

A Revision of the
North American Moths of the
Superfamily Eriocranioidea
with the Proposal of a New Family,
Acanthopteroctetidae (Lepidoptera)

DONALD R. DAVIS

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ABSTRACT

Davis, Donald R. A Revision of the North American Moths of the Superfamily Eriocranioidea with the Proposal of a New Family, Acanthopteroctetidae (Lepidoptera). *Smithsonian Contributions to Zoology*, number 251, 131 pages, 344 figures, 3 tables, 6 maps, 1978.—The general biology, biogeography, morphology, and classification are reviewed for the five genera and 16 species (including one subspecies) of North American Eriocranioidea. One new genus, *Neocrania*; one new subgenus, *Disfurcula*, of *Eriocraniella*; nine new species, *Eriocrania breviapex*, *Eriocraniella xanthocara*, *E. longifurcula*, *E. platyptera*, *E. variegata*, *E. trigona*, *E. falcata*, *Neocrania bifasciata*, and *Acanthopteroctetes unifascia*; and one new subspecies, *Eriocrania semipurpurella pacifica*, are described. A new family, Acanthopteroctetidae, is proposed for the endemic North American genus, *Acanthopteroctetes*. The Australian-Fijian family Agathiphagidae is removed from the Eriocranioidea and placed in the new superfamily Agathiphagoidea. Distribution maps and keys are provided for all species. The larval stages for nearly half of the known Nearctic eriocraniid species are described for the first time. All stages are fully illustrated by line drawings and photographs.

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A Revision of the North American Moths of the Superfamily Eriocranioidea with the Proposal of a New Family, Acanthopterocetidae (Lepidoptera)

Donald R. Davis

Introduction

The superfamily Eriocranioidea contains some of the most primitive elements within the order Lepidoptera; consequently, a thorough study of its members should be of considerable importance to anyone interested in the phylogeny and systematics of the order. The superfamily is further interesting in that it is believed to represent one of the first successful phyletic lines within the Lepidoptera to explore and fully utilize the leaf-mining habitat. Largely for these reasons, it has become imperative that a revision of our North American species be undertaken. From the relative number of new taxa and information presented on the following pages, it should be apparent that such an investigation has been long overdue.

The present study represents the first attempt to revise the Nearctic Eriocranioidea. Although the completion of this revision has been somewhat curtailed by the absence of a similar treatment for the Palearctic species, much information concerning the Old World fauna has been derived from an examination of most of the known species as well as from critical data generously supplied me by sev-

eral colleagues. The European Eriocraniidae have been superficially reviewed by such early workers as Spuler (1910), or reviewed more recently for specific countries by Heath (1958, 1976) and Razowski (1975).

This report marks the first in a series of investigations by the author on select families of North American leaf-mining moths. The research has been partially supported by grants from the Smithsonian Research Foundation. In addition to this aid, I would like to acknowledge several individuals who have helped me during the course of this study by providing critical information or special assistance. In this regard I wish to thank Dr. Robert Carlson, United States Department of Agriculture, Washington, D.C.; Mr. John Heath, Monks Wood Experimental Station, Huntingdon, England; Prof. Syuti Issiki, Ito City, Japan; Dr. Niels Kristensen, Zoologisk Museum, Copenhagen, Denmark; Dr. Tosio Kumata, Hokkaido University, Sapporo, Japan; Dr. Akira Mutuura, Entomology Research Institute, Ottawa, Ontario; Dr. Paul Opler of the Office of Endangered Species, United States Department of the Interior, Washington, D.C.; and Dr. A. K. Zagulajev, Zoological Institute, Academy of Sciences, Leningrad, USSR. I wish especially to express my appreciation to Mr. Heath and Dr. Kristensen for assisting me with numerous inquiries re-

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lating to this problem. Most of the line illustrations in this paper were completed under contract by Miss Ann Szymkowitz, variously assisted by me and by the following staff artists of the Department of Entomology, Smithsonian Institution: Miss Biruta Akerbergs, Mr. Lawrence Druckenbrod, Mr. Ambrose Nelson, and Mr. George Venable. I am indebted to Mr. Victor Kranz of the Smithsonian Photographic Laboratory and to Miss Mary Mann and Mr. Walter Brown of the Scanning Electron Microscope Laboratory for their much appreciated photographic assistance. Finally, I wish to thank my colleagues at the institutions and collections listed below for allowing me to examine specimens under their care or for other assistance.

AMNH	American Museum of Natural History, New York, New York
BMNH	British Museum (Natural History), London, England
BrM	Collection of Bryant Mather, Clinton, Mississippi
CAS	California Academy of Sciences, San Francisco, California
CNC	Canadian National Collection, Entomology Research Institute, Ottawa, Canada
CPK	Collection of Charles P. Kimball, Barnstable, Massachusetts
DCF	Collection of Donald C. Frack, La Puente, California
JBH	Collection of John B. Heppner, Gainesville, Florida
LACM	Los Angeles County Museum, Los Angeles, California
NSM	Nova Scotia Museum, Halifax, Nova Scotia
RHL	Collection of Ronald L. Leuschner, Gardena, California
UCB	University of California, Berkeley, California
UCR	University of California, Riverside, California
USNM	United States National Museum collections (in the National Museum of Natural History, Smithsonian Institution, Washington, D.C.)

Biology

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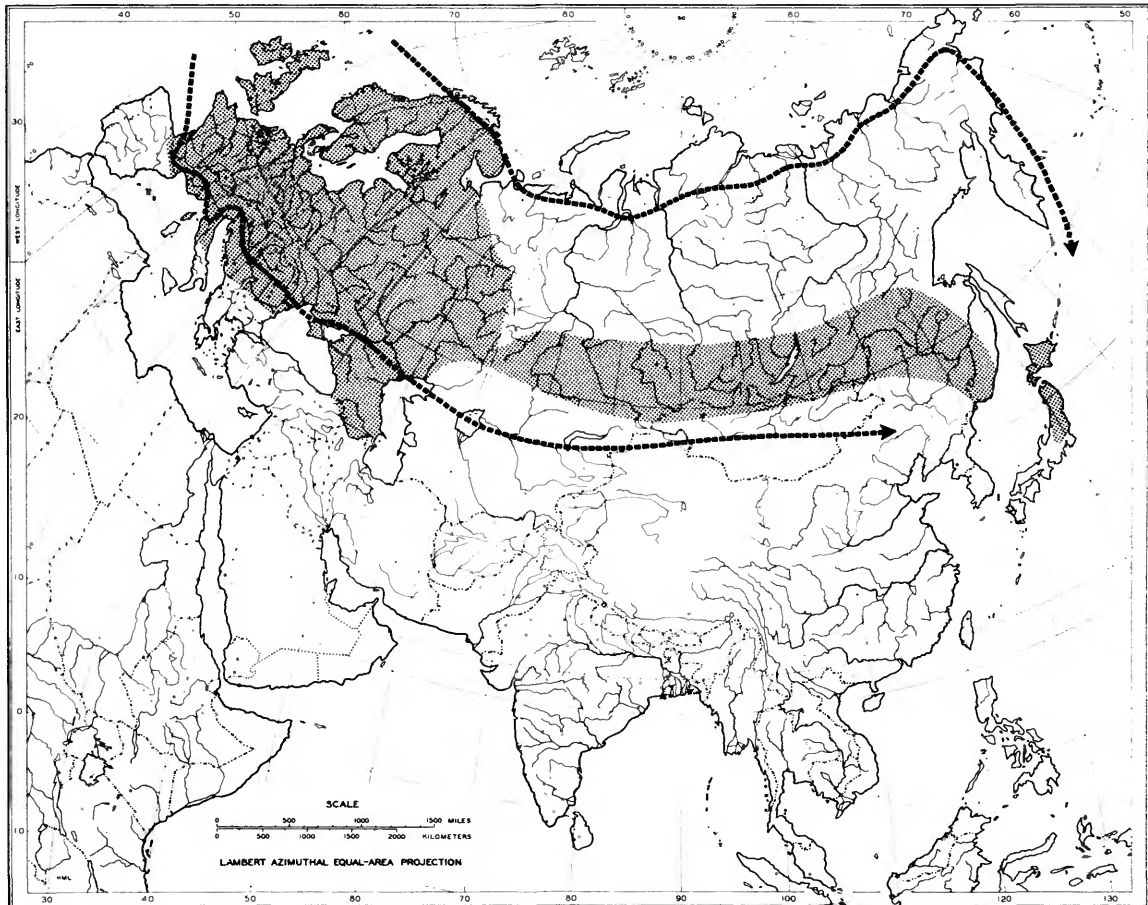
MAPS 1-6

All members of the Acanthopteroctetidae and Eriocraniidae are confined to the Holarctic region. Prior to this study, the Eriocraniidae was known principally from the Palearctic region, but recent collecting in North America has shown the family to be even more diversified in the New World. Meyrick (1921b) lists 12 species of Eriocraniidae as occurring in Europe; one or two of these names

have since been synonymized, and at least two additional names were proposed subsequently. The great majority of the Palearctic species are known primarily from western Europe, but at least two species have been reported from northern Japan. The distribution of this family in Asia is very poorly known because of insufficient collecting in several critical areas. From the scant records presently available, it appears that the northern and southern distributional limits of the family through this area may roughly approximate that of one of the common host species, *Betula pubescens* Ehrhart as outlined by Schmucker (1942, map 69) and partially reproduced herein on Map 1.

Previously, only three genera including seven species of Eriocranioidea were known from North America. One of these species, *Micropteryx* [sic] *luteiceps* Walker, has been found to be a new (junior) synonym of *Paraclemensia acerifoliella* (Fitch), a member of the monotrystian family Incurvariidae. Another species, *Dyseriocrania cyanosparsella* (Williams) is treated as a junior synonym of *D. auricyanea* (Walsingham) in this paper. Despite these new synonymies, the North American fauna has been found to include at least 15 species and one subspecies distributed in two families and five genera. Of these, one family and three genera appear to be indigenous to the Nearctic region. Briefly mentioned, but not named in the present study, are representatives of five additional, endemic species. One of these, known only from a unique male in imperfect condition from Ontario, Canada, may also represent an additional, undescribed genus. The general distribution of the superfamily in North America is intimately associated with the two principal montane features of our continent, the western North American Cordillera and the eastern Appalachian Highlands. No members of Eriocranioidea are known to occur from the vast Interior Plains.

The genus *Dyseriocrania* is presently represented by two Nearctic species and at least one western Palearctic species. The two North American species are amply separated by the Interior Plains of the continent, with the eastern *D. griseocapitella* (Walsingham) ranging widely through the Appalachian Highlands and the adjacent Atlantic Coastal Plain; the western *D. auricyanea* (Walsingham) is confined to the southern ranges and coastal valleys of the Pacific Mountain system.



MAP 1.—General distribution of Palearctic Eriocraniidae (shaded area) in relation to *Betula pendula* Roth (dotted line).

Although the genus *Eriocrania* contains several Palearctic species, only two distinct members of this group have been discovered thus far in North America; however, some evidence exists for yet another species. One of our North American species, *E. semipurpurella* (Stephens), also ranges widely through the Palearctic region, reportedly from Great Britain to Japan. In North America, the typical form of this species is restricted primarily to the northern Appalachian Highlands and St. Lawrence Valley region, with a widely disjunct, western form, *E. s. pacifica*, new subspecies, occurring at low elevations along the northern Pacific Coast Ranges. One new species, *E. breviapex*, from

the Appalachian Plateau of New York is apparently endemic to North America.

The endemic genus *Eriocraniella* has its main center of distribution and probable origin in the western United States where two subgenera and seven species are known to occur. Evidence for an eighth species exists. Only one member of this group is known from the entire eastern United States, this being *E. platyptera*, new species, from the Appalachian Plateau of New York. In this regard, it is of interest to note that the latter shares closest affinities with *E. longifurcula*, new species, the most eastern ranging of the western species and the only member of that assemblage not restricted to cison-

tane California.

The new genus *Neocrania* presently contains only one species endemic to the coastal ranges of southern California.

The family Acanthopteroctetidae is represented by a single genus *Acanthopteroctetes*, which is indigenous to western North America. Although only three species are currently recognized for our fauna, evidence for two others is available. Most of the collection records to date indicate that the members of this genus prefer relatively cool, wet, boreal habitats; however, the only known habitat of *A. unifascia*, new species, is that of a relatively dry, coastal chaparral biota.

LIFE HISTORY

All records to date indicate the members of Eriocranioidea to be consistently univoltine with the adult moths emerging relatively early in the spring or late winter, usually during February to late May depending upon the latitude or elevation. Some adults of the genus *Acanthopteroctetes* have been collected as late as mid-July. The early seasonal emergence of the adults has undoubtedly contributed to the usual sparseness of specimens in collections and the frequent lack of adequate study material and distributional records.

The Eriocranioidea are of minor economic importance, with only a single reference to date alluding to larval damage by a member of this group. Keifer (1927) reported a heavy infestation of *Dyseriocrania auricyanea* (Walsingham) in the leaves of live oak, *Quercus agrifolia* Neé, in San Francisco, California.

The adults may often be found resting on foliage or tree trunks in the early morning. Their flight, according to Williams (1905), tends to be in a slow, direct manner. Williams also noted that the moths, when captured by net, would sometimes feign death and lie motionless in the bottom of the bag. The adults are typically diurnal and are capable of flight anytime during the daylight or evening hours. Opler (1974) observed the adults of *Dyseriocrania auricyanea* to be most active in the hours just before sunset.

The highly modified, piercing ovipositor enables the female to insert the egg under the leaf epidermis. The eggs are usually laid singly into young leaves in the process of opening and expanding.

Wood (1890) presents evidence to suggest that the females of *Eriocrania haworthi* Bradley (= *purpurella* Haworth) deposit more than one egg per site and often three. Because of the partially unopened condition of the developing leaves, a female eriocraniid frequently oviposits on the underside of a leaf. As summarized by Needham et al. (1928), the time required for the female to cut an incision and deposit an egg may vary from 2.5 to 15 minutes, largely depending upon the relative temperature. After the eggs have been deposited, they may swell to more than twice their original size.

As a direct result of the damage done to the leaf tissue during oviposition, an oval hole, or insertion scar (Figure 134), typically develops soon after an egg has been deposited. The scar may be obliterated later by the developing mine, but often it persists as a small hole, usually measuring 1.5–2.0 mm in length and 1.0–1.2 mm in width. Normally evident along one side of the insertion scar is a small, reddish brown, cylindrical ovate egg pouch (Figure 164) often measuring 0.7–0.9 mm by 0.3–0.4 mm. Inside each egg pouch can normally be found the remains of a single egg. The formation of the egg pouch is not completely understood, but it may result from the relative adhesiveness of the egg chorion to the leaf epidermis with the eventual drying and collapsing of the leaf epidermis around the egg.

Within 7 to 15 days the first instar larva emerges and initiates a narrow, rather serpentine mine directed either toward or along the outer margin of the developing leaf. Again, this stage of the mine may sometimes be obliterated by the later feeding of the larva. Frequently, in *Dyseriocrania griseocapitella*, the linear mine forms a line of weakening across the leaf that later may rupture forming a narrow fissure. The length of the linear mine varies according to the species, usually ranging from 5 to 40 mm in length.

The termination of the linear, serpentine mine probably signals the initiation of the second larval instar. After this the mine either gradually or abruptly enlarges to form an irregular blotch that often is longer than wide. In some species the blotch tends to be very elongate and follows the margin of the leaf; in others an entire section (e.g., the apical third) of a leaf may be mined resulting in a much broader blotch. All of the parenchyma is devoured within the blotch, thus producing a full

depth, translucent mine. As noted by Kearfott (1902), the larva while feeding normally sweeps in small circles of 5 mm or more radius with its anal end functioning as a pivot. The final pattern of the mine usually results from a series of these semicircular movements marked by a series of fine, concentrically curved lines. The frass produced by eriocraniid larvae is characteristic in consisting of relatively long, slender segments or threads that are loosely scattered and intertwined within the mine. As noted by previous authors (Wood, 1890; Opler, 1974), a total of four larval stages are believed to exist, with the last three being responsible for the blotch mine. At maturity, only a single larva normally occupies each mine. In the case of *Eriocrania haworthi* (= *purpurella*), however, Wood (1890) has reported as many as six larvae per mine. Larval development proceeds rather rapidly and within 7 to 10 days all feeding ceases.

The immature stages of Eriocraniidae are not restricted to a leaf-mining habitat in that pupation occurs in the soil. In emerging from the leaf, the larva cuts a small semicircular slit in the upper epidermis and drops to the ground. The larva then digs down into the soil to a depth of 2 to 10 inches, probably depending in part upon the relative compactness of the soil. There the larva creates a small earthen cell within which it spins a thin but firm, oval cocoon (Figure 102), frequently measuring 2 mm by 3–4 mm. The cocoon is composed largely of whitish silk with small grains of earth and sand firmly incorporated into the matrix.

The entire life cycle of these moths is synchronized with the production of new, tender leaves containing a relatively low tannin content (Feeney and Bostock, 1968; Morris 1974). Throughout the summer and winter months, the larva remains inactive within the cocoon. A total of nearly 11 months may be spent underground with actual pupation perhaps not occurring until the final month, or a few weeks prior to adult emergence.

Pupal emergence from the cocoon was first described by Chapman (1893) and is accomplished primarily with the aid of the greatly enlarged and completely functional mandibles. Probably assisting the mandibles in this activity is a well-developed and elongate frontal ridge. The pharate adult first cuts a rather large opening in one end of the cocoon. Utilizing vigorous motions of the mandibles and head, this stage is able to work its way grad-

ually out of the cocoon to the soil surface. The legs are essentially useless during these activities and are held relatively motionless against the body as the pharate adult forces its way to the surface. In contrast, the mandibles are fully capable of being open and closed as well as being raised and lowered in conjunction with similar motions of the rather freely movable head. After emerging from the ground, the pharate adult remains quiescent for an indefinite period until final ecdysis can be accomplished.

Chapman (1893) reports that the adult of *Eriocrania haworthi* emerges in the morning about 6 to 7 A.M. The imaginal wings already are nearly fully expanded within the wing cases prior to emergence. After leaving the pupal shell, the moth normally climbs to some support for final wing expansion and drying. Within a relatively short interval, the adult is capable of flight.

PARASITISM

Very few examples of parasitism have been reported for the Eriocraniidae. As summarized in Table 1, these records involve at least four different wasp parasites of the family Ichneumonidae attacking a possible total of seven species of Eriocraniidae. Most of the wasps are not closely related but, instead, represent three different subfamilies of Ichneumonidae. It is of interest to note that no other families of Lepidoptera are known to be parasitized by any member of the tribes that these wasps represent.

The Ctenopelmatinae (=Scolobatinae) and Tryphonini almost exclusively attack sawflies. According to Townes (1971), the Tersilochinae are parasitic on beetle larvae, particularly those of Curculionidae. An important biological correlation among all the known hosts is that their larvae are typically feeders in plant tissue with pupation occurring in the soil. Thus, the sporadic distribution of host-parasite records to date indicates a situation involving certain wasps that have evolved primarily as parasites of other insect orders but which have later adapted to the Eriocraniidae largely because of similarities in the general life history of the hosts.

It is difficult to comment to any extent concerning relative host specificity because of the limited number of host-parasite relationships that have

TABLE 1.—Host-parasite relationships of Eriocraniidae

Host	Parasite	Subfamily of Ichneumonidae	Reference
<i>Dyseriocrania griseocapitella</i> (Walsingham)	<i>Lathrolestes mnemonicae</i> Rohwer <i>?Tersilochus</i>	Ctenopelmatinae Tersilochinae	Rohwer, 1914 new record
<i>Dyseriocrania subpurpurella</i> (Haworth)	undetermined	undetermined	Heath, 1961
<i>Eriocrania haworthi</i> Bradley (= <i>rubroaurella</i> Haworth) ...	<i>Lathrolestes clypeatus</i> (Zetterstedt) <i>Grypocentrus basalis</i> Ruthe	Ctenopelmatinae Tryphoninae	Heath, 1961 Heath, 1961
<i>Eriocrania salopiella</i> Stainton	<i>Lathrolestes clypeatus</i> (Zetterstedt)	Ctenopelmatinae	Heath, 1961
<i>Eriocrania sangii</i> Wood	<i>Lathrolestes clypeatus</i> (Zetterstedt) <i>Lathrolestes clypeator</i> [sic] <i>eriacraniae</i> Seyrig	Ctenopelmatinae Ctenopelmatinae	Heath, 1961 Seyrig, 1928
<i>Eriocrania semipurpurella semipurpurella</i> (Stephens) ...	<i>Grypocentrus basalis</i> Ruthe	Tryphoninae	Heath, 1961
<i>Heringocrania unimaculella</i> (Zetterstedt)	<i>Lathrolestes clypeatus</i> (Zetterstedt)	Ctenopelmatinae	Heath, 1961

been reported. It may be possible that the wasp parasites are largely linked to plant host-moth complexes and will attack any eriocraniid feeding within a particular plant group. Heath (1961), for example, concluded that the two ichneumonid species he reared probably parasitized all birch-feeding Eriocraniidae.

HOSTS

As summarized in Table 2, nearly all host records for the family Eriocraniidae are included in two plant families, the Betulaceae and Fagaceae of the order Fagales. According to Cronquist (1968) and nearly all other authorities, these two families are closely related and are derived by floral reduction from ancestors similar to the Hamamelidaceae. Only two possible host records have been reported from non-Fagales genera. *Eriocrania argyrolepidella* of Europe is suspected of feeding on *Populus tremula* in that adults have been observed flying around this plant. No eriocraniid larvae, however, have yet been collected from any member of the Salicales. Eriocraniid larvae, possibly representing the immature stages of the North American *Eriocrania semipurpurella pacifica*, new subspecies, have been found mining the leaves of a member of the Rosales, *Holodiscus discolor*. Because no adults have been definitely associated with these larvae or reared from *Holodiscus* the generic and specific identification of the larvae remains questionable.

With the possible exceptions of *Eriocrania alpina*, *E. argyrolepidella*, and *E. semipurpurella pacifica*, all members of the genus *Eriocrania* appear

to feed exclusively on *Betula*. Only one other eriocraniid, *Heringocrania unimaculella*, is reportedly monophagous on *Betula*. The generic placement of this particular species is questionable, and it may only represent a subgenus of *Eriocrania* (Birket-Smith and Kristensen, 1974; Razowski, 1975). Heath (1958) has noted that the birch-feeding species show a marked preference for young trees under 15 feet (4.6 m) in height.

The members of the predominantly North American genera *Dyseriocrania*, *Eriocraniella*, and possibly *Neocrania*, new genus, are almost entirely restricted to plants of the family Fagaceae. Only *D. subpurpurella* of Europe has been reported feeding on a nonfagaceous host (*Carpinus*). *Dyseriocrania griseocapitella* appears to be the most polyphagous of the North American eriocraniids in having been reared from at least three species of chestnuts and from representatives in both the red and white oak groups.

Unfortunately, nothing is known concerning the host associations of the family Acanthopteroctetidae.

Many facts relating to the distribution of the Eriocraniidae can be explained by reviewing the foregoing host data. For example, the restrictions of nearly all larvae to members of the Fagaceae and Betulaceae account for the general occurrence of the Nearctic Eriocraniidae over much of the broad-leaf forests of eastern and western North America as well as for their observed absence from the Interior Plains. Although some members of the Fagaceae range far south into Central America (*Quercus*) or are entirely restricted to the southern Hemisphere (*Nothofagus*), no examples of Eriocraniidae have yet been found south of the 25°N parallel.

TABLE 2.—General distribution and the known host plants of Eriocraniidae

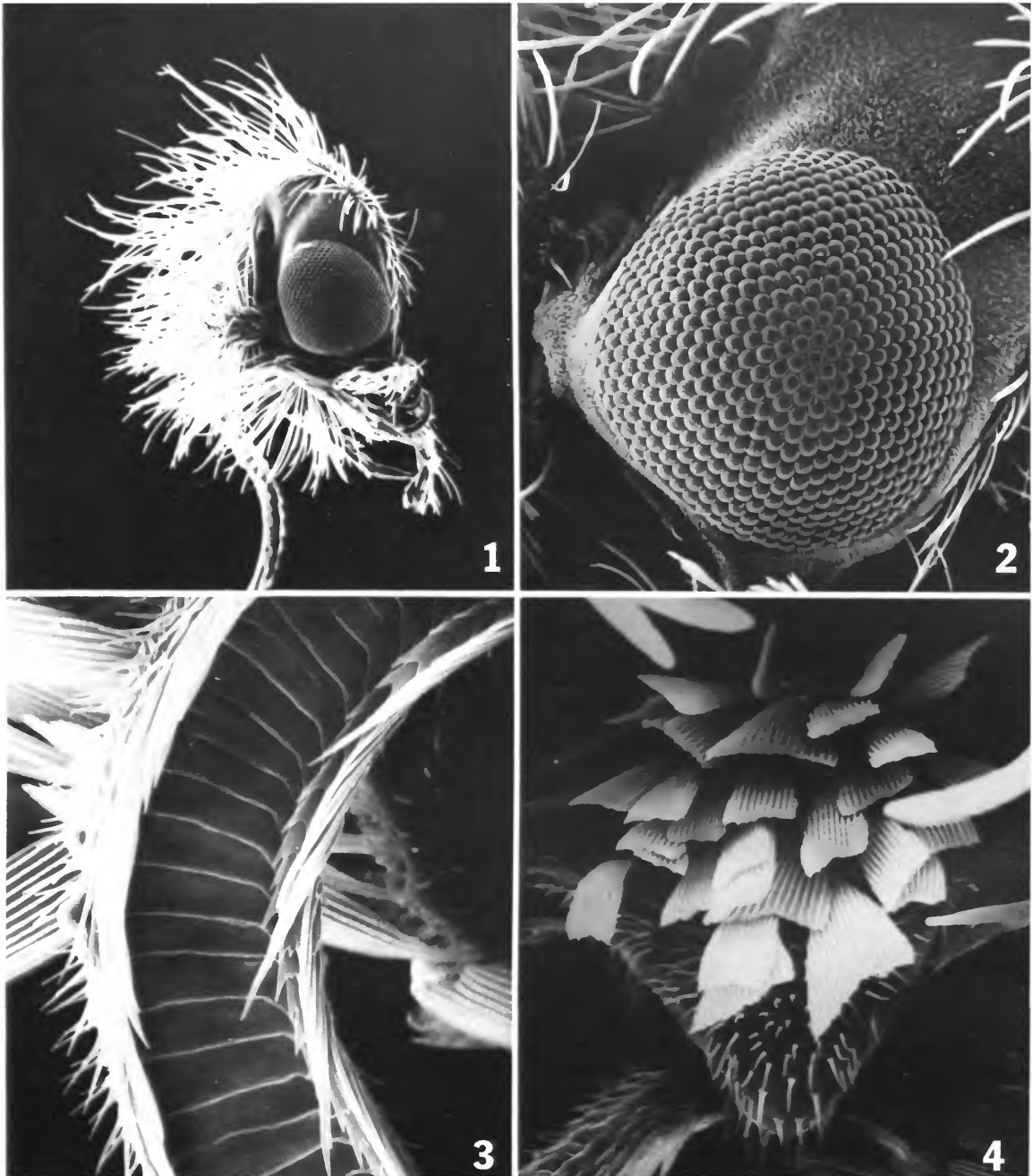
Species	Distribution	Host plants	Reference
<i>Dyseriocrania</i>			
<i>auricyanea</i> (Walsingham).....	California	<i>Quercus agrifolia</i> Neé <i>Q. douglasii</i> Hooke & Arnott <i>Q. dumosa</i> Nuttall <i>Q. lobata</i> Neé <i>Q. wislizenii</i> Alphonse de Candolle	Opler, 1974
<i>griseocapitella</i> (Walsingham).....	eastern North America	<i>Castanea dentata</i> (Marshall) Borkhausen <i>C. mollissima</i> Blume <i>C. pumila</i> (L.) P. Miller <i>Quercus alba</i> L. <i>Q. ?borealis</i> F. Michaux <i>Q. ?falcata</i> A. Michaux <i>Q. velutina</i> Lamarck	
<i>subpurpurella</i> (Haworth).....	western Europe	<i>Carpinus</i> species <i>Castanea</i> species <i>Quercus petraea</i> (Mattuschka) Lieblein <i>Q. robur</i> L.	Hering, 1957 Lhomme, 1949
<i>Eriocrania</i>			
<i>alpinella</i> Burmann.....	Austria	<i>Alnus viridis</i> Aug. de Candolle <i>Betula</i> species	Burmann, 1958
<i>argyrolepidea</i> Fuchs.....	western Europe	? <i>Populus tremula</i> L.	Hering, 1957
<i>haworthi</i> Bradley..... (= <i>purpurella</i> Haworth) (= <i>rubroaurella</i> Haworth)	western Europe	<i>Betula pendula</i> Roth	Lhomme, 1949
<i>salopiella</i> Stainton.....	western Europe	<i>Betula</i> species	Lhomme, 1949
<i>sangii</i> Wood.....	western Europe	<i>Betula</i> species	Hering, 1957
? <i>semipurpurella pacifica</i> Davis.....	northwestern North America	<i>Holodiscus discolor</i> Maximowicz (Pursh)	
<i>semipurpurella semipurpurella</i> (Stephens)....	Europe Japan northeastern North America	<i>Betula pendula</i> Roth <i>B. platyphylla</i> var. <i>japonica</i> (Miquel) Hara <i>B. pubescens</i> Ehrhart	Kumata (in litt.) Lhomme, 1949 Toll, 1959
<i>sparmannella</i> Bosc.....	western Europe	<i>B. pendula</i> Roth <i>B. platyphylla</i> var. <i>japonica</i> (Miquel) Hara	Kumata (in litt.) Lhomme, 1949
<i>Eriocraniella</i>			
<i>aurosarsella</i> (Walsingham).....	California, Oregon	<i>Quercus kelloggii</i> Newberry	
? <i>longifurcula</i> Davis.....	Arizona	? <i>Quercus gambelli</i> Nuttall X <i>arizonica</i> Gargent	
<i>xanthocara</i> Davis.....	California	<i>Quercus agrifolia</i> Neé <i>Q. wislizenii</i> Alphonse de Candolle	
species †.....	Idaho	<i>Quercus simulata</i> Knowlton	Opler, 1973
<i>falcata</i> Davis.....	California	<i>Quercus chrysolepis</i> Liebmann	
<i>Heringocrania</i> Kuznetsov			
<i>chrysolepidella</i> Zeller.....	western Europe	<i>Alnus</i> species <i>Carpinus betulus</i> L. <i>Corylus avellana</i> L. <i>Ostrya</i> species	Hering, 1957
<i>unimaculella</i> (Zetterstedt).....	western Europe	<i>Betula</i> species	Hering, 1957
<i>Neocrania</i> Davis			
<i>bifasciata</i> Davis.....	California	? <i>Quercus chrysolepis</i> Liebmann	

+ fossil record

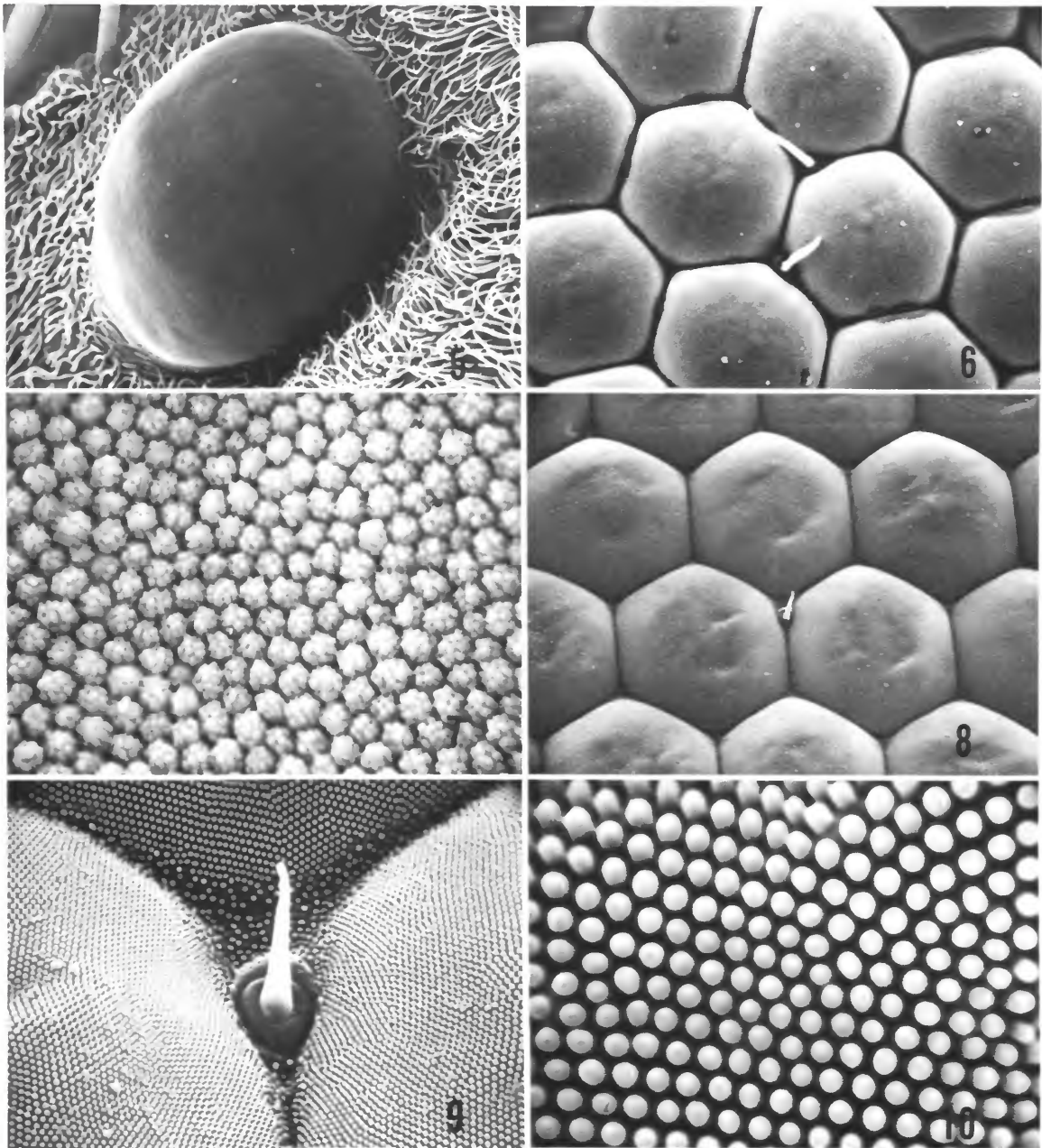
Morphology

The following discussion is not intended to be an exhaustive treatment on the morphology of the

various stages for the members of the Eriocranioidae. Instead, it is a review of those anatomical features investigated during the course of this and related studies that have been considered significant



FIGURES 1-4.—*Dyseriocrania griseocapitella* (Walsingham), adult head structure: 1, lateral view of head, $\times 55$; 2, compound eye and ocellus, $\times 170$; 3, inner surface of galea, $\times 1300$; 4, scales of labrum, $\times 620$. (Photographs reproduced at 100%.)



FIGURES 5-10.—Eye structure: 5, *Dyseriocrania griseocapitella* (Walsingham), surface detail of ocellus, $\times 1200$; 6, facets and microtrichia of compound eye, $\times 1700$; 7, corneal nipples with globular, secondary divisions, $\times 30,000$; 8, *Rhyacophila fuscata* (Walker), facets and microtrichia, $\times 1300$; 9, detail of microtrichia and corneal nipple array, $\times 7000$; 10, corneal nipples with smooth surfaces, $\times 30,000$. (Photographs reduced to 83%.)

in understanding the systematics of this group. The publications of Kristensen (1968b) and Birket-Smith and Kristensen (1974) may be consulted for further details on the anatomy of the head, alimentary canal and male genitalia.

ADULT MORPHOLOGY

HEAD.—The head (Figures 1, 11, 17) is hypognathous and sparsely covered with elongate, hairlike scales, except for the lower part of the frons and labrum; here the scales tend to be broader and triangular in form (Figure 4). The head capsule differs markedly in length between the two families. In the Eriocraniidae the postocular region is more extended and possesses a pair of prominent ocelli. One result of the lengthened head in the members of this group is that the compound eyes appear to be situated farther forward. The postocular region is more shortened in Acanthopteroctetidae, and the ocelli are absent. The size of the compound eye is slightly smaller in the Eriocraniidae, with most species possessing an interocular index (see Davis, 1975a:5) of approximately 0.70 to 0.75.

The surface of the eriocraniid compound eye appears naked under low magnification; actually, however, it is sparsely covered with minute microtrichiae (Figures 2, 6) arising between certain facets. Their length is less than the diameter of a single facet. The surface of each facet is composed of myriads of submicroscopic divisions (Figure 7), referred to as corneal nipples by Bernhard and Miller, 1962, and Møller, 1965. According to these authors, the function of the corneal nipple array is that of a natural impedance transformer whereby light reflection from the corneal surface may be reduced and transmission increased. They may also function as interference filters as concluded by Bernard and Miller (1968) for certain Tabanidae and operate as a contrast filtering device for vision. The corneal nipples vary considerably in structure and general arrangement among different insect groups, with some orders (e.g., Coleoptera and Orthoptera) lacking them (Miller et al., 1966). Under increased magnification (i.e., $\times 20,000$ and above), each corneal nipple in eriocraniids can be observed to be subdivided into more than 15 globular units. Similar secondary subdivisions, or sub-nipples, have also been observed by the author in moths of the genera *Greya* and *Acrolophus* but

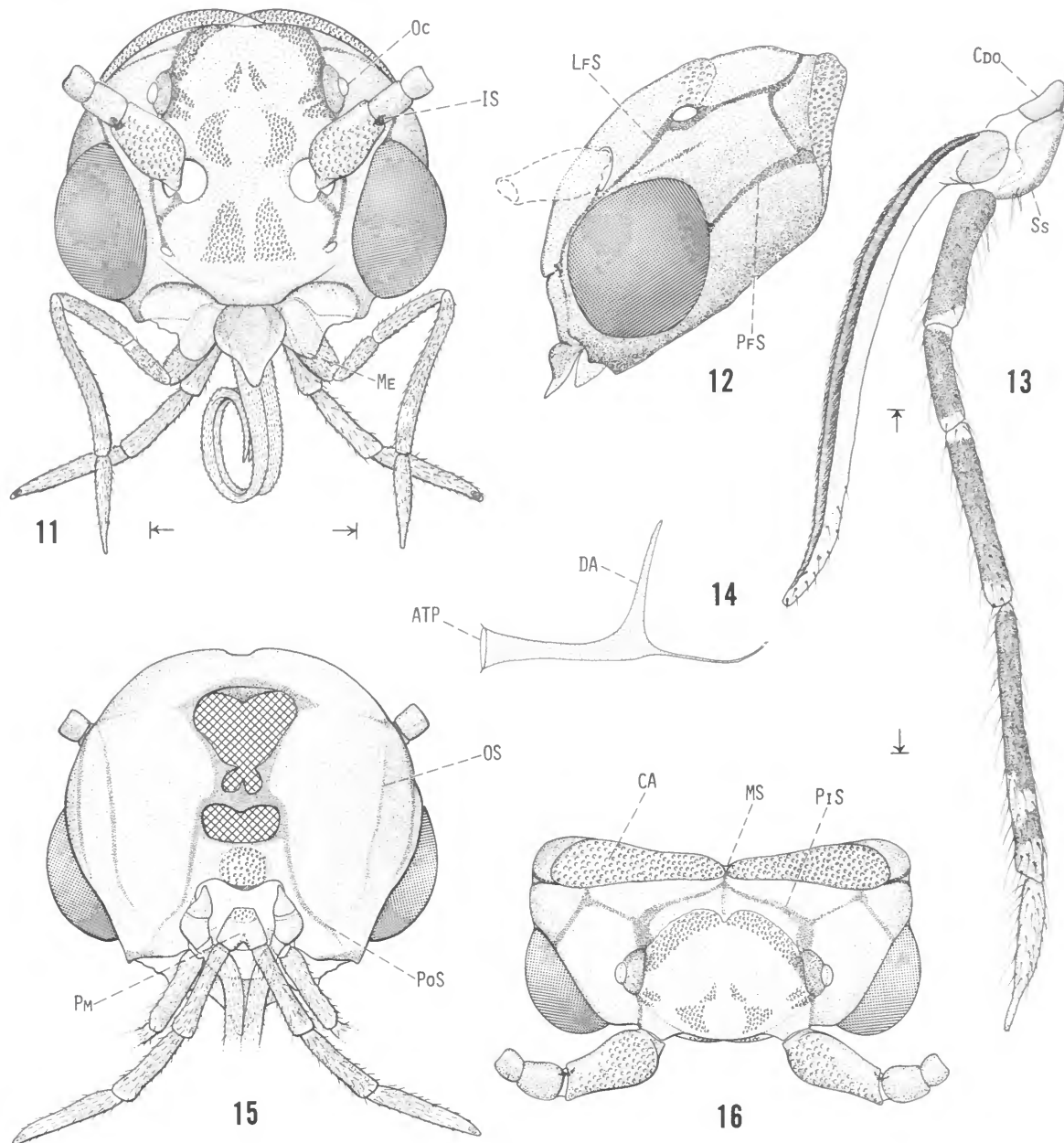
absent in the butterflies *Eurema* and *Pyrgus* and the caddisfly *Rhyacophila* (Figures 8–10). Consequently, the ultrastructure of the corneal nipples may have some significance in the higher systematics of the Lepidoptera.

The best review to date on the corneal nipple array in insects is that by Bernhard et al. (1970). These authors reported well-developed corneal nipples in several families of Lepidoptera, including the Eriocraniidae. Within most of the families examined, both nipped and nonnipped corneas were found represented. No mention was made of the more minute, secondary units comprising each nipple, and it is possible that these have never been noted previously.

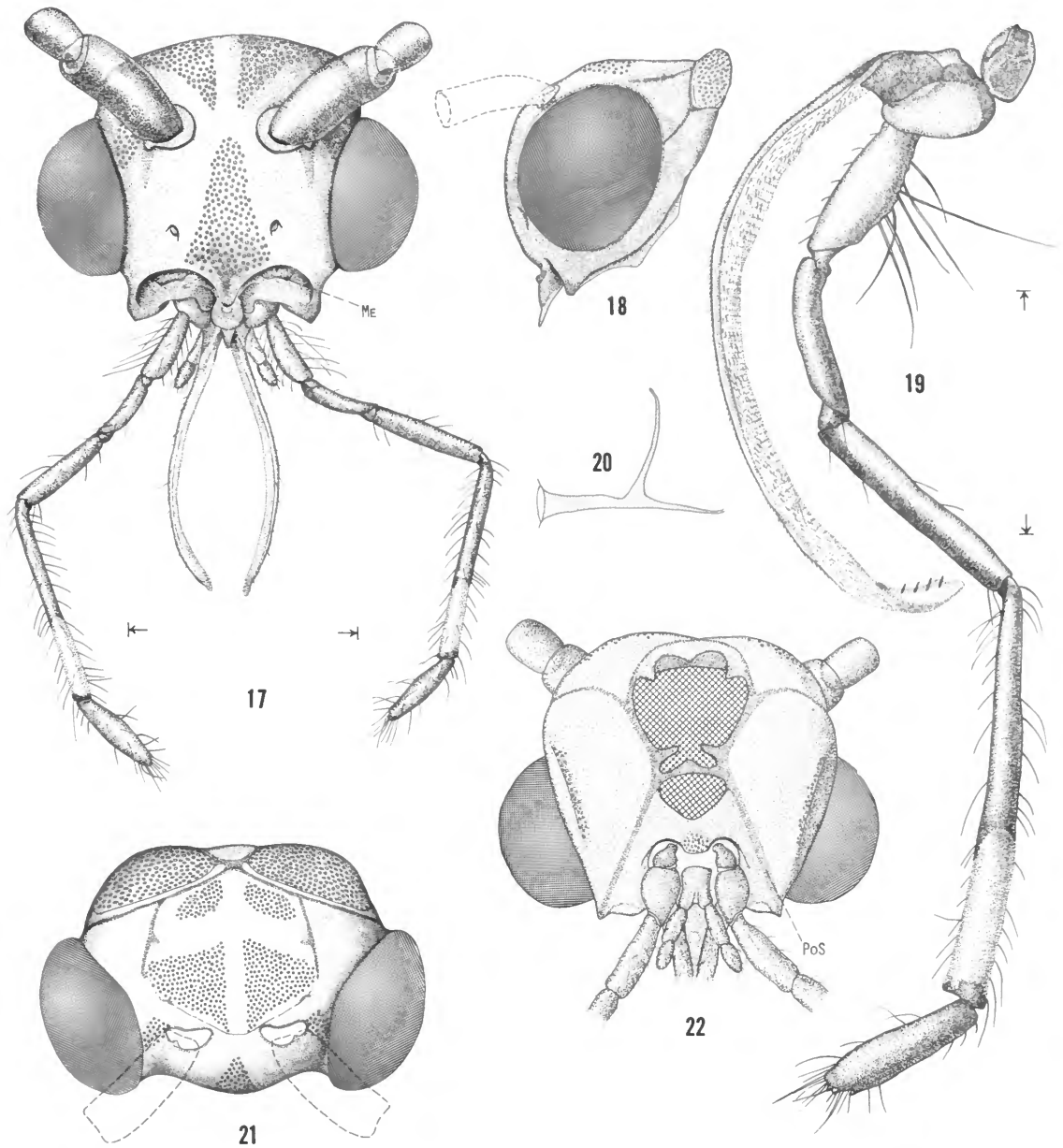
The cranial sulci generally are better developed in the Eriocraniidae than in the Acanthopteroctetidae. For example, the laterofacial sulci (LFS) are reduced in the latter family but extend to the anterior tentorial pits in the Eriocraniidae. The postfrontal sulci (PFS) terminate differently in the two groups. In the Eriocraniidae they curve anteriorly to the dorsal rim of the eye; in the Acanthopteroctetidae the postfrontal sulci continue in an almost straight line from the midcranial sulcus (MS), joining the eye posteriorly. The occipital sulci (OS), although evident in the Eriocraniidae, are obsolete in Acanthopteroctetidae. Internally, the dorsal tentorial arms are slender and elongate in both families, extending nearly to the vertex immediately behind the antennal insertions. Posterior to the origin of the dorsal arms, the anterior tentorial arms are variously developed in the Eriocraniidae and may either be strongly developed (in *Heringocrania*) or barely discernible and threadlike (in *Dyseriocrania* and *Eriocrania*). In *Acanthopteroctetes* the posterior half of the anterior arms is relatively well developed.

A pair of large, elongate chaetosemata are situated transversely across the occipital ridge of the head. Similarly raised areas are present elsewhere on the head (e.g., on the postmental area), which also may represent chaetosemata.

The antennae are relatively short and simple. A small, sometimes poorly defined intercalary sclerite is present between the scape and pedicel. The external vestiture of the entire antenna consists primarily of slender, elongate scales. Immediately beneath these scales are scattered, highly modified chemosensory sensilla, of the general type referred



FIGURES 11-16.—*Dyseriocrania griseocapitella* (Walsingham), adult head structure: 11, anterior view (scale = 0.5 mm); 12, lateral view; 13, maxilla (scale = 0.5 mm); 14, lateral view of tentorium; 15, posterior view; 16, dorsal view.



FIGURES 17-22.—*Acanthopteroctetes bimaculata* Davis, adult head structure: 17, anterior view (scale = 0.5 mm); 18, lateral view; 19, maxilla (scale = 0.5 mm); 20, lateral view of tentorium; 21, dorsal view; 22, posterior view.

to by Jefferson et al. (1970) as sensilla auricillica. Callahan (1975) discusses this and other forms of antennal sensilla and explains their general function with analogies to dielectric antennae. Sensilla auricillica probably occur in a wide variety of moths and have been reported by the above authors in the Noctuidae. I have also observed them present in the Nepticulidae but found them lacking in the Micropterigidae, Lophocoronidae, and Neopseustidae. The sensilla auricillica of Eriocraniidae are relatively small with longitudinally grooved surfaces and multiple apertures, thus, similar in general structure to that figured by Callahan (1975) for *Heliothis*. In Acanthopteroctetidae, these sensilla are considerably larger and lack grooves (Figure 26) and are densely covered with minute pores (Figure 34).

The eriocranioid labrum is relatively elongate and somewhat ovate in outline with a subaccuminate apex. It superficially resembles that of Micropterigidae and certain Agathiphagidae, except that in these families the labrum is broader and of a more quadrate outline. The pilifers with their usual array of prominent setae are not pronounced. The clypeolabral suture is usually well defined, although in *Acanthopteroctetes* this suture is barely discernible. In the latter group, the labrum is slightly reduced in size and more slender.

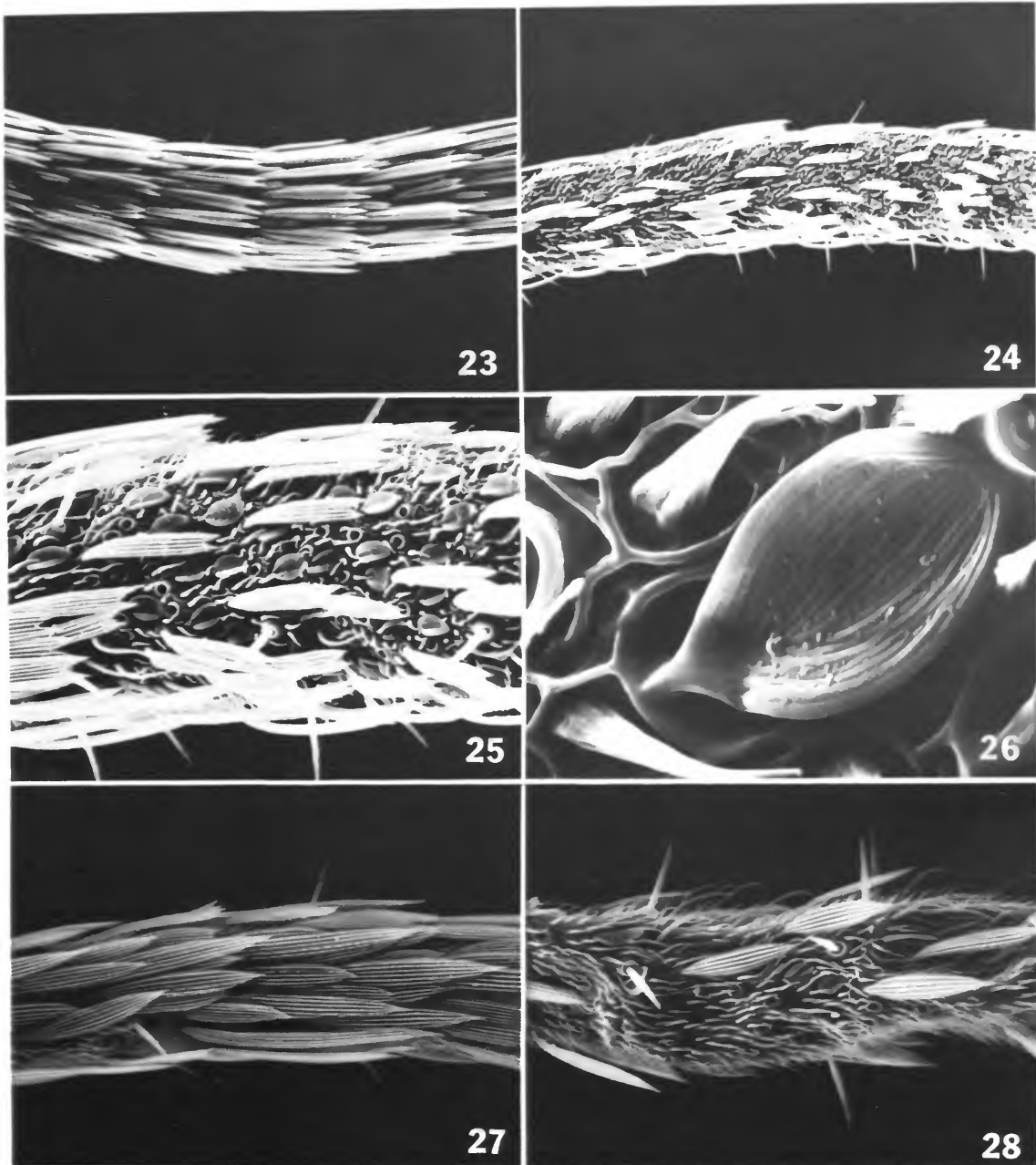
Although the adult mandibles have lost their normal function in the Eriocraniidae and are partially membranous, their relative size is still considerable in comparison to that of all other Lepidoptera, except the Micropterigidae and Agathiphagidae. More significantly, the internal apodemes of the mandibles, particularly the adductor, are relatively well developed (Figure 218). Studies by Kristensen (1968b) suggest a glandular function for the adductor apodeme in *Eriocrania*. The mandibles in Acanthopteroctetidae are only questionably present. An examination of the genal (or mandibular) cavity that the mandibles normally occupy reveals only a slightly thickened ridge that appears to be the sole vestige of mandibles in that family. The mandibular apodemes are similarly reduced and barely discernible. The mandibular condyles are essentially absent in the Eriocraniidae although slight indications of these still persist in some species (Figure 219).

Although the maxillae in the Eriocraniidae exhibit a very primitive condition, they are decidedly

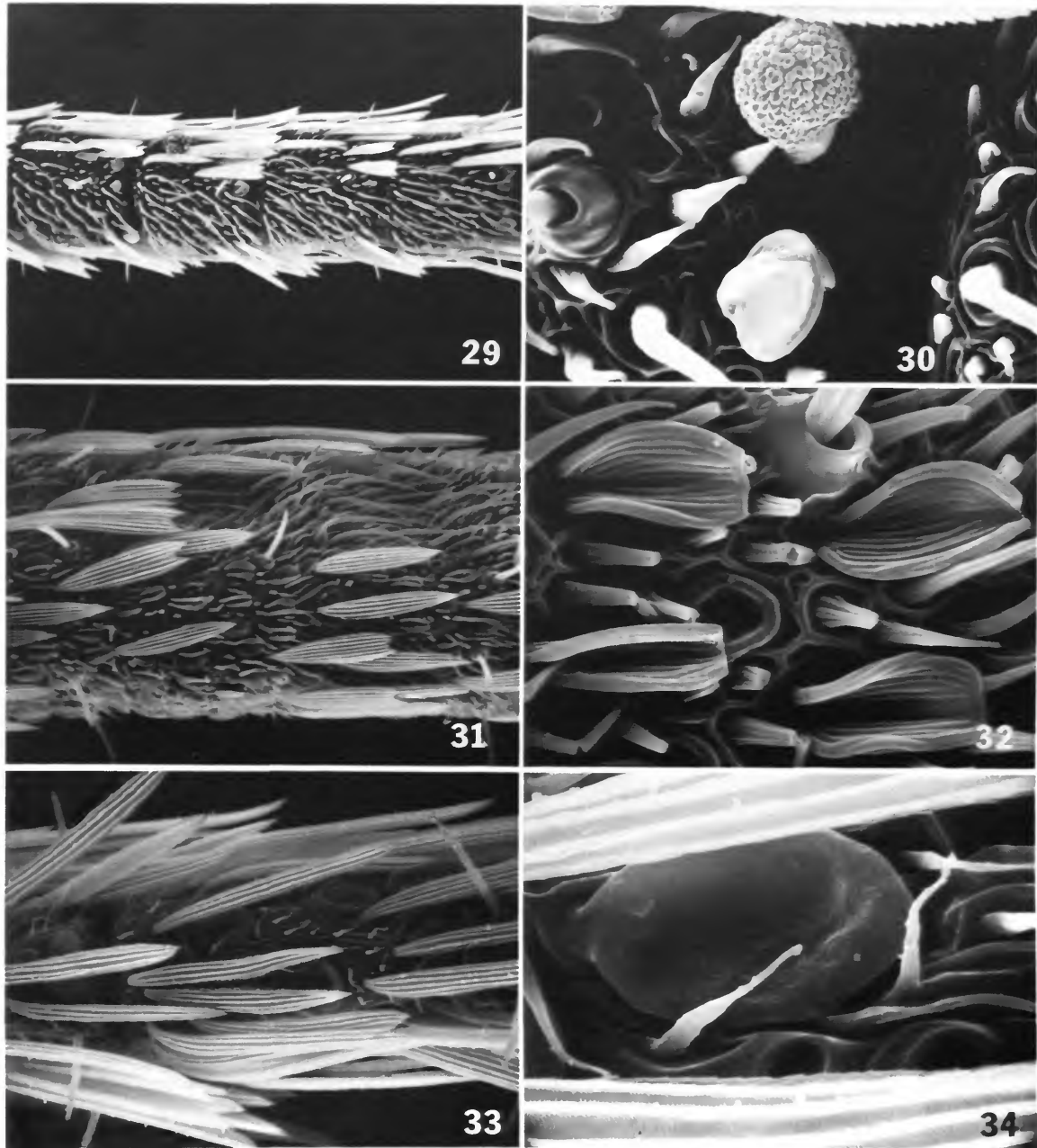
more specialized than those of the Agathiphagidae and especially Micropterigidae in possessing a functional haustellum and in having largely lost the lacinia. Kristensen has reported the lacinia as vestigial, being represented perhaps by a membranous protuberance arising from the inner surface of the stipes.

The maxillary palpi are elongate and consistently five segmented with the fourth being the longest; often it measures 2.0 to 2.5 times the length of the fifth. The fourth segment characteristically possesses a subapical, unpigmented zone. The apex of the fifth segment is variously modified depending on the species. The remainder of the segment is densely covered by primary (i.e., the longest) and secondary setae, numerous microtrichiae, and an occasional scale. In Acanthopteroctetidae the apex (Figure 217) is relatively unspecialized and rounded with several, relatively elongate, divergent setae. In the Eriocraniidae the apex is usually naked except for typically eight, stout, sensory setae arising from one to as many as five separate lobes. In the Nearctic eriocraniids the relative development of the setae and their supporting lobes are closely correlated with other characteristics (e.g., in venation and often male genitalia) and are helpful in delimiting genera. In the Palearctic species, however, a few exceptions to these correlations have been noted. For example, the apex of the fifth segment in the genera *Dyseriocrania* and *Eriocrania* are similar in that there is a single apex (i.e., not divided) usually bearing a crown of eight, short, stout setae (Figures 185, 191). The apex is slightly more attenuated in *Dyseriocrania* with two or three sensory setae situated more subapically. But in the European species *Eriocrania sangii* Wood and *E. haworthi*, the apex is divided into two, nearly symmetrical lobes, each bearing four short setae (Figure 195). Superficially, the apex of *E. sangii* resembles that of *Neocrania*, new genus, except in the latter the lobes are slightly subequal in length, and the apical setae are more elongate with striated sides (Figure 210). Under high magnification it can be determined that the apical sensory setae of *Eriocraniella* and *Neocrania* possess longitudinal ridges or striae (Figures 200, 214). The apical setae of *Dyseriocrania*, *Eriocrania*, and *Heringocrania* lack these striations and appear smooth.

Often correlated with these features of the apical



FIGURES 23-28.—Antennae (near middle of flagellum): 23, *Dyseriocrania griseocapitella* (Wal-singham), fully scaled, $\times 35$; 24-25, partially denuded, $\times 315$ and $\times 790$; 26, detail of sensory scale (sensillum auriculicum) $\times 7900$; 27, *Eriocrania brevipex*, new species, fully scaled, $\times 600$; 28, partially denuded, $\times 825$. (Photographs reduced to 83%.)



FIGURES 29-34.—Antennae (near middle of flagellum): 29, *Eriocraniella variegata*, new species, partially denuded, $\times 390$; 30, detail of sensory structure, $\times 3900$; 31, *E. aurosarsella* (Walsingham), partially denuded, $\times 825$; 32, sensory scales, $\times 5000$; 33, *Acanthopteroctetes bimaculata* Davis, partially denuded, $\times 1025$; 34, sensory scale (sensillum auricillicum) $\times 5400$. (Photographs reduced to 83%.)

lobes and setae is the barbed versus smooth condition of the primary setae of the fifth palpal segment. In those species with a divided apex (except *Eriocraniella platyptera*, *Eriocrania sangii*, and *E. haworthi*) and striated apical setae, the primary setae are barbed along their outer edges (Figure 212). Conversely, in those species with an undivided apex and unstriated sensory setae, the primary setae are simple and smooth (Figure 213). Barbed, primary setae exist in *Eriocraniella* and *Neocrania*, whereas *Dyseriocrania*, *Eriocrania*, and *Heringocrania* possess smooth primary setae.

The apex of the fifth palpal segment of *Eriocraniella* (Figures 198, 200) has been found to be the most complex of the types examined. A single, large apical lobe is present that bears typically one long and three short striated setae. The remaining four elongate setae all arise from four separate, slender lobes arranged in two pairs. The apical most pair of lobes is intermediate in size and the most subapical pair is the smallest.

The eriocranioid haustellum, although relatively short, is functional and is probably used to imbibe liquid nourishment such as water and honeydew secreted by certain Homoptera. Kristensen (1968b: 259) has noted, in living specimens drinking from water drops on a petridish, that, although the haustellum is normally united, it tends to split apart when pressed against a surface. The haustellum is composed of two galeae, each bearing a broad mesal groove, which when joined, form the typical sucking tube or food canal in Lepidoptera. The inner sides of the groove are completely lined with relatively large plates (Figure 3), each distally overlapping the basal edge of the succeeding plate.

The base of the labium is relatively simple and uniform among the species in consisting of a small, oval or triangular, slightly elongate median sclerite or prementum. In Acanthopteroctetidae this sclerite is somewhat more narrow. The anterior margin of the prementum is usually slightly cleft. The labial palpi differ greatly in structure between the two families. In the Eriocraniidae they are elongate and three segmented with all segments of approximately equal lengths. The apex of the third segment bears a noticeable sensory pit (organ of von Rath) that often contains from 15 to 26 short, peglike, basiconic sensillae (Figures 215–216). These structures are assumed to possess a chemosensory function. The palpi in Acanthopteroctetidae are reduced to two,

very short segments that barely surpass the first maxillary palpal segment in length. The second segment is usually very short and less than one-half the length of the first. The third segment has been lost along with any evidence of an organ of von Rath.

THORAX.—The general structure of the thorax appears uniform throughout the superfamily. The pronotum is quite small and mostly obscured dorsally by the mesoscutellum. The prosternum is extended anteriorly as a relatively slender sclerite free from the pleuron. Its basal area is sometimes slightly expanded laterally. The lateral cervical sclerites (LCS) are well developed, with broadly triangular bases (viewed anteriorly) that taper to slender rods anteriorly. The prothoracic spina and furcal apophyses are moderately developed and similar in form to those of Neopseustidae (Davis, 1975b).

The mesothoracic furcasternum possesses extremely short, almost obsolete apophyses (Figure 51). The katepisternum is well defined by a distinct paracoxal suture. The mesomeron is not greatly reduced and approaches the meseucoxa in size. The furcal apophyses of the metathorax are well developed, arising subparallel and diverging at their apices. Inside the metathorax, a broadly compressed, anteromedial process (APM) extends from the stem of the metafurcasternum toward the intercoxal lamellae of the basisternum (Figure 48). At this point the anterior end of the anteromedial process is shortly divided with elongate, thread-like tendons extending into the coxae on either side of the intercoxal lamellae. The anteromedial furcal process in Acanthopteroctetidae is very similar in structure except its anterior end is more distinctly separated from the intercoxal lamellae (Figure 49). It is possible that this structure (i.e., the anteromedial process) may be homologous with the mesal lamella of Brock (1971, fig. 31b, etc.). The meta-katepisternum is largely unsclerotized and reduced in width. The metacoxae of the Eriocraniidae differ from those of the Acanthopteroctetidae in having the eucoxa more well developed and the meron proportionately largely unsclerotized and reduced in width. The metacoxae of the Eriocraniidae differ from those of the Acanthopteroctetidae in having the eucoxa more well developed and the meron proportionately smaller. The metamera of both families are reduced and in that feature

resemble the reduced metamera of the Micropterigidae and certain ditrysian genera (Shepard, 1930).

The legs of both families are similar in retaining a single apical spur on the mesothoracic tibiae. The pro- and mesothoracic tibiae of the Eriocraniidae are somewhat more reduced in length. The tarsi (Figure 182) are of typical structure in possessing a pair of simple claws and a slender empodium, a broad, padlike arolium, and a lateral pair of relatively large, spinose pulvilli. Although an epiphysis is present in the genera *Eriocraniella* and *Neocrania*, it has been lost in *Dyseriocrania* and *Eriocrania* as well as in the Acanthopteroctetidae.

The wings of Eriocranioidea are moderately slender with subacute apices. The fore and hind wings are approximately equal in size but differ in venation according to genus. The venation is considered primitive for the Lepidoptera, particularly in the hind wings. The hind wings of all Eriocranioidea possess a four-branched radius with R₃ absent (probably through fusion with R₂). In the forewings the radius may be either four or five branched with R₁ frequently subdivided. A relatively well-developed jugum is present. The subcosta is sometimes subdivided in the forewings but normally not in the hind wings. Another primitive venational feature in this superfamily is the preservation of the base of the medial vein within the discal cell of both wings, a plesiomorphic trait that persists into certain primitive ditrysian families (e.g., many Tineoidea). As is true for nearly all members of Zeugloptera, Dacnonypha, and Monotrysia, all surfaces of both wings are uniformly and densely covered with microtrichiae. Besides being somewhat more slender, the wings of Acanthopteroctetidae differ significantly from those of the Eriocraniidae. In the former, vein M₁ is stalked with the stem of R₄+₅ in both wings, and the anal veins are completely separate in the forewings. In the Eriocraniidae, all three anal veins fuse distally in the forewing, and M₁ arises separate. A pterostigma is also typically evident in particularly the forewings of Eriocraniidae but is absent in Acanthopteroctetidae.

The broad discal scales of the forewings differ significantly in structure between the two North American families of Eriocranioidea. In the Eriocraniidae, most of the scales over the dorsal wing surface (i.e., the broader scales) possess minutely

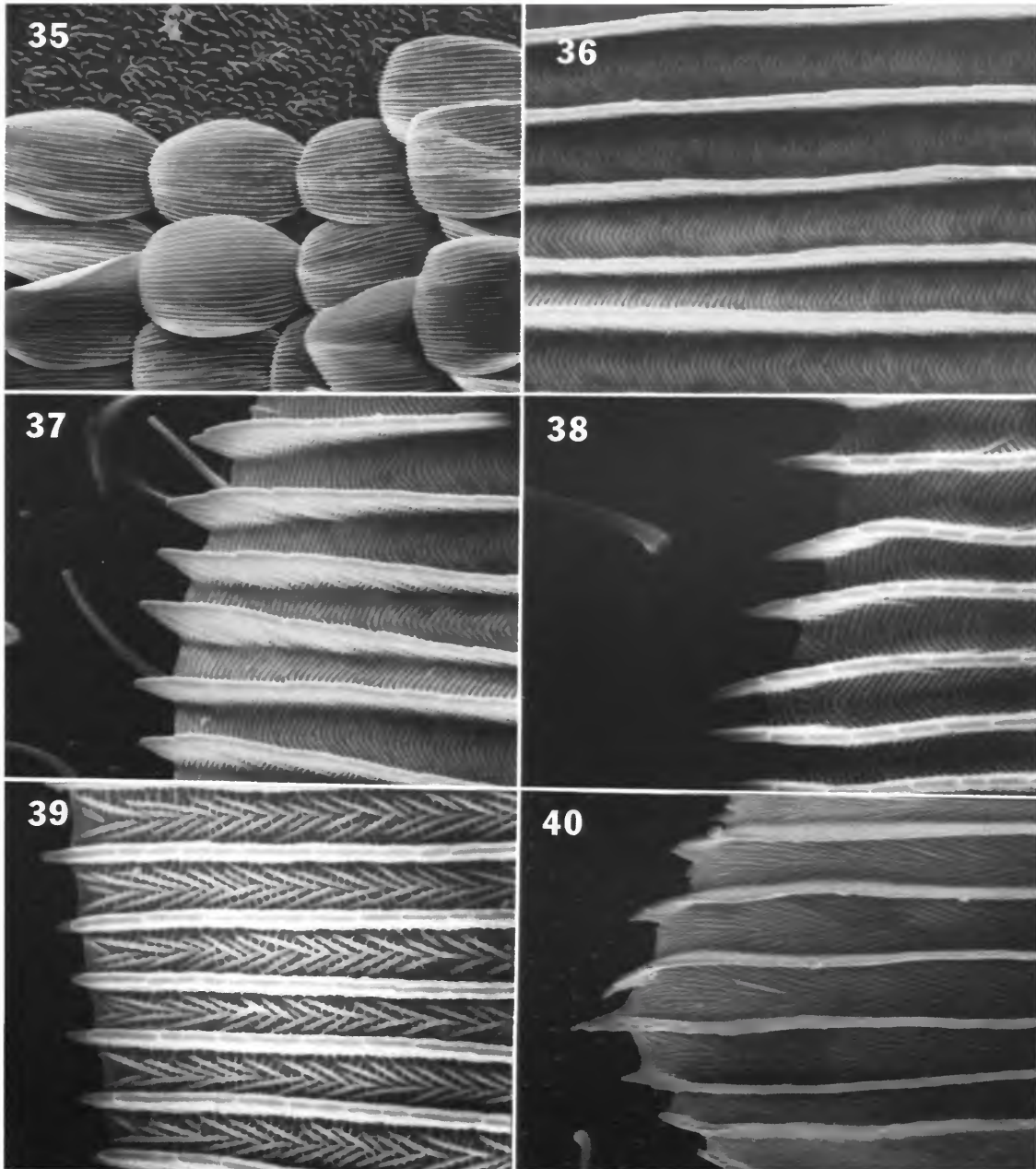
serrated apices and are of a nonperforated type (Figure 36–37) with a dense array of transverse striae interconnecting the rather prominently raised, longitudinal ribs. In cross section, as viewed through the Transmission Electron Microscope, these scales resemble a very thin, approximately 88 nm thick (Figure 45) plate, resulting from the fusion of the dorsal and ventral cuticle. In the ditrysian Lepidoptera, these surfaces are well separated in nearly all wing scales, thereby creating a relatively large internal lumen that normally is in direct contact with the surrounding air through the dorsal perforations, or lacunae. As Kristensen (1970) first noted, some variation in scale structure exists over the wing with the marginal, more hairlike scales frequently possessing a well-defined lumen (Figure 46). Even in these scales, however, no dorsal lacunae are present in the Eriocraniidae. Also evident in Figure 46 and characteristic of the slender marginal or fringe scales of most Lepidoptera are the presence of prominent ventral ribs. The latter are lacking in the typically broad lepidopteran scale, with the ventral surface being instead quite flat.

Another prominent feature of the typical eriocraniid scale is that the longitudinal ribs extend slightly beyond the terminal margin of the scale (Figure 37). In this respect they agree with the families with which they are most closely allied (Agathiphagidae, Neopsustidae, and Lophocoronidae), as well as with the Micropterigidae (Figures 38–40).

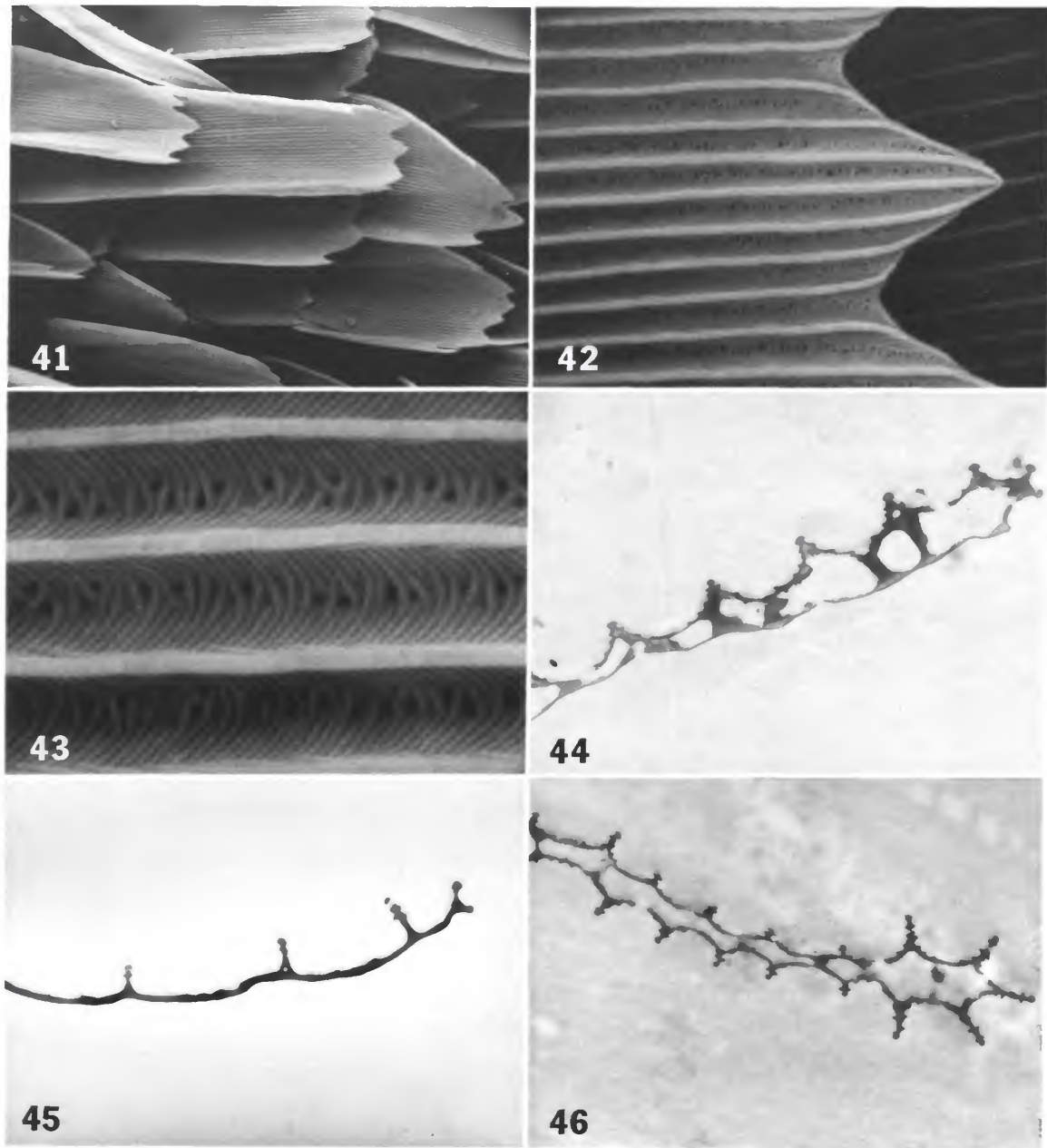
In contrast to the above, the discal scales in Acanthopteroctetidae possess prominently dentate apices in which the ribs do not extend beyond the apex of the scale (Figure 42). In addition, all scales (including the more hairlike ones) are of the perforated type with a well-developed internal lumen (Figure 44).

In both families the scales of the ventral surfaces of the wings and of the dorsal surface of the hind wings are typically more slender, and in the case of the latter, frequently hairlike. The dorsal scales in the hind wings of *Dyseriocrania*, *Eriocraniella*, and *Neocrania* are relatively broad.

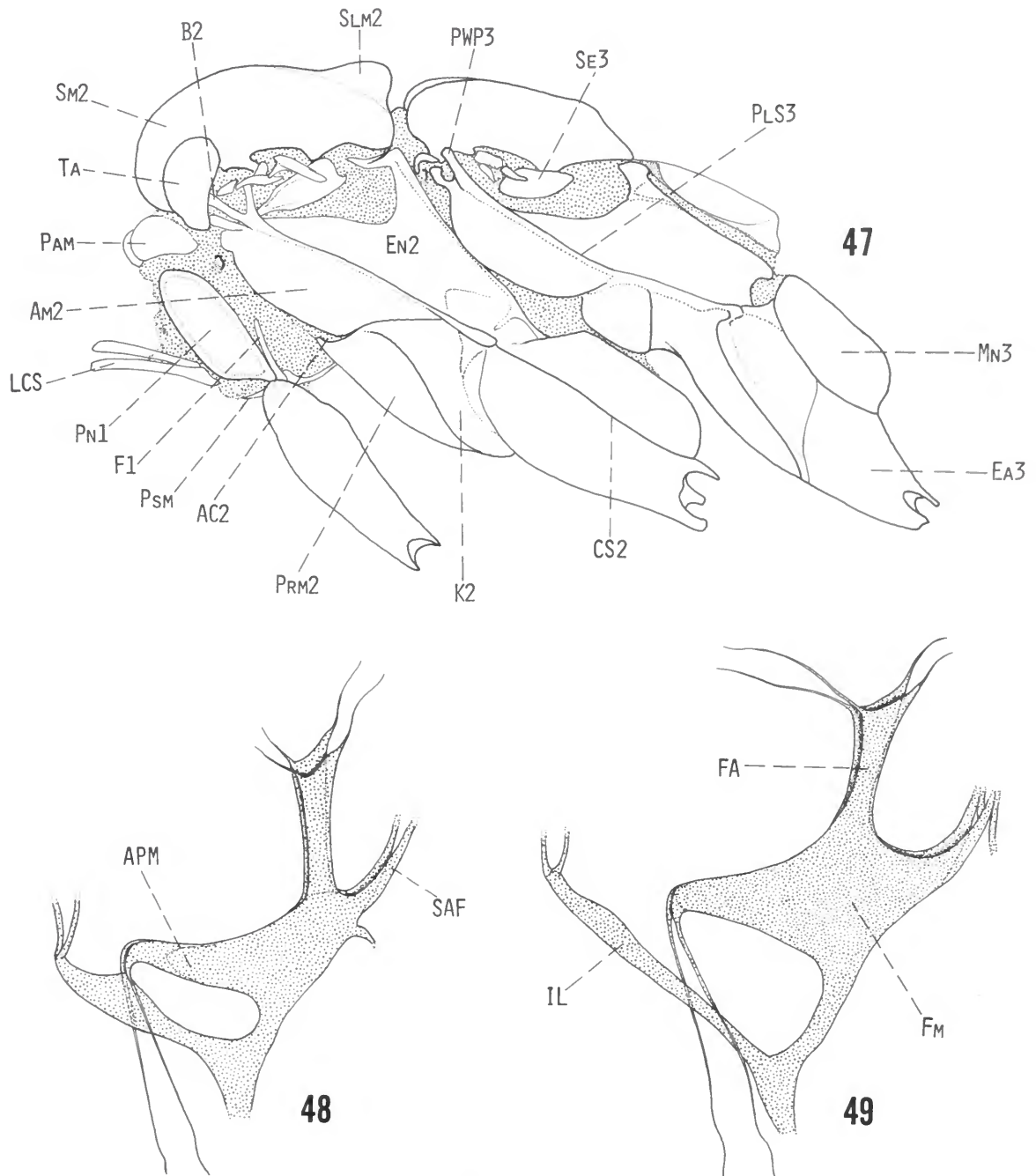
ABDOMEN.—The first abdominal segment in this superfamily, as is true in varying degrees in all Lepidoptera, has undergone reduction. The tergite is largely membranous, with sclerotization largely restricted to the lateral margins. The first sternite



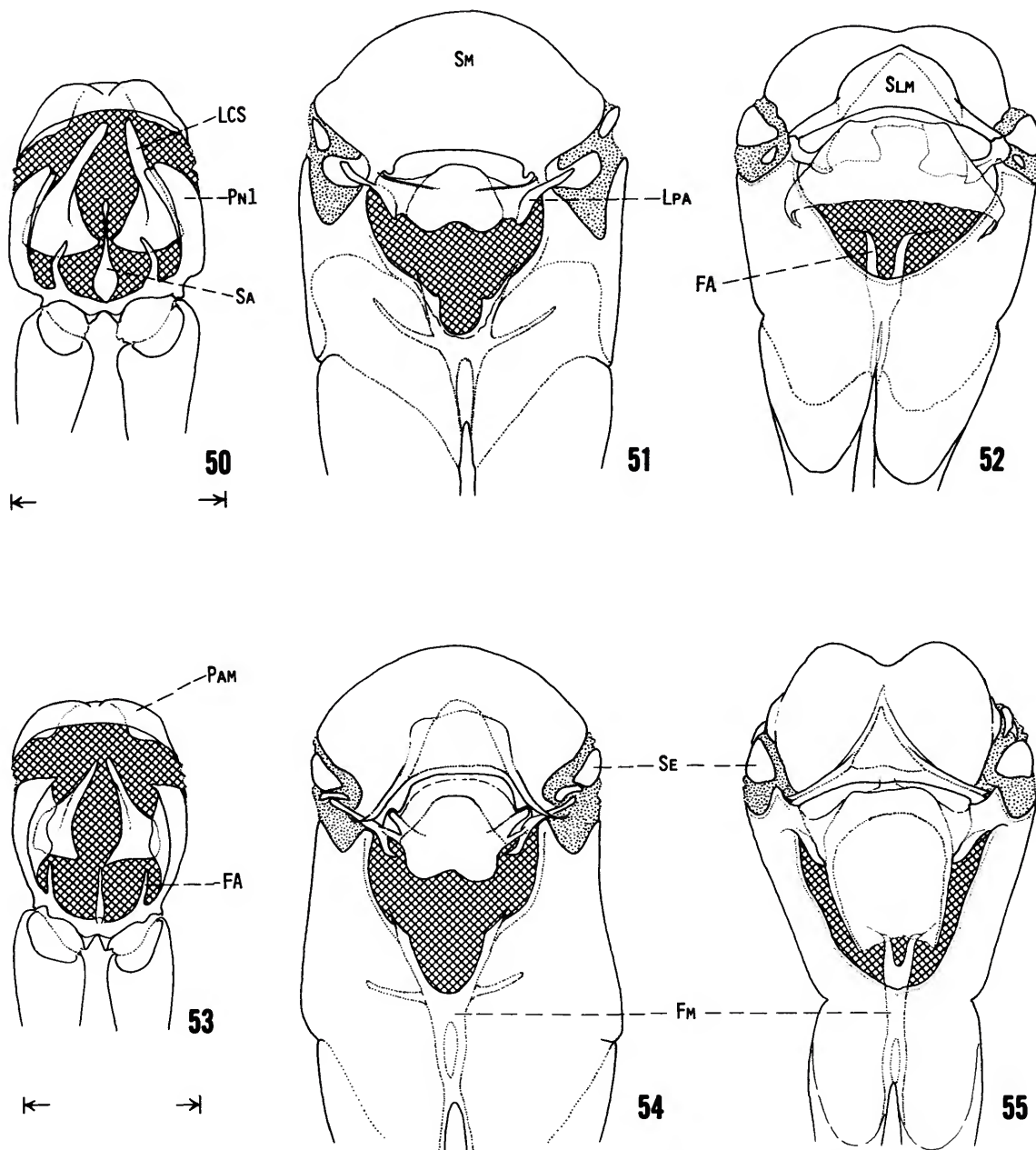
FIGURES 35-40.—Wing scales (from dorsal surface of discal cell of forewing): 35, *Dyseriocrania griseocapitella* (Walsingham), $\times 500$; 36, detail of scale in Figure 35, $\times 7500$; 37, apex of scale, $\times 7500$; 38, *Lophocorona pediasia* Common, apex of scale, $\times 10,000$; 39, *Agathiphaga queenlandensis* Dumbleton, apex of scale, $\times 7500$; 40, *Epimartyria auricrinella* Walsingham, apex of scale, $\times 7500$. (Photographs reduced to 83%.)



FIGURES 41-46.—Wing scales: 41, *Acanthopteroctetes bimaculata* Davis, dorsal scales from discal cell of forewing, $\times 500$; 42, apex of scale in Figure 41, $\times 5000$; 43, detail of scale in Figure 41, $\times 15,000$; 44, cross-sectional view of scale from Figure 41, $\times 10,200$; 45, *Dyseriocrania griseocapitella* (Walsingham), cross-sectional view of scale from Figure 35; 46, cross-sectional view of slender scale from marginal fringe of forewing, $\times 10,200$. (Photographs reduced to 83%.)



FIGURES 47-49.—Thoracic structure: 47, *Acanthopteroctetes bimaculata* Davis, lateral view of thorax; 48, *Dyseriocrania griseocapitella* (Walsingham), lateral view of metafurcasternum; 49, *A. bimaculata* Davis, lateral view of metafurcasternum.



FIGURES 50-55.—Caudal view of thoracic segments: 50, *Dyseriocrania griseocapitella* (Walsingham), prothorax; 51, mesothorax; 52, metathorax; 53, *Acanthopteroctetes bimaculata* Davis, prothorax; 54, mesothorax; 55, metathorax. (Scale = 0.5 mm.)

is extremely reduced, resulting in fragmented remnants that are difficult to homologize. In *Dyseriocrania* (Figure 56) the first sternite appears to be represented by a small, strongly bifid median plate with slender arms extending laterally. Immediately posterior to this is another, extremely narrow, crescentic sclerite that is, however, more elongate and interrupted at the midline. Each arm of the latter sclerite is superficially connected medially to the second sternite and fused laterally to the apices of the anterolateral processes of the second sternite. The medial connection in most species is by means of a small but well-defined furcate plate. The second, narrow sclerite, thus, may either represent a fragmentation of the first sternite or, more likely, the anterior edge of the second sternite. Consequently, as interpreted in this paper, the second sternite consists of a narrow, anterior margin separated from the main body of the sternite by a broad intrasegmental membranous area. The main body of the second sternite is rather broad and possesses a bilateral pair of slender, relatively elongate anterolateral processes referred to above. These processes, together with the fused apices of the anterior margin of the second sternite, are weakly articulated laterally to a bilateral pair of posterolateral processes of the first tergite that are situated well posterior of the first abdominal spiracles. There is no evidence of a prespiracular connection.

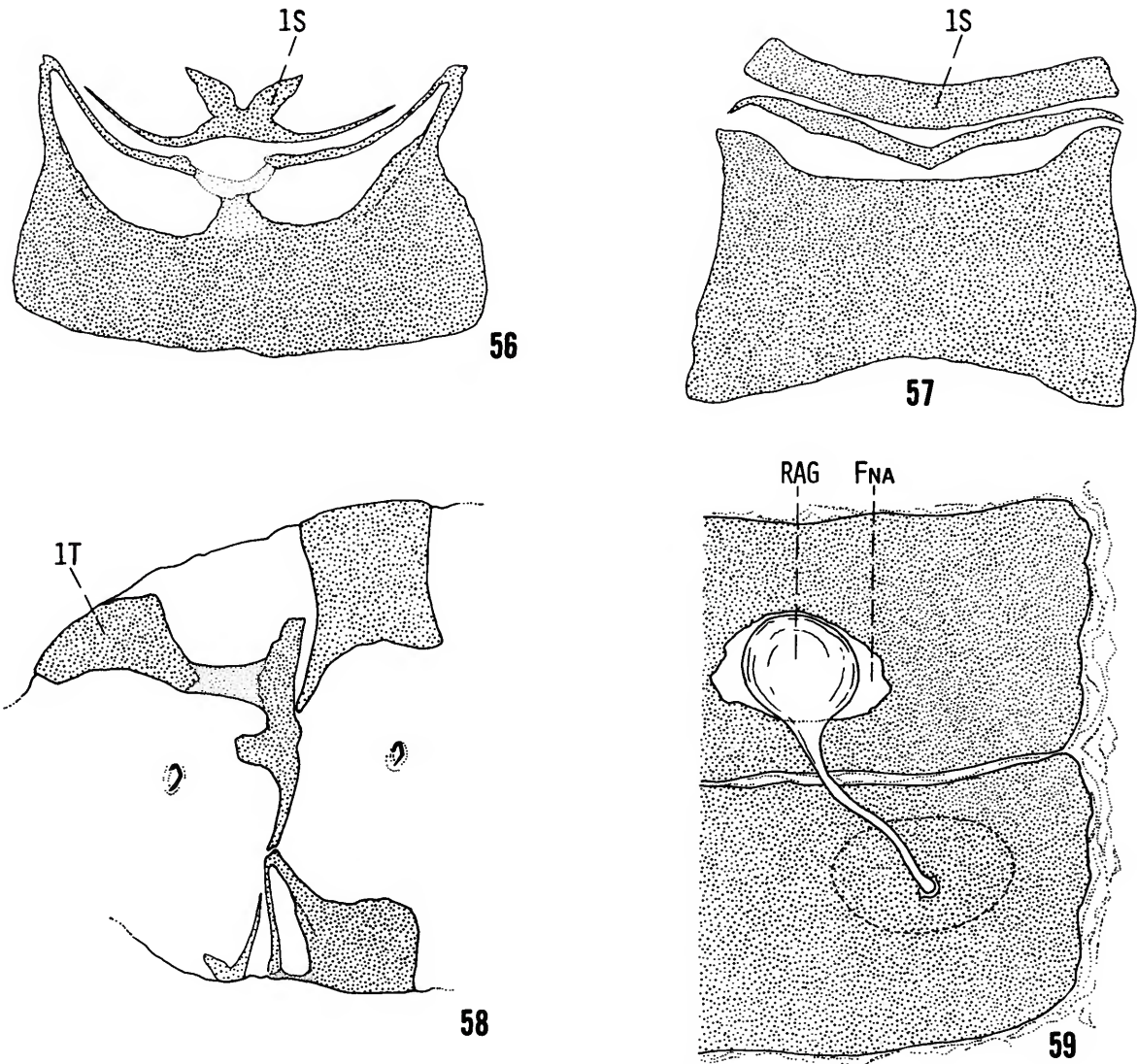
In *Acanthopteroctetes* the first abdominal tergite is similar in shape and degree of sclerotization to that of *Dyseriocrania*. The first sternite (Figure 57), however, is less modified and consists of a simple, narrow band. Immediately posterior to this is a second more narrow band extending completely across the venter. Unlike its homologue in *Dyseriocrania* this sclerite is entirely free from the main body of the second sternite. Also, unlike *Dyseriocrania*, the anterolateral angles of the second sternite are not produced, resulting in an even weaker connection with the posterolateral process of the first tergite. In general, the posterolateral processes of the first tergite are also less developed in this genus.

The third abdominal segment is usually unmodified in the Eriocraniioidea other than the presence of paired hyaline areas on the sternite of certain species. The male of *Acanthopteroctetes unifascia*, new species, however, possesses a bilateral pair of

unusual, pedunculate organs arising laterally near the third abdominal spiracles. These structures (Figure 165) consist of a triad of clavate filaments originating from a small, oval sclerotized plate. The enlarged terminal end superficially appears glandular in composition, although the exact function of these peculiar structures remains unknown. Similar organs are absent in the males and females of other species of *Acanthopteroctetes*. A determination of their existence in the opposite sex of *A. unifascia* will have to await the discovery of a female specimen.

The fourth and fifth abdominal sternites of most Eriocraniidae are variously modified in association with the presence of specialized, paired abdominal glands. These organs also occur in certain Trichoptera, and their general distribution among Lepidoptera has been reviewed by Philpott (1925), Razowski (1975a), and Davis (1975b). The sternal modifications of the fourth segment in the female typically resemble oval to circular, membranous windows, or fenestrae (Figures 59, 60) in the otherwise darkly sclerotized sternite. In the North American Eriocraniidae, fenestrae are absent from the fourth sternite in the males but are normally present in all females except *Neocrania bifasciata*, new species. Internally, the fenestrae are intimately associated with the small, globular reservoirs of the fifth sternal glands (Figure 59). In dissections of female abdomens of *Dyseriocrania griseocapitella* fixed in KAAD, the reservoirs were observed closely pressed against the inner wall of the fenestrae, held in place by strands of connective tissue and overlaid by fatty deposits. Thus, the fenestrae have no independent secretory function but merely appear to demarcate the presence of internal glands opening on the following sternite. The reservoirs in male *D. griseocapitella* (as well as in other male eriocraniines) appear to be as closely associated with the inner wall of the fourth sternite as in the female, but for some reason are rarely delimited by fenestrae externally. The same is probably true for females of *Neocrania bifasciata*. The external surface of the fenestrae (Figure 61) differs markedly from the rest of the sternite in lacking microtrichiae. The relative density of the body scales, however, is the same as on the surrounding area.

Similar, typically paired, hyaline areas can also be found on other abdominal segments of various Lepidoptera. For example, such a pair may be

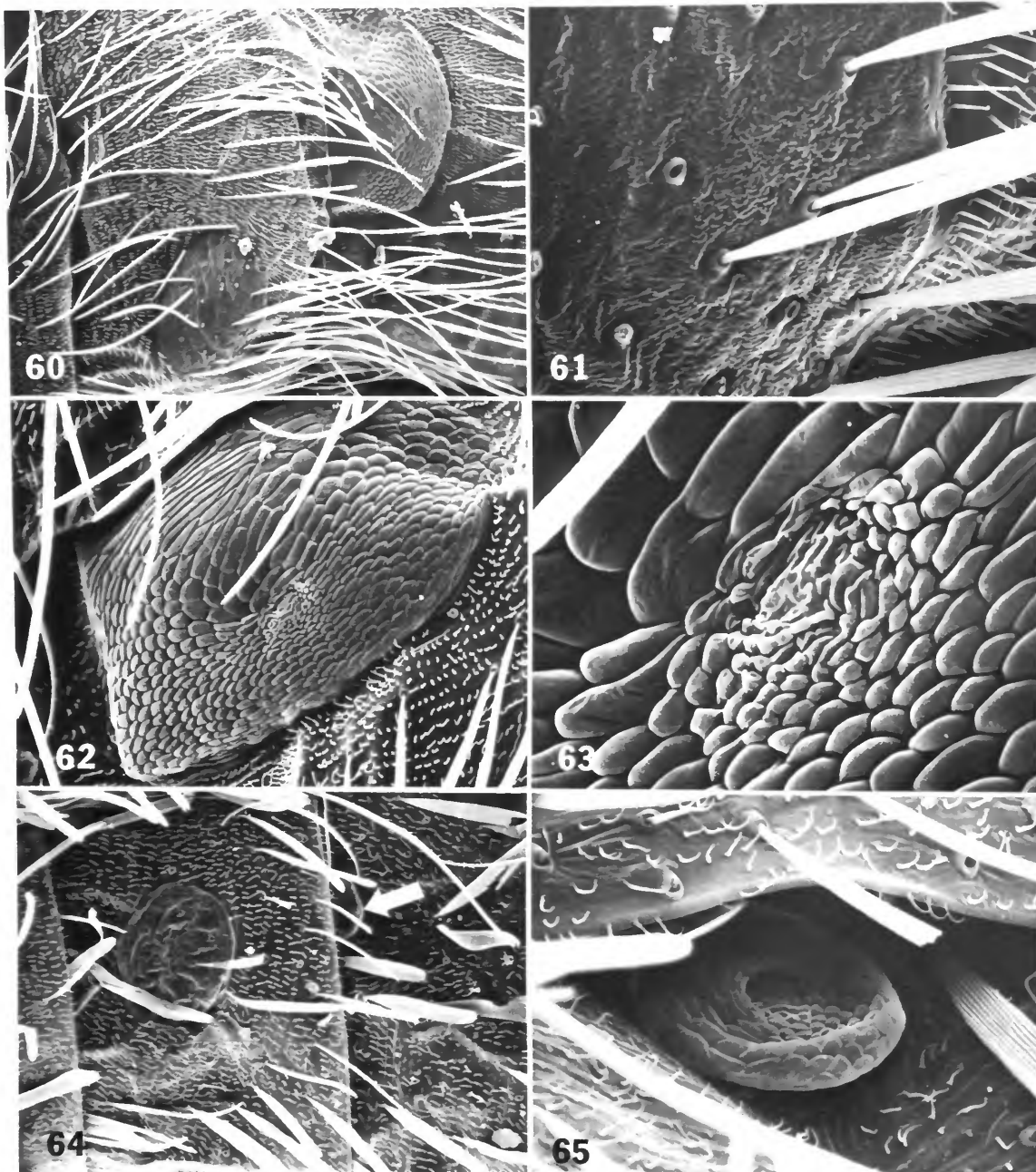


FIGURES 56-59.—Abdominal structure: 56, *Dyseriocrania griseocapitella* (Walsingham), ventral view of first and second abdominal sternites; 57, *Acanthopteroctetes bimaculata* Davis, ventral view of first and second abdominal sternites; 58, *D. griseocapitella* (Walsingham), lateral view of first and second abdominal segments; 59, internal view of fourth and fifth abdominal sternites and fifth abdominal gland.

observed in various stages of development in the males and females of some species of Eriocraniidae near the anterior margin of the third sternite. These are particularly evident in *Neocrania bifasciata* (Figure 243).

The sternal glands are completely separated in-

ternally and discharge through a pair of variously modified tubercles located near the anterior margin of the fifth sternite. Two distinct forms of tubercles are known in this family. The sternal tubercles of *Dyseriocrania* are unique in resembling greatly enlarged, flattened pads (Figure 62).



FIGURES 60-65.—Abdominal structure: 60, *Dyseriocrania griseocapitella* (Walsingham), fenestra and tubercle of fourth and fifth sternites respectively, $\times 170$; 61, surface detail of fenestra, $\times 1075$; 62, reniform sternal tubercle, $\times 420$; 63, detail of Figure 62 showing aperture of fifth sternal gland, $\times 2100$; 64, *Eriocraniella falcata*, new species, fenestra and tubercle (see arrow) of fourth and fifth sternites respectively, $\times 280$; 65, papillose sternal tubercle, $\times 100$. (Photographs reduced to 84%.)

In all other eriocraniid genera, the tubercles are reduced in size and are papiliform. In both types the external surface of the tubercles is covered with a dense reticulated pattern of interconnecting grooves radiating outward from a centrally located pore (Figure 63). The likely function of such a finely divided surface is to provide a greater overall surface area and a more efficient means of dispersing the secretions of the glands. Because the glands are usually present in both sexes (if present at all), it would seem most likely that they serve a defensive purpose. At least one Japanese eriocraniid species examined and all Acanthopteroctetidae lack any evidence of sternal tubercles or fenestrae.

The eighth segment in the male is unspecialized and is composed of a well-defined tergite and sternite. In the female, these two sclerites are largely united to form a relatively large, cylindrical cone that normally encloses the ninth and 10th segments (i.e., the ovipositor). The eighth segment in the females of Acanthopteroctetidae is very similar to that of the Eriocraniidae and differs only in the possession of a single row of elongate setae from the caudal margin of the former. A prominent, apparently functional spiracle is present in both groups immediately dorsal to the basal insertions of the anterior apophyses.

MALE GENITALIA.—Several structures in the male genitalia differ greatly between the two families. Among the small number of species within each family, however, the genital morphology is remarkably similar. In the following discussions and descriptions I have attempted to use terms familiar to lepidopterists (as defined by Klots, 1970) even though the exact homologies of some structures are questionable.

The ninth segment in the Eriocranioidea resembles that of a few other primitive groups in being cylindrical and undifferentiated into a distinct, dorsal tegumen or ventral vinculum. Although the latter sclerites are not well defined in this superfamily, for the sake of brevity, these terms have been used in the following taxonomic descriptions to designate the general dorsal and ventral areas of the ninth segment. The anterolateral angles of the vinculum in the Eriocranioidea are either merely sharply defined (as in Acanthopteroctetidae) or greatly elongated into a prominent pair of apophyses. Somewhat similar developments in the vinculum are also evident in varying degrees in

such families as the Neopseustidae and certain species of Nepticulidae. In one subgenus of *Eriocraniella*, a prominent furcate process, or furcula (Fra), arises midventrally near the caudal margin of the vinculum. Its function is unknown; possibly, it plays some role during copulation and may be brought into contact with the spinose pocket on the ninth segment of the female, as discussed later.

The 10th tergite, or uncus, is well developed in all species. It differs in form between the two families with that of the Eriocraniidae being more prominently divided or lobed. Any evidence of a sternite (gnathos, etc.) is lacking.

Often arising near the caudal margin of the ninth tergite and from the intersegmental region between the valvae and the base of the uncus is a bilateral pair of small digitate lobes, each bearing a single, elongate seta. These structures are typically present in *Eriocrania*, *Eriocraniella*, and *Neocrania* but absent in *Dyseriocrania* and *Acanthopteroctetes*. They have also been secondarily lost in *Eriocrania sparmannella*, (Birket-Smith and Kristensen, 1974). Largely because of their position (i.e., ventrad to the base of the uncus), they have been regarded as socii in the present paper. Because of the general absence of socii throughout the homoneurous families (with the possible exception of the Neopseustidae), however, the true homology of the socii in the Eriocraniidae is questionable. In their study of the male genitalia of *Eriocrania*, Birket-Smith and Kristensen (1974) have considered these structures to be basal processes of the valvae.

The valvae also differ greatly in form between families but are very uniform within each group. Those of the Eriocraniidae are greatly reduced and probably incapable of appreciable movement. Birket-Smith and Kristensen (1974), however, have found the valvae of *Dyseriocrania subpurpurella* to be movable by muscles inserted on their bases. The valvae of Acanthopteroctetidae are considerably more elongate, freely movable, and possess a peculiar membranous fringe along portions of the ventral margin.

One of the most complex areas of the male genitalia involves various sclerotizations in the diaphragma surrounding the aedeagus. In the Acanthopteroctetidae, these consist of two distinct sclerites that I have referred to as the transtilla (dorsal to aedeagus) and juxta (ventral to aedeagus). The transtilla (Figure 289) in this genus is in the form

of a heavily sclerotized transverse arch extending between, but separate from, the bases of the valvae. An elongate, similarly sclerotized process extends caudally from the center of the arch to the apex of the uncus. The apex of this median process typically curves dorsally to form an uncinatate lobe in each of the three known species. The main purpose of this process is probably to serve as a supporting guide for the aedeagus. The juxta in this subfamily lies relatively free along the ventral side of the aedeagus. It tends to be long and spatulate but differs in form and the relative amount of sclerotization among the known species.

A transtilla is entirely absent in the Eriocraniidae. The juxta is present but consists of a much more complex morphology. Its structure is described in detail by Birket-Smith and Kristensen (1974) wherein it is referred to as the median plate. As shown by these authors, the lateral edges of the juxta are continuous with the membranous walls of the genital cavity, thus separating this cavity into a dorsal genital chamber and a smaller, ventral subgenital crypt.

The 11th segment is largely represented by the anal tube. Usually the tube is entirely membranous, but occasionally it may contain numerous minute spinules within its walls (in *Dyseriocrania*) or small bilateral sclerites basally (in *Eriocrania*). The latter may represent vestiges of the 11th sternite, as suggested by Birket-Smith and Kristensen (1974).

The aedeagus in the Eriocraniidae is prominently divided into a primary dorsal branch (containing the vesica) and a secondary ventral branch. The vesica lacks well-developed cornuti, although a few scattered minute spines do sometimes appear. According to Birket-Smith and Kristensen (1974) both phallic branches are inserted during copulation. The base of the aedeagus is typically inflated and bulbous with the ventral branch often loosely articulated. The ventral branch tends to be more varied in form between species and may be variously lobed or even provided with apical external spines or cilia.

Internally, the male reproductive system in *Dyseriocrania* continues as an elongate, partially coiled ejaculatory duct (ED) extending anteriorly from the base of the aedeagus (Figure 66). Near its termination this duct divides but remains contiguous until the paired ducts completely separate near the junction of the inflated, slightly curved region

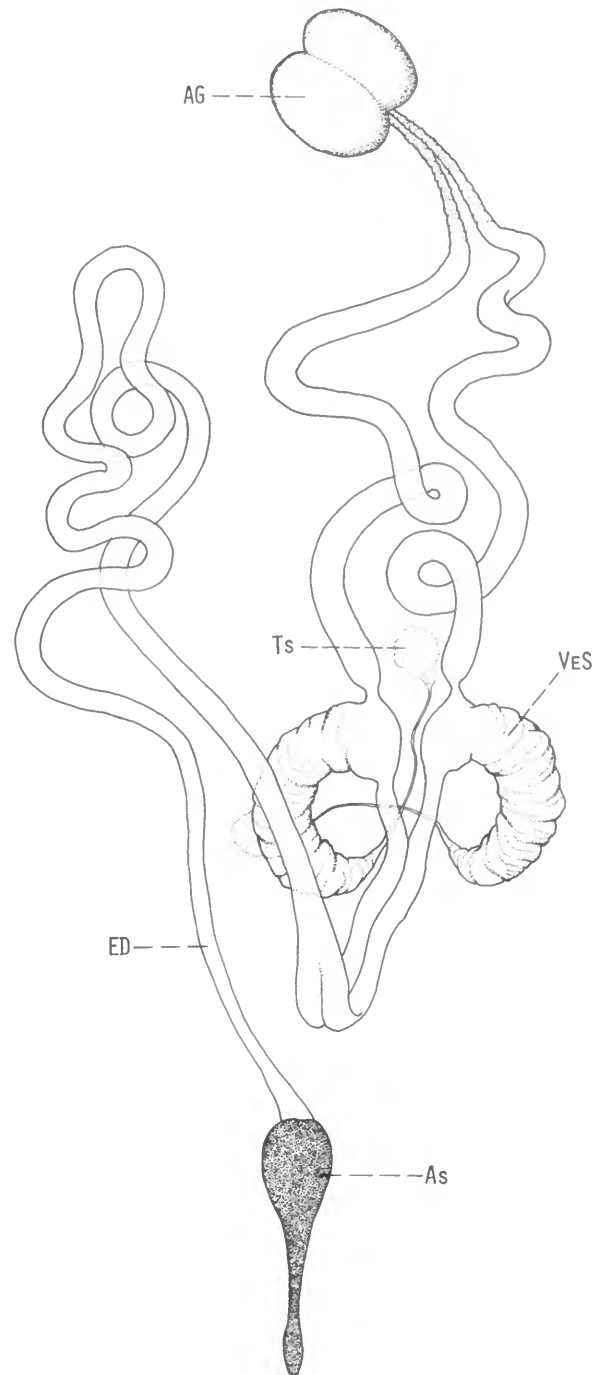


FIGURE 66.—Male internal reproductive system of *Dyseriocrania griseocapitella* (Walsingham).

of the vas deferens, or vesicula seminales (VeS). Beyond the latter the vasa deferentia constricts to a very slender duct leading to a reduced, relatively indefinite mass of tissue, the testis, which is largely enclosed by fat body cells. The interpretation of the testis as being present in such a vestigial condition in the Eriocraniidae has been suggested by Kristensen (pers. comm.), who will discuss his findings more fully in a forthcoming publication. One of the most revealing discoveries by Kristensen to support the above interpretation was the presence of spermatozoa in the vesicula seminales and testes and their pronounced absence elsewhere in the reproductive system.

Anterior to the junction of the paired vesicula seminales continue two elongate, somewhat convoluted ducts that lead to a firm, bilobed mass of tissue resembling the more typical lepidopteran testes but interpreted herein as the accessory glands. Gross dissections of this organ failed to reveal any indication of testicular follicles, thus supporting Kristensen's belief that the organ does not represent the true testes.

In the Acanthopteroctetidae the aedeagus is not divided and appears more simple except for a prominent array of endophallic cornuti. The particular arrangement of the cornuti varies according to species. The base of the aedeagus is relatively simple and not swollen.

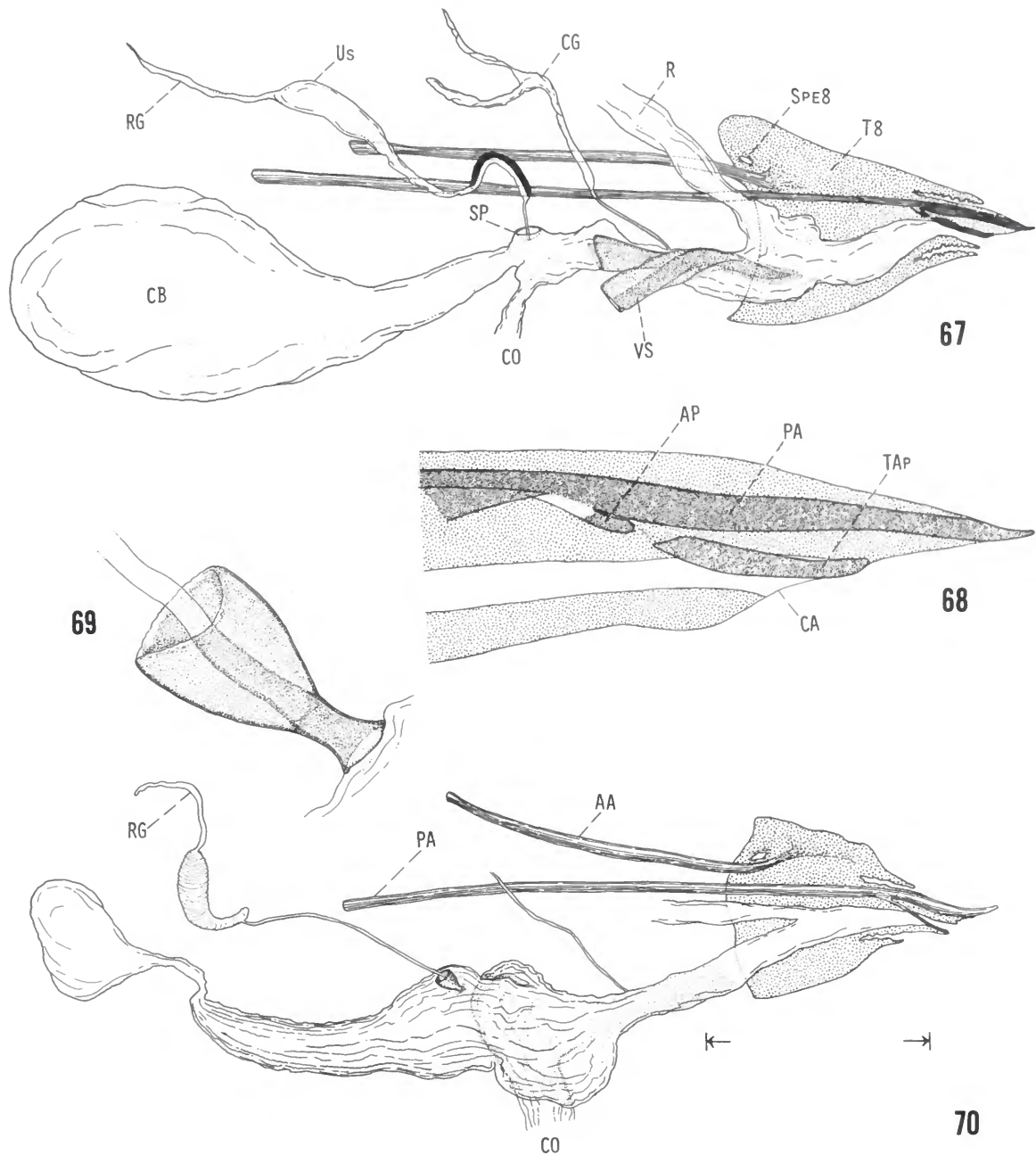
FEMALE GENITALIA.—The principal features of systematic importance in the female reproductive system have been recently reviewed by Stekol'nikov (1967), Mutuura (1972), Dugdale (1974), and Davis (1975b). In the Eriocranioidea, I have interpreted the ovipositor as consisting of structures derived from the ninth and 10th abdominal segments, normally enclosed largely by the eighth segment. In this regard I thus agree with the interpretations of Chapman (1917) and not with Philpott (1927). As already stated, the eighth segment is enlarged, conical in form, and normally (at rest) contains the retractible ninth and 10th segments. Two sets of elongate, rodlike apophyses are present that enable the female to insert her eggs under the leaf epidermis. The anterior apophyses arise from the eighth segment immediately below the eighth spiracle. The posterior pair originate in the 10th segment and are fused distally to form the actual piercing organ. The fused apex is strongly depressed and equipped with a lateral, subapical series of usually seven to

12 minute teeth. Closely associated with the apex of the posterior apophyses in Eriocraniidae is an accessory pair of short, tertiary apophyses (TAp) that are ventrally situated within the largely membranous body wall of the 10th segment. As early suggested by Wood (1891:178), these flattened rods may represent remnants of the 10th sternite. The tertiary apophyses lie parallel to one another and more or less laterad of the cloacal aperture. Whereas their caudal ends appear free, anteriorly the tertiary apophyses are weakly connected to a minute digitate process or articular process (AP), arising ventrally and well anterior of the apex of the posterior apophyses. Although articular processes are absent in Acanthopteroctetidae, tertiary apophyses are present but even more poorly defined.

The ninth segment in female Eriocraniidae is poorly defined and largely membranous. In one subgenus of *Eriocraniella*, however, a specialized midventral invagination has developed near the caudal end of the ninth segment. The lateral margins of this shallow depression, herein referred to generally as the spinose pocket (SPt) are typically densely covered with minute spines (Figures 310, 317). Its function is not known, but it may be involved in copulation as hypothesized under the discussion for the genus *Eriocraniella*.

Only one posterior body opening is present in the females of this superfamily and that is situated ventrally on the 10th segment (and not the eighth as stated by Mutuura, 1972), slightly anterior to the extreme apex of the ovipositor. Through this common opening, or cloacal aperture, all reproductive and alimentary functions pass. A rather elongate, well-defined cloaca is present, formed by the junction of the lower alimentary canal, or hindgut, with the vagina.

The typically enlarged portion of the vagina is sometimes referred to as the vestibulum. In the Eriocraniidae, a highly specialized, variously modified vaginal sclerite (VS) encircles the vaginal passage. Normally the vaginal passage is constricted at the point where it passes through the aperture of the sclerite. Because of its unusual position, the vaginal sclerite was simply termed the "valve" by Philpott (1927). Stekel'nikov (1967) used the same terminology but somewhat incorrectly stated that it was located at the base of the common oviduct. As noted by Stekel'nikov, large muscles occupying much of the eighth segment are attached to the vaginal



FIGURES 67-70.—Female reproductive system: 67, *Dyseriocrania griseocapitella* (Walsingham); 68, apex of ovipositor; 69, *Acanthopteroctetes bimaculata* Davis, detail of spermathecal papilla; 70, *A. bimaculata* Davis. (Scale = 0.5 mm.)

sclerite, particularly to the variously modified anteroventral half. In some eriocraniids this end is broadly depressed; in others, a large, compressed keel-like process develops ventrally. Although variable within a few species, the form of the ventral keel usually differs considerably between species and, consequently, can be most useful in species identification and, in some instances, generic delimitation. For example, the vaginal sclerite in *Eriocrania* characteristically possesses a sclerotized median process (MP) extending caudally from the base of the midventral keel; this process apparently does not occur in other genera.

Dorsal to the vaginal sclerite arises the slender duct from the usually bifid colleterial glands (CG). The anterior end of the vagina is marked by the junction of both the ventral common oviduct (CO) and the dorsal ductus spermathacae to the caudal end of the ductus bursae. In the Eriocraniidae, the ductus spermathacae is sinuate and possesses a rather prominent, elongate internal thickening. The spermathecal papilla (SP) is mostly membranous and cupuliform.

In the Acanthopteroctetidae, the vagina shows no indication of a specialized sclerite and tends to be much larger in diameter. The walls are considerably thicker and heavily folded, with one or more secondary lobes projecting in an irregular manner. In *Acanthopteroctetes bimaculata*, the common oviduct appears to emerge laterally from such a lobe (Figure 330). Probably what has occurred is that the normal, ventral junction of the common oviduct has migrated to a lateral lobe of the vagina as this lobe developed. As summarized by Dugdale (1974) and Davis (1975b), a ventral origin of the common oviduct is clearly the primitive condition within the panorpoid orders, and in no known instance does this passage arise laterally from the reproductive tract. In another but unnamed species of *Acanthopteroctetes*, the vestibulum (i.e., vagina) is even more irregularly lobed (Figure 332) and possesses a rather slender tube, assumed to be the common oviduct, arising from a more typical midventral position.

The spermathecal papilla is variously modified in the Acanthopteroctetidae and may be either membranous, as in the Eriocraniidae, or darkly sclerotized (Figure 69). The general structure of the spermatheca is similar to that of the Eriocraniidae in possessing a relatively small, elongate utriculus

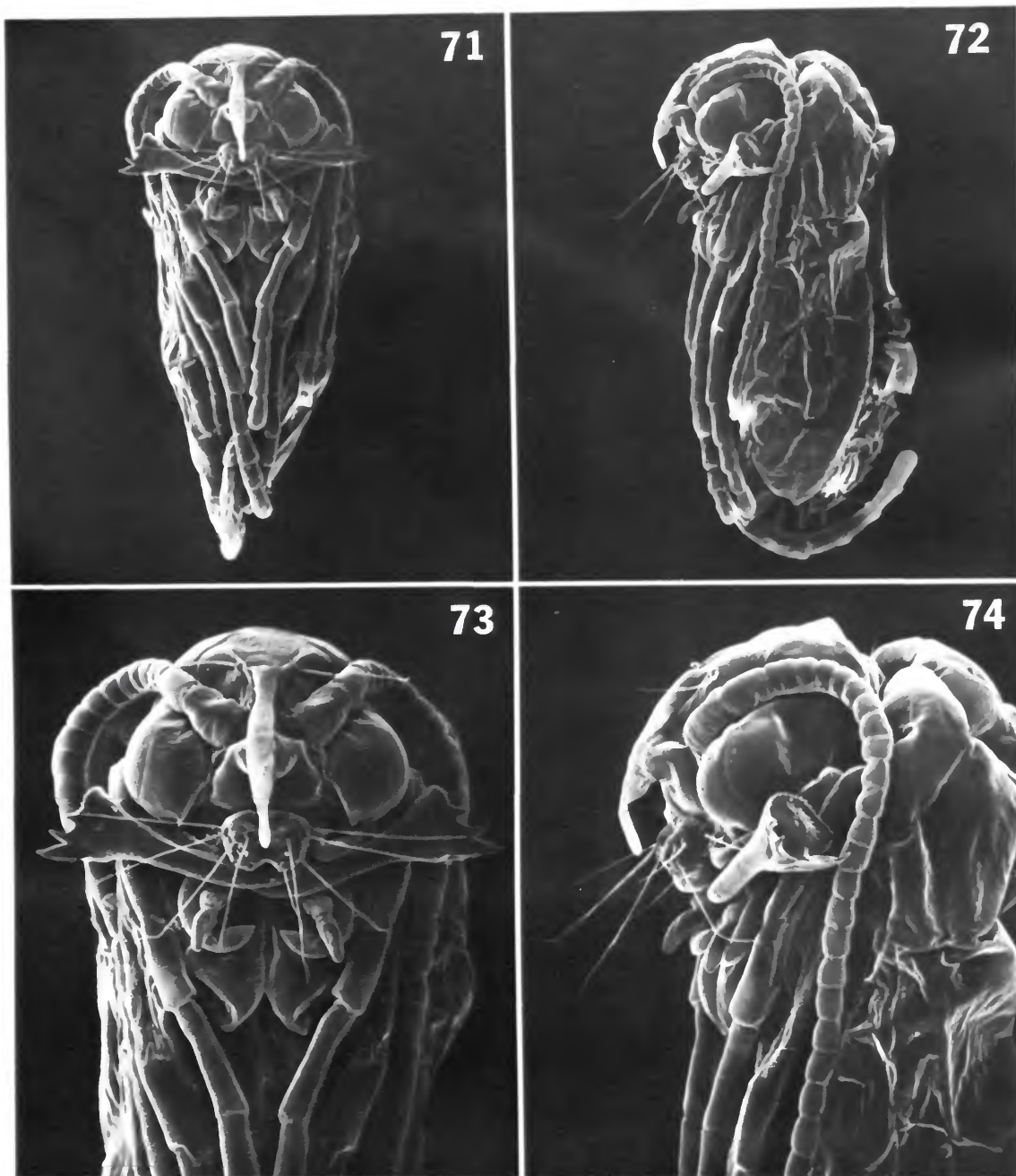
(Us) with a terminating and very slender, receptacular gland (RG). The spermathecal duct, however, does not possess any internal thickening.

Although no signum appears within the corpus bursae of any eriocranioid species, the walls of at least one species of *Dyseriocrania* are finely covered with a scattering of minute spinules (Figure 296).

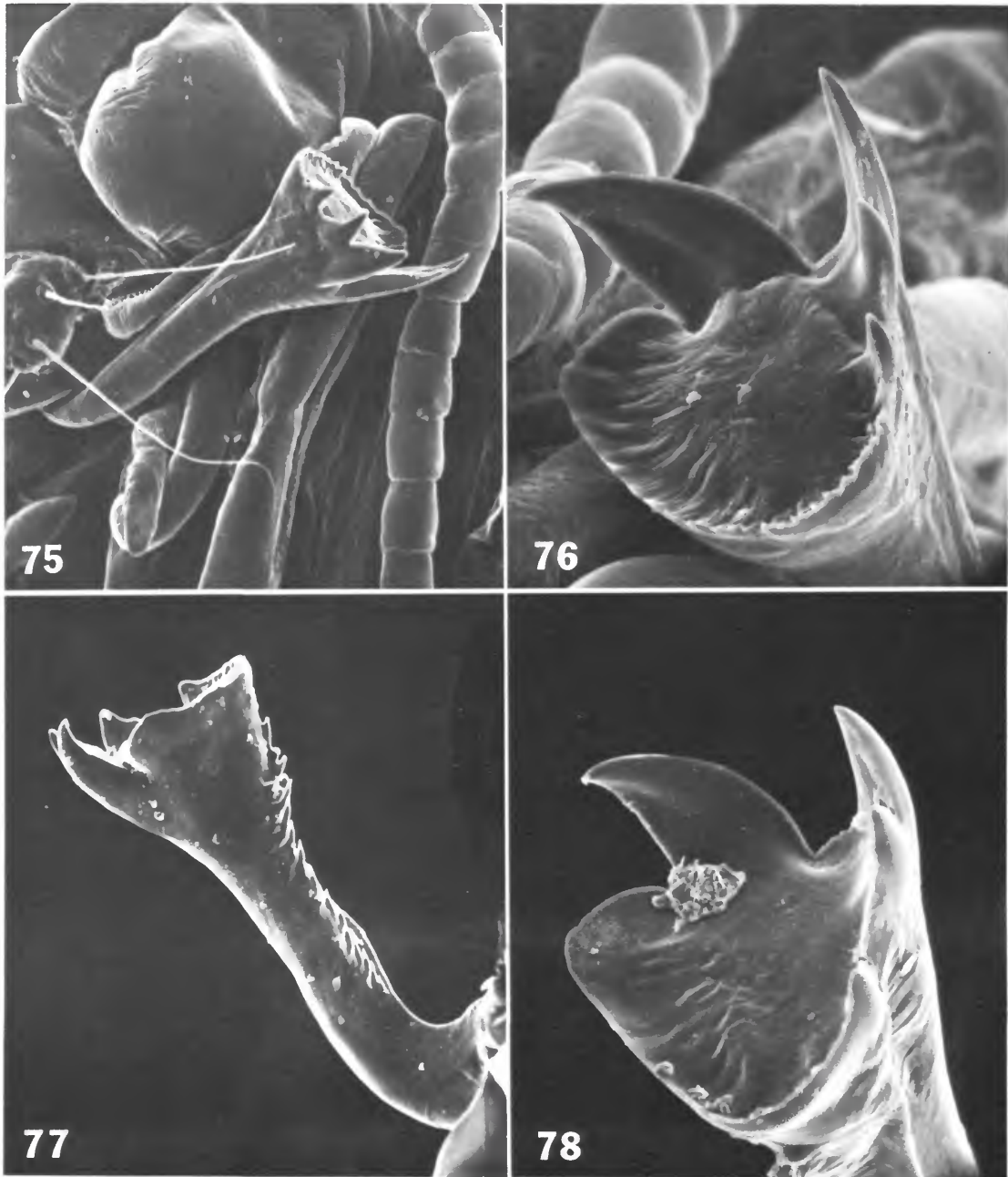
PUPAL MORPHOLOGY

Ever since Stainton described and illustrated a pupa of *Eriocrania ?purpurella* Haworth in 1863, the unusual morphology of the eriocraniid pupa has attracted wide interest. The completely functional, rather grotesque mandibles (Figures 71–78) are the most spectacular feature of this stage. Superficially the eriocraniid pupae resemble the denticous pupae of many Trichoptera, but, in the case of the latter, the mandibles are normally smaller and function in a more opposable manner. The broad, truncate apices of the eriocraniid mandibles are particularly striking and bear closest resemblance to those found in agathiphagid pupae. The unusual form of the mandibles probably assists the pharate adult in pushing its way from its underground cocoon to the soil surface. Except for the heavily sclerotized mandibles and certain structures that serve to strengthen the head, the eriocraniine pupal cuticle tends to be very thin and flexible. All appendages of the body are free and usually capable of varying degrees of movement; even the head is capable of some motion.

Another prominent feature of the head is the elongate frontal ridge that protrudes free of the head as far as the labrum. This ridge, or cocoon cutter, undoubtedly plays some role in assisting the mandibles to tear through the wall of the subterranean cocoon. The labrum is well defined and bears at least four radiating pair of elongate setae. The longest of these setae extend almost to the apices of the mandibles. Another pair or two of elongate setae arise from the vertex of the head. From the little comparative data available thus far, the chaetotaxy of the head seems very uniform. Likewise, the mandibles appear very similar in structure, judging from the only two species available for study (*Dyseriocrania griseocapitella* and *Eriocrania* species, perhaps *semipurpurella*). For example, a comparison of the highly modified mandibular apices of both species (Figures 76, 78)



FIGURES 71-74.—Pupa of *Eriocrania semipurpurella semipurpurella* (Stephens) from England: 71, ventral view, $\times 34$; 72, lateral view, $\times 34$; 73, ventral view, $\times 60$; 74, lateral view, $\times 60$. (Photographs reproduced at 100%.)



FIGURES 75-78.—Pupal structure: 75, *Eriocrania* ?*semipurpurella semipurpurella* (Stephens), detail of mouthparts of Figure 71, $\times 130$; 76, apex of mandible, $\times 320$; 77, *Dyseriocrania griseocapitella* (Walsingham), lateral view of mandible, $\times 120$; 78, apex of mandible, $\times 240$. (Photographs reduced to 94%.)

reveals essentially the same arrangement of four progressively larger spines and a slightly raised marginal ridge surrounding a relatively broad, flattened distal end. The only difference detected was in the minutely serrated ridge of *Eriocrania* species compared to the entire or smooth condition of the ridge in *D. griseocapitella*. The inner surface of the mandibular shafts of both species appears similarly serrated.

As pointed out by Hinton (1946a), the denticous pupa has no muscles of its own. Thus, the muscles that move the pupal mandibles belong to the adult. These are attached to the mandibular apodemes of the adult, which in turn encase (except at their juncture with the pupal mandibles) the pupal apodemes that actually project into the head of the adult. Consequently, the situation in the genus *Acanthopteroctetes*, wherein both the adult mandibles and mandibular apodemes appear extremely reduced, may indicate a reduction and even loss of function of the pupal mandibles. Certainly, it will be most interesting to examine the pupal stage of this genus, whenever it is discovered, for possible reduction or loss of articulation of the mandibles.

The cases enclosing the developing imaginal wings are elongate and frequently extend to the caudal end of the abdomen. The tarsal segmentation, as is true for the antennae, is clearly defined. Often even the scales of the wings and body are visible through the thin, membranous cuticle. As shown by Mosher (1916), the chaetotaxy of the abdomen is relatively simple, typically consisting of three pairs of dorsal setae over the first eight abdominal segments. All of the abdominal segments are capable of independent movement except for segments VIII–X, which are fused.

LARVAL MORPHOLOGY

Most of the larvae examined during the course of this study and described in the text are believed to represent the final, or fourth, instar. In the case of *Eriocrania ?semipurpurella pacifica*, new subspecies, however, it is possible that only third instar larvae were studied. From the few species examined, it was apparent that the chaetotaxy of the last two, and possibly three, instars was essentially identical; however, it was noted for some species that younger larvae tended to be more heavily pigmented and may even possess darkly sclerotized tergal plates

over the abdomen. Because the immature stages of the Acanthopteroctetidae are unknown, the following remarks pertain only to the Eriocraniidae.

Although the larvae of Eriocraniidae are leaf-miners throughout their entire feeding cycle and, consequently, do demonstrate several specializations for this behavior, they are not as highly specialized as many leaf-mining Lepidoptera. For example, in general form they superficially resemble the last instar (i.e., the spinning larva) of many Gracillariidae and Tischeriidae in that the head and body are cylindrical and not strongly depressed. They further resemble the Tischeriidae in possessing a well-developed spinneret throughout most of their larval life and in the possession of spinose tufts or brushes on the labrum and mandibles. The relatively few (i.e., four) instars exhibit no evidence of hypermetamorphism, although the first instar is yet to be studied.

HEAD.—The head capsule is partially retracted into the thorax, resulting in the extreme reduction of most of the posterior cranial setae. Several of the cranial setae are so reduced that it is difficult to examine them without resorting to either interference or electron microscopy. Frequently, for example, distinguishing between setal pores and setae becomes a serious problem. The vertex is deeply divided with the coronal notch extending to the frontal sclerite, or frons. The adfrontal sutures are prominent and externally mark very broad and thickened, inflected ridges internally. One of the diagnostic features of the head is in the development of the ecdysial lines, or frontal sutures, sometimes incorrectly referred to as the adfrontal sutures (Hinton, 1948). In the Eriocraniidae these sutures are very distinct and extend anteriorly from the coronal notch around the antennae, terminating on the posterior rim of the antennal socket. As a result, the adfrontal sclerite is sufficiently broad anteriorly to include seta A1. The latter is occasionally absent, thereby providing a useful character in species determination. The ecdysial suture itself forms a very irregular and often rather widely separated fissure. In some specimens, the fissure is broad enough to include certain marginal setae as AF2 and P1. The latter is often greatly reduced in size comparable to those of the V series. The North American species examined all agreed in having lost A3 and the third ocellar seta. In contrast, Hinton (1946, figs. 10–11) shows these to be present in

at least one European species. Two very minute gular setae are consistently present, although the pores associated with these setae appear variable in number as well as position.

As shown by Jayewickreme (1940), the internal structure of the head is unusual in possessing an extremely delicate tentorium. The anterior tentorial arms are further peculiar in being attached to small, anteriorly directed spurs of the epistomal ridge.

The ocelli (more properly termed, stemmata) are reduced to a single, vestigial element immediately beneath the antennae (Figure 158). Although it normally appears as a darkly pigmented spot, the lens is usually not well defined by a distinct margin. The cellular structure of the ocelli in *Eriocrania semipurpurella* was discussed in some detail by Hackman (1942). This author observed that the primary nerve leading to the ocellus possessed a rudimentary branch, thus suggesting the existence of a second ocellus at one time.

The antennae (Figure 91) are very short and appear two-segmented due to the reduction of the first segment. All the species examined possessed essentially the same antennal chaetotaxy. The second segment is reduced in length and bears two prominent apical setae, one more than twice the length of the other. Also arising from the second segment near the base of the third are two short basiconic sensillae and one minute spinelike seta. The small, very abbreviated third segment bears one basiconic sensilla and one minute spinelike seta of approximately the same length but of a much smaller diameter.

The labrum appears relatively normal in form except for the very spinose condition of the anterior margin (Figure 87) and ventral surfaces. Although most of these accessory spines may originate from the underlying "epipharynx," several appear to arise from the anterior margin of the labrum itself. Although, as Jayewickreme (1940) has observed, three pairs of epipharyngeal setae and several supernumerary ventral spines are typically present, true epipharyngeal spines are absent. The latter, when present in Lepidoptera, normally arise from the dorsal wall of the buccal cavity immediately posterior to the epipharyngeal setae. The primary labral setae consist of six pairs with the lower ones distinguishable from the adjacent spines by their socketed bases. The lower three pairs of setae (L3,

M2, and M3) may either be simple (Figure 87) or broadly compressed (Figure 155).

The mandibles are relatively unmodified and function in an opposable manner. A total of four cusps are consistently present with the fourth being considerably broader and less pronounced than the others. In addition to the normal pair of lateral setae, some species also possess a specialized tuft of barbed setae arising from the inner, mesal edges (Figures 95–100). Similar setal tufts are also present in the larvae of *Tischeria*.

The hypopharynx and portions of the maxillae are also densely covered with filamentous spines (Figure 93). A majority of the hypopharyngeal spines are barbed. Most, if not all, of these spinose structures, including those referred to above on the labrum and mandibles, probably serve a collective purpose in monitoring the passage of both solid and liquid food into the buccal cavity. As suggested by Trägårdh (1913), Jayewickreme (1940), and Gerasimov (1952), some of these structures may also aid in the absorption of plant liquids. The maxillary palpi are three segmented, with the apex of the third either truncate or terminating in a shallow apical depression containing usually seven to eight rather uniformly short, basiconic sensilla. The second segment bears usually three elongate, rather broad spines that arise from the dorsolateral rim at the apex. The palpigers possess a single, moderately large, ventral apical spine and three to four considerably smaller, lateral apical spines. The apices of the galeae resemble those of the maxillary palpi in being truncate with usually three short, basiconic sensilla. The galeae, however, are more reduced in length, and the apical sensilla tend to be more scattered. The relative lengths of the sensilla occasionally differ between species, with, for example, those of *Eriocraniella aurosarsella* (Figure 127) being larger than those of *Dyseriocrania griseocapitella* (Figure 90). Dorsally, the basal areas of the galeae are covered with several, moderately large, fleshy spines. The stipes bears one large basal seta and one much smaller distal seta.

The labium is relatively well developed in all instars studied. The submentum is rather unusual in having lost all setae. In most lepidopterous larvae, a long pair of midventral setae arises near the lateral margins of the submentum. The labial palpi typically consists of a single, elongate basal

segment and a minute apical segment with two, elongate apical setae. Trägårdh (1913) reports a three-segmented labial palpus in *Eriocrania* species (possibly *Dyseriocrania subpurpurella*). A rather indefinite groove (Figure 89) is sometimes present around the basal area of what is termed herein as the first palpal segment, which may represent a vestigial basal segment. From all indications, the spinneret is present throughout the life of the larva. Its function, however, may be restricted only to the last (fourth) instar as indicated by Trägårdh (1913). In form it resembles an elongate cone, with a simple, circular orifice.

THORAX.—The thorax of later instar larvae normally exhibits brownish pronotal and prosternal plates with the remainder of the thorax being whitish in color. Although thoracic legs are absent, paired callosities, or calli, that assist in locomotion are present. These are particularly evident on both the dorsal and ventral surfaces of the meso- and meta-thorax. The prothoracic subventral group of setae is of interest in that some North American species (e.g., *Dyseriocrania auricyanea* and *D. griseocapitella*) possess all three setae. This is in contrast to Hinton's statement (1946b:20) that the SV series is always bisetose in Lepidoptera. The arrangement and number of the microscopic proprioceptor setae of the thorax and abdomen are constant in all the species examined and agree with those listed by Hinton (1946b:21).

ABDOMEN.—The abdominal setae, similar to those of the head and thorax, tend to be reduced in length. The prolegs and crochets are completely absent. Generally the abdomen is whitish in color, at least in the later instars. The cuticle is densely spinose (Figure 94) over large areas of both the dorsal and ventral surfaces of the body. Minute spines are particularly evident over the thoracic calli and are a further aid to locomotion. Seta L1 is often diagnostic in either being situated unusually high on the segment well above the spiracles and SD1, or totally absent.

The chaetotaxy of the ninth segment is somewhat questionable, especially in *Dyseriocrania griseocapitella*. This species demonstrates the most primitive setal pattern examined in that the ninth segment shows no setal reduction from that of most of the preceding abdominal segments. Normally in this family, only seven primary setal pairs exist on the penultimate segment, but in *D. griseocapitella*, 10

pairs remain. The most controversial nomenclature involves the setae SD1, L1 and SD2 (if present). In this paper I have followed the more typical

 ABBREVIATIONS

AA	Anterior Apophyses	Mn	Merion
AC	Anapleural Cleft	MP	Median Process of Vaginal Sclerite
AG	Accessory Gland	MS	Midcranial Sulcus
Am	Anepisternum	Oc	Ocellus
AP	Articular Process	OS	Occipital Sulcus
APM	Anteromedial Process of Metafurcaster-num	PA	Posterior Apophysis
As	Aedeagus	Pam	Patagium
AT	Anal Tube	PfS	Postfrontal Sulcus
ATP	Anterior Tentorial Pit	Pha	Phragma (Post-notum)
B	Basalare	PiS	Postinterocellar Sulcus
BaS	Basal Sclerite of Anal Tube	PIS	Pleural Suture
BS	Barlike Spot (Brace-rod)	Pm	Prementum
CA	Cloacal Aperture	Pn	Pleuron
CB	Corpus Bursae	PoS	Postoccipital Sulcus
Cdo	Cardo	Prm	Pre-episternum
CG	Colleterial Gland	PrS	Prothoracic Spina
CO	Common Oviduct	Psm	Prosternum
CS	Coxal Suture	PWP	Pleural Wing Process
Cta	Chaetosema	R	Rectum
DA	Dorsal Arm of Tentorium	RAG	Reservoir of Abdominal Gland
DB	Dorsal Branch of Aedeagus	RG	Receptacular Gland
Ea	Eucoxa	S	Sternite of Abdomen
ED	Ejaculatory Duct	Sa	Spina
En	Epimeron	SAF	Secondary Arms of Furcaster-num
FA	Furcal Apophysis	Se	Subalare
Fm	Furcaster-num	Si	Socii
Fna	Fenestra of Fourth Abdominal Segment	Slm	Scutellum
Fra	Furcula	Sm	Scutum
IL	Intercoxal Lamella of Basisternum	SP	Spermathecal Papilla
IS	Intercalary Sclerite of Antenna	Spa	Spermatheca
J	Juxta	Spe	Spiracle
K	Katepisternum	SPT	Spinose Pocket
LfS	Laterofacial Sulcus	Ss	Stipes
LCS	Lateral Cervical Sclerite (Pre-episternum)	T	Tergite of Abdomen
Lpa	Laterophragma	Ta	Tegula
Me	Mandible	TAP	Tertiary Apophyses
MK	Midventral Keel of Vaginal Sclerite	Tr	Transtilla
		Ts	Testis
		U	Uncus
		Us	Utriculus
		Va	Valva
		VD	Vas Deferens
		Vm	Vinculum
		VS	Vaginal Sclerite
		VeS	Vesicula Seminales

interpretation of considering SD1 as arising dorsal to L1 on the ninth segment, even though this is not true on segments I to VIII of those species that have retained L1.

The 10th anal segment in later instar larvae seldom displays a distinct anal plate. The chaetotaxy is somewhat reduced in that only two pairs of dorsal setae are present, with the most caudal pair often being greatly reduced in size. Present in apparently all eriocraniid larvae near the latero-posterior margins of the 10th tergite is a pair of sclerotized, barlike spots (Figure 125). Gerasimov (1952) has referred to these slender structures as "brace-rods." In some species these rods are nearly obsolete, whereas in others (e.g., *Eriocraniella aurosparsella*) they are well defined and possess an enlarged, punctate cephalic end. Similar sclerotized spots are also present on the anal segment of certain Nepticulidae as shown by Klimesch (1972).

Systematics and Evolution

SUBORDINAL CLASSIFICATION

The heterogenous and probably paraphyletic suborder Dacnonypha previously included two superfamilies and four families (Davis, 1975b). The superfamily Eriocranioidea (Bourgogne, 1949) included the Australian-Fijian family Agathiphagidae, the Australian Lophocoronidae, and the Holarctic Eriocraniidae (Common, 1975). The Chilean-southeast Asian family Neopseustidae is also considered a possible member of this suborder, although it has been further removed from the Eriocraniidae and placed in a separate superfamily, Neopseustoidea (Davis, 1975b).

The Agathiphagidae differs from the Eriocraniidae in so many major respects that it should be removed from the Eriocranioidea. The Lophocoronidae are difficult to relate at present due to our ignorance regarding the female (i.e., no females have yet been collected). Based on the morphology of the male, however, this family's closest affinities appear to be with the Holarctic Eriocraniidae and may represent a sister group of the latter.

The Mnesarchaeidae, although frequently considered a member of the Dacnonypha (Hinton, 1946b; Friese, 1969; Birket-Smith and Kristensen, 1974; etc.), have recently been shown to be more closely allied to the Hepialoidea (Dugdale, 1974),

based on characters of the female reproductive system.

In his attempt to improve upon an earlier phyletic scheme proposed by Hennig (1953), Friese (1969) divided the Lepidoptera into two new suborders, the Gymnocera (including only the Hepialoidea) and the Angiocera (containing all other Lepidoptera). The Dacnonypha (including only the Eriocranioidea) are still retained as a group but are relegated to Friese's rank of "sub-cohort" in opposition to the Heteroneura (sensu Tillyard, 1918). In concluding that the Hepialoidea constitute the most primitive extant group of Lepidoptera (i.e., more primitive than the Zeugloptera), Friese has misinterpreted the phylogenetic significance of several morphological features, involving, particularly, the adult mouthparts and female genital system. Furthermore, the significance of the morphological diversity witnessed in the larval and pupal stages of the Lepidoptera was largely ignored or similarly misinterpreted. These oversights largely invalidate most of Friese's conclusions.

Recently, Razowski (1974) has revived a subordinal classification popularized by Tillyard (1918), but first proposed by Karsh (1898), in which the Lepidoptera are partitioned into two major suborders, the Homoneura and Heteroneura (Isoneuria and Anisoneuria, respectively, of Karsh). Following this scheme, Razowski does not recognize the taxon Dacnonypha and, instead, places the Eriocranioidea within the Homoneura.

In this report I have essentially followed the classification proposed by Hinton (1946b) and later modified by Dugdale (1974), wherein four suborders are recognized. Within the Dacnonypha I recognize the following three superfamilies: Agathiphagoidea, new superfamily, containing the single family Agathiphagidae; Eriocranioidea, consisting of the Eriocraniidae, Acanthopteroctetidae, and Lophocoronidae; and questionably, the Neopseustoidea, with the single family Neopseustidae. Problems effecting this subordinal classificational scheme and involving particularly the Dacnonypha still persist. For example, no synapomorphies have yet been proposed for the groups currently associated within the Dacnonypha.

The Agathiphagoidea, as defined essentially by Kristensen (1967) and Common (1973), may be distinguished from the Eriocranioidea in possessing functional and fully articulated mandibles, non-

haustellate galeae, and relatively well-developed lobular laciniae. Some of the most divergent apomorphies in adult *Agathiphaga* may be observed in the structure of the female genitalia. As illustrated by Common (1973) for *A. queenslandensis* Dumbleton, the ovipositor in this group is extensible but nonpiercing. The anterior apophyses are unique among the Lepidoptera in consisting of a double pair, with the dorsal pair arising from the anterior margin of the 8th tergite and the ventral pair from the anterior margin of the 8th sternite. The posterior apophyses are unusual in fusing before the caudal apex to form a single, slender rod. The ultrastructure of the wing scales of *Agathiphaga* (Figure 39) is unusual but similar to that of *Micropterix* and *Epimartyria* in possessing a minute network of obliquely oriented striae between the longitudinal ribs, underlaid by a layer of mostly transverse striae. After examining the apodal larva of *Agathiphaga*, Hinton (1958) concluded that it was typically lepidopterous in form and closely related to the Eriocraniidae.

It is becoming apparent that a cladistic approach similar to that attempted by Hennig (1953), wherein the major evolutionary steps within the Lepidoptera are emphasized, will provide the most logical and useful scheme for subdividing the order. Following such an approach, one may arrange the major phyletic lines as currently recognized within the Lepidoptera in the following sequence: (1) Zeugloptera, (2) Agathiphagoidea, (3) Eriocranioidea, (4) Neopseustoidea, (5) Exoporia (including the Hepialoidea and Mnesarcheoidae), (6) Monotrysia, and (7) Ditrysia. A few of these hierarchical groupings will require new names, although previously coined names are already available for most. The relative position of the Neopseustoidea and Exoporia are still questionable, but the eventual accumulation of new data (e.g., on the immature stages of the Neopseustoidea) may help to resolve most of this uncertainty.

FAMILY CLASSIFICATION

One of the major problems in analyzing the systematic relationships of the most primitive Lepidoptera (i.e., generally those with homoneurous venation) is that phenotypic as well as phyletic distances between the most related, extant taxa tend to be greatly emphasized due to the extinction of

annectant forms. The preponderant absence of adequate fossil evidence compounds this problem considerably. The paucity of taxa throughout these groups, with the possible exception of the relatively large family Hepialidae, is often encountered at all levels. For example, most of the homoneurous families are now recognized as comprising monotypic superfamilies. Similarly, familial concepts are frequently based on only one to a small number of genera, each typically containing a relatively small number of species. Consequently, the definitions of most homoneurous families tend to be rather restrictive, with the result that new or "aberrant" taxa (including the discovery of fossil forms) may be difficult to classify. Certain principles of phylogenetic systematics, as expounded by Hennig (1966) and Brundin (1966), can assist in resolving many of these problems; however, using this philosophy but placing emphasis upon different character systems can still result in questionable schemes of classification (cf. Friese, 1969). A phyletic analysis of the Eriocranioidea should be conducted eventually, but only in conjunction with a study of all the known taxa.

A reexamination of the aberrant genus *Acanthopteroctetes* has required the recognition of a new family, Acanthopteroctetidae. For reasons discussed above, the decision regarding the proper systematic position of this taxon was not decided easily. *Acanthopteroctetes* differs from the more homogenous members of Eriocraniidae to such an extent that its inclusion within that family has been questioned (Mutuura, 1971; Common, 1973). These differences involve major features of general head structure, mouthparts, wing venation and male genitalia. The significance of many of these differences is debatable, however, as similar magnitudes of variation are known to occur within other generally accepted moth families as well. For example, in some groups of Lepidoptera (e.g., the Noctuoidea) relatively minor, but consistent, differences in venation are relied upon in distinguishing families; in others (e.g., Tineoidea), however, rather major venational divergences may occur within presently recognized families. In this regard, the differences between the forewing pattern in the anal veins of Acanthopteroctetidae and Eriocraniidae appear somewhat comparable to those observed among major groups within the Psychidae. Similarly, the presence or absence of ocelli is a variable

character within several families, particularly the Noctuidae. A partial reduction of the labial palpi comparable to that which occurs in *Acanthopteroctetes* may also be witnessed within other groups (e.g., Psychidae and Prodoxinae).

As pointed out earlier, the extreme reduction of the adult mandibles in *Acanthopteroctetes* may possibly indicate a similar reduction in the prominent pupal mandibles usually considered so characteristic for the family. Even if the pupal mandibles are found to be reduced and nonfunctional in *Acanthopteroctetes*, however, this alone may not be justification for family separation, as similar extremes in variation are also known for other families with "decticous" pupae. Wiggins (1960) has shown the pupal mandibles in the caddisfly family Phryganeidae to be either normally well developed and functional or degenerate. He further found that in those species possessing vestigial pupal mandibles, the anterior sieve membrane closing the larval (and pupal) case had been similarly lost. Thus, significant modification in the primary organ used in escaping from the pupal case more than likely indicates some modification in this phase of an insect's biology. It is intriguing to hypothesize that the same may be true for *Acanthopteroctetes*.

Although the morphology of the male genitalia differs greatly between the two families recognized herein, the overall differences appear no greater than those present in certain other families, such as the Micropterigidae. One of the unusual features of the male in Eriocraniidae is the presence of a divided aedeagus, as compared to the more typical, entire form in Acanthopteroctetidae. A divided aedeagus also occurs within other families, such as the Micropterigidae (*Epimartyria*) and Tineidae (*Diataga* and *Praecedes*).

Of greater significance than most of the morphological differences discussed above between the Eriocraniidae and Acanthopteroctetidae are the pronounced differences in the structure of their wing scales. As described previously, the broad, discal scales of the forewings of *Acanthopteroctetes* differ markedly in basic structure from those of Eriocraniidae and resemble, instead, those of nearly all more recently evolved heteroneurous families. The wing scales of Neopseustidae and the exoporian Ditrysia also possess a basic structure most similar to that of *Acanthopteroctetes*. Thus, the major transition from the thin, platelike, nonperforated

wing scale so typical of the most primitive Lepidoptera to the more advanced, perforated scale possessing a large internal lumen is evident within the Eriocranioidea. I believe that this apomorphy, associated with the previously debated characters, such as the loss of ocelli, the mandibular reduction, the origin of M1 from R4+5, the distal separation of all three anal veins in the forewings, the less modified first abdominal sternite, and the several markedly different features of the male genitalia, sufficiently distinguish the Acanthopteroctetidae as a family separate from the Eriocraniidae.

Of at least equal importance in determining the relationship of *Acanthopteroctetes* to the Eriocraniidae is the evaluation of numerous morphological similarities that exist between the two groups. These involve both symplesiomorphic and, more importantly, synapomorphic character states. Symplesiomorphic similarities of the head involve such notable features as the prominent genal processes, the well-developed dorsal arms of the tentorium, the five segmented maxillary palpi, the prominent chaetosemata, and, possibly, the secondary subdivisions of the corneal nipples. The most prominent symplesiomorphic similarities in wing structure are the uniform distribution of microtrichia, the presence of a jugum in the forewings, and a four-branched radius in the hind wings. One of the most primitive features of the male genitalia is the undifferentiated, cylindrical form of the ninth segment, associated with a bisymmetrical pair of anteroventral processes or apophyses. In the female reproductive system, the ventral origin of the common oviduct, the sinuate ductus spermathecae, and well-developed cloaca must be considered symplesiomorphic. The presence of functional spiracles on the 8th abdominal segment is another primitive character shared by a few other homoneurous families.

Several synapomorphies exist that strongly indicate a close relationship between the Eriocraniidae and Acanthopteroctetidae. Some of the more notable synapomorphies include the subapical depigmented zone on the fourth maxillary palpal segment; the unpaired apical spur on the mesotibiae; the largely fused, ringlike 8th abdominal segment in the female; the short tertiary apophyses of the 10th segment, as well as the elongate, piercing, posterior apophyses. The latter superficially resemble those found in the Incurvarioidea and even in a

few Lyonetiidae; but in each group the piercing ovipositor is believed to have evolved independently. In addition, the reduced metamer in both families, as well as the development of the anteromedial process of the metafurcasternum, may represent synapomorphies. Although the meron is greatly reduced in the metathorax of Micropterigidae, in this family there is no anteromedial process extending anteriorly from the furcasternum.

The general structure of the metafurcasternum in Eriocraniidae and Acanthopteroctetidae is rather similar to that found in most Monotrysia in possessing a well-developed anteromedial process. In the latter group, however, the anterior pair of tendons (i.e., anterior to those arising from the furcal apophyses) typically extends dorsally instead of ventrally and evidently connects with different muscles than do the anterior tendons in Eriocraniidae and Acanthopteroctetidae, which are directed ventrally into the coxae.

GENERIC CLASSIFICATION

The generic concepts within the subfamily Eriocraniidae have recently been questioned by Birket-Smith and Kristensen (1974), resulting in the recognition of most previously accepted genera (*Dyseriocrania*, *Eriocraniella*, and *Heringocrania*) as subgenera of a single taxon, *Eriocrania*. This treatment has been followed by Razowski (1975) and Heath (1976), but it is not in agreement with the findings of the present study. As a result of this investigation, it is apparent that the Nearctic Eriocraniidae have evolved into a minimum of four distinct groups. Most of these groups (*Dyseriocrania*, *Eriocrania*, and *Eriocraniella*) are characterized by a number of correlated characters, involving such diverse character systems as maxillary palpi, wing venation, scales of the hind wing, and male genitalia. In addition, the members of *Dyseriocrania* are further unique in possessing very broad, pad-like tubercles on the fifth abdominal segment. Furthermore, it is evident that the endemic North American genus *Eriocraniella* has, at one time, subdivided to form two subgroups or subgenera, each containing more than a single species.

It is important to note that at least two of these genera are Holarctic in distribution, each possessing species endemic to both the Nearctic and Palearctic regions. In other words, the evidence to date

strongly suggests that both genera were not only in existence but were widely distributed prior to the ultimate separation of the two biotas. Although the known distribution of extant *Eriocrania* does not preclude a more recent trans-Beringian faunal connection, the geographical vicariance of *Dyseriocrania* appears to have resulted, in part, from the disruption of the North Atlantic faunal connection, an occurrence that McKenna (1975) fixes during the early Eocene, or approximately 49 million years ago. It seems, therefore, that the Nearctic-Palearctic counterparts of *Dyseriocrania* have evolved surprisingly little over the last 50 million years.

Because the three taxa referred to above are distinguished by a number of unrelated characters that more than likely originated as early as the Paleogene, I feel that it is more logical to recognize these taxa as genera. I also believe that such recognition is more equivalent to the generic concepts currently followed in the great majority of other moth families. The main problem remaining is to equate the other taxa of Eriocraniidae with the three genera above.

The genus *Neocrania*, as typified by *N. bifasciata*, new species, demonstrates several apomorphic characters that easily distinguish it from all other eriocraniids. Among the most characteristic differences are the bilobed apices of the labial palpi from which arise eight moderately long, striated setae; the relatively short, broadly bilobed uncus; the very irregular form of the aedeagus and the subapical cilia of the ventral phallic branch; and the asymmetry of the bases of the anterior apophyses of the female genitalia. *Neocrania* exhibits its closest affinities with certain elements of *Eriocraniella* and, thus, probably represents a derivative from that partially sympatric genus. *Neocrania* is also similar to *Eriocraniella* in retaining the epiphysis, a plesiomorphic trait that has been independently lost in *Dyseriocrania*, *Eriocrania*, and *Acanthopteroctetes*. *Eriocraniella falcata* shows some phenotypic intermediacy between the two genera, especially with regard to wing venation, but it shares more in common with the subgenus *Disfurcula* of *Eriocraniella* as partially characterized by the specialized chaetotaxy at the apex of the maxillary palpi.

The European genus *Heringocrania* presents the greatest difficulties in that, according to Birket-Smith and Kristensen (1974), no synapomorphies

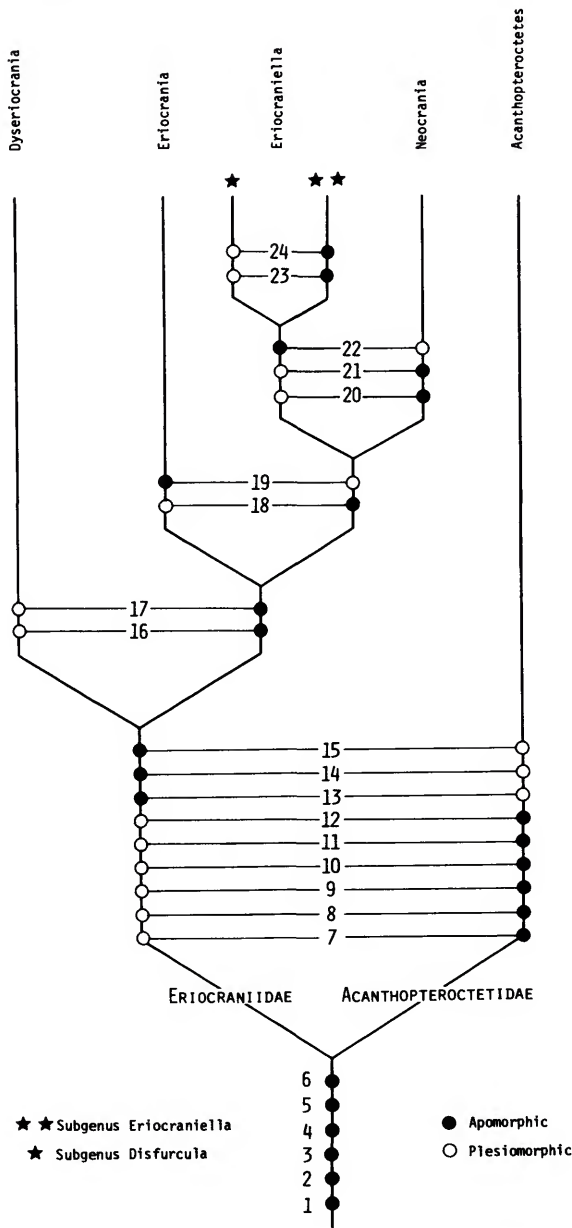


FIGURE 79.—Hypothetical phylogenetic relationships of Nearctic eriocranioid genera.

are known for the two presently included species. The venation of the type-species, *H. unimaculella*, evidently varies somewhat as evidenced by the connate condition of R4 and 5 in the hind wings as

figured by Common (1973) and the stalked condition as shown by Razowski (1975b). Razowski has also drawn Sc as being undivided in the forewing. Except for the latter variation, Razowski's rendition closely agrees in venation with *Dyseriocrania* in having R4 and 5 stalked in both wings. The fifth maxillary palpal segment is also similar to that of *Dyseriocrania* and especially *Eriocrania* in consisting of a single lobe crowned by a cluster of eight short, unstriated setae (Figure 196.)

As summarized in Figure 79, *Dyseriocrania* is believed to exhibit more plesiomorphic features than any other genus in the superfamily. This conclusion is based upon what is presently known concerning the biogeography of the Eriocranioidea as well as adult and larval morphology. An evaluation of some of the more significant adult characters is summarized in Table 3. The evaluation of at least one of these (i.e., the fifth abdominal tubercles) is rather questionable, although a consideration of the enlarged, flattened form of the tubercles in *Dyseriocrania* as plesiomorphic seems the most logical, especially in light of other correlated morphological and biogeographical data. Perhaps of some significance in this regard is the fact that at least some Trichoptera also possess broad, flattened sternal tubercles. As shown by Philpott (1925), the New Zealand philopotamid, *Hydrobiosella sternocera* Tillyard, possesses well-developed, reticulated tubercles very similar in form and relative size to those of *Dyseriocrania*. The preservation of the epiphysis in *Eriocraniella* and *Neocrania* and its absence in the supposed earlier evolved genera *Dyseriocrania* and *Eriocrania* is also problematic. If the scheme outlined in Figure 79 is correct, then the most logical assumption would be that the epiphysis has been independently lost in both *Dyseriocrania* and *Eriocrania* as well as in *Acanthopteroctetes*.

Although it is still somewhat premature to evaluate larval characters in this superfamily due to the lack of sufficient data for a majority of the species, some observations can be presented at this time. Of the known larvae, that of *Dyseriocrania griseocapitella* possesses the most primitive chaetotaxy in retaining SV3 on the prothorax, L1 on nearly all segments, and a full complement of 10 primary setal pairs on the ninth segment. The presence of the mandibular setal tuft may possibly represent a plesiomorphic condition, with the loss of this struc-

TABLE 3.—Subjective analysis of selected character states in Nearctic genera of Eriocraniioidea

Character	Character state	
	Plesiomorphic	Apomorphic
1. Maxillary palpi, 4th segment.....	entirely pigmented	subapically depigmented
2. Apical spurs of mesotibiae.....	2	1
3. Metafurcasternum.....	without anteromedial process (MA)	anteromedial process developed
4. Eighth abdominal segment (♀).....	tergite and sternite separate	tergite and sternite partially fused
5. Ovipositor.....	unspecialized, not piercing	specialized for piercing
6. Tertiary apophyses.....	undeveloped	developed
7. Discal scales of forewing.....	solid, without a lumen	with an internal lumen
8. Ocelli.....	present	absent
9. Mandibles.....	relatively large	extremely reduced
10. Labial palpi.....	3 segments	2 segments
11. Vein M1 (both wings).....	separate from R5	stalked to R5
12. Abdominal glands (5th sternite).....	present	absent
13. Anal veins (forewings).....	separate	partially fused
14. First abdominal sternite...	relatively unmodified, ligulate	reduced, furcate
15. Aedeagus.....	simple	divided
16. Abdominal tubercles (5th sternite).....	large, reniform	reduced, papiliform
17. Lobes of uncus (♂).....	short, poorly differentiated	elongate, well defined
18. Apex of maxillary palpi....	simple	lobed
19. Vein R3 (forewings).....	present	absent
20. Lobes of uncus (♂*).....	elongate	reduced
21. Anterior apophyses (♀)....	symmetrical	asymmetrical
22. Apex of maxillary palpi....	bilobed	5-lobed
23. Vinculum (♂).....	unmodified, smooth	with median furcula (Fra)
24. Ninth abdominal segment (♀).....	unmodified, membranous	with ventral spinose pocket

*Regressive apomorphic trend.

ture secondarily occurring in at least three North American species. The complete absence of true legs and prolegs is a synapomorphic condition evidently present throughout the Eriocraniidae.

As is often the case in most groups of holometabolous insects, the larval stage in the Eriocraniidae demonstrates a general lack of congruency with the adult. From the limited number of species investigated in this study (i.e., six), it has been observed that larvae belonging even to closely allied species may differ significantly. For example, the larvae of

Eriocraniella aurosparsella and *E. xanthocara*, whose adults are barely distinguishable morphologically, disagree with regard to major setal placements (e.g., the presence or absence of A1 and L1) as well as other important features (the presence or absence of the mandibular setal tuft). Thus, the application of larval characters to possible super-specific groupings of the adults does not appear feasible. Too little is presently known concerning the pupa to comment on the relative systematic congruency of this stage.

EARLY HISTORY

The earliest record of this superfamily, according to Martynova (1962), is from Paleogene deposits of Baltic amber. Although Kusnetzov (1941:70) lists two species of extinct, fossilized Eriocraniidae, it is possible that neither one actually represents a member of this family. *Micropterix pervetus* Cockerell, which Kusnetzov placed in *Dyseriocrania*, agrees in all important aspects of venation with the extant Australian–New Zealand genus *Sabatinca* and probably does represent a true member of the Micropterigidae.

The second species, *Electrocrania immensipalpa*, which Kusnetzov (1941) described from Baltic amber, is shown with a venation so aberrant (Figures 251–252) that it is difficult to relate to any known moth family. To make matters even more confusing, Kusnetzov presents two different venational interpretations of the type specimen and, most likely, neither is correct. Unfortunately, it is probably no longer possible to reexamine the type, because, as Kusnetzov notes on page 20, footnote 2, the amber sample containing the specimen crumbled after having been soaked for five days in toluene.

Although most of the deposits in which Baltic amber now occurs are typically stated to be of Oligocene age, it is possible, as pointed out by Kusnetzov (1941:91) and others, that the actual amber may have originated in even earlier pre-Eocene deposits. Consequently, the age of *Electrocrania immensipalpa* is most likely somewhere between 30 and 40 million years or well after the suspected minimum date for the existence of the genus *Dyseriocrania* and, perhaps, *Eriocrania* and *Eriocraniella*. The source of *Micropterix pervetus* was Burmese amber, which generally occurs in even later deposits of Miocene age.

Opler (1973) has identified a fossilized mine of *Eriocraniella* species on *Quercus simulata* Knowlton from the middle to upper Miocene of Thom Creek, Idaho. This record, in addition to those of several other extant genera of oak-mining Lepidoptera listed by Opler, clearly indicates the antiquity of the association of these particular leafminers with the Fagaceae. Opler (1974:74) also refers to the Eriocraniidae a Miocene leaf mine record originally believed by Lewis (1969) to have been caused by a nepticulid larva. Earlier, Opler (1973) considered

this mine to have been produced by a species of *Caloptilia* (Gracillariidae). Thus, the identity of this particular mine is questionable, but, if Lewis' description is correct, "The mine . . . is of a linear serpentine type coursing into a blotch-like area, and terminates as a linear-type mine," then most likely it was not caused by an eriocraniid larva.

As hypothesized previously (Davis, 1975b), the Eriocraniidae appear to have a Laurasian origin. Unfortunately, the prime reasons for this view, as well as many of the following opinions, are partially founded on negative evidence; however, the absence to date of any records of this family from the southern continents suggests the strong possibility that the Eriocraniidae arose in the Northern Hemisphere at sometime following the separation of Laurasia from Gondwana. As summarized by Takhtajan (1969) and Schuster (1976), the plant family Fagaceae is also presumed to possess a Laurasian origin, perhaps at sometime prior to the middle Cretaceous. Although Takhtajan records the remains of *Fagus* from the mid-Cretaceous, Wolfe (1973) indicates that the earliest unquestionable evidence of this genus may only be from the Eocene. As far as the principal host plants for the Eriocraniidae are concerned, *Betula* demonstrates the earliest fossil history as having been reported from the late Cretaceous (Muller, 1970). Wolfe (1973) states that *Quercus* has been positively identified from the early Eocene.

There is at this time no reason to assume that the present host association of the Eriocraniidae with the Amentiferae (particularly Betulaceae and Fagaceae) has not existed since the early origins of both components. Consequently, it is possible that the Eriocraniidae first arose sometime prior to the middle Cretaceous within the vast Boreal-Cretaceous region in association with the first Amentiferae. As characterized by Takhtajan, this region was dominated by an entirely temperate flora consisting mostly of mesophilous, broad-leaved, mainly deciduous trees and shrubs, such as *Acer*, *Alnus*, *Betulus*, *Cocculus*, *Corylus*, *Credneria*, *Fagus*, *Grewiopsis*, *Lindera*, *Magnolia*, *Platanus*, *Quercus*, *Sassafras*, *Viburnum*, and *Ziziphus*, as well as *Ginkgo*, various conifers, and ferns. The Eriocraniidae may have early undergone a radiation comparable to that experienced by these early angiosperms. Since the late Eocene, however, the Eriocraniidae have remained remarkably conservative and, except for the

possible extinction of many forms, may have evolved relatively little within the last 50 million years. Although present evidence does not support a pre-Cretaceous origin for the Eriocraniidae, future discoveries (e.g., from the Southern Hemisphere) may modify this situation. Certainly, several plesiomorphic features observed in the overall morphology of this group, particularly in the deciduous pupa, strongly suggest an earlier origin for the family.

Judging from the typical form of the Miocene mine of *Eriocraniella* (Opler, 1973), it also appears that the morphology of the mine and feeding behavior of the larvae has changed little since the Tertiary. If ontogeny bears any relationship to phylogeny with regard to larval leaf-mining behavior, then there may be some evidence to indicate that the earliest lepidopterous miners constructed linear, serpentine galleries. The first instar larvae of Eriocraniidae construct such mines as do most of the Nepticulidae, a successful, predominantly leaf-mining family that, like the Eriocraniidae, are perhaps the most primitive survivors of their phyletic stock. Among the more advanced, ditrysian leafminers, however, so many later specializations have occurred, even among those that initiate serpentine galleries, that it becomes almost meaningless to refer generally to primitive or derived types of mine morphology. In reference to this discussion, it may be of some significance to note that one of the earliest fossil leaf mines reported thus far is of a serpentine type from the early Eocene of Wyoming (Hickey and Hodges, 1975). The very extended, central frass line, clearly evident within the mine of that specimen, strongly suggests that it was produced by a species of *Phyllocnistis*, an extant genus of Gracillariidae.

CHECKLIST OF NEARCTIC ERIOCRANIOIDEA

(synonyms only in italics)

Eriocraniidae

- Dyseriocrania Spuler, 1910
Mnemonica Meyrick, 1912
 griseocapitella (Walsingham, 1898)
auricyanea Busck and Böving, 1914 [misidentification]
auricrinella (Fracker, 1930) [misidentification]
auricyanea (Walsingham, 1882)
cyanosparsella (Williams, 1908)
 Eriocrania Zeller, 1851
semipurpurella semipurpurella (Stephens, 1834)

- amentella* (Zeller, 1850)
inconspicua (Wood, 1890)
semipurpurella pacifica, new subspecies
semipurpurella Clarke, 1942 [misidentification]
 breviapex, new species
 Eriocraniella Viette, 1949
 Eriocraniella Viette, 1949, subgenus
 aurosparsella (Walsingham, 1880)
 xanthocara, new species
aurosparsella Opler, 1974 [misidentification]
 longifurcula, new species
 platyptera, new species
 Disfurcula, new subgenus
 variegata, new species
 trigona, new species
 falcata, new species
 Neocrania, new genus
 bifasciata, new species
 Acanthopterocetidae
 Acanthopterocetes Braun, 1921
 tripunctata Braun, 1921
tripunctella Davis, 1969 [misspelling]
 bimaculata Davis, 1969
 unifascia, new species

ERIOCRANIOIDEA

ADULT.—Small moths with moderately slender, fully scaled wings. Wing expanse ranging from 6 to 16 mm.

Head: Hypognathous, often broader than long, slightly more extended in Eriocraniidae; cranial sulci usually well developed; sometimes absent; dorsal arms of tentorium slender, elongate, nearly extending to vertex. Vestiture relatively sparse, hairlike, mostly erect and divergent except for a small tuft of nearly appressed, relatively broad scales often covering basal half of labrum. Chaetosemata present, consisting of a large, elongate pair of raised areas extending transversely across occiput and nearly meeting near vertex; a single, circular chaetosema may also be present ventrally on postmentum. Ocelli either present or absent. Antennae simple, of moderate length, usually 0.5–0.75 the length of forewings, typically covered with narrow, relatively long, appressed scales; each segment also bearing numerous and usually scattered, small, often oval and highly modified, sensilla auricillica (Figures 26, 34) immediately beneath outer scale covering; sensilla auricillica absent in Lophocoronidae. A minute intercalary sclerite present between scape and pedicel. Compound eyes relatively large in Acanthopterocetidae and Lophocoronidae, more reduced in diameter and posi-

tioned farther forward in Eriocraniidae; cornea sparsely covered with minute microtrichiae with a length less than diameter of a single facet. Labrum relatively well developed, elongate, constricted at base, more reduced in Lophocoronidae; pilifers obsolete. Ventral margin of gena extended into an angulate subgenal process. Mandibles vestigial, nearly absent in Acanthopteroctetidae, much more developed in Eriocraniidae, possessing a large adductor and very small abductor apodemes but with condyles greatly reduced or absent. Maxillae consisting of a distinct cardo and stipes, a relatively short, functional haustellum and an elongate, 5-segmented palpus (4-segmented in Lophocoronidae); each galea with a series of large, slightly overlapping plates lining the food canal; maxillary palpi with the 4th segment the largest and at least twice the length of 5th; a small depigmented zone usually situated subapically on penultimate segment; apex of 5th segment either relatively simple or with minute, secondary lobes; primary setae of 5th segment either simple or barbed; laciniae absent or vestigial. Labium with relatively narrow, elongate prementum and either 2- or 3-segmented palpi; sensory organs of von Rath either present (at apex of 3rd palpal segment) or absent in those species with 2-segmented palpi (in genus *Acanthopteroctetes*).

Thorax: Meso- and metascuta well developed, relatively elongate. Furcal apophyses of mesothorax greatly reduced, barely evident; furcal apophyses of metathorax well developed, prominently divided, arms relatively slender and not strongly divergent, subparallel; length of metafurcal apophyses either equaling or slightly exceeding the distance between their terminal apices. Metathoracic coxae with meron reduced, approximately 0.5–0.8 the length of eucoxa. Prothoracic tibiae either with or without epiphyses, often with 2–3 rather large apical setae; tarsal segments of all legs usually with 3–4 apical setae; mesothoracic tibiae with a single large apical spur (spurs paired in Lophocoronidae); metathoracic tibiae with 2 pair of long spurs, 1 pair at distal apex and another arising from distal two-thirds; all spurs of approximately equal lengths; tarsae of typical form, with simple claws and empodium, a broad padlike arolium, and a lateral pair of large, spinose pulvillae. Forewings relatively narrow, subacute with a rather prominent jugum at extreme base of hind

margin; Sc either simple or divided; radius with either 4 or 5 main branches; R1 either simple or divided, often with a moderately developed pterostigma over outer third of R1; R3 sometimes absent; R5 terminating near apex, either slightly above or below, or remote and on termen (in Lophocoronidae); medius well preserved within cell, 3-branched; M1 usually separated but stalked with R4 and R5 in Acanthopteroctetidae; anal veins either fused beyond basal half or completely separate. Hind wings with Sc simple; radius usually with 4 primary branches, sometimes 5; R1 simple; area around apex of R1 sometimes slightly pigmented; R3 present (in Lophocoronidae) or absent; R4 and 5 either stalked or separate. M1 usually arising separate but stalked to R4 and R5 in Acanthopteroctetidae. Both wings with microtrichiae dense and evenly distributed.

Abdomen: Pleural area of 3rd segment usually unmodified, rarely with a cluster of small, filamentous, clavate appendages. Fourth sternite either with or without a bilateral pair of circular, membranous fenestrae. Fifth sternite usually with a bilateral pair of reticulated, glandular tubercles usually arising near anterolateral margins; tubercles either large and reniform in outline or small and papiliform, with a central exit pore leading to a large ducted gland internally; reservoir of gland often closely associated with fenestrae of 4th sternite; glands and tubercles occasionally absent. Eighth segment with spiracles well developed and apparently functional; entire segment greatly enlarged in female and normally enclosing 9th and 10th segments or their derivatives.

Male Genitalia: Uncus either well developed, bifid, usually separated from 9th segment or absent (Lophocoronidae). Ninth segment in the form of a broad sclerotized cylinder, undifferentiated into a dorsal tegumen or ventral vinculum; cephalic margin of ventral area (vinculum) usually concave, with ventrolateral angles slightly to greatly extended anteriorly. Anal tube mostly membranous, sometimes with minute, scattered spinules or with a bilateral pair of small, disarticulated sclerites near base. Socii either present or absent; gnathos absent. Valvae either very short and relatively broad (Eriocraniidae) or more elongate and movable (Acanthopteroctetidae and Lophocoronidae). Anellus variously modified, either consisting of a single but complex plate, or juxta, ventral to

aedeagus and often fused laterally to 9th segment; or consisting of 2, very distinct, usually well-sclerotized structures, 1 dorsal (transtilla) to aedeagus and 1 ventral (juxta); transtilla heavily sclerotized with medial area greatly extended caudally. Aedeagus either divided for most of its length into a dorsal and ventral phallic branch, or undivided and with prominent cornuti.

Female Genitalia: Ovipositor of the piercing type with a depressed, relatively broad, triangular (viewed dorsally) apex possessing minutely serrated edges. Two pairs of very elongate, rodlike apophyses present, the anterior pair arising from the 8th abdominal tergite and often extending as far forward as the 5th segment; the posterior apophyses approximately twice the length of anterior pair and arising from the 10th segment, where they fuse to form the piercing ovipositor; a small, slightly elongate pair of articular processes usually present near junction of 9th and 10th segments; a pair of very short tertiary apophyses present within the 10th segment extending from the small articular processes previously described to the cloacal aper-

ture. Ninth segment largely membranous, roughened externally with numerous rows of minute spines dorsally and ventrally. Cloaca well developed, consisting of a relatively elongate tube opening on 10th segment immediately anterior and ventral to caudal apex of ovipositor; only 1 terminal body opening present, serving as common exit for both alimentary and reproductive systems. Corpus bursae variable in size; usually large with completely membranous walls; signa absent. Spermatheca typically arising from either a sclerotized or mostly membranous funnel-shaped papilla; spermathecal duct slightly sinuate, not coiled, often with an internal, rodlike thickening (in Eriocraniidae). Common oviduct typically joining ductus bursae ventrally opposite spermathecal papilla; oviduct rarely arising laterally. Colleterial gland arising dorsally from vagina, immediately anterior to junction of alimentary tract with cloaca; glands usually bifid. Vagina either membranous and partially encircled by a well-defined sclerite or without vaginal sclerite but with walls thickened and heavily folded.

Key to the Nearctic Families of Eriocranioidea

- Ocelli present. M1 arising separate from R4 and 5 in both wings; forewings with all three anal veins joining distally. Abdomen with a pair of glandular, reticulated tubercles frequently present on 5th sternite. Male genitalia with uncus prominently bilobed; valvae extremely reduced, considerably less than 0.5 the uncus in length; anellus completely membranous dorsal to aedeagus; aedeagus divided for most of its length. Eighth segment of female without ring of elongate setaeERIOCRANIIDAE
- Ocelli absent. M1 stalked with R4 and 5 in both wings; forewings with all 3 anal veins separate. Abdomen without sternal tubercles on 5th segment. Male genitalia with uncus only slightly cleft, not prominently bilobed; valvae slender, elongate, surpassing total length of uncus; anellus with a strongly sclerotized, elongate transtilla dorsal to aedeagus; aedeagus undivided. Female with a prominent row of elongate setae encircling caudal margin of 8th abdominal segmentACANTHOPTEROCETIDAE, new family

ERIOCRANIIDAE

ERIOCRANIIDES Tutt, 1899:104, 109, 110, 114, 131.
CHAPMANIIDAE Börner, 1925:370.

TYPE GENUS.—*Eriocrania* Zeller, 1851.

ADULT.—Moths of very small size, with a wing expanse of 6–13 mm; wings moderately slender.

Head: Relatively elongate with vertex well developed and extended; laterofacial sulci prominent. Lateral ocelli present. Compound eyes relatively

small, interocular index approximately 0.75; eyes positioned more anteriorly on head capsule. Mandibles vestigial but relatively large with well-developed adductor apodemes; condyles usually evident but very reduced in size. Apex of terminal (5th) segment of maxillary palpi variously modified, frequently with minute, secondary lobes. Labial palpi elongate, 3-segmented; apex of distal segment with a well-developed organ of von Rath containing several minute, basiconic sensillae.

Thorax: Prothoracic legs relatively reduced in

size, foretibiae approximately 0.3–0.33 the length of hind tibiae; epiphysis either present or absent. Forewings moderately slender, width approximately 0.30–0.34 the length; Sc either simple or shortly divided near costa; radius usually with 5 primary branches, sometimes 4-branched with loss of R3; R1 usually secondarily divided nearly a third its length; a faint pterostigma typically present near outer third of R1; R4 and 5 either separate or stalked; M1 widely separated from base of R5; all 3 anal veins arising separate at base of wing, then abruptly fusing near distal half; scales over dorsal surface of forewing mostly broad with longitudinal ribs projecting slightly beyond apical margin and without internal lumen or lacunae; scales of marginal fringe of termen mostly slender and with internal lumen. Hind wings with pterostigma usually faintly present near apex of R1 but greatly reduced; R3 absent; R4 and 5 usually separate or connate, sometimes stalked about 0.5 their length; M1 arising widely separate from R5; scales ranging from hairlike to relatively broad.

Abdomen: Pleural area of 3rd segment unmodified, without appendages. Fourth sternite usually with a circular to elliptical pair of membranous fenestrae in female; fenestrae absent in male. Fifth sternite usually with a pair of reticulated, reniform or papiliform tubercles in both sexes, rarely absent; a relatively large pair of globular glands with separate, slender ducts opening ventrally through a central pore in each tubercle present in all species possessing tubercles. Eighth segment of female without encirclement of elongate hairs.

Male Genitalia: Uncus prominently divided into 2 frequently large lobes; lobes usually slightly divergent and well separated with rather broadly rounded apices. A pair of usually elongate apophyses extending anteriorly from anterolateral margin of vinculum (i.e., venter of 9th segment). Anal tube membranous, occasionally with numerous, scattered minute spines or with a basal pair of small sclerites. Socii either present or absent. Valvae very reduced and relatively broad, total length less than 0.4 that of uncus; apex of cucullus strongly spined. Anellus not sclerotized dorsally; ventral half consisting of a large, rather complex plate (i.e., juxta) that fuses laterally to ventrolateral walls of 9th segment, thereby partially dividing cavity within 9th segment. Aedeagus divided most of its length into a primary dorsal branch contain-

ing the vesica and a secondary ventral branch that may be variously modified; ventral branch usually loosely articulated to prominent bulbous base of aedeagus.

Female Genitalia: Corpus bursae enlarged; ductus bursae membranous. Common oviduct arising ventral to bursa copulatrix usually opposite spermathecal papilla. Ductus spermathecae typically with an internal rodlike thickening; spermathecal papilla usually consisting of a shallow cuplike depression that may be either flush with vaginal wall or raised on a membranous, tubular extension. Vagina partially encircled by a usually well-defined, variously modified sclerite. Dorsal colleterial gland usually arising from vaginal wall approximately midway along sclerite. A short, slightly elongate articular process arising ventrally from posterior apophyses near juncture of 9th and 10 segments. Caudal region of 9th segment usually unmodified but occasionally with a midventral pocket densely lined laterally with minute spines.

LARVA.—Body mostly whitish in color, cylindrical and somewhat fusiform in outline, without thoracic legs or abdominal prolegs. Integument densely spinose. Total length usually not exceeding 11 mm.

Head: Prognathous, partially retracted into thorax, usually pale brown to stramineous in color. Vertex deeply divided to frons. Adfrontal sclerite broad with ecdysial line joining anterior margin of head laterad to antennae; ecdysial line very well defined, broad, irregular, sometimes enclosing P1. A single, rudimentary ocellus present near anterior margin of head immediately ventral to antennae. Majority of cranial setae very reduced in length; P1 either greatly reduced or moderately long; A1 either present or absent; if present, then arising from adfrontal sclerite; A3 either present or absent; C2 considerably longer than C1; O3 either present or absent. Labrum with anterior margin bearing numerous spines (possibly derived all or in part from underlying epipharynx); setae L3, M2, and M3 either simple or broadly compressed. Mandibles opposable, with 4 cusps; 4th cusp broad and relatively indistinct; inner, mesal margins of mandibles either with or without a dense tuft of elongate, barbed setae. Hypopharynx densely covered dorsally with numerous, rather elongate setae. Spinneret well developed, tubular, with a circular orifice.

Thorax: Usually whitish in color except for

large, brownish pronotal and prosternal plates. Prothorax with SV3 either present or absent; L3 present. Thoracic legs absent. Meso- and metathorax with paired, slightly raised dorsal and ventral calli.

Abdomen: Whitish in color; prolegs and crochets absent. L1 either present or absent, if present then arising well above level of spiracles; SV2 usually present but variable and occasionally absent; 9th segment usually with 7 pair of primary setae but ranging to as many as 10 pair in certain species. Tenth segment usually with anal plate poorly defined, only 2 pair of setae present dorsally and with a pair of small, elongate barlike spots situated lateroposteriorly.

PUPA (Figures 71–78).—Decticious with elongate, heavily sclerotized, functional mandibles. Pupal cuticle very thin, mostly transparent, with all appendages and most body segments free and movable. Length approximately 3.0–3.5 mm; diameter 1.3–1.8 mm.

Head: Vertex with 1–2 pair of elongate setae arising immediately above and posterior to antennal insertions. Frontal ridge greatly developed, raised and extending free of head to labrum. Antennae free, with all segments easily discernible, terminating just short of apices of wing pads. Labrum well defined, reniform, with pilifers prominent and bearing 6 pair of elongate setae; length of longest setae nearly 1.5 times the diameter of eye. Mandibles very elongate, their length approximately 2.0 the diameter of eye, consisting of a

strong but relatively slender, elongate, stalklike base that abruptly enlarges near apex; extreme apex truncate, with a broad, circular, median depression typically bordered peripherally by a progressively enlarged series of 4 broad spines and by a low, sometimes serrated ridge that encircles nearly one half of apical depression; basal stalk of mandibles with 1–2 indefinite rows of numerous, short spines extending along dorsal-inner surface; mandibles fully articulated and capable of strong movement.

Thorax: Appendages all free, segmentation clearly evident. Mesothoracic spiracles situated in the conjunctiva connecting the pro- and mesothorax. Forewing and hind wing pads separate, sometimes reaching to end of abdomen. Distal ends of metathoracic legs usually extending beyond last abdominal segment and sometimes curling around end of abdomen.

Abdomen: Pupal cuticle extremely thin and membranous. Segments I–VII movable in both sexes; VIII–X without definite sutures and probably incapable of independent movement; segment X larger in female and curved more ventrad than in male. Spiracles small, circular, not produced; first 8 abdominal spiracles present and apparently functional. Abdominal tergites typically with 2 longitudinal rows of elongate setae on either side, 1 row above and 1 below spiracular line, and a paired row of very short setae on either side of middorsal line; each setal row with 1 seta per segment; tergites lacking transverse rows of spines.

Key to the Genera of Nearctic Eriocraniidae

(based on the adult)

1. Sternal tubercles of 5th abdominal sternite broad, diameter approximately 0.5 the length of sternite, relatively flattened, reniform. Male genitalia without socii (Figure 225)
Dyseriocrania
 Sternal tubercles much smaller in diameter, more raised, papiliform (Figure 224). Socii present in male (Figure 267) 2
2. Forewings with R1 simple, undivided, R3 absent. Epiphysis absent. Terminal segment of maxillary palpi relatively simple (Figure 191), not lobed
Eriocrania
 Forewings with R1 divided; R3 present. Epiphysis present. Terminal segment of maxillary palpi variously lobed (Figures 198, 210), not simple 3
3. Forewings with Sc usually simple, though sometimes divided. Terminal segment of maxillary palpi with 1 relatively large apical lobe and 2 pair of smaller, subapical lobes (Figures 198, 202). Male with uncus divided for most of its length. Vaginal sclerite of female with a prominent, midventral keel (Figure 311)
Eriocraniella
 Forewings with Sc typically divided. Terminal segment of maxillary palpi with 2 apical lobes of nearly equal size (Figure 210). Male with uncus divided about 0.5 its length. Vaginal sclerite without midventral keel
Neocrania, new genus

Key to the Larvae of the Nearctic Eriocraniidae

1. Mandibles with a prominent mesal tuft of barbed setae (Figure 105)2
Mandibles without mesal setal tuft4
2. Seta A1 present, arising from adfrontal sclerite (Figure 104)*Dyseriocrania auricyanea*
Seta A1 absent3
3. Ninth abdominal segment with 10 pair of primary setae. P1 minute in size. Distribution:
eastern United States*Dyseriocrania griseocapitella*
Ninth segment with 7 pair of primary setae. P1 moderately long. Distribution: western
United States*Eriocraniella xanthocara*, new species
4. Abdominal segments I to VIII with L1 present. Prothorax with subventral setae usually
trisetose. Labrum with setae L3, M2, and M3 simple, not compressed
.....*Eriocrania semipurpurella pacifica*, new subspecies
Abdominal segments without L1. Subventral setae of prothorax bisetose. Labrum with L3,
M2, and M3 broadly compressed5
5. Labrum with ventral margins of L3, M2, and M3 simple (Figure 155). not dentate
.....*Eriocraniella longifurcula*, new species
Labrum with ventral margins of L3, M2, and M3 variably dentate (Figure 129)
.....*Eriocraniella aurosparsella*

Dyseriocrania Spuler

Dyseriocrania Spuler, 1910:483.—Fletcher, 1929:72, 141 [synonym of *Mnemonica*].—Hering, 1932:2.—Kuznetsov, 1941:19, 20.—Lhomme, 1949:1220.—Viette, 1949:30, 32; 1951:43, 44.—Gerasimov, 1952:189 [synonym of *Eriocrania*].—Toll, 1959:16, 21, 23.—Kristensen, 1968b:241, etc.—Common, 1973:16.—Birket-Smith and Kristensen, 1974:158, etc. [subgenus of *Eriocrania*].—Razowski, 1975:42 [subgenus of *Eriocrania*].—Heath, 1976:157 [synonym of *Eriocrania*].
Mnemonica Meyrick, 1912a:5; 1912b:18.—Barnes and McDunnough, 1917:197.—Tillyard, 1919:97, etc.; 1923:181, 195.—Crampton, 1920:26, 27.—Forbes, 1923:65 [subgenus of *Eriocrania*].—Philpott, 1924:361; 1927:320.—Meyrick, 1928:870, 872.—Fletcher, 1929:72, 141.—McDunnough, 1939:110.—Kuznetsov, 1941:19 [synonym of *Dyseriocrania*].—Hinton, 1946:11.—Viette, 1949:30 [synonym of *Dyseriocrania*]; 1951:43, 44 [synonym of *Dyseriocrania*].—Gerasimov, 1952:189 [synonym of *Eriocrania*].—Heath, 1958:117, 120.—Kristensen, 1968:242 [synonym of *Dyseriocrania*].—Dugdale, 1974:134.—Birket-Smith and Kristensen, 1974:159 [synonym of *Dyseriocrania*].—Razowski, 1975:42 [synonym of *Dyseriocrania*].—Heath, 1976:157 [synonym of *Eriocrania*].

TYPE-SPECIES.—*Tinea subpurpurella* Haworth, 1829; original designation by Spuler, 1910.

ADULT.—Small, relatively broad winged moths; wing expanse: 9–13 mm.

Head: Maxillary palpi with basal 0.9 of terminal segment densely setose; apical 0.1 largely naked; primary setae simple, without lateral barbs; apex of terminal segment subacute, simple, without secondary lobes but with a scattered series of usually 8–10 minute, subacute setae with smooth, unstriated sides; setae of rather uniform size, very

short and stout, usually less than 0.3 the diameter of apex in length.

Thorax: Forewings with Sc divided near costa; R1 divided approximately one-third its length; R2 and 3 separate; R4 and 5 stalked approximately 0.4 their length. Hindwings with Sc and R1 simple; R2 and 3 entirely fused; R4 and 5 stalked approximately one-third their length; scales relatively short, broad, not hairlike.

Abdomen: Fenestrae present on fourth sternite of female, relatively large and oval in form, absent in male. Sternal tubercles present on fifth sternite of both sexes, similar in form, very large and reniform, forming a broad, padlike plate.

Male Genitalia: Uncus bilobed but with lobes poorly developed and not deeply divided; lobes separated by a relatively shallow concave depression. Socii absent. Anal tube without basal sclerites but with numerous, minute spinules scattered over walls of tube. Vinculum with median caudal margin variously produced into shallow lobes, not smoothly convex; furcula absent; cephalic margin evenly concave between apophyses, without median process. Caudal apex of juxta variously modified but typically symmetrical. Aedeagus with ventral phallic branch extremely slender, often less than 0.3 the dorsal branch in diameter; apex of ventral branch simple, acute, without lobes or processes.

Female Genitalia: Vaginal sclerite variable in form, either with or without midventral keel. Ninth segment without a midventral spinose pocket.

DISCUSSION.—*Dyseriocrania* is represented in

North America by two very distinct species, *auricyanea* and *griseocapitella*, and in Europe by the type of the genus, *D. subpurpurella* (Haworth). The European member of this group is readily distinguished from the American species on the basis of male genital characters, particularly in the relative

development of the paired apophyses. The cephalic margin of the vinculum is not as deeply divided in *D. subpurpurella* with the result that the apophyses are much shorter (length of apophyses less than 0.5 the length of undivided vinculum) than in the American species.

Key to the Species of Nearctic *Dyseriocrania*

Forewings light golden bronze, heavily mottled with minute specks of darker scales. Male genitalia (Figure 255) with lobes of uncus widely separated; vinculum with median caudal margin shallowly bilobed. Vaginal sclerite (Figure 295) of female without midventral keel; corpus bursae without spinules. Distribution eastern United States

.....*Dyseriocrania griseocapitella*

Forewings light golden brown, faintly crossed by 3 irregular, purplish fasciae. Male genitalia (Figure 257) with lobes of uncus narrowly separated; vinculum with a pronounced, median, caudal lobe. Vaginal sclerite (Figure 298) with a prominent ventral keel; walls of corpus bursae with a scattering of numerous tiny spinules. Distribution cismontane California

.....*Dyseriocrania auricyanea*

Dyseriocrania griseocapitella (Walsingham)

FIGURES 1-7, 11-14, 23-26, 35-37, 45-46, 48, 50-52, 56, 58-63, 66-68, 77-78, 80-108, 166, 184-185, 213, 215, 220-221, 244, 255-256, 293-295, 333; MAP 2

Eriocrania griseocapitella Walsingham, 1898:162.—Kearfott 1902:129.—Forbes, 1923:66.

Eriocephala griseocapitella (Walsingham).—Dyar, 1902 [1903]: 581, no. 6619.—Kearfott, 1903:125, no. 7166.

Mnemonic griseocapitella (Walsingham).—Meyrick, 1912a: 19; 1912b:5.—Barnes and McDunnough, 1917:197, no. 8479.—McDunnough, 1939:110, no. 9854.

Mnemonic auricyanea Busck and Böving, 1914:151 [misidentification, not Walsingham, 1898].—Rohwer, 1914:141.—Mosher, 1916:35.—Forbes, 1923:65.—Crampton, 1920:33, 34.—Philpott, 1924:361; 1925:458; 1926:723.—Hinton, 1946: figures 10-12.—Muesebeck et al., 1951:329.—Gerasimov, 1952:92.—Friese, 1969:209.—Razowski, 1975a:5.

Eriocrania auricyanea (Busck and Böving).—Forbes, 1923:66.—Forbes, 1928:534, no. 8477.—Needham, Frost, and Tottill, 1928:72.—Shepard, 1930:243.

Dyseriocrania auricyanea (Busck and Böving).—Kristensen, 1968:242.—Opler, 1974:17.—Davis, 1975:10.

Epimartyria auricinella Fracker, 1930:57 [misidentification, not Walsingham, 1898].

ADULT (Figure 166).—*Wing Expanse*: ♂, 10-13 mm; ♀, 9-12.5 mm.

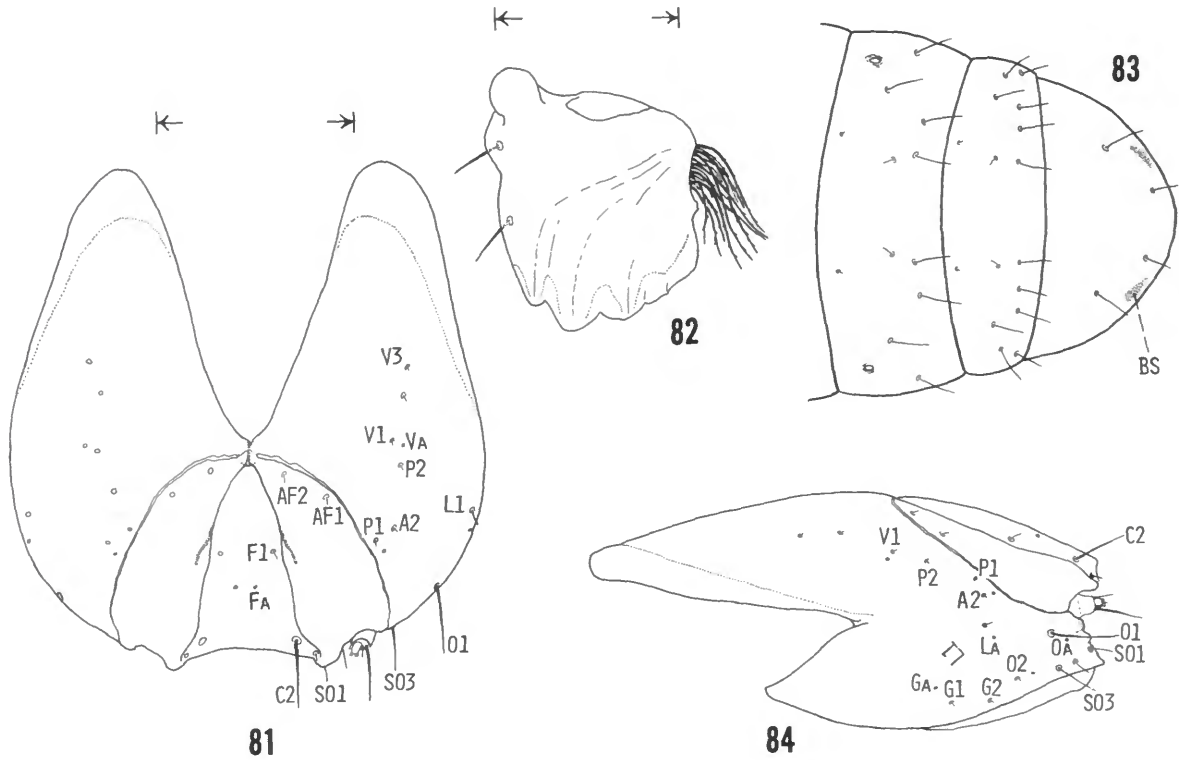
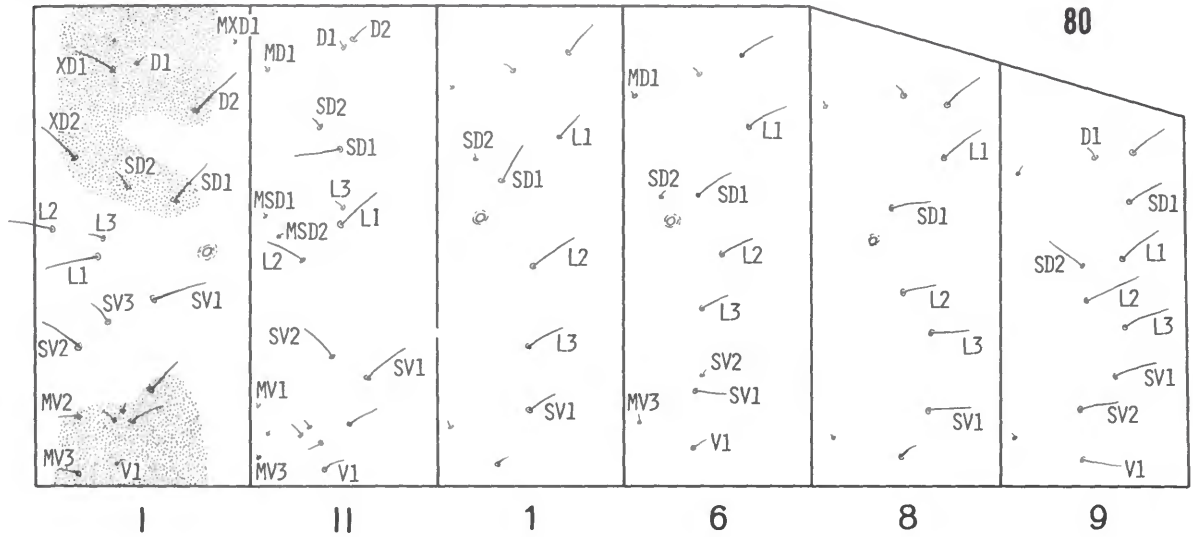
Head: Vertex and frons covered with long, predominantly white hairs intermixed with fuscous. Antennae approximately 0.53-0.57 the length of forewing, 43- to 47-segmented; scape predominantly white, irrorated with fuscous; flagellum white beneath, fuscous above. Maxillary and labial palpi

white, irrorated with fuscous. Maxillary palpi with apex of 5th segment naked except for 5-6 apical setae and 2-3 subapical setae; setae very short, length not exceeding 2.0 their width.

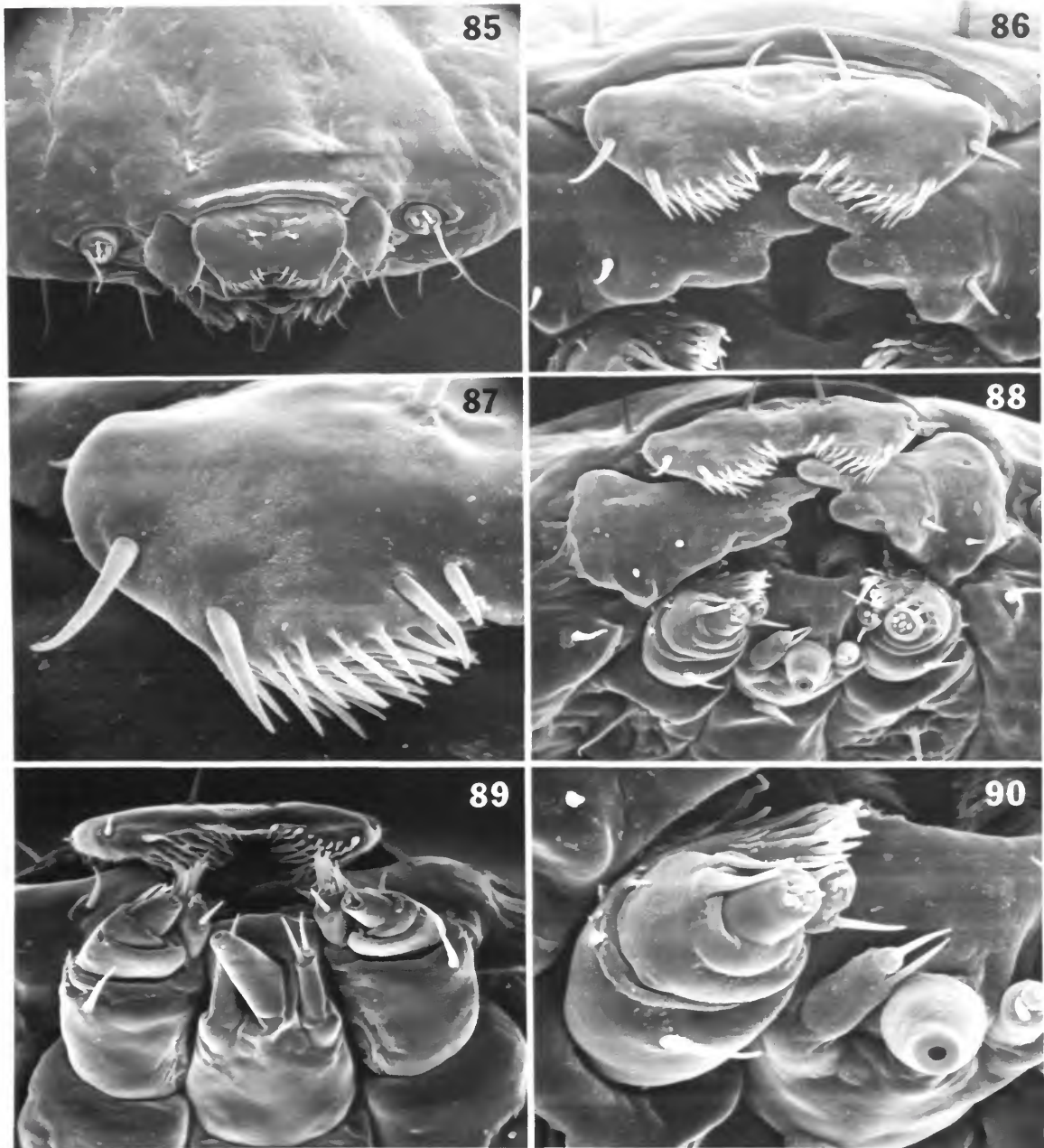
Thorax: Dorsum almost equally intermixed with elongate hairs and broader, appressed scales of white and fuscous. Venter white. Legs white ventrally, light fuscous dorsally, usually darker on prothoracic legs. Forewings golden bronze, heavily mottled with minute specks of darker scales which, under low magnification may appear iridescent bluish purple; forewings rather evenly mottled except for a small, pale subtornal spot usually present on hind margin; fringe bronzy brown. Hind wings paler, grayish with a slight purplish luster, sparsely covered with moderately broad scales.

Abdomen (Figures 56, 58-63, 220-221): Sparsely covered with long brownish hairs dorsally, whitish ventrally. Fourth sternite of female with fenestrae nearly equaling sternal tubercles in size, diameter approximately 0.5 the length of sternite; fenestrae absent in male. Fifth sternite of both sexes with a pair of large, reniform tubercles that are usually wider than long, length approximately 0.5 the length of sternite. Caudal margin of 8th sternite and tergite of female relatively indistinct, subtruncate, not deeply clefted.

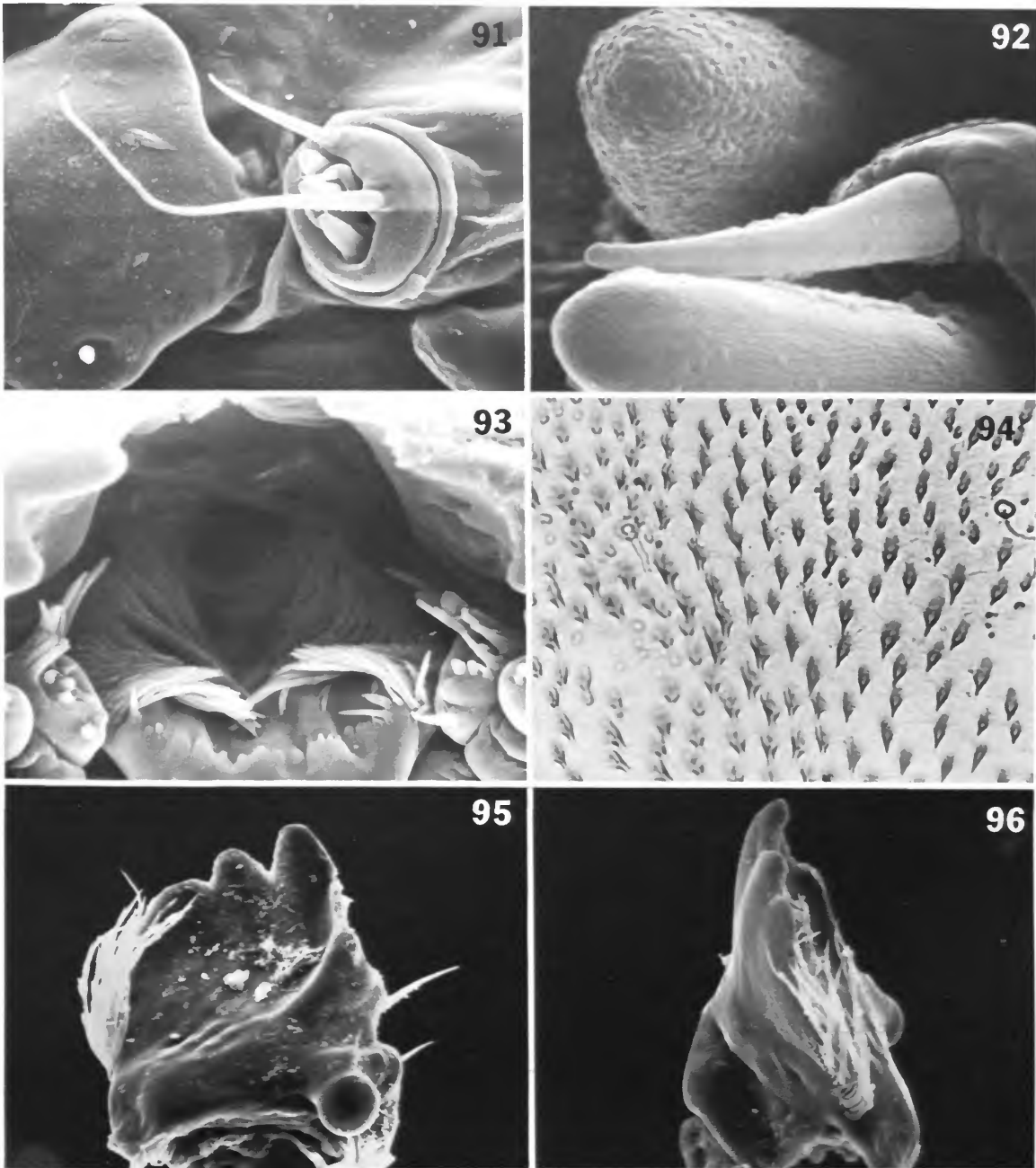
Male Genitalia (Figures 255-256): Uncus shallowly bilobed; lobes reduced, widely separated. Anal tube membranous, with minute, scattered spines; basal sclerites absent. Vinculum with caudal



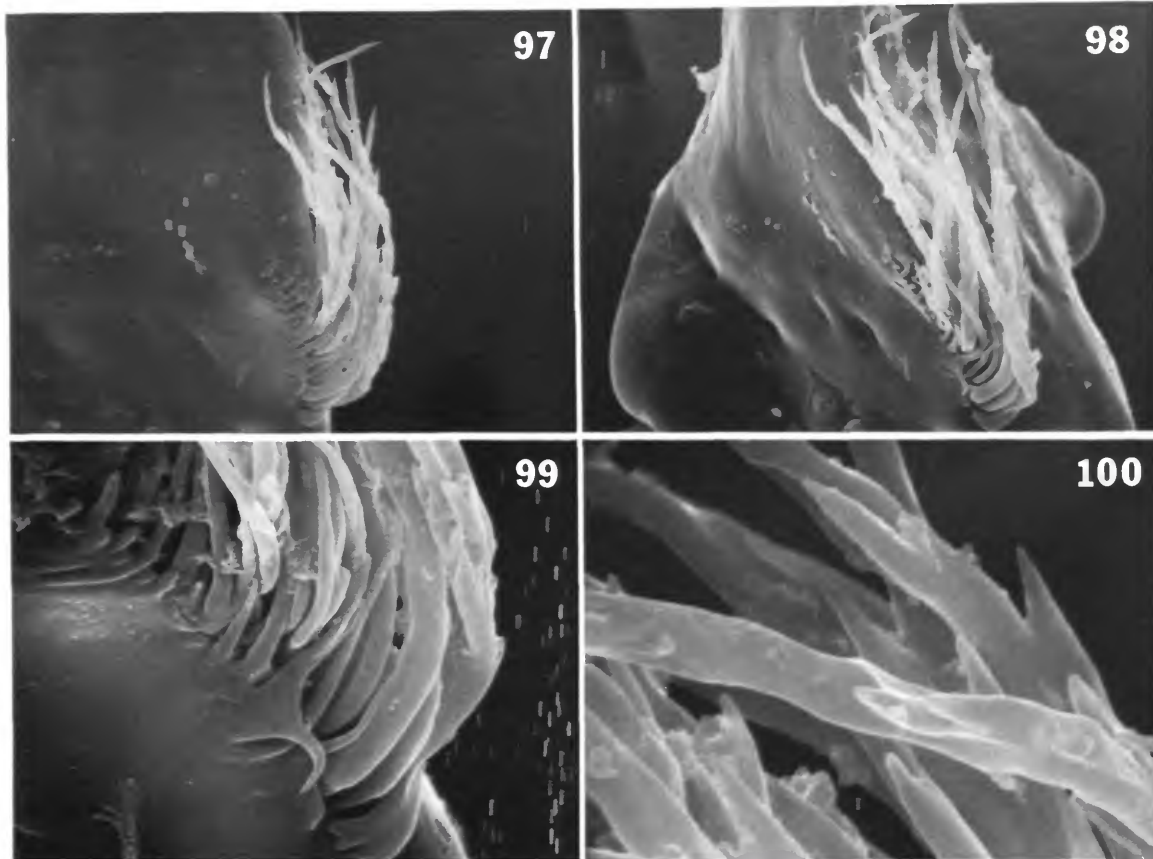
FIGURES 80-84.—*Dyseriocrania griseocapitella* (Walsingham), larval chaetotaxy: 80, lateral view of prothorax, mesothorax, and abdominal segments 1, 6, 8, and 9; 81, dorsal view of head (scale = 0.3 mm); 82, left mandible (scale = 0.1 mm); 83, dorsal view of abdominal segments 8-10; 84, lateral view of head.



FIGURES 85-90.—*Dyseriocrania griseocapitella* (Walsingham), larval head structure: 85, dorsal view of anterior margin of head, $\times 220$; 86, anterior view of labrum and mandibles, $\times 525$; 87, chaetotaxy of labrum, $\times 1250$; 88, anterior view of mouthparts, $\times 360$; 89, ventral view of mouthparts, $\times 420$; 90, details of maxilla and spinneret, $\times 800$. (Photographs reduced to 84%.)



FIGURES 91-96.—*Dyseriocrania griseocapitella* (Walsingham), larval head structure: 91, antenna, $\times 930$; 92, surface detail of antennal basiconic sensilla, $\times 9425$; 93, anterior view of buccal cavity and chaetotaxy of hypopharynx, $\times 870$; 94, integument of fifth abdominal tergite between setae D1; 95, ventral view of left mandible, $\times 500$; 96, mesal view of left mandible, $\times 500$. (Photographs reduced to 84%.)



FIGURES 97-100.—*Dyseriocrania griseocapitella* (Walsingham), larval mandibles: 97, dorsal view of setal tuft, $\times 950$; 98, mesal view of setal tuft, $\times 1000$; 99, base of setal tuft, $\times 3100$; 100, detail showing barbs of setal tuft, $\times 7650$. (Photographs reduced to 84%.)

margin superficially bilobed; anterior margin with apophyses elongate, approximately 0.75 the length of undivided vinculum. Juxta broadest anteriorly, tapering caudally to a narrow, minutely clefted apex; greatest width approximately 0.6–0.65 its length. Base of aedeagus prominently swollen; ventral branch of aedeagus very slender, simple, without any apical projections or basal lobes.

Female Genitalia (Figures 293–295, 333): Apex of ovipositor acuminate; lateral edges serrulate, with 10–12 minute teeth. Bursa copulatrix relatively elongate, extending noticeably beyond apices of anterior apophyses; walls of corpus bursae entirely membranous. Vaginal sclerite moderately broad, greatest width about 0.45–0.5 its length,

depressed, not darkly sclerotized, and without ventral keel; general structure as shown in Figure 294.

LARVA (Figures 80–100).—Length of largest larva 10 mm; diameter 1.8 mm.

Head: Mostly pale brown to light yellow in color; adfrontal suture outlined in dark brown. Greatest width 0.6 mm; length 0.85 mm. Va variable in position, usually either laterad or posterior to V1. P1 very reduced in size, approximately equal to A2, usually separate from ecdysial line. A2 situated either slightly anterior or posterior to P1. A1 absent. Labrum with all setae simple, acute; anterior margins of pilifers and epipharynx densely spinose; M3 arising much closer to M2 than to L3. Mandibles with an inner, median tuft of 12–18

elongate setae; each seta finely branched, appearing somewhat serrate.

Thorax: Pronotal and prosternal plates well developed, dark brown. Meso- and metathorax without sclerotized plates, whitish in color. L2 relatively well developed on meso- and metathorax, approximately equal to L1 in size. Subventral setae trisetose on prothorax.

Abdomen: Integument without pigmentation, usually whitish except for a pair of minute, longitudinal, brownish spots near lateroposterior margin of anal segment; barlike spots without enlarged cephalic end. L1 present on all segments, situated relatively high above SD1 and spiracles on I to VIII. SV2 absent in segment I, usually present on II, VII, and IX but variable. Segment IX with 10 pair of primary setae; both SD2 and SV2 present and well developed.

TYPE.—Holotype, ♂; in the British Museum (Natural History).

TYPE-LOCALITY.—Washington, D.C.

HOSTS.—Fagaceae: "chestnut [*Castanea dentata*

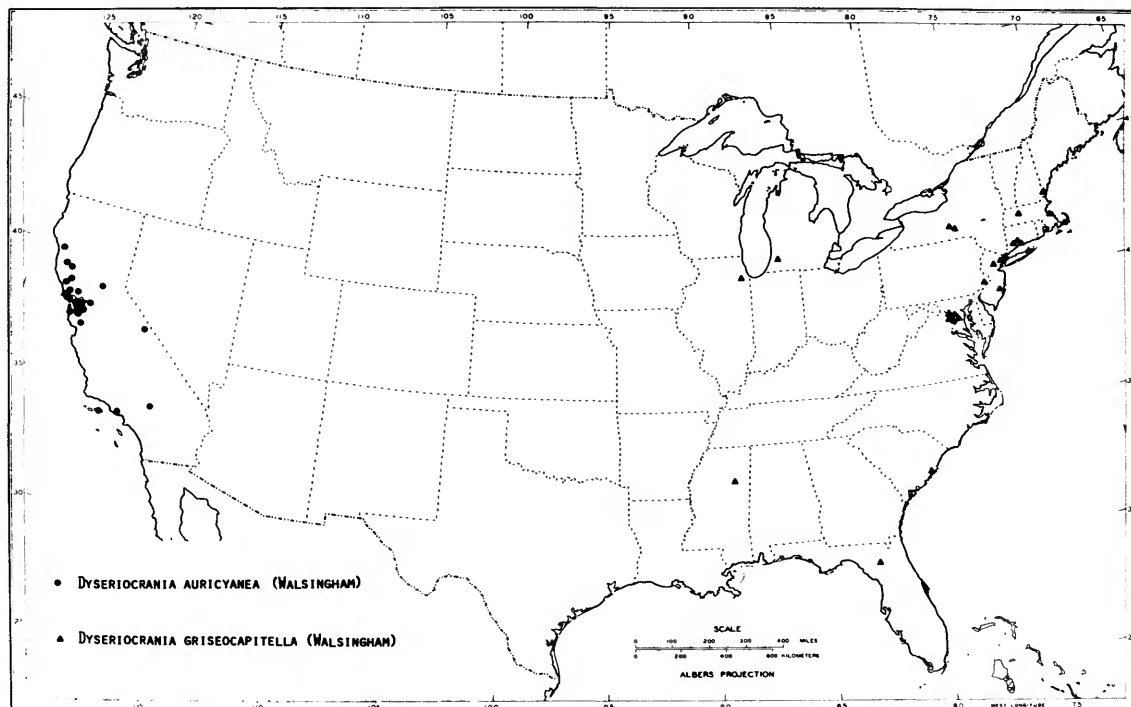
(Marsh.) Borkh.]; chinquapin [*Castanea pumila* (L.) Mill.]; oak [*Quercus* species]," Busck and Böving (1914). *Castanea mollissima* Blume; *Quercus alba* L.; *Quercus ?borealis* (Michaux) Farw.; *Q. ?falcata* Michaux; *Q. velutina* Lamarck.

PARASITES.—Ichneumonidae: "*Lathrolestes mneumonicae* (Rohwer)," Rohwer (1914); near *Tersilochus* species.

FLIGHT PERIOD.—Late February to late May; univoltine.

DISTRIBUTION (Map 2).—This species ranges widely along the Atlantic states of North America from Nova Scotia south to northern Florida. It is known to occur as far westward as Michigan, Illinois, and Mississippi.

MATERIAL EXAMINED.—97 males, 154 females, and 41 larvae. CANADA. NOVA SCOTIA: Bridgewater: 1 ♂, 1 Jun (NSM). UNITED STATES. CONNECTICUT: New Haven Co: Bethany: 1 ♂, 19 May (USNM). Hamden: 1 ♀, 2 May (USNM). New Haven: 1 ♂, 5 May (USNM). Yale Preserve, New Haven: 4 ♂, 5 ♀, 18 Apr–9 May (USNM). West Rock Pk, New Haven: 2 ♀, 24 May (USNM). DISTRICT OF COLUMBIA: Washington:



MAP 2.—Distributions of Nearctic *Dyseriocrania* in the United States.

1 ♂ (holotype, *E. griseocapitella*) (BMNH); 1 ♂, 1 ♀ (LACM); 1 ♀ 4 larvae, 20 May (USNM); Ft Totten: 3 larvae, 15 May (USNM). FLORIDA: Alachua Co: San Felasco Hammock, 5 mi [8 km] SE Alachua: 1 ♀, 22 Feb (JBH). ILLINOIS: Palos Pk: 1 ♂, 25 Apr (USNM). MARYLAND: Montgomery Co: Forest Glen: 1 ♂, 2 May (USNM). Plummers Island: 4 ♂, 7 Apr (USNM). Prince Georges Co: Adelphi: 1 ♀, 2 May (USNM). MASSACHUSETTS: Barnstable Co: Barnstable: 1 ♂, 15 May (CPK). Franklin Co: Leverett: 1 ♂ (USNM). Norfolk Co: Cohasset: 1 ♂, 11 May (USNM). Suffolk Co: Forest Hills: 1 ♂, 1 ♀, 12 May (USNM). MICHIGAN: Allegan Co: T2N, R14W, Sec 7: 2 ♀, 23 May (LACM); 1 ♀, 23 May (USNM). MISSISSIPPI: Oktibbeha Co: Mississippi State Univ: 1 ♂, 25 May (BrM). NEW HAMPSHIRE: Rockingham Co: Hampton: 1 ♂, ♀, ? May (LACM); 1 ♀, 17 May (USNM). NEW JERSEY: Essex Co: 1 ♂, 1 ♀, 19 Apr (USNM). Essex Co Pk: 1 ♂, 1 ♀, 21 Apr-4 May (USNM). Ocean Co: Lakehurst: 1 ♂, 6 May (USNM). NEW YORK: Bronx: Bronx Pk: 1 ♂, 29 Apr (AMNH). Tompkins Co: Dryden, Ringwood Reserve: 3 ♀, 8-15 May (USNM). Ithaca, Six Mile Ck: 15 ♂, 58 ♀, 7-15 May (USNM). Westchester Co: Pelham: 34 ♂, 68 ♀, 21-30 Apr (AMNH); 1 ♂, 1 ♀, 21-30 Apr (USNM). PENNSYLVANIA: Philadelphia Co: Mt. Airy (USNM). SOUTH CAROLINA: Berkeley Co: McClellanville, The Wedge: 1 ♀, 15 Apr (RBD); 13 ♂, 6 ♀, 17-22 Mar (USNM). VIRGINIA: Augusta Co: Staunton: 10 larvae, 22 May (USNM). Fairfax Co: Falls Church: 1 ♀, iss. 23 May (AMNH); 9 ♂, 8 ♀, iss. 9 Mar-3 Apr (USNM); 23 larvae, 9-18 May (USNM). Minor Hills, E Falls Church: 1 larva, 15 May (USNM).

DISCUSSION.—Most of the references to this insect in the literature, unfortunately, have been issued under the name *auricyanea*. As discussed later in this paper, under the latter species, an examination of the type of *auricyanea* has revealed it to be the senior synonym of *D. cyanosparsella*, a species known only from California. Previous authors, evidently misled by Walsingham's (1882) statement of the original type deposition (Peabody Academy of Science, Salem, Massachusetts), assumed that *auricyanea* was an eastern insect. Actually, no mention was made by Walsingham concerning the origin of his specimen, and very likely he did not realize himself that it was probably collected in cismontane California. Consequently, later authors, without closely examining the type specimen of *auricyanea*, preferred to use this earlier name in lieu of *D. griseocapitella*, which was proposed 16 years later. *Dyseriocrania griseocapitella* was never officially synonymized under *auricyanea*, although its distinction had been questioned (Forbes, 1923).

Because of the rather poor condition of the types of both *D. auricyanea* and *D. griseocapitella*, casual comparison of the two would probably lead one to conclude they were the same. Examination

of their genitalia, however, leaves no doubt regarding their true identity. In the male, the caudal margin of the vinculum in *D. griseocapitella* is superficially bilobed; the lobes of the uncus are widely separated; and the base of the ventral branch of the aedeagus is without lateral lobes. In *D. auricyanea*, the caudal margin of the vinculum is deeply excavated on either side of a median lobe-like extension, the apical lobes of the uncus are not widely separated, and the ventral branch of the aedeagus possesses a bilateral pair of small lobes at its base. The females of these two, closely related species are most easily separated by comparing the very different forms of their vaginal sclerites (Figures 294 and 297).

The first observation of the immature stages of this species was by Kearfott (1902). This author discovered larvae mining the leaves of *Castanea americana* (= *C. dentata*) near Montclair, New Jersey. Because he was not able to rear any adults, Kearfott was uncertain as to the identity of the larvae in question; he did, however, suggest *Dyseriocrania griseocapitella* as a possibility.

The most complete account treating the life history of *D. griseocapitella* is that by Busck and Böving (1914). The adults emerge in late winter to early spring, which may be from late February through March in the southern parts of its range to as late as April and May farther north. According to Busck and Böving, the female abdomen contains approximately 40 eggs. These are reported to be relatively large, oblong (0.5 mm long and 0.2 mm in diameter), soft in texture with a whitish color, and finely sculptured with minute dots. The eggs are inserted singly into the young leaves of oak and chestnut before the leaves have fully opened. Usually the eggs are deposited near the edge over the outer half of the leaf. Needham et al. (1928) state that the eggs require 7 to 15 days to hatch.

The mine (Figure 101) commences as a narrow, linear passage extending toward the leaf margin. This early stage of the mine is usually obliterated as the mine is enlarged and often causes a characteristic fissure to form eventually in the leaf. Immediately following the serpentine stage, the mine broadens to form a large, somewhat inflated blotch suggestive of many coleopterous mines, so much so that Kearfott (1902), after first discovering the mines of this moth, believed them to be caused by

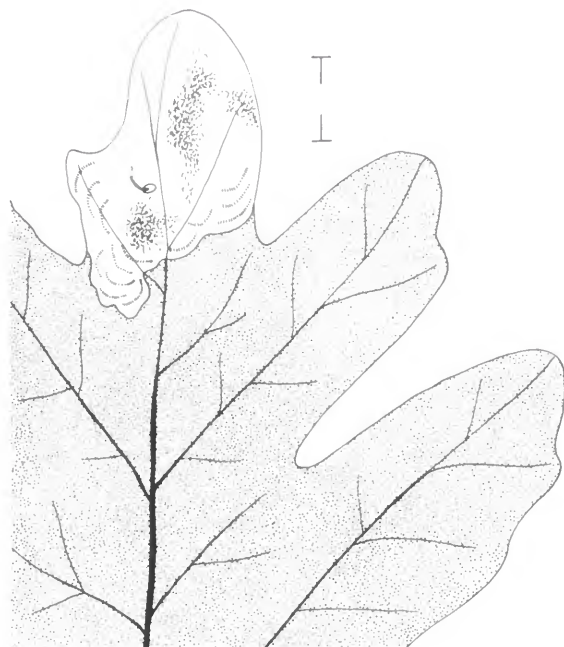


FIGURE 101.—Leaf mine of *Dyseriocrania griseocapitella* (Walsingham) on *Quercus alba* L. (Scale = 10 mm.)

a beetle. The rather abrupt change from a linear mine to a blotch mine probably signals the initiation of the second larval instar often characteristic in certain other lepidopterous leafminers. Kearfott noted that the larva usually sweeps in small circles of 5 mm or more radius in feeding, with its anal end functioning as a pivot. The final outline of the mine often results from a series of these semi-circles marked by a series of fine, concentric curved lines. The blotch becomes full depth (i.e., with the entire parenchyma within the mine being devoured), causing the mine to become semitransparent. Consequently, the larva and its dark frass, usually lying loosely inside the mine, may be easily observed through the leaf epidermis.

Larval feeding is rather rapid. Within 7 to 10 days the larva drops to the ground and burrows into the soil as deep as 12 inches (30 cm). A relatively tough oval cocoon (Figure 102) measuring approximately 3 mm long and 2 mm in diameter is spun of silk and small particles of soil. The larva diapauses inside this cocoon for several months until sometime during the winter when it finally pupates. Busck and Böving report the

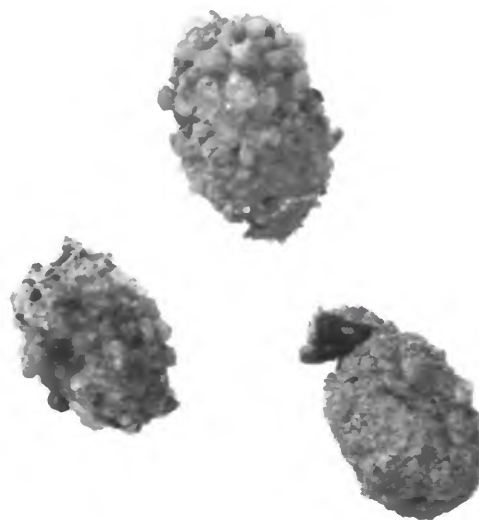


FIGURE 102.—Pupal cocoons of *Dyseriocrania griseocapitella* (Walsingham). Length of largest cocoon 3.1 mm.

greatly developed pupal mandibles to be heavily relied upon by the pupa not only for emerging from the cocoon but also for digging its way to the surface of the soil. After emerging from the ground, the pupa remains quiescent for an indefinite period until final ecdysis can be performed. Rather soon after emerging from the pupal shell, the adult is capable of flight.

The larva of *D. griseocapitella* is easily distinguished from that of its nearest relative, *auricyanea*, by several setal characters. Most significantly, seta A1 is lost in *griseocapitella* but present in *auricyanea*. The ninth abdominal segment of the former demonstrates the most primitive chaetotaxy of the family studied thus far in possessing 10 pair of primary setae, including what is assumed to be SD2 and SV2. In contrast, the ninth segment of *auricyanea* possesses the more normal complement of seven primary setal pairs.

As noted by Hinton (1946:11), Fracker's reference to the larva of *Epimartyria auricrinella* Walsingham is incorrect. The description he provides actually pertains to an eriocraniid, most probably *D. griseocapitella*.

The larva and possibly pupa of this moth are known to be parasitized by two genera of Ichneumonidae. Only one of these, *Lathrolestes mnemoni-*

cae Rohwer, was previously reported. A second parasite was discovered in the collections of the National Museum of Natural History within a cocoon collected and preserved by A. Busck. The latter may represent an undescribed genus, near *Tersilochus*, as determined by R. W. Carlson of the U.S. Department of Agriculture. Both parasites are believed to oviposit in the larva of *D. griseocapitella* during its mining phase but do not kill the larva until it has completed its cocoon underground.

This particular host-parasite relationship appears somewhat of an anomaly in that no other members in the respective subfamilies of these two wasps are known to parasitize Lepidoptera. For example, Townes (1969:13), evidently overlooking previous literature references to the above host record of *Lathrolestes mnemonicae*, stated that all species of the subfamily Scolobatinae are internal parasites of sawflies. Similarly, Townes (1971:33) summarized that all members of the subfamily Tersilochinae are parasitic on coleopterous larvae, especially those of Curculionidae. Regarding the latter, he further adds that the host species attacked seem to be those with larvae in plant tissue and pupation in the soil. Consequently, it appears that at least some parasitic wasps that normally attack other orders of insects have secondarily adapted to *D. griseocapitella* largely due to certain similarities in the general life history of the host. Further attempts to rear adult eriocraniids will undoubtedly reveal additional associations of parasites.

Dyseriocrania auricyanea (Walsingham)

FIGURES 103–108, 167, 186–187, 222–223, 257–258,
296–298, 334; MAP 2

Micropteryx auricyanea Walsingham, 1882:204.—Riley, 1891: 111, no. 6016.

Eriocrania auricyanea (Walsingham).—Walsingham, 1898:162.

Eriocrania aurocyanea [sic] (Walsingham).—Walsingham, 1898:162.

Erioccephala auricyanea (Walsingham).—Dyar, 1902[1903]:581, no. 6618.—Kearfott, 1903:125, no. 7165.

Mnemonica auricyanea (Walsingham).—Meyrick, 1912a:19; 1912b:5.—Barnes and McDunnough, 1917:197, no. 8477.—McDunnough, 1939:110, no. 9852.

Eriocrania cyanosparsella Williams, 1908:14 [new synonym].—Needham, Frost and Tothill, 1928:78.

Mnemonica cyanosparsella (Williams).—Meyrick, 1912a:19; 1912b:5.—Barnes and McDunnough, 1917:197, no. 8476.—

Keifer, 1927:138.—McDunnough, 1939:110, no. 9851.—Armitage, 1951:111.

Dyseriocrania cyanosparsella (Williams).—Opler, 1974:16.

ADULT (Figure 167).—*Wing Expanse*: ♂, 10.5–13 mm; ♀, 9.3–10.5 mm.

Head: Vertex and frons covered with long, divergent white to predominantly white hairs intermixed with a scattering of pale brownish hairs. Antennae approximately 0.65 the length of forewings, 44–48 segmented; scape whitish; flagellum white ventrally and laterally, light fuscous dorsally. Maxillary palpi pale brown; apex of terminal segment largely naked except for 5–6 apical setae and 2–3 subapical setae; setae very short, length less than 2.0 their width; surface of apical region rougher than in *D. griseocapitella* due to a scattered series of rudimentary, appressed spines. Labial palpi whitish, particularly on ventral and inner surfaces, with scattered, elongate brownish scales.

Thorax: Dorsum almost equally intermixed with elongate hairs and broader, appressed scales of white and light brown. Venter white. Legs mostly white ventrally and bronzy brown dorsally. Forewings pale golden brown, and rather distinctly marked with several small patches of darker, purplish scales; heaviest patches of purplish scales typically arranged into three narrow, irregular, and approximately parallel bands obliquely slanted from hind margin toward costa and apex; the median fascia usually the most distinct with the outer fascia the least well developed; purplish spots also present along costal margin and outer margins of wings; fringe uniformly light golden brown. Hind wings slightly darker in color, more grayish brown with a slight purplish luster.

Abdomen (Figures 222–223): Sparsely covered pale grayish white hairs, usually more whitish ventrally. Fifth sternite of both sexes with a pair of large, reniform tubercles situated toward lateral margin of sternite; surface of tubercles swollen, reticulated; tubercles wider than long; length approximately 0.5–0.6 the length of sternite. Fourth sternite of female with a pair of moderately large fenestral areas about half the diameter of 5th sternal tubercles; fenestrae situated more mesad than glands; 4th sternite of male without fenestrae. Posterior margin of 8th segment of female not deeply clefted, nearly simple.

Male Genitalia (Figures 257–258): Uncus shallowly bilobed, lobes reduced, rather narrowly sepa-

rated. Anal tube membranous, with several minute, scattered spines; basal sclerites absent. Median lobe from caudal margin of vinculum pronounced; margin deeply excavated on either side of median lobe; anterior apophyses elongate, approximately 0.8 the length of undivided vinculum. Juxta broadest anteriorly, then narrowing gradually to acute caudal apex; greatest width approximately 0.7 its length. Base of aedeagus moderately swollen, much less so than in *D. griseocapitella*; ventral branch of aedeagus slender, with bilateral pair of small, rounded lobes at basal sixth; apex of ventral branch simple, acute.

Female Genitalia (Figures 296–298, 334): Apex of ovipositor subacuminate to acute; lateral edges serrulate, with 12–14 minute teeth. Bursa copulatrix of moderate length, not surpassing cephalic apices of anterior apophyses when extended; walls of corpus bursae with numerous minute spines concentrated especially over caudal two-thirds. Vaginal sclerite moderately sclerotized; broad, greatest width approximately 0.65 its length, not depressed, with a prominent, triangular ventral keel; structure of sclerite as in Figure 297.

LARVA (Figures 103–107).—Length of largest larva 8.5 mm; diameter 1.2 mm.

Head: Relatively dark brown except for blackish outline of frontal sutures. Greatest width 0.6 mm; length 0.7 mm. Va situated approximately midway between VI and V2. P1 moderately elongate, arising either within or very approximate to ecdysial line. A1 present. Chaetotaxy of labrum similar to that of *D. griseocapitella*; all setae simple, acute; anterior margin of pilifers and epipharynx densely spinose; M3 arising much closer to M2 than L3. Mandibles with an inner median tuft of 12–15 elongate, finely branched setae.

Thorax: Pronotal shield consisting of 2 pair of irregular, brownish plates partially confluent across midline. Prosternum with a large pair of brownish plates partially confluent at midline; plates roughly triangular in form with apex of triangle directed anteriorly. Meso- and metathorax without sclerotized plates. L2 relatively well developed on meso- and metathorax, approximately equal to L1. Subventral setae trisetose on prothorax.

Abdomen: Integument without pigmentation, appearing whitish except for a minute pair of longitudinal, brownish spots near lateroposterior mar-

gin of anal segment; barlike spots without enlarged cephalic end. L1 present on all segments, situated relatively high above SD1 and spiracles on I to VIII. SV2 variable, but typically present on segments I to VIII. Segment IX with 7 pair of primary setae; SD2, L3, and SV2 absent.

TYPES.—Holotype, ♂, No. 1622 (*Eriocrania auricyanea*); in the Museum of Comparative Zoology, Harvard University. Holotype ♂, No. 3219 (*Eriocrania cyanosparsella*); in the California Academy of Sciences.

TYPE-LOCALITIES.—Unknown [probably California] (*Eriocrania auricyanea*). At the base of Mt. Tamalpais, Marin County, California, in a small grove of oaks (*Quercus agrifolia*), (*Eriocrania cyanosparsella*).

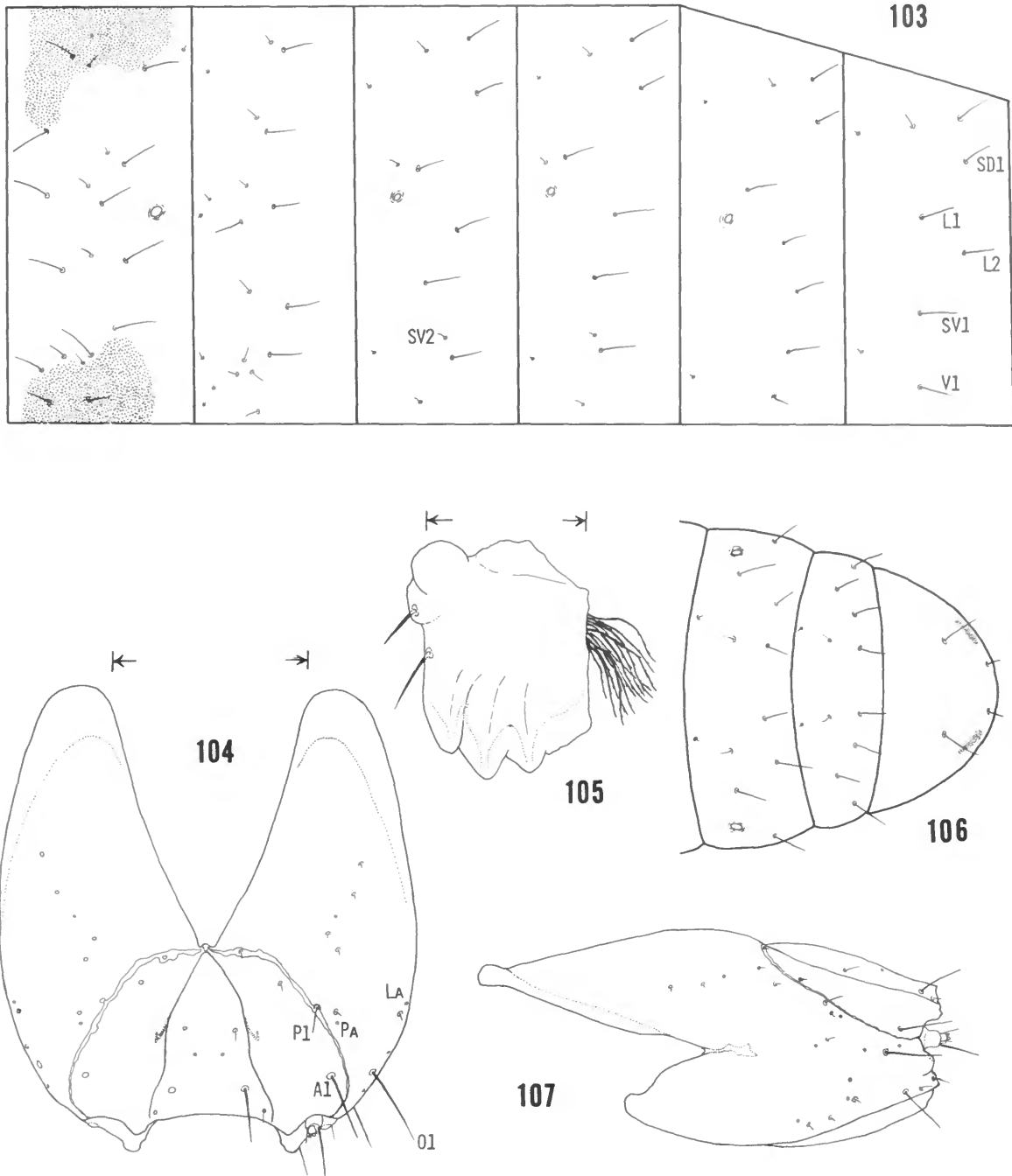
HOST.—Fagaceae: “*Quercus agrifolia* Neé,” Keifer, 1927; “Putative mines on *Quercus douglasii* H. and A., *Q. dumosa* Nutt., *Q. lobata* Neé and *Q. wislizenii* A.DC.,” Opler, 1974.

FLIGHT PERIOD.—Early March to mid-April; univoltine. The December through March emergence dates of Keifer (see “Material Examined”) have not been considered here because they are suspected to be laboratory rearings and, thus, probably do not reflect natural emergence dates.

DISTRIBUTION (Map 2).—This species is known only from California, where it occurs, according to Opler (1974), from Shasta County southward in the Coast ranges and western foothills of the Sierra Nevadas to Santa Cruz Island and the San Gabriel Mountains.

MATERIAL EXAMINED.—35 males, 17 females, and 1 larva. UNITED STATES. CALIFORNIA: Alameda Co: Alameda: 1 ♂, 1 ♀ (CAS). Strawberry Canyon, Berkeley Hills: 1 ♀, 23 Mar, 1 larva, 11 Apr (UCB). Lake Co: Lakeport: 6 ♂, 1–15 Apr (CAS). Lower Lake: 2 ♂, 1 ♀, 15 Apr (CAS). Marin Co: Mt Tamalpais: 1 ♂ (holotype), 3 Mar (CAS); 1 ♂ (paratype), 3 Mar (CAS); 2 ♂ (paratypes), 3 Mar (USNM). Novato: 1 ♀, 6 Apr (CAS). San Luis Obispo Co: Black Mts: 1 ♀, 29 Mar (USNM). San Mateo Co: San Francisco: 2 ♂, 14 Apr (LACM); 15 ♂, 9 ♀, 6 Dec–30 Mar (CAS); 3 ♂, 3 ♀, 7 Dec–29 Mar (USNM). Sonoma Co: Boyes Hot Springs: 1 ♂, 31 Mar (CAS). Cazadero: 1 ♂, 12 Apr (CAS).

Other Records (not examined): CALIFORNIA: Alameda Co: Berkeley, Univ. Calif. campus: 2 ♂, 26 Feb (UCB). Contra Costa Co: Antioch: 2 ♀, 26 Mar (UCB). 2 mi [3.2 km] E Antioch: 3 ♂, 26 Mar (UCB). 2 mi [3.2 km] N Orinda: 2 ♂, 1 ♀, 26 Feb (UCB). Russel Farm, 4 mi [6.4 km] NE Orinda: 1 ♂, 19 Apr (UCB). Richmond: 1 ♀ 10 Apr (UCB). El Dorado Co: Cool: 2 ♀, 23 Mar (UCB). Marin Co: Vicinity of Phoenix Lake: 1 ♂, 2 Apr (UCB). Mendocino Co: 3 mi [4.8 km] N Branscomb, 1400 ft [427 m]:



FIGURES 103-107.—*Dyseriocrania auricyanea* (Walsingham), larval chaetotaxy: 103, lateral view of prothorax, mesothorax, and abdominal segments 1, 6, 8, and 9; 104, dorsal view of head (scale = 0.3 mm); 105, left mandible (scale = 0.1 mm); 106, dorsal view of abdominal segments 8-10; 107, lateral view of head.

2♂, 4♀, 16–17 May (UCB). San Bernardino Co: 10 mi [16 km] N Fontana, Lytle Creek Ranger Sta: 1♀, 17 Apr (UCB). Santa Barbara Co: Prisoner's Harbor, Santa Cruz Island: 4♀, 16 Mar (UCB). Santa Clara Co: Herbert Cr, 3 mi [4.8 km] W New Almaden: 1♀, 18 Apr (UCB). Sierra Co: Shenanigan Flat, 14 mi [22.4 km] W Donnieville: 1♂, 18 Apr (UCB). Ventura Co: Oxnard: 1♂, 11 Apr (UCB).

DISCUSSION.—An examination of the holotype of *Dyseriocrania auricyanea* has clearly shown that it does not represent our common eastern eriocraniid as once believed; instead it was discovered to be the senior synonym of the California species formerly known as *D. cyanosparsella*. This change in names is an unfortunate but necessary action.

As summarized in the discussion of the preceding species, *D. griseocapitella*, a number of morphological characters, particularly in the male and female genitalia, easily distinguish these two closely related species. They can most quickly be identified by their widely disjunct distributions and different forewing maculation. The forewings of *D. auricyanea* are lighter in color with a definite golden luster and are more distinctly marked with dark, oblique but irregular fasciae.

The life history of *D. auricyanea* has recently been reviewed (under the name *cyanosparsella*) by Opler (1974). In general, its life history is very similar to that of its eastern counterpart. The eggs are inserted singly into opening leaves in early spring. Normally, the usual oviposition site is on the apical half of the leaf. A small egg pouch is normally loosely attached to one side of the oviposition scar formed by the impression of the previously hatched egg. The eggs are believed to hatch in approximately the same period (7–15 days) as in *D. griseocapitella*.

Upon emerging, the larva develops rapidly, passing through at least four instars. Opler encountered larvae in the field as early as 14 March in the southern part of its range and as late as 19 May farther north. The first instar mine begins as a linear or slightly curved passage to the leaf margin. Following this stage, the mine is quickly enlarged to an inflated, full length blotch. Larval feeding during this period usually progresses in a series of semicircular swaths. At maturity, the larva leaves the mine through a slit in the upper leaf epidermis and drops to the ground. It burrows into the litter beneath the host tree and forms a whitish silken cocoon covered with darker soil particles.

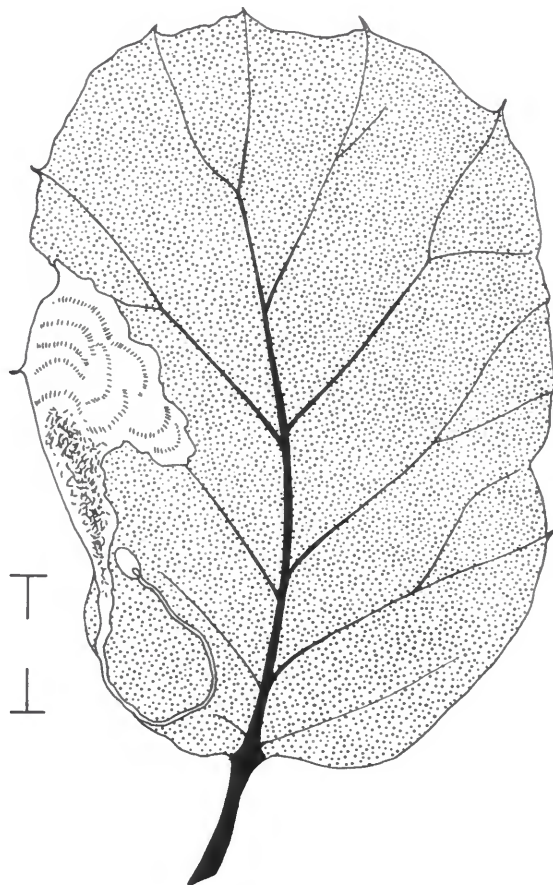


FIGURE 108.—Leaf mine of *Dyseriocrania auricyanea* (Walsingham) on *Quercus agrifolia* Neé. (Scale = 10 mm.)

The larva diapauses through the summer until sometime during the winter when it pupates.

The adults emerge in the late winter or early spring. Opler reports the moths most active in the hours just before sunset, although they are capable of flight at any time during the daylight hours.

The mature larva is easily distinguished from that of its eastern sister species, *D. griseocapitella*, by the presence of A1 arising from the adfrontal sclerite (absent in *griseocapitella*) and by the reduction of setae on the ninth abdominal segment. In *D. auricyanea* only seven primary setae are present compared to 10 in *griseocapitella*. From *Eriocraniella aurosparsella*, the larvae of *D. auricyanea* differ in retaining setae SV3 on the prothorax, L1 on abdominal segments I–VIII, as well as the man-

dibular setal tuft (all absent in *E. aurosparsella*). The larva of the only other California eriocraniid studied, *E. xanthocara*, new species, differs from *D. auricyanea* in having lost the cranial seta A1.

Eriocrania Zeller

Eriocrania Zeller, 1851:323.—Chapman, 1900:94, 96.—Rebel, 1901:246.—Meyrick, 1912a:4; 1912b:17.—Chapman, 1917:310, 312.—Tillyard, 1919:97, etc.; 1923:181, 195.—Forbes, 1923:65.—Philpott, 1926:371, 374; 1927:319.—Meyrick, 1928:870.—Seyrig, 1928:261, 262.—Fletcher, 1929:84.—Hering, 1932:2.—Kuznetsov, 1941:19, 20.—Hinton, 1946:6, etc.—Lhomme, 1949:1221.—Viette, 1949:32; 1951:43, 44.—Hering, 1951:40, etc.—Gerasimov, 1952:189.—Heath, 1958:117.—Toll, 1959:16, 20.—Kristensen, 1968a:70, 71; 1968b:241, etc.—Mutuura, 1972:1055.—Common, 1973:13, 15, 16.—Dugdale, 1974:134.—Birket-Smith and Kristensen, 1974:157, etc.—Razowski, 1975a:5, 7.—Heath, 1976:157.

Eriochania [sic].—Forbes, 1923:65, fig. 38.

Chapmania Spuler, 1910:483 [preoccupied, not Montic, 1893] [type-species: *Lampronia semipurpurella* Stephens, 1835].—Fletcher, 1929:45, 84 [synonym of *Eriocrania*].—Hering, 1932:2.—Kuznetsov, 1941:19 [synonym of *Eriocrania*].—Viette, 1951:43, 44 [synonym of *Eriocrania*].—Razowski, 1975:48 [synonym of *Eriocrania*].—Heath, 1976:157 [synonym of *Eriocrania*].

Allochapmania Strand, 1917:137 [type-species: *Lampronia semipurpurella* Stephens, 1835].—Fletcher, 1929:10, 84 [synonym of *Eriocrania*].—Viette, 1949:32; 1951:43, 44 [synonym of *Eriocrania*].—Gerasimov, 1952:189 [synonym of *Eriocrania*].—Toll, 1959:16, 20, 23.—Razowski, 1975:48 [synonym of *Eriocrania*].—Heath, 1976:157 [synonym of *Eriocrania*].

TYPE-SPECIES.—*Lampronia semipurpurella* Stephens, 1835; designated by Meyrick, 1912a.

ADULT.—Small moths with relatively broad wings; wing expanse: 7.8–13.5 mm.

Head: Maxillary palpi with basal 0.9 of terminal segment densely setose; apical 0.1 largely naked; primary setae simple, without lateral barbs; apex of terminal segment rounded to subacute, simple, without secondary lobes but with 7–8 minute, unstriated, subacute setae concentrated around extreme apex; setae mostly of uniform length, very short and stout, usually less than 0.5 the diameter of apex in length.

Thorax: Venation somewhat reduced, with Sc and R1 simple in both fore and hind wings; R2 and 3 completely fused in both wings; R4 and 5 stalked approximately half their length in both wings. Hind wings with scales elongate, very slender and hairlike.

Abdomen: Fenestrae usually present on ster-

nite of female, either absent in male or rudimentary. Sternal tubercles present on 5th sternite of both sexes, relatively small, papilliform.

Male Genitalia: Uncus deeply bilobed; lobes divergent, lateral margins straight, tapering slightly to apex. Socii present. Anal tube completely membranous except for a bilateral pair of minute, relatively free sclerites near base. Vinculum with median caudal margin only smoothly convex or slightly produced to form a short lobe, not deeply clefted; cephalic margin with a median, triangular process projecting anteriorly between lateral apophyses. Caudal apex of juxta distinctly asymmetrical, subacute, with a short, median longitudinal fold and an even shorter, transverse fold to the left of median fold. Aedeagus with ventral phallic branch very slender, usually half the diameter of dorsal branch, and simple, without prominent lobes or processes.

Female Genitalia: Vaginal sclerite variable in structure, usually in the form of a broad, depressed plate with cephalic margin of plate broadly rounded; cephalic 0.5–0.8 of plate sometimes curved sharply ventrad forming a prominent ventral process; midventral keel relatively low and poorly developed; a sclerotized, median process typically extending caudally from basal area of midventral keel. Ninth segment without midventral spinose pocket.

DISCUSSION.—The genus *Eriocrania* appears to be a rather well-defined, monophyletic assemblage of several Holarctic species. The group may be easily distinguished by several synapomorphic features, such as the loss of one of the radial veins (R3, probably through fusion with R2) in both the fore and hind wings and by a number of characters of the male genitalia, principal among these being the presence of paired, basal sclerites embedded in the anal tube; the asymmetrical caudal apex of the juxta with its peculiar folds; and, perhaps, the median projection of the cephalic margin of the vinculum. The male genitalia appear so uniform among the members of this genus that frequently it is difficult to identify species on this basis alone. The female genitalia may be partially characterized by the presence of a slender, sclerotized process (MP) extending medially and caudally from the base of the relatively poorly developed midventral keel of the vaginal sclerite.

Most of the previous references to the original description of this genus (e.g., Meyrick, 1912a, b,

brownish fuscous above, silvery white below and on inner margins.

Thorax: Dorsum predominantly brownish fuscous, irrorated with whitish hairs; tegulae equally intermixed with long whitish and brownish fuscous hairs. Venter sparsely clothed with slender whitish scales. Legs brownish fuscous above with most of leg, particularly the femur, white ventrally. Forewings mostly fuscous, with a distinct purplish iridescence, heavily mottled with pale, whitish spots; markings small and randomly scattered over wing except for a large, narrowly triangular sub-tornal spot extending halfway across wing from hind margin and extending into basal margin of fringe immediately basad of tornus; fringe along outer margin uniformly grayish fuscous. Hind wings much paler, sparsely covered with very slender scales, uniformly grayish.

Abdomen (Figures 224–225): Sparsely covered with long grayish to pale brownish hairs above, whitish ventrally. Fourth sternite of female with a pair of moderately large, oval fenestrae approximately 0.35 the length of sternite in diameter; fourth sternite of male without fenestrae. Sternal tubercles present on 5th sternite of both sexes, papiliform, diameter about 0.27–0.30 the length of sternite. Caudal apex of 8th tergite of female distinctly and deeply divided; caudal apex of 8th sternite slightly clefted about 0.3 the distance of tergal cleft.

Male Genitalia (Figures 261–262): Uncus deeply bilobed; lobes prominent, widely separated at apex for a distance equivalent to their length. Anal tube membranous; a bilateral pair of minute, basal sclerites present. Vinculum with median area of caudal margin only slightly raised, smoothly curved posteriorly; apophyses elongate, approximately 0.7 the length of undivided vinculum. Juxta broadest anteriorly, gradually tapering posteriorly to a rather broad, subacute apex; greatest width approximately equaling length. Base of aedeagus prominently swollen; ventral phallic branch slender without apical or basal lobes, about 0.5 the diameter of dorsal branch; apex of ventral branch acute, relatively simple except for 4–6 subapical exophallic spines.

Female Genitalia (Figures 305–309; 336): Apex of ovipositor acuminate; lateral edge serrulate, with 12–14 minute teeth. Bursa copulatrix of moderate length, usually not surpassing cephalic apices of

posterior apophyses when fully extended; walls of corpus bursae completely membranous, without spines. Vaginal sclerite darkly sclerotized, broad, often relatively short but variable in length, greatest width approximately equaling length (viewed dorsally); cephalic apex of sclerite extended ventrally into a broad, elongate, slightly curved process as in Figures 306–309.

TYPES.—Syntype, ♂ (*Lampronia semipurpurella*); in the British Museum (Natural History). Syntypes, 1 ♂ and 1 ♀ (*Micropteryx* [sic] *amentella*); in the British Museum (Natural History). Syntype(s), unmarked and unsegregated (*Micropteryx* [sic] *inconspicuella*); presumably in the J. H. Wood collection of the British Museum (Natural History).

TYPE-LOCALITIES.—Darent Wood [50°25'40"N, 0°16'E], Kent, England (*Lampronia semipurpurella*). Not specifically stated (*Micropteryx amentella*). Not stated (*Micropteryx inconspicuella*); presumably in the vicinity of Tarrington, Ledbury, England.

HOST.—Betulaceae: "*Betula pendula* Roth," Lhomme, 1949; "*Betula pubescens* Ehrh.," Toll, 1959; "*Betula platyphylla* var. *japonica* (Miq.) Hara," Kumata (in Litt.).

FLIGHT PERIOD.—Late April to late May; univoltine.

DISTRIBUTION (Map 3).—In North America this species is known to occur from eastern Ontario east to Nova Scotia and south to southern New York. According to Heath (1976), it occurs widespread in Great Britain, through northern and central Europe to Japan.

MATERIAL EXAMINED (North American Records only).—3 males and 5 females. CANADA. NOVA SCOTIA: Boulderwood, Halifax: 1 ♂, 11 May (NSM); 1 ♂, 14 May (USNM). Kings Co, Coldbrook: 1 ♀, 18 May (NSM). Ontario: Black Sturgeon Lake [49°20'N, 88°52'W]: 1 ♀, 31 May (CNC). Ottawa: 1 ♀, 4 May (CNC). QUEBEC: Lac Mondor [46°37'N, 72°46'W], Ste. Flore: 1 ♂, 4 May (CNC); 1 ♀, 15 May (USNM). UNITED STATES. NEW YORK: Westchester Co: Pelham: 1 ♀, 21–30 Apr (AMNH).

DISCUSSION.—The vaginal sclerite of this species appears to be quite variable, both in the Old and New World populations. The rather broad, spatulate anterior process is the most variable feature of the sclerite, both in relative length and in the degree of ventral curvature. Figures 306 and 309 provide some idea as to the range of this variation in North American specimens.

The aedeagus of the male provides the most diagnostic character in recognizing this species and in separating it from the following new subspecies known only from the northwestern United States. The ventral phallic branch of *E. semipurpurella semipurpurella* possesses a row of approximately four to six short, rather appressed subapical spines that are lacking in *E. semipurpurella pacifica*.

Although fenestrae are typically absent from the fourth sternite in all eriocraniid males, a few males of *E. semipurpurella semipurpurella* exhibit paired, faintly depigmented areas on this sternite. These areas are even more evident in the males of *E. semipurpurella pacifica*.

Lectotypes have not been designated for this species in the present study because tentative selections, to be published eventually, have already been made by others.

***Eriocrania semipurpurella pacifica*, new subspecies**

FIGURES 109–120, 169, 190–191, 218, 226–227, 259–260, 299–301, 337; MAP 3

Eriocrania semipurpurella.—Clarke, 1942:276 [misidentification; not Stephens, 1835].

Eriocrania species.—Heath, 1976:165.

ADULT (Figure 169).—*Wing Expanse*: ♂, 10–11 mm; ♀, 10–11 mm.

Head: Sparsely covered with brownish fuscous to grayish hairs. Antennae moderately long, 0.55–0.6 the length of forewing, 35–37 segmented; scape and flagellum uniformly clothed with brownish fuscous scales. Maxillary palpi predominantly brownish fuscous with basal segments whitish beneath; apex of terminal (5th) segment relatively simple, not lobed, with an apical cluster of 6–7 minute, subacute setae of equal lengths, length of setae approximately 0.3 the diameter of apex. Base of galeae largely naked, pubescent, but with a small tuft of whitish scales over extreme base arising from labrum. Labial palpi predominantly brownish fuscous, with inner sides strongly suffused with white.

Thorax: Dorsum and tegulae brownish fuscous. Venter sparsely clothed with brownish fuscous to grayish hairs. Legs mostly pale fuscous to grayish above, paler, more whitish beneath. Forewings brownish fuscous with a slight golden brassy iridescence; a small, whitish tornal spot present along margin near vein CuA₂; fringe brownish fuscous

except for white at tornal spot. Hind wings paler, more thinly scaled; grayish in color; scales slender, hairlike.

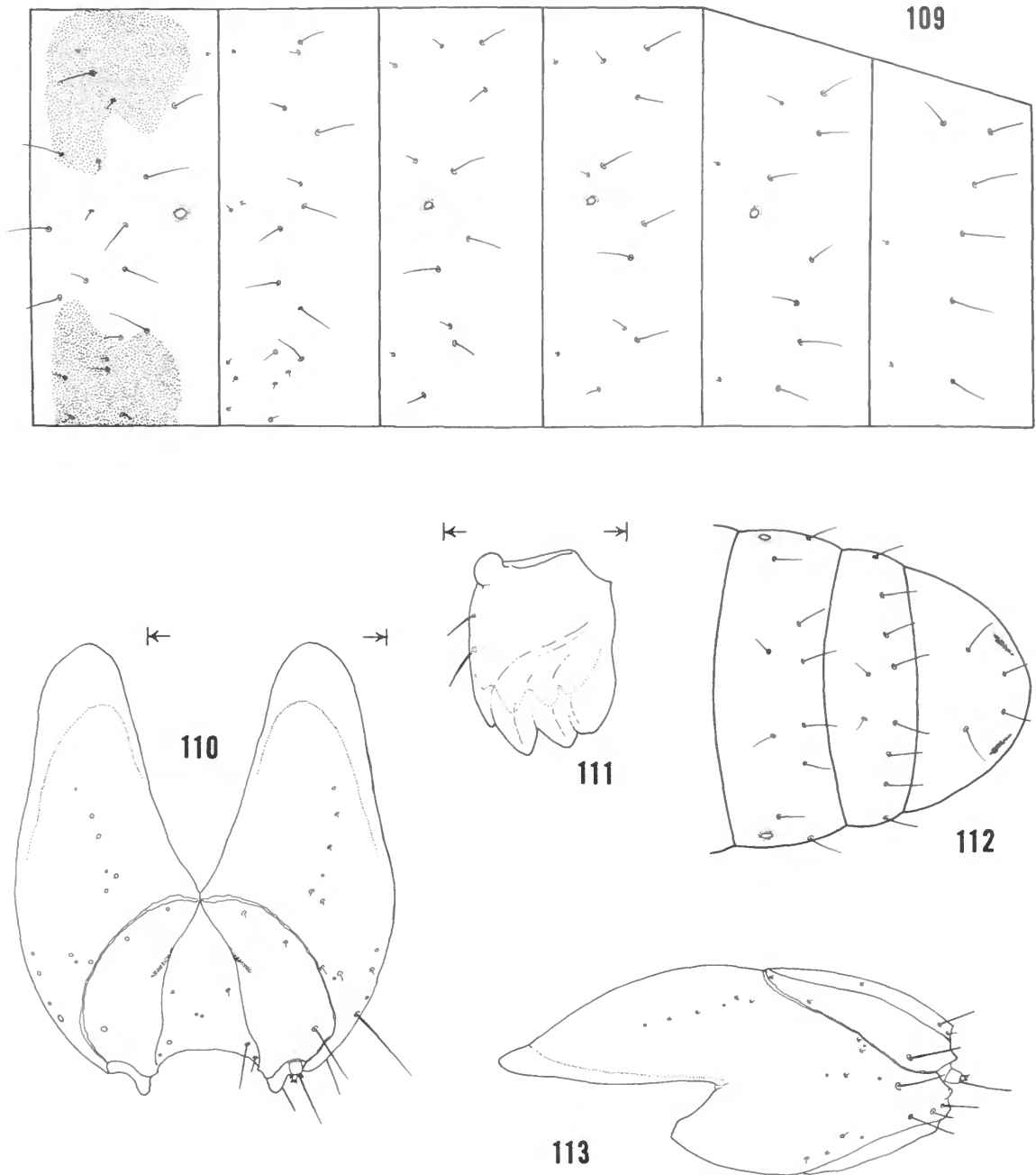
Abdomen (Figures 226–227): Sparsely covered with long brownish scales above, more grayish beneath. Fourth sternite of female with a pair of well-defined, transverse-elliptical fenestrae approximately 0.35–0.40 the length of segment in greatest diameter, greatest (transverse) diameter about 1.8 the smallest diameter; 4th sternite of male with fenestrae poorly defined, consisting of a pair of irregular, unpigmented areas. Sternal tubercles present on 5th sternite of both sexes, tubular in form, diameter approximately 0.20–0.22 the length of segment. Caudal apex of 8th tergite of female well defined, deeply forked; apex of 8th sternite only slightly divided, but with furcations widely separated.

Male Genitalia (Figures 259–260): Uncus deeply bilobed; lobes prominent, widely separated at apex for a distance equivalent to their length. Anal tube membranous, with a bilateral pair of minute, basal sclerites present. Vinculum with median area of caudal margin slightly convex, smoothly curved posteriorly; anterior apophyses elongate, approximately 0.72–0.75 the length of undivided vinculum. Juxta broadest anteriorly, gradually tapering posteriorly to a relatively broad, subacute apex; greatest width approximately 0.6 its length. Base of aedeagus moderately swollen; ventral phallic branch very slender, about 0.5 the diameter of dorsal branch, apex smooth without minute spines; length of ventral branch slightly shorter than dorsal branch.

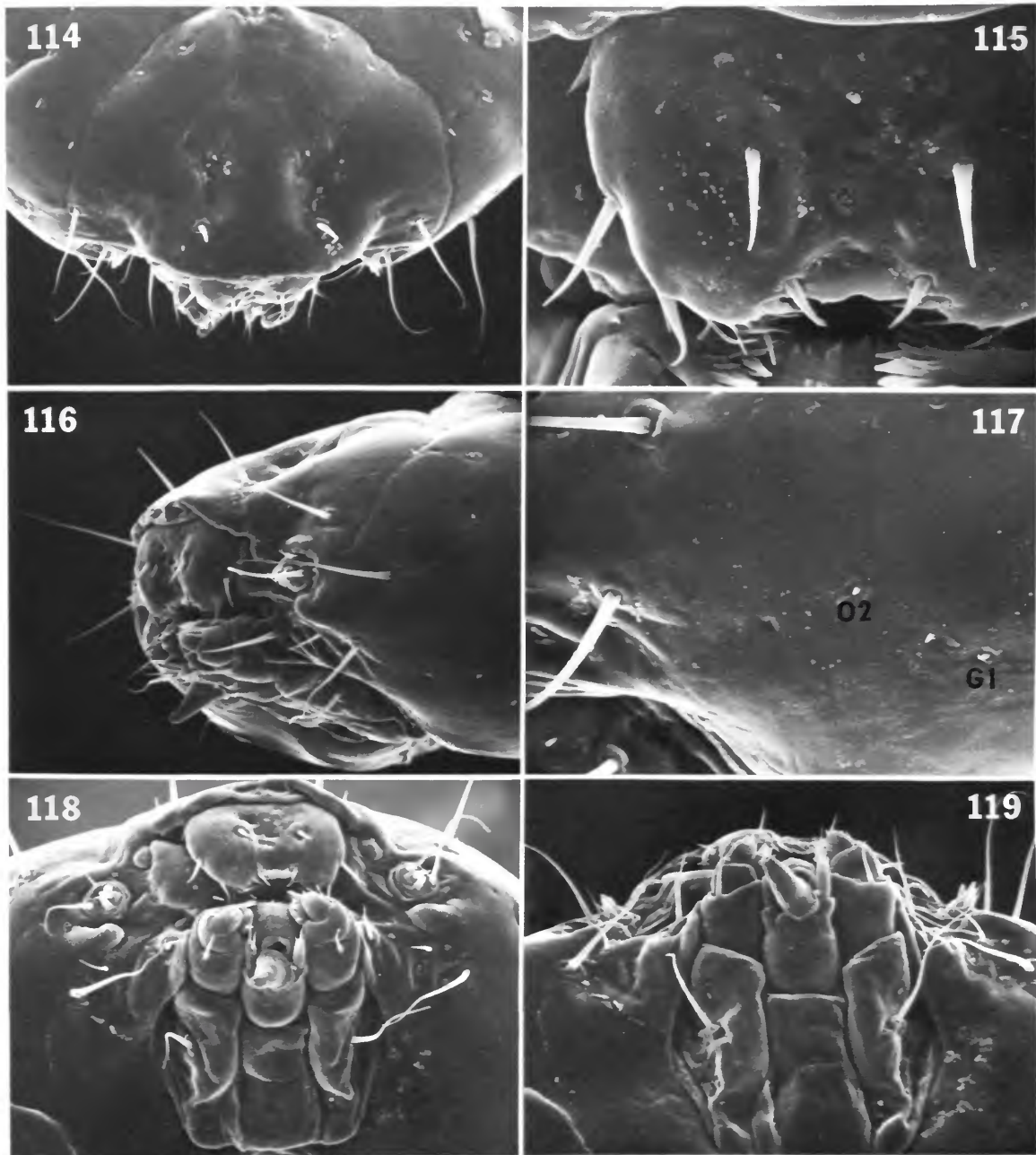
Female Genitalia (Figures 299–301, 337): Apex of ovipositor acuminate, lateral edges serrulate, with 12–14 minute teeth. Bursa copulatrix relatively short, terminating far short of cephalic apices of posterior apophyses when extended; walls of corpus bursae completely membranous, without spines. Vaginal sclerite darkly sclerotized, relatively broad, but with slender caudal extension, greatest width approximately 0.4 its length; cephalic two-thirds of sclerite a flattened, oval plate with a low, median ventral keel as shown in Figure 301.

LARVA (Figures 109–119).—Length of largest larva 7 mm; diameter 1 mm.

Head: Uniformly pale brown except for dark outline of adfrontal sutures and mandibles. Greatest width 0.4 mm; length 0.55 mm. Va located usually posterior to VI, sometimes laterad; P1 minute,



FIGURES 109-113.—*Eriocrania ?semipurpurella pacifica*, new subspecies, larval chaetotaxy: 109, lateral view of prothorax, mesothorax, and abdominal segments 1, 6, 8, and 9; 110, dorsal view of head (scale = 0.3 mm); 111, left mandible (scale = 0.1 mm); 112, dorsal view of abdominal segments 8-10; 113, lateral view of head.



FIGURES 114-119.—*Eriocrania ?semipurpurella pacifica*, new subspecies, larval head structure: 114, dorsal view of anterior margin of head, $\times 245$; 115, chaetotaxy of labrum, $\times 925$; 116, lateral view of head, $\times 285$; 117, gular setae, $\times 540$; 118, anteroventral view of mouthparts, $\times 300$; 119, ventral view of labrum, $\times 350$. (Photographs reduced to 84%.)

arising closely adjacent to ecdysial line; A1 present; chaetotaxy of labrum very similar to that of *Dyseriocrania*, with all setae simple, not compressed; anterior margin of pilifers and epipharynx densely spinose; M2 and M3 closely approximate, nearly contiguous, arising near median cleft remote from L3. Mandibles without inner medial setal tuft.

Thorax: Pronotal plate consisting of 2 pairs of usually confluent, irregular, light brownish areas. Prosternum with a single, large brownish plate; meso- and metathorax without pigmentation. L2 subequal to L1 on meso- and metathorax. Subventral setae usually trisetose on prothorax.

Abdomen: Integument without pigmentation, appearing whitish (in alcohol) except for a pair of minute, longitudinal dark brownish spots near lateroposterior margin of anal segment; barlike spots without enlarged cephalic end. L1 present on all segments, situated relatively high above SD1 and spiracles on I to VIII. Segment IX with 7 pair of primary setae; SD2, L3, and SV2 absent.

HOLOTYPE.—♂, Seward, Alaska, 23 May 1951, W. J. Brown; in the Canadian National collection.

PARATYPES.—UNITED STATES. ALASKA: Third Judicial Division: Seward: 1♂, 23 May 1951, W. J. Brown, slides USNM 18232, 18233 (USNM). WASHINGTON: Whatcom Co: 1♂, 3♀, 3–8 Apr 1923, J. F. Clarke, slides USNM 18070, 18256, 18257, 18258 (USNM). Described from a total of 3 males and 3 females.

Other Material Examined: CANADA: British Columbia: Vancouver Island: 6 larvae, coll. B. H. Tothill, USNM slides 18237, 18260–18262, 18273 (USNM).

HOST.—Questionable; possibly Rosaceae: "*Holodiscus discolor* Maxim," from specimen label.

FLIGHT PERIOD.—Early April to late May; univoltine.

DISTRIBUTION (Map 3).—Adults of this subspecies are presently known from only two localities in southern Alaska and northwestern Washington. Larvae, suspected to represent this insect, have also been collected on Vancouver Island. All localities represent low coastal habitats bordering the northern Pacific Coast Mountain System.

DISCUSSION.—This subspecies, except for minor morphological differences, is very similar to the typical subspecies, *Eriocrania semipurpurella semipurpurella*. It may be distinguished from the latter by the entirely smooth apex of its ventral phallic branch as compared to the typically spinose condition in *E. s. semipurpurella* (Figures 259, 262).

Their vaginal sclerites differ slightly, although individual variation obscures these differences somewhat. For example, the slender, caudal third of the sclerite appears more strongly ridged dorsally in *E. s. pacifica* than in the nominate subspecies. The larval and host associations summarized below, if proven correct, also indicate at least subspecific recognition for *E. s. pacifica*. The name *pacifica* is intended to refer to the general distribution of this subspecies, which presently is restricted to the northwestern borders of the Pacific Mountain System.

Six, probably immature, larvae collected from Vancouver Island, British Columbia, have been tentatively identified as this subspecies. No adults have been reared or otherwise definitely associated with these larvae; consequently, the present determination will have to remain questionable until rearings can be conducted. The specimens are of interest because they reportedly were mining the leaves of *Holodiscus discolor* Maxim (= *Spiraea discolor*). If the host identification is accurate, then these larvae represent not only the first record of an eriocraniid feeding on a member of the Rosaceae, but also a host association that is rather remote from the more typical Betulaceae-Fagaceae associations typical of the other members of Eriocraniidae. *Holodiscus discolor* is a woody shrub attaining a maximum height of approximately 5 to 6 meters. It occurs naturally in western North America from British Columbia south to California. The shrub is also utilized somewhat as an ornamental and, thus, may occur more widely under cultivation.

In chaetotaxy the larvae resemble *Dyseriocrania auricyanea* closely except they lack the prominent mandibular setal tuft of that and a few other species. From *Eriocraniella aurosarsella* they differ in typically possessing three subventral setae on the prothorax and seta L1 on the abdominal segments I to VIII. The prothoracic seta SV3 may occasionally be lacking (as in specimen slide USNM 18273) because of individual variation.

A closely related, but possibly distinct species, may also occur within the general range of *E. s. pacifica*. A single male specimen with identical male genitalia (including smooth, ventral phallic branch) was collected by Walsingham at Camp Watson in Grant County, Oregon, during April 1872. This specimen is now deposited in the British Museum (Natural History). I am indebted to N. P. Kristen-

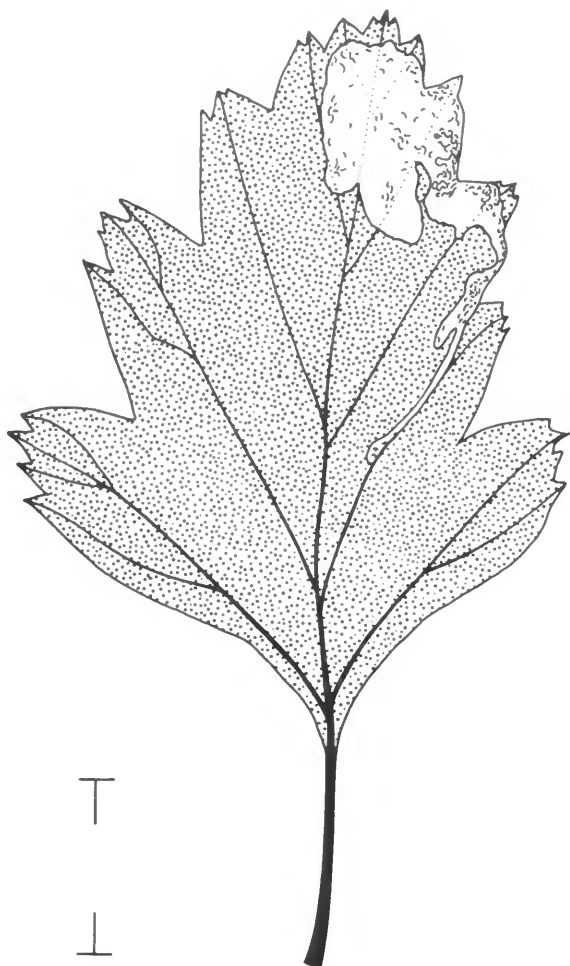


FIGURE 120.—Leaf mine of *Eriocrania ?semipurpurella pacifica*, new subspecies, on *Holodiscus discolor* Maxim. (Scale = 10 mm.)

sen for calling my attention to this specimen as well as to the fact that the wings of the Oregon specimen, particularly the hind wings, are unusually narrow. For example, the width of the hind wings of the Oregon specimen is only 0.25 their length, a ratio considerably less than any other eriocraniid examined during the course of this study. By comparison, this same ratio measures 3.0 or more in the specimens of *E. s. pacifica*. Because the Oregon specimen is unique, it can not be decided now whether the specimen is atypical with regard to relative wing width. Any further consideration of

the taxonomic status of this specimen will have to await the discovery of additional material.

Eriocrania breviapex, new species

FIGURES 27–28, 170, 188–189, 228, 245, 302–304, 335; MAP 3

ADULT (Figure 170).—*Wing Expanse*: ♀, 7.5–9 mm.

Head: Sparsely covered with whitish hairs intermixed with light fuscous. Antennae relatively long, 0.6–0.7 the length of forewing, approximately 35-segmented; scape whitish; flagellum mostly brownish fuscous and irrorated with white above, entirely white beneath. Maxillary palpi light brownish fuscous; apex of terminal segment rather blunt, crowned with a series of about 8 short spines of equal lengths. Base of galeae clothed with whitish scales. Labial palpi whitish, with a few scattered fuscous hairs ventrally.

Thorax: Dorsum mostly light brownish fuscous with a slight bronzy luster; tegulae with a tuft of long white and brownish fuscous hairs equally intermixed. Venter white. Legs typically light brownish fuscous dorsally, white ventrally. Forewings light fuscous with a slight bronze to purplish iridescence, irregularly marked with small pale golden to brassy spots; a distinct and relatively large subternal spot present, extending halfway across wing to middle of discal cell; fringe uniformly pale brownish fuscous except for whitish suffusion of subternal spot. Hind wings distinctly paler than forewings, sparsely scaled with long, slender, hair-like brownish-fuscous scales.

Abdomen (Figure 228): Sparsely covered with long grayish brown hairs above, whitish ventrally. Fourth sternite with a pair of moderately large oval fenestrae 0.52–0.54 the length of sternite in greatest diameter. Sternal tubercules present on 5th sternite, papiliform, diameter about 0.23–0.26 the length of sternite. Caudal apex of 8th tergite distinct and deeply divided, branches divergent; caudal apex of 8th sternite likewise distinct and divided approximately 0.5 the distance of tergal cleft.

Female Genitalia (Figures 302–304, 335): Apex of ovipositor relatively broad, abruptly narrowing to a short, acute tip; lateral margins serrulate, usually with 11–12 minute teeth. Bursa copulatrix relatively long, surpassing cephalic ends of posterior

apophyses when fully extended by nearly half its length; walls of corpus bursae entirely membranous. Vaginal sclerite darkly sclerotized, broad, greatest width approximately 0.5 its length; cephalic end broad, relatively flat, not extended ventrally; a low, median keel present as shown in Figure 304.

HOLOTYPE.—♀, Six Mile Creek, Ithaca, Tompkins County, New York, 12 May, 1961, R. W. Hodges, photograph on file USNM, USNM Type 72102; in the National Museum of Natural History, Smithsonian Institution.

PARATYPES.—UNITED STATES. New York: Tompkins Co: Six Mile Cr, Ithaca: 1♀, 10 May 1959, R. W. Hodges, ♀ genitalia slide USNM 17206, head slide USNM 18208 (USNM); 1♀, 7 May 1961, R. W. Hodges, ♀ genitalia slide USNM 17199 (USNM); 1♀, 13 May 1961, R. W. Hodges, wing slide USNM 16156, ♀ genitalia slide USNM 17499 (USNM). Described from a total of 4 females.

HOST.—Unknown.

FLIGHT PERIOD.—Early to mid-May; univoltine.

DISTRIBUTION (Map 3).—This species is presently known only from the type-locality, which is located in the Cayuga Lake Basin of northwestern New York.

DISCUSSION.—Although no males have been examined thus far, *Eriocrania breviapex* is easily distinguished from all other Eriocraniidae by the rather abbreviated apex of its ovipositor. This diagnostic feature has suggested its name, which is derived from the Latin *brevis* (short) and *apex* (top).

This species demonstrates greatest affinities to *E. semipurpurella pacifica*, new subspecies, from the northwestern United States, particularly with regard to the similar form of their vaginal sclerites. That species, however, as well as the northeastern *E. semipurpurella semipurpurella*, can be readily separated from *E. breviapex* on the basis of the above-mentioned ovipositor character.

Eriocraniella Viette

Eriocraniella Viette, 1949:30.—Opler, 1973:1321.—Birket-Smith and Kristensen, 1974:159.

TYPE-SPECIES.—*Micropteryx aurosparsella* Walsingham, 1880; original designation and by monotypy.

ADULT.—Small moths with relatively broad wings; wing expanse: 6–10 mm.

Head: Maxillary palpi with terminal segment densely setose nearly to apex; primary setae barbed laterally; apex of terminal segment complex, consisting of a single relatively large, apical lobe bearing 4 stout setae and 2 pair of smaller, subapical lobes, each bearing a single large seta; the most subapical pair of lobes the most reduced in size; all setae arising from the above lobes longitudinally striated.

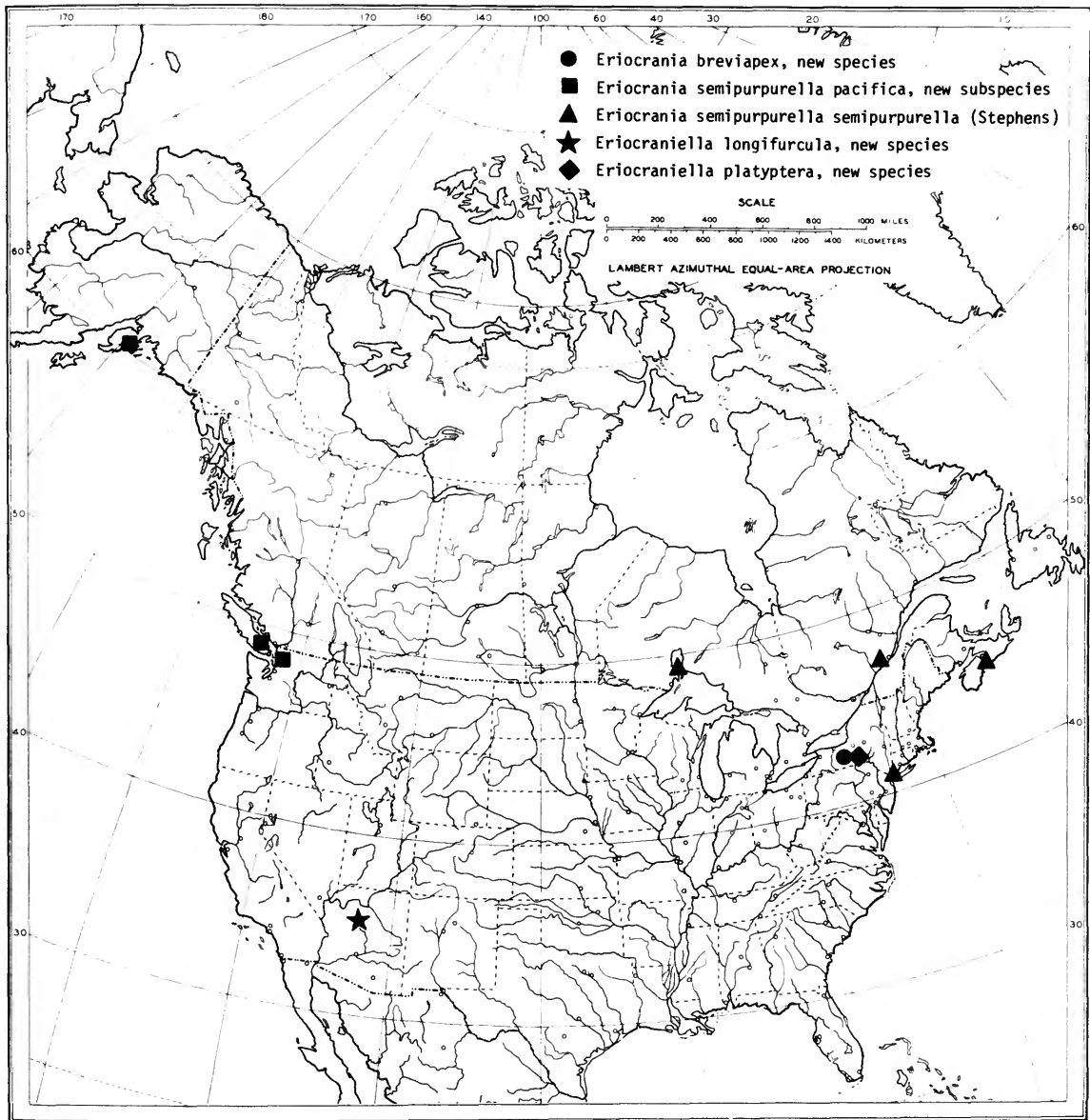
Thorax: Epiphysis present. Forewings with Sc usually simple, rarely divided; R1 divided approximately 0.4 its length; R2, 3, 4, and 5 all arising separate from cell. Hind wings with Sc and R1 simple; R2 and 3 entirely fused; R4 and 5 separate; scales relatively short and broad, not hairlike.

Abdomen: Fourth sternite of females with a pair of well-defined, relatively small, oval to circular fenestrae; fenestrae absent in male. Sternal tubercles present on 5th sternite of both sexes, similar in form, papiliform, relatively small.

Male Genitalia: Uncus well developed, deeply divided to form 2 elongate lobes with rounded or tapered apices; lobes usually distinctly curved from middle outward. Anal tube entirely membranous, without basal sclerites. Socii present. Caudal margin of vinculum variously modified, either produced into a slightly raised, median lobe (subgenus *Disfurcula*) or with a prominent, median furcate process, or furcula, arising submarginally (subgenus *Eriocraniella*); cephalic margin of vinculum smoothly concave, without a median process. Caudal apex of juxta broad, subtruncate to slightly concave; caudal end with a series of minute, transverse ridges. Aedeagus with ventral phallic branch stout, usually equaling dorsal branch in diameter; apex of ventral branch with a nearly transparent, spinose flabellate process in subgenus *Eriocraniella*; apex more simple and acute in subgenus *Disfurcula* but with a single, subapical conical or spinose process.

Female Genitalia: Vaginal sclerite with cephalic end typically broad, usually slightly flared, and with a distinct midventral keel. Ninth segment with a midventral, invaginated pocket laterally bordered with numerous minute spines in subgenus *Eriocraniella*; spinose pocket absent in subgenus *Disfurcula*.

DISCUSSION.—As presently defined, the genus *Eriocraniella* consists of at least eight species, including one not named in this paper, all of which



MAP 3.—Distribution of Nearctic *Eriocrania* and *Eriocraniella* (subgenus *Eriocraniella*) not recorded in California.

are endemic to the Nearctic region. As originally described by Viette (1949), the members of this genus are characterized by their venation, particularly by the undivided subcosta (though often divided in *E. falcata*) and divided first radius, with all radial veins present in the forewings and arising

separate. In addition the extreme apex of the maxillary palpi is very similar among all the species examined in possessing three distinct sets of minute lobes, each bearing a specific number of mostly elongate, striated setae. Similar to the following genus, *Neocrania*, *Eriocraniella* is also

partially characterized by the presence of an epiphysis.

The genus appears to have speciated well in North America, and further field work undoubtedly will result in the discovery of additional species in our fauna. One such species is illustrated (Figure 267) in this paper but not named because of a lack of adequate material. It appears most closely allied to *E. xanthocara*, new species, and is mentioned further under the discussion of that species.

On the basis of genital characters, the genus may be further divided into two distinct groups or subgenera. The presence of a furcula in the male appears to be correlated with the development of a midventral, spinose pocket near the posterior end of the ninth segment in the female. Although their respective functions are not known, it is possible

that these two morphological features may only be secondary sexual characteristics and that their function may be interrelated. Future observations may show, for example, that the male furcula somehow engages the spinose pocket of the female during copulation.

In addition to the above, possibly interrelated, secondary sexual characteristics, the two subgenera also differ with respect to other autapomorphic features. In the subgenus *Eriocraniella*, the apex of the ventral phallic branch typically bears a somewhat transparent, flabellate process with a marginal fringe of small to large spines. The males of the subgenus *Disfurcula* do not possess this structure; instead, the members of this group demonstrate a more simplified phallic apex, which has, however, developed a relatively prominent, subapical lobe or spinelike process.

Key to the Subgenera of *Eriocraniella*

- Male genitalia with a prominent, median furcate process, or furcula, arising immediately anterior to caudal margin of vinculum (Figure 263). Ninth segment of female with a midventral pocket lined laterally with numerous, minute spines (Figure 310)*Eriocraniella*
 Vinculum of male without midventral furcula. Ninth segment of female without midventral, spinose pocket*Disfurcula*, new subgenus

Subgenus *Eriocraniella* Viette

TYPE-SPECIES.—*Micropteryx aurosparsella* Walsingham, 1880.

ADULT.—*Wing Expanse*: 7–10 mm.

Head, Thorax, and Abdomen: As described for genus.

Male Genitalia: Vinculum with a prominent, median furcate process, or furcula, arising from caudal submarginal area. Apex of ventral phallic

branch relatively complex and enlarged, with a nearly transparent flabellate process projecting from extreme tip; a series of 6–12 variably developed spines arranged around outer margin of process.

Female Genitalia: Caudal end of 9th segment with a shallow midventral pocket lined laterally with several rows of minute spines; spines sometimes more prominent on one side than on other.

Key to the Species of the Subgenus *Eriocraniella*

1. Male with furcula divided 0.5 its length (Figure 263). Female with ventral, spinose pocket of 9th segment asymmetrical, heavily thickened and spinose on left side (Figure 310)2
 Male with furcula divided at least 0.7 its length or more (Figure 269). Female with ventral pocket symmetrical, forming a thickened spinose ring on both sides3
2. Head vestiture grayish white irrorated with fuscous. Forewings brownish fuscous, with a slight bronze to light purplish iridescence
Eriocraniella (Eriocraniella) aurosparsella (Walsingham)
 Head vestiture pale yellowish orange. Forewings a darker fuscous, with a distinct greenish iridescence*Eriocraniella (Eriocraniella) xanthocara*, new species
3. Head vestiture grayish white. Forewings relatively long (length 4.0–4.5 mm) and slender (width approximately 0.30 the length). Distribution: southwestern United States
Eriocraniella (Eriocraniella) longifurcula, new species

Head vestiture pale yellowish orange. Forewings relatively short (length 3.0–3.5 mm) and broad (width approximately 0.34 the length). Distribution: northeastern United States.....
*Eriocraniella (Eriocraniella) platyptera*, new species

Eriocraniella (Eriocraniella) aurosparsella
 (Walsingham)

FIGURES 31–32, 121–134, 174, 197–198, 229–230, 246, 263–264,
 310–312, 339; MAP 4

Micropteryx aurosparsella Walsingham, 1880:83.—Riley, 1891:
 111, no. 6017.

Erioccephala aurosparsella (Walsingham).—Dyar, 1902 [1903]:
 581, no. 6620.—Kearfott, 1903:125, no. 7167.

Mnemonic aurosparsella (Walsingham).—Meyrick, 1912a:19;
 1912b:5.—Barnes and McDunnough, 1917:197, no. 8478.—
 McDunnough, 1939:110, no. 9853.

Eriocraniella aurosparsella (Walsingham).—Viette, 1949:31.—
 Davis, 1975:10, 33.

Eriocraniella species, Opler, 1974:4.

ADULT (Figure 174).—*Wing Expanse*: ♂, 8.0–9.0
 mm; ♀, 7.5–8.5 mm.

Head: Relatively sparsely covered with whitish to grayish hairs intermixed with fuscous hairs. Antennae relatively short, approximately 0.35–0.38 the length of forewing, 31- to 35-segmented; scape dark fuscous above, white beneath; flagellum almost entirely covered with narrow, dark fuscous scales above and laterally except for apical 3–4 segments that are thinly scaled with white; venter of flagellum mostly devoid of scales, instead densely covered with brownish pubescence. Maxillary palpi usually entirely fuscous; distal 2 segments sometimes slightly irrorated with grayish white; apex of terminal (5th) segment divided into 3 series of minute lobes as follows: (a) a single, relatively elongate, apical lobe bearing one long (length ca. 1.7 the diameter of lobe), blunt seta and 3 short (length less than diameter of lobe), subapical subacute setae, (b) an identical pair of moderately long, subapical lobes, each bearing one long, subacute apical seta, and (c) identical subapical pair of very short lobes, each bearing one long, apical subacute seta. Base of galeae covered with whitish scales irrorated with fuscous. Labial palpi fuscous above and on outer sides, silvery white along inner sides.

Thorax: Dorsum smoothly covered with broad, dark fuscous scales, slightly bronzy in iridescence; tegulae with long tufts of predominantly fuscous hairs irrorated with white. Venter grayish white. Legs usually fuscous above, whitish ventrally. Fore-

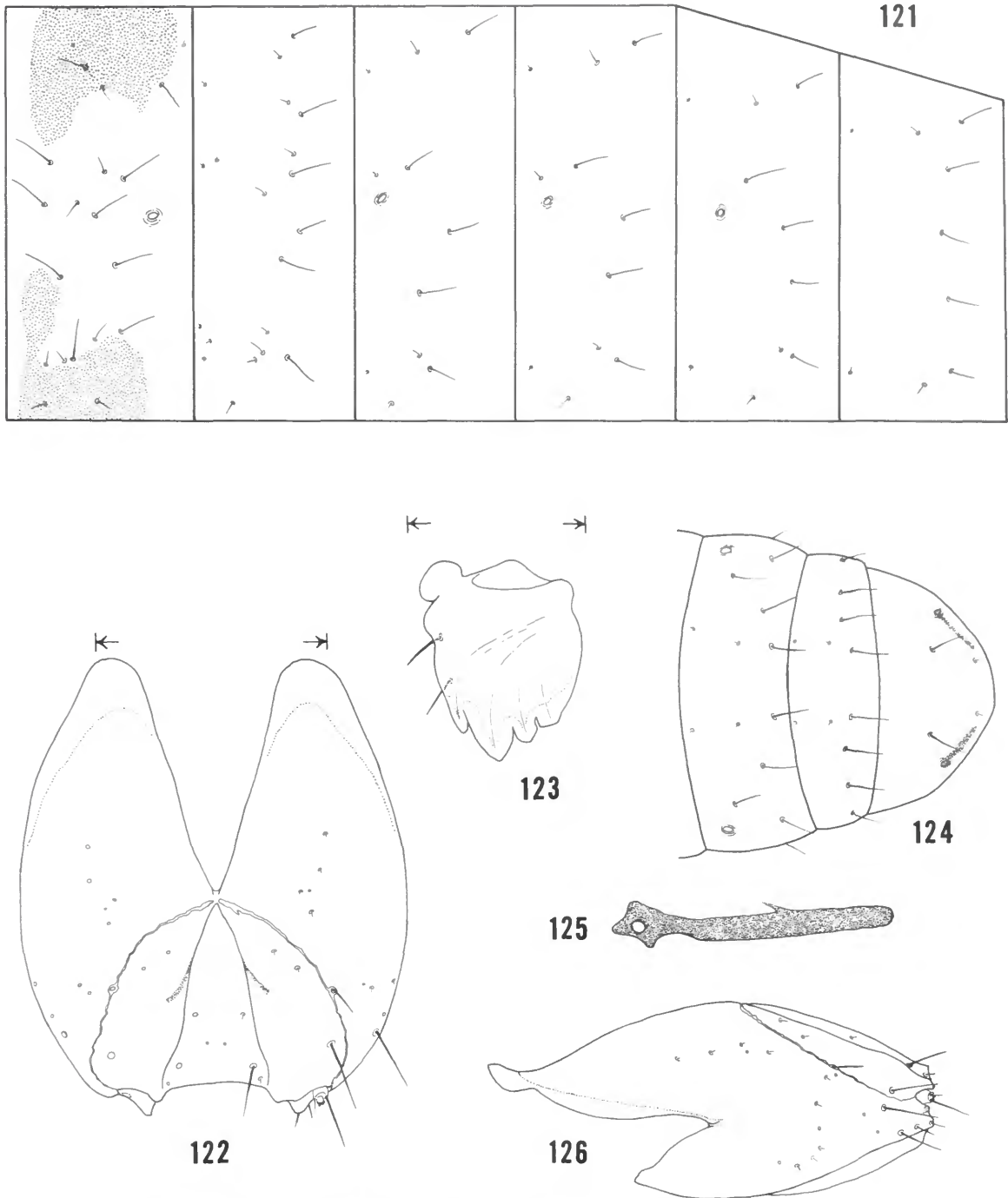
wings immaculate, brownish fuscous, usually with a distinct bronzy to light purplish iridescence; fringe uniformly brownish fuscous. Hind wings similar to forewings in color though less lustrous, uniformly covered with relatively broad scales.

Abdomen (Figures 229–230): Thinly clothed with brownish fuscous hairlike scales above, grayish white ventrally. Fourth sternite of female with oval and relatively small fenestrae; diameter of fenestrae approximately 0.22–0.25 the length of sternite; fenestrae absent in male. Sternal tubercles present on 5th sternite of both sexes, papiliform; diameter approximately 0.2 the length of sternite. Caudal apices of 8th tergite and sternite in female normally entire, not divided, acute and well defined.

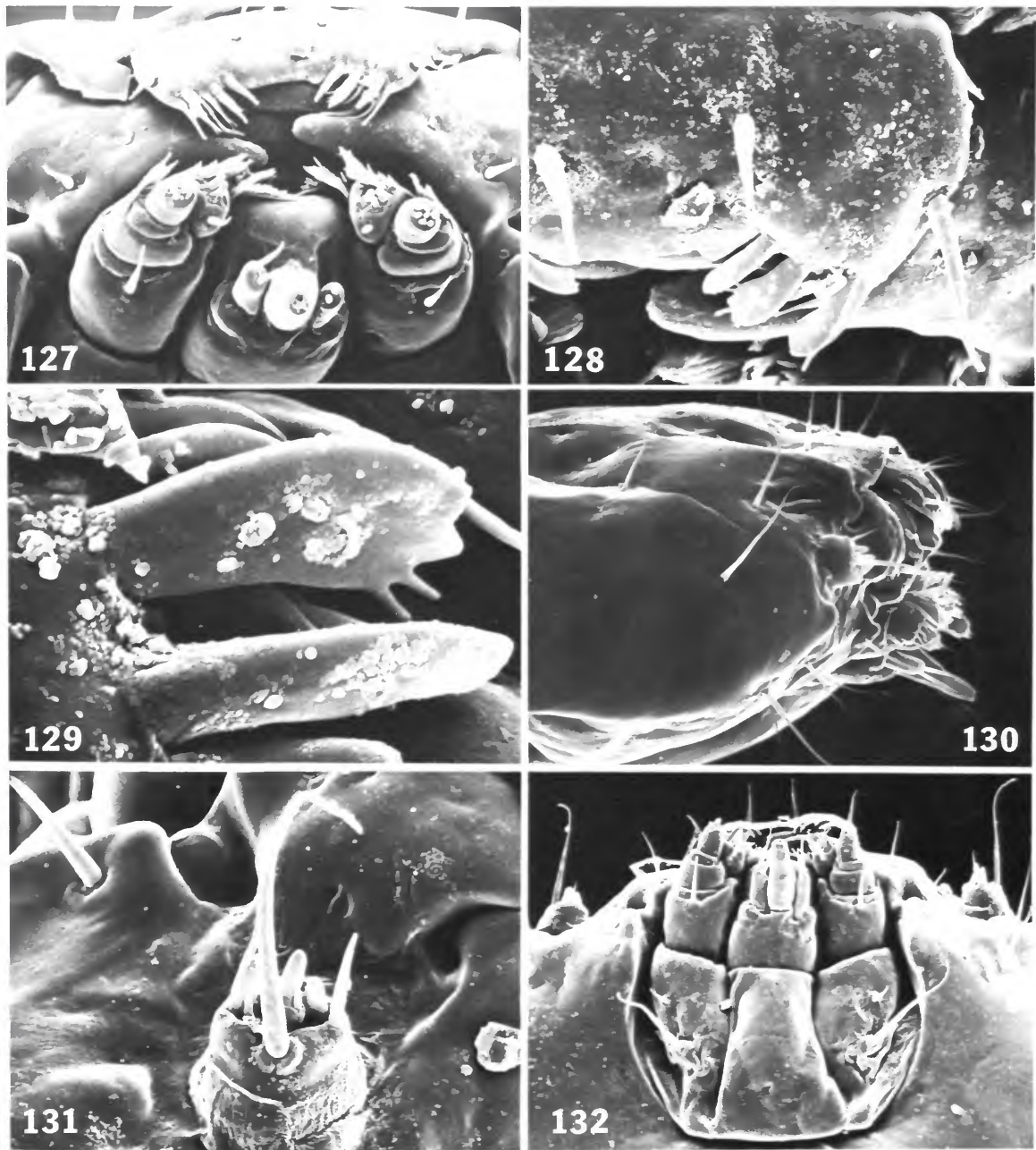
Male Genitalia (Figures 263–264): Uncus deeply bilobed; lobes prominent, curved laterally; apices broadly rounded, widely separated for a distance approximately equal to their length. Anal tube membranous; basal sclerites absent. Caudal margin of vinculum with a prominent, deeply divided process, or furcula, arising medially; length of furcula approximately equaling length of lobes of uncus; lobes of furcula slender, acute, about 0.5 the length of entire furcula. Anterior apophyses moderately long, 0.55–0.6 the length of undivided vinculum. Juxta broadest anteriorly, narrowing slightly posteriorly to a rather broad, concave apex; greatest width approximately 0.75 its length. Base of aedeagus bulbous; ventral phallic branch slightly sinuate, stout, equaling the dorsal branch in diameter; apex of ventral branch with a cluster of 9–10 large exophalic spines; ventral branch loosely articulated to bulbous base of dorsal branch.

Female Genitalia (Figures 310–312, 339): Apex of ovipositor acuminate; lateral edges serrulate, with 6–8 minute teeth. Bursa copulatrix of moderate length, not surpassing cephalic apices of anterior apophyses when extended; wall of corpus bursae completely membranous. Vaginal sclerite darkly sclerotized, moderately long, greatest width 0.60–0.65 its length; cephalic apex of sclerite broad, with a relatively well-developed, rounded ventral keel as in Figure 311.

Caudal apex of 9th segment with a prominent,



FIGURES 121-126.—*Eriocraniella aurosparsella* (Walsingham), larval chaetotaxy: 121, lateral view of prothorax, mesothorax, and abdominal segments 1, 6, 8, and 9; 122, dorsal view of head (scale = 0.3 mm); 123, left mandible (scale = 0.1 mm); 124, dorsal view of abdominal segments 8-10; 125, detail of barlike spot or "brace-rod" of tenth segment; 126, lateral view of head.



FIGURES 127-132.—*Eriocraniella aurosparsella* (Walsingham), larval head structure; 127, anterior view of mouthparts, $\times 575$; 128, chaetotaxy of labrum, $\times 1250$; 129, detail of labral seta M3 with dentate margin, $\times 4950$; 130, lateral view of head, $\times 350$; 131, antenna, $\times 1100$; 132, ventral view of mouthparts, $\times 325$. (Photographs reduced to 83%.)

spinose pocket; lateral margin of left side of pocket greatly thickened and more spinose, with approximately 15–17 minute teeth; right side poorly developed.

LARVA (Figures 121–132).—Length of largest larva 7.0 mm; diameter 1.0 mm.

Head: Uniformly dark brown with frontal sutures darkly outlined. Greatest width 0.5 mm, length 0.6 mm. Va variable, situated either anterior, laterad, or posterior to V1. P1 moderately elongate, several times larger than A2, usually arising from or contiguous to ecdysial line. A2 usually laterad to P1. A1 present. Labrum usually with apices of M2, M3, and L3 broadly compressed (Figure 129), subtruncate, with a subapical row of 3–4 minute but relatively prominent teeth along ventral margin. M3 arising approximately equidistant between M2 and L3; anterior margin of pilifers and epipharynx spinose. Mandibles with inner margins smooth; mesal setal tufts absent.

Thorax: Pronotal and prosternal plates well developed, dark brown. Meso- and metathorax without sclerotized plates. L2 reduced in size on meso- and metathorax, approximately 0.3 the length of L1. Subventral setae bisetose on prothorax.

Abdomen: Integument without pigmentation, whitish except for a minute pair of longitudinal, brownish spots near lateroposterior margin of anal segment; barlike spot with cephalic end slightly enlarged and punctate; anal segment largely unpigmented. L1 absent on I to VIII. SD2 present on I to VIII. Segment IX with 7 pair of primary setae; SD2, L3, and SV3 absent.

TYPE.—Holotype, sex unknown; in the British Museum (Natural History).

TYPE-LOCALITY.—Southern Oregon.

HOST.—Fagaceae: "*Quercus kelloggii* Newb.," Opler, 1974.

FLIGHT PERIOD.—Late February to late May; univoltine.

DISTRIBUTION (Map 4).—This species is known to range from southern Oregon south through the coastal ranges of California to Santa Clara County and Santa Cruz Island.

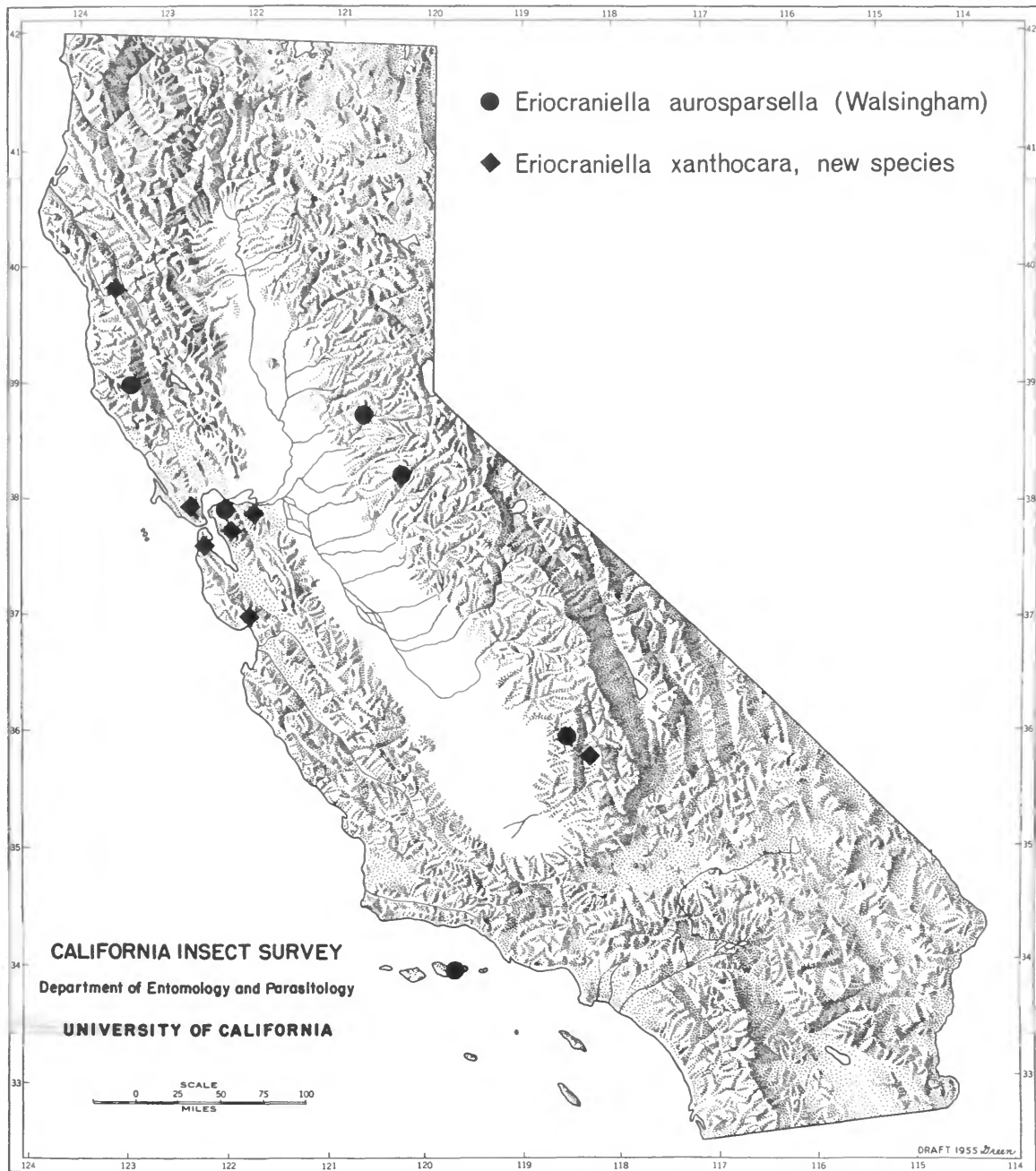
MATERIAL EXAMINED.—80 males, 15 females, and 15 larvae. UNITED STATES. CALIFORNIA: Alameda Co: Berkeley: 1 ♀, 22 May (USNM). Contra Costa Co: Orinda. 3 ♂, 5 ♀, 26 Feb–6 Mar, *Quercus kelloggii* (UCB); 1 ♂, 6 Mar, *Quercus kelloggii* (USNM). El Dorado Co: Blodgett Forest, 12 mi [19.2 km] E Georgetown: 10 ♂, 6 ♀, 20 May (UCB). Sly Park Dam:

8 larvae, 19 May (UCB); 6 larvae, 19 May (USNM). Mendocino Co: Hopland Field Sta Hdq., 900–1600 ft [274–488 m]: 2 ♀, 27 Apr (UCB). Hopland Field Sta, Kelsey Cab Orch area, 2600–2800 ft [793–854 m]: 2 larvae, 29 Apr (UCB); 1 larva, 29 Apr (USNM). Santa Barbara Co: Prisoner's Harbor, Sta Cruz Island: 1 ♀, 16 Mar (UCB); 1 ♀, 16 Mar (USNM). Tulare Co: Fairview: 1 ♀, 27 Apr (UCB). Tuolumne Co: South Fork Stanislaus R, 4 airline mi [6.4 km] NE Columbia: 35 ♂, 3 Apr (UCB); 4 ♂, 28 Mar–3 Apr (USNM); 25 ♂, 28 Mar–3 Apr (CAS). Tuolumne City, 3 mi [4.8 km] NE: 1 ♂, 23 Mar (UCB); 1 ♂, 23 Mar (USNM).

DISCUSSION.—Walsingham described *Eriocraniella aurosarsella* from a unique specimen collected at an unspecified locality in southern Oregon during May 1872. Essig's (1941) account of Walsingham's itinerary through Oregon during that period does not provide sufficient information to pinpoint the type-locality of this species more accurately. The sex of this specimen was not stated by Walsingham and cannot be determined now due to the loss of the abdomen. Fortunately, the identity of *E. aurosarsella* can be established from the wing venation of the holotype as well as by noting Walsingham's own description. For example, he described the head as being "greyish," which is one of the key characters in recognizing this species from its nearest relative.

Eriocraniella aurosarsella can be readily distinguished from all other members of the family, with the exception of *E. xanthocara*, on the basis of genitalic characters. Both *E. aurosarsella* and *E. xanthocara* possess essentially the same genital and venational structure, a fact that reflects the close degree of relationship and relatively recent divergence of these two insects. For example, both species possess a prominent furcula, divided for half its length in the male; furthermore, both also demonstrate a unique development of the spinose pocket wherein the left margin has become heavily sclerotized and densely spined. The two species may be distinguished by their different coloration. Most noticeably, the head vestiture of *E. aurosarsella* is whitish intermixed with fuscous compared to the pale orange head of *E. xanthocara*. Also, the forewings of *E. aurosarsella* are not as dark and are more bronzy than in *E. xanthocara*. These two species also demonstrate host preferences with the larvae of *E. aurosarsella*, apparently restricted to *Quercus kelloggii*, and those of *E. xanthocara* feeding on *Q. agrifolia* and *Q. wislizenii*.

In the reference by Opler (1974), the hosts of



MAP 4.—Distribution of *Eriocraniella* (subgenus *Eriocraniella*) recorded in California.

these two species were associated differently than listed above. The reason for this discrepancy is simply that the names of the two moths were misapplied, with Opler referring to the orange-headed species as *Eriocraniella aurosarsella* and the gray-headed form as an undescribed species of *Eriocraniella*. All specimens associated with *Quercus kelloggii* examined thus far, however, possess a head vestiture of whitish to pale gray irrorated with fuscous; consequently, they agree more closely with Walsingham's original diagnosis of *Eriocraniella aurosarsella*.

The larva of *E. aurosarsella* differs significantly from that of *E. xanthocara*. *Eriocraniella aurosarsella* can be distinguished in the larval state by the presence of the cranial seta A1, the absence of the mesal tuft of mandibular setae, and by the absence of L1 on the abdominal segments I through VIII. In contrast, the larva of *E. xanthocara* has lost A1

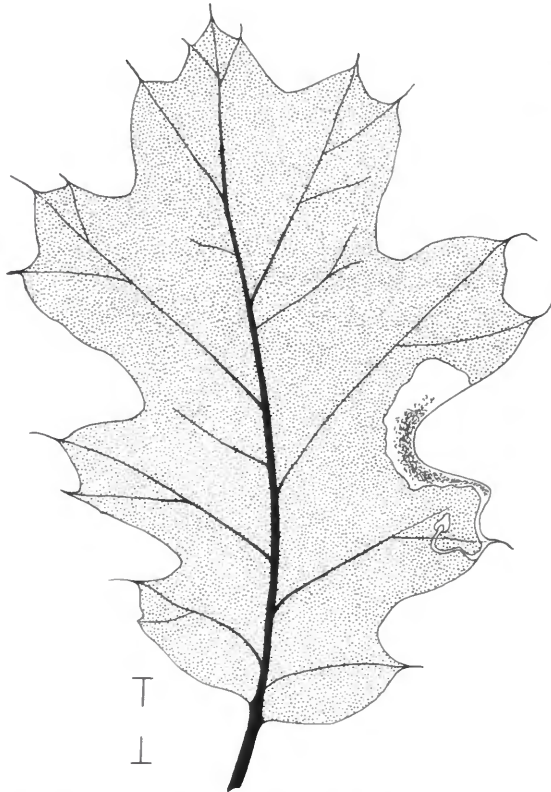


FIGURE 133.—Leaf mine of *Eriocraniella aurosarsella* (Walsingham) on *Quercus kelloggii* Newberry (Scale = 10 mm.)

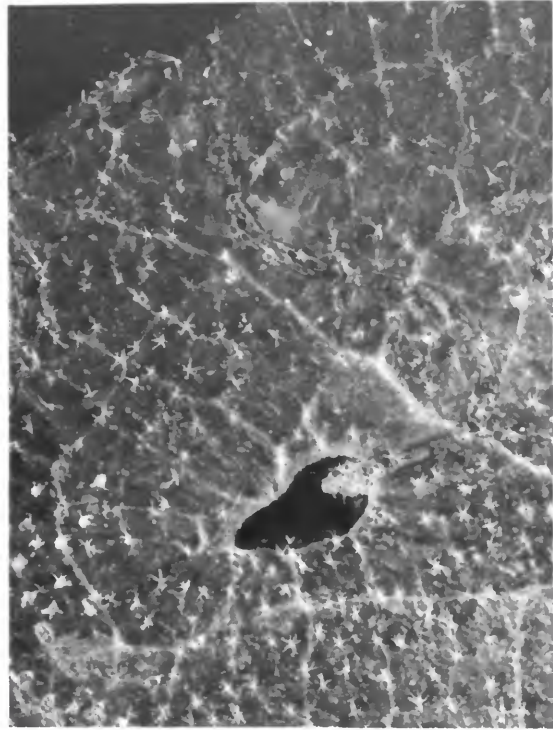


FIGURE 134.—Leaf mine of *Eriocraniella aurosarsella* (Walsingham) on *Quercus kelloggii* Newberry showing oviposition scar and egg pouch.

but has retained the mandibular setal tuft and L1 on all abdominal segments.

The larval mine (Figure 133) of this species appears very similar to that of *E. xanthocara* in that an elongate, linear mine first extends from a brownish egg pouch and leaf scar usually toward the outer margin of the leaf. After following the leaf margin a short distance, the linear mine abruptly enlarges to form a large, full-depth blotch.

***Eriocraniella (Eriocraniella) xanthocara*,
new species**

FIGURES 135–146, 175, 182–183, 199–200, 231–232, 265–266,
313–314, 340; MAP 4

Eriocraniella aurosarsella.—Opler, 1974:4, 18 [misidentification; not Walsingham, 1880].

ADULT (Figure 175).—*Wing Expanse*: ♂, 7.0–8.0 mm; ♀, 7.5–8.5 mm.

Head: Relatively sparsely covered with pale

orange to pale ochreous hairs. Antennae of moderate length, approximately 0.5–0.55 the length of forewing; 33- to 37-segmented; scape dark fuscous above, white beneath; flagellum almost entirely covered with narrow, dark fuscous scales except for apical 4 segments that are thinly scaled with white; venter of flagellum with a narrow pubescent streak along midline. Maxillary palpi entirely fuscous except for terminal (5th) segment that is covered mostly with grayish pubescence; apex of 5th segment similar to *E. aurosparsella*, divided into 3 series of minute lobes as follows: (a) a single, relatively elongate apical lobe bearing 1 large (length ca. 1.6 the diameter of lobe), blunt seta, and 3 short (length less than diameter of lobe), subapical subacute setae, (b) a pair of moderately long, subapical lobes, each bearing 1 long apical seta, and (c) a very short subapical pair of lobes, each bearing one long apical seta. Base of galeae sparsely scaled with dark fuscous. Labial palpi fuscous above and on outer sides, mostly silvery white on inner sides.

Thorax: Dorsum smoothly covered with broad, dark fuscous scales, slightly bronzy to purplish in luster; tegulae with long tufts of fuscous hairs posteriorly and whitish hairs anteriorly. Venter grayish white. Legs usually fuscous above, whitish ventrally. Forewings immaculate, dark fuscous with a prominent greenish blue iridescence; fringe uniformly dark fuscous. Hind wings similar to forewings in color though less lustrous and with more purplish iridescence; uniformly covered with relatively broad scales.

Abdomen (Figures 231–232): Thinly covered with dark fuscous hairs above, more grayish ventrally. Fourth sternite of female with relatively small, oval fenestrae similar in size to those of *E. aurosparsella*; male without fenestrae. Sternal tubercles present on 5th sternite of both sexes, similar in size and form to those of *E. aurosparsella*. Caudal apices of 8th tergite and sternite usually entire, sometimes weakly divided, acute and well defined.

Male Genitalia (Figures 265–266): Very similar to that figured and described for *E. aurosparsella*.

Female Genitalia (Figures 313–314, 340): Very similar to that figured and described for *E. aurosparsella*. Spinose pocket similar to *E. aurosparsella* in being asymmetrical, with lateral margin of left side more heavily sclerotized and spinose.

LARVA (Figures 135–145).—Length of largest larva 9 mm; diameter 1.4 mm.

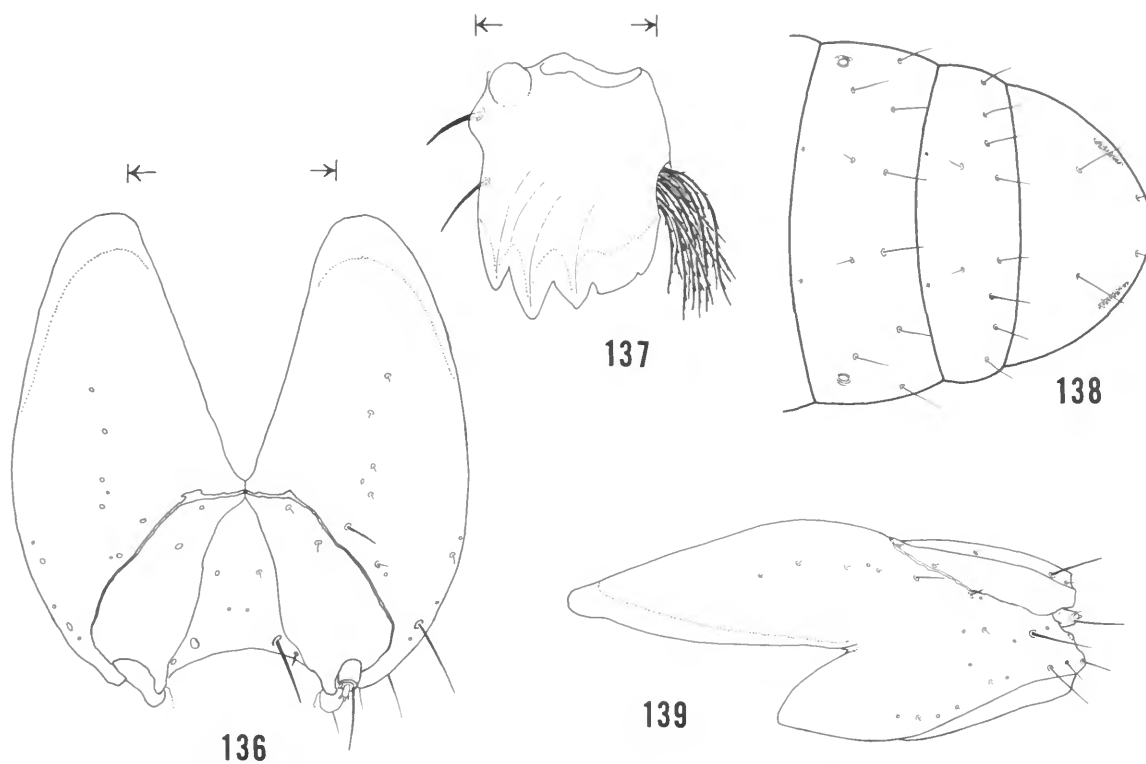
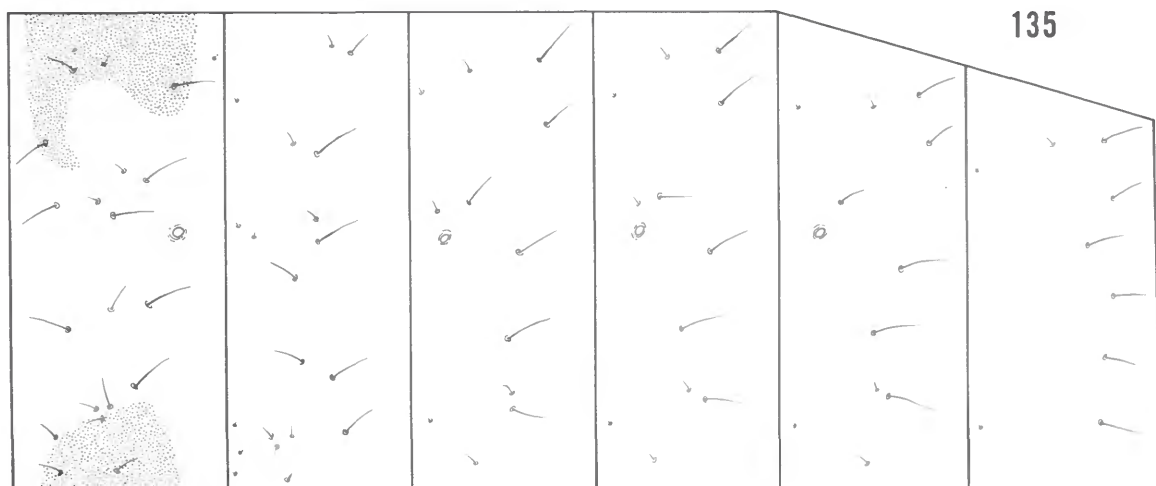
Head: Relatively uniformly light brown to stramineous with frontal sutures darkly outlined. Greatest width 0.6 mm; length 0.7 mm. Va variable, often situated between V1 and P2. P1 moderately elongate, several times larger than A2, usually separate from ecdysial line but occasionally contiguous. A1 absent. Chaetotaxy of labrum similar to that of *Dyseriocrania*; all setae simple and acute; anterior margin of pilifers and epipharynx densely spinose; M3 closer to M2 than to L3. Mandibles with an inner median tuft of 11–15 elongate setae; each seta finely branched, appearing serrate.

Thorax: Pronotal and prosternal plates present but inconspicuous in mature larvae (in alcohol), and lightly pigmented; much darker, brownish in young larvae. Meso- and metathorax with sclerotized plates. L2 relatively well developed on meso- and metathorax, approximately equal to L1. Subventral setae trisetose on prothorax.

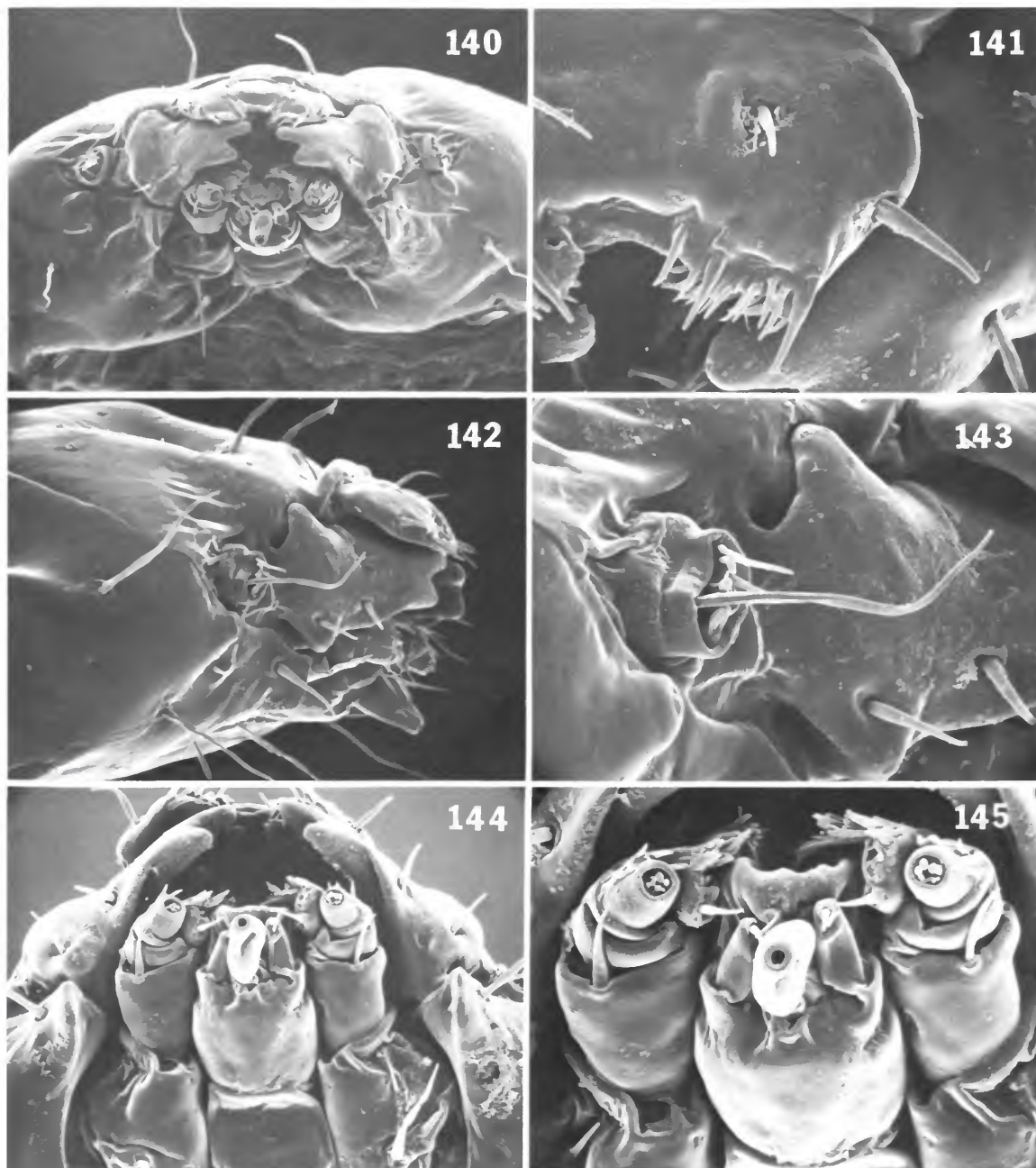
Abdomen: Integument without pigmentation in mature larvae, appearing whitish (in alcohol) except for a pair of minute, longitudinal brownish spots near lateroposterior margin of anal segment; barlike spots without enlarged cephalic end; anal plate brownish in immature larvae. L1 present on all segments, situated relatively high above SD1 and spiracles on I to VIII. SV2 present on segments I to VIII. Anal segment with 7 pair of primary setae; SD2, L3, and SV2 absent.

HOLOTYPE.—♂, Russel Farm, 4 mi [6.4 km] NE Orinda, Contra Costa County, California, 6 March 1970, collector P. A. Opler, *Quercus agrifolia*; in the California Academy of Sciences on indefinite loan from the University of California, Berkeley.

PARATYPES.—UNITED STATES. CALIFORNIA: Alameda Co: Berkeley Hills, NE Oakland, 1400 ft [427 m]: 1 ♂, 8 Apr 1964, J. Powell (UCB). Contra Costa Co: 2 mi [3.2 km] E. Antioch: 8 larvae, 7–8 Apr 1969, *Quercus agrifolia*, P. Opler (UCB); 5 larvae (same data), larval slides USNM 18150, 18151, 18153, 18155, 18222 (USNM). Russel Farm, 4 mi [6.4 km] NE Orinda: 1 ♂, 1 ♀, 6 Mar 1970, P. Opler, ♂ slides USNM 16096, 16097, *Quercus agrifolia* (USNM); 3 ♂, 2 ♀, 6 Mar 1970, P. Opler, *Quercus agrifolia* (UCB). Strawberry Canyon, Berkeley Hills: 2 larvae, 11 May 1967, *Quercus agrifolia*, J. Powell (UCB). Kern Co: 3 mi [4.8 km] W Wofford Hts: 1 ♂, 28 Apr 1964, J. Doyeh, ♂ slide USNM 16098 (USNM). Marin Co: Alpine Lake, hills N 1100 ft [335 m]: 1 ♀, 17 Apr 1970, P. Opler, *Quercus agrifolia*, ♀ slide USNM 16101 (USNM). Noyato: 1 ♂, 25 Mar 1962, D. Rentz, ♂ slide PO 94 (UCB). San Mateo Co: Golden Gate Pk, San Francisco: 1 ♀, 28 Mar 1961, P. Arnaud, Jr., on leaf of *Quercus agrifolia* (UCB). Junipero Serra Pk: 4 ♀,



FIGURES 135-139.—*Eriocraniella xanthocara*, new species, larval chaetotaxy: 135, lateral view of prothorax, mesothorax, and abdominal segments 1, 6, 8, and 9; 136, dorsal view of head (scale = 0.3 mm); 137, left mandible (scale = 0.1 mm); 138, dorsal view of abdominal segments 8-10; 139, lateral view of head.



FIGURES 140-145.—*Eriocraniella xanthocara*, new species, larval head structure: 140, anterior view of head, $\times 220$; 141, chaetotaxy of labrum, $\times 860$; 142, lateral view of head, $\times 275$; antenna, $\times 760$; 144, ventral view of mouthparts, $\times 330$; 145, detail ventral view of maxillae and labrum, $\times 570$. (Photographs reduced to 83%.)

29 Mar–4 Apr 1964, P. Arnaud, Jr., on foliage *Quercus agrifolia* (CAS); 1 ♀, 29 Mar 1964, P. Arnaud, Jr., ♀ slide USNM 18197 (USNM). San Francisco, Lake Merced: 1 ♀, 9 Apr 1964, P. Arnaud, Jr. (CAS). Santa Clara Co: Herbert Cr, 3 mi [4.8 km] W New Almaden: 1 ♀, 18 Apr 1969, J. Powell, flushed ex *Q. agrifolia* 3:00 P.M., ♀ slide PO 92 (UCB). Described from a total of 8 males, 13 females, and 15 larvae.

Other Records (not examined): Contra Costa Co: Redwood Regional Pk: 1 ♀, 29 Apr 1975, P. Rude (UCB). Marin Co: 2 mi [3.2 km] W Fairfax: 1 ♀, 13 Mar 1970, J. Powell (UCB). Mendocino Co: NCCRP, 3 mi [4.8 km] N Branscomb, 1400 ft [427 m]: 2 ♂, 4 ♀, 16–17 May 1975, Powell and Schlinger (UCB).

HOST.—Fagaceae: "*Quercus agrifolia* Née and *Q. wislizenii* A. DC.," Opler, 1974.

FLIGHT PERIOD.—Early March to late April; univoltine.

DISTRIBUTION (Map 4).—According to Opler (1974), this species occurs in California from Shasta County southward through the coast ranges to at least Santa Clara County and Santa Cruz Island.

DISCUSSION.—*Eriocraniella xanthocara* agrees closely with *E. aurosparsella* in genital structure, but it may be easily distinguished from the latter on the basis of general scale color. The light orange head vestiture of *E. xanthocara* contrasts sharply with the whitish to gray head of Walsingham's species, a fact that has suggested its specific name, derived from the Greek, *xanthos* (orange) and *kara* (head). In addition, the wings of *E. xanthocara* are darker and exhibit a more bluish luster than does *E. aurosparsella*. In the few specimens compared, the vaginal sclerite (Figure 314) of *E. xanthocara* appears more narrow at its cephalic end than does that of *E. aurosparsella*, but this may merely represent normal populational variation.

The specific distinction of the two insects in question appears justified, especially in view of the fact that they occur at least partially sympatric and are restricted to different hosts, as pointed out by Opler (1975:5). As discussed under the preceding species, however, Opler assigns host associations to the two species different from those listed in the present treatment.

The greatest degree of morphological differentiation between *E. xanthocara* and *E. aurosparsella* may be observed in their larvae. The larva of *E. xanthocara* is easily distinguished from *E. aurosparsella* by the absence of cranial seta A1, the presence of a prominent tuft of setae arising from the

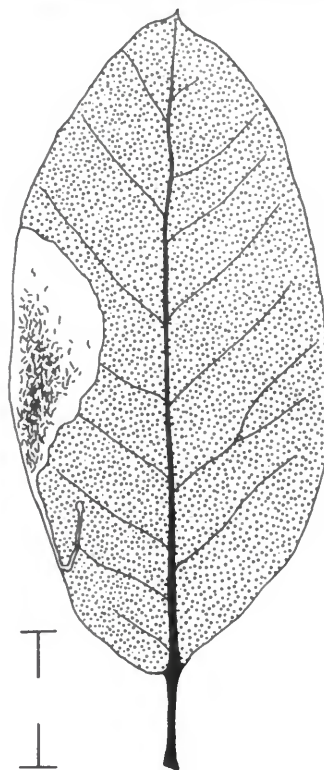


FIGURE 146.—Leaf mine of *Eriocraniella ?xanthocara*, new species on *Quercus wislizenii* A.DC. (Scale = 10 mm.)

inner margins of the mandibles, and by the presence of L1 on all abdominal segments. In contrast, *E. aurosparsella* has retained A1 but has lost the mandibular setal tufts and L1 from abdominal segments I through VIII. In addition, the barlike, lateral pair of spots on the anal segment possess a minute, cephalic enlargement in the latter species that is not present in *E. xanthocara*. The anal shield of the latter may also be darker in color, but this should be verified with living material.

Opler (1974) reports the life history of this species to be similar to *Dyseriocrania auricyanea* (= *cyanosparsella*). He has observed the two species occurring sympatrically and synchronically at a number of localities in coastal California and on Santa Cruz Island. The primary distinction between the life histories of these two species is apparent in their oviposition sites and mine config-

urations. The eggs of *E. xanthocara* are not deposited in as great a concentration in the apical half of the leaf, as is characteristic for *D. auricyanea*, but are scattered more over the outer four-fifths. The linear stage of mine construction differs in that the length of this portion is noticeably longer in *E. xanthocara* than in *D. auricyanea*.

An additional, unnamed species of *Eriocraniella* is known from San Luis Obispo, California, where it was collected during March by A. H. Vachell. The unique male specimen, now deposited in the National Museum of Natural History, Smithsonian Institution, has not been named because of its poor condition. The species resembles *E. xanthocara* in wing color and possesses a similar head vestiture of pale reddish orange. The furcula of the male genitalia (Figure 267) differs noticeably by being less deeply divided than that of either *E. aurosparsella* or *E. xanthocara*. The terminal flabellate process of the ventral phallic branch also is more elongate with very reduced, apical spines.

Eriocraniella (Eriocraniella) longifurcula,
new species

FIGURES 147-162, 176, 233, 269-270; MAP 3

ADULT (Figure 176).—*Wing Expanse*: ♂, 9.5-10 mm.

Head: Sparsely covered with whitish to grayish hairs. Antennae of moderate length, approximately 0.5 the length of forewing, 36-segmented; scape fuscous above, irrorated with white beneath; flagellum mostly covered with slender fuscous scales except for a narrow streak of pubescence ventrally. Maxillary palpi fuscous, slightly irrorated with white ventrally; apex of terminal (5th) segment very similar in structure to *E. platyptera*, with a series of minute lobes arranged in 3 ranks as follows: (a) a single, relatively large apical lobe bearing 4 moderately long subacute setae, (b) an identical pair of much shorter subapical lobes, each bearing a single, elongate subacute seta, and (c) an identical pair of very short subapical lobes, each with a single, elongate subacute seta. Base of galeae sparsely scaled with fuscous. Labial palpi fuscous with a slight whitish irroration on apical segment.

Thorax: Dorsum fuscous; tegulae with long whitish and fuscous hairs; collar with long, mostly whitish hairs. Venter whitish. Legs fuscous above,

mostly white ventrally. Forewings relatively slender, width about 0.3 the length, immaculate, fuscous with a slight bluish purple iridescence; fringe uniformly fuscous. Hind wings slightly paler than forewings in color, grayish, uniformly covered with relatively broad scales.

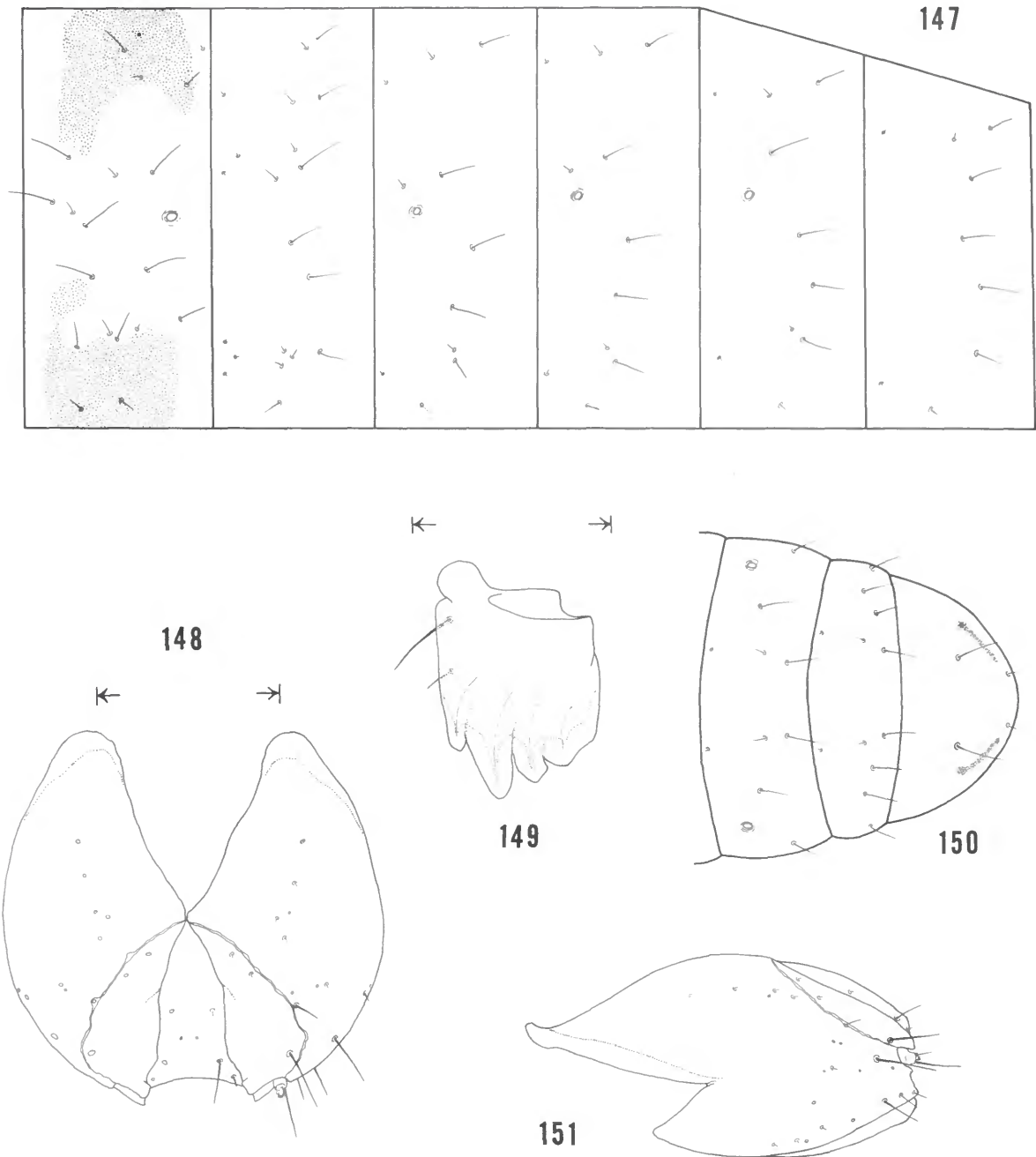
Abdomen (Figure 233): Thinly covered with fuscous hairs above, more grayish ventrally. Fourth sternite of male without fenestrae. Sternal tubercles present on 5th sternite, tubular in form, diameter approximately 0.17 the length of sternite.

Male Genitalia (Figures 269-270): Uncus deeply bilobed; lobes prominent, distinctly curved laterally, lobes widely separated at apex for a distance slightly greater than their length. Anal tube completely membranous, without basal sclerites. Vinculum with lateral arms of furcula greatly extended, slender; furcula divided approximately 0.7-0.8 its entire length; median cephalic margin of vinculum between apophyses smoothly concave, without median process; apophyses elongate, approximately 0.8 the length of undivided vinculum (excluding furcula). Juxta broad, with lateral margins nearly parallel; greatest width about 0.75 its length; caudal apex broadly truncate. Base of aedeagus greatly swollen, bulbous; ventral phallic branch stout, equaling diameter of dorsal branch; apex of ventral branch with a minute, flabellate serrated lobe bearing 5-7 marginal teeth; dorsal branch with a short, broadly conical, acute process arising subapically; ventral branch loosely articulated to bulbous base of aedeagus.

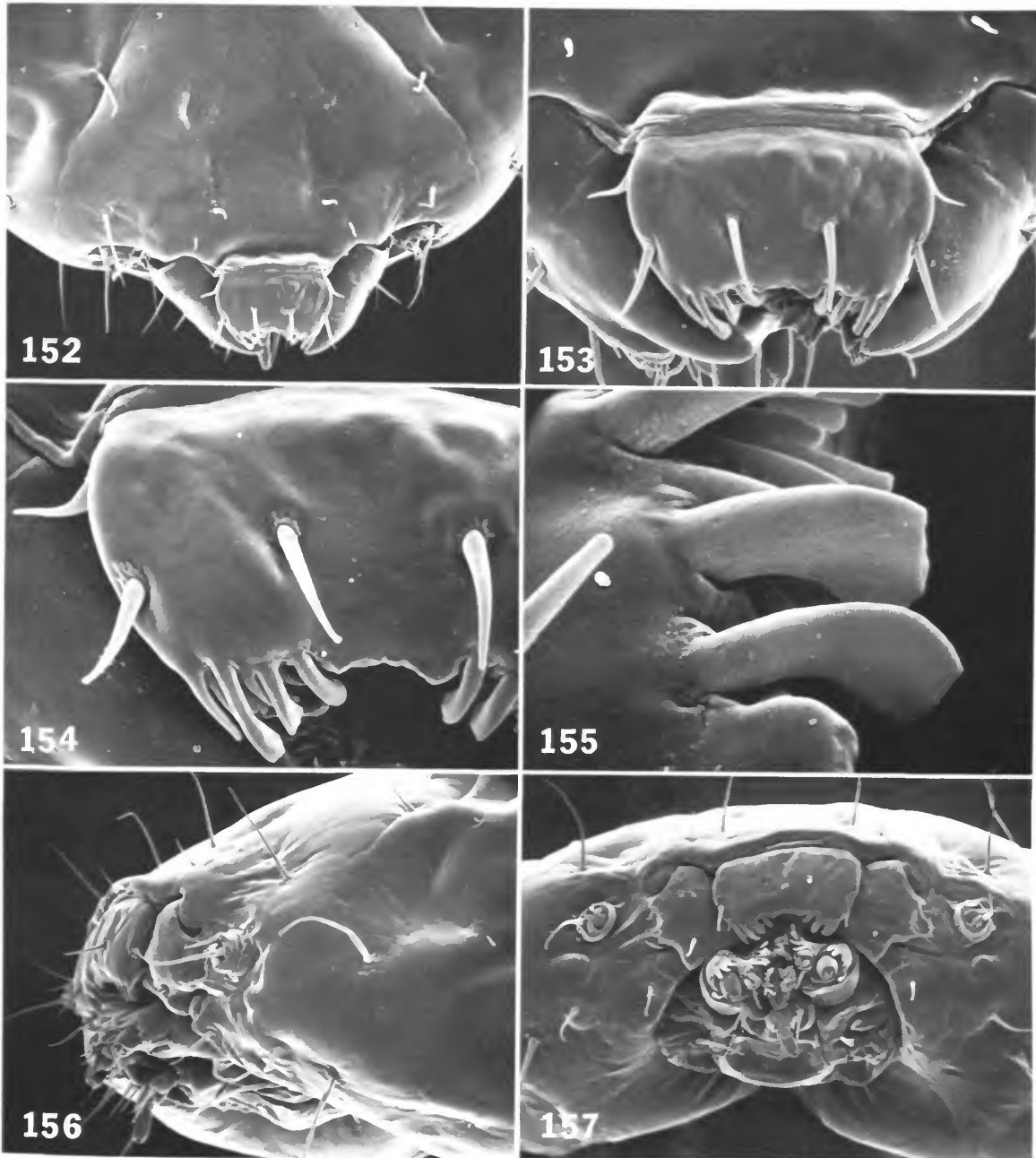
LARVA (Figures 147-161).—Length of largest larva 7 mm; diameter 1 mm.

Head: Uniformly light brown to stramineous with frontal sutures darkly outlined. Greatest width 0.5 mm; length 0.6 mm. Va variable, either laterad or posterior to VI. P1 relatively elongate, several times larger than A2, either contiguous or slightly separate from ecdysial line. A2 usually well separated from and laterad to P1. A1 present. Labrum similar to *E. aurosparsella*, with apices of M2, M3, and L3 broadly compressed (Figure 155); ventral margins of foregoing setae entire, not dentate as in *E. aurosparsella*; M3 arising approximately equidistant between M2 and L3; anterior margin of pilifers and epipharynx spinose. Mandibles with inner margin smooth; median setal tufts absent.

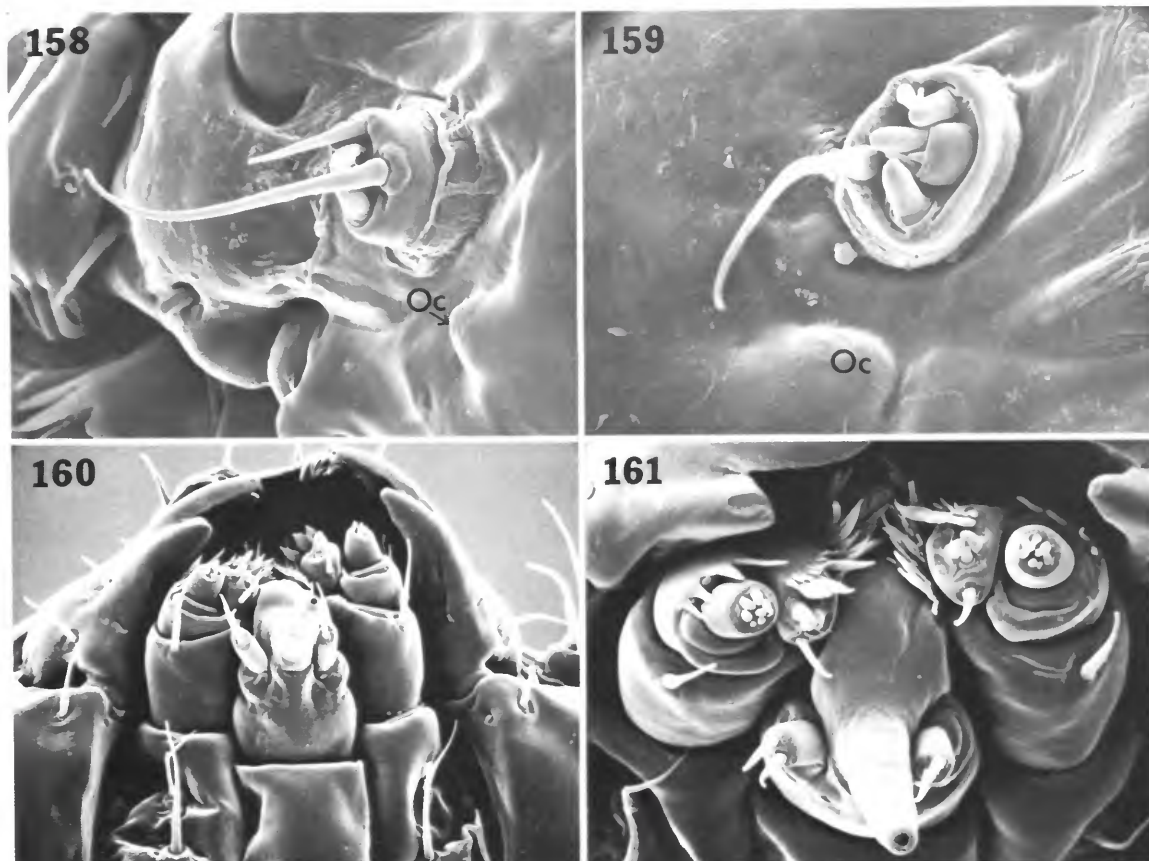
Thorax: Pronotal and prosternal plates well developed, dark brown. Meso- and metathorax with-



FIGURES 147-151.—*Eviocraniella longifurcula*, new species, larval chaetotaxy: 147, lateral view of prothorax, mesothorax, and abdominal segments 1, 6, 8, and 9; 148, dorsal view of head (scale = 0.3 mm); 149, left mandible (scale = 0.1 mm); 150, dorsal view of abdominal segments 8-10; 151, lateral view of head.



FIGURES 152-157.—*Eriocraniella longifurcula*, new species, larval head structure: 152, dorsal view of frontal area, $\times 220$; 153, chaetotaxy of labrum, $\times 580$; 154, detail of labrum, $\times 1100$; 155, lateral detail of labral setae L3 and M3, $\times 3550$; 156, lateral view of head, $\times 280$; 157, anterior view of head, $\times 265$. (Photographs reduced to 84%.)



FIGURES 158–161.—*Eriocraniella longifurcula*, new species, larval head structure: 158, lateral view of antenna and ocellus (stemma), $\times 850$; 159, anterior view of antenna and ocellus, $\times 1200$; 160, ventral view of mouthparts, $\times 400$; 161, detail of maxillae and spinneret, $\times 715$. (Photographs reduced to 84%.)

out plates, whitish. L2 reduced in size on meso- and metathorax, approximately 0.3–0.5 the length of L1. Subventral setae bisetose on prothorax.

Abdomen: Integument without pigmentation, usually whitish (in alcohol) except for a pair of minute, longitudinal brownish spots near latero-posterior margin of anal segment; barlike spots similar to those of *E. aurosparsella* in form, with cephalic end slightly enlarged and punctate. L1 absent on I to VIII. SD2 typically present on I to VIII. Segment IX with 7 pair of setae; SD2, L3, and SV3 absent.

HOLOTYPE.—♂, Workman Creek, Sierra Ancha [Mts.], Gila County, Arizona, 3 May 1947, H. and M. Townes, USNM 72101, genitalia slide USNM

18071; in the National Museum of Natural History, Smithsonian Institution.

PARATYPE.—ARIZONA: Coconino Co: Oak Cr Canyon: 1 ♂, 25 May 1974, 5200 ft [1585 m], genitalia slide DRD 2959, wing slide 2990, R. Leuschner (RHL). Described from 2 males.

Other Material Examined: ARIZONA: Coconino Co: North Rim Oak Cr Canyon: 3 larvae, 3 Jun 1968, coll. P. Opler, on *Quercus gambelli* \times *arizonica*, JAP 68F13, larval slides DRD 3010, 3020 (UCB); same data: 2 larvae, larval slides USNM 18146, 18147, (USNM).

Host.—Uncertain; possibly Fagaceae: "*Quercus gambelli* Nutt. \times *arizonica* Sarg.," from specimen labels.

FLIGHT PERIOD.—May; probably univoltine.

DISTRIBUTION (Map 3).—This species is presently known from only two sites located in adjacent counties of central Arizona.

DISCUSSION.—Only two male specimens, both from Arizona and in relatively poor condition, are all that were available of this species for study. The species is interesting because it represents another member of the genus *Eriocraniella* with a well-developed furcula.

The deeply divided furcula of this species readily distinguishes it from all other known Eriocraniidae with the exception of the following species, *E. platyptera*. The furculae of both species are very similar in possessing slender, elongate arms. *Eriocraniella longifurcula* may be separated from the latter by its grayish head, more elongate wings, and more western distribution. In contrast, *E. platyptera* possesses a head vestiture of pale orange, shorter and relatively broader wings, and a more eastern distribution. The female of *E. longifurcula* is unknown and, thus, cannot be compared with that of *platyptera*. The specific name, *longifurcula*, is derived from the Latin, *longus* (long) and *furcula* (little pitchfork) and obviously refers to the elongate furcate arms of this species.

The identity of the larvae described for *E. longifurcula* must remain questionable because no adults have definitely been associated with these larvae. The specimens in question consist of five, perhaps mature, examples collected 3 June 1968 from a possible hybrid of *Quercus gambelli* Nuttall × *arizonica* Sargent. Because the origin of this sample (north rim of Oak Creek Canyon, Coconino County, Arizona) is very near the site where the adult paratype was collected, it is possible that the larvae do represent this species.

Morphologically, the larvae are very similar to those described for *E. aurosarsella*; however, their different host plants and distribution suggest at least some degree of biological divergence. Only one, seemingly minor, difference in chaetotaxy has been found to distinguish the Arizona specimens from the larvae of typical *aurosarsella*. In the Oak Creek Canyon larvae, setae M2, M3, and L3 of the labrum possess smooth ventral margins (Figure 155). The ventral surfaces of these broad setae are dentate in *E. aurosarsella* (Figure 129).

The larval mine (Figure 162) is typically eriocraniid in form and commences with a minute, brownish egg pouch. The initial mine is slender,

usually following the outer margin of the leaf for a short distance, but gradually enlarges to form a rather elongate blotch, usually 5 mm or more in width.

***Eriocraniella (Eriocraniella) platyptera*,
new species**

FIGURES 177, 201–202, 214, 234–235, 271–272, 317–319, 342;
MAP 3

ADULT (Figure 177).—*Wing Expanse*: ♂, 7–8 mm; ♀, 8.2 mm.

Head: Sparsely covered with pale yellowish orange hairs. Antennae of moderate length, approximately 0.5 the length of forewing, 35- to 37-segmented; scape and flagellum uniformly dark fuscous, densely covered to apex with slender scales. Maxillary palpi uniformly fuscous except for whitish pubescence apically; apex of terminal (5th) segment with a series of minute lobes arranged in 3 ranks as follow: (a) a single, relatively long apical lobe bearing 3 short and 1 moderately long subacute setae, (b) an identical pair of much shorter subapical lobes, each with a single elongate subacute seta, and (c) an identical pair of very short subapical lobes, each bearing a single, elongate subacute seta. Base of galeae pubescent. Labial palpi fuscous with venter of apical segment whitish.

Thorax: Dorsum dark fuscous with a pronounced brassy iridescence; tegulae and mesoscutum with long, erect black hairs; collar pale yellowish orange. Venter pale grayish white with a strong silvery luster. Legs fuscous with tibial spurs and tarsi of meso- and metathoracic legs heavily suffused with white. Forewings relatively broad, width about 0.34 the length, immaculate, dark fuscous with a prominent golden brassy to blue green iridescence (depending upon incidence of light) frequently highlighting dorsalmost scales; fringe uniformly fuscous. Hind wings much paler, grayish fuscous with a slight purplish luster; scales moderately broad.

Abdomen (Figures 234–235): Thinly covered with dark fuscous hairs above and below. Fourth sternite of female with a pair of moderately large, well-defined fenestrae approximately 0.35 the length of sternite in diameter; male without fenestrae. Sternal tubercles present on 5th sternite of both sexes, papiliform, diameter approximately

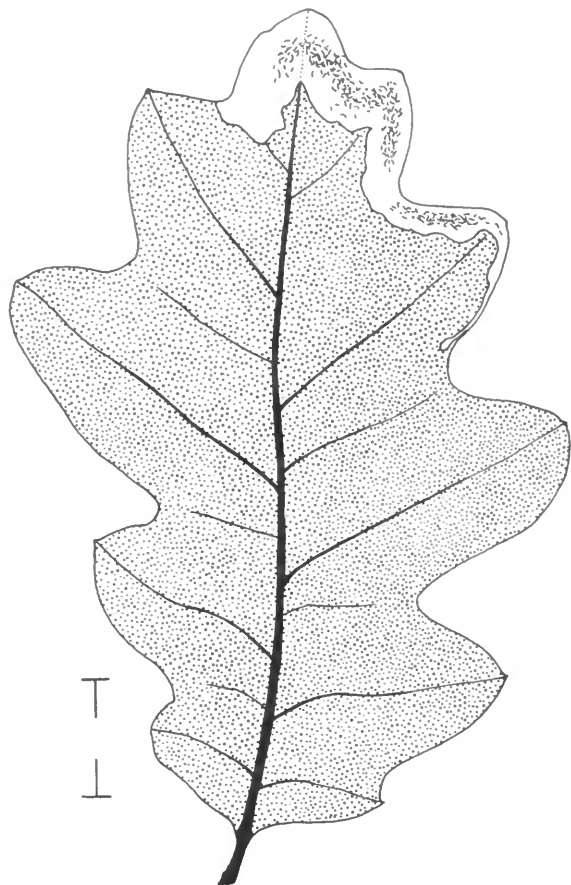


FIGURE 162.—Leaf mine of *Eriocraniella ?longifurcula*, new species, on *Quercus gambelli* Nuttall. (Scale = 10 mm.)

0.18–0.20 the length of sternite. Caudal apex of 8th sternite sharply defined, acute in female, not divided; apex of 8th tergite with a shallow cleft.

Male Genitalia (Figures 271–272): Very similar to *E. longifurcula*. Uncus deeply bilobed; lobes prominent, curved laterally; widely separated at apex for a distance equal to their length. Anal tube completely membranous, without basal sclerites. Vinculum with lateral arms of furcula greatly lengthened and very slender; furcula divided approximately 0.8–0.9 its entire length; median cephalic margin of vinculum between apophyses smoothly concave, without median process; apophyses elongate, approximately 0.7 the length

of undivided vinculum (excluding furcula). Juxta broad with lateral margins nearly parallel, greatest width about 0.7 its length; caudal apex subtruncate, slightly concave. Base of aedeagus greatly swollen, bulbous; ventral phallic branch stout, equaling dorsal branch in diameter but slightly shorter; apex of ventral branch with a minute, flattened serrated lobe bearing 10–12 marginal teeth; dorsal branch with a short, broadly conical subapical process; ventral branch loosely articulated to bulbous base of aedeagus.

Female Genitalia (Figures 317–319, 342): Apex of ovipositor acute; lateral edges serrulate with 8–10 minute teeth. Bursa copulatrix elongate, surpassing cephalic apices of anterior apophyses when fully extended; walls of corpus bursae membranous. Vaginal sclerite darkly sclerotized, relatively narrow and elongate with greatest width approximately 0.4 its length; a slender, median ventral keel from cephalic end of sclerite; keel moderately well developed with broad apex directed ventrally as shown in Figure 318. Ninth segment with mid-ventral pocket well developed, thickened, and symmetrical with numerous minute teeth bordering inner lateral margins of pocket.

HOLOTYPE.—♂, Six Mile Creek, Ithaca, New York, 14 May 1961, J. G. Franclemont, genitalia slide USNM 18152, SEM slide USNM 18120; USNM holotype 72103; in the National Museum of Natural History, Smithsonian Institution.

PARATYPES.—NEW YORK: Tompkins Co: Ithaca, Six Mile Cr: 1 ♂, 11 May 1959, R. W. Hodges, genitalia slide USNM 18236 (USNM); 1 ♀, 13 May 1961, R. W. Hodges, genitalia slide USNM 18235 (USNM). Described from a total of 2 males and 1 female.

HOST.—Unknown.

FLIGHT PERIOD.—May; univoltine.

DISTRIBUTION (Map 3).—Known only from the type-locality that is situated within the Cayuga Lake Basin of northwestern New York.

DISCUSSION.—This species may be easily distinguished from all other known members of the family, save one, on the basis of the genital structure, particularly by the attenuated development of the furcula in the male. The male genitalia of *Eriocraniella platyptera* and *E. longifurcula* are essentially identical; however, the two may be readily separated by other means. For example, their widely disjunct distribution suggests several

markedly different ecological adaptations involving such factors as host-plant preferences and climatic tolerances. Structurally, *E. platyptera* is characterized by its pale orange head and relatively short, broad wings. The latter feature has suggested its specific epithet, which is derived from the Greek, *platys* (broad) and *pteron* (wing). In contrast, *E. longifurcula* possesses a grayish head vestiture and relatively elongate, narrow wings. The female genitalia structure of these two species cannot be compared because no females of *E. longifurcula* have been examined.

It is interesting to note that these two species demonstrate a peculiar relationship similar to that of another sibling pair within the same genus. *Eriocraniella aurosarsella* and *E. xanthocara* likewise possess essentially identical genitalia, with one (*xanthocara*) being easily recognized by its pale orange head vestiture as compared to the grayish head of the other (*aurosarsella*). The host preferences and larval morphology of the latter two have been found to differ significantly, and it is expected that similar distinctions will also be discovered for

E. platyptera and *E. longifurcula*.

Disfurcula, new subgenus

TYPE-SPECIES.—*Eriocraniella (Disfurcula) variegata*, new species.

ADULT.—*Wing Expanse*: 6–10 mm.

Head, Thorax, and Abdomen: As described for genus.

Male Genitalia: Vinculum without median furcula; caudal margin sinuate, with a relatively prominent, median conical lobe. Aedeagus with apex of ventral phallic branch relatively simple, acute, without a flabellate, spinose process, but with a rather prominent, subapical conical to spinose lobe.

Female Genitalia: Ninth segment without a mid-ventral spinose pocket.

DISCUSSION.—The subgeneric name, *Disfurcula*, has been derived from the Latin, *dis* (without) and *furcula* (little pitchfork), and refers to the absence of the furcula in the male; it has been treated as feminine in gender.

Key to the Species of the Subgenus *Disfurcula*

1. Forewings with subcostal vein usually divided. Male genitalia with lobes of uncus relatively straight, and gradually tapering in width to subacute apices (Figure 273).....*Eriocraniella (Disfurcula) falcata*, new species
- Forewings with subcostal vein simple. Uncus with lobes distinctly curved laterally, terminating in broadly rounded apices (Figure 275)2
2. Aedeagus with ventral phallic branch relatively stout, nearly equaling dorsal branch in diameter; apex of ventral branch with a very prominent subapical, triangular lobe (Figure 275)*Eriocraniella (Disfurcula) trigona*, new species
- Aedeagus with ventral phallic branch relatively slender, less than 0.5 the diameter of dorsal branch; subapical lobe of ventral branch more reduced and rounded (Figure 278).....*Eriocraniella (Disfurcula) variegata*, new species

Eriocraniella (Disfurcula) variegata, new species

FIGURES 171, 203–204, 236–237, 247, 277–278, 320–322, 343;
MAP 5

ADULT (Figure 171).—*Wing Expanse*: ♂, 8.2–9.5 mm; ♀, 7.8–8.7 mm.

Head: Uniformly covered with pale yellow to stramineous hairs. Antennae moderately long, approximately 0.52–0.57 the length of forewing, 38- to 42-segmented; scape mostly whitish; flagellum entirely fuscous except for apical 5–6 segments, which are sparsely covered with narrow whitish scales. Maxillary palpi brownish fuscous; apex of terminal

segment complex with a single, relatively large apical lobe bearing 4 moderately long, striated setae, and 2 pair of very reduced subapical lobes, each bearing a single, elongate apical seta with lateral striations. Labial palpi uniformly brownish fuscous.

Thorax: Dorsum brownish fuscous with a bronzy luster; tegulae with long stramineous hairs. Venter silvery gray. Pro- and mesothoracic legs with tibial and tarsal segments brownish fuscous above, white beneath; metathoracic legs paler, grayish above and white underneath. Forewings irregularly and almost equally marked with iridescent gold and purplish fuscous; markings typically in the form of trans-

verse bands across the wing but which are sometimes fragmented into large irregular spots; fringe pale brownish fuscous with a light golden luster. Hind wings usually slightly darker and less lustrous than forewings though usually with a slight purplish iridescence near apex; scales relatively broad.

Abdomen (Figures 236–237): Sparsely covered with grayish hairlike scales above, whitish beneath. Fourth sternite of female with a pair of relatively small, circular fenestrae approximately 0.25 the length of sternite in diameter; male without fenestrae. Sternal tubercles present on 5th sternite of both sexes, papiliform, diameter 0.14–0.18 the length of sternite. Caudal apex of 8th sternite moderately defined in female, minutely bifurcate; apex of 8th tergite more sharply defined, deeply divided.

Male Genitalia (Figures 277–278): Uncus deeply bilobed; lobes large, broadly rounded, widely separated at their apices for a distance approximately equal to their length. Anal tube entirely membranous. Vinculum with caudal margin produced into a moderately large, medium conical lobe; margin sharply excavated on either side of median lobe; apophyses relatively short, 0.51–0.55 the length of undivided vinculum; cephalic margin of vinculum between apophyses smoothly concave. Juxta broadest anteriorly, tapering slightly to broad, shallowly concave caudal end; greatest width of juxta about 0.8 its length. Base of aedeagus moderately swollen; ventral phallic branch loosely articulated to base, relatively slender, approximately 0.5 the diameter of dorsal branch; caudal end of ventral branch with a small, rounded membranous process projecting usually somewhat laterad; apex of dorsal branch variously lobed, typically with a low, broad dorsal lobe and a similar, more apical lobe laterally.

Female Genitalia (Figures 320–322, 343): Apex of ovipositor acute; lateral edges serrulate with 7–9 minute teeth. Bursa copulatrix of moderate length, slightly surpassing cephalic ends of posterior apophyses when fully extended; walls of corpus bursae entirely membranous. Vaginal sclerite darkly sclerotized, relatively elongate and narrow; greatest width approximately 0.37–0.4 the length of sclerite; cephalic end with a short, low median keel ventrally as shown in Figure 321.

HOLOTYPE.—♂, Coldbrook Station, San Gabriel Canyon, Los Angeles, California, 26 May 1973, D. C. Frack; in the Los Angeles County Museum.

PARATYPES.—UNITED STATES. CALIFORNIA: Los Angeles Co: 3000 ft [915 m] on Angeles Crest Hwy: 1 ♀, 11 May 1974, R. Leuschner, ♀ genitalia slide USNM 18212, wing slide USNM 18173 (USNM). 3300 ft [1006 m] on Angeles Crest Hwy, Big Tujunga Canyon: 1 ♂, 11 May 1974, R. Leuschner (RHL); 1 ♂, 11 May 1974, R. Leuschner, ♂ genitalia slide USNM 18214 (USNM); Big Tujunga Jct: 1 ♂, 11 May 1974, R. Leuschner (USNM). 4000 ft [1220 m] on Angeles Crest Hwy, San Gabriel Mts: 1 ♂, 2 ♀, 12 May 1974, R. Leuschner, ♂ genitalia slide DRD 2994 (RHL). Cloudburst Canyon, San Gabriel Mts, T2N, R12W, Sec 14, 4000 ft [1220 m]: 1 ♂, 10 May 1972, J. P. and K. E. Donahue, ♂ genitalia slide USNM 18183 (USNM). Coldbrook Sta, San Gabriel Canyon: 2 ♀, 12 May 1972, D. Frack (DCF); 1 ♀, 12 May 1972, D. Frack, ♀ genitalia slide USNM 18211 (USNM); 5 ♂, 1 ♀, 26 May 1973, D. Frack, ♂ head slide DRD 2995 (DCF). Josephine Cr, San Gabriel Mts, T2N, R12W, Sec 6, 3350 ft [1021 m]: 1 ♀, 9 May 1972, J. P. and K. E. Donahue (LACM). Described from a total of 11 males and 8 females.

HOST.—Unknown.

FLIGHT PERIOD.—May; univoltine.

DISTRIBUTION (Map 5).—Presently, this species is known only from the San Gabriel Mountains of Los Angeles County, California, where it occurs at elevations from 3000 feet [915 m] to 4000 feet [1220 m].

DISCUSSION.—One of the easiest means of recognizing this species is by its irregular, variegated forewing pattern of iridescent pale gold and purplish fuscous, a feature from which the specific name is derived. Unfortunately, this delicate pattern is not always pronounced or evident, particularly in rubbed specimens.

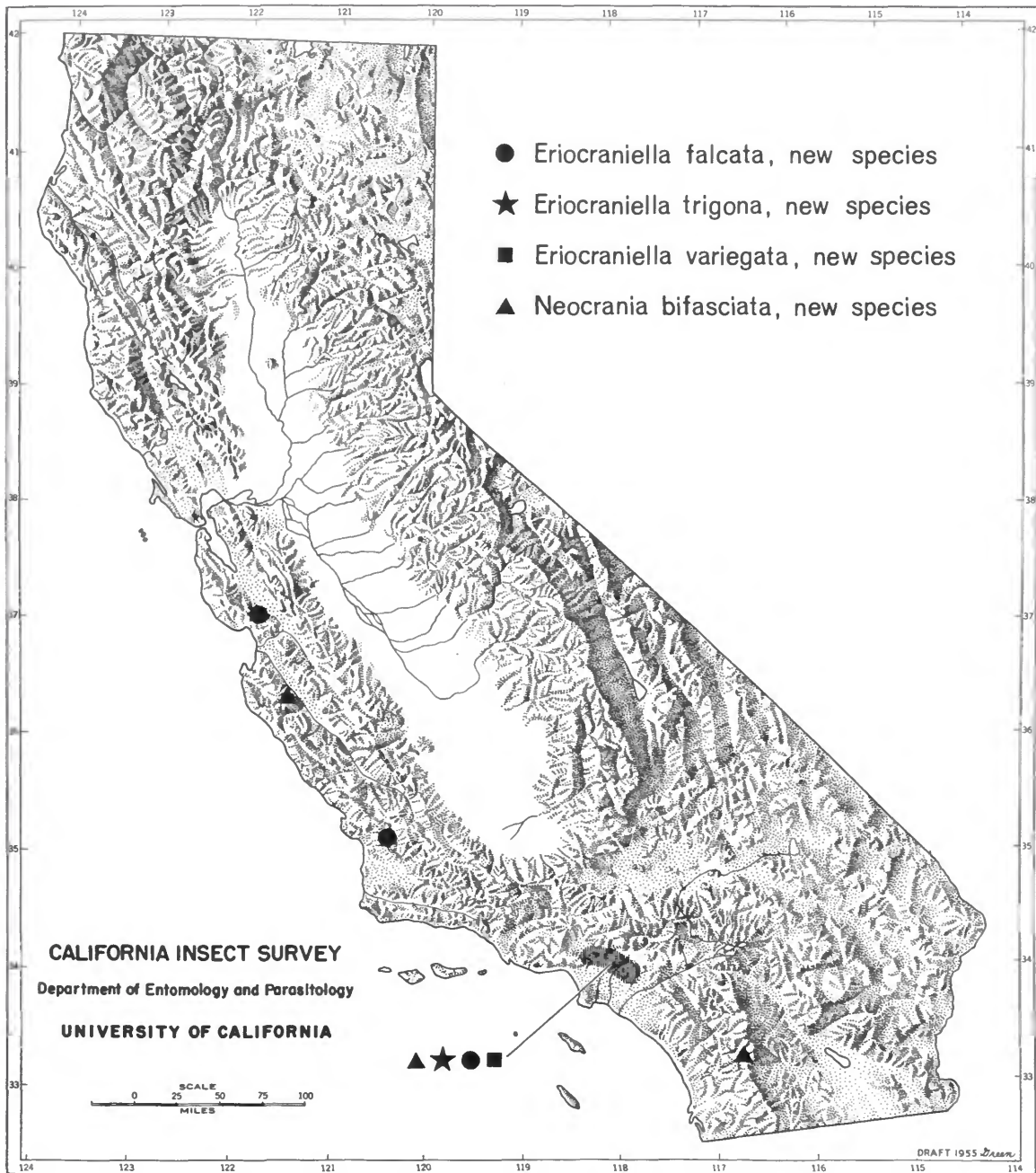
Structurally, *E. variegata* is most similar to *E. trigona*, new species, but the two may be readily distinguished by the different form of their aedeagi. The ventral phallic branch of *E. variegata* is more slender and possesses a much smaller subapical lobe. Their vaginal sclerites may also be distinctive, but the female of *E. trigona* has yet to be collected and studied.

Eriocraniella (Disfurcula) trigona, new species

FIGURES 172, 205–206, 238, 275–276; MAP 5

ADULT (Figure 172).—*Wing Expanse*: ♂, 6–8 mm.

Head: Sparsely covered with whitish hairs. Antennae relatively short, approximately 0.48–0.52 the length of forewing, 35- to 38-segmented; scape silvery white above, mostly fuscous below; flagellum uniformly brownish fuscous except for terminal 6–7



MAP 5.—Distribution of *Eriocraniella* (subgenus *Disfurcula*) and *Neocrania*.

segments, which are sparsely covered with slender white scales. Maxillary palpi light brownish fuscous; apex of terminal segment with 3 distinct series of lobes: (a) 1 relatively large terminal lobe bearing 3 short and 1 long setae, (b) a pair of shorter, slightly more subapical lobes, each bearing 1 long seta, (c) a pair of very short lobes, each bearing 1 long seta. Base of galeae naked except for grayish white pubescence. Labial palpi brownish fuscous, irrorated with white.

Thorax: Dorsum light brownish fuscous to stramineous, with a slight bronzy luster; tegulae with long, pale brownish hairs. Venter silvery white. Pro- and mesothoracic legs fuscous above, light gray ventrally; metathoracic legs mostly whitish to gray. Forewings and fringe uniformly fuscous with a bronzy to purplish iridescence; Sc simple. Hind wings paler in color, more grayish and less iridescent; scales moderately broad.

Abdomen (Figure 238): Sparsely covered with long brownish fuscous, hairlike scales above, paler, more grayish ventrally. Fourth sternite of male without fenestrae. Sternal tubercles present on 5th sternite, papiliform; diameter approximately 0.2 the length of sternite.

Male Genitalia (Figures 275–276): Uncus deeply bilobed; lobes elongate, strongly curved outward; apices widely separated for a distance approximately equal to their length. Anal tube mostly membranous, with a few scattered, minute spinules, without basal sclerites. Vinculum with median, caudal margin produced into a moderately large, conical lobe; margin distinctly excavated on either side of median lobe; apophyses relatively short, approximately 0.6 the length of undivided vinculum; cephalic margin of vinculum between apophyses smoothly concave, not extended. Juxta broadest anteriorly, narrowing slightly to broad, shallowly concave caudal end; greatest width of juxta about 0.9 its length. Base of aedeagus moderately swollen; secondary phallic branch loosely articulated to base, stout, nearly equaling primary branch in diameter; caudal end of secondary branch with a large, triangular subapical projection; primary branch with a similar, though broader and less pronounced, subapical process.

HOLOTYPE.—♂, Josephine Creek, San Gabriel Mts, T2N, R12W, Sec 6, elev. 3350 ft [1021 m], Los Angeles County, California, 18 May 1973, Blacklite, D. C. Frack, ♂ genitalia slide DRD 2962, pho-

tograph on file USNM; in the Los Angeles County Museum.

PARATYPE.—UNITED STATES. CALIFORNIA: Los Angeles Co: Josephine Cr, 3300 ft [1006 m] on Angeles Crest Hwy: 1 ♂, 11 May 1974, R. H. Leuschner, ♂ genitalia slide DRD 2993, wing slide DRD 3001 (RHL). Described from 2 males.

HOST.—Unknown.

FLIGHT PERIOD.—Mid-May; univoltine.

DISTRIBUTION (Map 5).—This species is presently known from only two adjacent localities in the San Gabriel Mountains of Los Angeles County, California, at elevations of slightly over 1000 meters.

DISCUSSION.—Only two specimens of this species, both males, have been examined. The paratype was unspread and in poor condition (and has now been largely dissected); the holotype is somewhat rubbed but with most scale characteristics still discernible. The species is easily characterized by the male genitalia, particularly the aedeagus. Both branches of the aedeagus possess prominent subapical processes, with that of the ventral branch being the most pronounced. The triangular shape of the latter has suggested the specific name that is derived from the Greek *trigonos* (triangular).

Eriocraniella trigona appears most related to *E. variegata*, new species. The two may be distinguished by the different form of the ventral branch of their aedeagi, with that of *E. trigona* being stouter and possessing a much larger subapical process.

Eriocraniella (Disfurcula) falcata, new species

FIGURES 64–65, 163–164, 173, 207–208, 239–240, 248, 273–274, 323–325, 341; MAP 5

Dyseriocrania species Opler, 1974:4

ADULT (Figure 173).—*Wing Expanse:* ♂, 7–10 mm; ♀, 7–10 mm.

Head: Relatively sparsely covered with white to cream white hairs. Antennae moderately long, 0.55–0.6 the length of forewing, 40–45 segmented; scape mostly cream white, slightly irrorated with fuscous ventrally; flagellum almost entirely fuscous except for dorsal suffusion of white over basal 5–6 segments and for slender white scales over apical 5–7 segments. Maxillary palpi brownish fuscous, frequently suffused heavily with silvery white ven-

trally; apex of terminal segment with a single, relatively large apical lobe bearing one large, bluntly rounded seta and 3 smaller, more acute setae of variable lengths, and 2 pair of smaller subapical lobes, each bearing a single, elongate acute seta apically; all setae with striated sides. Base of galeae mostly naked, sometimes with scattered, narrow whitish scales. Labial palpi brownish fuscous above, silvery white ventrally.

Thorax: Dorsum uniformly light bronzy brown; tegulae with an elongate tuft of cream white hairs. Venter mostly silvery white. Legs cream white to stramineous except for dorsum of tibial and tarsal segments of forelegs. Forewings uniformly bronzy brown, often with a pale golden luster; fringe brownish at base, becoming paler and whiter toward outer edge; Sc usually divided, crossvein r present. Hind wings slightly darker than forewings, less iridescent but with a slight purplish luster, becoming darker toward outer margins; scales relatively broad, particularly over outer half; crossveins m and m-cu present.

Abdomen (Figures 239–240): Sparsely covered with slender bronzy brown, hairlike scales above, whitish ventrally. Fourth sternite of female with a pair of relatively small, nearly circular fenestrae approximately 0.3 the length of sternite in diameter; male without fenestrae. Sternal tubercles present on 5th sternite of both sexes, papiliform, diameter approximately 0.17–0.22 the length of sternite. Caudal apex of 8th sternite sharply defined in female, normally bifurcate, though occasionally merely concave; apex of 8th tergite deeply divided.

Male Genitalia (Figures 273–274): Uncus deeply bilobed; lobes prominent, lateral margins straight but tapering; lobes widely separated at apex for a distance equivalent to their length. Anal tube membranous, without basal sclerites. Vinculum with median caudal margin not raised, relatively truncate; median cephalic margin between apophyses smoothly concave, not extended, apophyses elongate, approximately 0.73–0.77 the length of undivided vinculum. Juxta broadest immediately anterior to middle; lateral margins nearly parallel; greatest width approximately 0.45–0.6 its length; caudal apex subtruncate to slightly rounded (convex). Base of aedeagus moderately swollen; ventral phallic branch relatively stout, approximately equal in diameter and length to dorsal branch; apex of

ventral branch acute, with a small spinose process loosely articulated subapically; length of subapical process varying from 0.5–1.2 the diameter of ventral phallic branch; remainder of ventral branch without lobes or processes.

Female Genitalia (Figures 323–325, 341): Apex of ovipositor acuminate; lateral edges serrulate, with 5–7 minute teeth. Bursa copulatrix of moderate length, slightly surpassing cephalic apices of posterior apophyses when extended; walls of corpus bursae entirely membranous. Bases of anterior apophyses symmetrical, not unusually swollen. Vaginal sclerite darkly sclerotized, relatively narrow and elongate with greatest width only 0.24–0.27 its length; a prominent, falcate ventral keel present along midline, with apex projecting caudally as shown in Figure 325.

HOLOTYPE.—♂, Cloudburst Canyon, San Gabriel Mts, T2N, R12W, Sec 14, 4000 ft [1220 m], Los Angeles County, California, 10 May, 1972, J. P. and K. E. Donahue; in the Los Angeles County Museum.

PARATYPES.—UNITED STATES. CALIFORNIA: Los Angeles Co: Big Tujunga Canyon, 3300 ft [1006 m] on Angeles Crest Hwy: 1 ♂, 1 ♀, 11 May 1973, R. H. Leuschner (RHL). Cloudburst Canyon, San Gabriel Mts, T2N, R12W, Sec 14, 4000 ft [1220 m]: 1 ♂, 2 ♀, 30 Apr–10 May 1972, J. P. and K. E. Donahue (LACM). Josephine Cr, San Gabriel Mts, T2N, R12W, Sec 6, 3350 ft [1021 m]: 7 ♂, 14 ♀, 9 May 1973, J. P. and K. E. Donahue, ♂ genitalia slide DRD 2998, ♀ genitalia slide DRD 2999 (LACM); 1 ♂, 1 ♀, 9 May 1973, J. P. and K. E. Donahue, ♂ genitalia slide USNM 18184, ♀ genitalia slide USNM 18189 (USNM); 1 ♂, 11 May 1974 D. C. Frack (DCF); 9 ♂, 1 ♀, 18 May 1973, D. C. Frack (DCF); 1 ♂, 18 May 1973, D. C. Frack (USNM). Josephine Cr, 3300 ft [1006 m] on Angeles Crest Hwy: 12 ♂, 2 ♀, 11 May 1973, R. H. Leuschner (RHL); 3500 ft [1067 m]: 1 ♂, 11 May 1973, R. H. Leuschner, ♂ genitalia slide DRD 3003 (RHL). Mt. Wilson Rd, 4600 ft [1402 m] on Angeles Crest Hwy: 1 ♂, 11 May 1973, R. H. Leuschner, ♂ genitalia slide USNM 18159 (USNM). Littlerock: 1 ♂, 28 Mar 1964, P. Opler, ♂ genitalia slide DRD 2901 (UCB). 3000 ft [915 m] on Angeles Crest Hwy: 5 ♂, 2 ♀, 11 May 1973, R. H. Leuschner (RHL); 1 ♂, 2 ♀, 11 May 1973, R. H. Leuschner, ♂ genitalia slide USNM 18186, ♀ genitalia slide USNM 18188 (USNM). San Luis Obispo Co: San Luis Obispo: 1 ♀, March, A. Vachell, ♀ genitalia slide USNM 18205 (USNM). Santa Clara Co: Herbert Cr, 3 mi [4.8 km] W New Almaden: 2 ♀, 28 Apr 1969, P. Opler, *Quercus chrysolepis*, ♀ genitalia slides PAO 87, DRD 2957 (UCB); 1 ♀, 28 Apr 1969, P. Opler, *Quercus chrysolepis*, ♀ slides USNM 16102, 18194 (USNM); 1 ♀, 18 Apr 1969, J. Powell, flying under *Q. agrifolia* 12:00 noon, ♀ genitalia slide DRD 2975 (UCB). Described from a total of 43 males and 30 females.

HOST.—Fagaceae: "*Quercus chrysolepis* Liebm.," Opler (1974) and from specimen labels.

FLIGHT PERIOD.—Late March to mid-May; univoltine.

DISTRIBUTION (Map 5).—This species occurs through the Coast Ranges of Central California from Santa Clara County south to the San Gabriel Mountains of Los Angeles County, where it is found at elevations up to 1400 m.

DISCUSSION.—This species presently stands relatively alone among our North American Eriocraniidae; consequently, it is not likely to be confused with any known species. Although amply distinct on a specific level, the generic relationships of *Eriocraniella falcata* are not as well defined. As expressed earlier in this paper, the overall morphology of this species, particularly as witnessed in the general structure of the maxillary palpi, and male and female genitalia, suggests strong affinities with the subgenus *Disfurcula*. The rather complex and specialized structure of the apex of the maxillary palpi is identical to the other members of *Eriocraniella*. The wing venation is somewhat atypical for *Eriocraniella* and instead resembles that of *Neocrania bifasciata*, particularly in the forking of the subcostal vein and the presence of certain crossveins in the forewings (r) and hind wings (m, m-cu). The relatively straight and gradually tapering lobes of the uncus in the male genitalia are also atypical for *Eriocraniella* and, instead, more resemble those of *Eriocrania*. There is, however, no median extension of the vinculum between the apophyses that appears to be characteristic of the latter genus. The absence of the median furcate process, or furcula, is another feature that associates *E. falcata* with the subgenus *Disfurcula*. The aedeagus of this species is unique in possessing a rather loosely appended, variably shaped spinose process near the apex of the ventral phallic branch. The female genitalia, particularly the apex of the ovipositor, closely resemble that of the other members of *Eriocraniella*. The females, however, are easily distinguished from all other eriocraniine species by the prominent, sickle-shaped keel of the vaginal sclerite, a unique feature that has suggested the specific name, *falcata*, which is derived from the Latin, *falcatus* (sickle-shaped or curved).

Eriocraniella falcata is the only eriocraniid known to mine leaves of *Quercus chrysolepis*. Mine damage on six leaves of *Quercus chrysolepis* be-

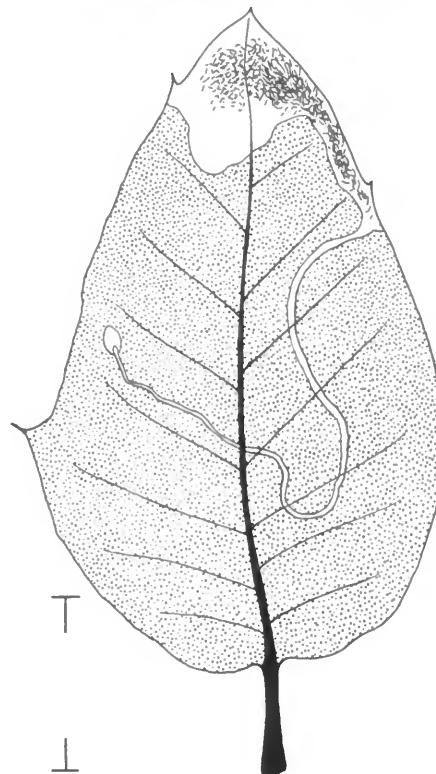


FIGURE 163.—Leaf mine of *Eriocraniella* ?*falcata*, new species, on *Quercus chrysolepis* Liebm. (Scale = 10 mm.)

lieved to be caused by *E. falcata* have been examined. The early instar linear mine appears to be unusually long and in one leaf (Figure 163) extremely long. A typical, elliptical hole is produced in the leaf at the site of oviposition with the characteristic brownish egg pouch (Figure 164) attached along one side. The linear mine continues to the leaf margin and then abruptly enlarges to form a full depth blotch usually covering the apical third to one-fifth of the leaf.

Neocrania, new genus

TYPE-SPECIES.—*Neocrania bifasciata*, new species.

ADULT.—Small moths with relatively broad wings; wing expanse: 7–10 mm.

Head: Maxillary palpi with basal 0.8–0.9 of terminal segment densely setose; primary setae

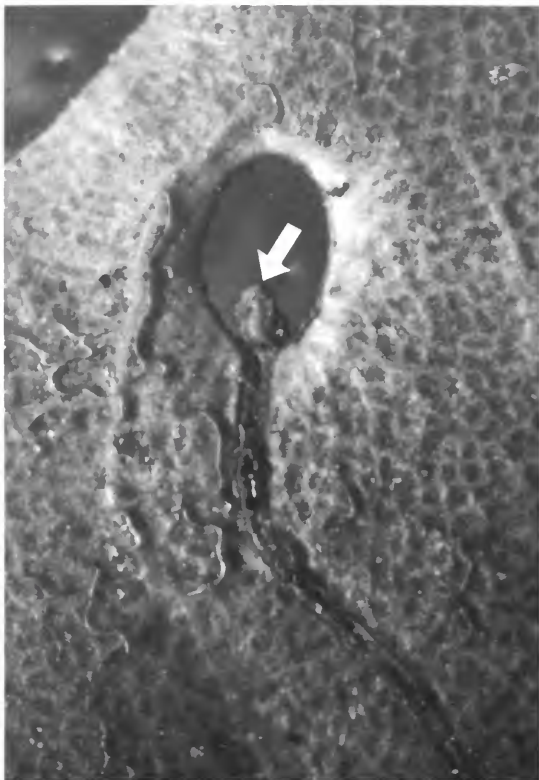


FIGURE 164.—Leaf mine of *Eriocraniella ?falcata*, new species, on *Quercus chrysolepis* Liebmann showing oviposition scar and egg pouch (see arrow).

barbed laterally; apical 0.2–0.1 of segment largely naked, divided to form 2 relatively large, subacute lobes, one slightly shorter than the other; each lobe bears 4 stout, moderately long setae with striated sides; 1 pair of setae typically arise from extreme apex of each lobe and the 2nd pair arise more subapically; setae approximately equal in size, with a length not greater than the diameter of the lobe from which they arise.

Thorax: Epiphysis present. Forewings with Sc often superficially divided near costa; R1 divided approximately 0.4 its length; R2, 3, 4, and 5 all arising separate from cell; crossvein r present. Hind wings with Sc and R1 simple; R2 and 3 entirely fused; R4 and 5 either connate or separate; crossveins m and m-cu present; scales relatively short and broad, not hairlike.

Abdomen: Third sternite with a pair of slender, triangular fenestrae near anterior margin. Fourth

sternite without fenestrae. Sternal tubercles present on 5th sternite of both sexes, similar in form, relatively small, papiliform.

Male Genitalia: Uncus prominently bilobed; lobes broad, relatively short, and narrowly separated. Socii present. Anal tube completely membranous, without basal sclerites. Vinculum with caudal margin produced into a prominent median lobe; cephalic margin evenly concave between elongate lateral apophyses, without a median process. Caudal apex of juxta symmetrical, subtruncate to slightly convex. Aedeagus with ventral phallic branch very irregular in outline and with a cluster of several subapical cilia.

Female Genitalia: Anterior apophyses asymmetrical at base. Vaginal sclerite with cephalic end developed to form a relatively broad, elongate process ventrally.

DISCUSSION.—This monotypic genus exhibits several apomorphies, some of which may eventually be regarded only as of specific importance. *Neocrania* appears to represent a specialized offshoot of the predominantly western North American genus *Eriocraniella*. It differs from the latter in several peculiarities of the maxillary palpi, abdomen, and male and female genitalia.

The maxillary palpi are unique among the Nearctic Eriocraniidae in possessing a bifid apex, with each lobe bearing four moderately long setae. Only two other members of this family, the European *Eriocrania sangii* and *E. haworthi* are known to possess a bilobed palpal apex. This condition in both species is obviously independently derived, as the chaetotaxy of the terminal segment agrees in all respects with typical *Eriocrania*. In *Eriocraniella*, the apex appears more complex than that of *Neocrania* in consisting of one rather large apical lobe and two pair of progressively smaller more subapical lobes. The derivation of both types of sensory structures from an immediate, common ancestral model seems evident, however, in that a total of eight striated setae are present in the members of both genera. The somewhat more complex palpal apex demonstrated by *Eriocraniella*, for example, could have been derived from the bifid type possessed by *Neocrania* through further division of one of the two large lobes of the latter, resulting in two pair of smaller lobes, each bearing one large seta.

Neocrania further demonstrates its close ties with *Eriocraniella* through strong venational similarities

with *Eriocraniella falcata*. The venational pattern of *N. bifasciata* and *E. falcata* together differ from the other known members of *Eriocraniella* in typically possessing a forked subcostal vein in the forewings and a fuller complement of crossveins.

As typified by *N. bifasciata*, the male and female genitalia of *Neocrania* exhibit some unusual specializations not known to occur in other eriocraniid genera. For example, the ventral phallic branch of the male bears a series of elongate, filamentous subapical setae. Similarly, in the female, the anterior apophyses are asymmetrical with the basal region of the left member being noticeably expanded. The vaginal sclerite differs from the typical form in *Eriocraniella* by lacking a midventral keel and by having the cephalic half of the sclerite deflected sharply ventrad.

The prefix *neo-* in the generic name *Neocrania* is derived from the Greek *neos* (new) and is intended to refer to the general distribution of the group, which is known only from the New World. The generic name has been treated feminine in gender.

Neocrania bifasciata, new species

FIGURES 178, 209–210, 242–243, 249, 279–280, 326–328, 338;
MAP 5

ADULT (Figure 178).—*Wing Expanse*: ♂, 8–9 mm; ♀, 7–10 mm.

Head: Covered with whitish to pale stramineous hairlike scales. Antennae moderately long, approximately 0.52–0.60 the length of forewing, 42- to 44-segmented; scape entirely whitish to stramineous; flagellum usually uniformly whitish to stramineous, occasionally banded dorsally with brownish fuscous. Maxillary palpi whitish to light brown; apex of terminal (5th) segment divided into 2 relatively large lobes of almost equal size (Figure 210); each lobe with an apical pair and a subapical pair of moderately long striated setae; length of setae approximately equal to diameter of supporting lobe. Base of galeae nearly naked, sparsely covered with short whitish hairs. Labial palpi whitish to stramineous, lightly irrorated with pale brownish hairs ventrally.

Thorax: Dorsum stramineous, occasionally more whitish laterally near the wing bases; tegulae usually entirely stramineous. Venter silvery white. Legs mostly whitish to stramineous, sometimes with

tibiae brownish fuscous above; tarsi ringed with brownish fuscous. Forewings pale brownish fuscous with a golden iridescence; wings crossed by a pair of broad, golden fasciae; one situated at base, the other, more irregular fascia, across middle of wing; a series of 6–8 small, golden submarginal spots sometimes evident along termen from R2 to tornus; fringe pale brownish fuscous. Hind wings slightly darker than forewings, more fuscous and sometimes with a slight purplish sheen; scales relatively broad.

Abdomen (Figures 242–243): Sparsely covered with long stramineous hair above, more whitish ventrally. Fourth sternite without fenestrae in both sexes. Sternal tubercles present on 5th sternite of both sexes, diameter approximately 0.15–0.16 the length of sternite. Caudal apices of 8th tergite and sternite in female entire, not deeply clefted.

Male Genitalia (Figures 279–280): Uncus shallowly bilobed; lobes large, broadly rounded, rather narrowly separated at apex for a distance about 0.75 their length. Anal tube entirely membranous, without basal sclerites. Vinculum with median area of caudal margin produced into a broad conical lobe; apophyses slender, elongate, approximately equaling the length of undivided vinculum; cephalic margin of vinculum between apophyses smoothly concave, not extended. Juxta broadest anteriorly, tapering slightly to broad, truncate caudal end; greatest width of juxta about 1.4 its length. Base of aedeagus moderately swollen; secondary phallic branch stout, its diameter nearly equaling that of primary branch; apex of secondary branch irregular, somewhat sinuate, with a series of 8–11 long, slender setae.

Female Genitalia (Figures 326–328, 338): Apex of ovipositor acute; lateral edges serrulate, with 9–12 minute teeth. Caudal bases of anterior apophyses asymmetrical with left apophysis broadly expanded at juncture with 8th tergite. Bursa copulatrix of moderate length, only slightly surpassing cephalic apices of posterior apophyses when fully extended; walls of corpus bursae entirely membranous, without spines. Vaginal sclerite darkly sclerotized, relatively elongate, narrow; greatest width approximately 0.42–0.45 the length of sclerite; a broad elongate, tapering keel extending ventrally from cephalic end of sclerite as in Figure 328.

HOLOTYPE.—♀, Josephine Creek, San Gabriel Mts, T2N, R12W, Sec 6, elevation 3350 ft [1021 m], 9 May 1973, J. P. and K. E. Donahue, ♀ genitalia

slide DRD 3002, photograph on file USNM; in the Los Angeles County Museum.

PARATYPES.—CALIFORNIA: Los Angeles Co: Josephine Cr, San Gabriel Mts, T2N, R12W, Sec 6, 3350 ft [1021 m]: 2 ♂, 5 ♀, 6–9 May 1973, J. P. and K. E. Donahue (LACM); 2 ♂, 2 ♀, 6–11 May 1973, J. P. and K. E. Donahue, USNM slides 18174, 18181, 18182, 18187, 18207 (USNM); 5 ♀, 11 May 1974, (DCF). Josephine Cr, 3300 ft [1006 m] on Angeles Crest Hwy: 1 ♂, 11 May 1974, R. Leuschner, ♂ genitalia slide DRD 2992 (RHL); 1 ♀, 11 May 1974, R. Leuschner, ♀ genitalia slide USNM 18190 (USNM). 3000 ft [915 m] on Angeles Crest Hwy: 1 ♂, 2 ♀, 11 May 1974, R. Leuschner (RHL). Monterey Co: 1 air mi [1.6 km] S Jamesburg, Santa Lucia Mts, 2900 ft [884 m]: 1 ♂, 1 ♀, 8 May 1975, on *Quercus chrysolepis*, J. Powell and J. Chemsak (UCB); 1 air mi [1.6 km] S Jamesburg, 2900 ft [884 m]: 1 ♀, 5 May 1975 (UCB); 1 ♂ (same data), USNM genitalia slide 18259 (USNM). San Diego Co: Nate Harrison Grade Rd, near Mt Palomar, 4700–5000 ft [1435–1524 m]: 2 ♀, 2 June 1968, assoc. with Black light, C. Beesley (UCR); 1 ♀, same data, USNM slide 20203 (USNM). Described from a total of 8 males and 21 females.

HOST.—Unknown; possibly *Quercus chrysolepis* Liebm.

FLIGHT PERIOD.—Early June; univoltine.

DISTRIBUTION (Map 5).—This species is known only from the Coast Ranges of southern California, where it occurs from the Santa Lucia Mountains of Monterey County south to the San Gabriel Mountains of Los Angeles County and Mt. Palomar in San Diego County. All the specimens collected thus far were found between 850 and 1525 m in elevation.

DISCUSSION.—*Neocrania bifasciata* is one of the most colorful and, hence, recognizable members of this family. The pair of golden fasciae traversing the forewings easily distinguishes the species from all other Eriocraniidae. The male genitalia are unique in several respects, particularly with regard to the short, broad lobes of the uncus and the peculiar ciliate setae arising near the apex of the ventral phallic branch. The female is similarly unusual in being the only known North American eriocraniid without abdominal fenestrae on the fourth sternite and with asymmetric anterior apophyses.

The specific name is derived from the Latin *bi* (two) and *fascia* (band) and refers to the characteristic banding on the forewings of this moth.

Although the immature stages of this species have yet to be discovered, it is possible that the larvae may feed on *Quercus chrysolepis*. Adults were collected resting on this plant in early May by Powell and Chemsak.

ACANTHOPTEROCTETIDAE, new family

TYPE GENUS.—*Acanthopteroctetes* Braun.

ADULT.—Moths of moderately small size, wing expanse 11–16 mm. Wings very slender.

Head: Vertex not elongate; laterofacial sulci obsolete. Ocelli absent. Compound eyes relatively large; interocular index approximately 0.75–0.80; eyes situated more laterally. Mandibles vestigial, nearly absent. Apex of terminal (5th) segment of maxillary palpi relatively simple, without secondary lobes. Labial palpi 2-segmented, short, approximately equal to 1st segment of maxillary palpi in length; apex of distal segment relatively simple, without organs of von Rath and basiconic sensilla.

Thorax: Prothoracic legs relatively long; foretibiae approximately 0.42–0.46 the length of hind tibiae; epiphysis absent. Forewings very slender, width approximately 0.19–0.20 the length; Sc simple, not divided; radius with 4 primary branches; R3 absent; R1 secondarily divided for most its length; pterostigma absent; R4 stalked with R5 for nearly two-thirds their length; M1 stalked to R4+5; anal veins widely separate to margin; 3A very short, closely associated with jugal fold. Hind wings with Sc and R1 simple; radius with 4 primary branches; R3 absent; R4 and 5 and M1 stalked as in forewings; lower half of distal cell open due to atrophy of medial-cubital crossvein; scales typically long and hairlike.

Abdomen: Pleural area of 3rd segment either unmodified or with a bilateral pair of filamentous appendages (Figure 165). Fourth and 5th sternites unmodified, without paired fenestrae or glandular tubercles. Eighth segment of female with a single row of elongate setae arising from caudal margin and projecting caudad; setal row encircling segment with setae more elongate dorsally than ventrally.

Male Genitalia: Uncus superficially bifid, lateral margins revolute, serrulate, or spinose near apex. Socii absent. Caudal margin of vinculum relatively deeply concave or excavate; cephalic margin shallowly concave; lateral angles only slightly evident, not produced into elongate apophyses. Anellus with two separate areas of sclerotization surrounding aedeagus: a darkly sclerotized, dorsal transtilla and a thinner, less sclerotized juxta ventrally; transtilla in the general form of an inverted T with a prominent, elongate median process extending caudad almost to apex of uncus; apex of median pro-

ess with an acute, uncinatè apex curving dorsally; ventral subapical margin of medium process serrulate; base of transtilla abruptly expanded laterally toward, but separate from, bases of valvae. Juxta of various form, typically consisting of a thin elongate plate, slightly broader at the middle. Valvae slender, greatest width approximately one-fourth the length, elongate with apices surpassing apex of uncus and relatively simple except for a narrow, membranous fringe along ventral margin. Aedeagus undivided, relatively stout, with a prominent and complex array of endophallic cornuti.

Female Genitalia: Corpus bursae relatively reduced in size, ductus bursae and vagina with thickened, folded walls. Common oviduct arising either ventral or lateral to bursa copulatrix and somewhat posterior to spermathecal papilla. Spermatheca entirely membranous, without an internal thickening in ductus spermathecae; spermathecal papilla either strongly sclerotized or largely membranous. Vaginal sclerite absent. Colleterial gland arising from dorsal wall of vagina caudad of vestibulum. Posterior apophyses with tertiary, closely associated rodlike sclerites in 10th segment. Ninth segment entirely membranous except for spinose ridges.

Acanthopteroctetes Braun

Acanthopteroctetes Braun, 1921:22.—Tillyard, 1923:195.—Philpott, 1926:723.—Fletcher, 1929:2.—McDunnough, 1939:110.—Viette, 1949:32.—Davis, 1969:137, 138.—Mutuura, 1971:1129.—Common, 1973:11, 13, 16.—Dugdale, 1974:127, 132, 134, 142.—Birket-Smith and Kristensen, 1974:158, 159.—Razowski, 1975:36.

TYPE-SPECIES.—*Acanthopteroctetes tripunctata* Braun; by monotypy.

Generic characters as for family Acanthopteroctetidae.

DISCUSSION.—Although this endemic North American genus presently contains only three named species, at least two other species may exist. The latter have not been named because both are represented by unique females in poor condition. One of these, mentioned previously by Braun (1921) and Davis (1969), consists of a single female collected at Monache Meadows, Tulare County, California from an elevation of 8000 ft [2439 m] on 10 July 1917. The female genitalia closely resemble that of *A. bimaculata* except for the form of the spermathecal papilla. The papilla of the Monache Meadows specimen is less sclerotized and more elongate and cylindrical in shape. The specimen possesses a wing expanse of 13 mm and appears to be a relatively pale, uniformly colored moth.

A second unnamed species was collected 8 July 1966 by J. H. Baker from Spring Creek, Baker, Oregon. This locality is also the original source of the type series of *A. bimaculata*. Although the unique female specimen was badly broken in shipment to the Smithsonian Institution (where it is now deposited), most of its diagnostic features can easily be observed. The forewings of this species are distinct in being uniformly pale golden brown, and the head vestiture is stramineous in color. The female genitalia differs greatly from that of other known members of the genus in possessing a more broadly depressed and irregularly lobed vestibulum (Figure 332). The spermathecal papilla is indistinct and unsclerotized. The common oviduct apparently enters the vestibulum at a more typical (for this family) midventral position.

Key to the Species of *Acanthopteroctetes*

1. Forewings pale grayish with two, rather large, fuscous spots along hind margin (Figure 180) *Acanthopteroctetes bimaculata*
- Forewings darker, with whitish to pale yellowish markings 2
2. Forewings with a single, narrow whitish fascia at distal third (Figure 181)
 *Acanthopteroctetes unifascia*, new species
- Forewings with three large, pale yellowish spots; two nearly confluent spots at distal third and another at basal third of wing (Figure 179) *Acanthopteroctetes tripunctata*

Acanthopteroctetes tripunctata Braun

FIGURES 179, 281–284; MAP 6

Acanthopteroctetes tripunctata Braun 1921:22.—Fletcher, 1929:2.—McDunnough, 1939:110, no 9857.—Viette, 1949:31.—Davis, 1969:140.

Acanthopteroctetes tripunctella [sic].—Davis, 1969:142 [misspelling of *tripunctata* Braun].

ADULT (Figure 179).—*Wing Expanse*: ♂, 11 mm.

Head: Vestiture pale reddish brown, unicolorous. Antennae pale fuscous; scape more whitish. Palpi pale brown.

Thorax: Scales of dorsum fuscous; bristlelike tufts on tegula pale fuscous; venter pale brown with slight suffusion of white. Legs fuscous. Forewings fuscous with a slight coppery luster; three large, pale yellowish spots, one at basal third of wing, two at apical third; outer pair nearly anastomosing to form an irregular and incomplete band across wing. Hind wings slightly paler, scales narrower, approximately one-half the width of those in forewings.

Abdomen: Fuscous.

Male Genitalia (Figures 281–284): Uncus not deeply bilobed, ventral margin (as viewed laterally) with approximately 4 pair of minute serrations. Tegumen relatively short, about same length as uncus. Caudal margin of vinculum with a deep V-shaped, median cleft. Median process of transtilla with 3–4 pair of ventral serrations. Juxta elongate, exceeding length of entire transtilla, acuminate at caudal end. Valvae with ventral membranous fringe reduced; sacculus more expanded than in *A. bimaculata*. Aedeagus with 2 stout cornuti at apex and a series of 3 aligned down 1 side.

TYPE.—Holotype ♂; in the collection of the Academy of Natural Sciences, Philadelphia.

TYPE-LOCALITY.—Glacier National Park, Montana, Canyon Creek, 5500 ft [1677 m].

HOST.—Unknown.

FLIGHT PERIOD.—July; probably univoltine.

DISTRIBUTION (Map 6).—Presently reported only from Glacier National Park, in the Rocky Mountains.

DISCUSSION.—This species is represented only by the unique holotype that was collected 23 July 1920, while flying in sunshine through an open area in the forest, by A. F. Braun.

Acanthopteroctetes bimaculata Davis

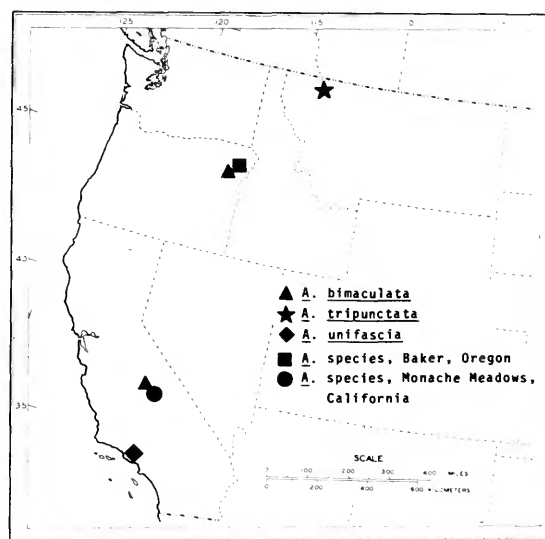
FIGURES 17–22, 33–34, 41–44, 47, 49, 53–55, 57, 69–70, 180, 217, 250, 254, 285–288, 329–330, 344; MAP 6

Acanthopteroctetes bimaculata Davis, 1969:140.

ADULT (Figure 180).—*Wing Expanse*: ♂, 14.5–16 mm; ♀, 15 mm.

Head: Vestiture consisting of a scattered mixture of white and fuscous hairlike scales. Antennae with 47–50 segments, banded along proximal half of flagellum, with scales of each segment brownish fuscous at base, white at apex; distal half of flagellum mostly fuscous; scape mostly whitish with pale suffusion of brown. Palpi sparsely covered with pale brown and whitish scales.

Thorax: Dorsum clothed with a scattered mixture of white and pale brownish scales; bristlelike scale tufts on tegulae and rear portion of mesonotum fuscous; venter mostly whitish. Legs fuscous. Forewings mostly white, with a somewhat irregular suffusion of pale brown to fuscous; two irregularly shaped but very distinct spots of fuscous located along hind margin near proximal third and distal third of wing; fringe whitish along outer margin, becoming pale brown along hind margin. Hind wings thinly scaled; scales very slender, hairlike,

MAP 6.—Distribution of *Acanthopteroctetes*.

less than one-fourth the width of those in primaries, pale brownish; fringe unicolorous, brownish.

Abdomen: Pale fuscous.

Male Genitalia (Figures 285–288): Uncus rather deeply bilobed; lower margins with approximately 5 pair of minute serrations. Tegumen relatively long, exceeding length of uncus. Caudal margin of vinculum less deeply excavated than in *A. tripunctata*. Median process of transtilla with 3–4 pair of ventral serrations. Juxta elongate, nearly equaling the length of valvae; basal 0.2 constricted with caudal 0.8 relatively broad and spatulate, and terminating in a broadly rounded apex; a pair of oval, hyaline spots slightly confluent at midline, present near basal one-third. Valvae with ventral membranous fringe prominent; sacculus less expanded than in *A. tripunctata*. Armature of aedeagus complex, with a single, large apical spine and two rows of approximately 10–12 stout cornuti at middle.

Female Genitalia (Figures 69–70, 329–330, 344): Apex of ovipositor with approximately 10 minute serrations along ventral margin. Caudal margin of 8th segment with a series of about 9 pair of stout, elongate, sensory setae encircling abdomen; the longest setae originating dorsally with series gradually decreasing in length toward venter and arising from rather large well-defined sockets. Vestibulum with thickened, heavily folded walls; common oviduct apparently arising from a large lateral lobe of vestibulum. Spermathecal papilla darkly sclerotized, funnel shaped. Corpus bursae relatively reduced in size, walls completely membranous; ductus bursae membranous, increasing in diameter toward vestibulum.

TYPE.—Holotype ♀, USNM 69929, in the National Museum of Natural History, Smithsonian Institution.

TYPE-LOCALITY.—Spring Creek, Baker, Baker County, Oregon.

HOST.—Unknown.

FLIGHT PERIOD.—May to mid-July; univoltine.

DISTRIBUTION (Map 6).—Known only from the Blue Mountains-Wallowa Mountains section of the Columbia Plateau in northeastern Oregon and the southern Sierra Nevada of east-central California.

MATERIAL EXAMINED.—2 males and 2 females. CALIFORNIA: Tulare Co: Monache (misspelled on label as Monacbec) Meadows, 8000 ft [2439 m]: 1 ♀ (paratype), 8–14 July (USNM). OREGON: Baker Co: Baker, Spring Cr: 1 ♂ (paratype), 7 May;

1 ♀ (holotype), 17 May (USNM); Spring Cr, Blue Mts, 4000 ft [1220 m]: 1 ♂, 13 May (USNM).

DISCUSSION.—*Acanthopteroctetes bimaculata* is easily distinguished from the other members of this genus by its pale grayish wings and dark fuscous spots. The large plate, or juxta, ventral to the aedeagus was originally described and illustrated in a folded condition within the male genitalia. Examination of an additional male specimen has enabled me to redescribe this structure in its more normal posture.

The common oviduct is described in this species as arising laterally from the vestibulum or the enlarged, thickened region of the vagina. A lateral origin for this tract has never been reported in any other species of Lepidoptera. A possible explanation for this apparent anomaly in *A. bimaculata* is that actually the common oviduct emerges ventrally (as is typical in the other members of this family) from a lateral lobe of the vestibulum. The latter region can be very irregularly lobed in this genus and a slight transfer of the common oviduct to one of these lobes seems possible. Further remarks concerning this will have to await the examination of additional female specimens in a better state of preservation.

Acanthopteroctetes unifascia, new species

FIGURES 165, 181, 289–292; MAP 6

ADULT (Figure 181).—*Wing Expanse:* ♂, 8.5 mm.

Head: Occipital area brownish fuscous; vertex whitish becoming darker on lower part of frons. Antennae uniformly brownish fuscous, including scape; length uncertain (antennae broken) but appearing at least 0.5 the length of forewing. Maxillary and labial palpi brownish fuscous.

Thorax: Dorsum and tegulae grayish fuscous with a distinct bronzy luster. Venter paler, silvery gray. Legs mostly light fuscous to gray. Forewings brownish fuscous with a bronzy iridescence; a very prominent, white transverse band across wing at outer third near apex of discal cell; a less distinct but relatively long spot present near hind margin at basal fourth; fringe light fuscous to gray. Hind wings nearly as dark as forewings but less iridescent, uniformly grayish fuscous.

Abdomen (Figure 165): Uniformly brownish fuscous with a slight bronzy luster; slightly paler,

more grayish beneath. Third segment of male with a cluster of small, filamentous sensilla (Figure 165) arising from pleural area near each spiracle.

Male Genitalia (Figures 289–292): Uncus bilobed with apex appearing truncate when viewed laterally; ventral margins with a subapical row of 4 pair of short stout spines. Tegumen long, nearly twice the length of uncus. Caudal margin of vinculum moderately excavated. Median process of transtilla with 6 pair of ventral serrations. Juxta relatively elongate, mostly membranous with sclerotized lateral margins. Valvae slender, greatest width 0.25 that of length; ventral membranous fringe reduced, restricted to apical half. Aedeagus slender, equaling length of entire genitalia; exterior walls densely pubescent around middle; cornuti of irregular form, consisting of a paired structure with apices subdivided and spinose.

HOLOTYPE.—♂, Circle X Ranch, B.S.A. Camp, 1500 ft [457 m], Ventura County, California, 24 April 1966, coll. J. Powell, ♂ genitalia slide DRD 2828, in the California Academy of Sciences on indefinite loan from the University of California, Berkeley.

HOST.—Unknown

FLIGHT PERIOD.—Late April; probably univoltine.

DISTRIBUTION (Map 6).—This species is known only from the type-locality, which is situated in the western sector of the Santa Monica Mountains, a coastal range in Ventura County, southern California.

DISCUSSION.—*Acanthopteroctetes unifascia* may be readily separated from the other members of this aberrant genus by its maculation, particularly by the single band, or fascia, traversing the forewing. The genitalia are characteristic in having the juxta and membranous fringe of the valvae reduced and the aedeagus with a reduced number of subapical cornuti. One of the most unique features of this species is the presence of a lateral triad of pedunculate sensilla (Figure 165) arising from a single, minute plate near the spiracle of the third abdom-

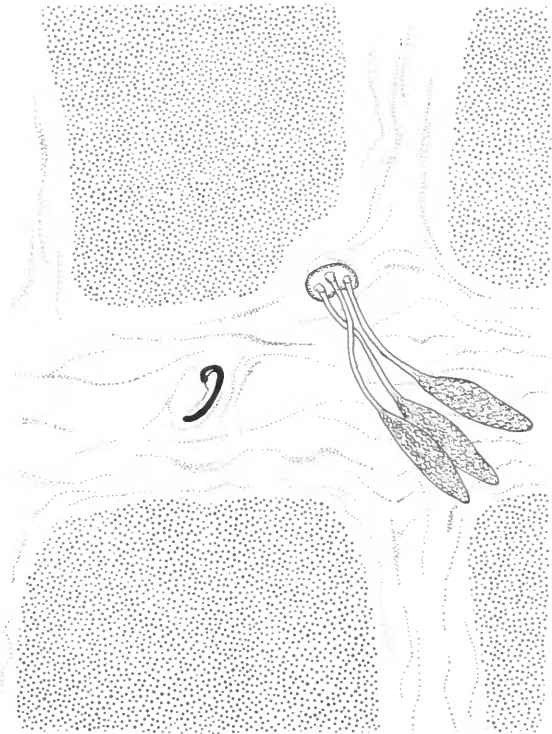


FIGURE 165.—*Acanthopteroctetes unifascia*, new species, pedunculate lateral glands of third abdominal segment.

inal segment. Each lateral plate appears to bear three sensilla consisting of a bulbous apical part supported by a filamentous stalk. Although the functions of these structures are not known, they appear glandular in nature and may be secretory, not sensory, in function.

Powell (in litt.) reports the habitat of the type-locality to be most similar to a dry chaparral. Consequently, this coastal locality differs strikingly from the wetter and more interior boreal habitats frequented by the other known members of this genus.

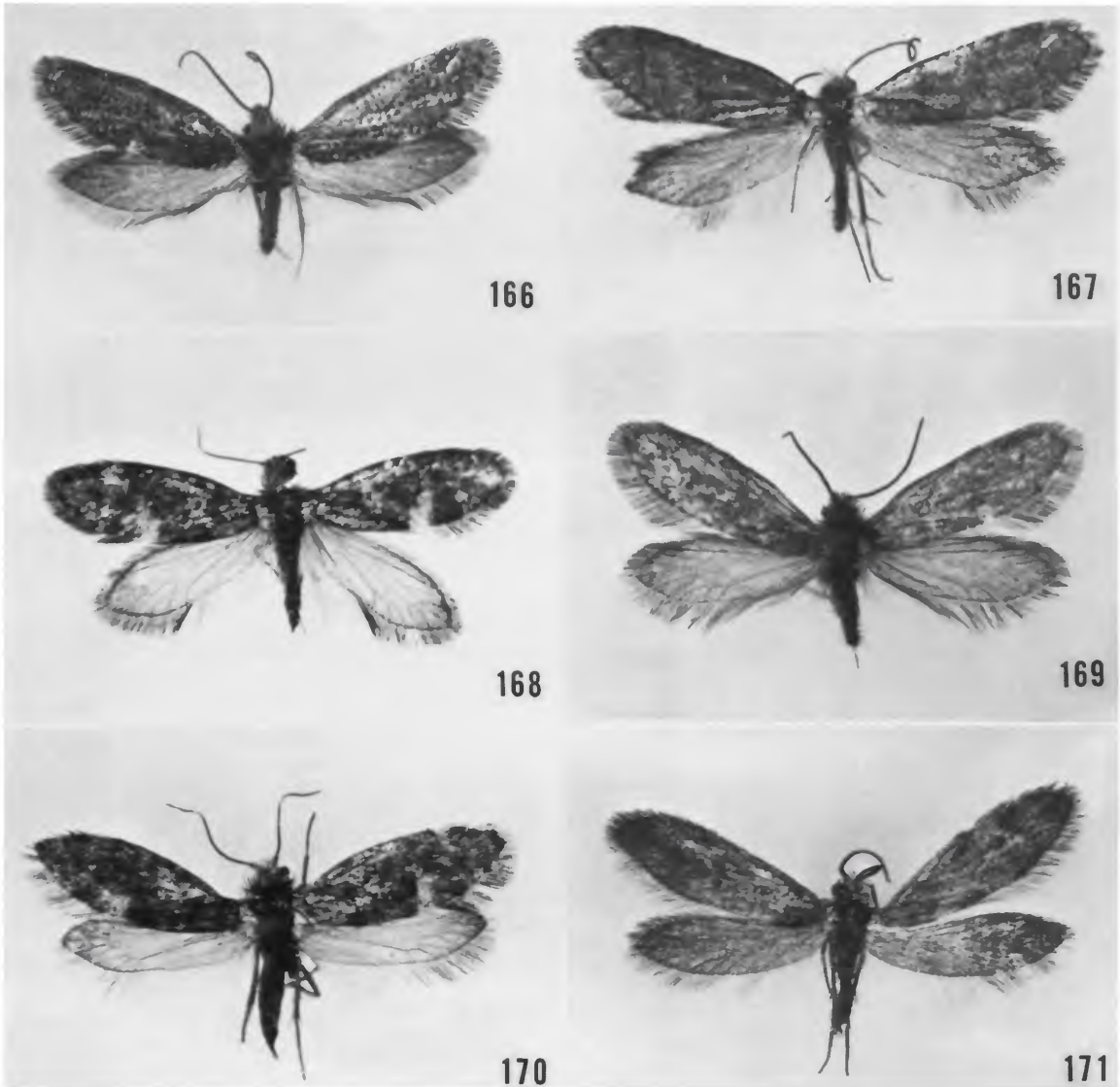
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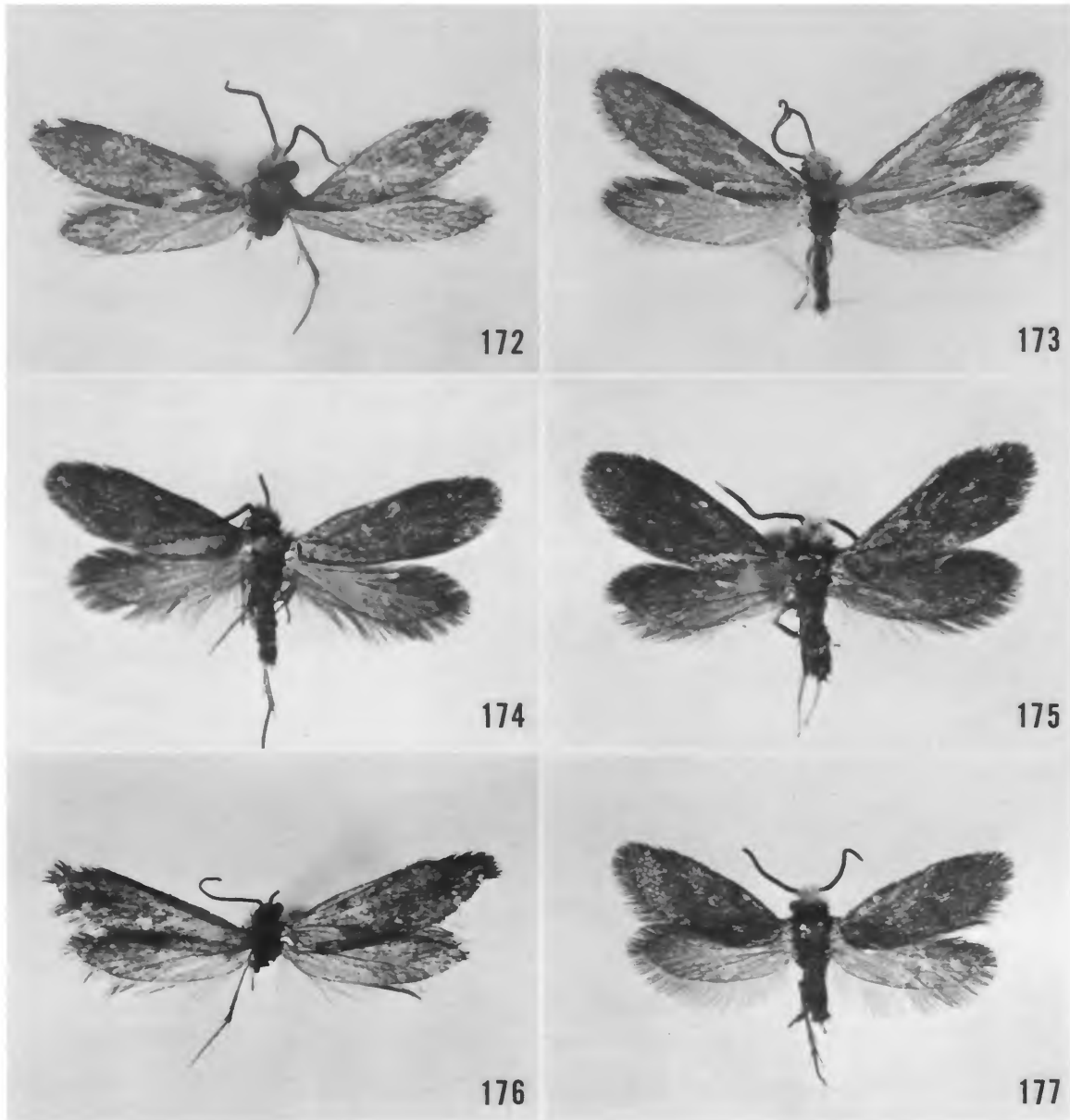
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FIGURES 166-171.—Adult moths: 166, *Dyseriocrania griseocapitella* (Walsingham), ♂, wing expanse 11.2 mm; 167, *D. auricyanea* (Walsingham), ♂, wing expanse 12.3 mm; 168, *Eriocrania semipurpurella semipurpurella* (Stephens) wing expanse 10.8 mm; 169, *E. s. pacifica*, new subspecies, ♂, holotype, wing expanse 10.6 mm; 170, *E. breviapex*, new species, ♀, holotype, wing expanse 9 mm; 171, *Eriocraniella variegata*, new species, ♂, holotype, wing expanse 9.1 mm.



FIGURES 172-177.—Adult moths: 172, *Eriocraniella trigona*, new species, ♂, holotype, wing expanse 6 mm; 173, *E. falcata*, new species, ♂, holotype, wing expanse 9.5 mm; 174, *E. aurosparsella* (Walsingham), ♂, wing expanse 9 mm; 175, *E. xanthocava*, new species, ♂, holotype, wing expanse 7.5 mm; 176, *E. longijuvula*, new species, ♂, holotype, wing expanse 10.2 mm; 177, *E. platyptera*, new species, ♂, holotype, wing expanse 7 mm.



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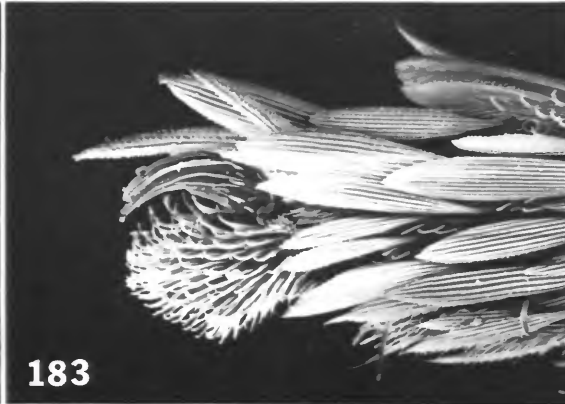
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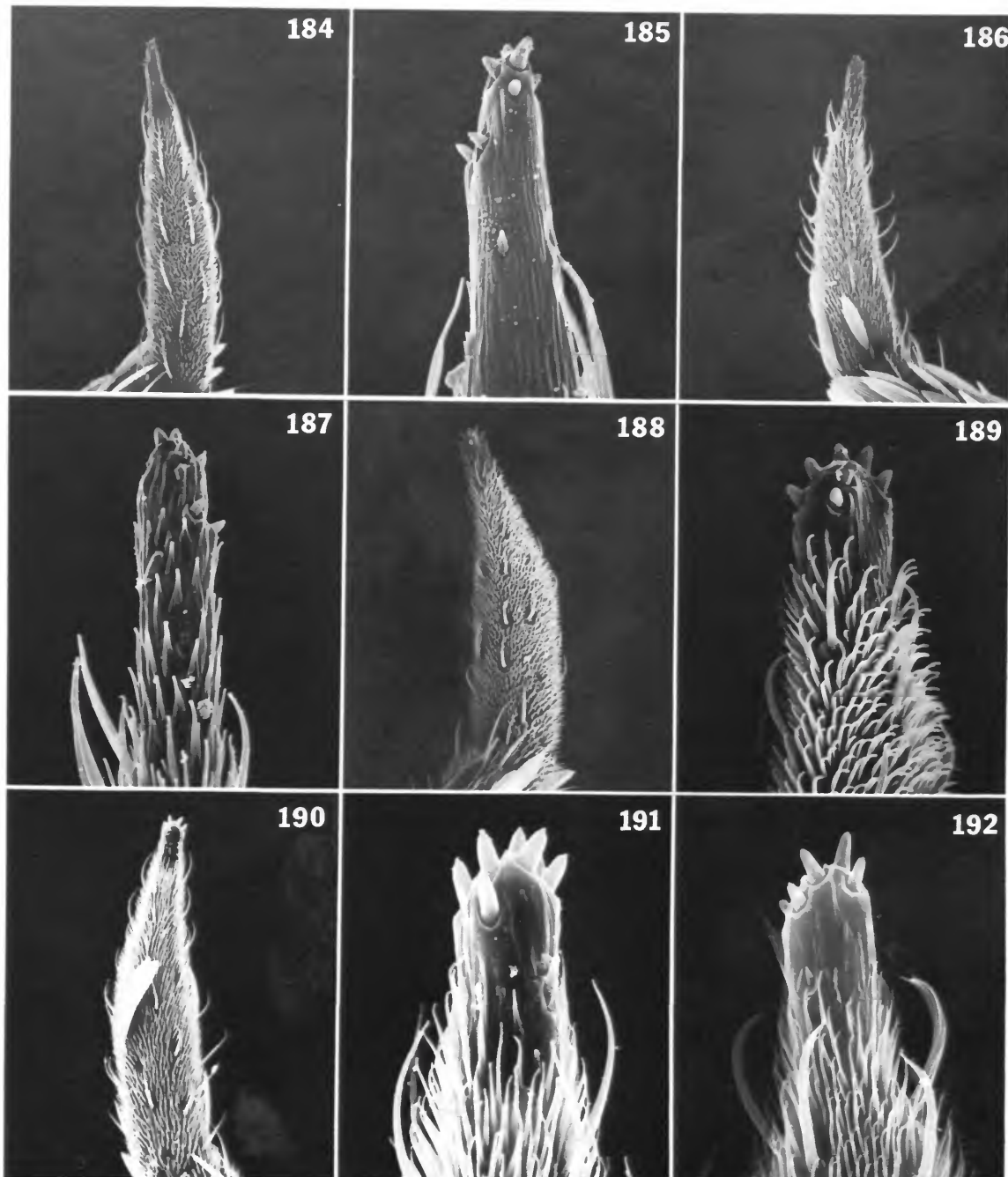


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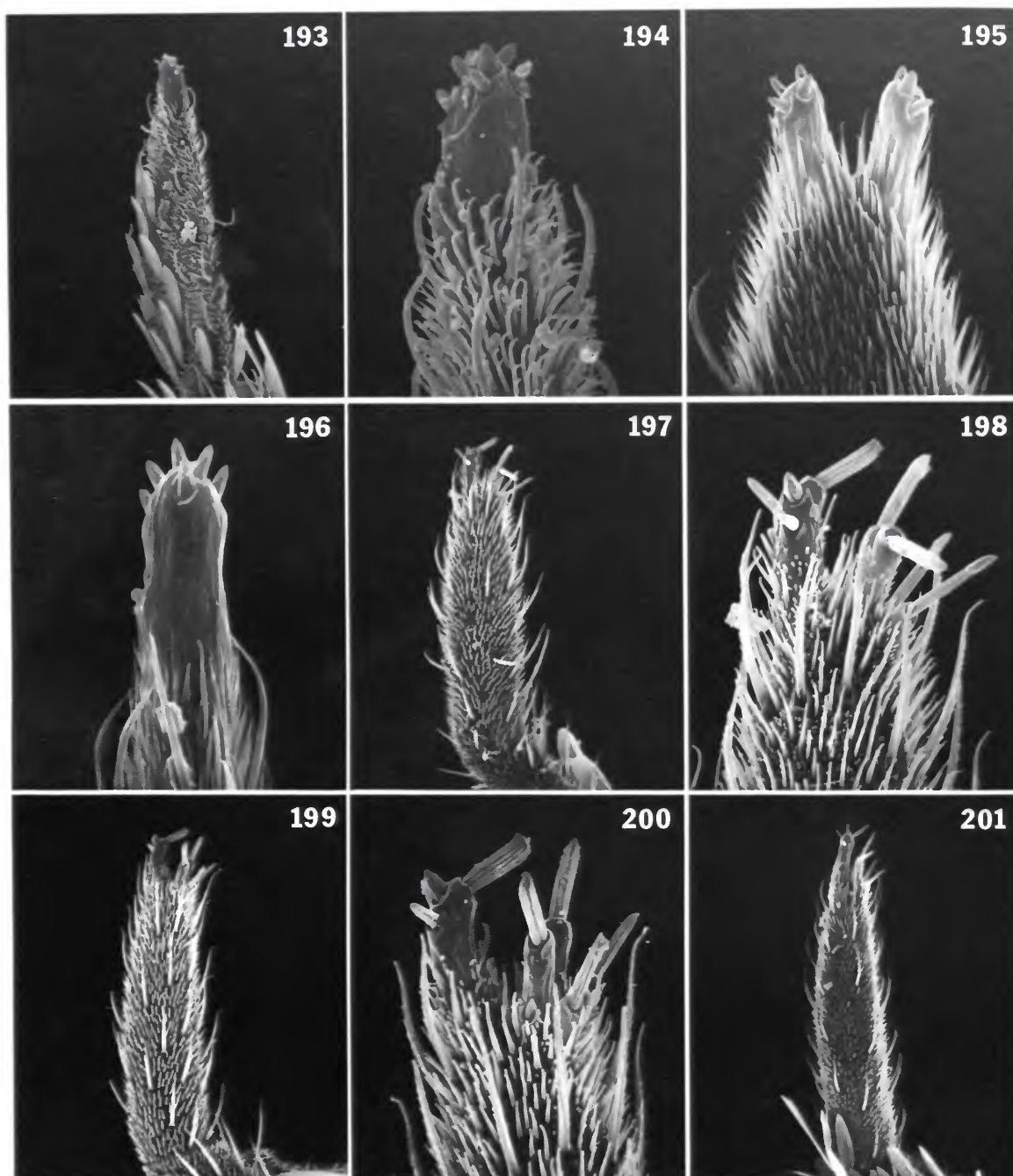


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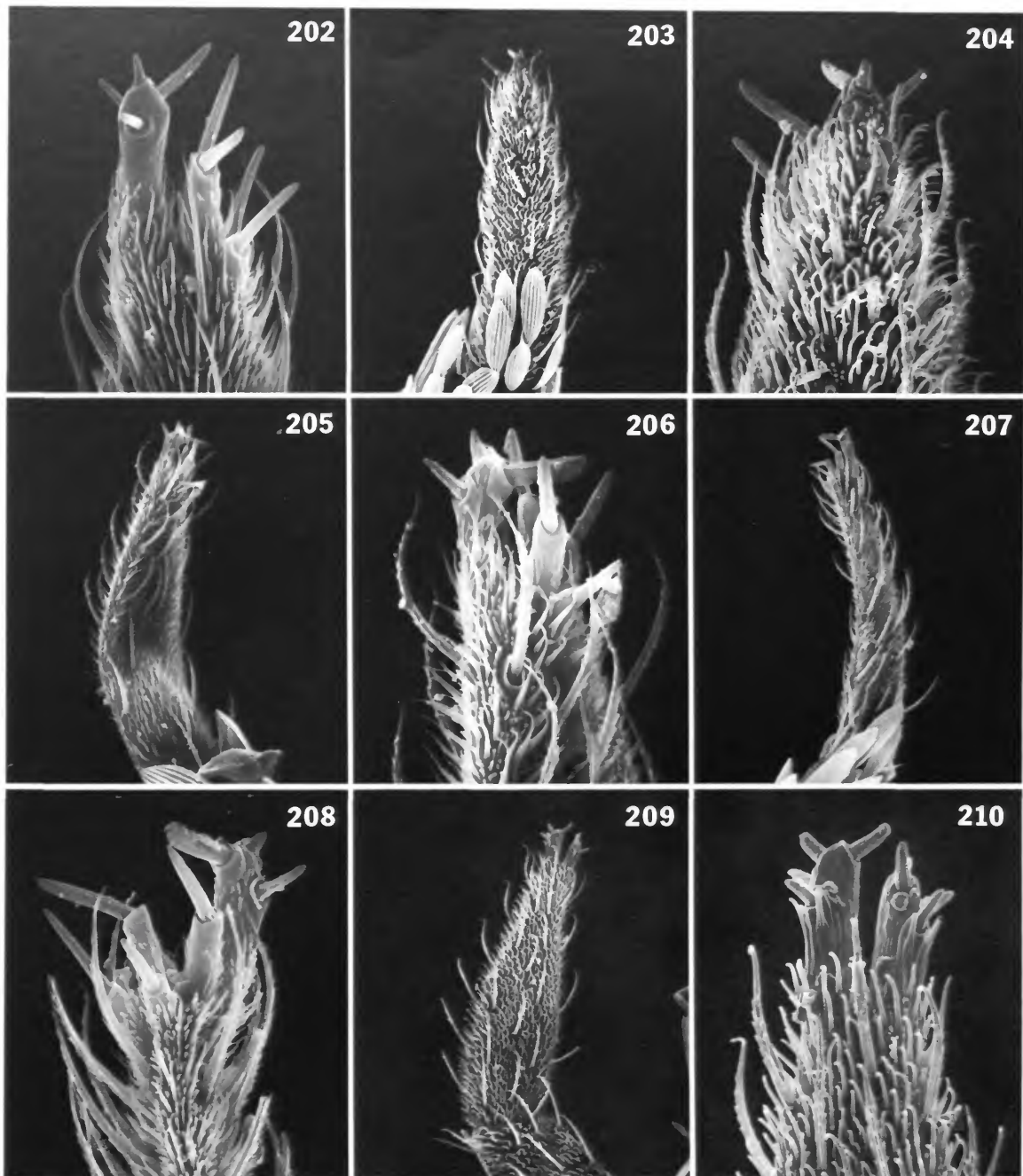
FIGURES 178-183.—Adult moths: 178, *Neocrania bifasciata*, new species, ♀, holotype, wing expanse 9 mm; 179, *Acanthopteroctetes tripunctata* Braun, ♂, holotype, wing expanse 11 mm; 180, *A. bimaculata* Davis, ♀, holotype, wing expanse 15 mm; 181, *A. unifascia*, new species, ♂, holotype, wing expanse 8.5 mm; 182, *Eriocranella xanthocara*, new species, ventral view of metatarsal claws, $\times 800$; 183, lateral view of metatarsal claws, $\times 800$.



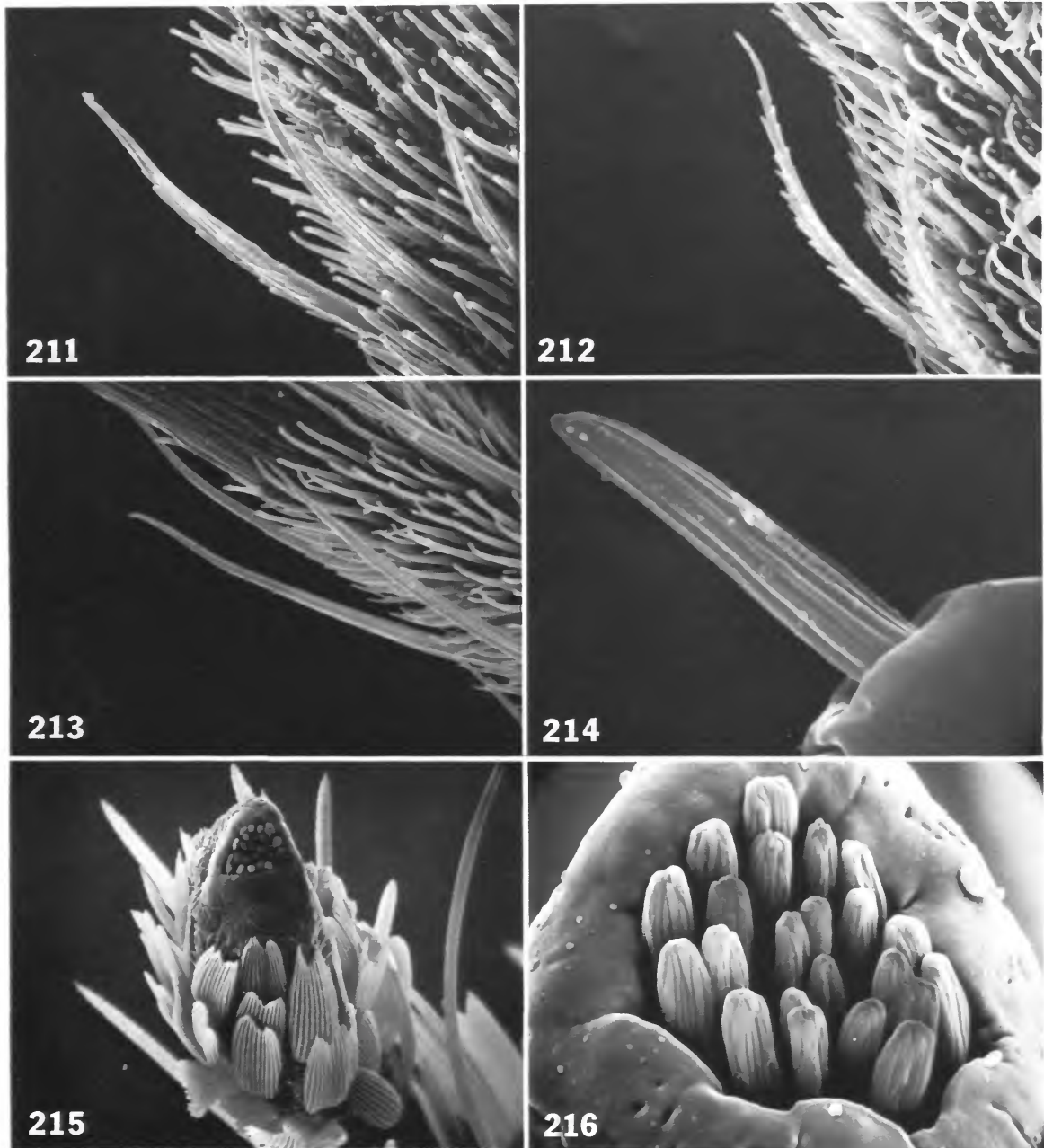
FIGURES 184-192.—Apices of maxillary palpi; 184, *Dyseriocrania griseocapitella* (Walsingham), $\times 400$; 185, detail of Figure 184, $\times 1900$; 186, *D. auricyanea* (Walsingham), $\times 400$; 187, detail of Figure 186, $\times 1900$; 188, *Eriocrania breviapeax*, new species, $\times 500$; 189, detail of Figure 188, $\times 2000$; 190, *E. semipurpurella pacifica*, new subspecies, $\times 480$; 191, detail of Figure 190, $\times 2300$; 192, *E. s. semipurpurella* (Stephens), Westmoreland, England, $\times 1950$. (Photographs reduced to 69%.)



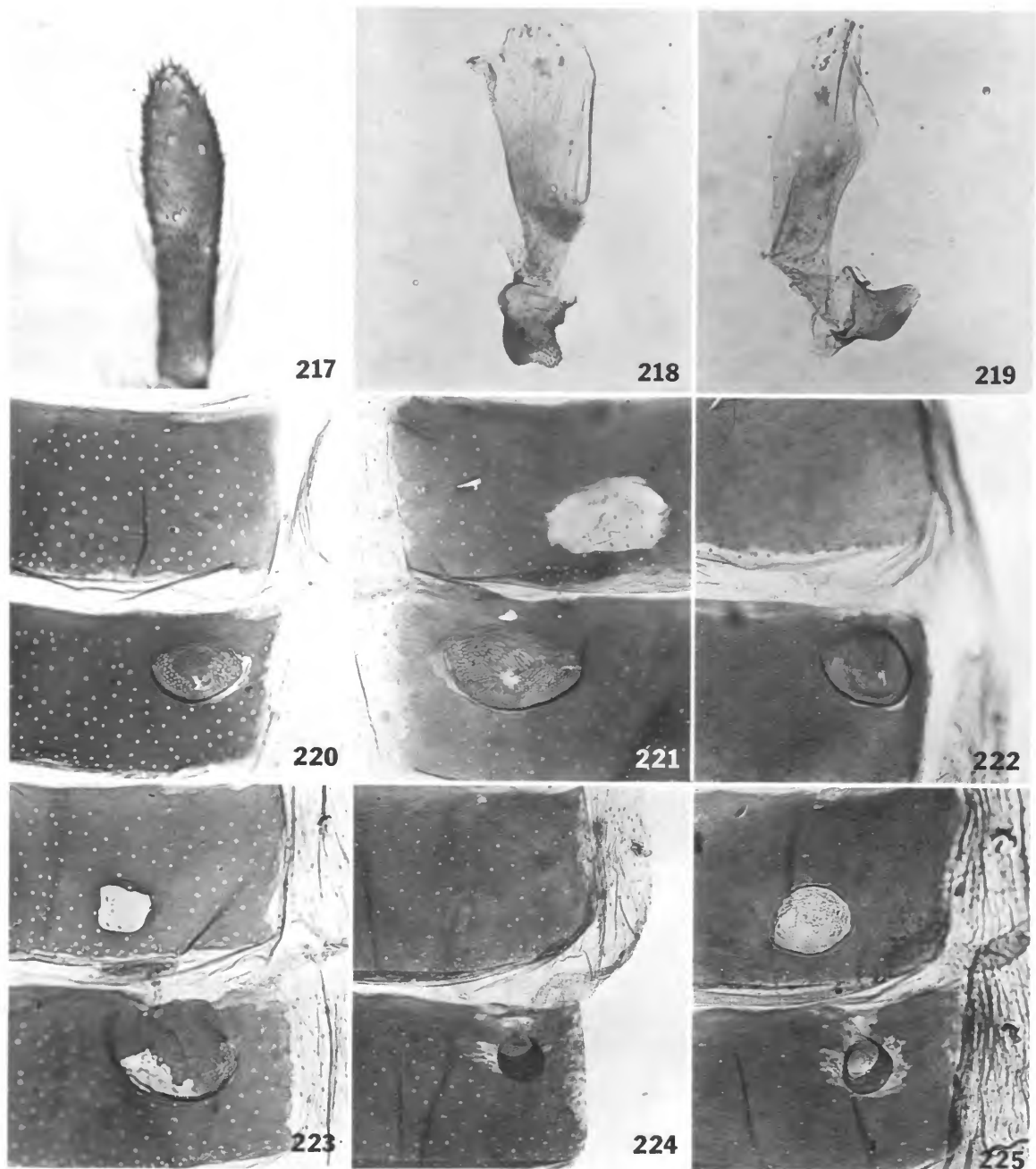
FIGURES 193-201.—Apices of maxillary palpi: 193, *Eriocrania semipurpurella semipurpurella* (Stephens), Quebec, Canada, $\times 500$; 194, detail of Figure 193, $\times 2000$; 195, *E. sangii* Wood, Westmoreland, England, $\times 1800$; 196, *Heringocrania unimaculella* (Zetterstedt), Europe, $\times 2140$; 197, *Eriocraniella aurosparsella* (Walsingham), $\times 500$; 198, detail of Figure 197, $\times 1580$; 199, *Eriocraniella xanthocara*, new species, $\times 500$; 200, detail of Figure 199, $\times 1530$; 201, *E. platyptera* new species, $\times 475$. (Photographs reduced to 69%.)



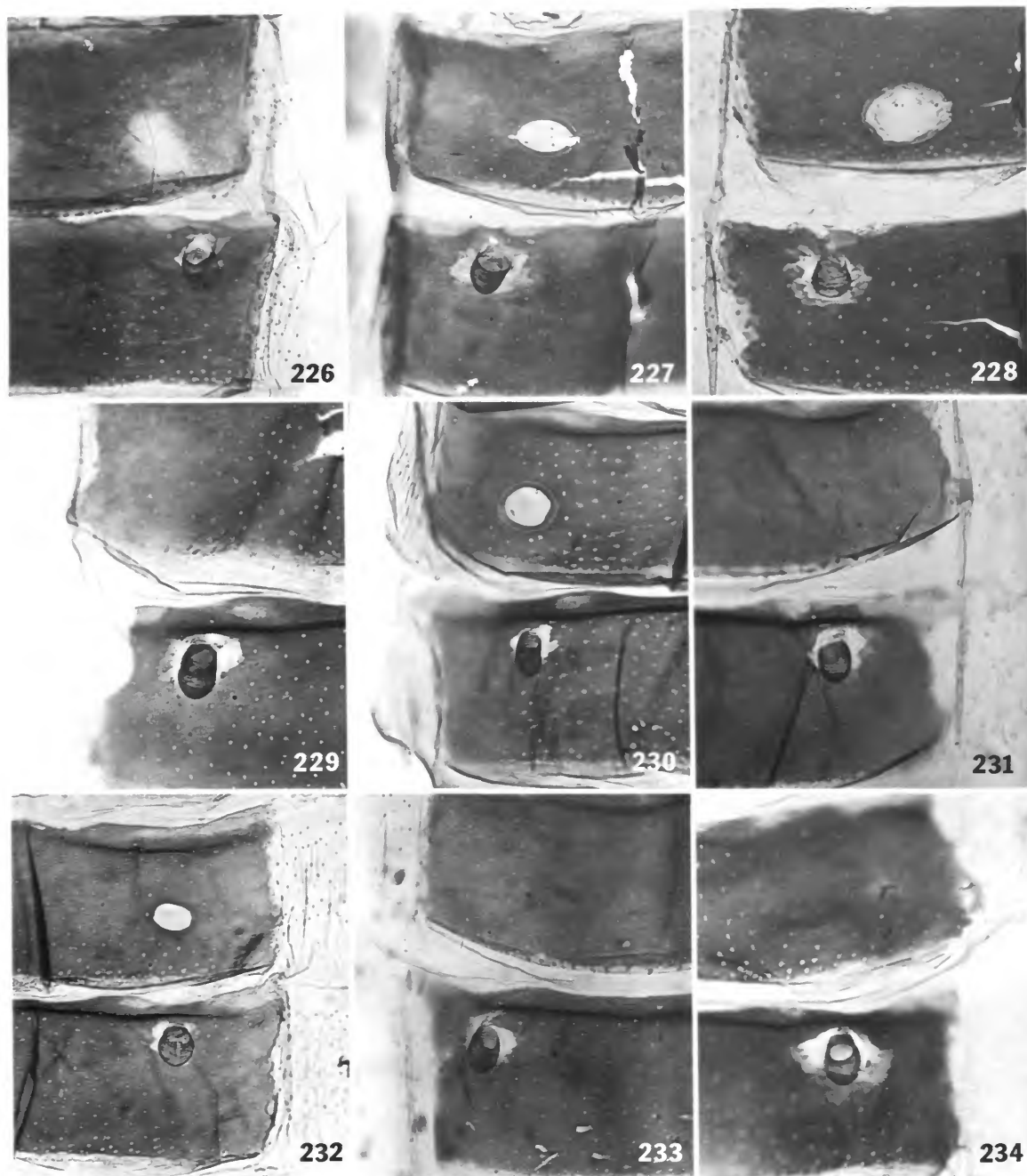
FIGURES 202-210.—Apices of maxillary palpi: 202, detail of Figure 201, $\times 1700$; 203, *Eriocraniella variegata*, new species, $\times 585$; 204, detail of Figure 203, $\times 1800$; 205, *E. trigona*, new species, $\times 750$; 206, detail of Figure 205, $\times 2300$; 207, *E. falcata*, new species, $\times 500$; 208, detail of Figure 207, $\times 2000$; 209, *Neocrania bifasciata*, new species, $\times 500$; 210, detail of Figure 209, $\times 2000$. (Photographs reduced to 69%.)



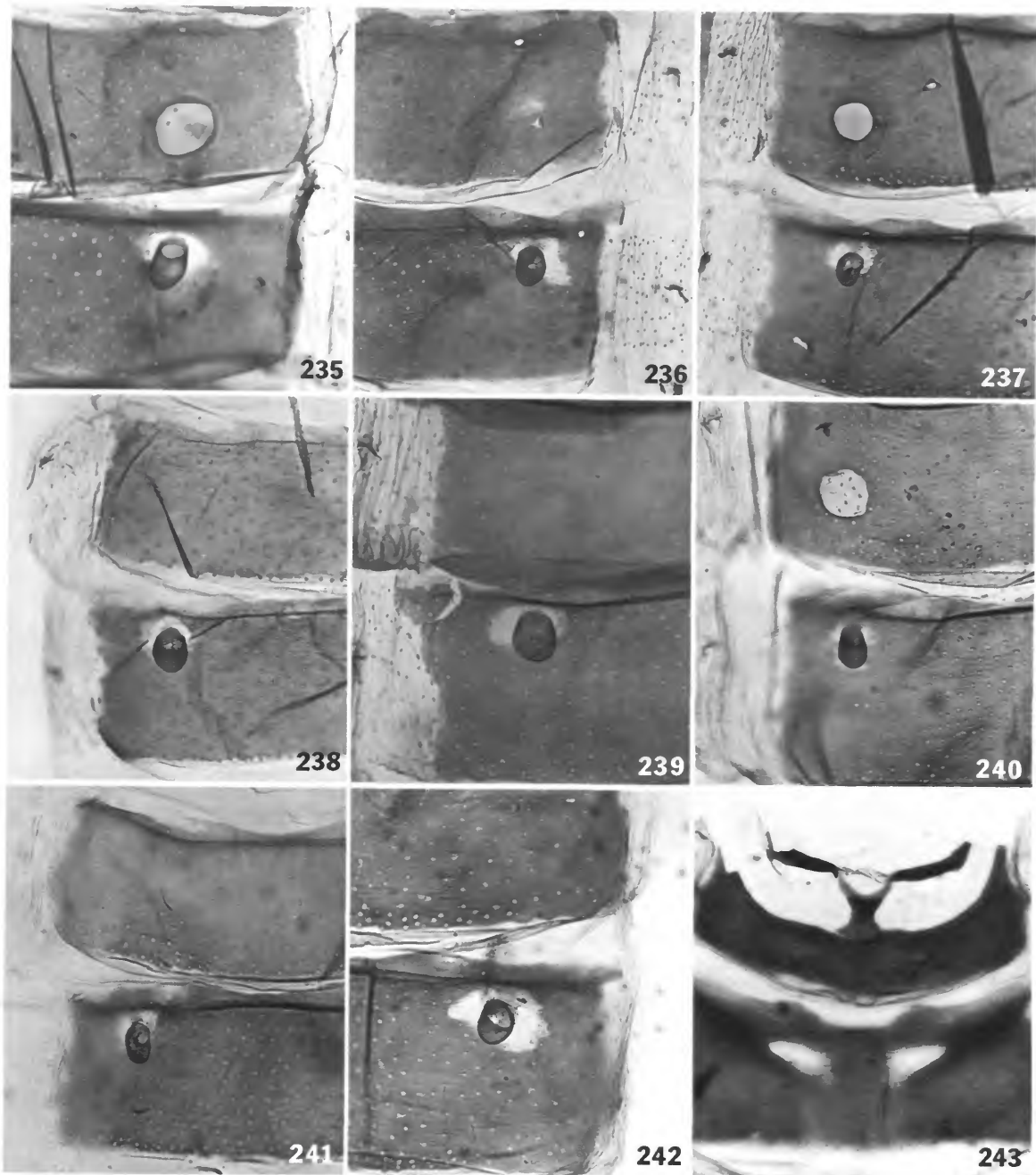
FIGURES 211-216.—Maxillary and labial palpal structure: 211, *Eriocraniella platyptera*, new species, barbed primary setae of fifth maxillary palpal segment, $\times 3400$; 212, *E. variegata*, new species, barbed primary setae of fifth maxillary palpal segment, $\times 3600$; 213, *Dyseriocrania griseocapitella* (Walsingham), smooth primary setae of fifth maxillary palpal segment, $\times 2500$; 214, *Eriocraniella platyptera*, new species, striated seta from apex of fifth maxillary palpal segment, $\times 9500$; 215, *D. griseocapitella* (Walsingham), sensory pit (Organ of von Rath) at apex of third labial palpal segment, $\times 750$; 216, detail of basiconic sensilla in Figure 215, $\times 5000$. (Photographs reduced to 79%.)



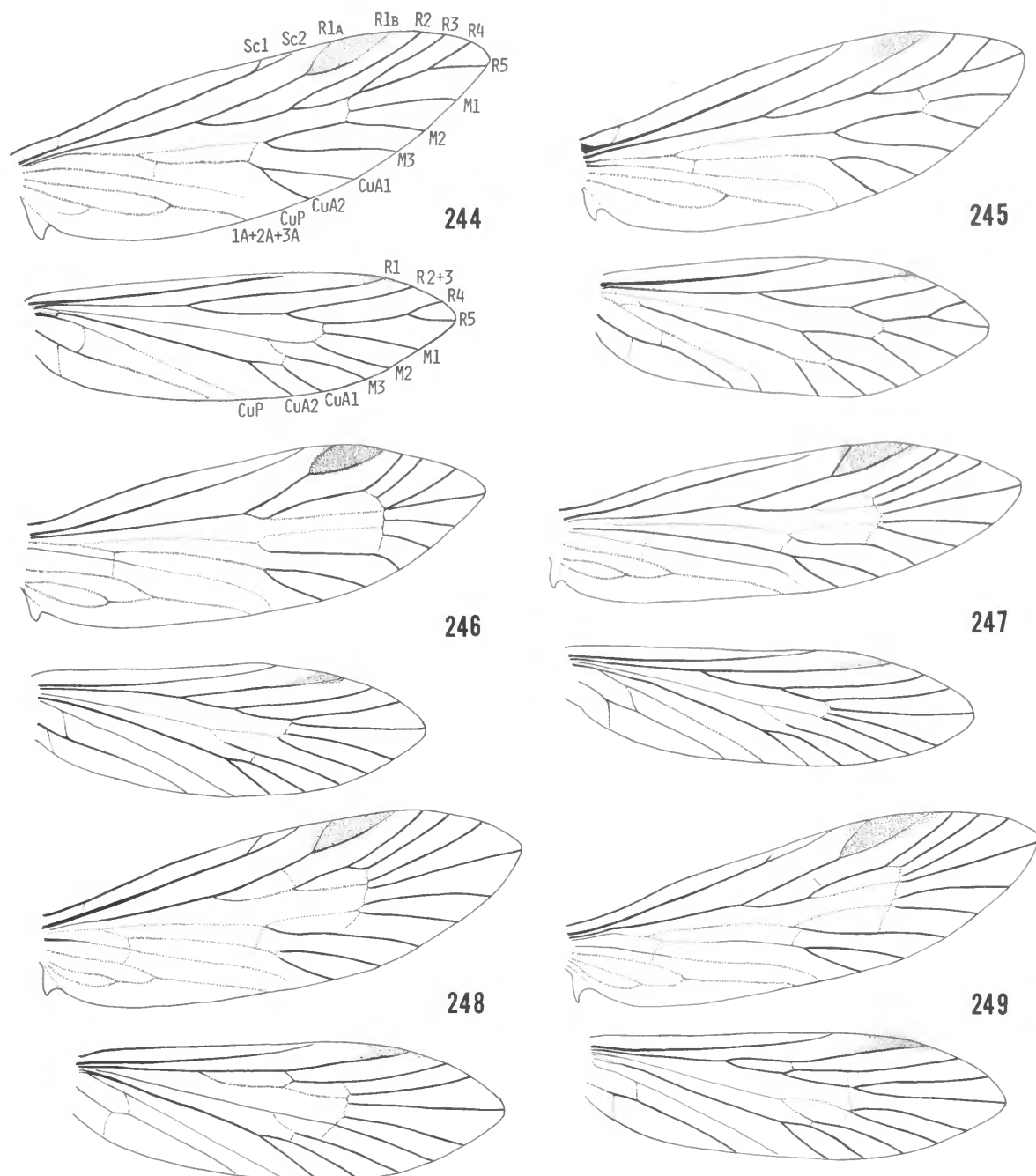
FIGURES 217-225.—Adult structure: 217, *Acanthopteroctetes bimaculata* Davis, apical segment of maxillary palpus; 218, *Eriocrania semipurpurella pacifica*, new subspecies, mandible; 219, *Eriocraniella falcata*, new species, mandible. Fourth and fifth abdominal sternites with external structures associated with paired glands of fifth segment: 220, *Dyseriocrania griseocapitella* (Walsingham), tubercule of male; 221, fenestra and tubercule of female; 222, *D. amricyanea* (Walsingham), tubercule of male; 223, fenestra and tubercule of female; 224, *Eriocrania semipurpurella semipurpurella* (Stephens), tubercule of male; 225, fenestra and tubercule of female.



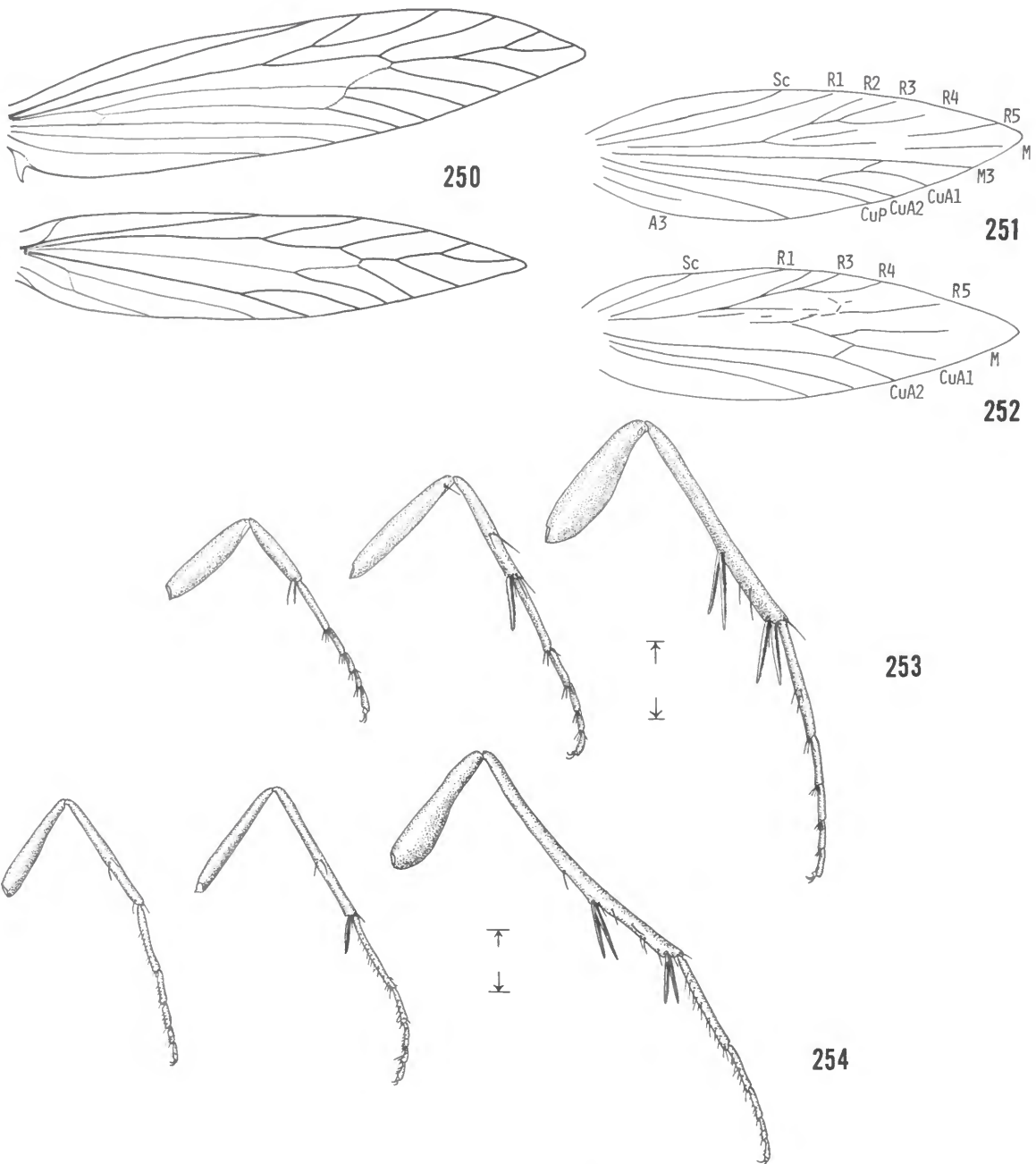
FIGURES 226-234.—Fourth and fifth abdominal sternites with external structures associated with paired glands of fifth segment: 226, *Eriocrania semipurpurella pacifica*, new subspecies, rudimentary fenestra and tubercle of male; 227, fenestra and tubercle of female; 228, *E. breviapex*, new species, fenestra and tubercle of female; 229, *Eriocraniella aurosparsella* (Walsingham), tubercle of male; 230, fenestra and tubercle of female; 231, *E. xanthocara*, new species, tubercle of male; 232, fenestra and tubercle of female; 233, *E. longifurcula*, new species, tubercle of male; 234, *E. platyptera*, new species, tubercle of male.



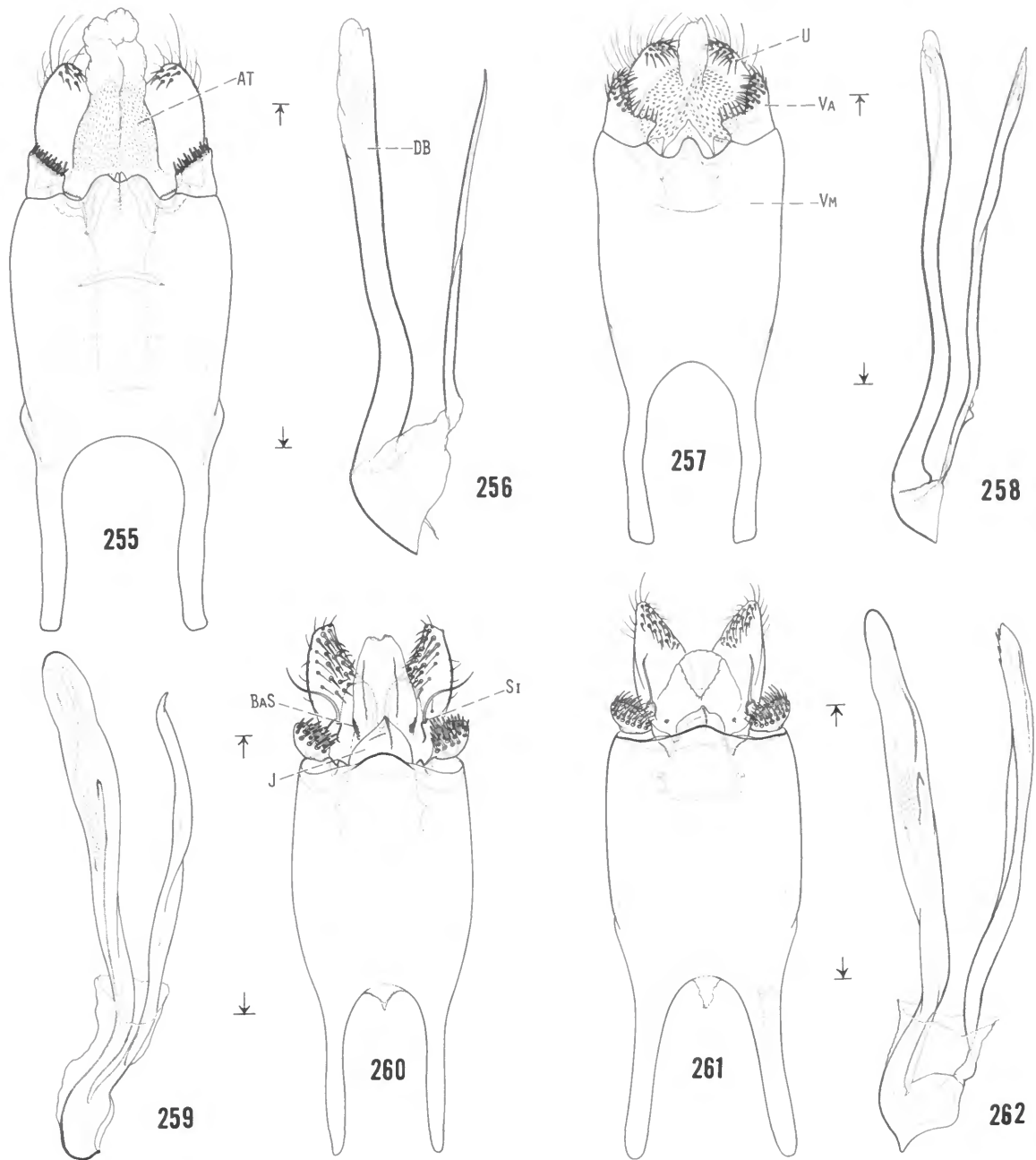
FIGURES 235-243.—Abdominal structures associated with fourth and fifth sternites (235-242) and first, second, and third sternites (243): 235, *Eriocraniella platyptera*, new species, fenestra and tubercle of female; 236, *E. variegata*, new species, tubercle of male; 237, fenestra and tubercle of female; 238, *E. trigona*, new species, tubercle of male; 239, *E. falcata*, new species, tubercle of male; 240, fenestra and tubercle of female; 241, *Neocrania bifasciata*, new species, tubercle of male; 242, tubercle of female; 243, first, second, and third abdominal sternites.



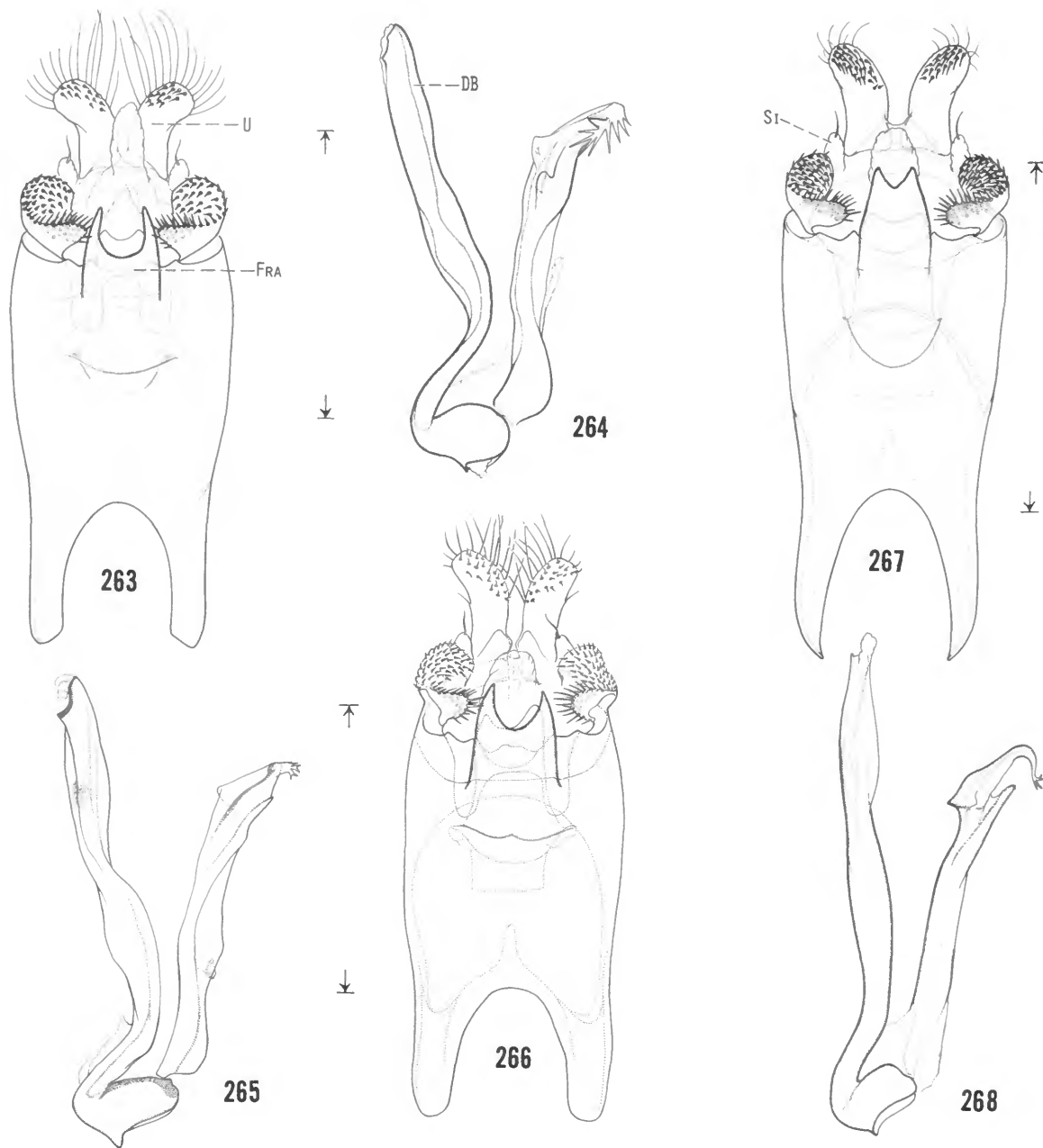
FIGURES 244-249.—Wing venation: 244, *Dyseriocrania griseocapitella* (Walsingham); 245, *Eriocrania breviapex*, new species; 246, *Eriocraniella aurosarsella* (Walsingham); 247, *E. variegata*, new species; 248, *E. falcata*, new species; 249, *Neocrania bifasciata*, new species.



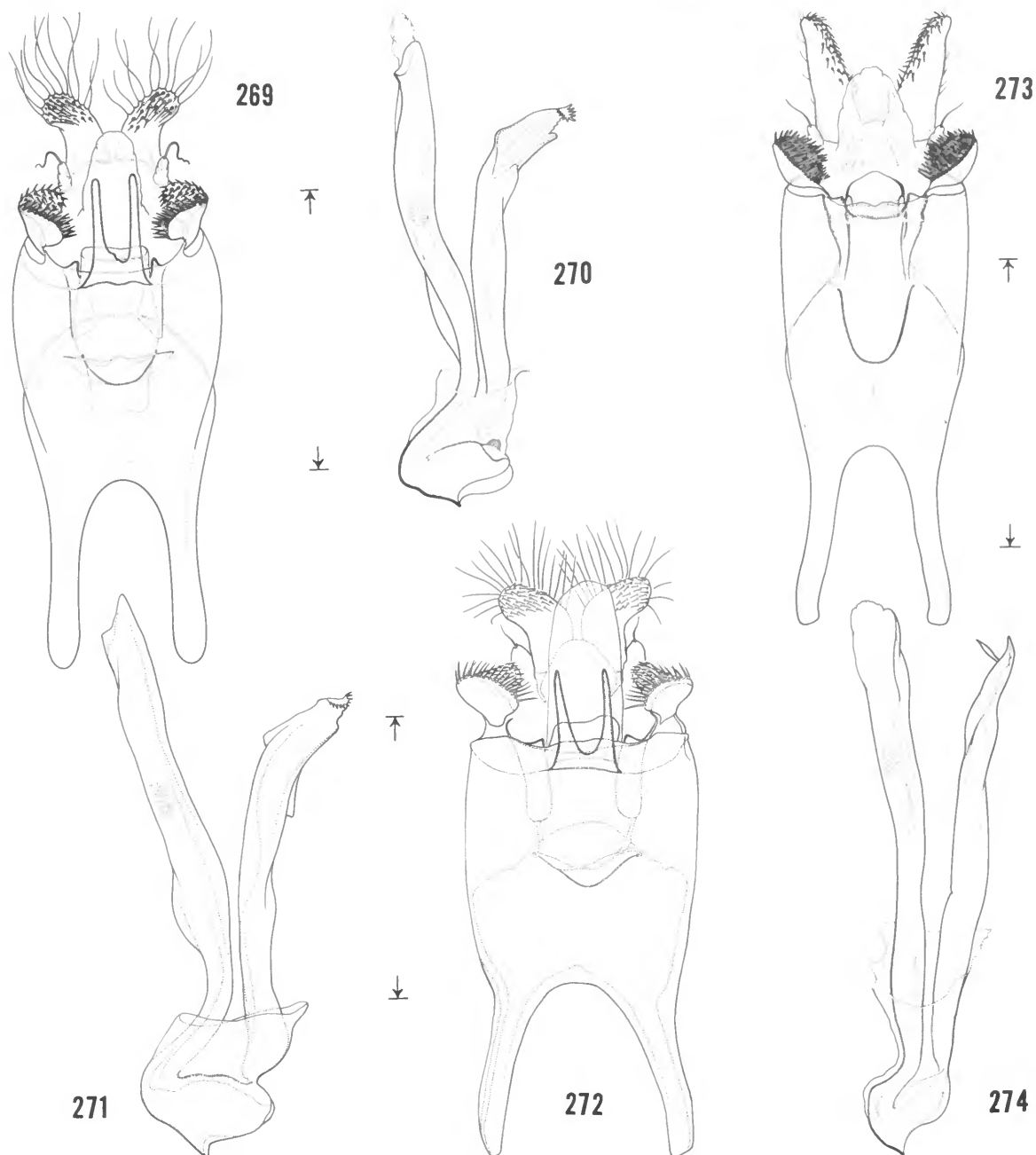
FIGURES 250-254.—Wing venation and leg structure: 250, *Acanthopteroctetes bimaculata* Davis; 251, *Electrocrania immensipalpa* Kusnetzov, forewing; 252, forewing; 253, *Dyseriocrania griseo-capitella* (Walsingham); 254, *A. bimaculata* Davis. (Scale = 0.5 mm.)



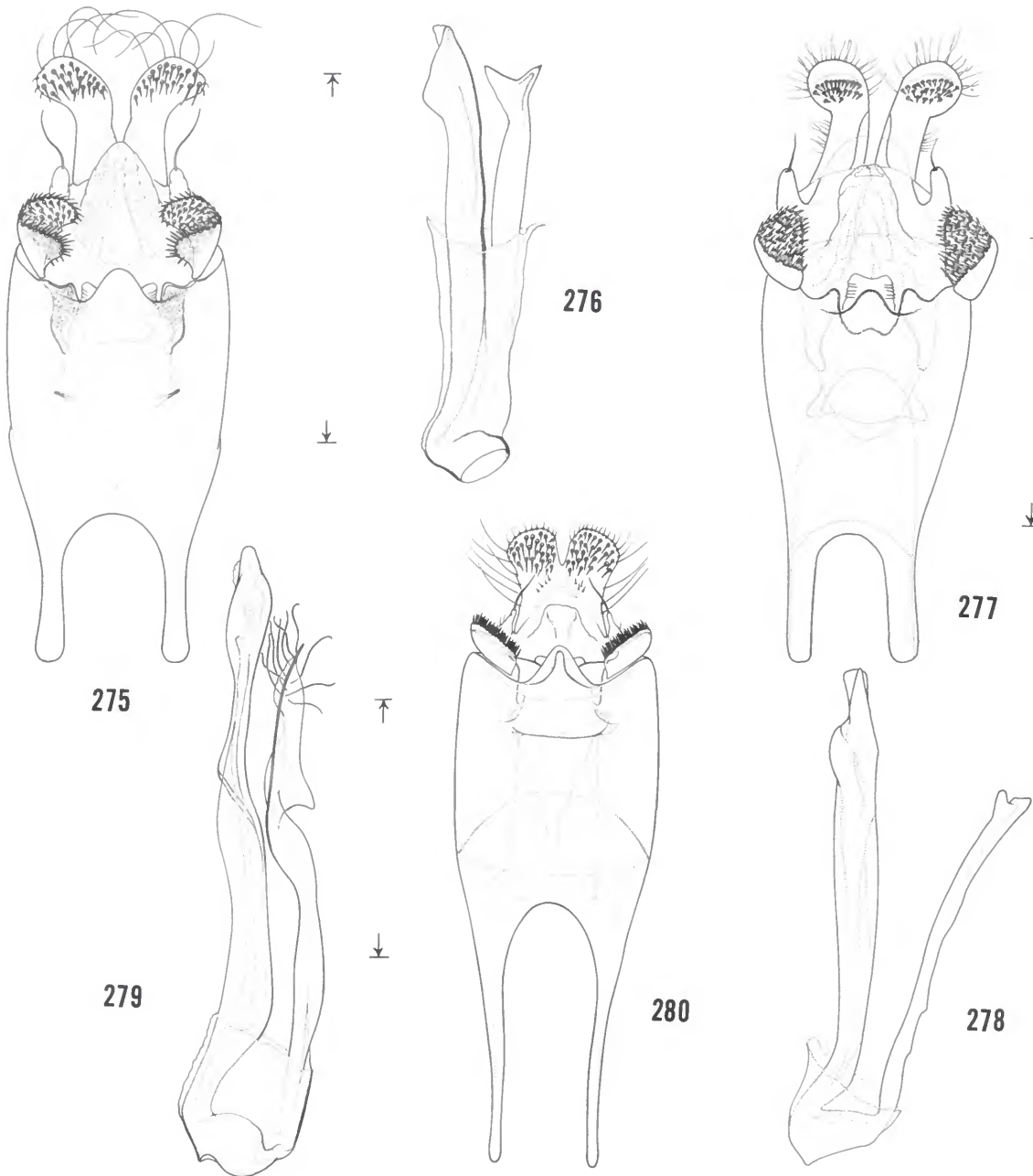
FIGURES 255-262.—Male genitalia: 255, *Dyseriocrania griseocapitella* (Walsingham), ventral view; 256, lateral view of aedeagus; 257, *D. auricyanea* (Walsingham), ventral view; 258, lateral view of aedeagus; 259, *Eriocrania semipurpurella pacifica*, new subspecies, lateral view of aedeagus; 260, ventral view; 261, *E. s. semipurpurella* (Stephens), ventral view; 262, lateral view of aedeagus. (Scale = 0.5 mm.)



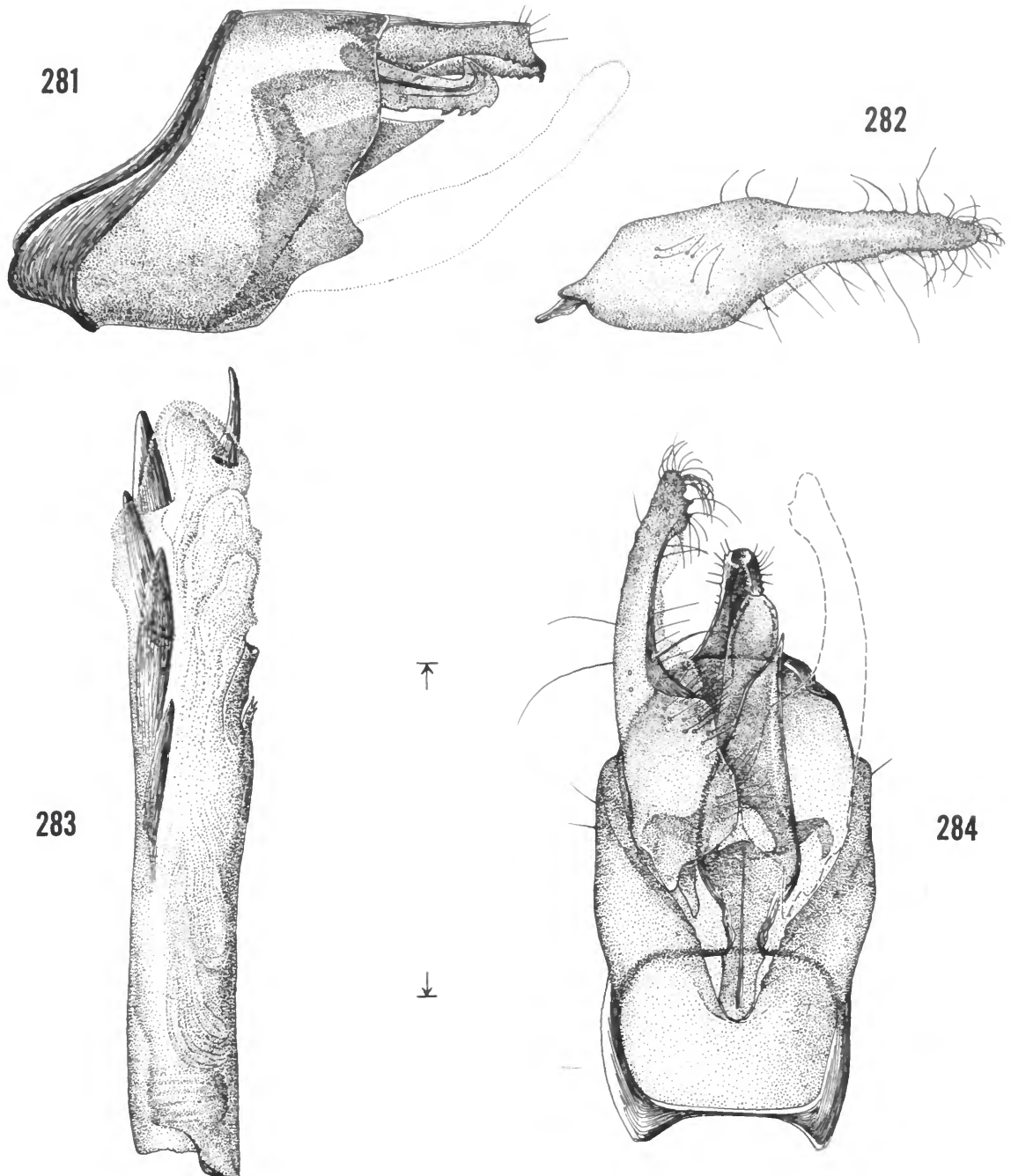
FIGURES 263-268.—Male genitalia: 263, *Eriocraniella aurosparsella* (Walsingham), ventral view; 264, lateral view of aedeagus; 265, *E. xanthocara*, new species, lateral view of aedeagus; 266, ventral view; 267, *Eriocraniella* species, San Luis Obispo, California, ventral view; 268, lateral view of aedeagus. (Scale = 0.5 mm.)



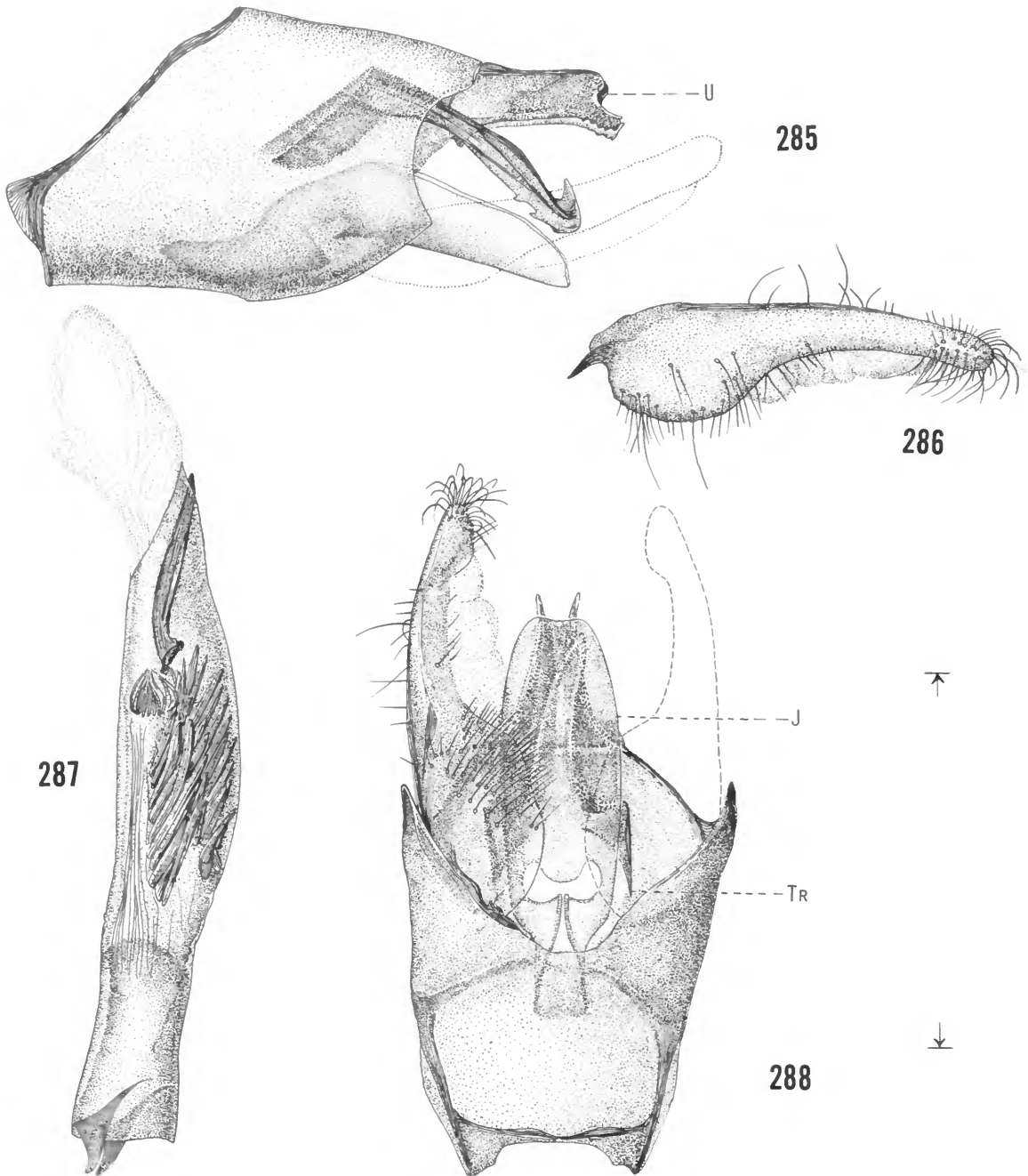
FIGURES 269-274.—Male genitalia: 269, *Eriocraniella longifurcula*, new species, ventral view; 270, lateral view of aedeagus; 271, *E. platyptera*, new species, lateral view of aedeagus; 272, ventral view; 273, *E. falcata*, new species, ventral view; 274, lateral view of aedeagus. (Scale=0.5 mm.)



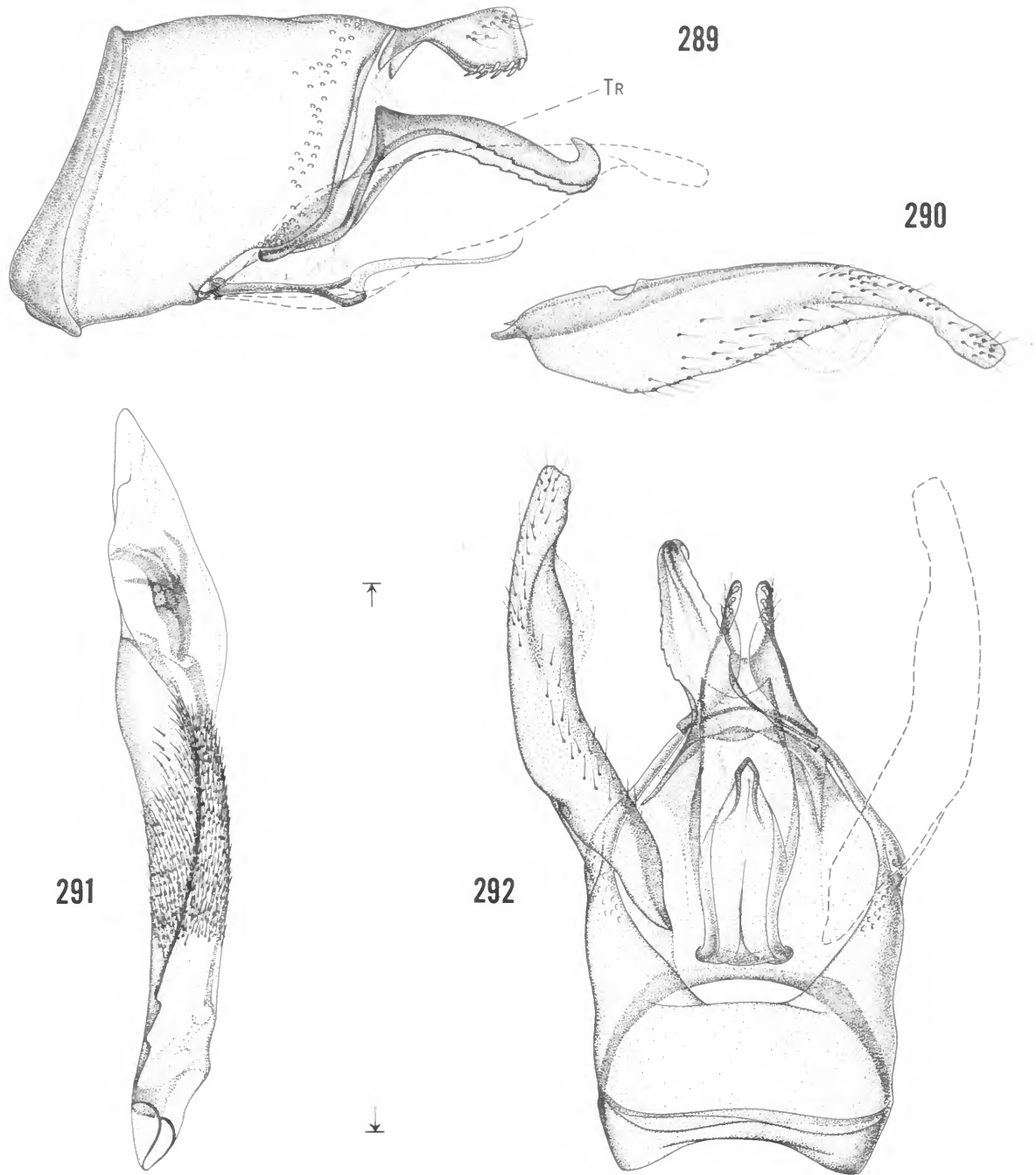
FIGURES 275-280.—Male genitalia: 275, *Eriocraniella trigona*, new species, ventral view; 276, lateral view of aedeagus; 277, *E. variegata*, new species ventral view; 278, lateral view of aedeagus; 279, *Neocrania bifasciata*, new species, lateral view of aedeagus; 280, ventral view. (Scale = 0.5 mm.)



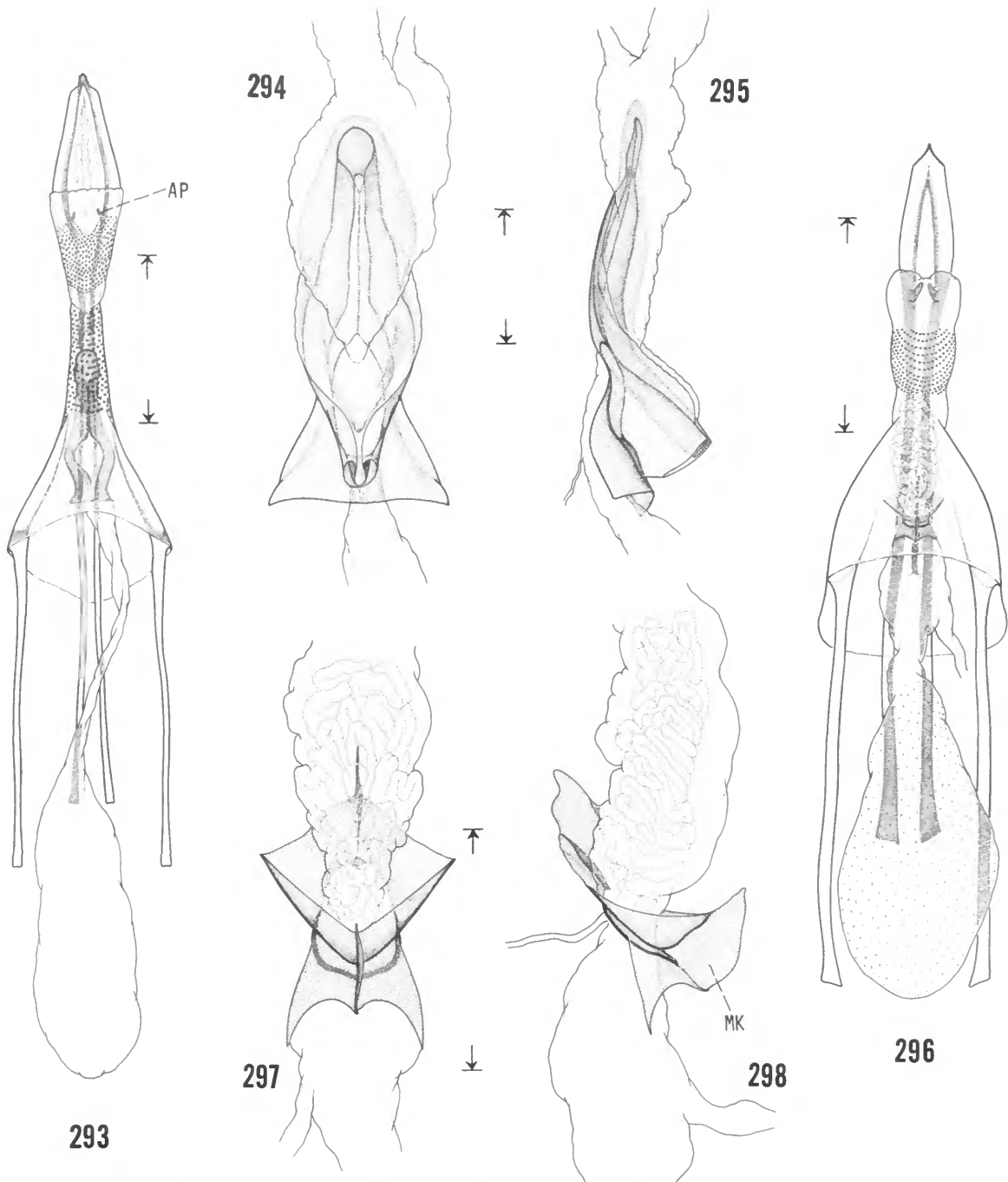
FIGURES 281-284.—*Acanthopteroctetes tripunctata* Braun, male genitalia: 281, lateral view; 282, lateral view of valva; 283, aedeagus; 284, ventral view. (Scale = 0.5 mm.)



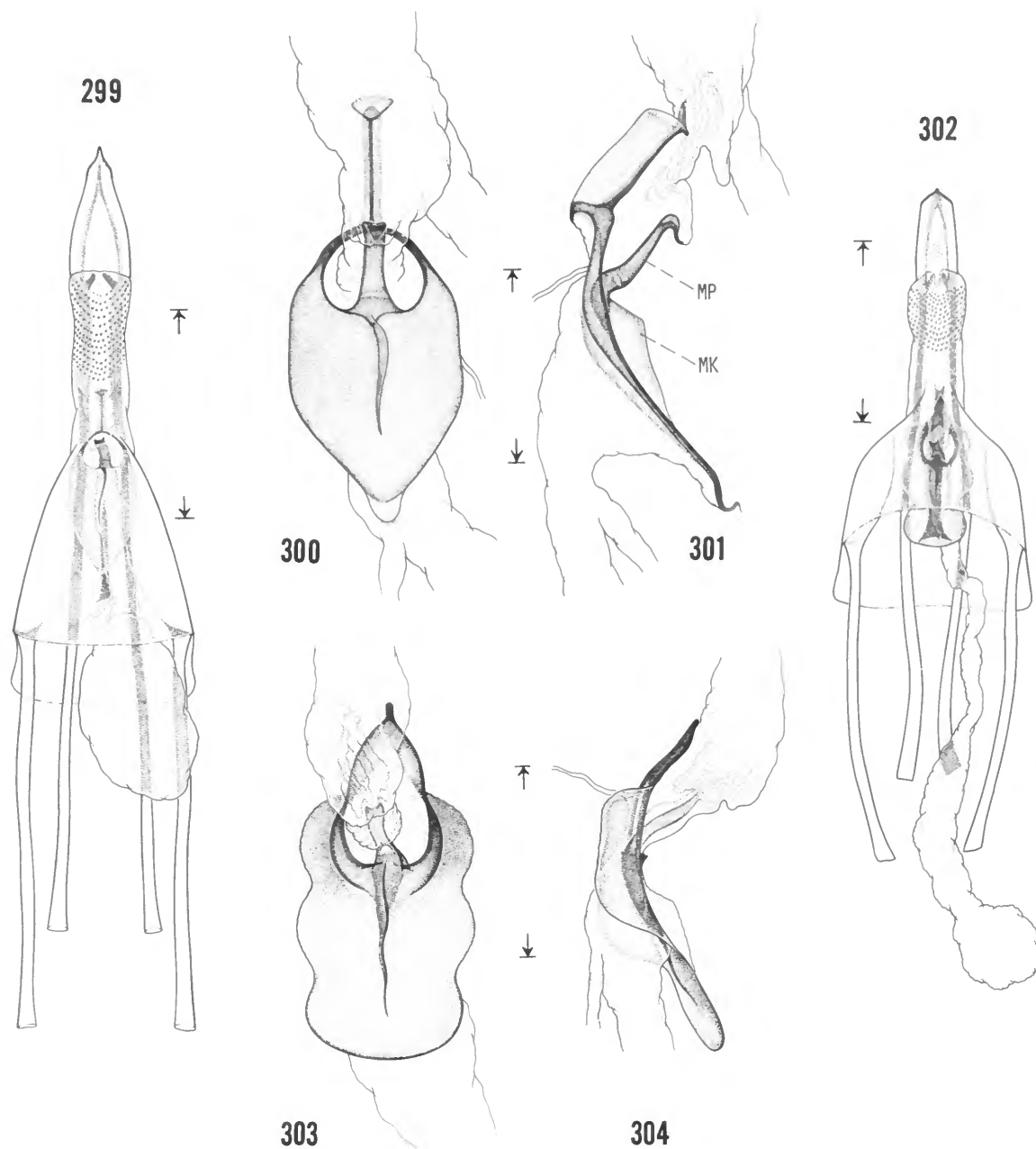
FIGURES 285-288.—*Acanthopteroctetes bimaculata* Davis, male genitalia: 285, lateral view; 286, lateral view of valva; 287, aedeagus; 288, ventral view. (Scale = 0.5 mm.)



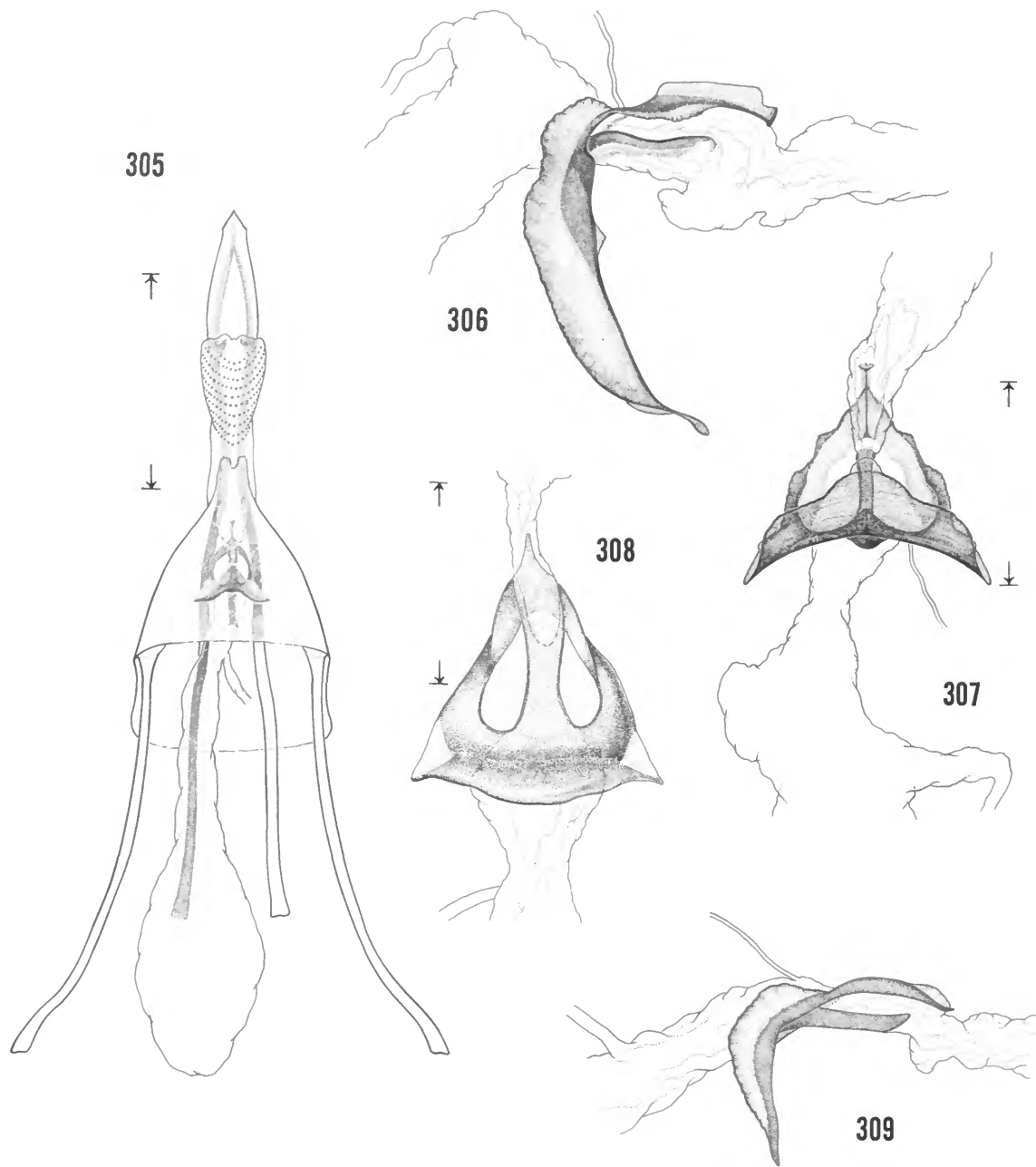
FIGURES 289-292.—*Acanthopteroctetes unifascia*, new species, male genitalia: 289, lateral view; 290, lateral view of valva; 291, aedagus; 292, ventral view. (Scale = 0.5 mm.)



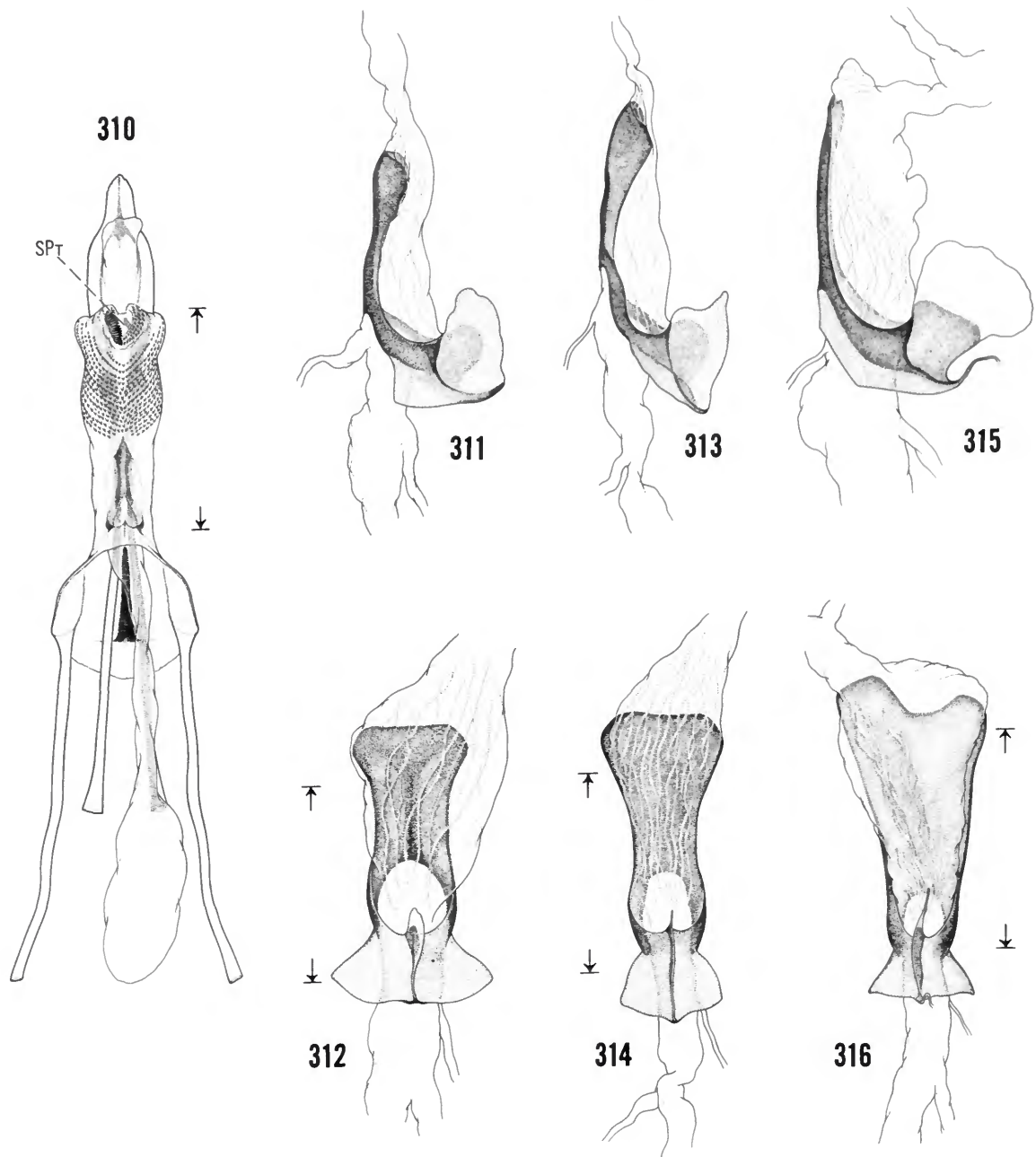
FIGURES 293-298.—Female genitalia: 293, *Dyseriocrania griseocapitella* (Walsingham), ventral view, (scale = 0.5 mm); 294, ventral view of vaginal sclerite (scale = 0.2 mm); 295, lateral view of Figure 294; 296, *D. auricyanea* (Walsingham), ventral view (scale = 0.5 mm); 297, ventral view of vaginal sclerite (scale = 0.2 mm); 298, lateral view of Figure 297.



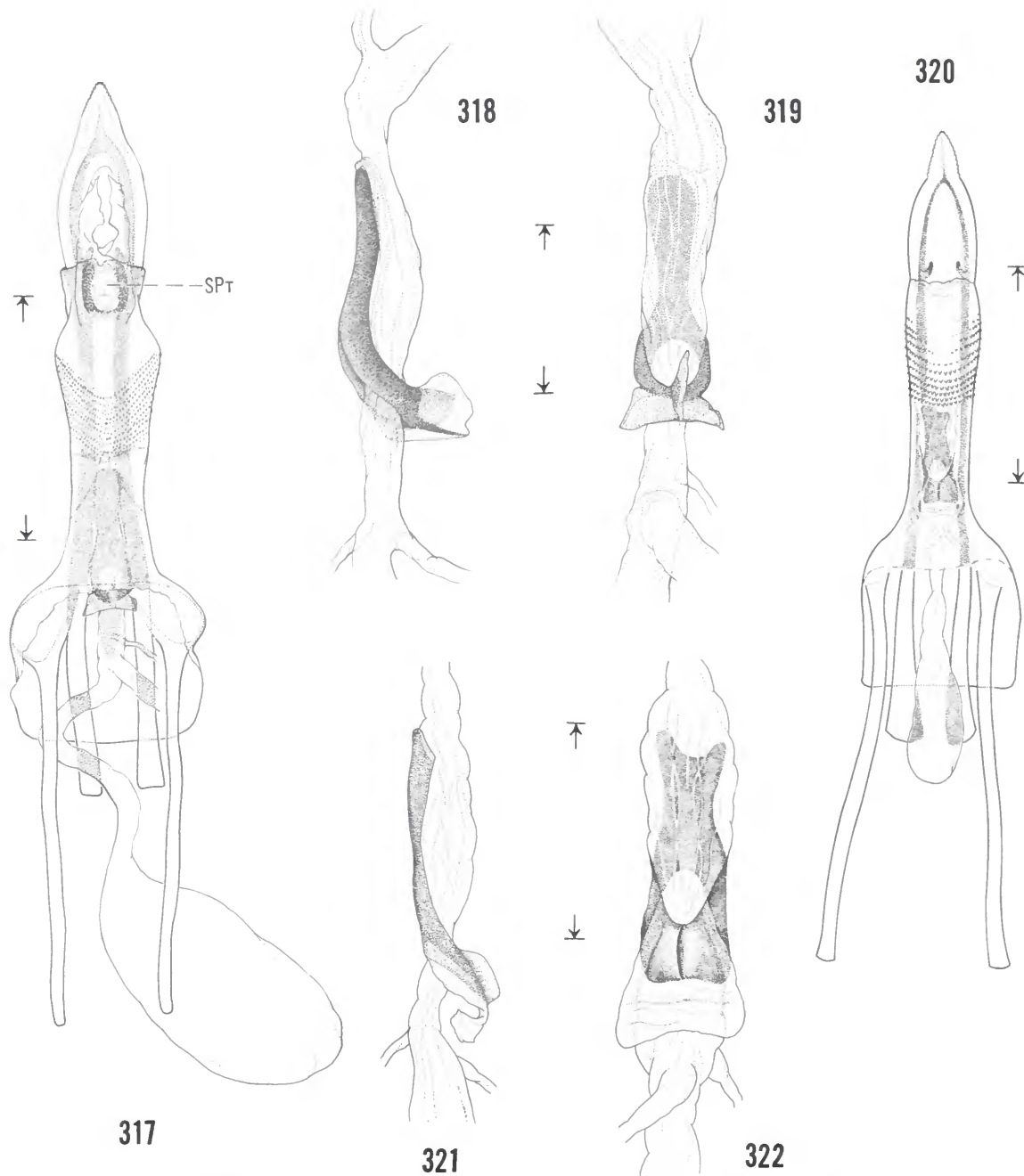
FIGURES 299-304.—Female genitalia: 299, *Eriocrania semipurpurella pacifica*, new subspecies, ventral view (scale = 0.5 mm); 300, ventral view of vaginal sclerite (scale = 0.2 mm); 301, lateral view of Figure 300; 302, *E. breviapex*, new species, ventral view (scale = 0.5 mm); 303, ventral view of vaginal sclerite (scale = 0.2 mm); 304, lateral view of Figure 303.



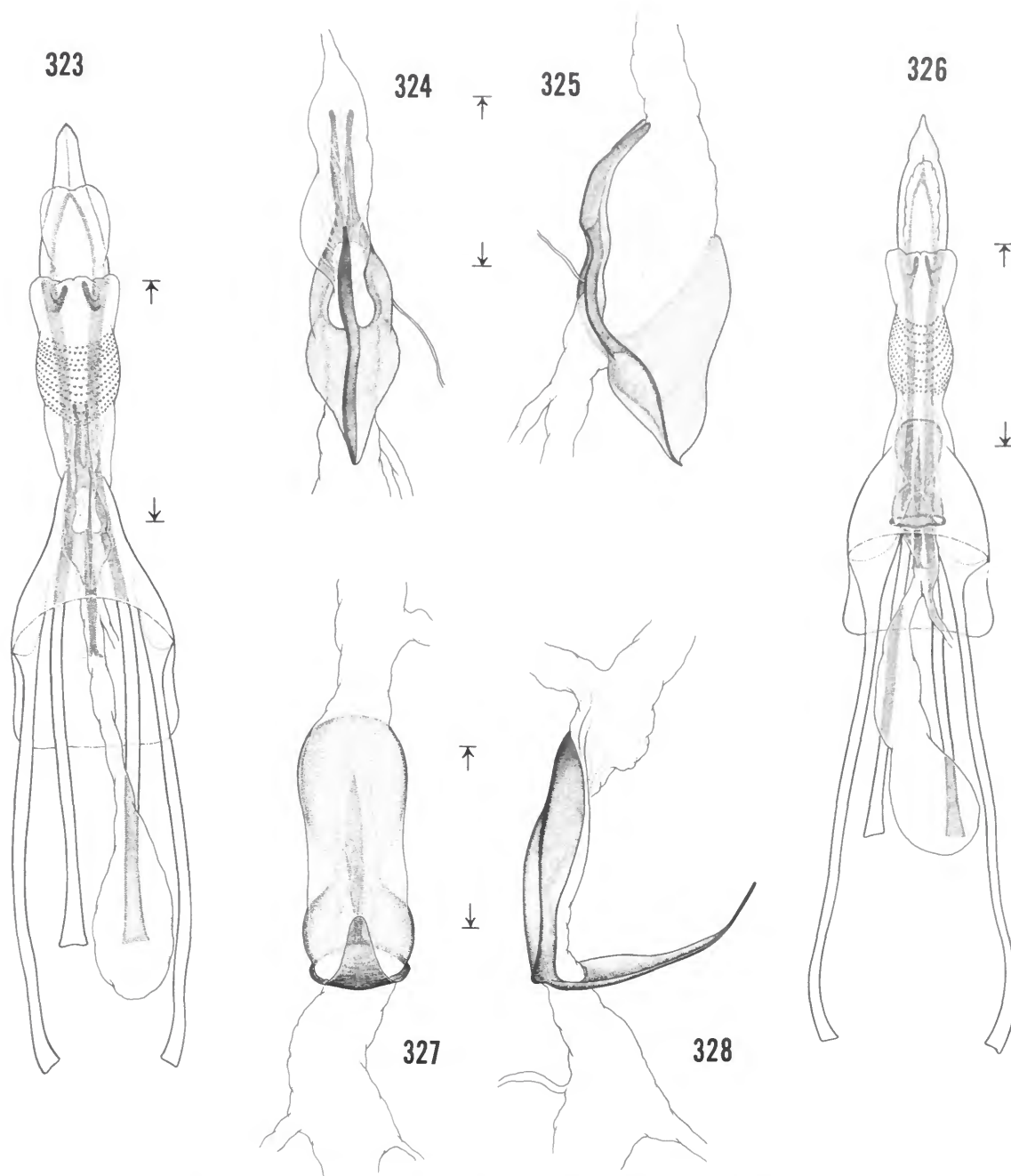
FIGURES 305-309.—*Eriocrania semipurpurella semipurpurella* (Stephens), female genitalia: 305, ventral view, (scale = 0.5 mm); 306, lateral view of vaginal sclerite, Lac Mondor, Quebec, Canada; 307, ventral view of Figure 306 (scale = 0.2 mm); 308, ventral view of vaginal sclerite, Pelham, New York (scale = 0.2 mm); 309, lateral view of Figure 308.



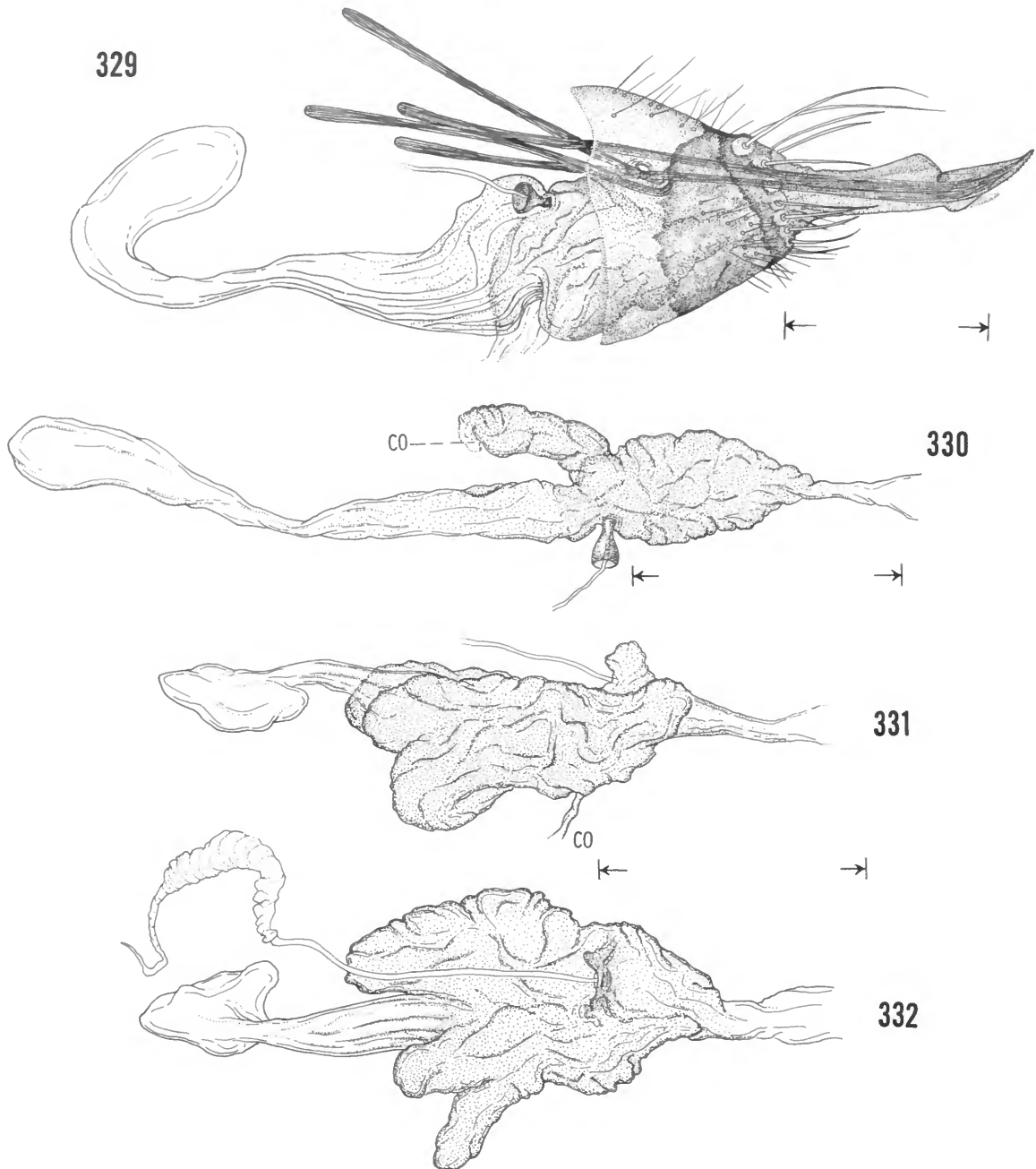
FIGURES 310-316.—Female genitalia: 310, *Eriocraniella aurosparsella* (Walsingham), ventral view (scale = 0.5 mm); 311, lateral view of vaginal sclerite; 312, ventral view of Figure 311 (scale = 0.2 mm); 313, *E. xanthocara*, new species, lateral view of vaginal sclerite; 314, ventral view of Figure 313 (scale = 0.2 mm); 315, *Eriocraniella* species, lateral view of vaginal sclerite, San Luis Obispo, California; 316, ventral view of Figure 315 (scale = 0.2 mm).



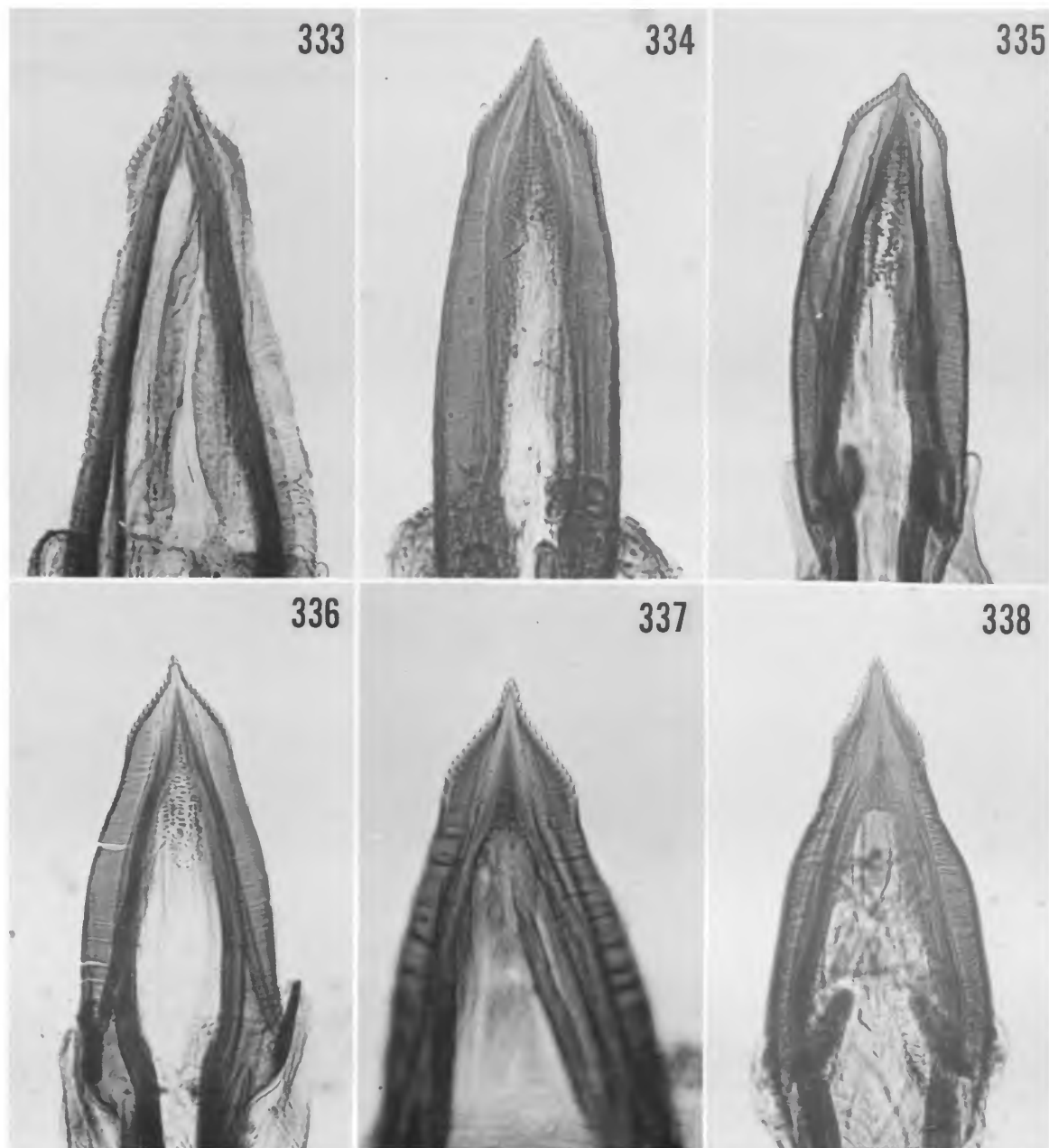
FIGURES 317-322.—Female genitalia: 317, *Eriocraniella platyptera*, new species, ventral view (scale = 0.5 mm); 318, lateral view of vaginal sclerite (scale = 0.2 mm); 319, ventral view of Figure 318; 320, *E. variegata*, new species, ventral view (scale = 0.5 mm); 321, lateral view of vaginal sclerite (scale = 0.2 mm); 322, ventral view of Figure 321.



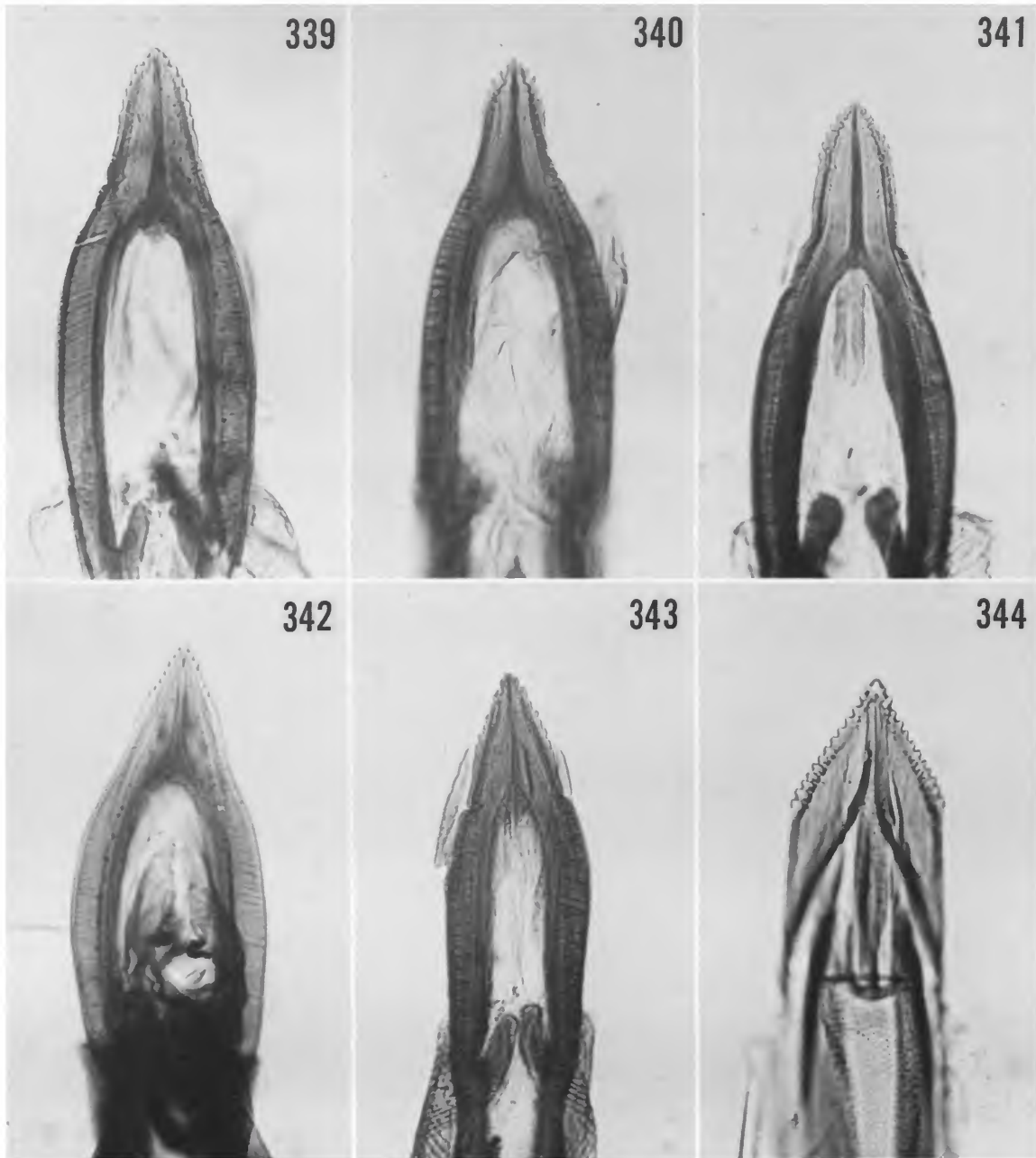
FIGURES 323-328.—Female genitalia: 323, *Eriocraniella falcata*, new species, ventral view (scale = 0.5 mm); 324, ventral view of vaginal sclerite (scale = 0.2 mm); 325, lateral view of Figure 324; 326, *Neocrania bifasciata*, new species, ventral view (scale = 0.5 mm); 327, ventral view of vaginal sclerite (scale = 0.2 mm); 328, lateral view of Figure 327.



FIGURES 329-332.—Female genitalia: 329, *Acanthopteroctetes bimaculata* Davis, lateral view; 330, dorsal view of vestibulum and bursa copulatrix of Figure 329; 331, *Acanthopteroctetes* species, Baker, Oregon, lateral view of vestibulum and bursa copulatrix; 332, dorsal view of Figure 331. (Scale = 0.5 mm.)



FIGURES 333-338.—Posterior apex of ovipositor: 333, *Dyseriocrania griseocapitella* (Walsingham); 334, *D. auricyanea* (Walsingham); 335, *Eriocrania breviapeax*, new species; 336, *E. semipurpurella semipurpurella* (Stephens); 337, *E. s. pacifica*, new subspecies; 338, *Neocrania bifasciata*, new species.



FIGURES 339-344.—Posterior apex of ovipositor: 339, *Eriocraniella aurosarsella* (Walsingham); 340, *E. xanthocara*, new species; 341, *E. falcata*, new species; 342, *E. platyptera*, new species; 343, *E. variegata*, new species; 344, *Acanthopteroctetes bimaculata* Davis.

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