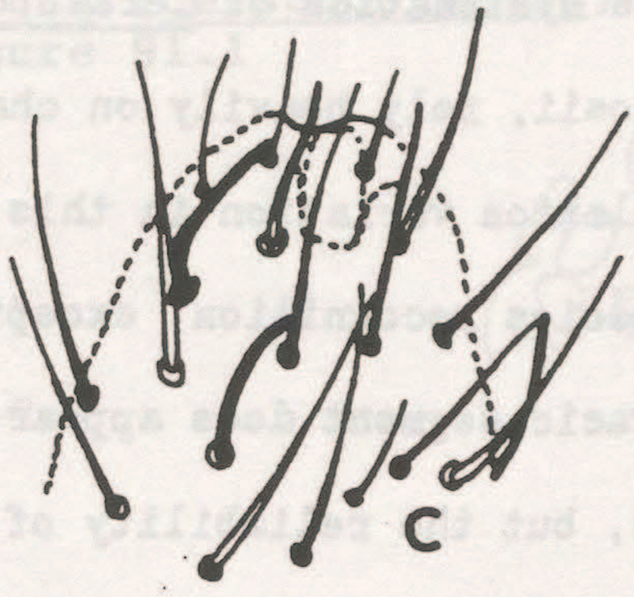
E) Forms of mucro, after Folsom.

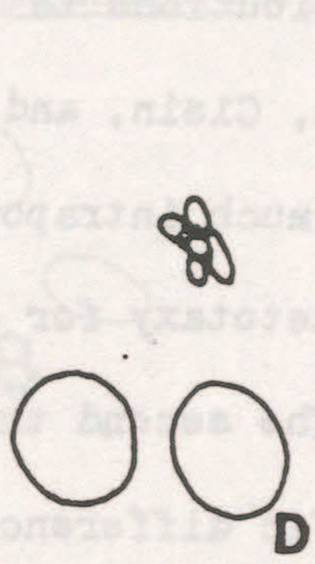
F) Mucro and dens, after Stach.

G) Region of postantennal organ, after Stach.

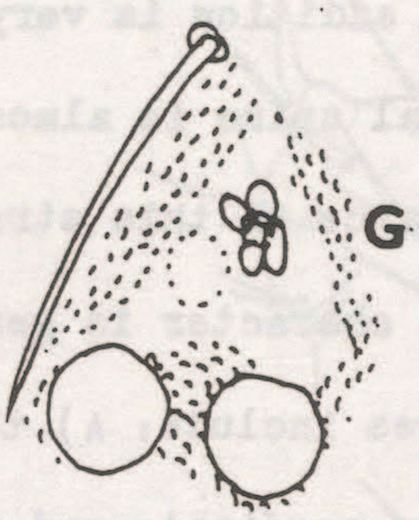
H) Anal spines, after Stach.

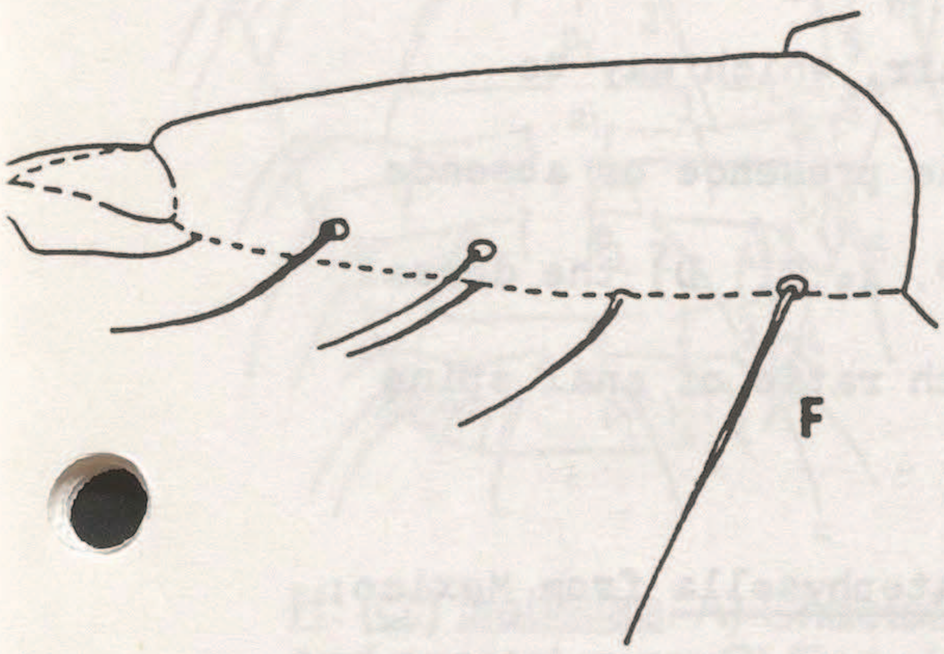


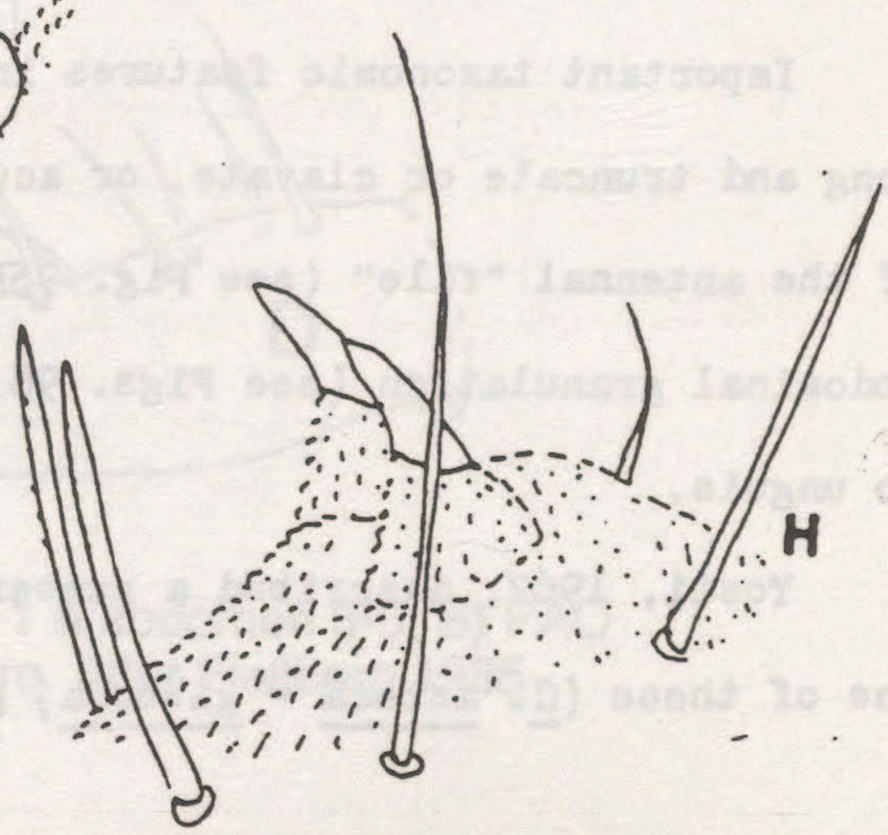












Subgenus Ceratophysella Börner, 1932

Type species: Podura armata Nicolet, 1842.

Syn.: Spinachorutes Scott, 1962a, type species: S. krafti Scott, 1962a, n.syn.

The members of this subgenus are species of Hypogastrura with a well developed unguiculus and a spoon-shaped mucro with a lateral flap, but with the posterior arms of the P. A. O. not surrounding the accessory boss. Most have s.s. = p_3 on the second thoracic segment, but this seta may be minute or difficult to differentiate from others. All have lateral and internal ungual teeth and relatively large (never minute) anal spines). Most species have 7 blunt setae on the fourth antennal segment, distributed as shown in Fig. 109D.

Remarks

This is the second largest subgenus. It is quite difficult to work with. Important recent contributions to the systematics of Ceratophysella, for example in papers by Cassagnau, Gisin, and Yosii, rely heavily on chaetotaxy. In our work we have found so much intrapopulation variation in this character that we have avoided using chaetotaxy for species recognition, except for a few clear-cut features. The second thoracic segment does appear to show some consistent interspecific differences, but the reliability of these and other characters must be established by further study. The mucro is fairly uniform throughout the subgenus, and in addition is very confusing to examine. In particular, the apparent mucronal spine is almost always a folded lamella. In most forms the spinelike appearance of this structure varies between individuals and with the angle of view; the character is generally worthless taxonomically.

Important taxonomic features include: A) the tenent hair, which may be long and truncate or clavate, or acuminate and short: B) the presence or absence of the antennal "file" (see Fig. 95B); C) the form of the P. A. O.; D) the dorsal abdominal granulation (see Figs. 98, 102); and E) the length ratio of anal spine to unguis.

Yosii, 1962, described a number of new species of Ceratophysella from Mexico; one of these (C. azteca = gibbosa) has been found in the United States, and there

is a good chance that others will be also. For this reason, they are incuded with the Nearctic forms in Table VII.

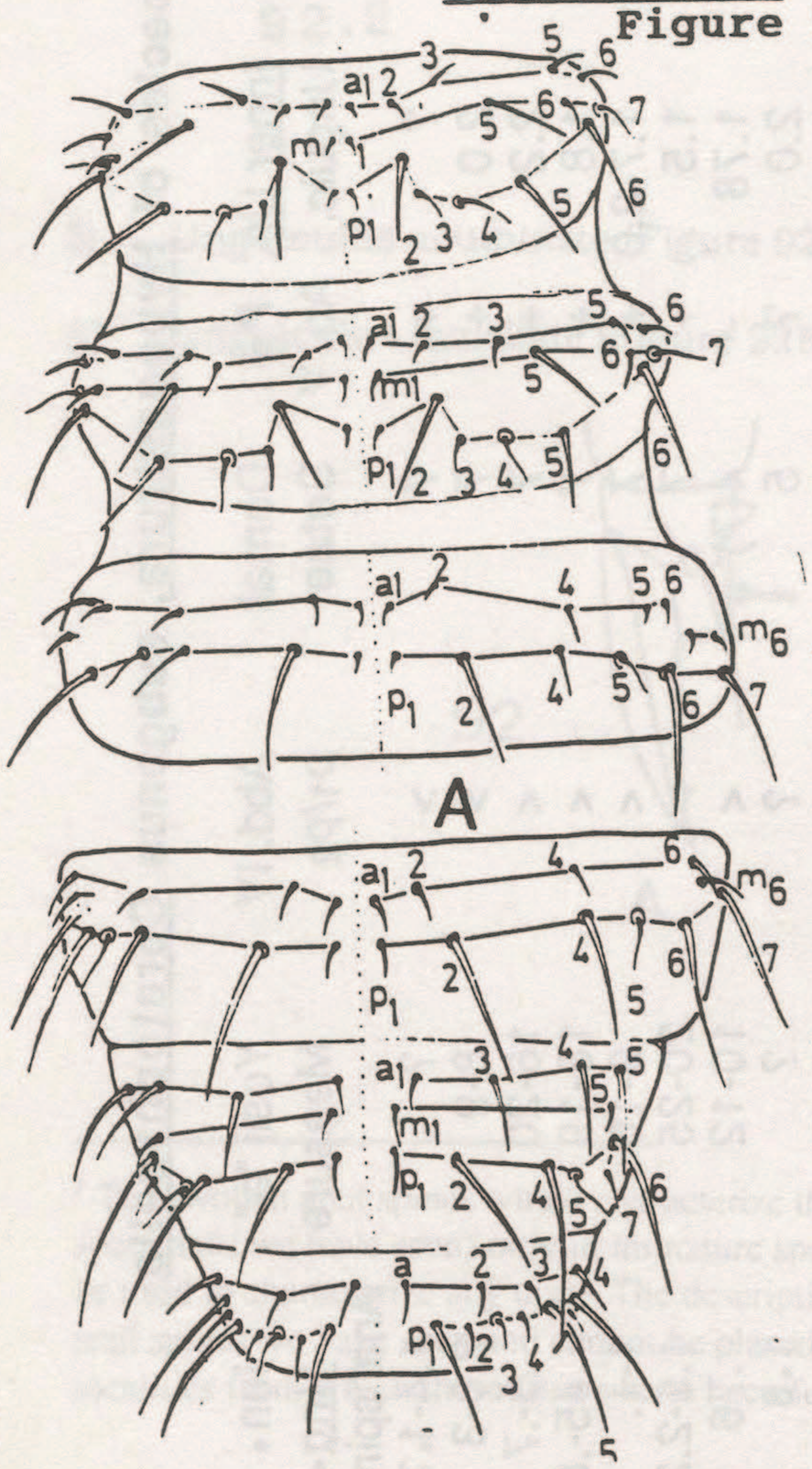
Yosii divided Ceratophysella into 3 species groups, to which we add a fourth; characteristics of these groups are shown in Table VI.

Table VI
Characteristics of Species Groups of Nearctic Ceratophysella

Group Name	Fourth Abdominal Segment Chaetotaxy	Tenent Hair	Yosii "a" Measure	No. of Nearctic Species
armata	$P_1 > P_2$	acuminate to clavate	16-25	6
boletivora	$P_1 < P_2$	clavate	9-20	3
denticulata	$P_1 < P_2$	acuminate or truncate	7-13	8
maheuxi	$P_1 < P_2$	acuminate	17-20	3

In addition, Maynard's species densomata is shown as having acuminate unguiculi; if this is the case it would represent a fifth group.

Hypogastrura (Ceratophysella) isabellae Fjellberg 1985
Figure 91.1



H. (C.) isabellae. A) Chaetotaxy, thorax 2-3 , abdomen 1 & abdomen 3-5; B) PAO and nearest eyes; C) End of abdomen; D) Dens & mucro. After Fjellberg 1985

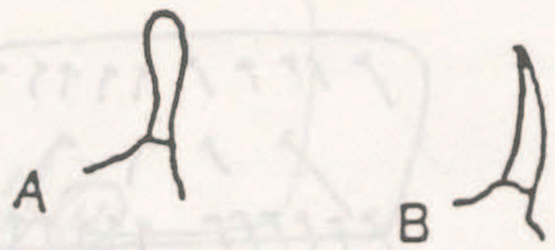
Table VII. Characteristics of Nearctic Species of Hypogastrura, subgenus Ceratophysella

Species	Clear Ant. IV "file"	P.A.O. Lobes Ant./Post.	N	Tenent Hair*	Inner Un. Unguic.	P_3 Ab. V	Dental Setae	Abd. IV p_1/p_2	Yosii "a" Measure	Inn. Ung. Anal spines
armata	+	1.4-1.7	4	A	?	+	7	>	?	1.4-1.7
bengtssoni	-	1.2-1.4	4	T-C	2.0	+	7	>	8-9	2.0-3
biloba	-	1.25-1.5	4	C	2.2	+	7	<	16-20	.3-.7
boletivora	-	1.2-1.4	4	C	1.8	+	7	<	18-19	.45-.80
brevis	-	1.2-1.4	4	A	1.7-2.0	+	7	<	9-10	1-1.
brevisensillata	+	1.5-2.0	4	A-T	1.5	+	7	>	20-25	1.5-2.2
czukzorum	-	2.0-2.5	4	A	1.78	-	4(7)	<	10-12	.76
densornata	?	1.2-1.5?	4	A?	2.0	?	5	?	?	1.8
denticulata complex	+,-	1.75-2.0	4	A	1.4-2.2	+	7	<	8-10	.45-.90
gibbosa	+	1.5-1.8	4	A	2.0	+	7	<	8-9	.6-.8
glancei	?	1.75	4	A	2.0-2.3	-	7	>	?	1.2
granulifera	+	1.4	4	A	2.8-3.1	+	7	<	7-9	.55
guthriei	-	1.6	4	A	2.2	+	7	<	15-18	.65-.90
isabellae	-	1.8	4	A	≈2.0	+	7	<	13-20	1.5
jondavi	-	1.8	4	A	2.0	?	7	<	16±	1.4-2.0
sp. K (Quebec)	+	1.8-2.0	4	A-T	≈3.0	+	7	<	9-11	.55-.63
krafti	+	1.3-1.5	4	A(T)	2.0-2.2	+	7	<	18-20	.5-1.1
longispina	+	1.13	4	A	≈2.0	-	7	>	?	1.5
lucifuga	-	1.5-1.8	4	A	1.7-1.8	+	7	<	10-12	.6-.9
sp. L (Texas)	-	≈	5-10	A	1.7-2.0	-	7	<	14-16	.48-.67
maheuxi	-	1.7-2.0	4	A	2.1-2.6	+	7	<	17-18	1.4-1.5
sp. NN (Missouri)	±	1.3-1.4	4	A	1.5-1.8	+	7	<	19-22	.85-.95
sp. OO (Oregon)	-	≈	4-5	A	1.9-2.4	+	7	<	10-11	1.8-1.6
palustris	-	1.6	4	A	2.3	-	7	<	8-11	.7
pecki	-	1.3-1.5	4	A	.8-1.0	+	7	<	9-10	.60-.73
pratorum	-	1.3-1.5	4	T-C	2.3	+	7	<	13-15	.77
pseudarmata	-	2.0-2.5	4	T-C	1.6-2.0	+	7	>	20-25	1.3-1.7
scotti	-	2.0	4	A	1.8	+	5(6)	<	11-13	.65-1.0
succinea	-	1.3-1.8	4	A	1.7-2.0	+	6	<	10-11	.6-.8

*A - acuminate; C- clavate; T - truncate

Symbols in parentheses represent exceptional conditions.

1) Anal spines swollen distally (Fig. 92.1A) ----------H. "gravesi"[1]
1') Anal spines not swollen (Fig. 92.1B) ----------2



92.1

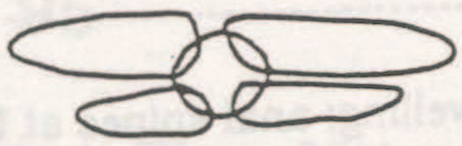
2) P.A.O. lobes confluent (Figure 92.2)----------H. (Mucrella) hibernica Fjellberg. 1987a

2') P.A.O. lobes separate (Figure 100)----------3

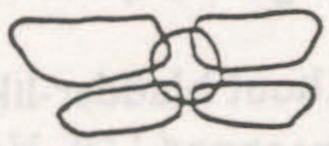


92.2

100



A



B

3) Unguiculus acuminate (Figure 92A)----------H. (C.) densornata

3') Unguiculus lamellate (Figure 92B)----------4

92



A

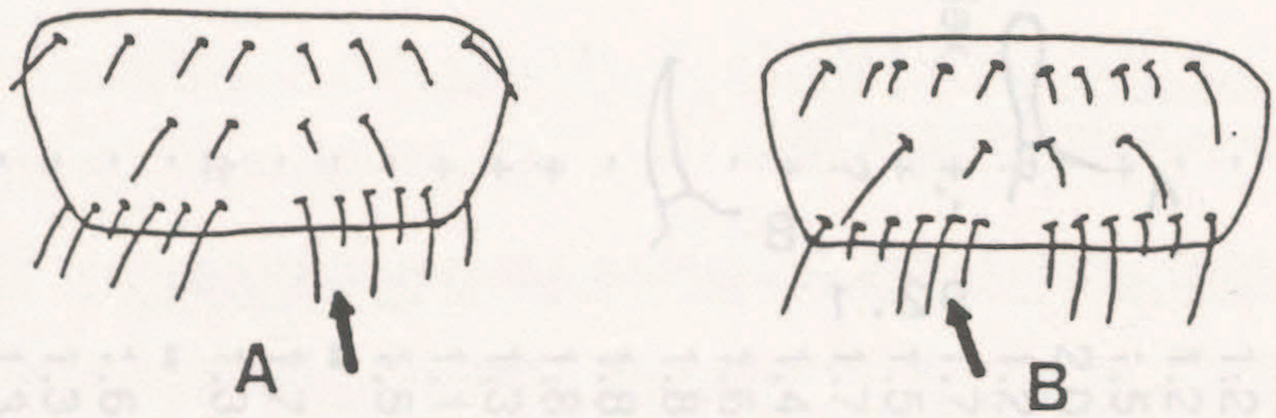


B

[1] The swollen anal spines which characterize this form are found in a number of different species. These occur (in specimens we have seen) only in immature specimens. This is almost certainly an ecomorphic condition and cannot be used to characterize any taxa. The descriptions and figures of Wray do not match any of the forms having swollen anal spines we have seen and cannot be placed taxonomically. It is extremely interesting that three of the five localities from which these forms have been found are in Macon County, North Carolina.

4) Fourth abdominal segment with P_1 longer than P_2 (armata group) (Figure 93A)------5

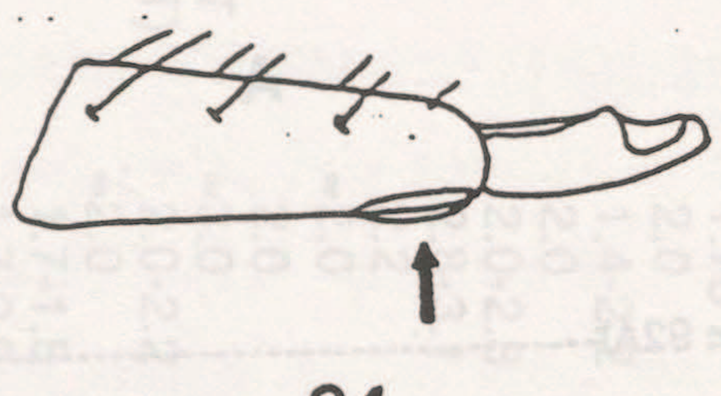
4') Fourth abdominal segment with P_1 shorter than P_2 (Figure 93B)----------11



93

*5) Dens with bladder-like swelling; anal spines usually less than half as long as inner unguis (Figure 94)----------H. (C.) bengtssoni

5') Dens without bladder-like swelling; anal spines at least 1/2 as long as inner unguis-6



94

6) Mucro less than 1/4 length of dens----------H. (C.) glancei

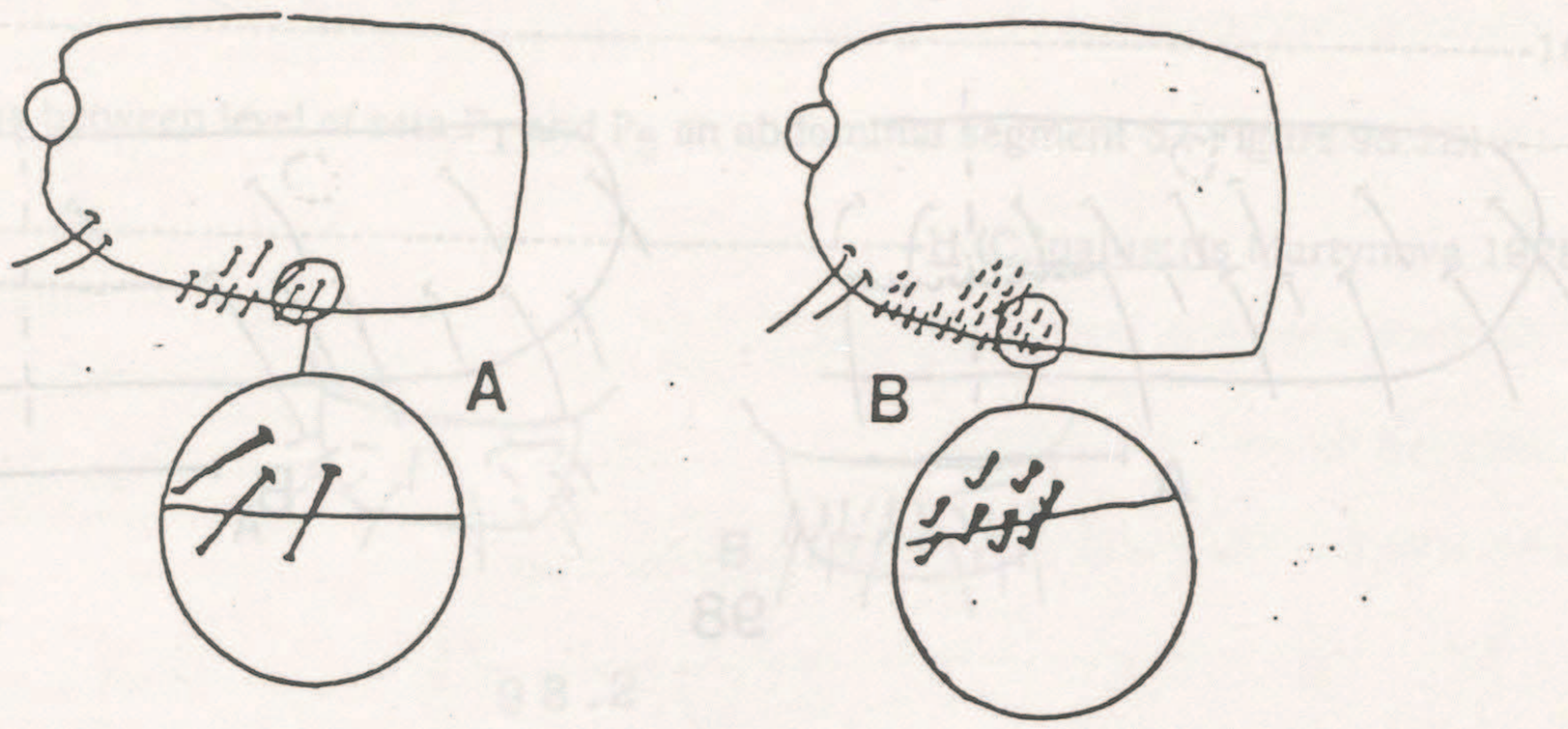
6') Mucro at least 1/3 length of dens----------7

*7) Tenent hair clavate or truncate----------H. (C.) pseudarmata

7') Tenent hair acuminate----------8

**8) Fourth antennal segment without clear ventral "file" (Figure 95A)------H. (C.) londavi

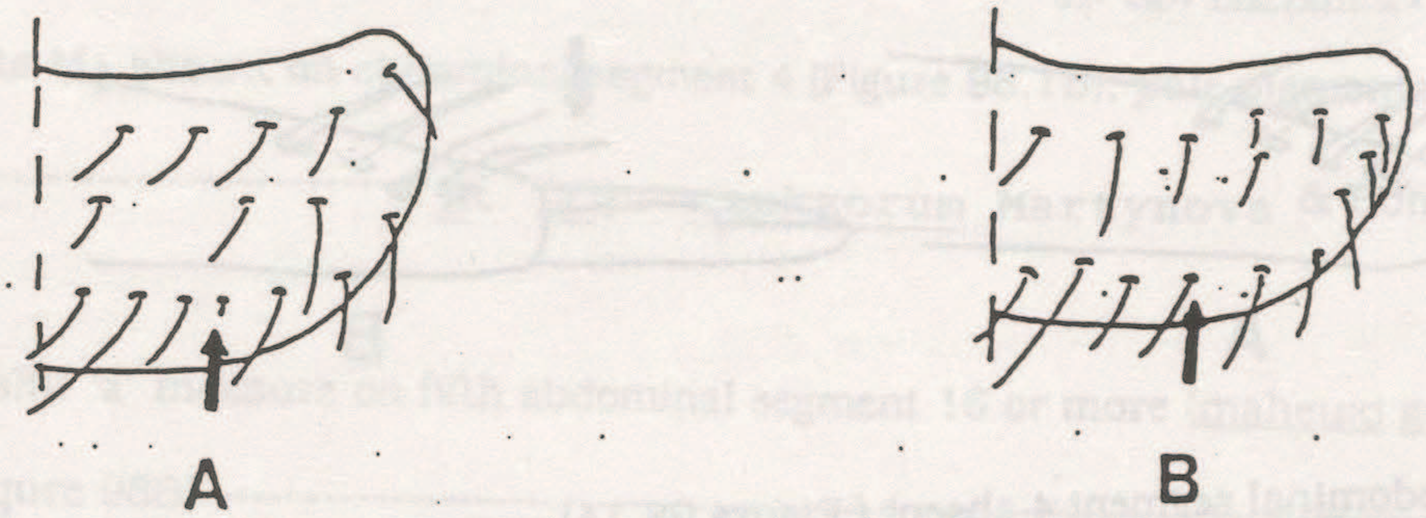
8') Fourth antennal segment with clear ventral "file" (Figure 95B)----------9



95

9) Second thoracic segment with s.s. minute (Figure 96A)----------H. (C.) brevisensillata

9') Second thoracic segment with s.s. normal (Figure 96B)----------10



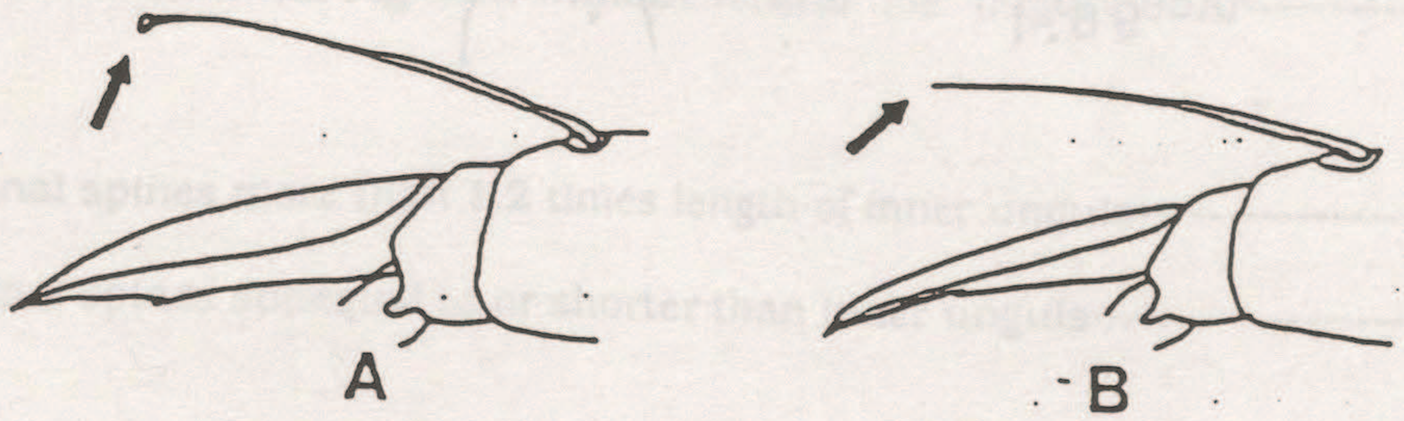
96

*10) Black; body setae rough----------H. (C.) longispina

10') Brown; body setae smooth----------H. (C.) armata

11) Tenent hair clavate (boletivora group) (Figure 97A)----------12

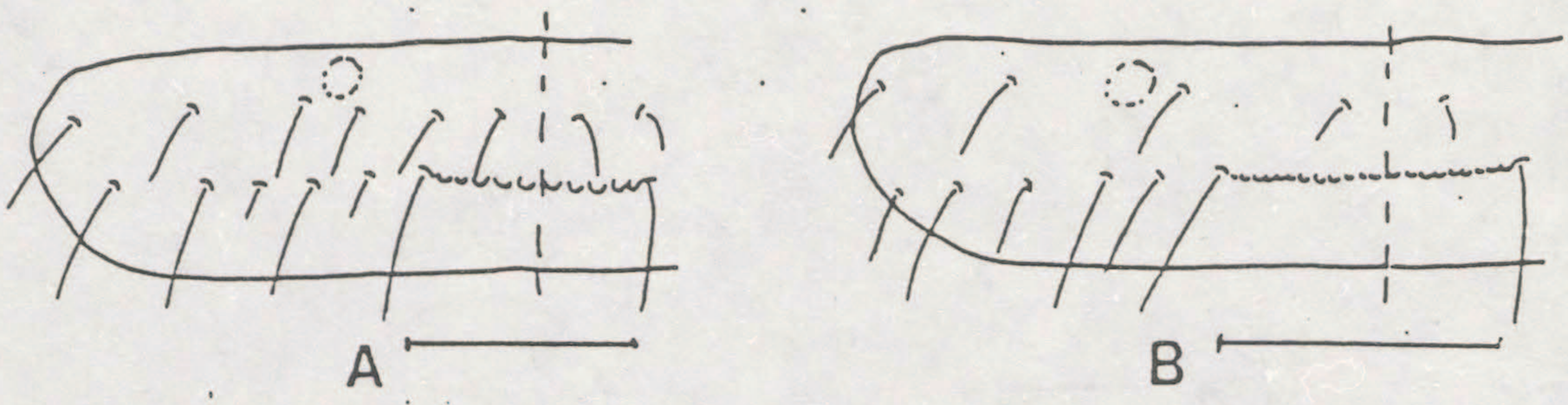
11') Tenent hair acuminate (Figure 97B)----------14



97

**12) Yoshii "a" measure 9 -13 (Figure 98A)----------H. (C.) pratorum

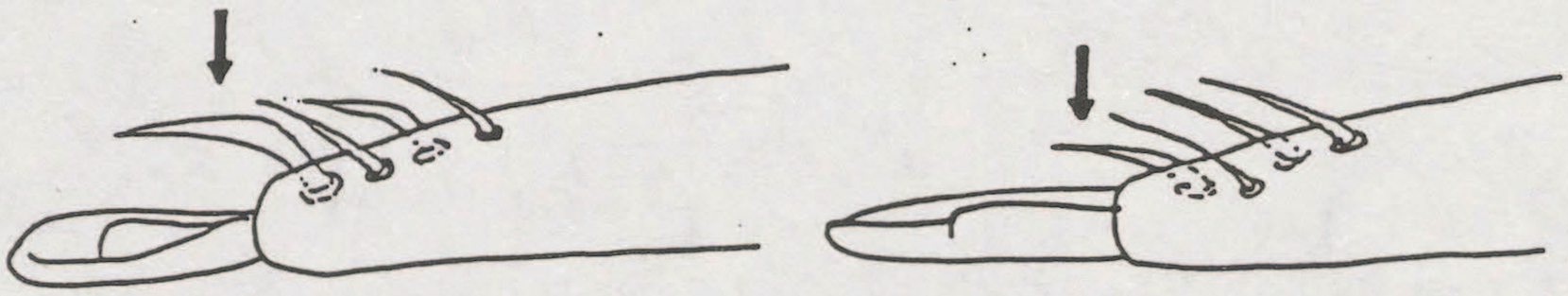
12') Yoshii "a" measure 16 - 20 (Figure 98B)----------13



98

**13) Inner 2 distal dental setae angulate and basally much thicker than others (Figure 99A)----------H. (C.) biloba

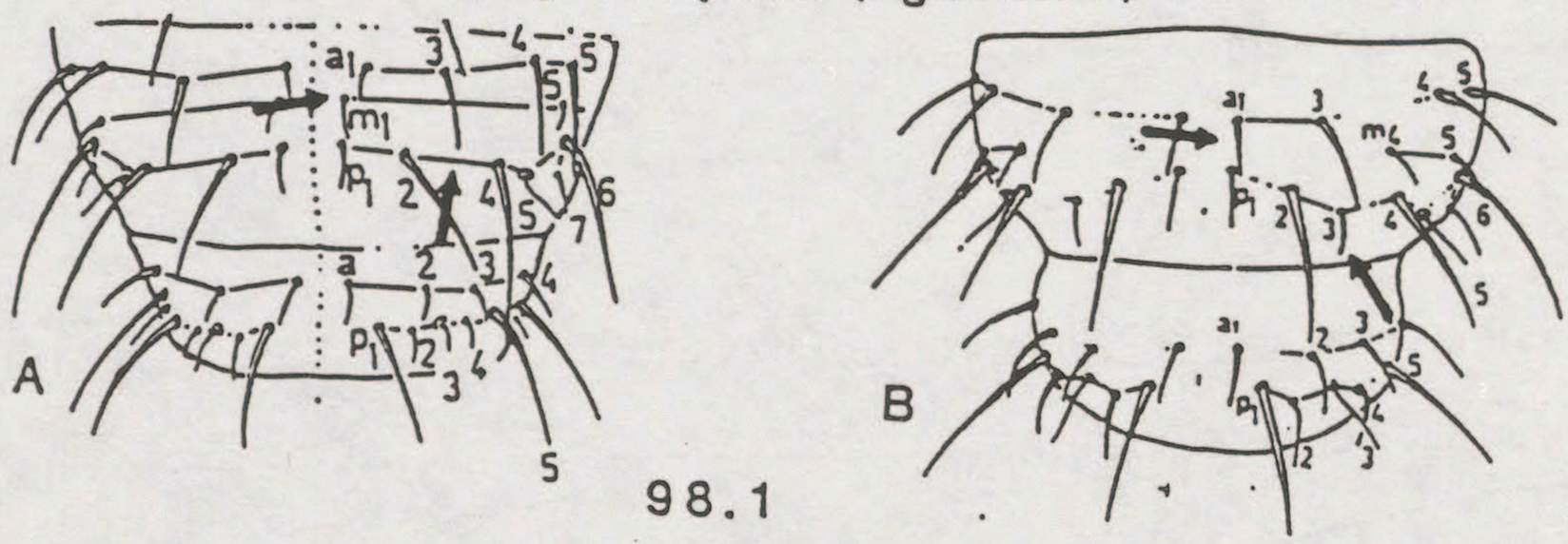
**13') Inner 2 distal dental setae similar to others (Figure 99B)----------H. (C.) boletivora



99

14) Seta P_3 on Abdominal segment 4 absent (Figure 98.1A) ----------15

14) Seta P_3 on abdominal segment 4 present (Figure 98.1B)----------17



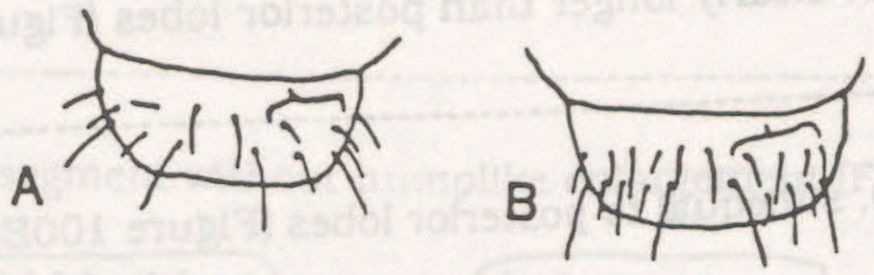
98.1

15) 2 A setae between the level of seta P1 and P5 on abdominal segment 5(Figure 98.2A)--

----------16

15') 4 A setae between level of seta P_1 and P_5 on abdominal segment 5 (Figure 98.2B)------

----------H.(C.)palustris Martynova 1978



98.2

16) Seta M_1 present on abdominal segment 4 (Figure 98.1A), darkly pigmented----------

----------H. (C.) isabellae Fjellberg 1985

16') Seta M_1 absent on abdominal segment 4 (Figure 98.1B), pale pigmentation----------

---------- H. (C). czukzorum Martynova & Bondarenko, 1978

17) Yoshii "a" measure on fifth abdominal segment 16 or more (maheuxi group)

(Figure 98B)----------18

17') Yoshii "a" measure on fifth abdominal segment 14 or fewer(denticulata group)

(Figure 98A)----------22

** 18) Fourth antennal segment with ventral "file" (Figure 95B)----------

----------H. (C.) krafti (Fjellberg 1985: In Cyclograna = Mitchellania)

18') Fourth antennal segment without ventral "file" (Figure 95A)----------19

19) Anal spines more than 1.2 times length of inner unguis----------20

19') Anal spines subequal to or shorter than inner unguis----------21

**20) Apical antennal bulb unlobed----------H. (C.) guthriei

**20') Apical antennal bulb bilobed or trilobed (intact specimens have clavate tenent hair)-

----------H. (C.) bolettvora

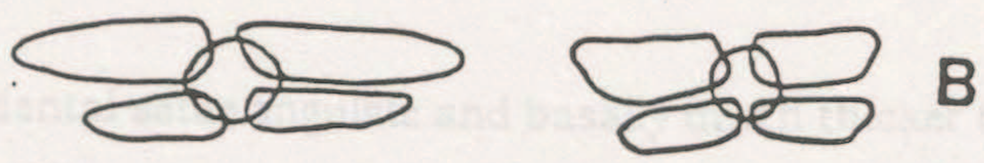
*21) Anterior lobes of P.A.O. clearly longer than posterior lobes (Figure 100A)----------

----------H. (C.) maheuxi

21') Anterior lobes of P.A.O. subequal to posterior lobes (Figure 100B)----------

----------(part) brevis group

100



22) 4 - 6 dorsal dental setae----------23

22') 7 dorsal dental setae----------25

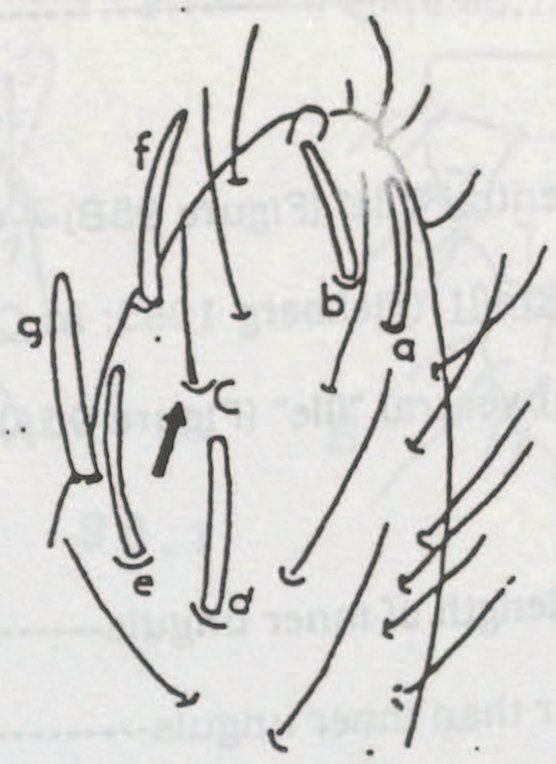
23) 4 dental setae----------H. (C.) czukczorum

23') 5 - 6 dental setae----------24

*24) Antennal seta "c" acuminate (Figure 101); usually 5 dental setae----------H. (C.) scotti

*24') Antennal seta "c" blunt, 6 dental setae----------H. (C.) succinea

101



**25) Filament of unguiculus exceeding apex of unguis; all dental setae straight or gently curved----------H. (C.) peckl

25') Filament of unguiculus not reaching apex of unguis, and/or 2 inner distal dental setae basally swollen and angulate----------26

*26) Fifth abdominal segment with humplike enlargement between p_1 setae (Figure 102A)----------H. (C.) gibbosa

26') Fifth abdominal segment without humplike enlargement (Figure 102B)----------27

102



**27) P.A.O. with anterior and posterior lobes subequal (Figure 100B)----------H. (C.) brevis

(see couplet 21, above)

27') P.A.O. with anterior lobes clearly longer than posterior lobes (Figure 100A)---------28

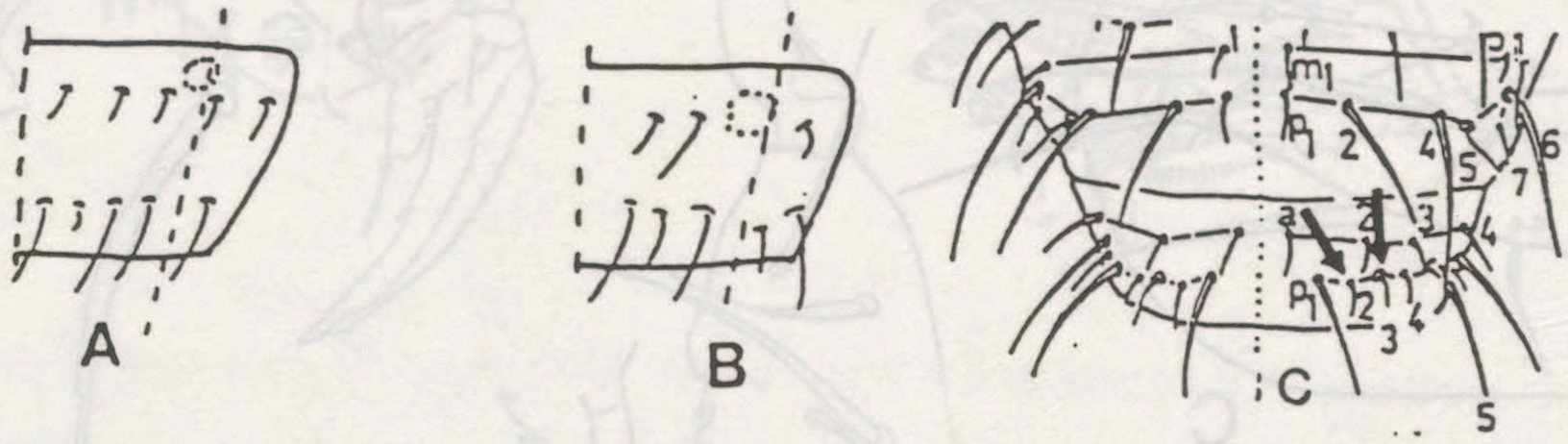
*28) Unpigmented cave form----------H. (C.) lucifuga

28') Pigmented forms----------29

29) Seta P_2 only slightly shorter than P_3 on fifth abdominal segment (Figure 103C)----------H. (C.) isabellae Fjellberg 1985a

29') Seta P_2 clearly shorter than P_3 on fifth abdom.segment (Figure 103A&B)----------30

103

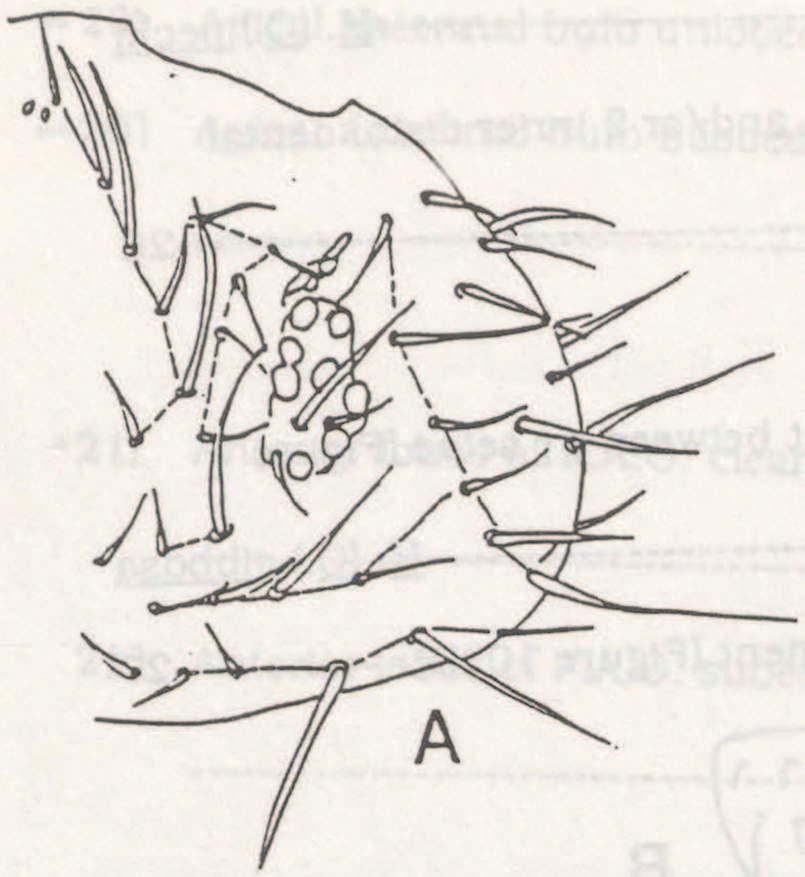


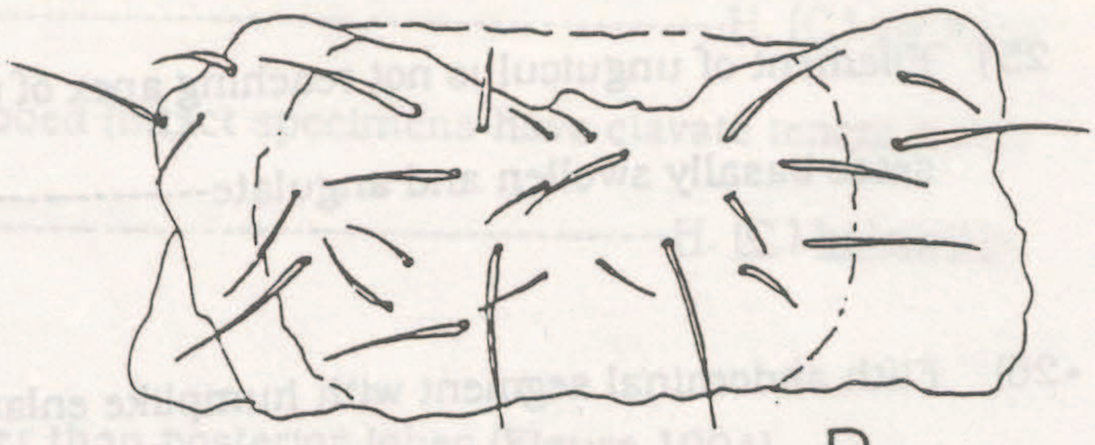
*30) 4 + 4 posterior setae between level of foveae on fifth abdominal segment (Figure 103A)----------H. (C.) granulifera

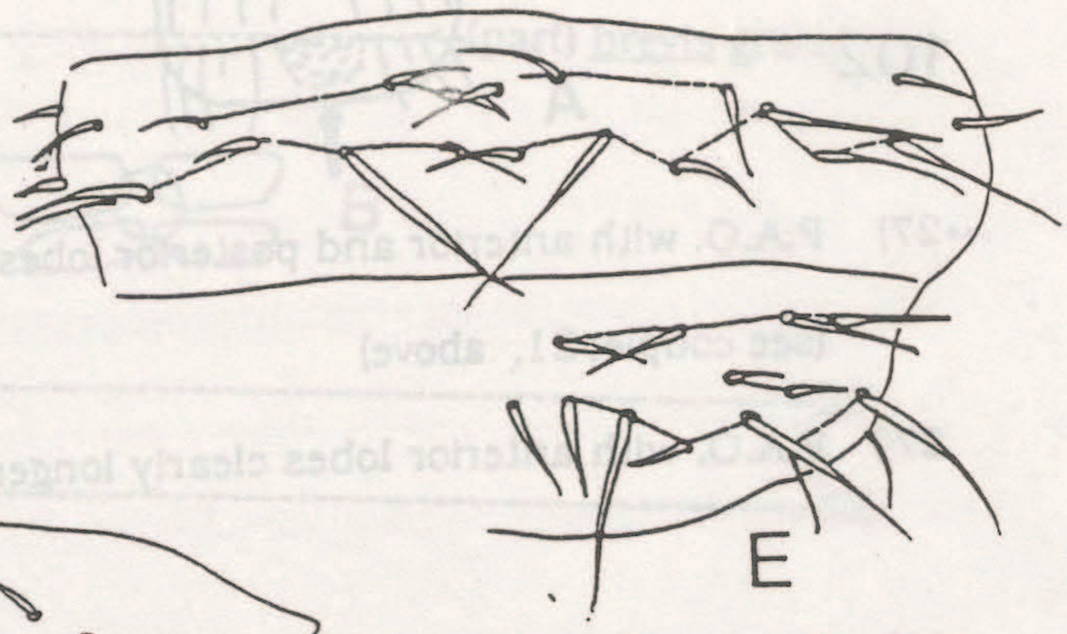
*30') 2 + 2 or 3 + 3 posterior setae between level of foveae on fifth abdominal segment (Figure 103B)----------H. (C.) denticulata complex

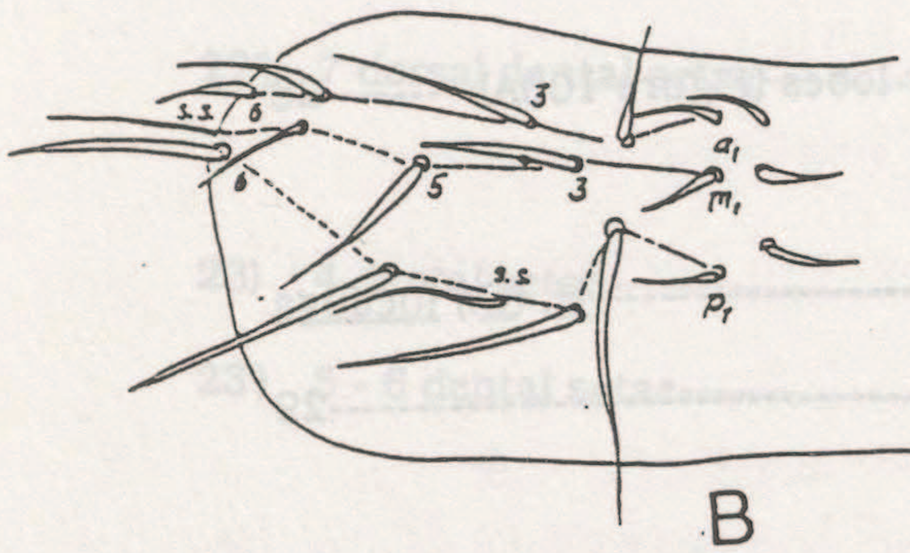
Hypogastrura (Ceratophysella) czukczorum Martynova 1978

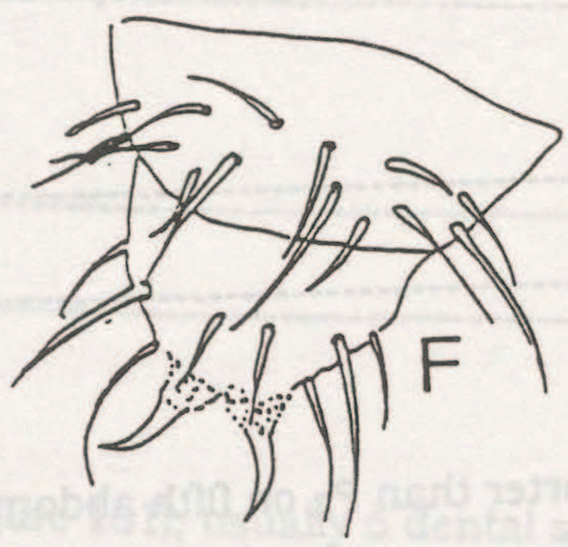
Figure 103.1

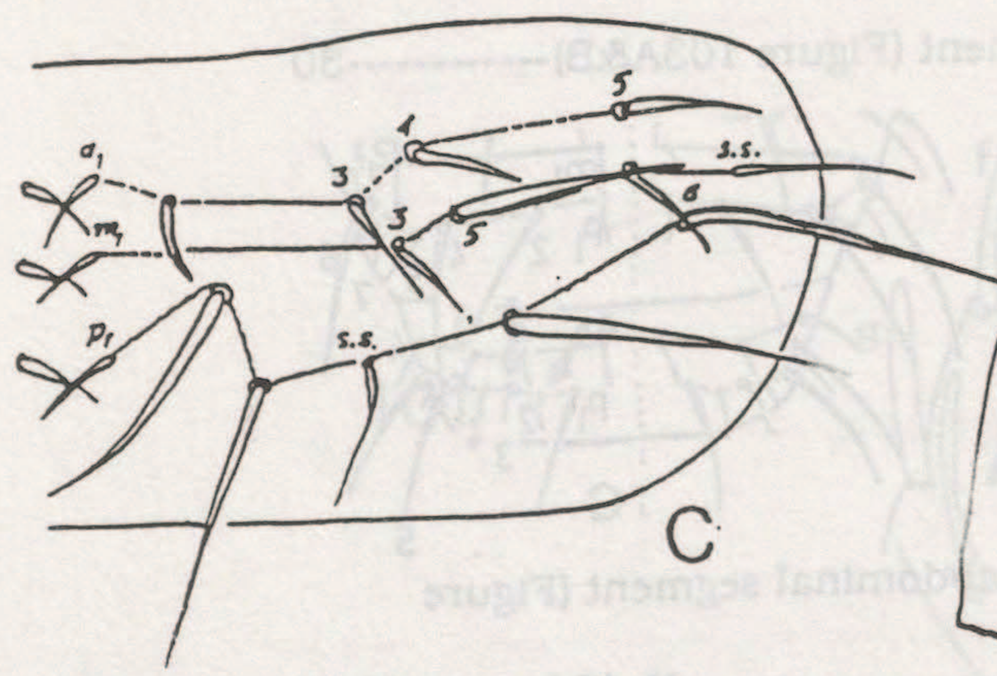














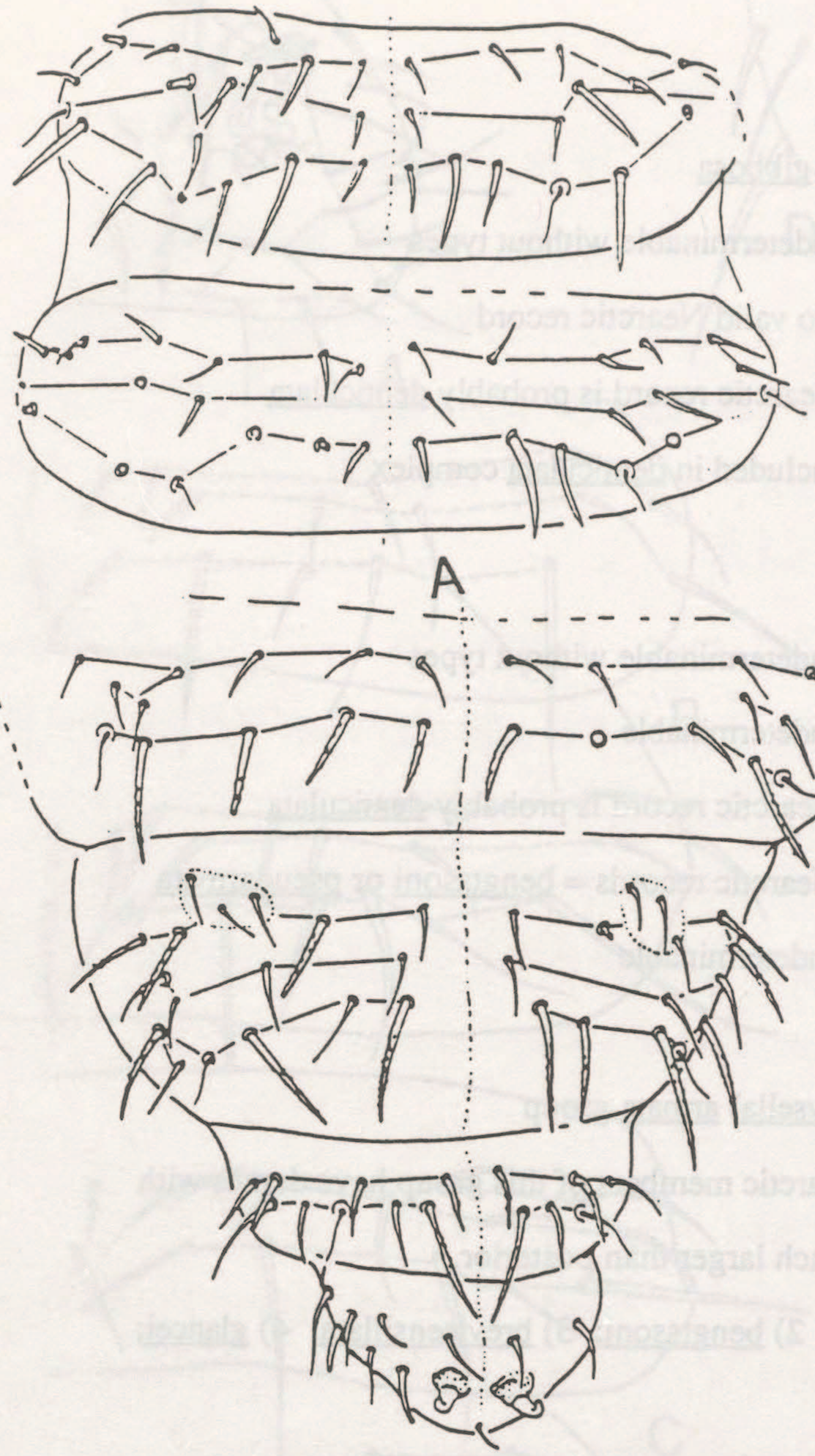


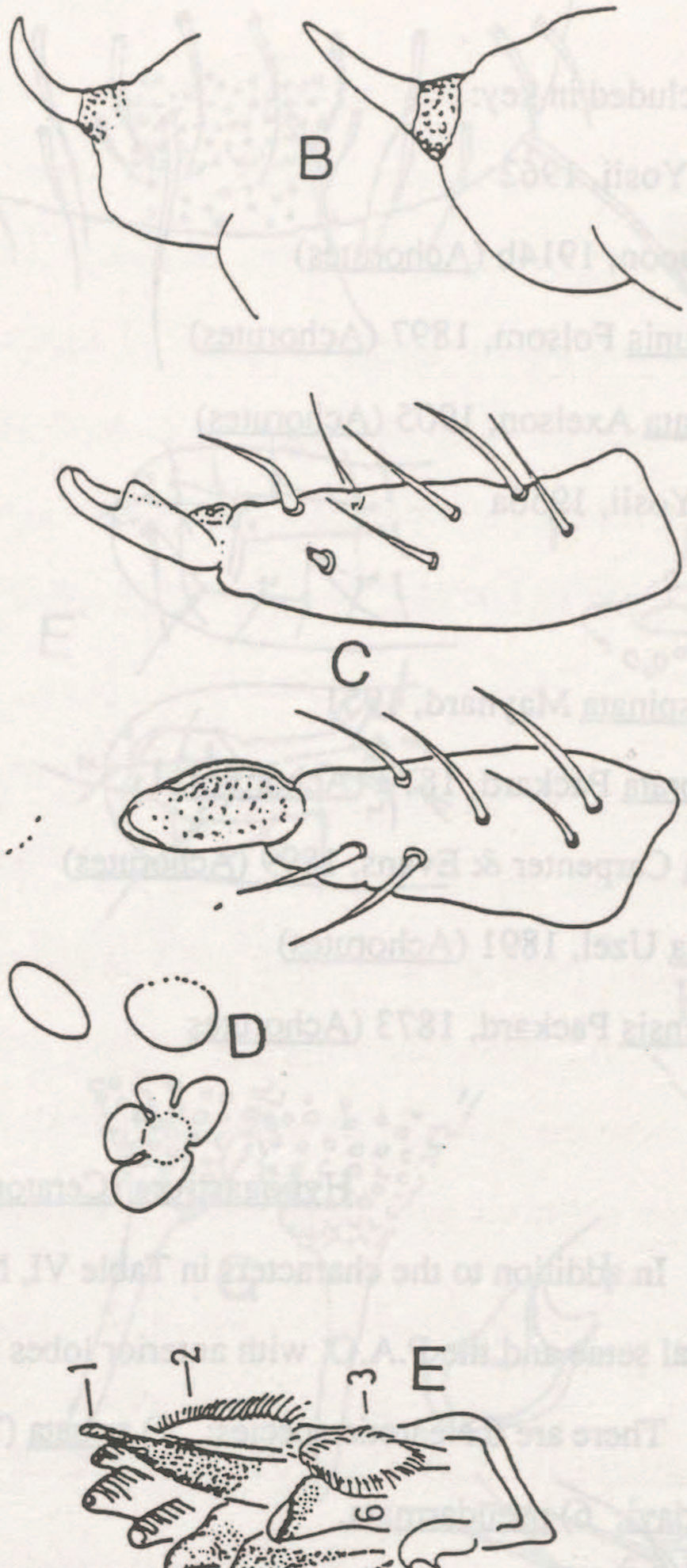


H. (C.) czukczorum. A) Head chaetotaxy, eyes and PAO; B) Chaetotaxy thoracic segment II; C) Chaetotaxy normal thoracic segment III; D) Thoracic segment III; unusual specimen; E) Chaetotaxy abdominal segments II & IV; F) Abdominal segments V and VI; G) PAO; H) Foot complex; I Tenaculum, dens and mucro; J) Posterior macrochaeta; K) Anal spine. After Martynova 1978 (modified).

Hypogastrura (Ceratophysella) longispina Tullberg

Figure 103.2





H. (C.) longispina. A) Chaetotaxy of Th. 2-3 & Abd. 3-6; B) Anal spines of syntpe (left) and Alaska specimen (right); C) dens and mucro syntype; D) Right PAO and closest eyes; E Maxilla. After Fjellberg 1985.

(Ceratophysella key, cont.)

Not included in key:

azteca Yosii, 1962	= gibbosa
citri Bacon, 1914b (Achorutes)	Indeterminable without types
communis Folsom, 1897 (Achorutes)	No valid Nearctic record
cuspidata Axelson, 1905 (Achorutes)	Nearctic record is probably denticulata
exilis Yosii, 1956a	Included in denticulata complex
macrospinata Maynard, 1951	Indeterminable without types
marmorata Packard, 1873 (Achorutes)	Indeterminable
scotica Carpenter & Evans, 1899 (Achorutes)	Nearctic record is probably denticulata
sigillata Uzel, 1891 (Achorutes)	Nearctic records = bengtssoni or pseudarmata
**texensis Packard, 1873 (Achorutes	Indeterminable

Hypogastrura (Ceratophysella) armata group

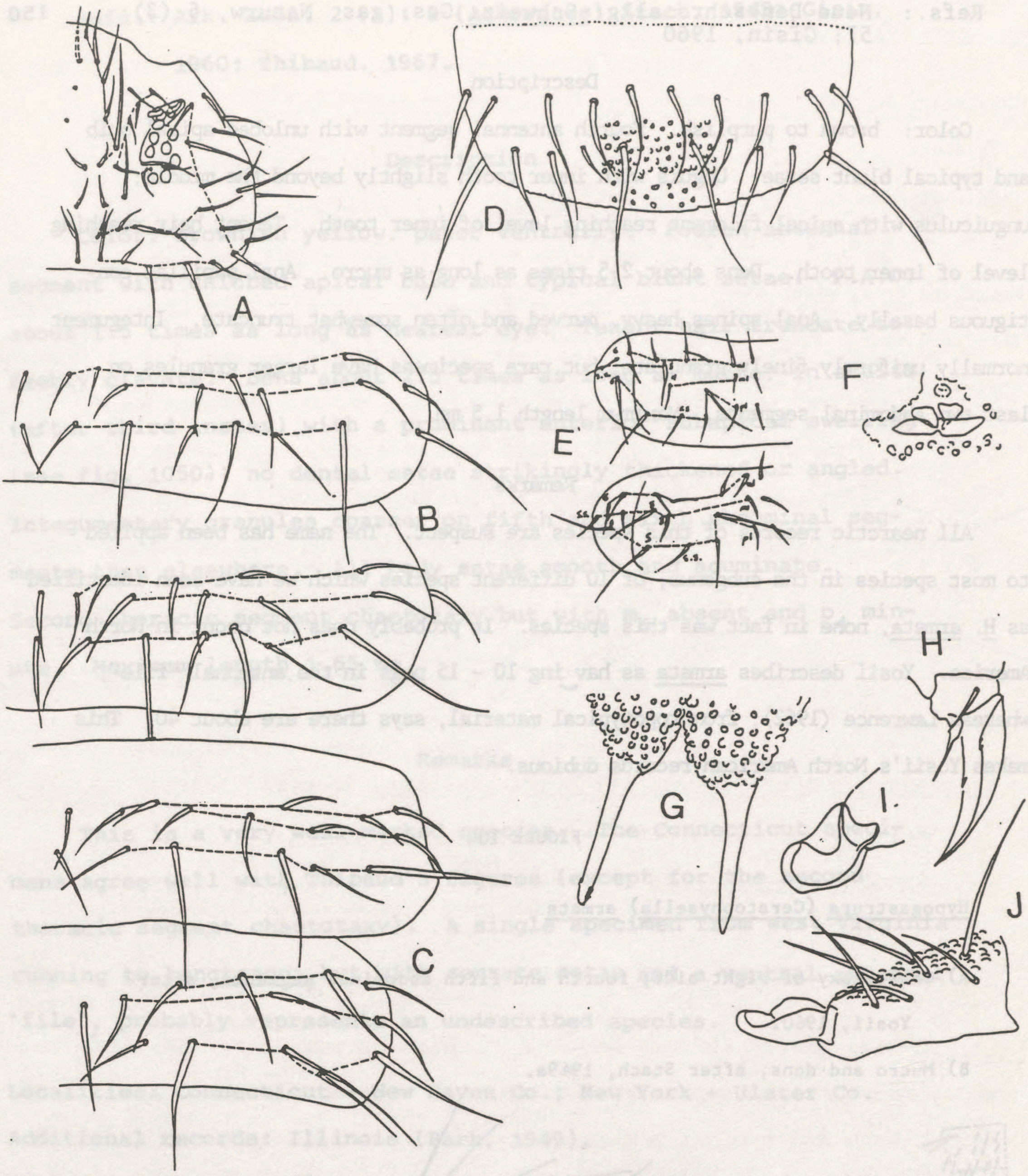
In addition to the characters in Table VI, Nearctic members of this group have dentes with 7 dorsal setae and the P.A.O. with anterior lobes much larger than posterior.

There are 6 Nearctic species: 1) armata (?); 2) bengtssoni; 3) brevisensillata; 4) glancei; 5) jondavi; 6) pseudarmata.

Remarks

This appears to be primarily an Old World group. Most, if not all, North American records of the first species are apparently the result of misidentifications.

Figure 103.3



H. (C.) palustris. A) Head chaetotaxy, eyes and PAO; B) Chaetotaxy abdominal segments I and II; C) Chaetotaxy abdominal segments III and IV; D) Abdominal segment V showing chaetotaxy and median integumentary granules; E) Chaetotaxy thoracic segments II and III; F) PAO; G) Anal spines; H) Mid foot complex; I) Mucro; J) Dens and mucro. After Martynova 1978 (modified).

Hypogastrura (Ceratophysella) armata (Nicolet), 1842 Fig. 104

Refs.: Neue Denkschr. allg. Schweiz. Ges. gas. Naturw. 6 (3): 150
57; Gisin, 1960

Description

Color: brown to purplish. Fourth antennal segment with unlobed apical bulb and typical blunt setae. Unguis with inner tooth slightly beyond the middle; unguiculus with apical filament reaching level of inner tooth. Tenent hair reaching level of inner tooth. Dens about 2.5 times as long as mucro. Anal papillae contiguous basally. Anal spines heavy, curved and often somewhat truncate. Integument normally uniformly finely granulate, but rare specimens have larger granules on last two abdominal segments. Maximum length 1.5 mm.

Remarks

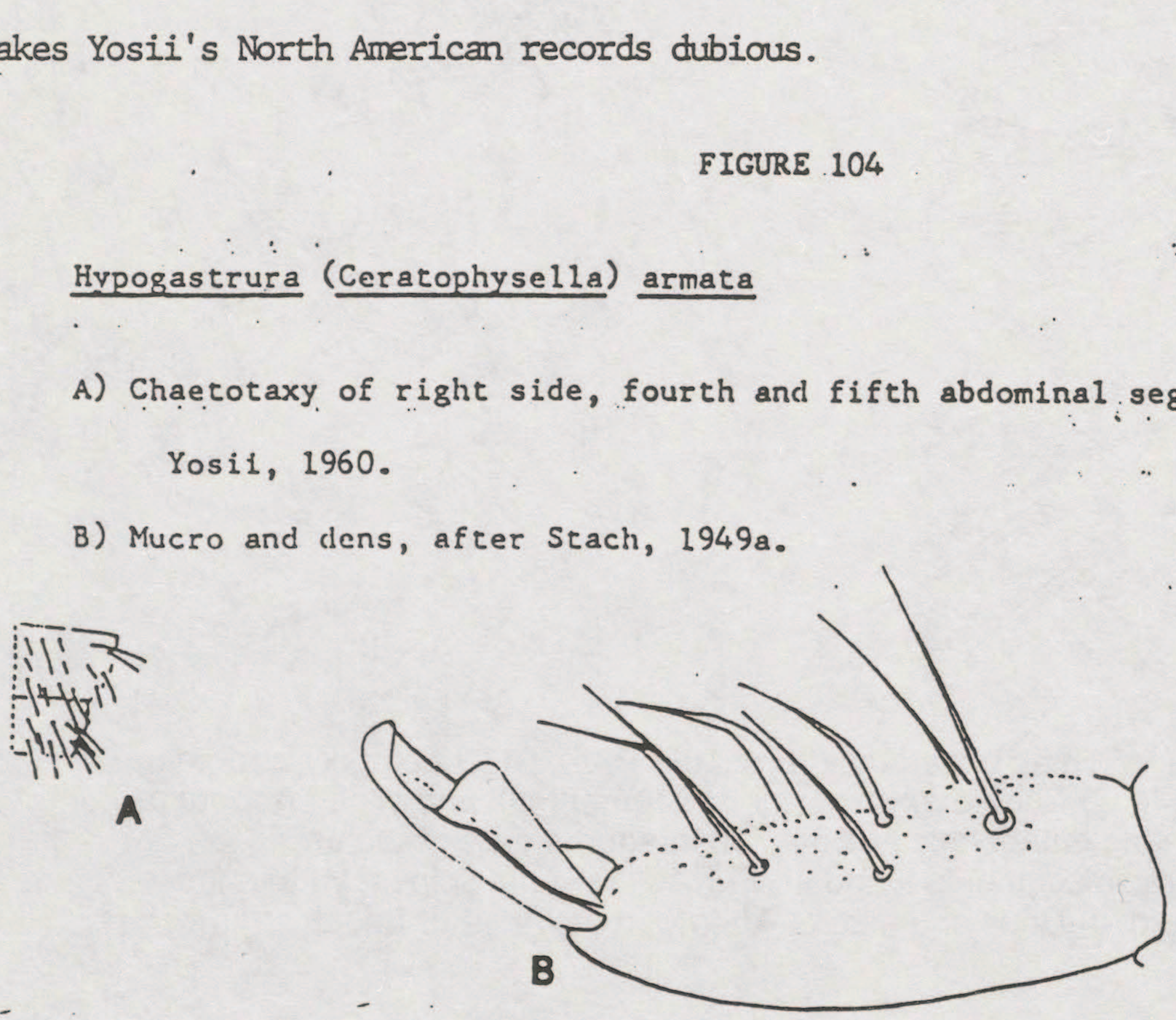
All nearctic records of this species are suspect. The name has been applied to most species in the subgenus; of 10 different species which we have seen identified as H. armata, none in fact was this species. It probably does not occur in North America. Yosii describes armata as having 10 - 15 pegs in the antennal "file", whereas Lawrence (1962), from topotypical material, says there are about 40. This makes Yosii's North American records dubious.

FIGURE 104

Hypogastrura (Ceratophysella) armata

A) Chaetotaxy of right side, fourth and fifth abdominal segments, after Yosii, 1960.

B) Mucro and dens, after Stach, 1949a.



Hypogastrura (Ceratophysella) bengtssoni (Ågren), 1904 Fig. 105

Refs.: Ark. Zool. 2 (1): 2 (Achorutes) Stach, 1949a; Gisin, 1960; Thibaud, 1967.

Description

Color: brownish yellow, paler ventrally. Fourth antennal segment with unlobed apical bulb and typical blunt setae. P.A.O. about 1.5 times as long as nearest eye. Tenent hair truncate to feebly clavate. Dens about 2.5 times as long as mucro, in adults (after third instar) with a prominent anterior subapical swelling (see fig. 1050); no dental setae strikingly thickened or angled. Integumentary granules coarser on fifth and sixth abdominal segments than elsewhere. All body setae smooth and acuminate. Second thoracic segment chaetotaxy but with m_6 absent and p_4 minute. Maximum length 1.65 mm.

Remarks

This is a very well-marked species. The Connecticut specimens agree well with Thibaud's figures (except for the second thoracic segment chaetotaxy). A single specimen from West Virginia running to bengtssoni, but with serrate setae and a ventral antennal "file", probably represents an undescribed species.

Localities: Connecticut - New Haven Co.; New York - Ulster Co.

Additional records: Illinois (Park, 1949).

Biology: Thibaud, 1970.

FIGURE 105

Hypogastrura (Ceratophysella) bengtssoni

A) Chaetotaxy of right side, fourth and fifth abdominal segments, after Thibaud.

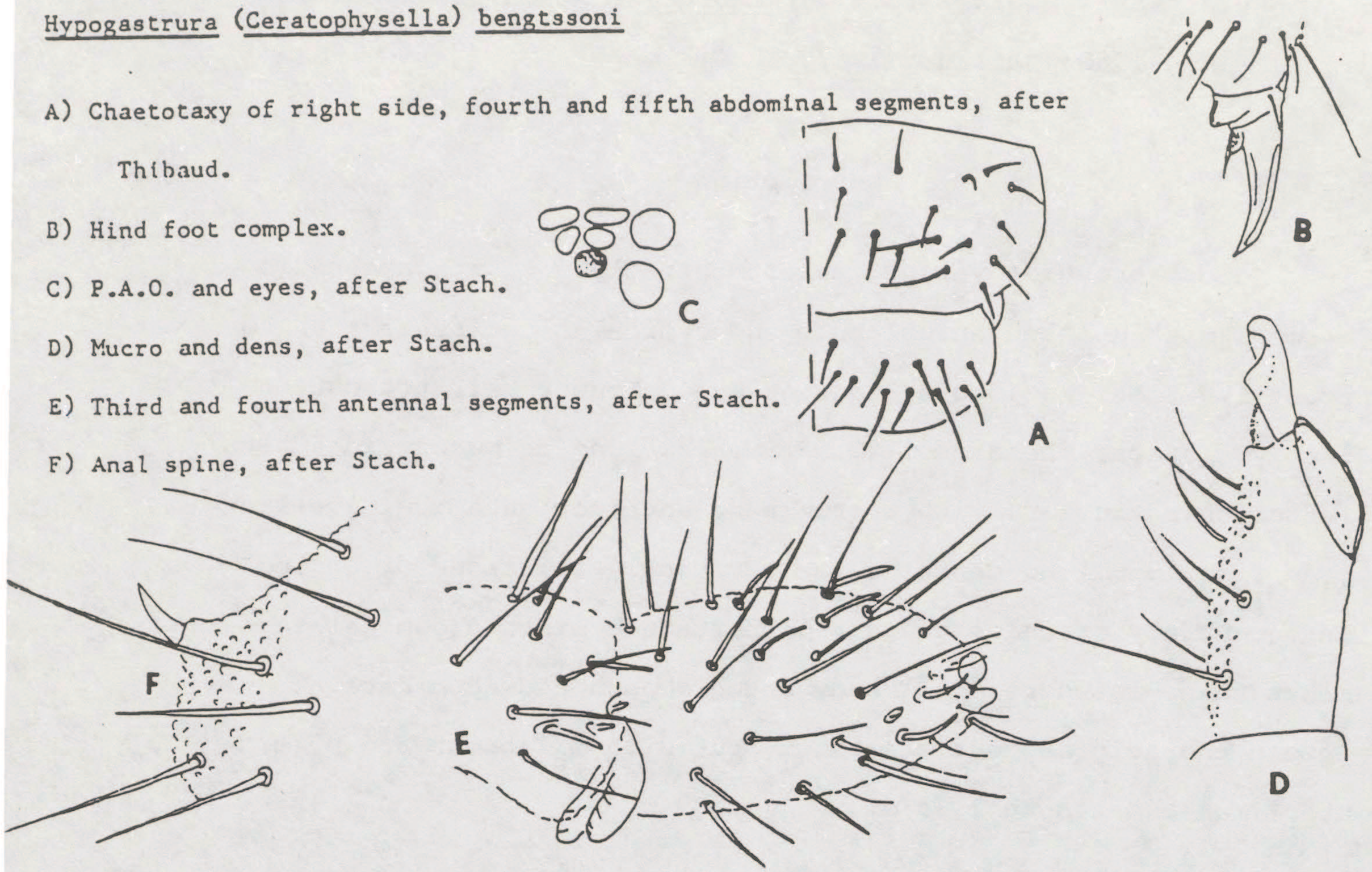
B) Hind foot complex.

C) P.A.O. and eyes, after Stach.

D) Mucro and dens, after Stach.

E) Third and fourth antennal segments, after Stach.

F) Anal spine, after Stach.



Hypogastrura (Ceratophysella) brevisensillata (Yosii), 1961 Fig. 106

Ref.: Amer. Midl. Nat. 66: 251 (Ceratophysella)

Syn.: H. pseudarmata of Yosii, 1960, not of Folsom, 1916.

Description

Color: medium to dark brown, with pigment noticeably heavier along segmental margins. Fourth antennal segment with unlobed apical bulb and typical blunt setae, and a ventral "file" of about 20 setae. P.A.O. 1 - 1.3 times nearest eye. Dens 2 - 2.5 times as long as mucro, with four inner distal setae basally swollen and angled at mid level (see fig. 99). Integument finely granulate. Second thoracic segment with s.s. minute or even absent. Maximum length 1.8 mm.

Examination of specimens from the type series shows that the chaetotaxy of the second thoracic segment is slightly different from that shown by Yosii (see Fig. 106F). The rearward positioning of the m_2 seta might make one count it as a "p" seta. The proper s.s. is not visible even under oil immersion on many specimens. Except for this and the antennal "file" the species appears to be identical to H. pseudarmata. Hammer's record of H. sigillata from northern Canada may be one of these species; because of the similarity of these species and the absence of other records, we are not considering sigillata as part of our fauna.

Localities: Connecticut - Fairfield Co., Hartford Co.; Massachusetts - Middlesex Co., Plymouth Co.; Virginia - "Blue Ridge".

FIGURE 106

Hypogastrura (Ceratophysella) brevisensillata

A) Chaetotaxy of second thoracic segment, specimen from type series.

Figures B-F after Yosii.

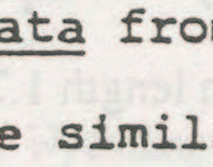
B) Chaetotaxy of right side, second thoracic segment.

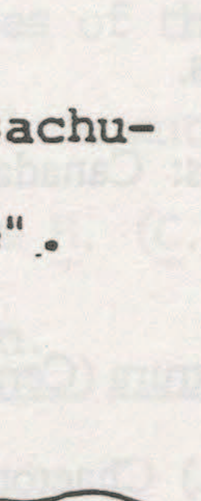
C) Chaetotaxy of right side, fourth through sixth abdominal segments.

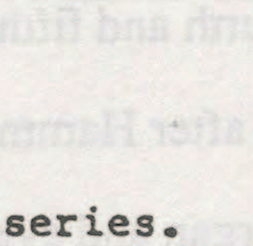
D) Foot complex.

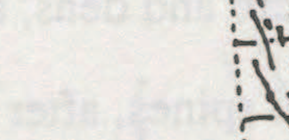
E) Postantennal organ and eyes.

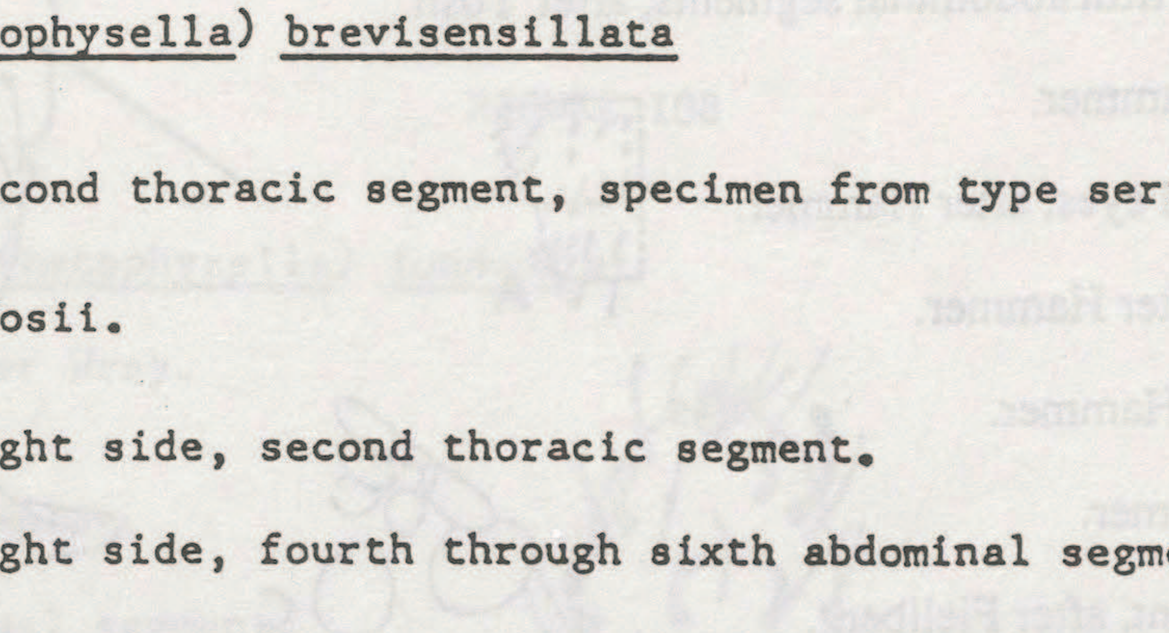
F) Mucro and dens.











Hypogastrura (Ceratophysella) glancei (Hammer), 1953 Fig. 107

Refs.: Acta arct. 6: 18; Yosii, 1960

Description

Color: purple to black, mottled with light gray spots. Fourth antennal segment with unlobed apical bulb and 6 -7 blunt setae. Dens about 4 times as long as mucro. Anal spines about twice as long as papillae. Integument finely granulate throughout. Second thoracic segment chaetotaxy with m_2 displaced posteriorly and much larger than p_2; s.s. reduced in length. Maximum length 1.7 mm.

Remarks

The peculiar form of the mucro readily separates this species from all other members of the subgenus.

Localities: Canada - Coppermine, N. W. T.

FIGURE 107

Hypogastrura (Ceratophysella) glancei

A) Chaetotaxy fourth and fifth abdominal segments, after Yosii.

B) Foot complex, after Hammer.

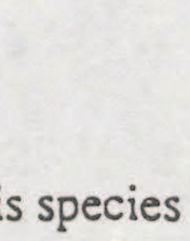
C) Postantennal organ and eyes, after Hammer.

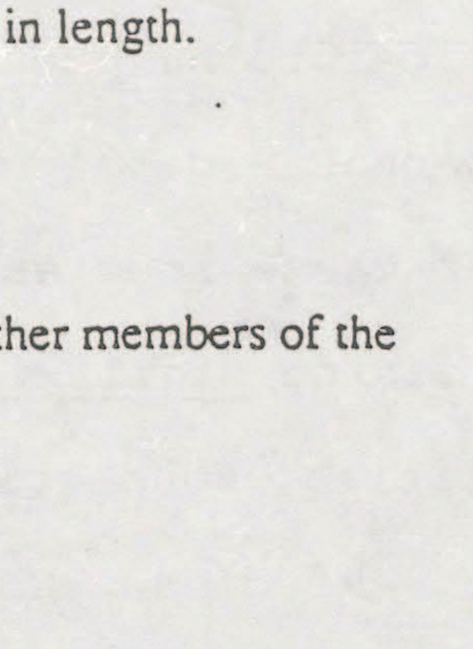
D) Mucro, from above, after Hammer.

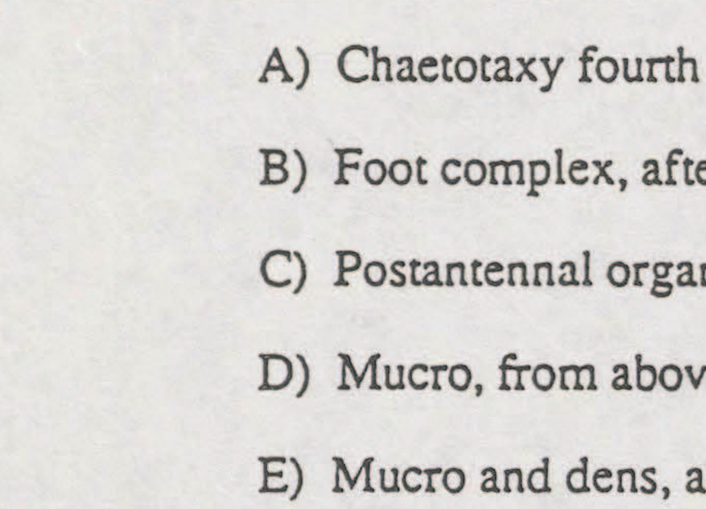
E) Mucro and dens, after Hammer.

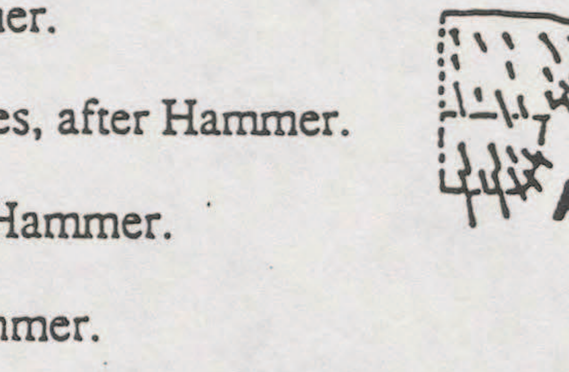
F) Anal spines, after Hammer.

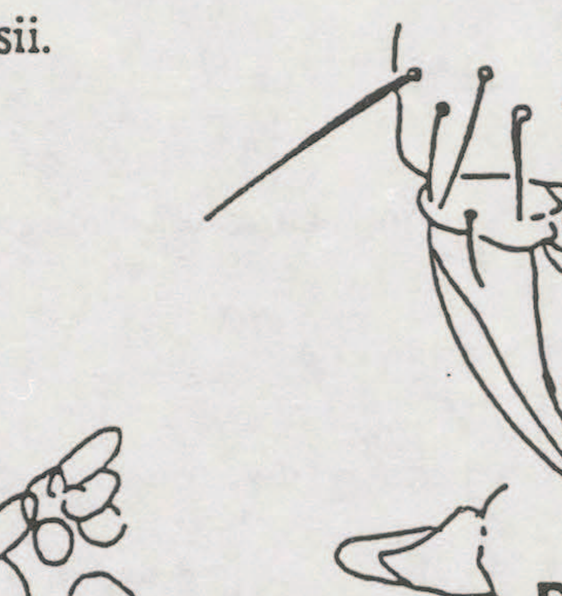
G) Fourth antennal segment, after Fjellberg.











Hypogastrura (Ceratophysella) jondavi (Wray), 1946 Fig. 108

Ref.: Bull. Brooklyn ent. Soc. 41: 79-80 (Achorutes)

Description

Color: background yellow, sprinkled with reddish-rust colored spots. Apical antennal bulb unlobed but with clear accessory papilla. Dens twice as long as mucro, with at least two inner distal setae clearly angled and basally expanded. Maximum length 1.6 mm.

Remarks

A single specimen of the type series was seen, and a single alpine Wyoming specimen, and these appeared to have fourth abdominal setae of the armata type. If further examination verifies this, it can be distinguished from other Nearctic species of the group by the acuminate tenent hairs and lack of an antennal "file". Precise placement of this species must await further study. The species is similar to the Japanese H. (C.) ainu but differs in "a" measure (16 as opposed to 22) and in coloration.

Localities: North Carolina - Wake Co. (type); Wyoming - Fremont Co.

FIGURE 108

Hypogastrura (Ceratophysella) jondavi

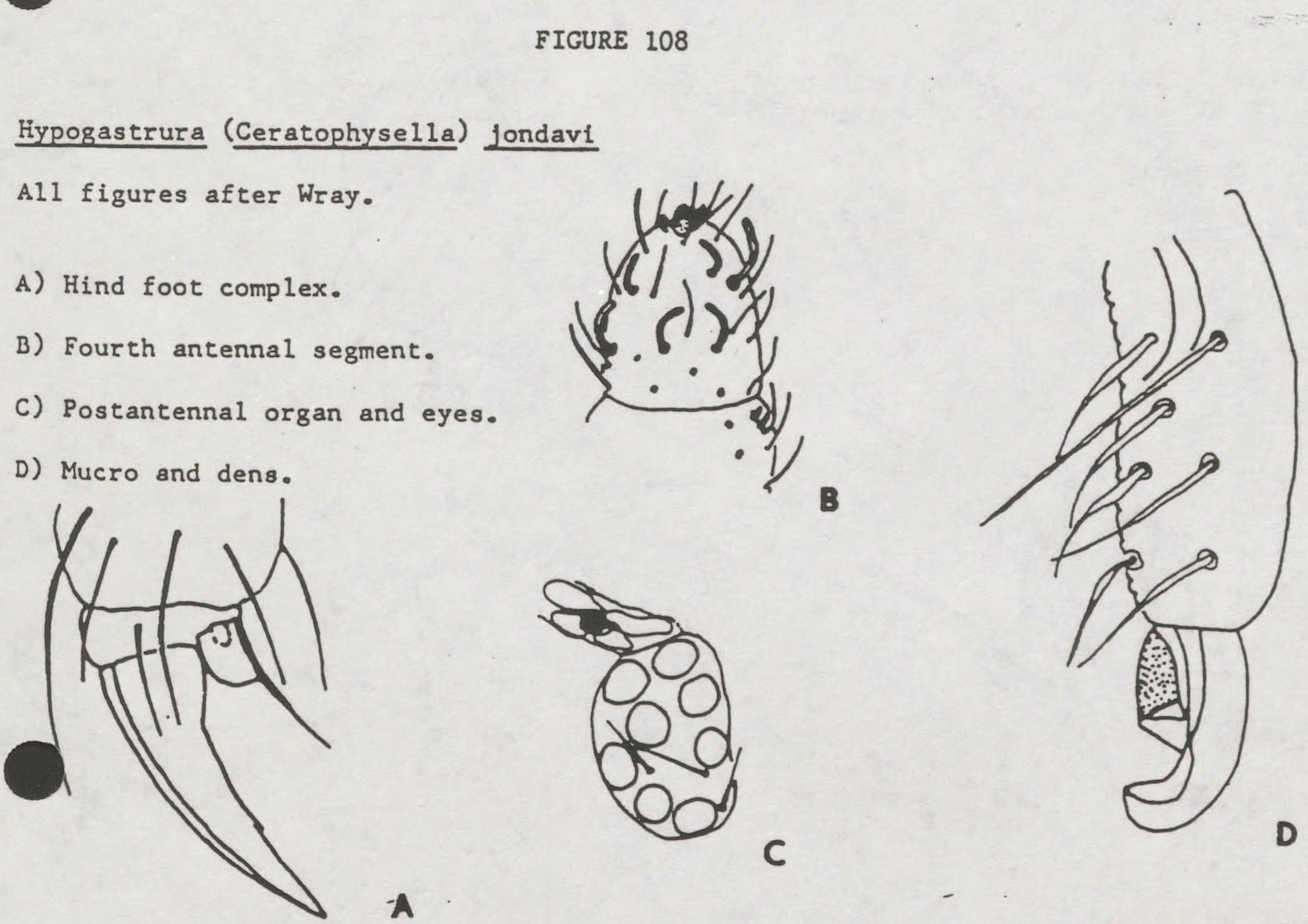
All figures after Wray.

A) Hind foot complex.

B) Fourth antennal segment.

C) Postantennal organ and eyes.

D) Mucro and dens.



Hypogasturua (Ceratophysella) pseudarmata (Folsom), 1916 Fig. 109

Ref.: Proc. U.S. natn. Mus. 50: 490; Yosii, 1962; Salmon, 1974.

Description

Color: black or purple-brown to mottled dark blue. Thoracic segment 2 with s.s. filamentous and well-developed. Otherwise as in H. brevisensillata. Maximum length 1.8 mm.

Remarks

This species is closely related to H. brevisensillata.

Localities: California - Contra Costa Co., Los Angeles Co.; Connecticut - Hartford Co., New Haven Co.; Georgia - Pine Co.; Washington - King Co., Thurston Co.; Canada - British Columbia- Banff and Kaslo. Additional records (suspect because of possible confusion with brevisensillata): Iowa (O'Neill and Pedigo, 1969); New York (Maynard, 1951); North Carolina (Pearse, 1946); Utah (Knowlton et al., 1950).

FIGURE 109

Hypogastrura (Ceratophysella) pseudarmata

All figures after Yosii.

A) Chaetotaxy of right side, second and third thoracic and fourth and fifth abdominal segments.

B) Hind foot complex.

C) Apex of abdomen.

D) Fourth antennal segment.

E) Postantennal organ and eyes.

F) Mucro and dens.

In addition to the characters in Table VI, members of this group have 2 or more apical antennal lobes. There are 7 dental setae.

There are 3 Nearctic species: 1) biloba; 2) boletivora; 3) pratorum.

Remarks

This group is characterized by the striking tenent hair. Two of the species have bilobed apical antennal bulbs; the third has a bulb and closely associated terminal papilla.

Hypogastrura (Ceratophysella) biloba, Fig. 110

Description

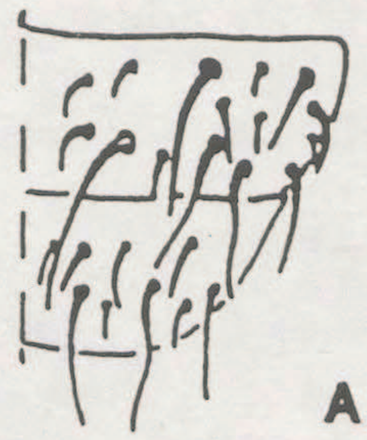
Color: background yellow with heavy blue pigment over dorsum and head. Fourth antennal segment with typical blunt setae and with peculiar bilobed apical bulb as in boletivora. P.A.O. about twice as long as nearest eye. Dens about twice as long as mucro with two inner distal setae basally enlarged and sharply angled at mid level. Integument uniformly finely granulate. Second thoracic segment with normal chaetotaxy but seta m_4 sometimes absent. Larger body setae minutely and sparsely serrate to smooth. Maximum length 1.5 mm.

Remarks

This is very similar to boletivora; however, the different dental setae, shorter anal spines, and different abdominal chaetotaxy indicate a different species.

Type locality: Clarksville, Montgomery Co., Tenn., 12 June 1940, on tobacco (U.S. Nat. Mus. No. 40-11880).

FIGURE 110



Hypogastrura (Ceratophysella) biloba

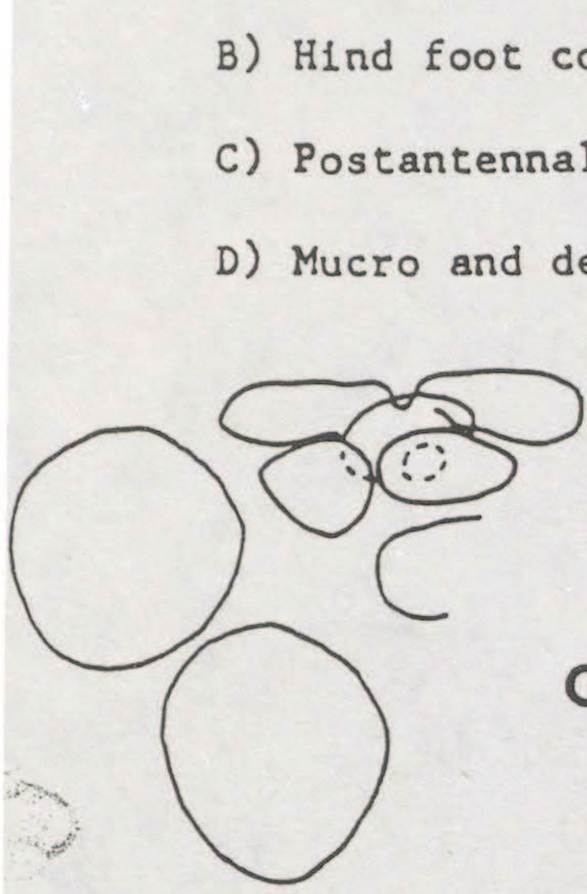
All figures from type specimens.

A) Chaetotaxy of right side, fourth and fifth abdominal segments.

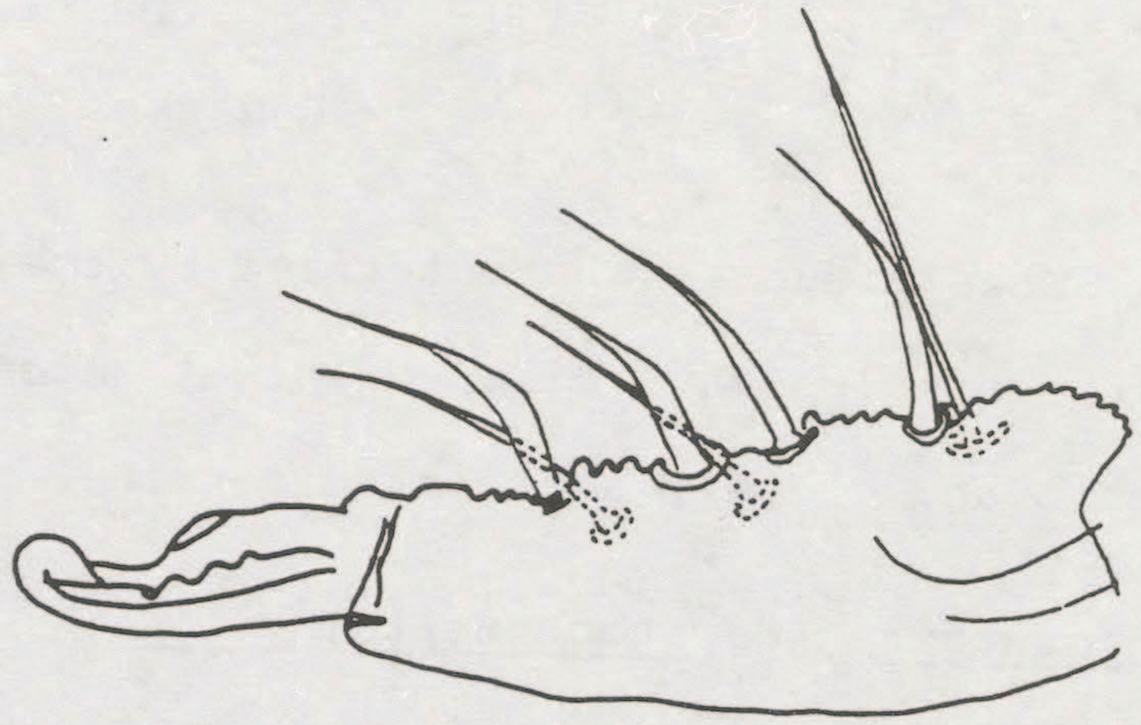
B) Hind foot complex.

C) Postantennal organ.

D) Mucro and dens.







Hypogastrura (Ceratophysella) boletivora (Packard), 1873 Fig. 111

Ref. : Rep. Peabody Acad. Sci. 5: 30 (Achorutes)

Description

Color: dark to medium blue, uniformly distributed. Fourth antennal segment with a peculiar bilobed apical bulb and typical blunt setae. P.A.O. almost twice as long as nearest eye. Tenent hair long and clearly clavate. Dens 2.3 - 2.4 times as long as mucro, without basally enlarged angle setae. Anal spines slender and curved. Integument uniformly granulate. Second thoracic segment with normal chaetotaxy. Larger body setae clearly coarsely serrate. Maximum length 2.9 mm.

Remarks

The types of Packard's boletivora do not show chaetotaxy characters clearly, and apparently include 3 species of Ceratophysella; however, among them are two specimens which appear to agree in the fourth and fifth abdominal segment chaetotaxy, unguis, tenent hairs, P.A.O. and dental setae with the specimens described above. One of these has been designated as lectotype. In a number of specimens the tip of the tenent hair is broken, giving it an acuminate appearance. The Texas specimens have the large setae less prominently serrate.

Localities: Arizona - Santa Cruz Co.; Illinois - Cisco; Indiana - Union Co.; Iowa - Poweshiek Co.; Kansas - Wilson Co.; Massachusetts Essex Co. (type); Texas - Bexar Co.

Additional record: West Virginia (Lippert and Butler, 1976).

FIGURE 111

Hypogastrura (Ceratophysella) boletivora

A) Dorsal chaetotaxy of right side, fourth and fifth abdominal segments, specimen from Poweshiek Co., Iowa.

B) Hind foot complex specimen, from same collection.

C) Apex of antenna, same specimen.

D) Postantennal organ and eyes, specimen from same collection.

E) Anal spine, same specimen.

F) Postantennal organ and neighboring eyes, specimen from Bexar Co., Texas.

G) Sixth abdominal segment, specimen from same collection.

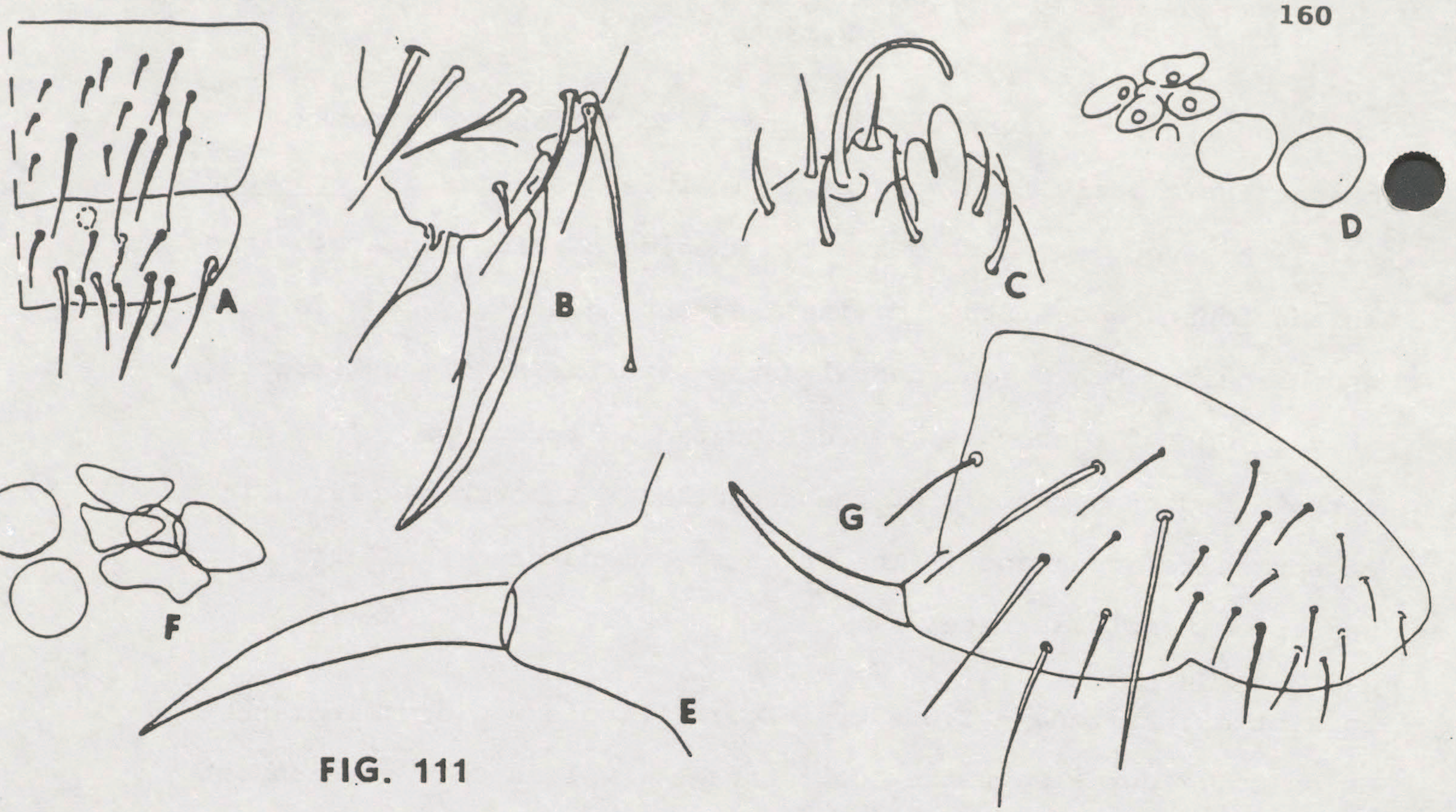


FIG. 111

Hypogastrura (Ceratophysella) pratorum (Packard), 1873 Fig. 112

Ref.: Rep. Peabody Acad. Sci. 5: 30-31 (Achorutes)

Description

Color: blue pigment scattered over dorsum of segments in the form of irregular transverse bands. Fourth antennal segment with a large unlobed apical bulb and a closely associated protective papilla, giving a bilobed appearance to the antennal apex; with seven clear blunt setae; without ventral "file", but with 11 - 13 relatively long straight setae. P.A.O. about two times as long as nearest eyes. Dens about twice as long as mucro, without basally enlarged angled setae. Anal spines slender, on unusually large contiguous papillae usually. Maximum length 1.2 mm.

Remarks

In many respects this species resembles H. boletivora, but it may readily be distinguished by the unlobed apical bulb and the differently shaped P.A.O. The description above is largely based on two California specimens. Types were examined and insofar as could be seen they agreed with this diagnosis.

Localities: California - Riverside Co.; Louisiana - Baton Rouge Par.; Main - Penobscot Co., Sagadahoc Co. (type); Oregon - Polk Co.

FIGURE 112

Hypogastrura (Ceratophysella) pratorum

All figures of Riverside Co., California specimens.

A) Hind foot complex.

B) Apex of antenna.

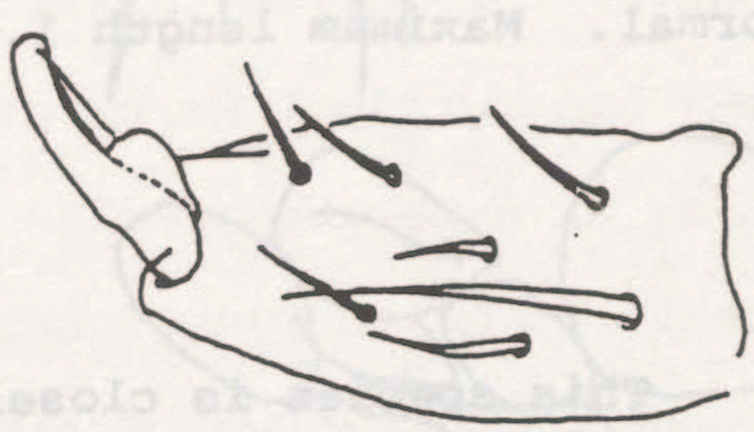
C) Postantennal organ and eyes.

D) Mucro and dens.









Hypogastrura (Ceratophysella) denticulata group

In addition to the characters listed in Table VI, members of this group have the integumental granulation heterogenous, some areas being more coarsely granulate than others.

There are 8 Nearctic species: 1) brevis; 2) denticulata complex; 3) gibbosa; 4) granulifera; 5) lucifuga; 6) pecki, 7) scotti; 8) succinea.

Remarks

The cluster of forms around denticulata probably represent a series of three to six species (see remarks under denticulata). The other species of the group are readily identified.

Hypogastrura (Ceratophysella) brevis, Christiansen & Bellinger, 1980 Fig. 113

Description

Color: dark blue to black with scattered paler spots. Fourth antennal segment with unlobed apical bulb and typical blunt setae. P.A.O. 1.7 - 2 times as large as nearest eye. Dens about 3 times as long as mucro, with all setae slender. Anal spines on large contiguous papillae. Integument with coarse granules on abdominal dorsum. Second thoracic segment chaetotaxy normal. Maximum length 1.7 mm.

Remarks

This species is closely related to the denticulata complex, but can easily be separated by the P.A.O. and the lack of basally enlarged dental setae. The description above applies well to populations from Wyoming, Utah, and Kentucky. Two California populations differ somewhat in the dens/mucro ratio (2.1 - 2.8) and the somewhat longer anal spines; however, they have the abdominal chaetotaxy and antennal and P.A.O. features of brevis and are probably local variations. The a_3 seta on abdominal segment 4 may be present. This species is very similar to Asiatic specimens of H. communis (Folsom), but differ in lacking clavate tenent hairs or serrate body setae.

Type locality: 5 miles west of Snowy Range Pass, Rt. 130, Medicine Bow National Forest, Albany Co., Wyoming, Tullgren extract of loose bark, 13 August 1950 (K. Christiansen).

Additional localities: California - Sacramento Co. (?), Tulare Co. (?); Kentucky - Edmonson Co. (cave); Utah - Utah Co.

FIGURE 113

Hypogastrura (Ceratophysella) brevis

A) Chaetotaxy of right side, fourth and fifth abdominal segments, specimen from Wayne Co., Wyoming.

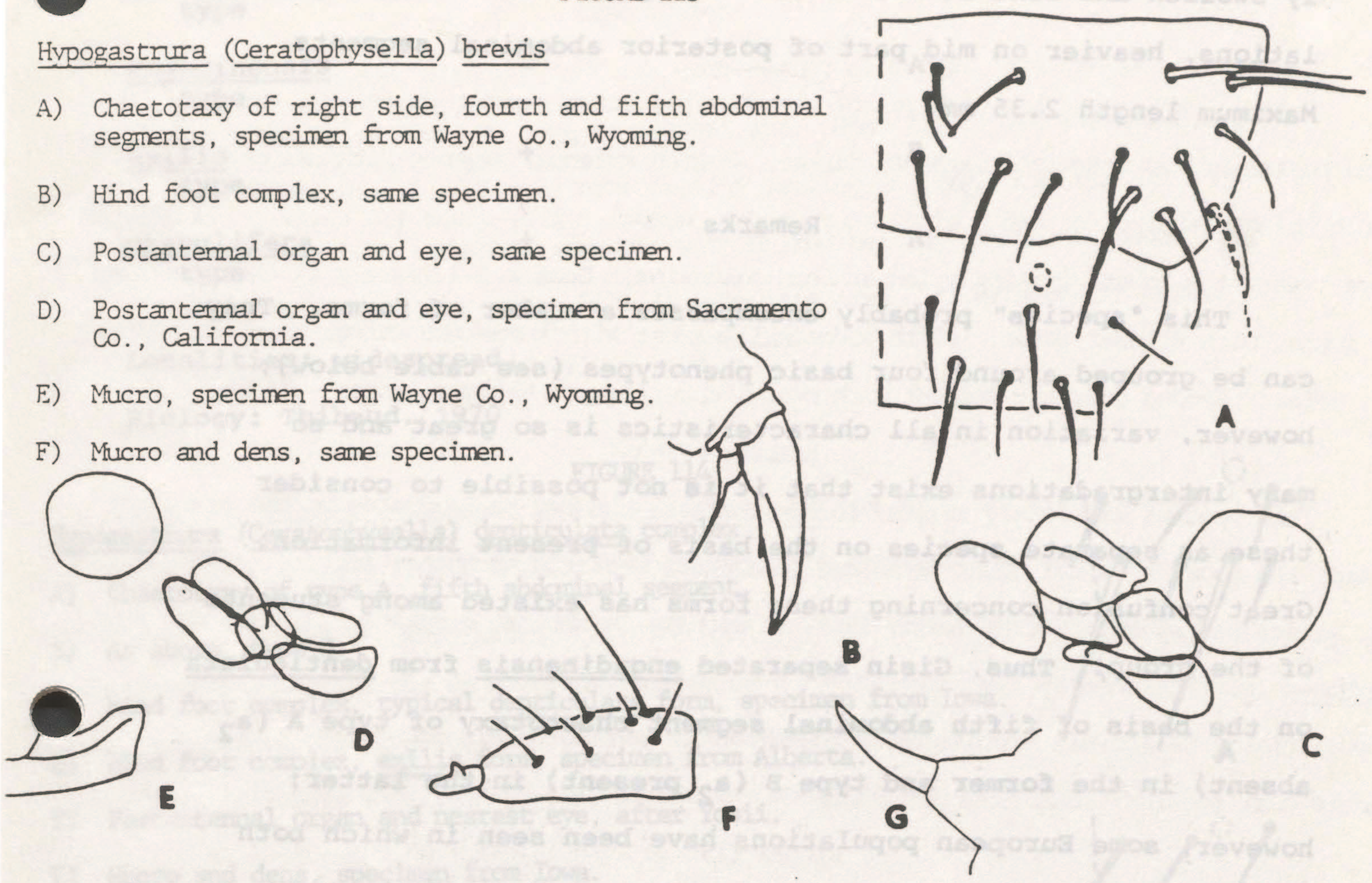
B) Hind foot complex, same specimen.

C) Postantennal organ and eye, same specimen.

D) Postantennal organ and eye, specimen from Sacramento Co., California.

E) Mucro, specimen from Wayne Co., Wyoming.

F) Mucro and dens, same specimen.



Hypogastrura (Ceratophysella) denticulata (Bagnall), 1941 Fig. 114

Refs.: Entomologist's mon. Mag. 77: 218 (Achorutes); Lawrence, 1962.

Syns.: engadinensis Gisin, 1949, Mitt. Schweiz. ent. Ges. 22: 391 (?); exilis Yosii, 1956, Contr. biol. Lab. Kyoto Univ. 3: 14 (?).

Description

Color: variable, patchy in distribution and paler ventrally. Fourth antennal segment with unlobed apical bulb and typical blunt setae. P.A.O. with anterior lobes strikingly longer than

posterior; about 2 times as long as nearest eye. Dens 1.7 - 2 times as long as mucro, with inner distal two dorsal setae basally swollen and bent at mid level. Integument with coarse granulations, heavier on mid part of posterior abdominal segments. Maximum length 2.35 mm.

Remarks

This "species" probably encompasses a number of forms. They can be grouped around four basic phenotypes (see table below); however, variation in all characteristics is so great and so many intergradations exist that it is not possible to consider these as separate species on the basis of present information. Great confusion concerning these forms has existed among students of the group. Thus, Gisin separated engadinensis from denticulata on the basis of fifth abdominal segment chaetotaxy of type A (a_2 absent) in the former and type B (a_2 present) in the latter; however, some European populations have been seen in which both types were present, and Cassagnau, 1959, synonymized the two. Some specimens from a series ascribed by Yosii to exilis have been found to have a clear fourth antennal "file", a feature described as absent in his 1956 definition of this form. In all other features (length of unguiculus, file 1 setae of fourth abdominal segment, etc.) intergraduations exist, and there is no congruence between variation in these features and the fifth abdominal or antennal characteristics. Until a detailed study of the group is made, we feel it best to lump all members under the name denticulata. It is possible that a situation of extreme local variation exists here, such as was uncovered by Christiansen (1964) in Tomocerus, and by Bödvarsson (1970) in Onychiurus.

	Antennal "file"	Abd. V Chaetotaxy type
denticulata type	-	B
engadinensis type	-	A
exilis type	+	B
granulifera type	+	A

Localities: widespread.

Biology: Thibaud, 1970

FIGURE 114

Hypogastrura (Ceratophysella) denticulata complex

A) Chaetotaxy of type A, fifth abdominal segment.

B) As above, type B.

C) Hind foot complex, typical denticulata form, specimen from Iowa.

D) Hind foot complex, exilis form, specimen from Alberta.

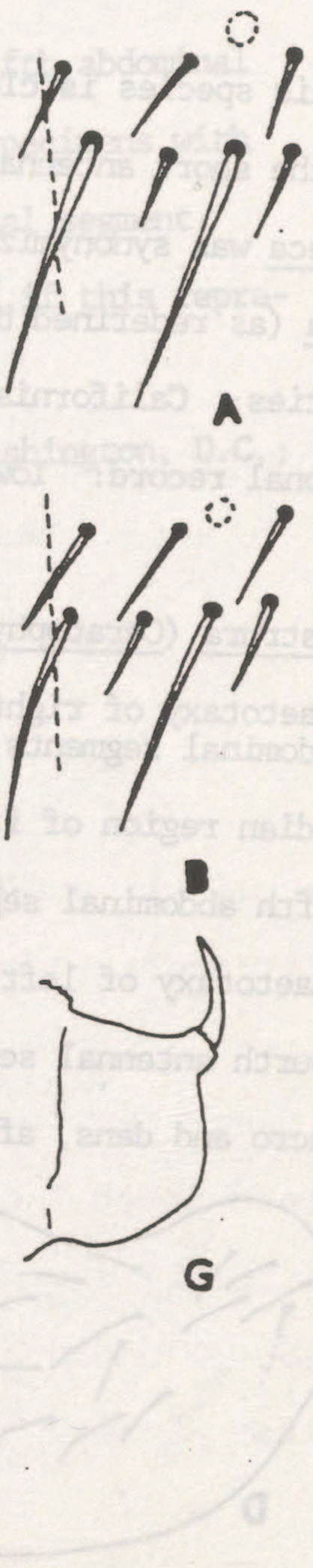
E) Postantennal organ and nearest eye, after Yosii.

F) Mucro and dens, specimen from Iowa.

G) Anal spines, after Yosii.

H) Dorsal median granules of fifth abdominal segment, after Yosii.

I) Profile of fifth and sixth abdominal segments, after Gisin.



Hypogastrura (Ceratophysella) gibbosa (Bagnall), 1940 Fig. 115

Refs.: Entomologist's mon. Mag.: 165 (Achorutes); Lawrence, 1962.

Syn.: azteca Yosii, 1962, Contr. biol. Lab. Kyoto Univ. 13: 8 (Ceratophysella)

Description

Color: background brownish yellow with mottled brown pigment dorsally. Antennae, head, and posterior two abdominal segments darker. Fourth antennal segment with unlobed apical bulb; blunt setae c, d, and e often shorter than normal; P.A.O. about 1.4 times / as long as nearest eye; anterior lobes strikingly longer than posterior. Dens 2.5-3 (rarely 2) times as long as mucro, with slender setae. Fifth abdominal segment with hump-like enlargement between the p_1 setae. Second thoracic segment with normal chaetotaxy. Maximum length 1.95 mm.

Remarks

This species is closely related to denticulata, but may be separated by the abdominal hump; the short antennal blunt setae are also characteristic, but this feature is variable. C. azteca was synonymized by Yosii, 1966; it appears to show no consistent differences from gibbosa (as redefined by Lawrence).

Localities: California - widespread; Pennsylvania - Philadelphia Co.

Additional record: Iowa (Bagnall, 1941).

FIGURE 115

Hypogastrura (Ceratophysella) gibbosa

A) Chaetotaxy of right side, fourth and fifth abdominal segments, after Yosii.

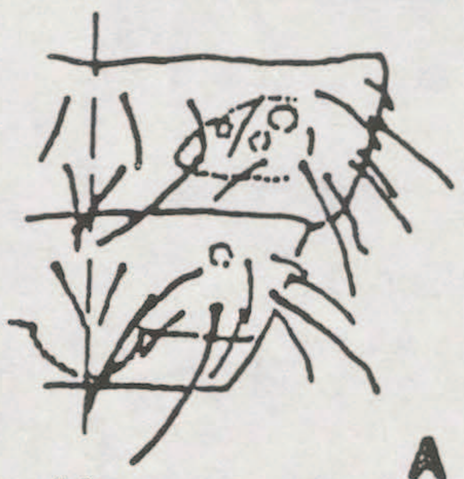
B) Median region of fifth abdominal segment, after Yosii.

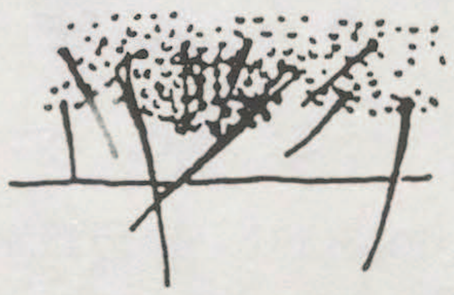
C) Fifth abdominal segment hump, after Lawrence.

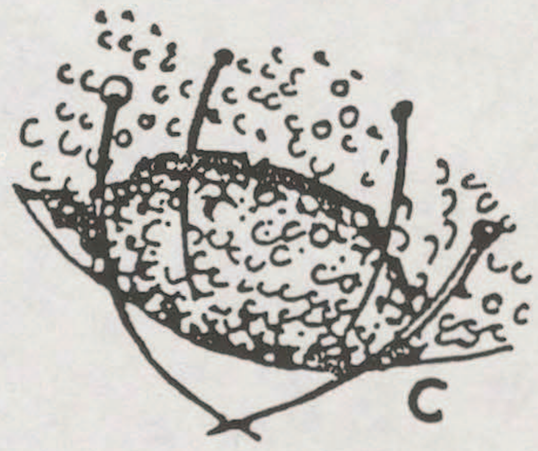
D) Chaetotaxy of left side, second thoracic segment, after Lawrence.

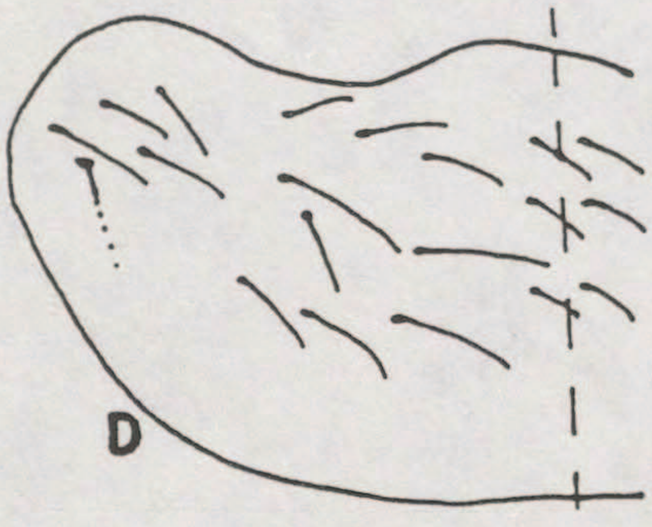
E) Fourth antennal segment, after Yosii.

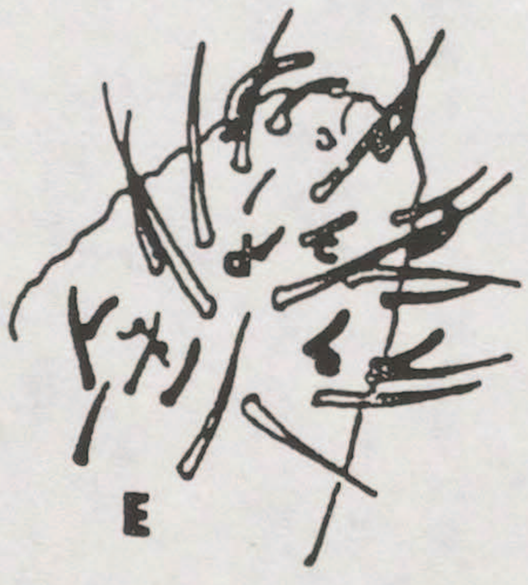
F) Mucro and dens, after Yosii.

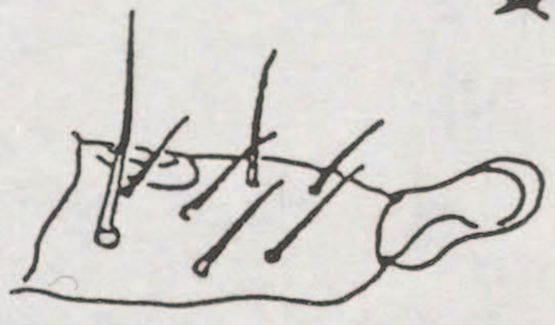












Ref.: Contr. biol. Lab. Kyoto Univ. 13: 11 (Ceratophysella)

Description

Color: violet black, strongly mottled; each segmental margin, and ventral area, paler. P.A.O. about 1.8 times as long as nearest eye. Dens 1.7 to 2.0 times as long as mucro, with inner distal 2 dorsal setae basally swollen and angled at mid level. Second thoracic to second abdominal segments with paired heavily granulate areas; third abdominal segment with a median heavily granulate area. Chaetotaxy of second thoracic segment normal. Maximum length 1.0 mm.

Remarks

This is a doubtful species. If all specimens have the peculiar fifth abdominal chaetotaxy illustrated by Yosii it is a well-marked form; however some specimens with the general features of granulifera have a typical A type fifth abdominal segment. These forms are part of the denticulata complex (see remarks there) and if this represents granulifera its true position remains to be determined.

Localities: Illinois - Silram Springs; Maryland - Anne Arundel Co.; Washington, D.C.; Virginia - Massamittem.

FIGURE 116

Hypogastrura (Ceratophysella) granulifera

All figures after Yosii.

A) Chaetotaxy of right side of third through fifth abdominal segments.

B) Hind foot complex.

C) Chaetotaxy of right side of second thoracic segment.

D) End of abdomen.

E) Postantennal organ and nearest eyes.

F) Mucro and dens.

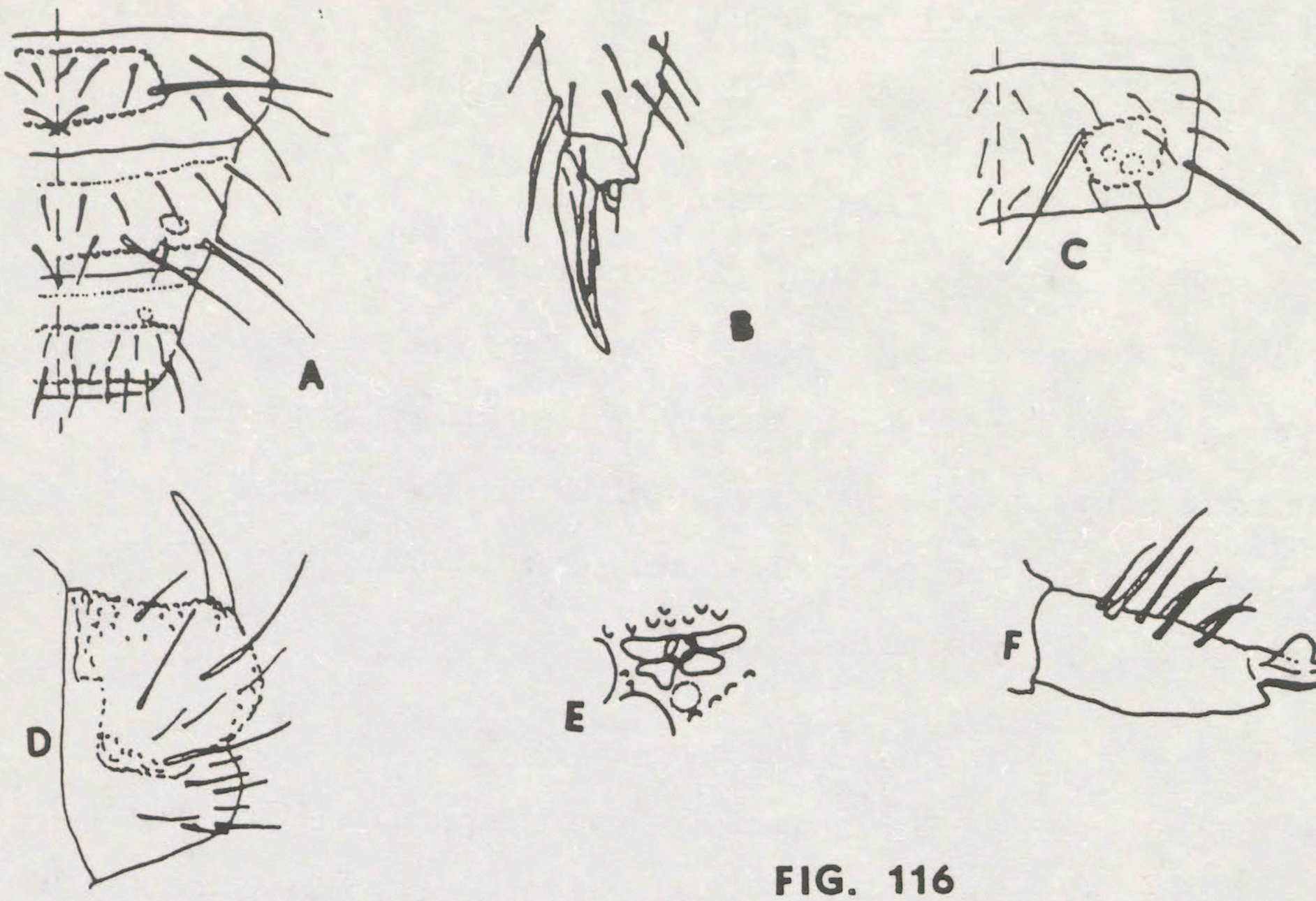


FIG. 116

Hypogastrura (Ceratophysella) lucifuga (Packard), 1888 Fig. 117

Refs.: Mem. natn. Acad. Sci. 4: 65 (Achorutes?); Bonet, 1934

Description

Color: white except for eyepatches. Fourth antennal segment atypical; apical bulb apparently unlobed but deeply sunken and difficult to examine; 8 - 9 very large blunt setae. P.A.O. 2.2 - 3 times as long as nearest eyes, with anterior lobes strikingly larger than posterior; sometimes with more than 4 lobes (5 - 7). Dens about 2 times as long as mucro, with distal inner dorsal seta slightly expanded basally. Integument heavily granulate on mid-dorsal regions. Second thoracic segment chaetotaxy normal, except that m_4 seta is usually absent. Maximum length 2.6 mm.

This is clearly a local variation of the denticulata complex. It appears to have differentiated sufficiently to merit specific status.

Locality: Indiana - Crawford Co. (Wyandotte Cave).

FIGURE 117

Hynogastrura (Ceratophysella) lucifuga

All figures of specimens from Wyandotte Cave.

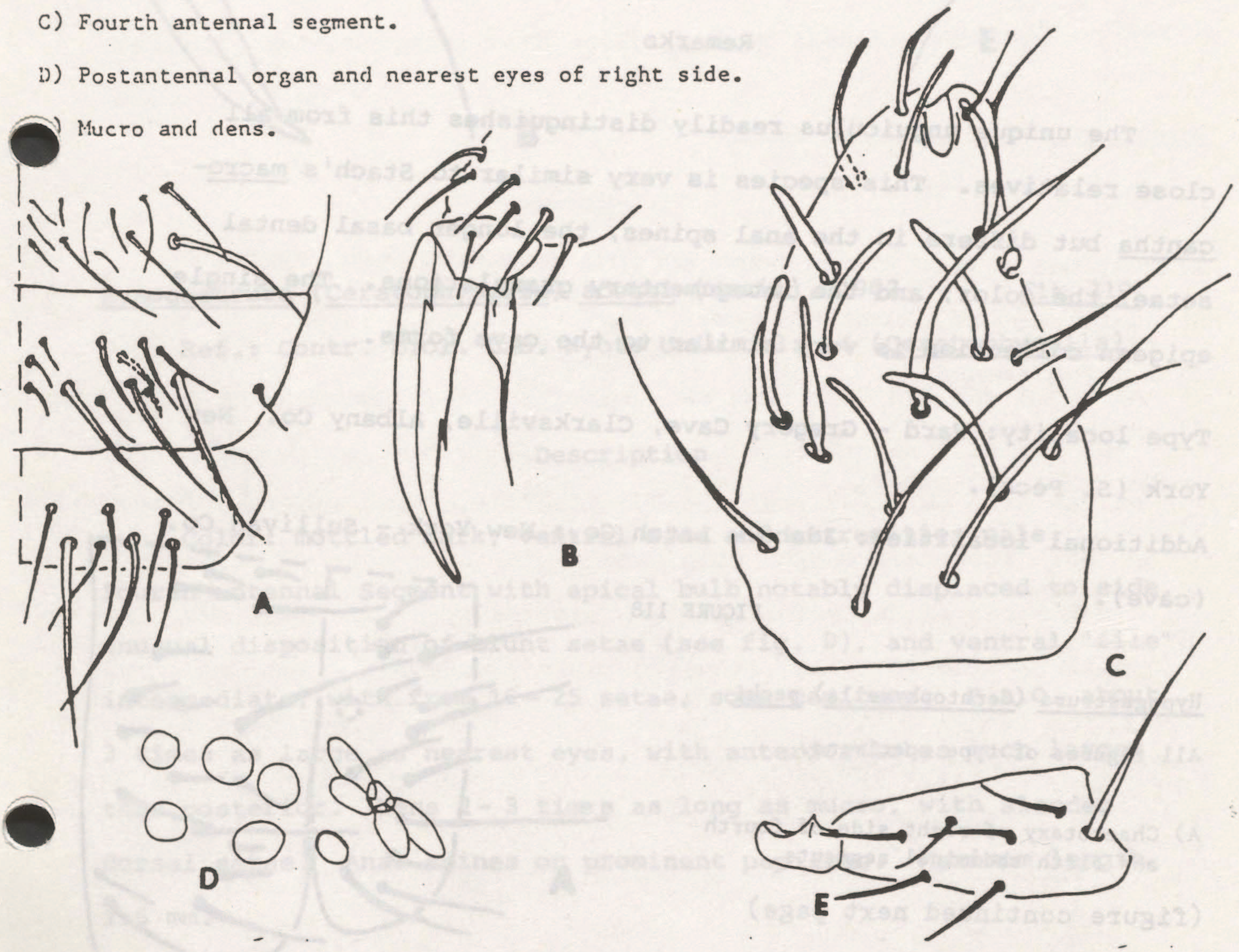
A) Chaetotaxy of right side of third, fourth and fifth abdominal segments.

B) Hind foot complex.

C) Fourth antennal segment.

D) Postantennal organ and nearest eyes of right side.

E) Mucro and dens.



Hypogastrura (*Ceratophysella*) *pecki*, Christiansen & Bellinger, 1980 Fig. 118

Description

Color: white to spotted pale blue except for blue eye patches. Fourth antennal segment with unlobed apical bulb and typical blunt setae. P.A.O. extremely elongate, 2.2 - 3 times as long as nearest eye. Unguiculus with apical filament exceeding level of apex of unguis. Dens 2.2 - 2.6 times as long as mucro, with no dorsal setae enlarged basally; basal dental seta longer than dens. Anal spines very slender. Integument with dorsal more coarsely granulate areas. Second thoracic chaetotaxy normal. Maximum length 2.3 mm.

Remarks

The unique unguiculus readily distinguishes this from all close relatives. This species is very similar to Stach's *macrocantha* but differs in the anal spines, the longer basal dental setae, the color, and the integumentary granulations. The single epigean collection is very similar to the cave forms.

Type locality: Ward - Gregory Cave, Clarksville, Albany Co., New York (S. Peck).

Additional localities: Idaho - Latch Co.; New York - Sullivan Co. (cave).

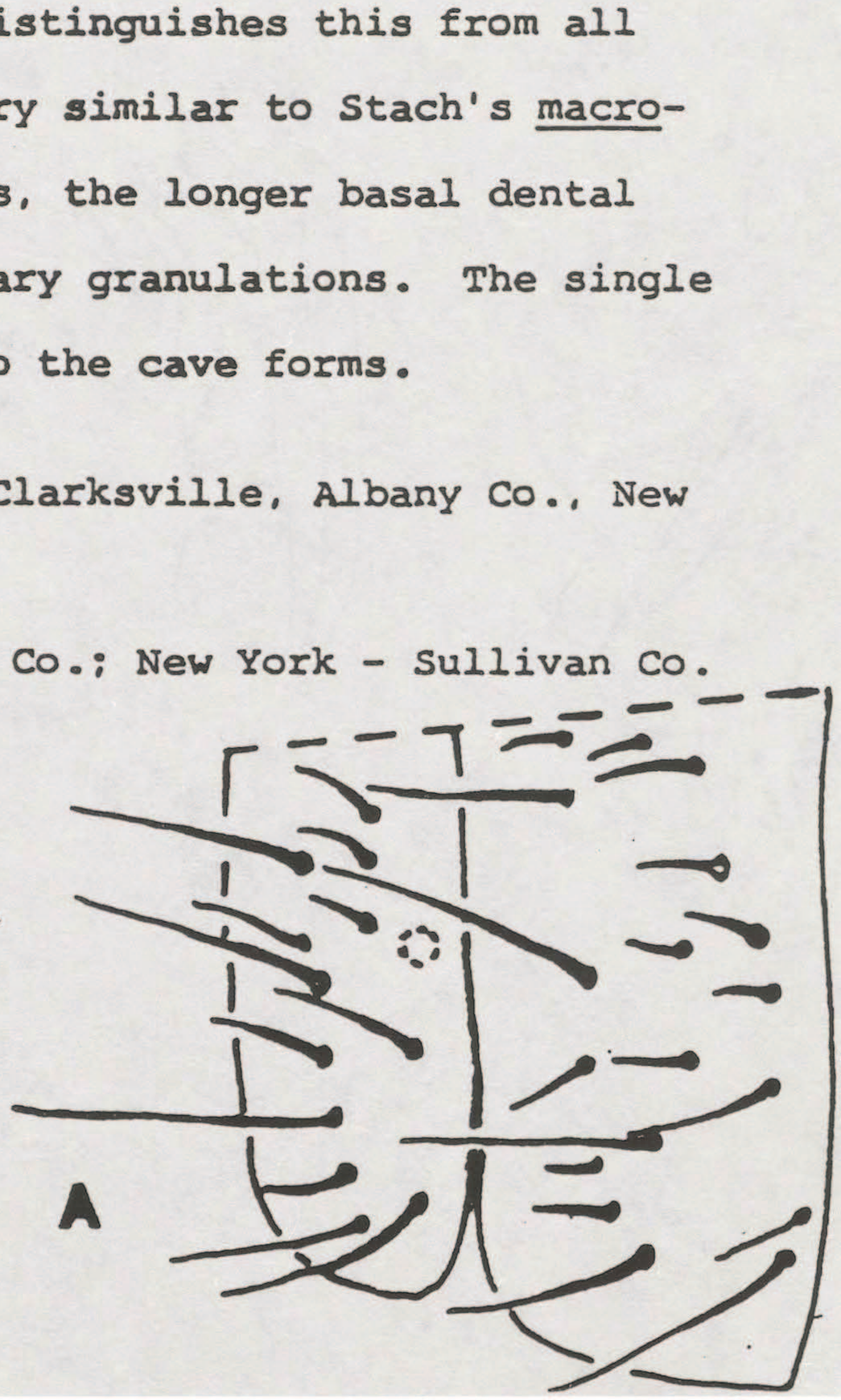
FIGURE 118

Hypogastrura (*Ceratophysella*) *pecki*

All figures of type specimens.

A) Chaetotaxy of right side of fourth and fifth abdominal segments.

(figure continued next page)

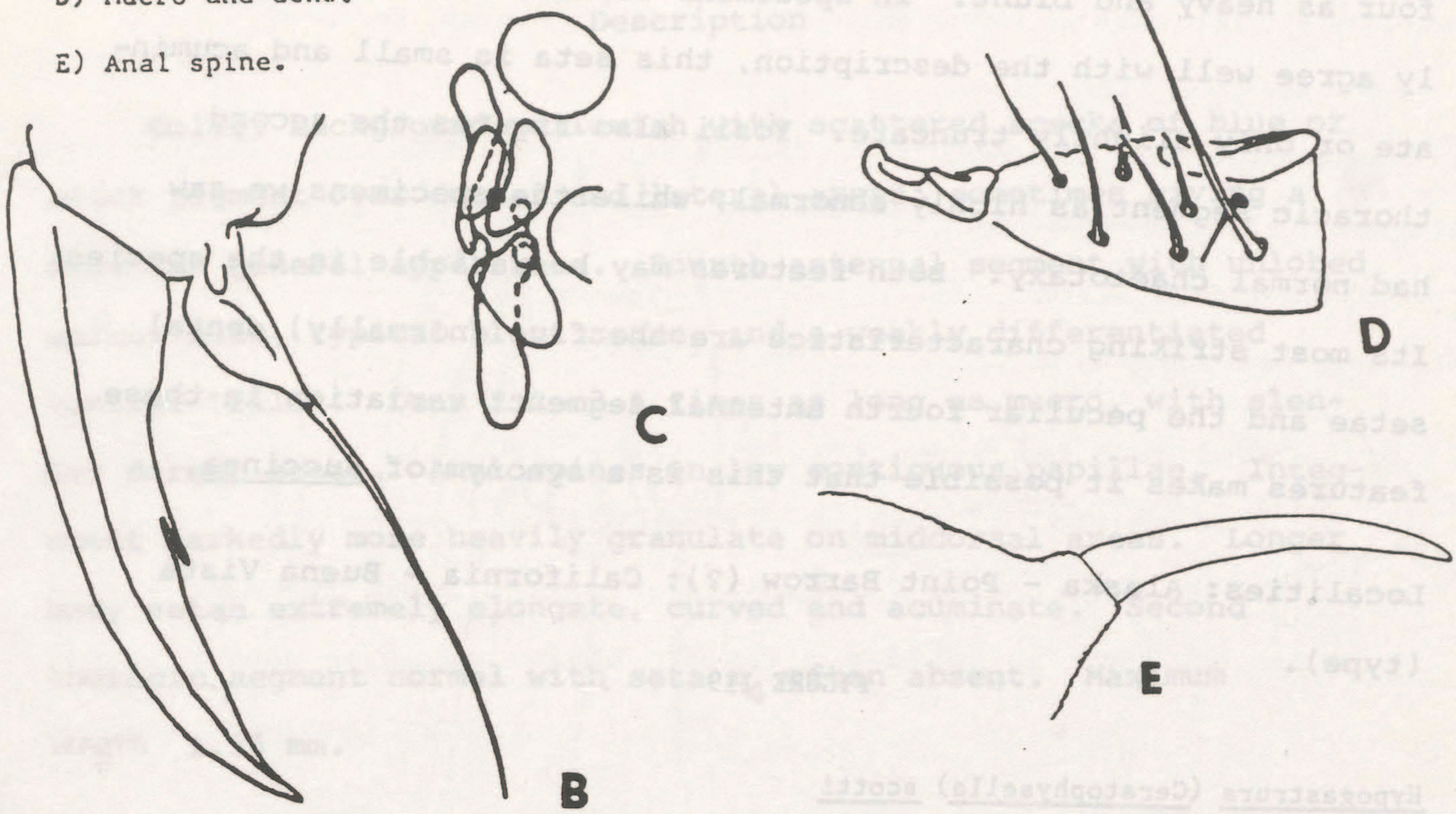


B) Hind foot complex.

C) Postantennal organ and nearest eye. (Shape of the postantennal organ will vary with the angle at which it is viewed).

D) Mucro and dens.

E) Anal spine.



Hypogastrura (Ceratophysella) scotti (Yosii), 1962 Fig. 119

Ref.: Contr. biol. Lab. Kyoto Univ. 13: 14 (Ceratophysella)

Description

Color: mottled dark, ventral side and extremities pale. Fourth antennal Segment with apical bulb notably displaced to side, unusual disposition of blunt setae (see fig. D), and ventral "file" intermediate, with from 16 - 25 setae, some capitate. P.A.O. about 3 times as large as nearest eyes, with anterior lobes much larger than posterior. Dens 2 - 3 times as long as mucro, with slender dorsal setae. Anal spines on prominent papillae. Maximum length 1.6 mm.

Yosii figures and describes the seta p_5 on abdominal segment four as heavy and blunt. In specimens we have seen which generally agree well with the description, this seta is small and acuminate or only slightly truncate. Yosii also figures the second thoracic segment as highly abnormal, while the specimens we saw had normal chaetotaxy. Both features may be variable in the species. Its most striking characteristics are the five (normally) dental setae and the peculiar fourth antennal segment; variation in these features makes it possible that this is a synonym of succinea.

Localities: Alaska - Point Barrow (?); California - Buena Vista (type).

FIGURE 119

Hypogastrura (Ceratophysella) scotti

All figures after Yosii.

A) Chaetotaxy of right side of fourth and fifth abdominal segment, showing an enlargement of a blunt body seta.

B) Hind foot complex.

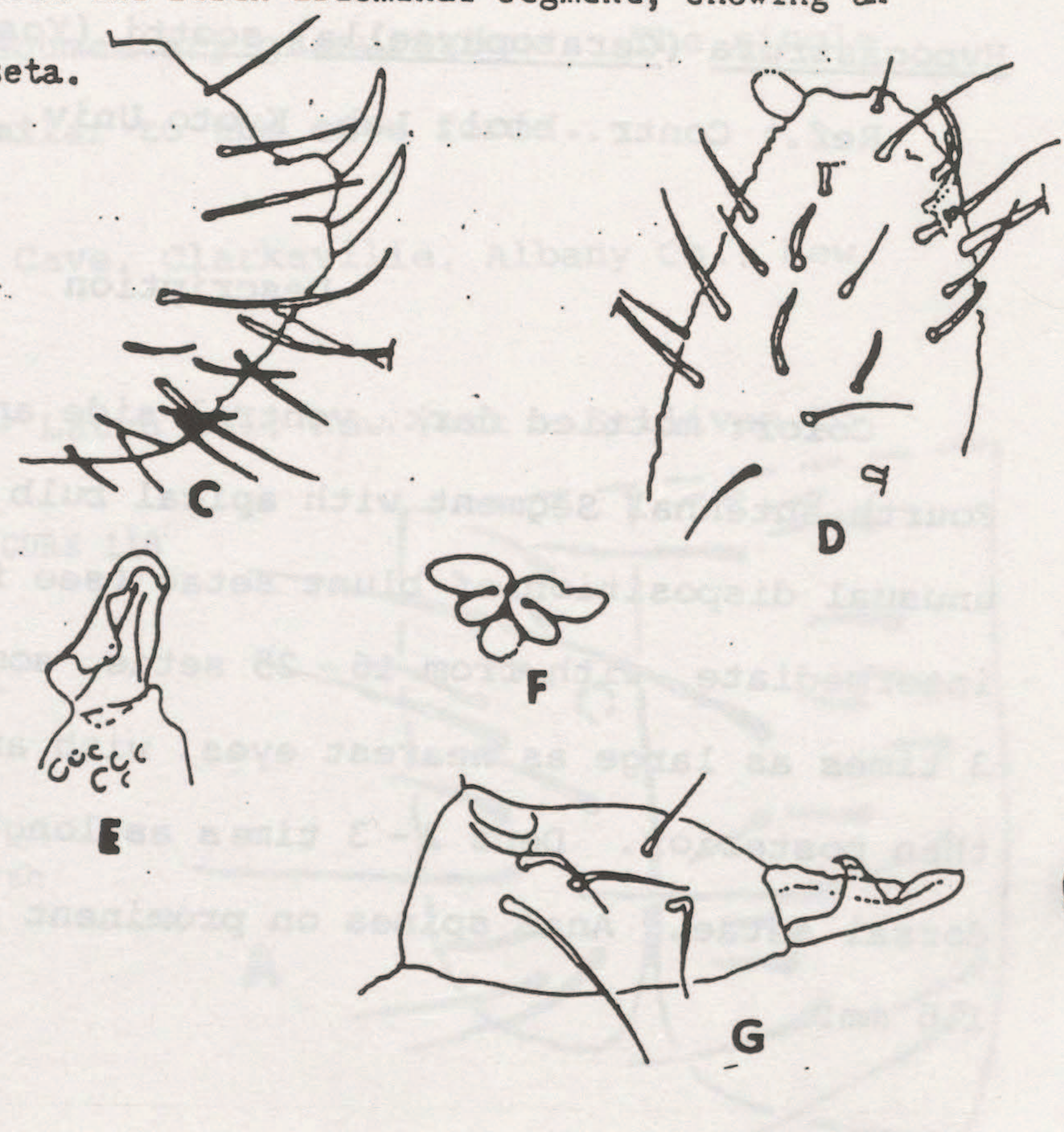
C) Apex of abdomen.

D) Fourth antennal segment

E) Mucro from above.

F) Postantennal organ.

G) Mucro and dens.



Hypogastrura (Ceratophysella) succinea Gisin, 1949 Fig. 120

Refs.: Mitt. schweiz. ent. Ges. 22: 387; Gisin, 1960

Description

Color: background yellowish with scattered specks of blue or black pigment over dorsal and lateral areas; sometimes giving a brownish general appearance. Fourth antennal segment with unlobed apical bulb, typical blunt setae, and a weakly differentiated ventral "file". Dens 2.2 - 3.1 times as long as mucro, with slender dorsal setae. Anal spines on low contiguous papillae. Integument markedly more heavily granulate on middorsal areas. Longer body setae extremely elongate, curved and acuminate. Second thoracic segment normal with seta m_4 often absent. Maximum length 1.55 mm.

Remarks

The six dental setae serve to separate this from all species of the group save exceptional scotti. The fourth antennal segment serves to distinguish these forms. We have examined the European form of succinea, and while it has some differences from the Nearctic specimens they are similar enough that the same name may be applied. The cave populations each show unique features. The Maryland specimens have serrate cephalic setae, while those from Kentucky have a moderately clear antennal file. Several species may be involved.

Localities: Connecticut - New Haven Co.; Florida - Citrus Co.; Indiana - Wayne Co.; Kentucky - Edmonson Co. (cave); Maryland - Washington Co. (cave); North Dakota - Adams Co., Billings Co.; Texas - Culbertson Co. (cave).

FIGURE 120

Hypogastrura (Ceratophysella) succinea

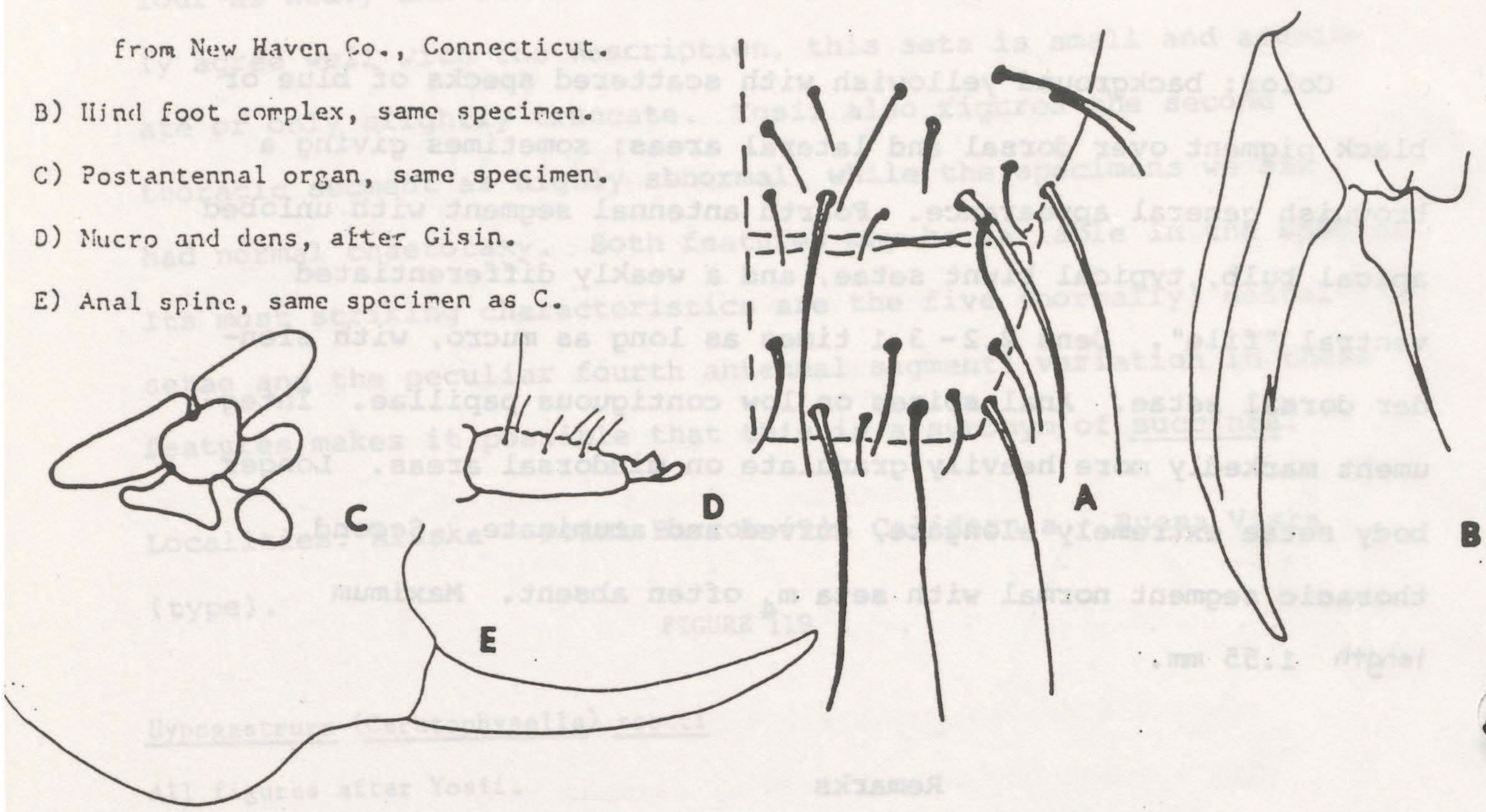
A) Chaetotaxy of right side of fourth and fifth abdominal segments, specimen from New Haven Co., Connecticut.

B) Hind foot complex, same specimen.

C) Postantennal organ, same specimen.

D) Mucro and dens, after Gisin.

E) Anal spine, same specimen as C.



Hypogastrura (Ceratophysella) maheuxi group

In addition to the characters listed in Table VI, members of this group have the tenent hair short and acuminate and the integument finely granulate.

There are 3 Nearctic species: 1) guthriei; 2) krafti; 3) maheuxi.

Remarks

The group has been redefined to include only the finely granulate forms of the communis group in Yosii's sense.

H. communis (Folsom), 1897 is a member of the boletivora group, closely related to or synonymous with pratorum. H. communis auctt.

is a different species, belonging to the maheuxi group as defined here. We have seen a single specimen which may be referable to communis auctt.; more material is needed to decide on the status of this form.

Hypogastrura (Ceratophysella) guthriei (Folsom), 1916 Fig. 121

Ref.: Proc. U.S. natn. Mus. 50: 489-490 (Achorutes)

Description

Color: dark blue with scattered pale spots and pale intersegmental membranes; head and ventral surface of body paler. Fourth antennal segment with unlobed apical bulb. Dens 2 - 2.3 times as long as mucro, without basally swollen or angulate setae. Maximum length 1.1 mm.

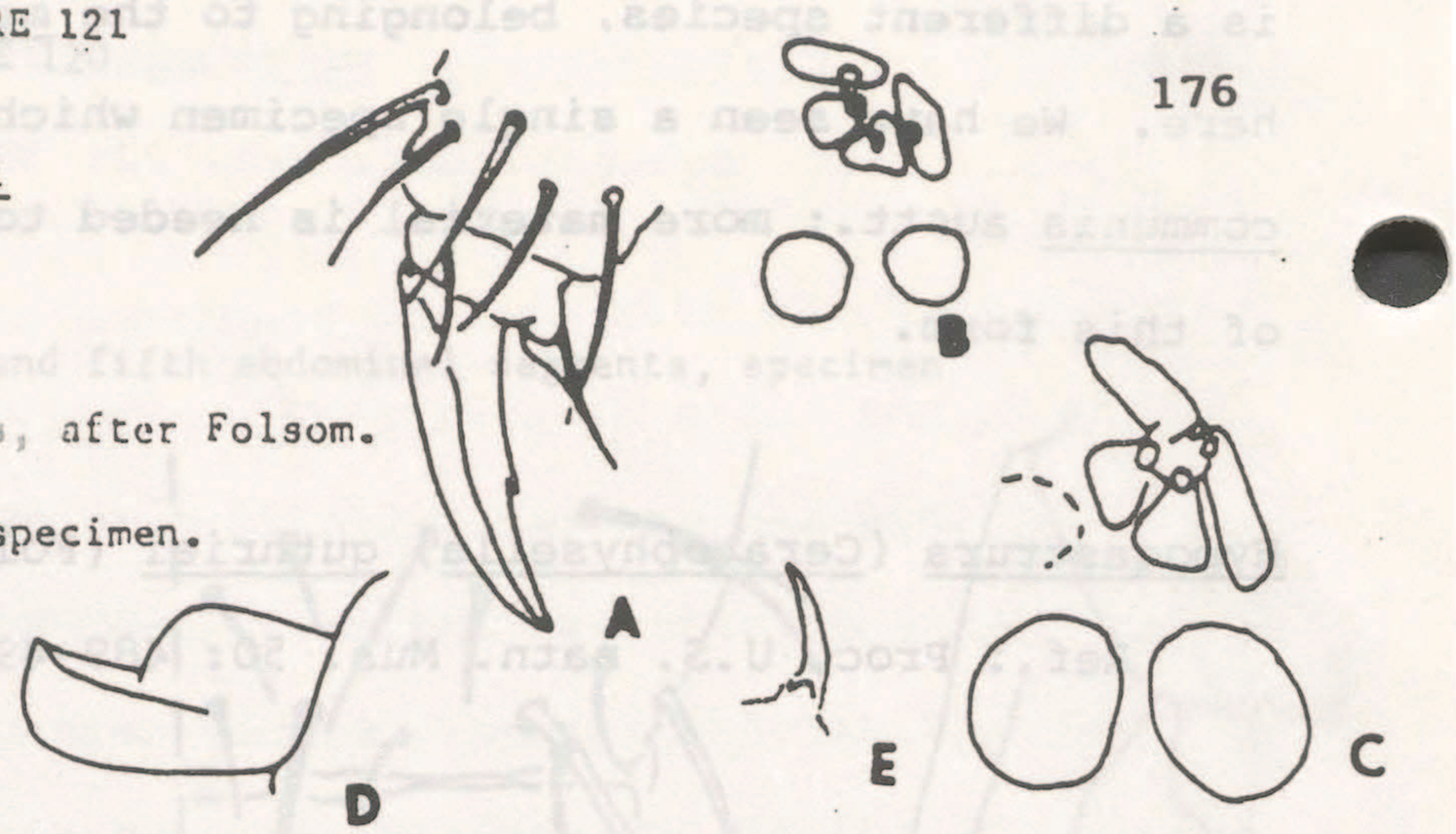
Remarks

Most of the specimens we have seen of this species are those of the type series. Most of these are opaque mounted forms; however, they did display very fine dorsal granulations and are apparently of the maheuxi group. The relatively long anal spines serve to separate this species from the other members of the group. A single California specimen shows a much more normal mucro than that of the types.

Localities: California - Riverside Co.; Minnesota - Lake Pepin (type).

Additional records: Oregon (Scott, 1963); Utah (Wray et al., 1950); Ontario (James, 1933).

FIGURE 121



Hypogastrura (Ceratophysella) guthriei

A) Hind foot complex, after Folsom.

B) Postantennal organ and nearest eyes, after Folsom.

C) Postantennal organ and eyes, type specimen.

D) Mucro, type specimen.

E) Anal spines, after Folsom.

Hypogastrura (Ceratophysella) krafti (Scott), 1962, n. comb. Fig. 122

Ref.: Ent. News 73: 238 (Spinachorutes)

Description

Color: pale blue, lighter ventrally. Fourth antennal segment with unlobed apical bulb, typical blunt setae, and a well-developed ventral "file" of about 50 setae. P.A.O. about 2 times as long as nearest eye, with anterior lobes clearly longer than posterior. Dens about 1.7 times as long as mucro, with inner 2 distal setae basally expanded. Anal spines on low papillae, sometimes doubled and so 4 in number. Second thoracic segment chaetotaxy unique; sometimes with supplementary setae in files 3 and 5; seta s.s. unclear. Fifth abdominal segment chaetotaxy with p_1 shifted forward so as to resemble an m_1 seta. Maximum length 2.1 mm.

Remarks

This well-marked species was first described by Scott in a new genus, Spinachorutes, on the basis of some probably ecomorphic specimens with 4 anal spines. Topotypical specimens we have examined agree well with the types but have normal anal spines.

In addition, all the other characteristics of the type specimens clearly place them in the subgenus Ceratophysella. The species resembles some species of the subgenus Mitchellania in the thoracic and abdominal chaetotaxy; however, it is very different in the P.A.O. and other features. The supplementary setae on the fourth abdominal segment, shown in Fig. 122A, are not always present. The Placer Co., California specimens have the tenent hairs truncate.

Localities: California - Placer Co., Sacramento Co.; Oregon - Benton Co. (type).

FIGURE 122

Hypogastrura (Ceratophysella) krafti

A) Chaetotaxy of right side of second thoracic segment, specimen from type locality.

B) Chaetotaxy of right side of fourth abdominal segment, type specimen.

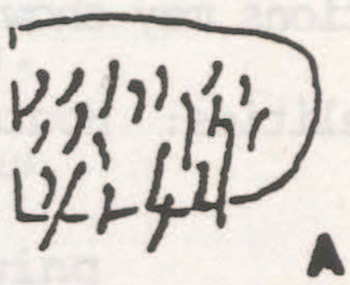
C) Chaetotaxy of right side of fourth and fifth abdominal segments, specimen from type locality.

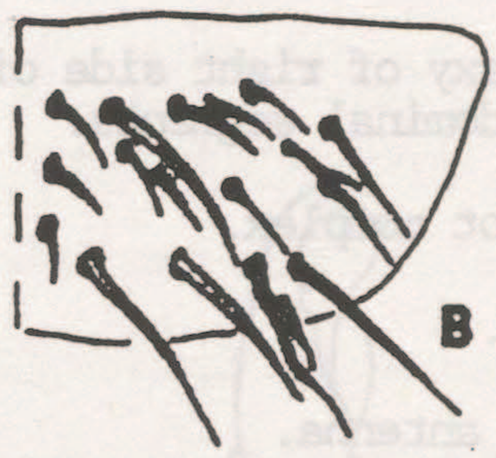
D) Hind foot complex, specimen from type locality.

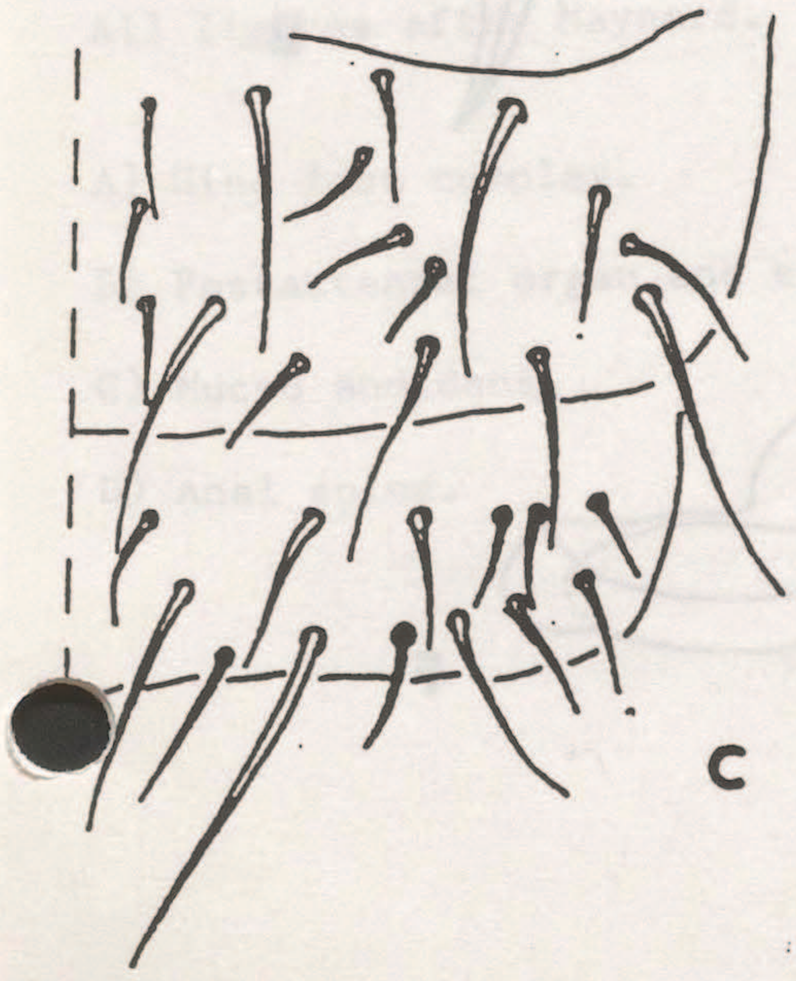
E) Postantennal organ, type specimen.

F) Postantennal organ, specimen from type locality.

G) Anal spine, specimen from type locality.

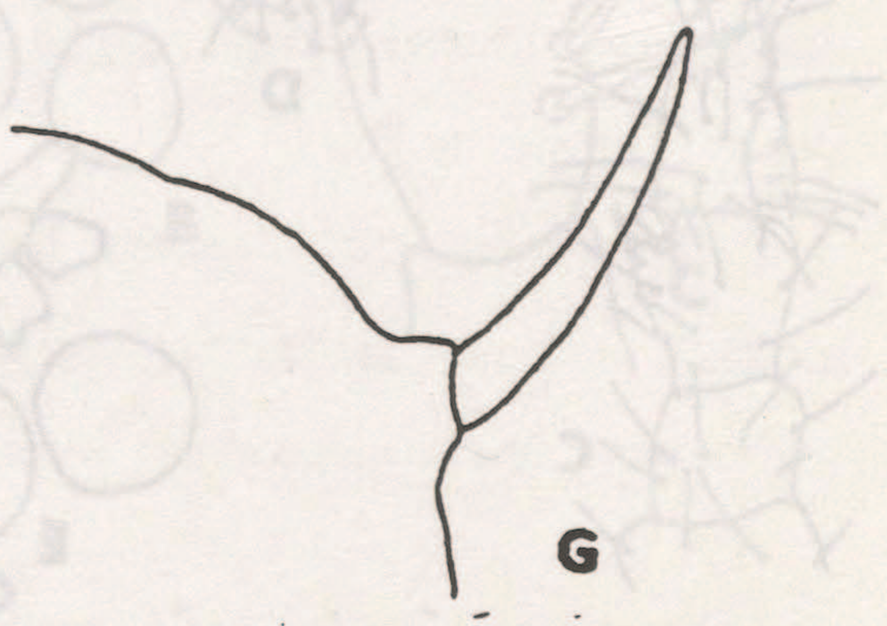












Hypogastrura (Ceratophysella) maheuxi Butler, 1966 Fig. 123

Original description: Naturaliste can. 93: 683

Description

Color: light blue. Fourth antennal segment with trilobed apical bulb and typical blunt setae. P.A.O. slightly less than twice as long as nearest eye; posterior lobes much shorter than anterior. Dens about 2 times as long as mucro, with no dorsal setae basally thickened or bent. Integument uniformly granulate. Maximum length 1.35 mm.

Remarks

This well-marked species is easily separated from its relatives by the trilobed apical antennal bulb. A single specimen from Montana has a shorter mucro (.4 as long as dens), a weakly developed antennal file, and somewhat larger anal spines. Further collections may show it to be a separate form.

Localities: Montana - Glacier Co.; New York - Rensselaer Co.; Canada - Quebec (type).

FIGURE 123

Hypogastrura (Ceratophysella) maheuxi

All figures after Butler.

A) Chaetotaxy of right side of last four abdominal segments.

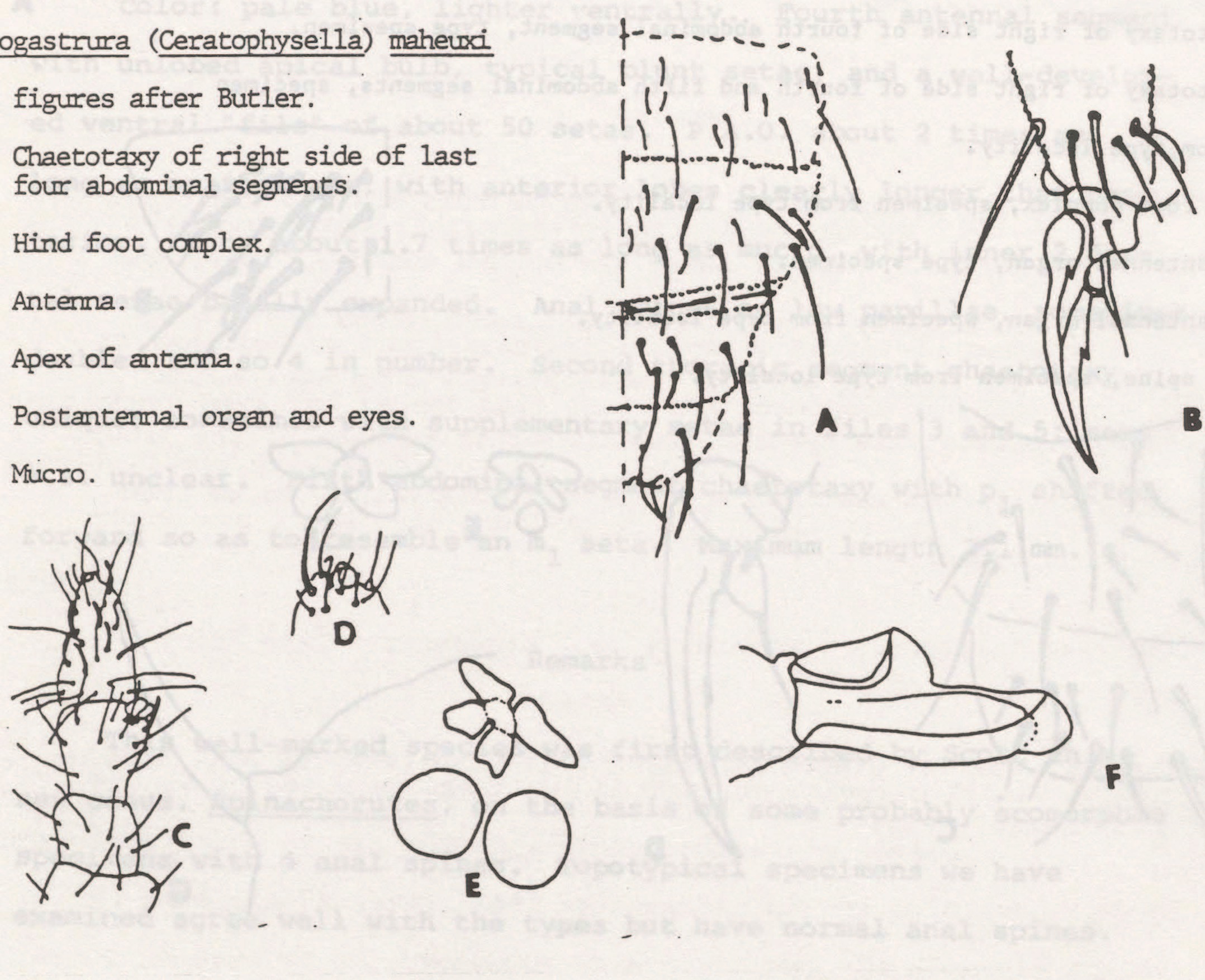
B) Hind foot complex.

C) Antenna.

D) Apex of antenna.

E) Postantennal organ and eyes.

F) Mucro.



Ref.: Collembola of New York: 31

Description

Color: deep blue-black. P.A.O. about twice as large as nearest eyes, with anterior arms much longer than posterior. Unguiculus acuminate. Dens about twice as long as mucro. Anal spines on unusually large papillae. Maximum length 1.8 mm.

Remarks

If Maynard's description and figures even approximate this animal it should be readily distinguished from its congeners. In addition to the acuminate unguiculus and short anal spines, he figures 5 dorsal setae on the dentes. If a specimen showing these features shows up it should be readily recognized.

Type locality: New York - Sea Cliff, L.I.

FIGURE 124

Hypogastrura (Ceratophysella) densornata

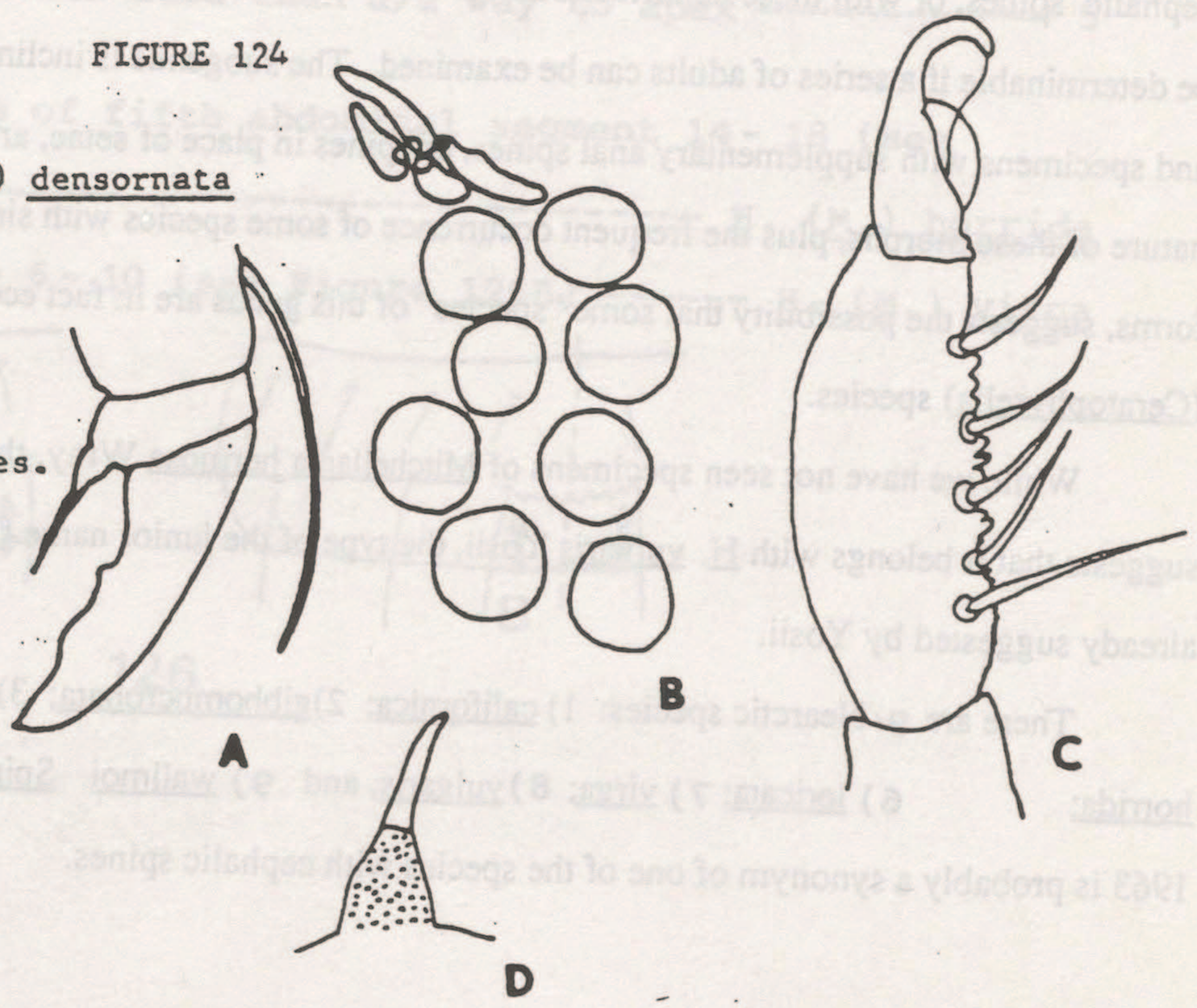
All figures after Maynard.

A) Hind foot complex.

B) Postantennal organ and eyes.

C) Mucro and dens.

D) Anal spine.



Subgenus Mitchellania Wray, 1953

Type species: Mitchellania hermosa Wray, 1953 n.status

Syn.: Cyclograna Yosii, 1961, type species: Hypogastrura (Cyclograna) vulgaris Yosii, 1960, syn.; Spinifacies Scott, 1963, type species: Spinifacies oregonensis Scott, 1963,

This subgenus includes the forms having a clear unguiculus, large anal spines, a spoon-shaped mucro with a lateral flap, and seta m2 present on the second thorasic segment. In most species, the posterior lobes of the P.A.O surround the accessory boss. The tenent hair is acuminate, the unguiculus is distinct and lamellate though sometimes small, and there are 7 dental setae.

Remarks

Most members of this subgenus are readily placed here on the basis of the P.A.O. structure, but this is less distinct in krafti and wallmoi, which must be distinguished from the denticulata group of Ceratophysella by the second thoracic segment chaetotaxy; the latter has not been described for all Mitchellania species. Problems of identification arise from intrapopulation variation in chaetotaxy in some species, particularly plurichaetosis (the presence of numerous supplementary setae) and the presence of cephalic spines. Plurichaetosis appears to increase with age or size. Individuals without cephalic spines, or with these abnormal number and position, may occur, but the normal pattern should be determinable if a series of adults can be examined. The subgenus is inclined towards ecomorphosis, and specimens with supplementary anal spines, or spines in place of setae, are common. The extreme nature of these morphs, plus the frequent occurrence of some species with similar H. (Ceratophysella) forms, suggests the possibility that some "species" of this genus are in fact ecomorphs of H. (Ceratophysella) species.

While we have not seen specimens of Mitchellania hermosa Wray, the form of its P.A.O. suggests that it belongs with H. vulgaris Yosii, the type of the junior name Cyclograna, a position already suggested by Yosii.

There are 9 Nearctic species: 1) californica; 2)gibbomucronata; 3) hermosa; 4) hiawatha; 5) horrida; 6) loricata; 7) virga; 8) vulgaris, and 9) wallmoi. Spinifacies oregonensis Scott, 1963 is probably a synonym of one of the species with cephalic spines.

Key to Species of Subgenus Mitchellania

1) Cephalic spines (see Figure 125) present in at least same specimens of population ---------- 2

1') Cephalic spines absent ---------- 6



125

2) 1 + 1 or 2 + 2 cephalic spines ---------- 3

* 2') 3 + 3 cephalic spines (sd_1 & sd_4 & sd_5) ------ H. (M.) loricata

3) P.A.O. with more than 4 arms ---------- H. (M.) hermosa

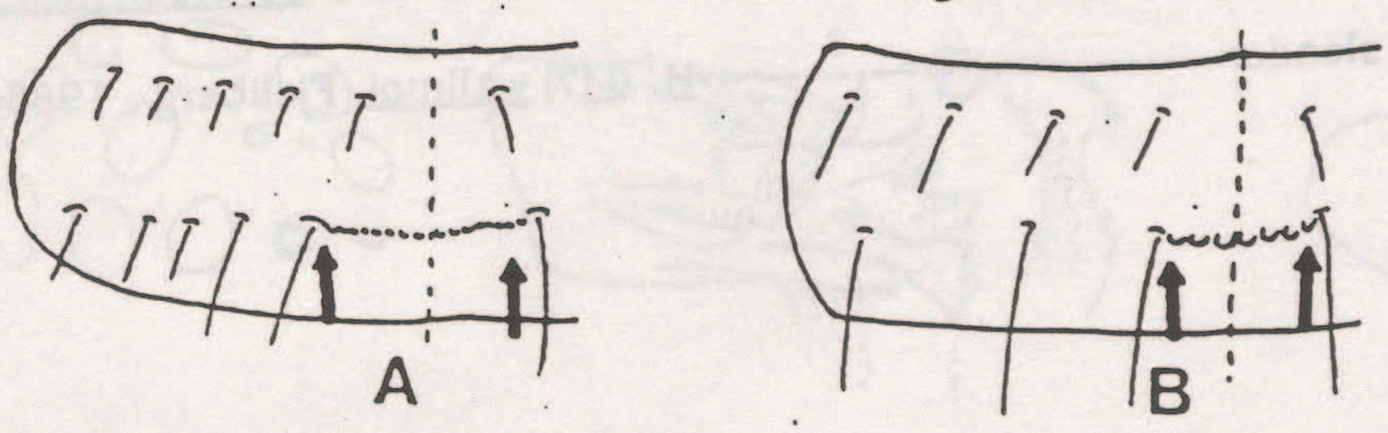
3') P.A.O. with 4 arms ---------- 4

* 4) Internal ungual tooth more than 1/2 way to apex ---------- H. (M.) hiawatha

4') Internal ungual tooth less than 1/2 way to apex ---------- 5

* 5) Yosii "a" measure of fifth abdominal segment 14 - 18 (see Figure 126A) ---------- H. (M.) horrida

** 5') Yosii "a" measure 6 - 10 (see Figure 126B) ------ H. (M.) virga



126

6) Mucro with rod-like projection (see Figure 127) ----------

---------- H. (M.) gibbomucronata

6') Mucro spoon-shaped (see Figure 29A-E) ---------- 7

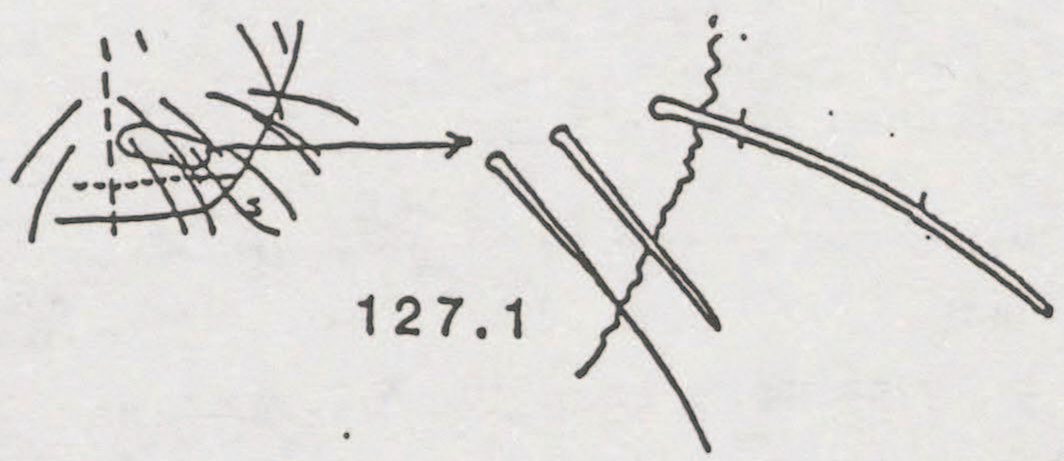


127

7) Some posterior setae on abdominal segment 4 blunt and ciliate (Figure 127.1)------

----------H. (M.) californica

7) All setae on abdominal segment 4 smooth and acuminate ----------8



127.1

8) Yoshii "a" measure 12 - 15----------H. (M.) vulgaris

8) Yoshii "a" measure more than 20----------9

* 9) Inner apical setae of dens thickened and angular----------

----------H. (M?) krafti (Fjellberg 1985a, transferred from Ceratophysella)

9) All dental setae slender----------H. (M?) wallmoi Fjellberg , 1985a

Hypogastrura (Mitchellania) californica (Bacon), 1914 n. comb. Fig. 128
Refs.: J. Ent. Zool. 6: 165 (Achorutes); Yosii, 1962

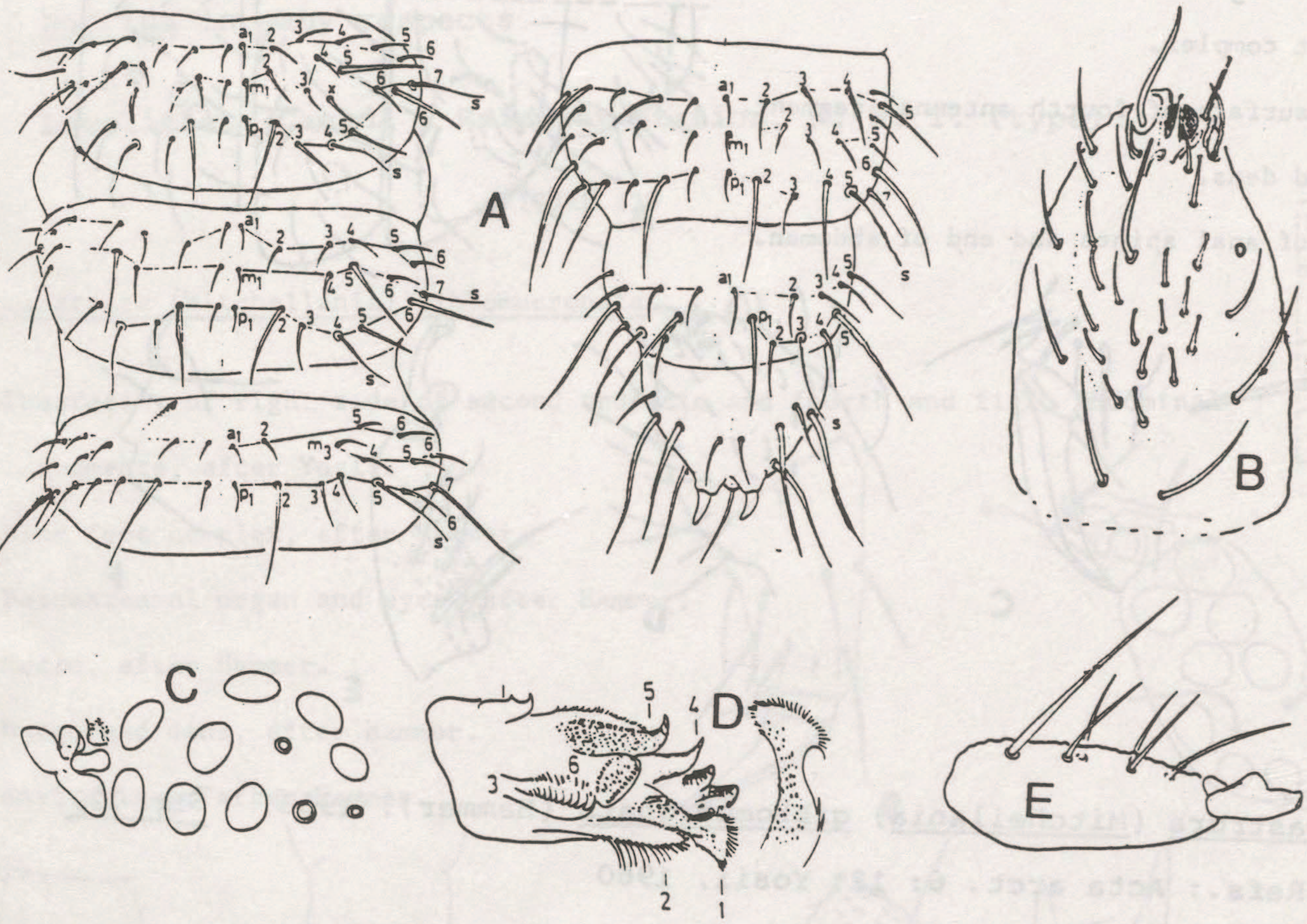
Description

Color: dark brown; antennae and dorsum mottled. Fourth antennal segment with unlobed apical bulb and about 12 short peglike setae in ventral "file". Ventral tube with 4+4 setae. Dens about 2 times as long as mucro, without basally enlarged setae. Integument with coarsely granulated areas on fifth and sixth abdominal segments. Yosii "a" measure 18. Longer body setae untapered and finely ciliate. Supplementary setae on second thoracic segment (shown by dotted lines in Fig. 128A) sometimes present. Chaetotaxy of thoracic segments irregular. Maximum length 1.5 mm.

Remarks

Bacon's species has the typical P.A.O. of Mitchellania, while the structure of this organ in Yosii's specimens is unknown; nevertheless, we are accepting Yosii's redefinition tentatively, since his form shows general features of Mitchellania and does not fit any known Ceratophysella. It is readily distinguished from all other species of the subgenus by the samll number of elements in

Hypogastrura (Mitchellania) wallmoi Fjellberg 1985
Figure 127.2



H. (M.) wallmoi. A) Dorsal chaetotaxy, thorax 2-3, abdomen 1 & 4-6; B) Ventral surface fourth antennal segment; C) Right eyes and PAO; D) Maxilla with enlargement of first lamella; E) Mucro & dens. After Fjellberg 1985.

the ventral antennal "file". The large number of granules in the Yosii "a" measure sharply distinguish it from virga, which it somewhat resembles. 184

Localities: California - Contra Costa Co., Orange Co. (type).

FIGURE 128

Hypogastrura (Mitchellania) californica

All figures after Yosii.

A) Chaetotaxy of right side of second thoracic and second, fourth and fifth abdominal segments.

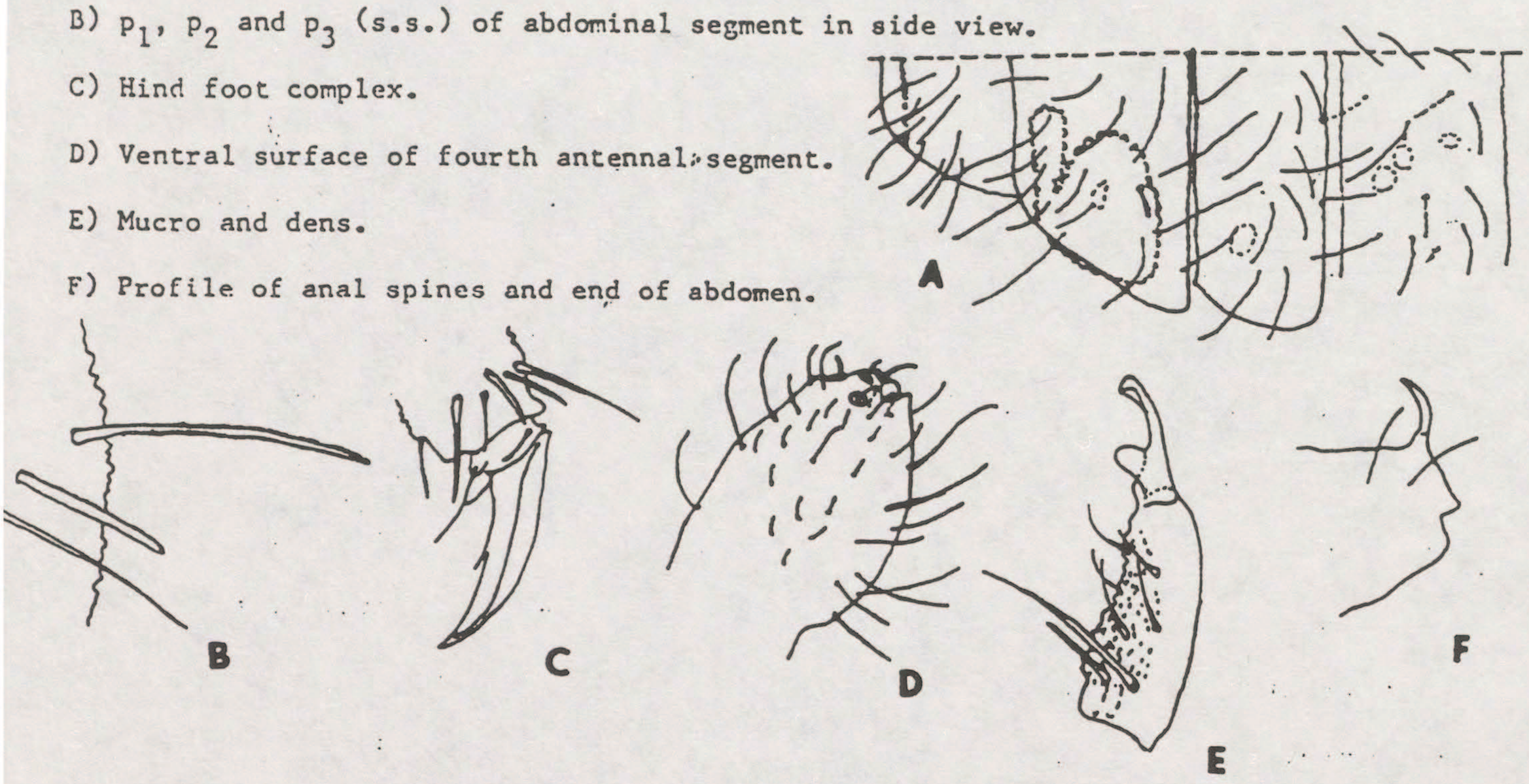
B) p_1, p_2 and p_3 (s.s.) of abdominal segment in side view.

C) Hind foot complex.

D) Ventral surface of fourth antennal segment.

E) Mucro and dens.

F) Profile of anal spines and end of abdomen.



Hypogastrura (Mitchellania) gibbomucronata (Hammer), 1953 Fig. 129

Refs.: Acta arct. 6: 12; Yosii, 1960

Description

Color: greyish to light violet with color as scattered thin purple patches in greyish background; paler ventrally. Fourth antennal segment with undivided apical bulb and ventral "file" of

"numerous" short setae. Unguiculus "hardly" half as long as inner unguis. Tenaculum with 4 + 4 teeth. Dens about 4 times as long as mucro, without basally expanded setae. Mucro of unique shape (see Fig. 129F). Anal spines about twice as long as inner unguis. Coarsely granulate area at middle of fifth abdominal segment. All body setae smooth and acuminate. Head without cephalic spines. Thoracic and abdominal segments plurichaetotic.

Remarks

If the remarkable mucro is a regular feature of this species it is unique in the subgenus. It otherwise resembles H. (M.) horrida in many respects.

Localities: Canada - Reindeer Station, N. W. T. (type).

FIGURE 129

Hypogastrura (Mitchellania) gibbomucronata

A) Chaetotaxy of right side of second thoracic and fourth and fifth abdominal segments, after Yosii.

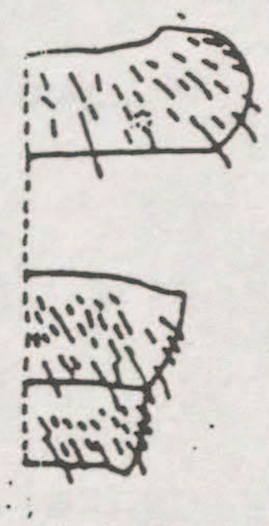
B) Hind foot complex, after Hammer.

C) Postantennal organ and eyes, after Hammer.

D) Mucro, after Hammer.

E) Mucro and dens, after Hammer.

F) Anal spines, after Hammer.



Hypogastrura (Mitchellania) hermosa (Wray), 1953 . Fig. 130

Ref.: Mature Notes, Raleigh, N.C. 1: 1 (Mitchellania)

Description

Color: yellowish white background with blotches of purple pigment; intersegmental membranes pale, giving a banded appearance; pale ventrally. Fourth antennal segment with unlobed (?) apical bulb. P.A.O. with 5 - 6 lobes, 3 or 4 of which surround the accessory boss. Dens 5/3 as long as mucro, with "about 6 - 7" dorsal setae, 5 of which are ciliate (?). Anal spines more than twice as long as inner unguis (?). Head with 2 + 2 cephalic spines. Body setae with "one row of extremely heavy spines mid-dorsally and two rows dorsolaterally, one laterally and one near base of precoxae, with shorter stout setae intermingled." Larger setae ciliate. Maximum length 2.0 mm.

Remarks

The unique P.A.O. may actually be 2 superimposed organs in a premolt specimen. If so, this might be a synonym of either loricata or virga; however, because of the P.A.O. and the ciliate dental setae it merits specific separation pending further study.

Localities: North Carolina - Yancey Co. (type), Swain Co. (Wray, 1963).

FIGURE 130

Hypogastrura (Mitchellania) hermosa

All figures after Wray.

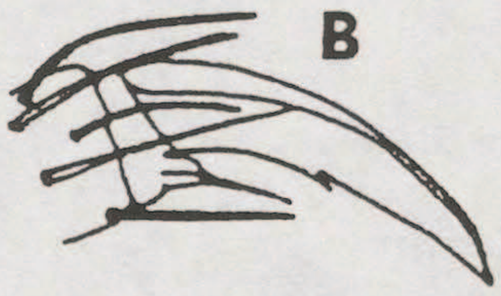
A) Habitus.

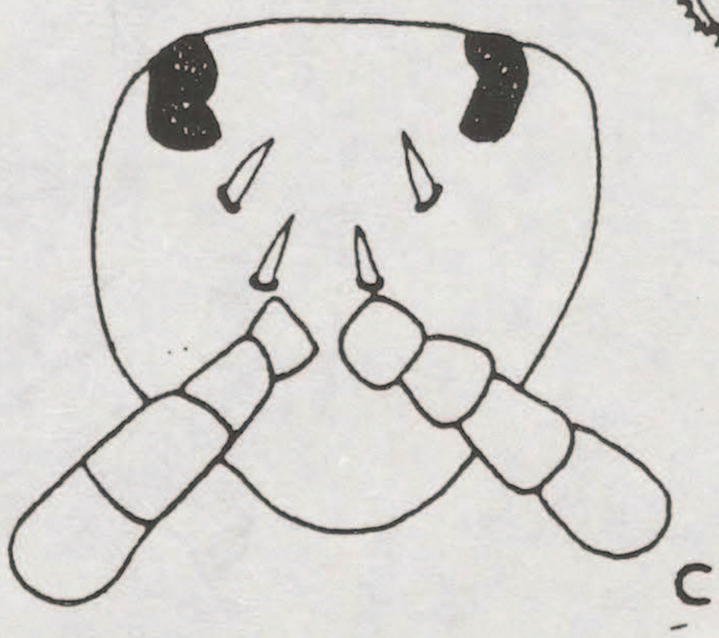
B) Hind foot complex.

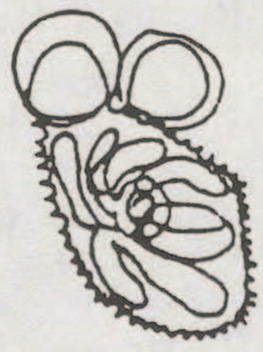
C) Head.

D) Postantennal organ and nearest eyes.









Ref.: Contr. biol. Lab. Kyoto Univ. 13: 17 (Cyclograna)

Description

Color: dark to light gray, pigment mottled; paler on intersegmental membranes and venter. Fourth antennal segment with an unlobed apical bulb, and 7 (-8?) blunt setae; ventral "file" well developed, of 30-40 setae. Inner unguis 2 - 3 times as long as unguiculus. Ventral tube with 4 + 4 setae. Tenaculum with 4 + 4 teeth. Dens 1.7 to 2 times as long as mucro, with the four inner setae basally enlarged and bent at mid level. Anal spines shorter than inner unguis. Integument moderately finely granulate; Yosii "a" measure 14 - 15. Head with 2 + 2 cephalic spines representing setae sd_4 and d_5; these may be poorly developed in young specimens. Setae otherwise all slender and acuminate; many thoracic and abdominal setae extremely short. Maximum length 1.5 mm.

Remarks

The specimens we have seen ascribable to this species share the unique features of small anal spines, weak setae, and four heavy, bent inner dental setae. They differ from Yosii's in their smaller unguiculus and greater plurichaetosis on the fourth abdominal segment. Indiana specimens, otherwise typical, may have the cephalic spines weak or the ungual tooth more basal (approaching horrida in this respect).

FIGURE 131

Hypogastrura (Mitchellania) hiawatha

A) Chaetotaxy of right side of second thoracic and fourth and fifth abdominal segments, after Yosii. Dotted setae transposed.

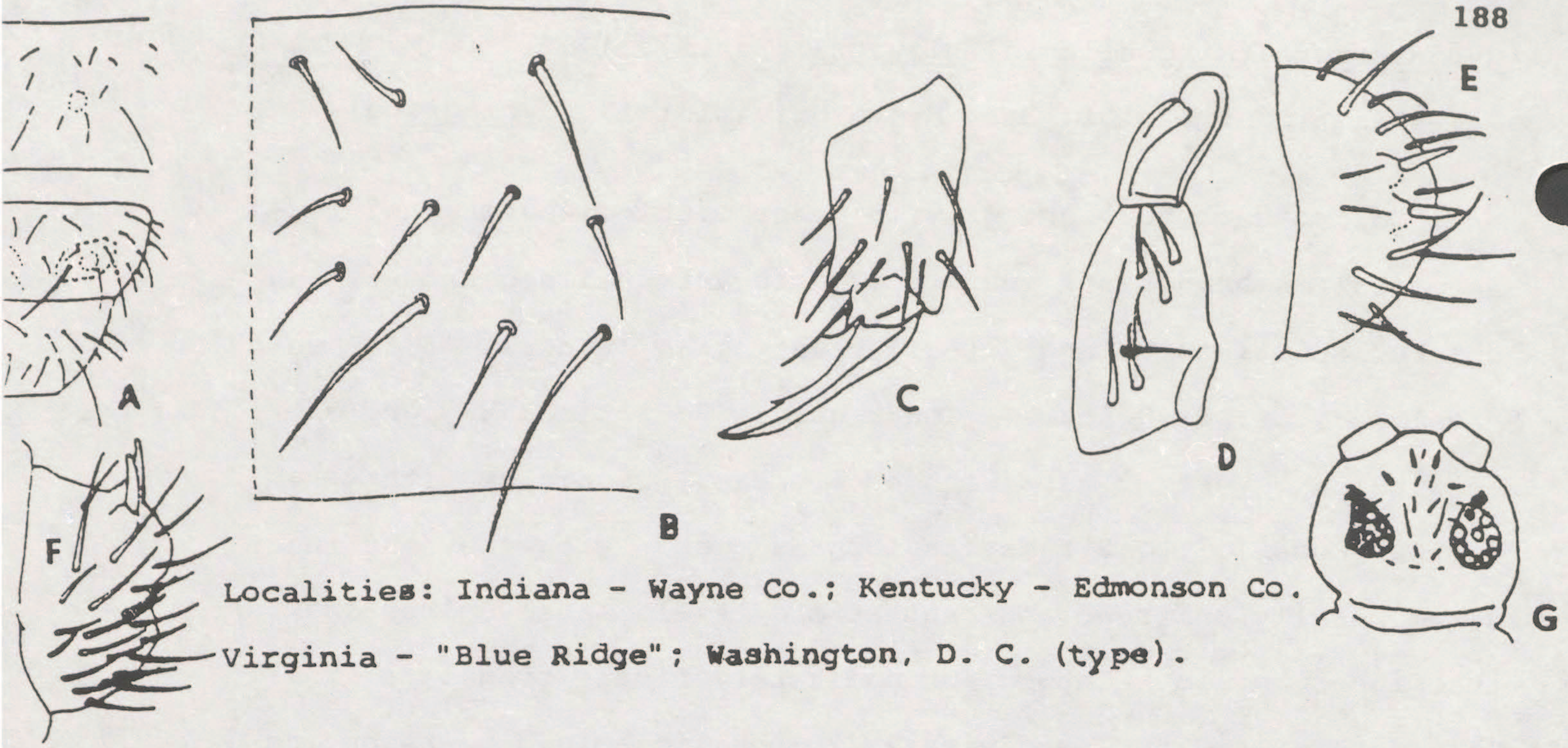
B) Chaetotaxy of right side of inner fourth abdominal segment, specimen from Powell Co., Kentucky.

C) Hind foot complex, after Yosii.

D) Mucro and dens, after Yosii.

E) and F) Sixth abdominal segment and anal spines, after Yosii.

G) Dorsum of head, after Yosii.



Localities: Indiana - Wayne Co.; Kentucky - Edmonson Co.

Virginia - "Blue Ridge"; Washington, D. C. (type).

Hypogastrura (Mitchellania) horrida Yosii, 1960 Fig. 132

Original description: Am. Midl. Nat. 64: 266

Description

Color: chestnut brown, mottled dorsally. Fourth antennal segment with 7 typical blunt setae and a well-developed ventral "file" of 40 - 60 very short angulate setae. Inner unguis 2 - 2.7 times as long as unguiculus. Ventral tube with 4 + 4 setae. Tenaculum with 4 + 4 teeth. Dens about 2 times as long as mucro, with 7 dorsal setae, distal 3 to 5 setae basally enlarged and angulate at mid level. Anal spines yellowish brown in color, relatively straight and 1.2 - 1.5 times as long as inner unguis. Integument somewhat more heavily granulate on fifth and sixth abdominal segments. Yosii "a" measure 14 - 17. Head with 4 cephalic spines normally present, representing setae sd_4 and d_5. Body setae all relatively slender, smooth and acuminate. Extreme plurichaetosis often displayed. Maximum length 1.46 mm.

Remarks

This species resembles H. virga, but is distinguished by the extreme development of the antennal "file", the slender setae, and

the smaller granules on the fifth abdominal segment ("a" measure of virga is 8 - 10); the unguiculus of horrida is also generally longer. In both species the amount of plurichaetosis varies greatly. Some populations from California with the general characters of horrida contain individuals lacking cephalic spines. One specimen from Oregon has the anal spines shorter than the inner unguis.

Localities: California - Alameda Co., Del Norte Co., Humboldt Co., Los Angeles Co., Napa Co., Sonoma Co.; Oregon - Benton Co. (type); Canada - Vancouver I.

FIGURE 132

Hypogastrura (Mitchellania) horrida

A) Chaetotaxy of right side of second thoracic and last four abdominal segments, after Yosii.

B) Chaetotaxy of right side of fourth and fifth abdominal segments, specimen from Norte Co., California.

C) Hind foot complex, after Yosii.

D) Head, after Yosii.

E) Postantennal organ and eyes, after Yosii

F) Mucro and dens, after Yosii.

Hypogastrura (Mitchellania) loricata Yosii, 1960 Fig. 133

Original description: Am. Midl. Nat. 64: 264

Description

Color: blue to purple pigment on a yellow background, sometimes giving brownish appearance, absent on intersegmental membranes so that animals appear banded; pale ventrally. Fourth antennal segment with normal blunt setae, and unlobed apical bulb and a ventral "file" of 25 - 35 short curved setae. P.A.O. with posterior lobes somewhat shorter than typical, sometimes not fully enclosing accessory boss. Inner unguis 2.5 - 3.2 times as long as unguiculus. Dens 1.8 - 2.5 times as long as mucro, with 2 (and to a lesser extent the third) distalmost inner setae basally enlarged. Anal spines strongly curved and 1.8 - 2.4 times as long as inner unguis. Integument extremely coarsely granulate; Yosii "a" measure 8 - 11. 3 + 3 cephalic spines, representing sd_1,. sd_4 and d_5. Body setae all acuminate, mostly heavy; some setae unilaterally serrate. Without plurichaetosis. Maximum length 2 mm.

Remarks

This well-marked species is easy to distinguish from all its congeners by the 3 + 3 cephalic spines. In one population a single spineless specimen was seen. In many respects this species resembles virga, and the two may in fact be geographical variants, but the difference in cephalic spines and plurichaetosis justify their separation at present. There is some variation in chaetotaxy. On Th. 2, a_2 and p_2 are sometimes spine-like.

Localities: Alaska - Anaktuvuk; Connecticut - Fairfield Co., New Haven Co.; Maine - Cumberland Co., Lincoln Co.; New Hampshire - Coos Co. (type); Pennsylvania - Berks Co.

FIGURE 133

Hypogastrura (Mitchellania) loricata

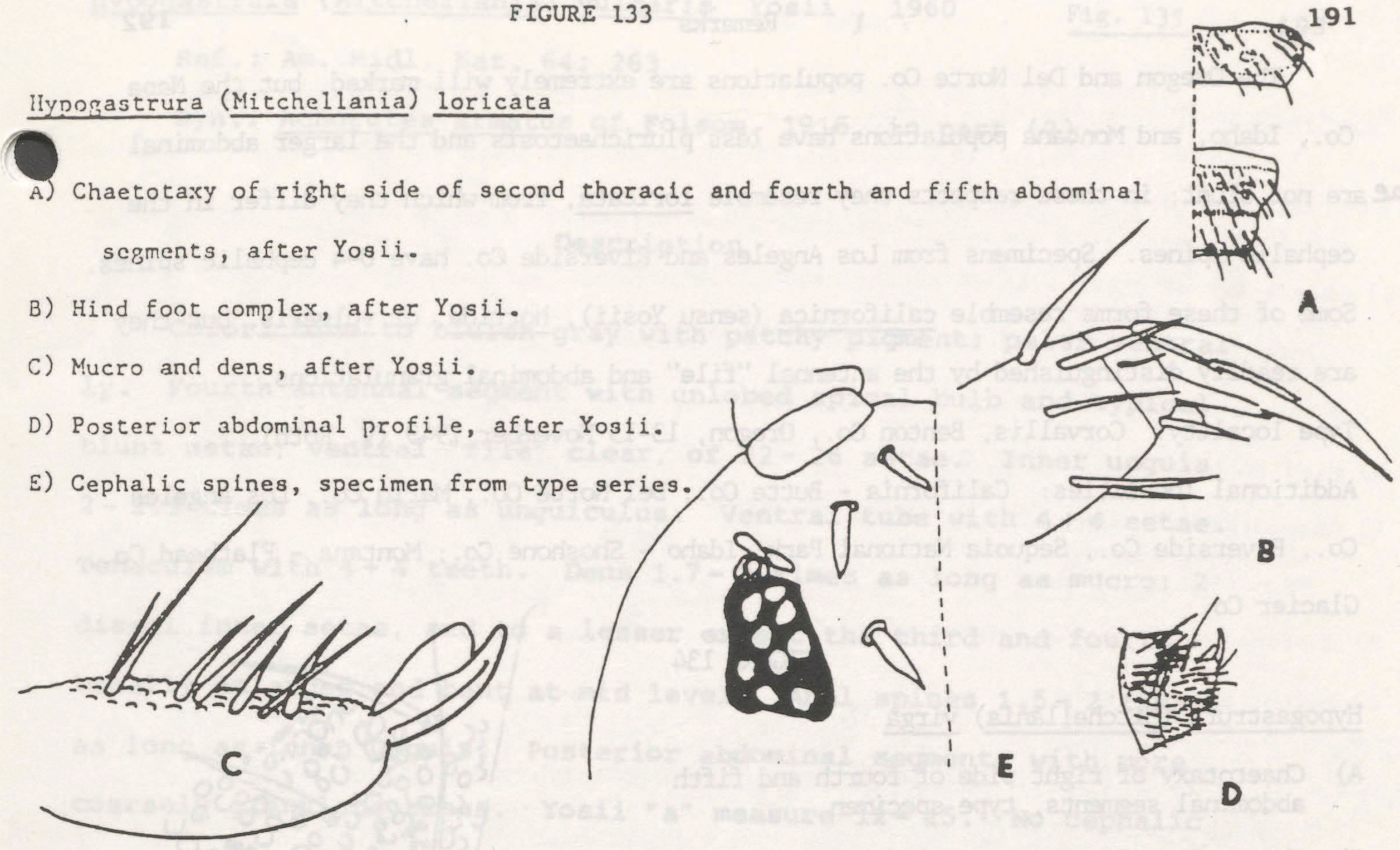
A) Chaetotaxy of right side of second thoracic and fourth and fifth abdominal segments, after Yosii.

B) Hind foot complex, after Yosii.

C) Mucro and dens, after Yosii.

D) Posterior abdominal profile, after Yosii.

E) Cephalic spines, specimen from type series.



Hypogastrura (Mitchellania) virga, Christiansen & Bellinger, 1980 Fig. 134

Description

Color: background yellowish, speckled with blue, particularly heavily over mid-dorsal areas; pigment absent on intersegmental membranes; general impression: pale blue. Fourth antennal segment with unlobed apical bulb, 7 heavy blunt setae, and a ventral "file" of 15-26 setae. Inner unguis 2.5-3 times as long as unguiculus. Ventral tube with 4 + 4 setae. Tenaculum with 4 + 4 teeth. Dens 1.7-2.2 times as long as mucro; inner 4 distal setae basally swollen and angled at mid level. Anal spines 1.4-1.8 times as long as inner unguis, on low, broad papillae. Integument with extremely heavily granulate dorsal regions on thorax and abdomen, sharply marked off from rest of integument. Yosii "a" measure 8-10. Head usually with 4 cephalic spines representing setae d_5 and sd_4. Longest posterior body setae very heavy, finely serrate, and usually unapered except at apex. Plurichaetosis present in larger specimens, with many supplementary setae. Maximum length 3.0 mm.

The Oregon and Del Norte Co. populations are extremely will marked, but the Napa Co., Idaho, and Montana populations have less plurichaetosis and the larger abdominal setae are not blunt; in these respects they resemble loricata, from which they differ in the cephalic spines. Specimens from Los Angeles and Riverside Co. have 0-4 cephalic spines. Some of these forms resemble californica (sensu Yosii), horrida, or vulgaris, but they are readily distinguished by the antennal "file" and abdominal granulations.

Type locality: Corvallis, Benton Co., Oregon, 13-15 November 1949 (V. Roth).

Additional localities: California - Butte Co., Del Norte Co., Marin Co., Los Angeles Co., Riverside Co., Sequoia National Park; Idaho - Shoshone Co.; Montana - Flathead Co., Glacier Co.

FIGURE 134

Hypogastrura (Mitchellania) virga

A) Chaetotaxy of right side of fourth and fifth abdominal segments, type specimen.

B) Chaetotaxy of right side of fourth and fifth abdominal segments, specimen from Montana.

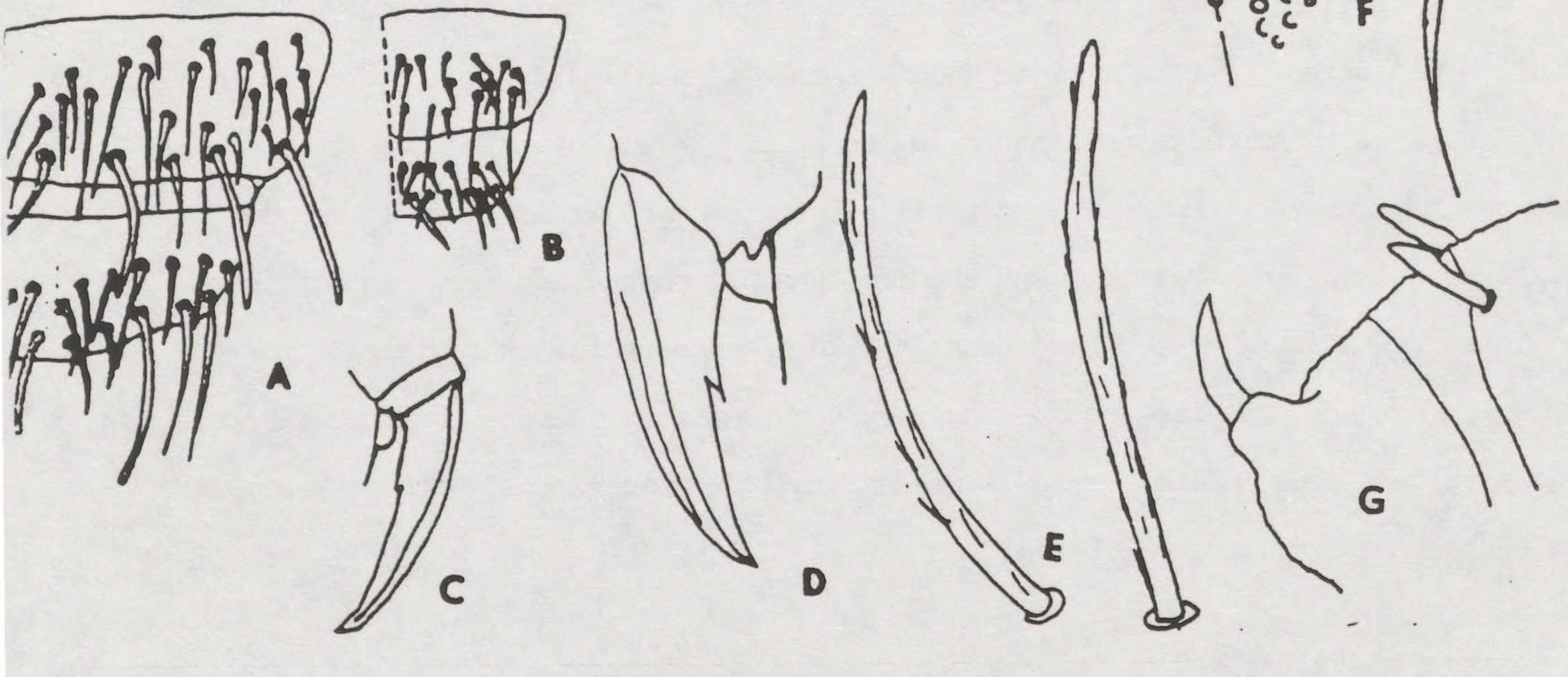
C) Hind unguis and unguiculus, type specimen.

D) Hind unguis and unguiculus, specimen from Montana.

E) Large fourth abdominal segment setae, type specimen.

F) Interocular setae of right side, type specimen.

G) Ecomorphic form with supplementary spines, specimen from Oregon.



Ref.: Am. Midl. Nat. 64: 263

Syn.: Achorutes armatus of Folsom, 1916, in part (?)

Description

Color: blue to bluish gray with patchy pigment; paler ventrally. Fourth antennal segment with unlobed apical bulb and typical blunt setae; ventral "file" clear, of 22 - 26 setae. Inner unguis 2 - 2.3 times as long as unguiculus. Ventral tube with 4 + 4 setae. Tenaculum with 4 + 4 teeth. Dens 1.7 - 2 times as long as mucro; 2 distal inner setae, and to a lesser extent the third and fourth, basally enlarged and bent at mid level. Anal spines 1.5 - 2 times as long as inner unguis. Posterior abdominal segments with more coarsely granulate areas. Yosii "a" measure 12 - 15. No cephalic spines. All body setae slender, smooth and acuminate. Maximum length 2.5 mm.

Remarks

This species is easily confused with H. (Ceratophysella) krafti which occurs in the same habitat and localities; however, they are placed in different subgenera because of the P.A.O., and differ further in the antennal "file" and granulation. We have examined specimens from the type locality, and agree with Yosii's descriptions and figures save in two respects: the second thoracic chaetotaxy, which is always different (compare figures A and B), and the fourth and fifth abdominal chaetotaxy, which are quite variable. Larger specimens display some plurichaetosis. 2 specimens from Vancouver show features (chaetotaxy and short mucro) similar to H. (M.) gibbomucronata; 1 specimen has unusually short spines.

Localities: Massachusetts - Middlesex Co.; Oregon - Benton Co. (type); Canada - Vancouver I. (see figure next page)

FIGURE 135

Hypogastrura (Mitchellania) vulgaris

A) Chaetotaxy of right side of second thoracic and fourth and fifth abdominal segments, after Yosii.

B) Chaetotaxy of right side of second thoracic segment, specimens from type locality (dotted lines represent unusual setae).

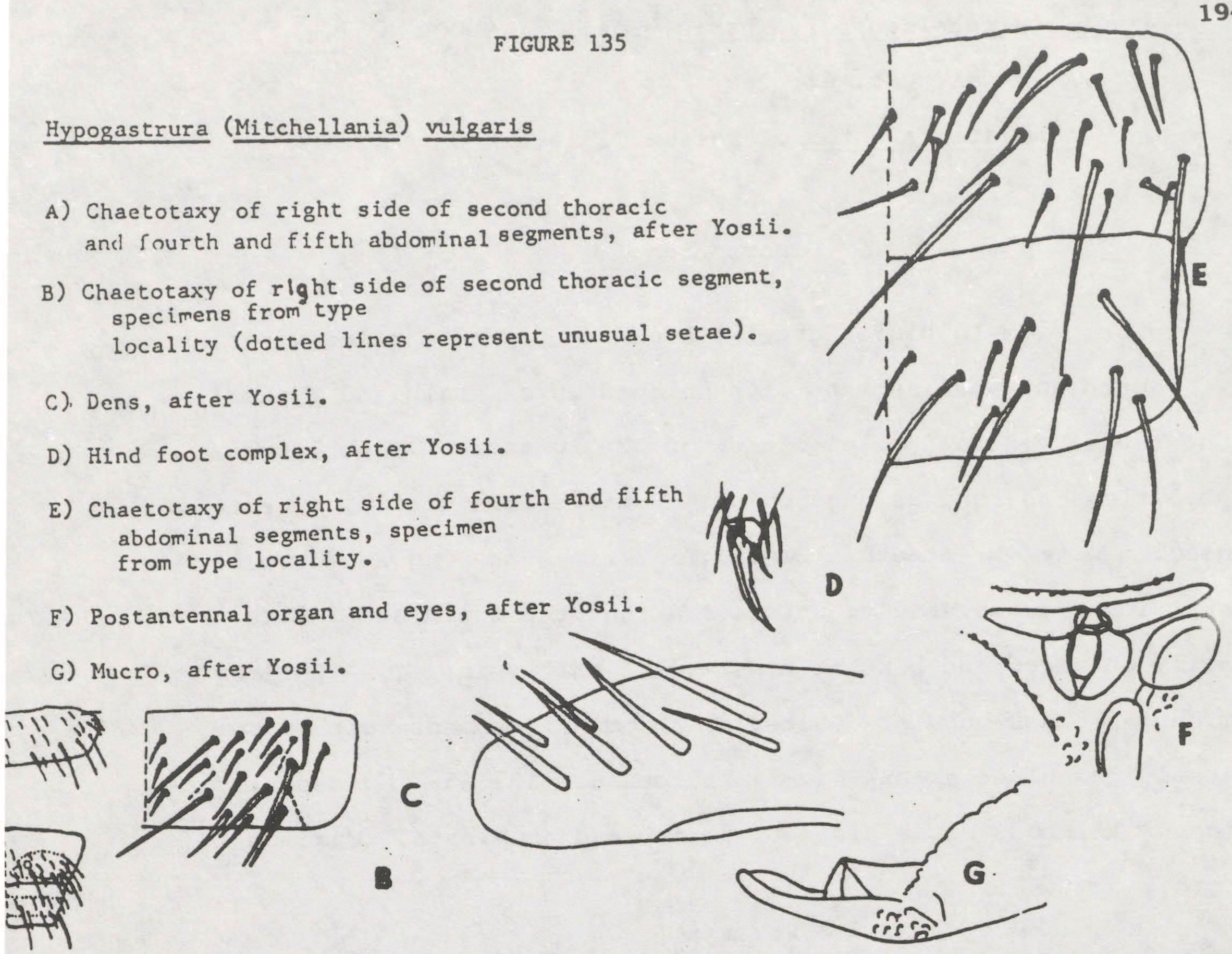
C) Dens, after Yosii.

D) Hind foot complex, after Yosii.

E) Chaetotaxy of right side of fourth and fifth abdominal segments, specimen from type locality.

F) Postantennal organ and eyes, after Yosii.

G) Mucro, after Yosii.



Subgenus Schoettella Schäffer 1896

Type species: Achorutes ununguiculatus Tullberg , 1869

This subgenus includes all the forms with the unguiculus minute or absent. The anal spines are small or absent, and the P.A.O. has equivalent lobes and is usually smaller than the nearest eye. The dens has 5 or fewer dorsal setae and the mucro is either acuminate or with a single lamella.

Remarks

These forms are generally very small to minute and as a result are very difficult to work with. Two of the species are very com-

mon (ununguiculata and glasgowi) and the others are very rare. Due to their minute size and generally heavy pigmentation, the chaetotaxy of the group is very hard to see. Although we have not seen some of the species described in this group, the striking nature of the described features should make them easy to identify when discovered. It is quite possible that examination of the types will show that in some cases the descriptions were inaccurate, and that the forms are in fact synonyms of one of the two common species, or do not belong in this subgenus.

There are 3 nearctic species: 1) banksi; 2) glasgowi; 3) ununguiculata.

Key to Nearctic species of Subgenus Schoettella

1) P.A.O with more than 5 lobes----------H. (S.) banksi

1') P.A.O. with 4 (often small lobes----------2

2) 3-4 clavate tenant hairs per foot----------H. (S.) ununguiculata

2') 2 clavate tenant hairs per foot----------H. (S.) glasgowi

Not included in key:

albamaculata Scott, 1960 — holotype is Xenylla pallescens

magnoliana Wray, 1952 — probably = glasgowi

TABLE VII-1

NEARCTIC SPECIES OF SUBGENUS Schoettella

species	antenna 4 apical bulb	antenna 4 blunt setae	ungual teeth	P.A.O. lobes	mucronal lamella	clavate tenent hair	anal spines	records
sp. A	-	5	-	4(very weak)	-	2	-	North Dakota
banksi	double	?	+	8	+	-	minute	New York, Mich. Louisiana
glasgowi	+	5-6	+	4	small	2	+	Illinois to Massachussetts
ununguiculata	+	8	+	4	small	3-6	+	Illinois to Massachussetts

Ref.: Collembola of New York: 50

Description

Color: deep blue-black. Fourth antennal segment with double apical bulb. P.A.O. larger than nearest eyes and of about 8 unequal lobes. Tenent hairs short and acuminate. Dens slightly less than 2 times as long as mucro. Anal spines minute. Body setae short, curved, and smooth (?), with longer setae near end of abdomen.

Remarks

Maynard, places this species in Schoettella; however much of his description would better fit a Brachystomella and it may be that the species is a member of that genus. If in fact this is a Schoettella, the P.A.O. will distinguish it readily from all its congeners.

Localities: New York - Sea Cliff, Long Island (type).
Additional records: Louisiana (Hepburn & Woodring, 1963); Michigan (Snider, 1967); New Mexico (Scott, 1960).

FIGURE 137

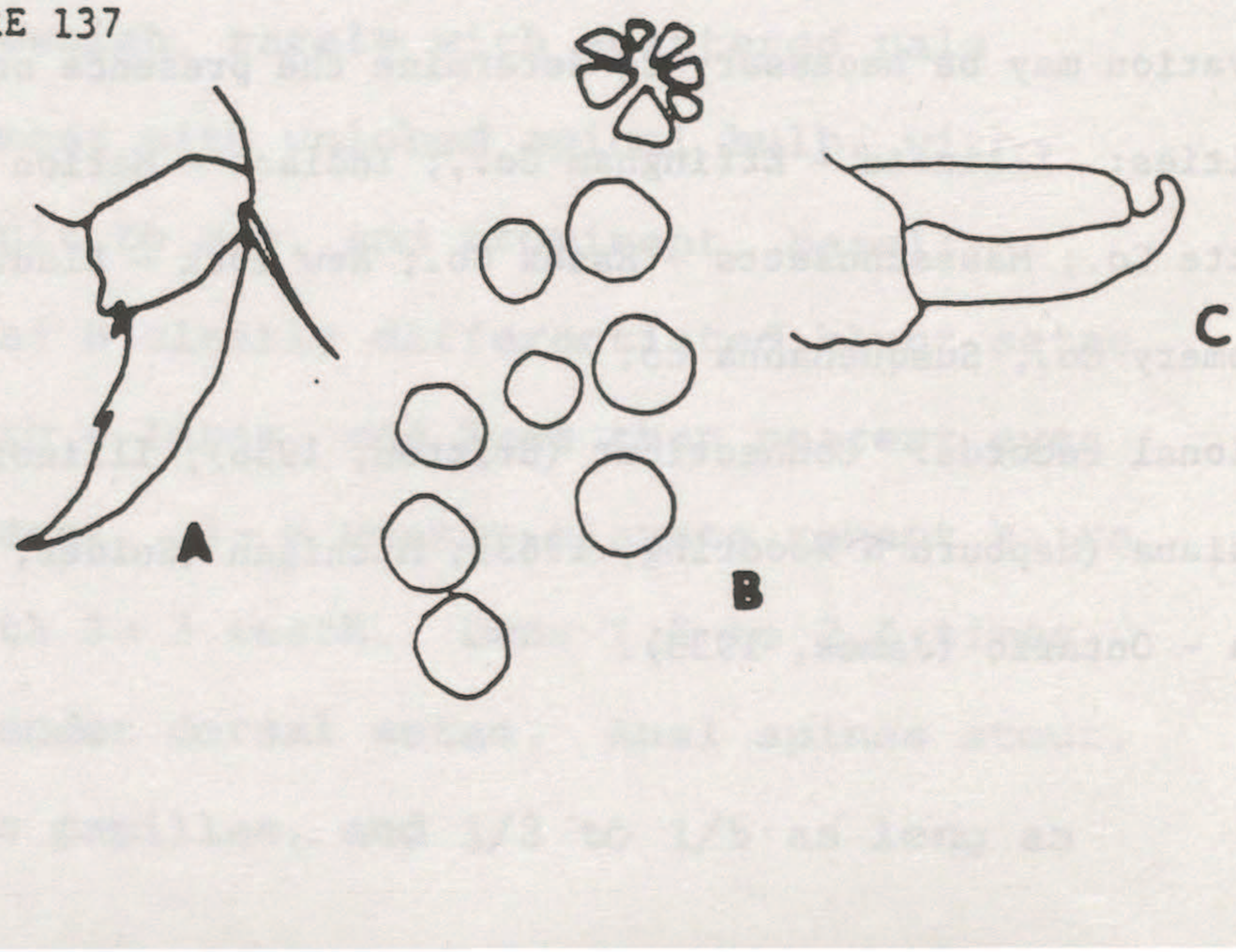
Hypogastrura (Schoettella) banksi

All figures after Maynard.

A) Hind unguis.

B) Postantennal organ and eyes.

C) Mucro.



Hypogastrura (Schoettella) glasgowi (Folsom), 1916 Fig. 138

Ref.: Proc. U.S. natn. Mus. 50: 194 (Achorutes)

New Syn.: Achorutes magnoliana Wray, 1952, Bull. Brooklyn ent. Soc. 47: 98

Description

Color: dark blue, slightly mottled and sometimes paler ventrally. Fourth antennal segment with unlobed apical bulb and 5-6 blunt setae, poorly differentiated from acuminate setae. P.A.O. of 4 joined lobes, somewhat smaller than nearest eyes. Unguiculus absent or in the form of a minute bristle. Each foot with 2 long clearly knobbed tenent hairs. Tenaculum with 3+3 teeth. Dens 1.4 to 1.8 times as long as mucro, with 4 slender dorsal setae. Anal spines 1/9 to 1/5 as long as inner unguis, and about 1.5 times as long as papillae. Integument more coarsely granulate on posterior abdominal segments; granules range from 10-21 micra in diameter. Body setae short and acuminate. Area verticalis with 2+2 setae. Maximum length 1.9 mm.

Remarks

Wray's magnoliana appears to be a synonym of this species. His figure shows the mucro and dens subequal, but his description says that the ratio is 10:15, well within the range of glasgowi. The only other differences are in the inner tooth of the unguis and the color, both of which are variable in this species. The 4 dental setae, the minute anal spines, and the 2 tenent hairs all point to synonymy.

This is a well-marked species. In mucronal shape it resembles H. ununguiculata, but it can readily be distinguished by the number of tenent hairs and dental setae.

The species resembles several species of the genus Xenylla superficially, and careful observation may be necessary to determine the presence or absence of the P.A.O.

Localities: Illinois - Effingham Co.,; Indiana - Marion Co.; Iowa - Story Co.; Kentucky - Fayette Co.; Massachusetts - Essex Co.; New York - Blauvelt (type); Pennsylvania - Montomery Co., Susquehanna Co.

Additional records: Connecticut (Britton, 1938); Illinois (Wray, 1952, for magnoliana); Louisiana (Hepburn & Woodring, 1963); Michigan (Snider, 1967); New York (Valiela, 1969); Canada - Ontario (James, 1933).

FIGURE 138

Hypogastrura (Schoettella) glasgowi

A) Chaetotaxy of right side of fourth abdominal segment, specimen from Marion Co., Indiana.

B) Hind foot complex, after Folsom.

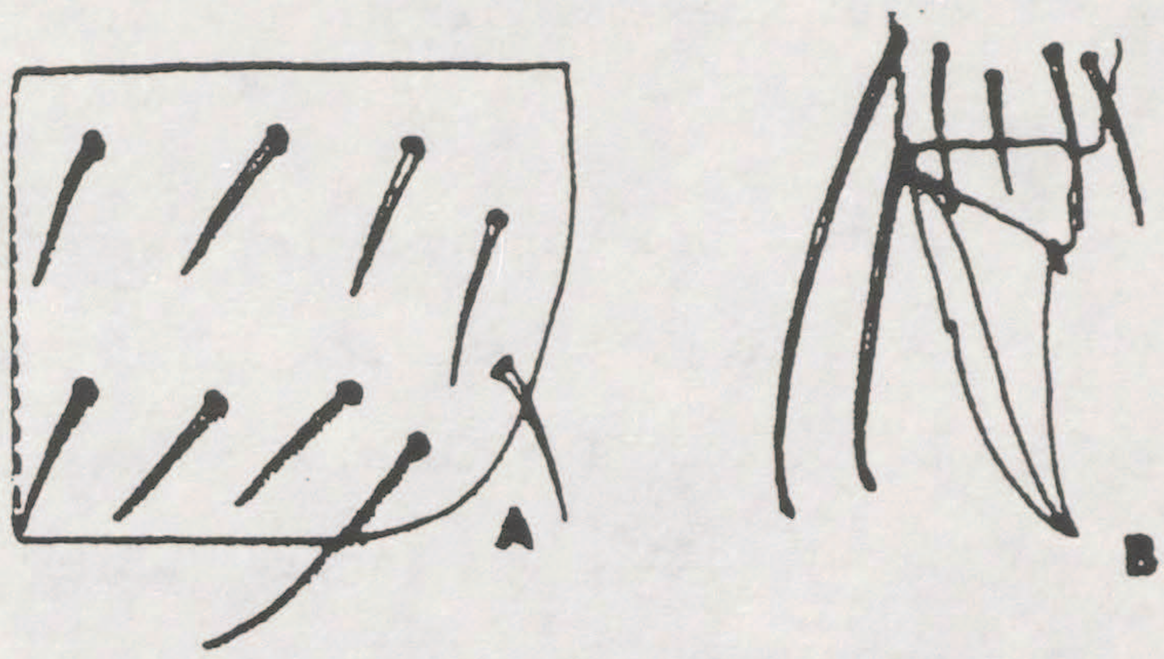
C) Mucro, after Folsom.

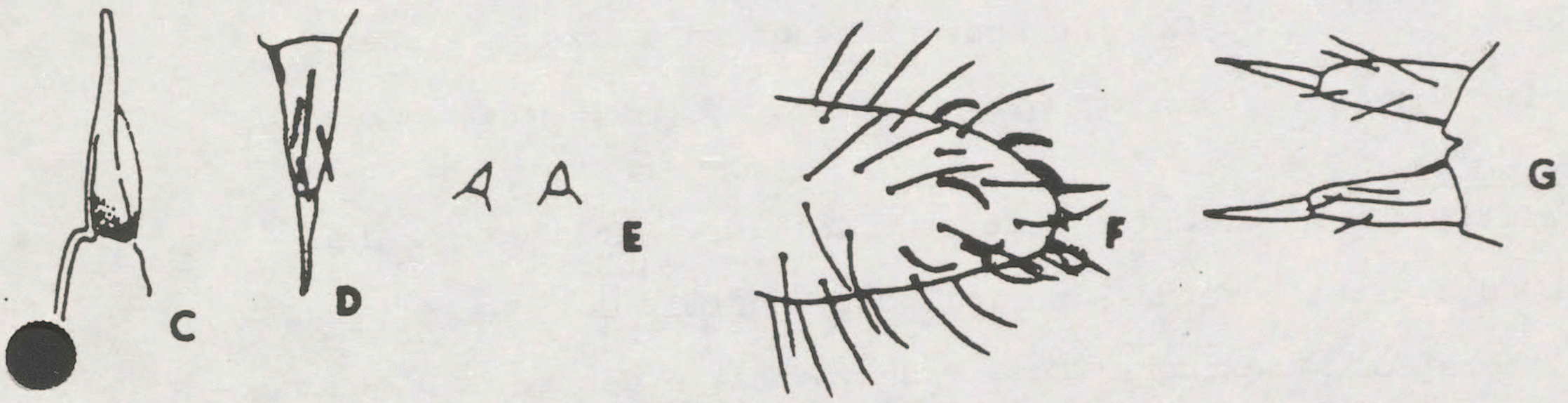
D) Mucro and dens, after Folsom.

E) Anal spines, after Folsom.

F) Fourth antennal segment, after Folsom.

G) Mucrones and dentes, after Folsom.





Hypogastrura (Schoettella) ununguiculata (Tullberg), 1869 Fig. 139

Refs.: Om skandinaviska Podurider: 11; Folsom, 1916; Stach, 1949a; Delamare and Jacquemart, 1961

Description

Color blue-black to brownish, rarely with scattered pale spots. Fourth antennal segment with unlobed apical bulb, withdrawn into a pit and difficult to see, and prominent, basally socketed, curved apical seta; 8 clearly differentiated blunt setae present. P.A.O. simple, with 4 lobes, and less than nearest eyes in diameter. Unguiculus absent. 3 - 6 weakly clavate tenent hairs on each foot. Tenaculum with 3 + 3 teeth. Dens 1.6 to 2.4 times as long as mucro, with 5 slender dorsal setae. Anal spines stout, slightly curved, subequal to papillae, and 1/3 to 1/5 as long as

inner unguis. Integument uniformly granulate with granules ranging from 12 to 15 micra in diameter. General chaetotaxy of small acuminate setae. Area verticalis difficult to distinguish, with 2 + 2 setae. Maximum length 1.7 mm.

Remarks

The multiple tenent hairs serve to distinguish this from all other forms in North America. In one specimen from New Hampshire, s.s is p_5 on abd. IV; this is as described by Delamare and Jacquemart, but unlike our figure, which represents most of the specimens seen. Further study may show that 2 sibling species are involved. This is by far the most abundant form in the eastern third of the area, being the species found in 80% of all samples containing Schoettella.

Localities: Connecticut - Middlesex Co., New Haven Co.; Maine - York Co.; Massachusetts - Norfolk Co., Suffolk Co.; New Hampshire - Hillsboro Co., Rockingham Co.; Pennsylvania - Centre Co., Huntingdon Co., Montgomery Co., Susquehanna Co.; West Virginia - Tucker Co.

Additional records: Illinois (Folsom, 1916);

Hudson Strait (Brown, 1932); Ungava Bay (Davis, 1936).

FIGURE 139

Hypogastrura (Schoettella) ununguiculata

A) Chaetotaxy of right side of fourth and fifth abdominal segments, specimen from Middlesex Co., Massachusetts.

B) Hind foot complex, after Folsom.

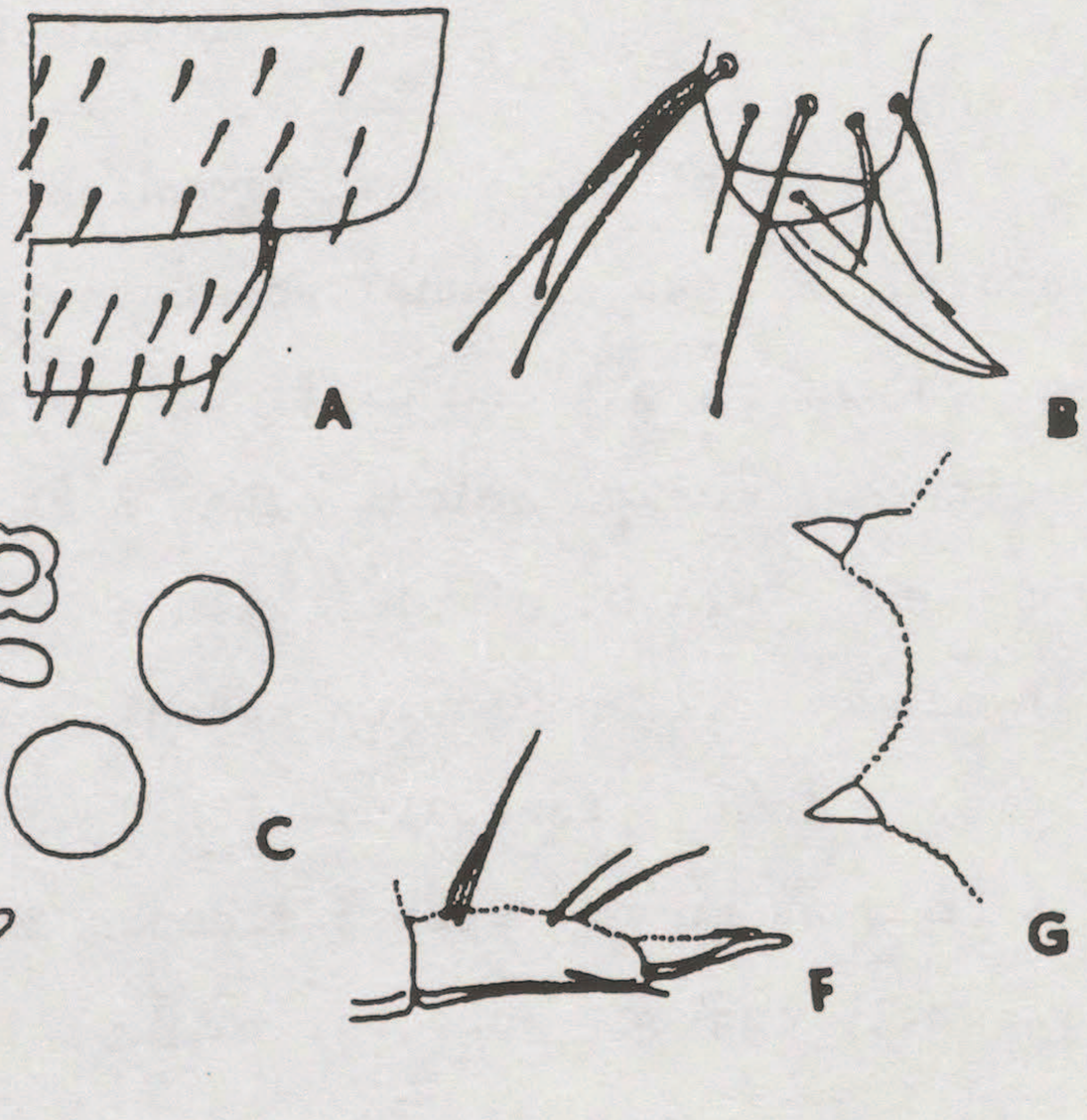
C) Postantennal organ and eyes, after Folsom.

D) Mucro, after Folsom.

E) Mucro, after Folsom.

F) Mucro and dens, after Folsom.

G) Anal spines, after Folsom.

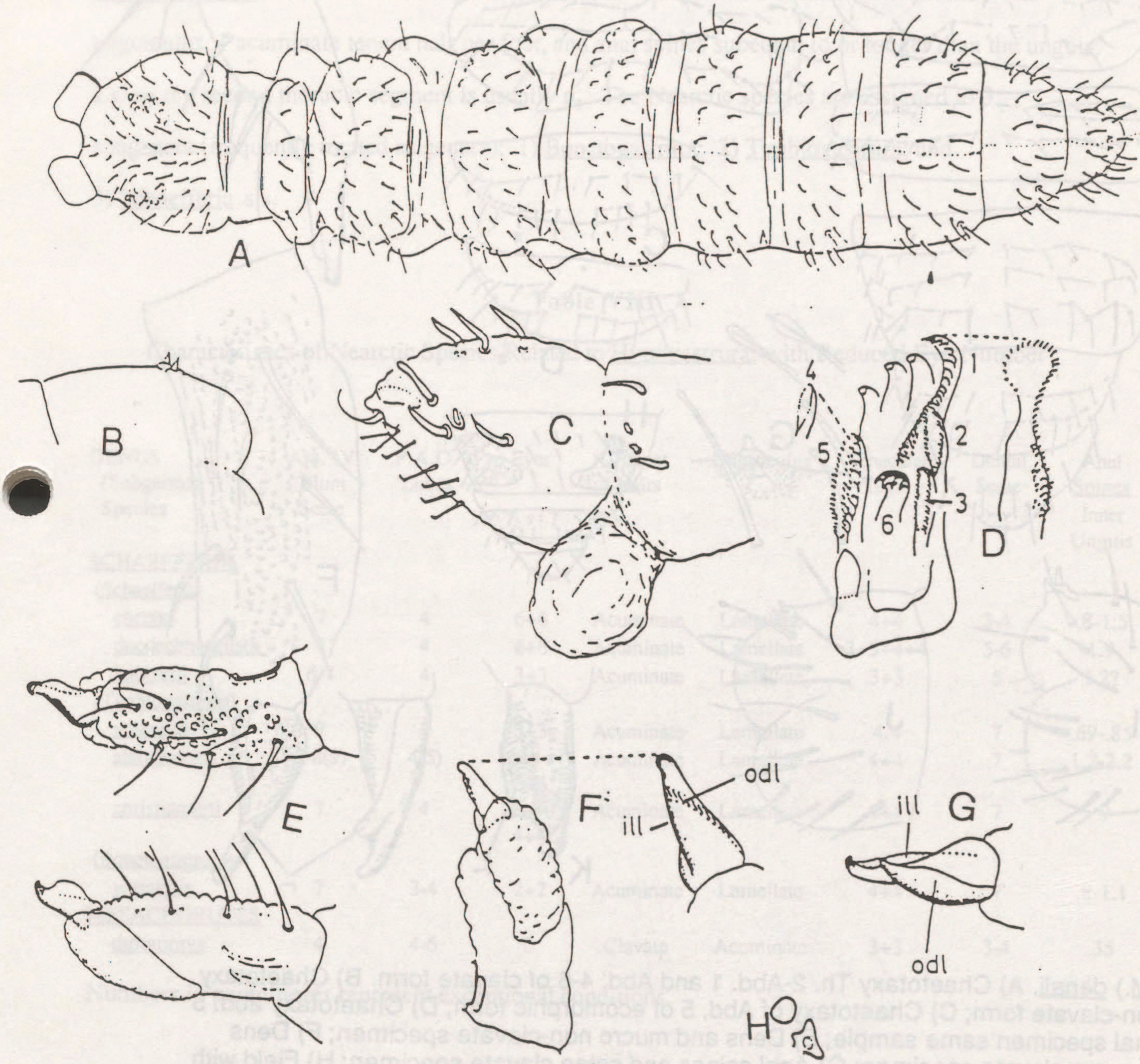


Subgenus Mucrella Fjellberg 1985

Type species : Hypogastrura (Mucrella) denali Fjellberg , 1985.

The members of this subgenus are characterized by the peculiar maxilla , having lobe 4 short and blunt (see Fig. 29.1A). In some respects the genus takes an intermediate position between Hypogastrura s.str. and Ceratophysella. There are 2 Nearctic species: 1) H. (M.) denali and 2) H. (M.) hibernica.

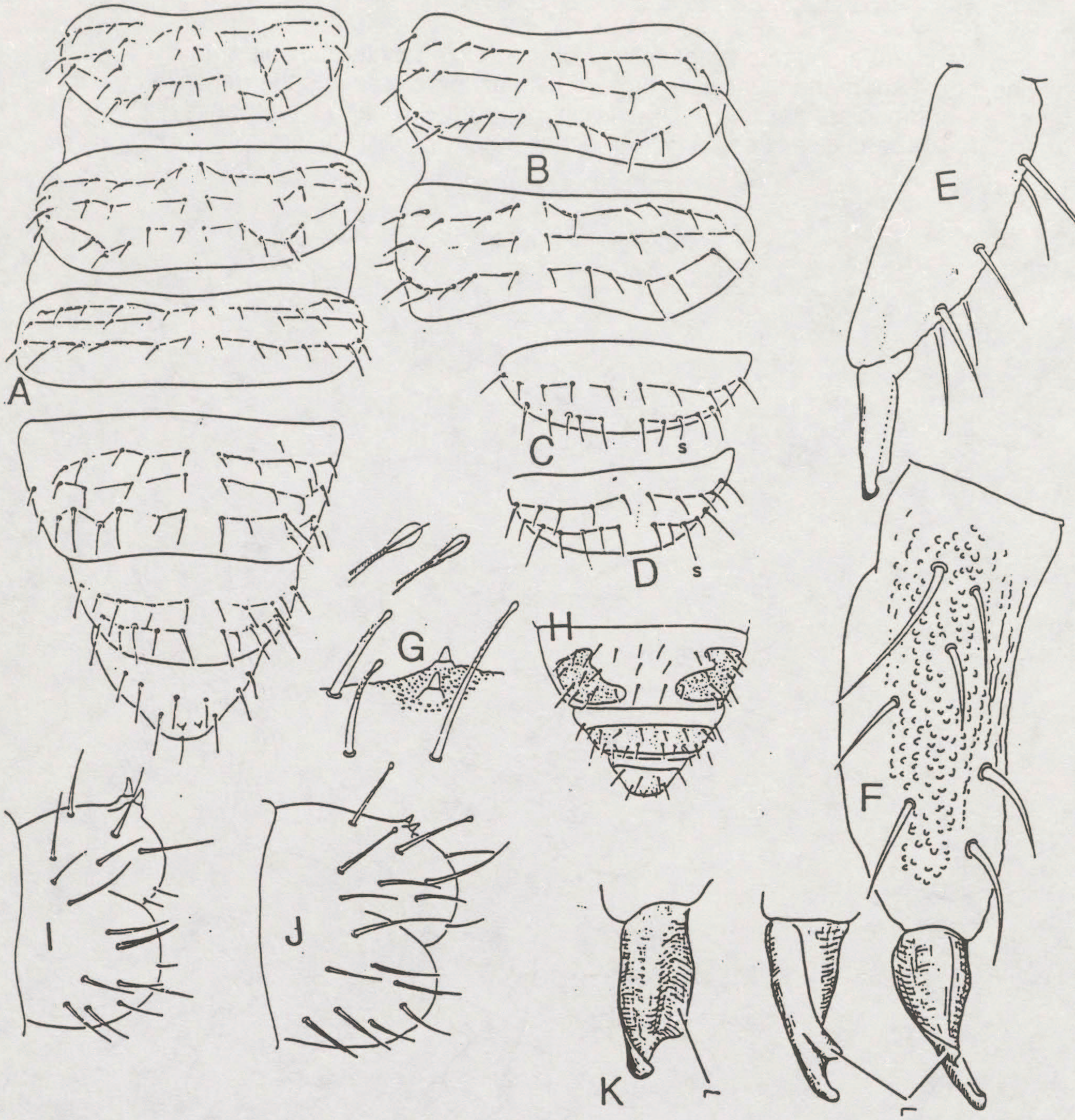
Figure 139,1 H. (M.) hibernica Fjellberg 1988



H. (M.) hibernica. A) Dorsal chaetotaxy and habitus; B) Abd. 6 with anal spines; C) Antennae 3-4 with sensillae and eversible sac; D) Left maxilla with six lamellae. Lamella 4 hidden by lamella 5; E) Dens and mucro, dorsal view (above) and lateral view (below); F) Dens and mucro with detail of mucro; G) Mucro, dorsolateral view; H) PAO and nearest ocellus. After Fjellberg 1987

Hypogastrura (Mucrella) denali Fjellberg 1985

Figure 139.2



H. (M.) denali. A) Chaetotaxy Th. 2-Abd. 1 and Abd. 4-6 of clavate form. B) Chaetotaxy of non-clavate form; C) Chaetotaxy of Abd. 5 of ecomorphic form; D) Chaetotaxy abd. 5 normal specimen same sample; E) Dens and mucro non-clavate specimen; F) Dens and mucro clavate specimen; G) Anal spines and setae clavate specimen; H) Field with enlarged granules; I) Abd. 6 normal specimen; J) Abd. 6 clavate specimen; K) Mucro non-clavate specimen.

Genus Schaefferia, Absolon, 1900

Type species: S. emucronata Absolon, 1900

This genus includes species similar to, and probably derived from, Hypogastrura (Ceratophysella), but with a reduced number of eyes. They have a basal lamella on the unguiculus, 1 acuminate tenent hair per foot, and anal spines subequal to or longer than the unguis; s.s. on the second thoracic segment is usually p_3. The Nearctic species are assigned to 3 subgenera (frequently treated as genera): 1) Bonetogastrura; 2) Typhlogastrura; and 3) Schaefferia s.s.

Table VIII

Characteristics of Nearctic Species Related to Hypogastrura, with Reduced Eye Number

GENUS (Subgenus) Species	Ant. IV Blunt Setae	P.A.O. Lobes	Eyes	Tenent Hairs	Unguiculus	Tenacular Teeth	Dental Setae	Anal Spines Inner Unguis
SCHAEFFERIA								
(Schaefferia)								
cheoha	7	4	6+6	Acuminate	Lamellate	4+4	3-4	.8-1.5
duodecimocellata	7	4	6+6	Acuminate	Lamellate	3+3+4+4	5-6	1.9
hubbardi	6-7	4	3+3	Acuminate	Lamellate	3+3	5	1.2?
(Typhlogastrura)								
valentini	9	4	3+3	Acuminate	Lamellate	4.4	7	.69-.85
alabamensis	7-8(9)	4(5)	4+4+ 6+6	Acuminate	Lamellate	4+4	7	1.2-2.2
christianseni	7	4	3+3+ 4+4	Acuminate	Lamellate	4+4	7	.9
(Bonetogastrura)								
variabilis	7	3-4	2+2	Acuminate	Lamellate	4+4	7	.8-1.1
MESACHORUTES								
thomomys	4	4-6	0	Clavate	Acuminate	3+3	3-4	.35

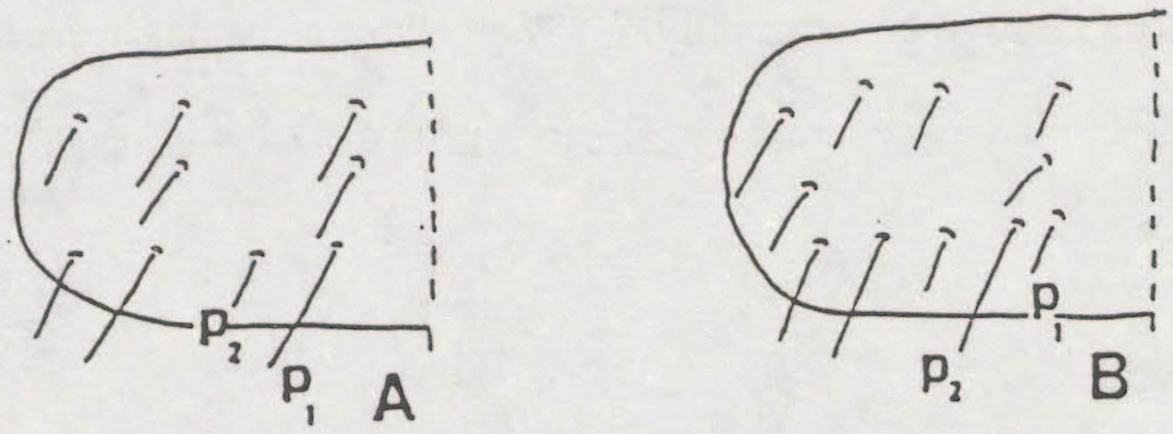
Numbers in parentheses represent exceptional conditions.

Key to Nearctic species of Schaefferia s. l.

1) Dens with 7 dorsal setae 2
1') dens with fewer that 7 dorsal setae (subgenus Schaefferia s.s.)..... 5

**2) Dorsum of 4th abdominal segment with seta P_1 longer than P_2 (Fig. 140A) (subgenus Bonetogastrura) ..... S. (B.) variabilis
2') Dorsum of 4th abdominal segment with seta P_1 shorter than P_2 (Fig. .... .140B) (subgenus Typhlogastrura) 3

140



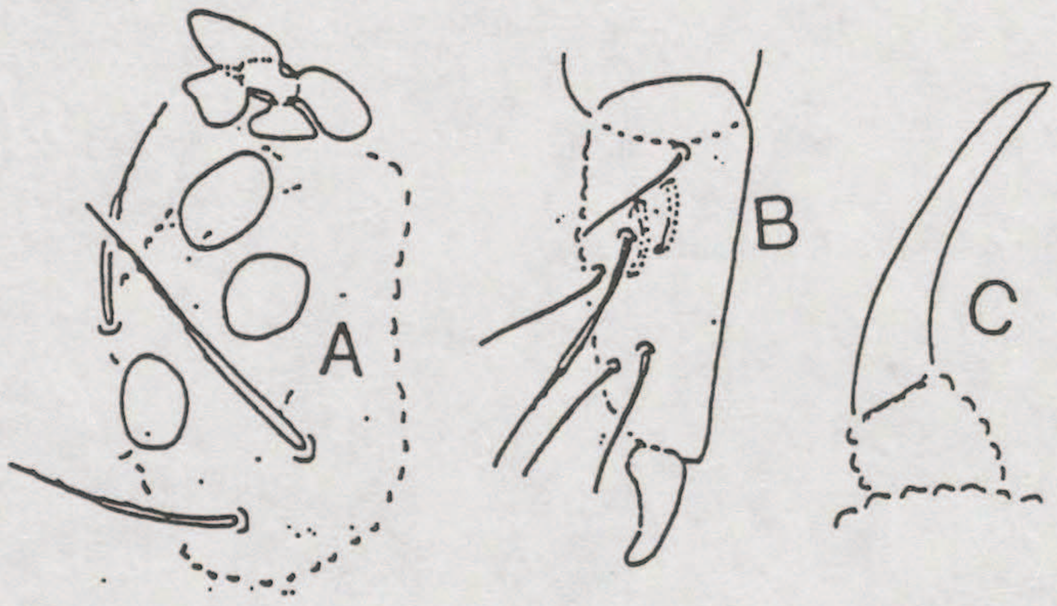
3) Anal spines shorter than inner edge of unguis 4
**3') Anal spines longer than inner edge of unguis ..... S. (T.) alabamensis

**4) Anal spines only slighty shorter than inner unguis (≈ .90) .....
..... (S.) (T.) christianseni
**4') Anal spines distinctly (< .86) shorter than inner unguis .....
..... S. (T.) valentini Thibaud 1996

**5) With 3 + 3 eyes ..... S. (S.) hubbardi Thibaud 1995
5') With 6 + 6 eyes 6

*6) Dens with 3-4 dorsal setae..... S. (S.) cheoha
6') Dens with 5 dorsal setae ..... S. (S.) duodecimocellata

Figure 140.1
Schaefferia (Typhlogastrura) hubbardi A Left Eyepatch and PAO; B) Mucro and dentes; C) Anal spine. After Thibaud 1995.

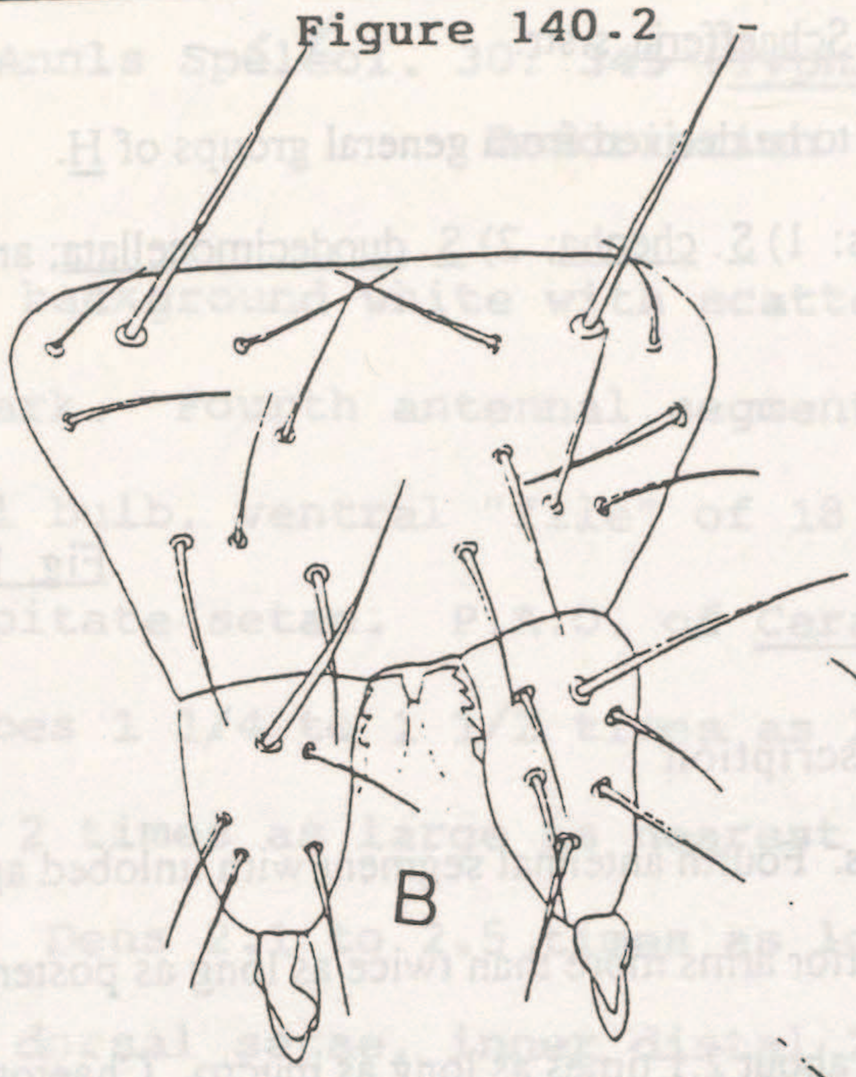


Schaefferia (Schaefferia) duodecimocellata Bonet 1945

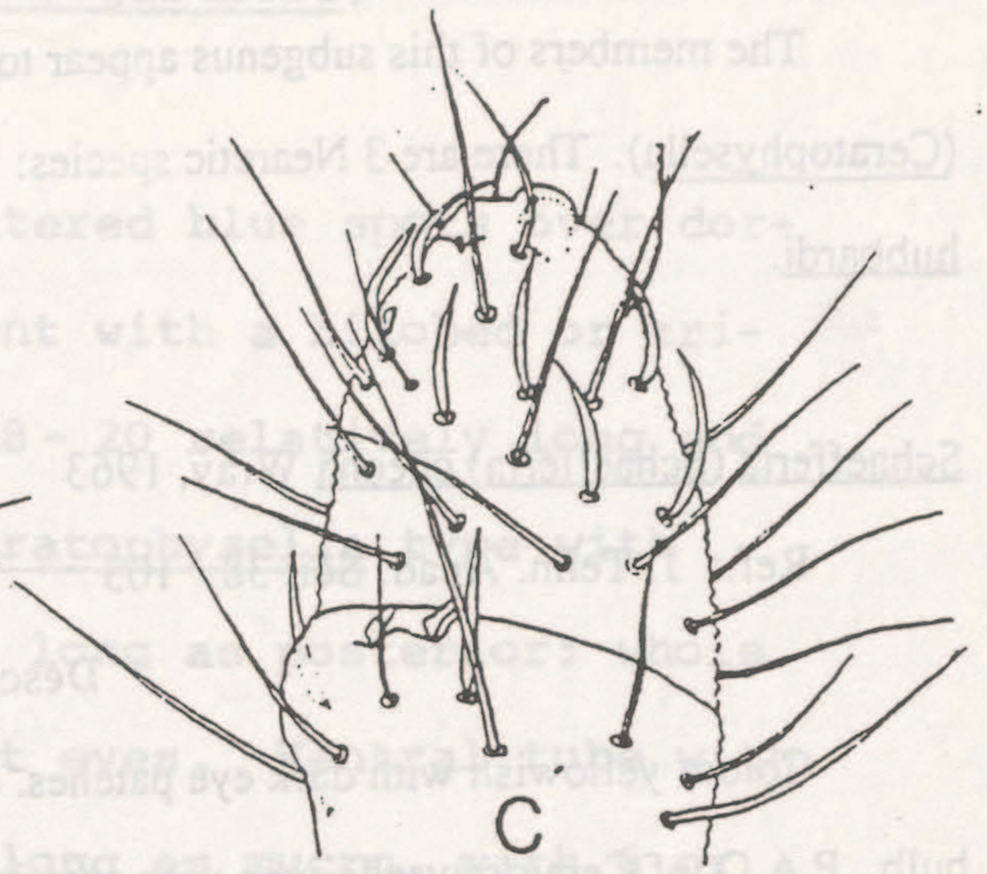
Figure 140.2 -



A



B



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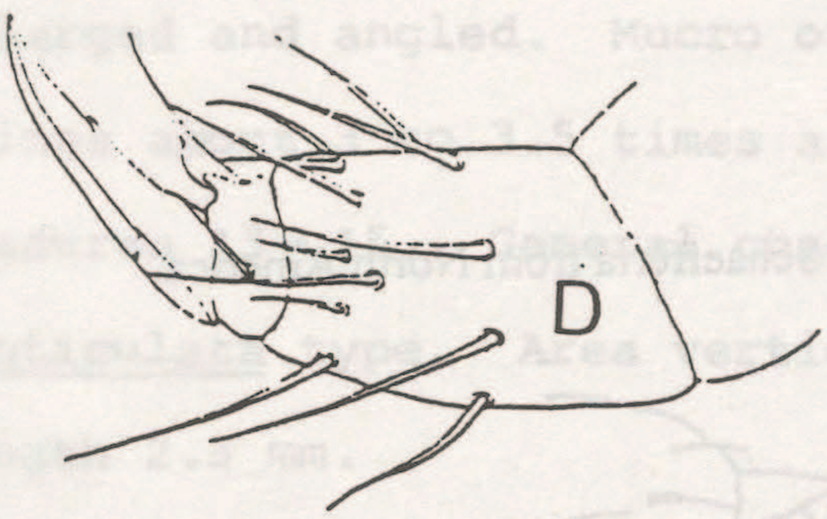

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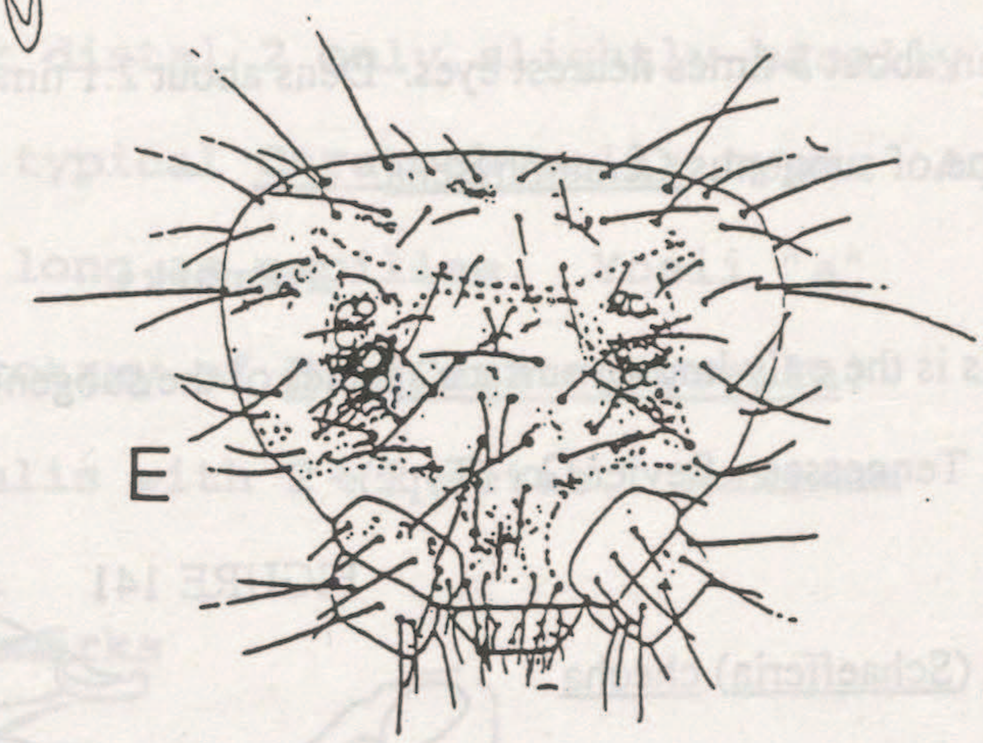
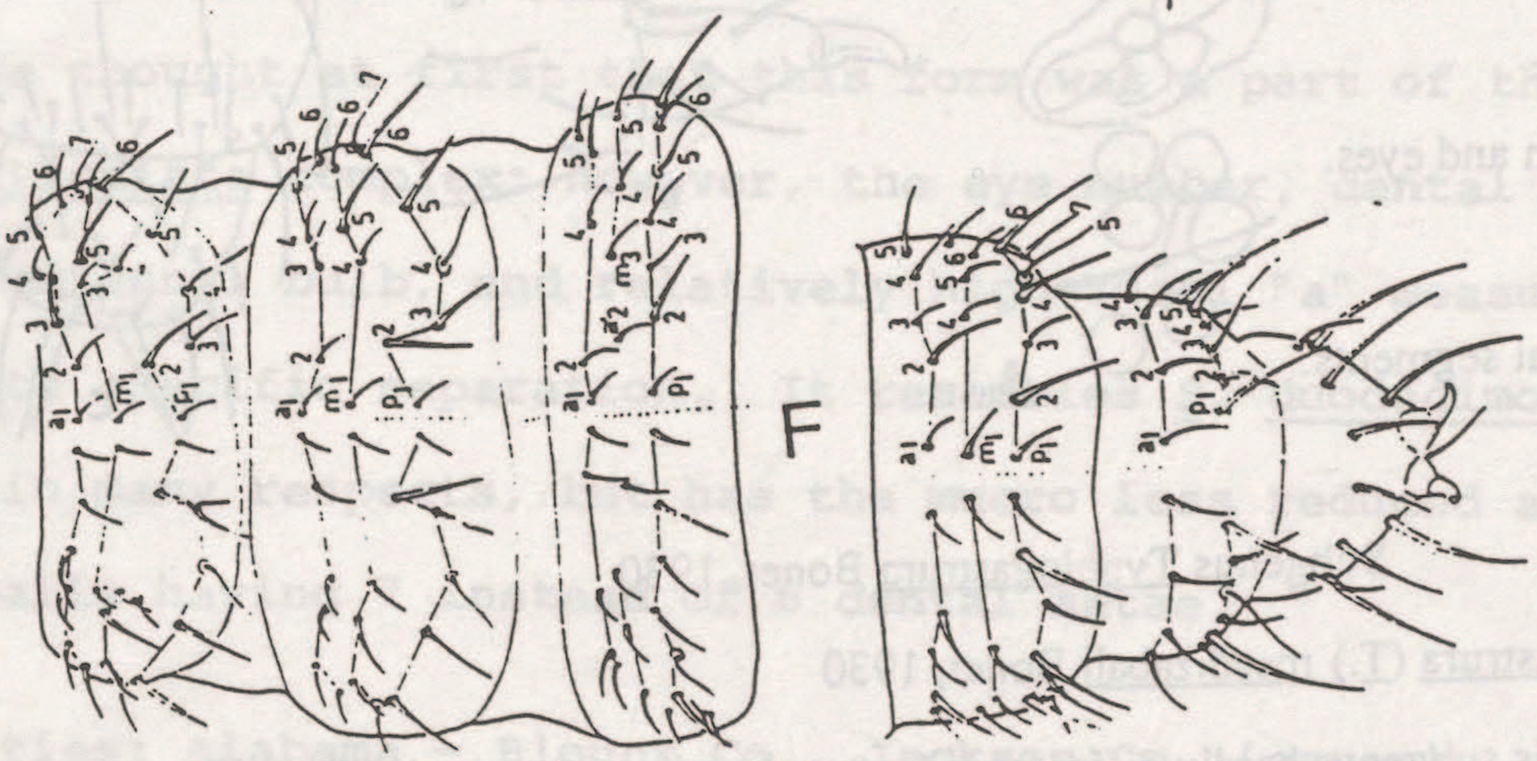


E



F

S. (S.) duodecimocellata. A) Eyepatch and PAO, after Bonet; B) Mucro, from above, after Bonet; C) apex of antenna , after Bonet; D) Hind tibiotarsus and foot complex , after Bonet; E) Dorsum of head , after Bonet; F) Chaetotaxy Th. seg. 2- Abd 1 & Abd 4-6. After Fjellberg 1985.

Subgenus Schaefferia s.str.

The members of this subgenus appear to be derived from general groups of H. (Ceratophysella). There are 3 Nearctic species: 1) S. cheoha; 2) S. duodecimocellata; and 3) S. hubbardi.

Schaefferia (Schaefferia) cheoha Wray, 1963 — Fig. 141

Ref.: J. Tenn. Acad. Sci. 38: 103

Description

Color: yellowish with dark eye patches. Fourth antennal segment with unlobed apical bulb. P.A.O. of Ceratophysella type with anterior arms more than twice as long as posterior and whole organ about 3 times nearest eyes. Dens about 2.1 times as long as mucro. Chaetotaxy of armatus type of subgenus Ceratophysella.

Remarks

This is the only known surface species of the subgenus Schaefferia from North America.

Locations: Tennessee - Sevier Co. (Type).

FIGURE 141

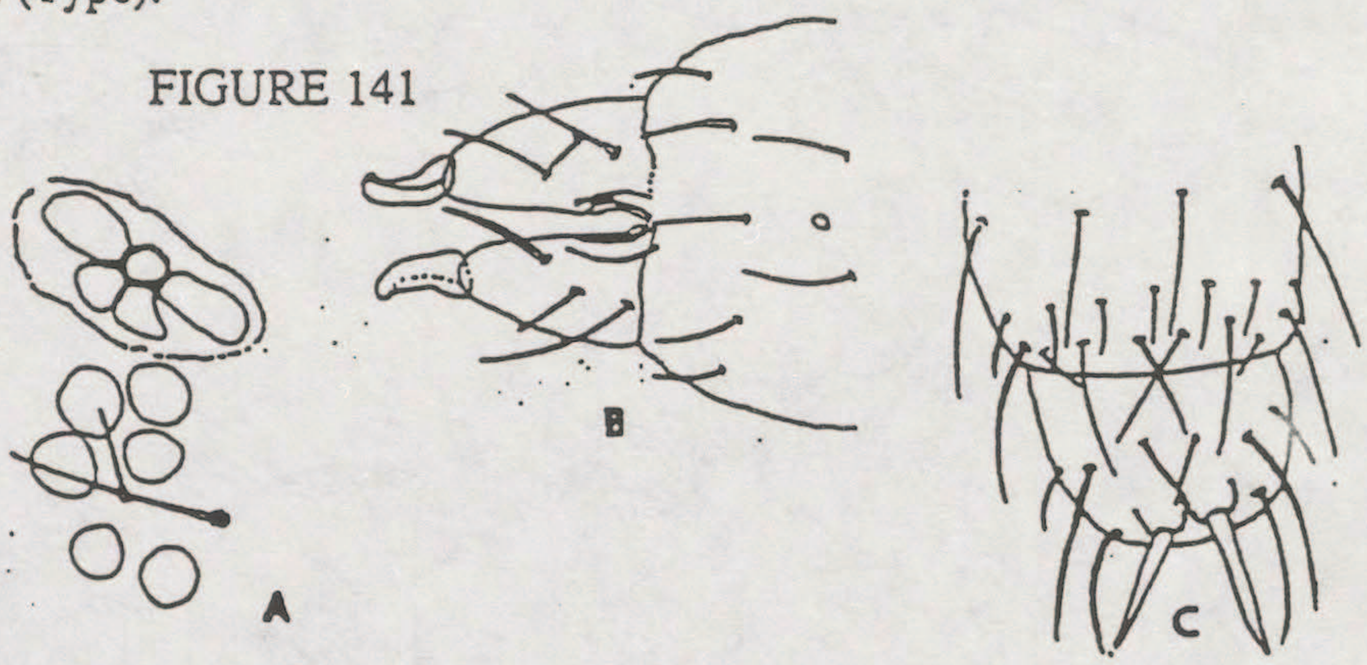
Schaefferia (Schaefferia) cheoha

All figures after Wray.

A) Postantennal organ and eyes.

B) Mucro and dens.

C) Last two abdominal segments.



Subgenus Typhlogastrura Bonet, 1930

Type species: Hypogastrura (T.) mendizabali Bonet, 1930

Members of this subgenus hardly differ from Ceratophysella except in the reduced number of eyes. The species of this subgenus derived from H. (Ceratophysella) denticulata. There are 4 Nearctic species: 1) alabamensis 2) christianseni, 3) variabilis, and 4) valentini

Schaefferia (Typhlogastrura) alabamensis (Thibaud), 1975, Fig. 142

Ref.: Annls Spéléol. 30: 345 (Typhlogastrura)

Description

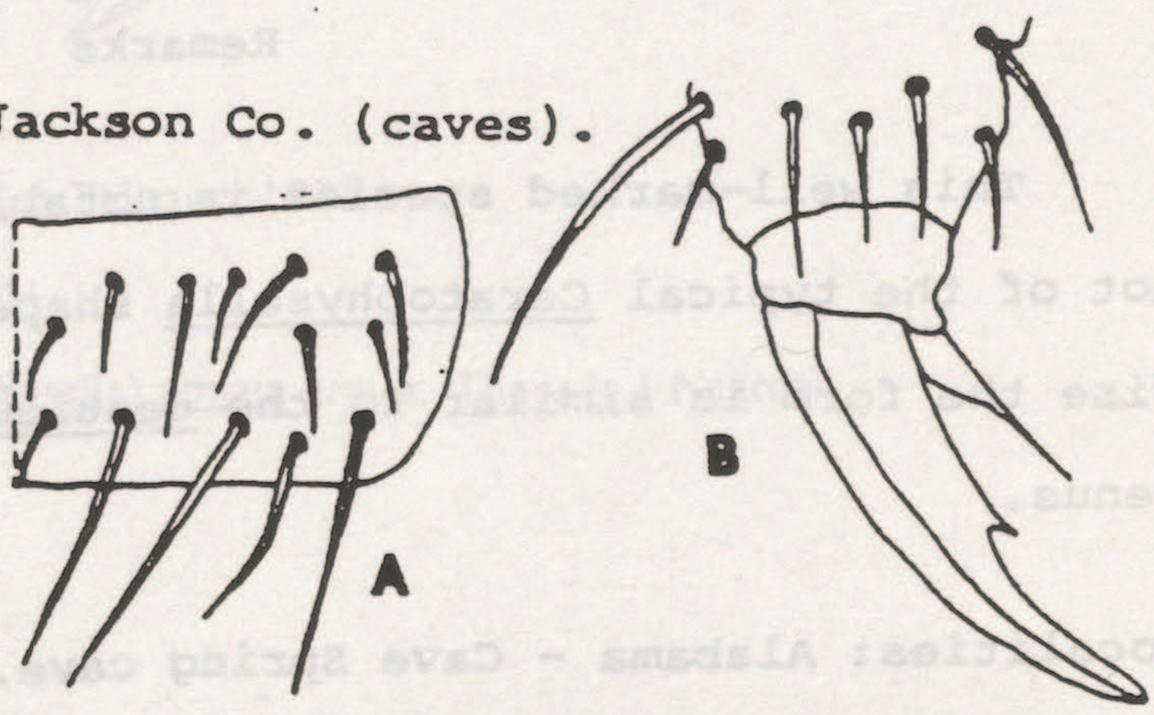
Color: background white with scattered blue spots over dorsum; eyes dark. Fourth antennal segment with a bilobed or trilobed apical bulb, ventral "file" of 18 - 20 relatively long and straight capitate setae. P.A.O. of Ceratophysella type with anterior lobes 1 1/4 to 1 1/2 times as long as posterior; whole organ about 2 times as large as nearest eyes. Ventral tube with 4 + 4 setae. Dens 2.1 to 2.5 times as long as mucro, with 6 or (usually) 7 dorsal setae, inner distal 2 only slightly basally enlarged and angled. Mucro of typical Ceratophysella type. Anal spines about 3 to 3.5 times as long as papillae. Yosii "a" measures 13 - 15. General chaetotaxy of H. (Ceratophysella) denticulata type. Area verticalis with 2 + 2 setae. Maximum length 2.3 mm.

Remarks

We thought at first that this form was a part of the variable H. denticulata complex; however, the eye number, dental setae, lobed antennal bulb, and relatively high Yosii "a" measure all indicate specific separation. It resembles S. duodecimocellata Bonet in many respects, but has the mucro less reduced and differs in usually having 7 instead of 6 dental setae.

Localities: Alabama - Blount Co., Jackson Co. (caves).

FIGURE 142



Schaefferia (Typhlogastrura) alabamensis

Figures A-D of type specimens.

A) Chaetotaxy of right side of fourth abdominal segment.
B) Hind foot complex.

(figure continued on next page)

FIGURE 142

Schaefferia (Typhlogastrura) alabamensis (cont')

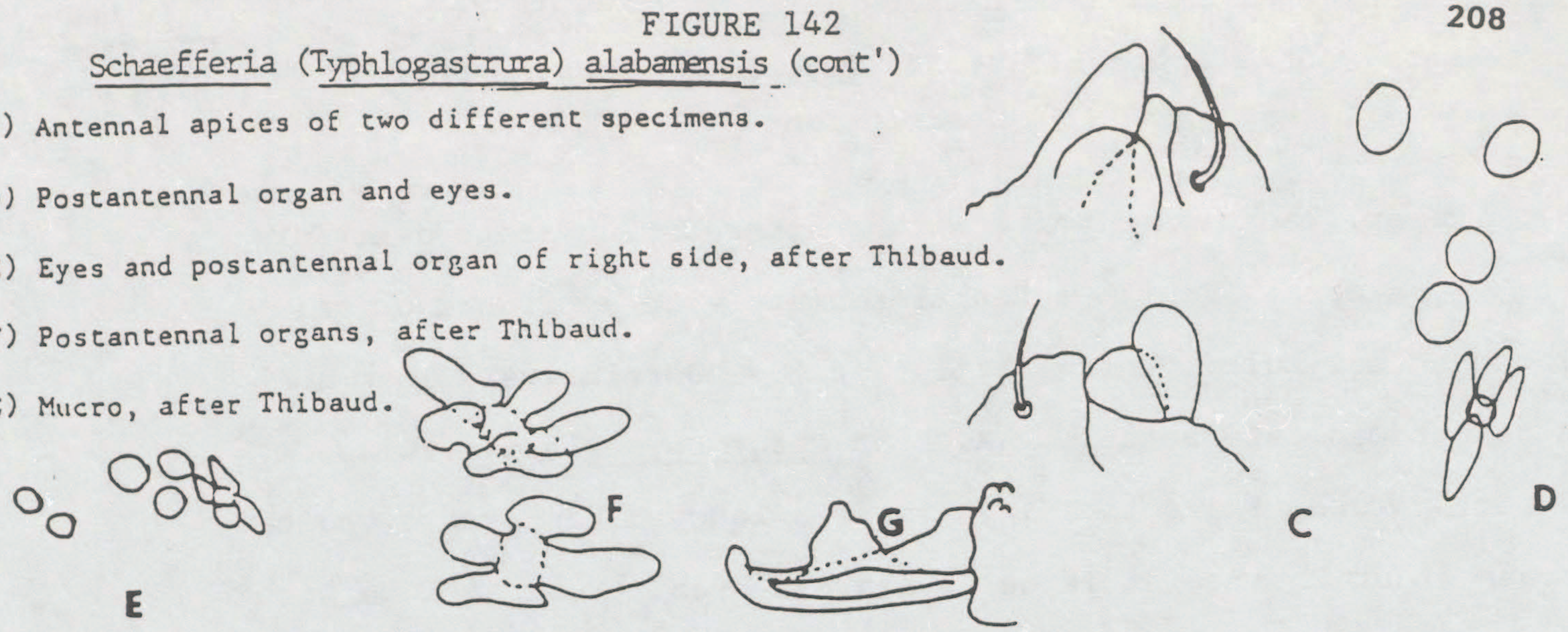
C) Antennal apices of two different specimens.

D) Postantennal organ and eyes.

E) Eyes and postantennal organ of right side, after Thibaud.

F) Postantennal organs, after Thibaud.

G) Mucro, after Thibaud.



Schaefferia (Typhlogastrura) christianseni Thibaud, 1975. Fig. 143

Ref.: Annls Spéléol., 30: 345 (Typhlogastrura)

Description

Color: background white, scattered pale blue spots over dorsum; eye patches dark. Fourth antennal segment with complex apical bulb (see Fig. D) and no ventral "file". P.A.O. of Ceratophysella type with anterior lobes about 1 1/4 times posterior and whole organ about 2.3 times nearest eyes. Ventral tube with 4 + 4 setae. Dens about 2 1/2 times as long as mucro, with 7 dorsal setae, none basally enlarged or angled. Anal spines about 3 times as long as papillae. Yosii "a" measure 10 - 12. General chaetotaxy of denticulata type. Area verticalis with 2 + 2 setae. Fifth abdominal segment with seta p_2 absent. Maximum length 1.6 mm.

Remarks

This well-marked species is notable for the mucro, which is not of the typical Ceratophysella shape (see Fig. D and E). Otherwise the form is similar to the denticulata complex of that subgenus.

Localities: Alabama - Cave Spring cave, Morgan Co. (type).

FIGURE 143

Schaefferia (Typhlogastrura) christianseni

Figures A-E from type specimens.

A) Chaetotaxy of right half of second thoracic segment.

B) Hind foot complex.

C) Apex of antenna, ventral surface.

D) Mucro and dens.

E) Muctones of one specimen.

F) Right eyes and postantennal organ, after Thibaud.

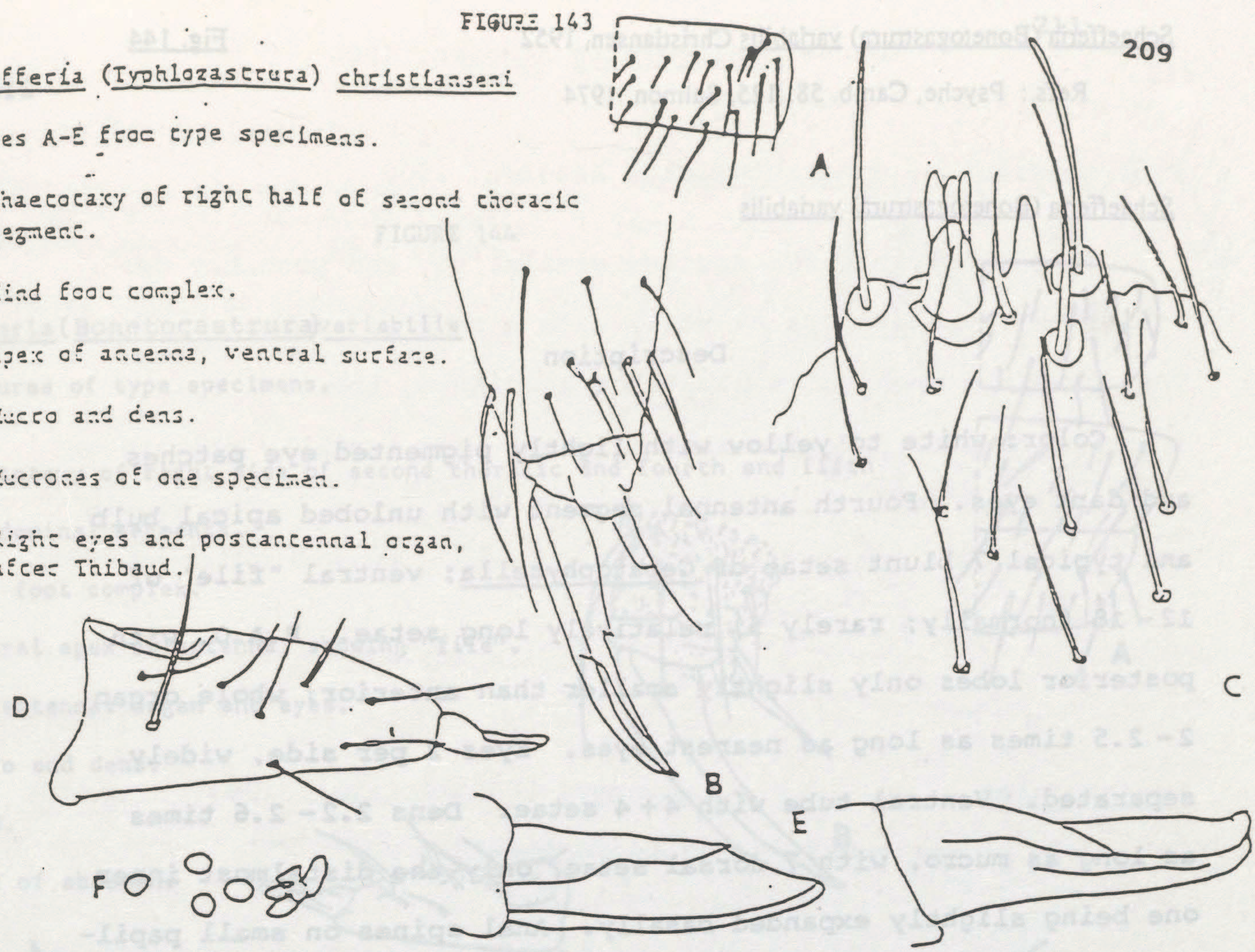
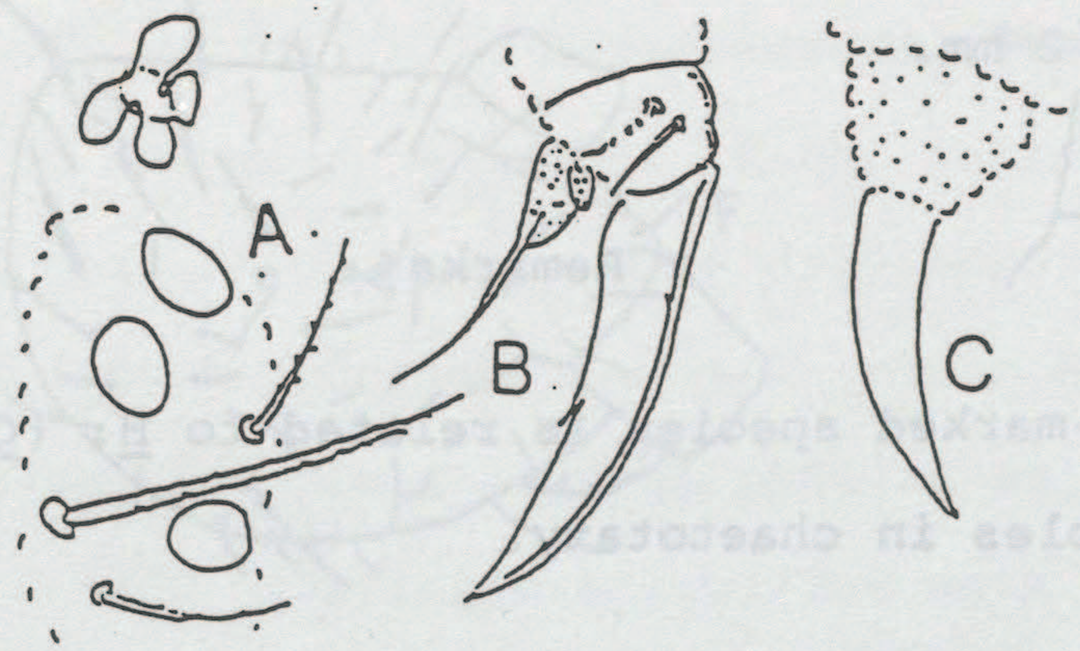


Figure 143-1

Schaefferia (Typhlogastrura) valentini . A) Right eyepatch and PAO; B) Foot complex; C) Anal spine. All after Thibaud 1996



Subgenus Bonetogastrura Thibaud, 1975

Type species: Typhogastrura balazuci Delamare, 1951

These species are derived from H. (Ceratophysella) armata group. There is 1 Nearctic species.

Refs.: Psyche, Camb. 58: 125, Salmon, 1974

Schaefferia (Bonetogastrura) variabilis

Description

Color: white to yellow with lightly pigmented eye patches and dark eyes. Fourth antennal segment with unlobed apical bulb and typical 7 blunt setae of Ceratophysella; ventral "file" of 12 - 18 (normally; rarely 5) relatively long setae. P.A.O. with posterior lobes only slightly smaller than anterior; whole organ 2 - 2.5 times as long as nearest eyes. Eyes 2 per side, widely separated. Ventral tube with 4+4 setae. Dens 2.2 - 2.6 times as long as mucro, with 7 dorsal setae, only the distalmost inner one being slightly expanded basally. Anal spines on small papillae. Integument uniformly granulate with Yosii "a" measure about 20. General chaetotaxy of armatus type of subgenus Ceratophysella. Maximum length 2 mm.

Remarks

This well-marked species is related to H. (C.) brevisensillata, which it resembles in chaetotaxy.

Localities: Alaska - Umiat, Pt. Barrow; Wisconsin - Sawyer Co.

FIGURE 144

Schaefferia (Bonetogastrura) variabilis

All figures of type specimens.

A) Chaetotaxy of right side of second thoracic and fourth and fifth abdominal segments.

B) Hind foot complex.

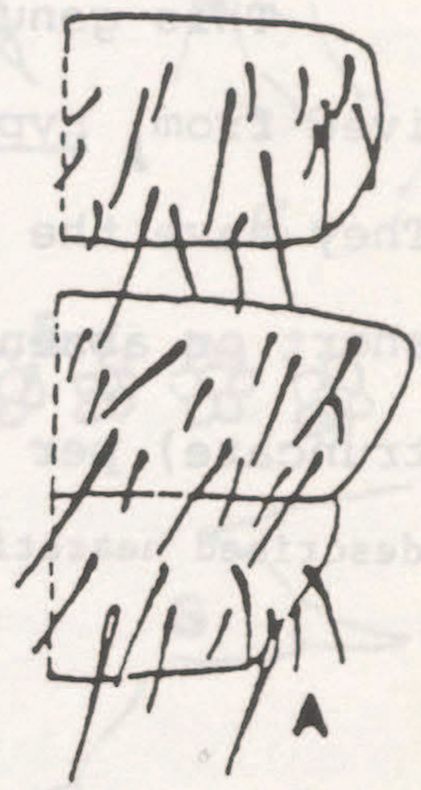
C) Ventral apex of antenna, showing "file".

D) Postantennal organ and eyes.

E) Mucro and dens.

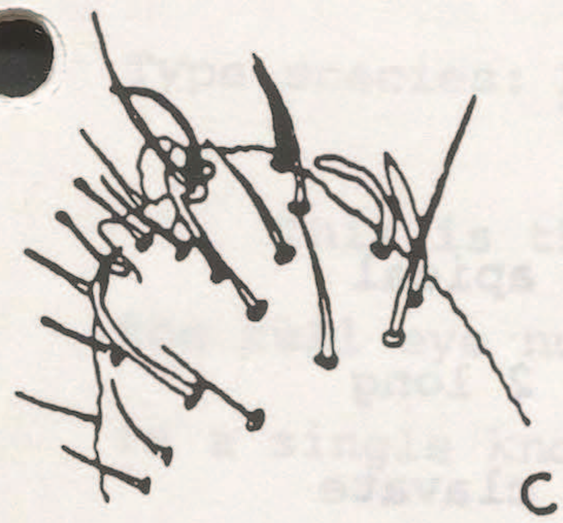
F) Head.

G) Apex of abdomen.

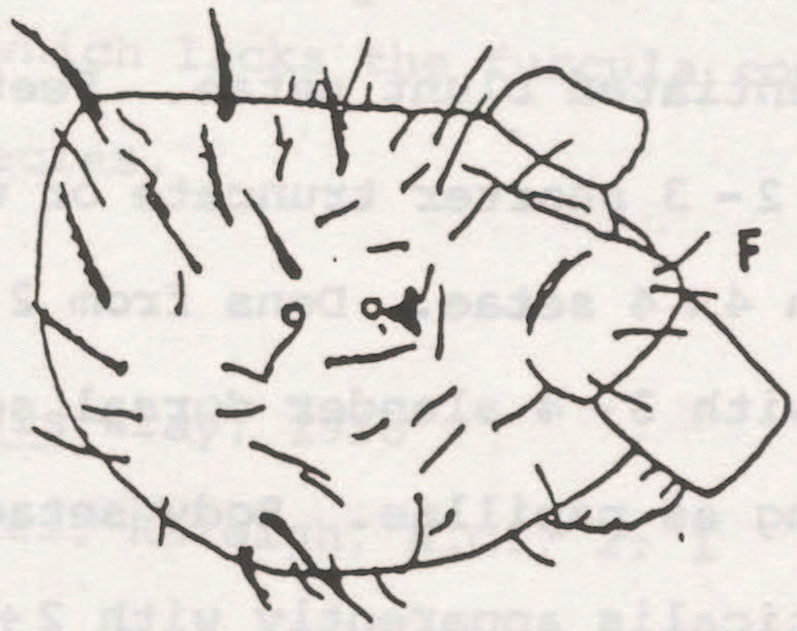


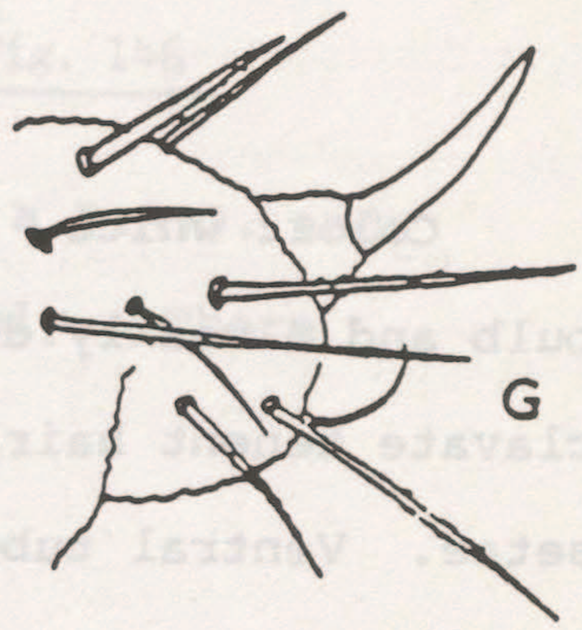












Genus Mesachorutes Absolon, 1900

Type species: M. quadriocellatus Absolon, 1900

This genus includes species similar to, and probably derived from, Hypogastrura s. str., with a reduced number of eyes. They have the unguiculus minute or acuminate, the anal spines short or absent, and more than 1 tenent hair (usually clavate or truncate) per foot; on the thorax s.s. is p_4 or p_5. The single described nearctic species does not fit any described subgenus (Deharveng 1979).

Mesachorutes thomomys (Chamberlain), 1943 Fig. 145

Ref.: Gt Basin Nat. 4: 39 (Achorutes)

Description

Color: white. Fourth antennal segment with unlobed apical bulb and 4 weakly differentiated blunt setae. Feet with 2 long clavate tenent hairs and 2 - 3 shorter truncate or weakly clavate setae. Ventral tube with 4 + 4 setae. Dens from 2.5 to 3.2 times as long as mucro, with 3 - 4 slender dorsal setae. Anal spines about twice as long as papillae. Body setae all short and acuminate. Area verticalis apparently with 2 + 2 setae.
Maximum length 1.2 mm.

Remarks

Populations we have seen are very similar to those described by Chamberlain. This species may be derived from the viatica group of Hypogastrura.

Localities: Montana - Cascade Co., Gallatin Co. (type); South Dakota - Meade Co.

FIGURE 145

Mesachorutes (Denigastrura) thomomys

A) Chaetotaxy of right side of second thoracic and fourth and fifth abdominal segments, specimen from Meade Co., South Dakota.

All remaining figures after Chamberlain

B) Hind foot complex.

C) Apex of antenna.

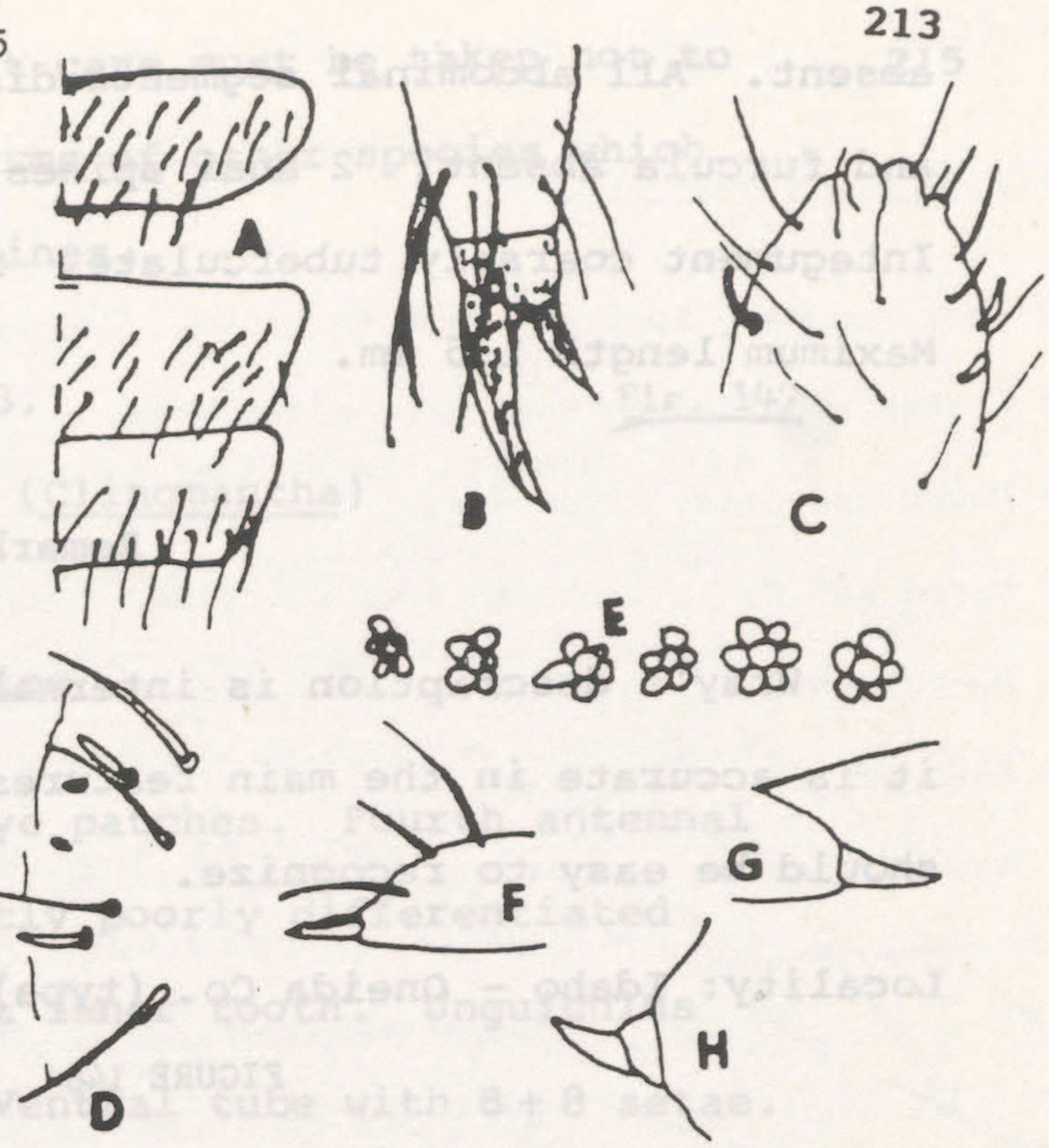
D) Apical organ of third antennal segment.

E) Variations in the postantennal organ.

F) Mucro and dens.

G) Apex of mucro and dens, another specimen.

H) Anal spine.



Genus Knowltonella Wray, 1958

Type species: K. idahoensis Wray, 1958 Fig. 146

This is the only genus of Hypogastrurinae with a P.A.O. and the full eye number which lacks the furcula completely. There is a single known species.

Knowltonella idahoensis Wray, 1958

Ref.: Nature Notes, Raleigh, N.C., 2: 1

Description

Color: deep purplish blue, with many pale spots. Fourth antennal segment with unlobed retractile apical bulb and differentiated blunt setae. P.A.O. simple but in a triradiate depression. Eyes 8+8. Mouthparts as in Hypogastrura (?). 4 clavate tenent hairs on each foot. Unguis with a weak inner tooth; unguiculus

absent. All abdominal segments distinctly separated. Tenaculum and furcula absent. 2 anal spines, 7/8 as long as inner unguis. Integument coarsely tuberculate. Body setae smooth and acuminate. Maximum length 1.5 mm.

Remarks

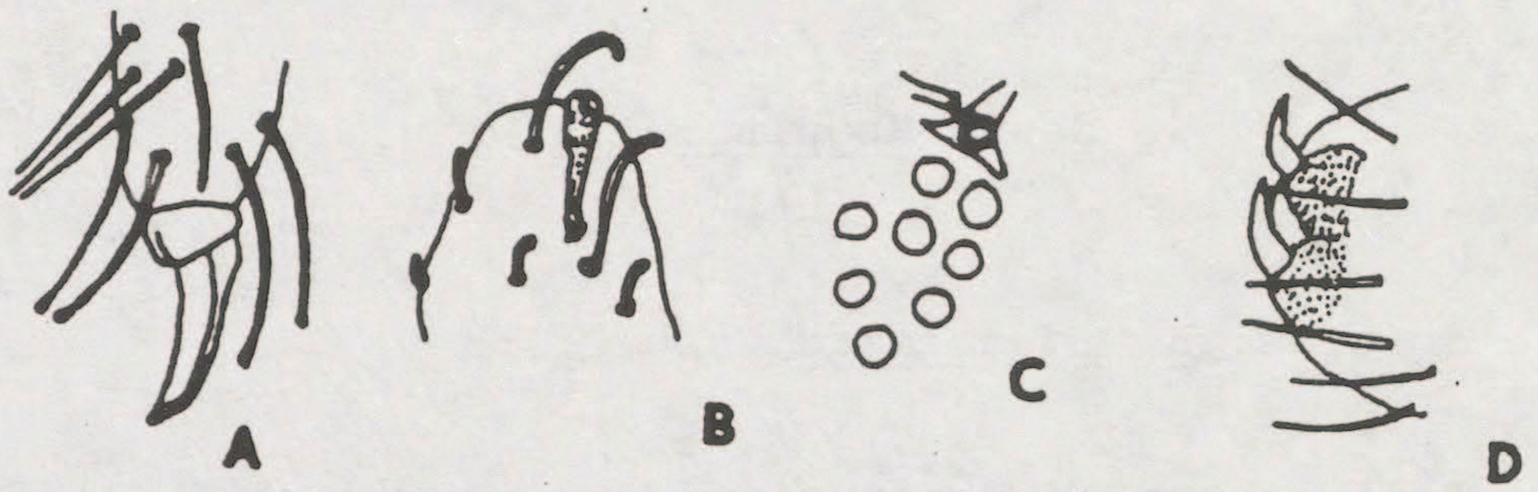
Wray's description is internally inconsistent in part, but if it is accurate in the main features this is a unique species which should be easy to recognize.

Locality: Idaho - Oneida Co. (type).

FIGURE 146

Knowltonella idahoensis

All figures after Wray.



A) Hind foot complex.

B) Apex of antenna.

C) Eyes and postantennal organ, left side of head.

D) Posterior end of abdomen.

Genus Triacanthella Schäffer, 1897

Type species: T. michaelseni Schäffer, 1897

Syn.: Clingmantha Wray, 1963, type species T. copelandi Wray, 1963, n.syn.

This genus includes all those forms having a well-developed molar plate, an unguiculus, and three anal spines in normal individuals. There are 8 + 8 eyes, but in most species two posterior eyes are reduced and may be represented only by pigment spots. The species generally have a heavily granulate integument, and often have a supplementary bulb or sac at the end of the dens. One Nearctic species T. copelandi

This is a well-marked genus, but care must be taken not to place here abnormal or ecomorphic forms of other species which may exceptionally have three anal spines.

Triacanthella copelandi (Wray), 1963, Fig. 147

Ref.: Tenn. Acad. Sci. 38: 101 (Clingmantha)

Description

Color: white except for dark eye patches. Fourth antennal segment with 8 - 10 blunt setae, mostly poorly differentiated from acuminate ones. Unguis without inner tooth. Unguiculus .6 to .7 as long as inner unguis. Ventral tube with 8 + 8 setae. Tenaculum with 3 + 3 teeth. Dens about 3.5 times as long as mucro with 9 - 12 slender doraal and lateral setae, and with an apical collapsible sac (sometimes absent?). Three anal spines on high papillae, varying in size from about half as long to slightly longer than inner unguis. Integument coarsely granulate: largest abdominal granules about 30 micra in diameter. Posterior long abdominal setae more or less clavate. Maximum length 1.5 mm.

Remarks

The White Co. specimens we examined differed strikingly from those described by Wray in 3 respects: A) the presence of a sac at the end of the dens; B) the absence of an apical antennal bulb; and C) the shorter anal spines. In spite of this the similarities as well as the localities justify considering them as belonging to the same species, at least at present.

Localities: Tennessee - Sevier Co. (type); White Co. (cave).

FIGURE 147

Triacanthella copelandi

A) Foot complex, specimen from White Co., Tennessee.

B) Postantennal organ and eyes, after Wray.

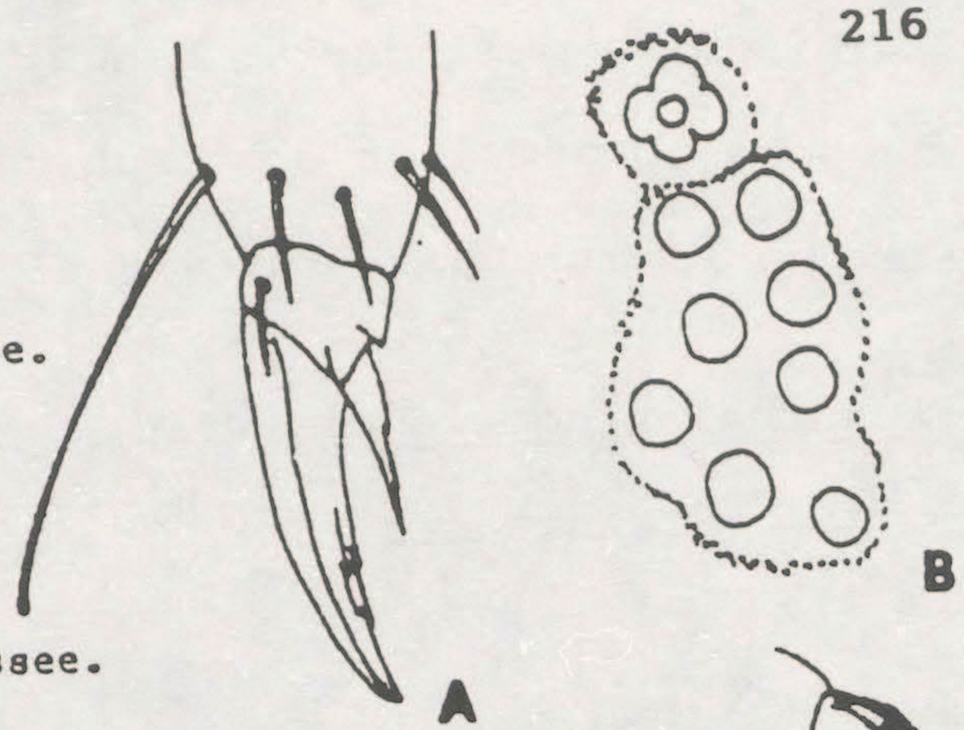
C) Mucro and dens, after Wray.

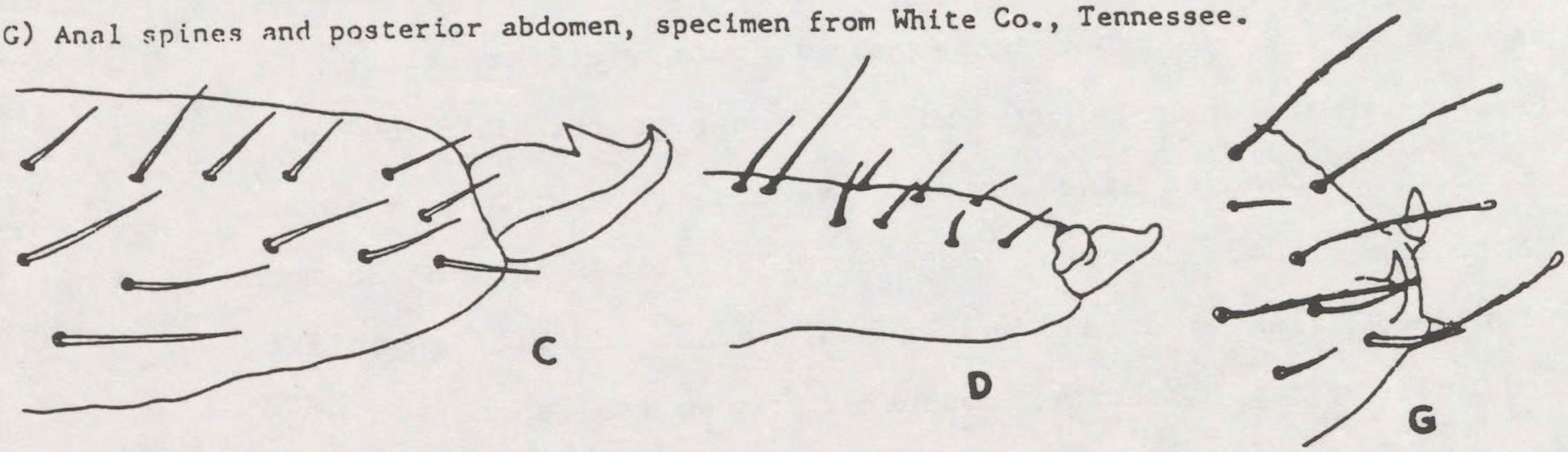
D) Mucro and dens, specimen from White Co., Tennessee.

E) Mucro and dens, another specimen from White Co., Tennessee.

F) Anal spines, after Wray.

G) Anal spines and posterior abdomen, specimen from White Co., Tennessee.





Genus Microgastrura Stach, 1922a

Type species: M. duodecimoculata Stach, 1922a

This genus includes those forms lacking apical teeth on the mandible and having a more or less rudimentary molar plate, but otherwise generally similar to Hypogastrura. They have a well developed P.A.O. of a peculiar shape, and no ventral file on the fourth antennal segment. The unguiculus and furcula are well developed. Microgastrura differs from Stenogastrura in body shape and size, mucro, setae, and other characters. There is one Nearctic species, M. minutissma.

Ref.: Collembola of Iowa: 13 (Achorutes (Schoettella))

Description

Color: reddish brown to gray. Fourth antennal segment with 6 to 7 blunt setae and a small apical bulb. Eyes 6 + 6. P.A.O. four lobed and subequal to or smaller than nearest eye. Unguis 3.5 - 4 times as long as unguiculus. Unguiculus elongate lamellate with a small apical filament. Tenent hair acuminate to weakly clavate. Tenaculum with 4 + 4 teeth. Dens usually with 7 dorsal setae and 2 - 3 times as long as mucro. Anal spines absent. Integument coarsely granulate. Maximum length .55 mm.

Remarks

The California specimens may represent a new species; however, they are so similar to Mills' description, and the minute size of these animals makes observation so difficult, that we feel it best to maintain them as the same taxon. The California specimens differ from Mills' description in having a shorter mucronal lamella and a longer filament on the unguiculus. In addition, the molar region appears to be better developed; however, in all these features the minute size of the organs makes different interpretations very easy.

Localities: California - Fresno Co., Yolo Co.; Connecticut - Middlesex Co.; Iowa - Story Co. (type); West Virginia - Monongalia Co.

FIGURE 148

Microgastrura minutissima

A) Habitus, after Wilkey.

B) Hind foot complex, after Mills.

C) Hind foot complex, after Wilkey.

D) Postantennal organ and eyes, after Mills.

E) Mandible, after Mills.

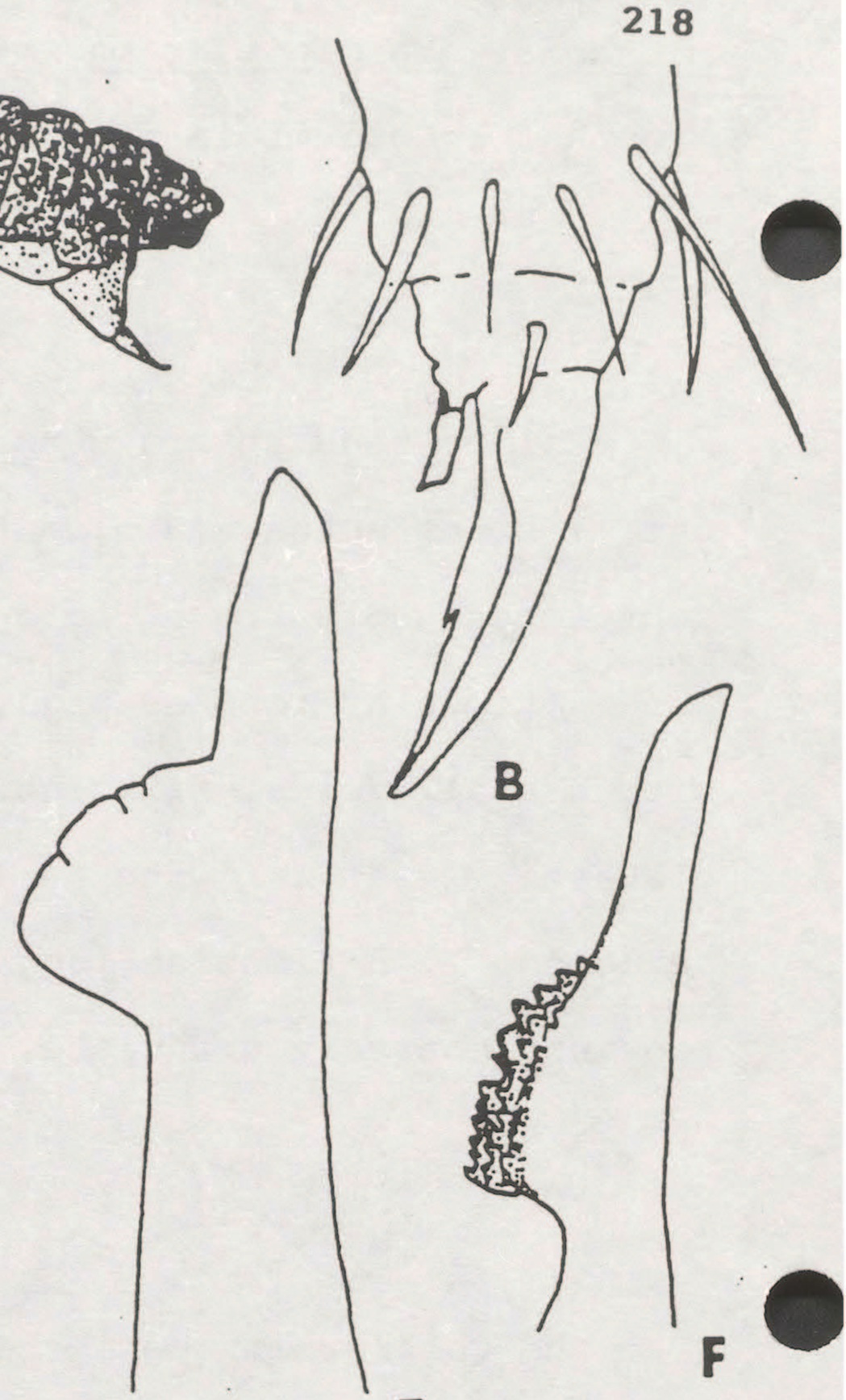
F) Mandible, after Wilkey.

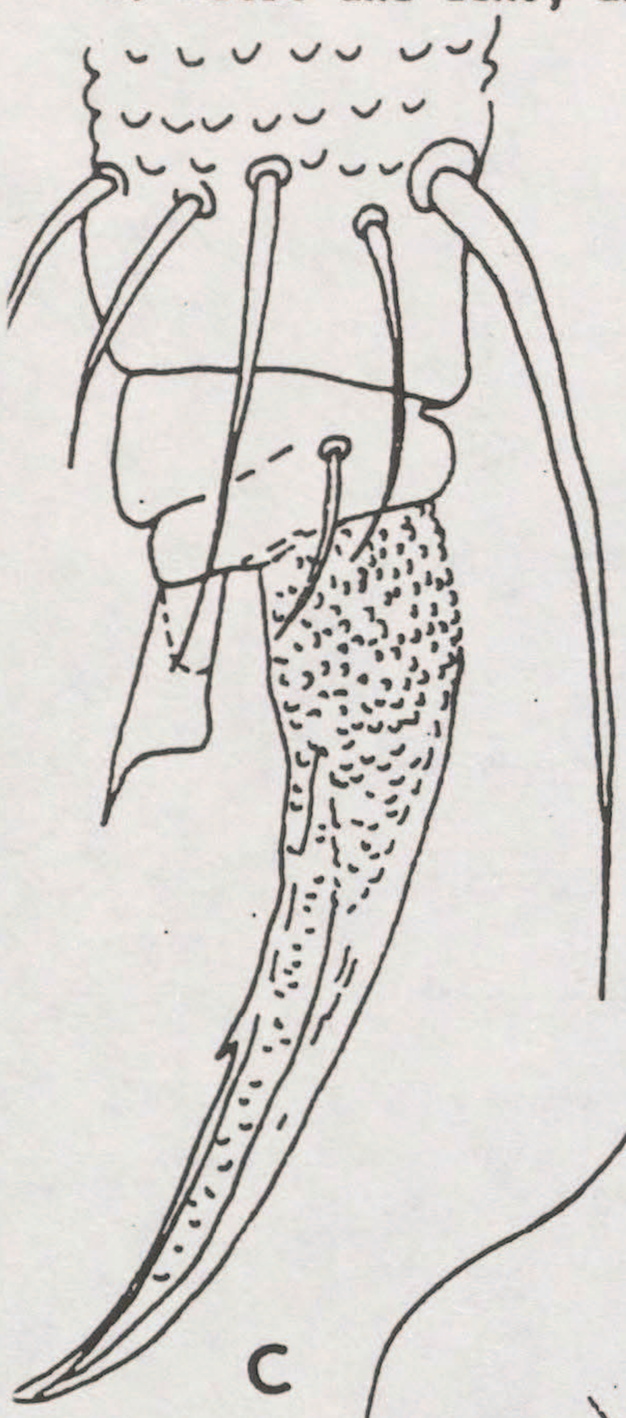
G) Maxilla, after Mills.

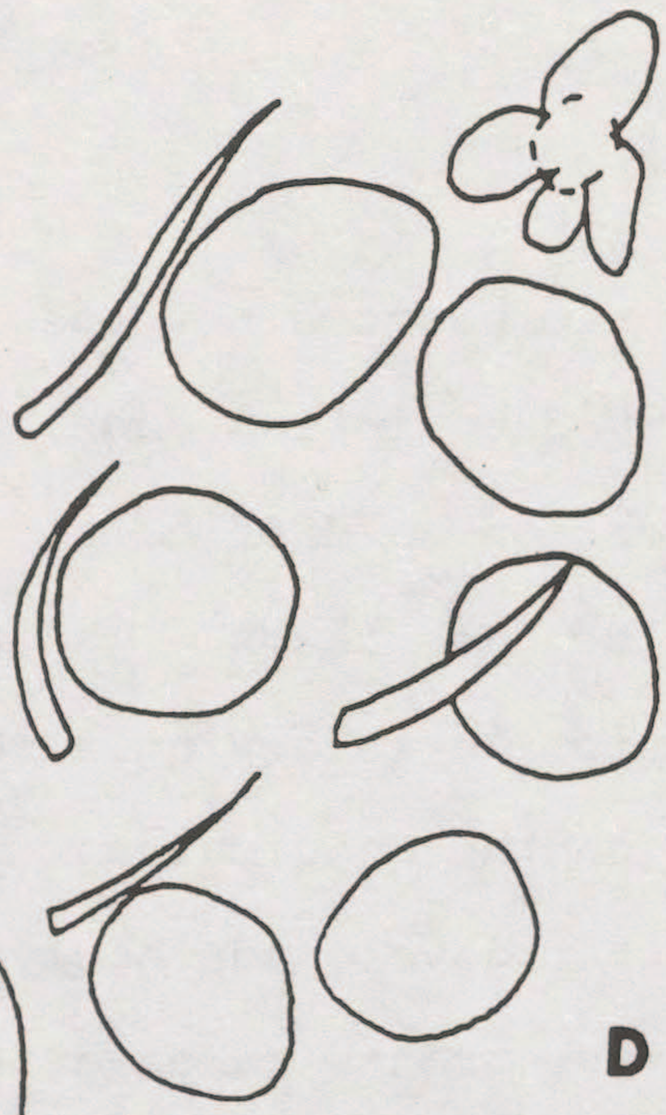
H) Mucro and dens, after Mills.

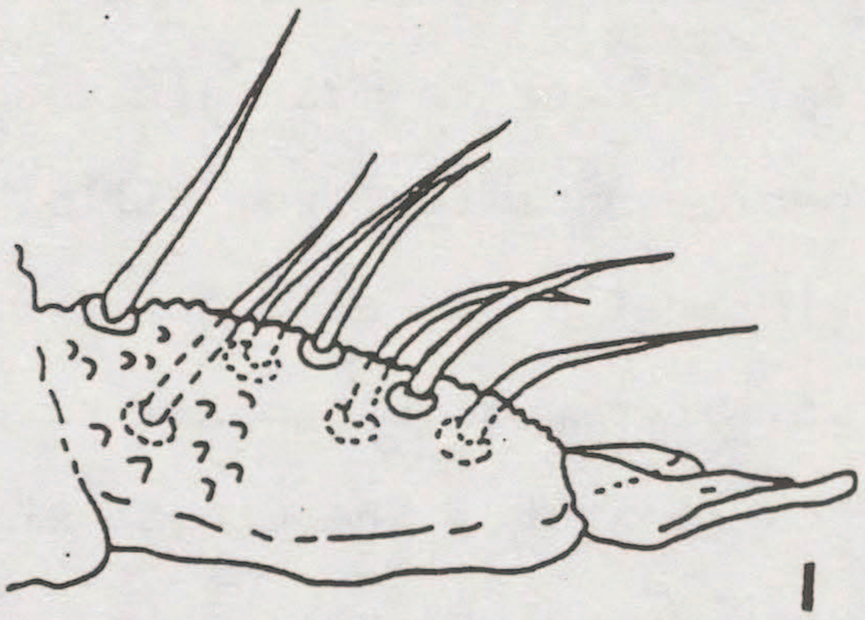
I) Mucro and dens, after Wilkey.

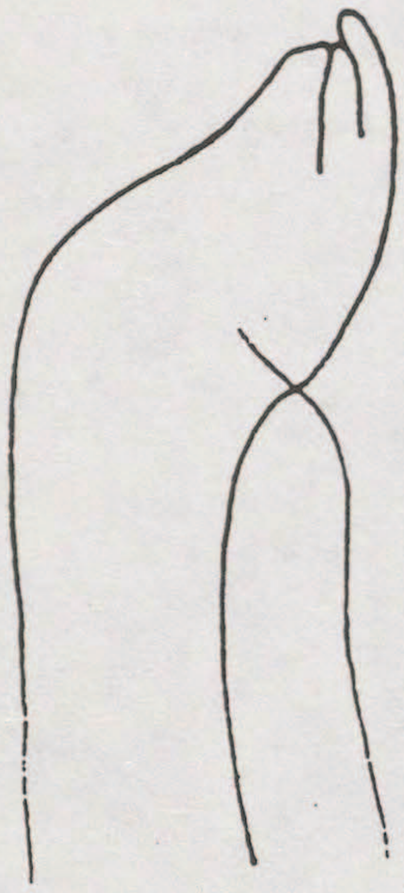


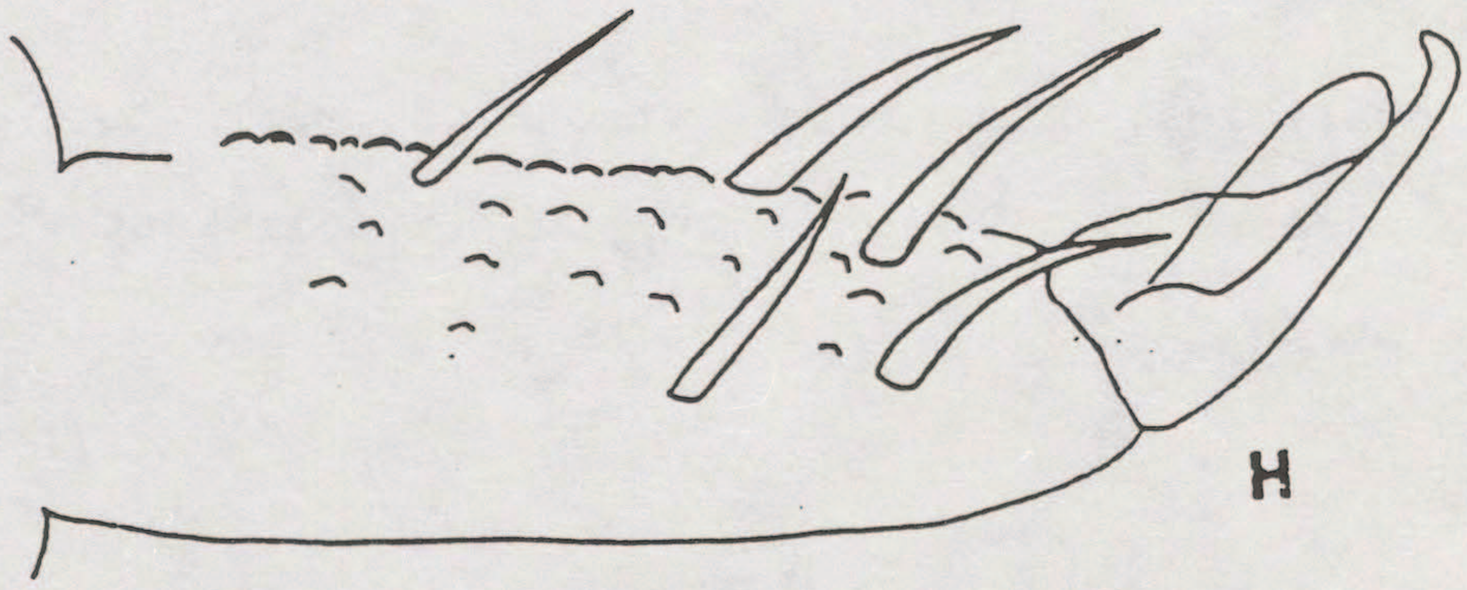












Type species: S. hiemalis, Christiansen & Bellinger, 1980

This genus is proposed for a peculiar member of the Hypogastrurinae having reduced mouthparts resembling those of Microgastrura, but with a simple P.A.O., greatly elongate and clavate body setae, and a unique mucro. The body form is that of a large and greatly elongate Hypogastrura.

There is a single Nearctic species, S. hiemalis,

FIGURE 149

Stenogastrura hiemalis

All figures of holotype.

A) Hind foot complex.

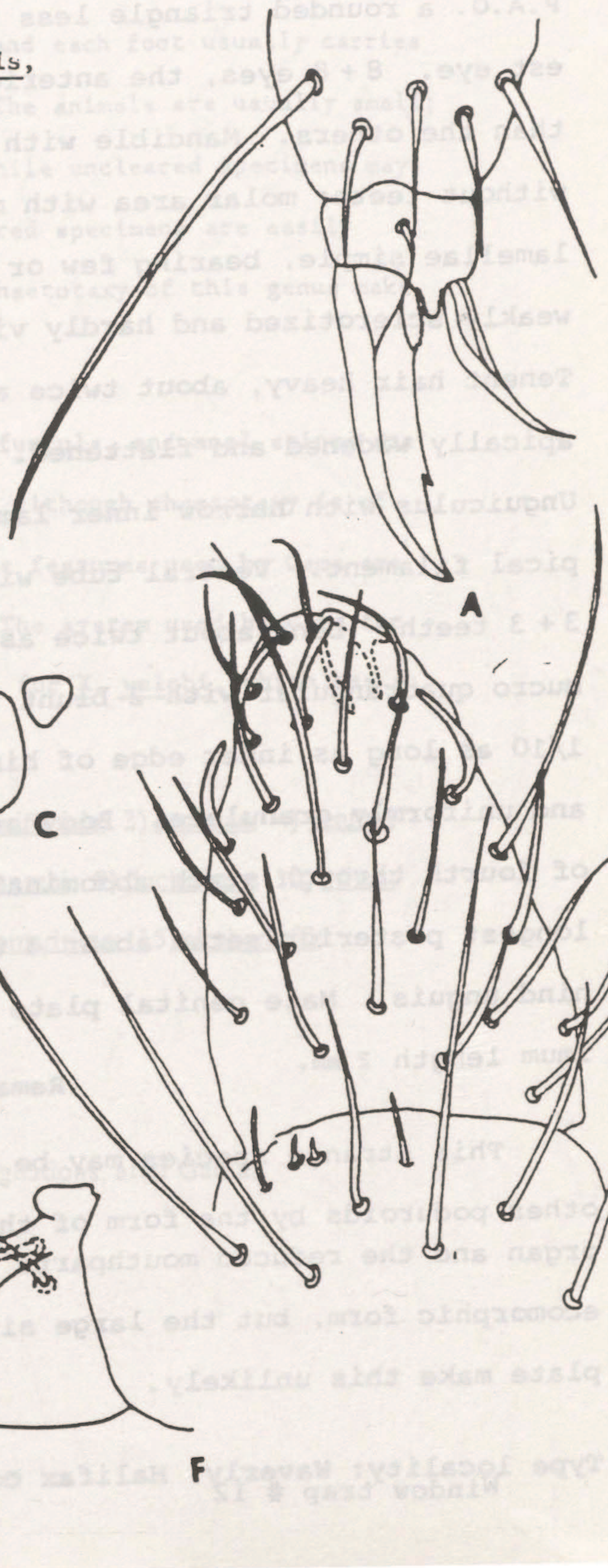
B) Fourth antennal segment.

C) Postantennal organ and eye patch, right side.

D) Mandible.

E) Maxilla.

F) Mucro and dens.



Description

Color: deep blue with rounded paler spots; legs and furcula pale. Body unusually elongate and narrow. Fourth antennal segment with unlobed apical papilla and more than 7 blunt setae. P.A.O. a rounded triangle less than 1/2 the diameter of the nearest eye. 8 + 8 eyes, the anterior median 3 conspicuously larger than the others. Mandible with apical portion short and blunt, without teeth; molar area with many fine teeth; maxilla with lamellae simple, bearing few or no teeth or fringes; mouthparts weakly sclerotized and hardly visible in undissected specimens. Tenent hair heavy, about twice as long as inner edge of unguis, apically widened and flattened. Unguis with strong inner tooth. Unguiculus with narrow inner lamella, gradually tapering, and apical filament. Ventral tube with 6 + 6 (?) setae. Tenaculum with 3 + 3 teeth. Dens about twice as long as mucro, with 5 setae. Mucro quadrangular with 2 blunt teeth. Anal spines erect, about 1/10 as long as inner edge of hind unguis. Integument coarsely and uniformly granulate. Body setae all smooth; some macrochaetae of fourth through sixth abdominal segments strongly clavate; longest posterior setae about 4 times as long as inner edge of hind unguis. Male genital plate with more than 100 setae. Maximum length 2 mm.

Remarks

This strange species may be distinguished at once from all other poduroids by the form of the mucro. The shape of this organ and the reduced mouthparts suggest that it might be an ecomorphic form, but the large size and distinctive male genital plate make this unlikely.

Type locality: Waverly, Halifax Co., Nova Scotia, Dept. of Forestry Window trap # 12

Genus Xenylla Tullberg, 1869

Type species: maritima Tullberg, 1869

Following Gisin and Gama, we place in this genus all Nearctic Hypogastruridae having a well developed molar plate, lacking a P.A.O., and having eyes. All of the Nearctic forms lack an unguiculus entirely. The dentes never have more than two dorsal setae, and each foot usually carries a pair of more or less clavate tenent hairs. The animals are usually small; most species do not exceed 1 mm. in length. While uncleared specimens may easily be confused with Schoettella, well cleared specimens are easily identified. Gama's excellent studies of the chaetotaxy of this genus make it a pleasure to work with. (See Figure 150).

The fourth antennal segment blunt setae, furcula, and anal spines are the simplest taxonomic characteristics to use, although chaetotaxy is of fundamental importance. The major chaetotactic features used by Gama are summarized for Nearctic species in Table IX. The system used by Gama for labelling the setae can be seen in Figure 150, for X. welchi, which has an almost complete set of setae.

There are 17 Nearctic species: 1) acauda; 2) affiniformis; 3) baconae; 4) berulae; 5) californica; 6) canadensis; 7) carolinensis; 8) christianseni; 9) duchesnea; 10) grisea; 11) humicola; 12) louisiana; 13) pallescens; 14) pseudomaritima; 15) simberloffi; 16) welchi; 17) wilsoni.

FIGURE 150

Chaetotaxy of Xenylla welchi showing setal designations, after Gama.

A) Dorsal surface.

B) Ventral surface.

(Figure on next page)

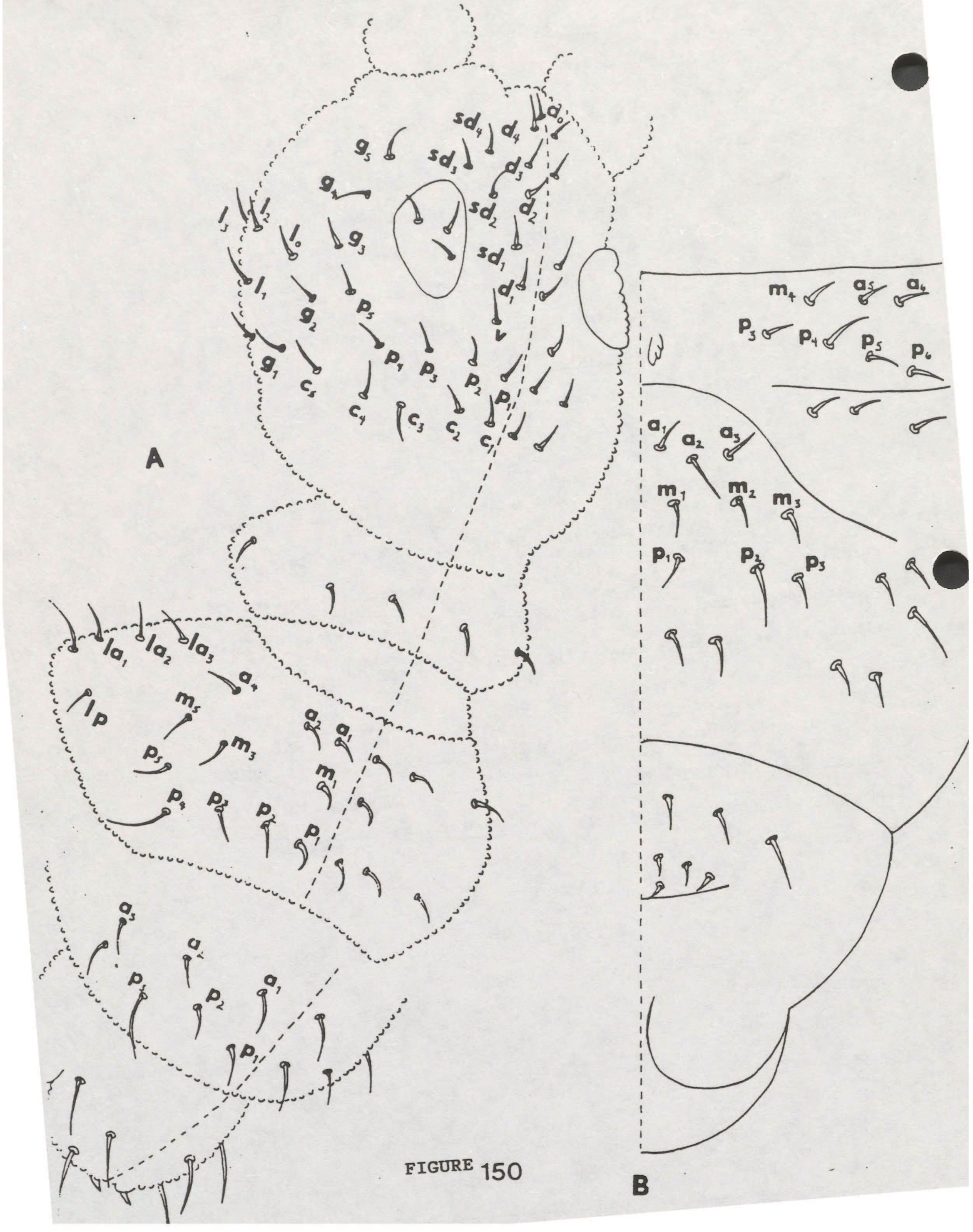

A
B
sd_4 d_4 d_0
g_5 sd_3 d_3
g_4 sd_2 d_2
g_3 sd_1 d_1
l_3 l_2 l_1 l_0
g_2 g_1 c_5 p_5 p_4 p_3 p_2 p_1
c_4 c_3 c_2 c_1
la_1 la_2 la_3 a_4
lp m_5 m_3 m_2 m_1
p_5 p_4 p_3 p_2 p_1
a_3 a_2 a_1
m_4 a_5 a_6
p_3 p_4 p_5 p_6
a_1 a_2 a_3
m_1 m_2 m_3
p_1 p_2 p_3

FIGURE 150

TABLE IX
Characteristics of Nearctic species of Xenylla

species	Chaetotaxy: Dorsum: Head a_0	p_1	p_2	Thorax II, III La_1	La_2	m_3	Abdomen V a_2	Venter: Head p_1	m_3	Thorax II, III	Abdomen IV m_1	Antenna 4 Blunt Setae	Tenacular Teeth	Dental Setae	Eye No.
sp. A. New Mexico	+	+	-	+	+	+	+	+	+		+	4	0	0	5
acauda	+	+	-	+	-	+	+	+	-	-	+	4	0	0	5
affiniformis	+	+	+	+	-	+	+	-	-	-	-	4	3?	2	5
baconae	+	+	+	+	-	+	+	-	+	-	+	4	3	2	5
betulae	+	-	+	-	+	-	-	+	+	+	-	4	3	1	5
californica	+	+	-	+	+	+	-	+	+	-	-	4	2	1	4
canadensis	+	+	-	+	+	+	-	?	?	?	+	5[4?]	2	1	5
carolinensis	chaetotaxy unknown											6	?	2	5
christianseni	+	+	-	+	+	+	+	+	+	-	+	4	2	1	5
duchesnea	+	+	-	+	+	+	+	+	-	+	-	4	2	1	5
grisea	+	-	+	-	+	-	-	+	+	+	-	4	3	2	5
humicola	+	+	+	+	+	+	+	-	+	-	+	4	3	2	5
louisiana	+	+	-	+	+	+	+	+	+	+	+	4	2	2	5
pallescens	+	+	-	+	+	+	-	+	+	-	+	4	2	1	5
pseudomaritima	+	-	+	-	+	+	-	+	+	+	-	4	3	2	5
simberloffi	-	-	+	-	+	+	-	+	+	-	-	5	3	2	5
welchi	+	+	+	+	+	+	+	+	+	-	+	4	3	2	5
wilsoni	+	+	-	+	+	+	-	+	+	-	+	4	2	1	5

Key to nearctic species of Xenylla

*1) - Furcula and tenaculum absent----------X. acauda

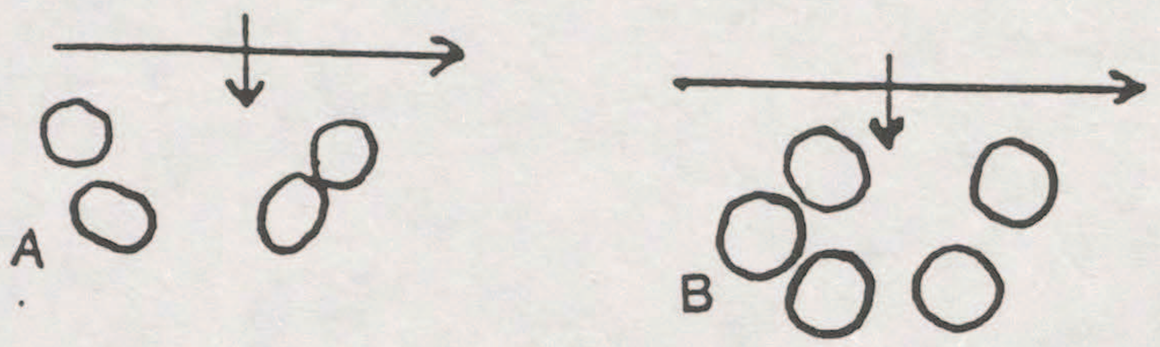
1') Furcula and tenaculum present----------2

2) Mucrodens with 1 seta----------3

2') Mucrodens with 2 setae----------9

**3) Eyes 4 + 4 (Figure 151.1A)----------X. californica

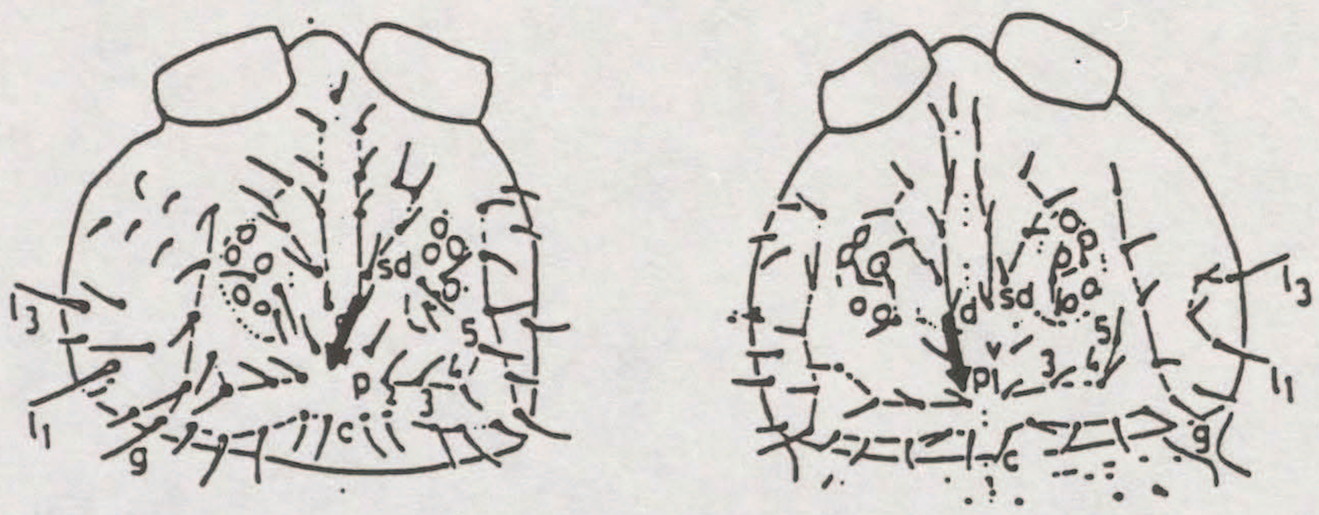
3') Eyes 5 + 5 (Figure 151.1B)----------4



151.1

4) Cephalic seta p_1 absent (Figure151.2A)----------X. betulae Fjellberg 1985

4') Cephalic seta p_1 present (Figure 151.2B)----------5



151.2

5) Mucrodens longer than inner edge of hind unguis----------6

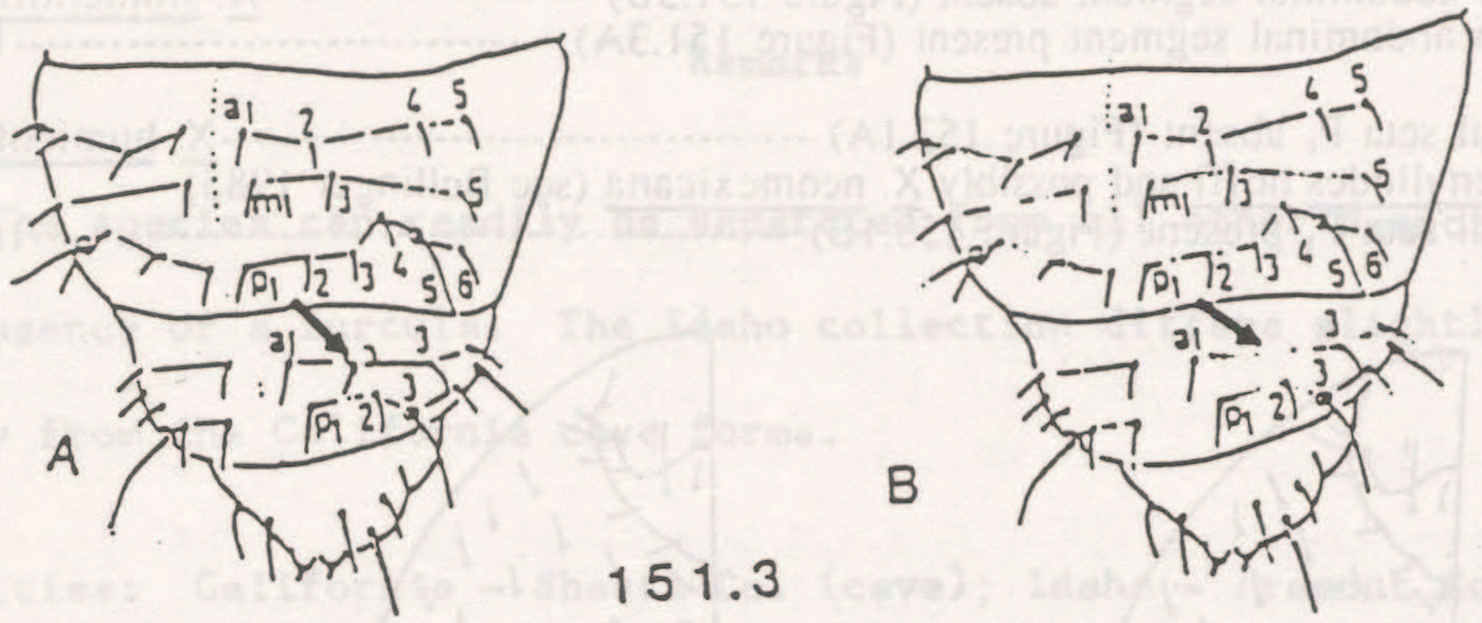
5') Mucrodens shorter than inner edge of hind unguis----------7

6) Seta a_2 on fifth abdominal segment present (Figure 151.3A)--------X. christiansenI

6') Seta a_2 on fifth abdominal segment absent (Figure 151.3B)----------X. wilsoni

7) Seta a_2 on fifth abdominal segment present (Figure 151.3A)----------X. duchesnea

7') Seta a_2 on fifth abdominal segment absent (Figure 151.3B)----------8



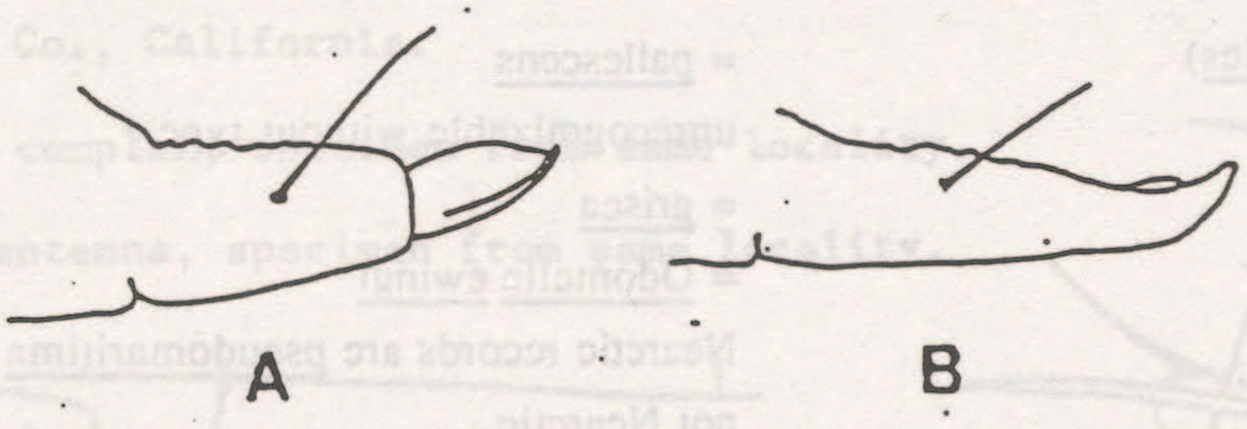
151.3

8) Seta P_1 on fifth abdominal segment more than half as long as P_3----X. pallescens

8') Seta P_1 on fifth abdominal segment less than half as long as P_3-----X. canadensis

9) Mucro fused to dens (Figure 151B)----------10

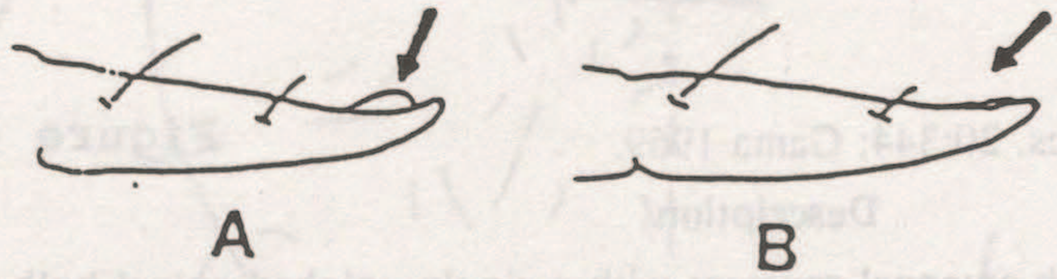
9') Mucro separate from dens (Figure 151A)----------11



151

10) Mucro with rounded lamella (Figure 153A)----------X. grisea

10') Mucro with straight narrow lamella (Figure 153B)----------X. pseudomaritima



153

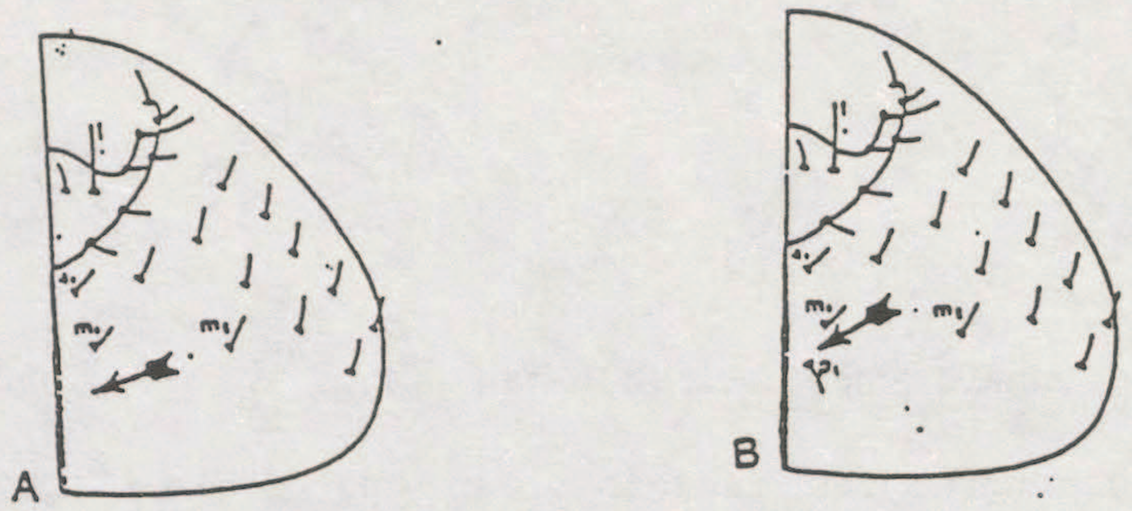
11) Anal spines absent ----------X. affiniformis Stach 1929
11') Anal spines present ----------12

12) Tenaculum with 2 + 2 teeth ----------X. louisiana
12') Tenaculum with 3 + 3 teeth ----------13

13) Fourth antennal segment with 6 blunt setae ----------X. carolinensis
13') Fourth antennal segment with 5-4 blunt setae ----------14

**14) Seta a_2 on fifth abdominal segment absent (Figure 151.3B) ----------X. simberloffi
14') Seta a_2 on fifth abdominal segment present (Figure 151.3A) ----------15

*15) Cephalic ventral seta P_1 absent (Figure 153.1A) ----------X. humicola
Synonyms: Xenyllodes hoffi and possibly X. neomexicana (see Bellinger 1985)
15') Cephalic ventral seta P_1 present (Figure 153.1B) ----------16



153.1

16) Mucro .5 -.55 times as long as dens ----------X. baconae
**16') Mucro .60-.75 times as long as dens ----------X. welchi

Not included in key:

alpina Scott, 1960 (Xenyllodes)	= pallescens
collis Bacon, 1914b	unrecogmizable without type
gracilis Guthric, 1903	= grisea
helena Scott, 1937	= Odontella ewingi
maritima Tullberg, 1869	Nearctic records are pseudomaritima
mucronata Axelson, 1903	not Nearctic
neomexicana Scott, 1960	unrecognizable without types
paludis Bacon, 1914b	unrecognizable without types
proxima Denis, 1931a	not Nearctic; or = pallescens or wilsoni ?

Xenylla acauda Gisin, 1947

Ref.: Mitt. Schweiz. ent. Ges. 20:344; Gama 1969. **Figure 154**

Description

Color: blue-gray (?). Fourth antennal segment with a single unlobed apical bulb, not full withdrawn into antenna. Unguis without inner tooth. Each foot with two clear clavate tenent hairs. Ventral tube with 4 + 4 scale.

Tenaculum and furcula completely absent. Anal spines stout, slightly curved, and 2/5 to 1/2 as long as inner hind unguis. Body finely to moderately coarsely granulate, with the granulation somewhat larger on the last two abdominal segments. Body setae acuminate, with curved setae of the last two segments weakly unilaterally serrate. Maximum length .8 mm.

Remarks

The species can readily be separated from all other Nearctic forms by the absence of a furcula. The Idaho collection differs slightly in chaetotaxy from the California cave forms.

Localities: California - Shasta Co. (cave); Idaho - Fremont Co.

Figure 154

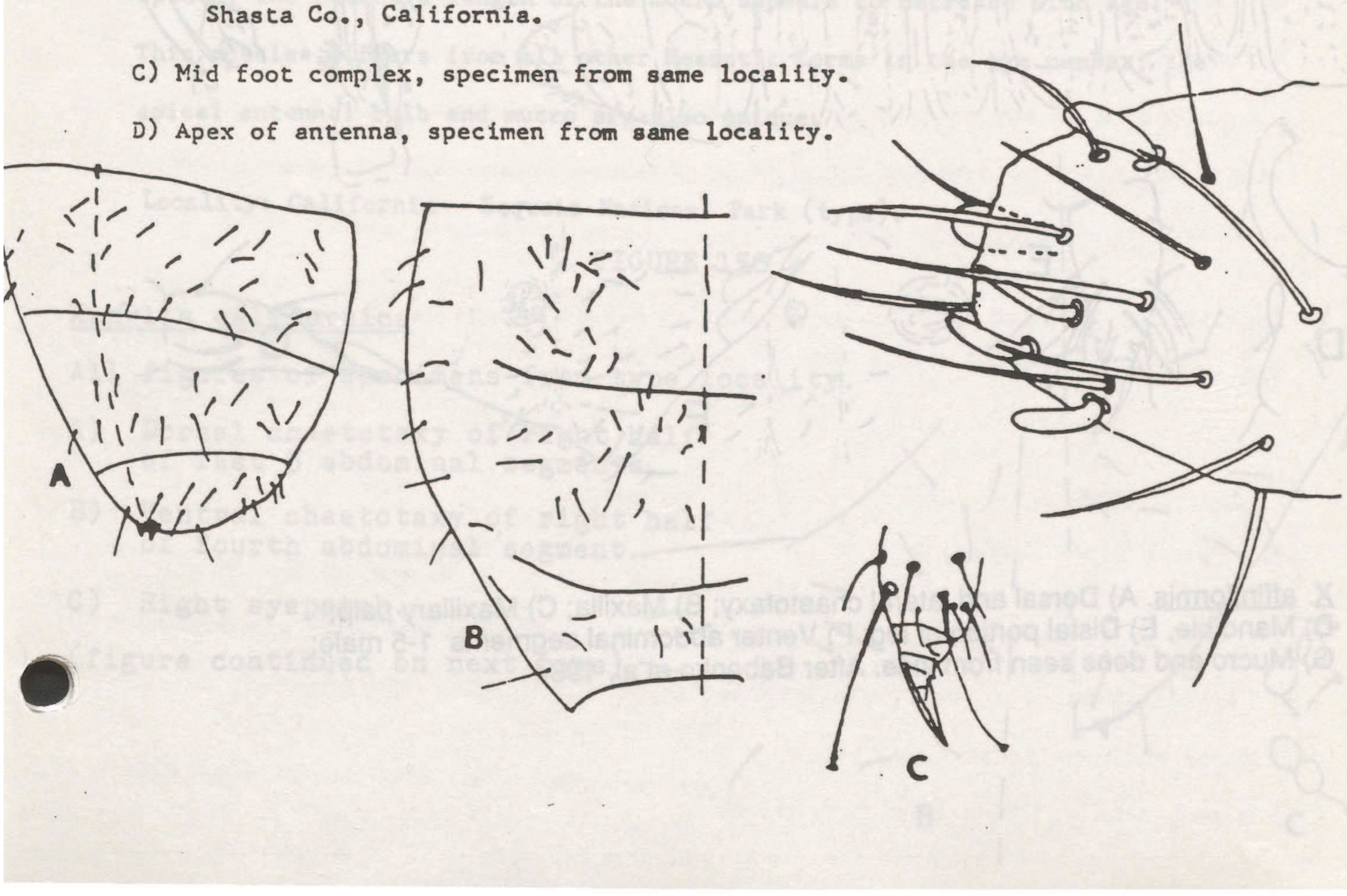
Xenylla acauda

A) Last 3 abdominal segments from side, specimen from Fremont Co., Idaho.

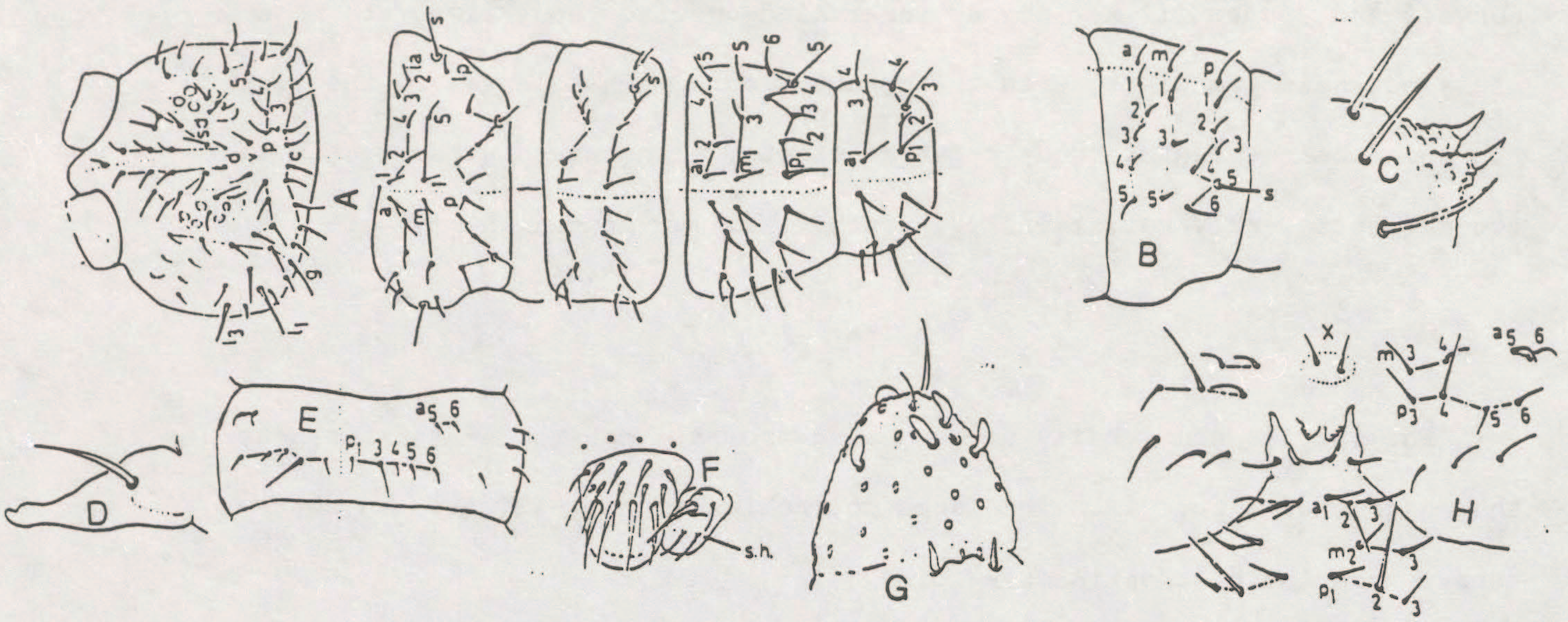
B) Ventral chaetotaxy of right side, abdominal segments 3-5, specimen from Shasta Co., California.

C) Mid foot complex, specimen from same locality.

D) Apex of antenna, specimen from same locality.

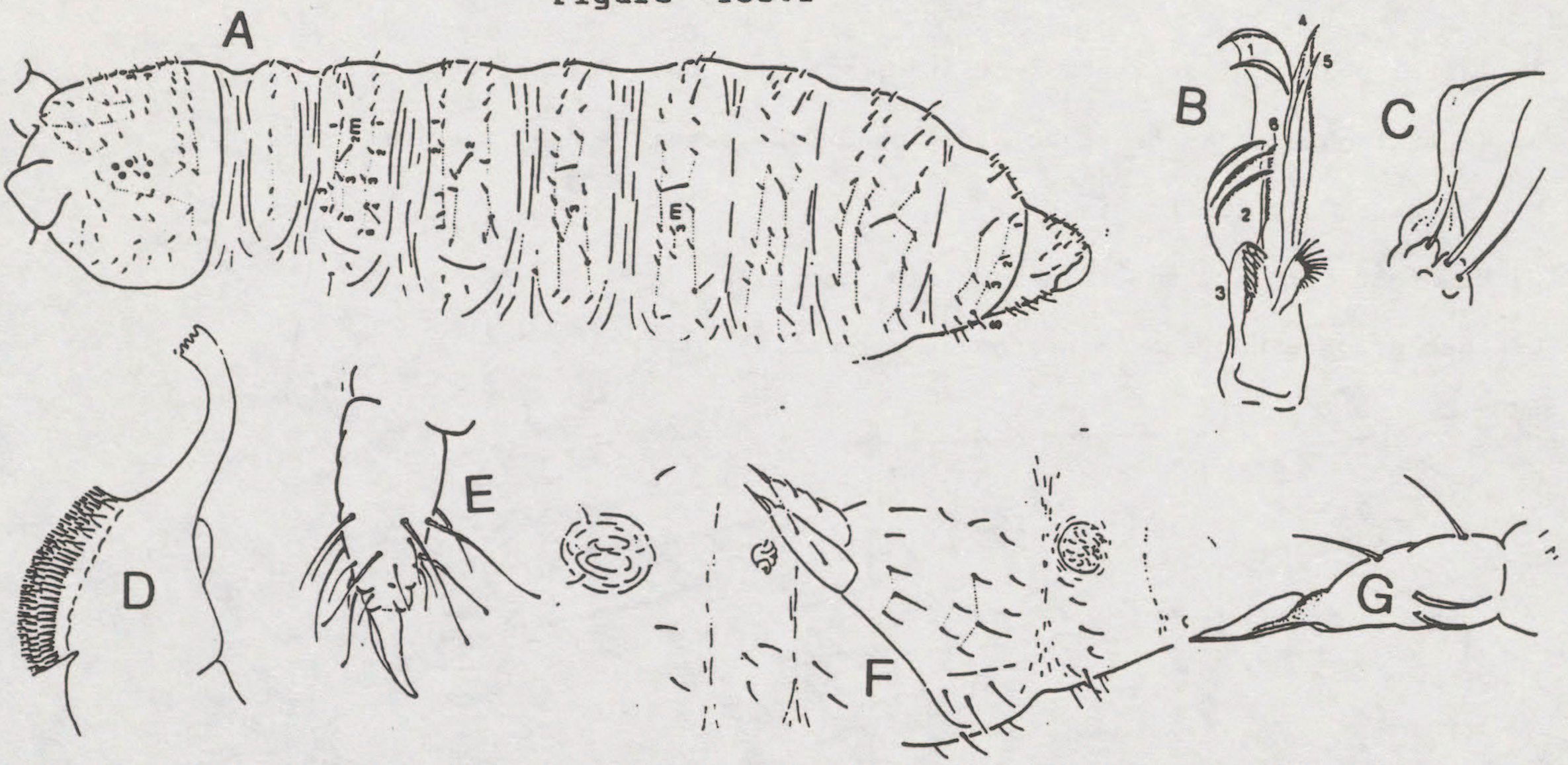


Xenylla betulae Fjellberg 1985
Figure 155



X. betulae. A Dorsal chaetotaxy head, Th. 3-Abd. 1 & Abd. 4-5; B) Abd. 5 , left side specimen with a3 present; C) Anal spines; D) Dens & mucro; E) Sternite Abd. 2; F) Labrum and maxillary palp; G) Sensillae right antenna; H) Sternite chaetotaxy Abd. 3-4. After Fjellberg 1985.

Xenylla affiniformis Stach 1929
Figure 155.1



X. affiniformis. A) Dorsal and lateral chaetotaxy; B) Maxilla; C) Maxillary palp; D) Mandible, E) Distal portion of leg; F) Venter abdominal segments 1-5 male; G) Mucro and dens seen from side. After Babenko et al. 1994

Ref.: Revue suisse Zool. 83:325.

Description

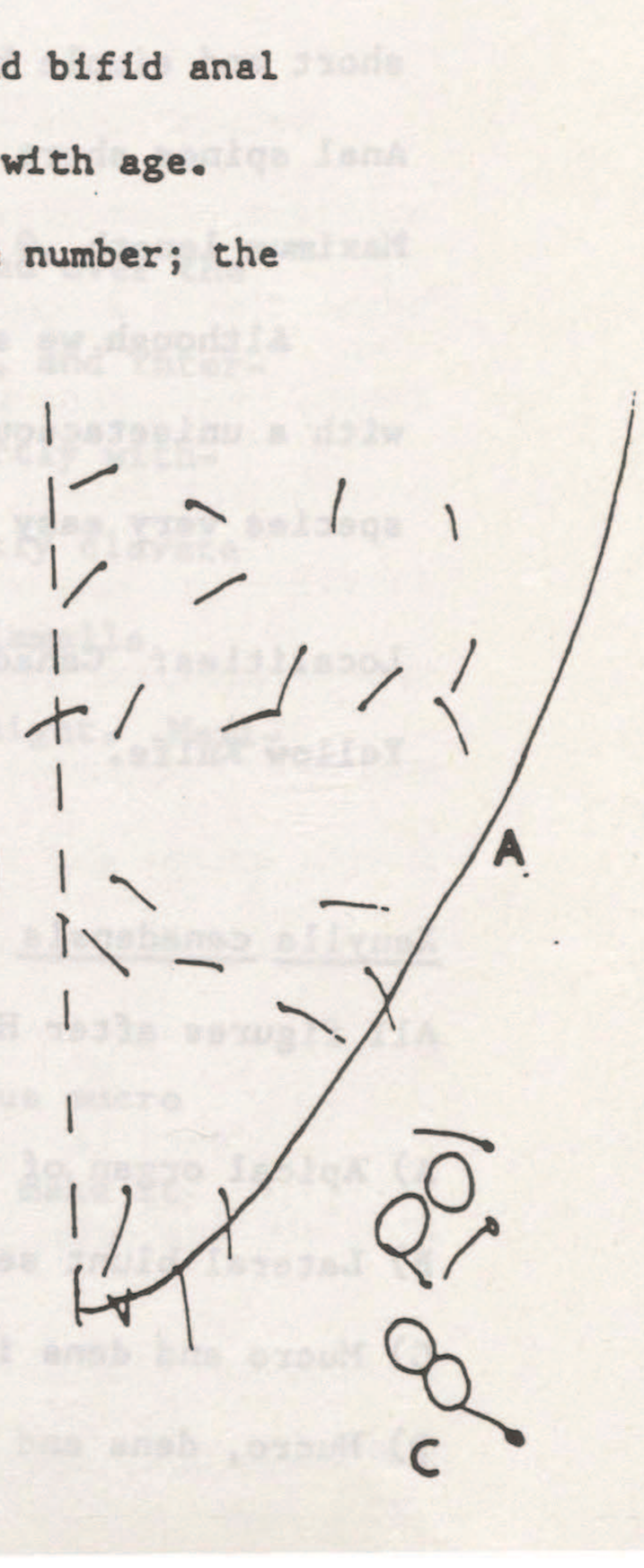
Color: mottled dark blue with intersegmental membranes, scattered spots, and legs pale; head generally lighter than body. Fourth antennal segment with projecting trilobed apical bulb. Each foot with two weakly clavate tenent hairs. Unguis with inner tooth. Mucrodens about twice as long as inner edge of unguis; mucro simple and hooklike, displaced toward dorsal apex of dens, and 1/3 length of dens or less. Anal spines stout, curved, and about half as long as inner edge of hind unguis. Integument uniformly finely granulate. All setae acuminate and smooth. Maximum length 1.2 mm.

Remarks

Juveniles differ in having fewer antennal blunt setae and bifid anal spines; the relative length of the mucro appears to decrease with age. This species differs from all other Nearctic forms in the eye number; the apical antennal bulb and mucro are also unique.

Locality: California - Sequoia National Park (type).

FIGURE 156



Xenylla californica

All figures of specimens from type locality.

A) Dorsal chaetotaxy of right half of last 3 abdominal segments.

B) Ventral chaetotaxy of right half of fourth abdominal segment.

C) Right eyepatch.

(figure continued on next page)

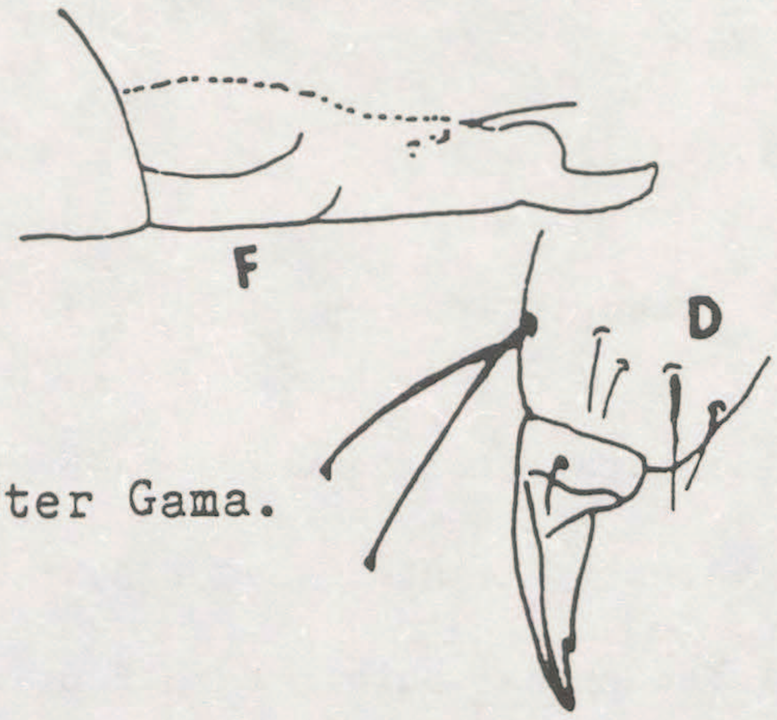
FIGURE 156 (cont')

Xenylla californica

D) Fore foot complex.

E) Apex of antenna.

F) Dens and mucro, after Gama.



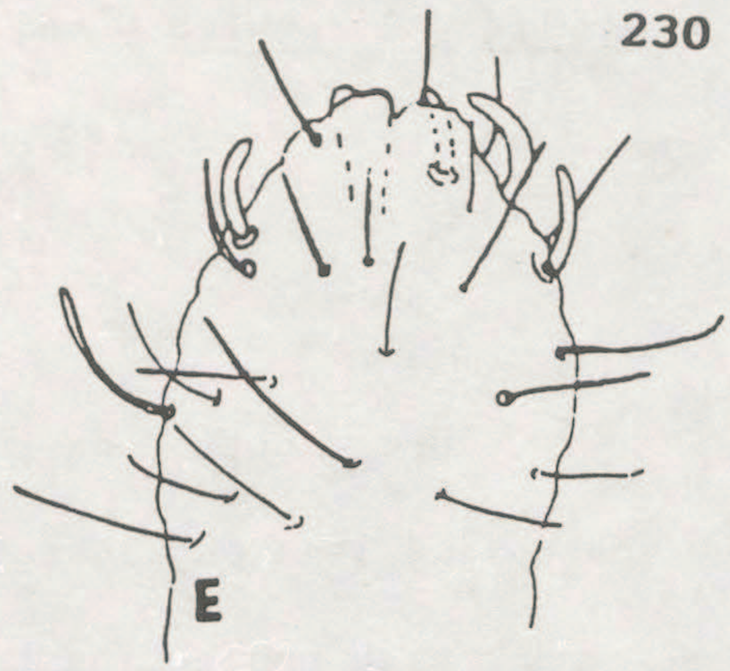


Fig. 157

Xenylla canadensis Hammer, 1953

Original description: Acta arct. 6:20.

Description

Color: blue gray to light lilac, sometimes brownish; pigment in the form of scattered granules with light gray spots. Fourth antennal segment with clear apical bulb. Unguis with a small inner tooth. Each foot with two clavate tenent hairs. Mucrodens barely as long as inner unguis; mucro short and simple but clearly separated from the dens in lateral view. Anal spines short and stout, commonly bifurcate and shorter than mucro. Maximum length .9 mm.

Remarks

Although we saw no specimens, the clearly separate mucro combined with a unisetaceous dens and the 5 blunt antennal setae should make this species very easy to identify.

Localities: Canada: Manitoba - Churchill; N.W.T. - Reindeer Station, Yellow Knife.

FIGURE 157

Xenylla canadensis

All figures after Hammer.

A) Apical organ of third antennal segment.

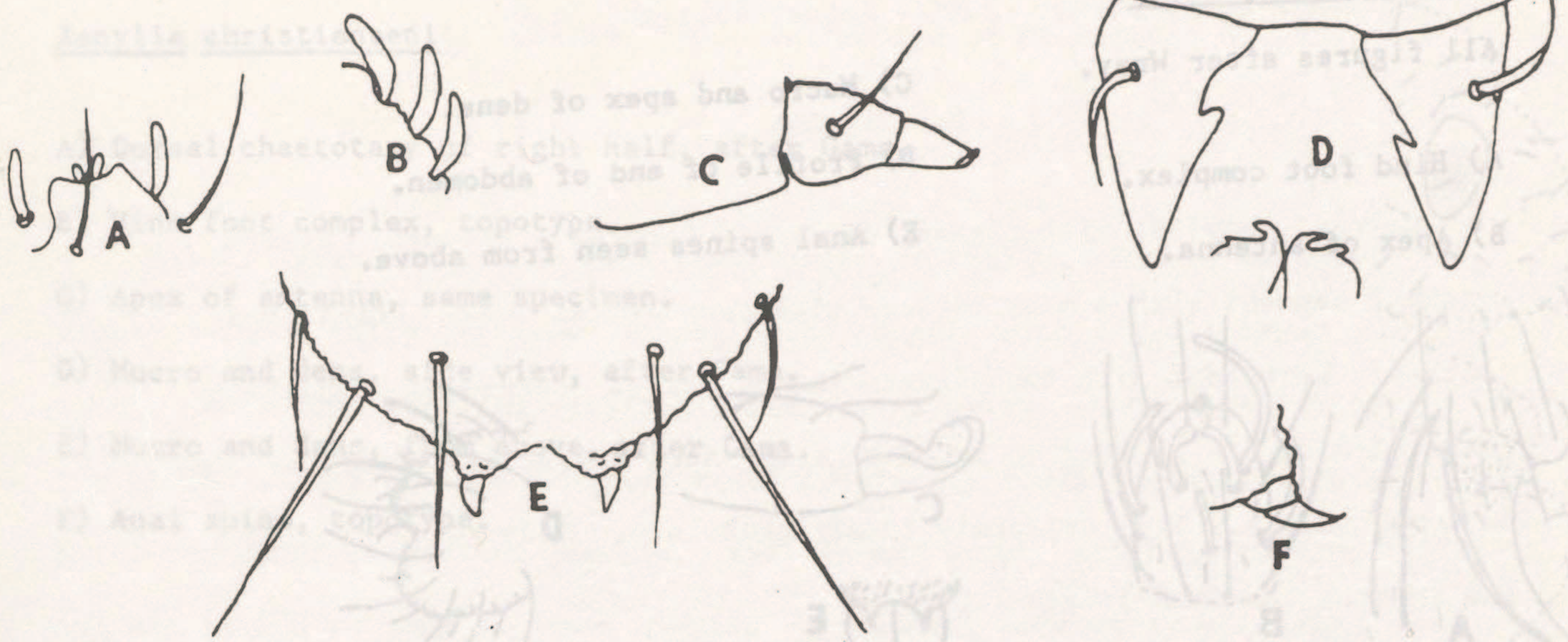
B) Lateral blunt setae of fourth antennal segment.

C) Mucro and dens in profile.

D) Mucro, dens and tenaculum from below.

E) End of the abdomen from above. X. canadensis

F) Anal spine, from side.



Xenylla carolinensis Wray, 1946 Fig. 158

Original description: Bull. Brooklyn ent. Soc. 41:30

Description

Color: bluish to purplish with pigment evenly distributed over the body in the form of semicircular spots; venter, legs, furcula, and intersegmental sutures lighter. Fourth antennal segment with a partly withdrawn apical bulb. Unguis untoothed. Each foot with two weakly clavate tenent hairs. Mucro 3/4 as long as dens, with a broad blunt lamella, indented in the middle. Anal spines small (?) and almost straight. Maximum length .5 mm.

Remarks

Although no specimens of this species were seen, the unique mucro plus the six blunt setae on the fourth antennal segment should make it easy to identify.

Locality: North Carolina - Wake Co. (type).

FIGURE 158

Xenylla carolinensis

All figures after Wray.

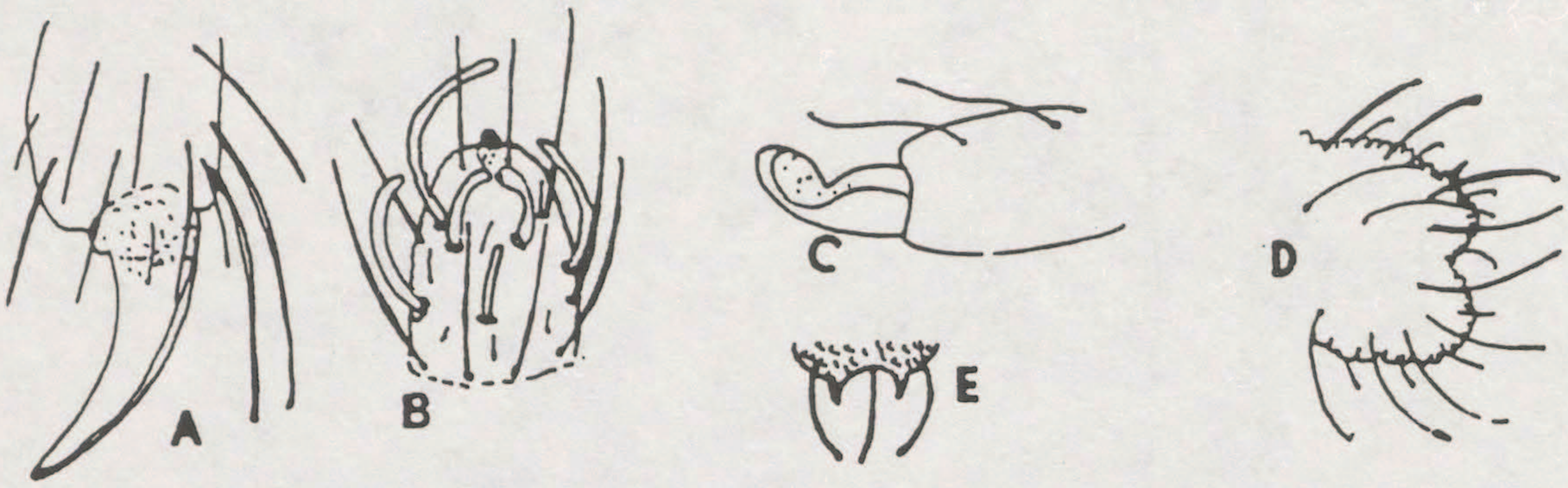
A) Hind foot complex.

B) Apex of antenna.

C) Mucro and apex of dens.

D) Profile of end of abdomen.

E) Anal spines seen from above.



Xenylla christianseni Gama, 1974 Fig. 159

Ref.: Revue suisse Zool. 81:323.

Description

Color: blue to gray with pigment in the form of scattered granules; numerous paler areas present, giving a mottled appearance. Fourth antennal segment with a completely withdrawn apical bulb. Unguis with a clear inner tooth. Each foot with two dorsal and two ventral weakly clavate to acuminate tenent hairs. Mucrodens 1.4 to 1.5 times inner unguis, with a single dorsal seta; mucro completely fused to dens but with a clear lamella. Anal spines slender, straight to gently curved, and 1/2 to 3/4 length of inner unguis. Integument uniformly finely granulate. Body setae acuminate and smooth except for the curved setae on the last two abdominal segments, which are weakly unilaterally serrate. Maximum length 1.0 mm.

Remarks

The peculiar structure of the mucrodens serves to separate this readily from all Nearctic congeners.

Localities: California - Catalina Mts. (type), Fresno Co., San Benito Co., San Diego Co., San Luis Obispo Co.

FIGURE 159

Xenylla christianseni

A) Dorsal chaetotaxy of right half, after Gama.

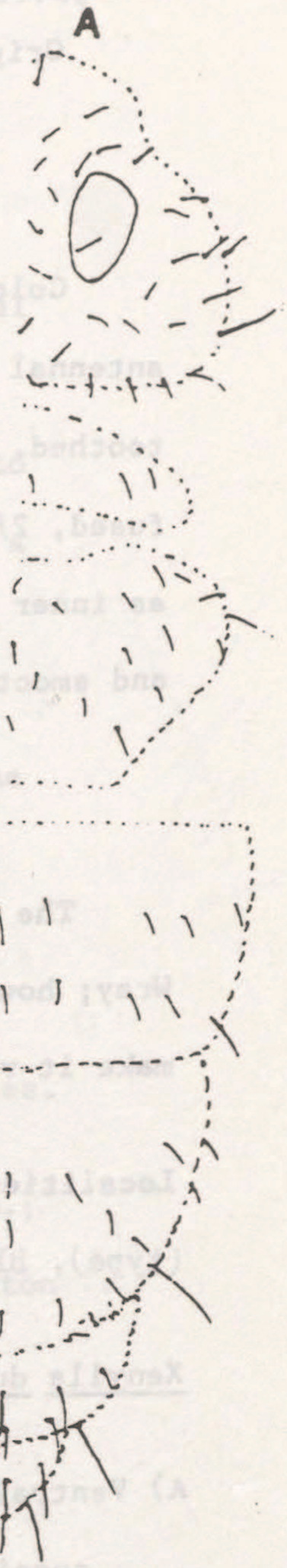
B) Hind foot complex, topotype.

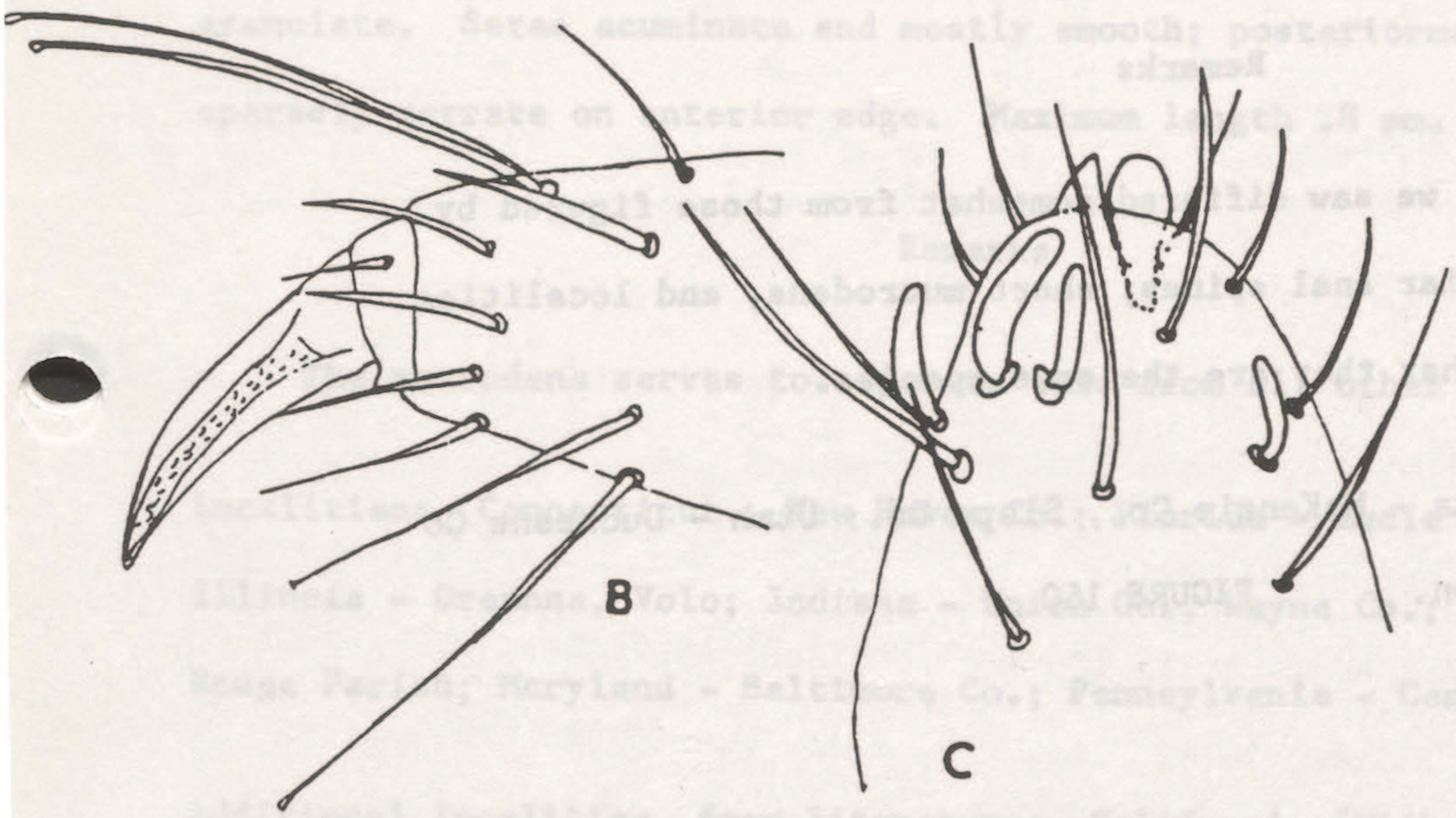
C) Apex of antenna, same specimen.

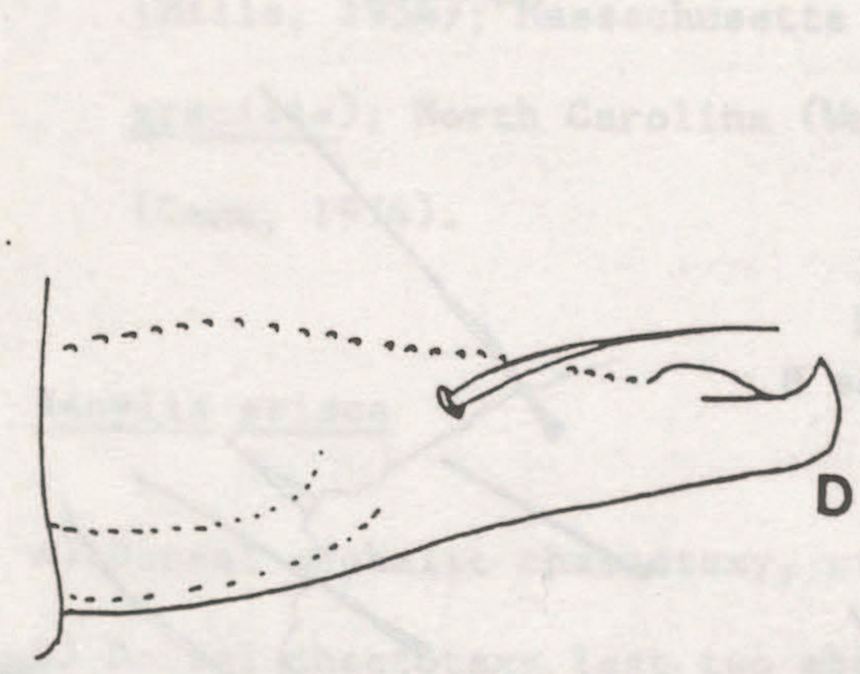
D) Mucro and dens, side view, after Gama.

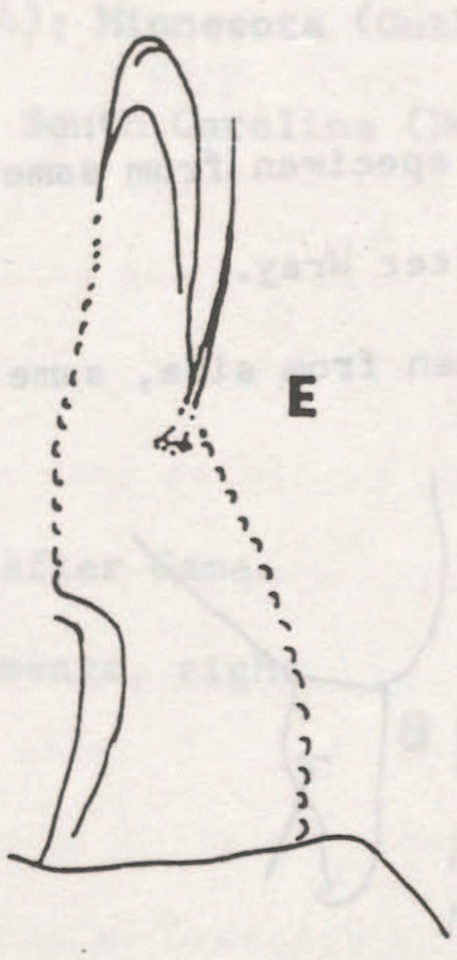
E) Mucro and dens, from above, after Gama.

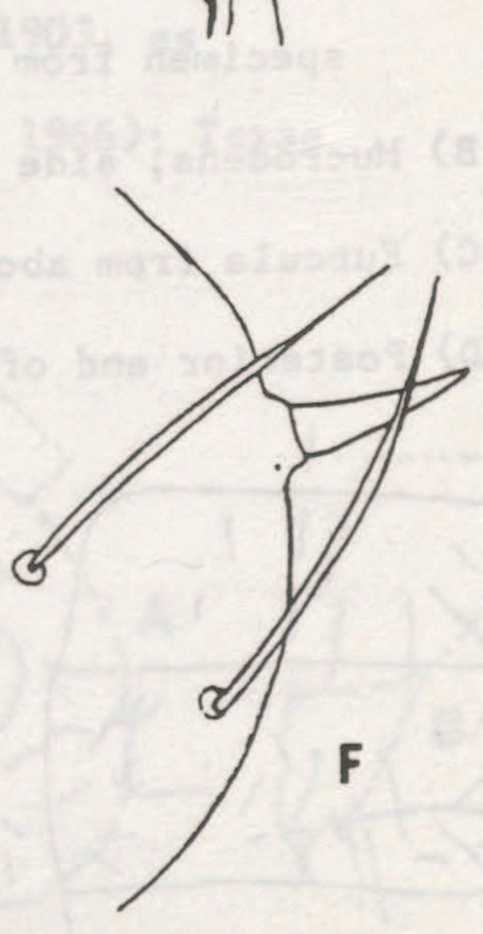
F) Anal spine, topotype.











Xenylla duchesnea Wray, 1958 Fig. 160

Original description: Nature Notes, Raleigh, 2:10.

Description

Color: purplish with pigment dispersed forming a network. Fourth antennal segment with a more or less withdrawn apical bulb. Unguis untoothed. Each foot with two clavate tenent hairs. Mucrodens completely fused, 2/3 to 3/4 as long as inner unguis. Anal spines 1/3 to 1/2 as long as inner unguis. Body uniformly finely granulate. Body setae acuminate and smooth. Maximum length 1.0 mm.

Remarks

The only specimens we saw differed somewhat from those figured by Wray; however the peculiar anal spines, short mucrodens, and localities make it very probable that they are the same species.

Localities: North Dakota - McKenzie Co., Slope Co.; Utah - Duchesne Co (type), Blacksmith Canyon.

FIGURE 160

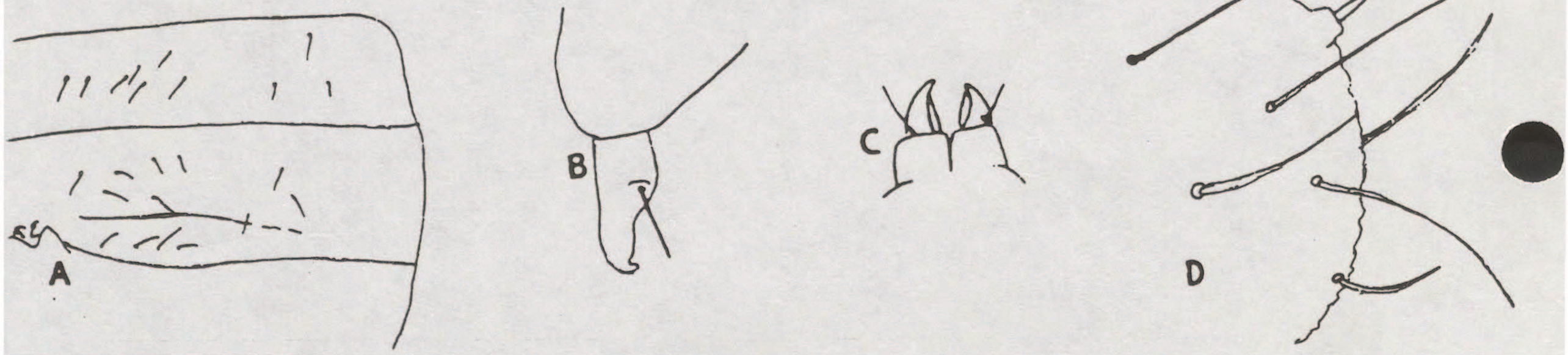
Xenylla duchesnea

A) Ventral chaetotaxy of left half of third and fourth abdominal segments, specimen from Utah.

B) Mucrodens, side view, specimen from same locality.

C) Furcula from above, after Wray.

D) Posterior end of abdomen from side, same specimen as B.



Ref.: Meddn. Soc. Fauna Flora fenn. 26:108; Stach, 1949a; Salmon, 1974.

Synonym: gracilis Guthrie, 1903, Collembola of Minnesota: 40, 95.

Description

Color: grayish blue to dark blue; paler ventrally. Fourth antennal segment with a fully withdrawn apical bulb. Unguis with a small inner tooth. Each foot with two weakly clavate tenent hairs. Mucrodens 1.5 to 2.1 times as long as inner unguis; mucro completely fused to dens, with a small but clear projecting lamella. Anal spines stout, slightly curved, and 1/4 to 2/3 as long as inner unguis. Integument moderately coarsely granulate. Setae acuminate and mostly smooth; posteriormost curved setae sparsely serrate on anterior edge. Maximum length .8 mm.

Remarks

The mucrodens serves to separate this from all other Nearctic species.

Localities: Connecticut - New Haven Co.; Florida - Lucie Co., Monroe Co.; Illinois - Oreanna, Volo; Indiana - Union Co., Wayne Co.; Louisiana - Baton Rouge Parish; Maryland - Baltimore Co.; Pennsylvania - Centre Co..

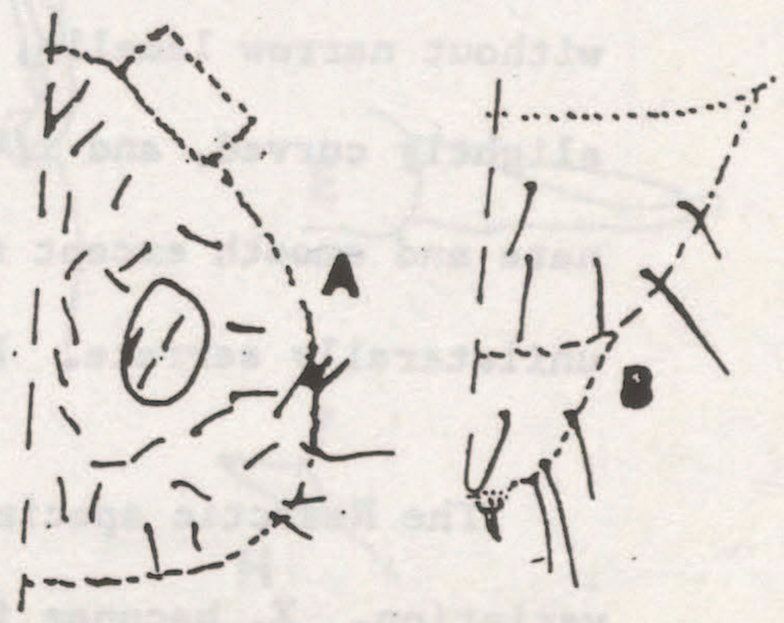
Additional localities, from literature: California (Wilkey, 1959); Iowa (Mills, 1934); Massachusetts (Gama, 1974); Minnesota (Guthrie, 1903, as gracilis); North Carolina (Wray, 1967); South Carolina (DuRant, 1966); Texas (Gama, 1974).

FIGURE 161

Xenylla grisea

A) Dorsal cephalic chaetotaxy, right side, after Gama.

B) Dorsal chaetotaxy, last two abdominal segments, right side, after Gama.

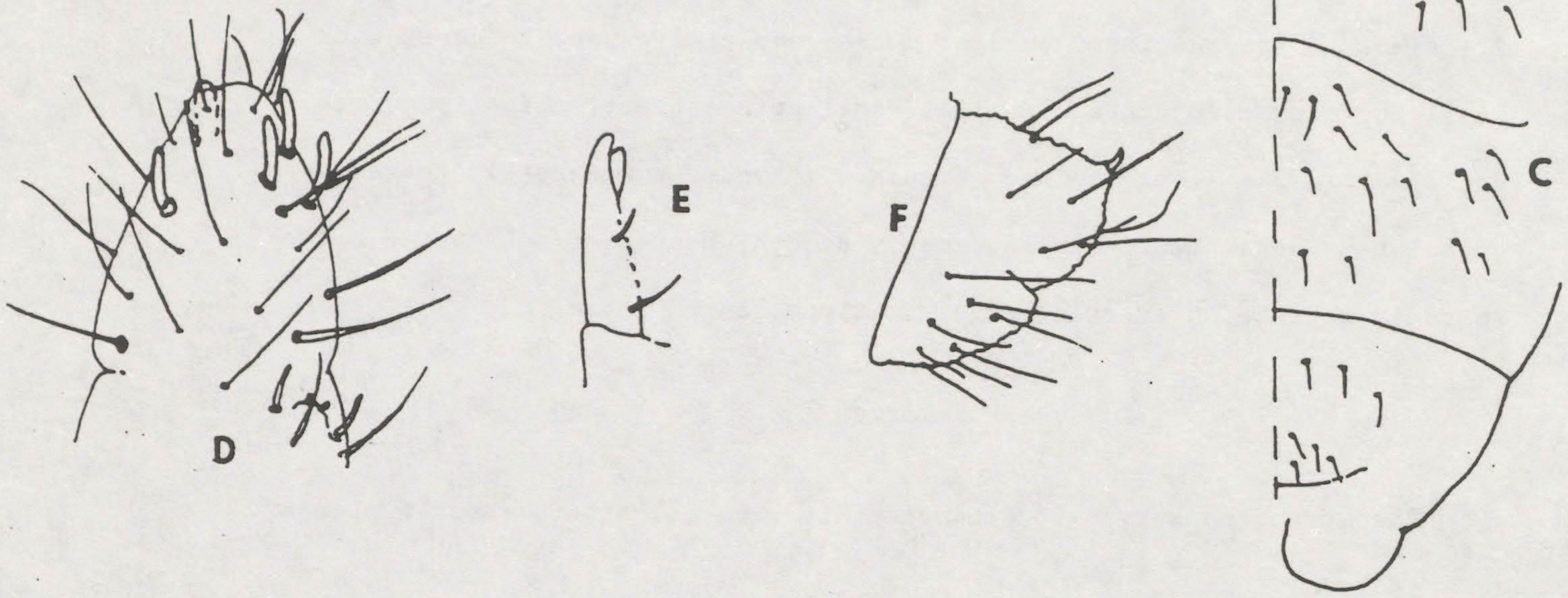


C) Ventral abdominal chaetotaxy, left side, after Gama.

D) Fourth and apex of third antennal segments, after Axelson.

E) Mucro and dens, after Mills.

F) Profile of end of abdomen, after Axelson.



Xenylla humicola (O. Fabricius), 1780 Fig. 162

Refs.: Fauna groenlandica 2:213 (Podura); Folsom, 1916; Strenzke, 1955.

Synonym: baconae Folsom, 1916, Proc. U.S. natn. Mus. 50:496, n.syn.

Description

Color: dark blue, paler ventrally. Fourth antennal segment with a withdrawn apical bulb. Unguis with inner tooth. Each foot with two faintly clavate tenent hairs. Mucro sharply separated from dens, 3/4 to 4/5 length of dens and 1.2 to 1.6 times as long as inner unguis; tapering, with or without narrow lamella, and with distinct ventral tooth. Anal spines short, slightly curved, and 1/4 to 1/8 as long as inner unguis. Body setae acuminate and smooth except for posterior curved setae which are coarsely unilaterally serrate. Maximum length 1.3 mm.

Remarks

The Nearctic specimens referred here to this species show considerable variation. X. baconae is supposed to differ in having longer anal spines,

no mucronal lamellae, and details of chaetotaxy; however, these differences appear to occur in uncoordinated fashion in specimens otherwise placed as humicola. The type of baconae has 2 dental setae (Gama, in Litt.).

Localities: Arizona - Pima Co.; Connecticut - New Haven Co.; Montana - Cascade Co.; Pennsylvania - Centre Co.; Texas - Presidio Co.; Utah - Cache Co.; Washington - Whatcom Co. Alberta - Edmonton; Ontario - Chalk River.

Additional localities, from literature: Indiana (Pedigo, 1970a); Louisiana (Hepburn and Woodring, 1963); Massachusetts (Folsom, 1916); New York (Folsom, 1916); West Virginia (Lippert and Butler, 1976). British Columbia (Spencer, 1948); Manitoba (Hammer, 1953).

Xenylla humicola

FIGURE 162

A) Dorsal chaetotaxy of right half of head and second thoracic segment, after Gama.

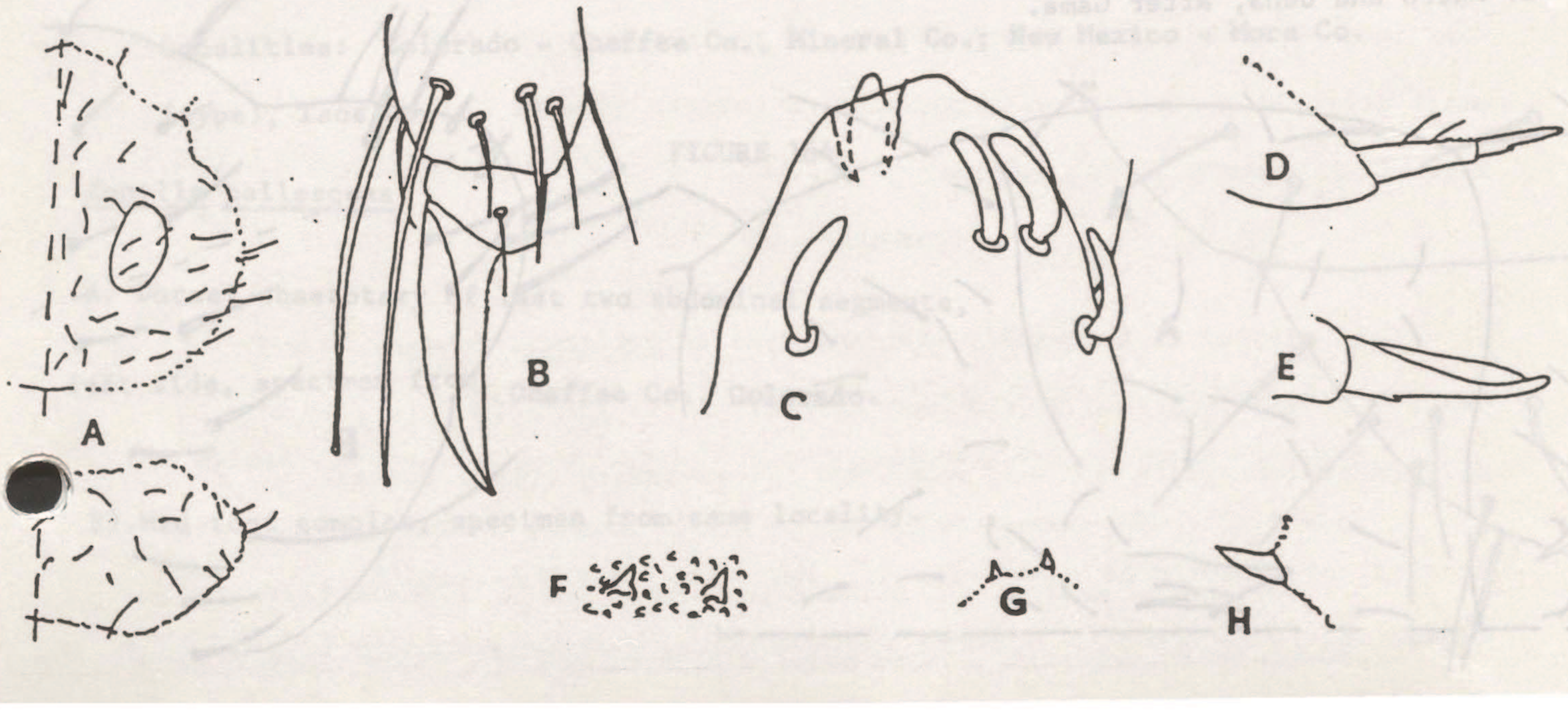
B) Hind foot complex, after Folsom.

C) Blunt setae of fourth antennal segment, specimen from Susquehanna Co., Pennsylvania.

D) Furcula from side, after Folsom.

E) Mucro, after Folsom.

F-H) Anal spines, after Folsom.



Xenylla louisiana Gama, 1976 Fig. 163

Ref.: Revue suisse Zool. 83:323.

Description

Color: blue. Fourth antennal segment with apical bulb. Unguis with a small, distal inner tooth. Each foot with two dorsal and two ventral tenent hairs. Mucro set off from dens ventrally, apically hooked, with large, rounded basal lamella, about .4 times length of dens. Anal spines slender, on weak papillae. Integumentary granulation relatively coarse. Maximum length .83 mm.

Remarks

The combination of two dental setae and two tenacular teeth distinguishes this species from other Nearctic forms. In general morphology and chaetotaxy it appears to be the most primitive of the group of endemic Nearctic species including christianseni, wilsoni, pallescens, and californica.

Localities: Louisiana - Ouachita Par. (type); Mississippi - Tunica Co.

Xenylla louisiana FIGURE 163

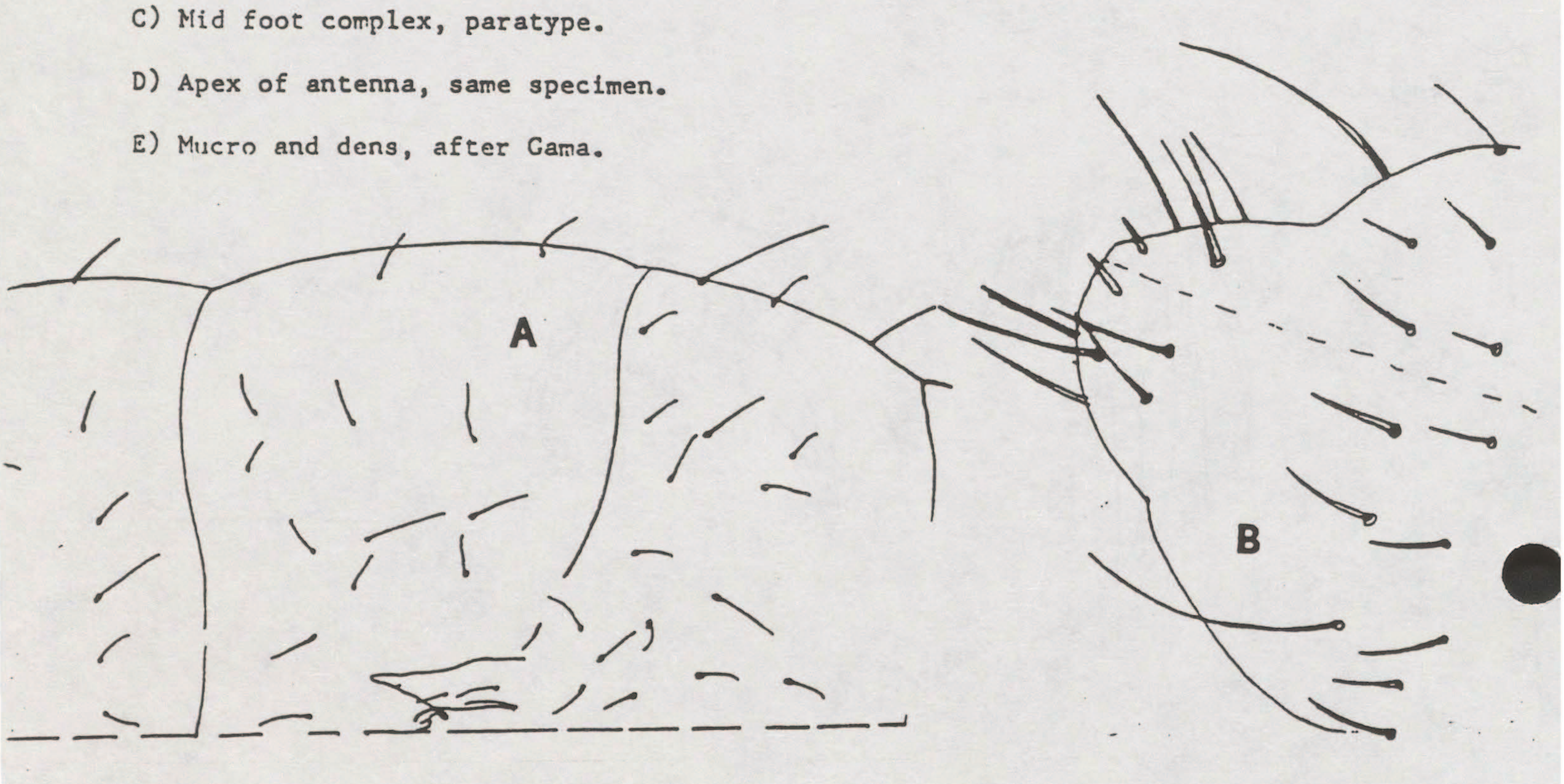
A) Posterior end of abdomen, from angle, paratype.

B) Ventral chaetotaxy of left side, abdominal segments 2 through 4, paratype.

C) Mid foot complex, paratype.

D) Apex of antenna, same specimen.

E) Mucro and dens, after Gama.



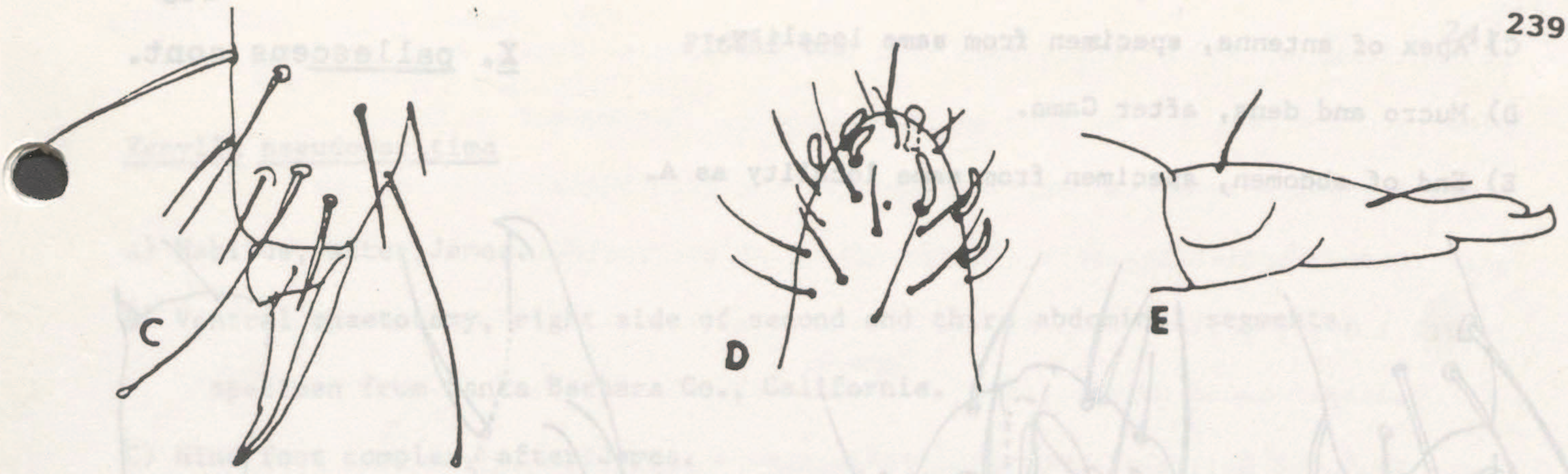


Fig. 164

Xenylla pallescens (Scott, 1960)

Refs.: Ent. News 71:184 (Xenyllodes); Gama, 1974.

Synonym: alpina Scott, 1960, Ent. News 71:184 (Xenyllodes),

Description

Color: pale blue with the pigment in the form of scattered granules. Fourth antennal segment with four sharply differentiated blunt setae and a deeply withdrawn unlobed apical bulb. Unguis with a clear inner tooth. Two weakly clavate to acuminate tenent hairs. Mucrodens completely fused, slightly shorter than inner unguis. Anal spines short, curved, and 1/3 to 2/5 as long as inner unguis. Body covered with uniform fine granulations. Body setae smooth, short, and acuminate. Maximum length 1.0 mm.

Remarks

The short mucrodens and small conical anal spines serve to separate this from all other Nearctic species. The species is close to X. wilsoni.

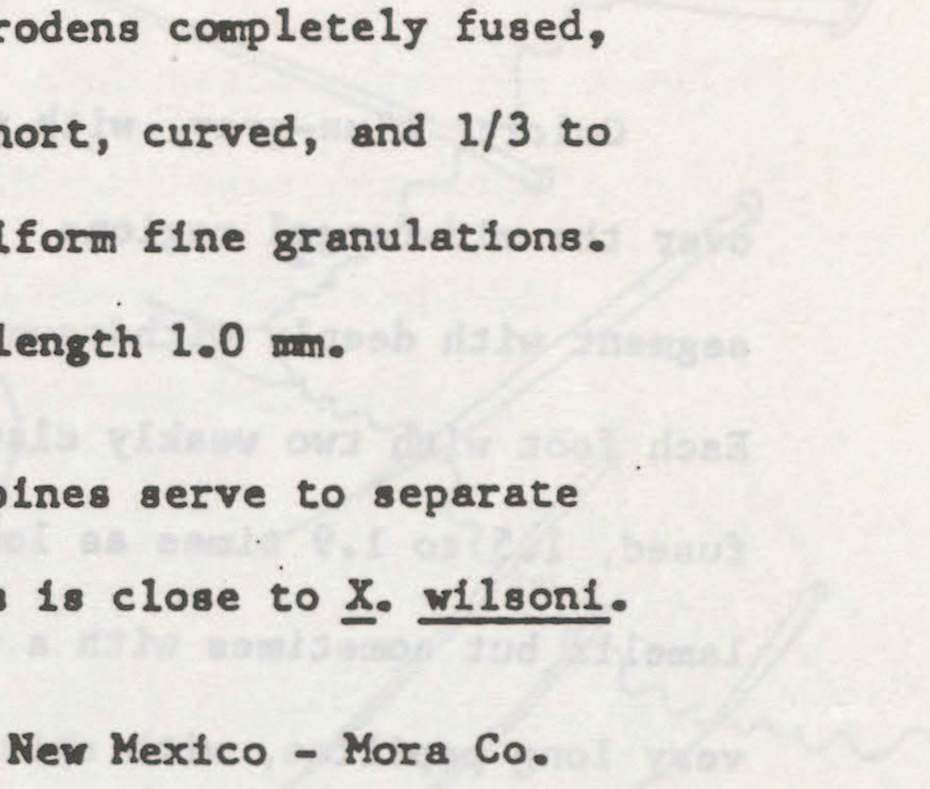
Localities: Colorado - Chaffee Co., Mineral Co.; New Mexico - Mora Co. (type), Taos Co.

FIGURE 164

Xenylla pallescens

A) Dorsal chaetotaxy of last two abdominal segments, left side, specimen from Chaffee Co., Colorado.

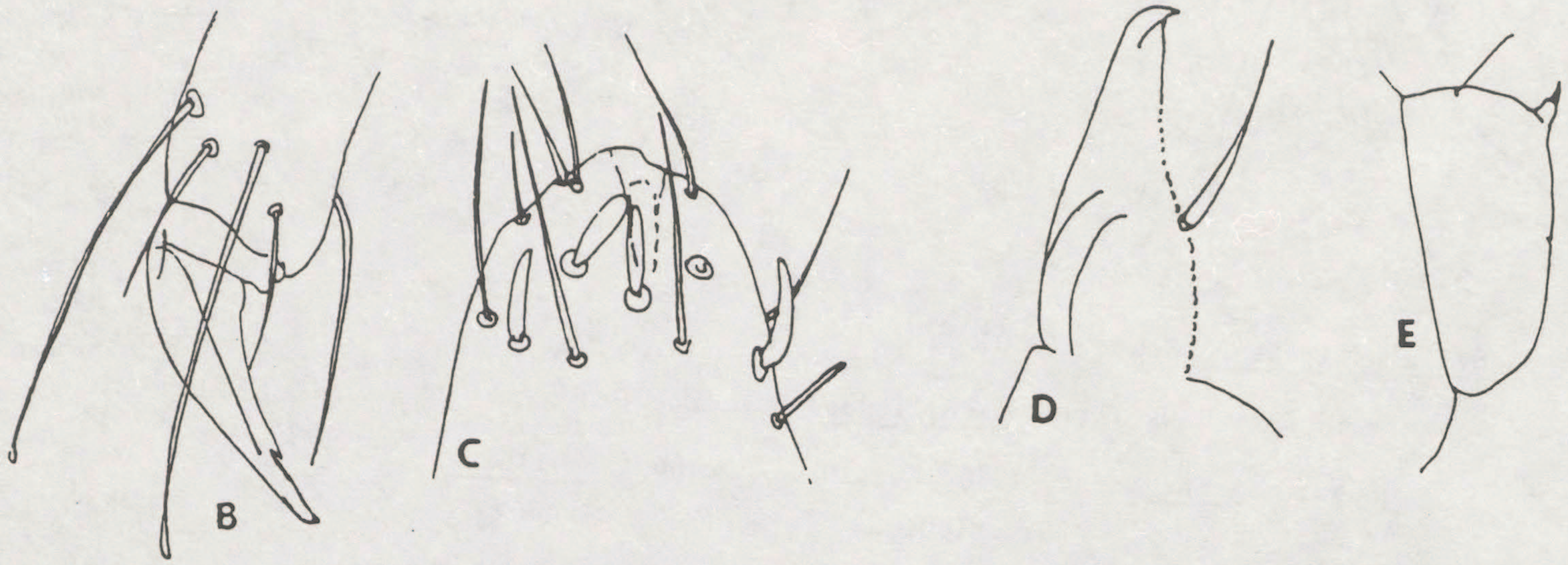
B) Mid foot complex, specimen from same locality.



C) Apex of antenna, specimen from same locality.

D) Mucro and dens, after Gama.

E) End of abdomen, specimen from same locality as A.



Xenylla pseudomaritima James, 1933 Fig. 165

Ref.: Trans. R. Can. Inst. 19:87

Description

Color: blue-gray, with pigment in the form of granules scattered over the mid-tergal regions, giving a striped appearance. Fourth antennal segment with deeply withdrawn apical bulb. Unguis with weak inner tooth. Each foot with two weakly clavate tenent hairs. Mucro and dens completely fused, 1.5 to 1.9 times as long as the inner unguis; mucro usually without lamella but sometimes with a very thin lamella along base. Anal spines on very long papillae, with spines .28 to .40 as long as inner unguis. Integument coarsely granulate, with granulation coarser on last two abdominal segments. Maximum length 1.0 mm.

Remarks

This species is frequently misidentified as maritima; however it may readily be distinguished by the anal spines. It is close to X. grisea but differs strikingly in mucronal shape and integumentary granulations.

Localities: California - Humboldt Co., Marin Co., Santa Barbara Co.; Connecticut - Hartford Co.; Utah - Salt Lake Co., Utah Co. Ontario (type).

FIGURE 165

Xenylla pseudomaritima

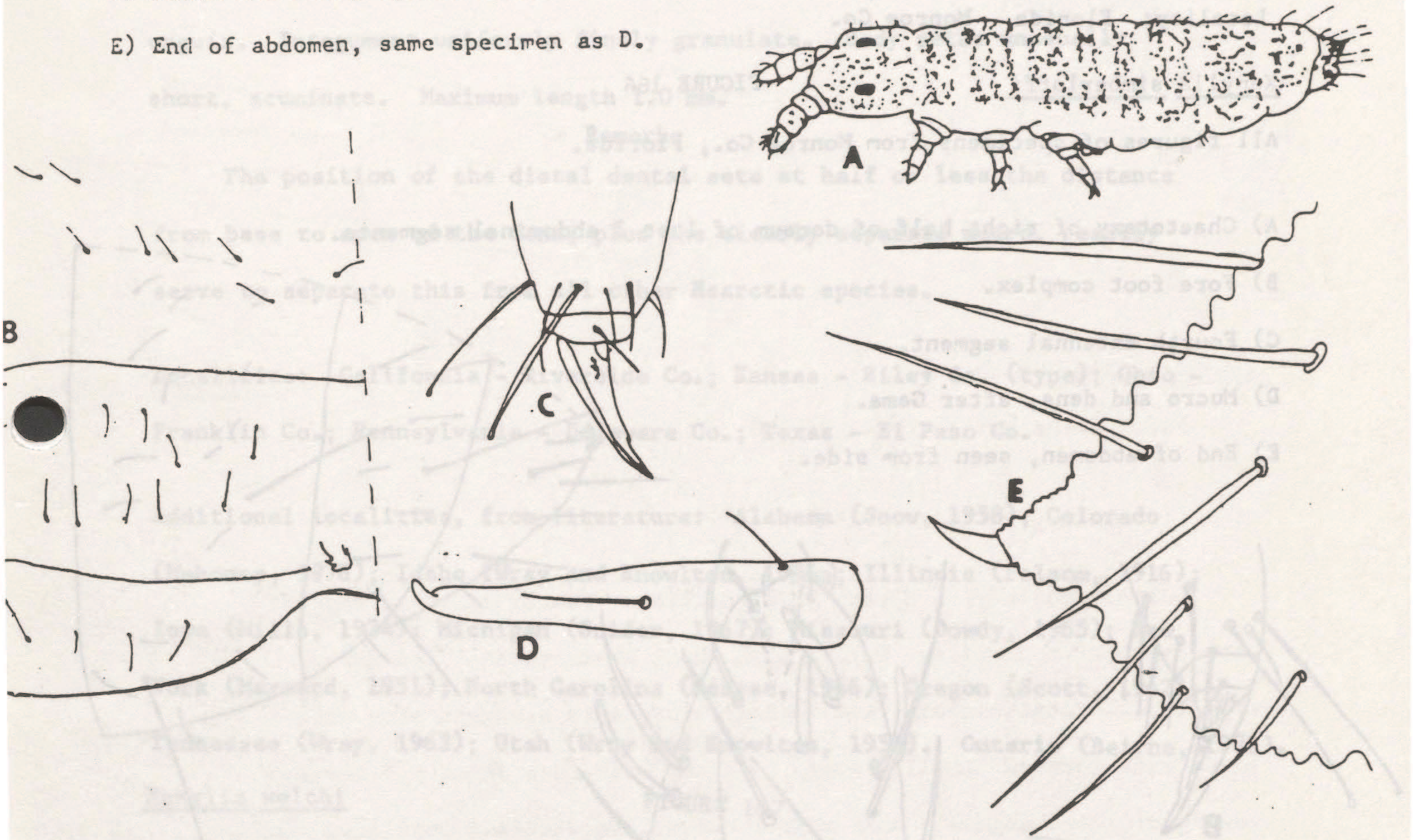
A) Habitus, after James.

B) Ventral chaetotaxy, right side of second and third abdominal segments, specimen from Santa Barbara Co., California.

C) Hind foot complex, after James.

D) Mucro and dens, specimen from same locality as B.

E) End of abdomen, same specimen as D.



Xenylla simberloffi Gama, 1974

Fig. 166

Ref.: Revue suisse Zool. 81:334

Description

Color: medium blue with the pigment uniformly distributed except for scattered circular pale spots. Fourth antennal segment with a deeply withdrawn apical bulb. Unguis with a minute inner tooth. Each foot with two strongly knobbed tenent hairs. Dens about 1 1/3 times as long as inner unguis; mucro sharply demarcated from dens, with a prominent central

curved lamella, and a little less than half as long as dens. Anal spines blunt and conical, 1/6 as long as inner unguis. Integument uniformly finely granulate. Setae mostly acuminate, but the longest setae on the posterior abdominal segments are curved and slightly clavate. Maximum length 1.0 mm.

Remarks

This very well marked species is probably primarily neotropical.

Locality: Florida - Monroe Co.

Xenylla simberloffi FIGURE 166

All figures of specimens from Monroe Co., Florida.

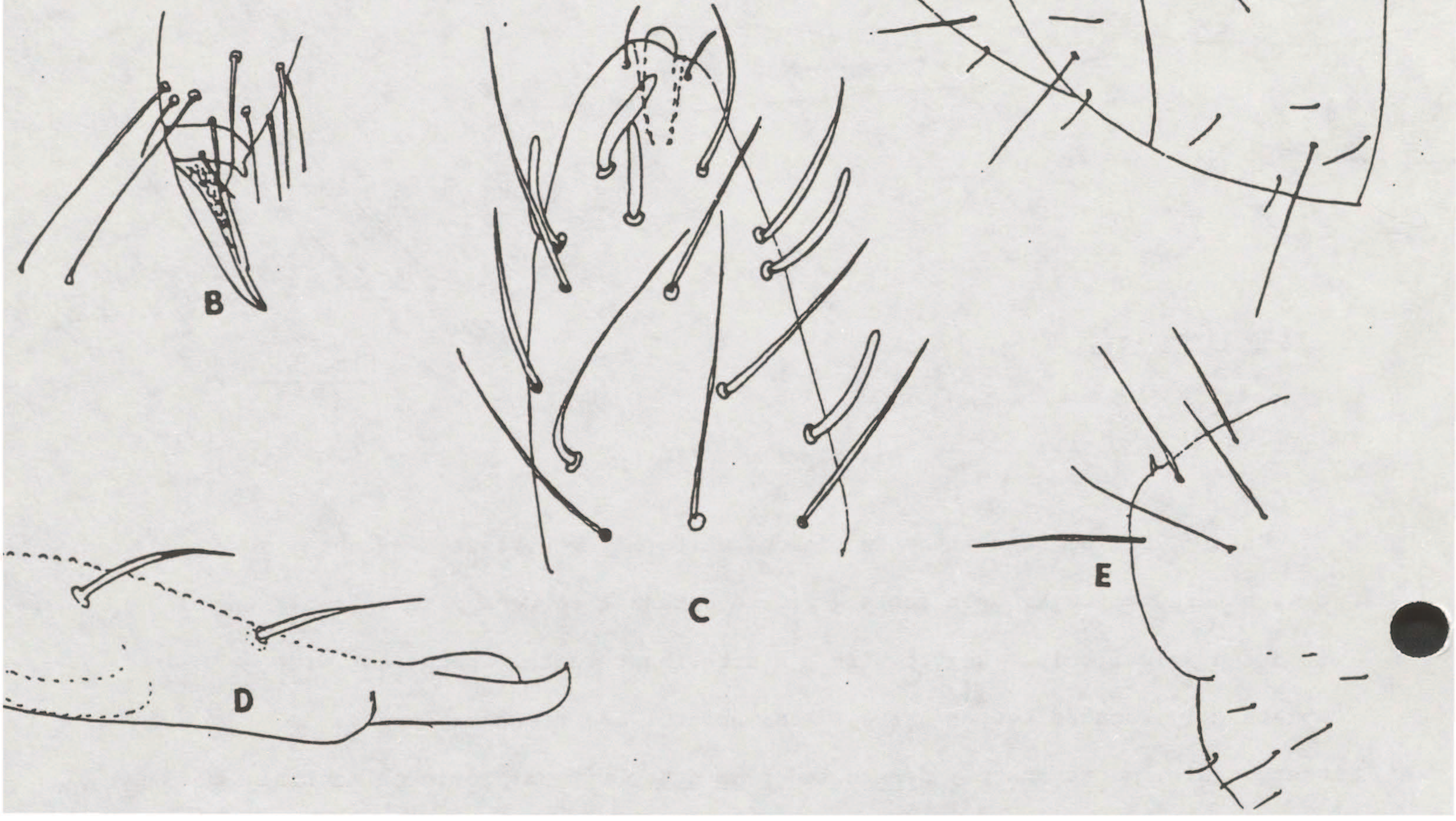
A) Chaetotaxy of right half of dorsum of last 3 abdominal segments.

B) Fore foot complex.

C) Fourth antennal segment.

D) Mucro and dens, after Gama.

E) End of abdomen, seen from side.



Xenylla welchi Folsom, 1916 Fig. 167

Ref.: Proc. U.S. natn. Mus. 50:447

Description

Color: pale violet or grayish with mottled pigment. Fourth antennal segment with deeply withdrawn apical bulb. Unguis with small inner tooth or toothless. Tenent hairs clearly clavate, one on first legs, two on second and third. Mucro clearly demarcated from dens, with broad lamella from base to apex, and slightly shorter than inner unguis and .6 to .7 as long as dens. Anal spines stout and minute, 1/6 or less as long as inner unguis. Integument uniformly finely granulate. Body setae unusually short, acuminate. Maximum length 1.0 mm.

Remarks

The position of the distal dental seta at half or less the distance from base to apex of the dens, plus the clearly separate mucro, readily serve to separate this from all other Nearctic species.

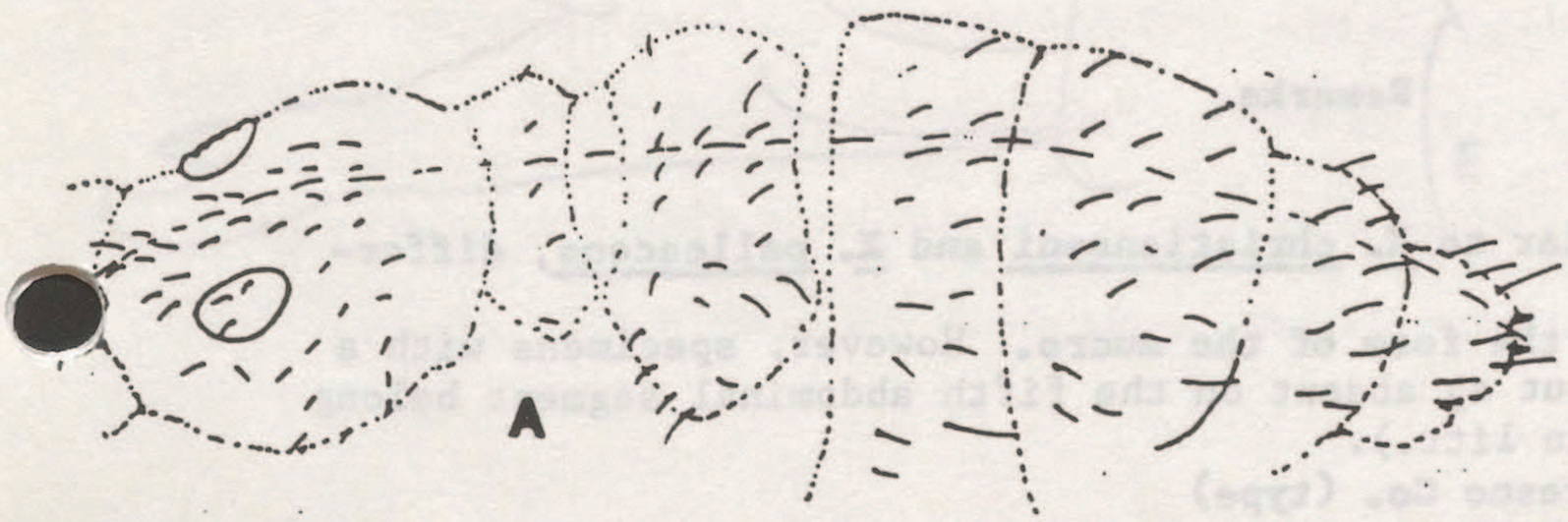
Localities: California - Riverside Co.; Kansas - Riley Co. (type); Ohio - Franklin Co.; Pennsylvania - Delaware Co.; Texas - El Paso Co.

Additional localities, from literature: Alabama (Snow, 1958); Colorado (Mahoney, 1976); Idaho (Wray and Knowlton, 1956a); Illinois (Folsom, 1916); Iowa (Mills, 1934); Michigan (Snider, 1967); Missouri (Dowdy, 1965); New York (Maynard, 1951); North Carolina (Pearse, 1946); Oregon (Scott, 1942); Tennessee (Wray, 1963); Utah (Wray and Knowlton, 1953). Ontario (Beirne, 1972).

Xenylla welchi FIGURE 167

A) Dorsal chaetotaxy, after Gama.

B) Ventral cephalic chaetotaxy, after Gama.





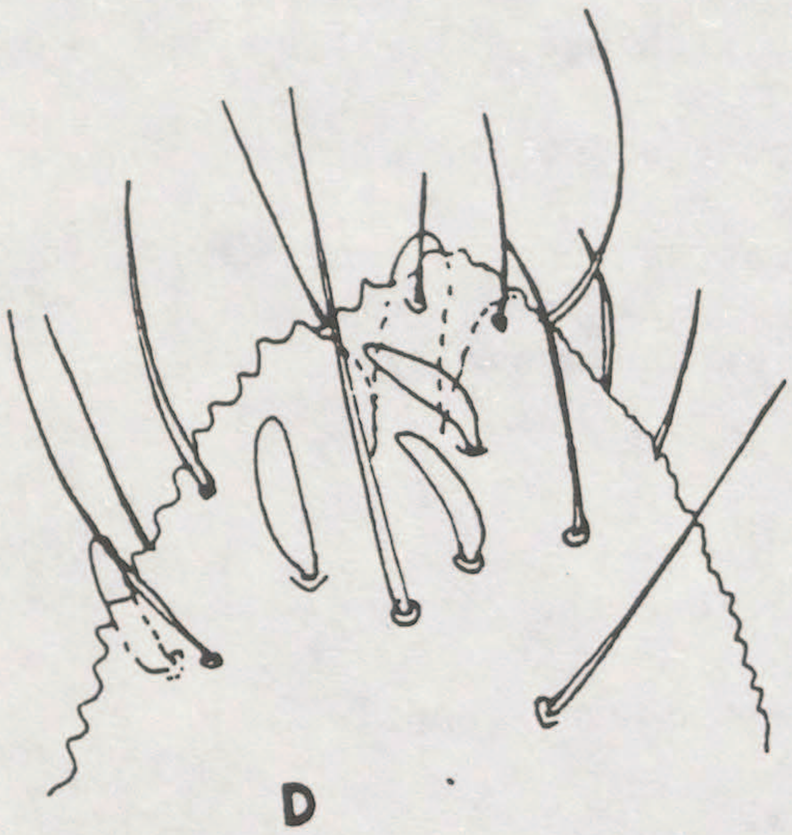
C) Hind foot complex, after Folsom.

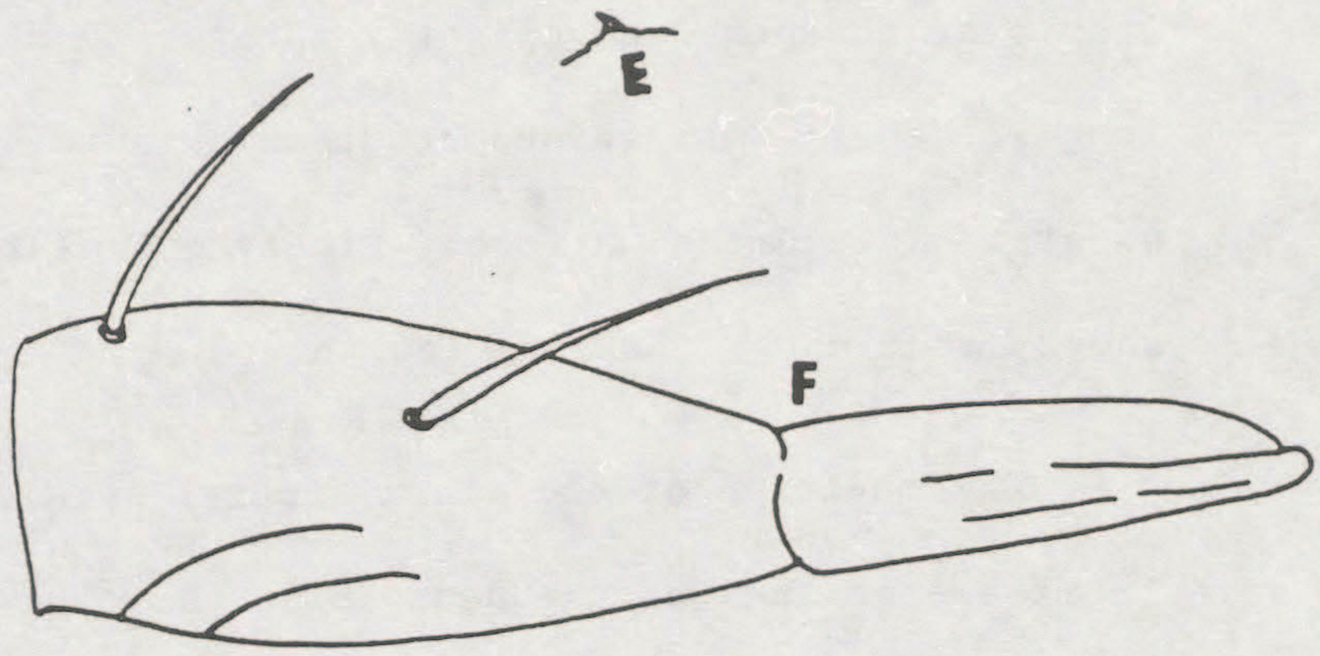
D) Apex of antenna, specimen from El Paso Co., Texas.

E) Anal spine, after Folsom.

F) Mucro and dens, specimen from Riverside Co., California.







Xenylla wilsoni Gama, 1974

Fig. 168

Ref.: Revue suisse Zool. 81:326

Description

Color: white with dorsal blue mottling. Fourth antennal segment with retractile papilla. Unguis with small inner tooth. Two dorsal tibiotarsal setae clavate; two ventral setae more elongate than others. Mucro with toothed lamella, fused to dens; mucrodens about 1.7 times length of third unguis. Anal spines curved, on distinct papillae. Integumentary granulation relatively coarse. Body setae smooth, short, and acuminate. Maximum length .95 mm.

Remarks

This species is similar to X. christianseni and X. pallescens, differing most conspicuously in the form of the mucro. However, specimens with a rounded mucronal lamella but a_2 absent on the fifth abdominal segment belong here, according to Gama (in litt.).

Locality: California - Fresno Co. (type)

FIGURE 168

Xenylla wilsoni

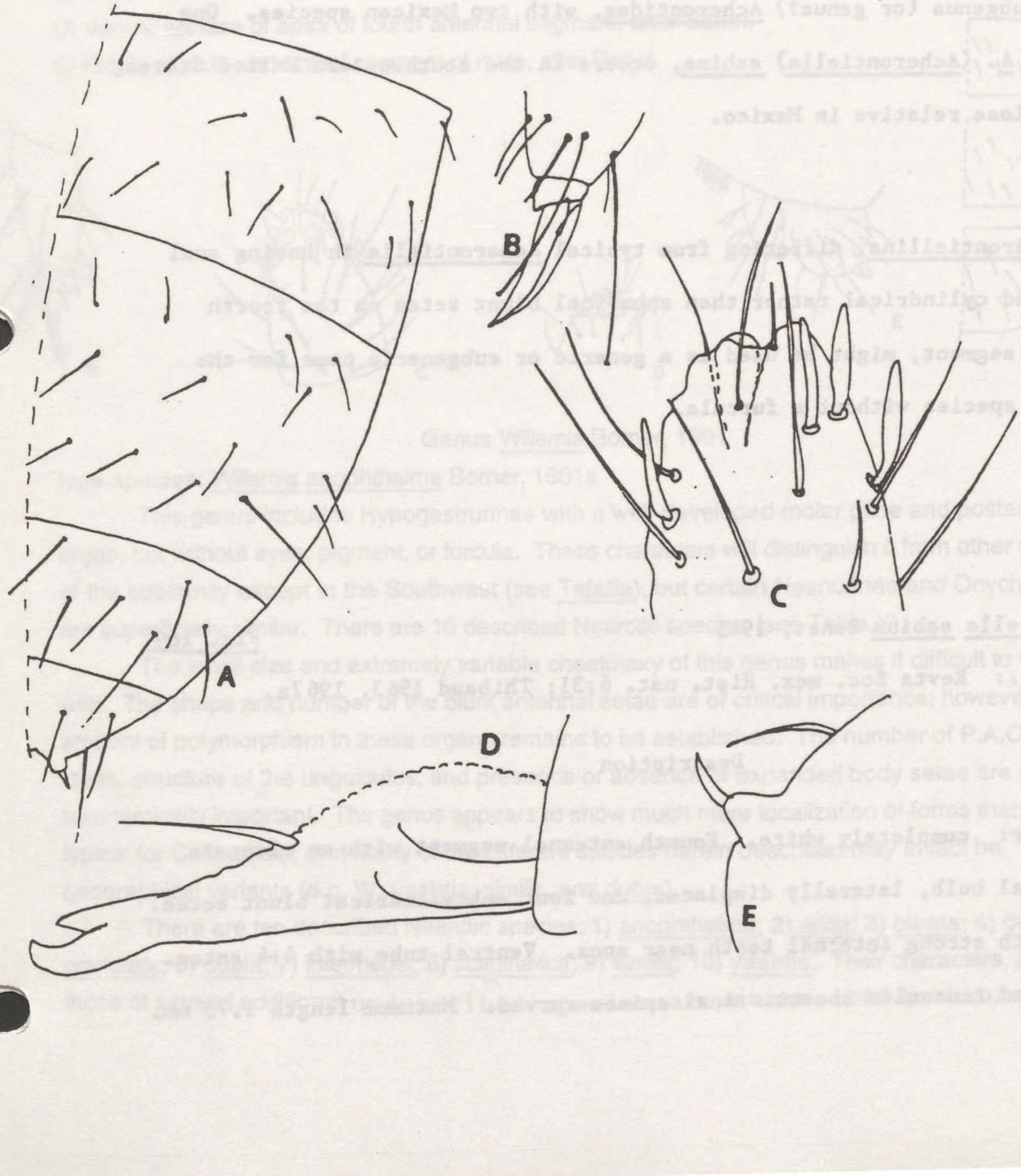
A) Dorsal chaetotaxy of right side of last 4 abdominal segments, paratype.

B) Fore foot complex, paratype.

C) Apex of antenna, paratype.

D) Mucro and dens, after Gama.

E) Anal spine, paratype.



Type species: onychiuriformis Absolon, 1913

Syn.: Acherontiellina Salmon, 1964; type species Acherontiella sabina Bonet, 1945.

This genus includes Hypogastrurinae with a well-developed molar plate, but without eyes, pigment, or postantennal organ; the last character distinguishes it from Willemia. The genus is probably derived from Xenylla; the furcula is absent in the typical subgenus, but present, though reduced, in the subgenus (or genus?) Acherontides, with two Mexican species. One species, A. (Acherontiella) sabina, occurs in the southwestern United States, with a close relative in Mexico.

Acherontiellina, differing from typical Acherontiella in having anal spines and cylindrical rather than spherical blunt setae on the fourth antennal segment, might be used as a generic or subgeneric name for the American species without a furcula.

Acherontiella sabina Bonet, 1945 Fig. 169

Refs.: Revta Soc. mex. Hist. nat. 6:31; Thibaud 1963, 1967a.

Description

Color: completely white. Fourth antennal segment with an elongate oval apical bulb, laterally displaced, and four subcylindrical blunt setae. Unguis with strong internal tooth near apex. Ventral tube with 4+4 setae. Furcula and tenaculum absent. Anal spines curved. Maximum length 1.75 mm.

Remarks

This well-marked species is the only member of the genus Acherontiella so far reported from this region. The lack of a postantennal organ serves to separate it from the superficially similar Willemia spp. the chaetotaxy is extremely variable, particularly on the thoracic segments.

Localities: New Mexico - Santa Fe Co. (Kangaroo Rat nests).

Also recorded from Mexico.

Acherontiella sabina Figure 169

A) Chaetotaxy of right half of second thoracic and third through fifth abdominal segments, specimen from New Mexico.

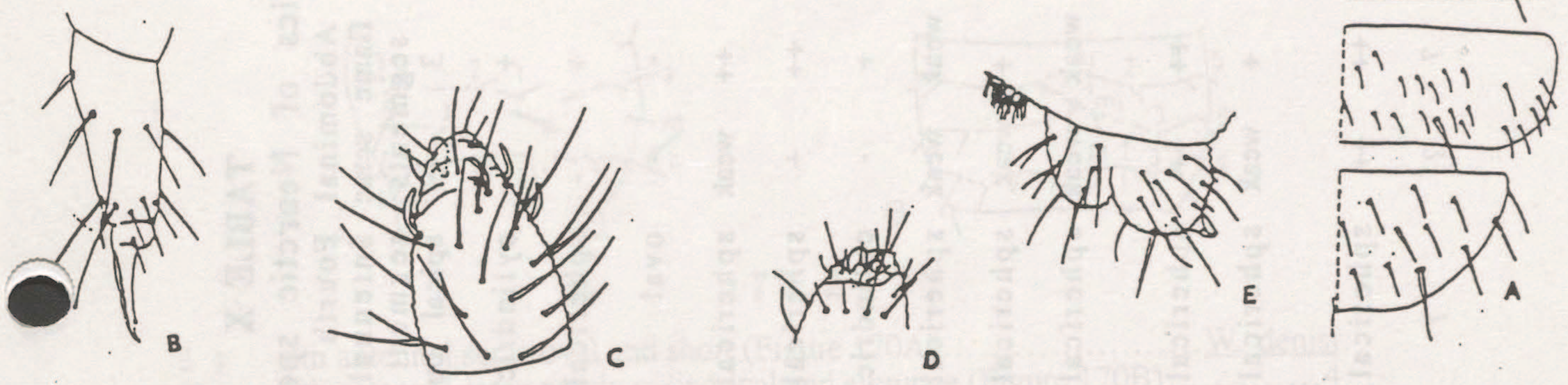
B) Hind foot complex, after Bonet.

C) Dorsal surface of fourth antennal segment, after Bonet.

D) Ventral surface of apex of fourth antennal segment; after Bonet.

E) Profile of sixth abdominal segment of male, after Bonet.





Genus Willemia Borner, 1901

type species: Willemia anophthalma Borner, 1901a

This genus includes Hypogastrurinae with a well-developed molar plate and postantennal organ, but without eyes, pigment, or furcula. These characters will distinguish it from other genera of the subfamily except in the Southwest (see Tafallia), but certain Neanurinae and Onychiurinae are superficially similar. There are 10 described Nearctic species (see Table X).

The small size and extremely variable chaetotaxy of this genus makes it difficult to work with. The shape and number of the blunt antennal setae are of critical importance; however, the amount of polymorphism in these organs remains to be established. The number of P.A.O. lobes, structure of the unguiculus, and presence or absence of expanded body setae are also taxonomically important. The genus appears to show much more localization of forms than is typical for Collembola, and many of the different species herein described may in fact be geographical variants (e.g. W. vashtia, similis, and dubia).

There are ten described Nearctic species: 1) anophthalma; 2) arida; 3) biseta; 4) denisi; 5) granulata; 6) dubia; 7) intermedia; 8) scadinavica; 9) similis; 10) vashtia. Their characters, and those of several additional undescribed species are summarized in table X.

TABLE X

Characteristics of Nearctic species of Willemia

species	Anal spines	Fourth antennal segment blunt setae	P.A.O. lobes	Abdominal flame setae segments 3	Abdominal flame setae segments 4	Fourth antennal segment apical bulb	Fourth abdominal segment seta M_1	Unguiculus	Number of fourth antennal segment blunt setae	unguiculus inner unguis
anopthalma	+	cylindrical slender	5	+	-	cylindrical	+	filiform	5	.3 - .6
arida	-	broadly oval	4	+	-	spherical	+	filiform	2	?
biseta	+,-	cylindrical thick	4	-	-	oval	+	filiform	2	< .33
denisi	-	broadly oval	4	++	weak	spherical	-	basally swollen	5	≈ .33
dubia	+	cylindrical thick	3 - 6	++	+	spherical	-	basally swollen	5 - 6	≈ .6
granulata	-	ovoid to cylindrical	4	+	-	cylindrical	+	filiform	2	≈ .5
intermedia	+	cylindrical slender	4	weak	weak	spherical	+,-	basally swollen	2 - 3	.4 - .6
scandinavica	+	cylindrical	6 - 12	+	weak	spherical	-	basally swollen	4 - 5	≈ .6
similis	+	cylindrical thick	6 - 12	weak	weak	spherical	+	filiform to base swollen	6	.5
vashtia	+	cylindrical thick	6 - 7	++	+	spherical	+	basally swollen	5 - 6	.3 - .5
Sp. A (North Dakota)	+	cylindrical thick	4	+	weak	spherical	-	filiform	3	.5
Sp. B (Kentucky)	+	cylindrical thick	12	++	++	spherical	+	basally expanded	6	.26
Sp. near denisi	-	broadly oval, acuminate	(3) 4	?	?	?	+	?	4	?

+ = present & normal, ++ = strong

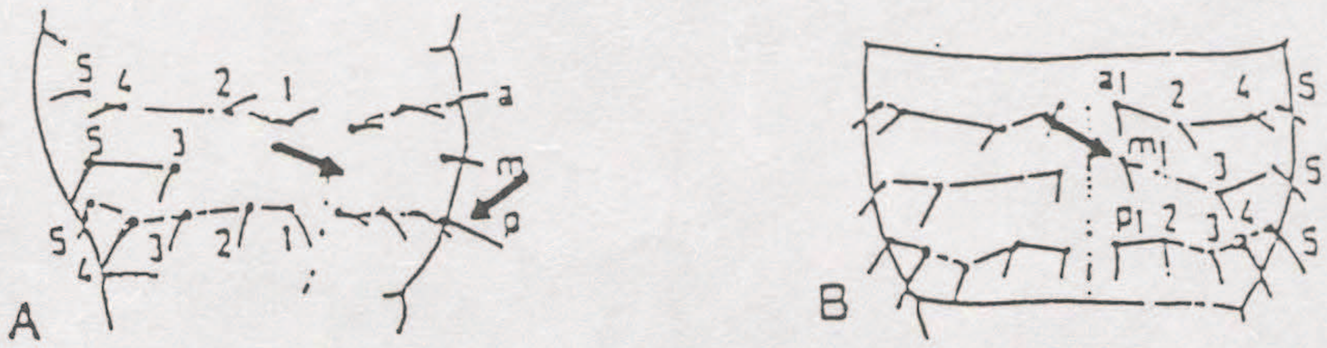
Key to described Nearctic species of Willemia

1) P.A.O. lobes with papillae (Figure 170.1).....8
1') P.A.O. lobes smooth.....2



170.1

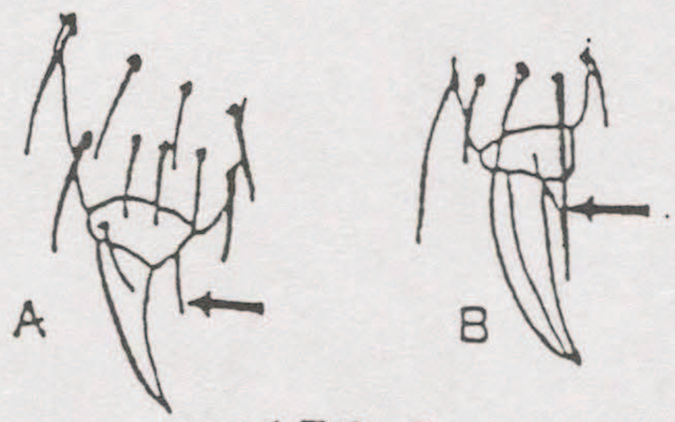
2) Abdominal segment IV with seta M_1 absent (Figure 170.2A).....3
2') Abdominal segment IV with seta M_1 present (Figure 170.2B).....5



170.2

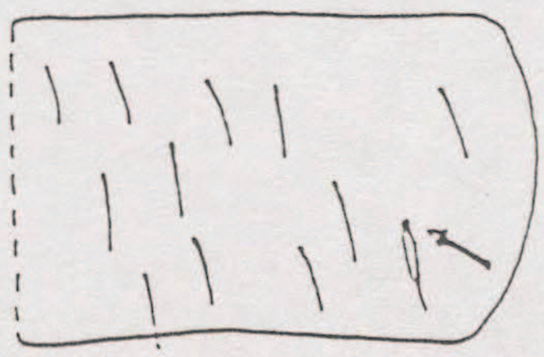
3) 4th antennal setae oval and short (Figure 170A).....W. denisi
3') 4th antennal setae nearly cylindrical and elongate (Figure 170B).....4

4) Seta P_4 or P_5 on abdominal segment IV flame-like (Figure 170.4). W. dubia
4') Seta P_4 and P_5 on abdominal segment IV normal (Figure 170.2A).....
.....W. scandinavica Stach, 1949a



170.3

5) 2-3 blunt setae on 4th antennal segment 6
5') 5-6 blunt setae on 4th antennal segment 7



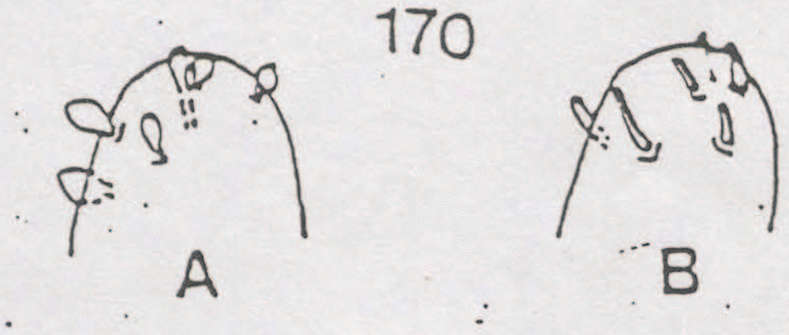
170.4

6) Unguiculus filiform (Figure 170.3A) ..... W. biseta
6') Unguiculus basally expanded (Figure 170.3B)..... W. intermedia

7) P.A.O. usually with 4-5 lobes ..... W. anophthalma
7') P.A.O. with 6 or more lobes..... W. similis group (including vashtia)[1]

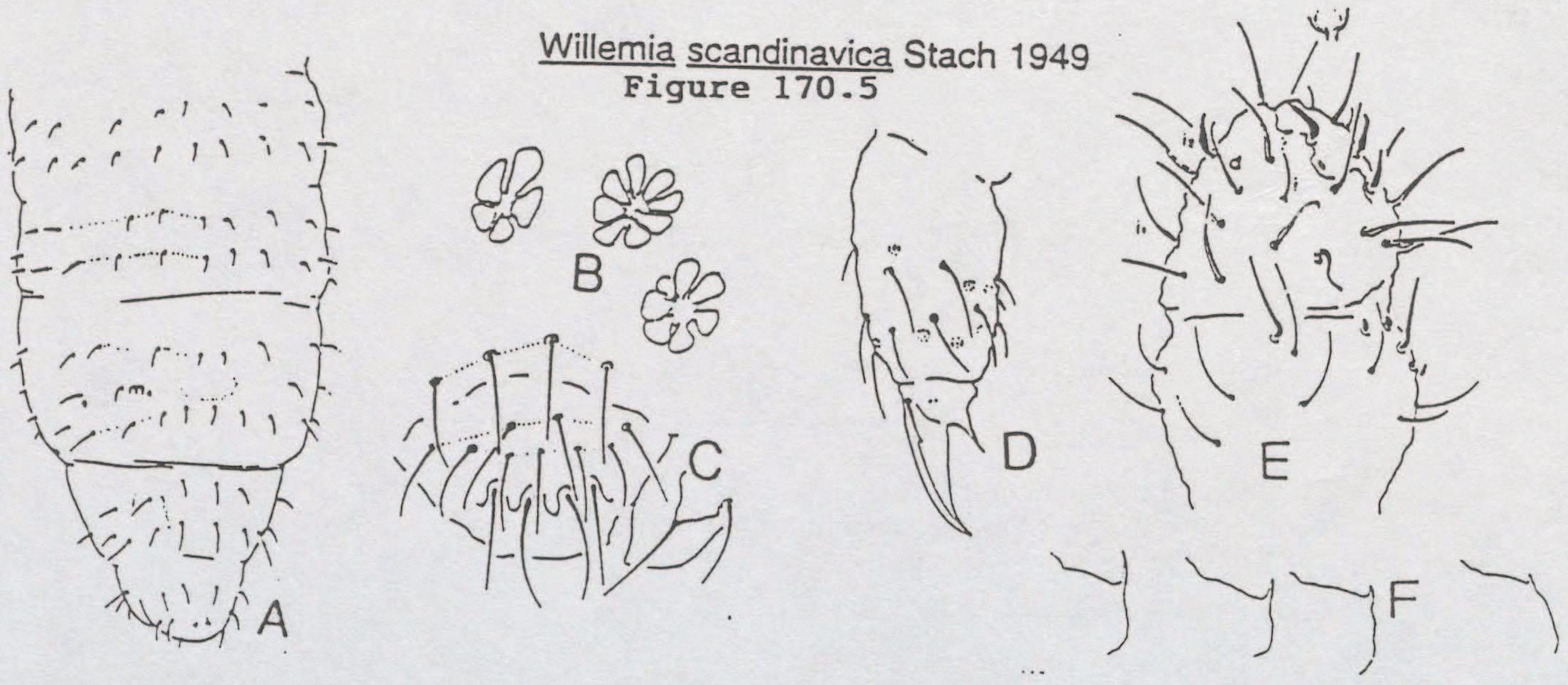
8) 4th antennal segment blunt setae broadly oval to spherical (Figure 170A) ...
..... W. arida Fjellberg, 1991
8') 4th antennal segment blunt setae nearly cylindrical (Figure 170B) .....
..... W. granulata Fjellberg, 1985

170



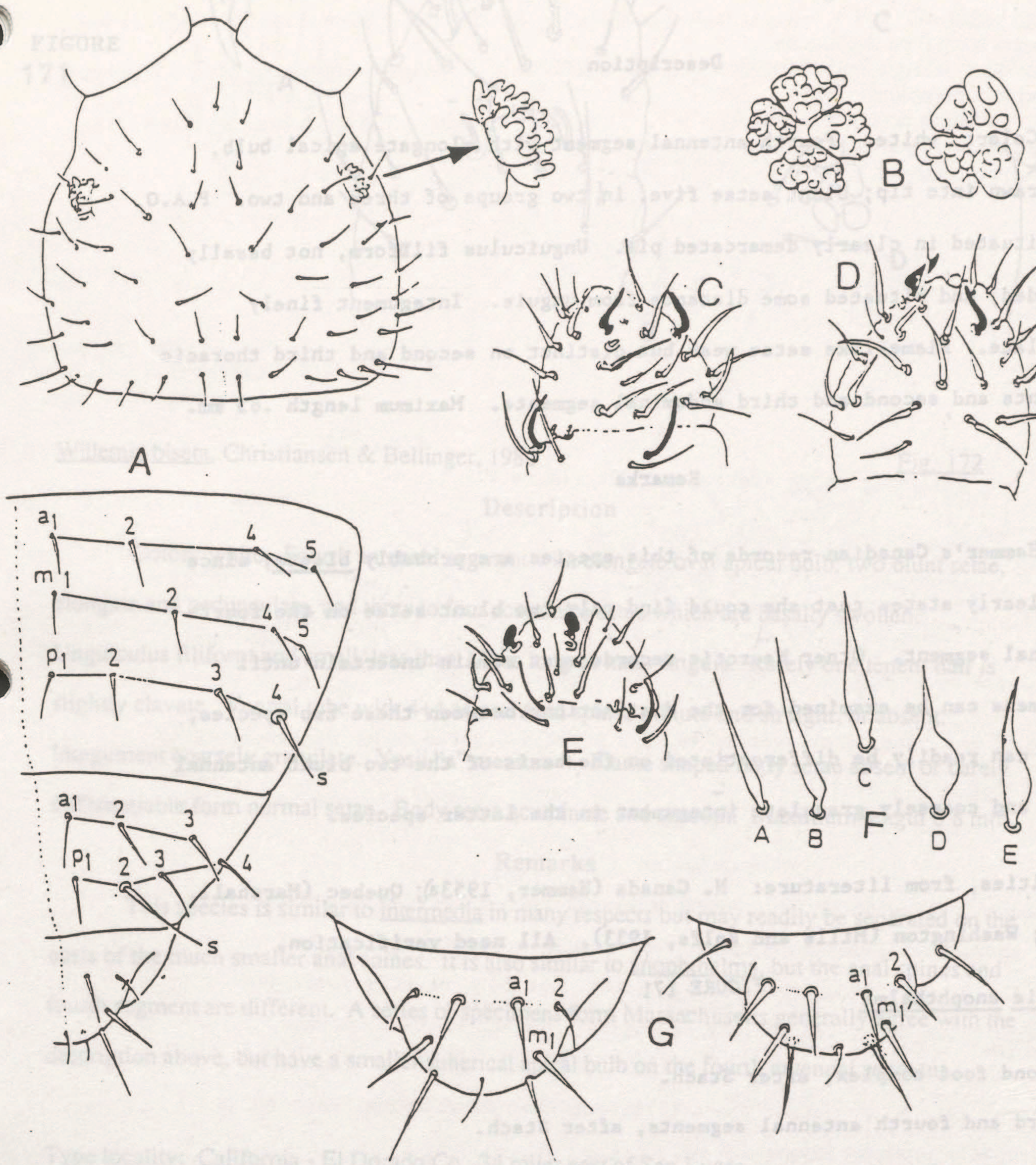
[1] Fjellberg's 1985a redefinition of similis makes a separation of these 2 species problematic. The types of W. similis need to be reexamined. There appear to be a number of undescribed species seen by us and Fjellberg (see table X).

Willemia scandinavica Stach 1949
Figure 170.5



W. scandinavica. Abdominal segments 2 -6, chaetotaxy; B) Variations in PAO; C) Labrum and maxillary palp; D) Hind tibiotarsus and foot; E) Third & fourth antennal segments; F) Variations in anal horns. After Bondarenko et al 1994.

Figure 170.5



W. granulata. A) Dorsal cephalic and Abd. 4-6 chaetotaxy with PAO detail; B) PAO s of type(left) and another locality; C) Lateral view antenna , paratype; D) Dorsal view of same specimen; E) Antenna 4 and apex of 3 , specimen from another locality; F) Sensillae, A: Th. 3 (p_4), B: Th. 3 (m_6), C: Th. 2-3 (P_4), D: Th. 3-Abd.1 (P_4), E: same Abd. 3; G) Abd. 6, specimens from different localities. After Fjellberg 1985.

Willemia anophthalma Börner, 1901 Fig. 171

Refs.: Zool. Anz. 24:429; Stach, 1949a; Gisin, 1960; HUther, 1962.

Description

Color: white. Fourth antennal segment with elongate apical bulb, withdrawn into tip; blunt setae five, in two groups of three and two. P.A.O. not situated in clearly demarcated pit. Unguiculus filiform, not basally expanded, and situated some distance from unguis. Integument finely granulate. Flame-like setae weak but distinct on second and third thoracic segments and second and third abdominal segments. Maximum length .65 mm.

Remarks

Hammer's Canadian records of this species are probably biseta, since she clearly states that she could find only two blunt setae on the fourth antennal segment. Other Nearctic records must remain uncertain until specimens can be examined for the distinctions between these two species, which can readily be differentiated on the basis of the two blunt antennal setae and coarsely granulate integument in the latter species.

Localities, from literature: N. Canada (Hammer, 1953a); Quebec (Marshall, 1967); Washington (Mills and Rolfs, 1933). All need verification.

FIGURE 171

Willemia anophthalma

A) Second foot complex, after Stach.

B) Third and fourth antennal segments, after Stach.

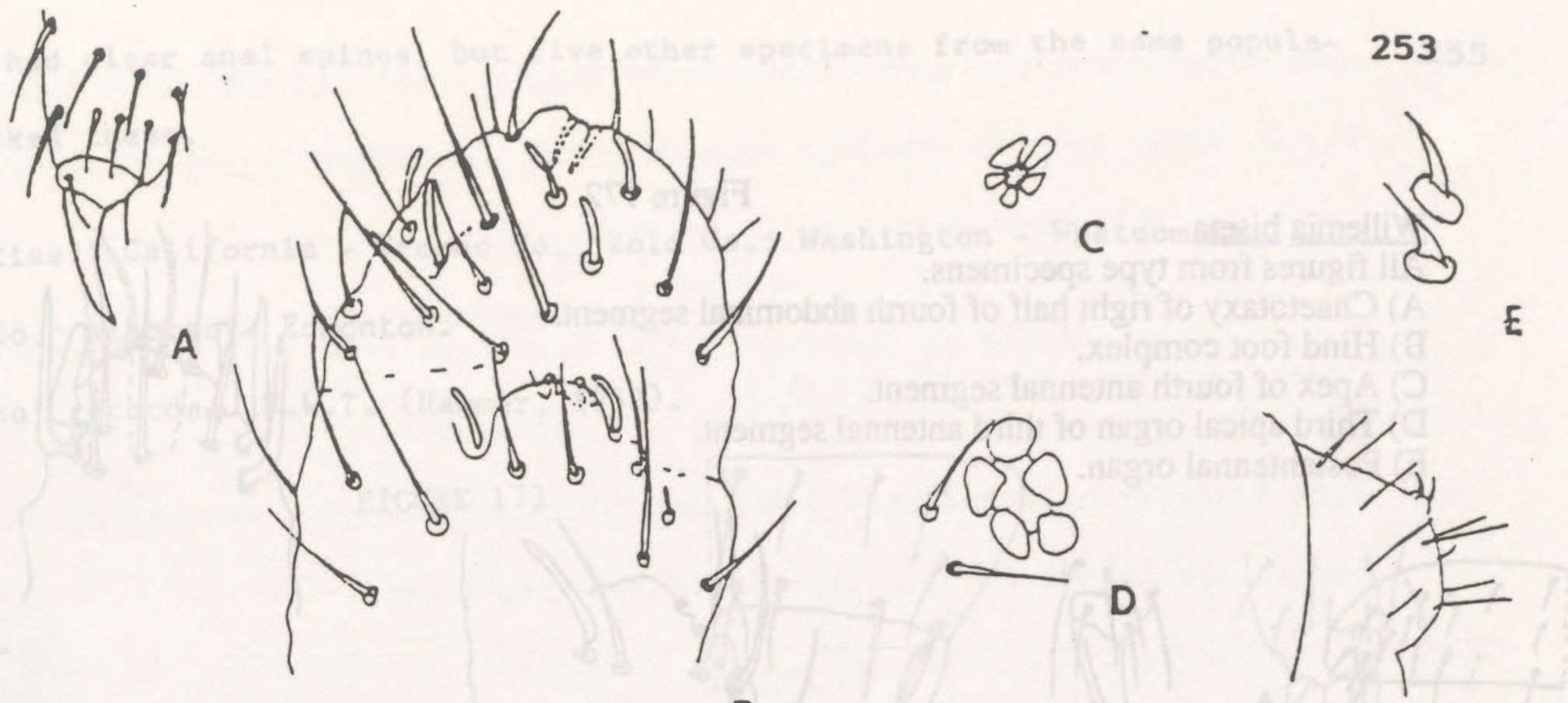
C) Postantennal organ, after Linnaniemi, 1912.

D) Postantennal organ, after Stach.

E) Anal spines, after Stach.

F) End of abdomen, after Stach.

FIGURE 171



Willemia biseta, Christiansen & Bellinger, 1980 Fig. 172

Description

Color: white. Fourth antennal segment with elongate oval apical bulb; two blunt setae, elongate and pedunculate, and three to four acuminate setae which are basally swollen. Unguiculus filiform and small, less than 1/3 as long as inner unguis. Rarely one tenent hair is slightly clavate. Ventral tube with 4+4 setae. Anal spines minute and straight, or absent. Integument coarsely granulate. Yosii "a" measure 4. Flame shaped body setae absent or barely differentiable form normal setae. Body setae acuminate and smooth. Maximum length 0.8 mm.

Remarks

This species is similar to intermedia in many respects but may readily be separated on the basis of the much smaller anal spines. It is also similar to anophthalma, but the anal spines and fourth segment are different. A series of specimens form Massachusetts generally agree with the description above, but have a smaller spherical apical bulb on the fourth antennal segment.

Type locality: California - El Dorado Co., 34 miles east of San Lucas.

Additional locality: Massachusetts - Essex Co. (?)

(See Figure 172 on next page.)

Figure 172

Willemia biseta
All figures from type specimens.
A) Chaetotaxy of right half of fourth abdominal segment.
B) Hind foot complex.
C) Apex of fourth antennal segment.
D) Third apical organ of third antennal segment.
E) Postantennal organ.

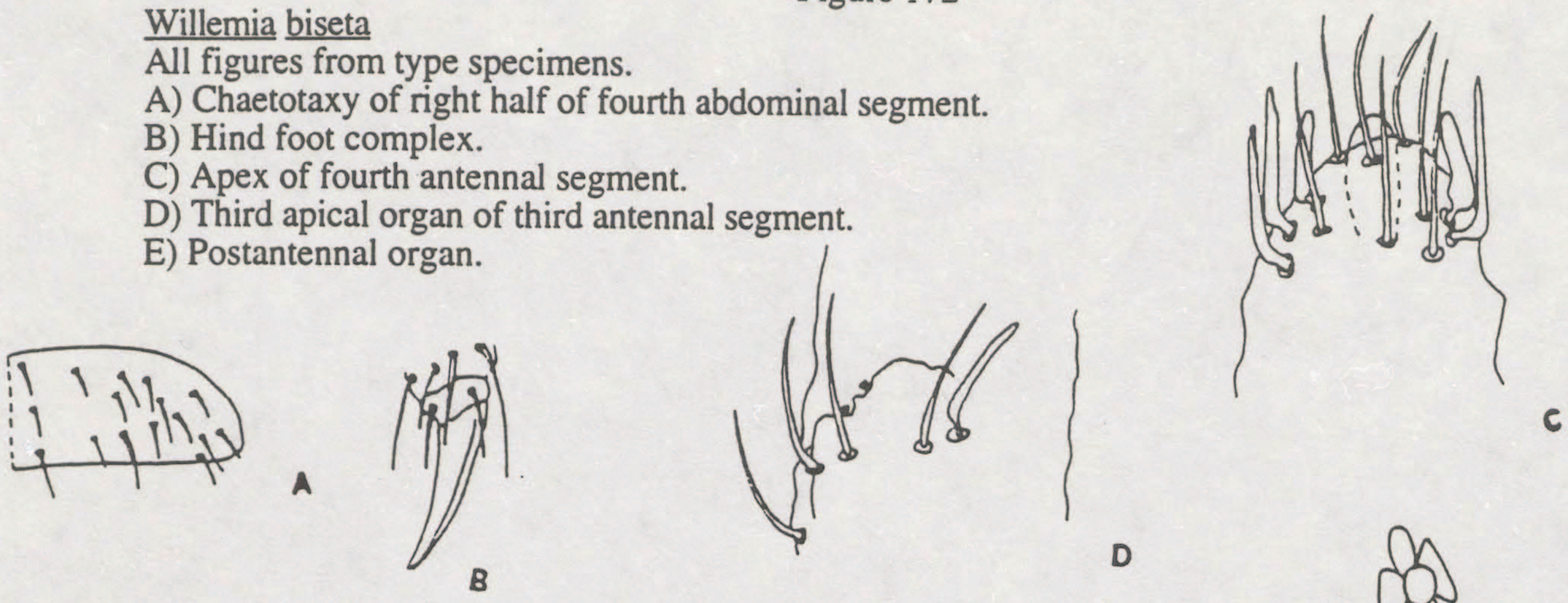
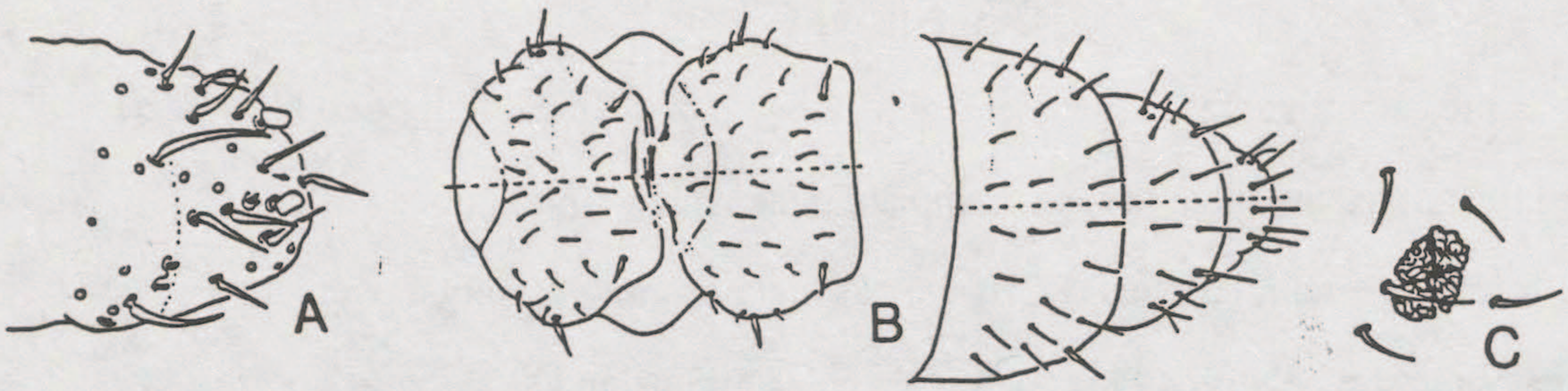


Fig. 173

Willemia arida Fjellberg 1991a Figure 172.1



W.arida.A) Ant. 3&4;B) Chaetotaxy Th. 2-3 & Abd.4-6;C)PAO.After Fjellberg 1991.

Willemia denisi Mills, 1932

Ref.: Iowa St. Coll. J. Sci. 6:263

Description

Color: yellowish white. Fourth antennal segment with a spherical, stalked apical bulb, not much larger than the five short, ovoid blunt setae. P.A.O. with four (rarely five) lobes, not in a clearly demarcated pit. Unguiculus about 1/3 as long as unguis. Tenent hairs acuminate. Ventral tube with 4+4 setae. Anal spines absent. Body setae acuminate and smooth; seta p_4 on second thoracic through fourth abdominal segment flame-shaped. Maximum length 1.1 mm.

Remarks

This well-marked species is easy to recognize by the blunt setae of the fourth antennal segment. The type specimens show little detail, but the flame-like setae are clearly visible. It is very close to W. aspinata Stach, 1949, but from descriptions and specimens that European species has p_4 flame-shaped on the fifth abdominal segment also. A single specimen from Edmonton,

Alberta had clear anal spines, but five other specimens from the same population lacked these.

Localities: California - Fresno Co., Yolo Co.; Washington - Whatcom Co., Yakima Co. Alberta - Edmonton.

Additional records: N.W.T. (Hammer, 1953).

FIGURE 173

Willemia denisi

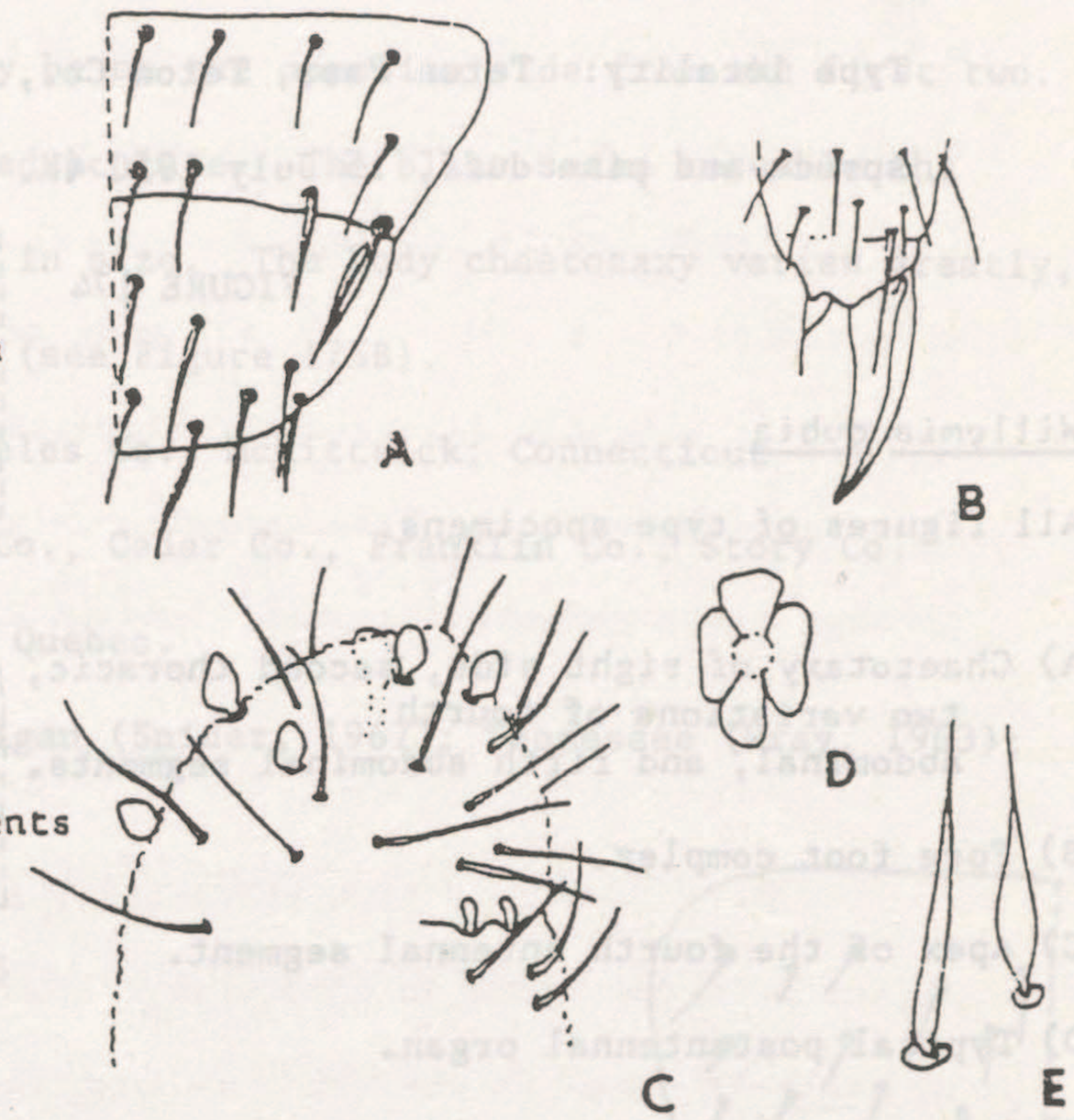
A) Chaetotaxy of right side of fourth and fifth abdominal segments, specimen from California.

B) Foot complex, after Mills.

C) Apex of antenna, after Mills.

D) Postantennal organ, after Mills.

E) P_4 setae of fourth and third abdominal segments respectively, specimen from Fresno Co., California.



Willemia dubia, Christiansen & Bellinger, 1980

Fig. 174

Description

Color: white. Fourth antennal segment with a small, clearly stalked end bulb, usually projecting somewhat, and cylindrical, slightly pedunculate blunt setae. P.A.O. in a clearly demarcated pit. Unguiculus slightly longer than 1/2 inner unguis, with clearly enlarged base. Ventral tube with 4+4 setae. Anal spines short and straight. Integument very coarsely granulate, particularly on posterior abdominal segments. Yosii "a" measure 4. Body setae smooth and acuminate. Seta p_4 on second thoracic through fourth abdominal segments flame-shaped as in W. denisi. Maximum length .8 mm.

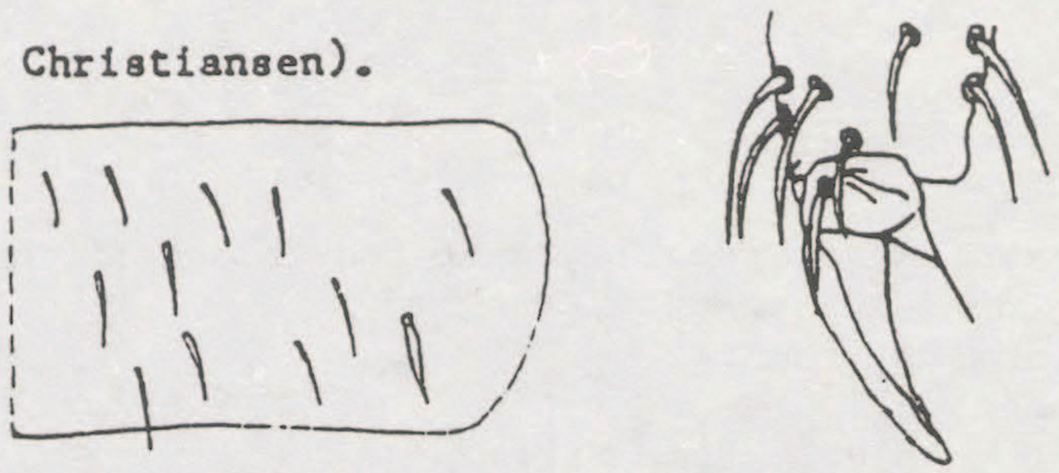
Remarks

This may represent a geographical variant of W. vashtia; however, the

coarser granulation, generally shorter anal spines, and different number of P.A.O. lobes justify specific separation at the present time. Detailed study may well show that similis, vashtia, and dubia are all part of a single variable species. As with several other species of this genus the abdominal chaetotaxy is extremely variable.

Type locality: Teton Pass, Teton Co., Wyoming, Tullgren extract of mixed spruce and pine duff, 15 July 1950 (K. Christiansen).

FIGURE 174



Willemia dubia

All figures of type specimens.

A) Chaetotaxy of right side, second thoracic, two variations of fourth abdominal, and fifth abdominal segments.

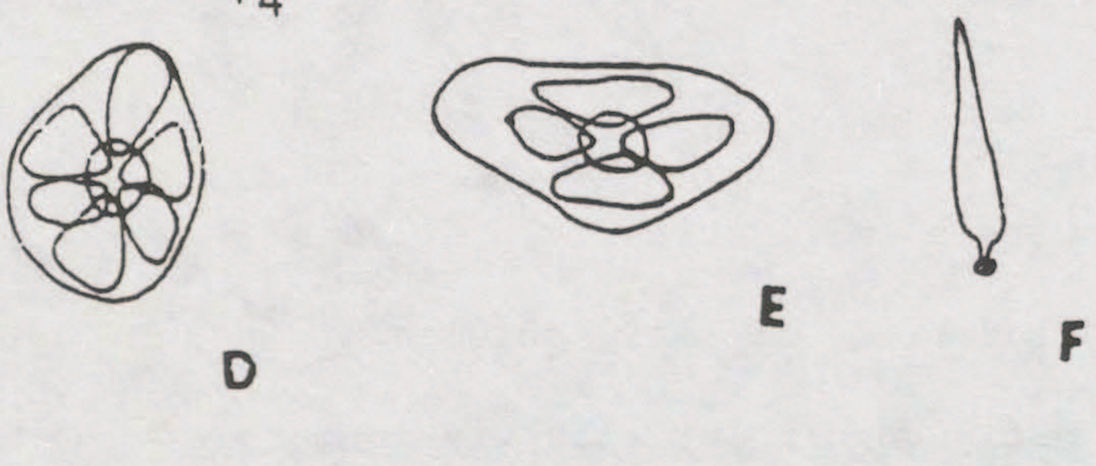
B) Fore foot complex.

C) Apex of the fourth antennal segment.

D) Typical postantennal organ.

E) Exceptional postantennal organ.

F) Seta p_4 of the third abdominal segment.



Willemia intermedia Mills, 1934

Fig. 175

Ref.: Collembola of Iowa: 17

Description

Color: white. Fourth antennal segment with sub-spherical apical knob, frequently slightly displaced to one side; blunt setae elongate cylindrical in shape. Unguiculus .4 to .6 as long as inner unguis. Tenent hairs acuminate; one sometimes weakly clavate. Ventral tube with 4+4 setae. Anal spines much longer than papillae. Integument coarsely granulate. Yosii "a" measure

5-6. Body setae smooth and acuminate. P_4 setae on second thoracic through fourth abdominal segments weakly flame-shaped. Maximum length .82 mm.

Remarks

This is an extremely variable species. As here defined it may encompass a series of closely related species. The blunt setae on the fourth antennal segment may be positioned as shown in Figure 175C, or the third seta may be on the opposite side from the first two. On the co-types the large setae are clearly pedunculate. The blunt setae resemble the acuminate ones more as the specimens increase in size. The body chaetotaxy varies greatly, even on the same segment of the same specimen (see Figure 175B).

Localities: California - Fresno Co., Los Angeles Co., McKittrick; Connecticut - Litchfield Co., Middlesex Co.; Iowa - Butler Co., Cedar Co., Franklin Co., Story Co. (type); Massachusetts - Norfolk Co.; Canada - Quebec.

Additional localities, from literature: Michigan (Snider, 1967); Tennessee (Wray, 1963); Utah (Wray and Knowlton, 1956a).

FIGURE 175

Willemia intermedia

A) Chaetotaxy of left side of fourth through sixth abdominal segments, specimen from Gorman, California.

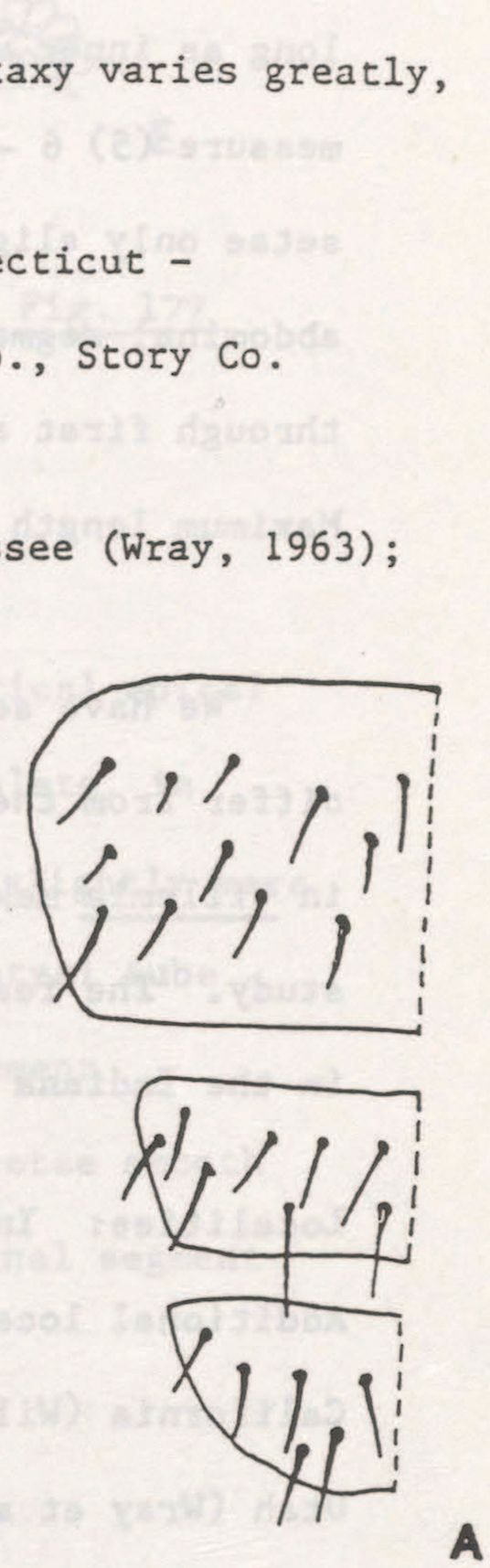
B) Chaetotaxy of fourth abdominal segment showing bilateral assymetry, specimen from McKittrick, California.

C) Foot complex, specimen from Fresno Co., California.

D) Apex of fourth antennal segment, specimen from Gorman, California.

E) Apical organ of third antennal segment, after Mills.

F) Postantennal organ, after Mills.



Willemia similis Mills, 1934 Fig. 176

Ref.: Collembola of Iowa: 19

Description

Color: white. Fourth antennal segment with simple apical knob having a clearly visible internal stalk, and six cylindrical, pedunculate blunt setae. P.A.O. elliptical. Unguiculus with clear basal swelling, 1/2 as long as inner unguis (or less). Ventral tube with 4+4 setae. Yosii "a" measure (5) 6 - 8. All body setae smooth and acuminate. P_4 setae only slightly enlarged (or flame-shaped on second through fourth abdominal segments and less conspicuously enlarged on the second thoracic through first abdominal segments and on the fifth abdominal segment). Maximum length .7 mm.

Remarks

We have seen only type specimens and a few from Indiana. The latter differ from the types in chaetotaxy; however, the variability of this feature in Willemia makes it advisable to keep them in the same taxon pending further study. The features in parentheses in the description above are found only in the Indiana specimens.

Localities: Indiana - Fayette Co., Washington Co.; Iowa - Story Co. (types).

Additional localities, from literature: Arctic Alaska (Weber, 1950);

California (Wilkey, 1959); Kansas (Mills, 1934); Tennessee (Copeland, 1960);

Utah (Wray et al, 1950). Northern Canada (Hammer, 1953a).

FIGURE 176

Willemia similis

A) Chaetotaxy of right side of second thoracic segment, specimen from Fayette Co., Indiana.

B) Chaetotaxy of right side of second thoracic and fourth and fifth abdominal segments, type specimen.

C) Fourth antennal segment, specimen from Fayette Co., Indiana.

D) Third antennal segment sense organ, after Mills.

E) Postantennal organ, after Mills.

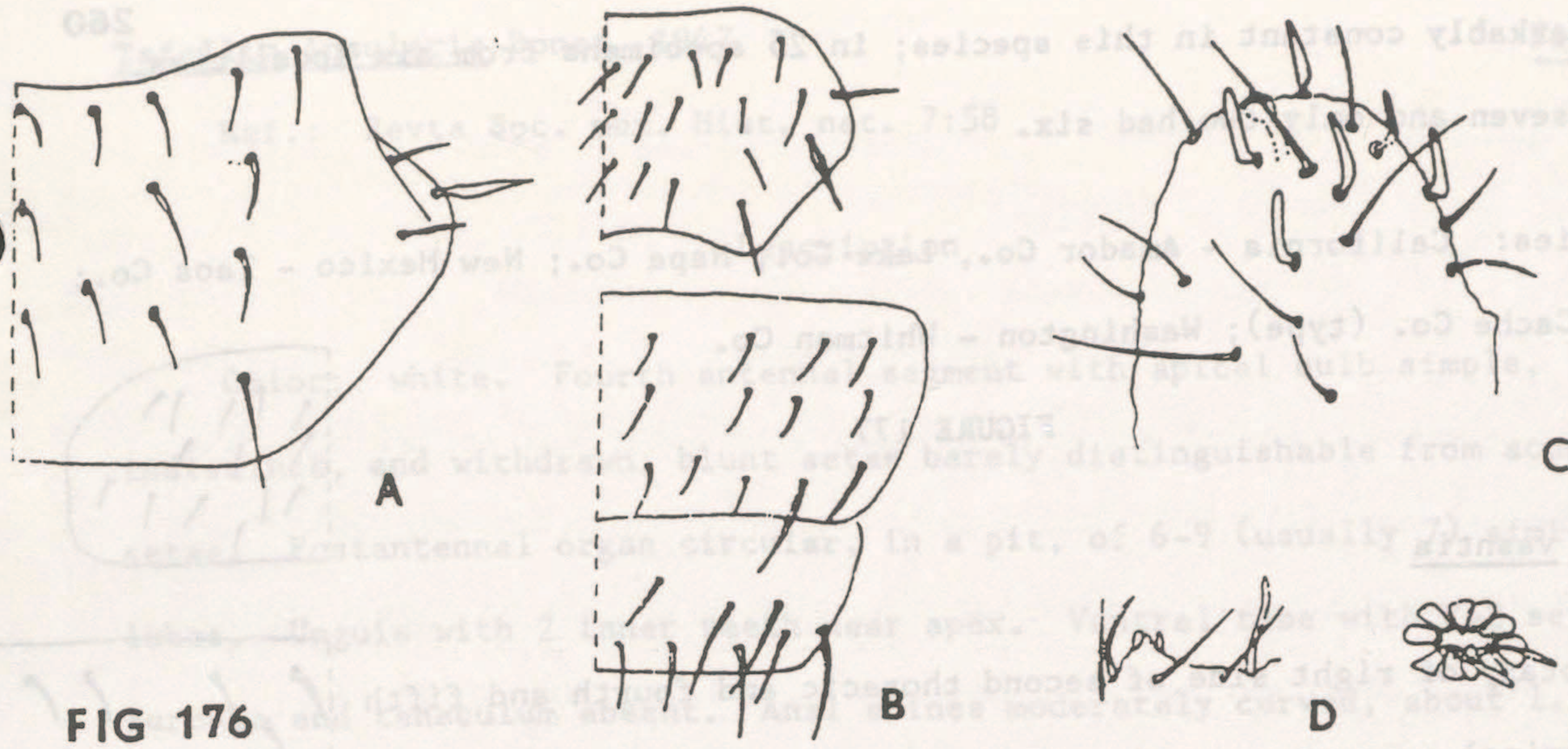


FIG 176

Willemia vashtia Wray, 1950 Fig. 177

Original description: Bull. Brooklyn ent. Soc. 45:92

Description

Color: yellow to white. Fourth antennal segment with spherical apical bulb having a clearly visible internal stalk; blunt setae pedunculate, in two groups (3+2 or 3+3). P.A.O. is in a pit. Unguiculus 1/3 to slightly more than 1/2 as long as inner unguis, with clear basal swelling. Ventral tube with 4+4 setae. Anal spines straight or slightly curved. Integument moderately granulate. Yosii "a" measure 6 - 9. All body setae smooth and acuminate. P_4 setae on second thoracic through fourth abdominal segment flame-shaped as in W. denisi. Maximum length 1.13 mm.

Remarks

This species may be a geographical variant of W. similis; however Mills clearly states that the lobes of the P.A.O. of that species are eight to twelve in number, whereas they never exceed seven in the present form. On this basis we feel it best to maintain the separate specific status pending more study. The number of blunt setae on the fourth antennal segment is extremely difficult to determine; in some cases as few as four are visible, but in large specimens five to six can always be seen. The lobes of the P.A.O.

are remarkably constant in this species; in 25 specimens from six localities, 23 had seven and only two had six.

Localities: California - Amador Co., Lake Co., Napa Co.; New Mexico - Taos Co.; Utah - Cache Co. (type); Washington - Whitman Co.

FIGURE 177



Willemia vashtia

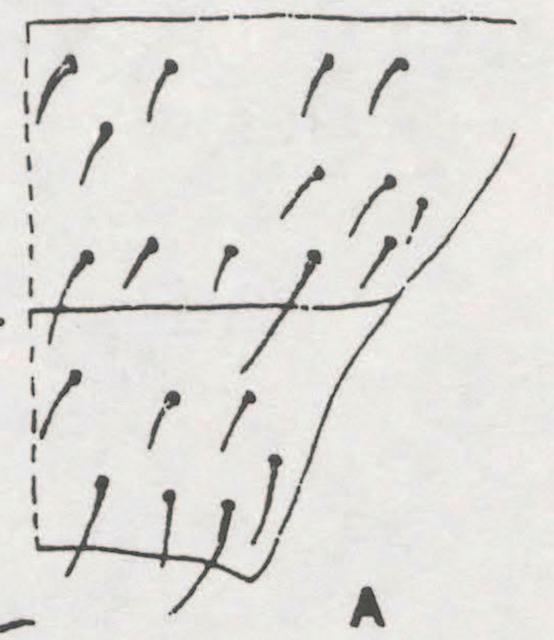
A) Chaetotaxy of right side of second thoracic and fourth and fifth abdominal segments, specimen from Cache Co., Utah.

B) Chaetotaxy of fourth abdominal segment, specimen from California.

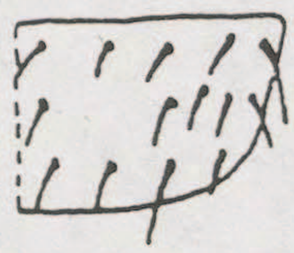
C) Hind unguis and empodium, specimen from Cache Co., Utah.

D) Apex of antenna, specimen from same locality.

E) Postantennal organ, specimen from same locality.



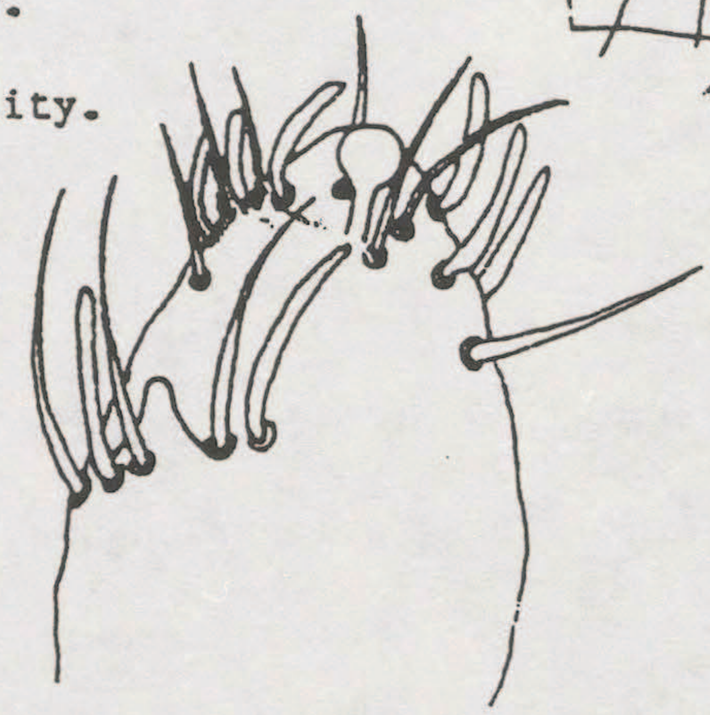
A



B



C



D



E

Genus TAFALLIA Bonet, 1947

Type species: insularis Bonet, 1947

Syn.: Hoffia Scott, 1961a, type species: robusta Scott, 1961a,

This is a small group so far recorded only from the far west. It may be distinguished from Willemia as noted in the key, and also by the absence of the unguiculus. The two species are doubtfully distinct.

Key to species

** Apical antennal bulb prominent, spherical ---------- robusta

Apical antennal bulb withdrawn, hemispherical ---------- insularis

Ref.: Revta Soc. mex. Hist. nat. 7:58

Description

Color: white. Fourth antennal segment with apical bulb simple, indistinct, and withdrawn; blunt setae barely distinguishable from acuminate setae. Postantennal organ circular, in a pit, of 6-9 (usually 7) similar lobes. Unguis with 2 inner teeth near apex. Ventral tube with 2+2 setae. Furcula and tenaculum absent. Anal spines moderately curved, about 1.5 times as long as papillae. Integument with coarse granulations. All body setae serrate. Maximum length 1.2 mm.

Remarks

T. robusta is very close to this form and may well be a geographic variant; however the two appear to be readily separable (see remarks under robusta).

Locality: Baja California - Isla Cedros.

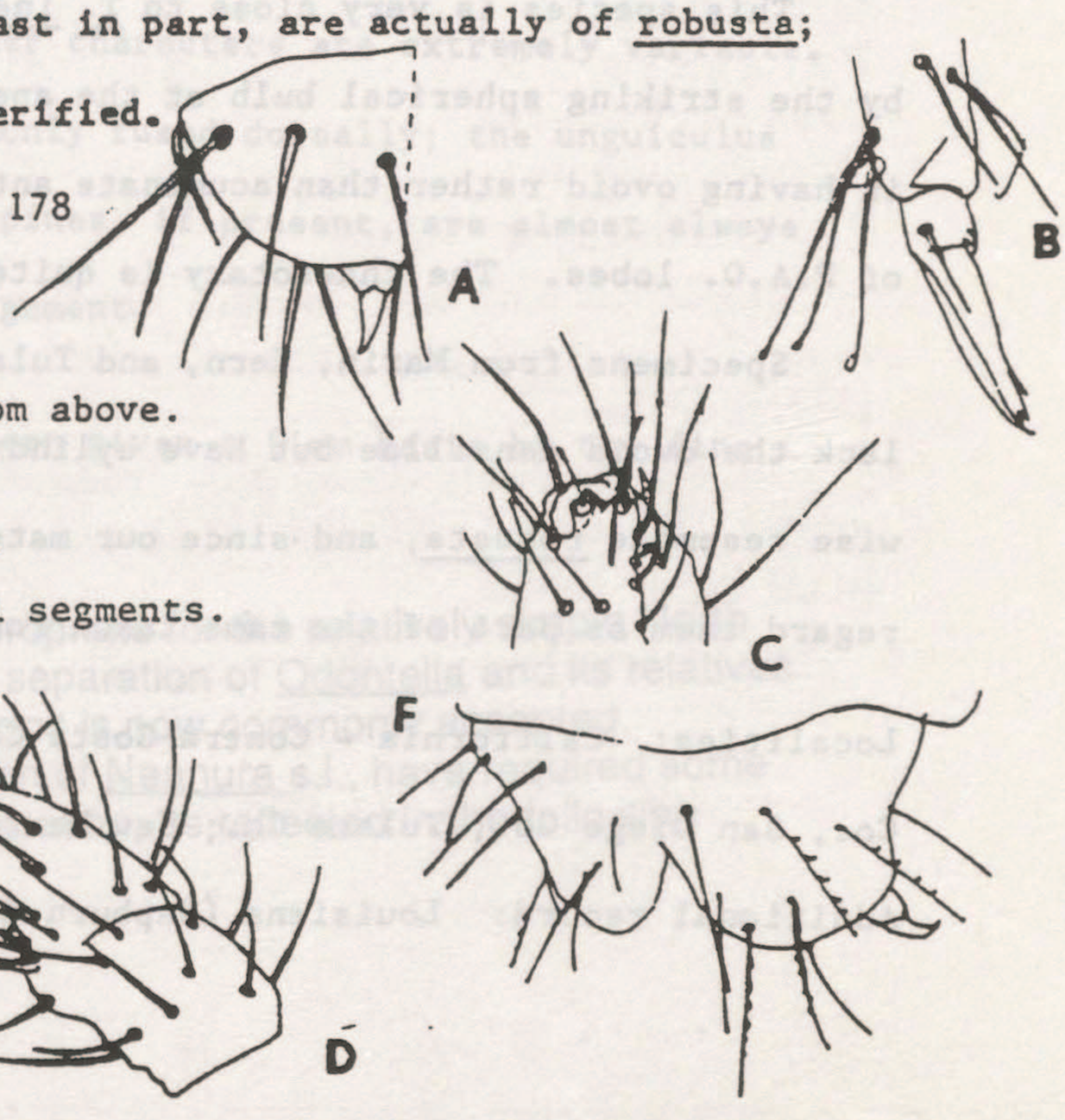
Additional records: California (Wilkey, 1959); Utah (Wray and Knowlton, 1956a). The California records, at least in part, are actually of robusta; all United States records should be verified.

FIGURE 178

Tafallia insularis

All figures after Bonet.

A) Left half of sixth abdominal segment from above.
B) Hind foot complex.
C) Ventral view of fourth antennal segment.
D) Dorsal veiw of third and fourth antennal segments.
E) Postantennal organ.
F) End of abdomen, from side.



Tafallia robusta (Scott), 1961, Fig. 173

Ref.: Ent. News 72:63 (Hoffia)

Description

Color: white. Fourth antennal segment with spherical apical bulb and retractile sac, and with 4-5 blunt setae, 3 or 4 of which are very short and ovate. Postantennal organ in circular pit, with 6 (rarely 5) lobes. Unguis with 1-3 inner teeth near apex. 1 (rarely) to 3 tenent hairs per foot. Ventral tube with 4+4 setae. Anal spines about 3 times as long as papillae, strongly curved. Setae smooth to serrate. Integument coarsely granulate, larger specimens with integument divided by coarse reticulations. Maximum length 1.01 mm.

Remarks

The description is based largely on California specimens; however, a single type specimen of Hoffia robusta Scott agrees well with this description. Scott apparently mistook the circular P.A.O. for a pseudocellus and placed the species as type of a new genus of the family Onychiuridae.

This species is very close to T. insularis, but is readily distinguished by the striking spherical bulb at the apex of the antenna. It also differs in having ovoid rather than acuminate antennal blunt setae and a smaller number of P.A.O. lobes. The chaetotaxy is quite variable.

Specimens from Marin, Kern, and Tulare Counties, California, apparently lack the ovoid sensillae but have cylindrical blunt setae. Since they otherwise resemble robusta, and since our material is limited, it seems best to regard them as part of the same taxon for the present.

Localities: California - Contra Costa Co., Kern Co., Los Angeles Co., Marin Co., San Diego Co., Tulare Co.; New Mexico - Valencia Co. (type).

Additional record: Louisiana (Hepburn & Woodring, 1963).

FIGURE 179

Tafallia robusta

A) Chaetotaxy of right side of second thoracic and fourth and fifth abdominal segments, specimen from Los Angeles Co., California.

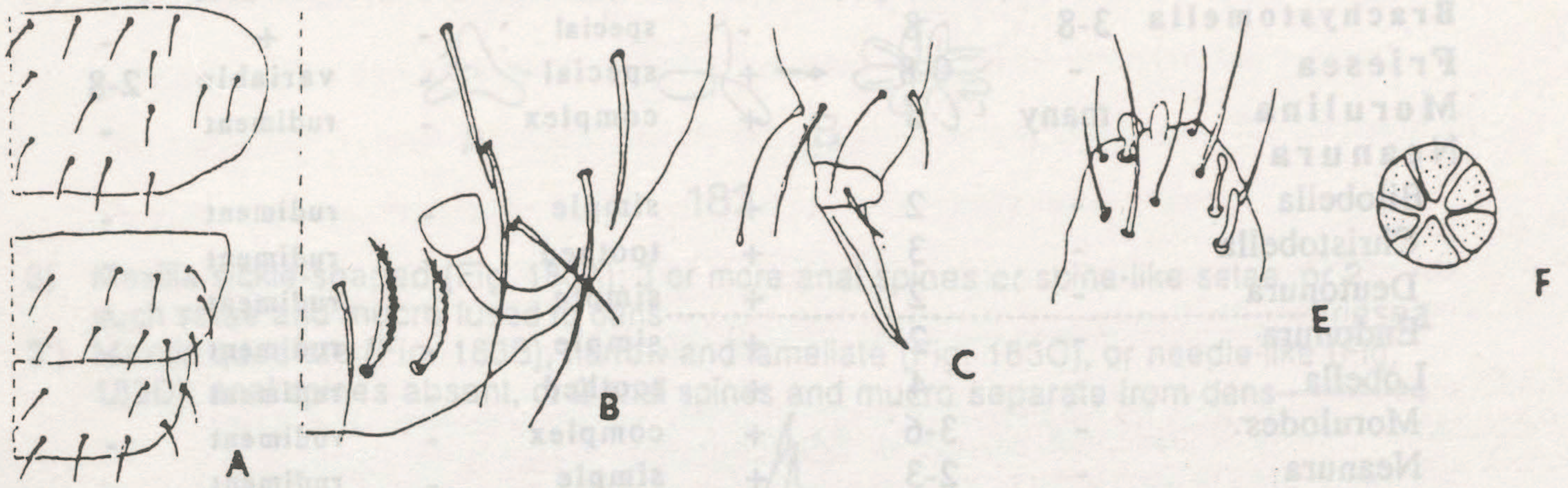
B) Right half of end of abdomen seen from above, same specimen.

C) Hind foot complex, specimen from same locality.

D) Apex of antenna, dorsal view, specimen from San Diego Co., California.

E) Apex of antenna, ventral view, specimen from Los Angeles Co., California

F) Postantennal organ, specimen from Los Angeles Co., California.



Subfamily Neanurinae

The absence of the molar plate, and sometimes of the mandible itself, distinguishes this group from all other North American Collembola. The group is probably polyphyletic, and other characters are extremely variable. The last two antennal segments are commonly fused dorsally; the unguiculus is setiform or (usually) absent; anal spines, if present, are almost always enlarged setae set directly on the integument.

The systematics of the group has been given a firm basis by the fine work of Massoud (1967).

While a conservative treatment is still appropriate for the relatively simple North American fauna, we should point out that separation of Odontella and its relatives in a different family from the remaining forms is now commonly accepted. Recent discoveries, and the reclassification of Neanura s.l., have required some modification of our original generic classification, as reflected in the following table and keys.

TABLE XI

Characteristics of Nearctic genera and subgenera ofNeanurinae

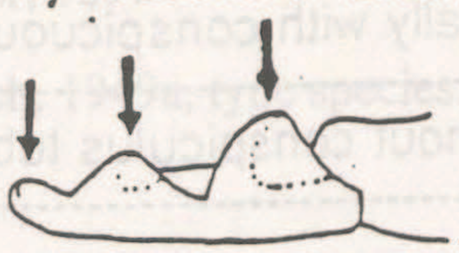
Genus subgenus	P.A.O. tubercles	Eyes	Mandible	Maxilla[1]	Unguiculus	furcula[2]	Anal spines
Anurida							
Anurida	5-40	0-5	+	complex	-	rudiment	-
Anuridella	9-20	0	+	complex	-	rudiment	-
Micranurida	5-11	0-8	+	simple	-	rudiment	-
Pratanurida	5-6	8	+	toothed	-	intermed rudiment	-
Protachorutes	10-12	8	+	complex	-	intermed.	-
Brachystomella	3-8	8	-	special	-	+	-
Friesea	-	0-8	+	special	-	variable	2-8
Morulina	many	5	+	complex	-	rudiment	-
Neanura							
Bilobella	-	2	+	simple	-	rudiment	-
Christobella	-	3	+	toothed	-	rudiment	-
Deutonura	-	2	+	simple	-	rudiment	-
Endonura	-	2	+	simple	-	rudiment	-
Lobella	-	4	+	toothed	-	rudiment	-
Morulodes	-	3-6	+	complex	-	rudiment	-
Neanura	-	2-3	+	simple	-	rudiment	-
Sensillanura	-	2	+	simple	-	rudiment	-
Odontella							
Odontella	1, lobed	5	+	simple	+ or -	+	0-3
Pseudostachia	1, lobed	0	-	sicle like	rudiment	+	0
Xenyllodes	1, lobed	5	+	sickle like	+	+	2
Oudemansia	-	8	+	simple	-	+	2
Paranura	-	0-3	+	simple	-	rudiment	-
Pseudachorutes							
Pseudachorudina	6-12	8	+	complex	-	+	-
Pseudachorutes	5-30	8	+	simple	-	+	-

[1] "simple" = with 1-2 needle like lamellae. "complex = with 2 or more lamellae at least one of which is multidentate. "toothed" intermediate.

[2] + = all segments developed. "rudiment" = only small vestige or absent. "Intermed" = Mucro absent but othe parts present."variable" = all types found.

Key to Nearctic Genera of Subfamily Neanurinae

1) Mucro trilamellate (Fig. 180)----------Odontella (Odontella)
1') Mucro not trilamellate; frequently reduced or absent----------2

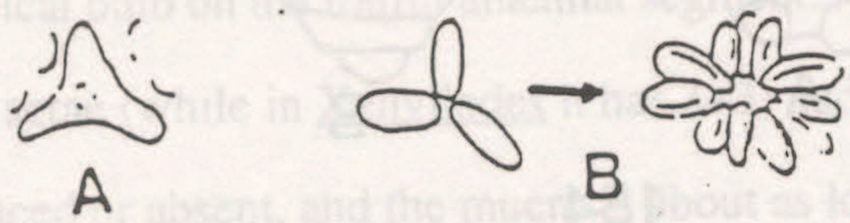


180



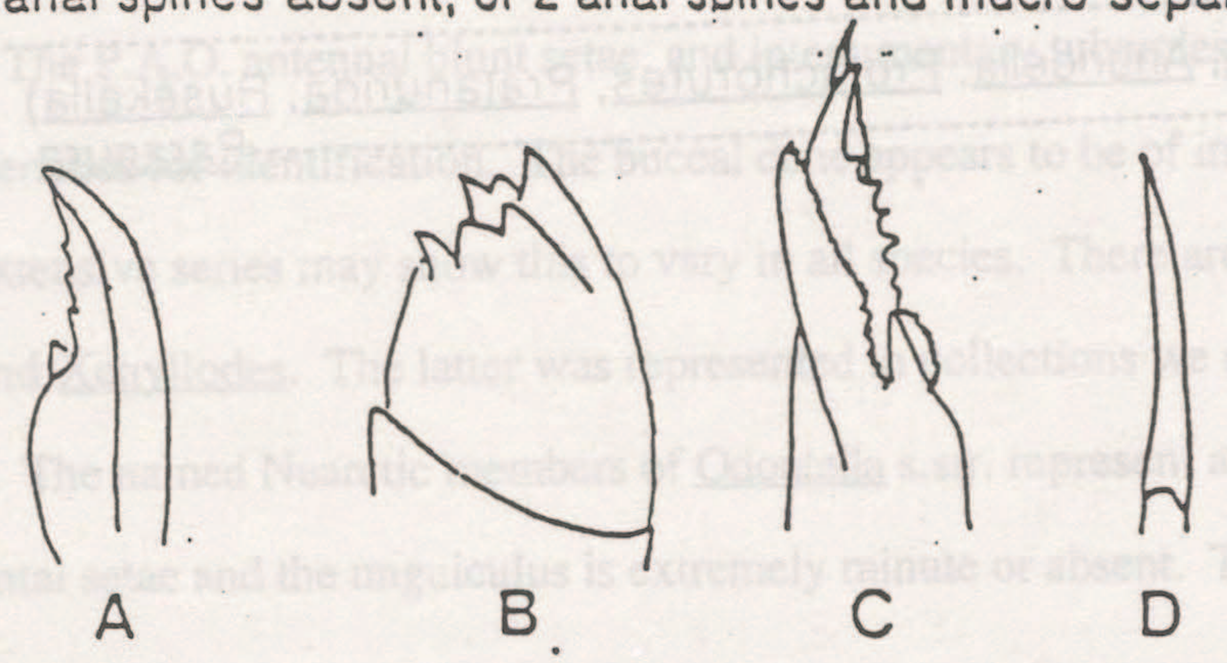
181

2) Unguiculus present (Fig. 181); P.A.O. triradiate (Fig. 182A)----Odontella (Xenyllodes)
2') Unguiculus absent; P.A.O. when present lobed (Fig. 182B)----------3



182

3) Maxilla sickle-shaped (Fig. 183A); 3 or more anal spines or spine-like setae, or 2 such setae and mucro fused to dens----------Friesea
3') Maxilla quadrate (Fig. 183B), narrow and lamellate (Fig. 183C), or needle-like (Fig. 183D); anal spines absent, or 2 anal spines and mucro separate from dens----------4



183

4) Furcula present with all segments distinct----------5
4') Furcula reduced or absent; mucro always absent----------9

5) Head of maxilla quadrate (Fig. 183B)----------Brachystomella
5') Maxilla otherwise (Figs. 183C,D)----------6

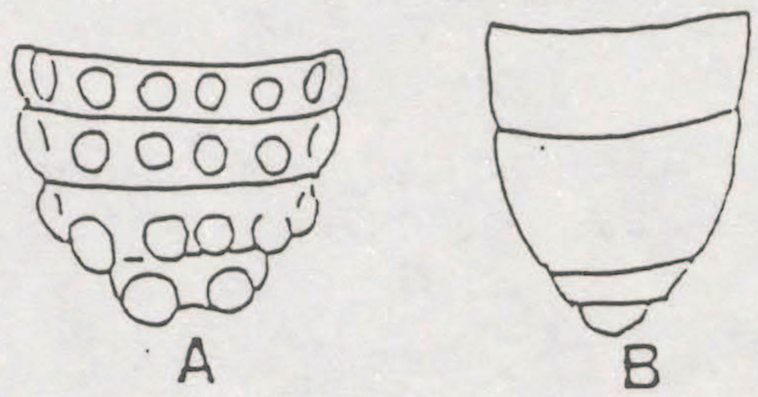
6) Mandible absent----------Rapoportella lowriei Najt, 1984
6') Mandible present----------7

7) P.A.O. present----------Pseudachorutes
7') P.A.O. absent----------8

8) Dens more than 4 times as long as mucro-----Pseudanurida sawayana Schuster 1965
8') Dens less than 3 times as long as mucro----------Oudemansia

9) Fourth antennal segment with one blunt seta much larger than others (Fig. 278A)----------
---Sensillanura
9') Fourth antennal segment with blunt setae similar in size (Fig. 278B)----------10

10) Last abdominal segment bilobed; body usually with conspicuous tubercles (Fig. 184A) ----------11
10') Last abdominal segment rounded; body without conspiculus tubercles (Fig. 184B)---
----------12



184

11) P.A.O. present----------Morulina
11') P.A.O. absent----------Neanura
(including Christobella, Deutonura, Endonura, Morulodes, etc.)

12) P.A.O. present----------
---Anurida (including Micranurida, Anuridella, Protachorutes, Pratanurida, Rusekella)
12') P.A.O. absent----------Paranura

Genus Odontella Schaffer, 1897

Type species: O. loricata Schaffer, 1897

Syn: Superodontella Stach, 1949a, type species: Odontella ewingi Folsom, 1916

Following Gisin, we place in this genus all poduromorph species lacking a mandible and the maxillary cardo and with a well-developed furcula. All named Nearctic species have five eyes per side and lack an apical bulb on the fourth antennal segment. The ventral tube in the subgenus Odontella s.s. has 4+4 setae (while in Xenyllodes it has 3+3) and the tenaculum has 3+3 teeth. The unguiculus is reduced or absent, and the mucro is about as long as the dens. The habitus of all Nearctic species is very similar, with a stout oval to fusiform body and short conical antennae.

The mouth is most intriguing. In some species, it appears to vary from extremely elongate to blunt and short. It does not appear to be exsertile, yet seems unlikely to be deciduous.

The P.A.O. antennal blunt setae, and integumentary tubercles are the most critical characteristics for identification. The buccal cone appears to be of importance in a few forms, but more extensive series may show this to vary in all species. There are two subgenera: Odontella s.str. and Xenyllodes. The latter was represented in collections we saw by a single species, armata. The named Nearctic members of Odontella s.str. represent a homogenous group. All have five dental setae and the unguiculus is extremely minute or absent. The subgenera can be separated as follows:

Mucro trilamellate ----------subgenus Odontella

Mucro simple ----------subgenus Xenyllodes

We recognize 11 Nearctic species: 1) armata; 2) bayeri; 3) biloba; 4) clavata; 5) cornifer; 6) ewingi; 7) rossi; 8) shasta; 9) stella; 10) substriata; 11) wapiti. There is a record of O. lamellifera Axelson which we have not verified. We have also seen a white, blind species near O. populosa Selga, 1963 from deep soil layers in Fresno Co., California; material is inadequate for description.

TABLE XII

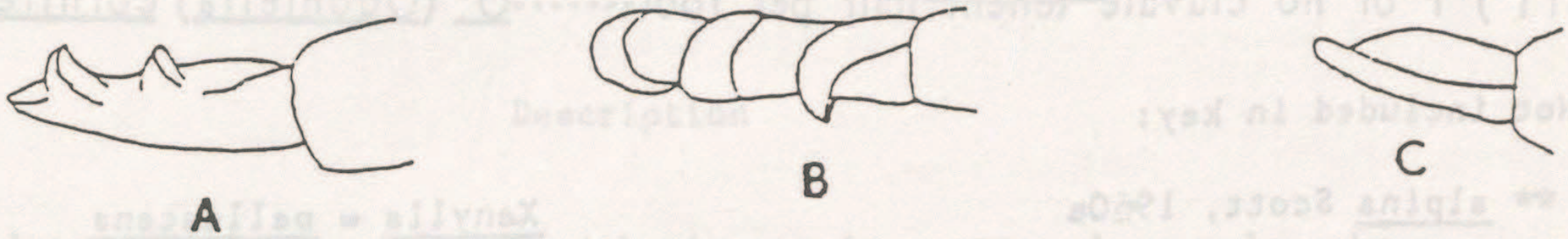
Characteristics of Nearctic species of Odontella s.l.

species	Antennal segment IV blunt setae	P.A.O. lobes	clavate tenent hairs	unguiculus	mucro	knobbed abdominal setae	clear anal spines
sp. A (Texas)	9-10	4	1-0	-	trilamellate	-	+ (some furcate)
armata	5-7	3	-	+	simple	+	+
bayeri	5	4	-	+	simple	_	+
biloba	5-7	1-(2)	-	+	trilamellate	-	+
clavata	7	4	3-4	-	"	-	+
cornifer	5-6	3-4	-	-	"	+, -	+
ewingi	2-3	4	-	-	"	-	+,-
rossi	4	3-4	+,-	-	"	-	-
shasta	5-6	4	+,-	-	"	-	-
stella	7-8	4	-	-	"	-	+
substriata	7-8	4-(5)	2	-	"	-	+
wapiti	6	3	-	-	simple	-	+

Key to Nearctic species of Odontella

1) Mucro simple (Fig. 185C) or absent----------2
1') Mucro trilamellate (Fig. 185 A & B)----------5

185



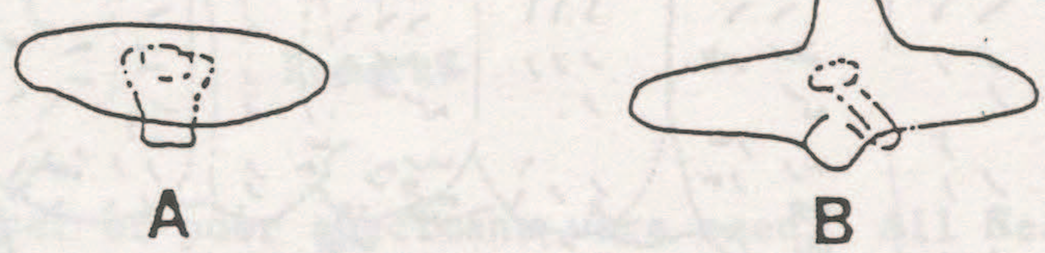
*2) Eyes 5 + 5----------O. (Xenyllodes) armatus
2') Eyes 2 + 2 or fewer----------3

3) Eyes absent----------O. (Pseudostachia) cf populosa Selga 1963
3') Eyes 2 + 2----------4

*4) Mucro separate from dens----------O. (Xenyllodes) baveri
4') Mucro fused to dens------O. (Xenyllodes) wapiti Fjellberg 1985c

**5) P.A.O. unlobed (Fig. 186A)----------O. (Odontella) biloba
5') P.A.O. 3-5 lobed Ffig. 186B)----------6

186



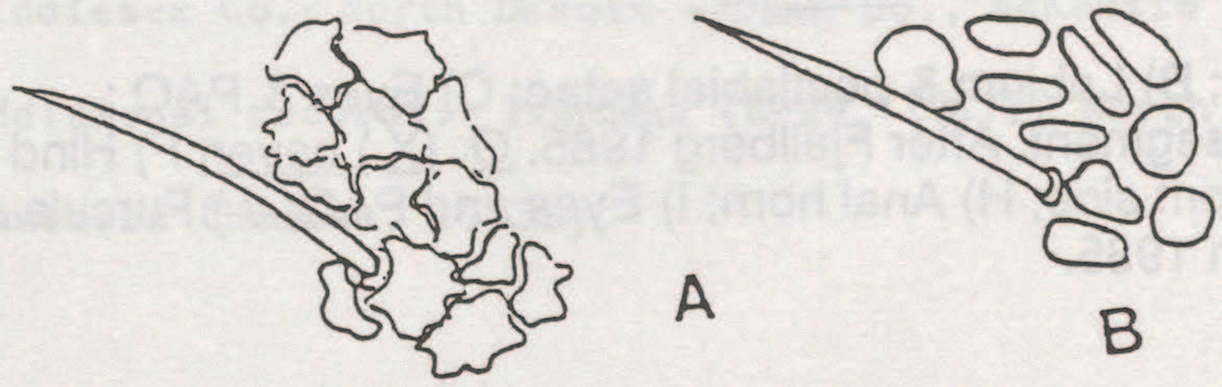
*6) 6-8 lateral cephalic spines present---------O. (Odontella ') ewingi
6') Cephalic spines absent----------7

7) Clavate tenent hairs 3-4 on each foot------O. (Odontella) clavata
7') Clavate tenent hairs two or fewer on each foot----------8

8) Fifth abdominal stellate or multiangulate in basal cross section (Fig. 187A)---------- 9

8') Fifth abdominal segment tubercles circular , oval or polygonal in basal cross section (Fig. 187B)----------10

187



**9) Clear anal spines present----------O. (Odontella) stella
**9') Clear anal spines absent----------O. (Odontella) shasta

10) Clear anal spines present----------11
**10') Clear anal spines absent----------O. (Odontella) rossi

*11) 2 clavate tenent hairs per foot----------O. (Odontella) substriata
*11') 1 or no clavate tenent hair per foot-------O. (Odontella) cornifer

Not included in key:

** alpina Scott, 1960a — Xenylla = pallescens

helena Scott, 1937 (Xenylla) — = ewingi

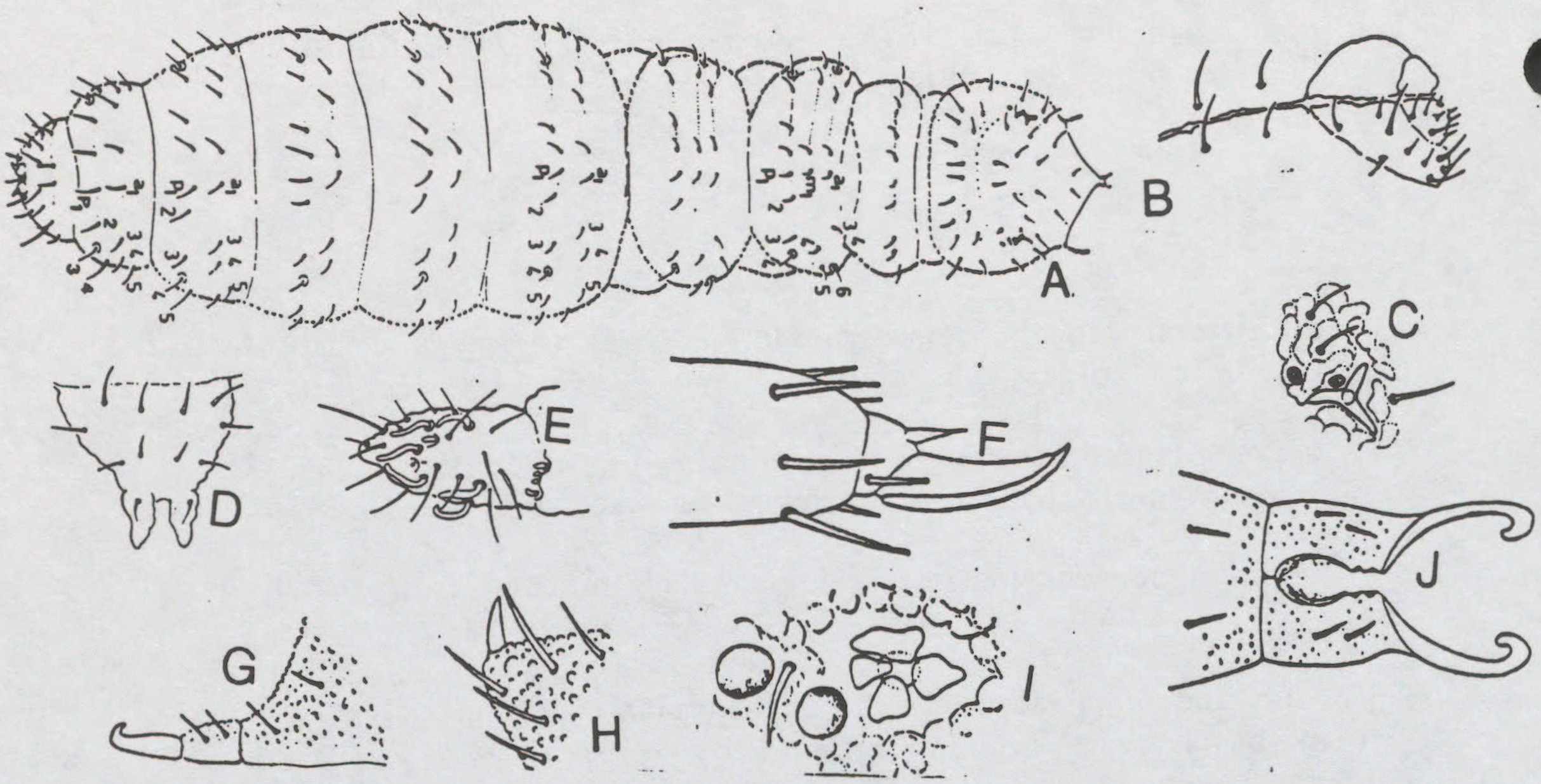
** hoffi Scott, 1960a — = Xenylla humicola (Bellinger 1985).

lamellifera Axelson, 1903 (Xenyllodes) — no valid U.S. records

** pallescens Scott, 1960a — Xenylla

Odontella (Xenyllodes) wapiti Fjellberg 1985 & bayeri Kseneman 1935

Figure 187.1



O. (X.) wapiti A) Chaetotaxy; B) Labium & postlabial setae; C) Eyes & PAO ; D) Furcula; E) 4th antennal segment. After Fjellberg 1985. O. (X.) bayeri F) Hind foot complex; G) Furcula seen from side; H) Anal horn; I) Eyes and PAO; J) Furcula seen from above. After Kseneman 1935.

Subgenus Xenyllodes Axelson, 1903

Type species: armatus Axelson, 1903

Odontella (Xenyllodes) armata (Axelson), 1903 — Fig. 188

Refs.: Acta Soc. Fauna Flora fenn. 25:4 (Xenyllodes); Stach, 1949a.

Description

Color: white to pale blue with pigment in scattered granules when present; eye patches dark. Fourth antennal segment with clearly differentiated blunt setae. Mouth cone blunt and not protruding. Unguis without teeth. Unguiculus reduced and filamentous but clearly present. Ventral tube with 3+3 setae. Dens with two dorsal setae. Mucro simple and lamellate. Anal spines well developed and on clear papillae. Integument coarsely tuberculate; tubercles with varied basal cross sections but never stellate. Posterior abdominal setae truncate or clavate. Maximum length 1.0 mm.

Remarks

Only a small number of poor specimens were seen. All Nearctic specimens of this subgenus which we observed were referable to this species. The minute size of most specimens makes the unguiculus difficult to see, but it is apparently always present. In Nearctic specimens one tibiotarsal seta is distinctly longer than the others.

Localities: Alaska - Pt. Barrow, Umiat, Chandler Lake; Illinois - Burksville; Indiana - Union Co.; Maryland - Green Ridge Mt., Williamsville; Massachusetts - Middlesex Co.; North Dakota - Dunn Co., McKenzie Co., Oliver Co., Stark Co.

Additional records: Montana (Wray, 1967), North Carolina (Wray, 1950a). Manitoba (Hammer, 1953a).

Fig. 188

Odontella (Xenyllodes) armata

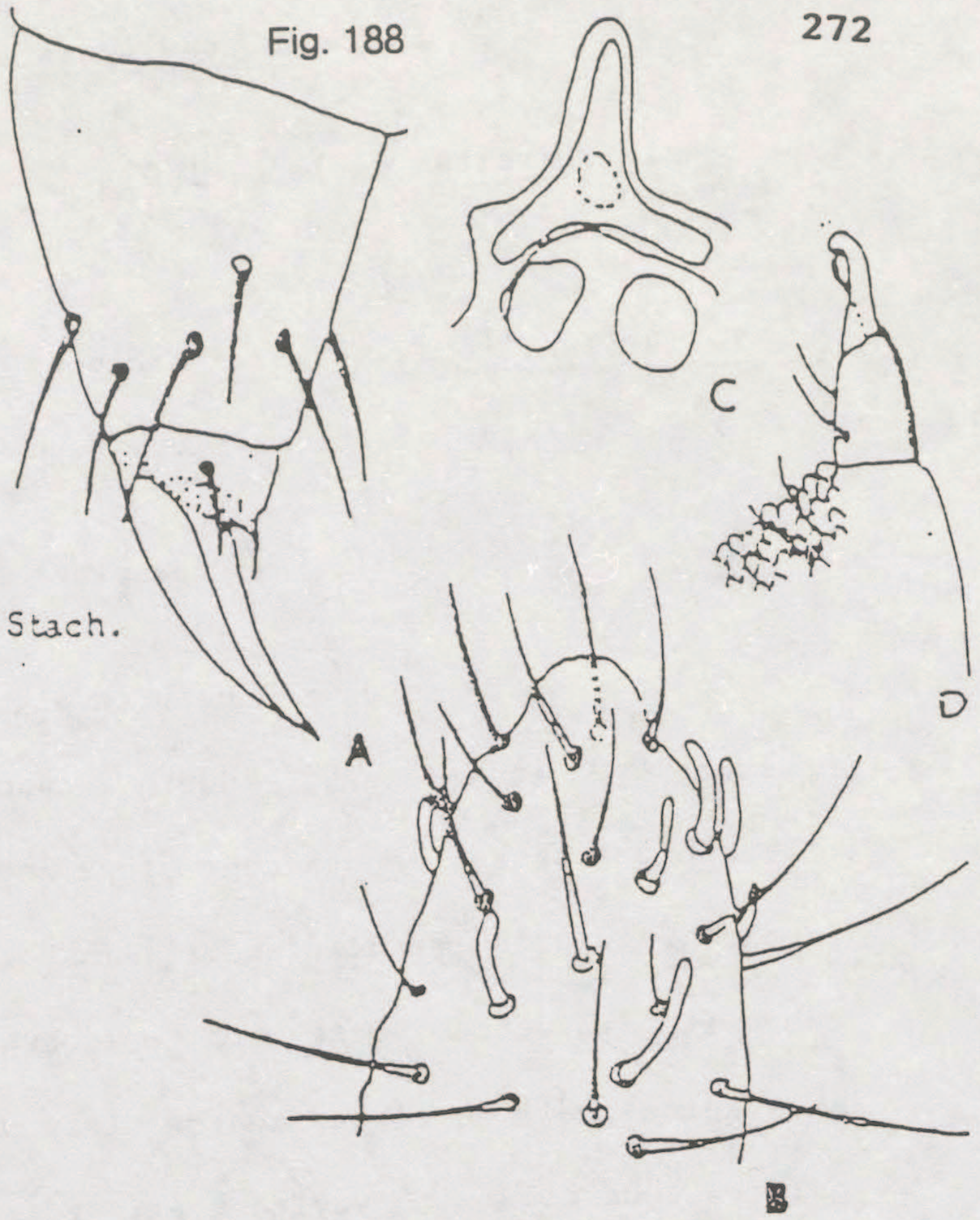
A) Hind foot complex, after Stach.

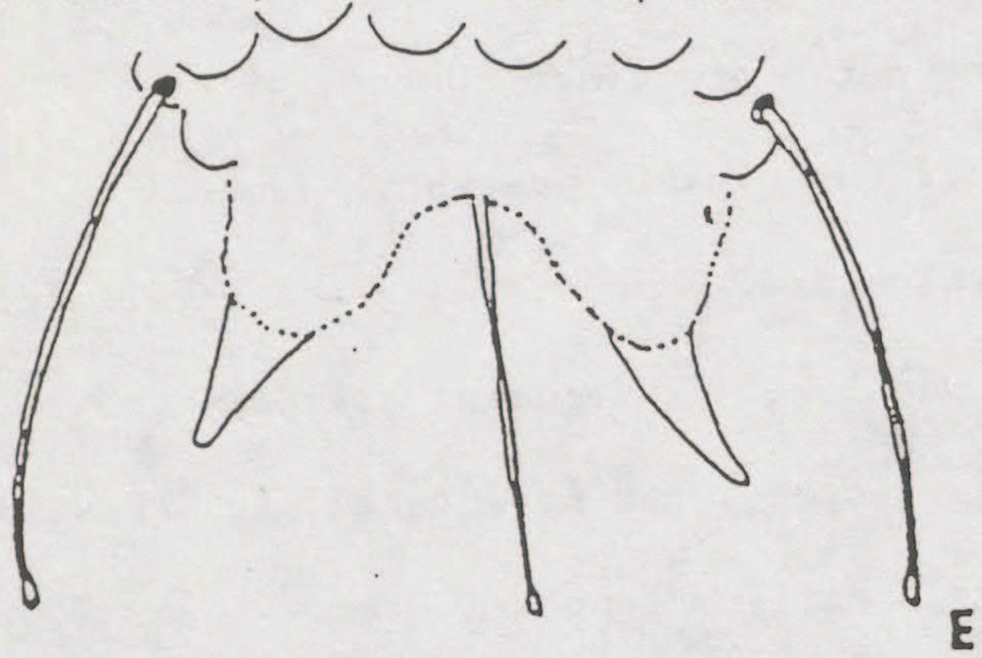
B) Fourth antennal segment, after Stach.

C) Postantennal organ and nearest eyes, after Stach.

D) Mucro and dens, after Axelson.

E) Apex of abdomen, after Massoud, 1967.





Odontella (Odontella) biloba, Christiansen & Bellinger, 1980 Fig. 189

Description

Color: blue (?). Fourth antennal segment with weakly differentiated blunt setae. P.A.O. slightly smaller to slightly larger than nearest eye, unlobed or weakly bilobed. Mouth cone blunt and not projecting. Unguis without inner tooth but with one (possibly two) lateral teeth. Each foot with a single weakly truncate tenent hair. Dens with five dorsal setae ranging from slender and filamentous to heavy and spinelike. Anal spines on clear papillae. Posterior tubercles extremely coarse and irregular. Maximum length 1.1 mm.

The unique P.A.O. readily separates this from all other Nearctic species. In this respect it is transitional to O. denticulata from Chile, in which the P.A.O. is circular; however it differs from the latter species in dental chaetotaxy and claw structure.

Type locality: 6 miles west of Oakville, Napa Co., Calif., litter of Douglas Fir, 23 Feb. 1960 (T.R. Haig).

Additional locality: California - Sonoma Co.

FIGURE 189

Odontella (Odontella) biloba

A) Fore foot complex, specimen from Sonoma Co., California.

B) Dorsal surface of fourth antennal segment, type specimen.

C) Postantennal organ and anterior two eyes, type specimen.

D) Left half of sixth abdominal segment, specimen from Sonoma Co., California.

E) Left eyes and postantennal organ, specimen from Sonoma Co., California.

F) Mucro and dens, specimen from Sonoma Co., California.

Odontella (Odontella) clavata, Christiansen & Bellinger, 1980 Fig. 190

Description

Color: mottled blue. Fourth antennal segment with clearly differentiated blunt setae. P.A.O. about as large as nearest eye. Mouth cone acuminate and moderately protruding. Unguis with prominent lateral teeth and a weak inner tooth. Tenent hairs long and clavate and 3-4 in number. Dens with five dorsal setae, two slender and three heavy and spine-like. Anal spines on clear papillae. Maximum size 2.0 mm.

Remarks

This species is readily separated from all its Nearctic congeners by the large number of clavate tenent hairs. In this respect it resembles O. cornuta Yosii, 1965, but differs in the absence of the cephalic spines characteristic of the latter species. It is also similar to O. substriata as described in this work, but may be readily separated on the larger number of clavate tenent hairs and differing integumentary reticulations.

Type locality: MacDonald Forest, Corvallis, Benton Co., Oregon, 15 October 1949 and 3 November 1949 (Roth).

FIGURE 190

Odontella (Odontella) clavata

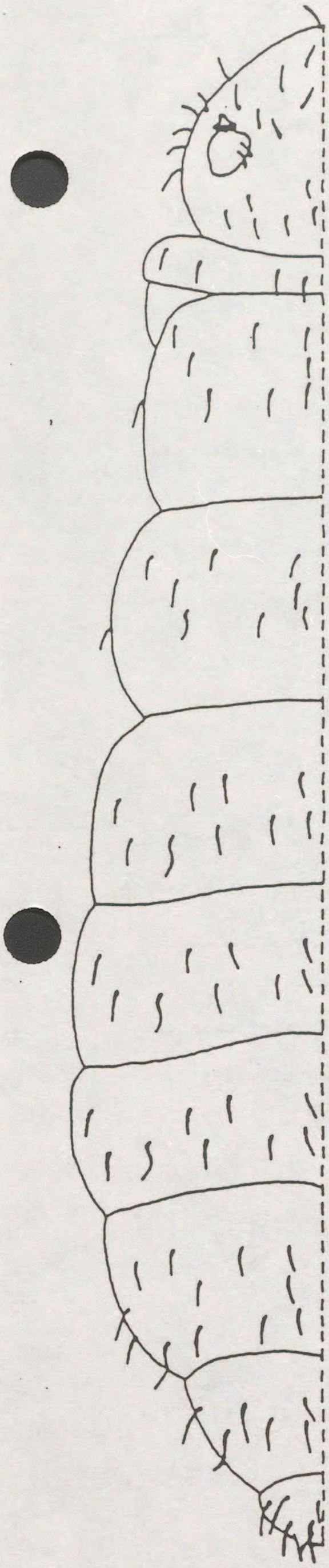
All figures of type specimens.

A) Dorsal chaetotaxy of left side.

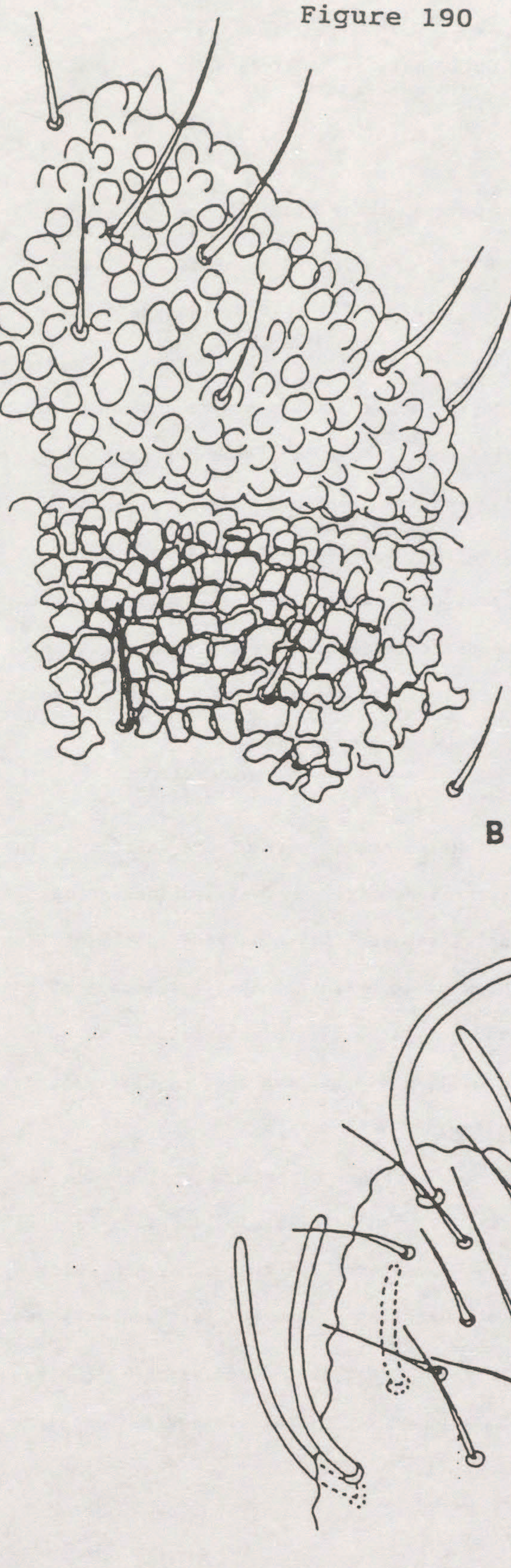
B) Posterior abdomen of left side, from above.

C) Hind foot complex.

D) Fourth antennal segment.



A



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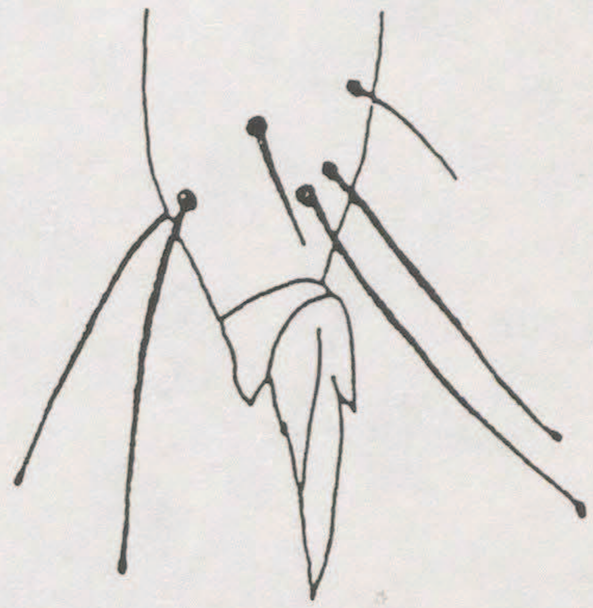

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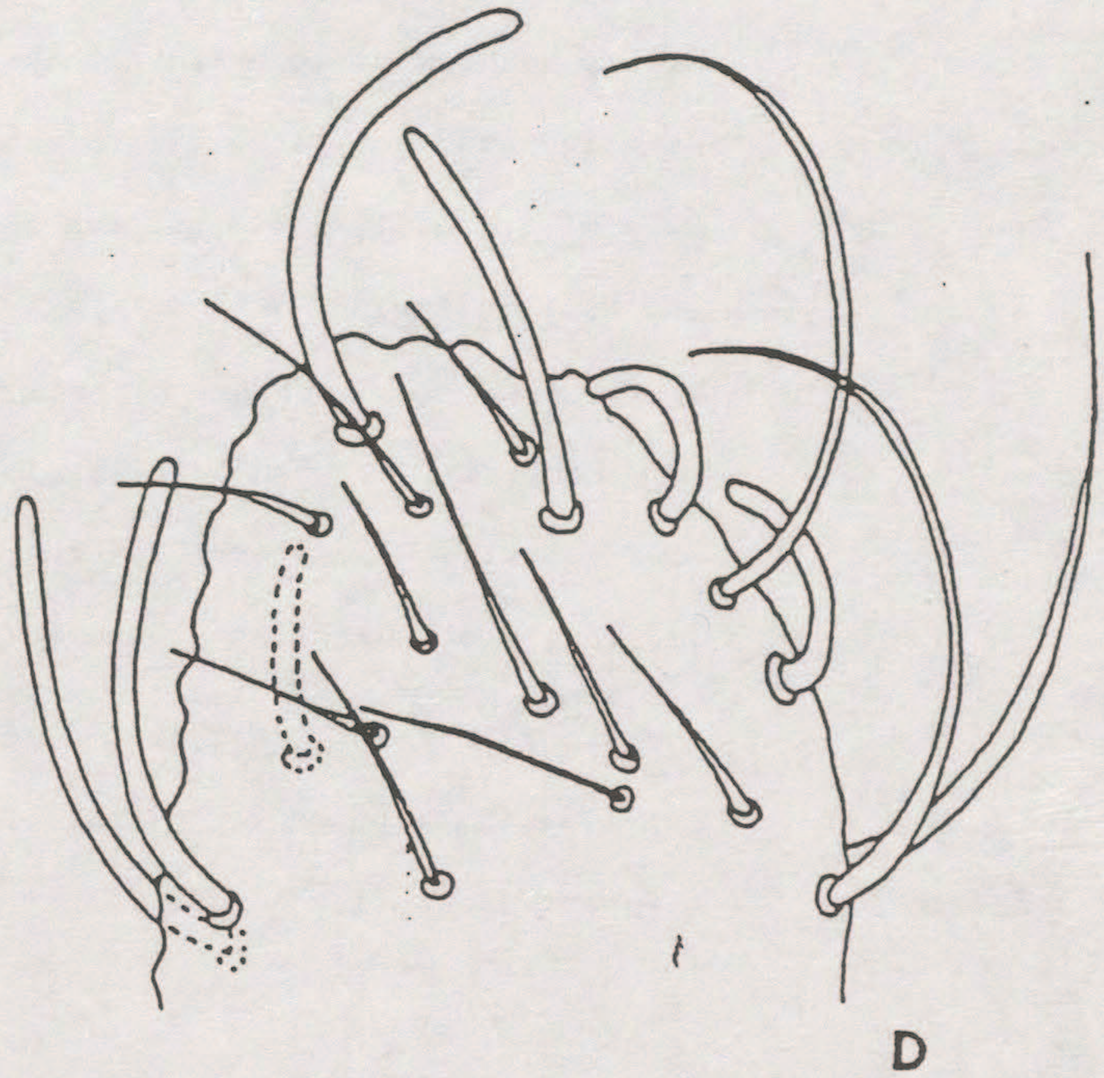


D

Odontella cornifer Mills, 1934 Fig. 191

Ref.: Collembola of Iowa: 25

Description

Color: pale speckled blue, lighter beneath. P.A.O. 1.2 - 1.5 times as large as nearest eye, with 3-4 lobes, the fourth lobe very small when present. Buccal cone ranging from elongate to blunt. Unguis not elongate, with or without a fine inner tooth and with two lateral teeth. Each foot with two elongate setae, one acuminate and one acuminate to minutely clavate. Dens slightly shorter to slightly longer than mucro, with five simple dorsal setae, 3 of which are sometimes considerable thicker than the others. Anal spines ranging from simple and close together to conical with papillae and clearly separated. Granulations of integument relatively regular; largest tubercles on posterior abdominal segments mostly oval or roundish in basal cross section. Longest dorsal abdominal setae smooth and truncate or weakly clavate. Maximum length 1.4 mm.

Remarks

At first we separated some of the California specimens having the anal spines adjacent (see Fig. 191B.) as a different species; however, examination of an extensive series, including some specimens identified as cornifer by Mills, has led us to believe that all are part of one variable taxon. More detailed study may show clear subdivision. We have examined specimens of O. similis Yosii, 1954a, and can find no differences between this species and O. cornifer.

Localities: California - Alameda Co., El Dorado Co., Los Angeles Co., Marin Co., Monterey Co., San Luis Obispo Co., Yolo Co.; Illinois - Karber's Ridge; Iowa - Louisa Co., Story Co. (type); Massachusetts - Middlesex Co., Worcester Co. (?); North Carolina - Buncombe Co.; Oregon - Benton Co.

Additional records: Maryland (Ostdiek, 1961); Missouri (Dowdy, 1965); South Carolina (DuRant and Fox, 1966); Tennessee (Copeland, 1960); West Virginia (Lippert and Butler, 1976).

FIGURE 191

Odontella (Odontella) cornifer

A) Chaetotaxy of left side of fourth abdominal segment, specimen from San Luis Obispo Co., California.

B) Sixth abdominal segment seen from above, specimen from Alameda Co., California.

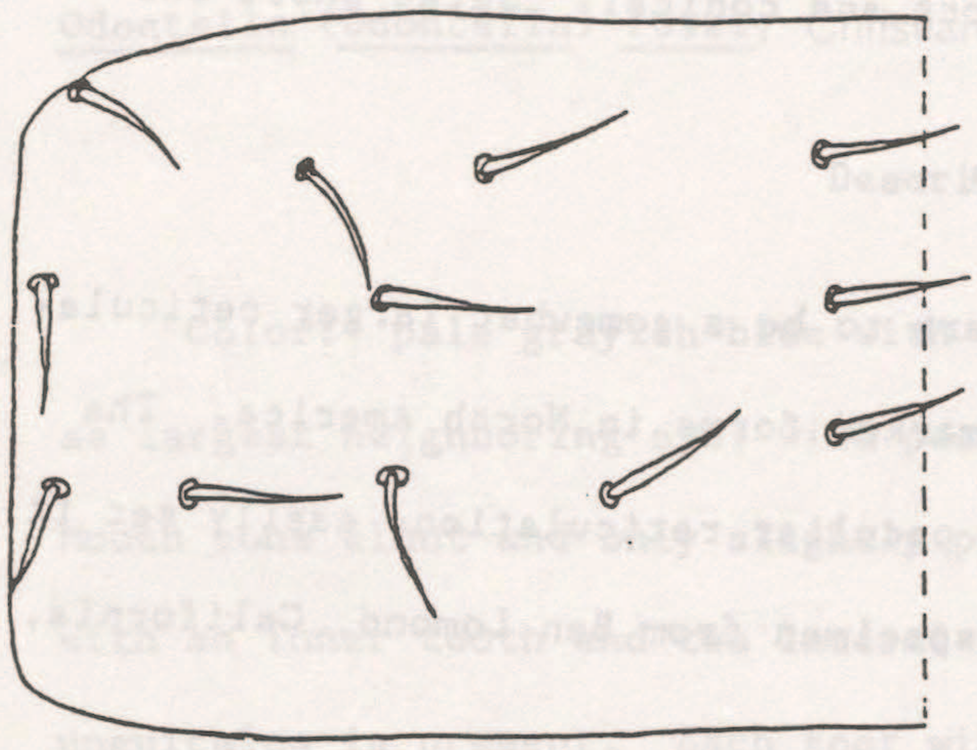
C) Detail of tubercles and seta on dorsum of fifth abdominal segment, specimen from San Luis Obispo Co., California.

D) Fourth antennal segment, same specimen.

E) Postantennal organ and nearest eyes, specimen from Alameda Co., California.

F) Anal spines, after Mills.

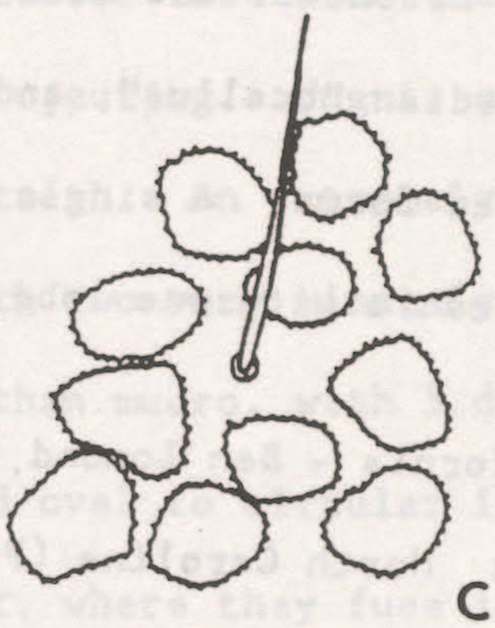
G) Profile of head, after Mills.



A



B



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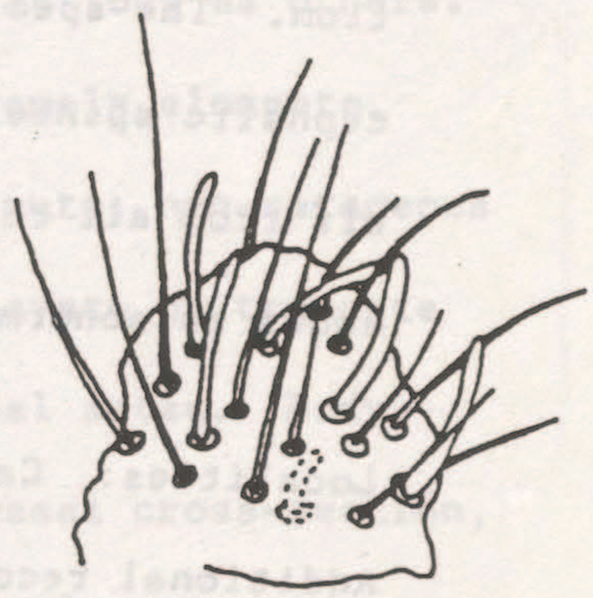

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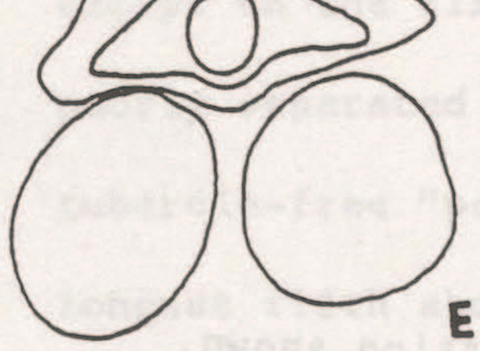

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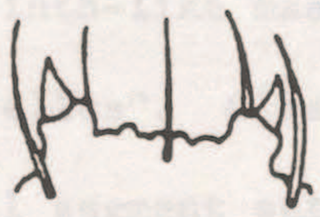
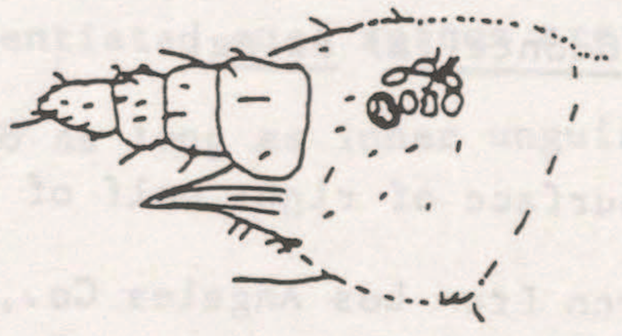


F



G

Odontella (Odontella) ewingi Folsom, 1916 Fig. 192

Ref.: Proc. U.S. natn. Mus. 50:502

Syn.: Xenylla helena Scott, 1937, Pan-Pacif. Ent. 13:133

Description

Color: blue (?) with black eye patches. Fourth antennal segment very small and with slightly differentiated blunt setae. P.A.O. with posterior lobe much smaller than the others. Buccal cone clear and projecting. On each side of the head there are 6-8 stout short spines. Head with a single mid-dorsal "ocellus" near the posterior margin. Unguis short and stout with a clear inner tooth and two lateral teeth. Tibiotarsus with a single acuminate tenent hair. Dens slightly longer than mucro, with two dorsal setae and three dorsal spines. Body coarsely reticulate, with the appearance of the reticulated surface being that of a complex jig-saw puzzle. Anal spines minute, or on papillae, short and conical. Setae short and acuminate. Maximum length 2 mm.

Remarks

The "pseudocellus" of Folsom appears to be a somewhat larger reticulation. The species is one of the best marked forms in North America. The cephalic spines, median "ocellus", and peculiar reticulations easily set it off from all related forms. A single specimen from Ben Lomond, California, shows an abnormal mucro with one lobe.

Localities: California - Ben Lomond, Los Angeles Co.; Oregon - Benton Co. (type).

Additional record: North Carolina (Pearse, 1945).

FIGURE 192

Odontella (Odontella) ewingi

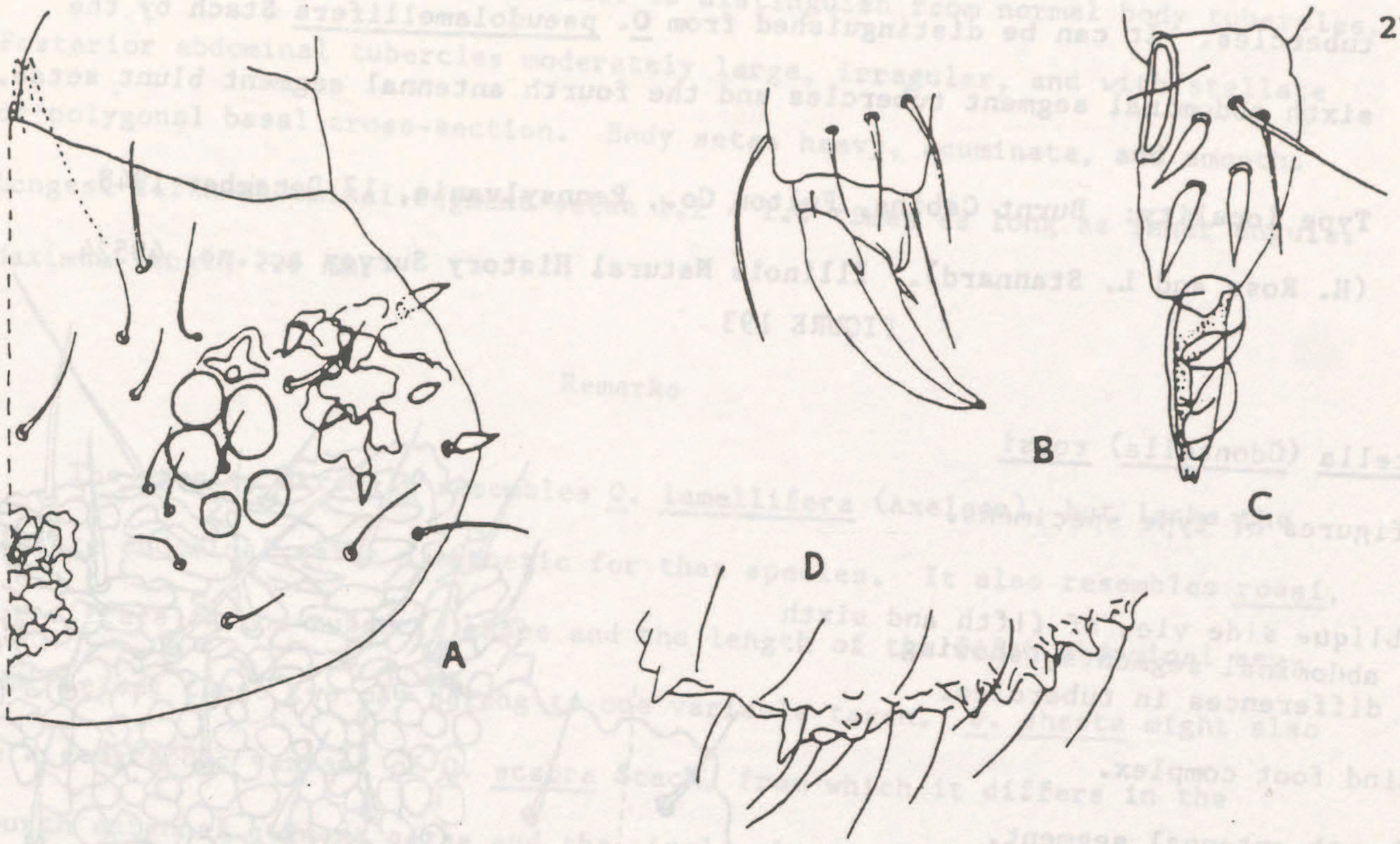
A) Dorsal surface of right half of head with samples of reticulation shown, specimen from Los Angeles Co., California.

B) Fore foot complex, after Folsom.

C) Mucro and dens, after Folsom.

D) End of abdomen, after Folsom.

Figure 192



Odontella (Odontella) rossi, Christiansen & Bellinger, 1980 Fig. 193

Description

Color: pale grayish blue with dark eye patches. P.A.O. about as long as largest neighboring eye; with posterior lobe about half as long as others. Mouth cone blunt and only slightly projecting. Unguis extremely elongate, with an inner tooth and two lateral teeth. An extremely minute, non-setaceous unguiculus is present. Each foot with two very minutely clavate or truncate tenent hairs. Dens slightly longer than mucro, with 5 dorsal setae. Body tubercles semicircular in profile and oval to circular in basal cross-section, except on the sixth abdominal segment, where they fuse into elongate and poorly separated labyrinth-like masses. Posterior to each eye spot is a tubercle-free "pseudocellus". Clearly differentiated anal spines are absent. Longest fifth abdominal segment setae about .8 as long as inner unguis. Maximum length 1.4 mm.

Remarks

This species is very similar to shasta but may be distinguished by the much shorter fifth abdominal segment setae and the different integumentary

tubercles. It can be distinguished from O. pseudolamellifera Stach by the sixth abdominal segment tubercles and the fourth antennal segment blunt setae.

Type locality: Burnt Cabins, Fulton Co., Pennsylvania, 17 December 1948 (H. Ross and L. Stannard). Illinois Natural History Survey acc.no. 49524.

FIGURE 193

Odontella (Odontella) rossi

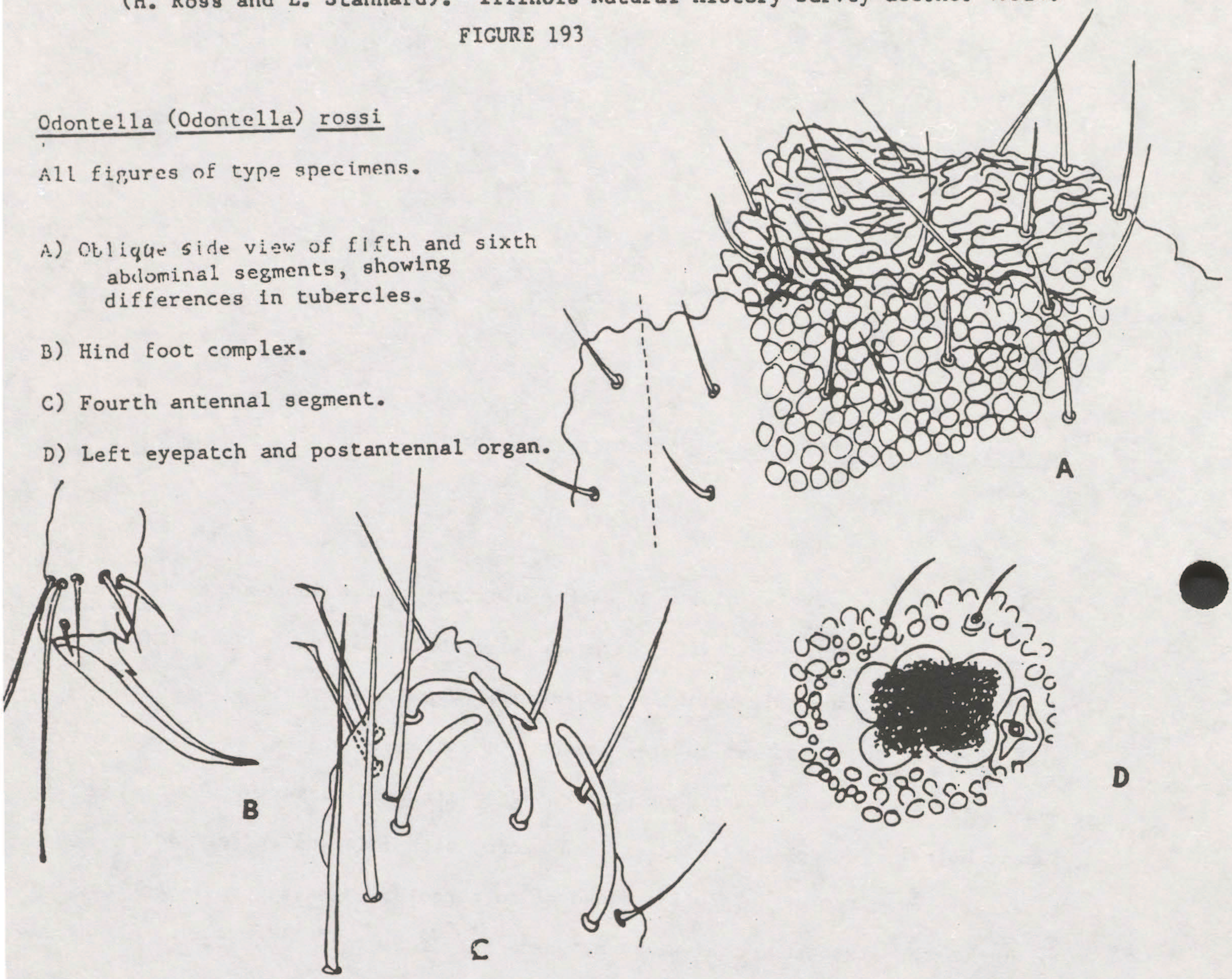
All figures of type specimens.

A) Oblique side view of fifth and sixth abdominal segments, showing differences in tubercles.

B) Hind foot complex.

C) Fourth antennal segment.

D) Left eyepatch and postantennal organ.



Odontella (Odontella) shasta, Christiansen & Bellinger, 1980 Fig. 194

Description

Color: blue (?), paler ventrally. P.A.O. with 4 lobes, the fourth lobe sharply angled upward so as to appear smaller than the others in some views, 1.1 - 1.8 times as large as largest neighboring eye. Mouth cone elongate and strongly projecting. Unguis with clear inner tooth and two lateral teeth. Each foot with a weakly clavate or acuminate tenent hair. Dens with five

dorsal setae. Anal spines difficult to distinguish from normal body tubercles. Posterior abdominal tubercles moderately large, irregular, and with stellate or polygonal basal cross-section. Body setae heavy, acuminate, and smooth. Longest fifth abdominal segment setae 1.2 - 1.6 times as long as inner unguis. Maximum length 1.6 mm.

Remarks

The species strongly resembles O. lamellifera (Axelson), but lacks the clavate abdominal setae diagnostic for that species. It also resembles rossi, but differs in the tubercle shape and the length of the fifth abdominal segment setae; these two may belong to one variable taxon. O. shasta might also be a geographic variant of O. scabra Stach, from which it differs in the fourth antennal segment setae and the single clavate tenent hair. It is very near O. biwonensis Lee, 1974, which however has 9 blunt setae on the fourth antennal segment.

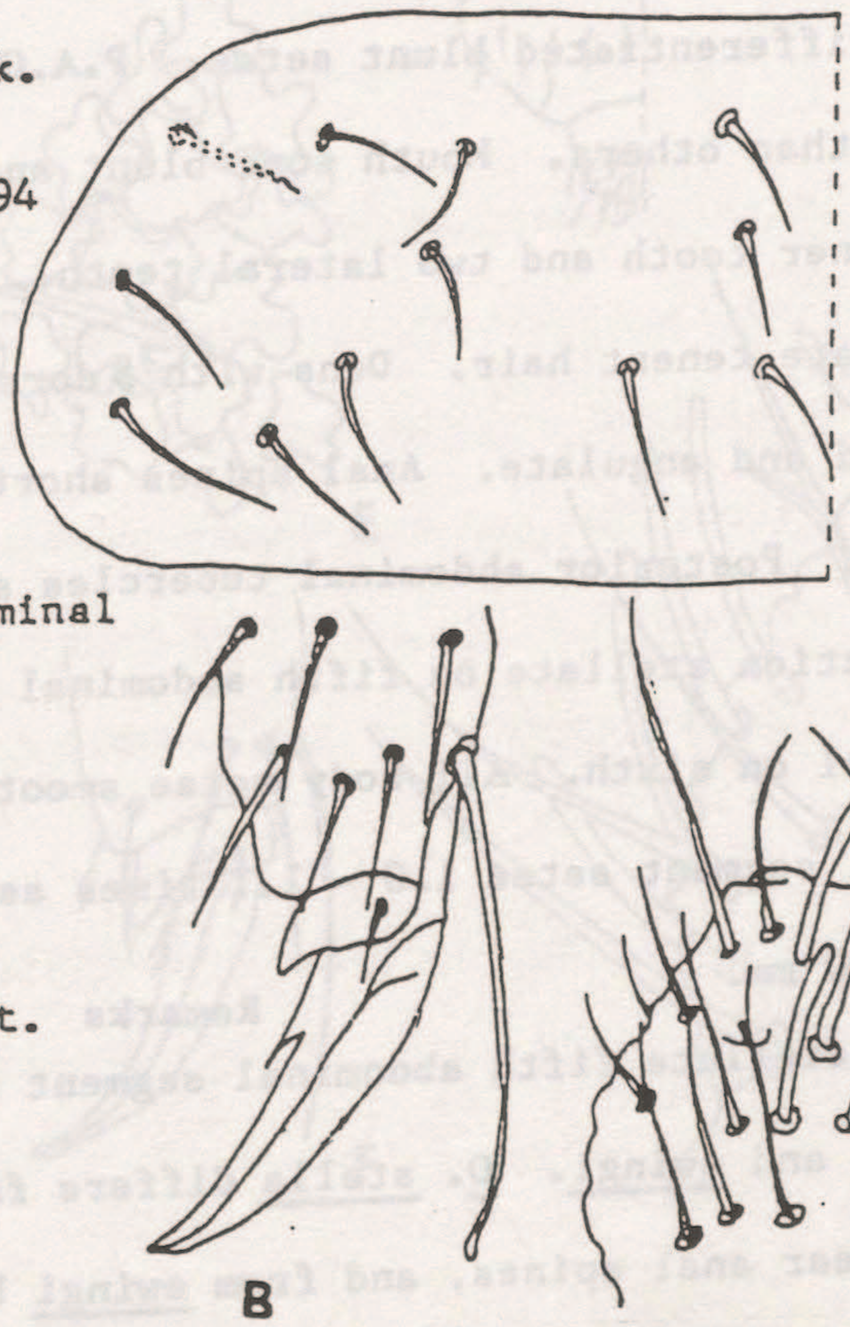
Type locality: Two miles down from Bunny Flat, Mt. Shasta, Shasta Co., California, Tullgren extract of duff, 24 July 1970 (T.R. Haig).

Additional localities: California - Siskiyou Co.; Illinois - (doubtful)- Massac Co., Starved Rock State Park.

FIGURE 194

Odontella (Odontella) shasta

All figures of type specimens.



A) Chaetotaxy of left side of fourth abdominal segment; dotted setae visible on one side only.

B) Hind foot complex.

C) Apex of fourth antennal segment.

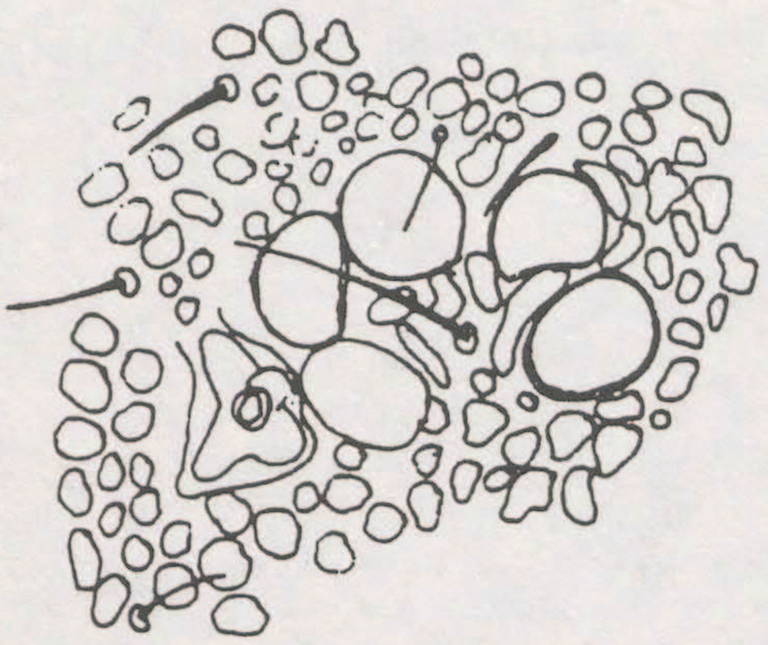
D) Oblique view of sixth abdominal segment.

E) Left eyepatch and postantennal organ.

F) Buccal cone, seen from side.

(Figures D, E, and F on next page)

FIGURE 194 Odontella (Odontella) shasta, continued.
All figures of type specimens.
D) Obligue view of sixth abdominal segment.
E) Left eyepatch and postantennai organ.
F) Buccal cone, seen from side.



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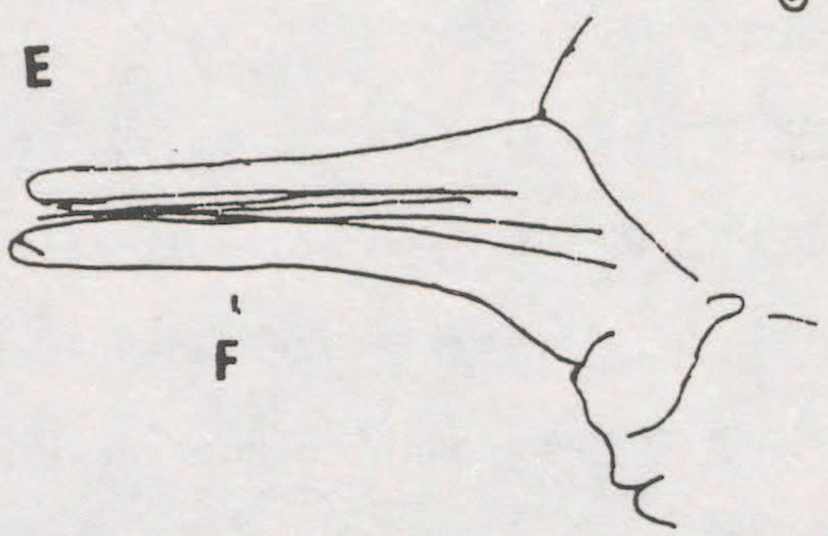
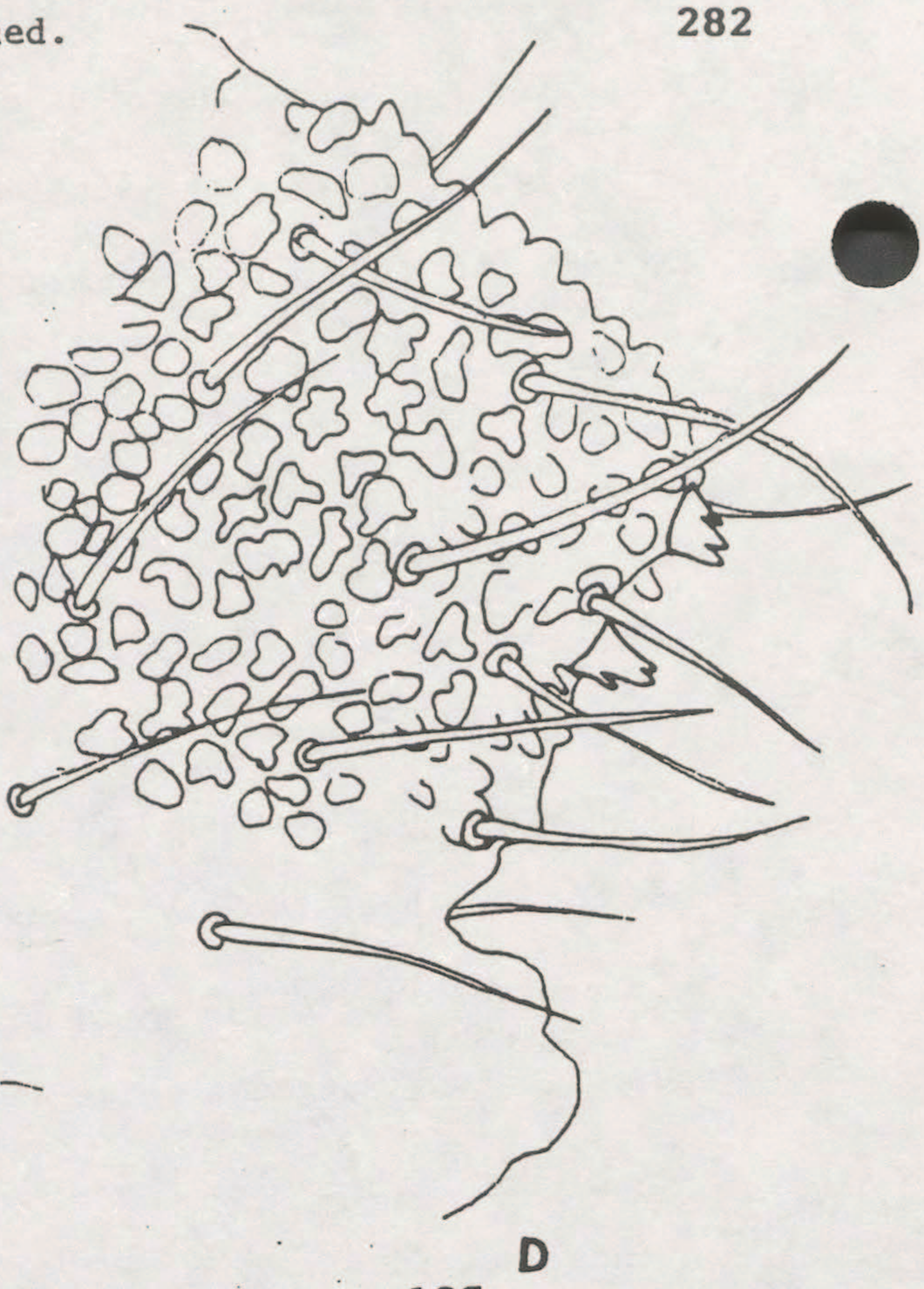


F



D

Odontella (Odontella) stella, Christiansen & Bellinger, 1980 Fig. 195

Description

Color: blue, with venter and intersegmental membranes yellow, giving a banded appearance as in O. substriata. Fourth antennal segment with poorly differentiated blunt setae. P.A.O. with posterior lobe somewhat smaller than others. Mouth cone blunt and not protruding. Unguis with a clear inner tooth and two lateral teeth. Each foot with a single acuminate or truncate tenent hair. Dens with 5 dorsal setae, 3 of which are basally thickened and angulate. Anal spines short, heavy, and distinct, on basal papillae. Posterior abdominal tubercles small to moderate in size; basal cross section stellate on fifth abdominal segment but generally oval to elliptical on sixth. All body setae smooth and acuminate; longest fifth abdominal segment setae 1.0 - 1.1 times as long as inner unguis. Maximum length 1.0 mm.

Remarks

The stellate fifth abdominal segment tubercles are similar to those seen in shasta and ewingi. O. stella differs from shasta and from O. scabra by having clear anal spines, and from ewingi by lacking cephalic spines. A

single specimen from California was seen; it differs from the Pennsylvania forms in the thoracic and fourth abdominal segment chaetotaxy, but is otherwise very similar.

Type locality: Bear Meadows, Centre Co., Pennsylvania, rotten stump, 25 October 1952 (S.W. Frost).

Additional localities: California - Marin Co.; Illinois - Jackson Co. (cave), North Carolina - Whitelake.

FIGURE 195

Odontella (Odontella) stella

A) Dorsal chaetotaxy of left side, type specimen.

B) Chaetotaxy of right side of fifth abdominal segment, type specimen.

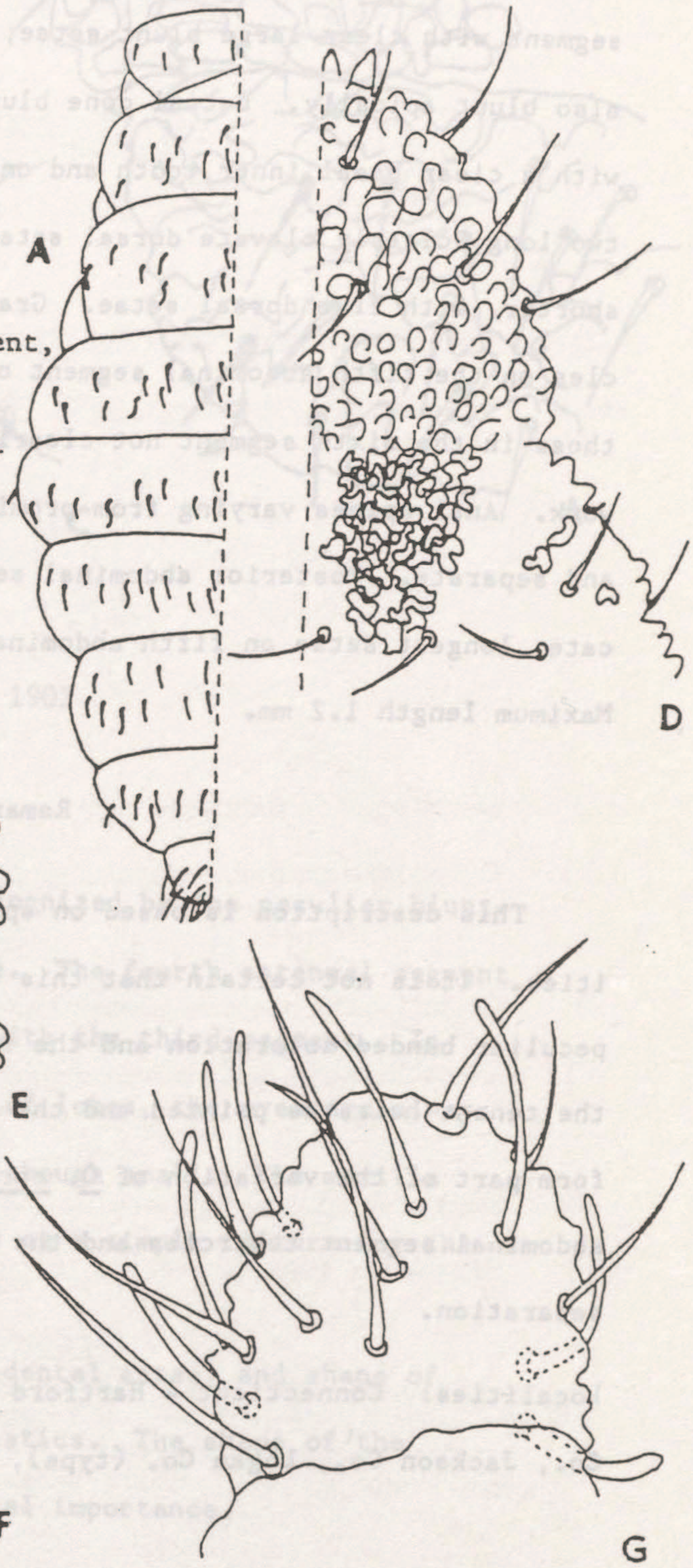
C) Chaetotaxy of left side of fifth abdominal segment, specimen from Marin Co., California.

D) Dorsum of left side of fifth and sixth abdominal segments, type specimen.

E) Detail of fifth abdominal segment tubercles, type specimen.

F) Mid foot complex, type specimen.

G) Fourth antennal segment, type specimen.



Odontella (Odontella) substriata Wray, 1952 Fig. 196

Ref.: Bull. Brooklyn ent. Soc. 47:104

Description

Color: pigment granular and blue, absent along intersegmental membranes giving the specimen a banded appearance; paler ventrally. Fourth antennal segment with clear large blunt setae; many of the more slender setae are also blunt apically. Buccal cone blunt to protruding. Unguis long and slender, with a clear basal inner tooth and one or two lateral teeth. Each foot with two long, clearly clavate dorsal setae. Dens subequal to mucro or slightly shorter, with five dorsal setae. Granulations of integument variable. Tubercles on the fifth abdominal segment oval to polygonal or elongate rectangular; those in the sixth segment not clearly separated, forming a complex ridgework. Anal spines varying from prominent to very small, but always on papillae and separate. Posterior abdominal setae smooth, acuminate to weakly truncate; longest setae on fifth abdominal segment subequal to inner unguis. Maximum length 1.2 mm.

Remarks

This description is based on specimens from a number of Illinois localities. It is not certain that this form is the same as substriata; the peculiar banded coloration and the locality are the same, but Wray described the tenent hairs as pointed and the unguis as untoothed. This species may form part of the variation of O. cornifer; however the very different sixth abdominal segment tubercles and the two clavate tenent hairs appear to justify separation.

Localities: Connecticut - Hartford Co. (?); Illinois - Champaign Co., Clark Co., Jackson Co., Logan Co. (type), Pope Co.; North Carolina - Watauga Co.

Odontella (Odontella) substriata

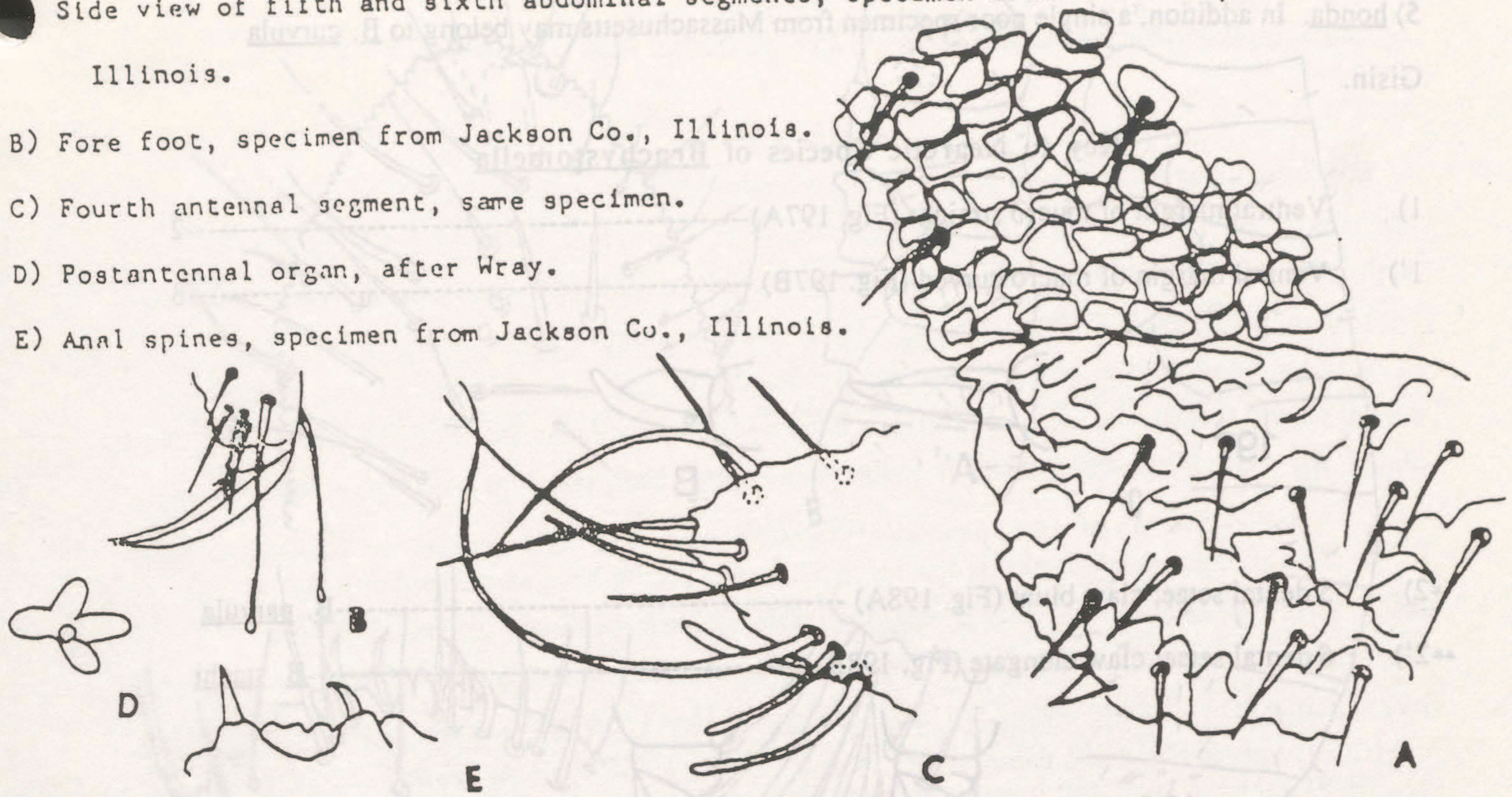
A) Side view of fifth and sixth abdominal segments, specimen from Clark Co., Illinois.

B) Fore foot, specimen from Jackson Co., Illinois.

C) Fourth antennal segment, same specimen.

D) Postantennal organ, after Wray.

E) Anal spines, specimen from Jackson Co., Illinois.



Genus Brachystomella Ågren, 1903

Type species: B. maritima Ågren, 1903.

This largely tropical genus is readily recognized by the peculiar blunt-toothed maxilla and the absence of the mandible. The fourth antennal segment has a well developed apical bulb and is fused with the third segment. In Nearctic species the P.A.O. has a small number of lobes, the eyes are always 8+8, and the furcula is present and complete although small. The maxilla is easily seen in cleared specimens, and serves as a simple feature for the identification of the genus.

The shape of the mucro, the tenent hairs, dental setae, and shape of the P.A.O. are the primary taxonomic characteristics. The shape of the maxilla and the setal structure are of occasional importance.

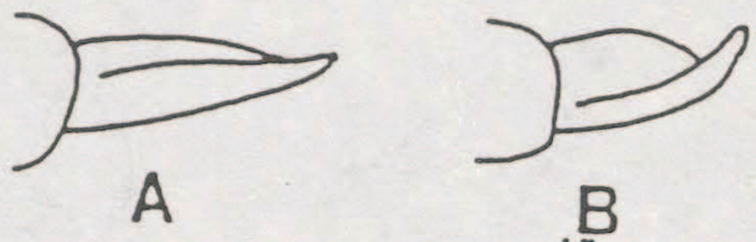
There are five Nearctic species: 1) neomexicana; 2) parvula; 3) stachi; 4) villalobosi; 5) honda. In addition, a single poor specimen from Massachusetts may belong to B. curvula Gisin.

Key to Nearctic Species of Brachystomella

1) Ventral margin of mucro straight (Fig. 197A)----------2

1') Ventral margin of mucro curved (Fig. 197B) ----------3

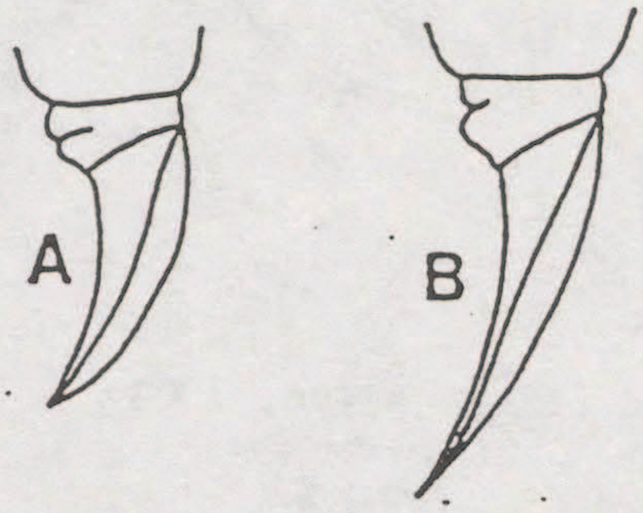
197



*2) 5 dental setae; claw blunt (Fig. 198A) ----------B. parvula

**2') 6 dental setae; claw elongate (Fig. 198B) ----------B. stachi

198



*3) Dorsal setae on sixth abdominal segment clavate ----------B. villalobosi

3') Dorsal setae on sixth abdominal segment acuminte----------4

*4) Dorsal lamella of mucro strongly curved, ending well before apex----------B. neomexicana

4') Dorsal lamella weakly curved or angled, nearly attaining apex ----------5

*5) Dens with 6 dorsal setae ----------B. curvula

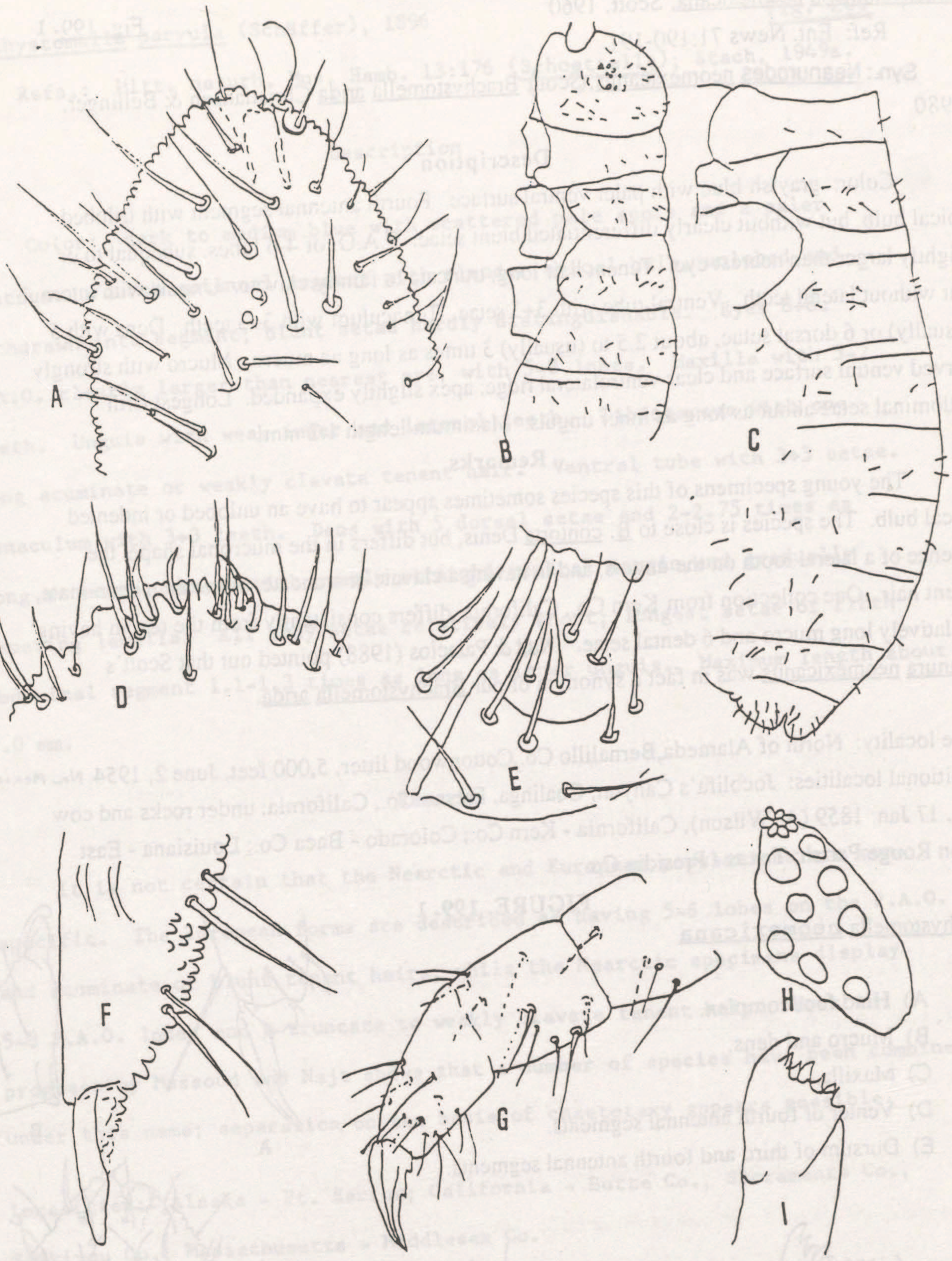
**5') Dens with 4 dorsal setae ----------B. honda Christiansen & Bellinger 1988

Brachystomella curvula Gisin 1948



Brachystomella honda Christiansen & Bellinger 1988

Figure 199



Brachystomella honda. A) Apex of antenna, holotype. B) and C) Anterior and posterior dorsal chaetotaxy, paratypes. D) Labrum, specimen from Pigeon Key. E) Ventral labial triangle, left side, specimen from Pigeon Key. F) Dens and mucro, paratype. G) Hind leg, specimen from Pigeon Key. H) Eyes and postantennal organ, left side, same specimen. I) Maxilla, specimen from Pigeon Key.

Brachystomella neomexicana, Scott, 1960 Fig. 199-1

Ref: Ent. News 71:190-191

Syn.: Neanurodes neomexicanus, (Scott); Brachystomella arida Christiansen & Bellinger, 1980.

Description

Color: grayish blue with paler ventral surface. Fourth antennal segment with trilobed apical bulb, but without clearly differentiated blunt setae. P.A.O. of 4-6 lobes, subequal to or slightly larger than nearest eye. Tenent hair long, truncate to faintly clavate. Unguis with internal but without lateral teeth. Ventral tube with 3+3 setae. Tenaculum with 3+3 teeth. Dens with 5 (usually) or 6 dorsal setae, about 2.5 to (usually) 3 times as long as mucro. Mucro with strongly curved ventral surface and clear ventrolateral ridge; apex slightly expanded. Longest fifth abdominal setae about as long as inner unguis. Maximum length 1.2 mm.

Remarks

The young specimens of this species sometimes appear to have an unlobed or indented apical bulb. The species is close to B. contorta Denis, but differs in the mucronal shape, the absence of a lateral tooth on the unguis, and in having a clavate or truncate, rather than acuminate, tenent hair. One collection from Kern Co., California, differs consistently from the rest in having a relatively long mucro and 6 dental setae. Najt & Palacios (1988) pointed out that Scott's Neanura neomexicanus was in fact a synonym of our Brachystomella arida.

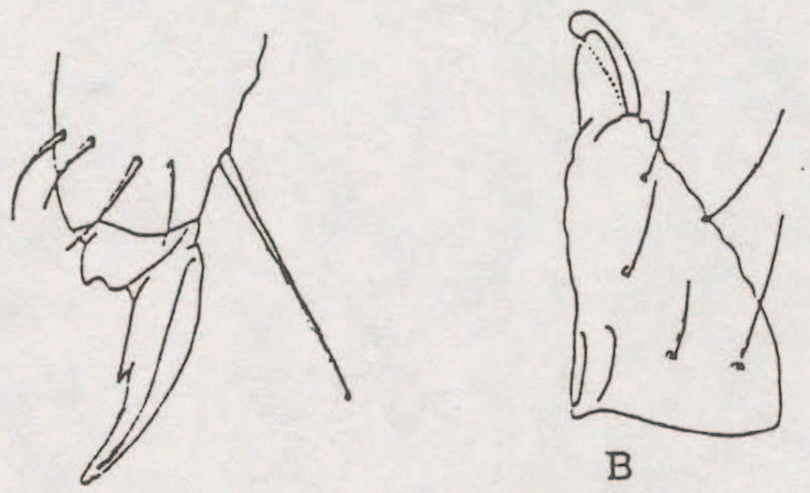
Type locality: North of Alameda, Bernalillo Co., Cottonwood litter, 5,000 feet, June 2, 1954. New Mexico

Additional localities: Jocolifa's Canyon, Coalinga, Fresno Co., California: under rocks and cow chip, 17 Jan. 1859 (A. Wilson), California - Kern Co.; Colorado - Baca Co.; Louisiana - East Baton Rouge Parish; Texas - Presidio Co.

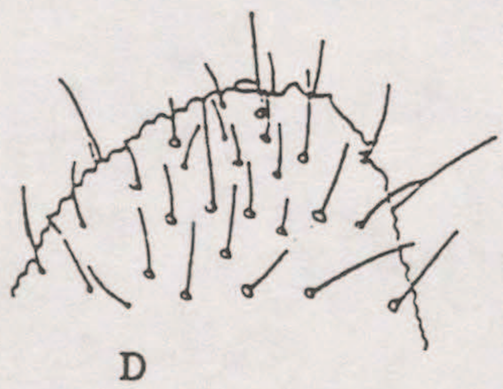
FIGURE 199-1

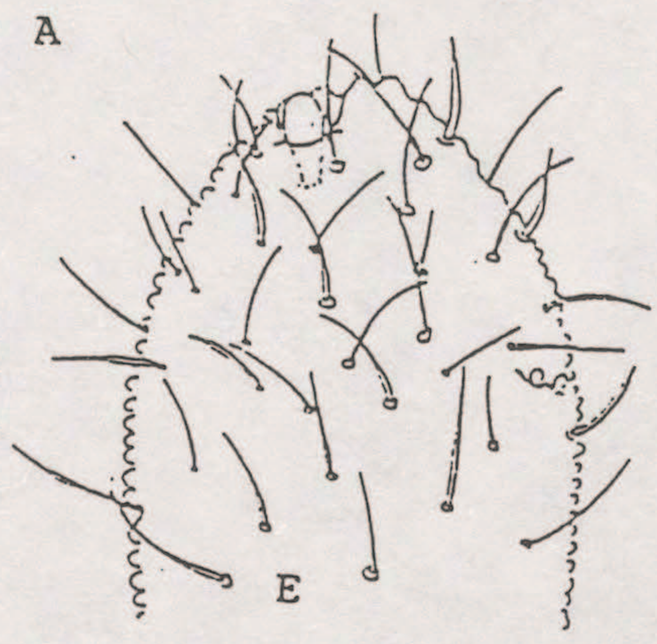
Brachystomella neomexicana

A) Hind foot complex.
B) Mucro and dens.
C) Maxilla.
D) Venter of fourth antennal segments.
E) Dorsum of third and fourth antennal segments.









Brachystomella parvula (Schäffer), 1896 Fig. 200

Refs.: Mitt. naturh. Mus. Hamb. 13:176 (Schoettella); Stach, 1949a.

Description

Color: dark to medium blue with scattered pale spots and a paler ventrum. Fourth antennal segment with slender apical bulb, unlobed and withdrawn into segment; blunt setae hardly distinguishable. Eyes 8+8. P.A.O. clearly larger than nearest eye, with 5-8 lobes. Maxilla with 5-7 teeth. Unguis with weak inner and lateral teeth. Tibiotarsus with one long acuminate or weakly clavate tenent hair. Ventral tube with 3+3 setae. Tenaculum with 3+3 teeth. Dens with 5 dorsal setae and 2-2.75 times as long as mucro. Mucro with nearly straight ventral margin and gradually tapering lamella. All body setae relatively short; longest setae of fifth abdominal segment 1.1-1.3 times as long as inner unguis. Maximum length about 1.0 mm.

Remarks

It is not certain that the Nearctic and European populations are conspecific. The European forms are described as having 5-6 lobes on the P.A.O. and acuminate or blunt tenent hairs, while the Nearctic specimens display 5-8 P.A.O. lobes and a truncate to weakly clavate tenent hair. Work in progress by Massoud and Najt shows that a number of species have been combined under this name; separation on the basis of chaetotaxy appears possible.

Localities: Alaska - Pt. Barrow; California - Butte Co., Sacramento Co., Siskiyou Co.; Massachusetts - Middlesex Co.

Additional records: Iowa (Mills, 1934); Utah (Wray and Knowlton, 1956a); Wisconsin (Lussenhop, 1973).

Biology: Adams and Salmon, 1972; Poinsot-Balaguer, 1976a.

FIGURE 200

Brachystomella parvula

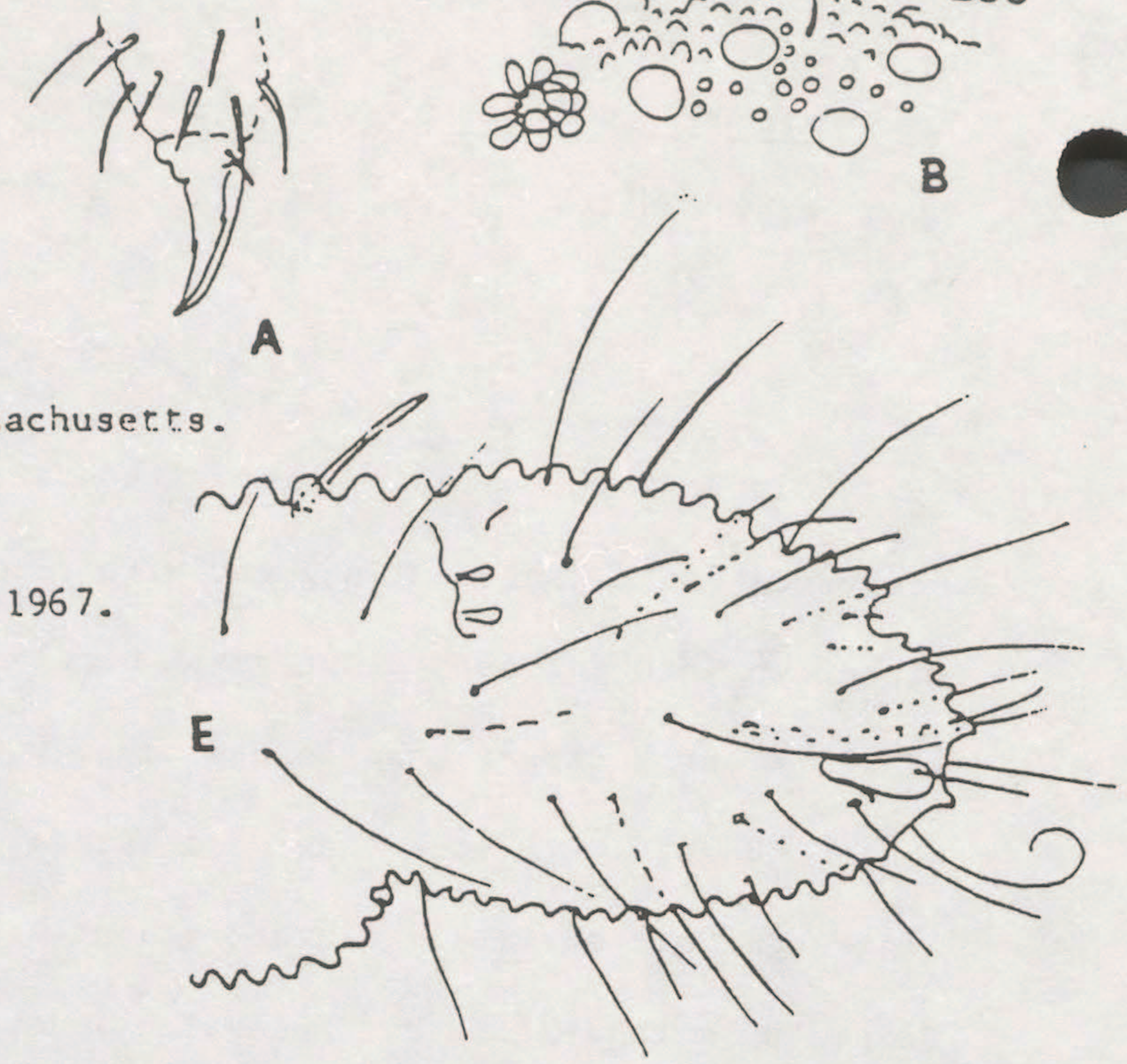
A) Hind foot complex, after Mills.

B) Postantennal organ and eyes, after Mills.

C) Maxilla, specimen from Middlesex Co., Massachusetts.

D) Mucro and dens, after Mills.

E) Dorsum of apex of antenna, after Massoud, 1967.



Brachystomella stachi Mills, 1934

Fig. 201

Ref: Collembola of Iowa: 19.

Description

Color: blue with irregular pigment; lighter ventrally. Fourth antennal segment with an unlobed apical bulb and six clear blunt setae. P.A.O. of 4-5 tubercles. Unguis elongate, with clear inner tooth. Tenent hair acuminate to weakly clavate. Dens about twice as long as mucro, with 6 dorsal setae. Mucro elongate triangular, with straight ventral edge. Maximum length .8 mm.

Remarks

The elongate unguis, straight large mucro, and six dental setae serve to separate this from other Nearctic forms. The type specimen examined showed little detail, and the description above is based on that of Mills and a single New York specimen. A number of specimens from Massachusetts agreed generally but had notably long setae on all body segments, whereas Mills described the species as having "sparse, short curving setae...longer on the last two segments of the abdomen".

Localities: Connecticut - Hartford Co.; Florida - Jackson Co.; Iowa - Story Co. (type); Massachusetts - Middlesex Co.; New York - Orange Co.

Additional records: Indiana (Pedigo, 1970a); Missouri (Dowdy, 1965); North Carolina (Brimley, 1938).

FIGURE 201

Brachystomella stachi

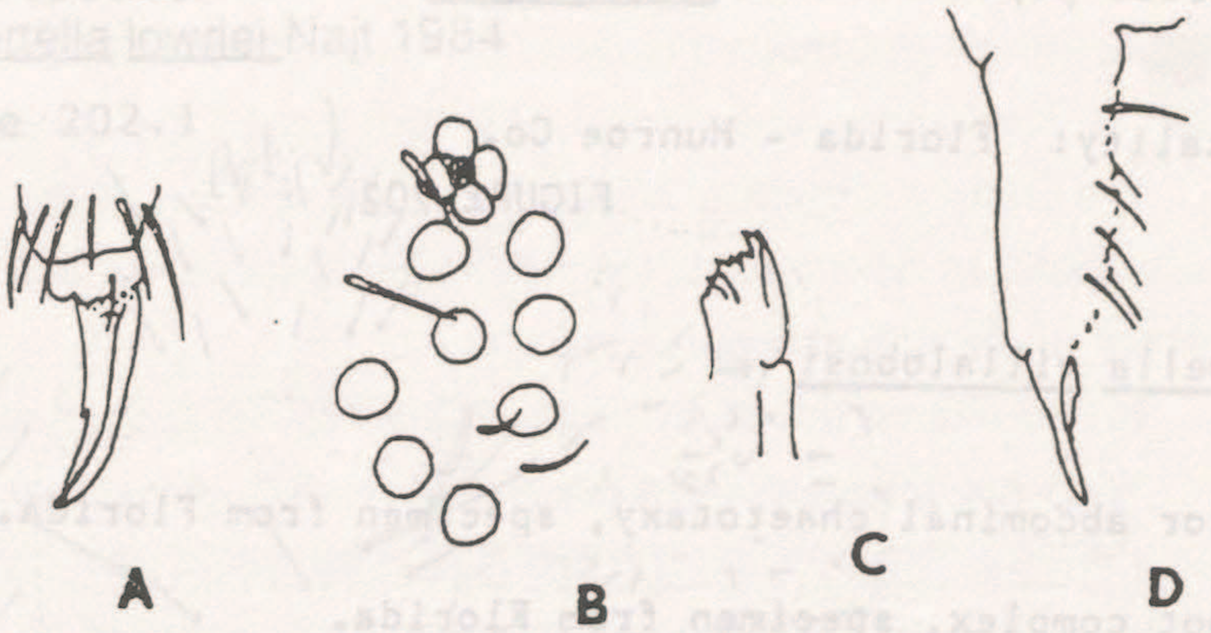
All figures after Mills.

A) Hind foot complex.

B) Postantennal organ and eyes.

C) Maxilla.

D) Mucro and dens.



Brachystomella villalobosi Cassagnau and Rapoport, 1962 Fig. 202

Ref.: Biol. Amer. austr. 1:154.

Description

Color: blue with granular pigment, paler ventrally. Fourth antennal segment with a clear trilobed apical bulb and 4 weakly differentiated blunt setae. P.A.O. of 3-4 lobes, smaller than largest eye. Unguis with or without a weak inner tooth. 3 - 4 clavate tenent hairs of similar length on each leg. Dens a little more than twice length of mucro, with 3 dorsal setae. Mucro short and stout with a strikingly curved ventral lamella. Some posterior setae clavate, weakly on the fifth and strongly on the sixth abdominal segments. Maximum length 1.2 mm.

Remarks

The single collection we have seen of this species is from one of the Florida Keys. It differs from the description of villalobosi in the longer lateral tenent hairs, the size of the dental setae, and details of the fifth abdominal segment chaetotaxy. Other similar species are the Japanese B. hiemalis Yosii, 1956, with a relatively shorter mucro and differences in the

unguis and tenent hairs, and B. globulosa Cassagnau and Rapoport, 1962, which 273
lacks clavate posterior setae. For the moment it seems best to assign the Florida population to villalobosi.

Locality: Florida - Munroe Co.

FIGURE 202

Brachystomella villalobosi

A) Posterior abdominal chaetotaxy, specimen from Florida.

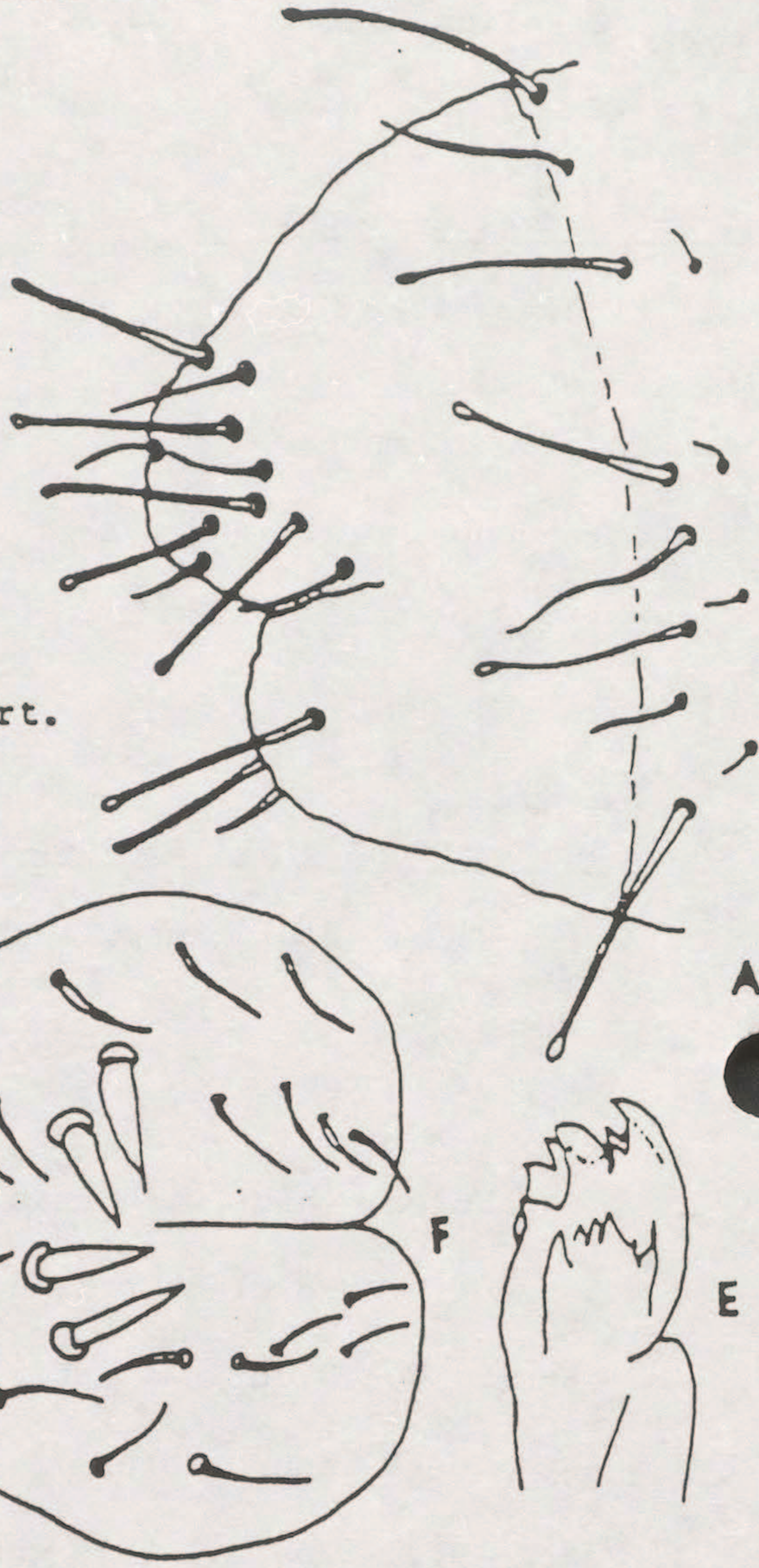
B) Hind foot complex, specimen from Florida.

C) Postantennal organ and eyes, after Cassagnau and Rapoport.

D) Mucro and dens, specimen from Florida.

E) Maxilla, after Cassagnau and Rapoport.

F) Male genital plate, after Cassagnau and Rapoport.



Genus Rapoportella Ellis & Bellinger 1973

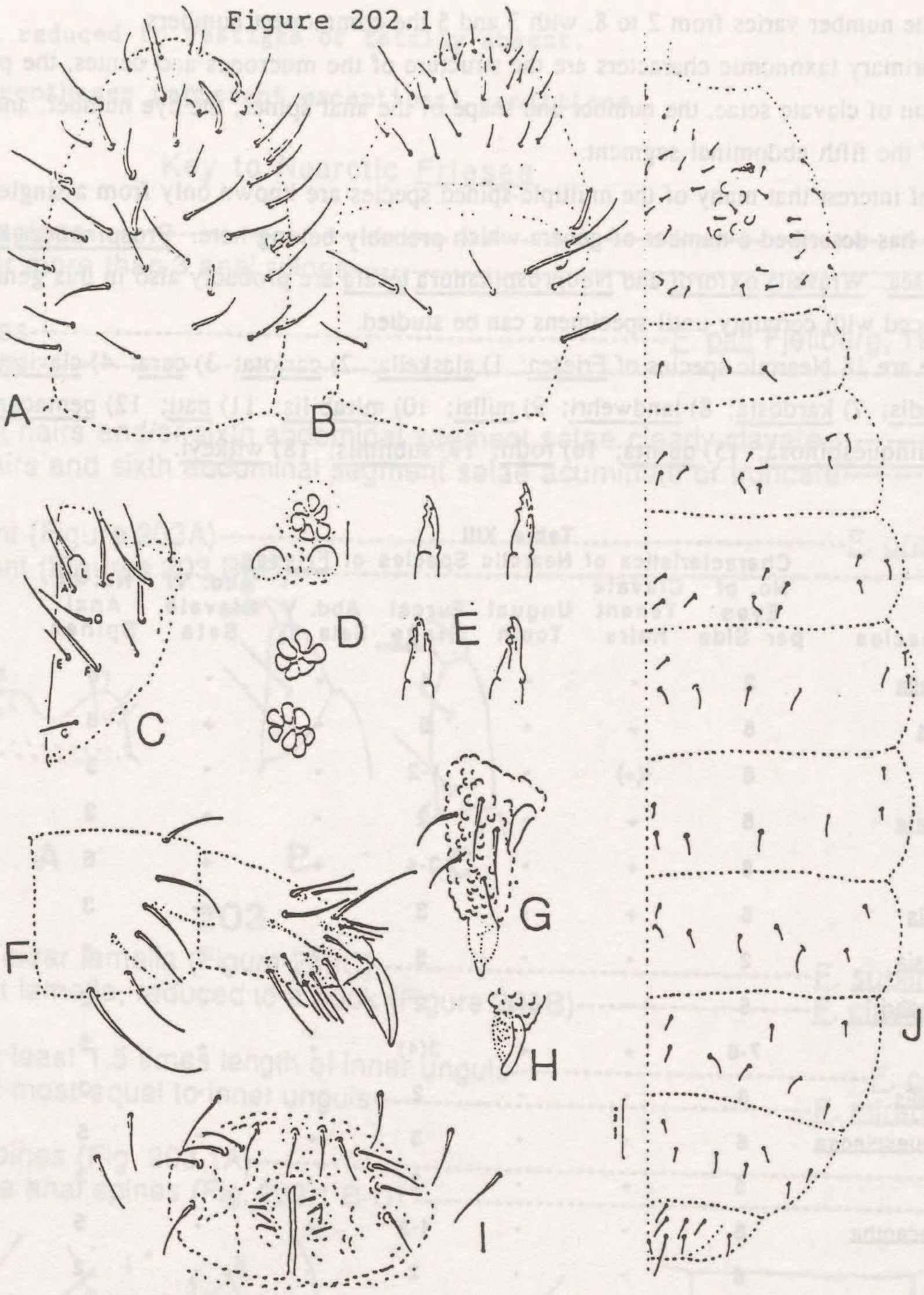
Type species Probrachystomella rhodosoma Rapoport, 1962

Syn. : Probrachystomella Rapoport 1962.

This genus is similar to Brachystomella except for the structure of the maxilla. There is a single Nearctic species.

Rapoportella lowriei Najt 1984

Figure 202.1



R. lowriei. A) Third and fourth antennal segments, dorsal & B) Ventral view; C) Labium; D) Postantennal organs; E) Maxillae, four different specimens; G) Dens and mucro, dorsal view; H) Mucro, side view; I) ♂ genital plate; J) Chaetotaxy. After Najt 1984.

Genus FRIESEA Dalla Torre, 1895

Type species Triaena mirabilis Tullberg, 1871

Syns.: Macgillivraya Grote, 1894 (rejected by opinion 1049); Prospinanura Wray, 1952, type species P. kardosia Wray, 1952,

The Nearctic members of this genus are easily recognized. All have a peculiar triangular maxilla of two blades (see Fig. 202D) and a relatively uniformly toothed mandible. They all lack a P.A.O. and unguiculus, and have a more or less reduced furcula with a maximum of three dental setae; accompanying this is a reduced tenaculum with a maximum of 2-2 teeth. All Nearctic species have anal spines; the number varies from 2 to 8, with 3 and 5 the commonest numbers.

The primary taxonomic characters are the structure of the mucrones and dentes, the presence and distribution of clavate setae, the number and shape of the anal spines, the eye number, and the chaetotaxy of the fifth abdominal segment.

It is of interest that many of the multiple-spined species are known only from a single locality.

Wray has described a number of genera which probably belong here. Prospinanura kardosia is certainly Friesea. Wravella oxfordi and Neoprospinanura tecala are probably also in this genus, but cannot be placed with certainty until specimens can be studied.

There are 18 Nearctic species of Friesea: 1) alaskella; 2) carlota; 3) cera; 4) claviseta; 5) fara; 6) grandis; 7) kardosia; 8) landwehri; 9) millsi; 10) mirabilis; 11) pati; 12) pentacantha; 13) polla; 14) quinquespinosa; 15) quinta; 16) rothi; 17) sublimis; 18) wilkeyi.

Table XIII
Characteristics of Nearctic Species of Friesea

Species	No. of Eyes per Side	Clavate Tenent Hairs	Ungual Tooth	Furcal Stage	Abd. V Seta a_2	Abd. VI Clavate Seta	No. of Anal Spines
alaskella	2	-	-	4	-	-	6
carlota	8	+	-	5	-	+	6
cera	8	-(+)	-	1-2	-	-	3
claviseta	8	+	-	2	-	+	3
fara	8	+	-	3-4	+	+	6
grandis	8	+	-	3	+	+/-	3
kardosia	2	-	-	5	?	-	8
landwehri	5	-	+(-)	2	-	-	2
millsi	7-8	+	+	3(4)	-	+	5
mirabilis	8	-	-	2	-	-	3
quinquespinosa	6	-	-	3	+	-	5
pati	5	+	-	2	-	-	3
pentacantha	8	-	-	4-5	+	-	5
polla	8	-	-	2	-	-	2
quinta	(3)4-5	-	-	3	-	-	5
rothi	8	+	-	5	+	+	4-6
sublimis	8	+,-	-	1	-	+	3
wilkeyi	2	-	+	2?	-	-	2

*Stages of furcal reduction (from Cassagnau, 1958):

1. Mucro with lamella, separate from dens; 3 dental setae.
2. Mucro without lamella, fused to dens; 3 dental setae.
3. No mucro; 3 dental setae.
4. Dens reduced to a tubercle with 2 setae.
5. Furcula reduced to vestiges or totally absent.

Symbols in parentheses represent exceptional conditions.

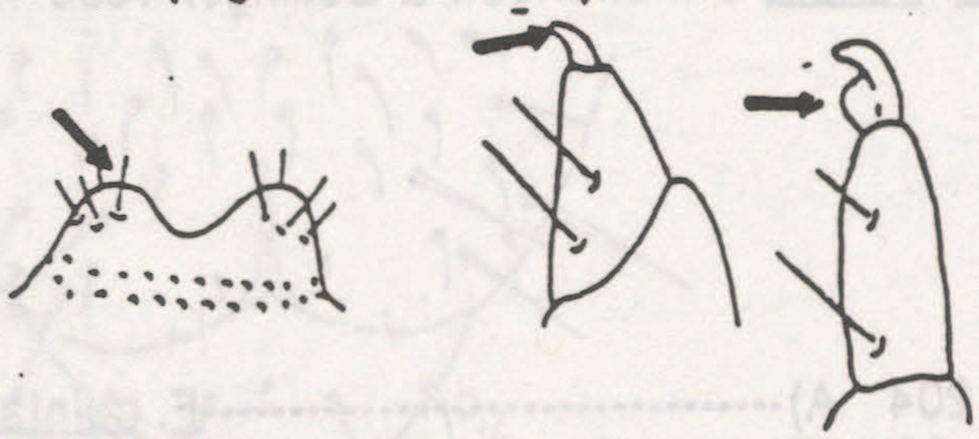
Key to Nearctic Friesea

1) With 3 anal spines----2
1') With fewer or more than 3 anal spines----7

2) With 5+5 eyes----F. pati Fjellberg, 1984b
2') With 8+8 eyes----3

3) Some tenent hairs and/or sixth abdominal segment setae clearly clavate----4
3') All tenent hairs and sixth abdominal segment setae acuminate or truncate----6

**4) Mucro absent (Figure 203A)----F. grandis
4') Mucro present (Figures 203 B&C)----5

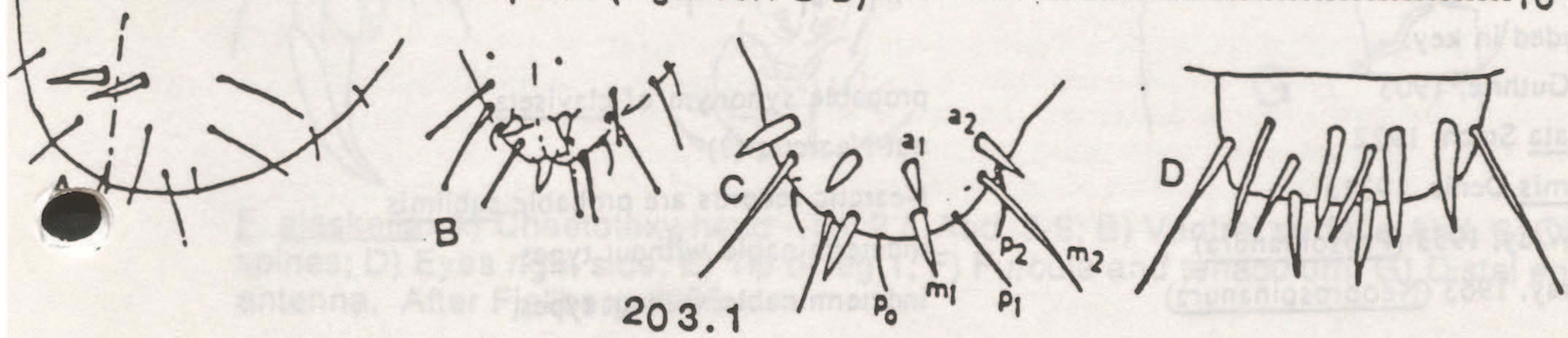


203

*5) Mucro with a clear lamella (Figure 203C)----F. sublimis
*5') Mucro without lamella, reduced to a hook (Figure 203B)----F. claviseta

**6) Mucrodens at least 1.5 times length of inner unguis----F. cera
*6') Mucrodens at most equal to inner unguis----F. mirabilis

7) With 2 anal spines (Fig. 203.1A)----8
7') With 4 or more anal spines (Fig. 203.1 B-D)----10



203.1

8) 8+8 eyes----------E. polla
8') Fewer than 8+8 eyes----------9

9) 2+2 eyes----------E. wilkeyi
9') 5+5 eyes----------E. landwehri

10) 2+2 eyes----------11
10') 3+3 or more eyes----------12

11) 6 anal spines (Fig. 203.1C) ---------- E. alaskella Fjellberg, 1985
11') 8 or more anal spines (Fig. 203.1D) ----------E. kardosia

12) Eyes 7+7 or more----------13
12') Eyes 3+3 - 6+6----------17

13) 5 anal spines (one median) (Fig. 203.1 B)----------14
13') 4 or 6 anal spines none median (Fig. 203.1 C)----------15

14) Tenent hairs clavate----------E. millsi
14') Tenent hairs acuminate---------- ----------E. pentacantha

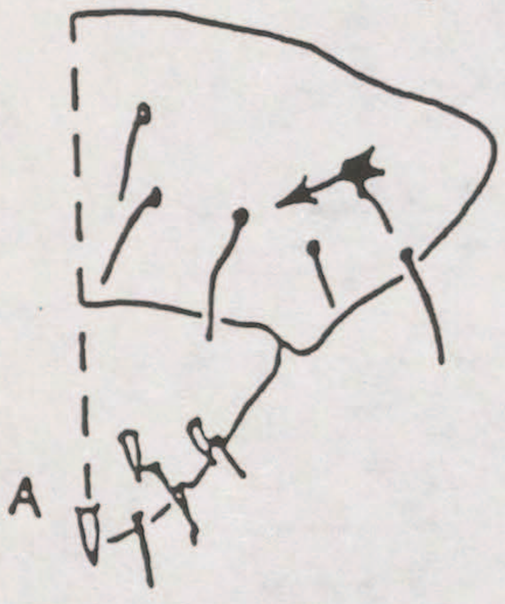
15) All posterior trunk setae acuminate----------E. rothi Christiansen & Bellinger 1988
15') Some posterior trunk setae clavate----------16

16) Dentes present (Fig. 203.2)----------E. lara
16') Furcula completely absent----------E. carlota Christiansen & Bellinger 1988



203.2

17) Abd. 5 with seta P_2 longer than P_1 (Figure 204 A)----------E. quinta
17') Abd. 5with seta P_2 shorter than P_1 (Figure 204. B)----------E. quinquespinosa



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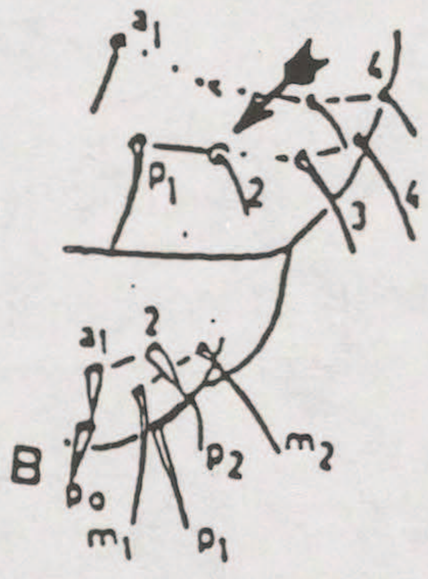
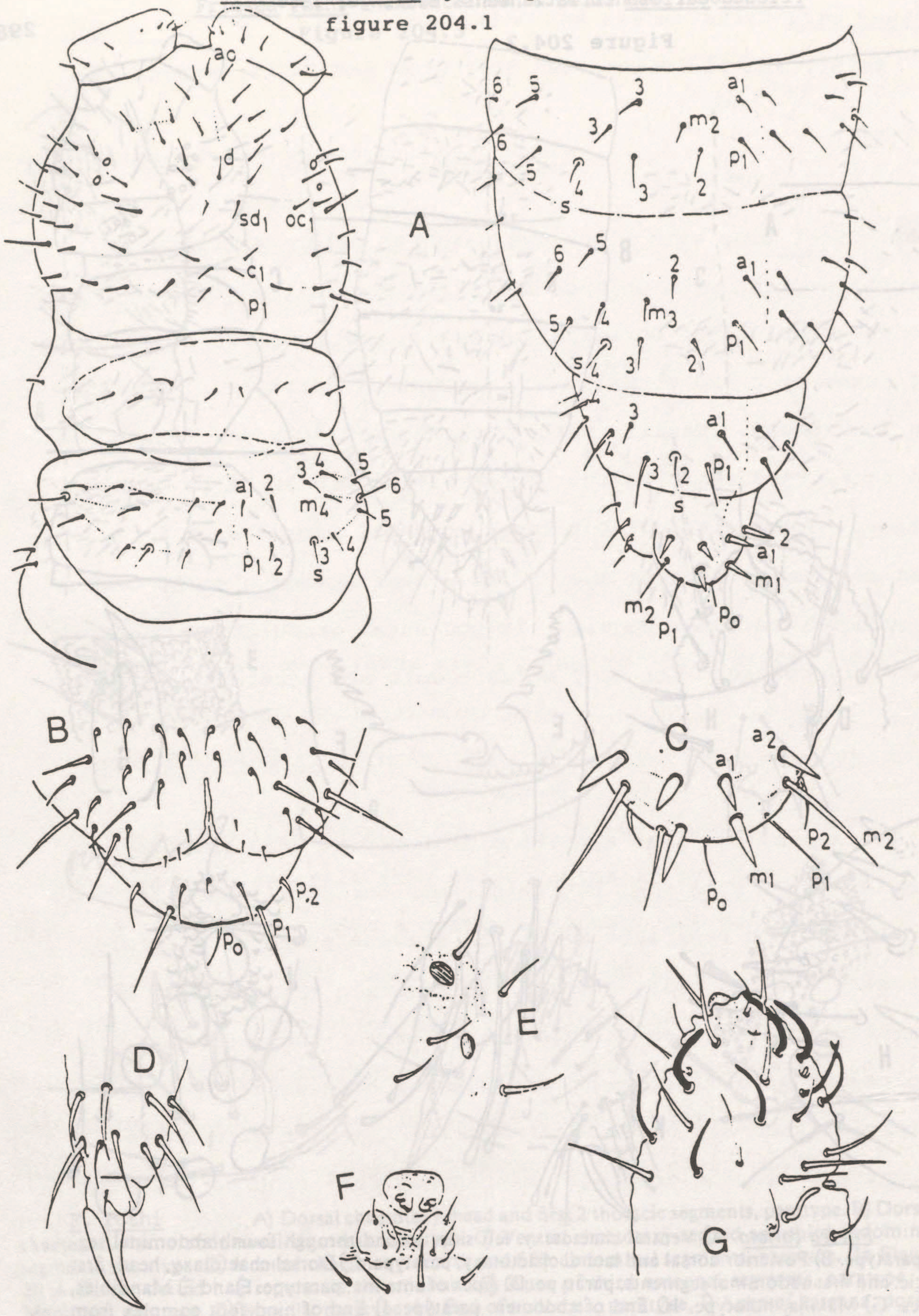


Not included in key:

caldaria Guthrie, 1903 — probable synonym of claviseta
emucronata Stach, 1922 — not Nearctic (?)
magnicornis Denis, 1931a — Nearctic records are probable sublimis
oxfordi Wray, 1953 (Prospinanura) — indeterminable without types
tecala Wray, 1963 (Neoprospinanura) — indeterminable without types

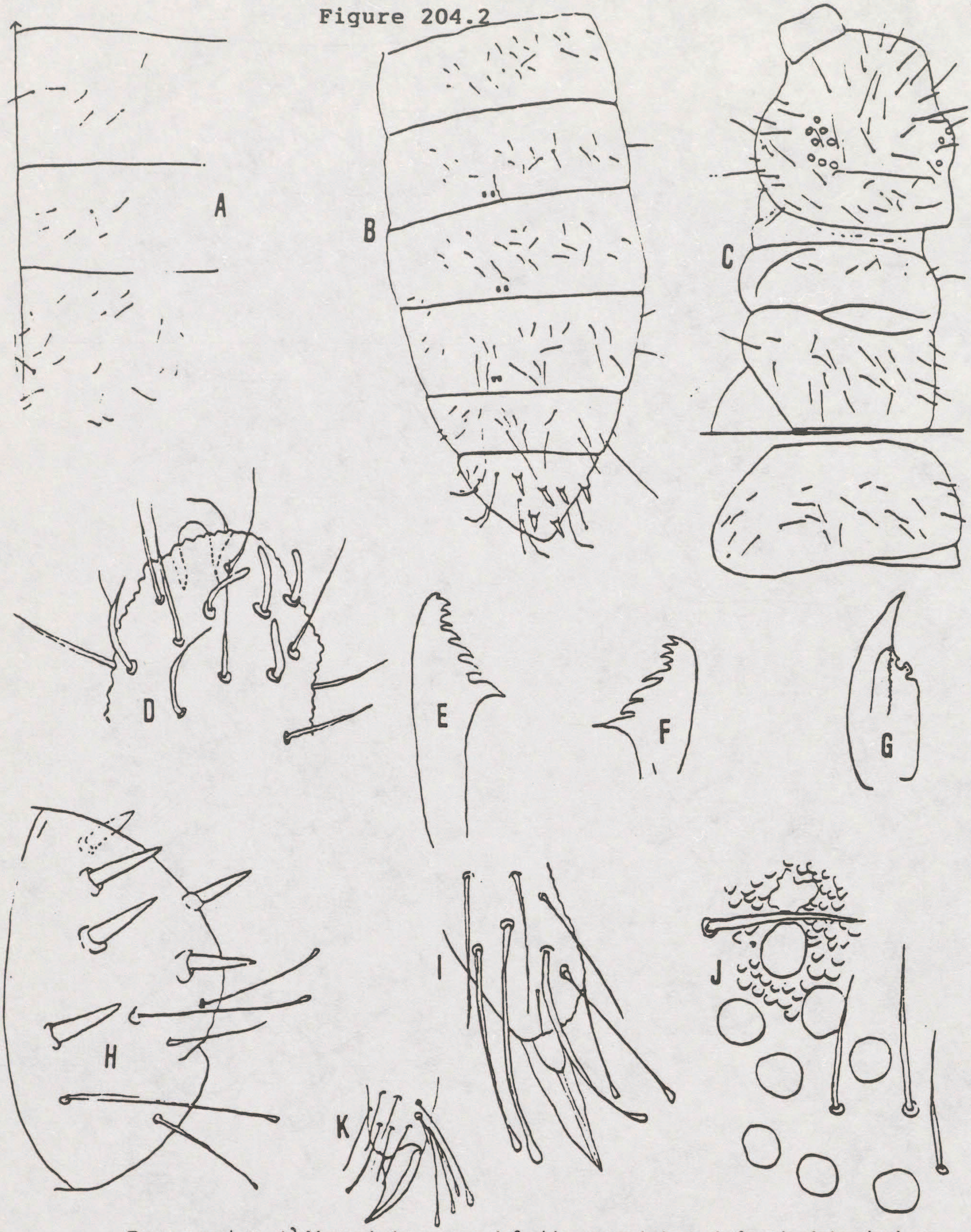
Friesea alaskella Fjellberg 1985

figure 204.1



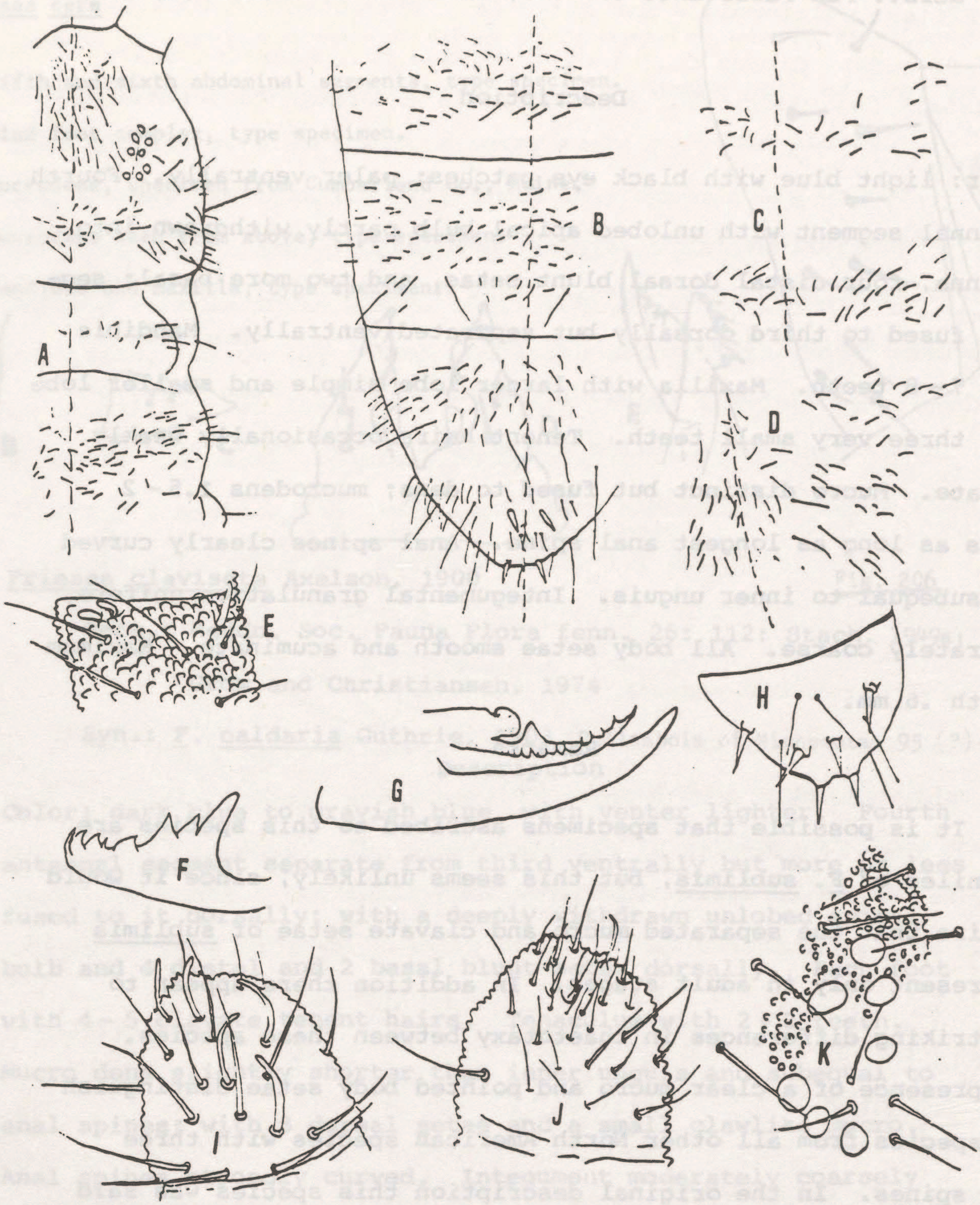
E. alaskella. A) Chaetotaxy, head - Th. 2 & Abd. 3-6; B) Ventral surface Abd. 6; C) Anal spines; D) Eyes right side; E) Tip of leg 1; F) Furcula and tenaculum; G) Distal end of antenna. After Fjellberg 1985.

Figure 204.2



Friesea carlota. A) Ventral chaetotaxy, left side, second through fourth abdominal segments, paratype. B) Posterior dorsal and lateral chaetotaxy, paratype. C) Dorsal chaetotaxy, head, first 2 thoracic, and first abdominal segments, paratype. D) Apex of antenna, paratype. E) and F) Mandibles, paratypes. G) Maxilla, holotype. H) End of abdomen, paratype. I) End of hind foot complex from inner side, paratype. J) Eyes of left side, paratype. K) Hind foot complex from side, holotype.

Figure 204.3



F. rothi ... A) Dorsal chaetotaxy, head and first 2 thoracic segments, paratype. B) Dorsal chaetotaxy, last 3 abdominal segments, paratype. C) Ventral chaetotaxy second and third abdominal segments, paratype. D) Ventral chaetotaxy, fourth and fifth abdominal segments, paratype. (In Figure 20 A–D, the dotted line represents the midline). E) Apex of third antennal segments, paratype. F) Mandible, paratype. G) Maxilla, paratype. H) End of abdomen, paratype. I) Apex of antenna, dorsal view, holotype. J) Apex of antenna, ventral view, holotype. K) Eyes of left side, paratype.

Friesea cera Christiansen and Bellinger, 1974 Fig. 205

Refs.: Pan-Pacif Ent. 49: 389; Grow and Christiansen, 1974

Description

Color: light blue with black eye patches; paler ventrally. Fourth antennal segment with unlobed apical bulb partly withdrawn into antenna, four distal dorsal blunt setae, and two more basal; segment fused to third dorsally but separated ventrally. Mandible with 7 - 8 teeth. Maxilla with larger lobe simple and smaller lobe with three very small teeth. Tenent hairs occasionally weakly clavate. Mucro distinct but fused to dens; mucrodens 1.5 - 2 times as long as longest anal spine. Anal spines clearly curved and subequal to inner unguis. Integumental granulation uniform, moderately coarse. All body setae smooth and acuminate. Maximum length .6 mm.

Remarks

It is possible that specimens ascribed to this species are juveniles of F. sublimis, but this seems unlikely, since it would require that the separated mucro and clavate setae of sublimis be present only in adult stages. In addition there appear to be striking differences in chaetotaxy between these species. The presence of a clear mucro and pointed body setae distinguish the species from all other North American species with three anal spines. In the original description this species was said to have no clavate tenent hairs: actually they may sometimes be weakly clavate.

Localities: Connecticut - Hartford Co.; Illinois - Volo; Iowa - Jasper Co. (type); Maine - Cumberland Co.; Massachusetts - Essex Co.; Pennsylvania - Centre Co., Singletown.

FIGURE 205

Friesea cera

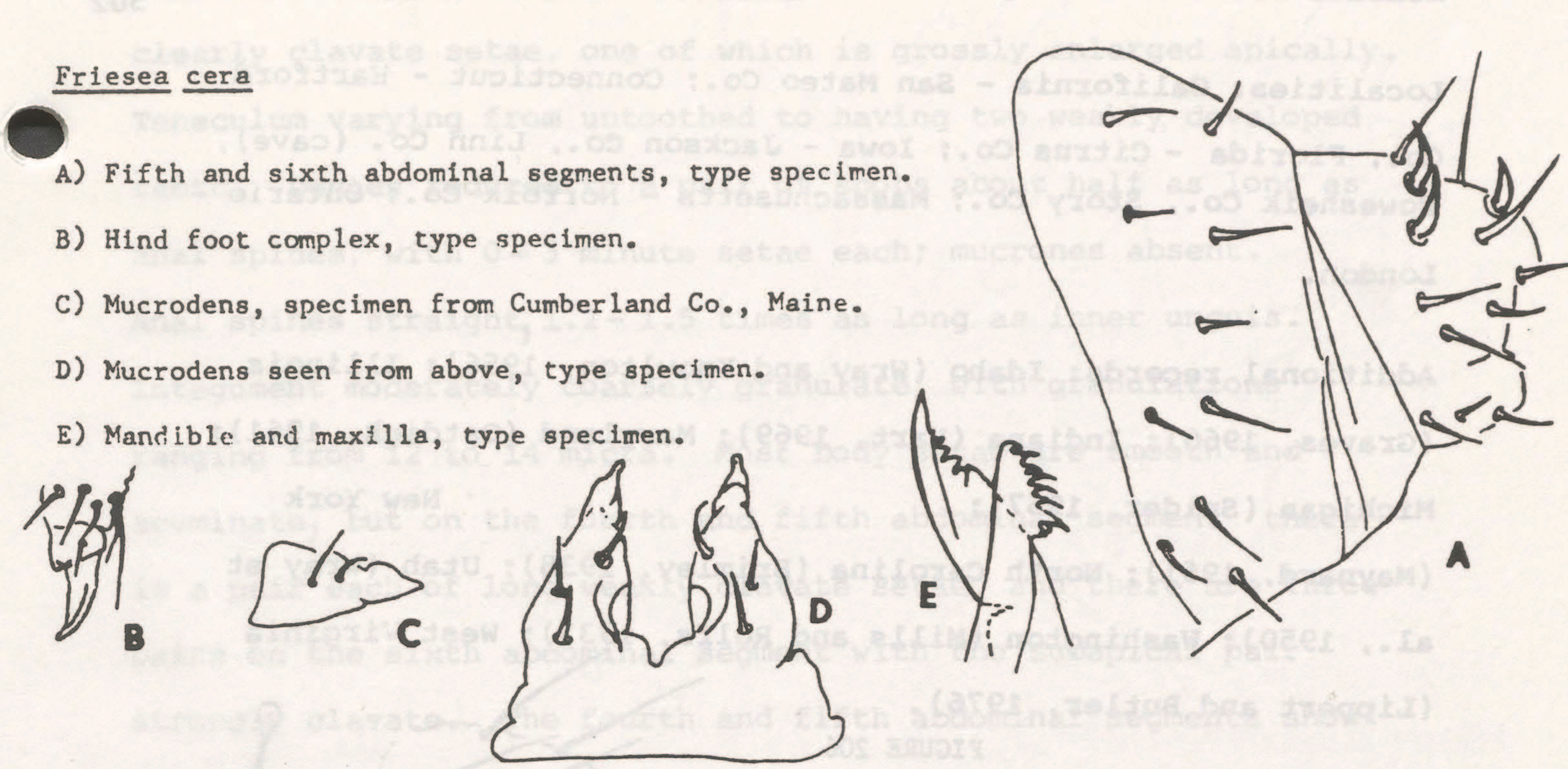
A) Fifth and sixth abdominal segments, type specimen.

B) Hind foot complex, type specimen.

C) Mucrodens, specimen from Cumberland Co., Maine.

D) Mucrodens seen from above, type specimen.

E) Mandible and maxilla, type specimen.



Friesea claviseta Axelson, 1900 Fig. 206

Refs.: Meddn. Soc. Fauna Flora fenn. 26: 112: Stach, 1949a;

Grow and Christiansen, 1974

Syn.: F. caldaria Guthrie, 1903, Collembola of Minnesota: 95 (?)

Description

Color: dark blue to grayish blue, with venter lighter. Fourth antennal segment separate from third ventrally but more or less fused to it dorsally; with a deeply withdrawn unlobed apical bulb and 4 distal and 2 basal blunt setae dorsally. Each foot with 4 - 5 clavate tenent hairs. Tenaculum with 2 + 2 teeth. Mucro dens slightly shorter than inner unguis and subequal to anal spines; with 3 dorsal setae and a small clawlike mucro. Anal spines strongly curved. Integument moderately coarsely granulate. Long posterior abdominal setae distinctly clavate. Maximum length 1.0 mm.

Remarks

The nearctic specimens appear to have 3 teeth on the smaller maxillary blade, but this lamella is very small and difficult to study. North American populations appear to be remarkably constant. A single specimen from Canada shows features inter-

mediate between this species and sublimis.

Localities: California - San Mateo Co.; Connecticut - Hartford Co., Florida - Citrus Co.; Iowa - Jackson Co., Linn Co. (cave), Powesheik Co., Story Co.; Massachusetts - Norfolk Co.; Ontario - London.

Additional records: Idaho (Wray and Knowlton, 1956); Illinois (Graves, 1960); Indiana (Hart, 1969); Maryland (Ostdiek, 1961); Michigan (Snider, 1967); New York (Maynard, 1951); North Carolina (Brimley, 1938); Utah (Wray et al., 1950); Washington (Mills and Rolfs, 1933); West Virginia (Lippert and Butler, 1976).

FIGURE 206

Friesea claviseta

A) Fifth and sixth abdominal segments, after Stach.

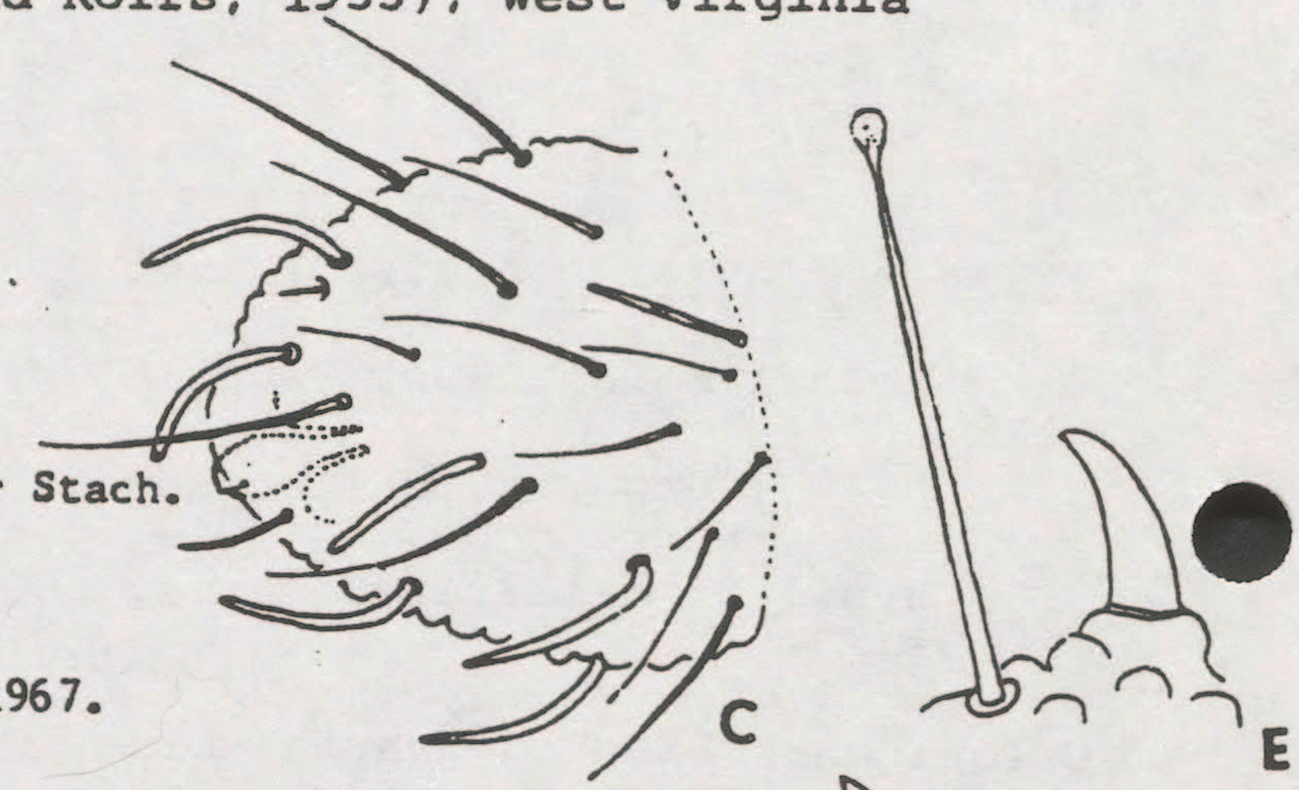
B) Hind foot complex, after Stach.

C) Fourth antennal segment, after Massoud, 1967.

D) Mucro and dens, after Stach.

E) Anal spine and adjacent clavate seta, after Stach.

F) Maxilla, after Axelson.



Friesea fara Christiansen and Bellinger, 1974 Fig. 207

Refs.: Pan-Pacif. Ent. 49: 393; Grow and Christiansen, 1974

Description

Color: unknown (only cleared specimens seen). Fourth antennal segment weakly separated from third on ventral side only; with a deeply withdrawn unlobed apical bulb and four apical and one basal blunt setae. Large maxillary blade with three teeth;

small blade apparently with four teeth. Each foot with 8 - 10 clearly clavate setae, one of which is grossly enlarged apically. Tenaculum varying from untoothed to having two weakly developed teeth. Dentes reduced to a pair of knobs about half as long as anal spines, with 0 - 3 minute setae each; mucrones absent. Anal spines straight, 1.2 - 1.5 times as long as inner unguis. Integument moderately coarsely granulate, with granulations ranging from 12 to 14 micra. Most body setae are smooth and acuminate, but on the fourth and fifth abdominal segment there is a pair each of long weakly clavate setae, and there are three pairs on the sixth abdominal segment with the subapical pair strongly clavate. The fourth and fifth abdominal segments show marked plurichaetosis. Maximum length 1.1 mm.

Remarks

The maxilla, plurichaetosis, and large clavate tenent hairs and clavate abdominal setae make this one of the most striking species of the genus. The plurichaetosis is not seen in very small specimens. The third pair of clavate hairs on abdominal segment 6 were not mentioned in the original description.

Locality: California - Farallon Islands (type).

FIGURE 207

<u>Friesea fara</u>

All figures of type specimens.

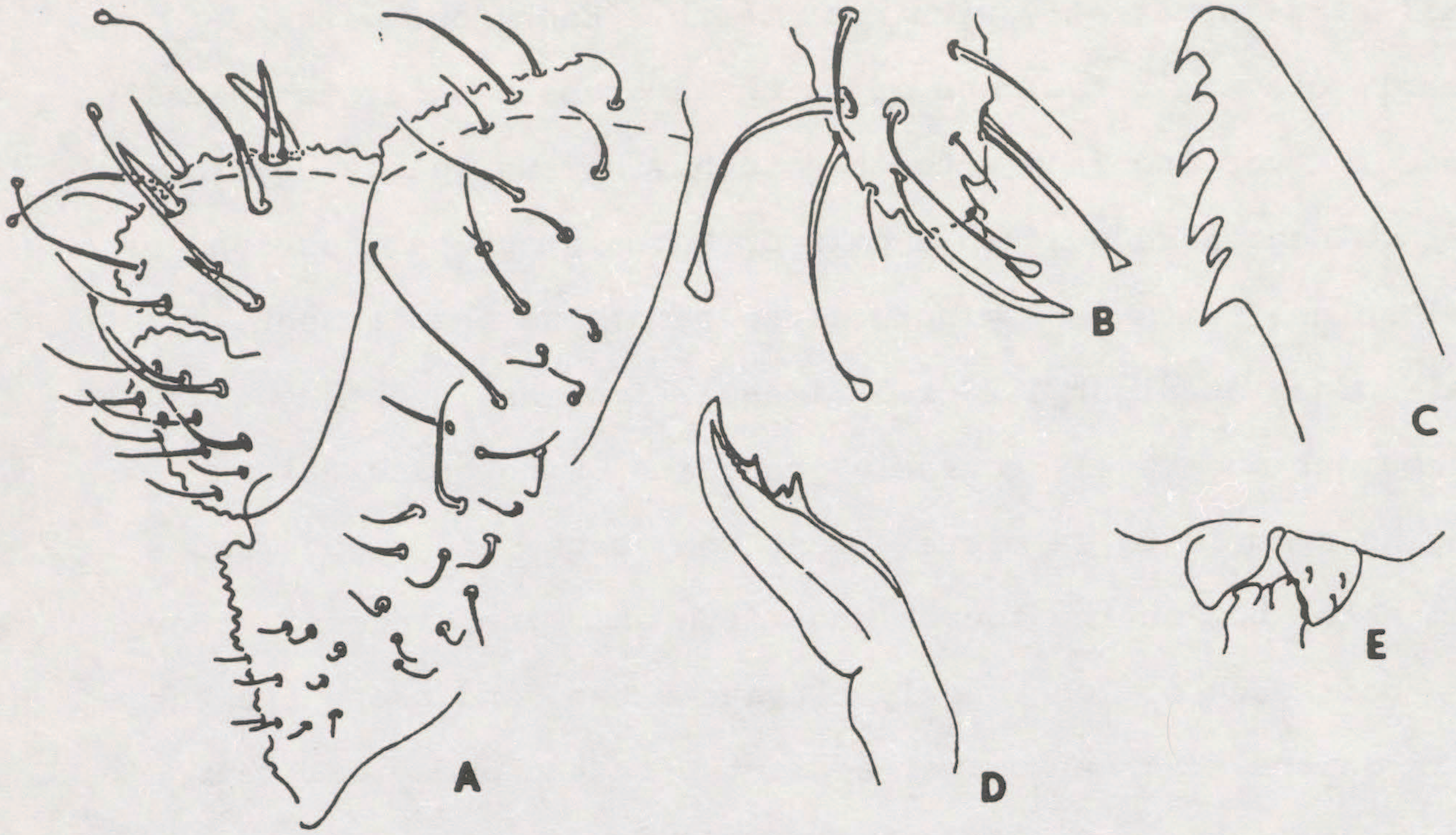
A) Fifth and sixth abdominal segments.

B) Hind foot complex.

C) Mandible.

D) Maxilla.

E) Furcula and tenaculum.



Friesea grandis Mills, 1934 Fig. 208

Refs.: Collembola of Iowa: 21, Grow and Christiansen, 1974.

Description

Color: deep blue to pale blue, paler along intersegmental membranes and, in lighter specimens, ventrally. Fourth antennal segment fused with the third dorsally but clearly separated ventrally; with deeply withdrawn unlobed apical bulb, three dorsal distal blunt setae and two more basally. Large maxillary blade untoothed; smaller blade with three teeth. Tibiotarsus with 4-5 weakly to moderately clavate tenent hairs. Tenaculum with 2+2 teeth. Dens with 3 setae, 1/2-2/3 as long as anal spines; mucro absent. Anal spines weakly curved, slightly shorter than inner unguis. Integument moderately coarsely granulate. Body setae generally acuminate, sometimes weakly serrate; one pair of setae beside the anterior anal spines are clavate. Maximum length 1.7 mm.

Remarks

This species appears to be generally constant. California specimens show considerable variation in the anal spines, which may be bifurcate or multiple on each papilla. The specimens we

have examined from Massachusetts have weakly clavate tenent hairs, while these are strongly clavate in California specimens. Most collections show no clear serrations on the body setae. A single specimen from Oregon lacked the typical clavate setae and may represent another species.

Localities: California - Nevada Co., Placer Co., Sacramento Co.; Iowa - Palo Alto Co. (type), Sac Co.; Massachusetts - Essex Co.; Oregon - Benton Co. (?); Pennsylvania - Berks Co.

Additional records: Idaho (Wray and Knowlton, 1956); North Carolina (Pearse, 1946); Utah (Wray et al., 1950).

FIGURE 208

Friesea grandis

A) Chaetotaxy of fifth and sixth abdominal segments, specimen from Sacramento Co., California.

B) Hind foot complex, after Mills.

C) Mandible, after Mills.

D) Mucrodens and tenaculum, after Mills.

E) Profile of anal spine, after Mills.

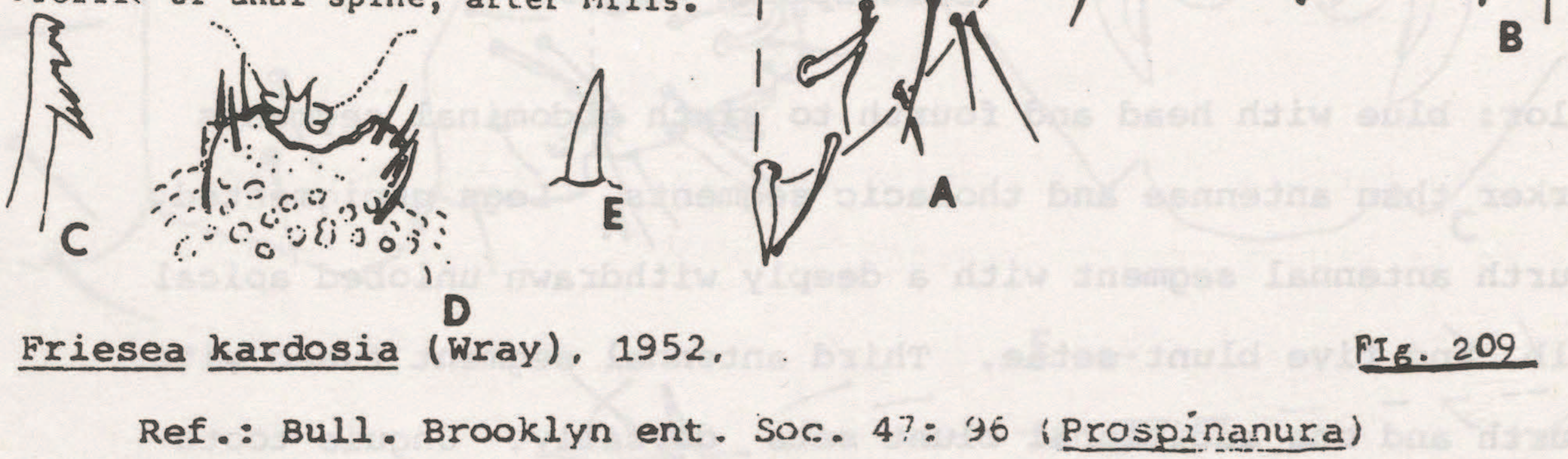


Fig. 209

Friesea kardosia (Wray), 1952.

Ref.: Bull. Brooklyn ent. Soc. 47: 96 (Prospinanura)

Description

Color: white with sparse scattered blue pigment and 2 + 2 separate pigment spots each bearing a single eye. Third and fourth antennal segments nearly fused, with faint ventral separation; fourth segment with more or less trilobed apical bulb and 6 - 8 blunt setae. Tenaculum and furcula absent. Anal spines 8 or more, straight and relatively long. Maximum length 1 mm.

Remarks

This species, placed by Wray in a new genus Prospinanura, is clearly part of the genus Friesea. The peculiarities described and figured by Wray are all within the limits of variation of Friesea as defined by Cassagnau and by Massoud. The only other North American species with 2 + 2 eyes is F. wilkeyi which differs strikingly in other features.

Locality: Utah - Glendale (type).

FIGURE 209

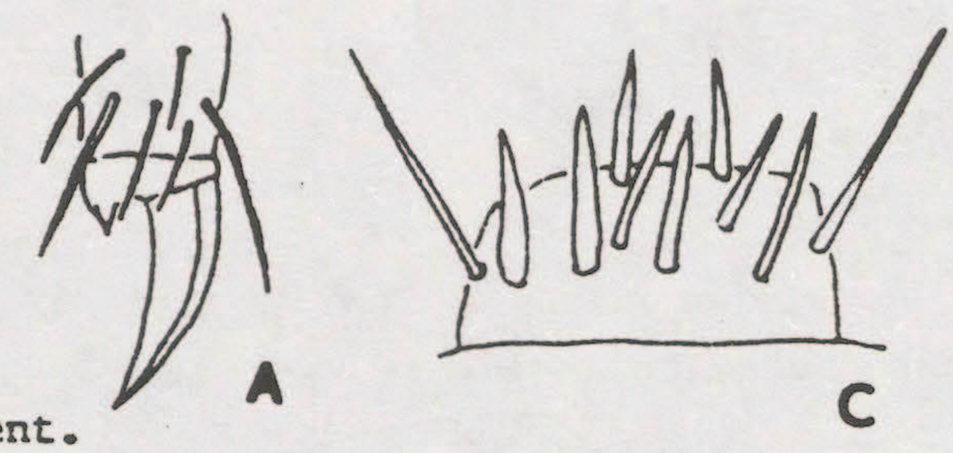
Friesea kardosia

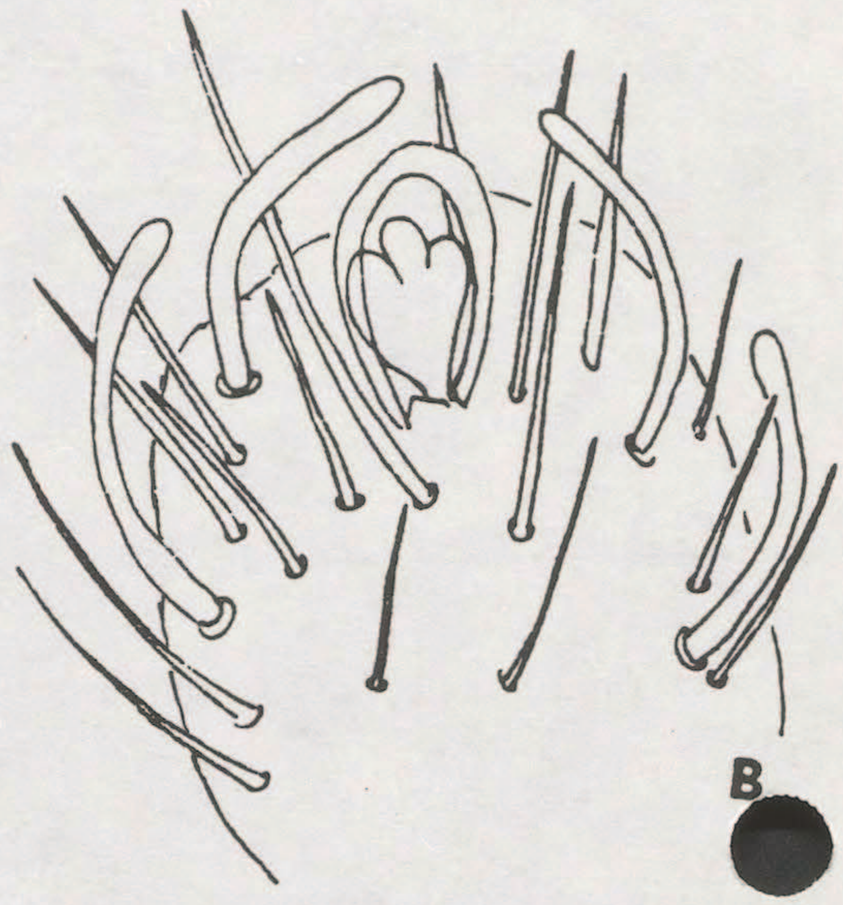
All figures after Wray.

A) Front foot complex.

B) Fourth antennal segment.

C) Sixth abdominal segment from above.





Friesea landwehri Christiansen & Bellinger, 1980 Fig. 210

Description

Color: blue with head and fourth to sixth abdominal segments darker than antennae and thoracic segments. Legs unpigmented. Fourth antennal segment with a deeply withdrawn unlobed apical bulb, and five blunt setae. Third antennal segment fused with fourth and one additional blunt seta dorsally. Unguis toothless, or with minute inner tooth. Tenent hairs short and acuminate. Mucrodens shorter than inner unguis, with 2 - 3 setae and 2 inner hooks. Tenaculum with 2 + 2 teeth. Anal spines as long as inner unguis. All body setae acuminate and smooth except the longest posterior setae which are slightly serrate. Maximum length 1.0 mm.

This species resembles polla and wilkevi, but is distinguished from both forms by eye number.

Type locality: Yosemite Valley, Mariposa Co., California, deciduous litter, 3 October 1971 (V.R. Landwehr).

FIGURE 210

Friesea landwehri

All figures of type specimens.

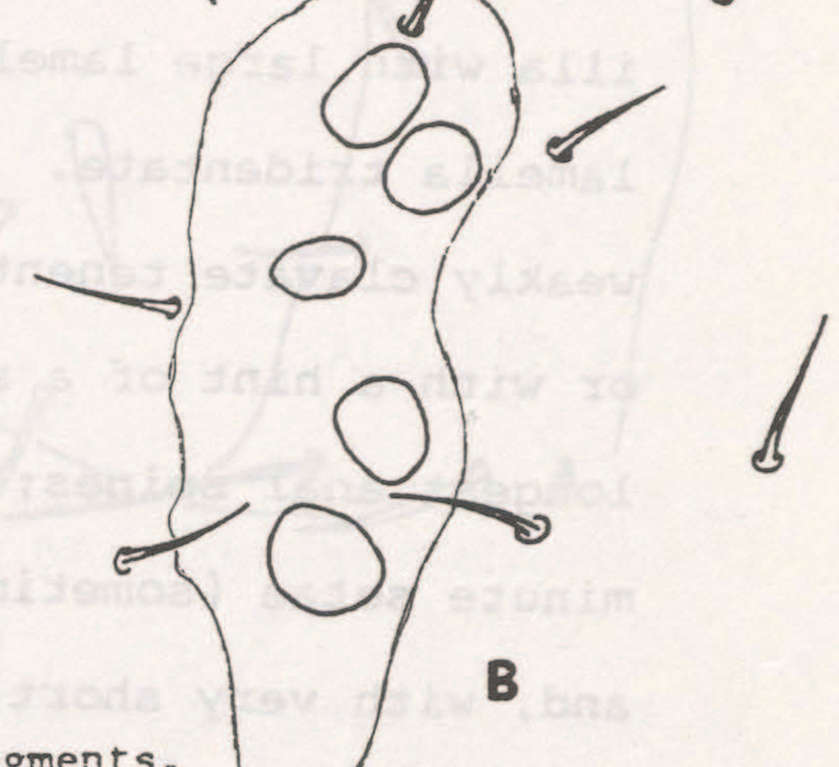
A) Ventral surface of antenna.

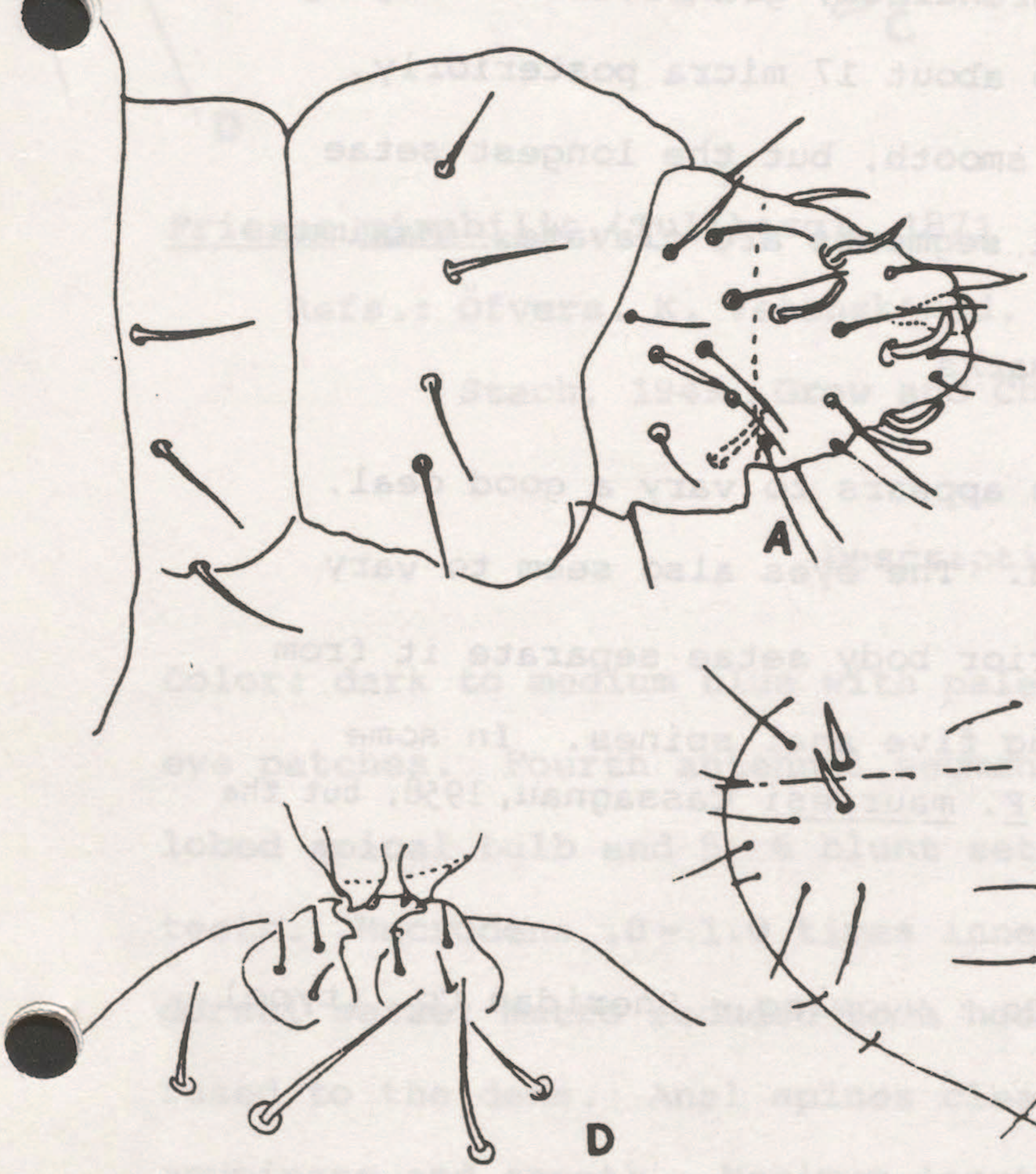
B) Left eyepatch.

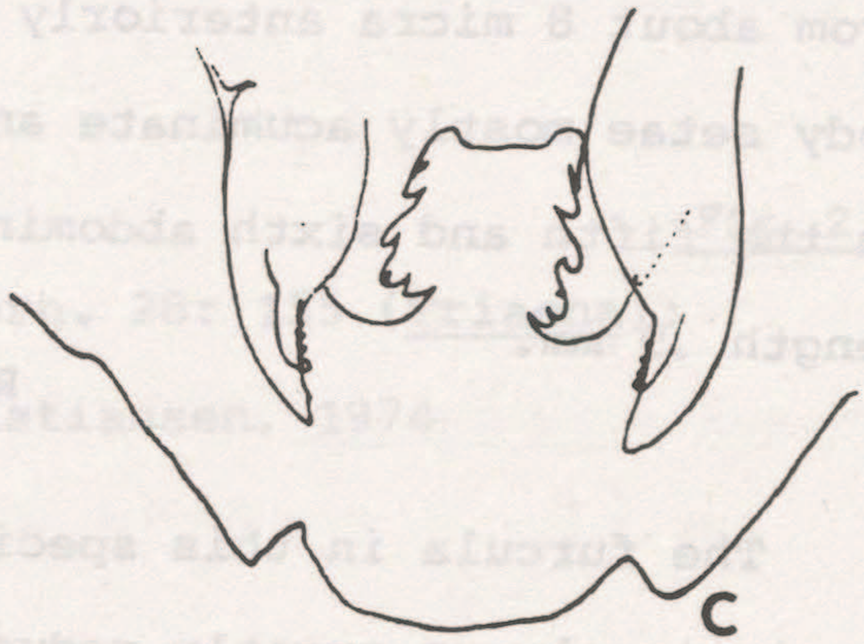
C) Ventral view of mandibles and maxillae.

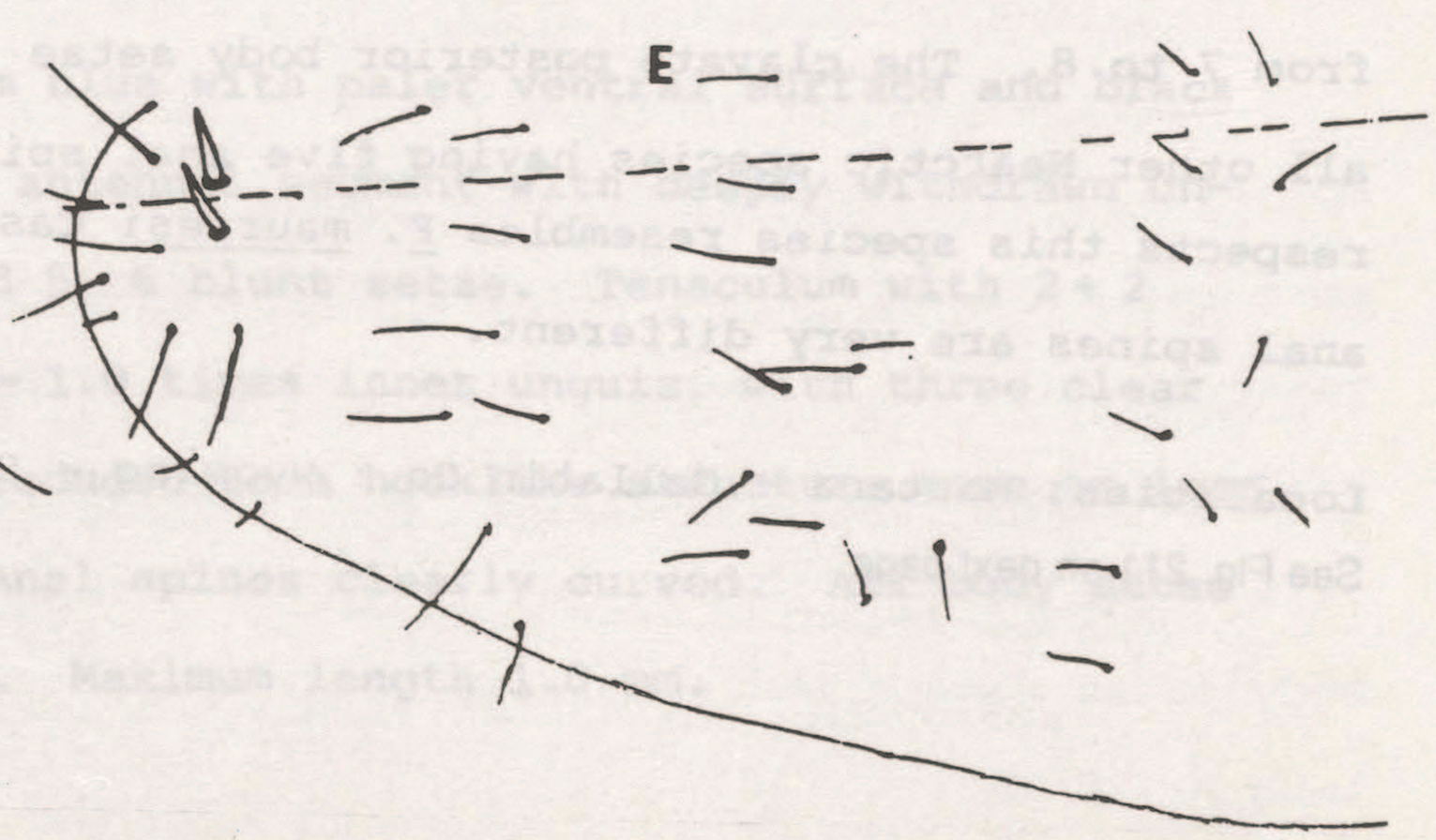
D) Oblique ventral view of furcula and tenaculum.

E) Dorsal chaetotaxy of right half of last four abdominal segments.









Friesea millsi Christiansen and Bellinger, 1974 Fig. 211

Refs.: Pan Pacif. Ent. 49: 389: Grow and Christiansen, 1974

Description

Color: pale blue except for dark eye patches; pigment in the form of scattered granules. Fourth antennal segment fused to third dorsally but separated ventrally; with a deeply withdrawn, unlobed apical bulb, five distal blunt setae, and a sixth basally. Maxilla with large lamella having a single inner tooth and smaller lamella tridentate. Unguis with a minute subapical tooth; three weakly clavate tenent hairs on each footh. Tenaculum unidentate or with a hint of a second tooth. Furcula 2/3 - 3/4 as long as longest anal spines; mucrodens fused to manubrium, with three minute setae (sometimes absent). Anal spines, short and straight and, with very short papillae, about as long as inner unguis. Integument moderately coarsely granulate; granulations ranging from about 8 micra anteriorly to about 17 micra posteriorly. Body setae mostly acuminate and smooth, but the longest setae on the fifth and sixth abdominal segments are clavate. Maximum length .9 mm.

Remarks

The furcula in this species appears to vary a good deal, but is is always greatly reduced. The eyes also seem to vary from 7 to 8. The clavate posterior body setae separate it from all other Nearctic species having five anal spines. In some respects this species resembles *F. mauriesi* Cassagnau, 1958, but the anal spines are very different.

Localities: Montana - Gallatin Co.: Wyoming - Sheridan Co. (type).

See Fig. 211 on next page.

FIGURE 211

Friesea millsi

All figures from type specimens.

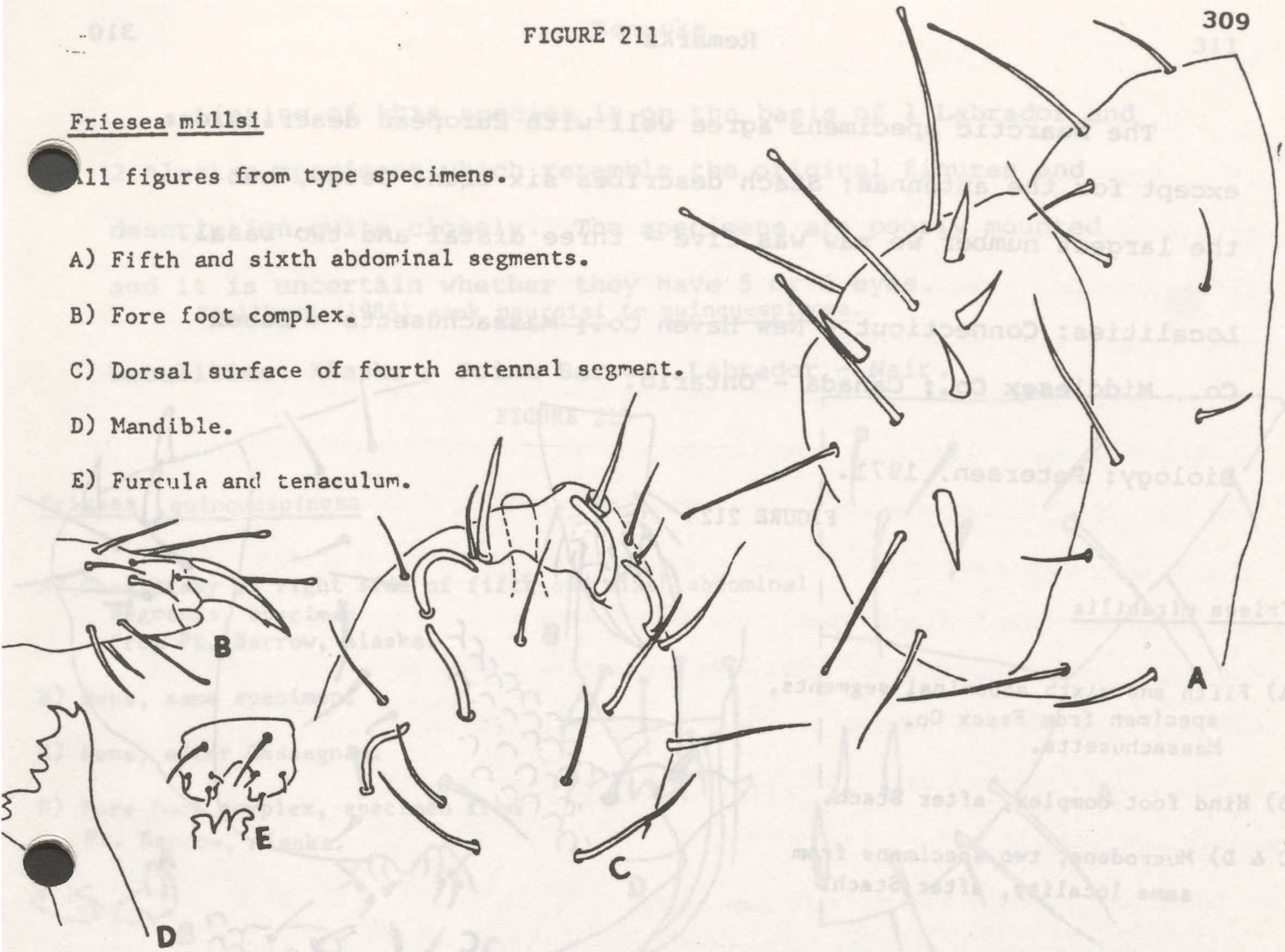
A) Fifth and sixth abdominal segments.

B) Fore foot complex.

C) Dorsal surface of fourth antennal segment.

D) Mandible.

E) Furcula and tenaculum.



Friesea mirabilis (Tullberg), 1871 Fig. 212

Refs.: Öfvers. K. VetenskAkad. Förh. 28: 155 (Triaena):

Stach, 1949a; Grow and Christiansen, 1974

Description

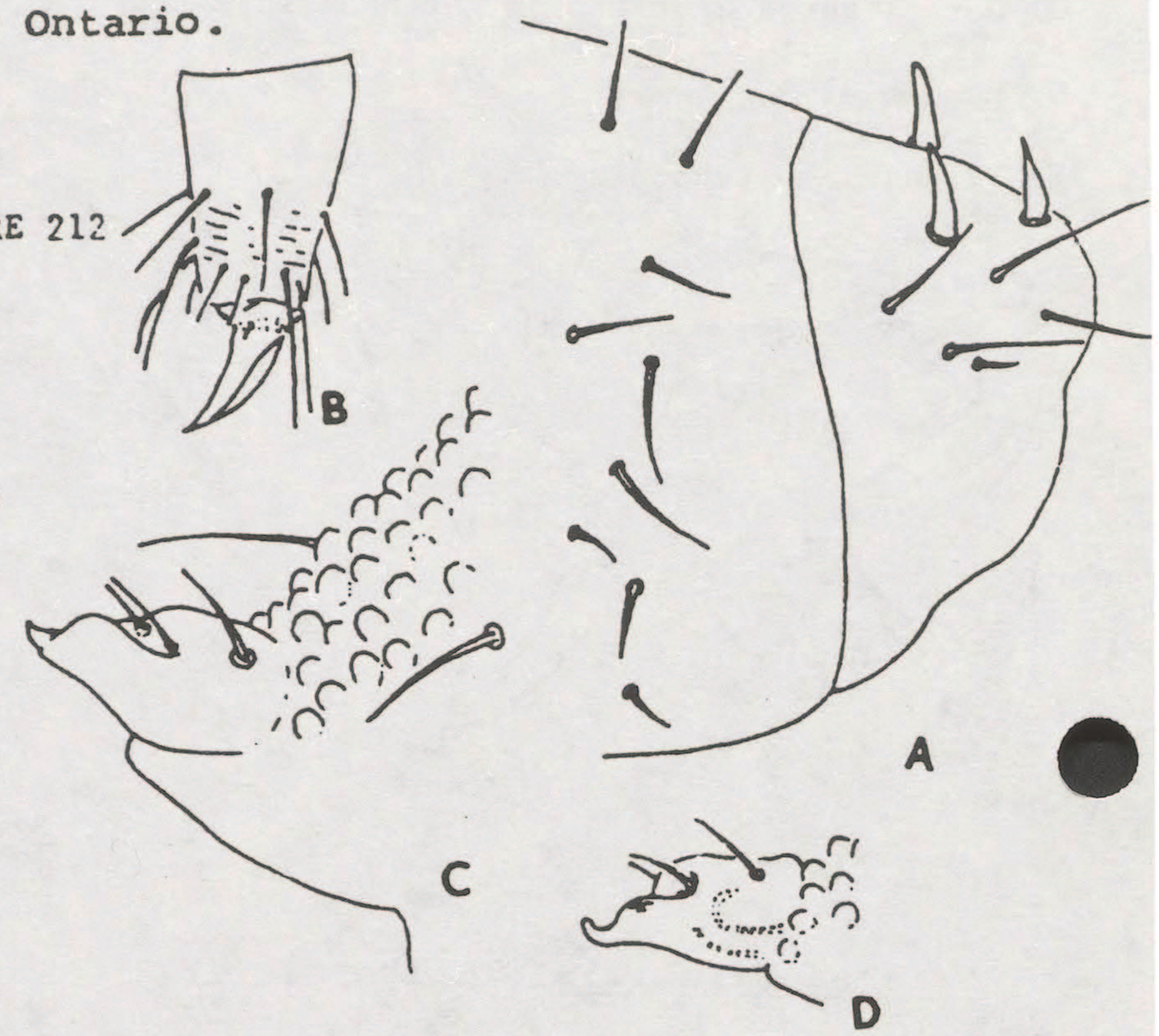
Color: dark to medium blue with paler ventral surface and black eye patches. Fourth antennal segment with deeply withdrawn unlobed apical bulb and 5 - 6 blunt setae. Tenaculum with 2 + 2 teeth. Mucrodens .8 - 1.0 times inner unguis, with three clear dorsal setae; mucro reduced to a hooklike structure more or less fused to the dens. Anal spines clearly curved. All body setae acuminate and smooth. Maximum length 1.0 mm.

The Nearctic specimens agree well with European descriptions except for the antennae; Stach describes six blunt setae, but the largest number we saw was five - three distal and two basal.

Localities: Connecticut - New Haven Co.; Massachusetts - Essex Co., Middlesex Co.; Canada - Ontario.

Biology: Petersen, 1971.

FIGURE 212



Frisea mirabilis

A) Fifth and sixth abdominal segments, specimen from Essex Co., Massachusetts.

B) Hind foot complex, after Stach.

C & D) Mucrodens, two specimens from same locality, after Stach.

Fig. 213

Friesea quinquespinosa (Wahlgren, 1900)

Ref.: öfv. K. svenska VetAkad. Förh. 57:368 (Polyacanthella).

Description

Color: light mottled blue with darker eye patches. Fourth antennal segment with deeply withdrawn unlobed apical bulb. Tenaculum with 2+2 teeth. Dens 1/3 - 1/2 as long as anal spines, with 3 dorsal setae; mucro absent. Anal spines straight and relatively narrow. Integument moderately coarsely granulate. Body setae smooth and acuminate or slightly truncate. Maximum length 1.5 mm.

Listing of this species is on the basis of 1 Labrador and 2 Alaskan specimens which resemble the original figures and description quite closely. The specimens are poorly mounted and it is uncertain whether they have 5 or 6 eyes.

Fjellberg (1985) sank nauroisi to quinquespinosa.

Localities: Alaska - Point Barrow; Labrador - Nair.

FIGURE 213

Friesea quinquespinosa

A) Chaetotaxy of right side of fifth and sixth abdominal segments, specimen from Pt. Barrow, Alaska.

B) Dens, same specimen.

C) Dens, after Cassagnau.

D) Fore foot complex, specimen from Pt. Barrow, Alaska.

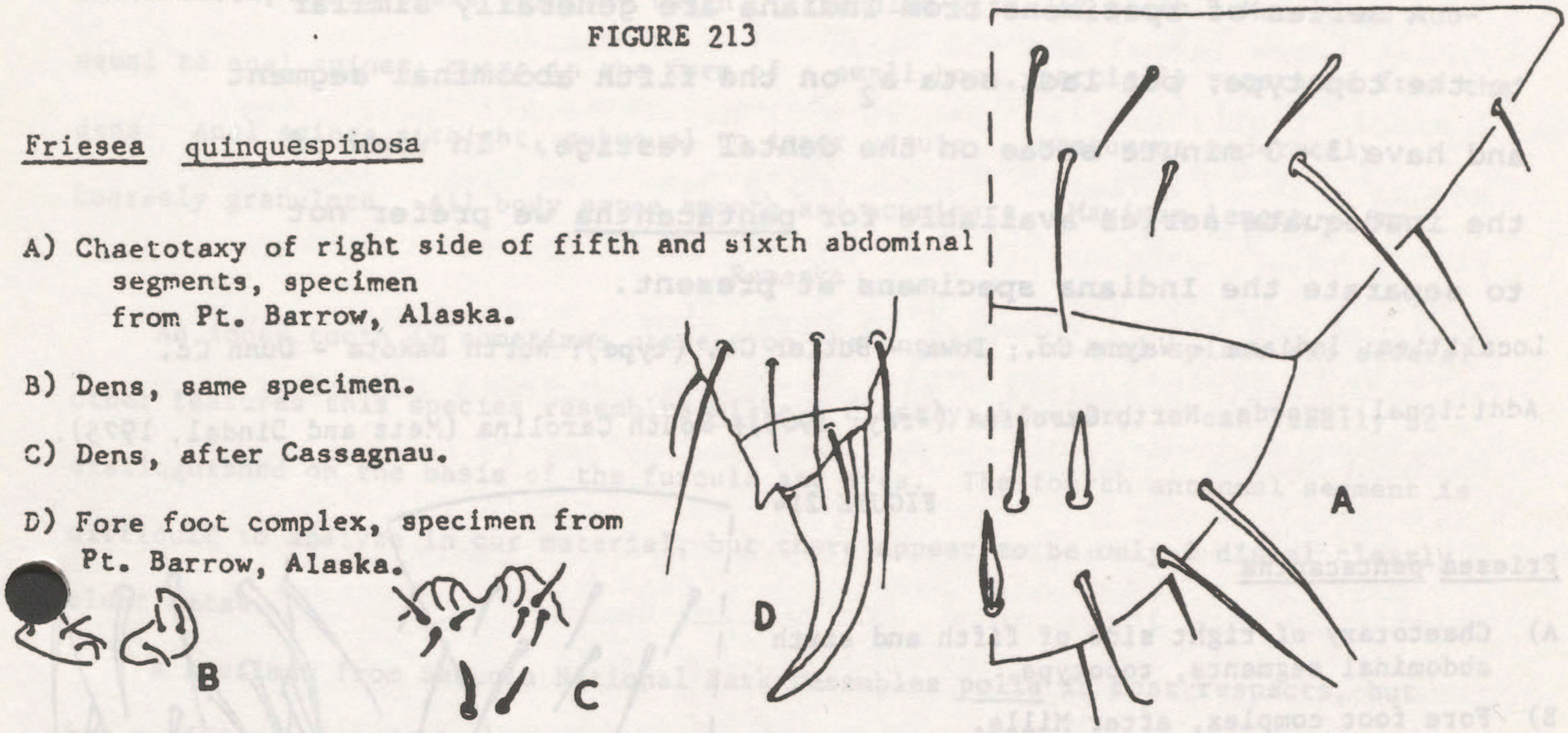


Fig. 214

Friesea pentacantha Mills, 1934

Ref.: Collembola of Iowa: 20

Description

Color: background yellow with scattered blue pigment granules dorsally and dark eye patches. Fourth antennal segment clearly separated from third, with withdrawn unlobed apical bulb and 3 - 4 blunt setae. Tenaculum absent. Furcula reduced to a pair of knobs about half as long as anal spines and carrying a single pair of setae; mucrones absent. Anal spines straight, about 3/4 as long as inner unguis. Integument with granules ranging from 12 to 14 micra. All body setae smooth and acuminate. Maximum length .7 mm.

A topotype, identified by Mills as pentacantha, was seen. It is very similar to nauroisi, but appears to differ in the greater reduction of the furcula, absence of a tenaculum, and fifth abdominal segment chaetotaxy. Further series may show them to be part of the same species.

A series of specimens from Indiana are generally similar to the topotype, but lack seta a_2 on the fifth abdominal segment and have 3 + 3 minute setae on the dental vestige. In view of the inadequate series available for pentacantha we prefer not to separate the Indiana specimens at present.

Localities: Indiana - Wayne Co.; Iowa - Butler Co. (type); North Dakota - Dunn Co.

Additional records: North Carolina (Wray, 1963); South Carolina (Metz and Dindal, 1975).

FIGURE 214

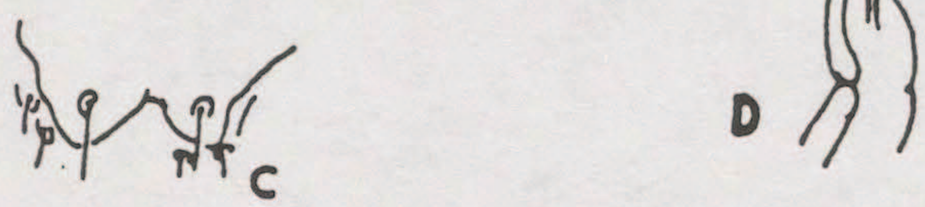
Friesea pentacantha

A) Chaetotaxy of right side of fifth and sixth abdominal segments, topotype.

B) Fore foot complex, after Mills.

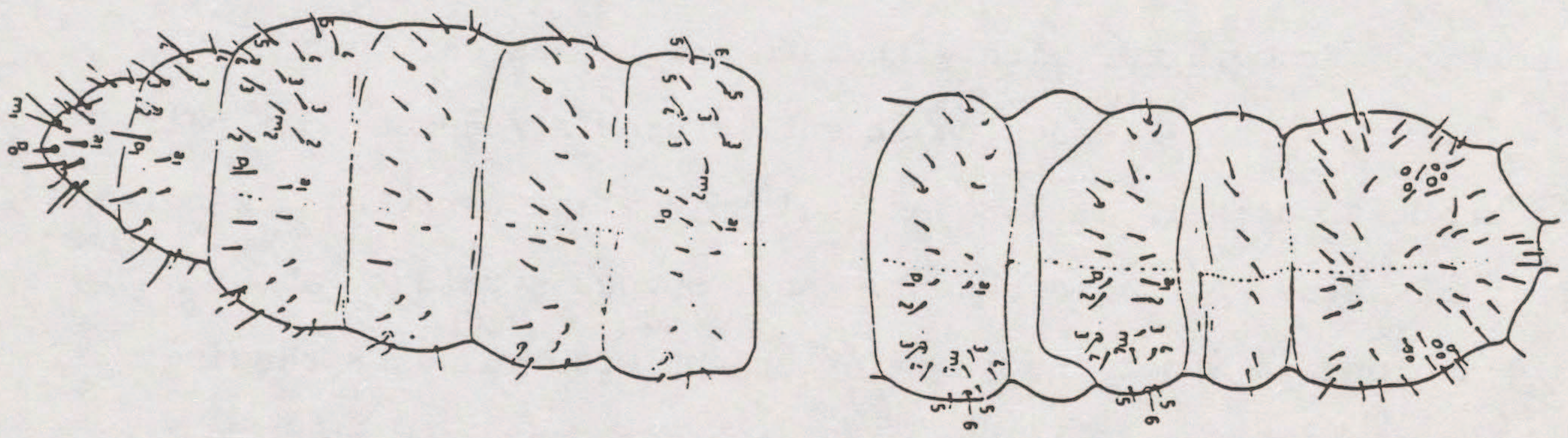
C) Furcula, topotype.

D) Maxilla, after Mills.



Friesea pati Fjellberg 1984 Figure 214.1

Dorsal chaetotaxy After Fjellberg 1984



Friesea polla Christiansen and Bellinger, 1974 Fig. 215

Refs.: Pan. Pacif. Ent. 49: 394; Grow and Christiansen, 1974

Description

Color: unknown (only cleared specimens seen). Fourth antennal segment weakly separated from third on ventral surface only; with deeply withdrawn unlobed apical bulb and two distal blunt setae; an additional blunt seta lies below the level of the apical sense organ of the third segment. Large maxillary blade with single inner tooth; small blade with 3-4 teeth. Tenaculum with 2+2 teeth. Mucrodens subequal to anal spines; mucro in the form of a small hook, partially separated from the dens. Anal spines straight, subequal to inner unguis. Integument moderately coarsely granulate. All body setae smooth and acuminate. Maximum length .7 mm.

Remarks

An inner tooth is sometimes present on the unguis. In anal spines and several other features this species resembles wilkeyi closely; however, it can readily be distinguished on the basis of the furcula and eyes. The fourth antennal segment is difficult to analyze in our material, but there appear to be only 2 distal clearly blunt setae.

A specimen from Sequoia National Park resembles polla in most respects, but has a different mandible, clavate tenent hairs, and a striking pattern: head and posterior abdominal segments purple, anterior trunk white.

Locality: California - El Dorado Co. (type).

FIGURE 215

Friesea polla

All figures of type specimens.

A) Dorsal chaetotaxy of right side of fifth and sixth abdominal segments.

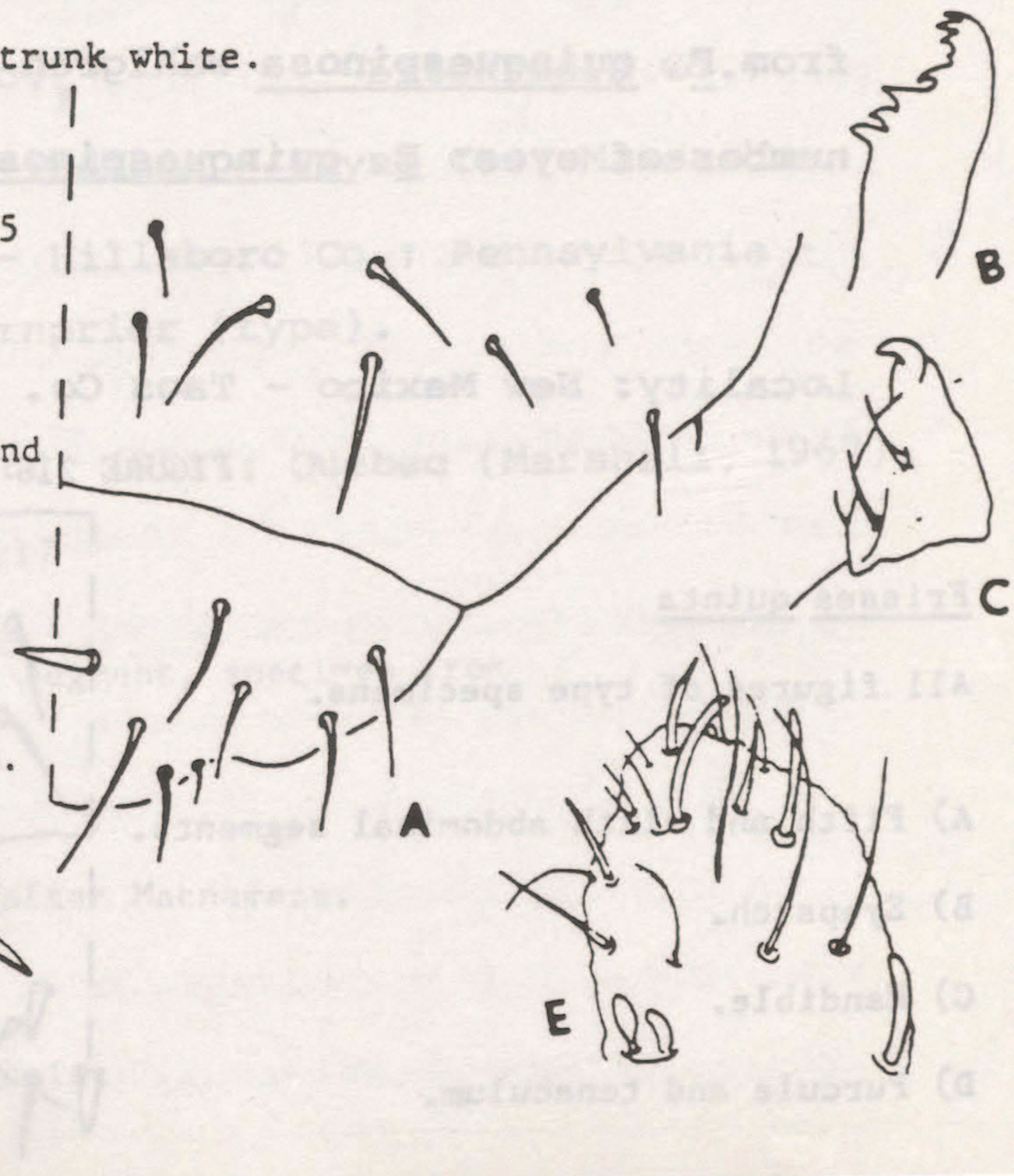
B) Mandible.

C) Mucrodens seen from side.

D) Mucrodens seen from above.

E) Fourth and apex of third antennal segments.

F) Hind foot complex.



Refs.: Pan. Pacif. Ent. 49: 392; Grow and Christiansen, 1974

Description

Color: white, with scattered blue pigment granules on dorsal surface and darker, partially subdivided eye patches. Fourth antennal segment separated from third ventrally but fused dorsally; with a deeply withdrawn unlobed apical bulb and four dorsal blunt setae, three distal and one basal. Larger maxillary blade with a single tooth; smaller lamella with about 7 small teeth. Tenaculum with 2+2 teeth. Dens sharply demarcate from manubrium, with 3 setae, subequal to anal spines; mucro absent. Anal spines straight and heavy, subequal to inner unguis. Integument moderately coarsely granulate. All body setae acuminate and smooth. Maximum length .7 mm.

Remarks

At first we assigned these specimens to F. nauroisi, but the relatively much longer dens, the smaller number of eyes, and differences in chaetotaxy between this form and Alaskan nauroisi appear to justify specific separation. F. quinta is distinguished from F. quinquespinosa Wahlgren only by the (usually) greater number of eyes; F. quinquespinosa, with 3+3 eyes.

Locality: New Mexico - Taos Co. (type).

FIGURE 216

Friesea quinta

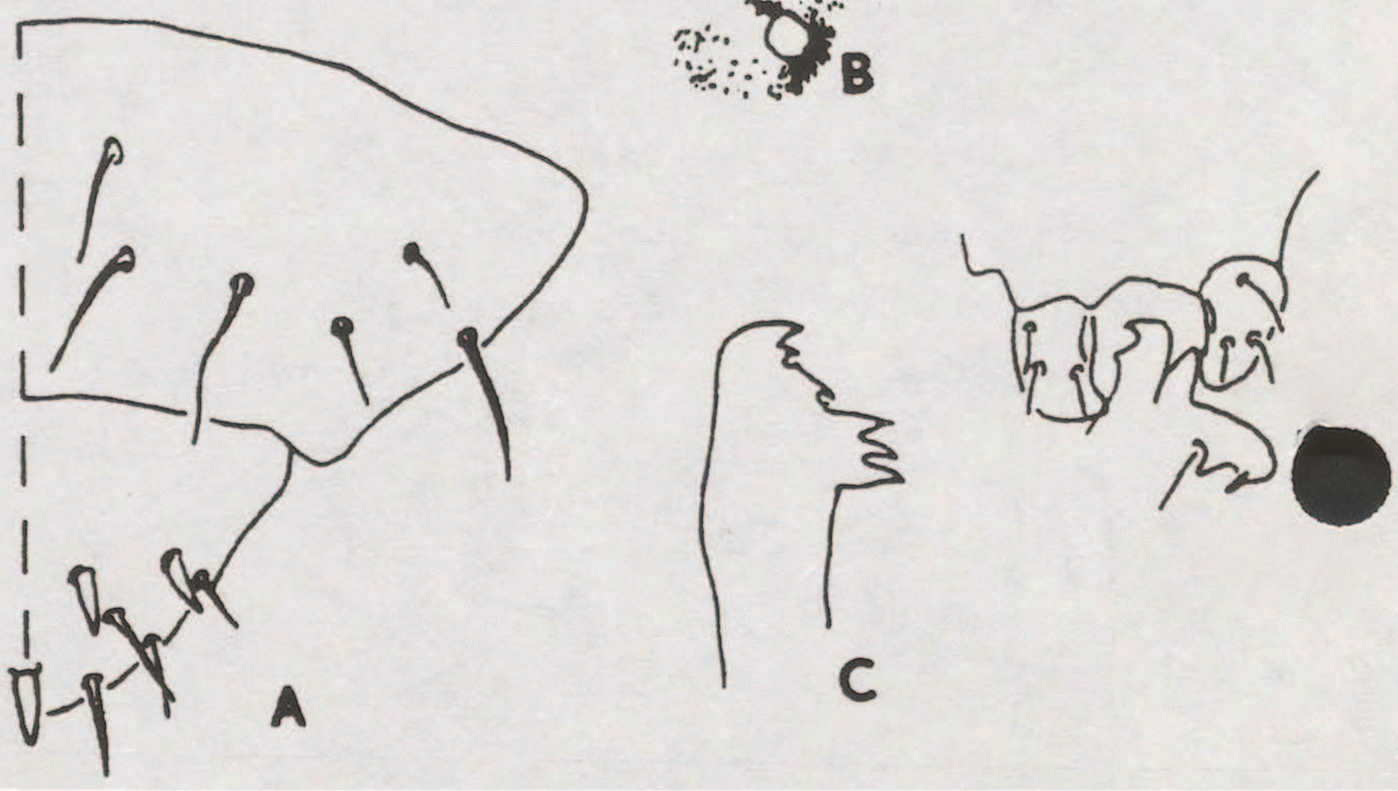
All figures of type specimens.

A) Fifth and sixth abdominal segments.

B) Eyepatch.

C) Mandible.

D) Furcula and tenaculum.



Friesea sublimis Macnamara, 1921 Fig. 217

Refs.: Can. Ent. 53: 128; Rusek, 1971a; Grow and Christiansen, 1974

Description

Color: pale lilac to blue violet, with venter pale, eye patches dark. Fourth antennal segment separated from third ventrally but more or less fused dorsally; with a deeply withdrawn unlobed apical bulb and five blunt setae. Each foot with 4 - 5 clavate setae of about equal length. Tenaculum with 2 + 2 teeth. Mucro and dens 1.1 - 1.8 times as long as anal spines; dens with 3 dorsal setae; mucro clearly separated from dens and about 1/3-1/2 as long as dens, with clear basal lamella. Anal spines strongly curved, .8 to 1.2 times as long as inner unguis. Integument moderately coarsely granulate. Long setae of body truncate to clavate, with clavation being marked on sixth abdominal segment. Maximum length 1.2 mm.

Remarks

The proportions of this species vary considerably, but the well-developed eyes, three anal spines, and various clavate setae combined with the strong mucro serve to identify it.

Localities: Connecticut - Hartford Co., Litchfield Co.; Illinois - Cook Co., Effingham Co.; Indiana - Wayne Co.; Massachusetts - Norfolk Co.; New Hampshire - Hillsboro Co.; Pennsylvania - Bedford Co., Centre Co.; Canada - Arnprior (type).

Additional records: New York (Maynard, 1951); Quebec (Marshall, 1967).

Friesea sublimis FIGURE 217

A) Chaetotaxy of right side of fourth abdominal segment, specimen from Cook Co., Illinois.

B) Hind foot complex, after Macnamara.

Fourth and apex of third antennal segments, after Macnamara.

D) Apex of dens and mucro, after Macnamara.

E) Mucro and dens, specimen from Cook Co., Illinois.

F) Sixth abdominal segment after Macnamara

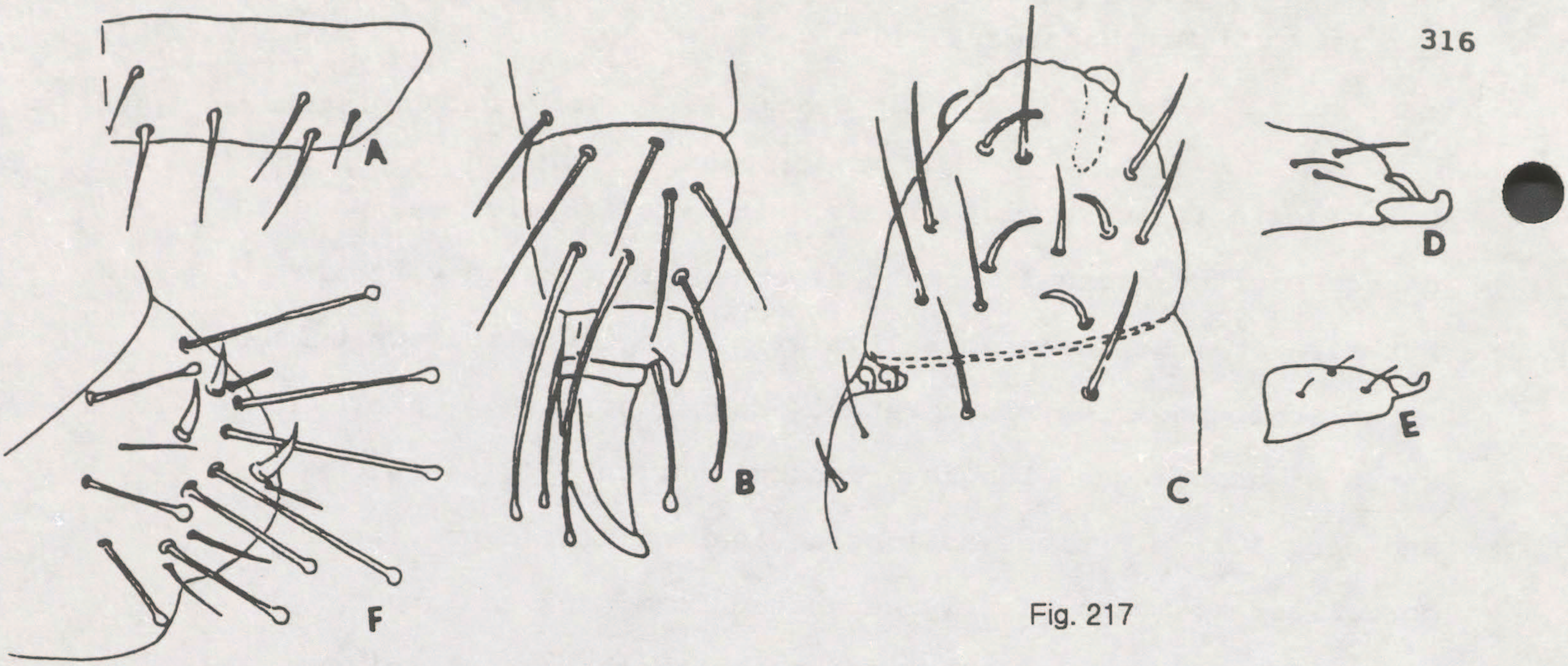


Fig. 217

Friesea wilkevi Christiansen and Bellinger, 1974 Fig. 218

Refs.: Pan Pacif. Ent. 49: 392; Grow and Christiansen, 1974

Description

Color: white with black eyes. Fourth antennal segment separated from third ventrally but fused dorsally; with a deeply withdrawn unlobed apical bulb and four distal and two basal blunt setae. Large blade of maxilla untoothed; smaller blade with 4 teeth. Unguis with a small subapical inner tooth and without lateral teeth. Tenaculum with 1+1 teeth. Dens and mucro completely fused, about 3/4 as long as anal spines. Anal spines perfectly straight and slightly shorter than inner unguis. Integumentary granulations vary from about 6 micra on the second thoracic tergum to about 15 micra on the sixth abdominal segment. All body setae acuminate and smooth or minutely serrate. Maximum length .75 mm.

Remarks

This species was discovered and accurately described by R.F. Wilkey. The 2+2 eyes and two anal spines distinguish it from all other species. It is closely related to polla and

landwehri, but differs in the number of eyes as well as in the structure of the furcula. In many respects F. wilkeyi resembles the Chilean F. mistrali Rapoport and Rubio, but it differs in the number of eyes and in the structure of the mucrodens.

Locality: California - Fresno Co. (type).

FIGURE 218

Friesea wilkeyi

All figures of types.

A) Chaetotaxy of fifth and sixth abdominal segments.

B) Hind foot complex, modified after Wilkey.

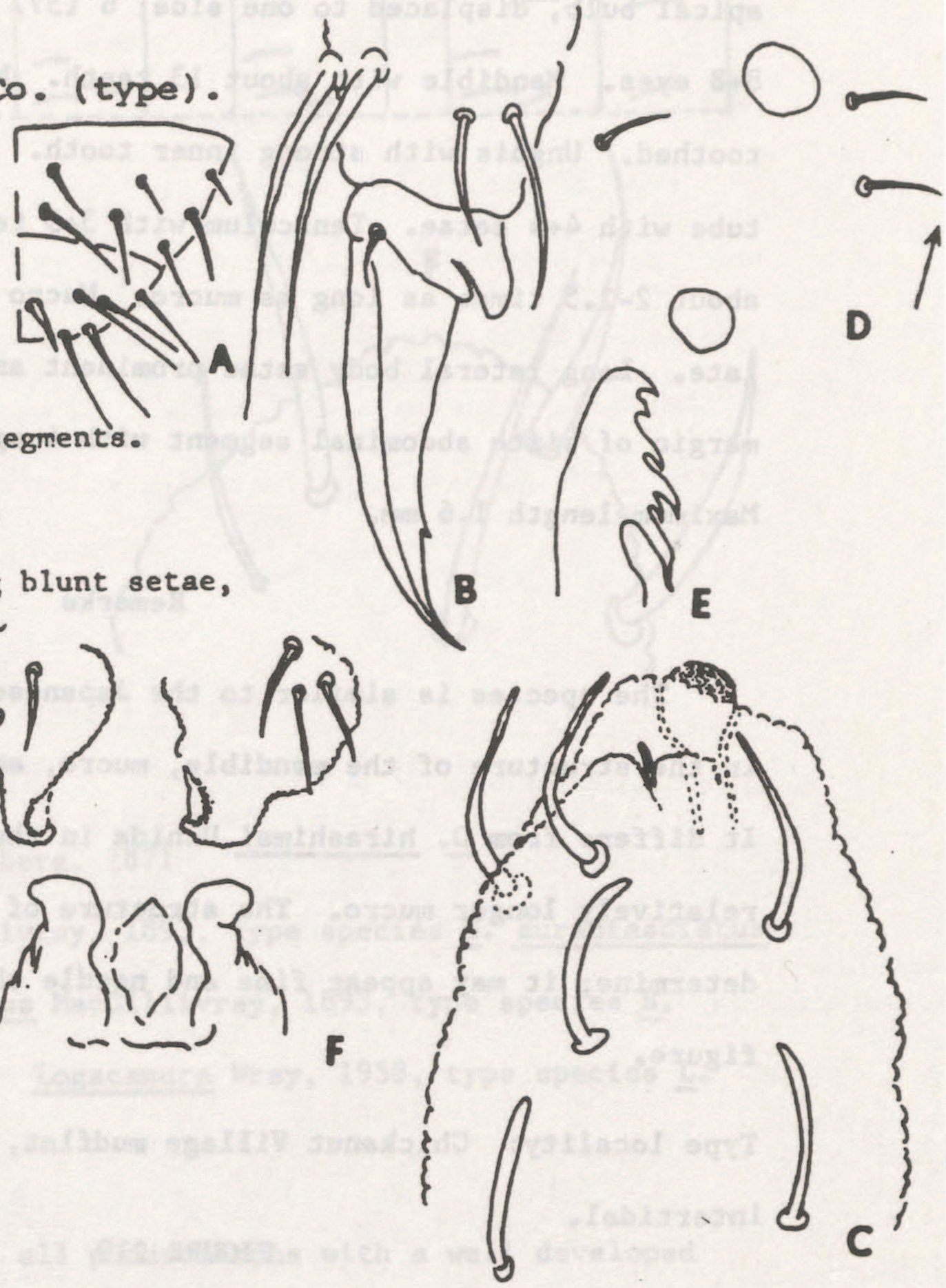
C) Dorsum of fourth antennal segment showing blunt setae, modified after Wilkey.

D) Eyes, modified after Wilkey.

E) Mandible, after Wilkey.

F) Furcula (above) and tenaculum (below), after Wilkey.

G) Habitus, after Wilkey.



Genus Oudemansia Schött, 1893b

Type species: O. coerulea Schött, 1893b

This genus is very similar to Pseudachorutes, but may easily be distinguished by the presence of spine-like setae or anal spines on the last abdominal segment, and by the strictly littoral habitat. It also differs from North American Pseudachorutes in lacking the P.A.O. and in the structure of the mandible. The genus is known only from the shores of the Indian Ocean and northern and western Pacific Ocean. There is a single North American species.

Description

Color: deep uniform blue. Fourth antennal segment with clear trilobed apical bulb, displaced to one side; 6 (5?) clear blunt setae; no ventral "file". 8+8 eyes. Mandible with about 13 teeth. Maxilla either needle like or apically toothed. Unguis with strong inner tooth. Tenent hairs acuminate. Ventral tube with 4+4 setae. Tenaculum with 3+3 teeth. Dens with six dorsal setae, about 2-2.5 times as long as mucro. Mucro with central portion strongly granulate. Long lateral body setae prominent and minutely capitate. Posterior margin of sixth abdominal segment with 4 spines or spine-like short setae. Maximum length 1.6 mm.

Remarks

The species is similar to the Japanese O. esakii Kinoshita, which differs in the structure of the mandible, mucro, and the sixth abdominal segment setae. It differs from O. hirashimai Uchida in the lack of clear anal spines and the relatively longer mucro. The structure of the maxilla is very difficult to determine; it may appear fine and needle shaped, or thin and serrate as in the figure.

Type locality: Chickanut Village mudflat, Bellingham, Whatcom Co., Washington, intertidal.

FIGURE 219

Oudemansia georgia

All figures of type specimens.

A) Chaetotaxy of left side of body.

B) Mandible.

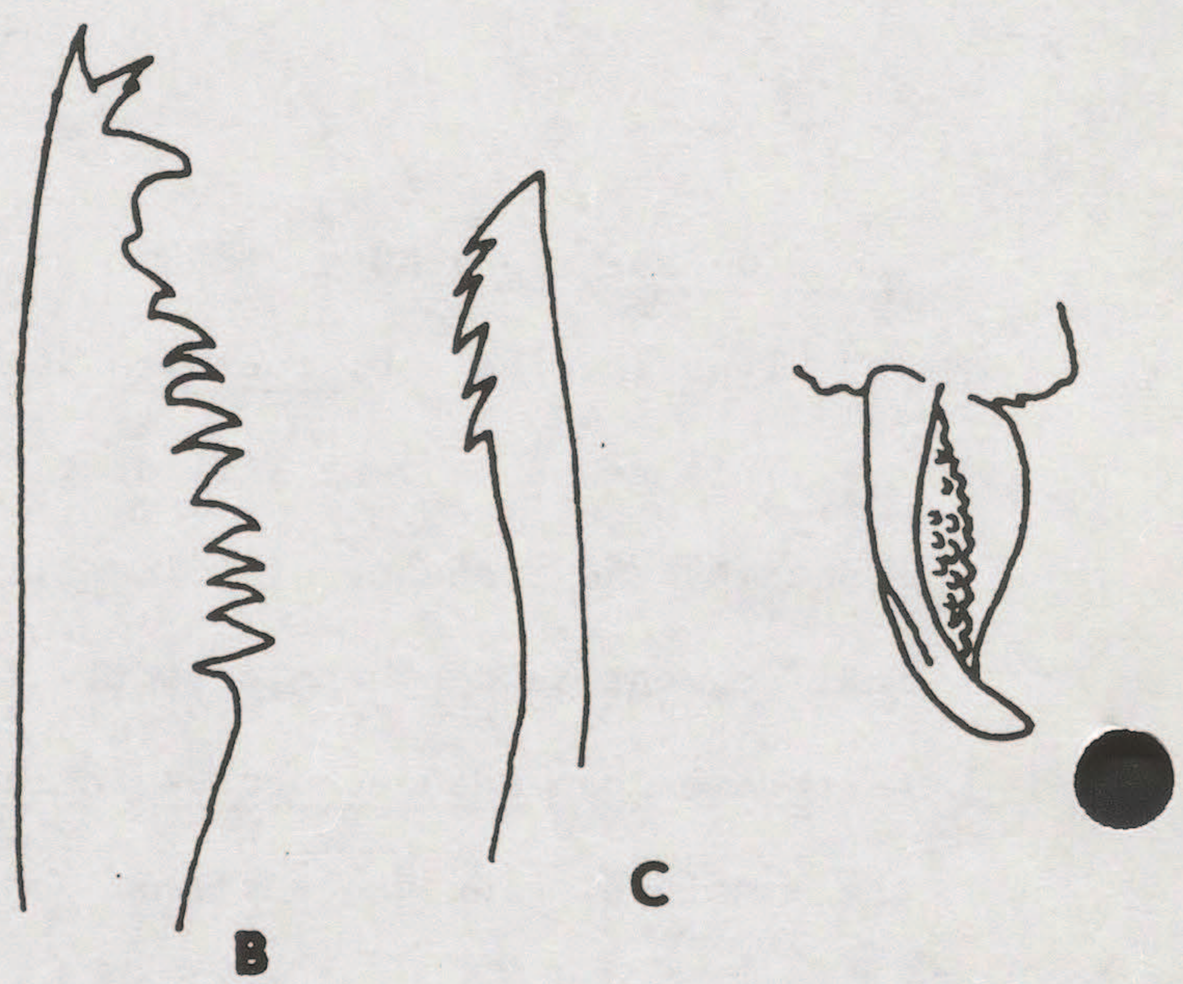
C) Maxilla.

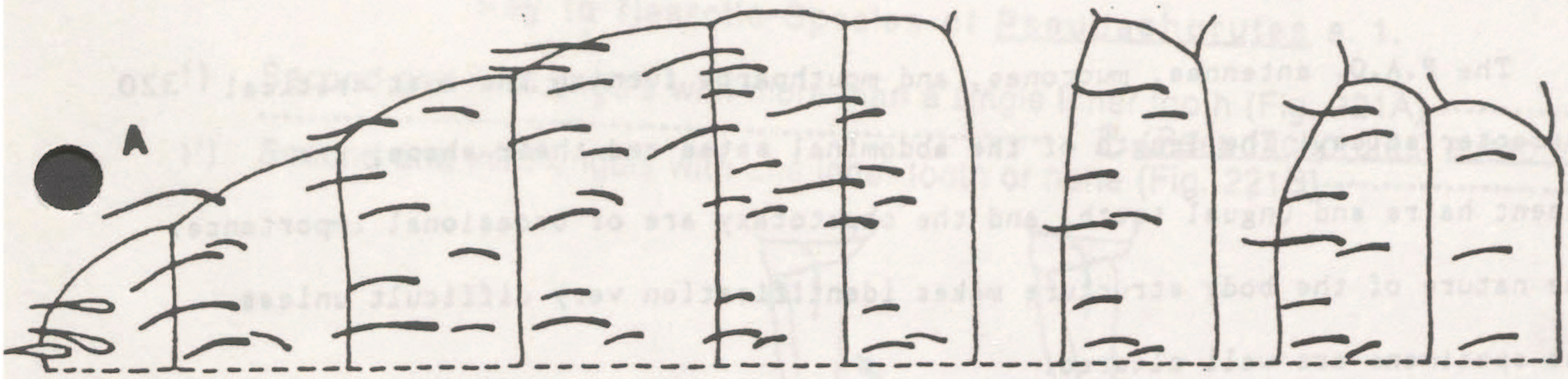
D) Mucro.

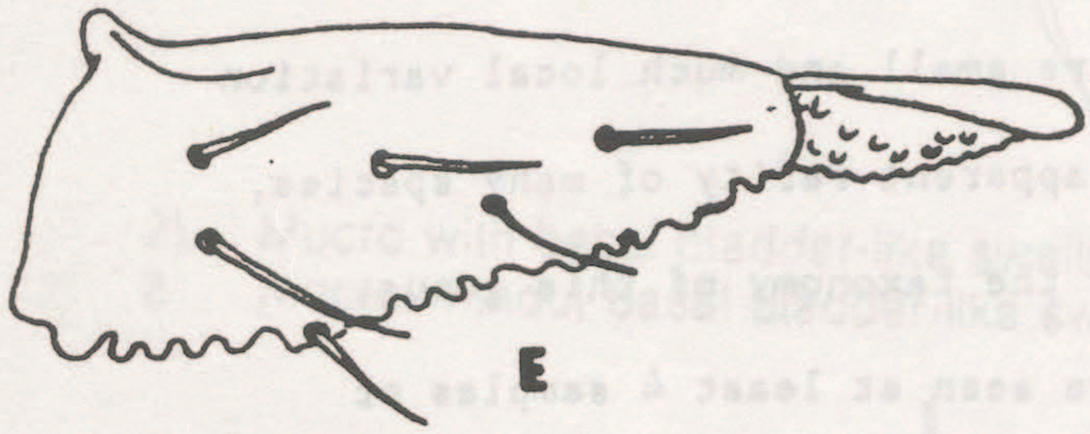
E) Mucro and dens of another specimen.

F) Posterior end of abdomen.

(Figures A, E, and F on next page)







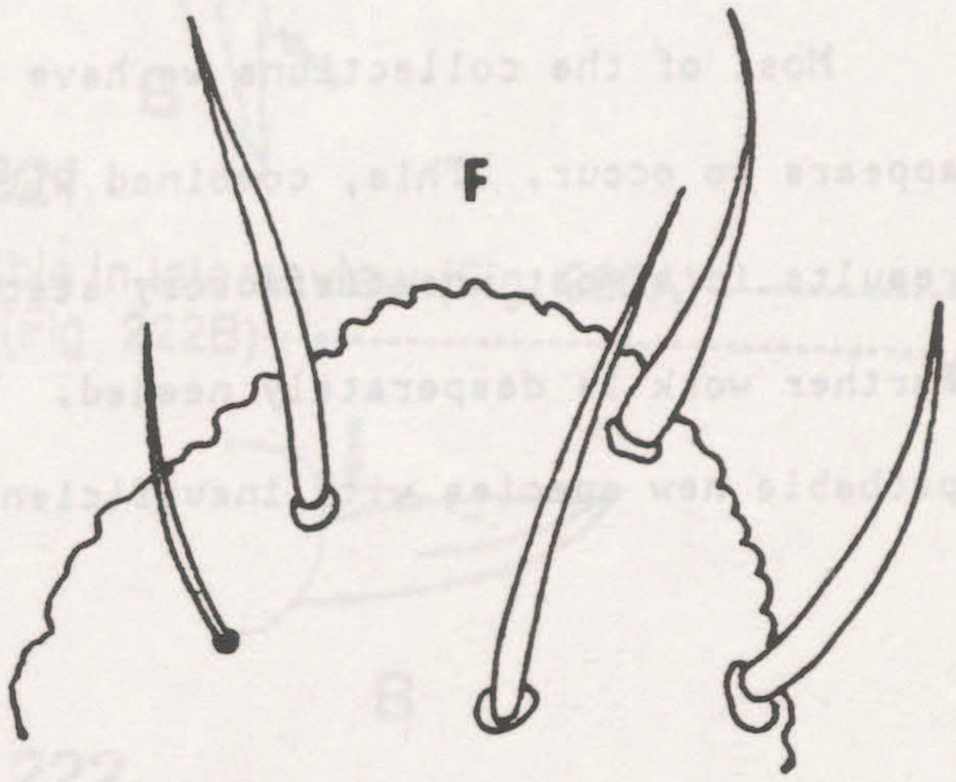


Fig 219

Genus Pseudachorutes Tullberg, 1871

Type species: subcrassus Tullberg, 1871

Syns.: Gnathocephalus MacGillivray, 1893, type species G. aureofasciatus MacGillivray, 1893; Brachysius MacGillivray, 1893, type species B. dilatatus MacGillivray, 1893; Logacanura Wray, 1958, type species L. pasura Wray, 1958, n.syn.

Following Gisin, we place here all poduromorphs with a well developed furca, eight eyes per side, without a molar plate on the mandible, with elongate maxillae, and without spines or spine-like setae on the sixth abdominal segment. Thus we include Pseudachorudina as a subgenus. The genus is primarily tropical, and we have found only thirteen species in North America.

In addition to the features mentioned above, the Nearctic members of the genus are characterized by the presence of the P.A.O., an elongate mouth cone, and a very plump, soft body. The colors are usually very dark and the animals are usually relatively smooth. Unguiculi and anal spines are absent.

The P.A.O. antennae, mucrones, and mouthparts furnish the most critical characteristics. The length of the abdominal setae and their shape, the tenent hairs and ungual teeth, and the chaetotaxy are of occasional importance. The nature of the body structure makes identification very difficult unless the specimens are well cleared. 320

Most of the collections we have seen are small and much local variation appears to occur. This, combined with the apparent rarity of many species, results in a most unsatisfactory status for the taxonomy of this genus. Further work is desperately needed. We have seen at least 4 samples of probable new species with insufficient material to be described.

TABLE XIV
Characteristics of Nearctic Species of Pseudachorutes s. 1.

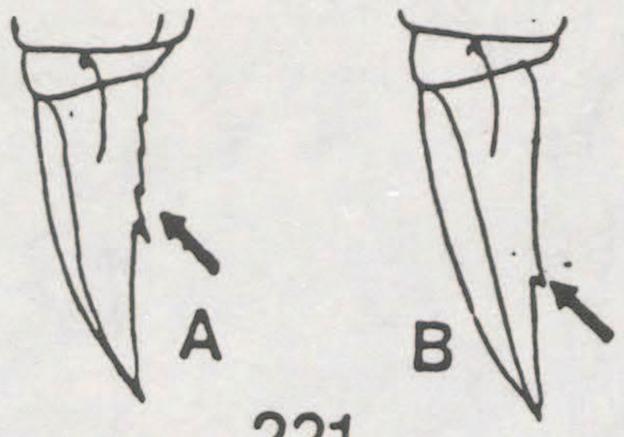
Species	Lobes 4th Antennal Bulb	P.A.O. Lobes	Large Mandibular Teeth	Clavate Tenent Hair	Mucro bladder	Clavate Posterior Setae	Largest 5th Abdominal Setae + Inner Unguis
sp. A (Arkansas)	-	26-42	3-4	-	+	-	1.15-2.0
americanus	1	5-8 (-11?)	2	+	-	+	1.0-1.1
aphysus	-	15-23	2	-	+	-	1.1-2.0
aureofasciatus	1-3	12-16	3	+,-	-	+,-	1.3-2.0
bifidus	3	17-22	3?	+,-	-	+	1.5-1.8
sp. C (Texas)	3	12-13	2	-	-	-	.95-1.1
complexus	?	20-25	?	-	-	-	"short"
corticicolus	1-3	6-10	2	+	-	+,-	1.0-1.2
curtus	2-3	6-7	3	-	-	+	1.3-2.0
sp. D (Texas)	3	5-6	4	-	-	-	1.5-1.7
ignotus	1-3	9-12	7-8	+	-	+,-	.6-.8
indiana	3	12-14	4	-	-	+,-	.9-1.0
lunatus	?	10-12	?	+	-	-	?
navajellus	1-3	6-10	3	-	-	-	1.1
orientalis	1	9-11	2	-	-	weak+	?
quadrisetosus	3	5	4-5	-	-	-	1.75
rugatus	-	28-30	4-5	-	-	+,-	.9-1.0
saxatilis	-	25-29	4-6	-	+	+	.9-1.2
simplex	2-3	(10)14-17	4	-	+	-	.4-.7
subcrassoides	3	8-14	4-5	-	-	-	.55-.85
texensis	3	6-8	6	+		-	1.2-1.4
columbicus *	1	6-7	3	+	-	-	.6?

* We overlooked this species (Rusek1991) until it was too late to fully include it in the revision.

Key to Nearctic Species of Pseudachorutes s. 1.

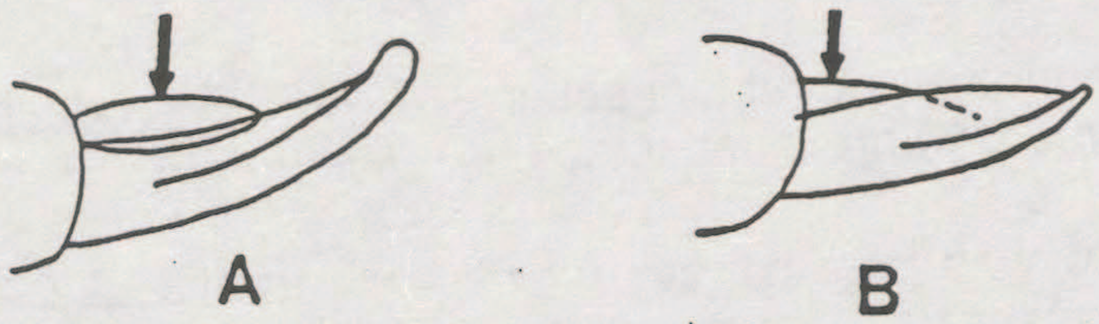
*1) Second and third unguis with more than a single inner tooth (Fig. 221A)----------
---------- P. (Pseudachorutes) aureofasciatus

1') Second and third unguis with one inner tooth or none (Fig. 221B)----------2



221

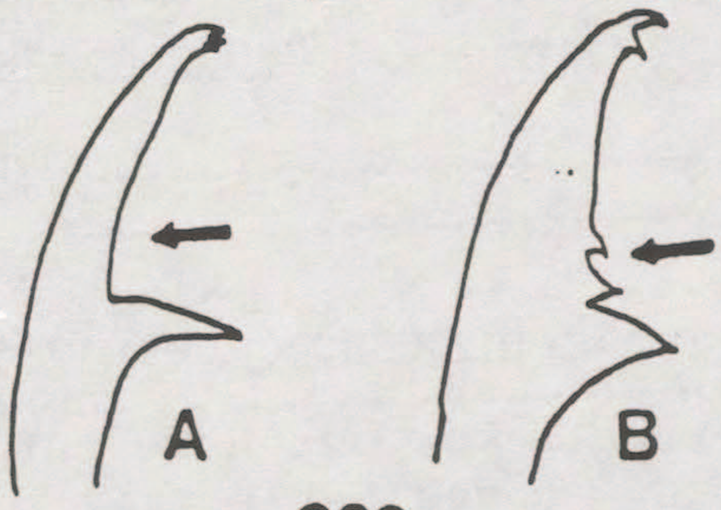
2) Mucro with basal bladder-like swelling visible in lateral view (Fig. 222A)----------3
2' Mucro without basal bladder-like swelling (Fig. 222B)----------5



222

*3) Antenna without apical bulb----------4
**3') Antenna with apical bulb----------P. (Pseudachorutes) simplex

**4) Mandible with 2 major teeth (Fig. 223A)----------P. (Pseudachorutes) aphysus
*4') Mandible with 4-6 major teeth (Fig. 223B)----------P. (Pseudachorutes) saxatilis



223

5) P.A.O. with 15 or more lobes----------6
5') P.A.O. with 14 or fewer lobes----------8

6) Dens with 4 setae----------P. (Pseudachorutes) complexus
6') Dens with more than 4 setae----------7

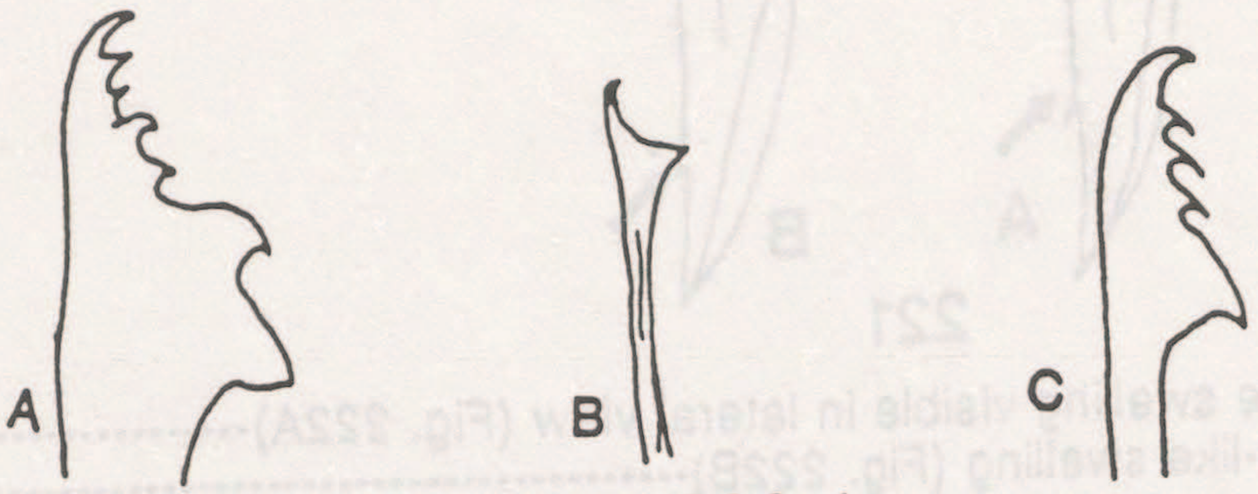
**7) Mucro not tuberculate----------P. (Pseudachorutes) bifidus
*7') Mucro tuberculate----------P. (Pseudachorutes) rugatus

8) With clavate tenent hair----------9
8') With acuminate, seta-like tenent hair----------14

9) Dens with 4 - 6 setae; no clavate posterior abdominal setae----------10
9') Dens with 5 - 6 setae; if 5 dental setae, posterior abdominal setae clavate----------11

10) P.A.O. lobes 10-12----------P. (Pseudachorutes) lunatus
**10') P.A.O. lobes 6 - 8----------P. (Pseudachorutes) texensis V

**11) Mandible with 7 - 8 apical teeth (Fig. 223.1A)----------P. (Pseudachorutes) ignotus
11') Mandible with 2 apical teeth (Fig. 223.1B)----------12



223.1

*12) Fourth antennal segment with 3-4 blunt setae----------P. (Pseudachorutes) americanus
12') Fourth antennal segment with 6 blunt setae----------13

*13) 8 + 8 eyes----------P. (Pseudachorutes) corticicolus
13') 5 + 5 eyes----------Stachorutes navajellus Fjellberg, 1984b

14) P.A.O. 1.2 to 1.8 times as large as nearest eye----------15
14') P.A.O. smaller than or subequal to nearest eye----------16

*15) Mandible with 2 apical teeth (Fig. 223.1B)----------P. (Pseudachorutes) subcrassoides
15') Mandible with 5 apical teeth (Fig. 223.1C)----------
----------P. (Pseudachorutes) orientalis Loring, 1984

*16) P.A.O. of 12 - 14 lobes----------P. (Pseudachorutes) indiana
16') P.A.O. of 5 - 7 lobes----------17

17) Dens with 4 dorsal setae----------P. (Pseudachorutes) quadrisetosus Snider, 1981b
*17') Dens with 6 dorsal setae---------- ---P (Pseudachorutes) curtus

V P. columbicus Rusek 1991 will key out here but can be easly distinguished (see table XIV)

Not included in key:

dilatatus MacGillivray, 1893 (Brachysius) unplaceable, types lost

corticicolus f. "globulisetosa" Gisin, 1944a Nearctic records are americanus

aureofasciatus f. "millsi" Maynard, 1951 = aureofasciatus

pasurus (Wray, 1958), n.comb. (Logacanura) unplaceable without types

subcrassus Tullberg, 1871 Nearctic records are subcrassoides

There are 18 Nearctic species: 1) americanus; 2) aphysus; 3) aureofasciatus; 4) bifidus; 5) complexus; 6) corticicolus; 7) curtus; 8) ignotus; 9) indiana; 10) lunatus; 11) navajellus; 12) orientalis; 13) quadrisetosus; 14) rugatus; 15) saxatilis; 16) simplex; 17) subcrassoides; 18) texensis.

Pseudachorutes (Pseudachorutes) americanus Stach 1949, Fig. 226

Refs.: Apterygotan fauna of Poland (3):119 (as boerneri ssp.); Mills, 1934 (as "corticolus").

Description

Color: dark blue, paler on sutures. Fourth antennal segment with an unlobed or weakly lobed apical bulb and 3 blunt setae; "file" absent. P.A.O. slightly larger than nearest eye. Maxillae needle-shaped. Unguis with minute tooth near apex. One large, clavate tenent hair. Ventral tube with 4+4 setae. Tenaculum with 3+3 teeth. Dens about 2.5 times as long as mucro, with 6 (rarely 5) dorsal setae. Posterior setae clearly capitate. Maximum length 1.1 mm.

Remarks

The specimens we have examined are undoubtedly the same taxon described by Mills under the name "corticolus" and by Stach as P. boerneri ssp. americanus. Since these forms share features of both corticolus and boerneri, and are clearly distinguishable from a form identified with Linnaniemi's corticiolus, we are conserving the name americanus for the Nearctic forms which have been referred to boerneri.

Localities: California - Yolo Co.; Iowa - Butler Co. (type).

FIGURE 226

Pseudachorutes (Pseudachorutes) americanus

A) Chaetotaxy of right side of body, specimen from Yolo Co., California.

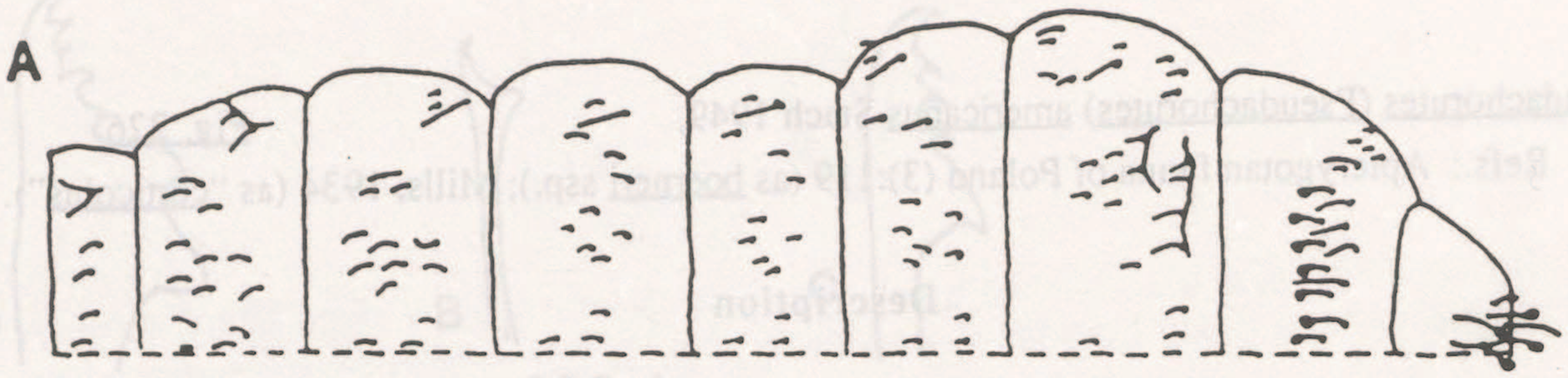
B) Hind foot, after Mills.

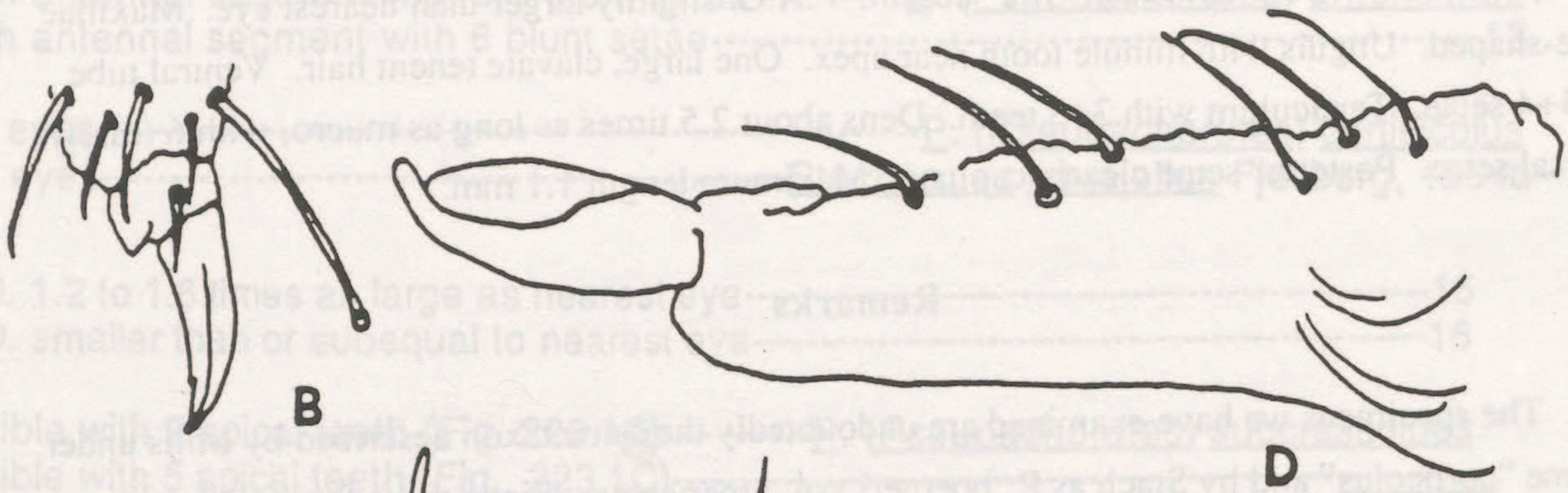
C) Apex of fourth antennal segment, specimen from Yolo Co., California.

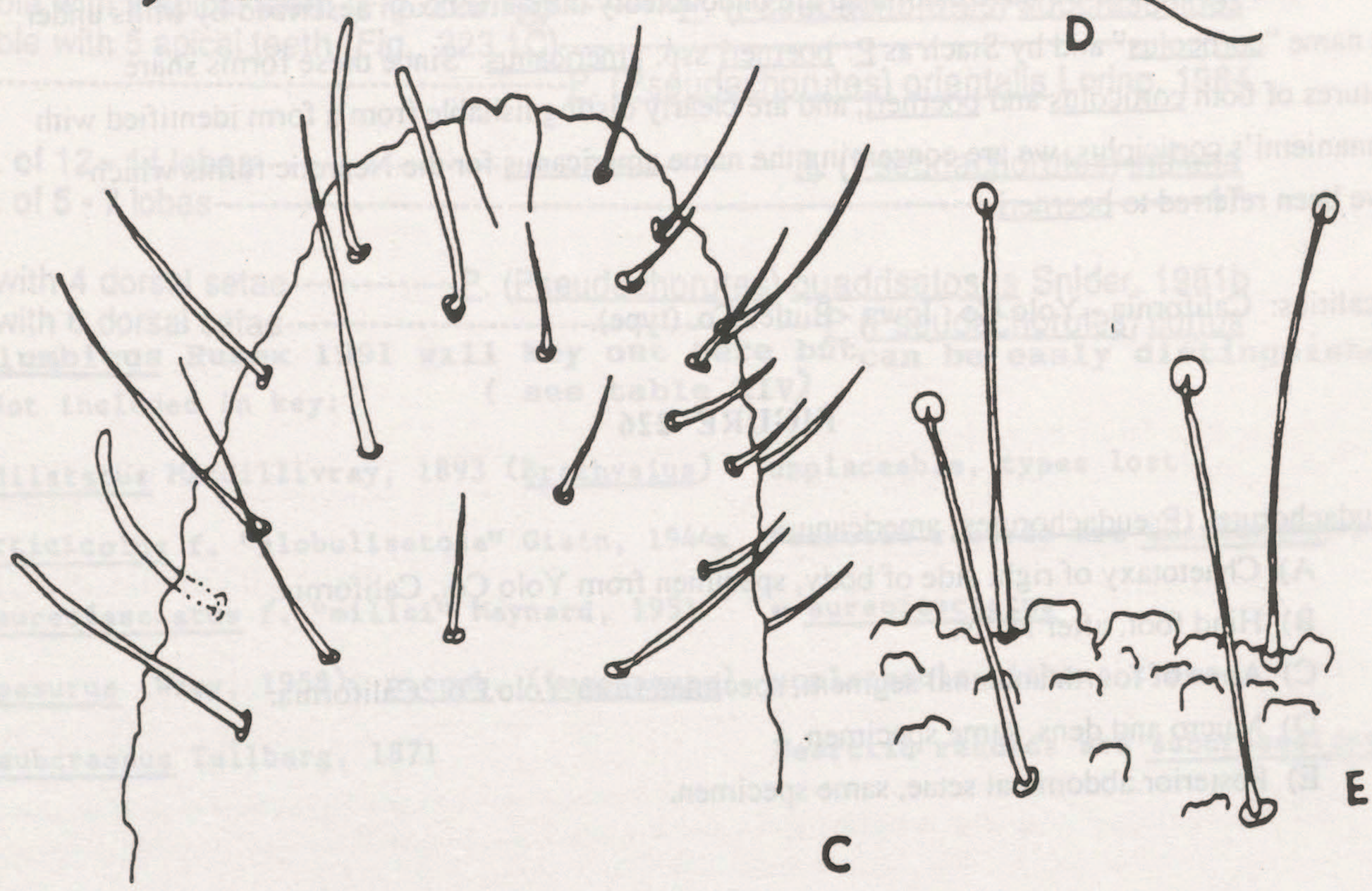
D) Mucro and dens, same specimen.

E) Posterior abdominal setae, same specimen.

Figure 226

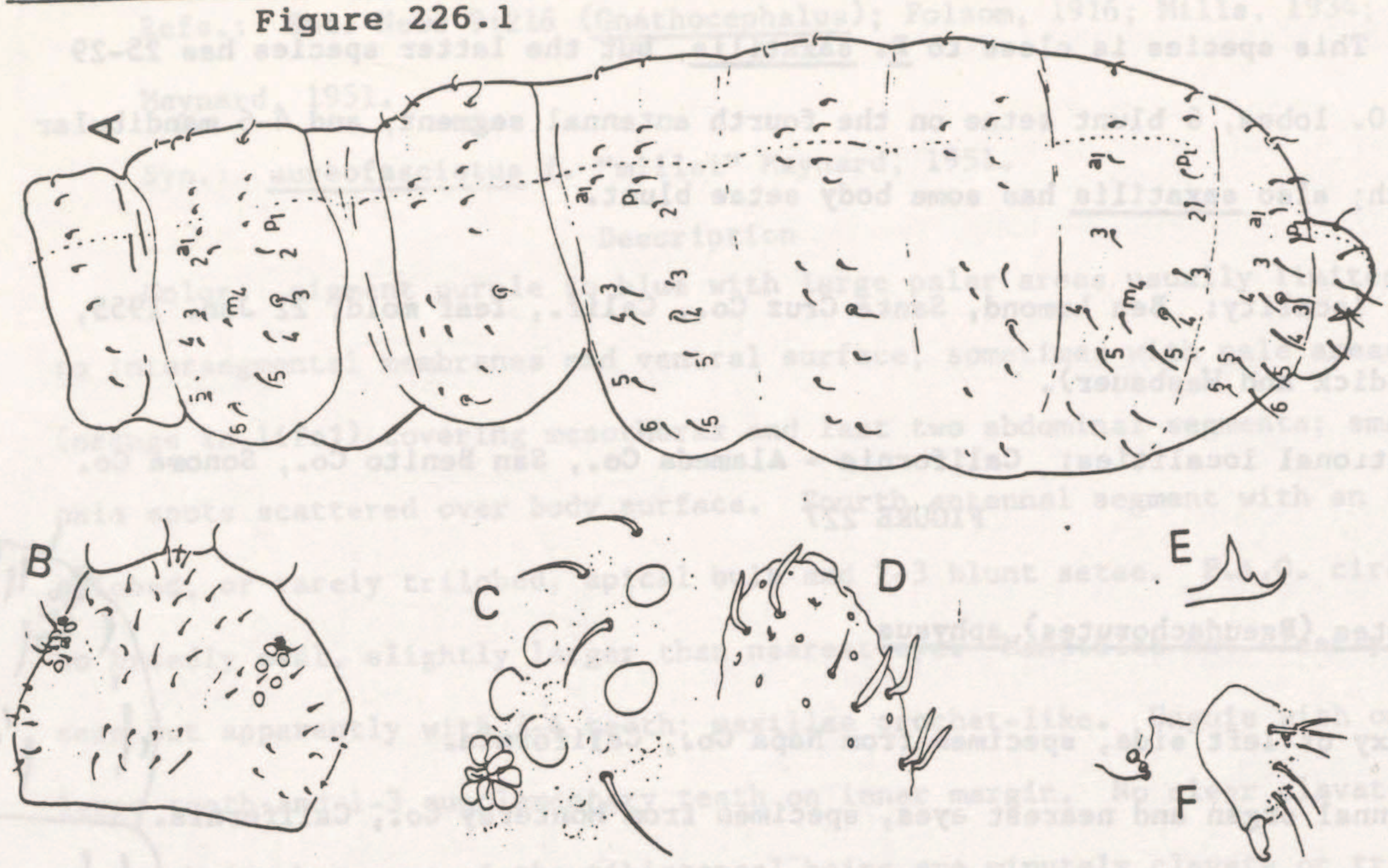






Pseudachorutes (Stachorutes) Navajellus Fjellberg 1984

Figure 226.1



P. (S.) navajellus A) Chaetotaxy of body; B) Head; C) Left PAO & ocelli; D) Sensillae of left ant. seg. 4; E) Mandible; F) Tenaculum and furcula. After Fjellberg 1984.

Pseudachorutes (Pseudachorutes) aphysus, Christiansen & Bellnger 1980 Fig.227

Description

Color: blue with granular pigment and an unpigmented venter. Fourth antennal segment without apical bulb and with 5 poorly differentiated blunt setae; ventral "file" of about 15 slightly shorter than normal straight setae. Maxillae stylet-like and two-bladed. P.A.O. elongate elliptical. Unguis with a simple inner tooth, sometimes difficult to distinguish. Ventral tube with 4+4 setae. Tenaculum with 3+3 teeth. Dens 2.6-3.2 times as long as mucro, with 6 dorsal setae. Mucro curved and with a clear bladder-like swelling at the base of the lamella. Body setae acuminate. Maximum length 1.5 mm.

Remarks

This species is close to P. saxatilis, but the latter species has 25-29 P.A.O. lobes, 6 blunt setae on the fourth antennal segment, and 4-6 mandibular teeth; also saxatilis has some body setae blunt.

Type locality: Ben Lomond, Santa Cruz Co., Calif., leaf mold, 22 Jan. 1955, (Burdick and Wasbauer).

Additional localities: California - Alameda Co., San Benito Co., Sonoma Co.

FIGURE 227

Pseudachorutes (Pseudachorutes) aphysus

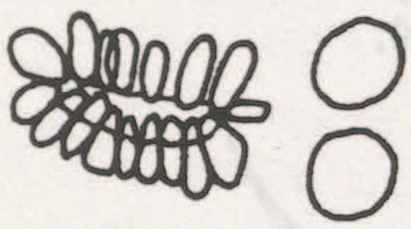
A) Chaetotaxy of left side, specimen from Napa Co., California.

B) Postantennal organ and nearest eyes, specimen from Monterey Co., California.

C) Mandible, holotype.

D) Maxilla, holotype.

E) Mucrones, holotype.



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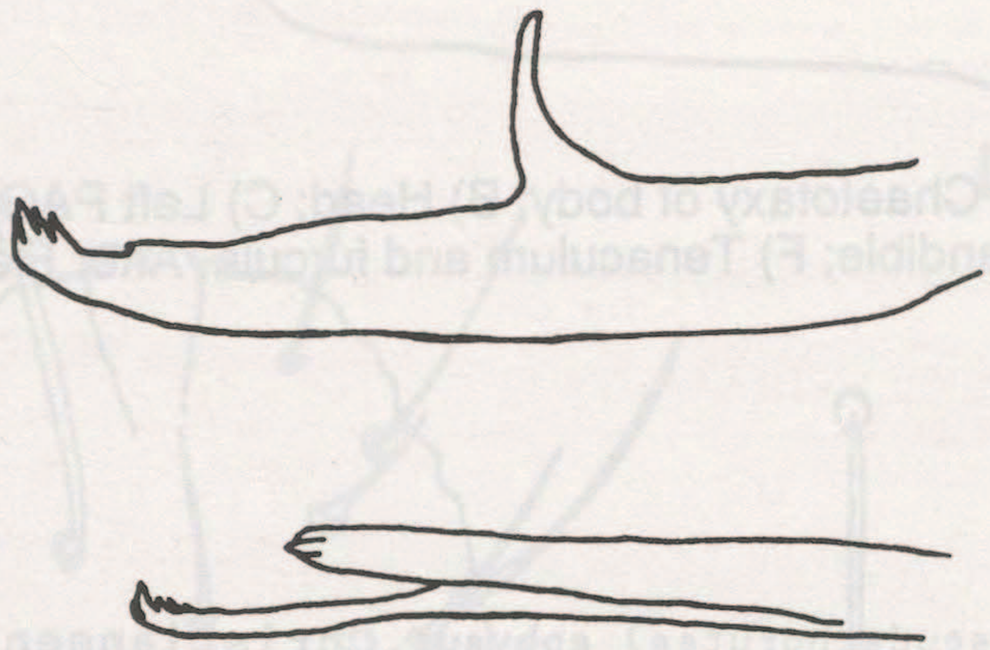

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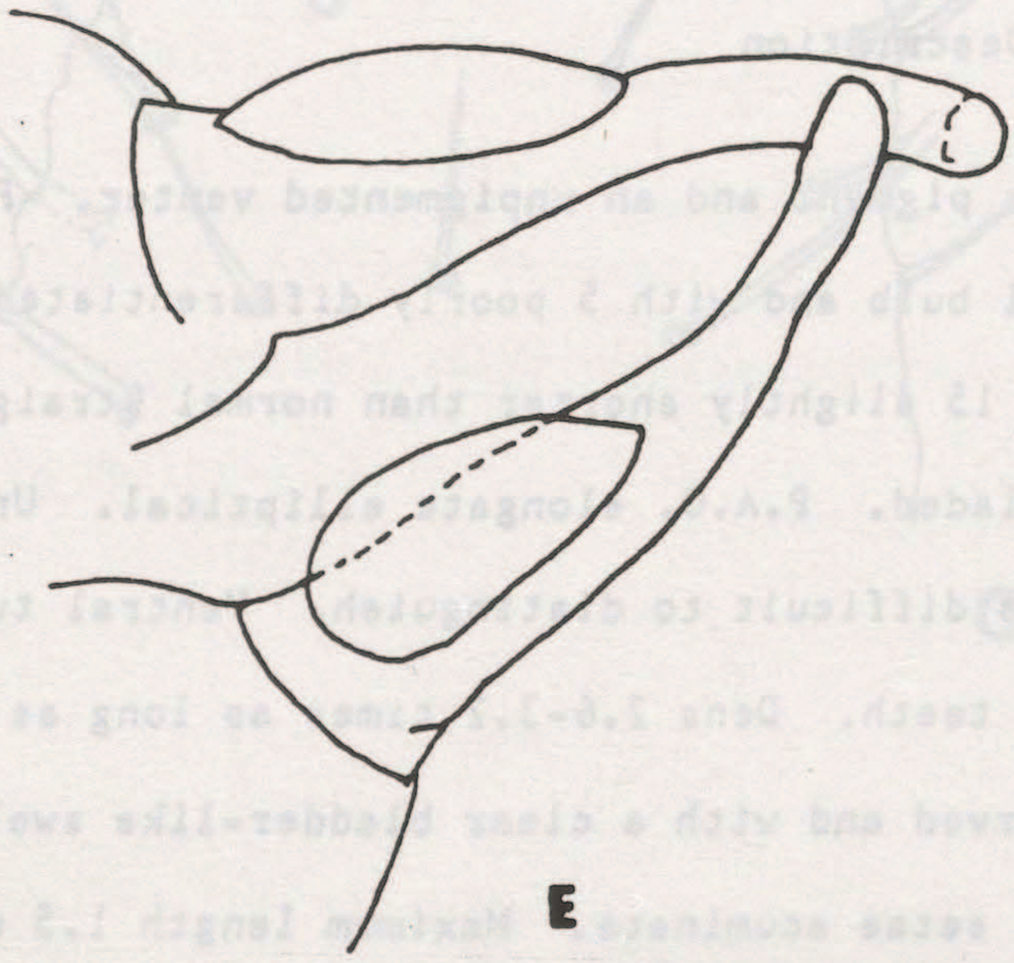
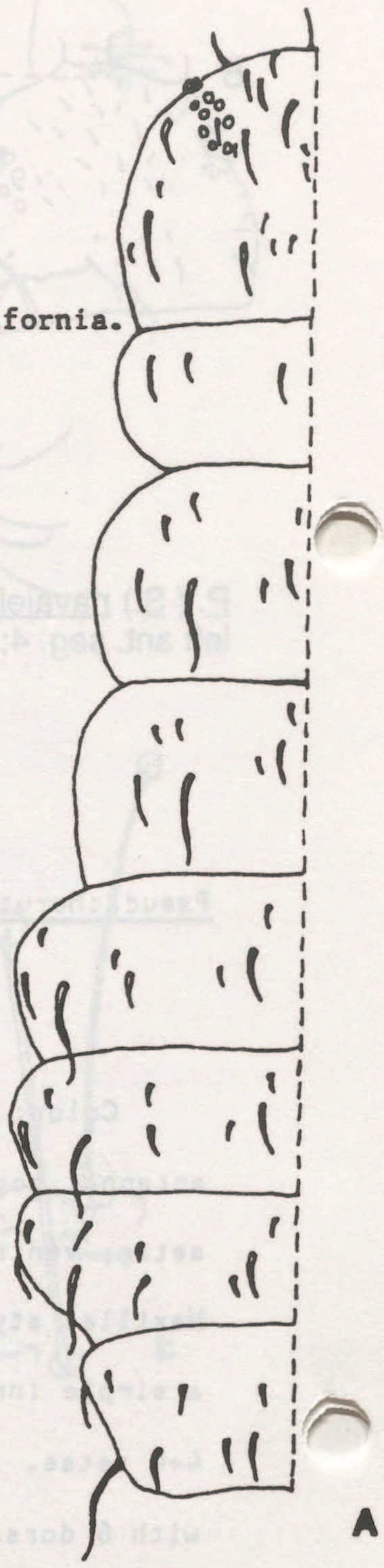


E



D

A

Pseudachorutes (Pseudachorutes) aureofasciatus (Harvey), 1898 Fig. 228

Refs.: Ent. News 9:216 (Gnathocephalus); Folsom, 1916; Mills, 1934; Maynard, 1951.

Syn.: aureofasciatus f. "millsi" Maynard, 1951.

Description

Color: pigment purple to blue with large paler areas usually limited to intersegmental membranes and ventral surface; sometimes with pale areas (orange in life?) covering mesothorax and last two abdominal segments; small pale spots scattered over body surface. Fourth antennal segment with an unlobed, or rarely trilobed, apical bulb and 2-3 blunt setae. P.A.O. circular to broadly oval, slightly larger than nearest eye. Mandibles not clearly seen but apparently with 3-4 teeth; maxillae crochet-like. Unguis with one large tooth and 1-3 supplementary teeth on inner margin. No clear clavate tenent hair, but some of the tibiotarsal hairs are minutely clavate or truncate. Ventral tube with 4+4 setae. Tenaculum with 3+3 teeth. Mucro about half as long as dens; scoop-shaped when seen from above, but broadly lamellate in side view. Posterior abdominal setae curved and truncate to weakly clavate. Maximum length 1.5 mm.

Remarks

The peculiar ungual teeth and clavate abdominal setae are used to distinguish this species. As presently defined this taxon almost certainly encompasses a number of species; however, present materials are inadequate to determine this.

Localities: California - Los Angeles Co.; Illinois - Calhoun Co., Guthrie Cave, Johnson Co., Union Co. (?); Indiana - Wayne Co.; Iowa - Jackson Co., Wapello Co.; Maine - Orono (type); Maryland - Green Ridge; Montana - Flathead Co; West Virginia - Tucker Co. (?). Canada: Alberta - Edmonton; British Columbia - Golden.

Additional records: Connecticut (Britton, 1939); Michigan (Snider, 1967); New York (Maynard, 1951); North Carolina (Wray, 1967); South Carolina (DuRantand Fox, 1966); Tennessee (Copeland, 1960). Quebec (Marshall, 1967).

FIGURE 228

Pseudachorutes (Pseudachorutes) aureofasciatus

A) Chaetotaxy of left side of body, specimen from Calhoun Co., Illinois.

B) Chaetotaxy of left side of body, specimen from Los Angeles Co., California.

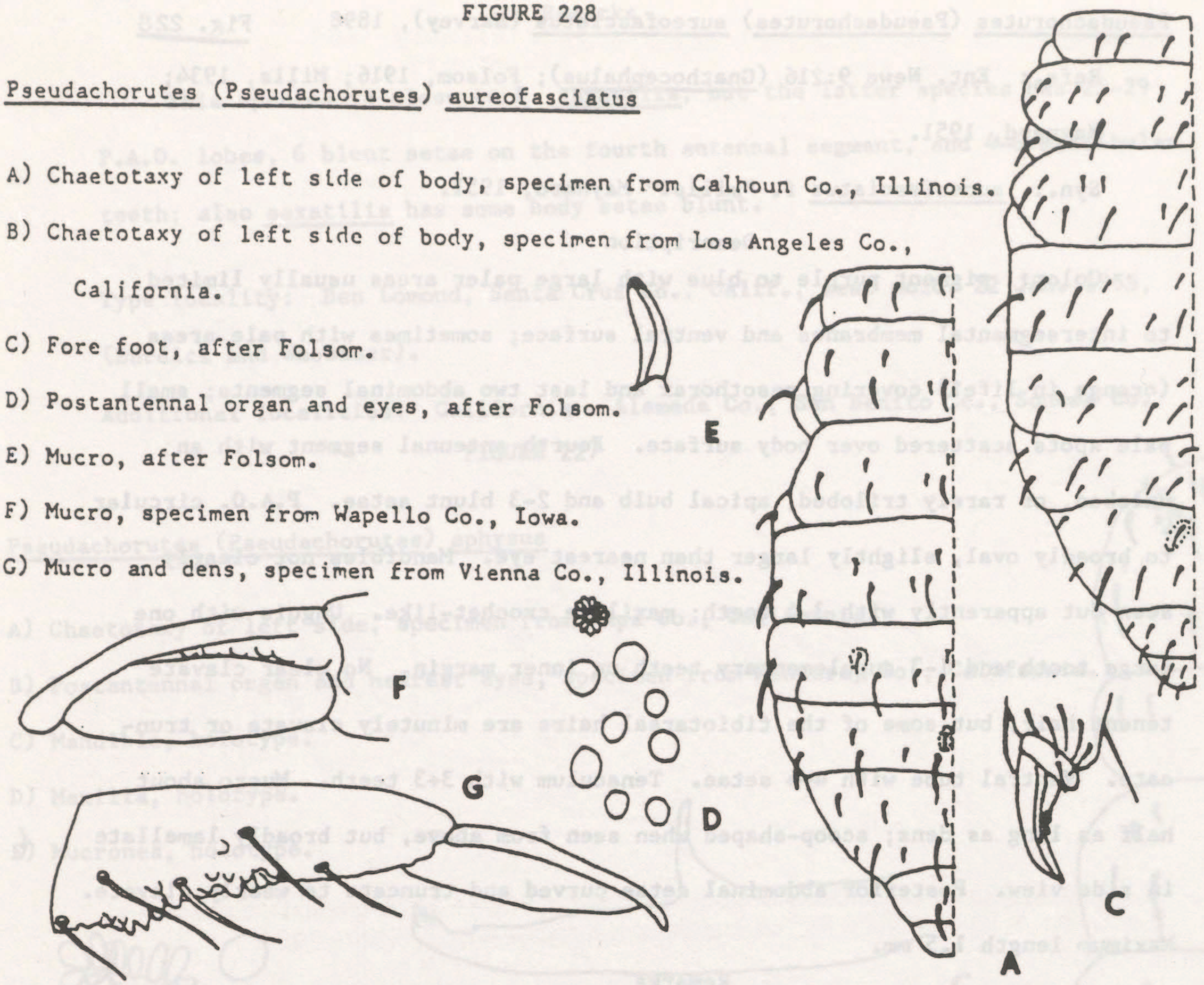
C) Fore foot, after Folsom.

D) Postantennal organ and eyes, after Folsom.

E) Mucro, after Folsom.

F) Mucro, specimen from Wapello Co., Iowa.

G) Mucro and dens, specimen from Vienna Co., Illinois.



Pseudachorutes (Pseudachorutes) bifidus Christiansen & Bellinger, 1980 Fig. 229

Description

Color: unknown, probably blue. Fourth antennal segment with clear subapical bulb and three poorly differentiated blunt setae; no ventral "file". P.A.O. circular and slightly larger than one eye. Maxilla two-bladed and crochet-like. Unguis with clear, single inner tooth. Tibiotarsus without clearly differentiated tenent hair in usual position, but with several weakly clavate hairs elsewhere. Ventral tube with 4+4 setae. Tenaculum with 3+3 (rarely 4+4) teeth. Mucro more than half as long as dens. Posterior abdominal setae long, curved, and clavate. Maximum length 3.0 mm.

Remarks

This species closely resembles P. aureofasciatus; however the simple ungual tooth, larger number of P.A.O. lobes, and trilobed apical antennal bulb justify specific separation. Further material may show this to be part of the geographic variation of aureofasciatus.

Type locality: Laytonville, Mendocino Co., California, bark of Douglas Fir, 14 Dec. 1960, (T.R. Haig).

FIGURE 229

Pseudachorutes (Pseudachorutes) bifidus

All figures of type specimens.

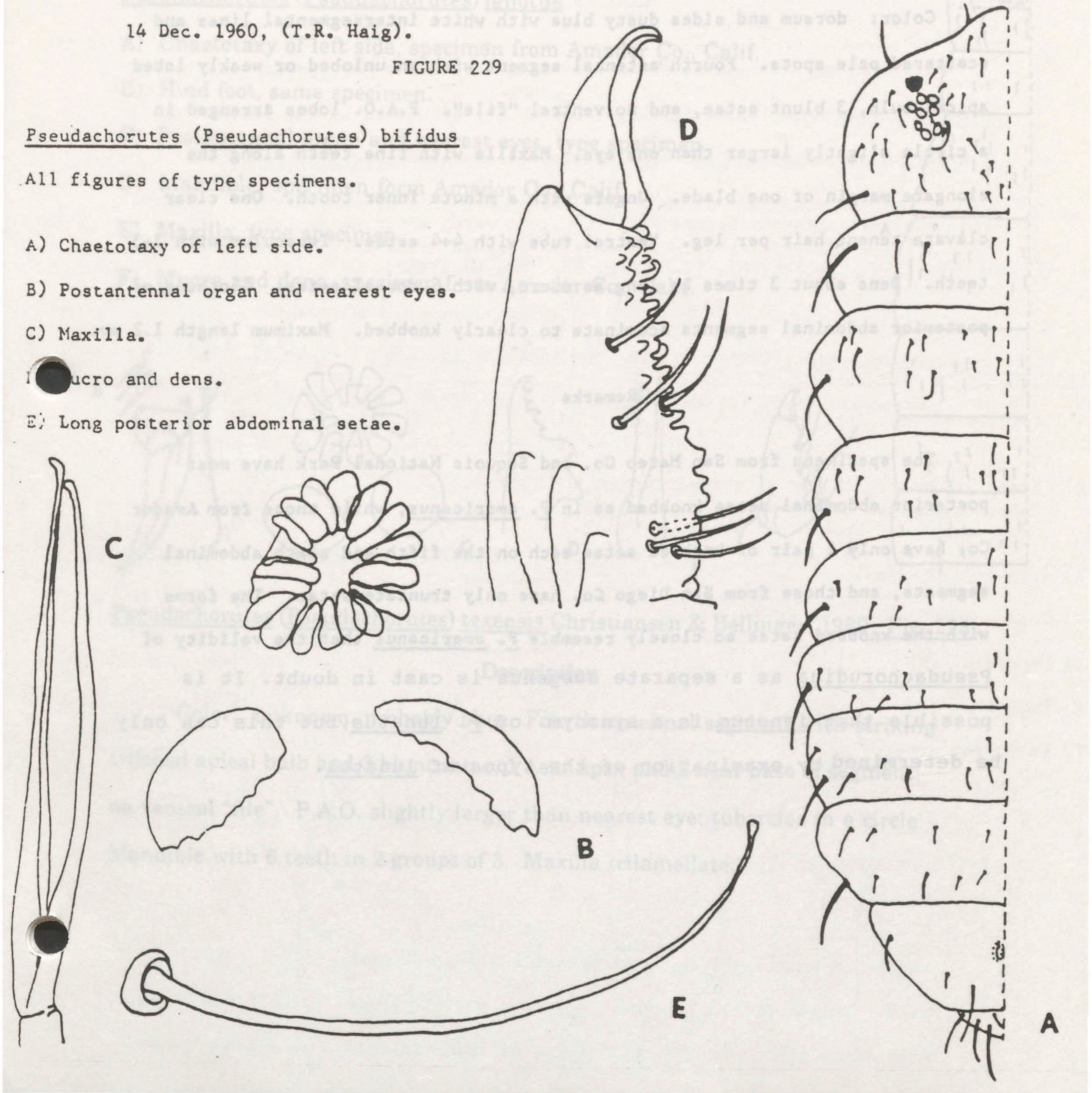
A) Chaetotaxy of left side.

B) Postantennal organ and nearest eyes.

C) Maxilla.

D) Mucro and dens.

E) Long posterior abdominal setae.



Pseudachorutes (Pseudachorutes) ignotus Christiansen & Bellinger, 1980 Fig. 224

Description

Color: dorsum and sides dusty blue with white intersegmental lines and scattered pale spots. Fourth antennal segment with an unlobed or weakly lobed apical bulb, 3 blunt setae, and no ventral "file". P.A.O. lobes arranged in a circle slightly larger than one eye. Maxilla with fine teeth along the elongate margin of one blade. Unguis with a minute inner tooth. One clear clavate tenent hair per leg. Ventral tube with 4+4 setae. Tenaculum with 3+3 teeth. Dens about 3 times as long as mucro, with 6 dorsal setae. Clothing of posterior abdominal segments acuminate to clearly knobbed. Maximum length 1.2 mm.

Remarks

The specimens from San Mateo Co. and Sequoia National Park have most posterior abdominal setae knobbed as in P. americanus, while those from Amador Co. have only 1 pair of knobbed setae each on the fifth and sixth abdominal segments, and those from San Diego Co. have only truncate setae. The forms with the knobbed setae so closely resemble P. americanus that the validity of Pseudachorudina as a separate subgenus is cast in doubt. It is possible that ignotus is a synonym. of P. lunatus, but this can only be determined by examination of the types of lunatus.

Type locality: Mt. Palomar, San Diego Co., Calif.; leaf mold, 18 April 1955, (R. Schuster).

Additional localities: California - Amador Co., San Mateo Co., Sequoia National Park.

FIGURE 224

Pseudachorutes (Pseudachorutes) ignotus

A) Chaetotaxy of left side, specimen from Amador Co., Calif.

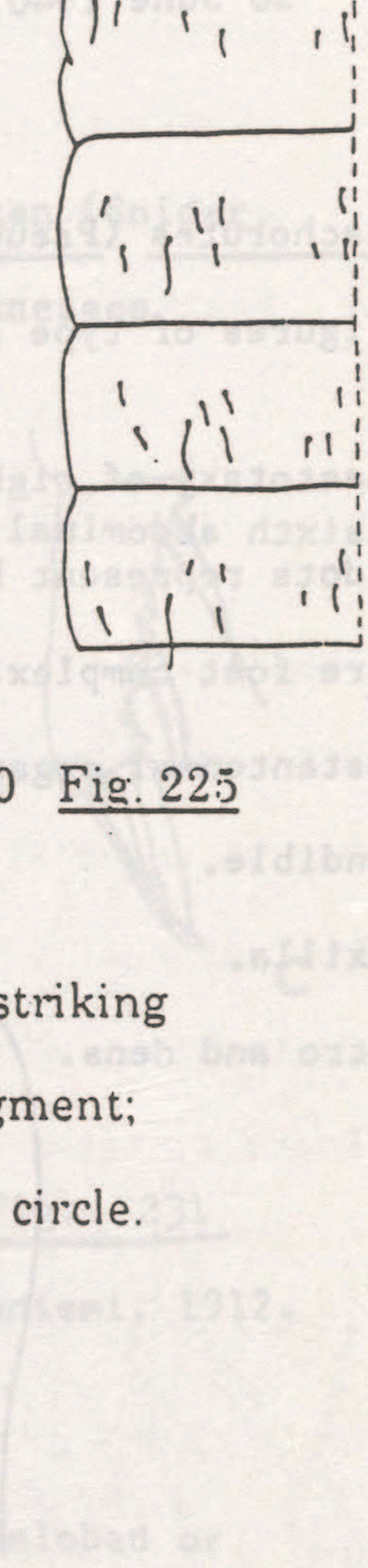
B) Hind foot, same specimen.

C) Postantennal organ and nearest eyes, type specimen.

D) Mandible, specimen form Amador Co., Calif.

E) Maxilla, type specimen.

F) Mucro and dens, specimen from Amador Co., Calif.



Pseudachorutes (Pseudachorutes) texensis Christiansen & Bellinger, 1980 Fig. 225

Description

Color: unknown, probably blue. Fourth antennal segment with striking trilobed apical bulb and 3 blunt setae, 1 near apex and 2 near base of segment; no ventral "file". P.A.O. slightly larger than nearest eye; tubercles in a circle. Mandible with 6 teeth in 2 groups of 3. Maxilla trilamellate,

with inner 2 lamellae toothed. One strong clearly clavate tenent hair on each foot. Unguis with a single prominent inner tooth. Ventral tube with 4+4 setae. Tenaculum with 3+3 teeth. Dens with 4-5 dorsal setae. Mucro 1/4 to 1/3 length of dens, with curved lower surface and a broad lamella. Clothing of stiff setae; some of the posterior setae blunt. Maximum length 1.3 mm.

Remarks

This well marked species shows some similarities to P. (Pseudachorudina) ignotus, but may readily be distinguished by the structure of the mouthparts. It also shows some similarities to species of the genus Brachystomella.

Type locality: Menard, Menard Co., Texas, on water after heavy rains, 30 June 1940, (R. Melvin), (U.S. nat. mus. No. 40-13858).

FIGURE 225

Pseudachorutes (Pseudachorutes:) texensis

All figures of type specimens.

A) Chaetotaxy of right side of second through sixth abdominal segments; dots represent broken off setae.

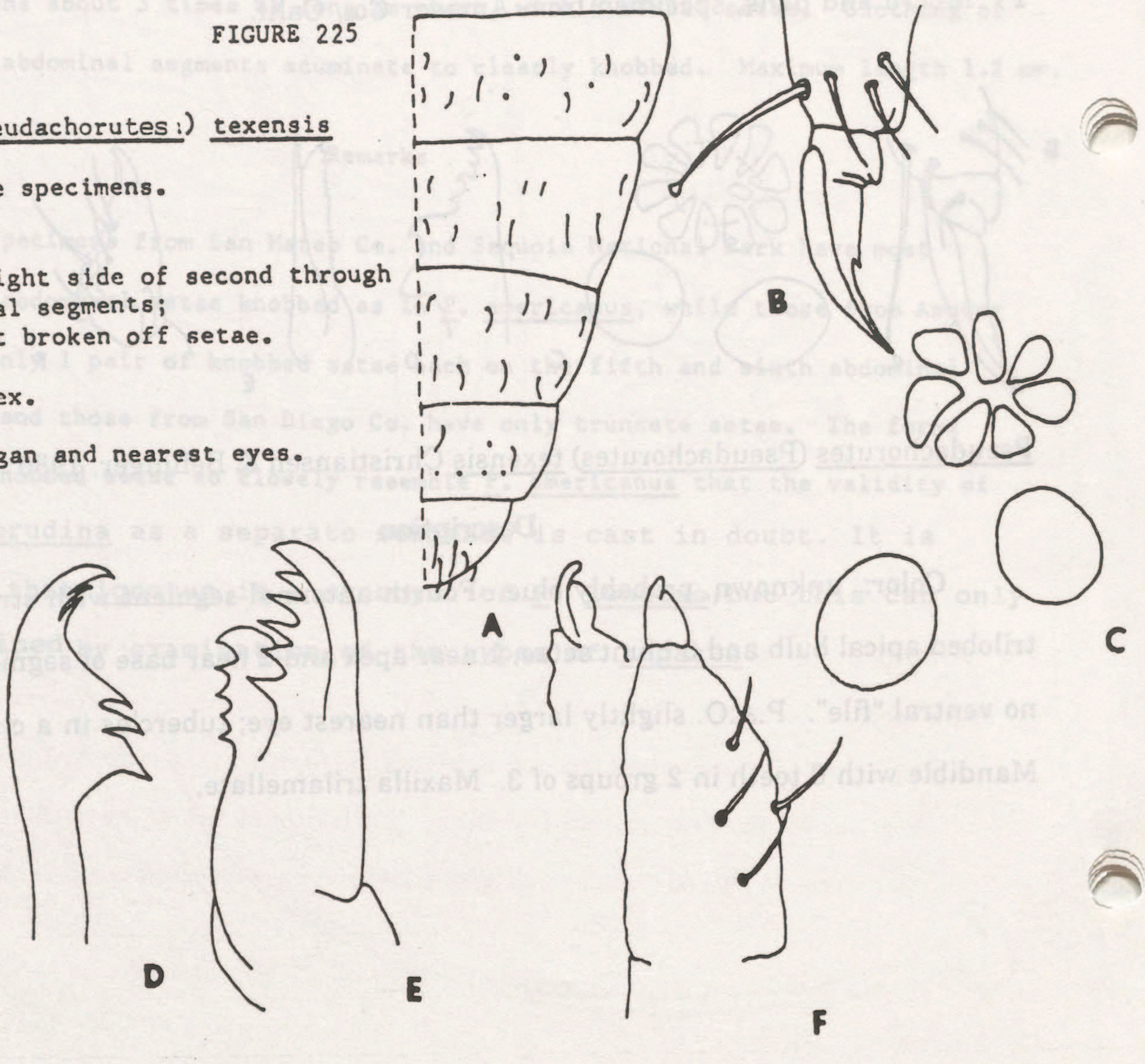
B) Fore foot complex.

C) Postantennal organ and nearest eyes.

D) Mandible.

E) Maxilla.

F) Mucro and dens.



Pseudachorutes (Pseudachorutes) complexus (MacGillivray), 1893 Fig. 230

Refs.: Can. Ent. 25:318 (Gnathocephalus); Folsom, 1916.

Description

Color: dark blue with lateral row of pale spots. P.A.O. oval. Unguis untoothed. Tenent hair short and acuminate. Dens 1.5 times as long as mucro, with four dorsal setae; mucro with ventral margin weakly curved. Maximum length 4.0 mm.

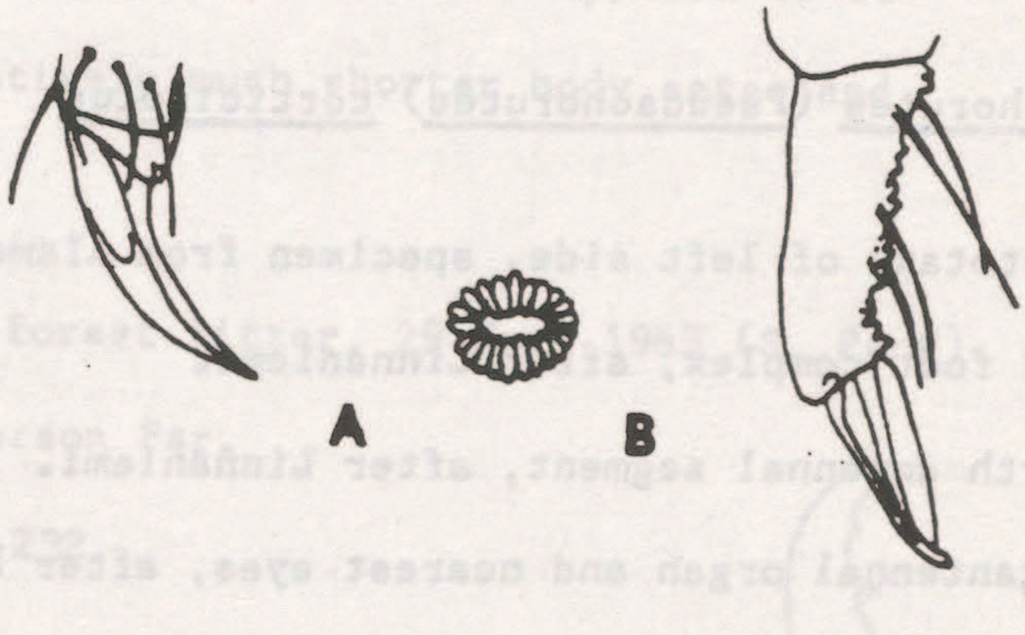
Remarks

If Folsom's description is accurate and typical this species should be easy to identify. No specimens have been seen by us, and those in the Urbana collection identified as complexus are clearly a different species.

Locality: Washington - Olympia (type).

Additional records: Louisiana (Hepburn and Woodring, 1963); Michigan (Snider, 1967); New York (Maynard, 1951); North Carolina (Pearse, 1946); Tennessee (Copeland, 1960).

FIGURE 230



Pseudachorutes (Pseudachorutes) complexus

All figures after Folsom.

A) Hind foot complex.

B) Postantennal organ.

C) Mucro and dens.

Pseudachorutes (Pseudachorutes) corticicolus (Schäffer), 1896 Fig. 231

Refs.: Mitt. naturh. Mus. Hamburg 13:176 (Schoettella); Linnaniemi, 1912.

Description

Color: blue; paler ventrally. Fourth antennal segment with unlobed or weakly lobed apical bulb, and 6 blunt setae; ventral "file" absent. P.A.O. lobes arranged in a circle. Maxilla acuminate. Unguis with a small inner

tooth. One large clavate tenent hair per foot. Ventral tube with 4+4 setae. Tenaculum with 3+3 teeth. Dens 2.25-3 times as long as mucro. Mucro simple and lamellate. Posterior abdominal setae weakly clavate. Maximum length 1.25 mm.

Remarks

The specimens identified by Mills as "corticolus" (sic!) are almost certainly Stach's americanus. A number of California specimens may be referred to corticicolus as defined by Axelson, who mentions 6 blunt antennal setae. Unfortunately the European species has been described by Stach as having 3 such setae, and by Schäffer, Stach, and Gisin as having the dens only twice as long as the mucro; its identity, and that of the American populations, is uncertain at the moment. The forms gathered under this name probably represent a cluster of species (see Simon - Benito 1985).

Locality: California - Alameda Co., Fresno Co.

Additional records: Iowa (O'Neill and Pedigo, 1969); Michigan (Snider, 1967); North Carolina (Pearse, 1946).

FIGURE 231

Pseudachorutes (Pseudachorutes) corticicolus

A) Chaetotaxy of left side, specimen from Alameda Co., California.

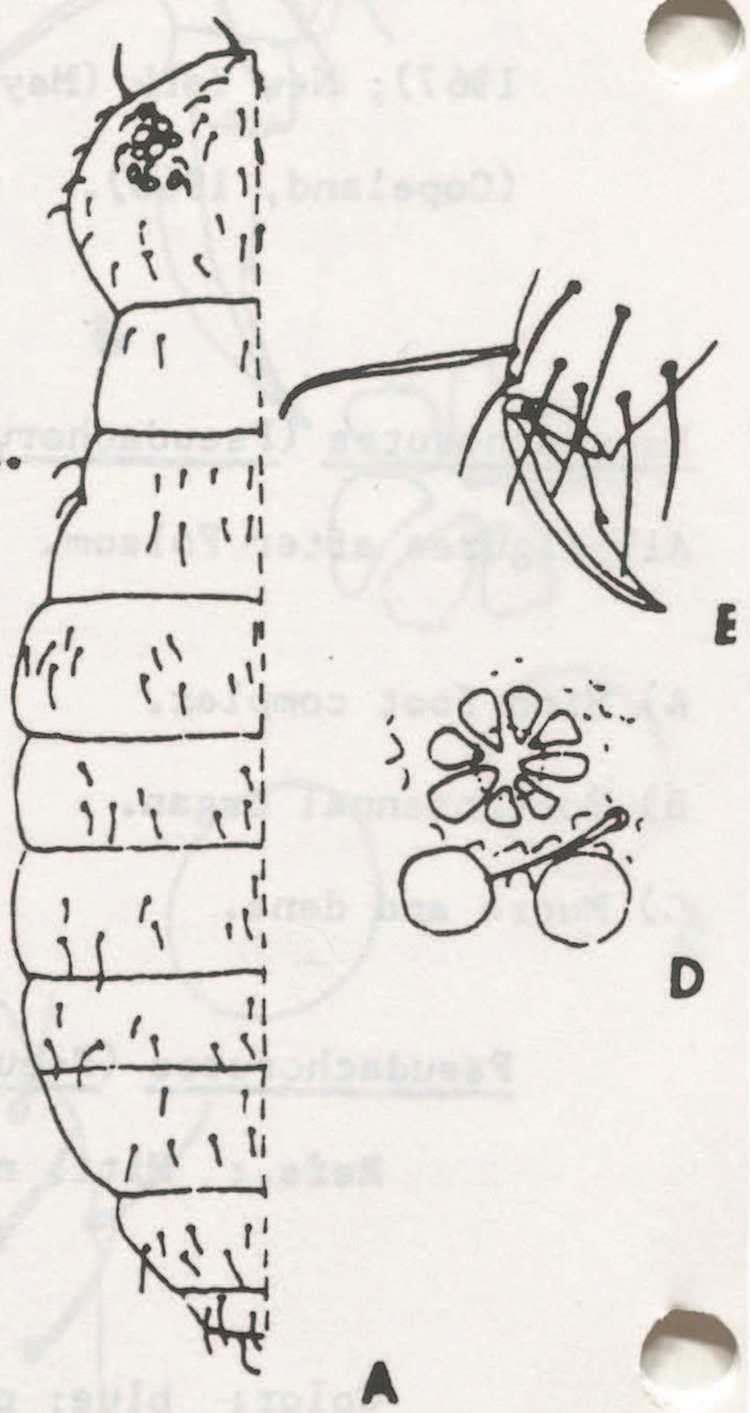
B) Hind foot complex, after Linnaniemi.

C) Fourth antennal segment, after Linnaniemi.

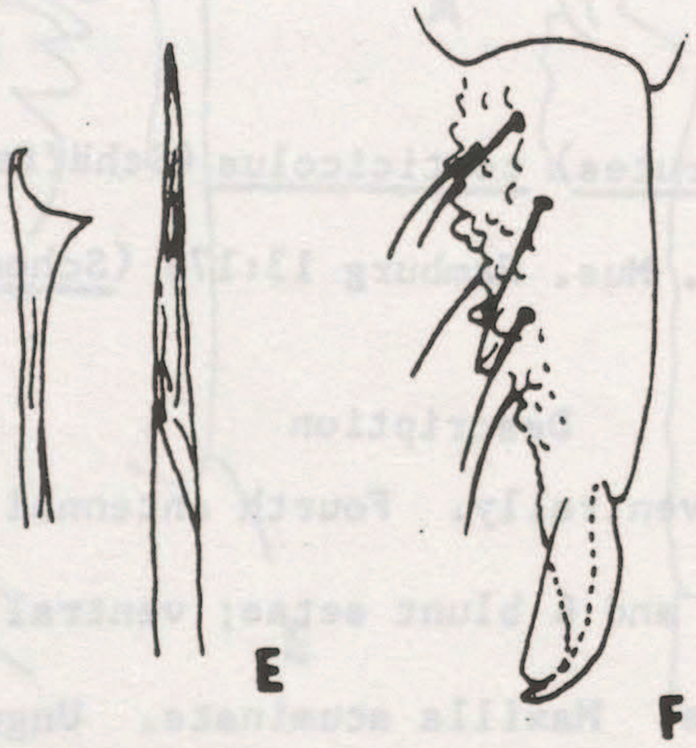
D) Postantennal organ and nearest eyes, after Linnaniemi.

E) Mouthparts, after Linnaniemi.

F) Furcula, after Stach, 1949.







Description

Color: pale blue granular pigment uniformly scattered over body except for thin lines on intersegmental membranes and small clear spots. Fourth antennal segment with clear apical bulb and five blunt setae; ventral "file" of 25-40 straight blunt setae. P.A.O. about as large as one eye. Mandible with 4 teeth and usually an additional minute fifth tooth; maxilla crochet-like. Unguis with clear inner tooth. Tenent hair short and acuminate. Ventral tube with 5+5 or 6+6 setae. Tenaculum with 4+4 teeth. Dens about 2.5 times as long as mucro, with six dorsal setae. Long posterior setae truncate or weakly clavate. Maximum length 2.75 mm.

Remarks

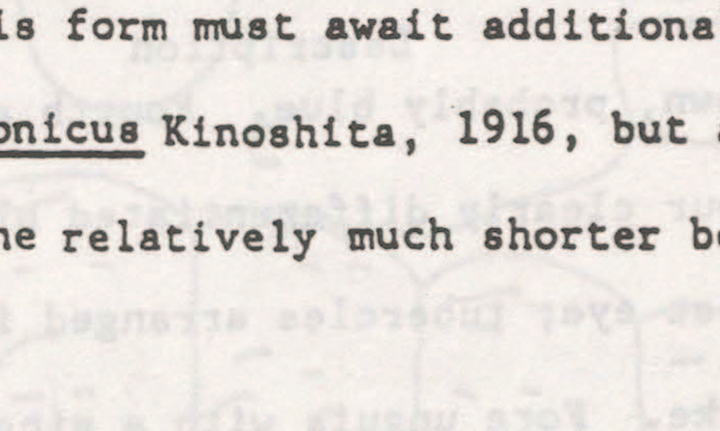
The Florida specimens show a remarkably well marked species. The small number of P.A.O. lobes and four-toothed tenaculum serve to separate it from all other U.S. species. One of the Louisiana specimens showed much shorter abdominal setae, only slightly longer than the inner unguis. Complete analysis of the variation of this form must await additional material. The species is very close to P. japonicus Kinoshita, 1916, but appears to be distinguished on the basis of the relatively much shorter body setae and much larger P.A.O.

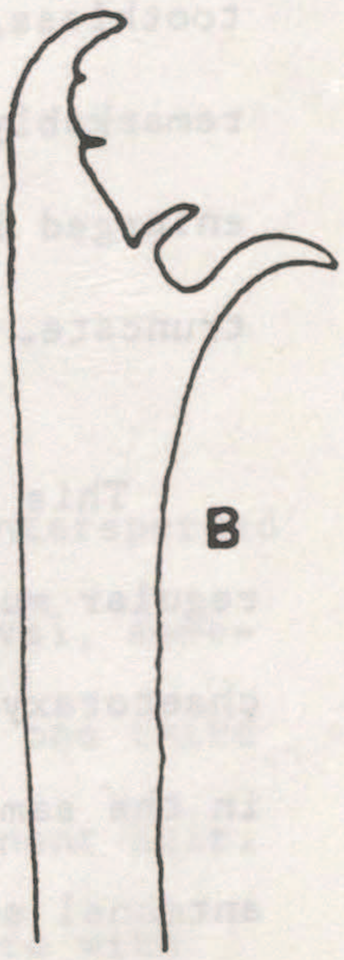
Type locality: Alachua Co., Florida, forest litter, 29 Nov. 1963 (S. Peck).
Additional locality: Louisiana - Jefferson Par.

FIGURE 232

Pseudachorutes (Pseudachorutes) curtus

All figures of type specimens.





A) Chaetotaxy of left side.

B) Mandible.

C) Fourth antennal segment.

D) Mucro.

E) Postantennal organ and nearest eyes. Figures A, C and E on next page.

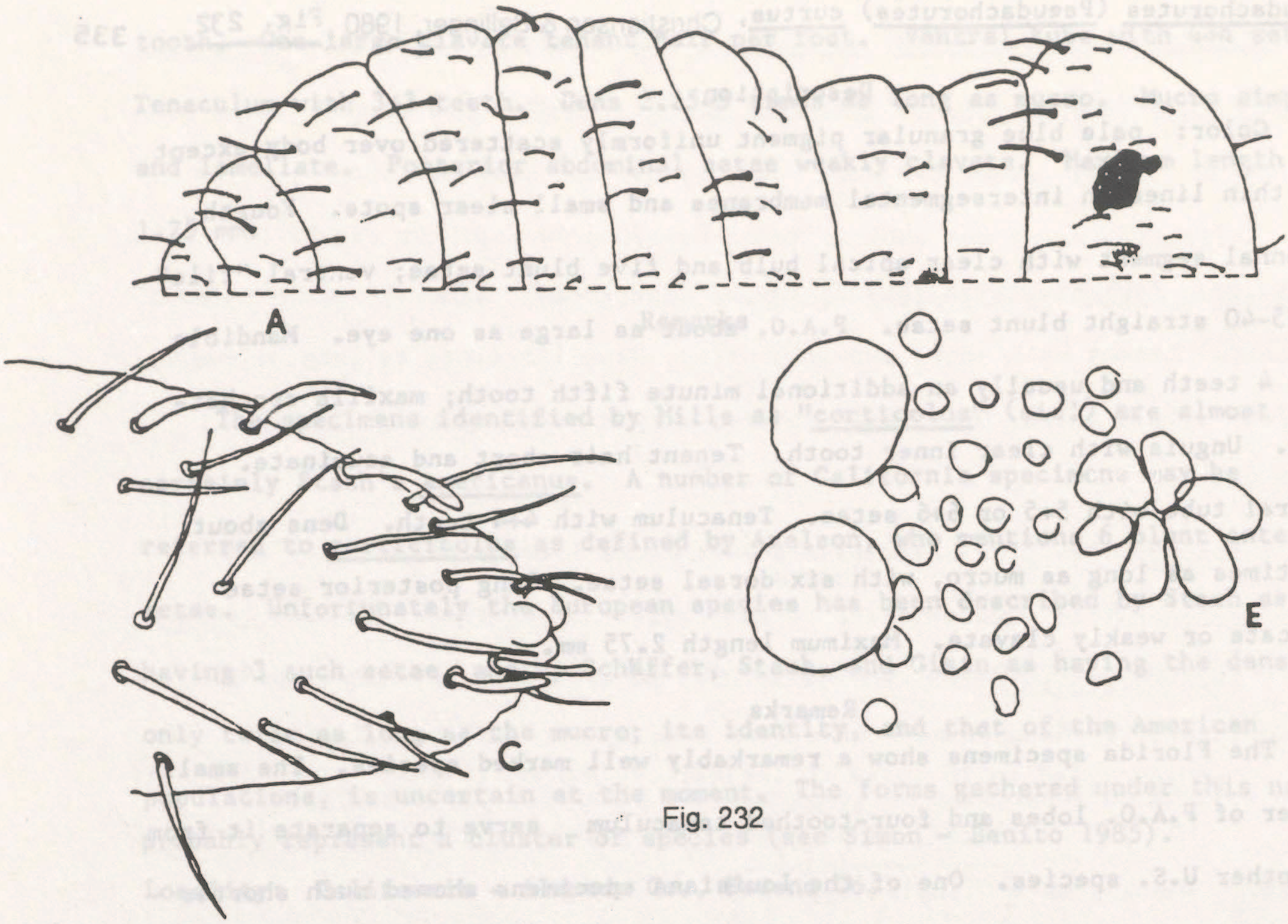


Fig. 232

Pseudachorutes (Pseudachorutes) indiana, Christiansen & Bellinger, 1980 Fig. 233

Description

Color: unknown, probably blue. Fourth antennal segment with a trilobed apical bulb and four clearly differentiated blunt setae. P.A.O. slightly smaller than nearest eye; tubercles arranged in a circle or broad ellipse. Maxilla crochet-like. Fore unguis with a single tooth or sometimes with a supplementary second tooth. Mid and hind unguis with a single small tooth or toothless. Ventral tube with 4+4 setae. Tenaculum with 3+3 teeth. Dens remarkably coarsely tuberculate. Mucro .52-.62 as long as dens, with medially enlarged lamella. Posterior abdominal setae curved and weakly clavate to truncate. Maximum length 1.5 mm.

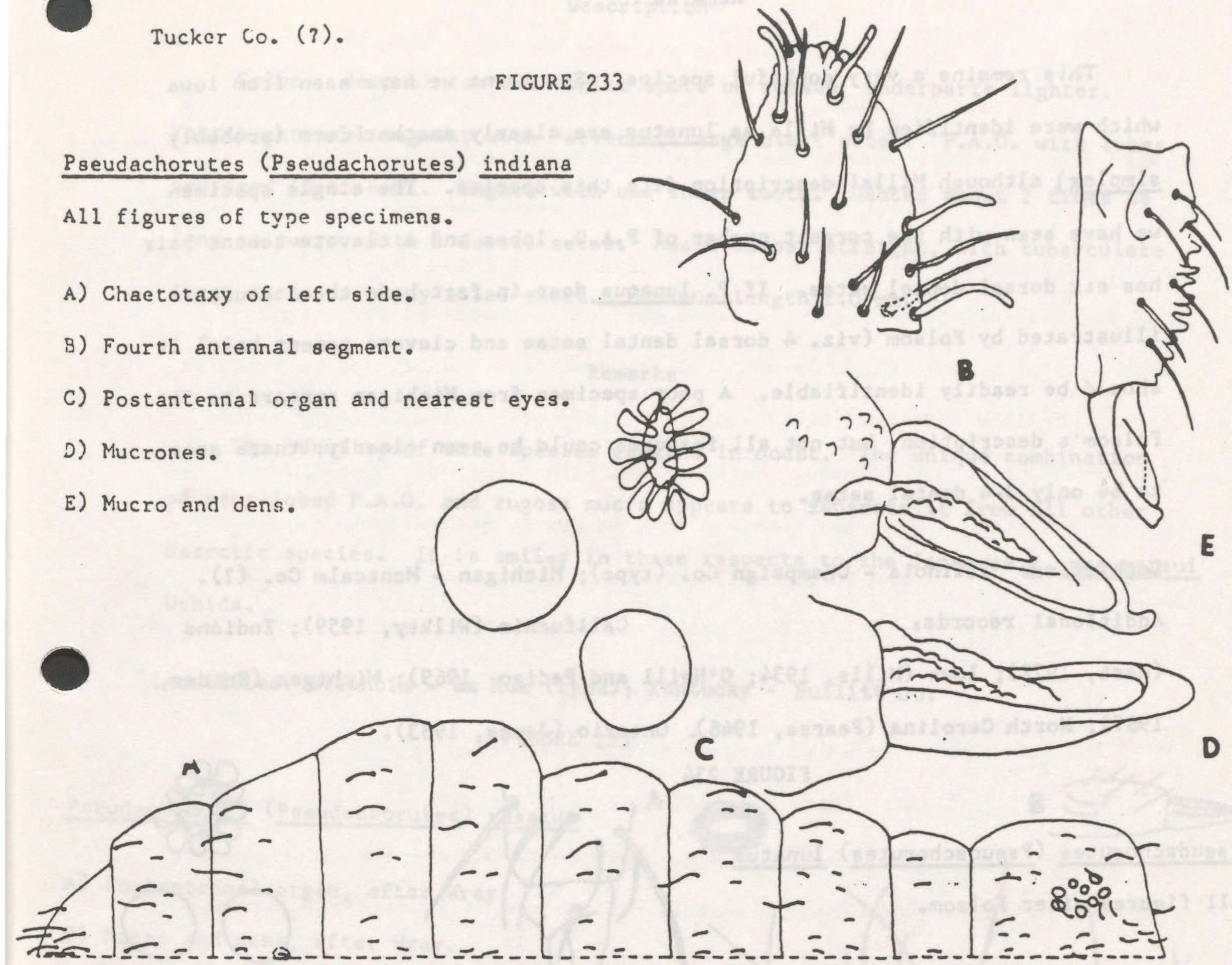
Remarks

This species is very close to aureofasciatus; however, the absence of regular multiple inner teeth on the unguis, the shorter setae, the different chaetotaxy, and the somewhat different furcula make it unwise to consider it in the same taxon. The West Virginia specimen has 5 blunt setae on the fourth antennal segment, but is otherwise similar.

Type locality: Five miles south of Indianapolis, Marion Co., Indiana, Tullgren extract of duff, 18 March 1972 (R. Wilkey).

Additional localities: Indiana - Parke Co. (?), Wells Co.; West Virginia - Tucker Co. (?).

FIGURE 233



Pseudachorutes (Pseudachorutes) indiana

All figures of type specimens.

A) Chaetotaxy of left side.

B) Fourth antennal segment.

C) Postantennal organ and nearest eyes.

D) Mucrones.

E) Mucro and dens.

Pseudachorutes (Pseudachorutes) lunatus Folsom, 1916 Fig. 234

Ref.: Proc. U.S. natn. Mus. 50:501

Description

Color: general impression grayish blue; mottled blue pigment interspersed with round pale spots; underparts unpigmented. P.A.O. lobes in an oval, somewhat larger than nearest eye. Unguis with a clear inner tooth about one third of the way to the apex. Tibotarsus with a single clearly clavate tenent hair. Dens about 2.5 times as long as mucro, with 4 (?) dorsal setae. Mucro with

strong lamella. Cuticle finely tuberculate. Anal and genital segments with numerous stiff setae of moderate length. Maximum length 3.0 mm.

Remarks

This remains a very doubtful species. Specimens we have seen from Iowa which were identified by Mills as lunatus are clearly another form (probably simplex), although Mills' description fits this species. The single specimen we have seen with the correct number of P.A.O. lobes and a clavate tenent hair has six dorsal dental setae. If P. lunatus does in fact have the features illustrated by Folsom (viz. 4 dorsal dental setae and clavate tenent hair) it should be readily identifiable. A poor specimen from Michigan appears to fit Folsom's description, but not all features could be seen clearly; there seem to be only 3-4 dental setae.

Localities: Illinois - Champaign Co. (type); Michigan - Montcalm Co. (?).

Additional records: California (Wilkey, 1959); Indiana (Hart, 1972); Iowa (Mills, 1934; O'Neill and Pedigo 1969); Michigan (Snider, 1967); North Carolina (Pearse, 1946). Ontario (James, 1933).

FIGURE 234

Pseudachorutes (Pseudachorutes) lunatus

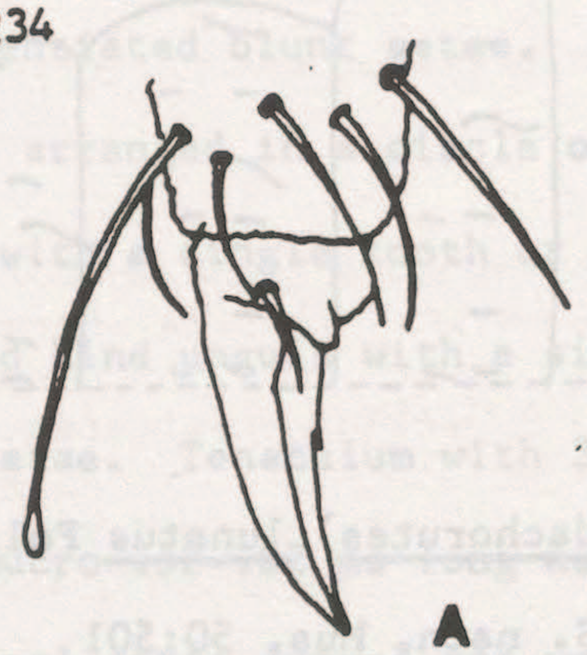
All figures after Folsom.

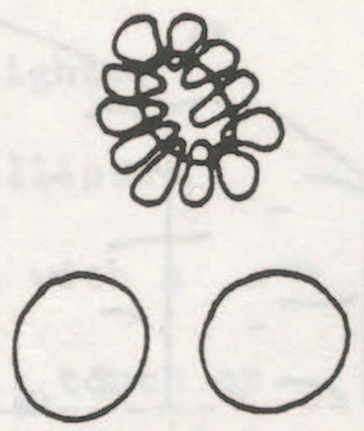
A) Left fore foot complex.

B) Postantennal organ and nearest eyes.

C) Mucro.

D) Mucro and dens.









Pseudachorutes (Pseudachorutes) rugatus Wray, 1952. Fig. 235

Ref.: Bull. Brooklyn ent. Soc. 47:99.

Description

Color: deep bluish with white spots on dorsum; underparts lighter. Fourth antennal segment with "several" large blunt setae. P.A.O. with lobes arranged in an oval. Unguis with one inner tooth. Dentes about 2 times as long as mucro, with 6 dorsal setae. Mucro almost straight, with tuberculate inner surface. Body setae short. Maximum length 2.0 mm.

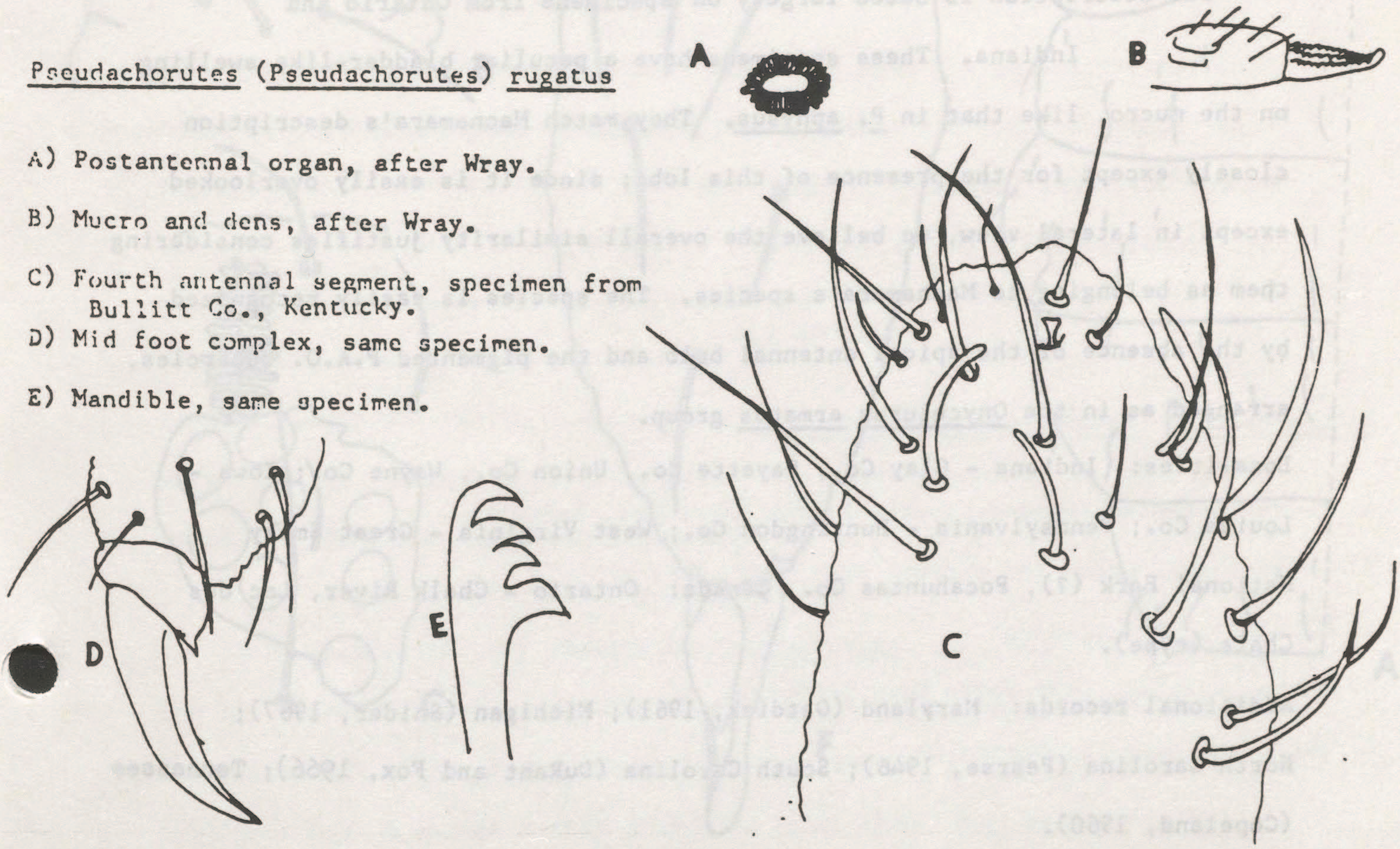
Remarks

The identity of this species remains in doubt. The unique combination of many-lobed P.A.O. and rugose mucro appears to separate it from all other Nearctic species. It is smilar in these respects to the Japanese P. yasumatsui Uchida.

Localities: Illinois - La Rue (type); Kentucky - Bullitt Co.

FIGURE 235

Pseudachorutes (Pseudachorutes) rugatus



A) Postantennal organ, after Wray.

B) Mucro and dens, after Wray.

C) Fourth antennal segment, specimen from Bullitt Co., Kentucky.

D) Mid foot complex, same specimen.

E) Mandible, same specimen.

Pseudachorutes (Pseudachorutes) saxatilis Macnamara, 1920 Fig. 236

Ref.: Can. Ent. 52:174; Mills, 1934.

Description

Color: blue to lavender with granular pigment and scattered pale spots which sometimes form regular rows. Fourth antennal segment without apical bulb and with 6-8 poorly differentiated blunt setae; ventral "file" of about 15 straight setae which are slightly shorter than normal. P.A.O. elongate and parallel-sided, of pigmented lobes most of which are at right angles to long axis of organ. Mandible with 2 large teeth and 2-3 smaller intermediate teeth. Maxilla styliform and 2-bladed. Unguis with a single inner tooth. Tenent hair minutely clavate. Ventral tube with 4+4 setae. Tenaculum with 3+3 or 4+4 teeth. Dens 3-4 times as long as mucro, with 6 dorsal setae. Mucro curved and with a bladder-like swelling at the base of the lamella, clear in lateral view only. Body setae mostly truncate. Maximum length 1.5 mm.

Remarks

Our description is based largely on specimens from Ontario and Indiana. These specimens have a peculiar bladder-like swelling on the mucro, like that in P. aphysus. They match Macnamara's description closely except for the presence of this lobe; since it is easily overlooked except in lateral view, we believe the overall similarity justifies considering them as belonging to Macnamara's species. The species is easily recognized by the absence of the apical antennal bulb and the pigmented P.A.O. tubercles, arranged as in the Onychiurus armatus group.

Localities: Indiana - Clay Co., Fayette Co., Union Co., Wayne Co.; Iowa - Louisa Co.; Pennsylvania - Huntingdon Co.; West Virginia - Great Smoky National Park (?), Pocahuntas Co. Canada: Ontario - Chalk River, Lac des Chats (type).

Additional records: Maryland (Ostdiek, 1961); Michigan (Snider, 1967); North Carolina (Pearse, 1946); South Carolina (DuRant and Fox, 1966); Tennessee (Copeland, 1960).

FIGURE 236

Pseudachorutes (Pseudachorutes) saxatilis

A) Chaetotaxy of left side, specimen from Chalk River, Ontario.

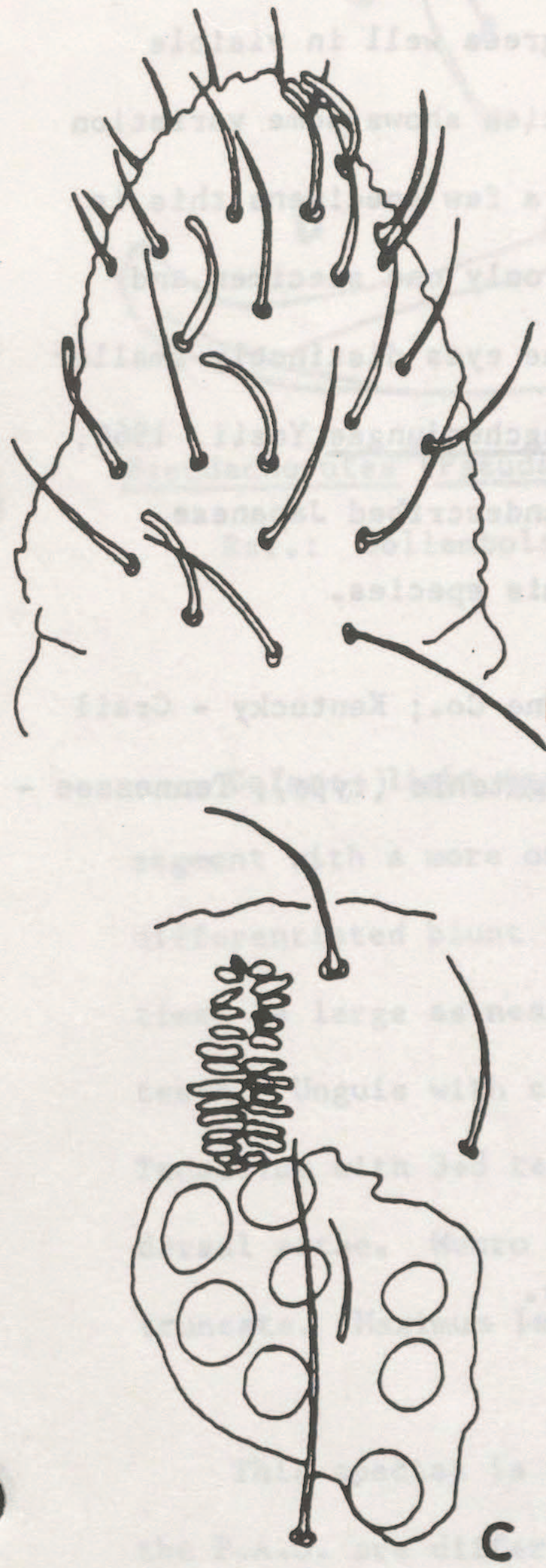
B) Fourth antennal segment, same specimen.

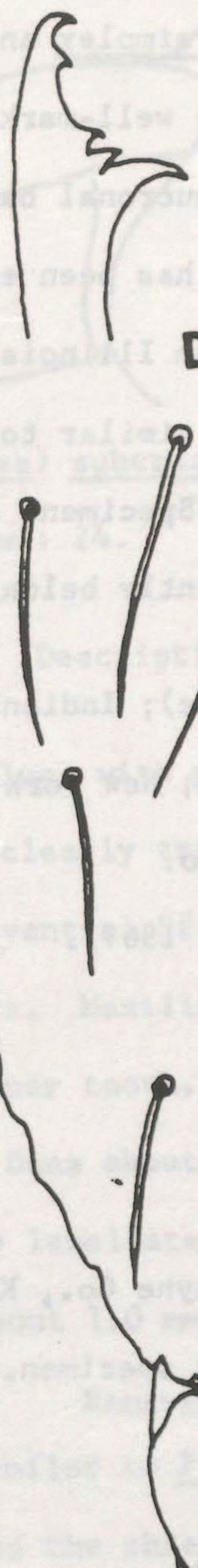
C) Eye and postantennal organ, same specimen.

D) Mandible, same specimen.

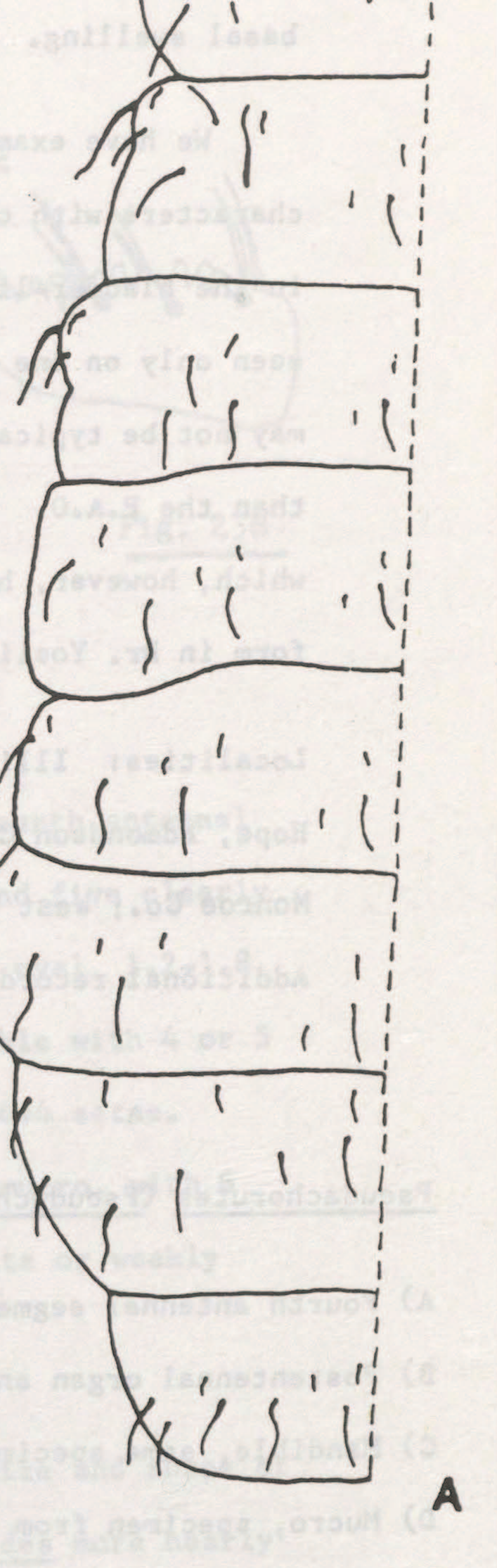
E) Maxilla, specimen from Wayne Co., Indiana.

F) Mucro and dens, specimen from Chalk River, Ontario.









Ref.: Collembola of New York: 59.

Description

Color: gray blue to blue with granular pigment and scattered pale spots. Fourth antennal segment with clear trilobed subapical bulb and six blunt setae; ventral "file" of 20-30 truncate straight setae. P.A.O. oval. Maxilla needle-like, with one or two apical teeth. Unguis with clear inner tooth. Tenent hairs short and acuminate. Tenaculum with 3+3 teeth. Dens 1.5-1.8 times as long as mucro, with six dorsal setae. Mucro with clear bladder-like basal swelling. Clothing of very short acuminate setae. Maximum size 2.2 mm.

Remarks

We have examined the type of P. simplex and it agrees well in visible characters with our specimens. This well-marked species shows some variation in the bladder-like swelling at the mucronal base; in a few specimens this is seen only on one side. The mandible has been seen on only one specimen and may not be typical. The specimen from Illinois has the eyes distinctly smaller than the P.A.O. The species appears similar to P. kangchenjungae Yosii, 1966, which, however, has 7 dental setae. Specimens of an undescribed Japanese form in Dr. Yosii's collection apparently belong to this species.

Localities: Illinois - Pope Co. (cave); Indiana - Wayne Co.; Kentucky - Crail Hope, Edmondson Co., Wayne Co. (cave); New York - Oswegatchie (type); Tennessee - Monroe Co.; West Virginia - Tucker. Co.

Additional record: Quebec (Marshall, 1967).

FIGURE 237

Pseudachorutes (Pseudachorutes) simplex

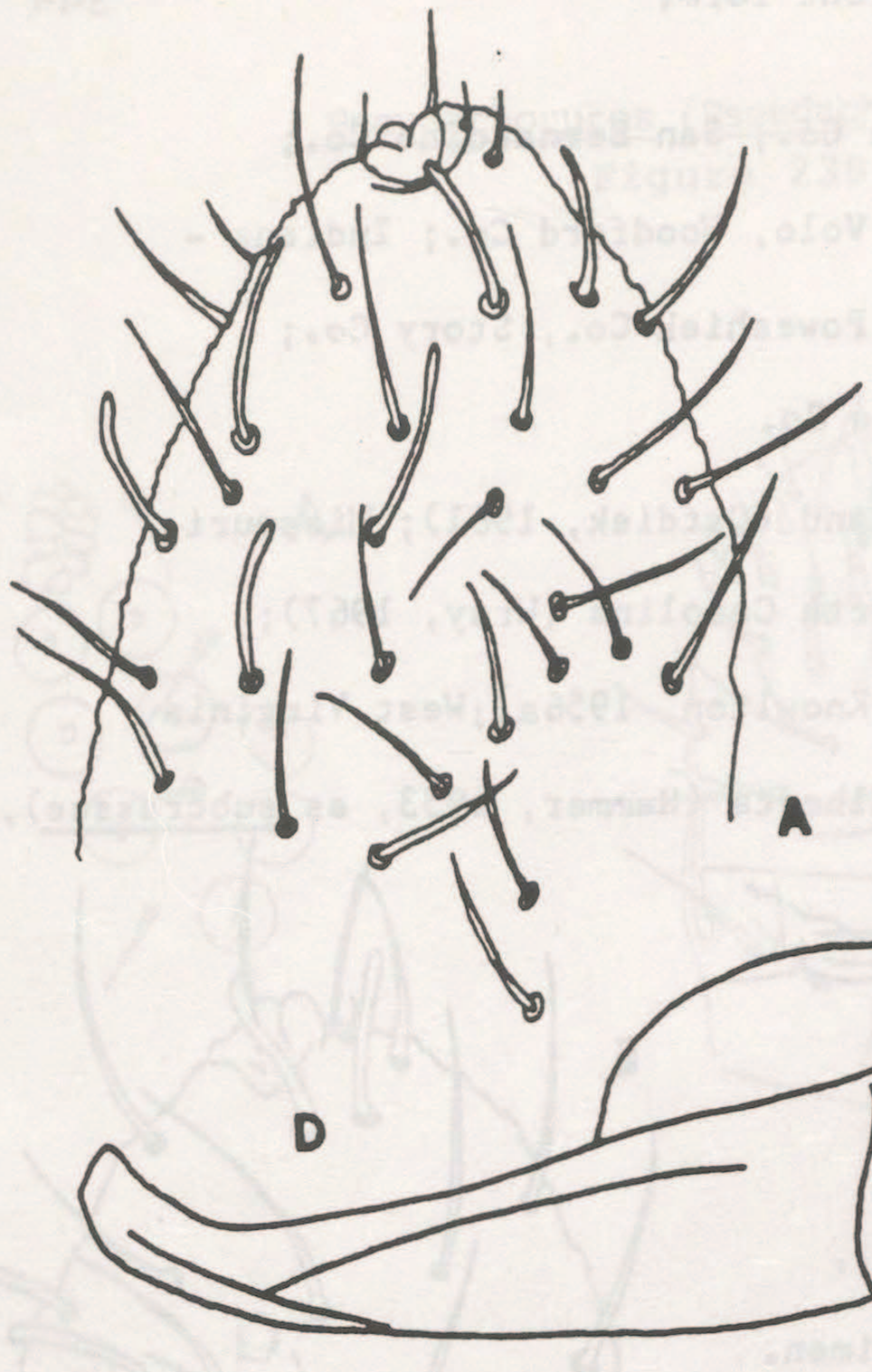
A) Fourth antennal segment, specimen from Wayne Co., Kentucky.

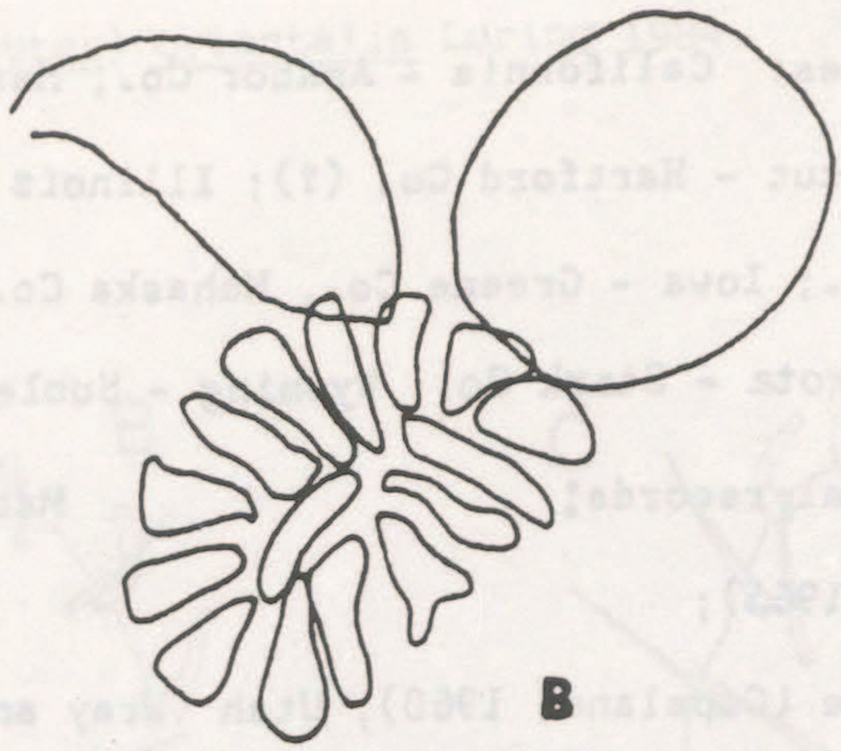
B) Postantennal organ and nearest eyes, type specimen.

C) Mandible, same specimen.

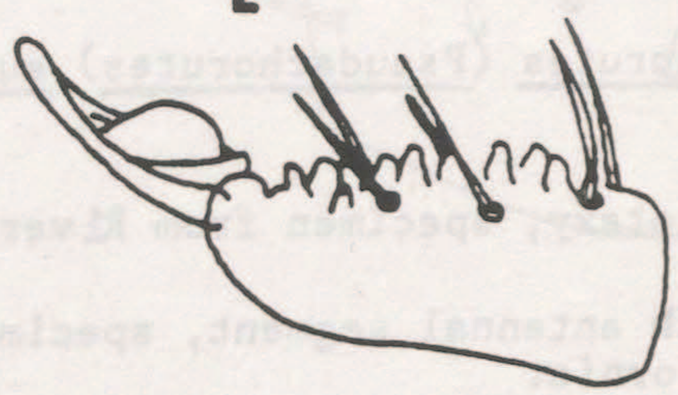
D) Mucro, specimen from Wayne Co., Kentucky.

E) Mucro and dens, type specimen.









Pseudachorutes (Pseudachorutes) subcrassoides Mills, 1934 Fig. 238

Ref.: Collembola of Iowa: 24.

Description

Color: light gray to blue, with pigment granular. Fourth antennal segment with a more or less clearly trilobed apical bulb and five clearly differentiated blunt setae; ventral "file" absent. P.A.O. oval, 1.2-1.8 times as large as nearest eye. Maxilla needle-like; mandible with 4 or 5 teeth. Unguis with clear inner tooth. Ventral tube with 4+4 setae. Tenaculum with 3+3 teeth. Dens about 2 times as long as mucro, with 6 dorsal setae. Mucro broadly lamellate. All setae acuminate or weakly truncate. Maximum length about 1.0 mm.

Remarks

This species is very similar to P. subcrassus. The size and shape of the P.A.O. are different, and the chaetotaxy of subcrassoides more nearly resembles that of P. crassus Gama, 1964 than that of P. subcrassus. The California specimens have a larger number of P.A.O. lobes than other specimens (9-14 as

opposed to 8-12) and may represent a different form.

Localities: California - Amador Co., Marin Co., San Bernardino Co.; Connecticut - Hartford Co. (?); Illinois - Volo, Woodford Co.; Indiana - Union Co.; Iowa - Greene Co., Mahaska Co., Poweshiek Co., Story Co.; North Dakota - Stark Co.; Wyoming - Sublette Co.

Additional records: Maryland (Ostdiek, 1961); Missouri (Dowdy, 1965); North Carolina (Wray, 1967); Tennessee (Copeland, 1960); Utah (Wray and Knowlton, 1956a); West Virginia (Lippert and Butler, 1967). (?) Canada: Alberta (Hammer, 1953, as subcrassus).

FIGURE 238

Pseudachorutes (Pseudachorutes) subcrassoides

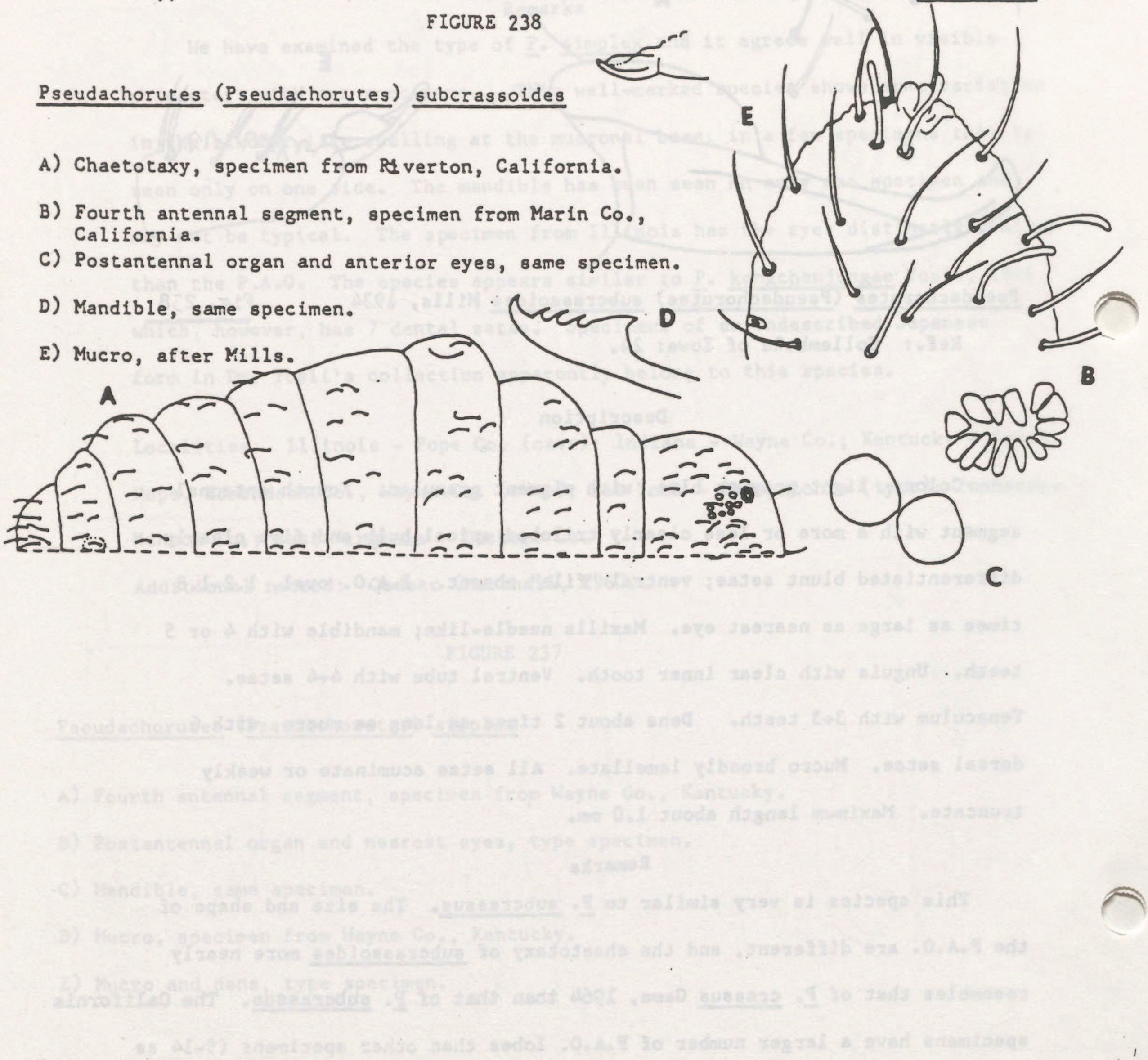
A) Chaetotaxy, specimen from Riverton, California.

B) Fourth antennal segment, specimen from Marin Co., California.

C) Postantennal organ and anterior eyes, same specimen.

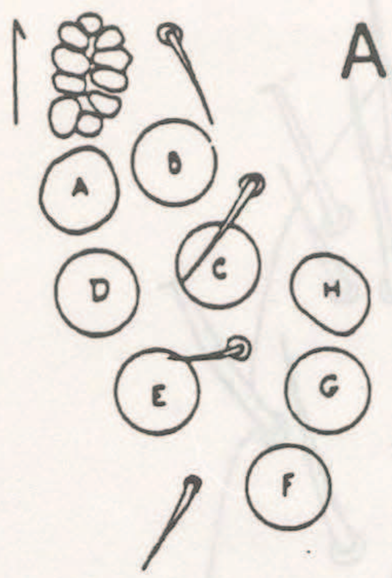
D) Mandible, same specimen.

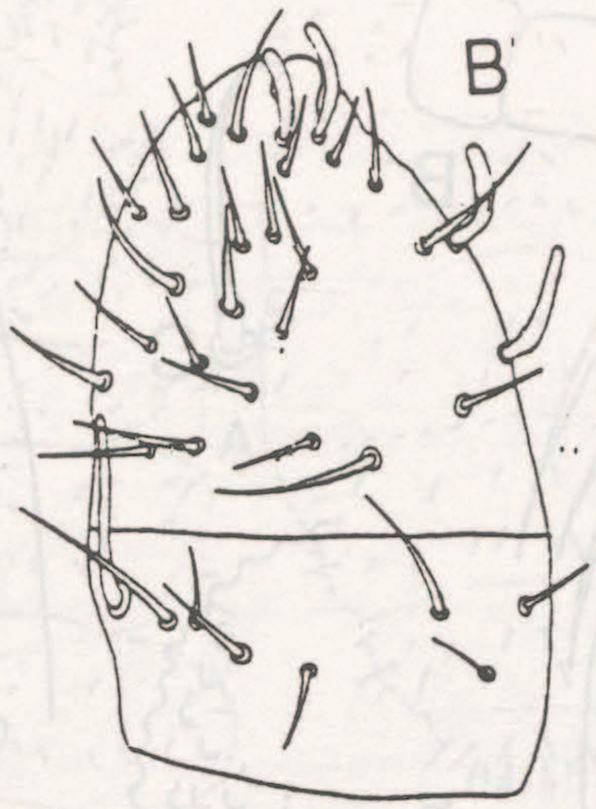
E) Mucro, after Mills.

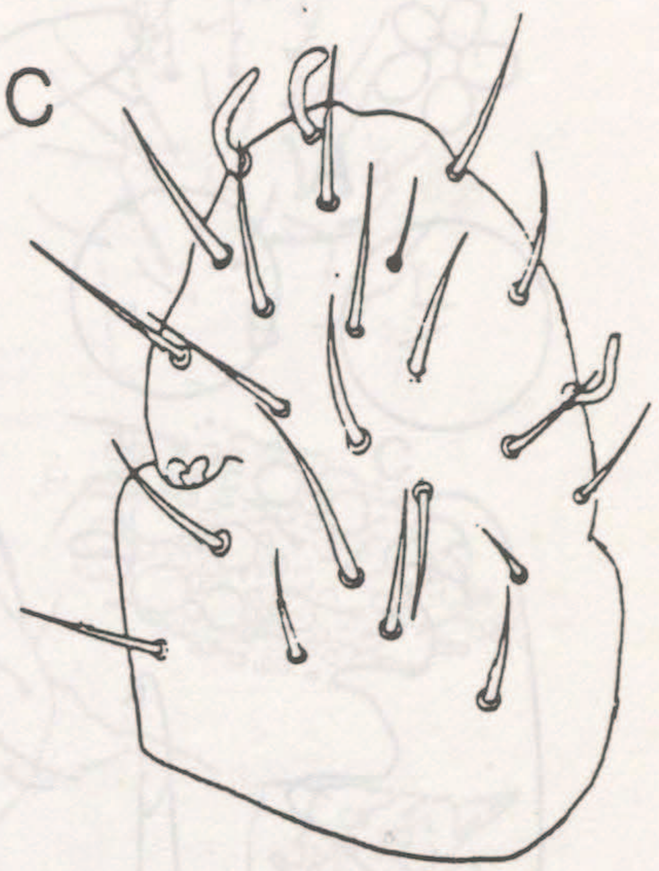


Pseudachorutes (Pseudachorutes) orientalis Loring 1984

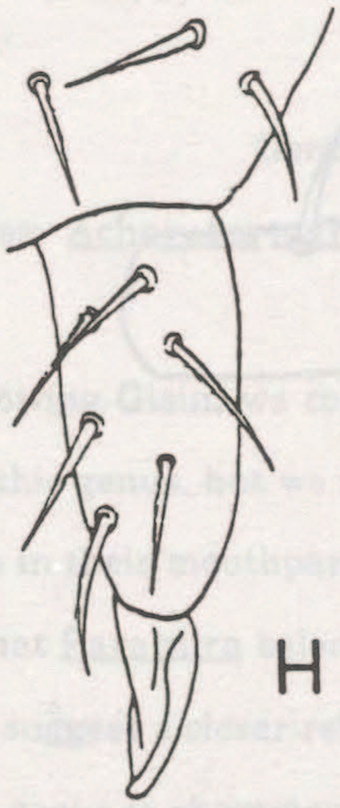
Figure 238.1

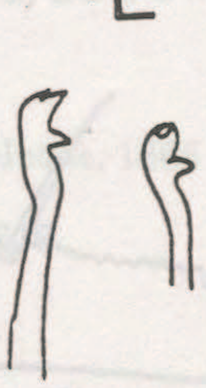


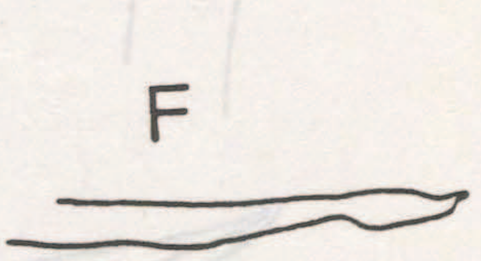


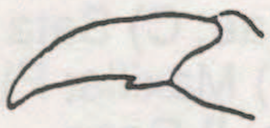


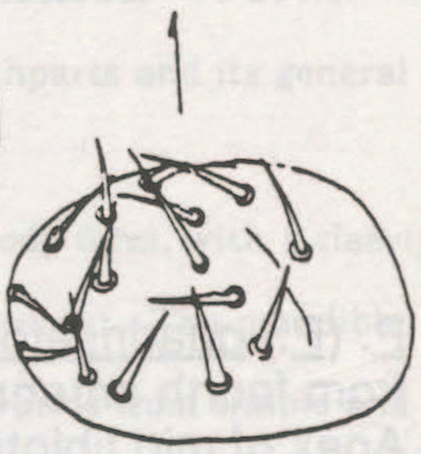






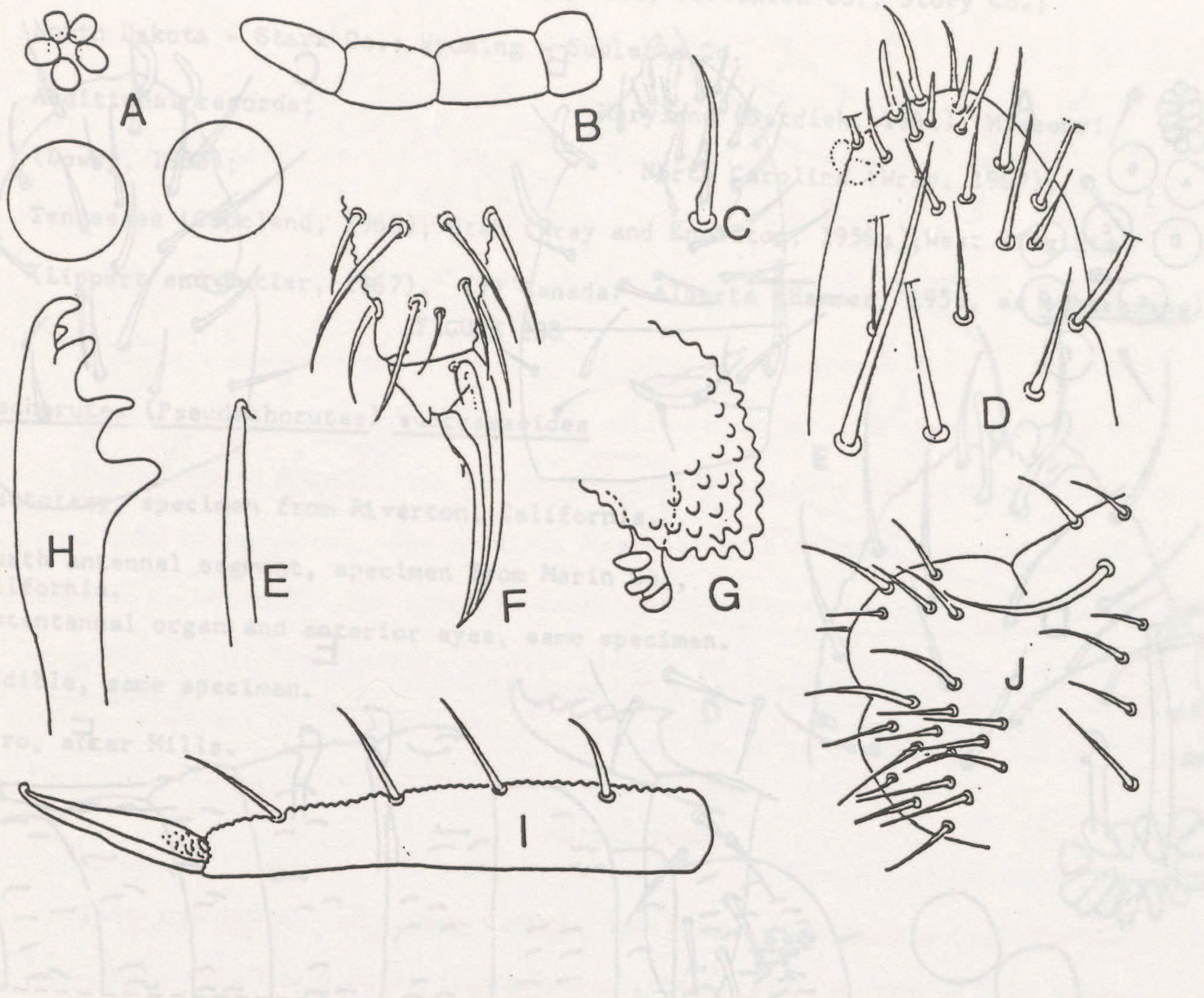






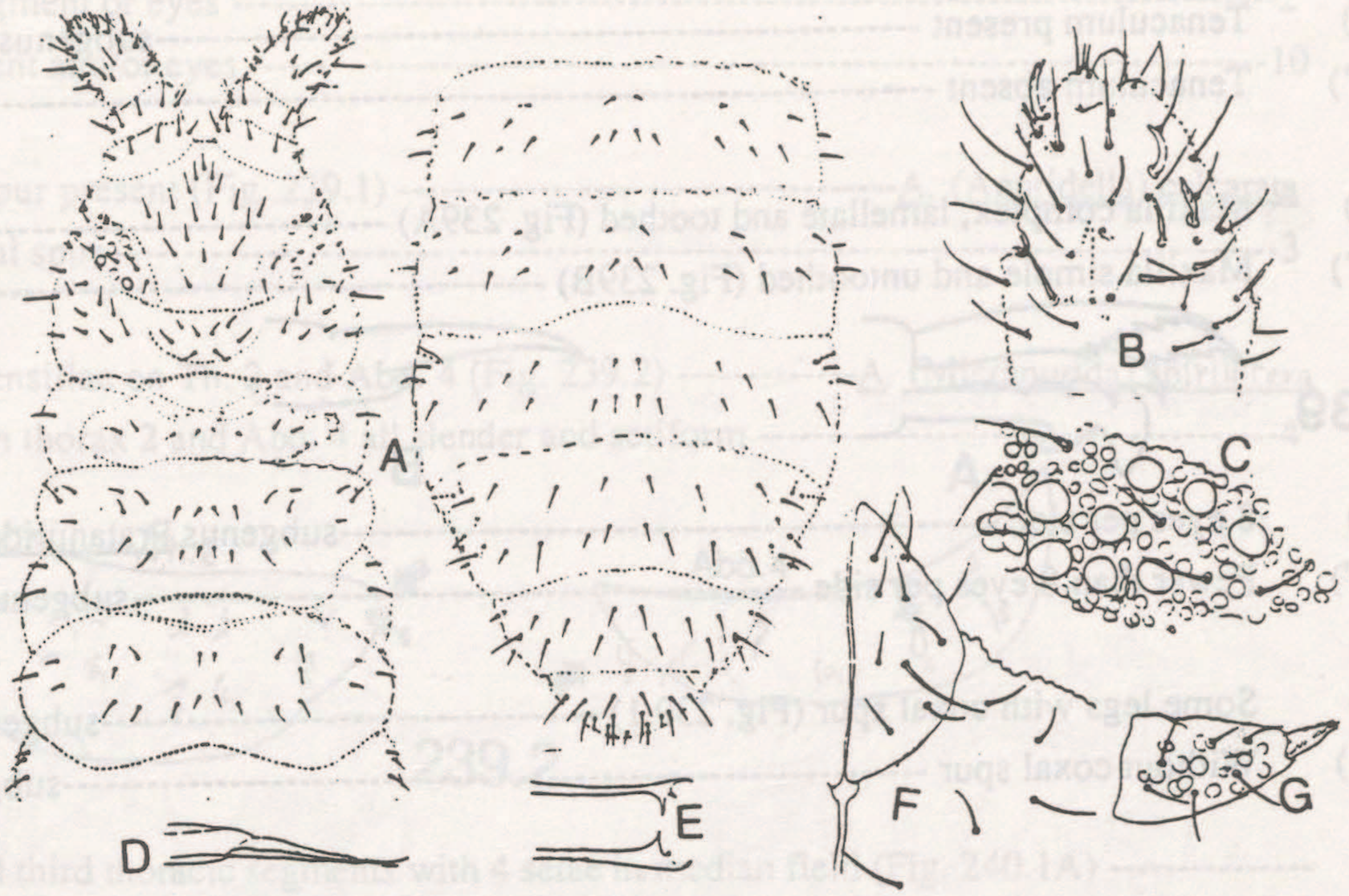
P. (P.) orientalis. A) Right eyes and PAO; B) Ventral view antennal segment 3 and 4; C) Dorsal view of same; D) Normal mandibles; E) Abnormal mandibles; F) Maxilla; G) Hind unguis; H) Furcula of left side , dorsal view; I) Male genital plate. After Loring 1984 .

Figure 238.2



P. (P.) quadrisetosus. A) PAO and nearest eyes; B) Outline of antennae; C) Seta from fourth antennal segment: D) Apex of fourth antennal segment; E) Maxilla; F) Apex of mid tibiotarsus and foot complex; G) Tenaculum; H) Mandible; I) Dens and mucro, seen from side; J) End of abdomen. After Snider 1981

Pseudachorutes columbicus Rusek 1991 Figure 238.3



P. columbicus. A) Dorsal chaetotaxy; B) Dorsal view, antennal segments 3 & 4; C) PAO & eyes; D) Maxilla; E) Mandibles; F) Left labium; G) Dens & mucro. After Rusek 1991.

Genus Anurida Laboulbène, 1865

Type species: Achorutes maritimus Guerin, 1838

Following Gisin, we consider Anuridella, Micranurida, and Protachorutes as part of this genus, but we maintain them as separate subgenera because of the differences in their mouthparts and their separation by Massoud. We do not consider that Paranura belongs here, since both its mouthparts and its general body form suggest a closer relationship to Neanura.

The genus is characterized by a pseudachorutiod body form, with a clearly unlobed sixth abdominal segment. A P.A.O. is always present. The mandible lacks a molar plate and has up to 12 teeth. The maxilla varies from simple and stylet-like to an extremely complex lamellate structure. The furcula is typically absent and, when best developed, lacks mucrones. The fourth antennal segment has well developed blunt setae of various sizes but no ventral "file" organ. The eye number varies, but is complete in only 4 species and 5+5 or less in the others. The unguiculus, clavate tenent hairs, and anal spines are absent.

Key to Subgenera of Anurida

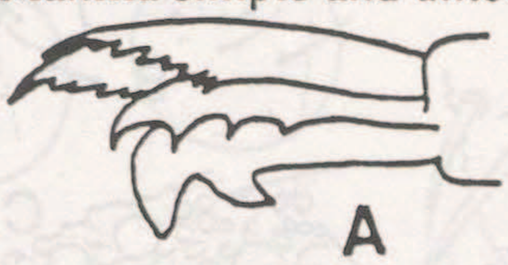
1) Tenaculum present ----------subgenus Protachorutes

1') Tenaculum absent ----------2

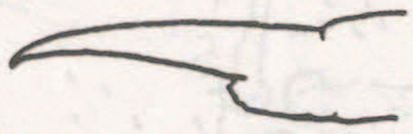
2) Maxilla complex, lamellate and toothed (Fig. 239A) ----------4

2') Maxilla simple and untoothed (Fig. 239B) ----------3

239



A



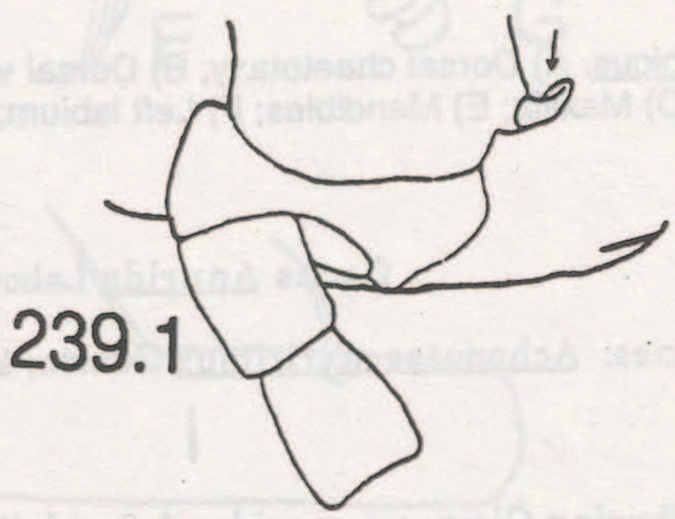
B

3) 8 eyes per side ----------subgenus Pratanurida Rusek, 1973

3") Fewer than 8 eyes per side ----------subgenus Micranurida

4) Some legs with coxal spur (Fig. 239.1) ----------subgenus Anuridella

4') Without coxal spur ----------subgenus Anurida



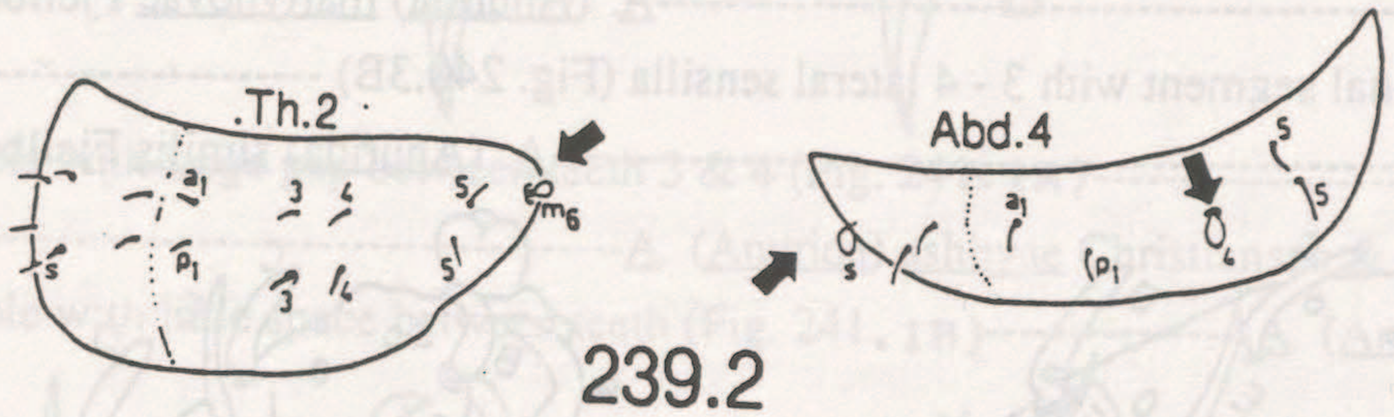
239.1

Key to nearctic species of Anurida s.l.

1) Without pigment or eyes ----------2
1') With pigment and/or eyes ----------10

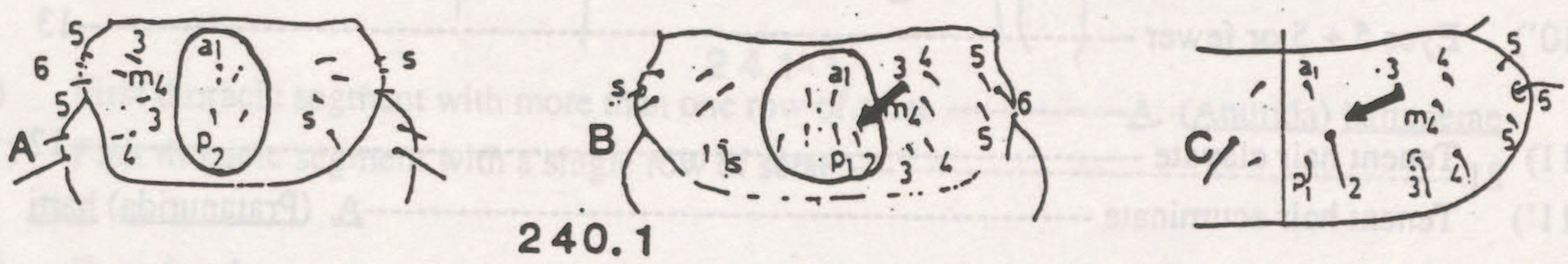
*2) Subcoxal spur present (Fig. 239.1) ----------A. (Anuridella) calcarata
2') No subcoxal spur ----------3

*3) Globular sensillae on Th. 2 and Abd. 4 (Fig. 239.2) ----------A. (Micranurida) spirillifera
3') Sensillae on thorax 2 and Abd. 4 all slender and setiform ----------4



239.2

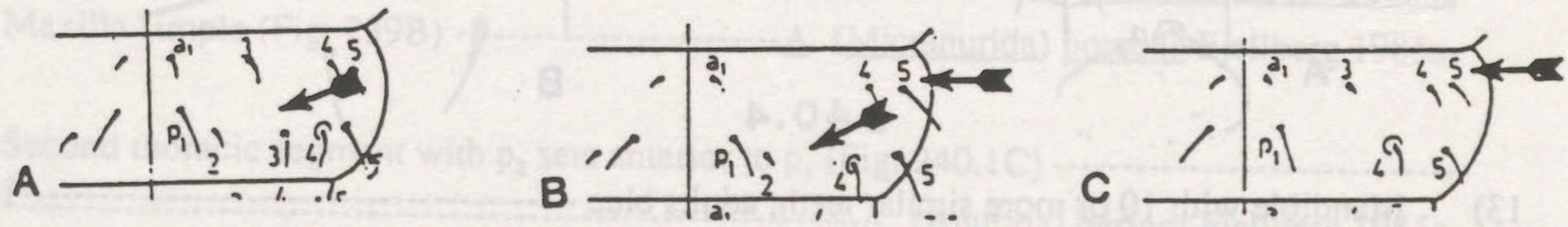
4) Second and third thoracic segments with 4 setae in median field (Fig. 240.1A) ----------
----------A. (Anurida) reducta
4') Second and third thoracic segments with 6 setae in median field (Fig. 240.1B) ----------5



240.1

5) Second thoracic segment with p_2 behind p_1 (Fig. 240.1B) ----------6
5') Second thoracic segment with p_2 in front of p_1 (Fig. 240.1C) ----------9

*6) Fourth abdominal segment with p_1 - p_5 all present (240.2A) ----------
-----A. (Anurida) polaris Hammer, 1954 [= A. frigida Fjellberg, 1985 see Fjellberg 1985]
6') Fourth abdominal segment with one or more p setae absent (Fig. 240.2B) ----------7



240.2

*7) Maxilla styliform (Fig. 239B) ----------A. (Micranurida) furcifera

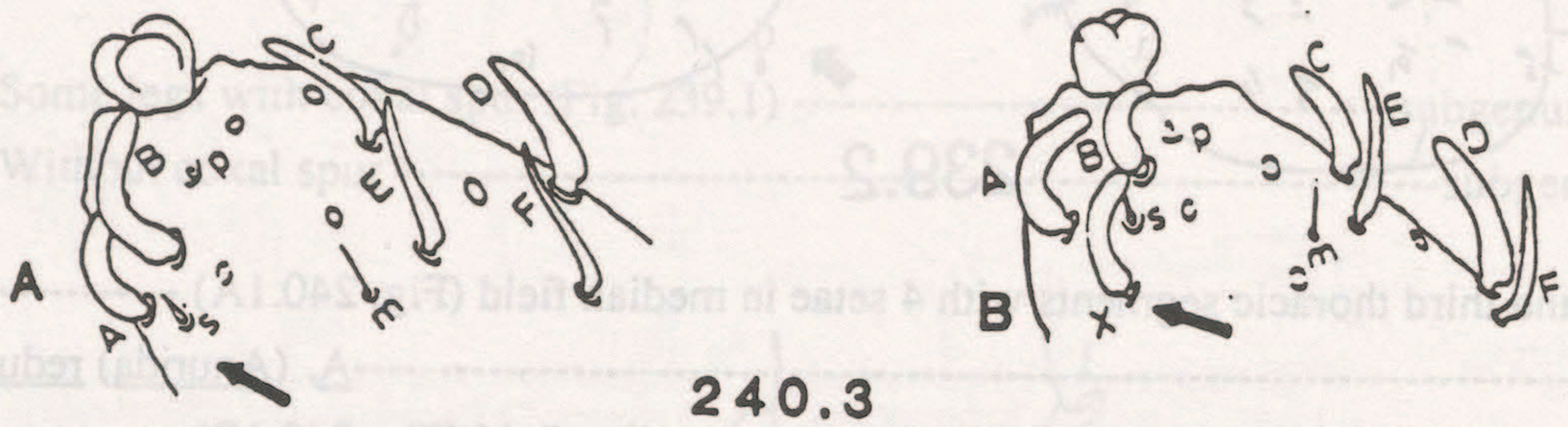
7') Maxilla complex (Fig. 239A) ----------8

*8) Fourth abdominal segment with 3 setae in a and 4 in p row (Fig. 240.2B) ----------
----------A. (A.) granaria

8') Fourth abdominal segment with 4 a and 3 p setae (Fig. 240.2C) ----------
----------A. (Anurida) subarctica Fjellberg, 1985a

9) Fourth antennal segment with 2 lateral sensilla (Fig. 240.3A) ----------
----------A. (Anurida) martynovae Fjellberg, 1985

9') Fourth antennal segment with 3 - 4 lateral sensilla (Fig. 240.3B) ----------
----------A. (Anurida) similis Fjellberg, 1985.



240.3

10) Eyes 8 + 8 ----------11

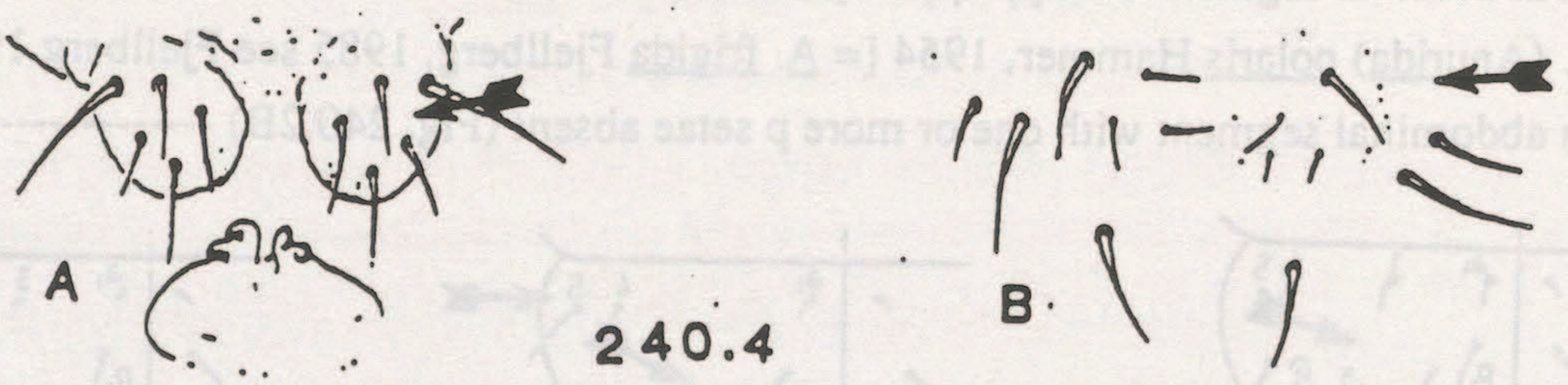
10') Eyes 5 + 5 or fewer ----------13

11) Tenent hair clavate ----------12

**11') Tenent hair acuminate ----------A. (Pratanurida) harti

12) With clear but reduced furcula (Fig. 240.4A)----------
----------A. (Pratanurida) tananensis Fjellberg 1985

12') Without clear furcula (Fig. 240.4B) ----------A. (Pratanurida) foxi Fjellberg 1985



240.4

13) Mandible with 10 or more similar teeth; adults blue ----------14

13') Mandible with 7 or fewer large teeth of different sizes; adults blue or white ----------15

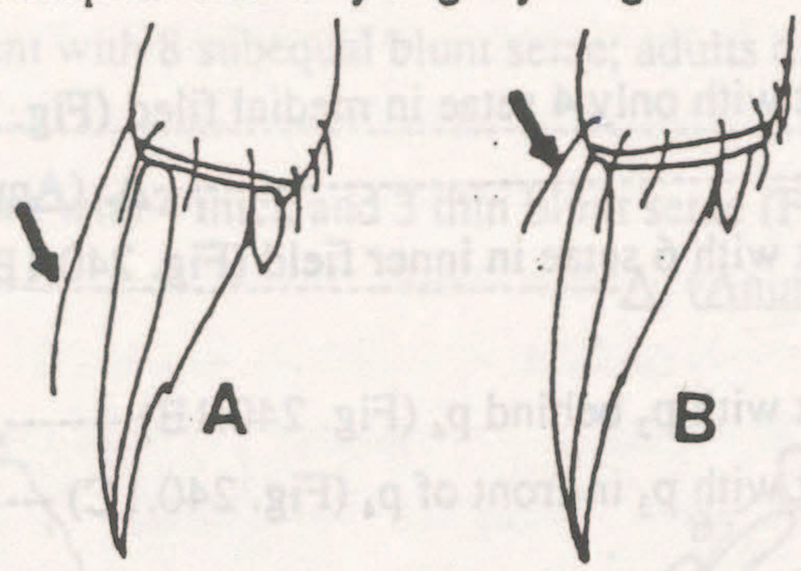
**14) PAO lobes 30 or more ----------A. (Anurida) amorita

**14') PAO lobes 14-15 ----------A. (Anurida) dentata

15) Tibiotarsus with outer subapical seta much longer than others (Fig. 241A) ----------16

15') Tibiotarsus with outer subapical seta only slightly longer than others (Fig. 241B) --------17

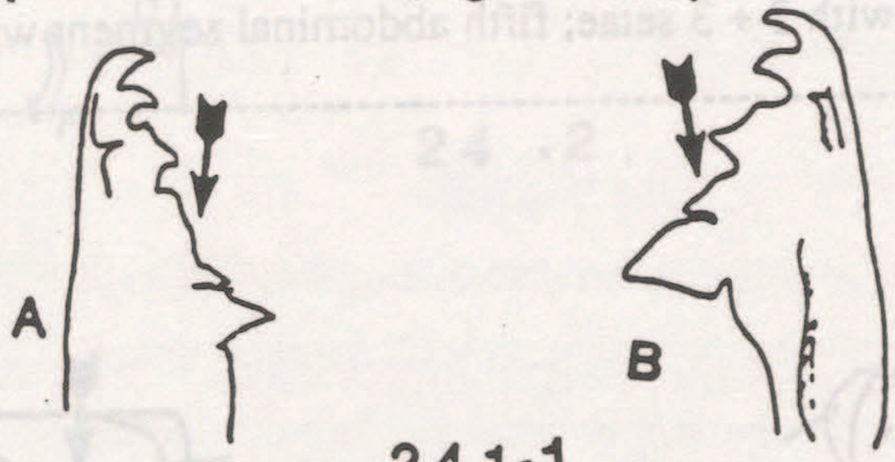
241



**16) Mandible with large gap between teeth 3 & 4 (Fig. 241.1A)----------

----------A. (Anurida) ashbyae Christiansen & Bellinger 1988

*16') Mandible with little space between teeth (Fig. 241.1B)----------A. (Anurida) maritima



241-1

**17) First thoracic segment with more than one row of setae ----------A. (Anurida) hammerae

17') First thoracic segment with a single row of setae ----------18

18) Eyes 5 + 5 ----------19

18') Eyes 4 + 4 or fewer ----------22

19) PAO lobes 12 or fewer ----------20

19') PAO lobes 13 or more ----------21

20) Maxilla complex (Fig. 239A) ----------A. (Anurida) decemoculata

20') Maxilla simple (Fig. 239B) ----------A. (Micranurida) porcella Fjellberg 1985a

21) Second thoracic segment with p_2 seta anterior to p_1 (Fig. 240.1C) ----------

----------A. (Anurida) beringi Fjellberg 1985a

*21') Second thoracic segment with p_2 seta posterior to p_1 (Fig. 240.1B) ----------

----------A. (Anurida) tullbergi

*22) PAO lobes 6 - 7 ----------A. (Micranurida) pygmaea

22') PAO lobes 10 or more ----------23

23) Eyes 1 + 1 ----------A. (Micranurida) valiana Fjellberg 1985

23') Eyes 2 + 2 or more ----------24

24) Second thoracic segment with only 4 setae in medial filed (Fig. 240.1A) ----------
----------A. (Anurida) narli Fjellberg 1985

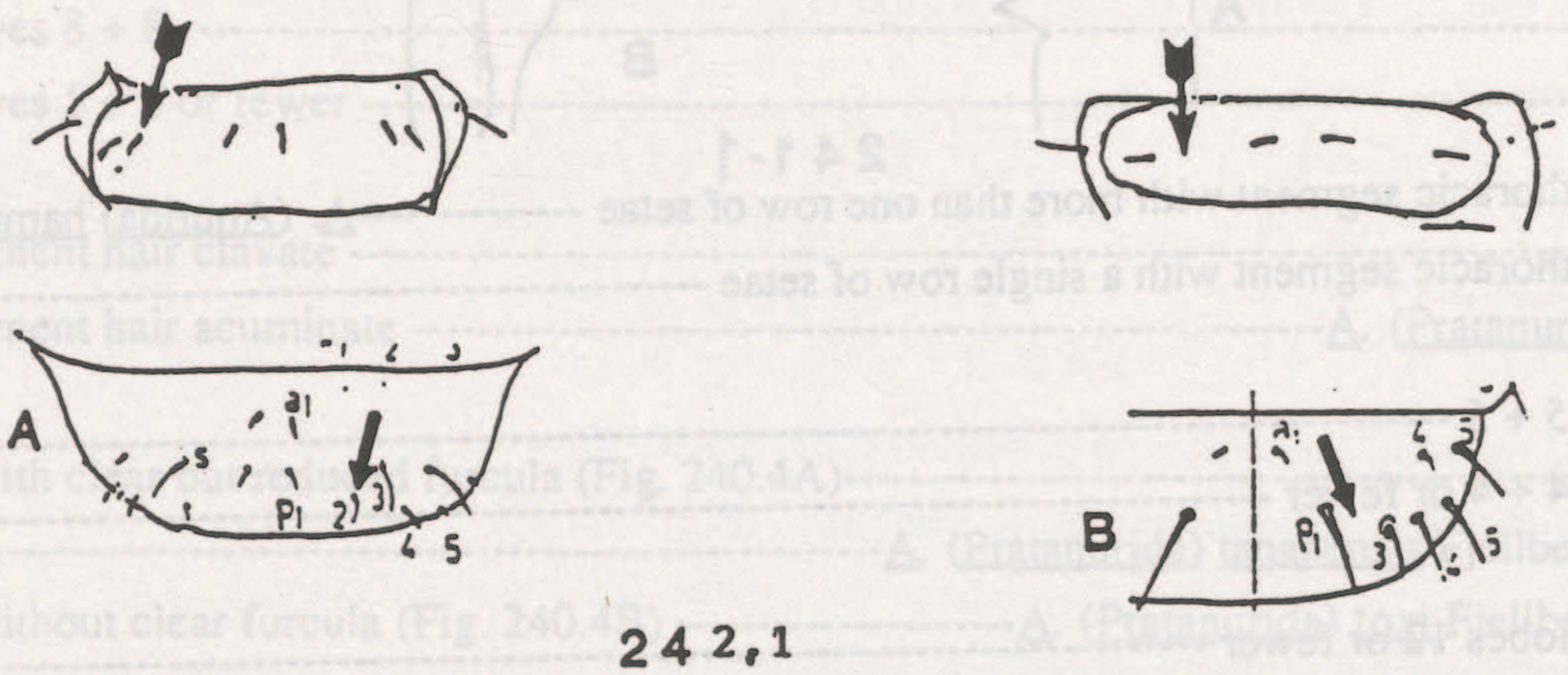
24') Second thoracic segment with 6 setae in inner field (Fig. 240.1B)----------25

*25) Second thoracic segment with p_3 behind p_4 (Fig. 240.1B) -------A. (Anurida) papillosoides

25') Second thoracic segment with p_3 in front of p_4 (Fig. 240.1C) ----------26

26) First thoracic segment with 4 + 4 setae; fifth abdominal segment with p_2 present
(Fig. 242.1A) ----------A. (Anurida) papillosa (Axelson, 1902)

26') First thoracic segment with 3 + 3 setae; fifth abdominal segment with p_2 absent
(Fig. 242.1B) ----------27



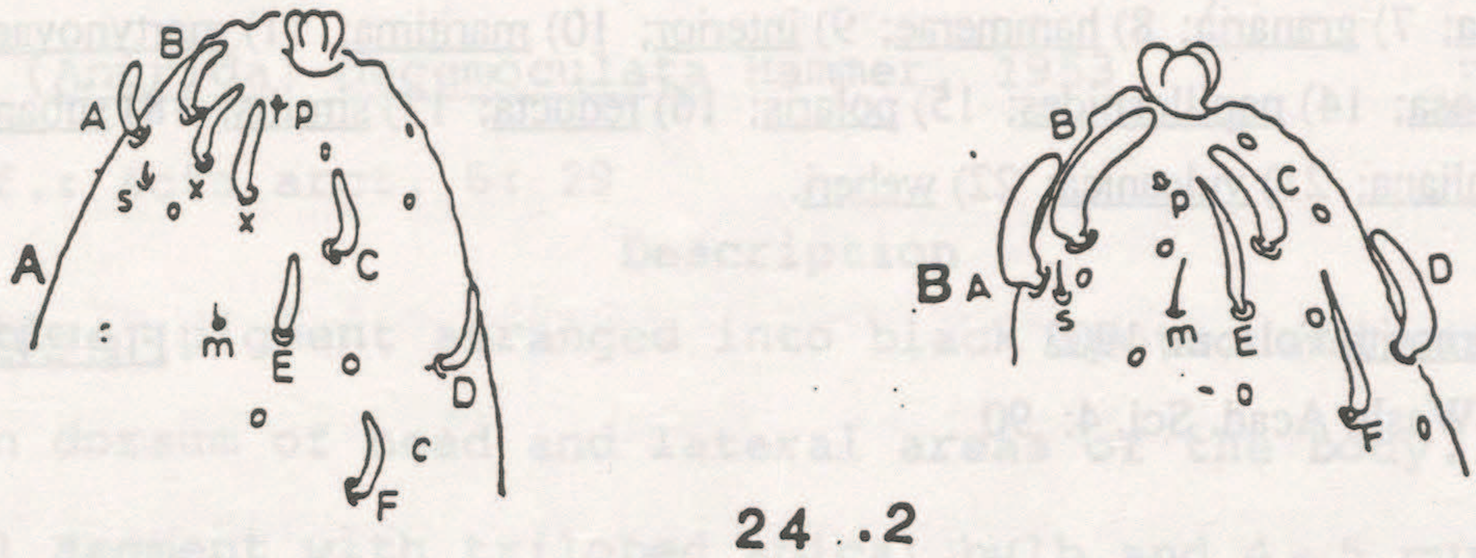
242.1

27) Fourth abdominal segment with seta p_2 and p_3 absent (Fig. 240.2C) ----------
----------A. (Anurida) vulcanica Fjellberg, 1985a

27') Fourth abdominal segment with seta p_2 and p_3 present (Fig. 240.2A) ----------28

** 28) Fourth antennal segment with 8 subequal blunt setae; adults dark blue (Fig. 242.2A) -------
----------A. (Anurida) weberi

28') Fourth antennal segment with 4 thick and 3 thin blunt setae (Fig. 242.2B) adults pale ------
----------A. (Anurida) interior Fjellberg, 1985



24 .2

Not included in key:

violacea Scott, 1960a = Xenylla humicola (Bellinger 1985).

Subgenus Anurida s. str.

Syn.: Aphoromma MacGillivray, 1893, type species granaria Nicolet, 1842.

This includes all forms of the genus having a complex maxilla and lacking subcoxal spurs. Most of the species are large, and many are well pigmented. The mandible has from five to eleven teeth, and the maxilla has three to five lamellae, generally of very different shapes. The fourth antennal segment blunt setae are cylindrical and usually prominent.

There are 22 Nearctic species: 1) amorita; 2) ashbyae; 3) beringi; 4) decemoculata; 5) dentata; 6) frigida; 7) granaria; 8) hammerae; 9) interior; 10) maritima; 11) martynovae; 12) narli; 13) papillosa; 14) papillosoides; 15) polaris; 16) reducta; 17) similis; 18) subarctica; 19) tullbergi; 20) valiana; 21) vulcanica; 22) weberi.

Anurida (Anurida) amorita Folsom, 1902 Fig. 243

Ref.: Proc. Wash. Acad. Sci. 4: 90

Description

Color: Dark blue pigment mottled on a white background; dorsum with a pair of median, broken longitudinal stripes. Fourth antennal segment with trilobed apical bulb; blunt setae not observed. P.A.O. of 30 - 40 tubercles generally arranged in a curved ellipse. Eyes 5 + 5. Mandible with 10 - 11 relatively small inner teeth and two minute lateral teeth near apex. Maxilla quadrilamellate, with all lamellae serrate. Unguis with strong inner tooth. Legs without particularly long setae. Integument finely granulate. Body setae all acuminate and smooth. Maximum length 4.1 mm.

Remarks

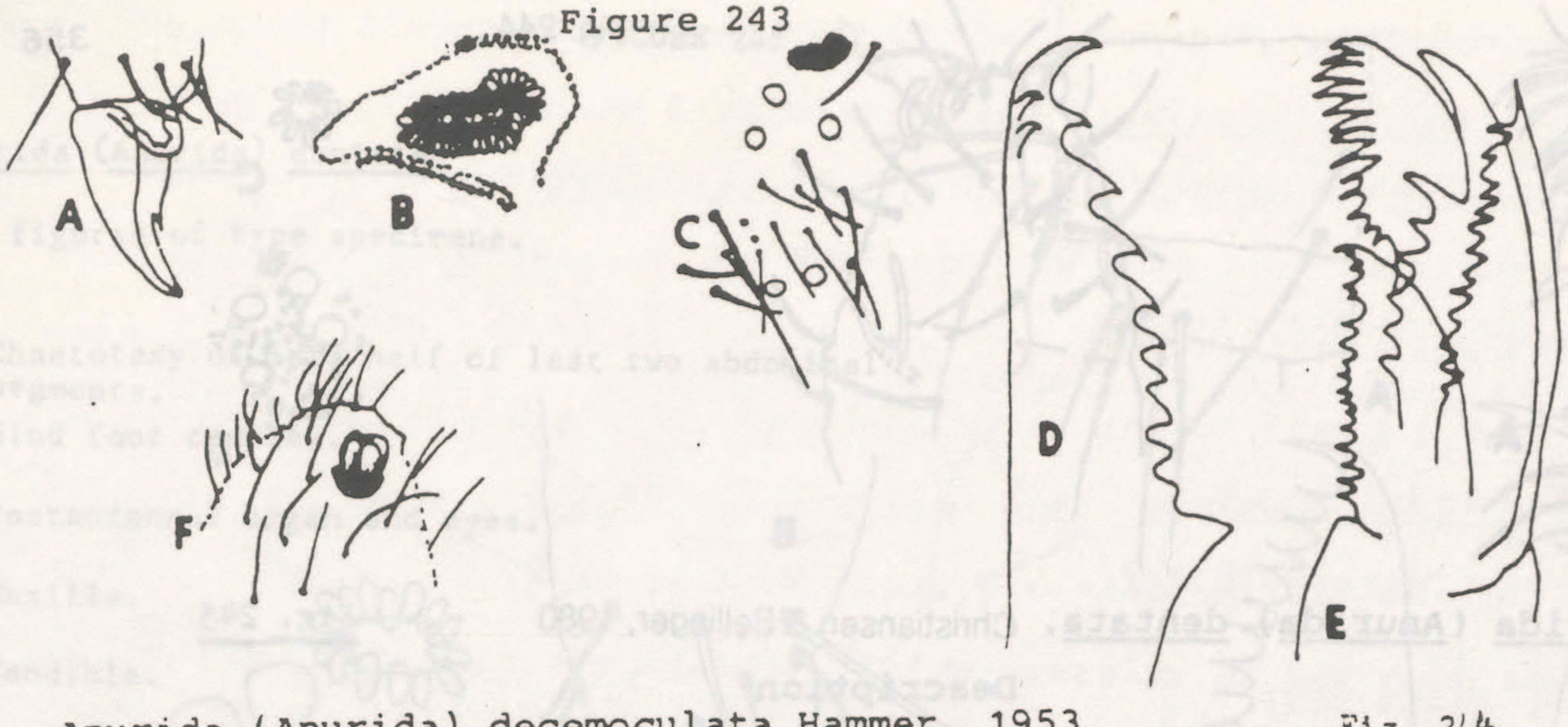
Partial dissection of one of the cotypes showed the mandible to have a remarkable structure shared by only one other Nearctic form, A. dentata. The latter can readily be distinguished by the smaller number of P.A.O. lobes and the presence of long internal tibiotarsal setae.

Locality: Alaska - Kukak Bay.

FIGURE 243

Anurida (Anurida) amorita

A) Mid foot complex after Folsom.
B) Postantennal organ, after Folsom.
C) Postantennal organ and eyes, after Folsom.
D) Mandible, seen at an angle, cotype.
E) Maxilla, cotype.
F) Apex and antenna, after Folsom.



Anurida (Anurida) decemoculata Hammer, 1953 Fig. 244

Ref.: Acta arct. 6: 29

Description

Color: blue; pigment arranged into black spots, and with white spots on dorsum of head and lateral areas of the body. Fourth antennal segment with trilobed apical bulb and 4 - 5 curved blunt setae. P.A.O. with 9 - 10 lobes arranged in a circle. Eyes 5 + 5. Unguis with weak inner tooth. Tibiotarsus with all setae fairly short and acuminate. Furcula absent. Integument coarsely granulate. Body setae sparse and fine; posterior abdominal segments with somewhat stouter setae. Maximum length .56 mm.

Remarks

Until the mouthparts of this species have been examined its exact position must remain in doubt. It may represent a young specimen of dentata; however, it appears readily separable on the absence of long setae on the anterior body segments, as well as the smaller number of lobes of the P.A.O..

Locality: Canada, N.W.T. - Yellowknife (type).

FIGURE 244

Anurida (Anurida) decemoculata

All figures after Hammer.

A) Tibiotarsus and unguis, first pair of legs.

B) Fourth antennal segment.

C) Postantennal organ.

D) Postantennal organ and eyes.

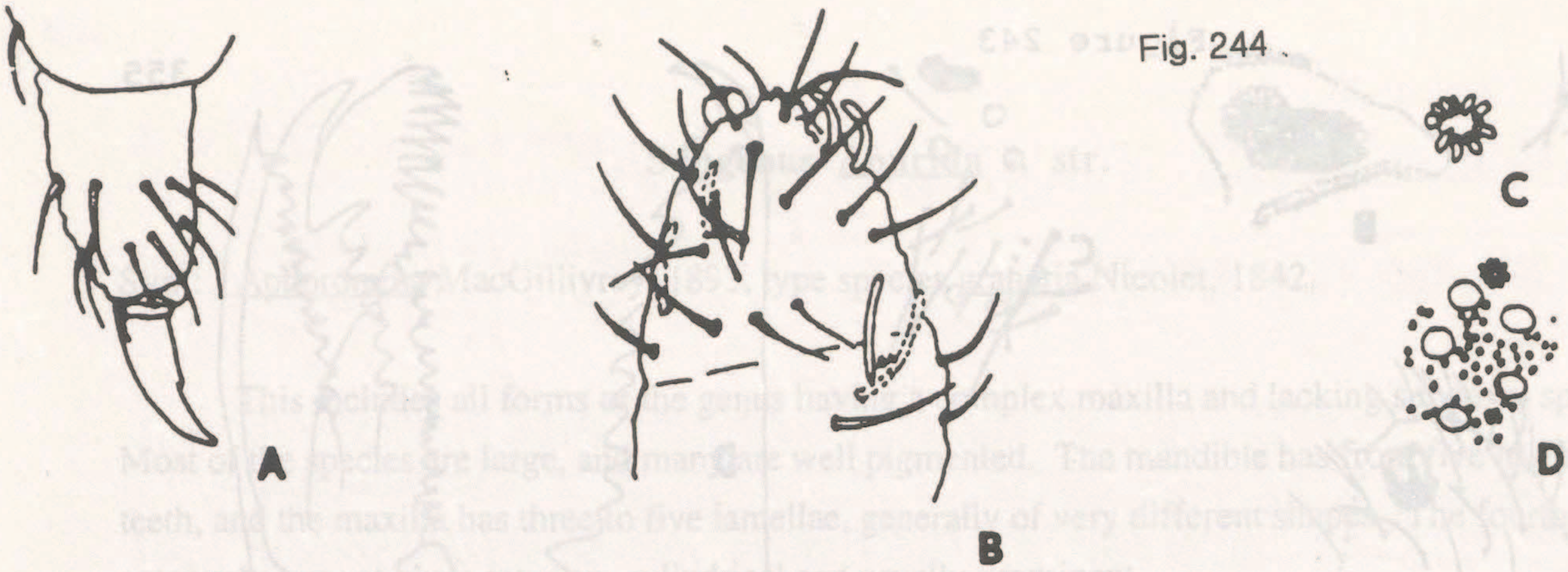


Fig. 245

Anurida (Anurida) dentata, Christiansen & Bellinger, 1980

Description

Color: blue. Fourth antennal segment with lobed (?) end bulb and 1 or 2 (?) blunt setae. P.A.O. of 14-15 lobes in a broad ellipse. Eyes 5+5. Mandible with more than 10 teeth, all slender and pointed. Maxilla quadrilamellate. Unguis with strong inner tooth and extremely large outer lamella. Tibiotarsus with one long inner seta exceeding tip of unguis. Ventral tube with 4+4 setae. Furcula reduced to two low humps bearing 2+2 setae. Integument extremely coarsely granulate. All body setae acuminate, and smooth or minutely serrate; each body segment with long prominent setae in addition to fine curved setae. Maximum length 1.8 mm.

Remarks

Only two specimens of this unique species have been seen, and in these the antennae are unclear. In the large number of intermediate teeth on the mandible this differs from most species of the genus, though resembling A. amorita and A. assimilis persimilis Yosii. In some respect the form resembles decemoculata Hammer; however, it differs in the chaetotaxy, ungual structure, and lobes of the P.A.O. Until the mouthparts of decemoculata have been described the separation of these two forms must remain tentative.

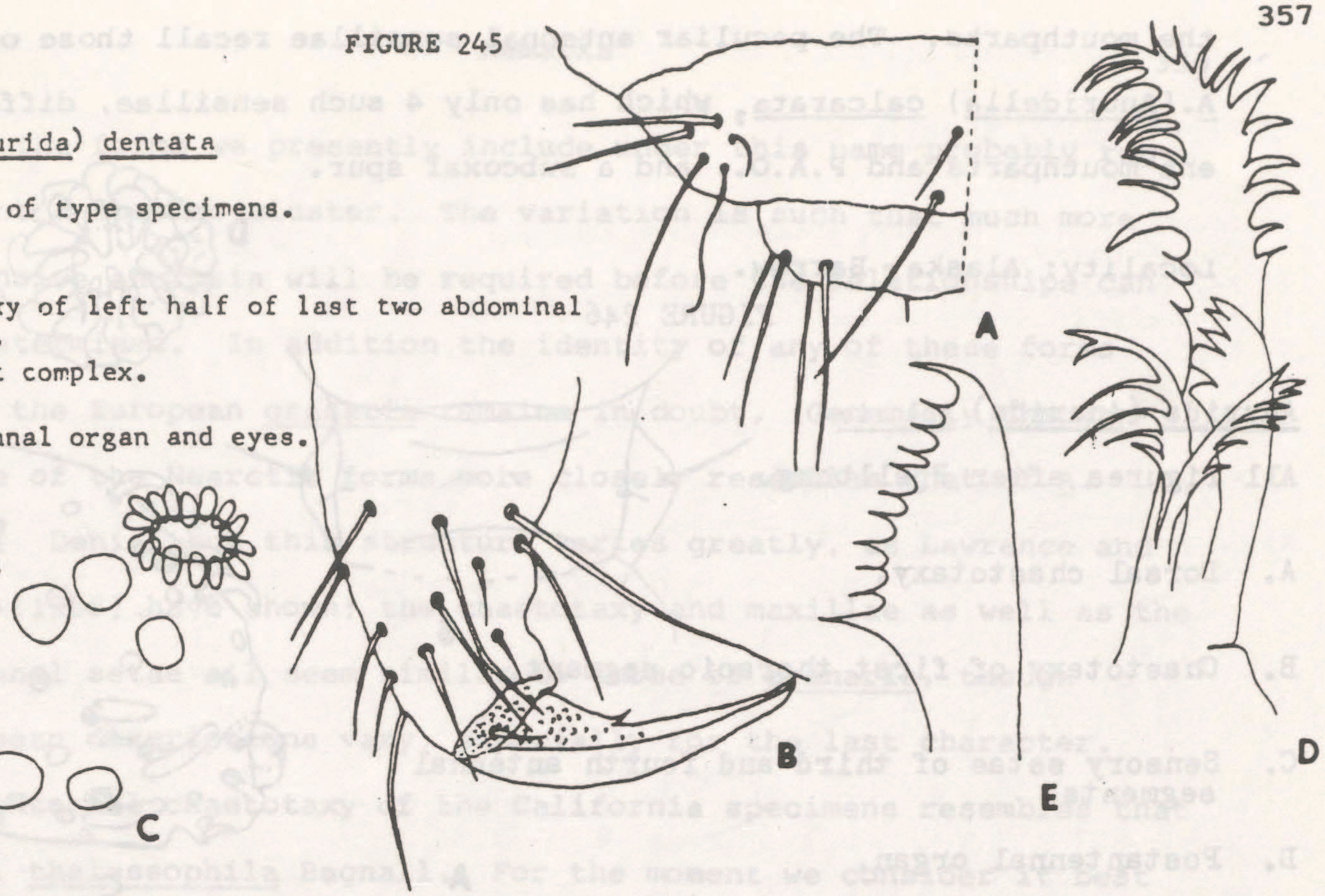
Type locality: Williamsville, Wayne Co., Missouri, 29 December 1949 (Illinois Natural History Survey acc. no. 49597).

FIGURE 245

Anurida (Anurida) dentata

[redacted]l figures of type specimens.

A) Chaetotaxy of left half of last two abdominal segments.
B) Hind foot complex.
C) Postantennal organ and eyes.
D) Maxilla.
E) Mandible.



Anurida (Anurida) polaris (Hammer), 1954

Fig. 246

Ref.: Medd Grønl. 127(5) (Micranurida);(Fjellberg, 1984)

[redacted]

syn.: frigida Fjellberg, 1973, Norsk ent Tidjskrift 20:285.

Description

Color: white. Fourth antennal segment with trilobed apical bulb and 7 laterally stalked blunt setae. P.A.O. of about 15 irregular tubercles in a circle. Eyes absent. Mandible with 5 - 6 teeth, the basal tooth the largest; maxilla with 3 fringed lamellae and 4 teeth on the ramus. Claw untoothed. Ventral tube with 4 + 4 setae. Furcula absent, but venter of fourth abdominal segment with 3 - 6 minute setulae among the normal setae. Integument moderately coarsely granulate. Body setae acuminate and smooth to very finely serrate. Maximum length 1.35 mm.

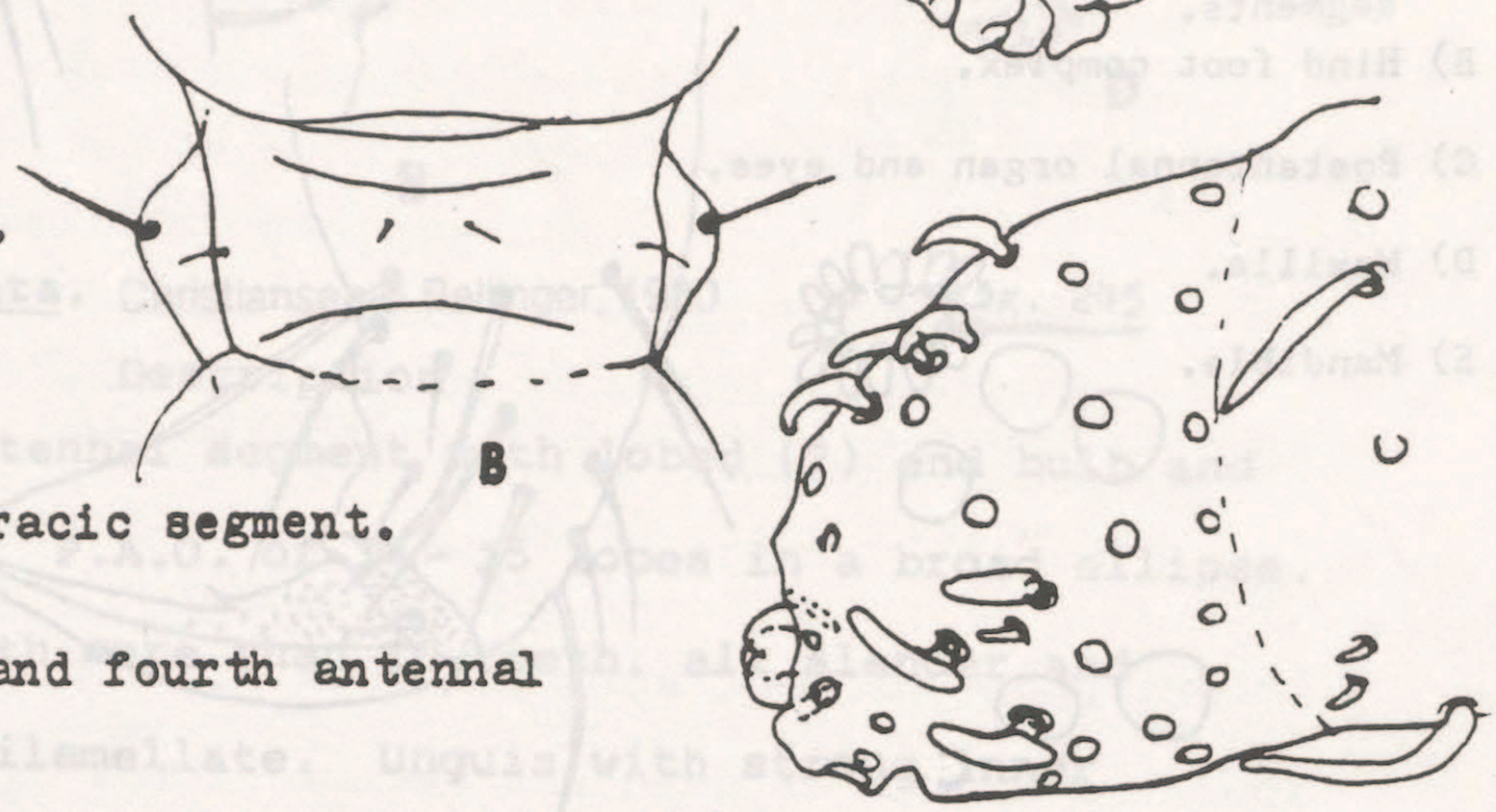
Results

A single specimen has been seen which matches the description of this alpine species from Norway except for minor differences in

the mouthparts. The peculiar antennal sensillae recall those of A.(Anuridella) calcarata, which has only 4 such sensillae, different mouthparts and P.A.O., and a subcoxal spur.

Locality: Alaska - Barrow.

FIGURE 246



Anurida (Anurida) polaris

All figures after Fjellberg.

A. Dorsal chaetotaxy.

B. Chaetotaxy of first thoracic segment.

C. Sensory setae of third and fourth antennal segments.

D. Postantennal organ.

Anurida (Anurida) granaria (Nicolet), 1847

Fig. 247

Refs.: Annls Soc. ent Fr. (2) 5: 387 (Anoura); Stach, 1949

Description

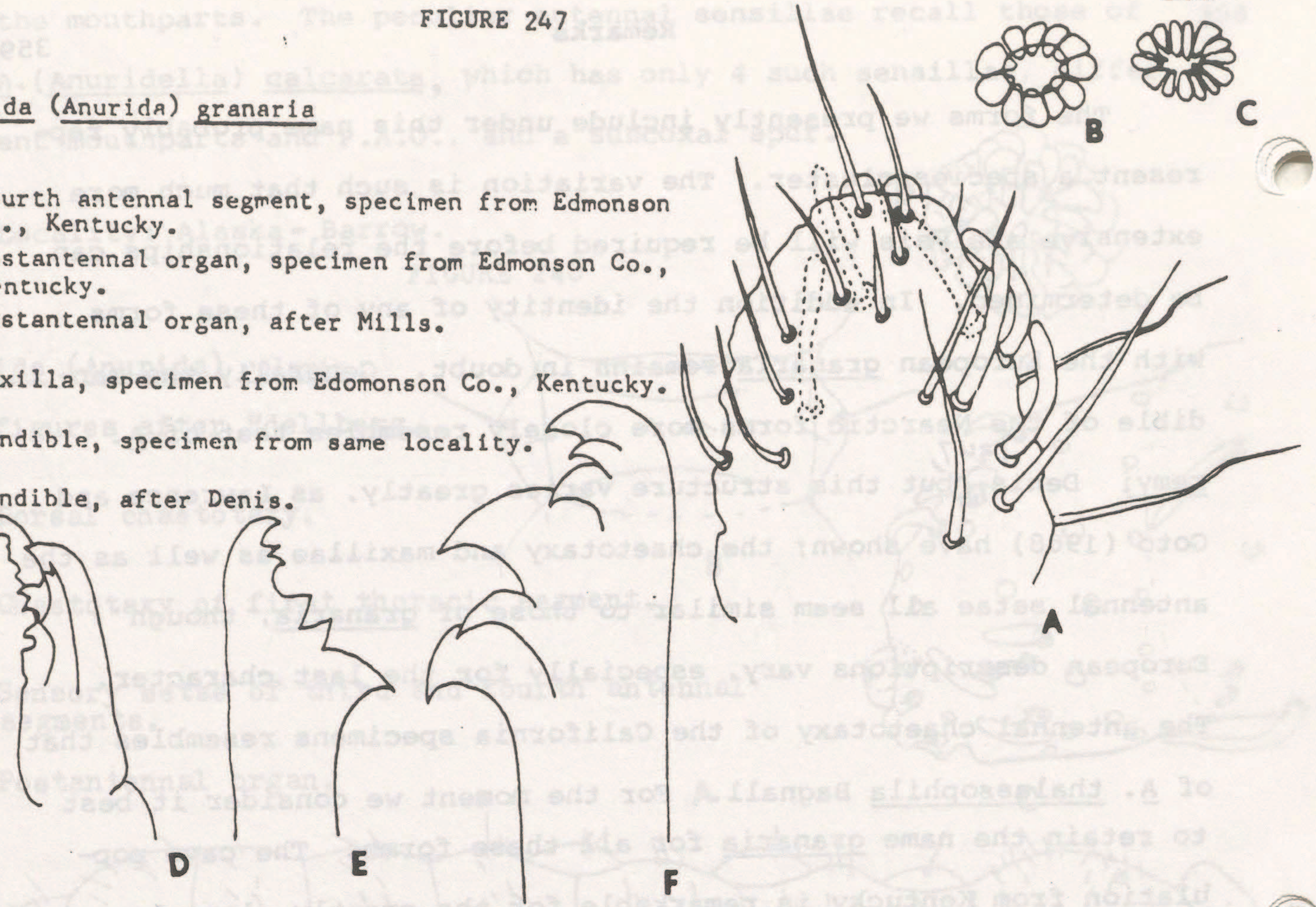
Color: white. Fourth antennal segment with apical lobed bulb and 5 - 6 long cylindrical blunt setae. P.A.O. of 10 - 20 lobes in a circle or very broad ellipse. Eyes absent. Mandible with six inner teeth; posterior teeth variable in size. Maxilla with a basal "claw" and 3 lamellae. Unguis without inner tooth. Ventral tube with 4 + 4 setae. Furcula reduced to two small knobs bearing 3 + 3 or 4 + 4 setae. Integument coarsely granulate. Maximum length 2 mm.

The forms we presently include under this name probably represent a species cluster. The variation is such that much more extensive analysis will be required before the relationships can be determined. In addition the identity of any of these forms with the European granaria remains in doubt. Generally the mandible of the Nearctic forms more closely resembles that of A. remyi Denis, 1947, but this structure varies greatly, as Lawrence and Goto (1968) have shown; the chaetotaxy and maxillae as well as the antennal setae all seem similar to those of granaria, though European descriptions vary, especially for the last character. The antennal chaetotaxy of the California specimens resembles that of A. thalassophila Bagnall. For the moment we consider it best to retain the name granaria for all these forms. The cave population from Kentucky is remarkable for the greatly elongate unguis.

Localities: Alaska - Point Barrow, Umiat; California - Humboldt Co, Marin Co.; Connecticut - Litchfield Co.; Illinois - Shawneetown; Indiana - Franklin Co., Wayne Co.; Kentucky - Edmondson Co. (cave); Ontario - Kirkwood.

Additional records: Connecticut (Bellinger, 1954); Iowa (Mills, 1934); Massachusetts (Folsom, 1916); New York (Maynard, 1951); North Carolina (Wray, 1967); West Virginia (Lippert and Butler, 1976). Canada - Ellesmere I. (Hammer, 1953); Northwest Territories (Hammer, 1953a); Ontario (James, 1933); Quebec (Marshall, 1967).

FIGURE 247



A) Fourth antennal segment, specimen from Edmonson Co., Kentucky.
B) Postantennal organ, specimen from Edmonson Co., Kentucky.
C) Postantennal organ, after Mills.
D) Maxilla, specimen from Edomonson Co., Kentucky.
E) Mandible, specimen from same locality.
F) Mandible, after Denis.

Anurida (Anurida) hammerae Christiansen, 1952 Fig. 248

Ref.: Psyche, Camb. 58: 135

Description

Color: white. Fourth antennal segment with trilobed apical bulb and 8 - 10 blunt setae. P.A.O. with 12 - 17 lobes in a rough circle. Eyes 4 - 5 per side, arranged almost in a line. Mandible with 5 inner teeth; basal two larger than others. Maxilla complex, with 5 lamellae. Unguis with a strong inner tooth. Ventral tube with 5 + 5 setae. Furcula absent. Integument moderately coarsely granulate. All body setae smooth and acuminate. Maximum length 3 mm.

Remarks

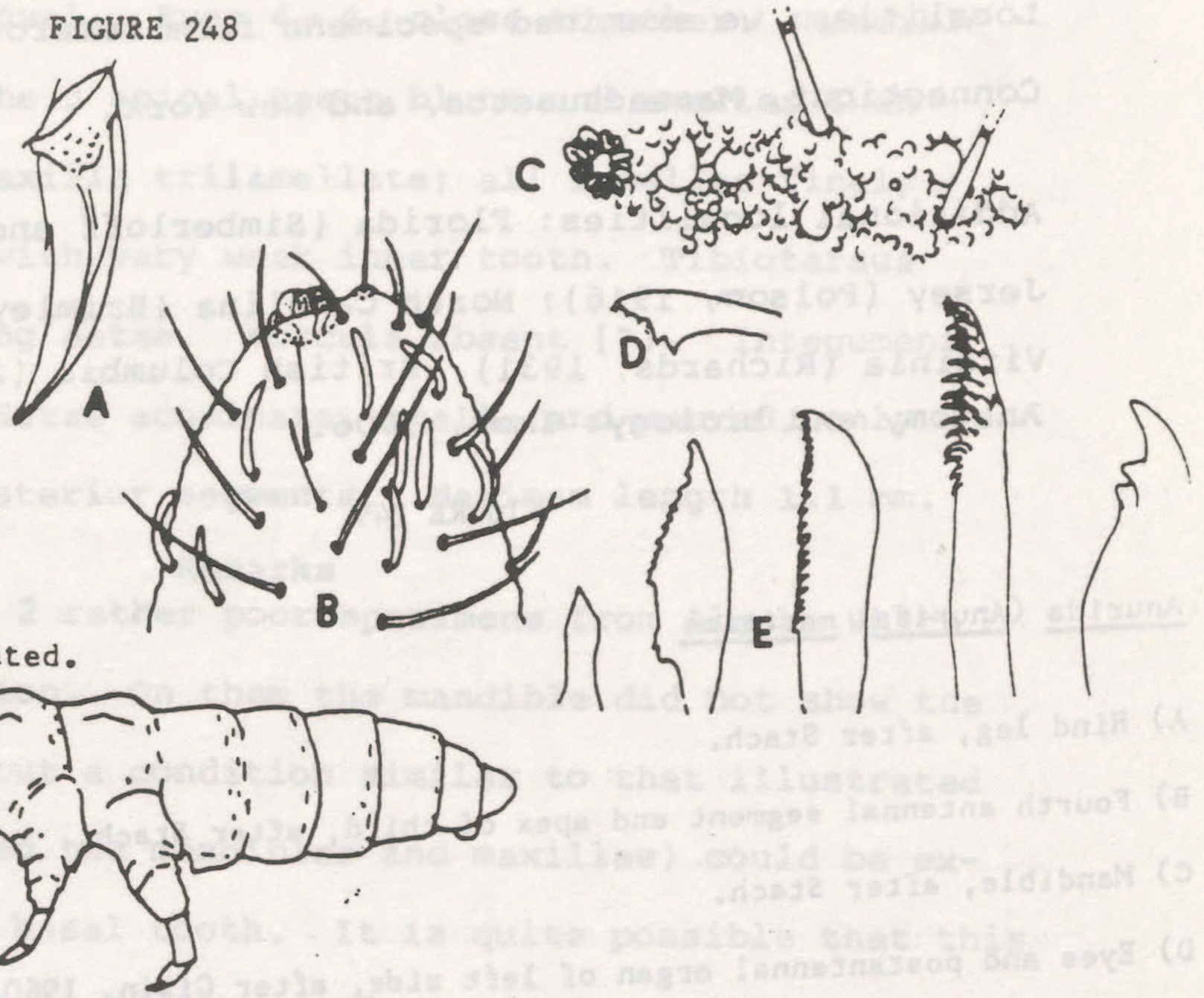
The peculiar combination of lack of pigment but 4 - 5 eyes make this easy to distinguish from all congeners. One large

specimen has the longest setae minutely rough, though not actual-
ly serrate.

Locality: Alaska - Point Barrow and vicinity (type).

Additional records: Canada - Northwest Territories (Hammer, 1953a).

FIGURE 248



Anurida (Anurida) hammerae

All figures after Christiansen

A) Posterior unguis.

B) Fourth antennal segment.

C) Postantennal organ and eyes.

D) Mandible.

E) Maxilla with lamellae separated.

F) Habitus.

Anurida (Anurida) maritima (Guerin), 1838 Fig. 249

Refs.: Dictionnaire pittoresque d'Historie Naturelle 8: 182

(Achorutes); Stach, 1949

Description

Color: dark uniform blue. Fourth antennal segment with apical or subapical trilobed bulb and six blunt setae, weakly differentiated from acuminate setae. P.A.O. of 5 - 10 tubercles in a circle. Eyes 5 + 5. Mandible with 6 - 7 inner teeth; basal two or three larger than others. Maxilla trilamellate. Unguis untoothed or with very minute inner tooth. Tibiotarsus with acuminate tenent hair longer than outer unguis. Ventral tube with 4 + 4 to 6 + 6 setae. Furcula absent. Integument finely granulate. Body setae acuminate, generally stout, and smooth to minutely serrate. Maximum length 3.5 mm.

Remarks

This halophile species is the most abundant and widespread littoral colembolan. The long tenent hair easily separates from all its congeners.

Localities: we examined specimens from numerous coastal areas in Connecticut, Massachusetts, and New York.

Additional localities: Florida (Simberloff and Wilson, 1969); New Jersey (Folsom, 1916); North Carolina (Brimley, 1938); Virginia (Richards, 1931), British Columbia (Spencer, 1948).

Anatomy and biology: Imms, 1906.

FIGURE 249

Anurida (Anurida) maritima

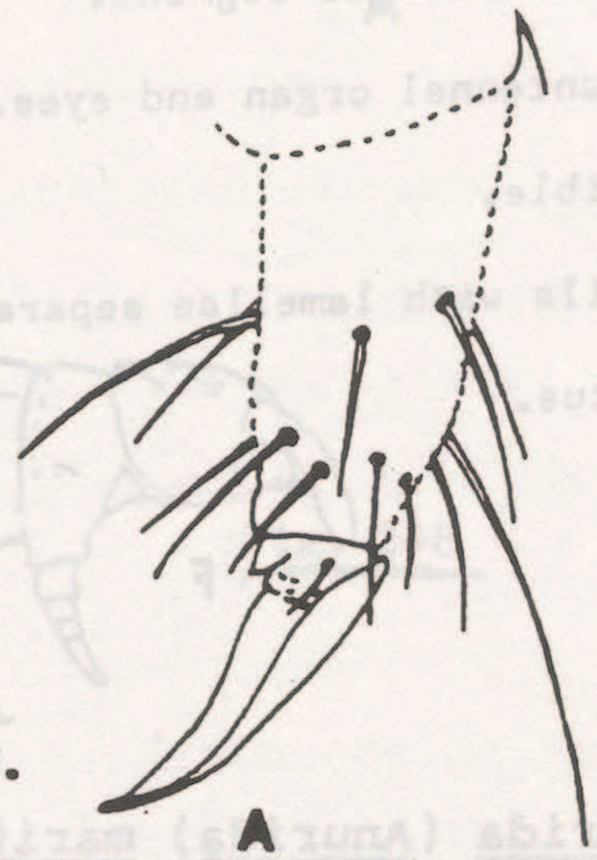
A) Hind leg, after Stach.

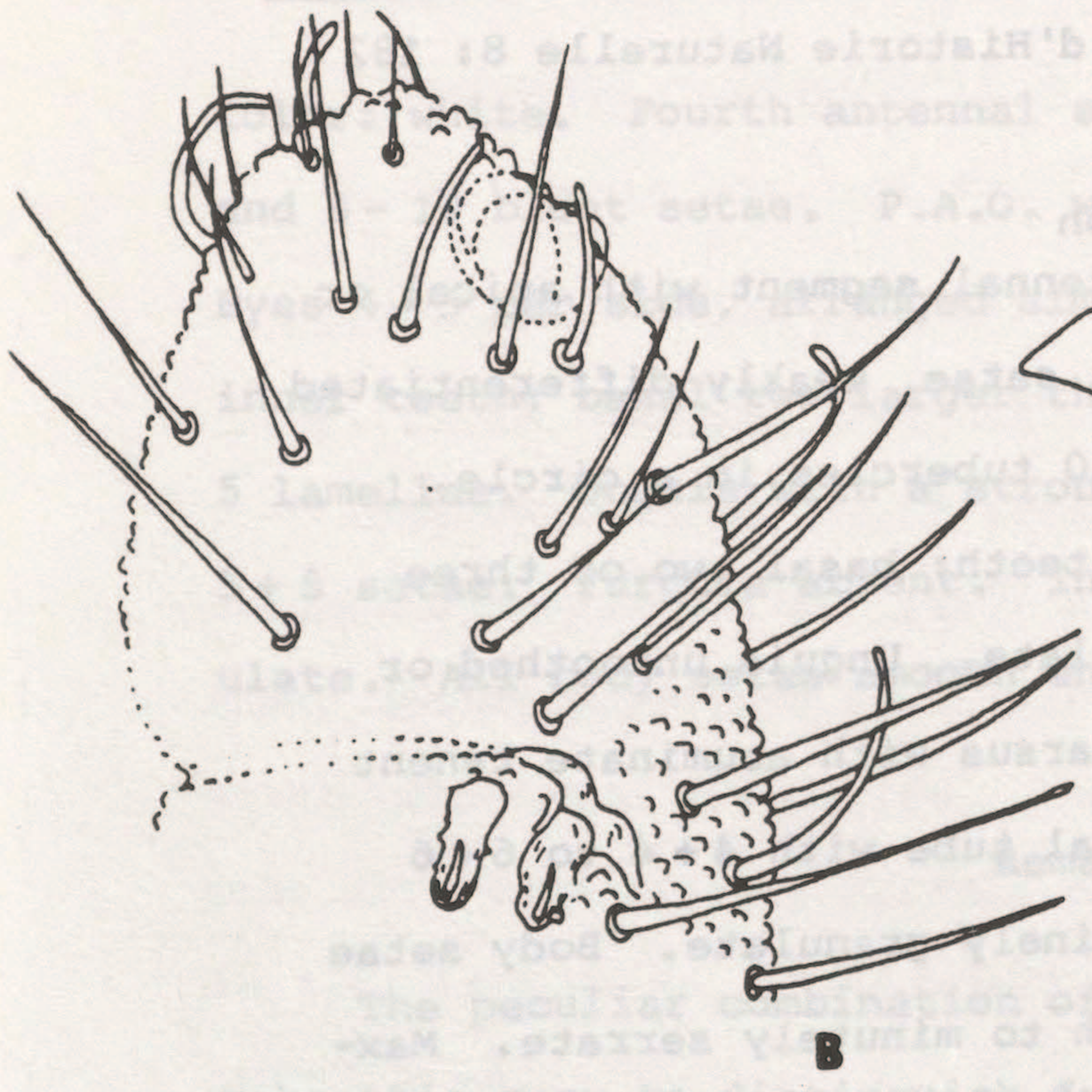
B) Fourth antennal segment and apex of third, after Stach.

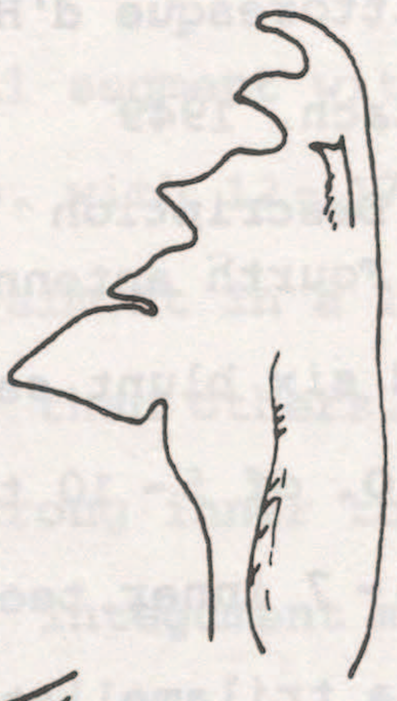
C) Mandible, after Stach.

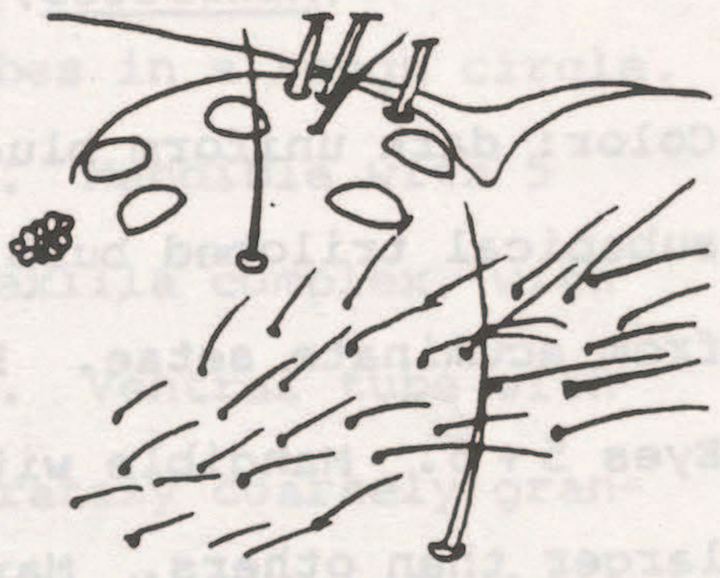
D) Eyes and postantennal organ of left side, after Gisin, 1960.

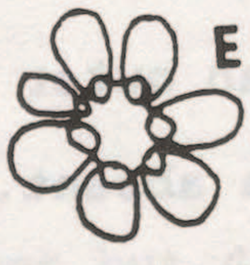
E) Postantennal organ, after Folsom, 1916.











Ref.: Acta arct. 6: 28 (Micranurida)

Description

Color: dark blue to mottled blue-gray. Fourth antennal segment with a trilobed apical bulb and 4 blunt setae. P.A.O. of 10 - 12 lobes arranged in an oval. Eyes 4 + 4, close together. Mandible with 5 inner teeth, the 3 apical teeth blunt and smaller than the posterior two. Maxilla trilamellate; all lamellae finely denticulate. Unguis with very weak inner tooth. Tibiotarsus without strikingly long setae. Furcula absent (?). Integument coarsely granulate. Setae acuminate, small, and curved, only slightly longer on posterior segments. Maximum length 1.1 mm.

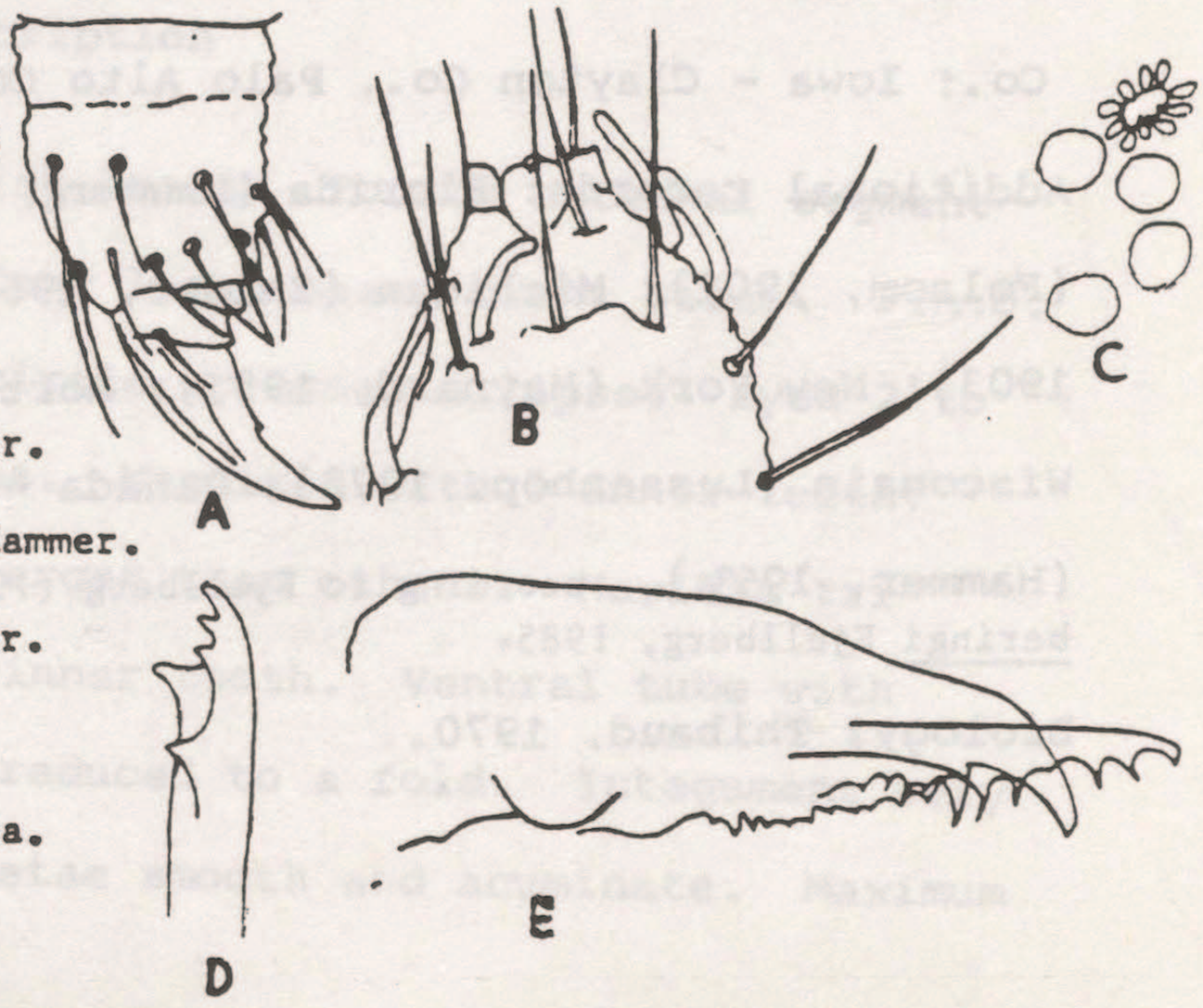
Remarks

We observed only 2 rather poor specimens from Alaska which fit Hammer's description. On them the mandible did not show the basal teeth clearly, but a condition similar to that illustrated by Hammer (who confused the mandibles and maxillae) could be explained by a flexible basal tooth. It is quite possible that this is a synonym of A. weberi but the differences in maxillary structure, eye position, and P.A.O. lobes justify separation pending further study.

Localities: Alaska - Point Barrow, Umiat; Canada, Northwest Territories - Coppermine (type).

FIGURE 250

Anurida (Anurida) papillosoides



A) Fore tibiotarsus and unguis, after Hammer.

B) Apex of fourth antennal segment, after Hammer.

C) Postantennal organ and eyes, after Hammer.

D) Mandible, after Hammer.

E) Maxilla, specimen from Pt. Barrow, Alaska.

Anurida (Anurida) tullbergi Schött, 1891 — Fig. 251

Refs.: Ent. Tidskr. 12: 192; Stach, 1949

Description

Color: pale gray (rarely white) to dark blue. Fourth antennal segment with 2 - 4 blunt setae and trilobed apical bulb. P.A.O. of 17 - 30 lobes in an elongate ellipse. Eyes 5 + 5. Mandible with 6 - 7 inner teeth. Maxilla quadrilamellate. Unguis with inner tooth. Ventral tube with 4 + 4 (?) setae. Furcula represented by a group of about 10 fine setae. Integument moderately to coarsely granulate. Body setae smooth to finely serrate, posterior setae heavy and straight. Maximum length 3 mm.

Remarks

The identity of the Nearctic specimens remains in doubt. Most of the specimens examined have 2 - 3 blunt setae on the fourth antennal segment, while Stach indicates that they are "usually 4 in number", and Massoud gives their number as 5. In addition to this the mandible in the Nearctic forms usually has 6 teeth, while both Massoud and Stach show it with 7. The specimens from Iowa show much coarser granulations on the abdomen, but further samples will be needed before it can be determined whether or not this is part of the normal variation of the species.

Localities: Alaska - Point Barrow, Umiat; California - San Joaquin Co.; Iowa - Clayton Co., Palo Alto Co.; Ontario - Westerville.

Additional records: Florida (Lönnberg, 1894); Massachusetts (Folsom, 1901); Michigan (Snider, 1967); Minnesota (Guthrie, 1903); New York (Maynard, 1951); North Carolina (Wray, 1967); Wisconsin (Lussenhop, 1973); Canada - Northwest Territories (Hammer, 1953a), according to Fjellberg (1985, 1986). Alaskan records are beringi Fjellberg, 1985.

Biology: Thibaud, 1970.

FIGURE 251

Anurida (Anurida) tullbergi

A) Hind foot complex, after Stach.

B) Postantennal organ and eyes, after Stach.

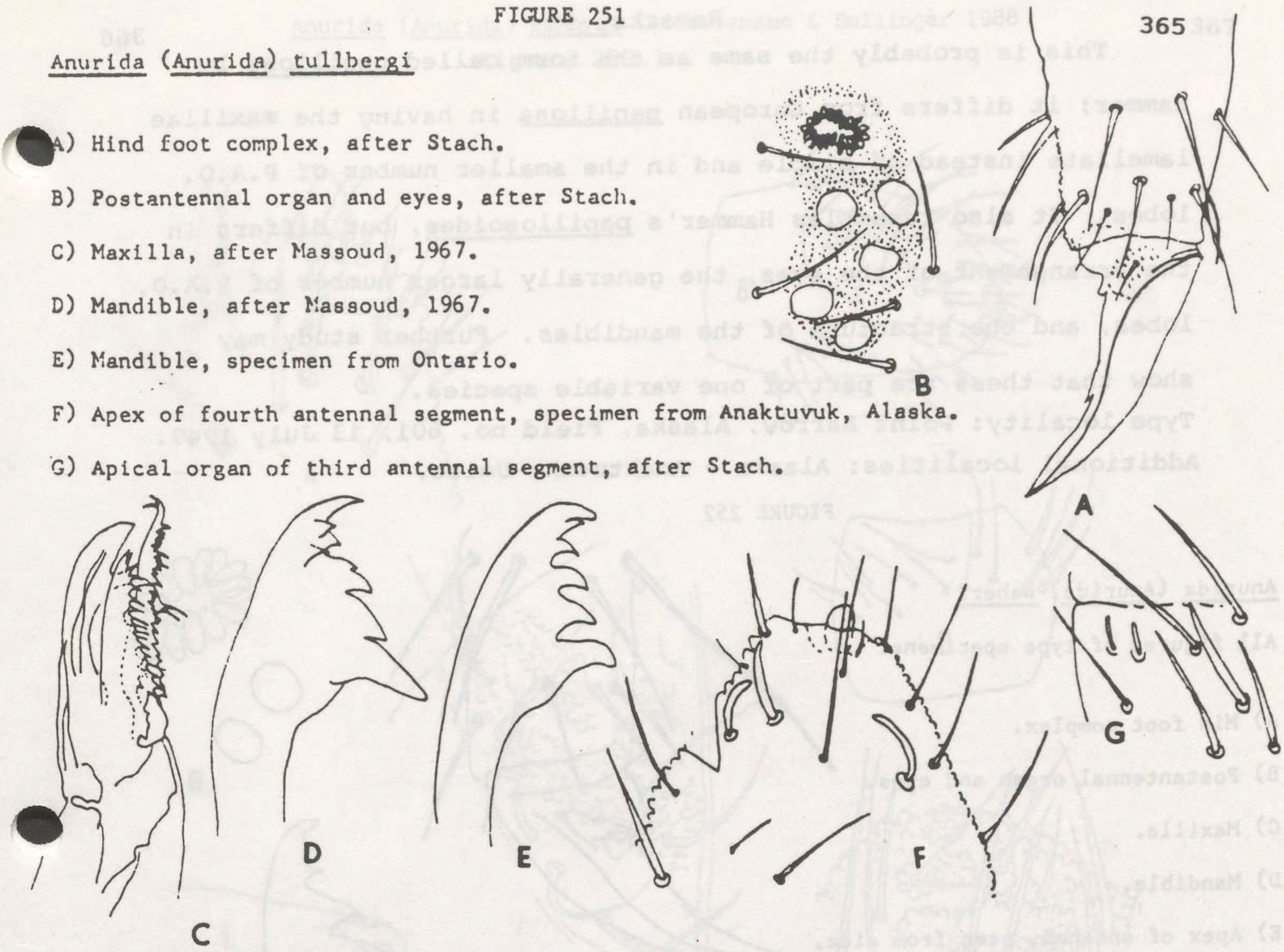
C) Maxilla, after Massoud, 1967.

D) Mandible, after Massoud, 1967.

E) Mandible, specimen from Ontario.

F) Apex of fourth antennal segment, specimen from Anaktuvuk, Alaska.

G) Apical organ of third antennal segment, after Stach.



Anurida (Anurida) weberi, Christiansen & Bellinger, 1980 Fig. 252

Syn.: Micranurida papillosa of Hammer, 1953, not Axelson (?)

Description

Color: mottled purple to purplish brown. Fourth antennal segment with bilobed or trilobed apical bulb and four large heavy blunt setae. P.A.O. of 12 - 15 lobes arranged in a circle or broad ellipse. Eyes 2 to 4 per side, arranged in 2 groups. Mandible with 5 inner teeth; basalmost thin, flexible, and larger than others. Maxilla trilamellate. Unguis with strong inner tooth. Ventral tube with 4 + 4 setae. Furcula absent or reduced to a fold. Integument very coarsely grnaulate. All body setae smooth and acuminate. Maximum length 3 mm.

Remarks

This is probably the same as the form called papillosa by Hammer; it differs from European papillosa in having the maxillae lamellate instead of simple and in the smaller number of P.A.O. lobes. It also resembles Hammer's papillosoides, but differs in the arrangement of the eyes, the generally larger number of P.A.O. lobes, and the structure of the mandibles. Further study may show that these are part of one variable species.

Type locality: Point Barrow, Alaska, Field no. 601, 13 July 1949.

Additional localities: Alaska - Anaktuvuk, Umiat.

FIGURE 252

Anurida (Anurida) weberi

All figures of type specimens.

A) Mid foot complex.

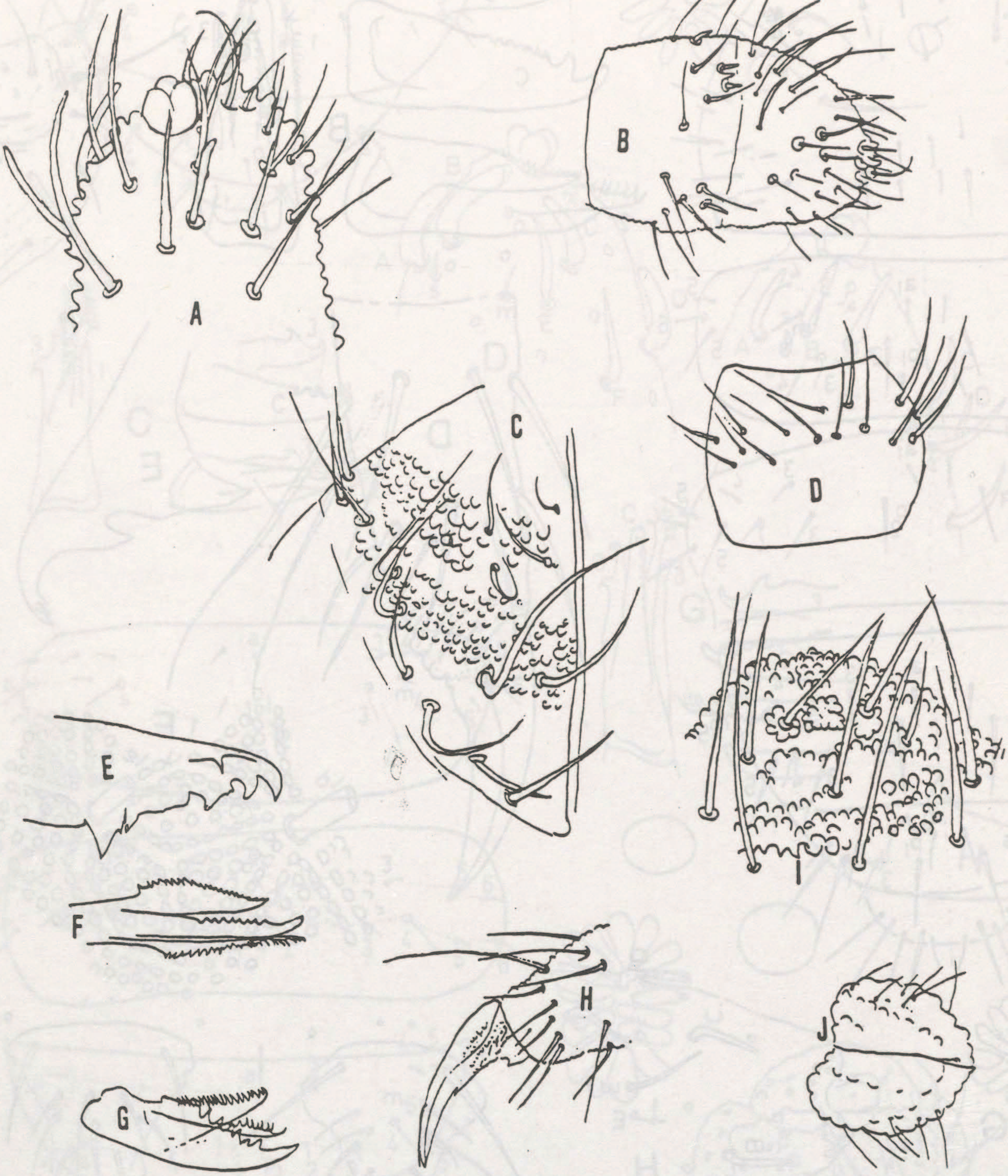
B) Postantennal organ and eyes.

C) Maxilla.

D) Mandible.

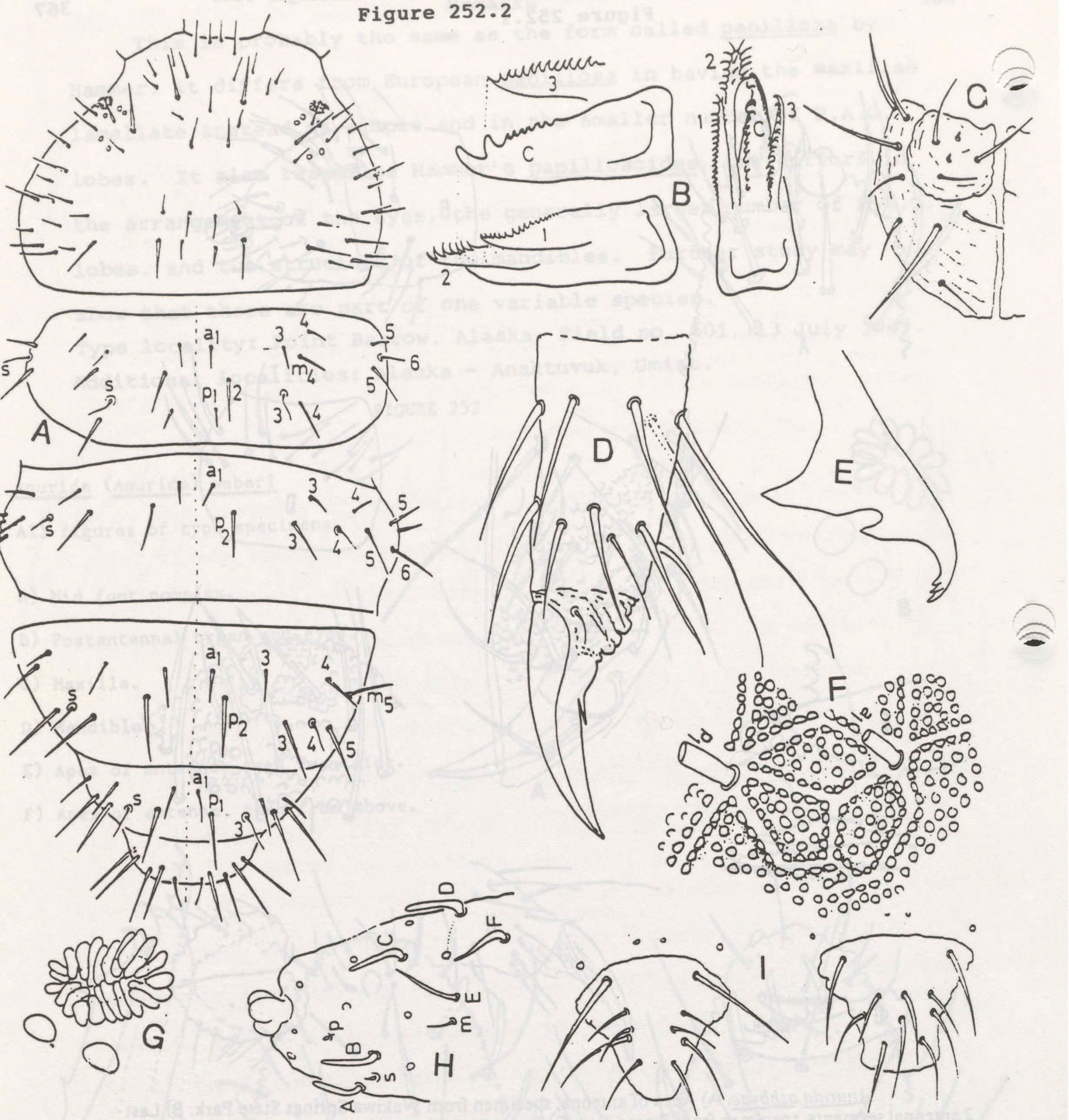
E) Apex of antenna, seen from side.

F) Apex of antenna, seen from above.



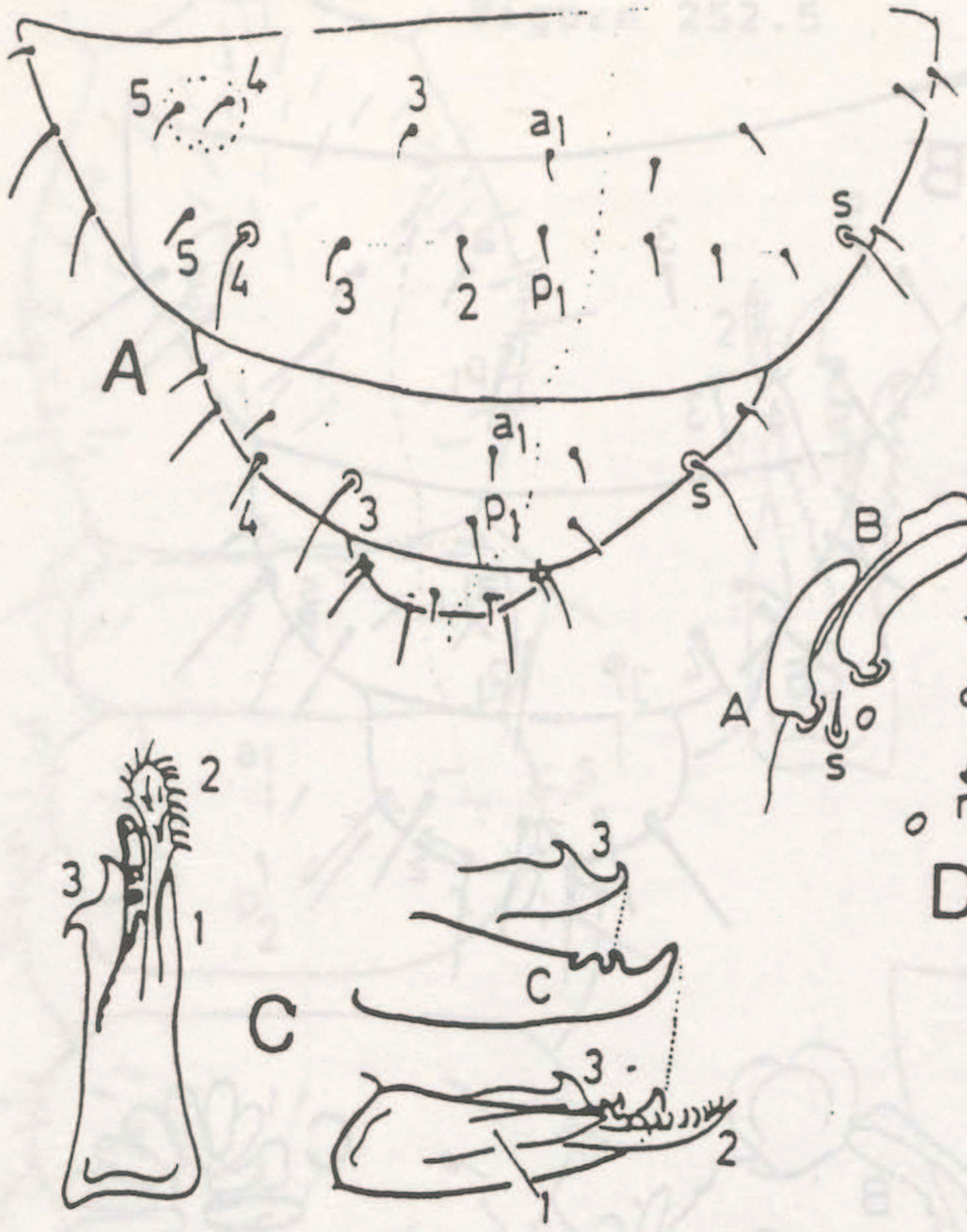
Anurida ashbyae. A) Apex of antenna, specimen from Wakiwa Springs State Park. B) Last 2 antennal segments, specimen from Pigeon Key. C) Right side of ventral labial triangle, same specimen as in A. D) First antennal segment, paratype. E) Mandible, paratype. F) Maxilla, seen on edge, specimen from Sanibel Island. G) Maxilla, specimen from Pigeon Key. H) Hind foot complex, paratype. I) Labrum, paratype. J) Ventral tube, paratype.

Figure 252.2



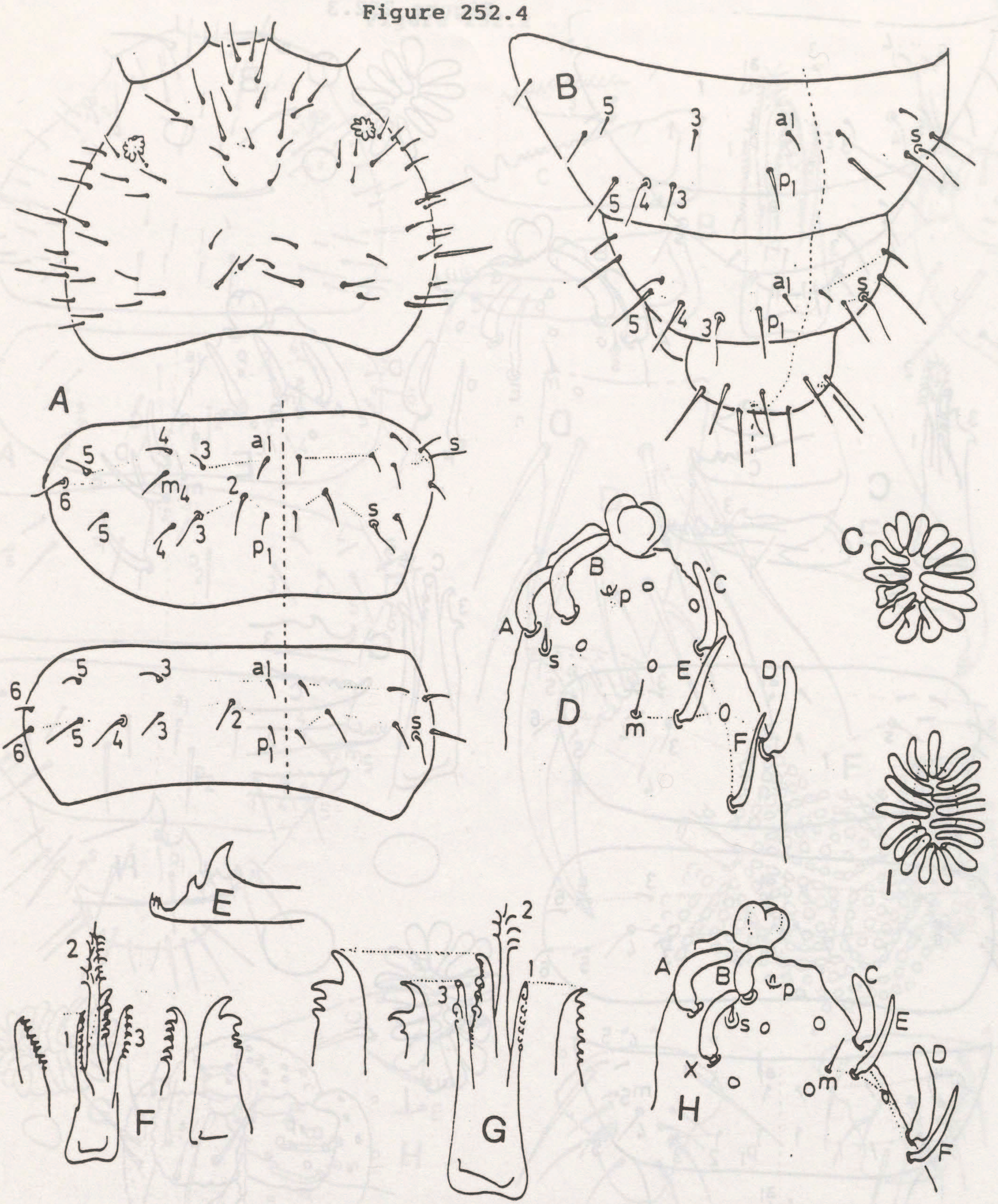
A. (A.) beringi. A) Chaetotaxy head , Th. 2, Abd. 1 & Abd. 4-6; B) Maxilla; C) Labium; D) Hind tibitarsus & foot; E) Mandible; F) Reticulations on Abd. 5; G) PAO; H) Sensillae of left 4th ant. ; I) Labrum , 2 specimens. After Fjellberg 1985.

Figure 252.3



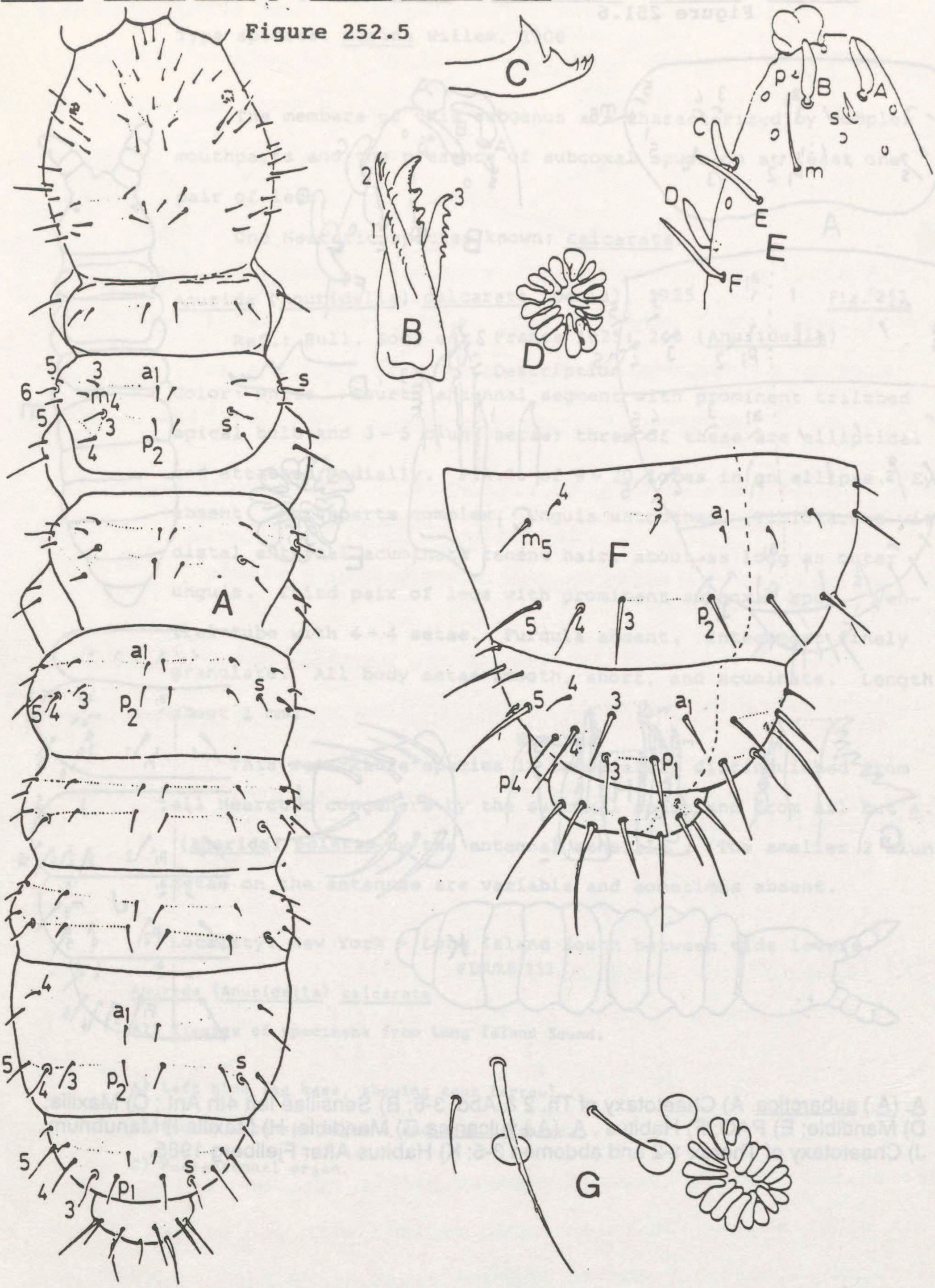
A.(A.) interior. A) Chaetotaxy Abd. 4-6; B) Left Eyes and PAO; C) Maxilla; D) Sensilla left 4th Ant. - A. (A.) papillosa. E) Sensillae of left 4th Ant.; F) Chaetotaxy of Th. 2. Abd.1, & Abd. 4-5; G) Maxilla; H) Mandible; I) Left PAO and anterior eyes; J) Labium. After Fjellberg 1985.

Figure 252.4



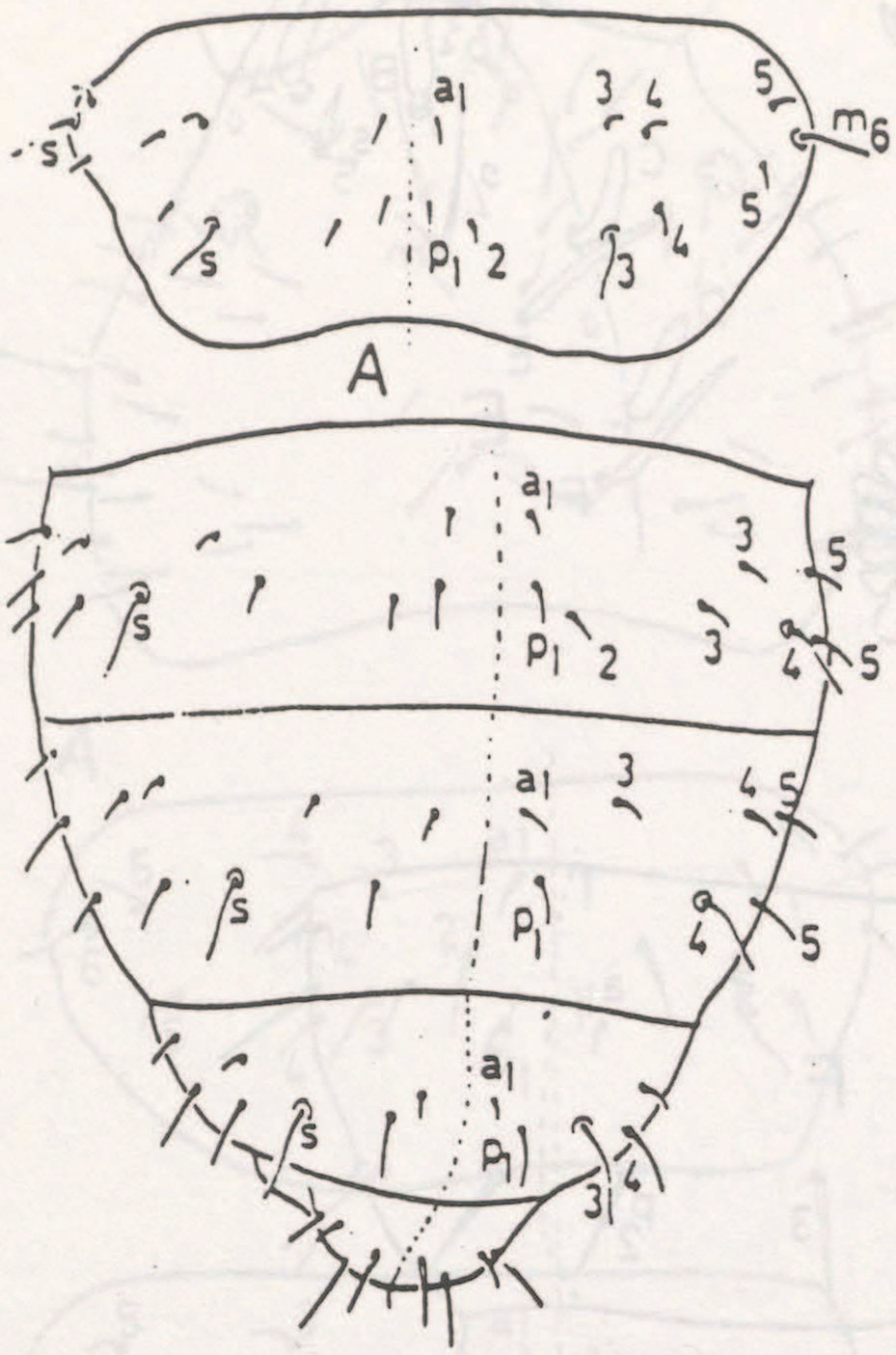
A. (A.) martynovae. A) Chaetotaxy of head, Th. 2, & Abd. 1; B) Chaetotaxy of Abd. 4-6; C) PAO; D) Sensilla left 4th Ant. seg.; E) Mandible; F) Maxilla- A. (A.) similis. G) Maxilla; H) Sensilla left 4th Ant.; I) PAO. After Fjellberg 1985.

Figure 252.5



A. (A.) reducta. A Dorsal chaetotaxy; B) Maxilla; C) Mandible; D) PAO; E) Sensilla of left 4th Ant.; A. (A.) narli. F) Chaetotaxy of Abd. 4-6; G) Right PAO and eyes. After Fjellberg 1985.

Figure 251.6



A. (A.) subarctica. A) Chaetotaxy of Th. 2 & Abd. 3-6; B) Sensillae left 4th Ant.; C) Maxilla; D) Mandible; E) PAO; F) Habitus . A. (A.) vulcanica G) Mandible; H) Maxilla I) Manubrium; J) Chaetotaxy of Thorax 1-2 and abdomen 3-5; K) Habitus After Fjellberg 1985.

Type species: marina Willem, 1906

The members of this subgenus are characterized by complex mouthparts and the presence of subcoxal spurs on at least one pair of legs.

One Nearctic species known: calcarata.

Anurida (Anuridella) calcarata (Denis), 1925 Fig. 253

Ref.: Bull. Soc. ent. France 1925: 243 (Anuridella)

Description

Color: white. Fourth antennal segment with prominent trilobed apical bulb and 3 - 5 blunt setae; three of these are elliptical and attached medially. P.A.O. of 9 - 20 lobes in an ellipse. Eyes absent. Mouthparts complex. Unguis untoothed. Tibiotarsus with distal external acuminate tenent hair, about as long as outer unguis. Third pair of legs with prominent subcoxal spur. Ventral tube with 4 + 4 setae. Furcula absent. Integument finely granulate. All body setae smooth, short, and acuminate. Length about 1 mm.

Remarks

This remarkable species is immediately distinguished from all Nearctic congeners by the subcoxal spurs, and from all but A. (Anurida) polaris by the antennal sensilla. The smaller 2 blunt setae on the antennae are variable and sometimes absent.

Locality: New York - Long Island Sound between tide levels.

FIGURE 253

Anurida (Anuridella) calcarata

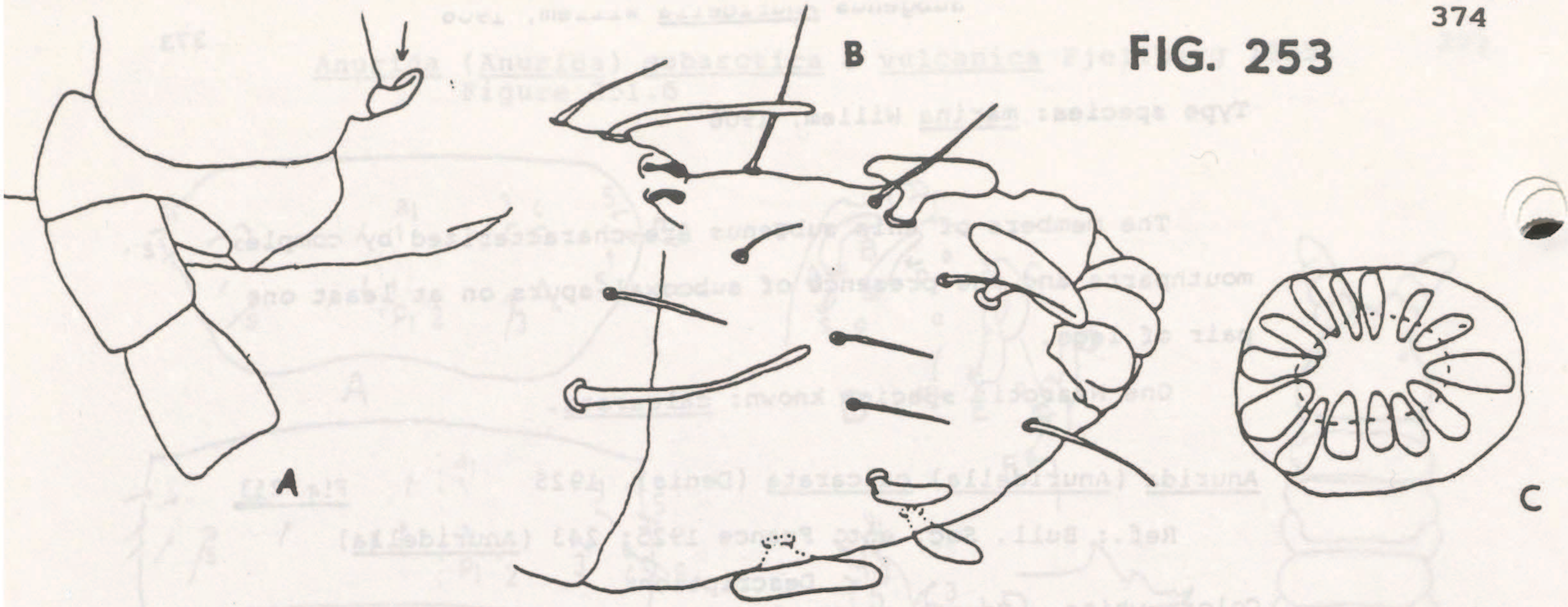
All figures of specimens from Long Island Sound.

A) Left hind leg base, showing spur (arrow).

B) Fourth antennal segment and apex of third.

C) Postantennal organ.

FIG. 253



Subgenus Micranurida Börner 1901

Type species: pygmaea Borner, 1901 and cassagnaui Rusek 1973

This includes all the forms of the genus having a simple maxilla and reduced eyes.

All of the Nearctic species are small to minute, and most are lightly pigmented of white. The mandible appears to have three teeth in almost all species. The fourth antennal segment blunt setae are usually oval. There are 4 Nearctic species: 1) furcifera; 2) porcella 3) pygmaea; 4) spirillifera

Anurida (Micranurida) furcifera (Mills), 1934, Fig. 254

Ref.: Collembola of Iowa 27 (Micranurida)

Description

Color: white. Fourth antennal segment with a trilobed apical bulb and six blunt setae. Third antennal segment with one of the long blunt setae sigmoidally curved in some specimens. P.A.O. of 8 - 11 tubercles in an ellipse. Eyes absent. Mandible unclear, probably tridentate. Maxilla rod-like, blunt at the tip and possibly with

a minute apical tooth. Unguis untoothed. Furcula in the form of a tubercle bearing 3 + 3 setae. Integument coarsely granulate. All body setae smooth and acuminate. Maximum length .7 mm.

Remarks

The only specimens seen were three cotypes from three different localities in Iowa, and 1 poor specimen from Connecticut. The small size and poor condition makes determination of some features difficult.

Localities: Connecticut - Litchfield Co.; Iowa - Louisa Co., Story Co., Wapello Co. (type localities).

FIGURE 254

Anurida (Micranurida) furcifera

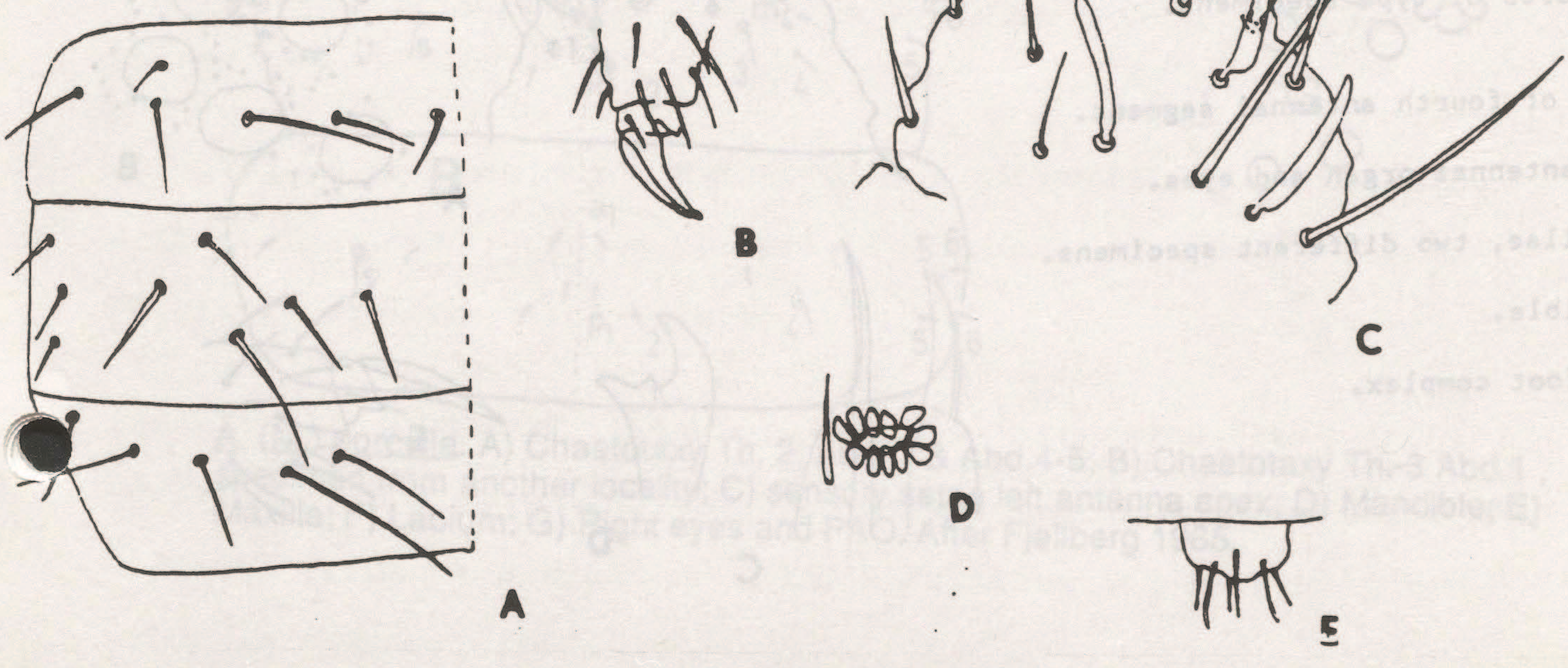
A) Chaetotaxy of left half of third through fifth abdominal segments, type specimens.

B) Right mid foot, after Mills.

C) Fourth antennal segment, type specimen.

D) Postantennal organ, after Mills.

E) Furcula, after Mills.



Description

Color: gray blue. Fourth antennal segment with conspicuous, projecting, unlobed apical papilla, and 6 blunt setae, the most dorsal seta being smaller than the others. P.A.O. with 4-9 tubercles in a rosette; organ nearly twice the diameter of the nearest eye. Eyes 8+8. Mandible apically bidentate, or tridentate with median tooth the smallest. Maxilla needlelike and gently curved. Unguis without teeth. Tibiotarsal setae short and acuminate. Furcula absent; position indicated by a group of 5-6 minute setae. Body moderately coarsely granulate. All setae acuminate and smooth; longest setae of fifth abdominal segment shorter than inner unguis. Length about .5 mm.

Remarks

The few specimens seen are immature and not in the best condition. The species is, however, so distinctive as to merit description; the presence of 8+8 eyes separates it from all known species of Micranurida and from all other North American Anurida except bicolor.

Type locality: Brookville Ecological Area, Union Co., Indiana, 19 December 1970 (J.W. Hart).

FIGURE 255

Anurida (Pratanurida) harti

All figures of type specimens.

A) Apex of fourth antennal segment.

B) Postantennal organ and eyes.

C) Maxillae, two different specimens.

D) Mandible.

E) Mid foot complex.

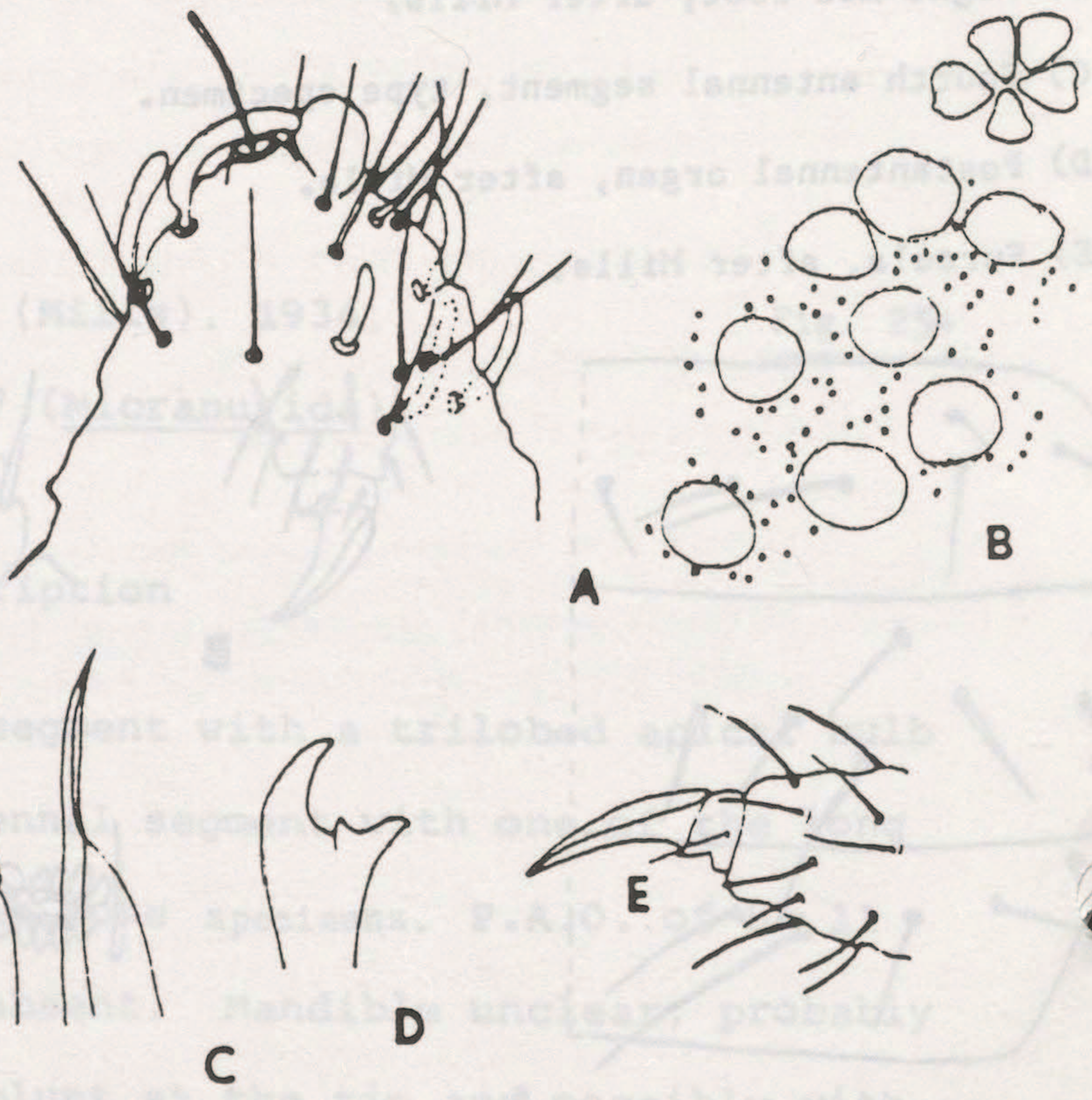
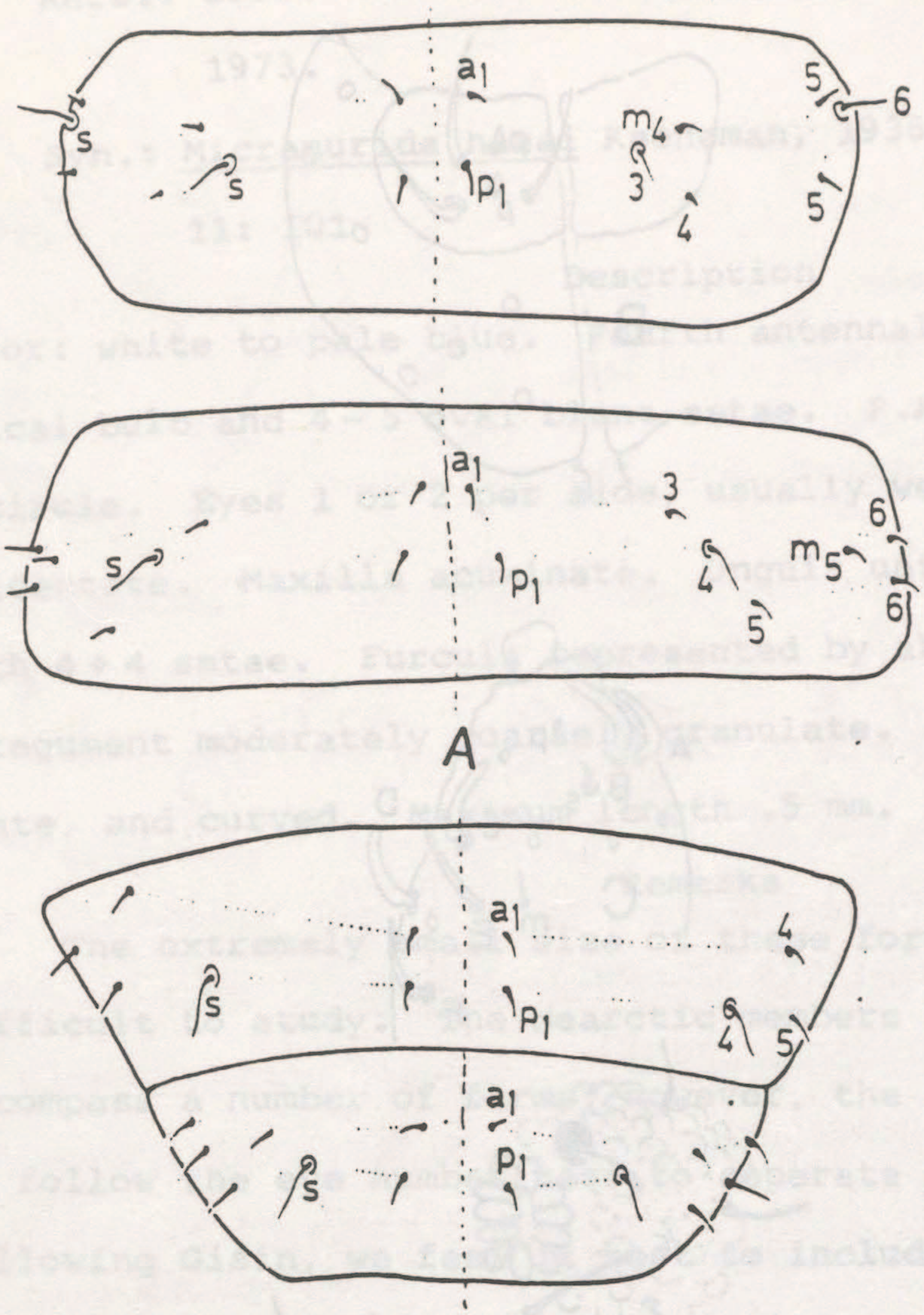
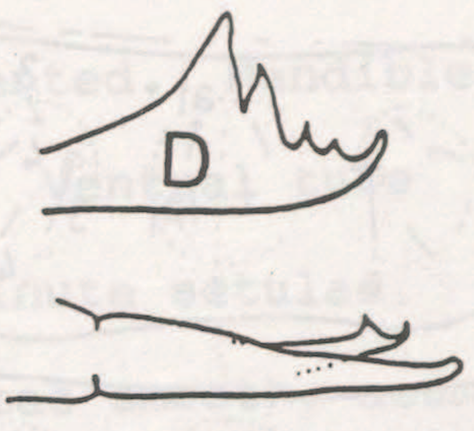
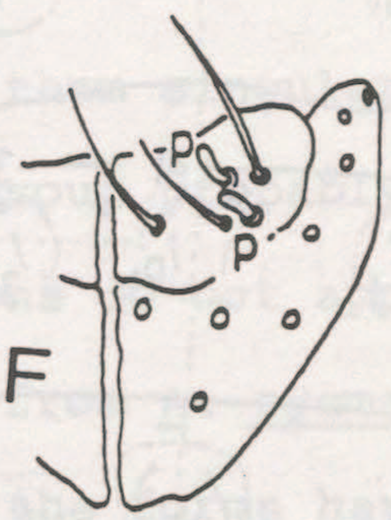


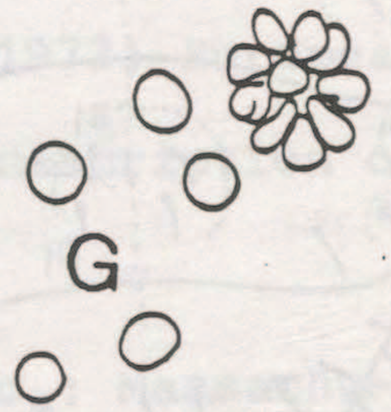
Figure 255.1





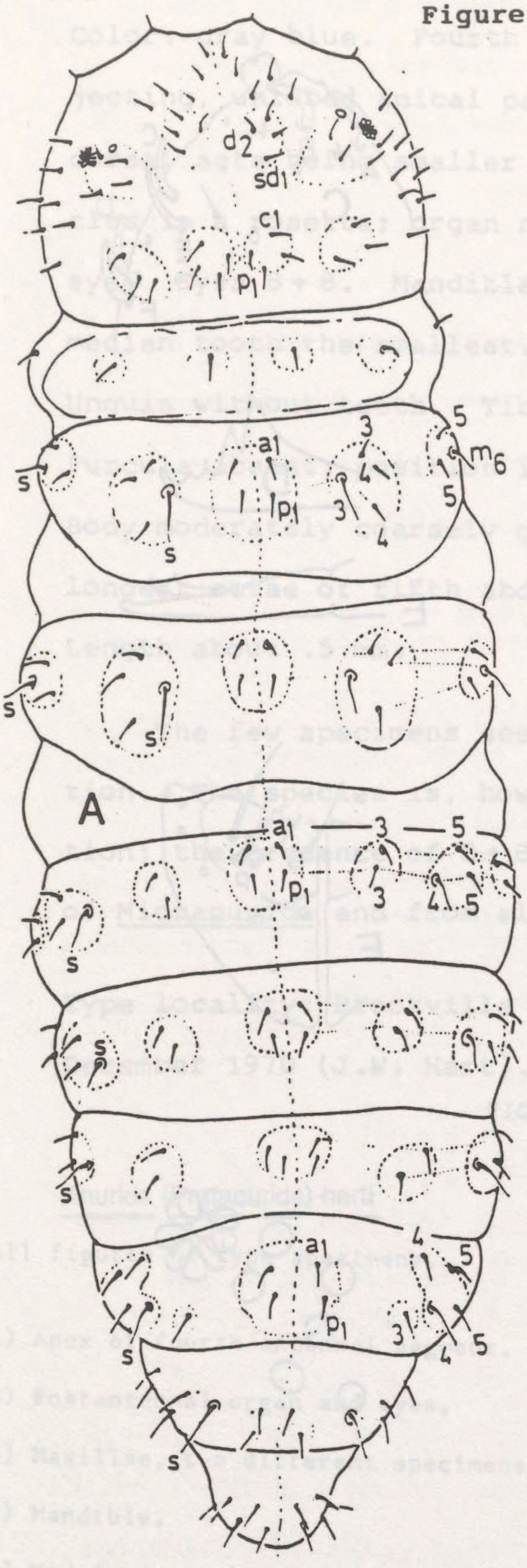






A. (M.) porcella. A) Chaetotaxy Th. 2, Abd. 1 & Abd.4-5; B) Chaetotaxy Th. 3 Abd 1 , specimen from another locality; C) sensory setae left antenna apex; D) Mandible; E) Maxilla; F) Labium; G) Right eyes and PAO. After Fjellberg 1985.

Figure 255.2



A. (M) valiana. A) Dorsal chaetotaxy; B) Labium; C) Sensillae of left 4th Ant.; D) PAO and eye; E) Maxilla; F) Mandible. After Fjellberg 1985.

Anurida (Micranurida) pygmaea (Börner), 1901 Fig. 256

Refs.: Zool. Anz. 24: 702 (Micranurida); Stach, 1949; Dallai, 1973.

Syn.: Micranurida hasai Kseneman, 1936, Sb. Čsl. Akad. zeměd. 11: 101

Description

Color: white to pale blue. Fourth antennal segment with trilobed apical bulb and 4-5 oval blunt setae. P.A.O. of 5-8 tubercles in a circle. Eyes 1 or 2 per side, usually well pigmented. Mandible tridentate. Maxilla acuminate. Unguis untoothed. Ventral tube with 4+4 setae. Furcula represented by about 4 minute setulae. Integument moderately coarsely granulate. Body setae smooth, acuminate, and curved. Maximum length .5 mm.

Remarks

The extremely small size of these forms makes them singularly difficult to study. The Nearctic members of this group probably encompass a number of forms; however, the separations do not appear to follow the eye number used to separate A. hasai from A. pygmaea. Following Gisin, we feel it best to include all of the forms having simple mouthparts and 1 or 2 eyes per side and 4-5 blunt setae on the fourth antennal segment under the name pygmaea pending a detailed analysis of the group. According to Dallai (1973) European pygmaea have a tridentate mandible, contrary to the description of Börner and others.

Localities: Connecticut - Hartford Co., Litchfield Co.; Massachusetts - Essex Co.; Canada, Alberta - Edmonton, Red Deer, Wabamum; Ontario - Kirkwood Twp.; Quebec.

Additional records: Iowa (Mills, 1934); Kentucky (Lesshafft, 1977); Maryland (Ostdiek, 1961); Michigan (Snider, 1967); West Virginia (Lippert and Butler, 1976); Manitoba and Northwest Territories (Hammer, 1953a).

FIGURE 256

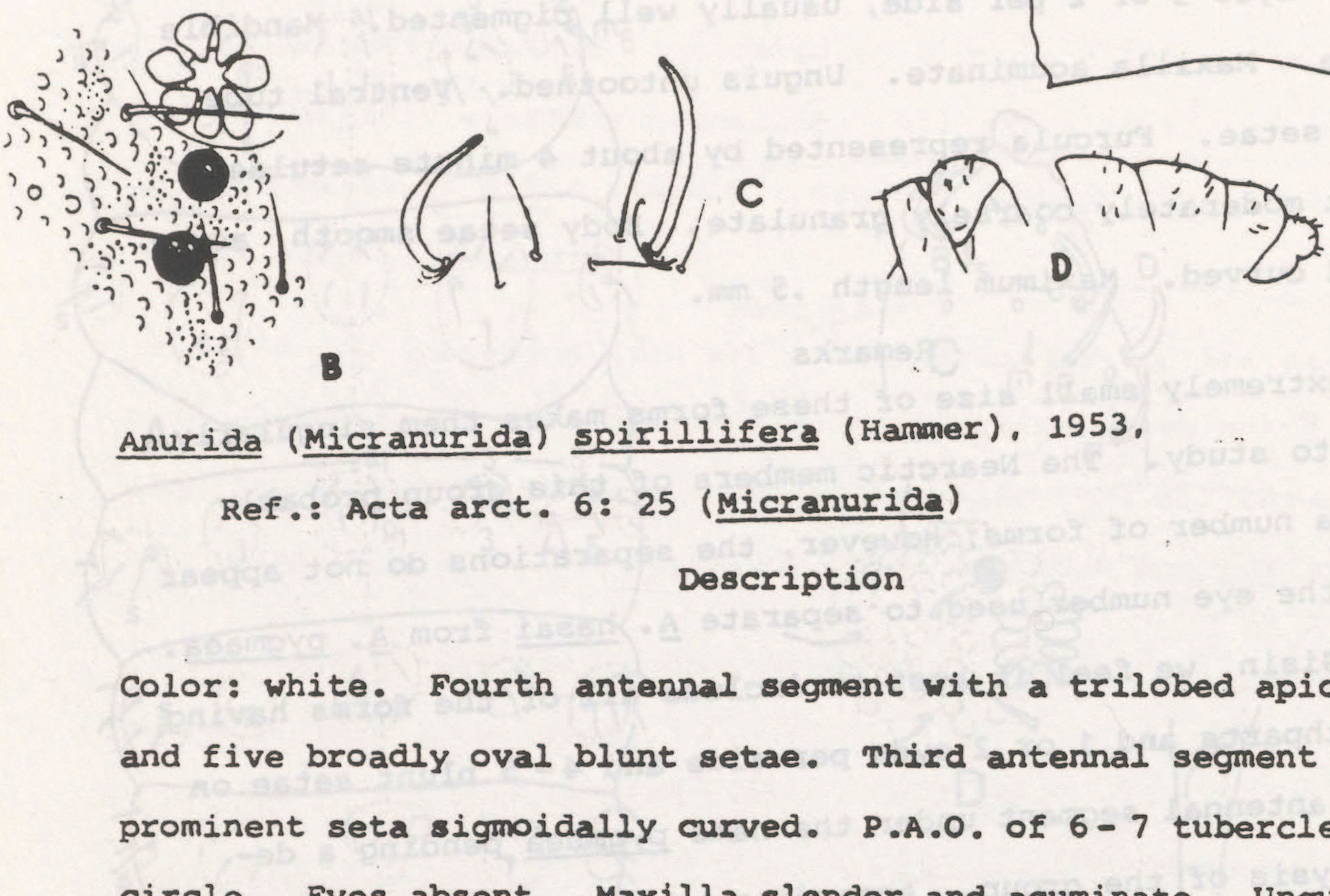
Anurida (Micranurida) pygmaea

A) Third and fourth antennal segments, after Stach.

B) Postantennal organ and eyes, after Stach.

C) Apical organ of third antennal segment, after Stach.

D) Chaetotaxy of left side of first 2 thoracic, and last 4 abdominal segments, after Gisin, 1960.



Anurida (Micranurida) spirillifera (Hammer), 1953, Fig. 257

Ref.: Acta arct. 6: 25 (Micranurida)

Description

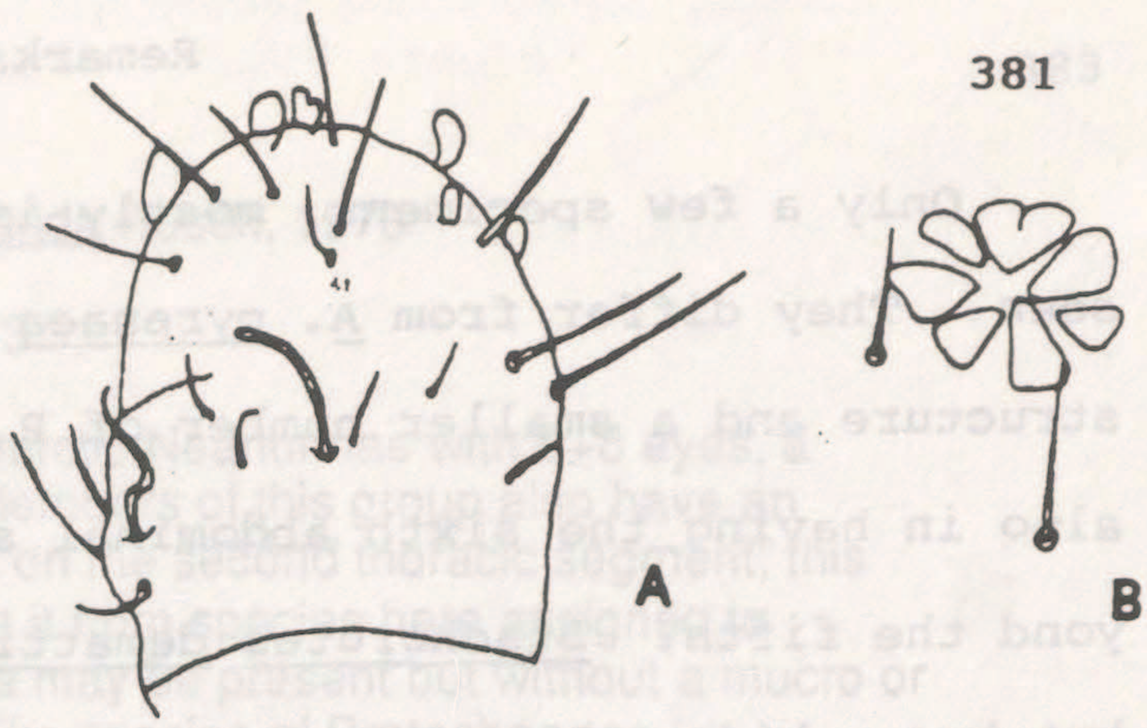
Color: white. Fourth antennal segment with a trilobed apical bulb and five broadly oval blunt setae. Third antennal segment with one prominent seta sigmoidally curved. P.A.O. of 6-7 tubercles in a circle. Eyes absent. Maxilla slender and acuminate. Unguis without inner tooth. Furcula absent. Integument moderately coarsely granulate. All body setae smooth acuminate. Maximum length .5 mm.

Remarks

This species is probably part of the pygmaea group. Pending further analysis it may be separated on the absence of eyes. We saw only 1 poor specimen from Quebec.

Localities: Canada, Northwest Territories - Churchill, Yellow Knife; Quebec (?).

FIGURE 257



Anurida (Micranurida) spirillifera

11 figures after Hammer.

A) Third and fourth antennal segments.

B) Postantennal organ.

Subgenus Protachorutes Cassagnau, 1955a

Type species: P. pyrenaeus Cassagnau, 1955a

We place here a single Nearctic species which differs from most Anurida in having the tenaculum and dentes well developed. The mouthparts appear to be intermediate in complexity between those of typical Anurida and Micranurida. It might also be placed in Cassagnaudina Massoud, 1967 (type species Pseudachorudina coiffaiti Cassagnau, 1955a) which is similar but has a fringed lamella on the maxilla (present but barely visible in our species).

Anurida (Protachorutes) bicolor, Christiansen & Bellinger 1980 Fig.258

Description

Color: blue with first and most of second thoracic segment, legs, and venter white. Fourth antennal segment with clear unlobed or weakly lobed apical bulb, with 2-3 weakly differentiated blunt setae. P.A.O. a little larger than nearest eye, with 10-12 tubercles. Eyes 8+8, subequal. Mandible with 5-6 apical teeth; maxilla with 2 lamellae, 1 simple, 1 apically hooked and finely serrate internally. Tenent hair acuminate. Unguis with very weak inner tooth or none. Tenaculum with 3+3 teeth. Dens with 2-5 setae. All body setae acuminate. Maximum length 0.8 mm.

Remarks

Only a few specimens, mostly immature, of this form have been seen. They differ from A. pyrenaea and coiffaiti in mouthpart structure and a smaller number of P.A.O. lobes and from the former also in having the sixth abdominal segment projecting normally beyond the fifth. Stachorutes dematiesi Dallai, 1973 is also similar but has a bidentate mandible, only 6 P.A.O. lobes and other differences. Superficially these specimens resemble Pseudachorutes species, but may be distinguished at once by the absence of the mucro. The striking color pattern, if consistent, will make the species easy to recognize.

Type locality: Sequoia National Park, California, Rt. 198, 6 mi. above 4000 ft. marker, damp leaves in culvert, 10 April 1974 (P. Bellinger).

FIGURE 258

Anurida (Protachorutes) bicolor

All figures of type specimens.

A) Foot complex.

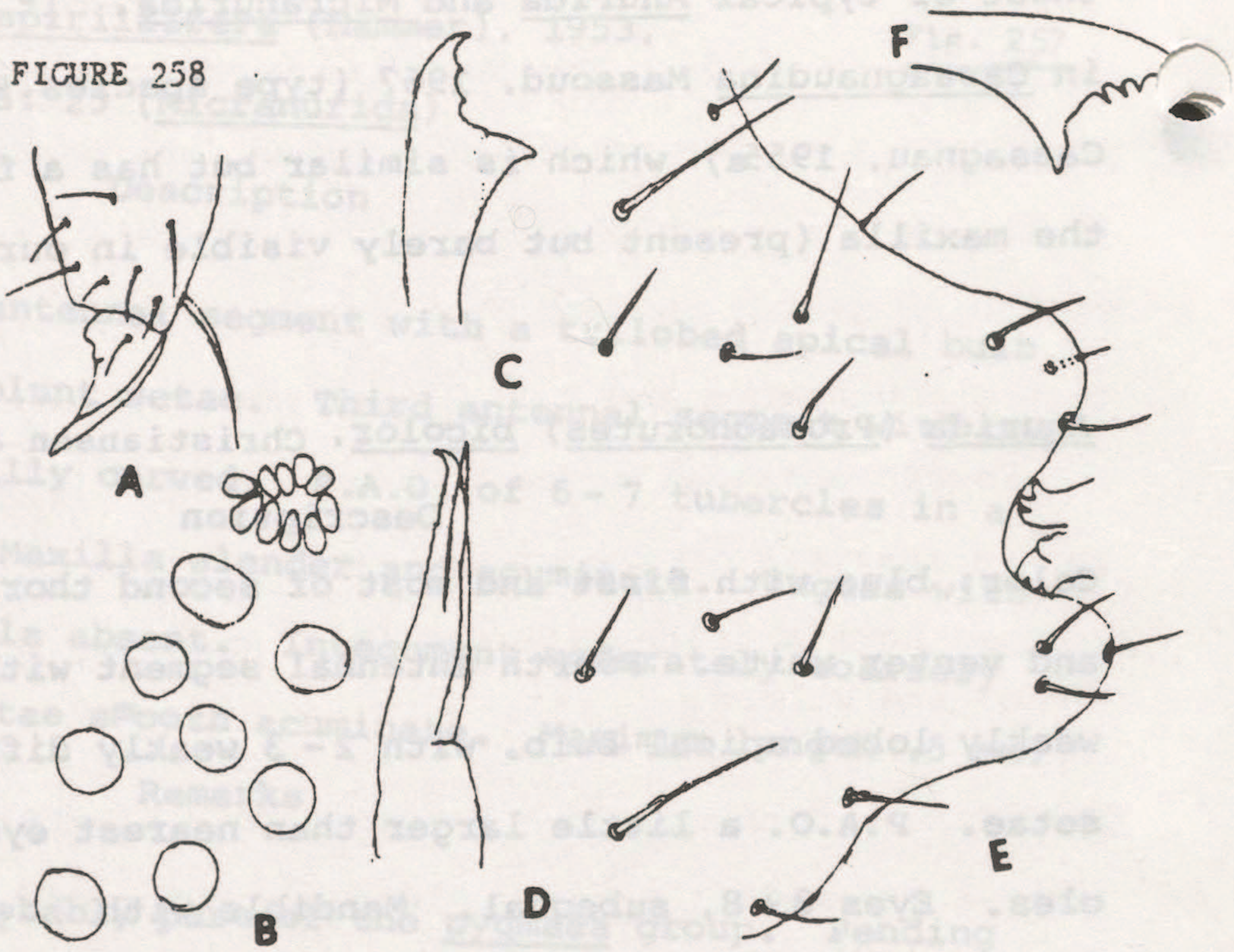
B) Eyes and postantennal organ.

C) Mandible.

D) Maxilla

E) Furcula and tenaculum.

F) Mandible of another specimen.



Subgenus Pratanurida Rusek, 1973

Type species: P. cassagnaui Rusek, 1973

We follow Fjellberg in placing here Nearctic Neanurinae with 8+8 eyes, a styliform maxilla, and a reduced furca. Members of this group also have an apical antennal bulb and seta a2 present on the second thoracic segment; this character and the eye number distinguish it from species here assigned to Anurida s.str. and Micranurida. The furca may be present but without a mucro or absent, and the tenaculum is absent, unlike species of Protachorutes. There are three nearctic species: 1) foxi, 2) harti, (see P#376) 3) tananensis.

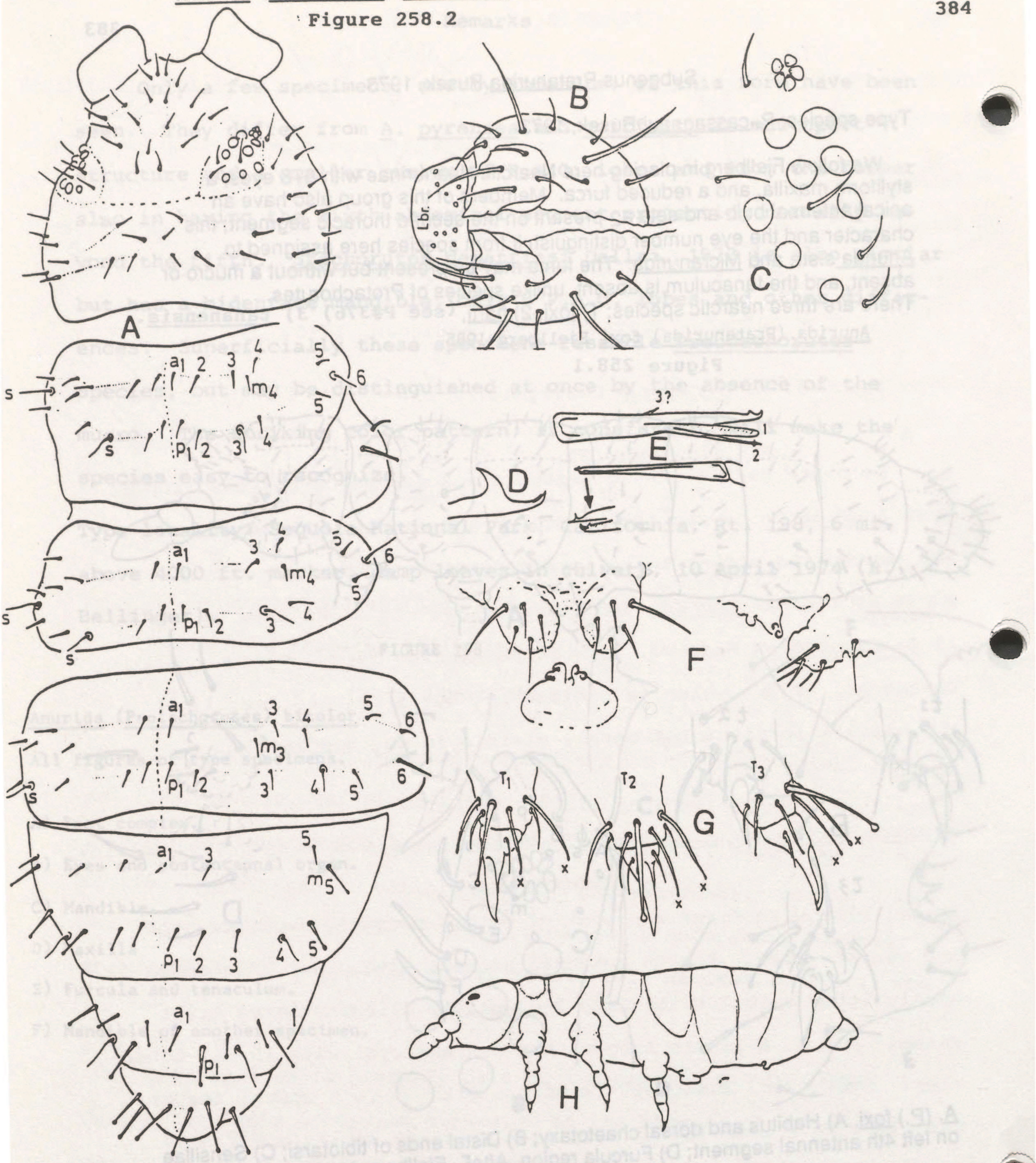
Anurida (Pratanurida) foxi Fjellberg 1985

Figure 258.1

A. (P.) foxi. A) Habitus and dorsal chaetotaxy; B) Distal ends of tibiotarsi; C) Sensillae on left 4th antennal segment; D) Furcula region. After Fjellberg 1985.

Anurida (Pratanurida) tananensis Fjellberg 1985

Figure 258.2



A. (P.) tananensis. A) Chaetotaxy head-Th. 3, Abd. 2 & Abd. 4-6; B) Labium; C) Left Eyes and PAO; D) Mandible; E) Maxilla; F) Furcula and tenaculum; G) Distal ends of feet; H) Habitus. After Fjellberg 1985.

Genus Paranura Axelson, 1902

Type species: P. sexpunctata Axelson, 1902

This genus is closely related to Neanura, and might be considered as a subgenus of that genus. The 2 are similar not only in gross morphology, but in the possession of large polytene salivary chromosomes (Cassagnau, 1971). Since it is traditionally considered a part of different tribe or subfamily, we maintain its separate identity; however, in view of its clear relationship we do not consider it as part of Anurida as Gisin does.

The Nearctic species all have tridentate mandibles, no P.A.O., 3+3 or few eyes, unguiculus in the form of a small protuberance, and needle-shaped maxillae. The furcula is reduced to a small knob, and the ventral tube has 4+4 setae. The body is generally similar to that of slimmer species of Neanura except for the absence of clear tubercles and the entire sixth abdominal segment. The species lack an enlarged fourth antennal sensilla; species with this character have been transferred to Sensillanura. Only one American species, P. colorata, is well pigmented.

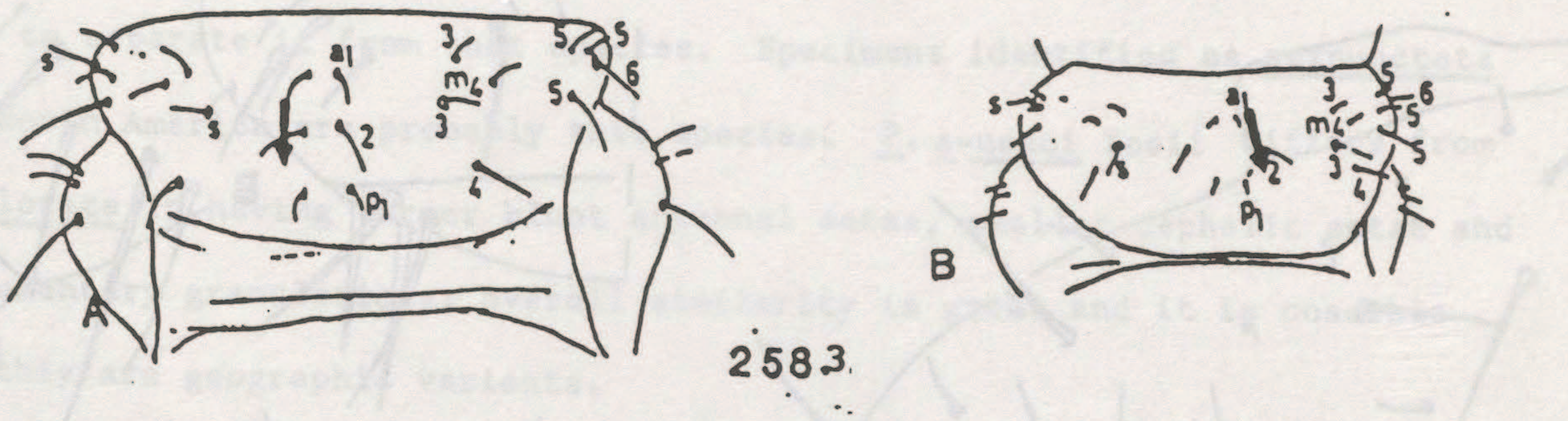
There are 5 known Nearctic species: 1) anops; 2) colorata; 3) quadrilobata; 4) sexpunctata; 5) sitchensis.

Key to Nearctic species of Paranura s. str.

1) Macrochaetae of last 2 abdominal segments clavate -------- P.sitchensis Fjellberg, 1985
1') All trunk macrochaetae acuminate ---------- 2

**2) Eyes absent ---------- P.anops
2') 2 + 2 or 3 + 3 eyes ---------- 3

3) 6 inner setae on second thoracic tergite in a straight line (Fig. 258.3A) ----------
---------- P.sexpunctata Axelson
3') 6 inner setae on second thoracic tergite in a hexagon (Fig. 258.3B) ---------- 4



258.3

*4) Eyes 2 + 2; body white ---------- P.quadrilobata
*4') Eyes 3 + 3; adults pigmented ---------- P.colorata

P.caeca and P.millsi of CONANRG are here placed in Sensillanura. P.caeca and P.anops may actually belong in Paleonura (Deharveng, 1990; Deharveng & Weiner, 1984).

Paranura anops, Christiansen & Bellinger, 1980 Fig. 259

Description

Color: white (?). Fourth antennal segment with a trilobed apical bulb, 6-8 similar blunt setae, and a weakly differentiated ventral "file" of 12-14 setae. Eyes absent. Mandible tridentate. Unguis untoothed. Furcula reduced to a small knob bearing three minute setae. Integument coarsely granulate, with weakly developed tubercles on posterior abdominal segments. Abdominal foveae clear. Setae smooth and acuminate. Maximum length 1.7 mm.

Remarks

This species is closely related to P. colorata, but may readily be separated on the lack of eyes and the abdominal chaetotaxy.

Type locality: Petaluma, Sonoma Co., Calif., pine litter, 10 Feb. 1960, (J. Buckett).

FIGURE 259

Paranura anops

All figures of type specimen.

A) Cephalic chaetotaxy of right side.

B) Posterior abdominal chaetotaxy of right side.

C) Fourth antennal segment.

D) Fore foot complex.

Paranura colorata Mills, 1934, new status

Fig. 260

Ref.: Collembola of Iowa: 28 (as sexpunctata var.)

Description

Color: light to dark blue (sometimes white?); paler on venter and intersegmental membranes. Fourth antennal segment with clear, trilobed apical bulb, 6-8 (rarely 5) blunt setae, and a ventral "file" of 16-20 straight setae. Three eyes per side. Mandible tridentate, with apical tooth sometimes minutely forked. Unguis untoothed. Furcula reduced to a knob bearing minute setae. Integument coarsely granulate. Segments of body often weakly separated; posterior abdominal segments sometimes with slight but noticeable tubercular enlargements. Abdominal segments with foveae present, lateral to inner setae. All setae smooth, acuminate of slightly blunt. Maximum length 3.0 mm.

Remarks

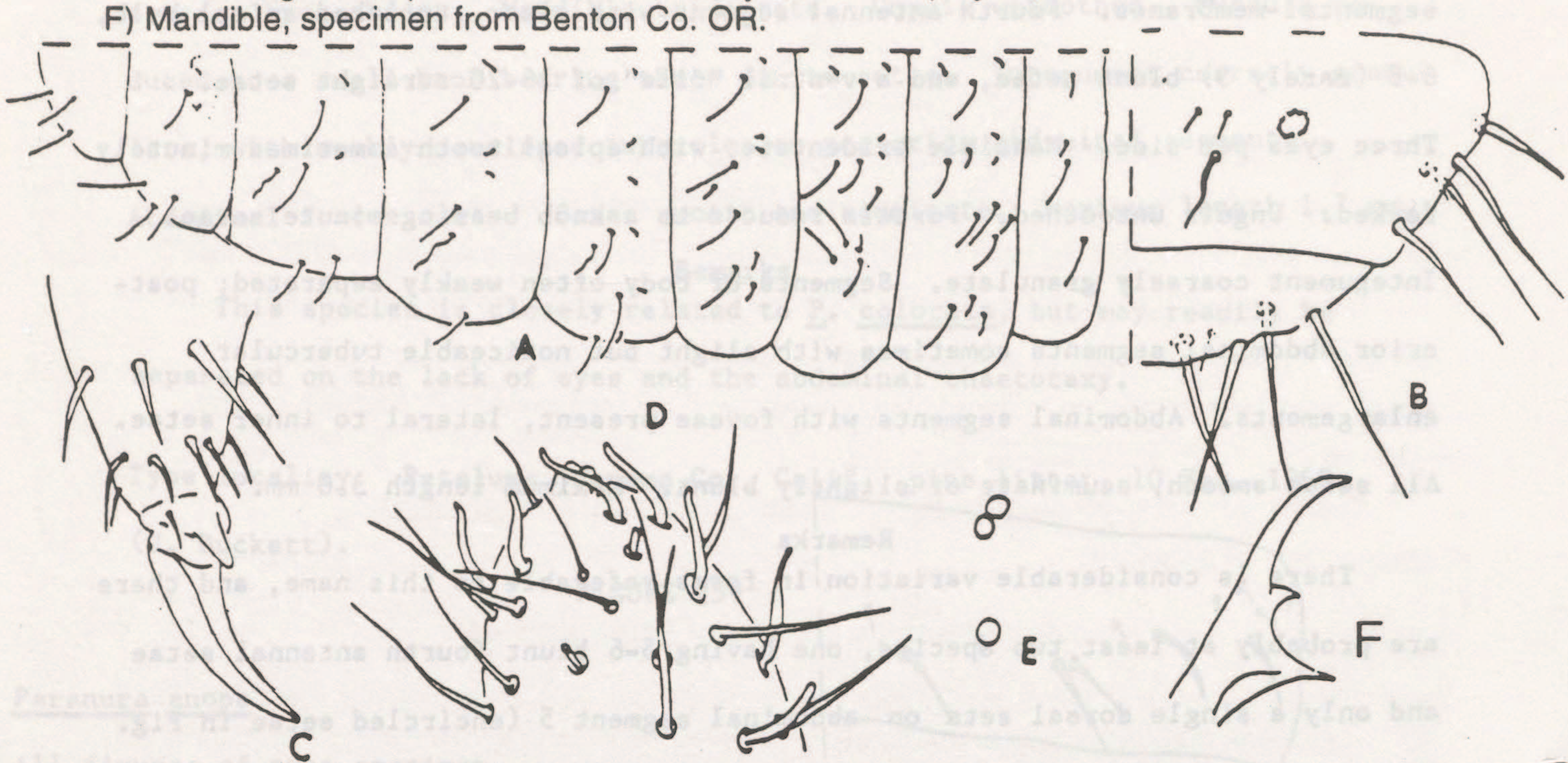
There is considerable variation in forms referable to this name, and there are probably at least two species, one having 5-6 blunt fourth antennal setae and only a single dorsal seta on abdominal segment 5 (encircled setae in Fig. 261A absent), the other with these setae present and 7-8 blunt antennal setae. The presence of these two forms in the same sample, combined with the range of variation, makes it inadvisable to separate them until further examination of more material is possible. This species was described as a form of P. sexpunctata; however the mandible, chaetotaxy, and blunt antennal setae all serve to separate it from that species. Specimens identified as sexpunctata from North America are probably this species. P. s-uenoi Yosii differs from P. colorata in having larger blunt antennal setae, smaller cephalic setae and integumentary granulations; overall similarity is great and it is possible that they are geographic variants.

Localities: California - Butte Co., Marin Co. (?), Modoc Co., San Benito Co., Sonoma Co., Tulare Co.; Iowa - Buena Vista Co., Hardin Co., Louisa Co.; Oregon - Benton Co.

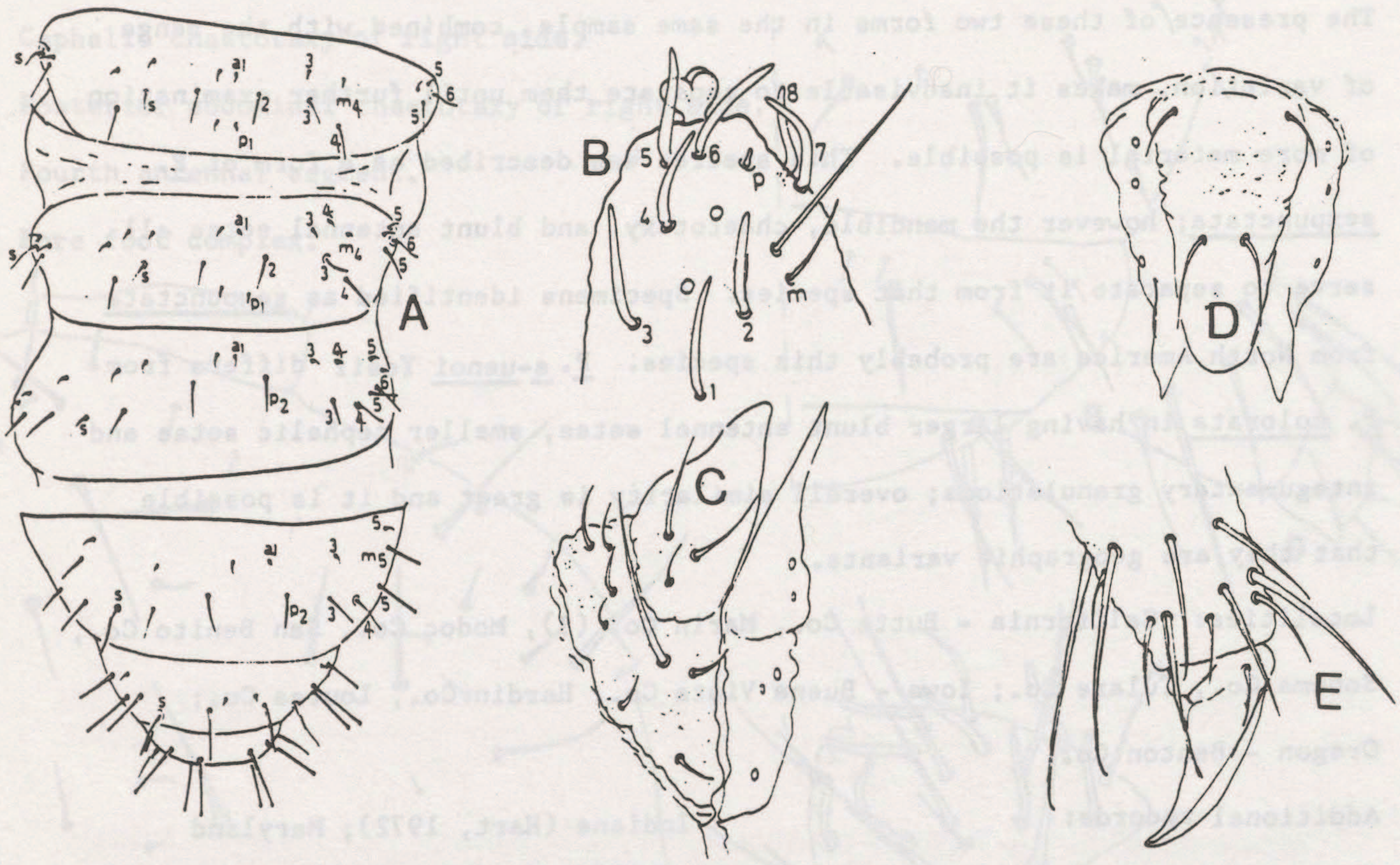
Additional records: Indiana (Hart, 1972); Maryland (Ostdiek, 1961); Michigan (Snider, 1967); North Carolina (Wray, 1967); South Carolina (DuRant and Fox, 1967); Utah (Wray and Knowlton, 1953).

Paranura colorata
FIGURE 260

A) Chaetotaxy, specimen from Monterey Co.. CA. B) Detail of chaetotaxy of 5th and 6th abdominal segments, showing fovea, specimen from benton Co. OR. C) Hind tibiotarsus and foot complex , specimen from same locality. D) Apex of 4th antennal segment, specimen from Monterey Co. CA. E) Eyes , after Mills. F) Mandible, specimen from Benton Co. OR.



Paranura sitchensis Fjellberg 1985 **Figure 260.1**



P. sitchensis A) Chaetotaxy Th. 2 - Abd. 1 & Abd. 4-6; B) Sensillae apex right antenna; C) Labium; D) Labrum; E) Tip of right first leg. After Fjellberg 1985.

Paranura quadrilobata Hammer, 1953 Fig. 261

Ref.: Acta arct. 6:24.

Description

Color: white. Fourth antennal segment with three or four-lobed apical bulb, and 7-8 similar blunt setae. Eyes 2+2, without pigment. Mandible tridentate (?). Unguis untoothed. Integument with heavy granulations which are gathered into clusters on the head and center of the posterior abdominal segments. Setae smooth and acuminate. Maximum length 1.0 mm.

Remarks

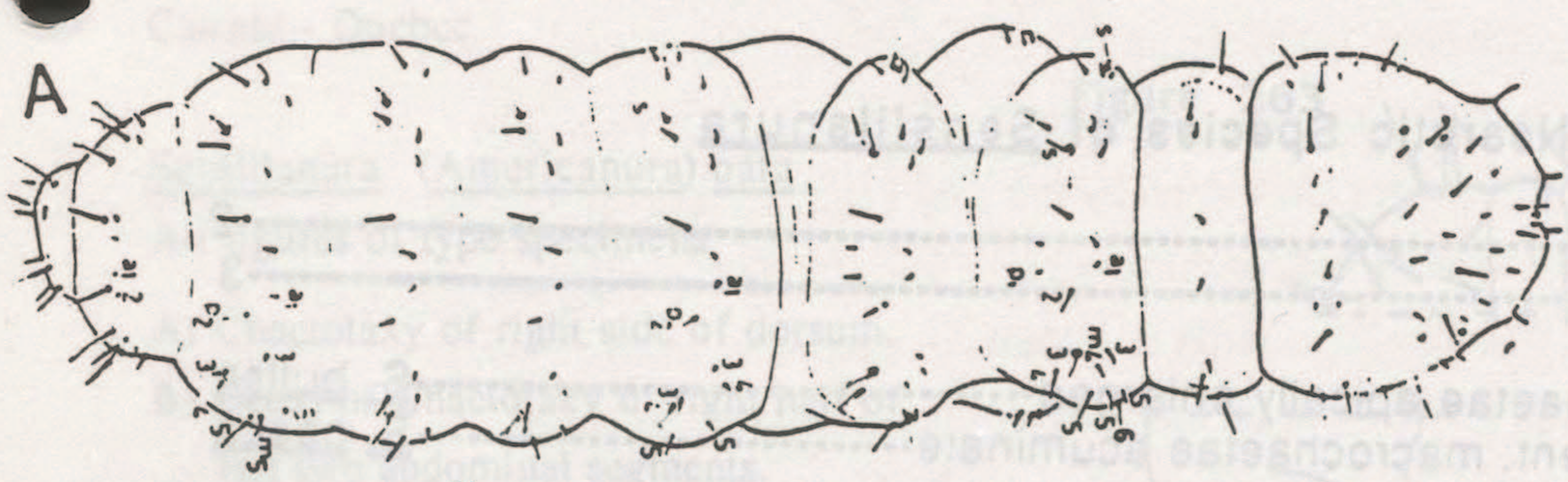
Specimens from Pennsyvania we considered as members of this species belong to an undescribed species (Fjellberg 1984).

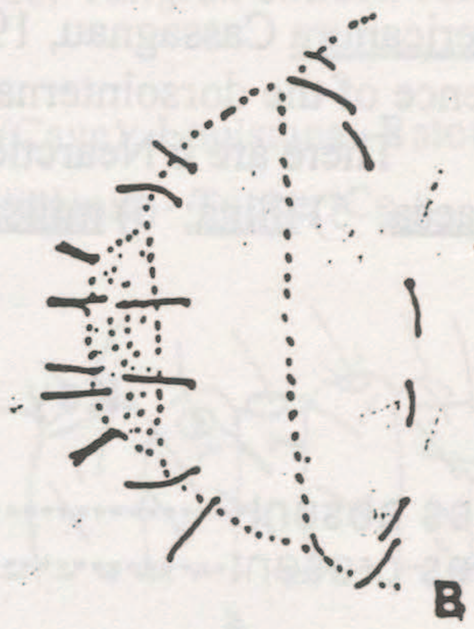
Localities: Colorado - Fjellberg 1985, Alaska - Fjellberg 1984; Canada - N.W.T. (types)

FIGURE 261

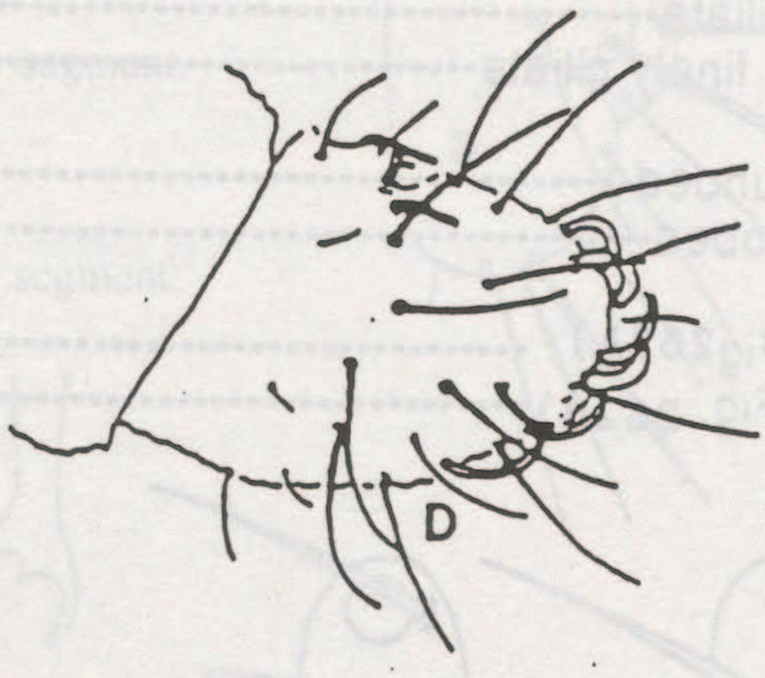
Paranura quadrilobata

A) Chaetotaxy, after Fjellberg.
B) Posterior abdominal chaetotaxy, after Hammer.
C) Hind unguis, modified after Hammer.
D) Fourth and third antennal segments, after Hammer.
E) Eyes, after Hammer.

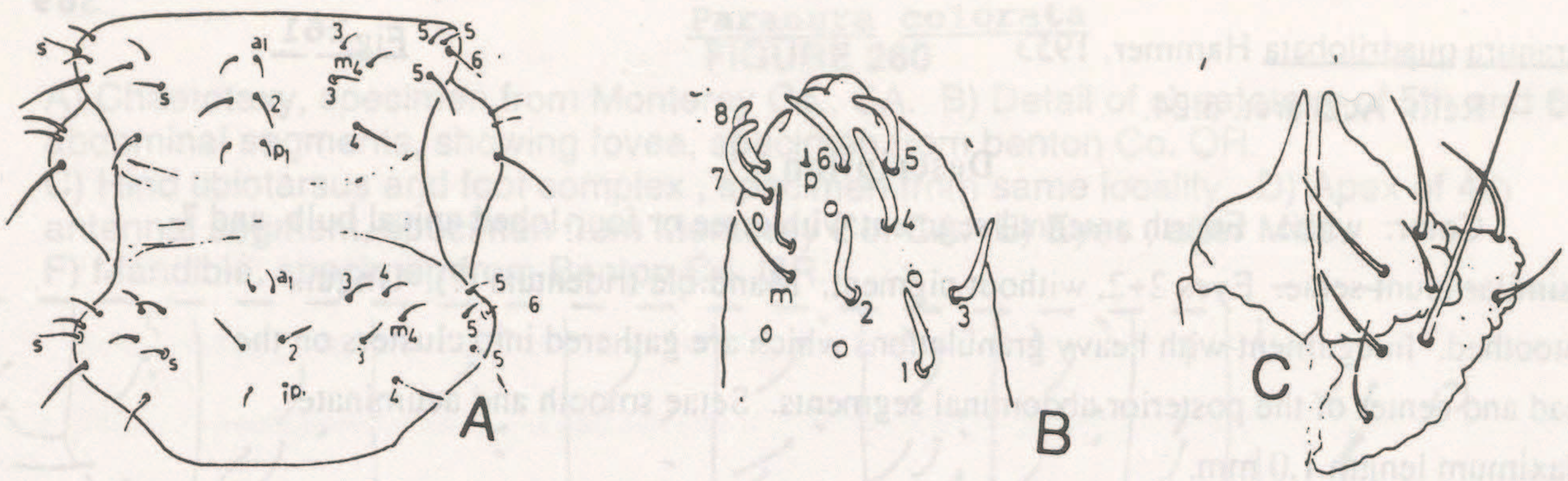












P. sexpunctata. A) Chaetotaxy Th. 2 & 3; B) Labium; C) Sensory setae, left 4th antennal segment. After Fjellberg 1985.

Genus Sensillanura Deharveng, 1981

Type species: Neanura barberi Handschin, 1928.

This genus includes Neanurinae which lack a P.A.O. and furcula and which have simple mouthparts and one greatly enlarged sensilla on the fourth antennal segment. Eyes may be 2+2 or absent. Body tubercles are absent or obscure in some species, but developed as in Neanura in others. Americanura Cassagnau, 1983 (type mexicana Cassagnau & Palacios, 1983), differing only the absence of the dorsointernal seta of the first thoracic segment, is here treated as a subgenus.

There are 6 Nearctic species: 1) (Americanura) bara; 2) barberi; 3) bullsa; 4) caeca; 5) illina; 6) millsi.

Key to Nearctic Species of Sensillanura

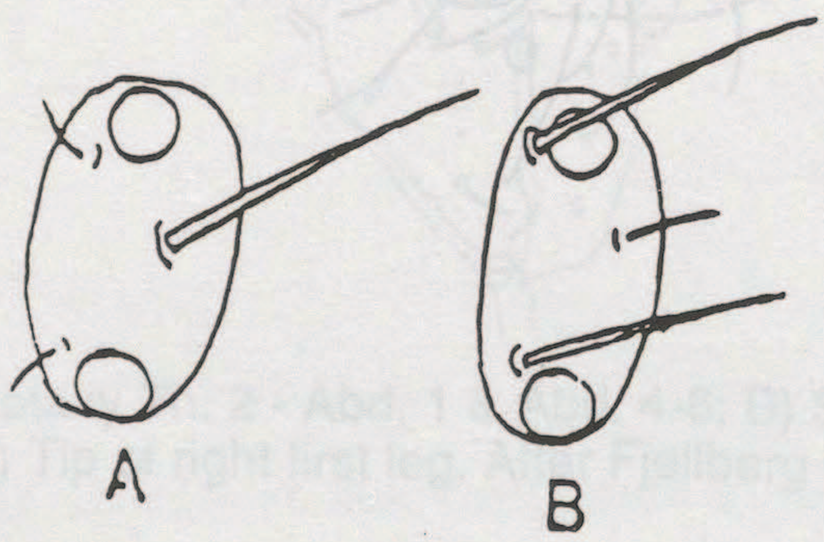
1) Eyes absent 2
1') Eyes present 3

2) Body tuberculate; macrochaetae apically enlarged ..... S. bullsa
* 2') Tubercles obscure or absent; macrochaetae acuminate ..... S. caeca

** 3) Large body setae coarsely ciliate ..... S. illina
3') Large body setae smooth or finely ciliate 4

** 4) Sixth abdominal segment rounded ..... S. millsi
4') Sixth abdominal segment bilobed 5

* 5) Ocular macrochaetae 1+1 (Fig. 262A) ..... S. barberi
** 5') Ocular macrochaetae 2+2 (Fig. 262B) ..... S (Americanura) bara



Sensillanura (Americanura) bara, Christiansen & Bellinger, 1980 Fig. 263

Description

Color: white with eyes dark. Fourth antennal segment with trilobed apical bulb and one large and 7 small blunt setae, one of which (arrow in Fig. 278D) is very similar to acuminate setae; ventral file of fourth antennal segment very poorly developed with about 10 differentiable setae. Eyes 2 per side, widely separated. Unguis untoothed. Body tubercles weakly developed except on posterior part of abdomen. Sixth abdominal segment barely visible from above; visible portion only weakly bilobed. Long setae on posterior part of head on thorax and abdomen blunt as in Morulina. Maximum size 2.5 mm.

Remarks

This species is very similar to barberi and illina but can be distinguished as shown in the table below:

	Large setae	Ocular macrochaetae	Central tubercles, abd. V	Median tubercle structure
bara	blunt to acuminate, smooth	2+2	separate to partly fused	weak to moderate
barberi	acuminate smooth to minutely serrate	1+1	separate to partly fused	weak to moderate
illina	heavily serrate	1+1	fused	pronounced

Specimens from Illinois show supplementary small setae on the dorsal tubercles.

Type locality: Santeetlah Lake Dam, Great Smoky Mts. National Park, Tennessee, Tullgren extract, June 1950.

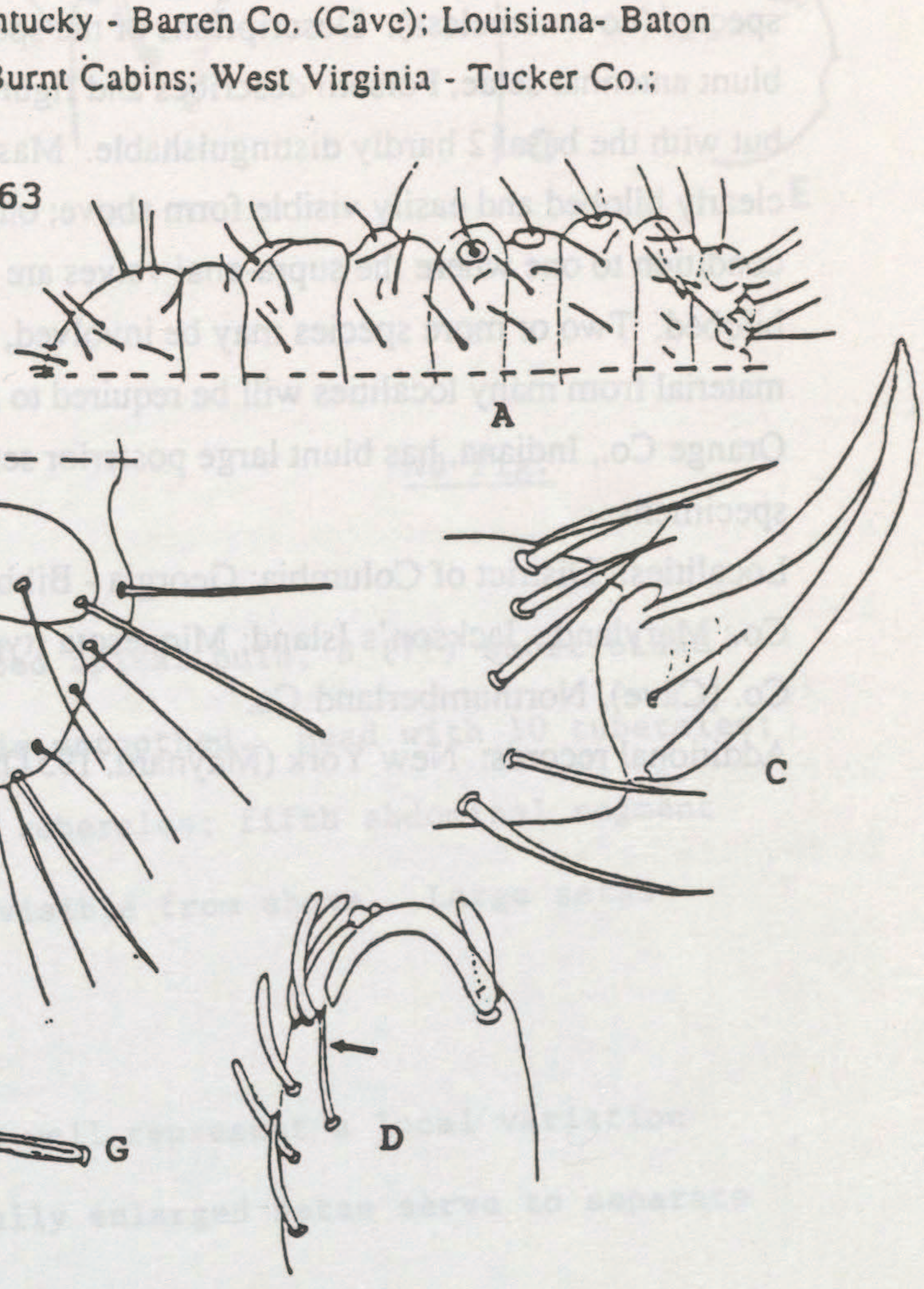
Additional localities: Illinois - Coles Co., La Salle Co.; Kentucky - Barren Co. (Cave); Louisiana- Baton Rouge Par.; North Carolina - Graham Co.; Pennsylvania - Burnt Cabins; West Virginia - Tucker Co.; Canada - Quebec

Figure 263

Sensillanura (Americanura) bara

All figures of type specimens.

A) Chaetotaxy of right side of dorsum.
B) Detail of Chaetotaxy of right half of last two abdominal segments.
C) Fore foot complex.
D) Blunt setae of fourth antennal segment.
E) Left eye tubercle.
F) Mandible.
G) Blunt seta of sixth abdominal segment.



Sensillanura barberi (Handschin) 1928 Fig. 264

Refs.: J. Linn. Soc. 36:537 (Achorutes); Folsom, 1916 (as quadrioculata); Massoud, 1967.

Syn.: quadrioculata Guthrie, 1903, Collembola of Minnesota: 2, 101 (nec Borner, 1901); pseudoquadrioculata Stach, 1951, Apterygotan fauna of Poland, Bilobidae 31: (Biloba).

Description

Color: White, sometimes with dark eyes. Fourth antennal segment with trilobed apical bulb; with 1 very large and 5-8 small blunt setae, the basal setae (see arrows in Fig. 284D) difficult to distinguish from acuminate ones; ventral "file" of 12-16 weakly differentiated setae. Two eyes per side, well separated. Unguis untoothed. Ventral tube with 4+4 setae. Body tubercles acuminate, smooth or minutely serrate. Maximum length 3.0 mm.

Remarks

The names barberi and pseudoquadrioculata were both proposed as replacements for quadrioculata Guthrie nec Borner, and by Article 72(d) of the International code barberi must be used for the United States species, even though Handschin's description is based on a Mexican species (now nameless). Descriptions of the species disagree in some respects. Massoud shows 9 blunt antennal setae, Folsom describes and figures 8, while most specimens we have seen have 8 but with the basal 2 hardly distinguishable. Massoud shows the sixth abdominal segment as clearly bilobed and easily visible form above; our specimens show all variations from this condition to one where the supra-anal valves are hidden by the fifth segment and only weakly bilobed. Two or more species may be involved, or this may be a variable form; analysis of material from many localities will be required to settle this point. A specimen from a cave in Orange Co., Indiana, has blunt large posterior setae but is otherwise similar to the other specimens.

Localities: District of Columbia; Georgia - Bibb Co.; Illinois - Calhoun Co., Mason Co., Wayne Co.; Maryland - Jackson's Island; Minnesota (type of quadrioculata Guthrie); Virginia - Augusta Co. (Cave), Northumberland Co.

Additional records: New York (Maynard, 1951); West Virginia (Lippert and Butler, 1976).

FIGURE 264

Sensillanura barberi

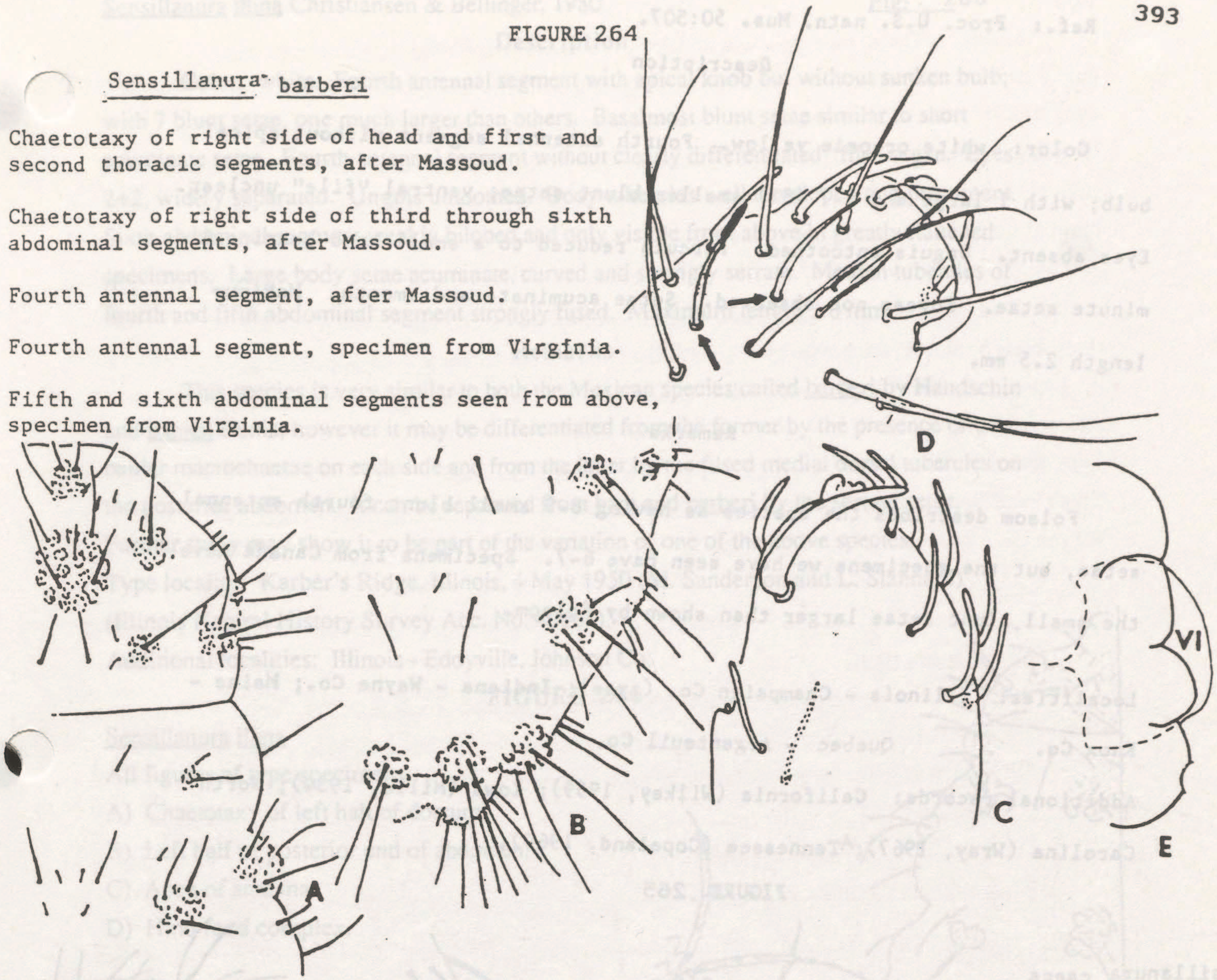
Chaetotaxy of right side of head and first and second thoracic segments, after Massoud.

Chaetotaxy of right side of third through sixth abdominal segments, after Massoud.

Fourth antennal segment, after Massoud.

Fourth antennal segment, specimen from Virginia.

Fifth and sixth abdominal segments seen from above, specimen from Virginia.



Sensillanura bullsa Wray, 1953
Ref.: Nature notes, Raleigh 1:7

NO Fig.

Description

Color: white. Fourth antennal segment with lobed apical bulb, 8 (7?) short blunt setae, and one large blunt seta. Eyes absent. Unguis untoothed. Head with 10 tubercles; first thoracic to fourth abdominal segments with 3+3 tubercles; fifth abdominal segment with 2+2 tubercles. Sixth abdominal segment clearly visible from above. Large setae apically enlarged. Maximum length 1.6 mm.

Remarks

This species is very similar to barberi and may well represent a local variation of that species. The described lack of eyes and apically enlarged setae serve to separate the two forms.

Locality: Sourth Carolina - Berkeley Co. (type).

Ref.: Proc. U.S. natn. Mus. 50:507.

Description

Color: white or pale yellow. Fourth antennal segment without apical bulb; with 1 large and 6-7 (8?) smaller blunt setae; ventral "file" unclear. Eyes absent. Unguis untoothed. Furcula reduced to a small knob bearing 6 minute setae. Foveae not observed. Setae acuminate and smooth. Maximum length 2.5 mm.

Remarks

Folsom describes the species as having 8-9 small blunt fourth antennal setae, but the specimens we have seen have 6-7. Specimens from Canada have the small blunt setae larger than shown by Folsom.

Localities: Illinois - Champaign Co. (type); Indiana - Wayne Co.; Maine - Knox Co. Quebec - Argenteuil Co.

Additional records: California (Wilkey, 1959); Iowa (Mills, 1934); North Carolina (Wray, 1967); Tennessee (Copeland, 1960).

FIGURE 265

Sensillanura caeca

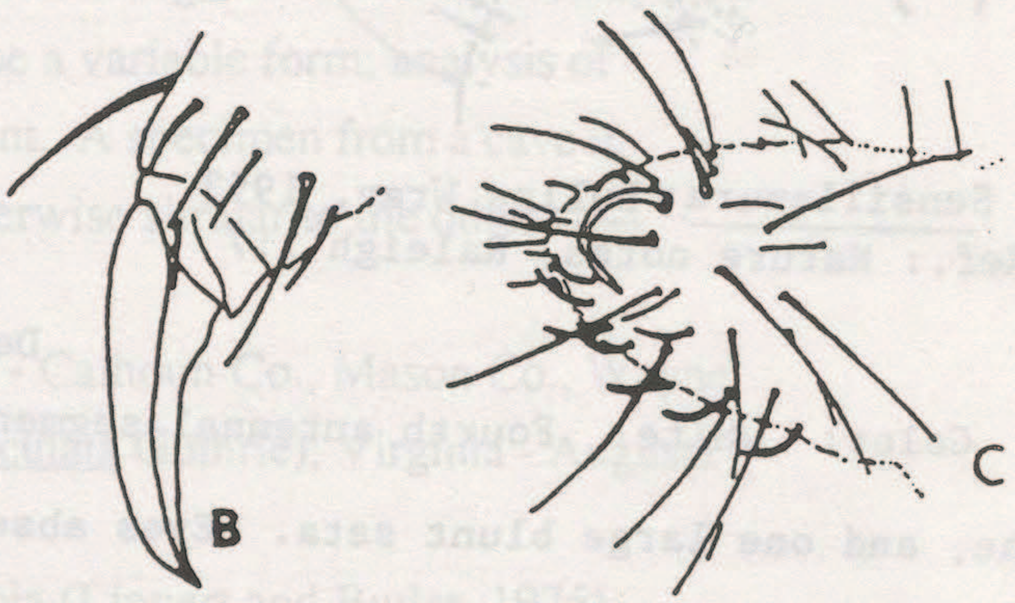
A) Chaetotaxy, specimen from Argenteuil Co., Quebec.

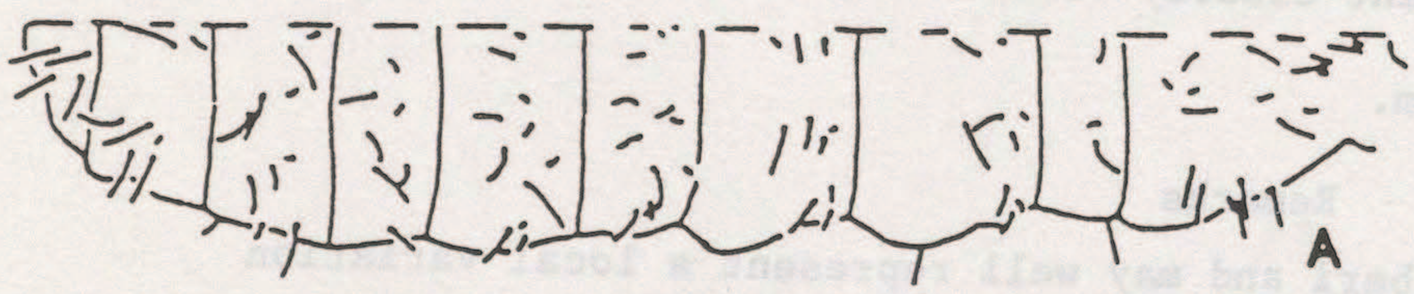
B) Forefoot complex, after Folsom.

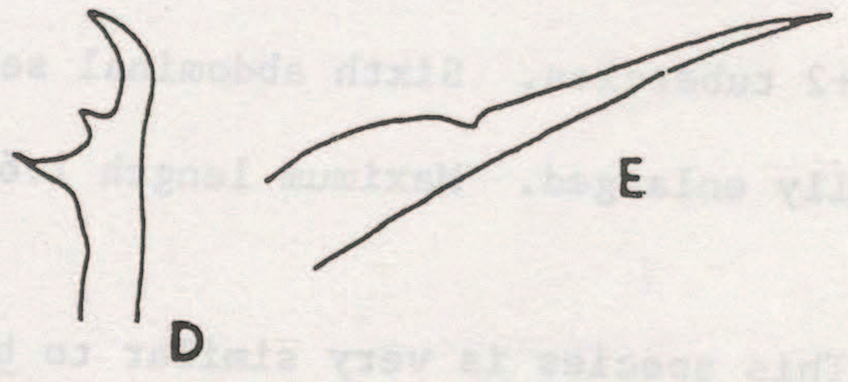
C) Fourth antennal apex, after Folsom.

D) Mandible, after Folsom.

E) Maxilla, after Folsom.







Sensillanura illina Christiansen & Bellinger, 1980 Fig: 266

Description

Color: white. Fourth antennal segment with apical knob but without sunken bulb; with 7 blunt setae, one much larger than others. Basalmost blunt setae similar to short acuminate setae. Fourth antennal segment without clearly differentiated "file" organ. Eyes 2+2, widely separated. Unguis untoothed. Body tubercles well developed and prominent. Sixth abdominal segment weakly bilobed and only visible from above in greatly flattened specimens. Large body setae acuminate, curved and strongly serrate. Median tubercles of fourth and fifth abdominal segment strongly fused. Maximum length 3.0 mm.

Remarks

This species is very similar to both the Mexican species called barberi by Handschin and banksi Denis; however it may be differentiated from the former by the presence of two ocular macrochaetae on each side and from the latter by the fused medial dorsal tubercles on the posterior abdomen. It can be separated from bara and barberi by the serrate setae. Further study may show it to be part of the variation of one of the above species.

Type locality: Karber's Ridge, Illinois, 4 May 1950 (M. Sanderson and L. Stannard) (Illinois Natural History Survey Acc. No. 49607).

Additional localities: Illinois - Eddyville, Johnson Co.

FIGURE 266

Sensillanura illina

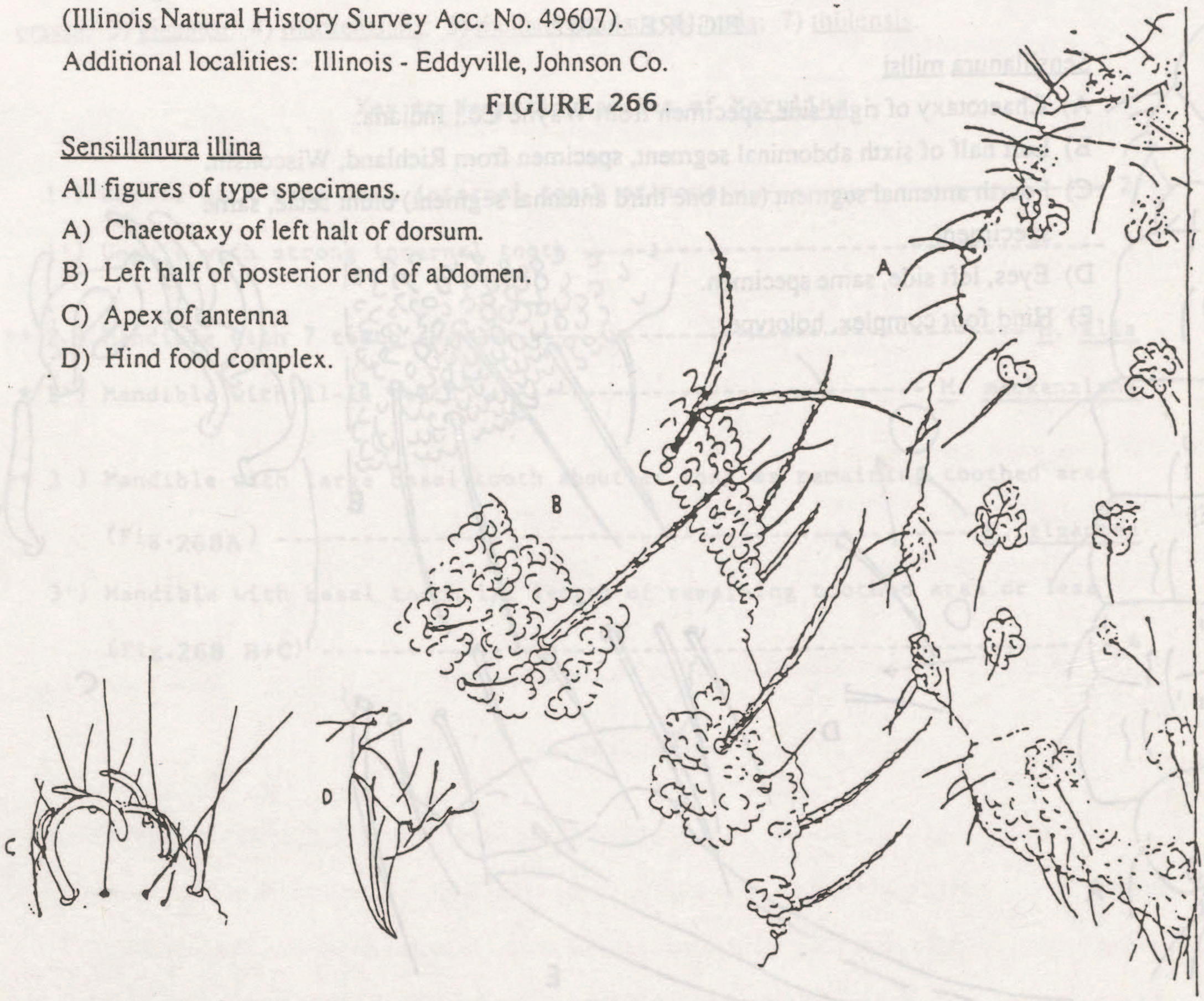
All figures of type specimens.

A) Chaetotaxy of left halt of dorsum.

B) Left half of posterior end of abdomen.

C) Apex of antenna

D) Hind food complex.



Description

Color: white to pale yellow with blue eyes. Fourth antennal segment with clear apical bulb, weakly lobed; blunt setae 7, 1 large and 6 small. Eyes 2+2, with posterior eyes smaller than anterior and difficult to see in cleared specimens. Mandible tridentate (?). Unguis untoothed. Furcula reduced to a small knob bearing 4-8 minute setae. Integument coarsely tuberculate. Body setae mostly accuminate and smooth; largest posterior setae blunt at tip. Maximum length 1.5 mm.

Remarks

This may be part of the normal range of variation of S. caeca, which it closely resembles; however, the presence of eyes and a clear apical antennal bulb appear to separate it. Two specimens from Colorado show a different chaetotaxy and may represent a different species.

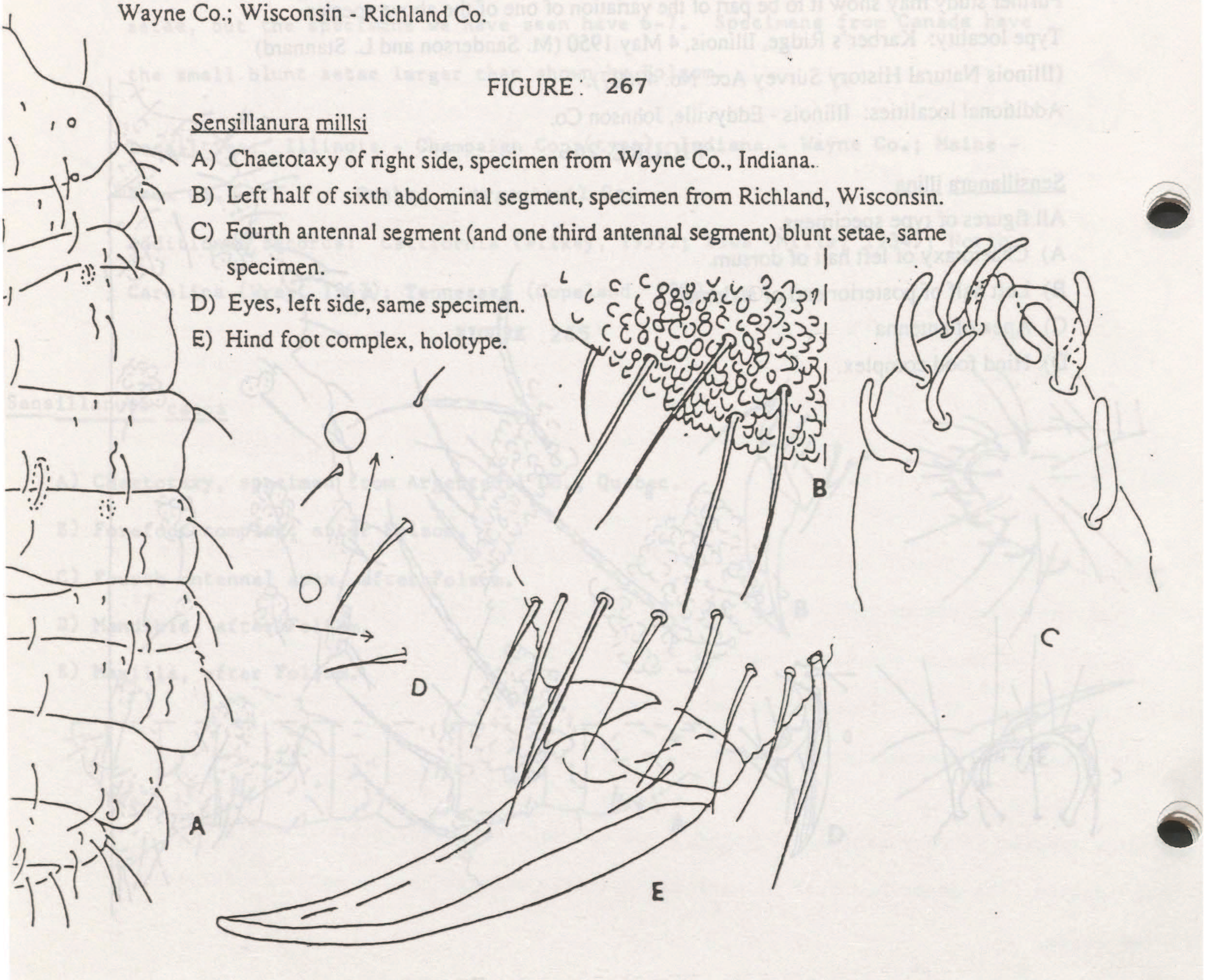
Type locality: Dixon Springs, IL, 18 July 1948 (Mills and Ross).

Other localities: Colorado - Clear Creek Co; Illinois - Johnson Co.; Indiana - Parke Co., Wayne Co.; Wisconsin - Richland Co.

FIGURE: 267

Sensillanura millsi

A) Chaetotaxy of right side, specimen from Wayne Co., Indiana.
B) Left half of sixth abdominal segment, specimen from Richland, Wisconsin.
C) Fourth antennal segment (and one third antennal segment) blunt setae, same specimen.
D) Eyes, left side, same specimen.
E) Hind foot complex, holotype.



Genus Morulina Börner, 1906

Type species: Anura gigantea Tullberg, 1876.

This genus includes the Neanura-like forms with a P.A.O. The unique shape of this organ, with from 25 to more than 50 massed tubercles, is enough to distinguish it from any other Nearctic group. The genus is quite uniform in most features. The Nearctic species all have: 1) well developed tubercles; 2) small, trilobed apical antennal bulb; 3) well developed ventral "file" on the fourth antennal segment; 4) no unguiculus; 5) sixth abdominal segment partly or completely hidden below the fifth segment; 6) five eyes per side. A bilobed furcal rudiment is found at least in some species. Generally these are very large animals with heavy setae. Differences between species are largely confined to the form of the mouthparts and the unguis, and the chaetotaxy. The mouthparts are remarkably constant within species limits; apparent variation is most often due to angle of viewing. The mouthparts can usually be seen in well cleared and flattened specimens; however, in uncleared forms they must be dissected out.

The genus as known at present is primarily Nearctic, with 7 species in this area: 1) alia; 2) crassa; 3) gigantea; 4) mackenziana; 5) multatuberculata; 6) nuda; 7) thulensis.

Key to Nearctic Species of Morulina

1) Unguis with very weak internal tooth or none ---------- 2

1') Unguis with strong internal tooth ---------- 3

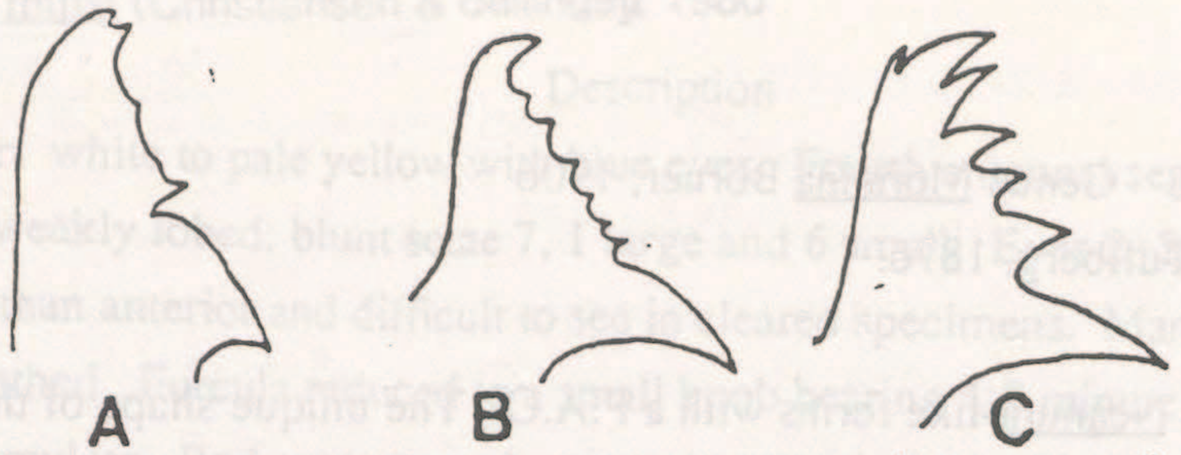
** 2) Mandible with 7 teeth ---------- M. alia

* 2') Mandible with 11-12 teeth ---------- M. mackenziana

** 3) Mandible with large basal tooth about as long as remaining toothed area (Fig.268A) ---------- M. gigantea

3') Mandible with basal tooth 1/2 length of remaining toothed area or less (Fig.268 B+C) ---------- 4

268



4) Three apical mandibular teeth dissimilar (Fig.268B) ---------- 5

4') Three apical mandibular teeth similar, hooked (Fig.268C) ---------- 7

5) Maxilla with four or more teeth, along length ---------- 6

* 5') Maxilla with only two teeth, at apex ---------- M. multatuberculata

* 6) Maxilla elongate, with many fine inner teeth ---------- M. nuda

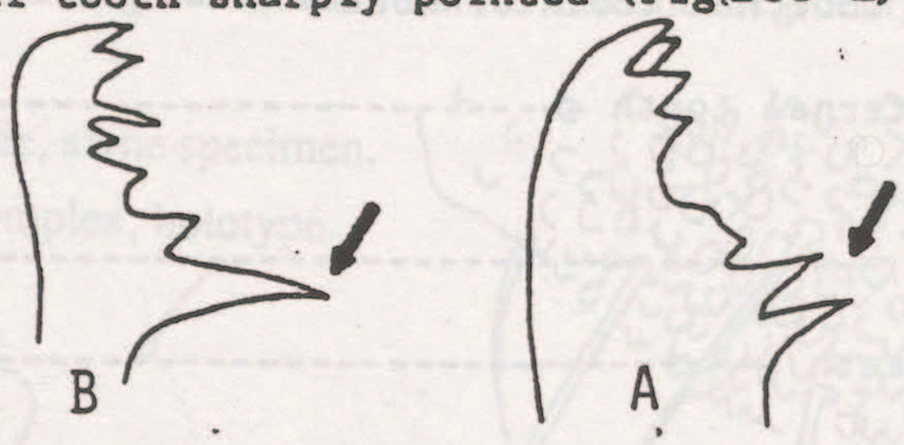
** 6') Maxilla blunt with 4-6 heavy inner teeth ---------- M. crassa

** 7) Median posterior tubercles of head with 6+6 setae ---------- M. alia

7') Median posterior tubercles of head with 9+9 setae ---------- 8

* 8) Basal two mandibular teeth sharply pointed (269 A) - M. multatuberculata

* 8') Only most basal tooth sharply pointed (Fig.269 B) ---------- M. thulensis



Not included in key:

callowayia Wray, 1953c = gigantea

kotzebuensis Böövarsson, 1960 = gigantea

Morulina alia, Christainasen & Bellinger 1980 Fig. 270

Description

Color: light to medium blue; pigment mottled and only slightly darker on tubercles. Fourth antennal segment with projecting trilobed apical bulb and 4-5 clearly differentiated blunt setae. P.A.O. hemispherical. Inner tibiotarsal setae smooth, straight, and slightly shorter than tibiotarsus. Unguis untoothed or weakly toothed. Ventral tube with 6-8 setae per side. Furcula

reduced to a single fold. Tubercles not prominent. Sixth abdominal segment barely visible from above. Long body setae acuminate, serrate; sometimes covered with an envelope, giving a blunt appearance as in thulensis. Maximum length 2.0 mm.

Remarks

This species may be a geographic variant of M. thulensis; however there are sufficient differences to justify separation. The specimens from New Mexico are from Wheeler Peak; they differ slightly from the Kentucky material but are probably the same form.

Type locality: Crail Hope, Kentucky, Tullgren extract, 15 April 1950 (Carl Cook).

Additional locality: New Mexico - Taos Co.

FIGURE 270

Morulina alia

All figures of type specimens.

A) Chaetotaxy of right side of dorsum.

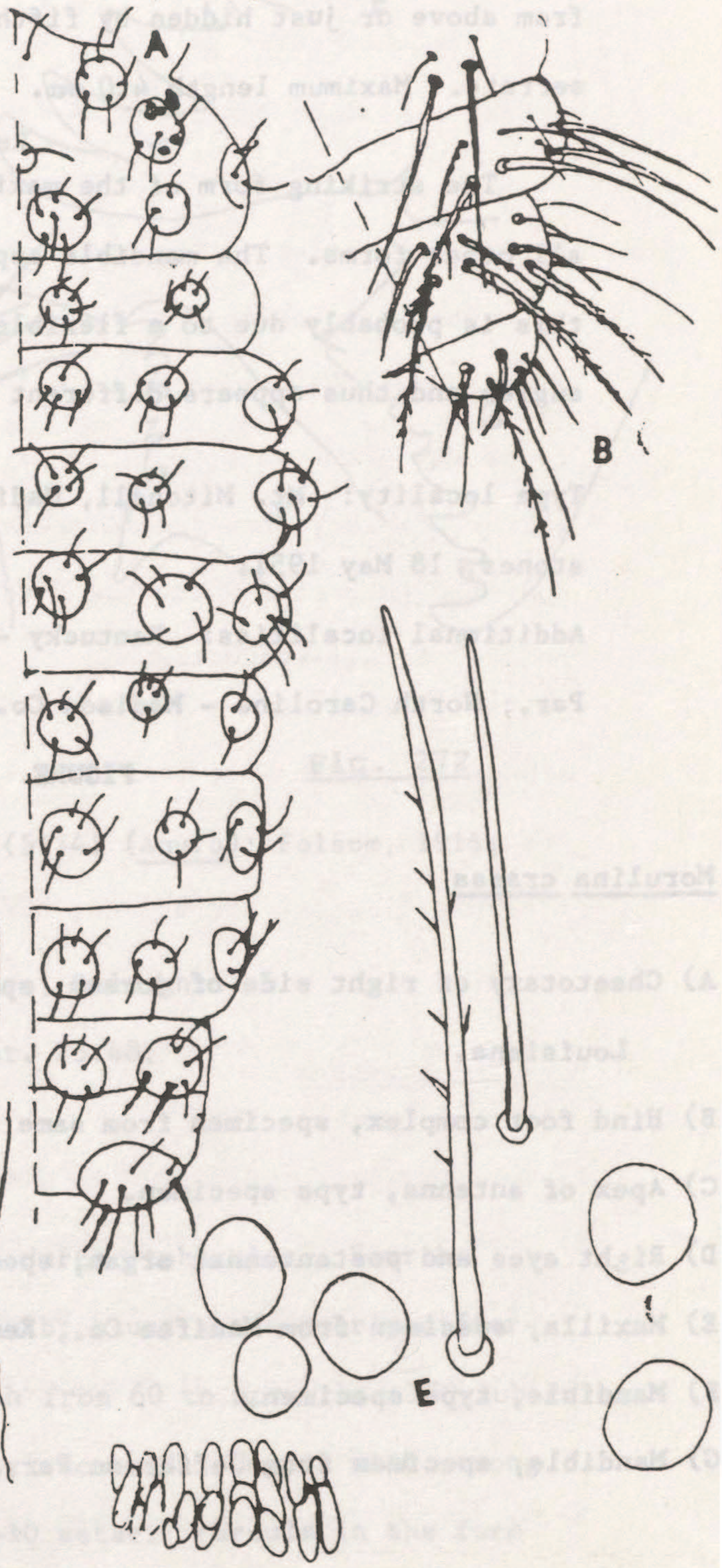
B) Detail of chaetotaxy of last three segments.

C) Hind unguis.

D) Apex of antenna.

E) Eyes and postantennal organ of right side.

F) Maxilla.



Description

Color: light to dark blue with tubercles markedly darker (often black). Fourth antennal segment with trilobed apical bulb sunken into apex and somewhat lateral in position; blunt setae difficult to distinguish from acuminate setae except for one short seta near the base of the segment. P.A.O. hemispherical. Long setae of inner tibiotarsus smooth, straight. Unguis with prominent inner tooth near base. Ventral tube with 8-11 setae per side. Body and posterior head tubercles prominent. Sixth abdominal segment barely visible from above or just hidden by fifth segment. Setae acuminate, most sparsely serrate. Maximum length 4.0 mm.

Remarks

The striking form of the maxilla easily distinguishes this species from all other forms. The mandible appears to be quite variable; however we believe this is probably due to a flexible basal lamella which is seen at various angles and thus appears different in different specimens.

Type locality: Mt. Mitchell, Madison Co., North Carolina, summit, under stones, 18 May 1951.

Additional localities: Kentucky - Menifee Co. (cave); Louisiana - Jefferson Par.; North Carolina - Madison Co.

FIGURE. 271

Morulina crassa

A) Chaetotaxy of right side of dorsum, specimen from Jefferson Par., Louisiana.

B) Hind foot complex, specimen from same locality.

C) Apex of antenna, type specimen.

D) Right eyes and postantennal organ, specimen from Liberty Co., Georgia.

E) Maxilla, specimen from Menifee Co., Kentucky.

F) Mandible, type specimen.

G) Mandible, specimen from Jefferson Par., Louisiana.

Figure 271

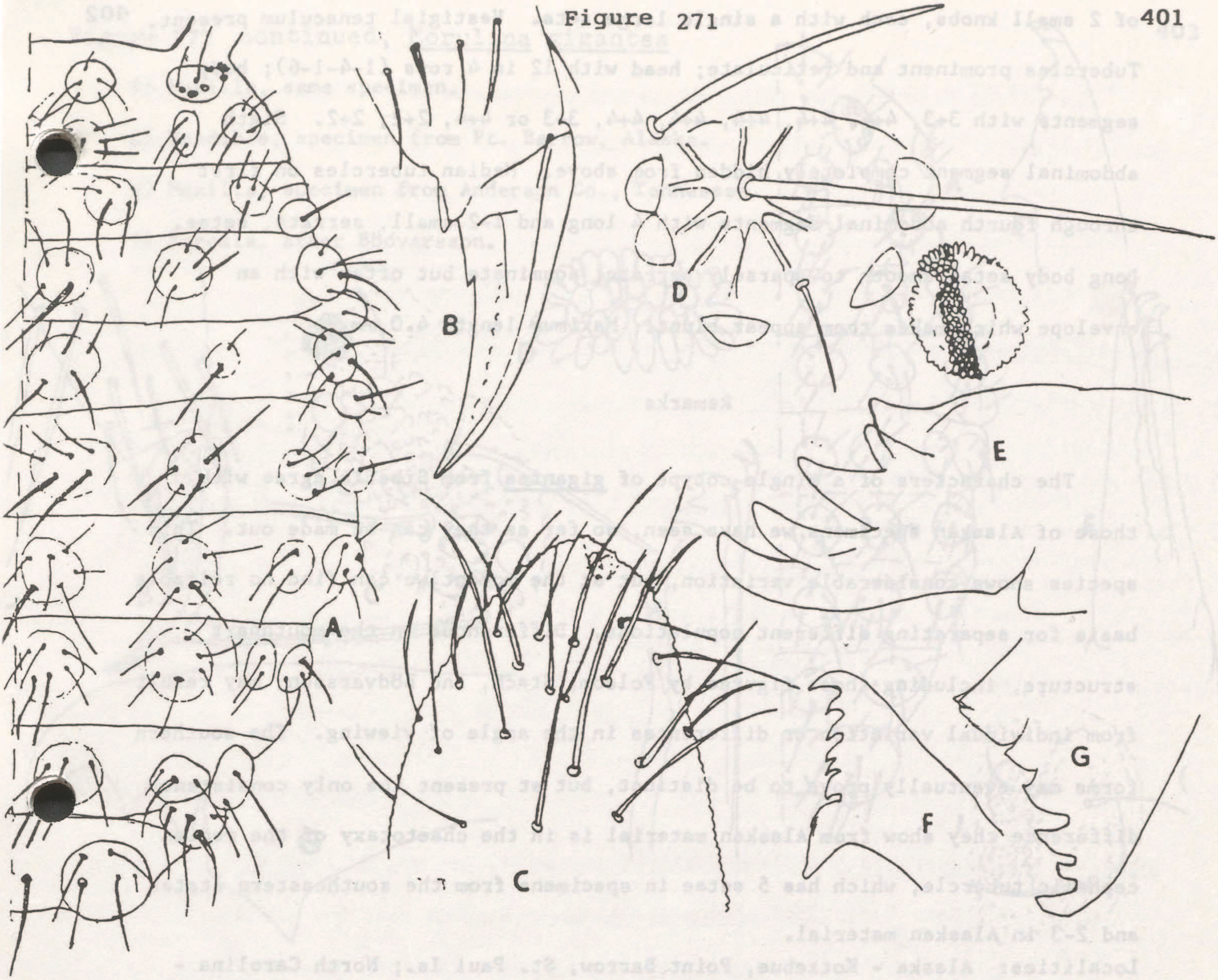


Fig. 272

Morulina gigantea (Tullberg), 1876

Refs.: Öfvers.K. VetenskAkad. Förh. 33(5):41 (Anura); Folsom, 1915; Stach, 1951.

Syn.: callowayia Wray, 1953, Nature Notes, Raleigh, 1:1

kotzebuensis Böövarsson, 1960, Opusc. ent. 25:48,

Description

Color: dark blue to purplish black with darker tubercles. Fourth antennal segment with small trilobed apical bulb; blunt setae poorly differentiated. P.A.O. hemispherical to ovate, with from 60 to more than 100 tubercles. Inner tibiotarsal setae very long and apically recurved. Unguis with strong inner tooth near base. Ventral tube with 10+10 setae. Furcula in the form

of 2 small knobs, each with a single large seta. Vestigial tenaculum present. Tubercles prominent and reticulate; head with 12 in 4 rows (1-4-1-6); body segments with 3+3, 4+4, 4+4, 4+4, 4+4, 4+4, 3+3 or 4+4, 2+2, 2+2. Sixth abdominal segment completely hidden from above. Median tubercles on first through fourth abdominal segments with 4 long and 1-2 small, serrate, setae. Long body setae smooth to sparsely serrate, acuminate but often with an envelope which makes them appear blunt. Maximum length 4.0 mm.

Remarks

The characters of a single cotype of gigantea from Siberia agree with those of Alaskan specimens we have seen, so far as they can be made out. This species shows considerable variation, but at the moment we can find no reliable basis for separating different populations. Differences in the mouthpart structure, including those figured by Folsom, Stach, and Bödvarsson, may result from individual variation or differences in the angle of viewing. The southern forms may eventually prove to be distinct, but at present the only consistent difference they show from Alaskan material is in the chaetotaxy of the median cephalic tubercle, which has 5 setae in specimens from the southeastern states and 2-3 in Alaskan material.

Localities: Alaska - Kotzebue, Point Barrow, St. Paul Is.; North Carolina - Linville, Orange Co.; Tennessee - Anderson Co.

Additional records: South Carolina (DuRant and Fox, 1966, as callowayia); West Virginia (Lippert and Butler, 1976).

FIGURE 272

Morulina gigantea

A) Chaetotaxy of right half of dorsum, specimen from Pt. Barrow, Alaska.

B) Hind foot complex, after Bödvarsson.

C) Left eyes and postantennal organ, after Bödvarsson.

D) Postantennal organ of "callowayia" type, specimen from Anderson Co., Tennessee.

E) Mandible, from type specimen of callowayia.

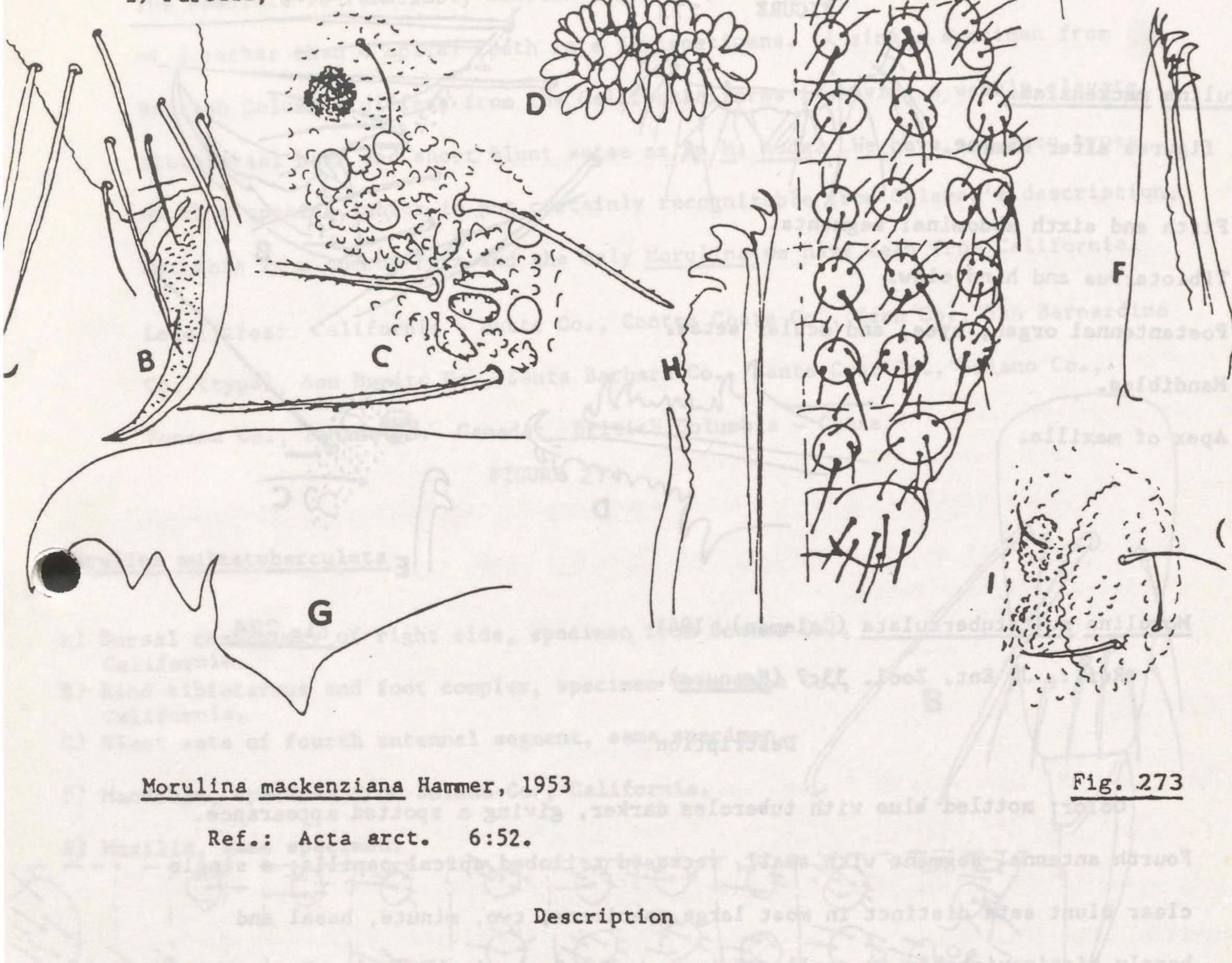
Figure 272 continued; Morulina gigantea

F) Maxilla, same specimen.

G) Mandible, specimen from Pt. Barrow, Alaska.

H) Maxilla, specimen from Anderson Co., Tennessee.

I) Furcula, after Bödvarsson.



Morulina mackenziana Hammer, 1953 Fig. 273

Ref.: Acta arct. 6:52.

Description

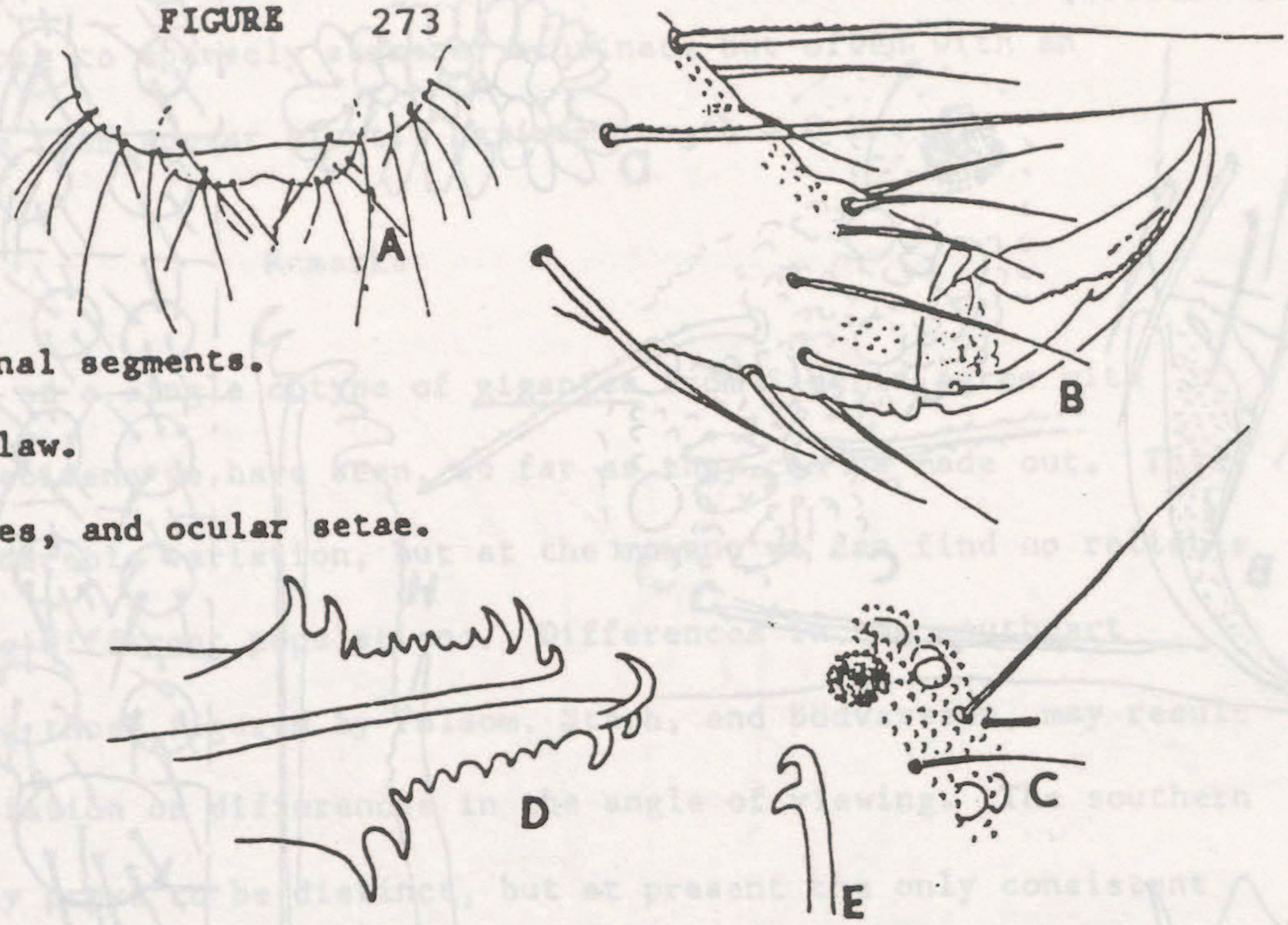
Color: greenish black; large tubercles only slightly darker than surroundings; setal bases clearly visible as light spots. Fourth antennal segment with small trilobed apical bulb; longer setae all acuminate. P.A.O. hemispherical, with relatively few tubercles (50 or less; about 25 in outer ring). Unguis without inner tooth. Inner tibiotarsal setae extremely long and unilaterally ciliate. Sixth abdominal segment visible from above. Body setae acuminate, with sparse serrations visible only at high magnification. Maximum length 2.2 mm.

Remarks

The unique mandibles of this species and the long ciliate tibiotarsal setae separate it from all other forms.

Locality: Alaska - Umiat (?); Canada - N.W.T., Richardson Mts., (types).

FIGURE 273



Morulina mackenziana

All figures after Hammer.

A) Fifth and sixth abdominal segments.

B) Tibiotarsus and hind claw.

C) Postantennal organ, eyes, and ocular setae.

D) Mandibles.

E) Apex of maxilla.

Morulina multatuberculata (Coleman), 1941

Fig.274.

Ref.: J. Ent. Zool. 33:7 (Neanura).

Description

Color: mottled blue with tubercles darker, giving a spotted appearance. Fourth antennal segment with small, recessed trilobed apical papilla; a single clear blunt seta distinct in most large specimens; two, minute, basal and barely distinguishable in small specimens. P.A.O. hemispherical. Eyes typical or (occasionally) anterior two fused. Inner tibiotarsal setae very long, the most basal setae flexible and sometimes recurved at apex. Claw strongly toothed internally. Ventral tube with 8-12 setae per side. Body tubercles prominent. Fifth abdominal segment with lobes contiguous; sixth segment completely hidden from above. Body setae usually smooth and blunt or acuminate; largest setae sometimes with envelope, giving blunt appearance as in thulensis. Maximum length 5.0 mm.

Remarks

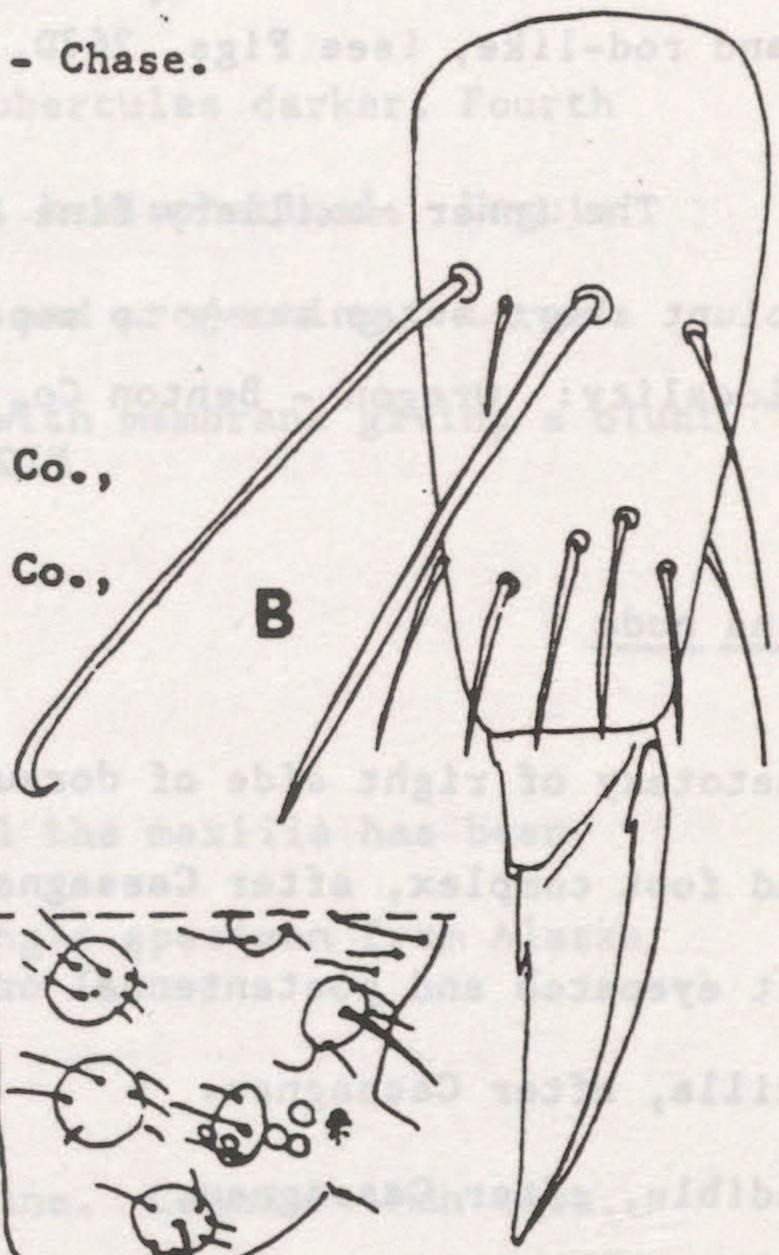
This species resembles both thulensis and alia. It can be separated from the former by the shape of the mandible and the chaetotaxy, and usually by the smooth setae. It differs from alia in lacking large blunt antennal setae. The mandible is remarkably constant; the only variation noted was the presence of 3 rather than 4 apical teeth in a few specimens. A single specimen from British Columbia differs from the California forms in having a weakly clavate tibiotarsal hair and short blunt setae as in M. nuda. We have not seen types of this species, which is not certainly recognizable from Coleman's description, but this is a common form and the only Morulina we have seen from California.

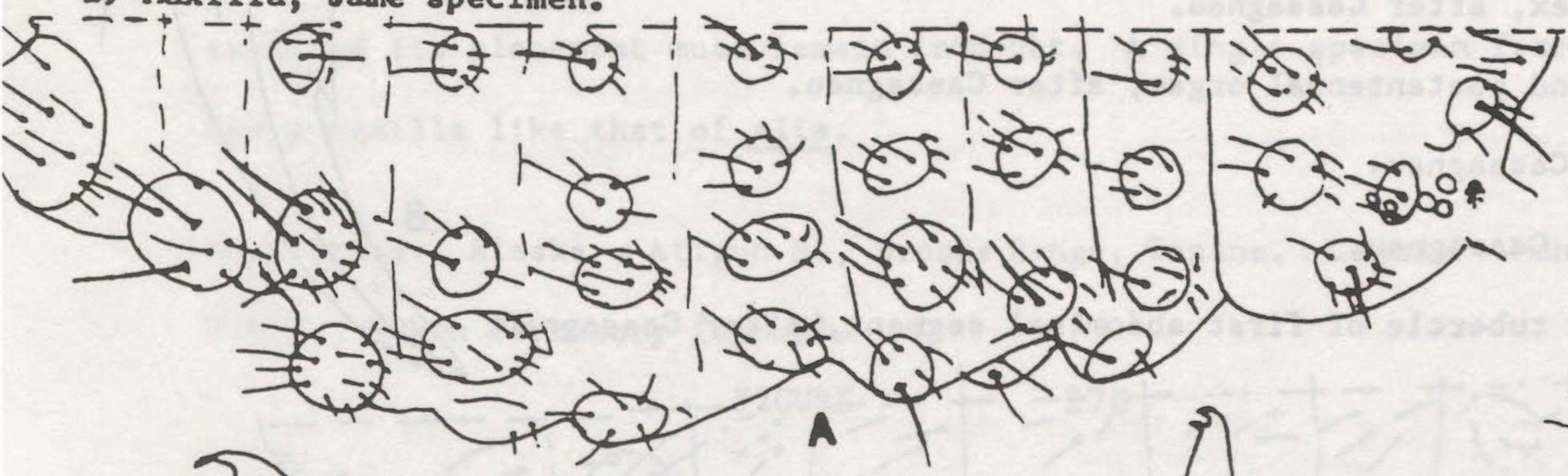
Localities: California - Butte Co., Contra Costa Co., Kern Co., San Bernardino Co. (type), San Benito Co., Santa Barbara Co., Santa Cruz Co., Solano Co., Sonoma Co., Tehama Co. Canada: British Columbia - Chase.

FIGURE 274

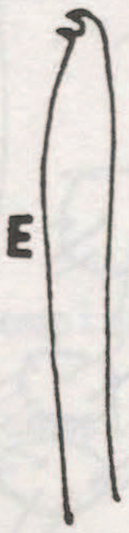
orulina multatuberculata

A) Dorsal chaetotaxy of right side, specimen from Sonoma Co., California.
B) Hind tibiotarsus and foot complex, specimen from Napa Co., California.
C) Blunt seta of fourth antennal segment, same specimen.
D) Mandible, specimen from Solano Co., California.
E) Maxilla, same specimen.









Morulina nuda Cassagnau, 1955 Fig.275

Ref.: Revue Fr. Ent. 22:158.

Description

Color: dark blue with slightly darker tubercles. Fourth antennal segment with small trilobed apical bulb and a well developed ventral "file"; all long antennal setae acuminate. P.A.O. hemispherical. Unguis with clear inner tooth. Longer inner tibiotarsal setae sometimes recurved at tip. Ventral tube with 8-17 setae per side. Furcula vestigial, in form of two small obscure knobs. Large tubercles weakly developed, indicated by darker pigment and presence of setae. Posterior lobes of fifth abdominal segment large and touching; sixth segment completely hidden. Shorter setae on head and body dorsum usually blunt and rod-like, (see Figs. 267D, E). Maximum length about 5.0 mm.

Remarks

The inner maxillary fine teeth are sometimes difficult to see. The unique blunt short setae serve to separate this from all other species of the genus.

Locality: Oregon - Benton Co.

FIGURE 275

Morulina nuda

A) Chaetotaxy of right side of dorsum, specimen from Benton Co., Oregon.

B) Hind foot complex, after Cassagnau.

C) Left eyepatch and postantennal organ, after Cassagnau.

D) Maxilla, after Cassagnau.

E) Mandible, after Cassagnau.

F) Setae of second tubercle of first abdominal segment, after Cassagnau.



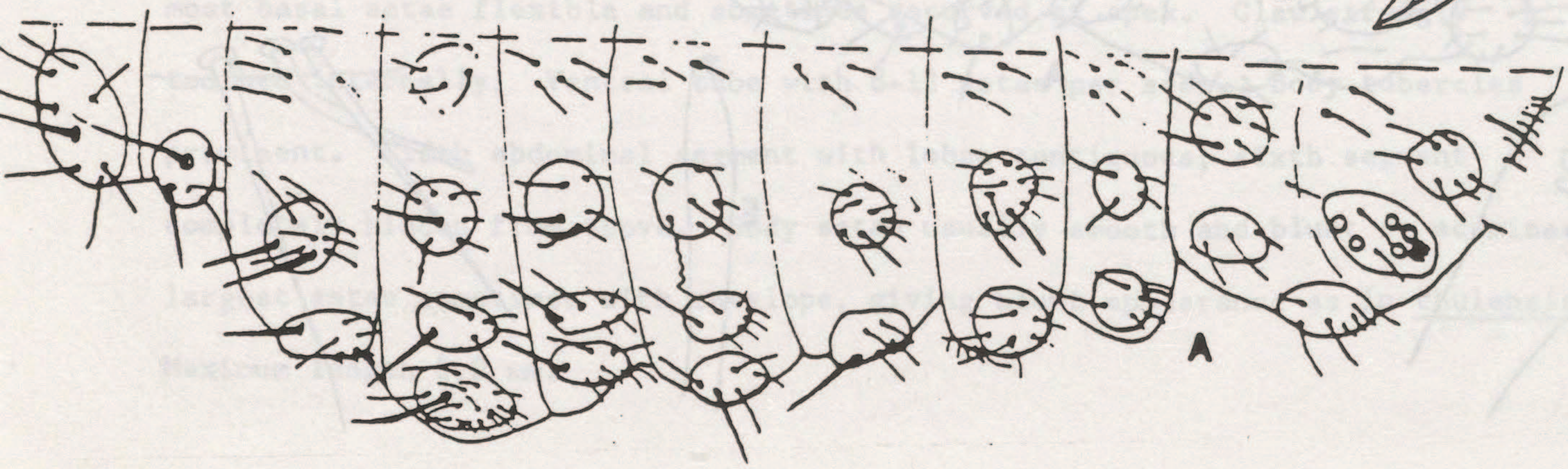
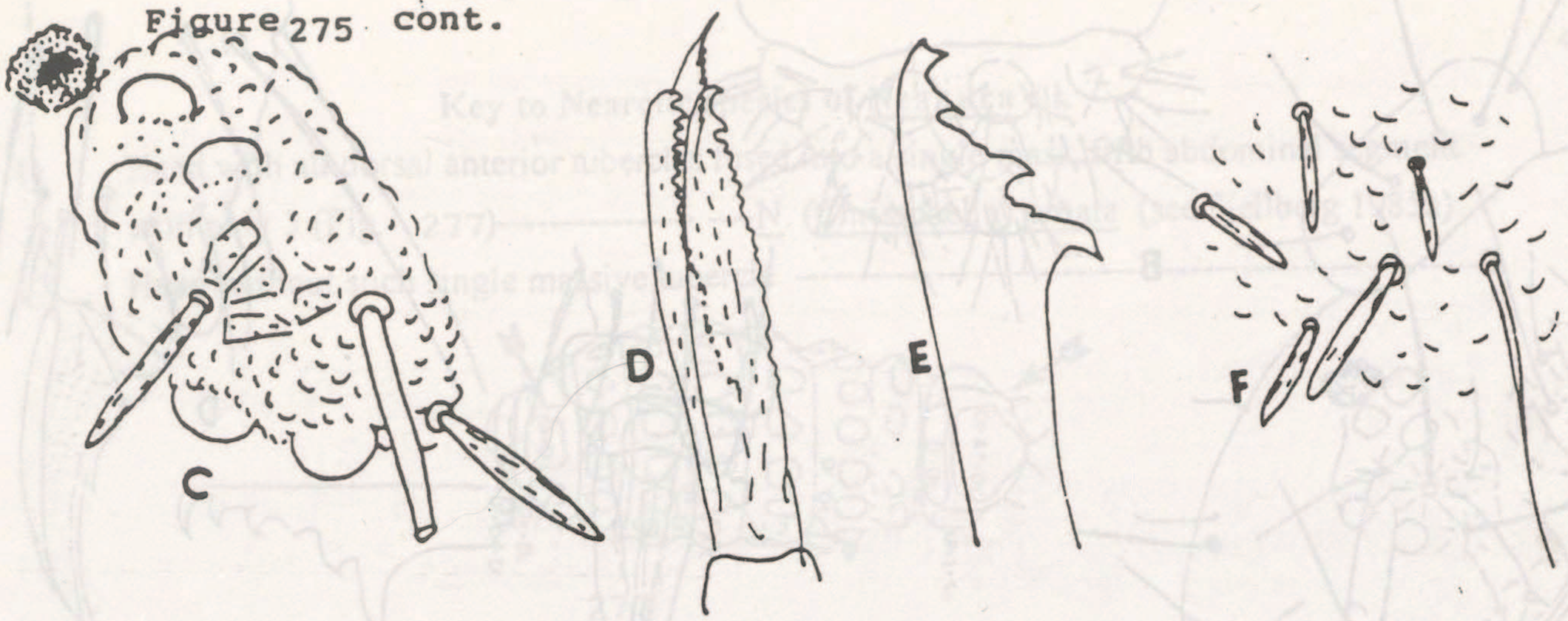


Figure 275 cont.



Morulina thulensis Hammer, 1953 Fig.276

Ref.: Acta arct. 6:31.

Description

Color: light blue to lilac, with segmental tubercules darker. Fourth antennal segment with trilobed apical bulb. P.A.O. hemispherical. Unguis with strong inner tooth. Body tubercles prominent and projecting. Large setae acuminate and sparsely serrate, and covered with membrane giving a blunt appearance at apex. Maximum size 2.0 mm.

Remarks

This is probably close to alia; however, until the maxilla has been examined its placement must remain in doubt. A single specimen from Alaska has a maxilla like that of alia.

Localities: Alaska - Atigun R., Brooks Range, Tanana. Canada - Manitoba, N.W.T., Yukon Territory (types).

FIGURE 276

Morulina thulensis

Final figures after Hammer.

A) Right half of dorsum of head.

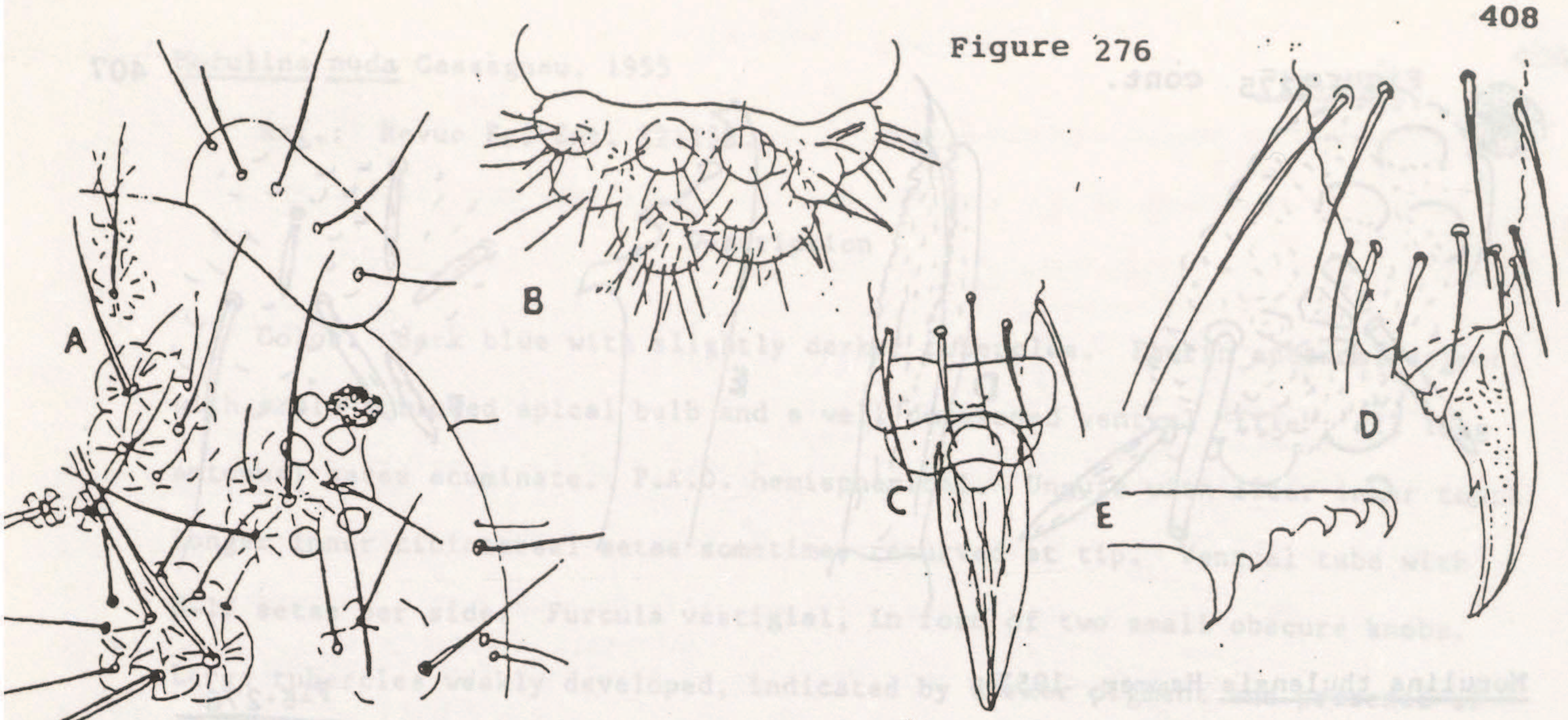
B) Posterior dorsum of abdomen.

C) Mid foot complex, seen on edge.

D) Hind foot complex.

E) Mandible.

Figure 276



Genus Neanura MacGillivray, 1893

Type species: Achorutes muscorum Templeton, 1835.

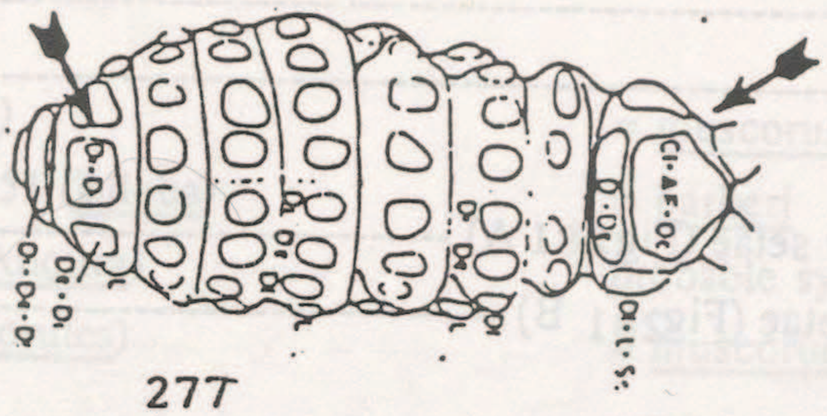
We place here Neanurinae with a bilobed sixth abdominal segment (unlike Paranura), no P.A.O. (unlike Morulina) and no enlarged antennal IV sensilla (unlike Sensillanura). Species of Neanura have 2+2 - 6+6 eyes, the last two antennal segments more or less fused, the furcula reduced to a knob or absent, and no anal spines. Useful specific characters include the structure of the mouthparts, the number of eyes, the chaetotaxy, the arrangement of tubercles, and the foot structure.

Nearctic species in this group fall in a number of recognized subgenera (or genera), but since not all our species have been assigned at present we prefer to give a single key to species, noting the position of those species whose position is understood.

Key to Nearctic species of Neanura s.l.

1) Head with all dorsal anterior tubercles fused into a single mass, fifth abdominal segment with only 3 (Fig. 277)---------- ----N. (Christobella) ornata (see Fjellberg 1985a)

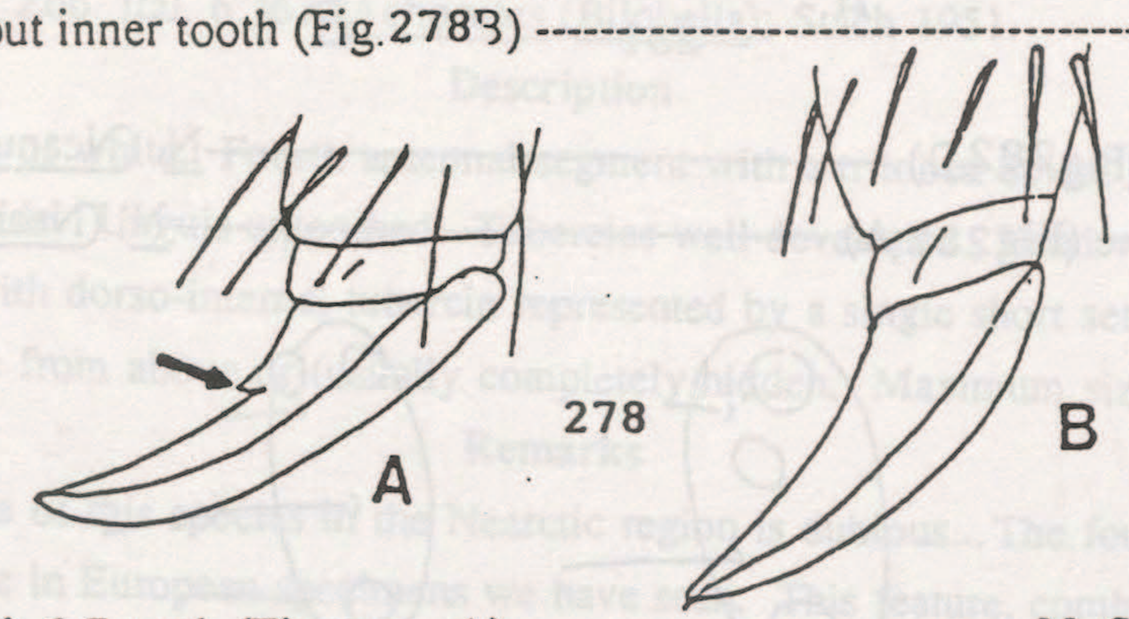
1') Head without such single massive tubercle ----------2



277

2) Unguis with strong inner tooth (Fig 278A) ----------3

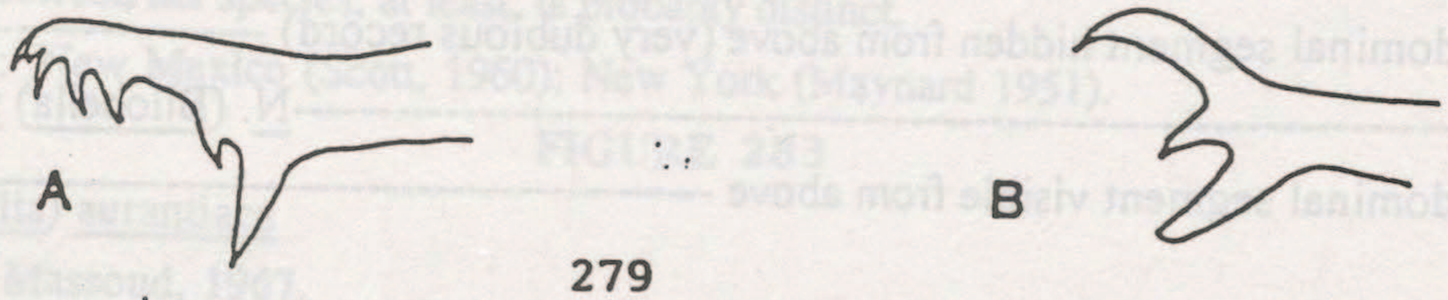
2') Unguis without inner tooth (Fig.278B) ----------5



278

3) Mandible with 6-7 teeth (Fig 279 A) ----------N. (Morulodes) ambigua

3') Mandible with 3 teeth (Fig. 279 B) ----------4



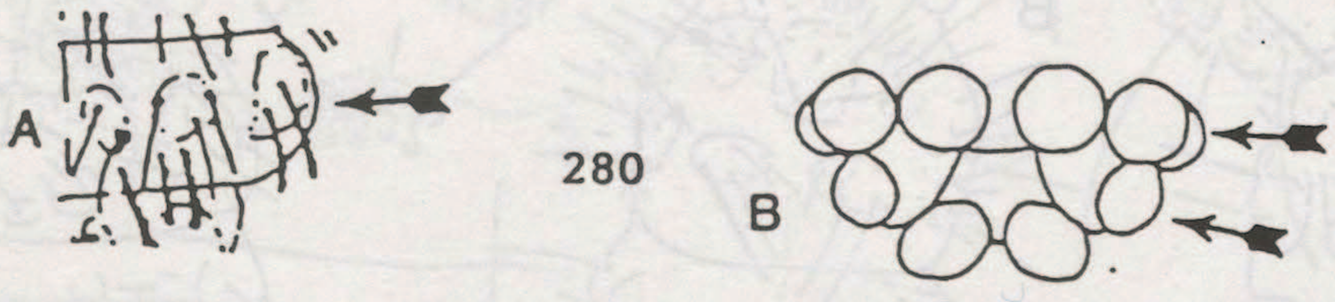
279

4) Fourth abdominal segment with tubercles in straight line (Fig 280A) ----------

----------N. (Morulodes) setosa

4') Fourth abdominal segment with one pair of tubercles behind the others (Fig 280 B) -----

----------N. (?) magna



280

5) Eyes 4 + 4 or more ----------N. (Morulodes) serrata

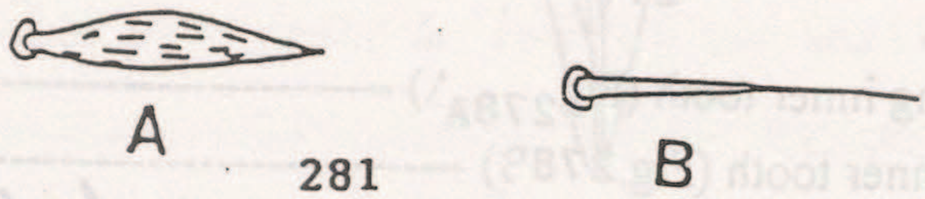
5') Eyes 3 + 3 or fewer ----------6

6) Eyes 3 + 3 ----------7

6') Eyes 2 + 2 or fewer ----------9

7) With sword shaped body setae (Fig281.A) ----------N. (Lobella) palmeri

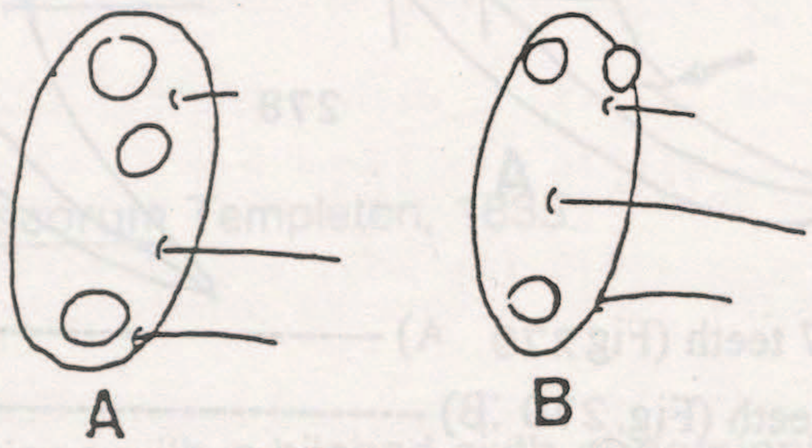
7') Without sword shaped setae (Fig281.B) ----------8



281

8) Eyes in a triangle (Fig.282.B) ----------N. (Neanura) muscorum

8') Eyes nearly in a line (Fig282.A) ----------N. (Neanura) persimilis



282

9) Sixth abdominal segment hidden from above (very dubious record) ----------
----------N. (Bilobella) aurantiaca

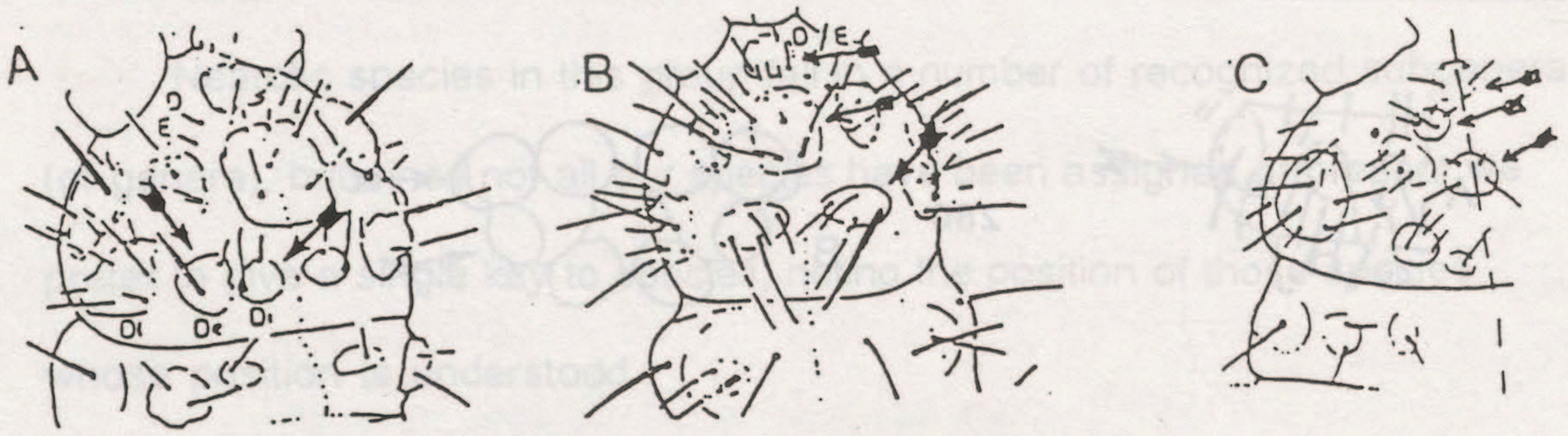
9') Sixth abdominal segment visible from above ----------10

10) Lateral and posterior cephalic tubercles unclearly delimited----- --N. (Neanura?) growae

10') Lateral and posterior cephalic tubercles clearly delimited (Fig. 281.1) ----------11

11) Di and De tubercles on head separate (Fig. 281.1A) ----------12

11') Di and De tubercles on head fused (Fig. 281.1B) ---------N. (Deutonura) frigida Yosii 1969



281.1

12) Head with 2 tubercles between ocular tubercles (Fig. 281. 1.A)----------
----------N. (Endonura) tundricola Fjellberg 1984a

12') Head with 4 tubercles between ocular Head tubercles (Fig.281.1C) ----------
----------N. (Vitronura) giselae[1]

Not included in key:

gibbosa Packard, 1873 (Anura) = muscorum

pseudoquadrioculata Stach, 1951 (Biloba) = barberi

sextuberculata Harvey, 1896 (Anoura) probable synonym of muscorum

tuberculata Nicolet, 1842 (Achorutes) = muscorum

Neanura (Bilobella) aurantiaca (Caroli), 1912 Fig. 283

Refs.: Archx. Zoo. Ital. 6:367 (Achorutes (Bilobella); Stach 1951.

Description

Color: orange or white. Fourth antennal segment with a trilobed apical bulb and 5 to 7 blunt setae. Two eyes per side. Unguis untoothed. Tubercles well developed. Head with 8 tubercles. Thoracic segment 1 with dorso-internal tubercle represented by a single short seta. Sixth abdominal segment barely visible from above or (usually completely hidden. Maximum size 2.5 mm.

Remarks

The occurrence of this species in the Nearctic region is dubious. The fourth antennal blunt setae are similar in size in European specimens we have seen. This feature, combined with the unique cephalic chaetotaxy, serves to separate it from all other Nearctic forms with 2+2 eyes. According to Maynard's description of his " aurantiaca", the head has 10 tubercles instead of the 18 described by Caroli; if this is correct, his species, at least, is probably distinct.

Nearctic records: New Mexico (Scott, 1960); New York (Maynard 1951).

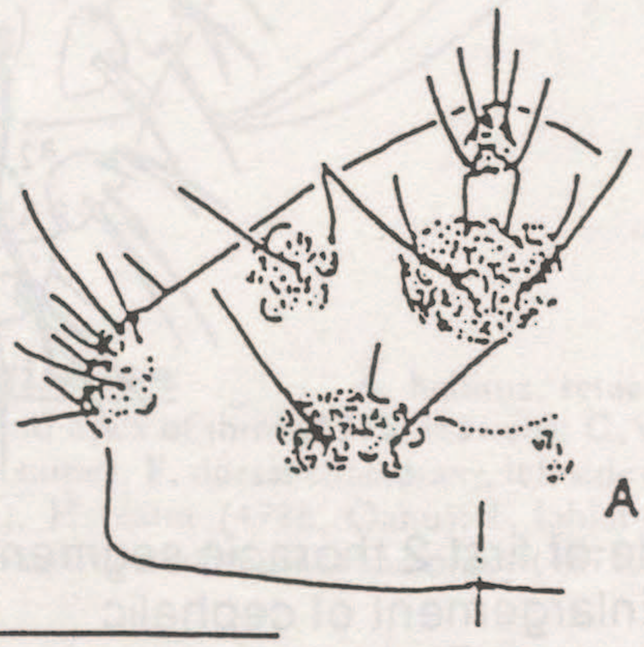
FIGURE 283

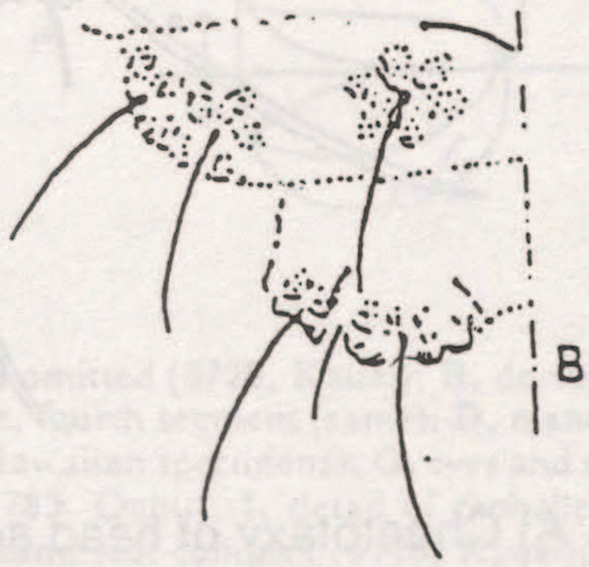
Neanura (Bilobella) aurantiaca

All figures after Massoud, 1967.

A) Cephalic chaetotaxy of left side

B) Chaetotaxy of left side of fourth and fifth abdominal segments.

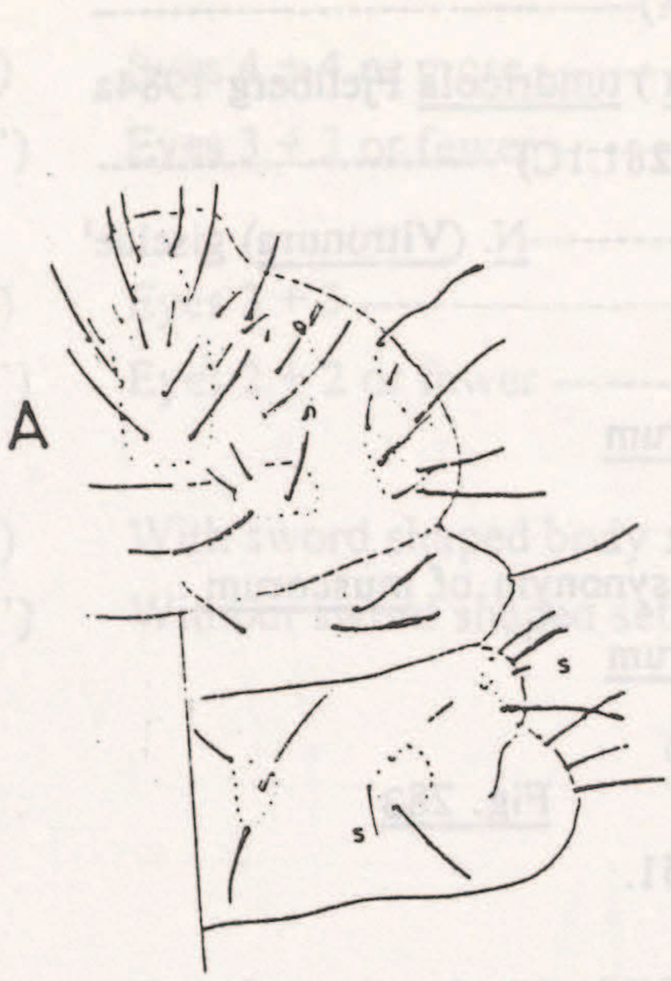


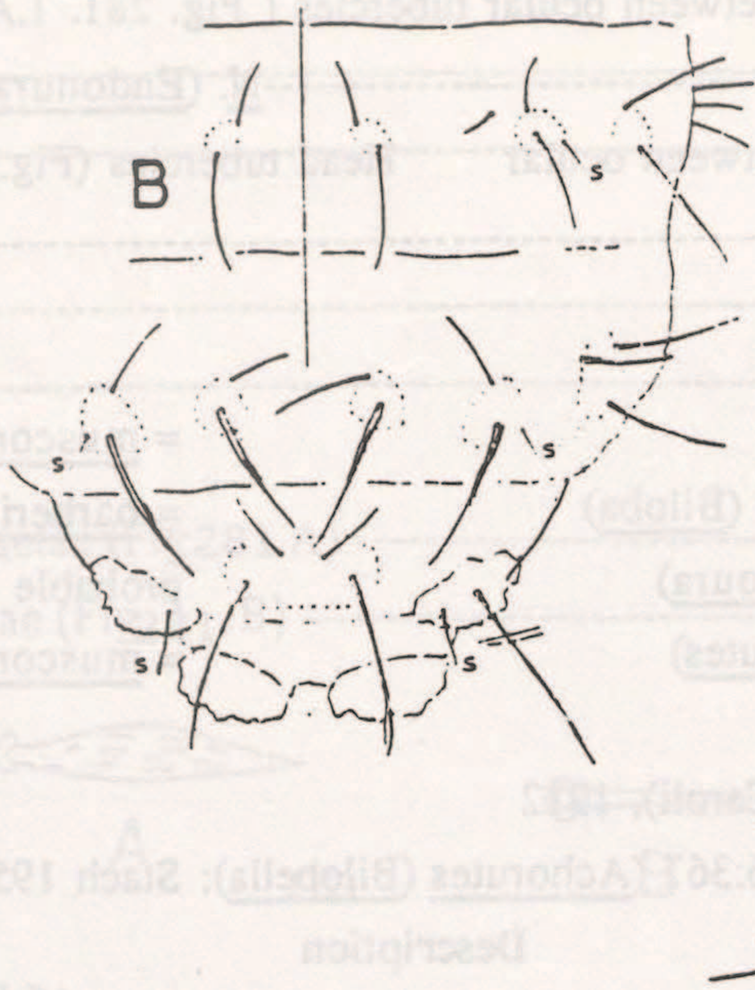


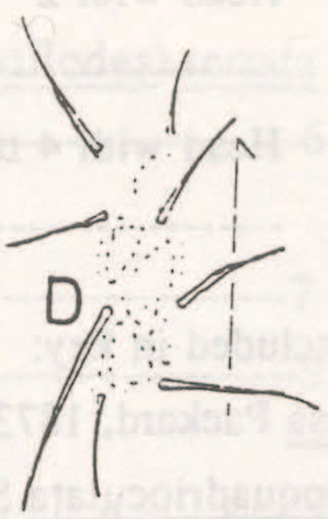
[1] This species has recently been record from Illinois by F. Soto-Adames.

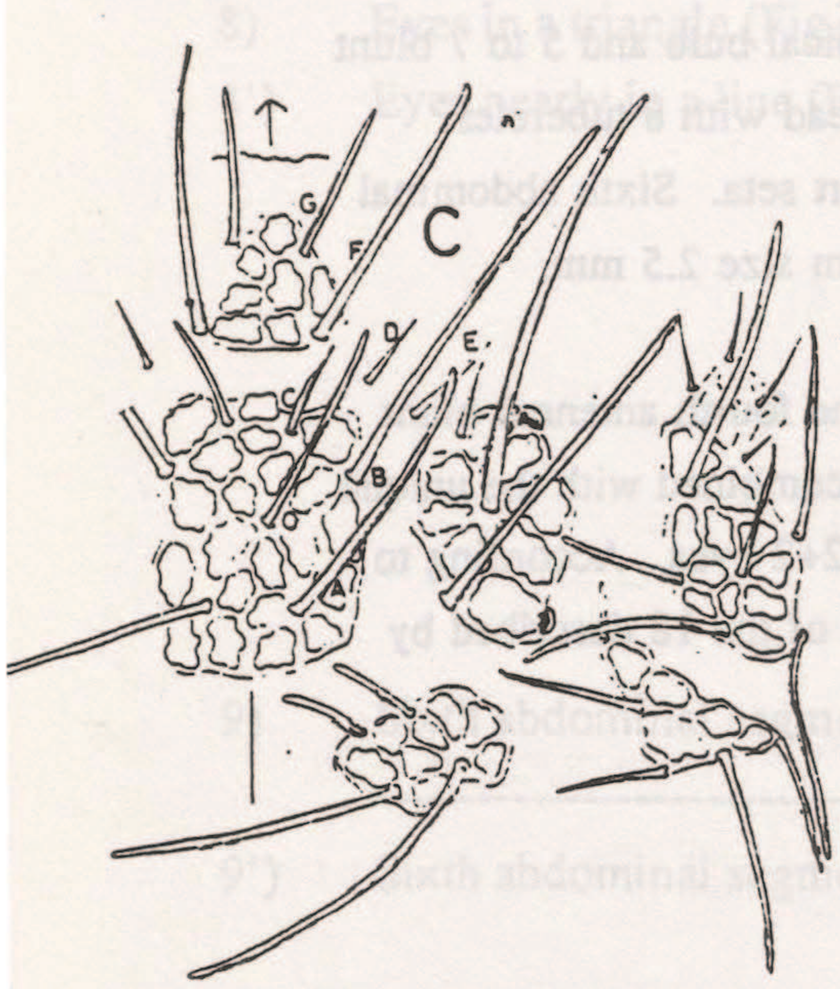
Neanura (Deutonura) frigida Yosii 1969

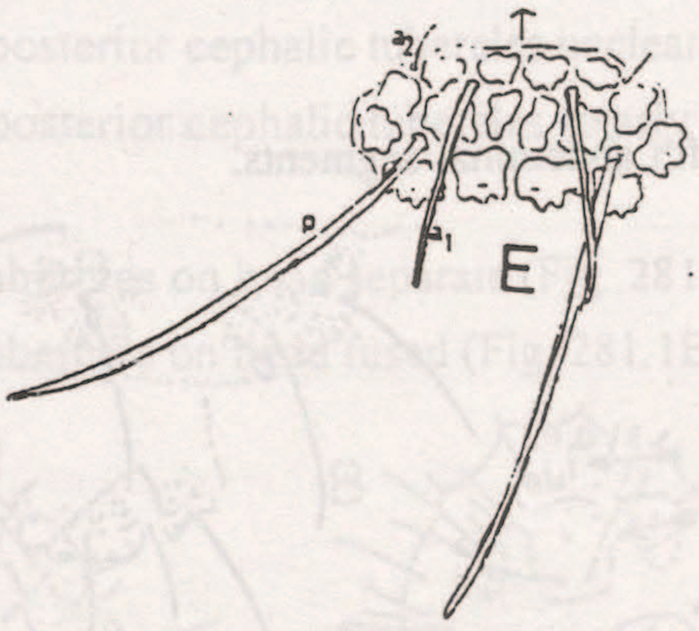
Figure 284

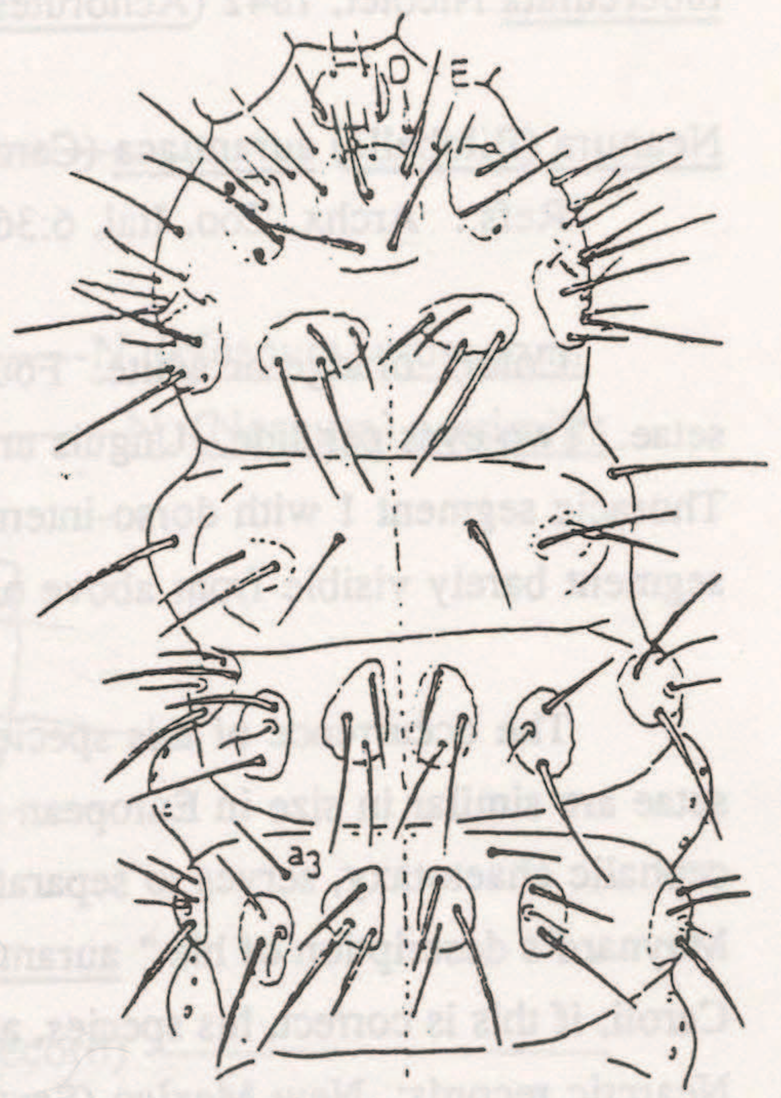


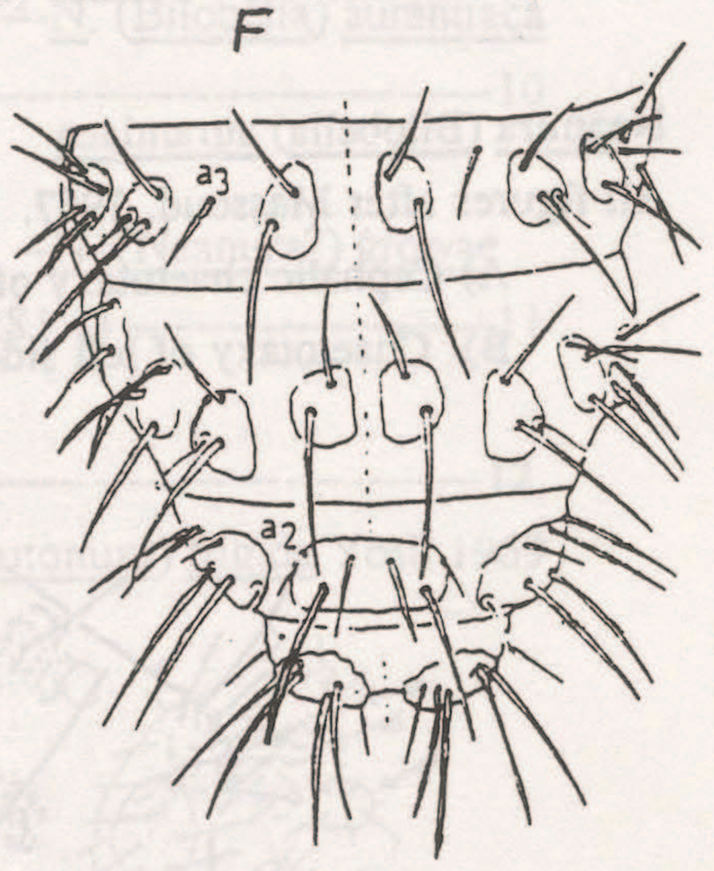






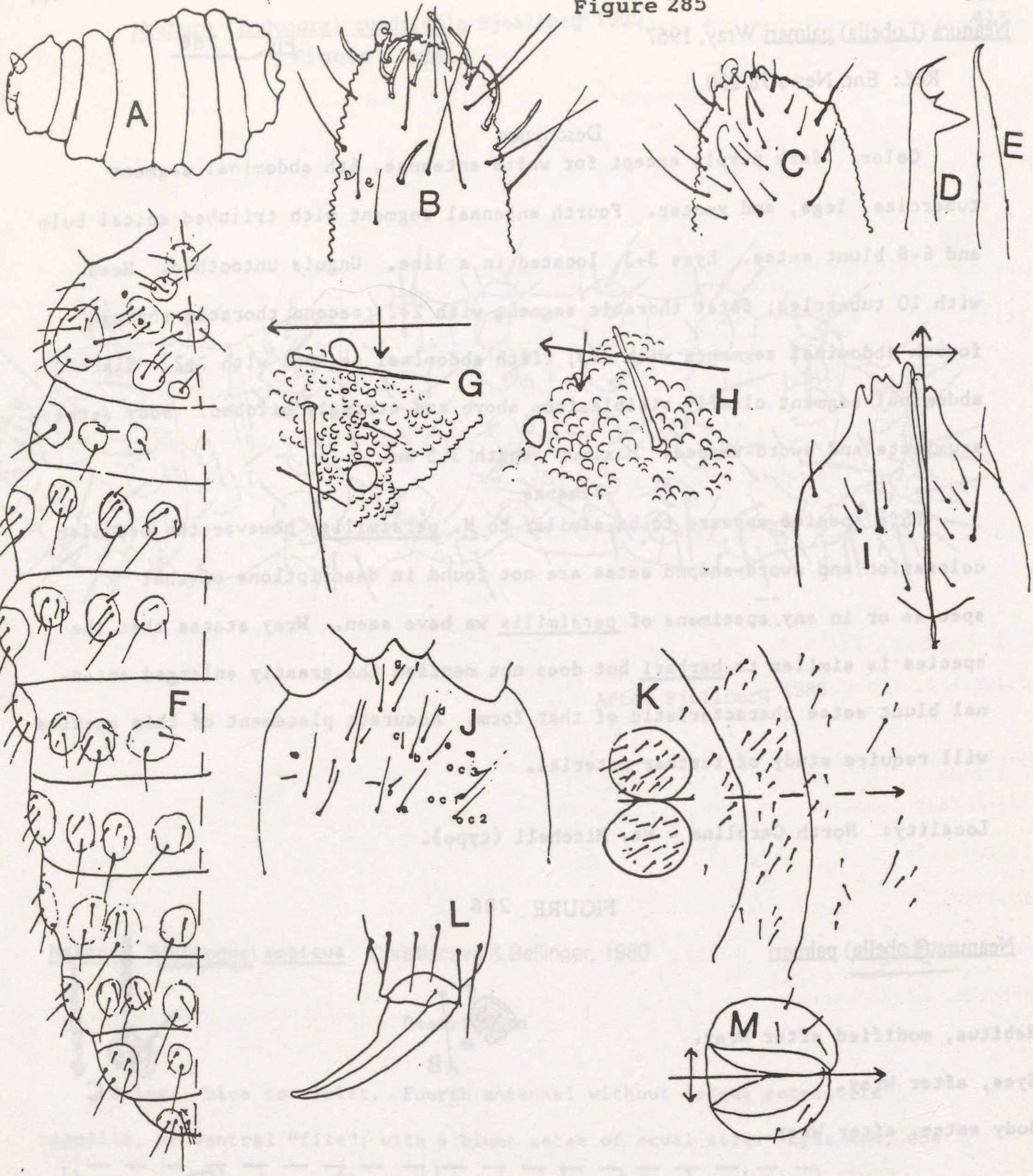






N. (D.) frigida. A) Chaetotaxy of head and right side of first 2 thoracic segments; B) Chaetotaxy of last 4 abdominal segments; C) Enlargement of cephalic chaetotaxy; D) Lateral tubercle of abdominal segment 4; E) Median dorsal tubercle of fifth abdominal segment. After Yosii 1969. F) Dorsal Chaetotaxy.

After Fjellberg 1985



N.(V.) giselae A, habitus, setae and tubercles omitted (6728, Kauai); B, dorsum of fourth antennal segment and apex of third (5345, Hawaii); C, ventral surface, fourth segment (same); D, mandible (4791, Oahu), E, maxilla (same); F, dorsal chaetotaxy, left side (composite, Hawaiian specimens); G, eyes and neighboring setae (4774, Oahu), H, same (4786, Oahu); I, labial chaetotaxy (4783, Oahu); J, detail of cephalic chaetotaxy (4785, Oahu); K, ventral abdominal chaetotaxy (4871, Hawaii); L, hind foot complex (6728, Kauai); M, ventral tube (same).

Neanura (Lobella) palmeri Wray, 1967 Fig. 286

Ref.: Ent. News 78:230.

Description

Color: dark purple except for white antennae, 6th abdominal segment tubercles, legs, and venter. Fourth antennal segment with trilobed apical bulb and 6-8 blunt setae. Eyes 3+3, located in a line. Unguis untoothed. Head with 10 tubercles; first thoracic segment with 2+2; second thoracic through fourth abdominal segments with 3+3; fifth abdominal segment with 2+2. Sixth abdominal segment clearly visible from above and strongly bilobed. Body setae acuminate and sword-shaped. Maximum length 3.5 mm.

Remarks

This species appears to be similar to N. persimilis; however the peculiar coloration and sword-shaped setae are not found in descriptions of that species or in any specimens of persimilis we have seen. Wray states that the species is similar to barberi but does not mention the greatly enlarged antennal blunt setae characteristic of that form. Accurate placement of this species will require study of further material.

Locality: North Carolina - Mt. Mitchell (type).

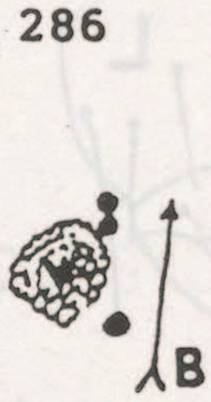
FIGURE 286

Neanura (Lobella) palmeri

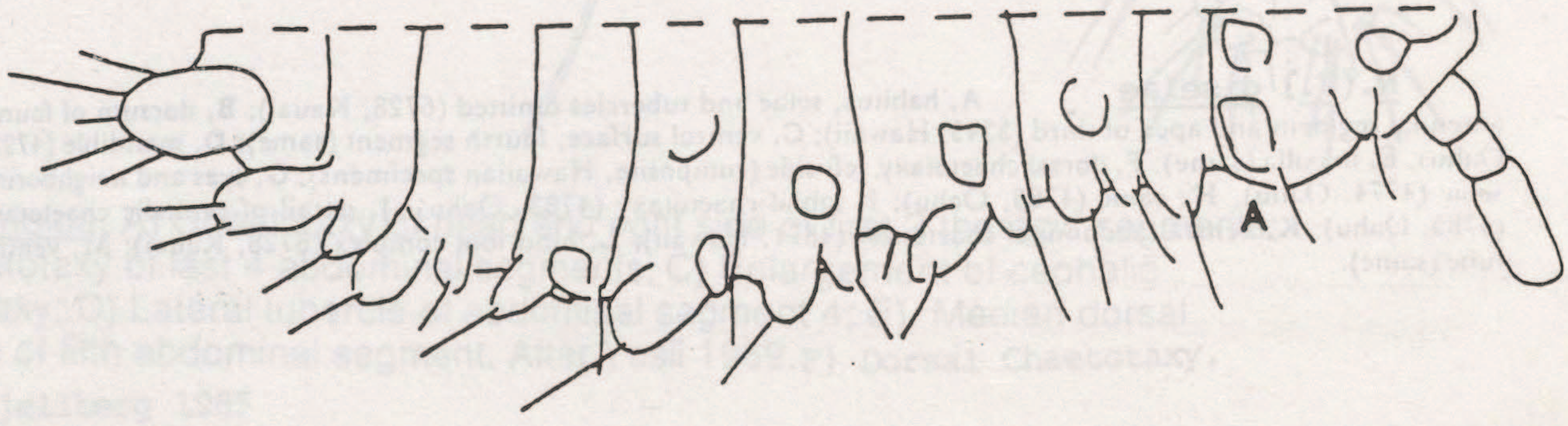
A) Habitus, modified after Wray.

B) Eyes, after Wray.

C) Body setae, after Wray.

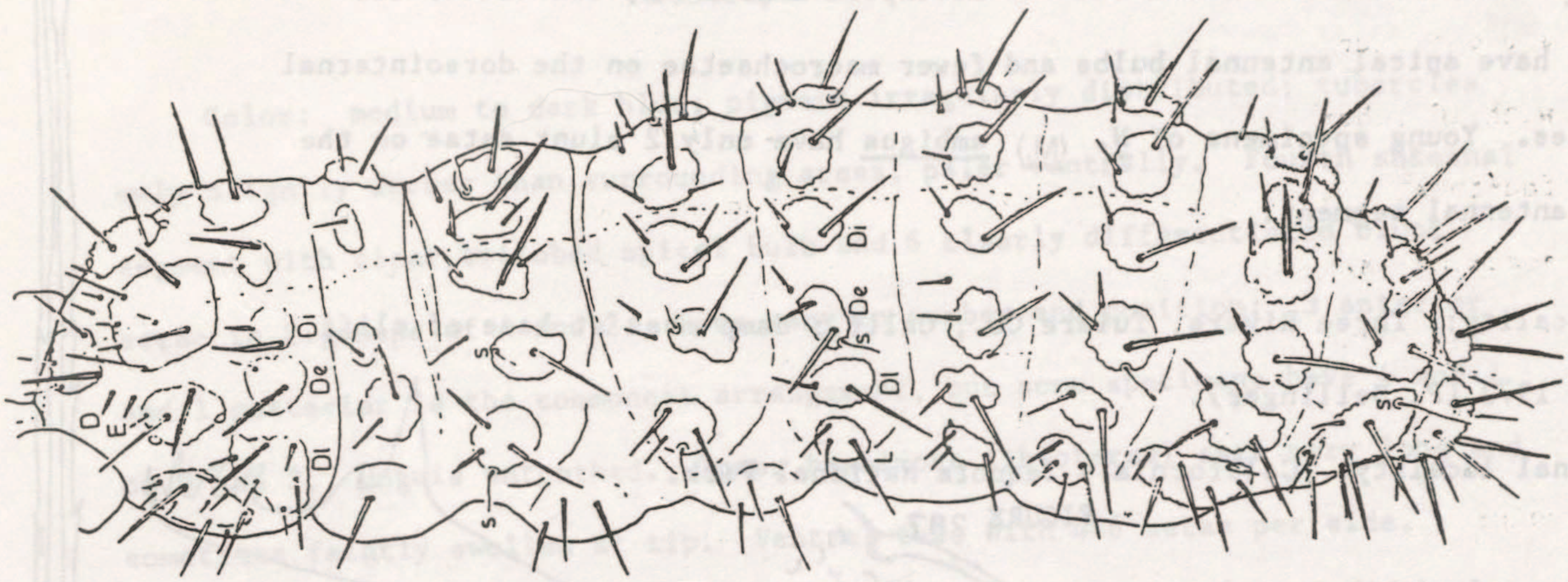






Neanura (Endonura) tundricola Fjellberg 1985

Figure 286.1



After Fjellberg 1985

Neanura (Morulodes) ambigua Christiansen & Bellinger, 1980 Fig.287

Description

Color: blue to violet. Fourth antennal without apical retractile papilla, or ventral "file"; with 6 blunt setae of equal size. Eyes 4+4, the posterior eye remote. Mandible with 7-8 teeth, the apical 2 side by side, the basal tooth the largest. Maxilla with 2 sharply recurved teeth at apex. Unguis with large basal inner tooth. Ventral tube with 4+4 distal setae. Fourth abdominal segment with dorsointernal tubercles fused. Sixth abdominal segment hidden under fifth. Large body setae with several rows of coarse seration

all on one side. Dorsointernal tubercles of second thoracic through third abdominal segments with 4 macrochaetae. Maximum length 2.5 mm.

Remarks

This species is easily confused with N. (N.) setosa or N. (Morulodes) serrata. Aside from the difference in mouthpart structure, the latter two species have apical antennal bulbs and fewer macrochaetae on the dorsointernal tubercles. Young specimens of N. (M.) ambigua have only 2 blunt setae on the fourth antennal segment.

Type locality: Three Rivers, Tulare Co., Calif.; damp moss at base of cliff, 29 Jan. 1973 (P. Bellinger).

Additional locality: California - Sequoia National Park.

FIGURE 287

Neanura (Morulodes) ambigua

All figures of types.

A) Chaetotaxy of right side of dorsum.
B) Middle foot complex.
C) Eye tubercle.
D) Mandible.
E) Maxilla.
F) Posterior macrochaeta.

Neanura (Morulodes) serrata Folsom, 1916 Fig. 288

Ref.: Proc. U.S. natn.Mus. 50:511

Syn.: Morulodes millsi Cassagnau, 1955, Revue fr. Ent. 22: 160
Kodiakia aleuta & K.prima Bödvarsson, 1960.

Description

Color: medium to dark blue; pigment irregularly distributed; tubercles only slightly darker than surrounding areas; paler ventrally. Fourth antennal segment with clear trilobed apical bulb and 6 clearly differentiated blunt setae in 2 groups of 4 and 2. Eyes vary in number and position: 3 anterior and 1 posterior is the commonest arrangement, but some specimens have 4 and 1 or 3 and 2. Unguis untoothed. Inner basalmost tibiotarsal seta very long and sometimes faintly swollen at tip. Ventral tube with 4-6 setae per side. Tubercles of body moderately well developed. Internal tubercles of fifth abdominal segment separate. Sixth abdominal segment sometimes barely visible from above. Setae very heavily serrate, but serrations lacking on one side so that in some views they appear unilaterally serrate; many of larger setae blunt apically. Maximum length 3.0 mm.

Remarks

The maxilla looks very different from different angles, but the elongate fringe is usually visible.

A single specimen from West Virginia is placed here tentatively; it resembles serrata in visible characters except for having a distinct ungual tooth.

Localities: California - Amador Co., Marin Co., Placer Co., Sacramento Co., Santa Cruz Co., Tulare Co.; Idaho - Benewah Co., Shoshone Co.; Oregon - Benton Co.; Washington - Whatcom Co.; West Virginia - Tucker Co. British Columbia - Vancouver.

FIGURE 288

Neanura (Morulodes) serrata

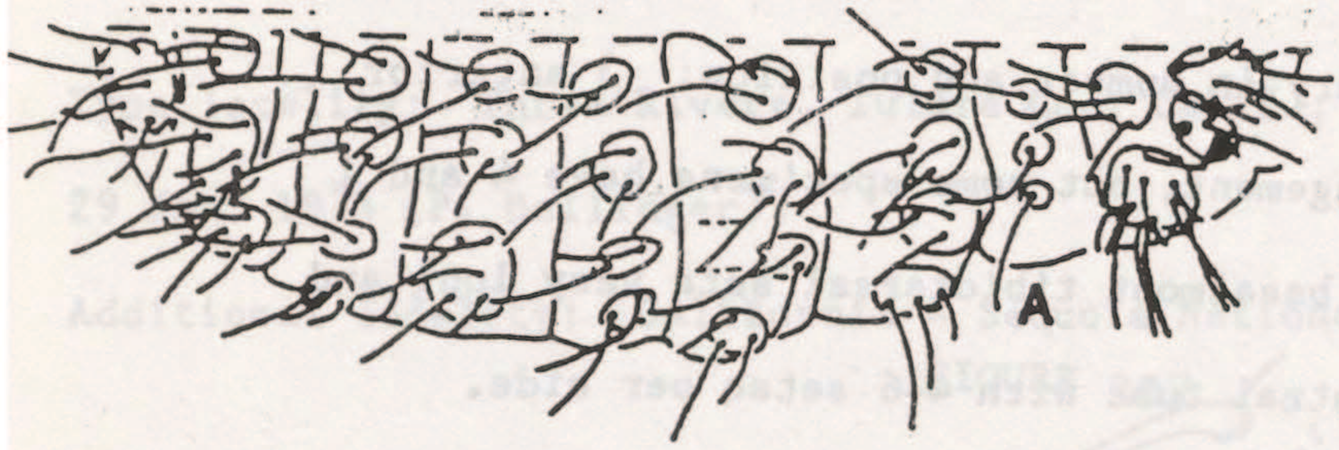
A) Chaetotaxy, specimen from Placer Co., California.

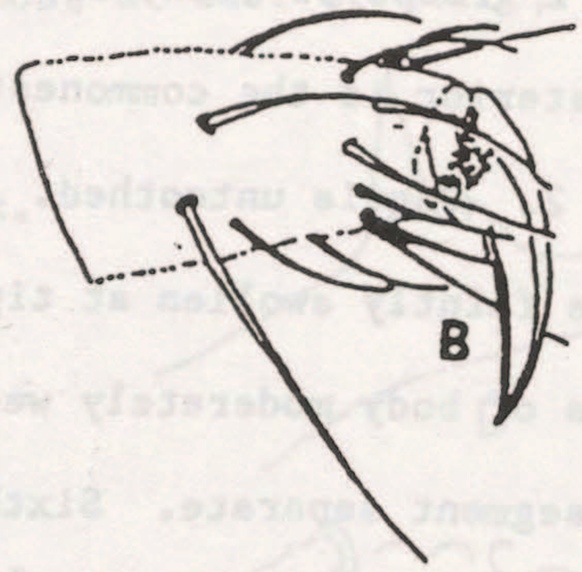
B) Hind tibiotarsus and unguis, after Folsom.

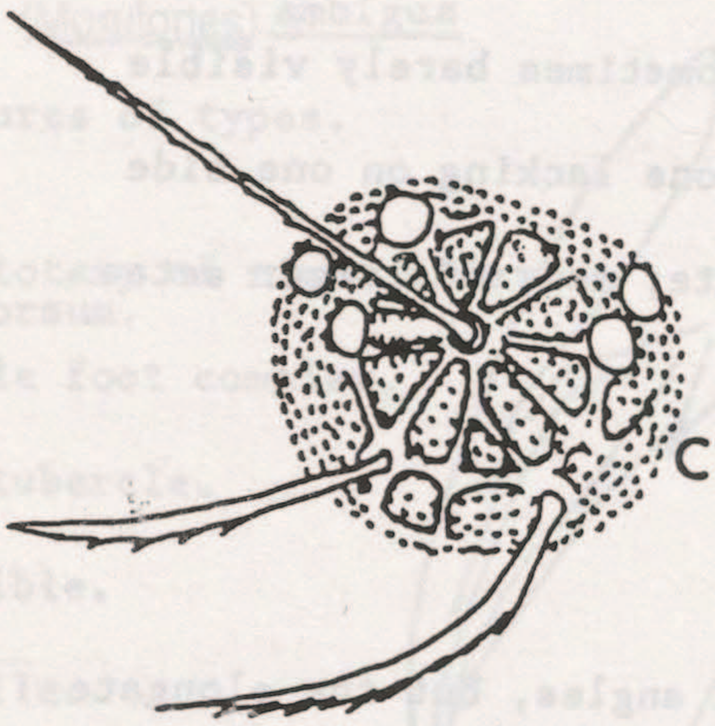
C) Eyes, after Folsom.

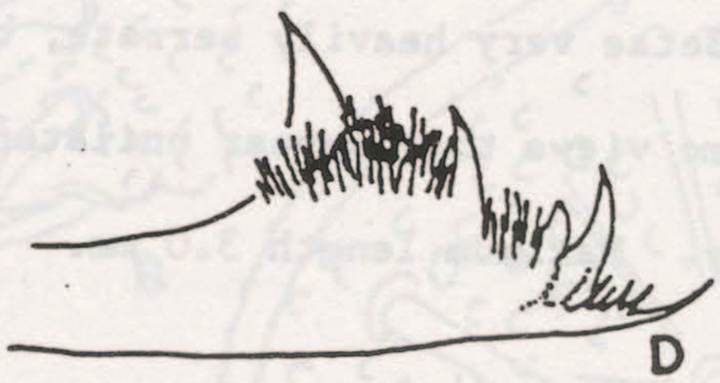
D) Mandible, after Massoud, 1967.

E) Maxilla, after Massoud, 1967.











Description

Color: background whitish to yellow with scattering of reddish or blue pigment; eyes usually darker. Fourth antennal segment with trilobed apical bulb; 7 (rarely 6) clearly differentiated blunt setae; and 14-17 setae in ventral "file." Eyes 4 on each side: 3 anterior and 1 posterior. Mandible as in N. muscorum. Unguis with strong inner tooth. Ventral tube with 4+4 setae. Vestigial furcula of 2 distinct lobes, with 4+4 setae. Sixth abdominal segment completely hidden by fifth. Large body setae heavily and strongly unilaterally serrate. Maximum length 3.0 mm.

Remarks

This is probably the most easily identified species of the genus. The eye number, heavy setae, and strong ungual tooth separate it immediately. A few specimens were seen with only 3 eyes on one side of the head. Superficially this species resembles N. (Morulodes) serrata, but it is easily distinguished by the mouthparts and the toothed unguis.

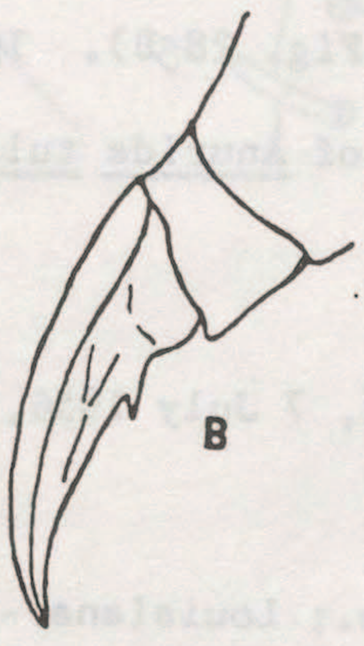
Localities: California - Alameda Co., Amador Co., El Dorado Co., San Bernadino Co. (Type), San Diego Co., San Mateo Co., Santa Clara Co., Solano Co., Yolo Co., Montana - Glacier Co., Silver Bow Co.; Washington - Tampico.

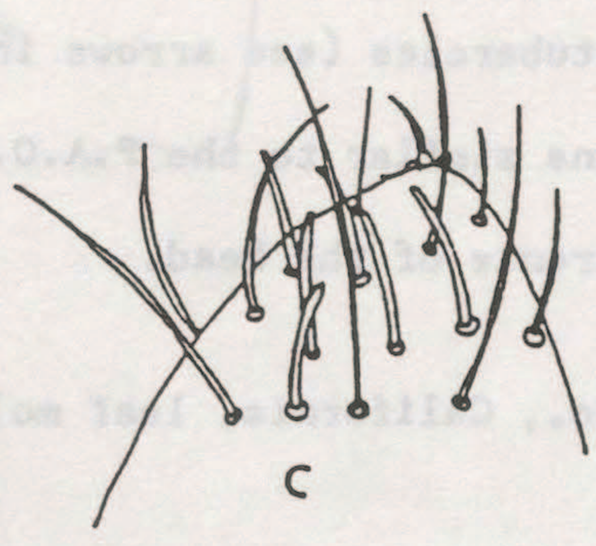
FIGURE 289

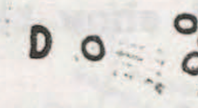
Neanura (Morulodes) setosa

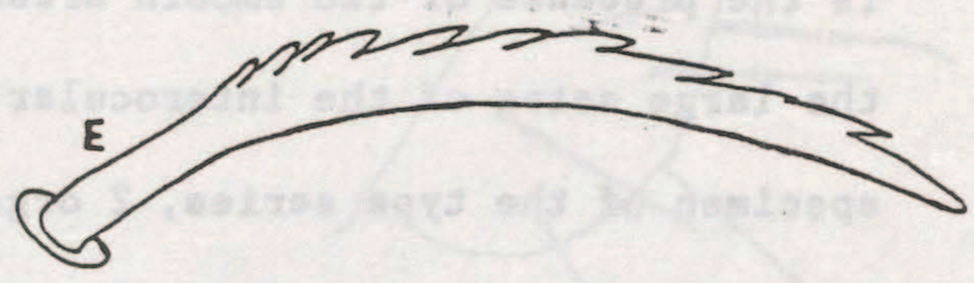
A) Dorsal chaetotaxy of right side, specimen from Santa Clara Co., California.
B) Hind unguis, specimen from Alameda Co., California.
C) Apex of antenna, same specimen.
D) right eyes, after Canby.
E) Body macrochaeta, specimen from Alameda Co., California.
F) Furcula, specimen from same locality.













Neanura (Neanura) growae, Christiansen & Bellinger, 1980 Fig. 290

Description

Color: unknown. Fourth antennal segment with trilobed apical bulb and 8 similar, clearly differentiated blunt setae; ventral "file" poorly developed, consisting of about 12 setae. Eyes 2+2, widely separated. Unguis untoothed. Ventral tube with 4+4 setae. Tubercles poorly developed except on head and posterior abdominal segments. 2 interocular tubercles. Fifth abdominal segment with 4 tubercles. Sixth abdominal segment clearly visible from above, weakly bilobed. Setae acuminate and smooth; slightly blunted on posterior abdominal segments. Maximum length 1.75 mm.

Remarks

The four eyes and similarly formed blunt antennal setae serve to separate this species from all other Nearctic forms. There are a number of exotic species having these characteristics; the peculiar chaetotaxy of the head and last two abdominal segments appear to separate it from all these; however the specimens observed show the chaetotaxy only poorly and further series may show this in fact to be a synonym of one of the four-eyed exotic forms. A peculiar feature is the presence of two smooth areas similar to primitive pseudocelli between the large setae of the interocular tubercles (see arrows in Fig. 285B). In one specimen of the type series, 2 organs similar to the P.A.O. of Anurida tullbergi occur in the posterior lateral quadrants of the head.

Type locality: Big Creek, Fresno Co., California, leaf mold, 7 July 1956, (R. Schuster).

Additional localities: California - Butte Co., El Dorado Co.; Louisiana - Baton Rouge Parish.

(See figure 285 next page)

FIGURE 290

Neanura (Neanura) growae

All figures of type specimens.

A) Chaetotaxy of left side of dorsum of body.

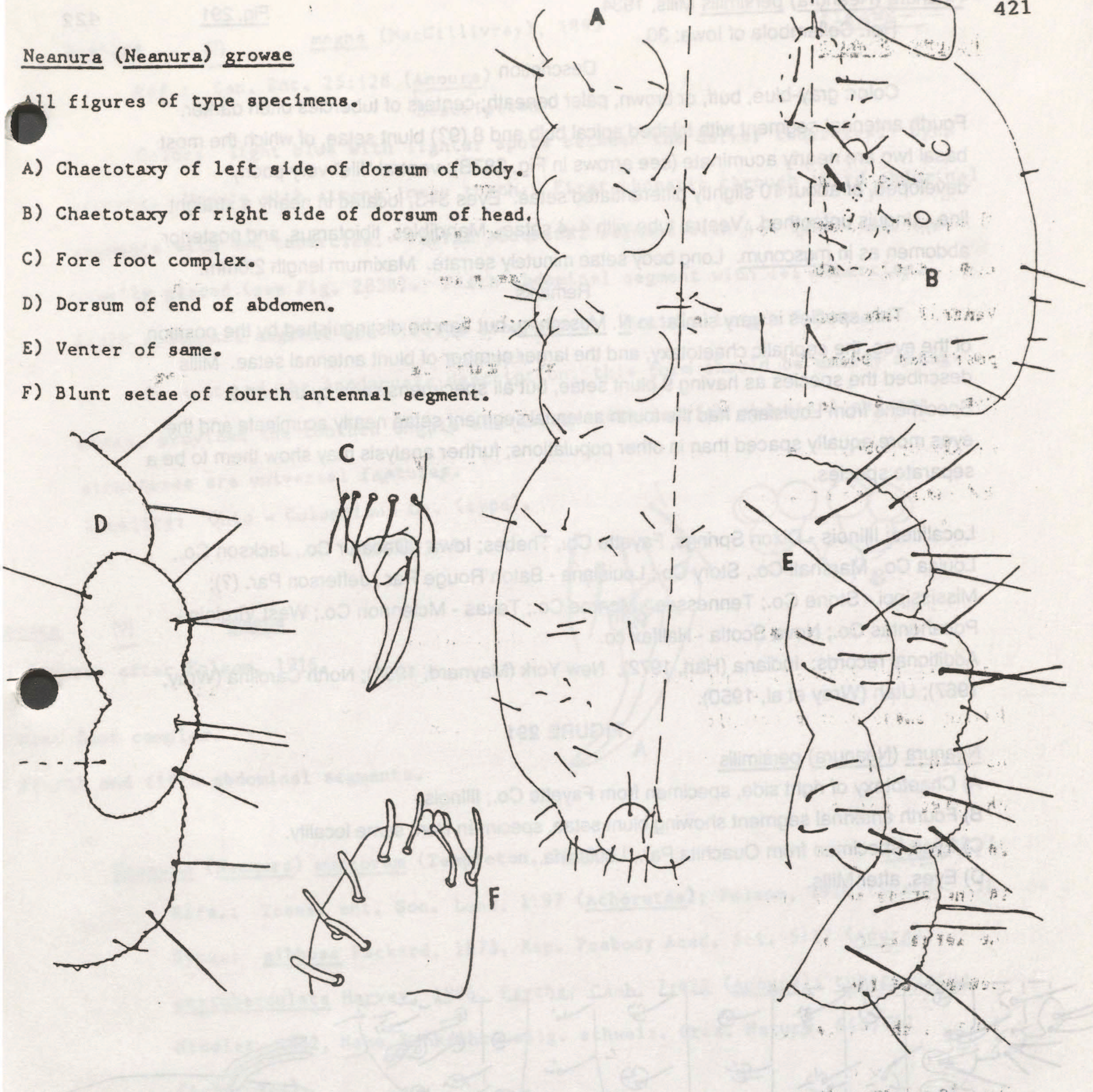
B) Chaetotaxy of right side of dorsum of head.

C) Fore foot complex.

D) Dorsum of end of abdomen.

E) Venter of same.

F) Blunt setae of fourth antennal segment.



Ref. Collembola of Iowa: 30.

Description

Color: gray-blue, buff, or brown, paler beneath; centers of tubercles often darker. Fourth antennal segment with trilobed apical bulb and 8 (9?) blunt setae, of which the most basal two are nearly acuminate (see arrows in Fig. 287B); ventral "file" very poorly developed, of about 10 slightly differentiated setae. Eyes 3+3, located in nearly a straight line. Unguis untoothed. Ventral tube with 4+4 setae. Mandibles, tibiotarsus, and posterior abdomen as in muscorum. Long body setae minutely serrate. Maximum length 2.0mm.

Remarks

This species is very similar to N. Muscorum, but can be distinguished by the position of the eyes, the cephalic chaetotaxy, and the larger number of blunt antennal setae. Mills described the species as having 9 blunt setae, but all specimens seen by us had 8. Specimens from Louisiana had the fourth antennal segment setae nearly acuminate and the eyes more equally spaced than in other populations; further analysis may show them to be a separate species.

Localities: Illinois - Dixon Springs, Fayette Co., Thebes; Iowa - Decatur Co., Jackson Co., Louisa Co., Marshall Co., Story Co.; Louisiana - Baton Rouge Par., Jefferson Par. (?); Mississippi - Stone Co.; Tennessee - Monroe Co.; Texas - Mclennon Co.; West Virginia - Pocahontas Co.; Nova Scotia - Halifax co.

Additional records: Indiana (Hart, 1972); New York (Maynard, 1951); North Carolina (Wray, 1967); Utah (Wray et al, 1950).

FIGURE 291

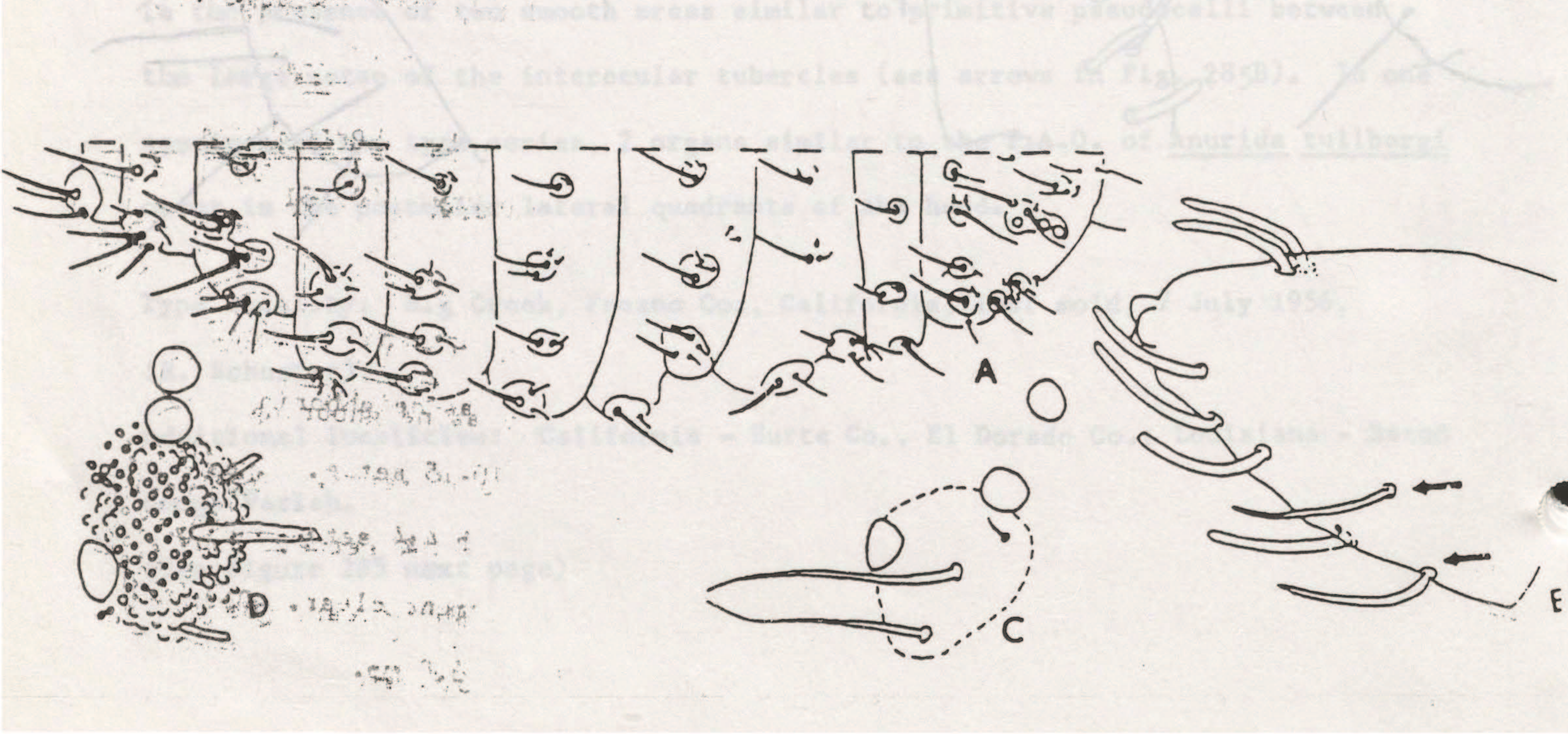
Neanura (Neanura) persimilis

A) Chaetotaxy of right side, specimen from Fayette Co., Illinois.

B) Fourth antennal segment showing blunt setae, specimen from same locality.

C) Eyes, specimen from Ouachita Par., Louisiana.

D) Eyes, after Mills.



Neanura (?) magna (MacGillivray), 1893 Fig 292.

Ref.: Can. Ent. 25:128 (Anoura)

Description

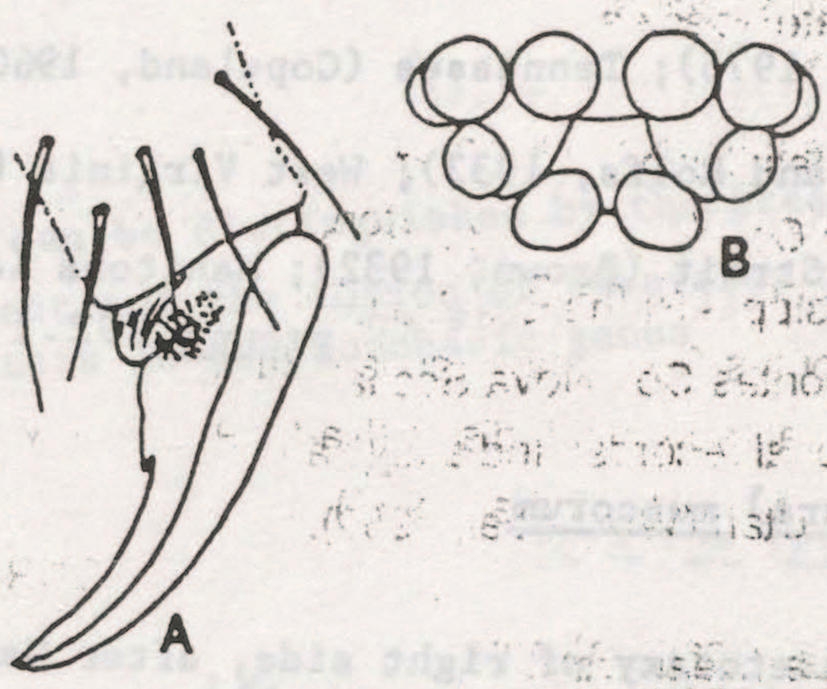
Color: light blue with lighter spots between the darker tubercles. Eyes present. Unguis with strong inner tooth. First thoracic through third abdominal segments with 4+4 tubercles. Fourth abdominal segment with 4+4 tubercles, unusually placed (see Fig. 283B). Fifth abdominal segment with 1+1 tubercles. Sixth abdominal segment not visible from above. Maximum length 5.0 mm.

Remarks

In spite of the inadequate description, this form should be easily recognized, provided the toothed unguis and unusual 4th and 5th abdominal segment structures are universal features.

Locality: Ohio - Columbiana Co. (type).

FIGURE 292



eanura (?) magna

11 gures after Folsom, 1916.

) Hind foot complex.

) Fourth and fifth abdominal segments.

Neanura (Neanura) muscorum (Templeton, 1835) Fig. 292.1

Refs.: Trans. ent. Soc. Lond. 1:97 (Achorutes); Folsom, 1916; Stach, 1L

Syns.: gibbosa Packard, 1873, Rep. Peabody Acad. Sci. 5:27 (Anura); sextuberculata Harvey, 1896, Psyche, Camb. 7:422 (Anoura); tuberculatus Nicolet, 1842, Neue Denkschr. allg. schweiz. Ges. Naturw. 6(3):51 (Achorutes).

Description

Color: medium to dark blue; paler ventrally. Fourth antennal segment with trilobed apical bulb, 6-7 blunt setae (about as thick as neighboring acuminate setae), and poorly developed ventral "file" of 10-15 setae. Eyes 3+3 forming triangles. Unguis untoothed. Ventral tube with 4+4 setae. Body tubercles well developed; bilobation of sixth abdominal segment clear. Body setae acuminate, smooth or weakly serrate. Maximum length 3.0 mm.

Remarks

Most of the Nearctic specimens seen agree well with the European forms except for the lateral cephalic chaetotaxy, which varies somewhat, particularly in southern specimens. This in the commonest form of the subfamily east of the Great Plains. Two very small specimens (from Massachusetts and Quebec) showed only two blunt olfactory setae; this probably is a characteristic of early instars.

Localities: Arizona (?); Connecticut, Indiana, Illinois, Iowa, Kentucky, Louisiana, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Ohio. Canada - Ontario.

Additional records: California (Wilkey, 1959); Colorado (Wilkey, 1951); Idaho (Wray and Knowlton, 1956); Illinois (Graves, 1960); Minnesota (Guthrie, 1903); North Carolina (Wray, 1967); South Carolina (Metz and Dindal, 1975); Tennessee (Copeland, 1960); Utah (Wray et al, 1950); Washington (Mills and Rolfs, 1933); West Virginia (Lippert and Butler, 1976). Canada - Hudson Strait (Brown, 1932); Manitoba (Aitchison, 1974); Ungava Bay (Davis, 1936).

FIGURE 292.1

Neanura (Neanura) muscorum

A) Cephalic chaetotaxy of right side, after Gama, 1964.

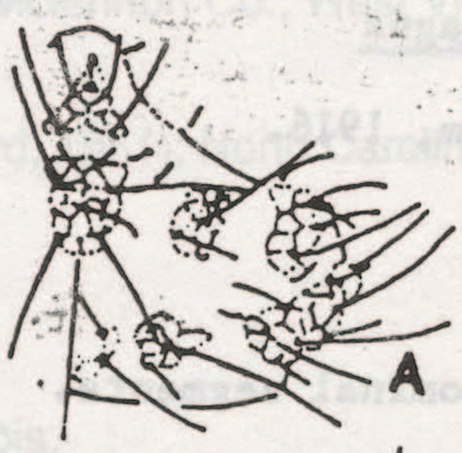
B) Chaetotaxy of right side of body, after Massoud, 1967.

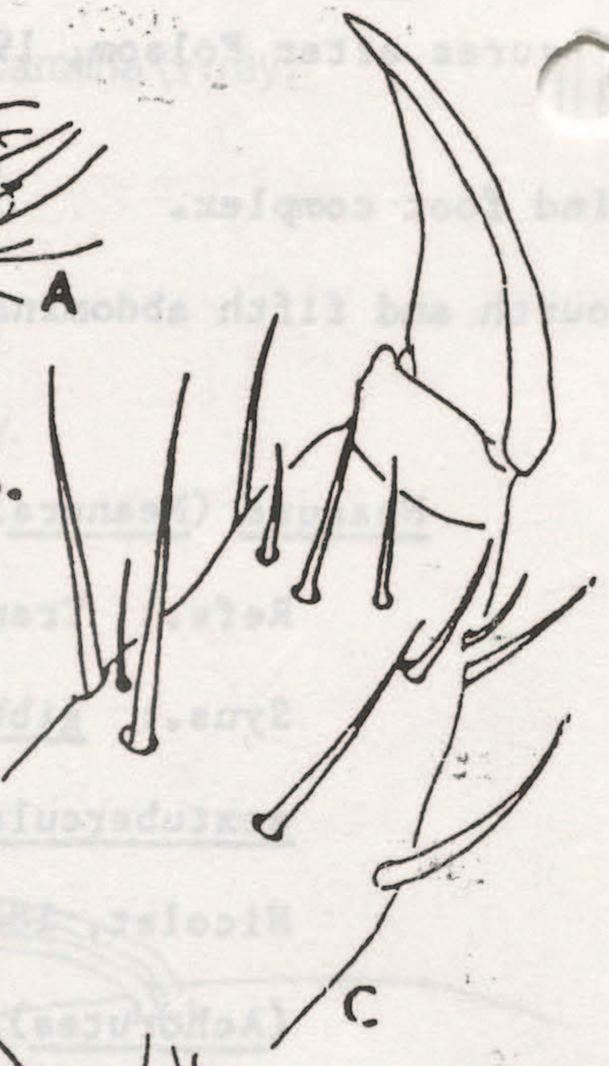
C) Hind foot and tibiotarsus, specimen from Kirkwood Township, Ontario.

D) Dorsum of fourth antennal apex, specimen from same locality.

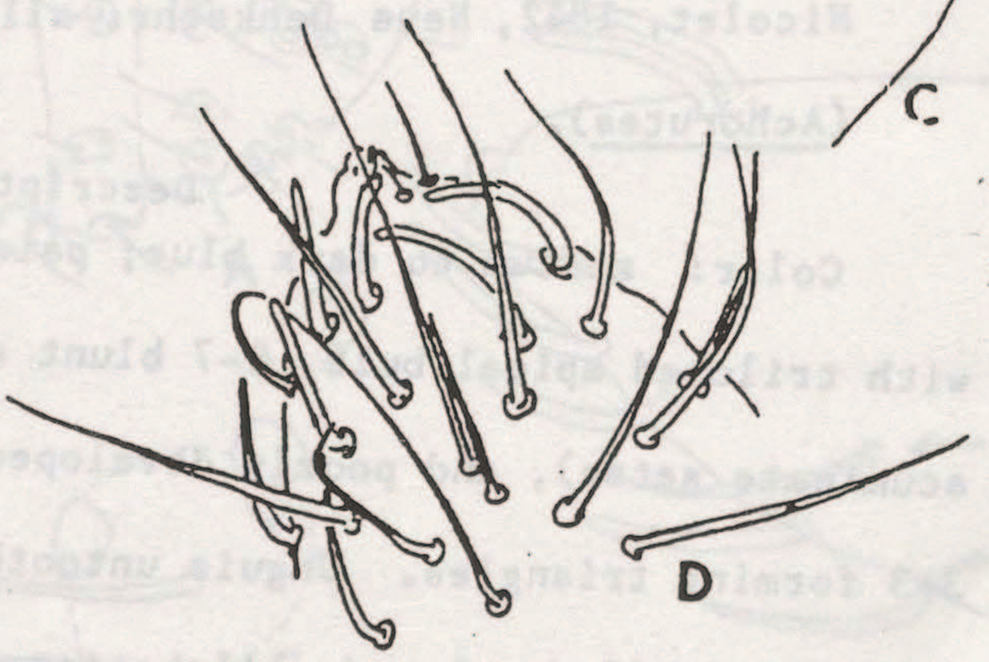
E) Eye tubercle, after Folsom.

F) Mandible, specimen from same locality as C.













Neanura (Christobella) ornata Folsom, 1902

Fig.292.2

Ref.: Proc. Wash. Acad. Sci. 4:89.

Description

Color: white, including eyes. Fourth antennal segment with apical bulb obscure; with 5 large, subequal blunt setae; ventral "file" poorly developed. Eyes 3+3, almost in a line; posterior eye sometimes absent (?). Unguis with prominent inner tooth. Tubercles of head fused together. Fifth abdominal segment with tubercles fused into a single mass. Sixth abdominal segment hidden from above, bilobed. Setae thick and acuminate, prominently unilaterally serrate. Maximum length 1.4 mm.

Remarks

This species resembles N. bullsa but can be distinguished by the presence of eyes. The hidden sixth abdominal segment and the fusion of tubercles on the fifth and sixth abdominal segments place this in the monobasic genus Christobella Fjellberg, 1985.

Locality: Alaska - Sitka (type).

FIGURE 292.2

Neanura (Christobella) ornata

A) Habitus, modified after Folsom.

B) Dorsum of head, modified after Folsom.

C) Hind tibiotarsus and foot, after Folsom.

D) Apex of fourth antennal segment, type specimen.

E) Setae of second thoracic segment, after Folsom.



