Systematics and Zoogeography of the Family Neopseustidae with the Proposal of a New Superfamily (Lepidoptera: Neopseustoidea)

DONALD R. DAVIS

SMITHSONIAN CONTRIBUTIONS TO ZOOLOGY • NUMBER 210

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ABSTRACT

Davis, Donald R. Systematics and Zoogeography of the Family Neopseustidae with the Proposal of a New Superfamily (Lepidoptera: Neopseustoidea). *Smithsonian Contributions to Zoology,* number 210, 45 pages, 98 figures, 1 table, 1975.—The general morphology, zoogeography, and classification are reviewed for the three genera and seven species of Neopseustidae. One new genus (*Apoplania*) and three new species (*Apoplania chilensis, Neopseustis bicornuta,* and *N. sinensis*) are described. The discovery of *Apoplania chilensis* marks the first record of this family from the Western Hemisphere. Distribution maps and keys are provided for all species. A new superfamily, Neopseustoidea, is proposed for the Neopseustidae which is tentatively placed in the suborder Dacnonypha.

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Contents

Systematics and Zoogeography of the Family Neopseustidae with the Proposal of a New Superfamily (Lepidoptera: Neopseustoidea)

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Introduction

Few families of Lepidoptera are as little known as the Neopseustidae, and even though this primitive group has been recognized as a valid and very distinct family for nearly fifty years, it is probable that the majority of lepidopterists today are little aware of its very existence. The reason for this obscurity is primarily one of rarity, apparently in nature as well as in collections, of both species and specimens. Until recently, for example, only one genus, comprising three rare species, had been described over the past sixty years. Furthermore, the family was known to occur only in the Indian region where probably fewer than eight collectors had ever encountered these insects in their natural habitats. Presently, only 26 specimens are known to exist of the three genera and seven species now recognized; all of these have been examined in the course of this study.

Unfortunately, essentially nothing is known regarding the life history of any member of this family. The adults may be primarily crepuscular or nocturnal in that they are readily attracted to lights and have not been noted active during the day. Their means of oviposition probably involves a rasping or tearing action perhaps similar to that described for the prodoxine moth, *Parategeticula* (Davis, 1967). The eggs likely are inserted into some part of a host plant possessing relatively firm composition, such as that of most young fruits or stems. The larvae are thus suspected of being internal borers, perhaps either in fruits or stems. The eggs are probably not inserted very deeply but may only be partially imbedded in shallow excavations similar to that formed by the females of *Parategeticula.*

The principal aim of this report is to inform entomologists and collectors of this almost totally neglected group, and in particular, to review the zoogeography, general morphology, and classification of its components. Similar studies are currently being pursued by the author on the almost equally primitive and poorly known families of Prototheoridae and Paleosetidae in an attempt to learn more of the antiquity and evolution of the Lepidoptera.

Several individuals have aided me during the course of this review by providing critical information or special assistance. In this regard I wish to express my appreciation to Dr. Ian Common, CSIRO, Canberra City, Australia; Dr. Thomas Donnelly, State University of New York, Binghamton, N.Y.; Dr. John Dugdale, Dept. of Scientific and Industrial Research, Nelson, New Zealand; Prof. Syuti Issiki, formerly of the University of Osaka, Osaka, Japan; Dr. N. P. Kristensen, Universitetets Zoologiske Museum, Copenhagen, Denmark; Dr. Tosio Kumata, Hokkaido University,

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Sopporo, Japan; Dr. M. S. Mani, St. John's College, Agra, India; and Dr. Akira Mutuura, Entomology Research Institute, Ottawa, Canada. I am especially grateful to Mr. Luis Peña G., Universidad de Chile, Santiago, Chile, for the habitat photographs and specimens of *Apoplania chilensis*, new species. For assistance with illustrations I wish to thank the following staff artists of the Department of Entomology, Smithsonian Institution: Mr. Lawrence Druckenbrod, Ms. Elsie Froeschner (retired), Mr. André Pizzini (recently deceased), and Mr. George Venable. I am further indebted to Mr. Victor Kranz of the Smithsonian Photographic Laboratory and to Mr. Walter Brown and Miss Mary Mann of the Smithsonian Scanning Electron Microscope Laboratory for their much appreciated photographic assistance. In addition, I wish to thank my colleagues in the institutions and collections listed below for allowing me to examine specimens under their care.

BMNH	British Museum (Natural History), London, England
CNC	Canadian National Collections, Entomology Research Institute, Ottawa, Canada
HU	Hokkaido University, Sopporo, Japan
LEP	Collection of Luis E. Peña, Universidad de Chile, Santiago, Chile
USNM	National Museum of Natural History (under catalog numbers of former United States National Museum), Smithsonian Institution, Washington, D.C.
ZMHU	Zoologisches Museum der Humboldt-Universität, Berlin, DDR-East Germany

Zoogeography

Previous to this report, members of the family Neopseustidae were known only from the Assam region of northeastern India, Burma, and Taiwan. Presented herein are the first records of neopseustids from the Western Hemisphere (the northern Valdivian forest region of Chile) and mainland China. Five of the seven known species occur at various points along the Himalayan Chain (Map 1), thus suggesting this general region as an important refugium for the family. Undoubtedly, other members of Neopseustidae remain to be discovered from this area. The endemic Formosan species is now somewhat geographically isolated from the Himalayan species; however, it is closely related to two species of *Neopseustis* from Burma and Szechuan, China.

The present distribution of this family corresponds to that of several other relict insect groups in being restricted to relatively cool, mountainous habitats. In this regard, it is interesting that the relict family Paleosetidae also shows an Assam-Taiwan distributional pattern, in addition to having endemic representatives in Australia. The limited capture data thus far indicate the Neopseutidae prefer forested habitats between 600 and 2300 meters.

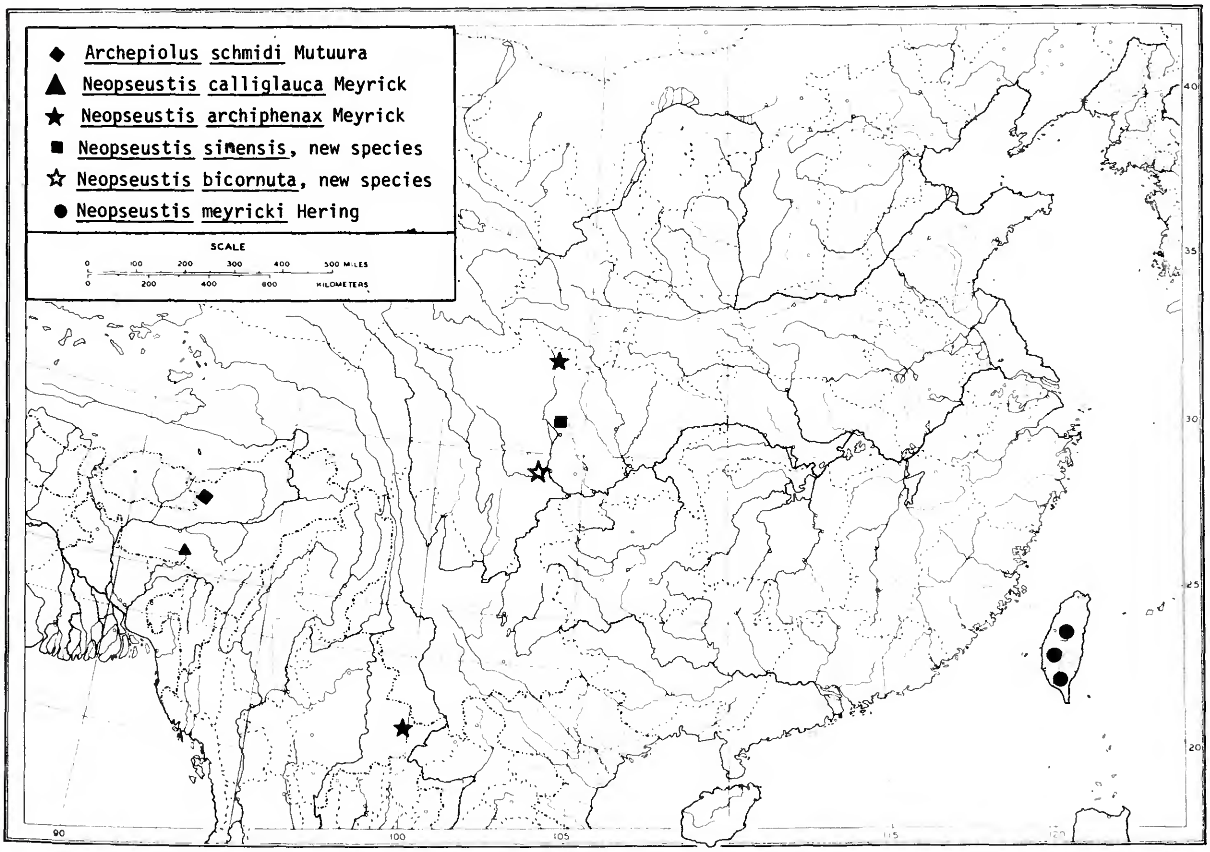
A consideration of the Himalayan Chain as an ancient faunal refugium may at first appear in strong contradiction to the observation that these mountains are relatively recent, beginning to form no earlier than the middle or late Miocene. The Himalayas, of course, have long been recognized as a Pleistocene refugium, with the present fauna being predominantly derived from the north (Asia). The lower or intermediate elevations, however, apparently harbor much older, Gondwanian elements, which originally migrated from the ancient southern Indian Peninsula during the formation of the Himalayas. Migrations from the Peninsula to the north were perhaps most frequent following a retreat of the Glaciers (post-Pleistocene) and before the Indo-Gangetic Plain achieved its present condition as a type of xerophytic barrier. As pointed out by Mani (1974), an exchange of Gondwanian and Asiatic faunas probably occurred during preglacial as well as postglacial times, particularly through the Assam gateway.

Understanding the present distribution of not only the Neopseustidae but of all families of primitive Lepidoptera (i.e., Zeugloptera, Dacnonypha, and Monotrysia) may prove to be a valuable means of establishing a better concept as to the age of the Order and the emergence of its major components. The inadequacy of fossil evidence in deducting phylogenies involving the Lepidoptera has been emphasized frequently. Although the Order is believed to have arisen over 200 million years ago, only one actual fossil remain—a fragmented larval head capsule embedded in Cretaceous amber—is known earlier than the Tertiary period (MacKay, 1970). Several authors (Tillyard, 1935; Forbes, 1932; Hinton, 1946) have proposed early Mesozoic or late Paleozoic origins for the Order, basing their beliefs more on conjecture or indirect comparisons with fossil evidence from other orders of insects.

Renewed interest within the last decade and a half in the phenomenon of continental drift, in conjunction with certain principles proposed in the recent upsurge of phylogenetic systematics (Hennig, 1966a, 1966b; Brundin, 1966), have facilitated means for dating extant groups for which fossil evidence is largely lacking. Thus, as the approximate occurrence of certain continental movements or land-bridge connections become better documented, minimum age determinations, or the *terminus post quem non* of Hennig (1966a), can be proposed for groups whose present distributions can best be explained by those phenomena.

Unfortunately, too little is known concerning the present distribution of the Neopseustidae to decide beyond a reasonable doubt on the origin and principal dispersal routes for this group. Although the recent discovery of the Andean genus ***Apoplania*** suggests a transantarctic dispersal route, a more northern, Laurasian origin cannot be excluded with the evidence available. As discussed recently by Ashlock (1974), under what he termed the "drift sequence rule," at least three continents must be involved in considerations of this nature before direct biotic connections can be confirmed. It is, of course, possible that additional members of this group might yet be discovered in other remnants of Gondwanaland, thereby indicating more strongly a Gondwanian origin. Climatic changes, however, during the late Tertiary and Cenozoic, as witnessed by the warming and drying trends in South Africa and Australia, may have exterminated any forms previously existing there.

There seems little doubt that the Neopseustidae,



MAP 1.—Distribution of Old World Neopseustidae.

as well as several other groups of aculeate Lepidoptera, are ancient enough to have had their present distributions seriously affected by continental drift, which, conversely, has been shown to have occurred late enough to be a major factor in the zoogeography of several extant groups of organisms. For example, evidence, based on morphology as well as biogeography, is beginning to appear which suggests that at least two major groups of Lepidoptera, represented by the present-day Micropterygidae and Hepialidae, arose early in the history of the Order. Both of these groups are considered among the most generalized Lepidoptera existing today, and both demonstrate a broad, bipolar distribution suggesting a widespread dispersal prior to the separation of Pangaea. If the present, widespread distributions of these two groups are the result of such a phenomenon, then this would suggest a minimum date for the existence of the Micropterygidae and Hepialidae of approximately 170 million years ago, or during the Jurassic. Also interesting in this regard are the Incurvariidae which likewise show a broad, bipolar distribution with sister-group complexes existing at similar latitudes between both the Nearctic-Palearctic and the southern Ethiopian-Neotropical regions.

The Micropterygidae have generally been considered the most primitive surviving group of all the Lepidoptera. For example, Hinton (1946), emphasizing several primitive features in the adult mouthparts, believed the Micropterygidae were even more primitive than the Trichoptera and retained the family in a separate order, Zeugloptera, as earlier proposed by Chapman (1917). Recently (Friese, 1969), the Hepialidae have been considered the most primitive and, therefore, the earliest of the Lepidoptera. Friese primarily arrived at his conclusions by deemphasizing characters of the mouthparts and instead utilized a partially different set of characters such as the relative development of the prothorax and the abdominal ganglia.

Several primitive families of Lepidoptera show a Gondwanian origin; thus, those groups may have appeared later than the Micropterygidae and Hepialidae and after a separation of the northern and southern continents. Families falling into this category are the Agathiphagidae, Lophocoronidae, Mnesarchaeidae, Paleosetidae, Prototheoridae, and possibly Neopseustidae. The Eriocraniidae probably appeared during the same general period but arose, instead, in Laurasia. Thus, the Eriocraniidae should have some indication of a sister group in the Southern Hemisphere. Such a group may be represented by the Lophocoronidae, a family only recently discovered (Common, 1973).

All present indications suggest an Old World origin, now concentrated in the Himalayan Chain for the Neopseustidae. *Archepiolus*, in possessing the greatest number of plesiomorphic characters, particularly in its wing structure, clearly presents the most generalized member of the group. Possessing a number of apomorphic characters (i.e., reduced epiphysis, reduced anal pocket in the forewing, and heavily sclerotized aedeagus), *Apoplania chilensis*, new species, represents an ancient derivative from a common stock shared with *Neopseustis*. Just how ancient was this divergence is largely conjectural at present, as pointed out previously. However, for many of the same reasons summarized by Hennig (1966a) for certain Diptera, the minimum period for the separation of the common *Neopseustis-Apoplania* stem would appear to be somewhere in the mid-Cretaceous. The Atlantic Ocean was forming during that period (Smith et al., 1973), and the separation between North and South America was well established (Kossmatt, 1936). Furthermore, considering that South America was isolated from North America for most of the Tertiary (Darlington, 1957), one would believe it improbable for the Neopseustidae to have migrated over such vast distances from Asia, or even from North America, during the late Tertiary and Cenozoic without leaving some evidence of their former existence. Certainly the Microlepidoptera fauna is far better known for the northern continents than for the southern ones.

Before general hypotheses such as those just discussed can be confirmed, further investigations, based on phylogenetic principles, are needed on the general morphology and zoogeography of the primitive Lepidoptera. Additional field work in critical areas is particularly necessary. As an example of the latter, recent field discoveries as reported in this paper and by Dumbleton (1952), Mutuura (1971), and Common (1973) have added significantly to our present meager knowledge of the aculeate Lepidoptera.

Review of Morphology and Classification

The first example of a member of this family was discovered in the Khasi Hills of Assam, India, by a native collector. The specimen was sent to Edward Meyrick, who described it under the name *Neopseustis calliglauca*. Originally, Meyrick (1909, 1912) included the species in his heterogeneous concept of the Micropterygidae, subfamily Eriocranianae [sic]. Martin Hering (1925), in describing a second species of *Neopseustis* from Taiwan, recognized the uniqueness of the moths and proposed the family Neopseustidae.

More recently, the Neopseustidae have been considered as members of the suborder Dacnonypha and have been usually associated with the Eriocraniidae in the Eriocranioidea (Bourgogne, 1949; Common, 1970). The Neopseustidae and Mnesarchaeidae were considered by Kristensen (1968) to be monophyletic sister groups and to represent the most advanced dacnonyphous families. Mutuura (1972) stressed the relationship of Neopseustidae to the New Zealand Mnesarchaeidae (largely on the basis of the male genitalia) and to the South African Prototheoridae (on the basis of venation and male genitalia). Dugdale (1974), basing his interpretation on data provided by Mutuura (1972), tentatively placed the Neopseustidae with the Hepialioidea in the exoporian Ditrysia.

Results of the present study have revealed the relative uniqueness of this family to such an extent that it becomes necessary to propose the new superfamily, Neopseustoidea. Because of the group's unusual morphology, coincident with the apparent extinction of annectant forms, it is now difficult to determine its relative position within the lepidopteran hierarchy. To date, numerous attempts have been made to subdivide the Lepidoptera into various suborders, and most of these have presented almost as many queries as they have solved. As our basic knowledge of the aculeate Lepidoptera increases, various refinements have been added to the current subordinal system; however, there is still a great need for additional information and improvements. Under the current system (as most recently defined by Dugdale, 1974), the Neopseustoidea most appropriately fall within the Dacnonypha. They are, however, only distantly related to the Eriocranioidea, and, with some character systems, show as close a relationship to members of other suborders (e.g., Nepticuloidea). Thus, in some features, the Neopseustoidea appear to occupy an intermediate position between the Dacnonypha and Monotrysia and, like the Nepticuloidea, as pointed out by Dugdale (1974:138), obscure the separation of these two suborders. Previously postulated close affinities of the Neopseustoidea with the Hepialoidea and Mnesarchaeoidea are not supported by the comparative morphology of the female abdomen and reproductive system. Similarities in wing structure, however, do suggest some relationship between these groups. The uniqueness of the female reproductive system of the Neopseustoidea actually suggests a new subordinal status for the group; but such a decision should await further studies of the other aculeate families, utilizing as many character systems as possible. Hopefully, it will eventually be possible to consider the morphology of the immature stages more in such a classification, as soon as those forms have been better collected and studied.

The general morphology of the head, as reviewed by Kristensen (1968), displays a mixture of primitive and specialized features. Among the more primitive are the elongate, five segmented maxillary palpi, a relatively large (though fused) labrum, and well developed frontal chaetosemata. The latter structures are usually present in the Neopseustidae as a pair of swollen areas on the frons beneath the antennal sockets, with another, often smaller pair situated above the antennae across the vertex. The chaetosemata of Lepidoptera were first described by Jordan (1923) and later studied further by Eltringham (1925), who demonstrated their nerve supply. Most likely these sensory structures are homologous to the "warts" of Trichoptera. In the Neopseustidae, the chaetosemata have been referred to as Eltringham's organs by Kristensen (1968) and Mutuura (1971).

Among the characters of the head that may be considered as derived or modified are the loss of ocelli, the loss of the sensory pits (organs of vom Rath) from the apical segment of the labial palpi, the reduction of the mandibles, and the specialization of the galeae. The head is hypognathous and broader than long. The compound eyes are unusually enlarged for the Dacnonypha, possessing an interocular index of 1.3–1.5 (see Davis, 1975). Similarly, the antennae are unusually long and many segmented (69–96 segments). A small intercalary sclerite (Figure 29) is present in *Neopseustis* and *Apoplania* between the scape and pedicel but absent in *Archepiolus*. The flagellar segments are usually submoniliform in outline and bear scattered rows of prominent sockets from which arise slender scales. The length and arrangement of these rows are generally similar to those scattered over the legs (Figure 48). The general chaetotaxy and structure of the antennal segments are quite similar among all three genera. In addition to scales, relatively large setal sensillae (sensilla trichodea) also arise from prominent sockets in the antennae. The sockets of the latter are larger and more scattered and not arranged in rows. The surfaces of these sensillae are densely covered by a mealy, waxlike substance (Figure 22). The function of these sensillae may possibly be chemoreceptive in nature. The mandibles are enlarged but only weakly sclerotized and are nonfunctional. The galeae are very short, their length usually not exceeding the length of the labial palpi. According to Kristensen (1968), the structure of the food groove consists of transverse bars, possibly subdivided into densely packed lamellae similar to the condition in higher Lepidoptera. The dorsal arms of the tentorium (Figure 26) are well devel-

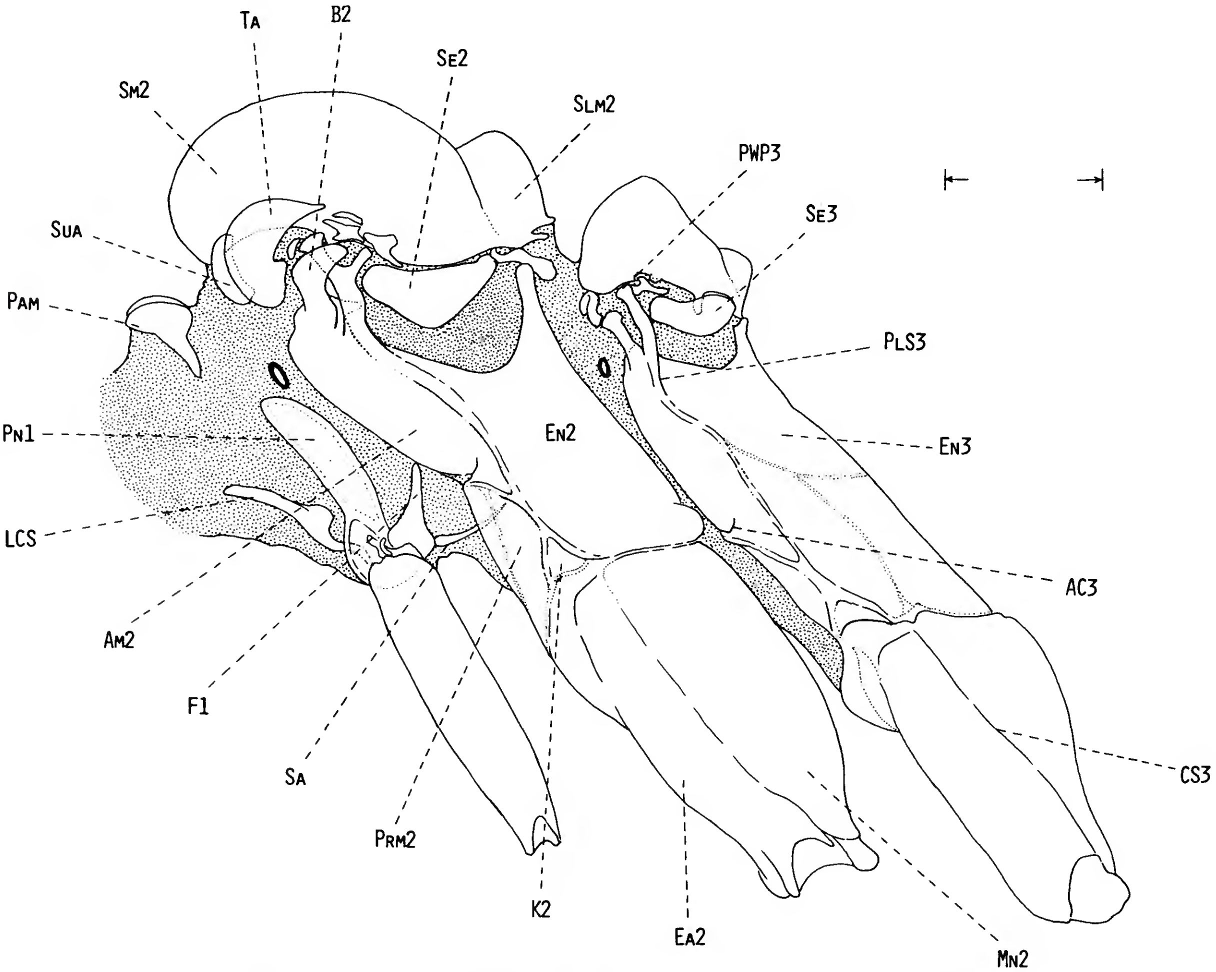


FIGURE 1.—*Neopseustis archiphenax* Meyrick, lateral view of thorax. (Scale=0.5 mm.)

oped in this family and nearly reach to the vertex. These arms are also well developed in the Mnesarchaeidae, Eriocraniidae, and Lophocoronidae but are reduced or absent in the Micropterygidae, Agathiphagidae, and nearly all other families of Lepidoptera. Ehrlich (1958), however, shows these arms secondarily developed in *Graphium* and *Lamproptera* of the Papilionidae.

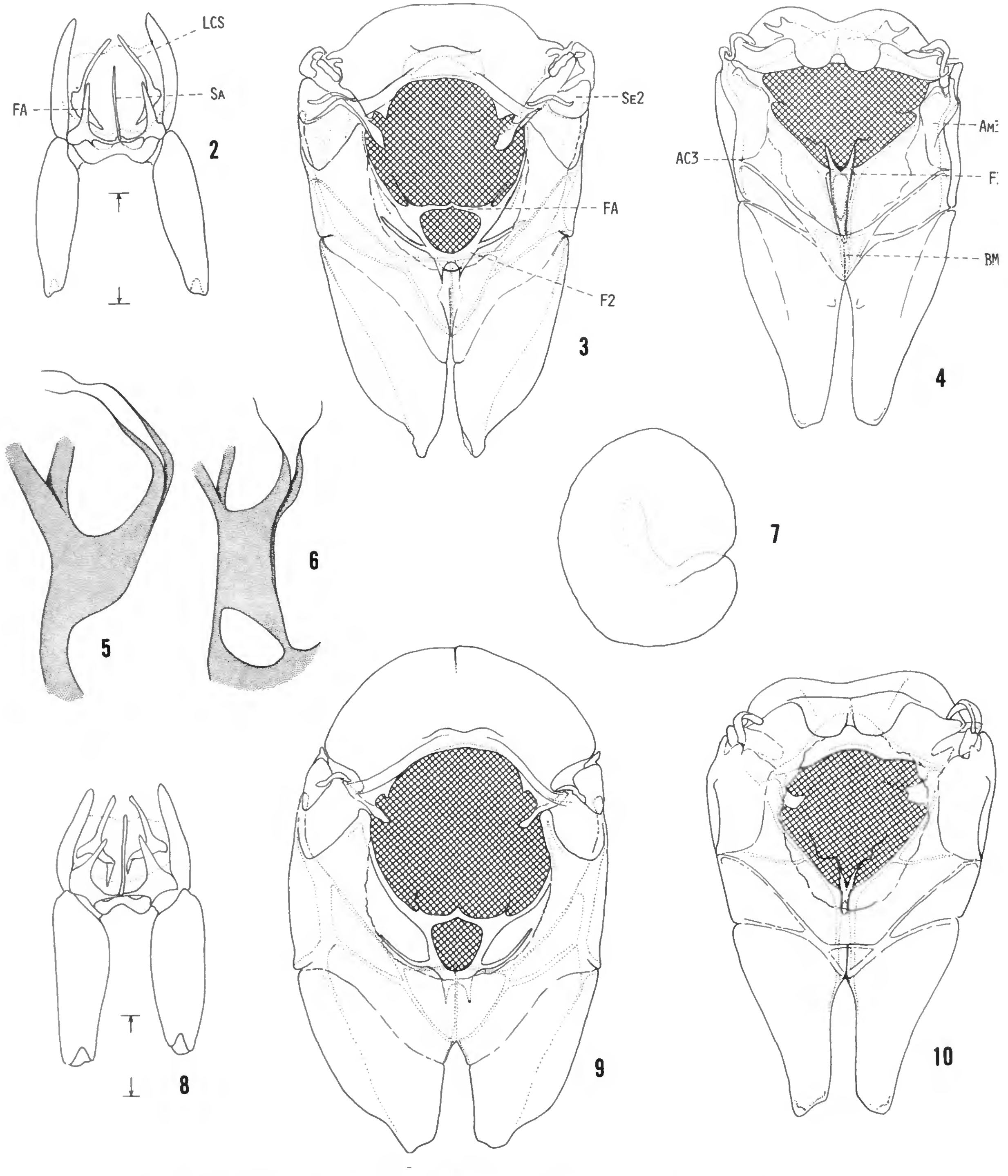
The general structure of the thoracic sclerites as viewed laterally (Figure 1) superficially resembles that of the trichopteran *Rhyacophila* as illustrated by Malicky (1973). The prothorax is reduced and free from the mesothorax. The pronotum is greatly reduced in size, very narrow, and is largely obscured dorsally by the mesonotum. The prothoracic furca and spina are well developed and elongate. The tegula is moderately large and nearly oval in full outline (Figure 7). The subtegular sclerite is relatively large and crescent shape. One of the most unusual features of the mesothorax is the fused condition of the furcal apophyses. The mesothoracic furcae of *Apoplania* and *Neopseustis* are very similar in structure with their apophyses extending medially and fusing, thus forming an internal bridge (Figures 3, 9). In several other families of primitive Lepidoptera examined (e.g., Micropterygidae, Eriocraniidae, Hepialidae, Palaeosetidae and Nepticulidae), these apophyses are either not well developed, or if developed, then widely separated.

The metathoracic furcae of *Neopseustis* and *Apoplania* differ significantly in structure (Figures 5–6). In *Apoplania* the base of the furca is secondarily joined ventrally to the internal fold of the basisternum, thereby creating a lumen (Figure 6) immediately ventrad to the furca. In *Neopseustis*, the base of the furca is relatively reduced in length and does not extend to connect secondarily with the basisternum.

The coxae of all legs are relatively long and slender in the Neopseustidae. An epiphysis is typically present in all species, but this becomes extremely reduced in *Apoplania* (Figure 48). The mesothoracic and metathoracic tibiae possess one and two pairs, respectively, of elongate, well-developed spurs. The terminal tarsal segment (Figure 52) is typically lepidopterous with a median, setiform empodium; a broad, triangular arolium; and a pair of densely setose pulvilli. The tarsal claws are simple, with no secondary specializations.

The wings are broad and usually thinly covered by slender scales (Figure 16) except for a sparse scattering of broad silvery scales on the forewings. Most Neopseustidae, thus, superficially resemble certain Neuroptera. *Archepiolus* is unusual in having the forewings clothed in predominantly dark, broad scales. The ultrastructure of the wing scales in this family is unusual. In *Neopseustis calliglauca* (Figures 38–39), the intervenal transverse striae are frequently interrupted by relatively large and often elongate lacunae. The lacunae are unique in being lined with a very distinct, thickened border. The wing scales of *Apoplania* are similar in general structure, except the lacunae are smaller (at least in the scales of the hindwing) and not as well defined. The scale structure of Neopseustidae in being lacuneate, thus differs significantly from the nonperforated type found in the Zeugloptera, Dacnonypha (Figure 46), and most Monotrysia. Instead, it bears more resemblance to the multiperforated (lacuneate) type of the Hepialoidea (Figure 43), Mnesarchaeoidea, and many endoporian Ditrysia. The microtrichiae (Figure 40) are dense and are randomly scattered over both surfaces of all wings.

Although the wing venation of the Neopseustidae is of a very archaic pattern, certain specializations are to be noted. *Archepiolus* possesses the most generalized wing structure in the family. In this regard it resembles the Hepialoidea, particularly the Paleosetidae, in possessing rather broad wings with a branched subcostal vein in the forewing and a five branched radial system in both wings. Although Hering (1925) believed a jugum to be absent, this structure is present in all three genera. The venations of *Apoplania* and *Neopseustis* are quite similar, and both show such specializations as the fusion of R2+3 and the development of an anal "pocket" in the forewing. The latter is best developed in *Neopseustis*, where it is formed by the dorsoanterior bending of the base of the first anal vein over the base of the posterior cubital vein (CuP). This has caused the base of the wing to be pushed up and forward (Figure 36), resulting in a corresponding pocket to form underneath. Hering (1925) was greatly impressed with the significance of the "axillar-Wurzelschlinge" and largely on this basis, as well as on the supposed "absence" of a jugum, removed *Neopseustis* from the Micropterygidae and recognized its current



FIGURES 2–10.—Thoracic morphology: 2, *Apoplania chilensis*, new species, caudal view of prothorax; 3, *A. chilensis*, new species, caudal view of mesothorax; 4, *A. chilensis*, new species, cephalic view of metathorax; 5, *Neopseustis archiphenax* Meyrick, lateral view of metathoracic furca; 6, *A. chilensis*, new species, lateral view of metathoracic furca; 7, *N. archiphenax* Meyrick, lateral view of tegula; 8, *N. archiphenax* Meyrick, caudal view of prothorax; 9, *N. archiphenax* Meyrick, caudal view of mesothorax; 10, *N. archiphenax* Meyrick, cephalic view of metathorax. (Scale=0.5 mm.)

status as a distinct family. Hering proposed the function of the anal pocket as a different type of wing coupling mechanism that had developed to replace the function of the "missing" jugum. However, examination of spread or partially spread specimens (i.e., in a condition somewhat similar to flight) shows the costal border of the hindwing rather remote from the pocket. It appears more likely that the anal pocket and the extended anal groove formed by the elevation of A1+2 would be of more use when the insect is resting. At least in unspread specimens, the costal margin of the hindwing lies closely approximate to the anal pocket and groove of the forewing. Consequently, the groove and pocket may be a modification to assist *Neopseustis* in closing its wings at rest and perhaps evolved in conjunction with a noticeable broadening of the wing base.

In connection with a discussion involving wing venation, an important fact regarding the correct terminology of the cubital system in Lepidoptera perhaps should be emphasized. American entomologists in particular have persisted in following Comstock's (1918) terminology by referring to the second primary branch of the cubitus (CuP) in Lepidoptera as the first anal vein (1A). The correct terminology for the cubital system has been most recently reviewed by Martynova (1960) and has been followed in the present paper. Martynova's belief that no more than two anal veins exist in Lepidoptera, however, should be critically examined as several genera appear to exhibit a small third anal vein (e.g., in the jugal fold of *Neopseustis*, and in several genera illustrated by Common, 1970).

The ventral articulation between the metathorax and abdomen is generally similar to that of other primitive families in that no sternal processes protrude from the second abdominal sternite (Figure 54). Remnants of the first sternite are believed present in the form of a narrow, transverse, median sclerite weakly connected to the anterior margin of the second sternite by a median, furcate bridge. The first sternite extends laterally as a very slender sclerite which joins the anterolateral angle of the second sternite. The lateral margin of the second sternite is thickened somewhat to form an internal rod, which, however, is entirely fused to the sternite. This thickening may represent the precursor of the sternal processes so prominent in the Tineoidea (Brock, 1971).

Within certain genera of the aculeate Lepidoptera, variously modified, paired organs appear on the fourth and/or fifth sternites of the male and female abdomen. These structures were first studied in the Lepidoptera by Philpott (1925), who regarded them questionably as scent organs. In Table 1, I have summarized their occurrence among several representative genera. In addition to the Lepidoptera, apparently homologous structures also occur in both sexes on the fifth sternite of certain primitive Trichoptera (Malicky, 1973). Philpott (1925) specifically mentions a well-developed pair of fifth sternal glands for a New Zealand philopotamid, *Hydrobiosella stenocera* Tillyard.

Within the Neopseustidae no such organs appear on the fifth sternite of either sex; however, paired, circular, membranous areas are present on the fourth sternite of the female (Figure 57). As noted in Table 1, only two other families, the Eriocraniidae and Nepticulidae, are known to possess similar structures on the fourth sternite. These structures are apparently synplesiomorphic characters that demonstrate yet another distant genetical link between these three otherwise very different groups. It should be noted that the eriocranioid genus *Acanthopteroctetes* lacks any sternal organs, which may be another justification for removing this genus from the Eriocraniidae; however, Kristensen has observed (pers. comm.) that the glands opening on the fifth sternum are sometimes lost in one or both sexes of certain *Eriocrania*.

The sternal organs of the fourth segment in both the Neopseustidae and Eriocraniidae appear as thin, membranous "windows" in the otherwise pigmented integument. They are usually spaced rather widely apart and near the caudal margin of the segment. In the Nepticulidae these structures are situated close together, reduced in size and possibly vestigial, and may be absent in some species. In contrast to the obviously glandular nature (i.e., with ducted glands) of those organs arising from the fifth sternite of certain genera, these structures of the fourth sternite exhibit no external openings or internal ducts. Their function may possibly be chemosensory in nature as compared to the apparent chemical production and secretory function of the fifth sternal glands. Kristensen (pers. comm.), however, has recently found that the unpigmented patches of the fourth sternum in *Eriocrania* merely demarcate the areas to which the globular reservoirs of the fifth sternal glands are attached. Kristensen (1972) has further suggested that the latter organs may serve a defensive purpose.

Table 1.—Occurrence of sternal abdominal glands among aculeate Lepidoptera

Species examined	Abdominal segments		
	4th ♀	5th ♀	5th ♂
Micropterygidae			
Micropteryx aruncella Scopoli	-	-	-
Epimartyria auricrinella Walsingham	-	+	+
Sabatinca incongruella Walker	-	+	+
Agathiphagidae			
Agathiphaga vitiensis Dumbleton	-	-	+
Eriocraniidae			
Acanthopteroctetes bimaculata Davis	-	-	-
Dyseriocrania auricyanea (Walsingham)	+	+	+
Eriocraniella aurosparsella (Walsingham)	+	+	+
Lophocoronidae			
Lophocorona pediasia Common	?	?	+
Neopseustidae			
Archepiolus schmidi Mutuura	?	?	-
Neopseustis meyricki Hering	+	-	-
Apoplania chilensis, new species	+	-	-
Hepialidae			
Hepialus sequoiolus Behrens	-	-	-
Paleosetidae			
Ogygioses eurata Issiki & Stringer	-	-	-
Mnesarchaeidae			
Mnesarchaea loxoscia Meyrick	-	-	-
Nepticulidae			
Nepticula variella Braun	+	-	-
Opostegidae			
Opostega albogaleriella Clemens	-	-	-
Incurvariidae			
Incurvaria russatella Clemens	-	-	-

The seventh and eighth abdominal sternites of most species of Neopseustidae also display some degree of specialization. For example, the males of *Neopseustis* and *Archepiolus* possess a small, median, sternal lobe or process directed caudally from the seventh sternite (Figure 55). This peculiar process is but one of several synapomorphic characters that dictates the inclusion of *Archepiolus* within the Neopseustidae. The sternal process is absent in *Apoplania*, although a shallow, lightly sclerotized, midventral depression is visible. In addition, the males of most *Neopseustis* possess a much broader median lobe near the anterior margin of the eighth sternite (Figure 55). This lobe is very low in profile and is densely covered with short, peglike spines. Both sternal processes are represented by similar, homologous structures in at least the females of *Neopseustis meyricki*. In the latter, however, the eighth sternal lobe (and spines) has moved even further anteriorly and is contiguous with the caudal margin of the seventh sternite. A similar, heavily spinose lobe exists in the female of *Apoplania chilensis*. The sternal spine of the seventh segment must serve a similar function in both males and females (e.g., assisting to support the body while resting in an upright vertical position). The spines of the eighth segment in the female, however, are believed to be used primarily during ovipositioning.

The eighth abdominal spiracle is present and well developed, in contrast to the Zeugloptera and some Monotrysia where it is lacking (Dugdale, 1974).

The male genitalia of Neopseustidae is complex to the extent that its corresponding structures are difficult to homologize with those of other families. In the terminology I have followed, I have attempted to use standard terms familiar to lepidopterists even though in some cases their homologies are uncertain. My selection of these terms was based primarily on their relative position as defined by Klots (1970). In the only other comparable study of the male neopseustid genitalia, Mutuura (1971) partially followed terminology sometimes used by trichopterists (Nielsen, 1970). Consequently, that author uses the term dorsal processes for what I refer to as the uncus, and lateroventral processes for what I collectively term the valvae.

The alimentary canal terminates near the center of a largely membranous pad of tissue, immediately ventrad and slightly caudad of the usually bilobed uncus (ninth tergite). This typically inflated pouch probably represents the tenth, or anal, segment. The entire structure may be somewhat swollen and protrusive, or it may be partially retracted into the body beneath the tegumen. On each side of the anal segment is situated a pair of densely setose pads referred to as socii. The setae of the socii are interesting in arising from prominent, tubercular follicles. A median, unpaired, and frequently uncinate gnathos lies immediately ventrad to the anal tube. Usually present at the lateroposterior margins of the tegumen is a pair of broad, lobelike processes, or tegumenal lobes (TL). Immediately ventrad to these lobes are the valvae which are usually rigidly fused to the tegumen and vinculum. The vinculum is superficially similar to that found in a few other primitive families (e.g., Eriocraniidae and Nepticulidae) in possessing a deeply excavate or concave cephalic margin.

Located in or arising from the diaphragma are a number of highly modified structures of uncertain homologies. In general, these structures are arranged into two more or less distinct areas: one group situated primarily dorsad and laterad to the aedeagus or gonopore; and a second, usually single structure entirely ventrad. The entire assemblage is rigidly joined to the center of the vinculum by means of a transverse bar (TB). Mutuura has referred to the dorsolateral plate and its appendages as the paramera. In contrast, I have termed the dorsolateral sclerotizations as the anellus. The most prominent features of this complex, the bilateral, armlike processes (LPA), are prominent in all three genera and are very useful in distinguishing species. In *Neopseustis* the anellus entirely surrounds the gonopore and is fused midventrally to the vinculum by means of the transverse bar. The ventral sclerotization in the diaphragma has been termed the juxta. It may be relatively broad and flat (e.g., in *Apoplania* and *Archepiolus*) or very compressed and spatulate as observed in *Neopseustis*.

An aedeagus is present in *Apoplania* and *Archepiolus* but absent in *Neopseustis*. In *Apoplania* the aedeagus is highly modified with prominent exophallic spines arranged in a rigid spiral around the apex. The vesica and possibly part of the ejaculatory duct are also modified and sclerotized. The comparable situation in *Neopseustis* is a curious one with the ejaculatory duct terminating in a broad cavity surrounded by the anellus. An eversible vesica as well as any clear indication of an aedeagus appear absent. Instead, from the ventral margin of the ejaculatory opening, or gonopore, arises a pair of long, free, digitate processes (Figure 82) which, because of their relative position, have been termed parameres (Pa). Unfortunately, my usage of the term paramere does not agree with that of Snodgrass (1957), nor of Mutuura (1971). Usage of the term by Snodgrass corresponds to what lepidopterists refer (probably incorrectly so) as the valve, or valva. It is possible, of course, that what is referred to in *Neopseustis* as parameres may actually represent the adeagus or structures derived from the aedeagus. If such is true, however, then its present form and function has diverged greatly from that of the typical aedeagus present in nearly all Lepidoptera. The parameres in *Neopseustis* are usually completely separated and contain no external opening (phallotreme) for sperm emission.

In *Neopseustis calliglauca* and *N. bicornuta* the parameres are poorly developed, membranous, and devoid of setae. In *N. archiphenax, N. meyricki,* and *N. sinensis* they are greatly lengthened with the basal half encased in a sclerotized sheath and the apical half densely pubescent on their ventral surfaces. Because similar structures do not appear in the two genera possessing a well-developed aedeagus, the parameres may somehow assist in sperm or spermatophore transfer in *Neopseustis*.

The female reproductive system also demonstrates several unusual features, which, in some instances, were misinterpreted recently by Mutuura (1972). Externally, one of the most conspicuous modifications is in the ventral invagination of the intersegmental region between the seventh and eighth sternites (Figure 88). The anterior rim of this pocket (formed largely by the seventh sternite) is strongly sclerotized and equipped with a median lobe bearing numerous short blunt spines (discussed previously). The pocket has no internal opening or ducts leading to it. The development of this pocket, in conjunction with a piercing type of ovipositor, suggests that it may have evolved to better anchor the apex of the abdomen during oviposition.

The tenth segment is represented by a pair of short but heavily sclerotized apophyses, which are fused at their caudal apex to form a blunt, rasping, ovipositor. Thus, the method of oviposition may be remotely similar to that performed by some members of the Eriocranioidea and Incurvarioidea. The extreme apex of the ovipositor is coarsely serrated and is partially defined by a narrow suture, which may represent the eleventh segment as suggested by Mutuura (1972).

As shown in Figures 90, 91, the anal aperture is a narrow slit immediately anterior to the apex of the ovipositor. The rectum is large and inflated. Arising from the anterior margin of the anus is the duct of the undivided colleterial gland. In most families of Lepidoptera these glands are paired or occasionally lacking. Partially separating the apertures of the colleterial gland and spermatheca is a pair of small sclerites representing the ninth sternite. The spermathecal duct is sinuate but not coiled as in the Nepticuloidea and most higher families of Lepidoptera. A spermathecal vesicle is present as an annular thickening at the termination of the duct. An internal canal is present within the spermathecal duct, but no evidence of a spermathecal papilla has been observed. The spermatheca of *Apoplania* (Figure 97) differs significantly in structure from that of *Neopseustis*. In *Apoplania*, the spermathecal utriculus is more reduced in size, and it possesses a filamentous, anterior extension (receptacular gland), which is apparently absent in *Neopseustis*. Slightly anterior to the spermathecal vesicle in *Neopseustis* arises a slender duct representing the lateral lagena, as figured by Dugdale (1974:137) for *Nepticula*. This tube actually resembles more closely a homologous structure shown by Unzicker (1968, therein referred to as the prespermathecal diverticulum) to occur in most Trichoptera. Although a lateral lagena is present in *Neopseustis*, this structure does not occur in *Apoplania*.

Anterior to the spermathecal aperture lies a very broad vulva which immediately divides to form a dorsal ductus bursae and ventral common oviduct. All of the body openings just referred to, including the anus, open into an abbreviated, incomplete cloaca similar to that described for certain *Opostega* by Dugdale (1974, fig. 21). Laterally the cloaca is partially exposed due to the flaplike structure of the eighth sternite.

As pointed out by Dugdale (1974) and others, the relative position of these various terminal apertures and their internal organs in the female is extremely important toward understanding the higher classification of the Lepidoptera. For example, the ventral position of the common oviduct (versus dorsal as figured by Mutuura, 1972) in the Neopseustidae amply distinguishes this family from the Hepialoidea and Mnesarchaeoidea. In the latter two groups, the oviporous is separate from and dorsal to the ostium bursae, thus typifying the exoporian ditrysian condition first described for the Hepialidae by Oiticica (1948). The ventral position of the common oviduct is clearly the primitive condition as universally demonstrated by all panorpoid orders (Unzicker, 1968; Dugdale, 1974) except the Lepidoptera. Within the Lepidoptera, an oviduct situated dorsal to the bursa copulatrix exists only in the exoporian and endoporian Ditrysia. Consequently, utilizing this character system, the Hepialoidea appear more specialized than the Micropterygidae.

The retention of a vestige of the ninth sternite separating the anus from the spermathecal aperture-vulva may prove significant not only to the higher classification of the Neopseustidae but to other families as well. Certainly no such separations are known to exist in any other members of the Dacnonypha. The presence of this sclerite (with its resulting demarcations) in *Neopseustis* somewhat obscures the definition of a true cloaca. Largely for this reason, a cloaca is not believed to be present in this family except in a rather incomplete or intermediate stage.

In summary then, the Neopseustidae, with their retention of a jugum, complete absence of a frenulum, rudimentary cloaca, sinuate spermathecal duct, and ventral oviduct, appear most related to the suborder Dacnonypha. They are, however, amply differentiated from the other members of the Dacnonypha and demonstrate certain affinities with other aculeate groups. For example, except for the rasping ovipositor, the female reproductive system more closely resembles that of certain Nepticuloidea, particularly in the presence of a vestigial ninth sternite. Similarly, the relatively broad wings and basic pattern of venation and scale structure is more typical of the Hepialoidea. If nothing else, the Neopseustidae demonstrate some basic problems in clearly defining the Dacnonypha and Monotrysia.

Abbreviations

A	anus
AC3	anapleural cleft of metathorax
Am2	anepisternum of mesothorax
Ans	anellus
Ar	arolium
B2	basalare of mesothorax
Bm	basisternum
Ca	chaetosema
CB	corpus bursae
Cdo	cardo
CG	colleterial gland
CO	common oviduct
CS3	coxal suture of metathoracic coxa
DA	dorsal arm of tentorium
DB	ductus bursae
Ea2	eucoxa of mesothoracic coxa
EC	external canal
Em	empodium
En2	epimeron of mesothorax
F1	furca of prothorax
FA	furcal apophysis
G	gnathos
IC	internal canal
IS	intercalary sclerite
J	juxta
K2	katepisternum of mesothorax
LCS	lateral cervical sclerite (pre-episternum)
LL	lateral lagena
LPA	lateroposterior process of anellus
Me	mandible
Mn2	meron of mesothoracic coxa
O	ovipositor (tenth abdominal segment)
PA	posterior apophysis
Pam	patagium
Pe	paramere
P1S3	pleural suture of metathorax
Pn1	pleuron of prothorax
Prm2	pre-episternum of mesothorax
PrS	prothoracic spina
Ps	pulvillus
PWP3	pleural wing process of metathorax
RG	receptacular gland
7S	seventh abdominal sternite
Sa	spina
Se2	subalare of mesothorax
Si	socii
Slm2	scutellum of mesothorax
Sm2	scutum of mesothorax
SP7	sternal process of seventh abdominal segment
Spa	spermatheca
Ss	stipes
St	sensilla trichodea
Sua	subtegula
SV	spermathecal vesicle
8T	eighth abdominal tergite
Ta	tegula
TB	transverse bar
TC	tarsal claw
TL	tegumenal lobes
Tn	tegumen
U	uncus
Us	utriculus
V	vulva
Va	valva
Ve	vesicle
Vm	vinculum

NEOPSEUSTIDAE

ADULT.—Small to medium size moths with relatively broad and usually thinly scaled wings; coloration usually of a cryptic or somber pattern, ranging in shades of pale gray to fuscous, variously marked with white. Wing expanse ranging from 14 to 27 mm.

Head: Vestiture relatively sparse, hairlike, mostly rough; occipital scales loosely appressed, directed forward toward vertex and converging between antennal sockets; a pair of usually large chaetosemata situated along front rim of eye below antennal sockets, each bearing an erect tuft of sensory scales; a second, usually smaller and contiguous pair of chaetosemata present slightly above and between the sockets; ventral margin of gena extended into an angulate, subgenal process. Antennae long, approximately equaling length of forewing, with 69 to 96 segments; segments submoniliform to subserrate, cupuliform, bearing two major types of sensory setae in definite sockets (Figures 20–23); entire shaft (except for a narrow, naked, midventral tract) thinly covered with narrow scales and setae; scale rows somewhat indefinite due to scattered sockets but appearing under low magnification as one scale row per segment; scape large, swollen, an intercalary sclerite usually present between scape and pedical (absent in *Archepiolus*). Ocelli absent. Compound eyes rounded, enlarged, interocular index approximately 1.3–1.5; eyes naked. Labrum triangular. Mandibles present, but reduced, weakly sclerotized, and nonarticulated. Maxillary palpi long, folded against head in repose, 5-segmented; the penultimate (fourth) and apical (fifth) segments the longest and of equal lengths; galeae relatively short, approximately 0.5 the length of maxillary palpi. Hypopharynx elongate, tapering to a triangular lobe ventrally. Labial palpi moderately long, 3-segmented; apical (third) segment elongate, equaling length of second. Dorsal tentorial arms (Figure 26) completely sclerotized, well developed, nearly reaching to vertex of cranium immediately posterior to antennal insertion.

Thorax: Mesothoracic furca with apophyses connected by their apices at midline (Figure 3). Legs of moderate length (Figures 49–51); prothoracic leg with epiphysis relatively long (0.3–0.5 the length of tibia) or minute (length less than width of tibia); epiphysis simple, not pectinate; tarsus equaling length of tibia; mesothoracic leg with one pair of apical spurs, tarsus equaling tibia; metathoracic leg with a pair of apical spurs and a pair of spurs arising from distal third or fourth of tibia; tarsus distinctly shorter than tibia; all paired spurs of unequal lengths. Forewings relatively broad, outer margin rounded, either 13 or 14 veined; Sc divided; R2 and 3 usually fused and stalked or connate with R4+5, but stalked over half their length and separate from R4+5 in *Archepiolus*; R4 and 5 stalked; M1 and 2 usually stalked (separate in *Archepiolus*); M3 separate; base of medius well preserved; m-cu crossvein present; CuA1 and 2 stalked over one-third their length; CuP weak; 1A and 2A separate at extreme base but united for most of their length to margin; 3A present at jugal fold; jugum present; a prominent pocket formed ventrally at base of anal veins in *Neopseustis* (Figure 36), which is poorly developed in *Apoplania* and absent in *Archepiolus*. Hindwings 11 or 12 veined; Sc simple, undivided; subcostal crossvein present at base of wing or absent; R2 and 3 either fused or strongly stalked; R4 and 5 stalked half their length or more; M1 and 2 stalked; M3 separate; m-cu crossvein absent, thus lower half of discal cell open; CuA1 and 2 stalked; CuP weak, connected at base to 1A in *Neopseustis* and *Apoplania* but not in *Archepiolus*. Both wings with microtrichiae dense and evenly distributed (Figure 37).

Abdomen: Eighth abdominal spiracle well developed, functional. Seventh sternite of male usually with a median, connate, spinose process or with a median, slightly depressed area; eighth sternite of male sometimes with a median, spinose ridge, though reduced or absent in some species. Female with a bilateral pair of oval, membranous pads near caudal margin of fourth sternite; entire seventh sternite heavily sclerotized, either with or without a median, connate process similar to male; caudal margin of seventh sternite produced into a low, median lobe bearing numerous short, blunt spines. Intersegmental area between seventh and eighth sternites deeply excavated.

Male genitalia: Uncus present, bifurcate, prominently developed in *Archepiolus* and *Apoplania*, very reduced and largely fused to tegumen in *Neopseustis*. Socii present, densely setose; setae arising from prominent, tubercular follicles. Anus terminating in middle of a usually inflated, membranous pouch which may either be extended or withdrawn slightly. Gnathos present; typically a median plate poorly connected to tegumen, and usually with a median process arising ventrally. Tegumen a narrow ring dorsally, expanding slightly laterally and fusing with valvae and vinculum; a bilateral pair of lobelike processes arising from lateroposterior margin of tegumen, reaching their maximum development in *Neopseustis*. Vinculum broadened laterally with a pair of lobes directed anteriorly; anterior margin of vinculum usually deeply concave. Valvae short, usually simple but divided in *Archepiolus*; articulation absent, with valvae fused to vinculum and tegumen. Diaphragma with two principal, rather complex, sclerotized areas around ejaculatory opening or aedeagus; plate (i.e., anellus) dorsal to gonopore usually bearing a bilateral pair of elongate processes; ventral plate (i.e., juxta) usually broad with a strongly compressed, median process extending cephalad in *Neopseustis*. Aedeagus either absent (in *Neopseustis*) and with ejaculatory duct terminating at base of a pair of elongate parameres, or present (in *Archepiolus* and *Apoplania*) and with parameres absent; endophallic cornuti absent.

Female genitalia: Tenth segment consisting primarily of a large pair of apophyses rigidly united at caudal apex by a stout bridge; extreme apex subacute and serrated, modified for rasping. Ninth tergite at least partially subdivided into two lateral plates or setose pads. Ninth sternite reduced to two lightly sclerotized plates embedded in dorsal wall of cloacal chamber, anterior to anus. Eighth tergite enlarged, hoodlike, covering most of ninth and tenth segments. Eighth sternite typically a relatively short but broad plate, possessing either a truncate or deeply concave caudal margin. All openings of the reproductive tract and alimentary canal emptying into a very short, incomplete cloacal chamber formed dorsally primarily by the ninth segment and ventrally by the eighth sternite. Colleterial gland present, undivided. Spermatheca relatively simple and undivided; spermathecal duct slightly sinuate, not coiled. Bursa copulatrix well developed; ductus bursae usually thickened, strongly sinuate in *Neopseustis*; corpus bursae membranous, signum absent. Common oviduct arising ventrad to bursa copulatrix.

Key to the Genera of Neopseustidae

1. R2 and 3 forked nearly one-half their length in both fore- and hindwings. Wings fully clothed with relatively broad scales (Figure 12)........***Archepiolus***
   R2 and 3 fused throughout their length in both wings. Wings thinly clothed with slender, hairlike scales (Figures 13–19)........2
2. Epiphysis elongate, over 0.3 the length of foretibia; forewing with fused portion of CuA approximately one-fifth the length of CuA1 (Figure 35); distal end of 1A+2A abruptly curving to hind margin........***Neopseustis***
   Epiphysis minute (Figure 48), less than the diameter of the foretibia in length; forewing with fused portion of CuA over one-third the length of CuA1 (Figure 34); distal end of 1A+2A gradually curving to hind margin........***Apoplania*, new genus**

Archepiolus Mutuura

Archepiolus Mutuura, 1971:1129.

TYPE-SPECIES.—*Archepiolus schmidi* Mutuura, original designation.

ADULT.—Small, slender-bodied moth, with fully scaled wings.

Head (Figure 24): Antennae without intercalary sclerite between scape and pedicel; segments submoniliform along basal and apical one-fifth of shaft, asymmetrically subserrate along middle (Figure 25); sensory scales arranged in rows of usually six sockets. Chaetosemata present on frons and at vertex but not as swollen as in *Neopseustis* and *Apoplania*. Galeae short, subequal in length to labial palpus. Maxillary palpi moderately long, slightly surpassing labial palpi in length, fourth and fifth segments the longest and approximately equal in size.

Thorax: Epiphysis 0.5 the length of foretibia (Figure 49) and reaching to base of tarsus; metathoracic tibia with basal spurs arising from outer fourth of segment. Forewings (Figure 33) 14-veined; R2 and 3 stalked approximately 0.5 their total length, arising separate from R4+5; M1 and 2 separate; discal cell relatively long, extending more than half the length of wing; base of anal area not raised, ventral axillary pocket absent; R2 and 3 stalked more than half their total length; crossvein r-m slanted obliquely outward toward M1; M1 and 2 separate; M3 arising relatively remote from crossvein r-m.

Abdomen: Ventral lobe of seventh sternite of male rounded, short, not extending beyond margin of seventh segment, densely covered by short setae.

Male genitalia: Uncus well developed, deeply forked. Socii padlike, densely covered with slender setae, situated on either side of bulbous anal tube. Tegumenal lobes broad but short. Gnathos well developed, not uncinate, consisting of an inverted V-shaped plate from whose apex arises a prominent, median, sclerotized lobe. Vinculum with anterior margin deeply concave. Valvae bilobed, deeply divided to form a relatively narrow, dorsolateral cucullar lobe and a much broader and more ventral, saccular lobe; ventral margins of sacculi fused partially together along midline. Juxta broad, platelike. Anellus consisting primarily of a bilateral pair of rodlike processes. Aedeagus mostly sclerotized.

DISCUSSION.—The recent discovery of this interesting genus has reaffirmed my earlier belief that the foothills and lower forested elevations of the Himalayan Chain may harbor an array of primitive Lepidoptera yet to be collected. In general appearance, *Archepiolus* does not resemble the other members of Neopseustidae, particularly in the darker, broader scaling of its wings. Its relationship to that family, however, is strongly suggested by morphological similarities of the head and male genitalia. In this regard, the discovery of *Apoplania*, an unquestionable member of the Neopseustidae from Chile, has been significant in demonstrating the range of morphological extremes in this family. It should prove very enlightening to examine the female reproductive system of *Archepiolus*, whenever that sex is collected. Certainly, any further meaningful discussion on the the family affinities of this genus must await the discovery of the female.

As pointed out by Mutuura (1971), the venation of *Archepiolus* is among the most primitive of the Lepidoptera. The radial system of both wings is very similar with all five branches of R distinct, thus differing from the 4-branched condition in *Neopseustis* and *Apoplania*. In addition, *Archepiolus* lacks the basal modification of the forewing (i.e., the anal pocket) developed in varying degrees in the two above-mentioned genera.

Archepiolus schmidi Mutuura

FIGURES 12, 24–25, 33, 49, 56, 59–63

Archepiolus schmidi Mutuura, 1971:1129.

ADULT (Figure 12).—*Wing expanse*: ♂, 16 mm.

Head: Rough, scales apparently dark, perhaps fuscous (not described by Mutuura prior to dissection). Antennae thinly covered with narrow, whitish scales; 94 segmented; segments slightly depressed; sensory scales arranged primarily in one band around segment, consisting typically of a longitudinal row of 6 raised sockets. Eyes large; interocular index approximately 1.4.

Thorax: Dorsum of thorax fuscous. Forewings rather heavily covered by broad scales with mostly bidentate apices, fuscous mottled with paler shades of gray and silvery white; a large, somewhat obscure area of dark fuscous situated midway along costa and extending approximately halfway across wing; relatively large, silvery white spots present near costa at Sc 1 and 2; a series of 3 or 4 irregular whitish spots continuing around outer margin to M3; cilia fuscous. Hindwing uniformly pale gray, thinly scaled; scales mostly narrow with acute apices, except for broader, bidentate scales near apex of wing.

Abdomen: Coloration unknown (previously mounted in balsam), probably fuscous.

Male genitalia (Figures 59–63): Uncus deeply bifurcate; lobes widely separated, elongate, nearly equaling valvae in length. Caudal margin of gnathos serrulate near base on either side, becoming strongly but bluntly serrate on median claviform process. Tegumenal lobes broadly rounded, reduced in length, less than 0.5 the length of valvae. Valvae deeply divided; outer (costa and cucullus) lobe more narrow with evenly rounded apex; inner lobe (principally sacculus) with ventral margins fused at midline for nearly half their length, apex irregular, bidentate. Vinculum a narrow ring ventrally, anterior margin deeply concave, expanding laterally and anteriorly to form elongate and widely separate arms. Caudal half of juxta a broad, thin plate with caudal margin excavate; anterior half compressed to a slender, keellike process similar to *Neopseustis*. Anellus with a bilateral pair of elongate, rodlike processes equaling valve in length. Aedeagus with base bilobed, slightly flared and sharply set off at an angle from main axis; main shaft straight, partially membranous, without cornuti.

TYPE.—Holotype, ♂, no. 11629; in the Canadian National Collection.

TYPE-LOCALITY.—Jhum La, Kameng, Frontier Division, Assam, India.

DISTRIBUTION (Map 1).—Known only from the type-locality located southwest of the town of Rupa near the border of Bhutan.

DISCUSSION.—Unfortunately, only a single male specimen of this interesting insect is known at present. Its collector, Dr. F. S. Schmid of Ottawa, Canada, has personally informed me that the specimen was collected May 13, 1961, at light (gasoline pressure lantern) near a mountain stream. The site was reportedly heavily forested with an estimated elevation of approximately 7000 feet [2154 m].

Neopseustis Meyrick

Neopseustis Meyrick, 1909:436; 1912:3.—Hering, 1925:143–145.—Fletcher, 1929:147; 1933:83.—Viette, 1946:25.—Dumbleton, 1952:26.—Kristensen, 1968:148.—Mutuura, 1971:1129.—Common, 1973:11, 13, 16.

Neopseustie [sic] Meyrick, 1909:436 [misspelling of *Neopseustis*].

Nepseustis [sic] Kristensen, 1968:141 [misspelling of *Neopseustis*].

Formopseustis Matsumura, 1931:1115, new synonym.

TYPE-SPECIES.—*Neopseustis calliglauca* Meyrick, 1909, by monotypy.

ADULT.—Small to medium size moths with thinly scaled, semitransparent wings. Wing expanse approximately 15–27 mm.

Head (Figures 26–27): Antennal segments submoniliform, slightly depressed and asymmetrical;

intercalary sclerite between scape and pedicel present; sensory scales arranged mostly in longitudinal rows of 4 raised sockets (Figures 21–23) in a somewhat staggered band around distal half of each segment; microtrichia evenly scattered over enlarged part of segment. Eyes large; interocular index approximately 1.3–1.4. Chaetosemata well developed on frons and at vertex of head. Galeae reduced, extending to base of terminal segment of maxillary palpus. Maxillary palpi very long, nearly doubling the length of labial palpi; fourth and fifth segments the longest and of equal size. Labial palpi elongate, slender, slightly surpassing length of galeae.

Thorax: Epiphysis well developed (Figure 47), approximately 0.3 the length of tibia; metathoracic tibiae with basal spurs arising from distal fourth of segment. Forewings (Figure 35) 13 veined; R2 and 3 completely fused, shortly stalked to base of R4+5; M1 and 2 stalked nearly half their total length; discal cell relatively short, closed basally by junction of radial and medial veins, extending less than 0.5 the length of wing; base of anal area raised to form a large pocket ventrally; fused portion of CuA approximately 0.2 the length of CuA1; distal end of A1+2 abruptly curving to hind margin. Hindwings 12 veined; crossvein present at base of costa; R2 and 3 completely fused; crossvein r-m slanted obliquely inward toward M1+2; M1 and 2 stalked over 0.3 their length; M3 arising approximate to crossvein r-m.

Abdomen: Relatively short and broad. Caudal margin of seventh sternite of male with an acute, setigerous, median lobe (Figure 55); eighth sternite sometimes with a small median, slightly bilobed process at caudal margin. Female with a bilateral pair of membranous disk-shaped pads present near caudal margin of fourth sternite; seventh sternite strongly sclerotized, caudal margin curved toward center producing a median, heavily spinose lobe; a slender, spinose sternal process arising ventrally and anterior to median lobe.

Male genitalia: Uncus greatly reduced, apparently fused with tegumen and indicated merely by a small, bilobed structure at the apex of the ninth tergite. Tegumen also reduced, largely membranous, represented principally by a thin, dorsal, lightly sclerotized ring weakly joined at caudal apex. Tegumenal lobes extended to form a bilateral pair of slender, slightly curved arms projecting beyond apex of uncus. Gnathos consisting of a thin median plate with either one or two heavily sclerotized processes projecting ventrally. Socii densely setose, widely separated on either side of a bulbous anal tube. Vinculum with anterior margin deeply concave, produced laterally into a pair of slender, armlike anterior lobes; length of vincular lobes approximately 0.8 that of tegumenal lobes. Valvae broad, relatively short, rigidly fused to vinculum, narrowly separated ventrally. Anellus consisting of a sclerotized sheath partially surrounding opening of ejaculatory duct and slender parameres; typically with a large, bilateral pair of armlike processes arising laterally and directed caudally. Juxta elongate, strongly compressed, forming a paddlelike extension anteriorly from a usually broad, transverse bar rigidly fused ventrally to vinculum. Aedeagus undeveloped, with ejaculatory duct terminating at base of paired, variously developed parameres.

Female genitalia: Posterior apophysis relatively stout, forming a heavily sclerotized, tapering ovipositor; apex of oviposter coarsely serrate, relatively broad. Ninth tergite partially subdivided into two lateral plates. Ninth sternite reduced, consisting of two, lightly sclerotized plates embedded in dorsal wall of cloacal chamber. Eighth tergite enlarged, hoodlike. Eighth sternite broad, with caudal margin deeply concave. Ductus bursae elongate, extending approximately 0.5 the length of entire bursa copulatrix, walls heavily thickened, irregular in outline; corpus bursae membranous. Spermatheca well developed, extending anteriorly almost to fifth segment; lateral lagena present, filamentous; receptacular gland absent.

DISCUSSION.—The genus *Neopseustis*, for many years represented by only three poorly known species, is now believed to consist of at least five species. Additional members of this interesting genus will surely be discovered after the Microlepidoptera fauna of southeastern Asia has been better sampled. Unfortunately, the holotype of *Neopseustis archiphenax* is lacking an abdomen, thereby prohibiting a positive diagnosis of that species; however, an additional male specimen, believed to be conspecific with *N. archiphenax*, has been studied.

On the basis of the available material, the genus appears to fall into two groups. One, characterized principally by well developed, densely pubescent parameres (Figures 77–82), includes the species *N. archiphenax, N. meyricki,* and *N. sinensis,* new species. The second group contains the smaller species, *N. calliglauca* and *N. bicornutus,* which possess male genitalia with poorly developed, naked parameres. In both groups the best means for species distinction is provided by the widely divergent forms of the anellar lobes in the male genitalia. Because the females of only one species (*N. meyricki*) have been collected, it is not known how great the female genitalia vary between species in this genus.

Key to the Species of *Neopseustis*

(based largely on males)

1. Wing expanse exceeding 25 mm .... ***Neopseustis archiphenax***
   Wing expanse less than 25 mm 2
2. Parameres greatly lengthened, curved, extending to apices of tegumenal lobes (Figure 82) 3
   Parameres reduced, indistinct, relatively straight, not surpassing apices of lateral processes of anellus (Figure 66) 4
3. Lateral processes of anellus thickened; spinose projections, irregular, stout (Figure 82) .... ***Neopseustis sinensis*, new species**
   Lateral processes of anellus slender, each process immediately subdividing to form two, slender, nearly symmetrical branches (Figure 77) .... ***Neopseustis meyricki***
4. Lateral processes of anellus simple, acute, resembling a pair of inwardly curving horns (Figure 72) .... ***Neopseustis bicornuta*, new species**
   Lateral processes not corneate, broader with rounded apices, divergent (Figure 66) .... ***Neopseustis calliglauca***

Neopseustis calliglauca Meyrick

FIGURES 13, 37–39, 64–68

Neopseustis calliglauca Meyrick, 1909:436; 1912:3, 4.—Hering, 1925:146.—Meyrick, 1928:404.—Fletcher, 1929:147; 1933: 83.—Mutuura, 1971:1129.

ADULT (Figure 13).—*Wing expanse*: ♂ 15–17.2 mm.

Head: Vertex and frons brownish fuscous. Antennae with 69–72 segments; dorsum of scape and pedicel brownish fuscous, flagellum light brown; venter of scape and pedicel stramineous. Maxillary palpi light brown. Labial palpi brownish fuscous.

Thorax; Dorsum brownish fuscous; venter stramineous. Legs with coxal and femoral segments stramineous, distal segments mostly brownish fuscous. Forewings with basal two-thirds light brown, mottled with irregular spots and transverse streaks of fuscous; a series of dark, transverse bars especially concentrated between bases of medial veins; distal third of wing whitish, heavily bordered with light grayish brown along apex and termen; an oblique, triangular patch of brown at outer third of costa at Sc2. Hindwings with basal two-thirds light brownish fuscous; distal third whitish with broad, terminal band of light grayish brown.

Abdomen: Sparsely clothed with slender, light-brown scales. Seventh sternite with rather acute, triangular median lobe; median lobe of eighth sternite absent.

Male genitalia (Figures 64–68): Gnathos a broad cordate plate with a pair of compressed, bilateral processes arising ventrally; distal ends of processes flared, broadly bifurcate. Posteroventral margin of valvae extended to form a short, rounded lobe. Anellus a broad, thin plate dorsally with median caudal margin folded ventrally; lateral lobes extending to bases of socii, broadly compressed with rounded apices and a small, serrated ridge situated laterally near middle. Juxta with a broadly compressed median lobe extending anteriorly slightly beyond lateral arms of vinculum. Parameres consisting of a pair of slender, unsclerotized, relatively inconspicuous, digitate processes extending caudally about halfway to apex of anellar lobes.

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

TYPE-LOCALITY.—Khasi Hills, Assam, India.

DISTRIBUTION (Map 1).—Known only from the Khasi Hills of northeastern India.

MATERIAL EXAMINED.—4 males.

INDIA. Assam: Khasi Hills: 1 ♂ (holotype), Oct. 1906 (BMNH). Shillong: 1 ♂, 20 May 1928 (BMNH); Shillong, 5000 ft.: 1 ♂, 19 May 1928 (BMNH); 1 ♂, May 1964 (USNM).

Discussion.—This species appears rather closely related to the following, *N. bicornuta*, in possessing relatively reduced, unsclerotized parameres that are in sharp contrast to those developed in *N. sinensis*, new species, and *N. meyricki*. The two species, however, can be easily separated by their very different gnathosi, *N. calliglauca* is the only member of the genus with a bifid gnathos.

Meyrick determined the sex of the holotype as a male, although this cannot be confirmed now due to the loss of the abdomen. He also gave the wing expanse as 20 mm, although it is actually closer to 17 mm. There is, however, no serious question concerning the identity of the holotype, and it agrees in maculation with the material later collected by Fletcher. Fletcher's note (1933) relating to the capture of this species is important in that it provides us with details of the source of his Shillong material, "a very restricted area just above the stream at the top of the Fruit Garden." This author further reported that the moths were found during the day resting on leaves and closely resembled birds' droppings.

Neopseustis bicornuta, new species

Figures 14, 23, 69–73

Adult (Figure 14).—*Wing expanse*: ♂, 19 mm.

Head: Vertex and frons brownish fuscous. Antennae brownish, darkest along basal fourth of shaft; underside of scape stramineous. Maxillary palpi stramineous. Labial palpi brownish above, stramineous below.

Thorax: Dorsum brownish fuscous; venter stramineous. Legs uniformly light brown to stramineous. Forewings with basal half predominantly light brown, mottled with irregular patches of brownish to dark fuscous and with a sparse scattering of broad, silvery white scales; distal half primarily whitish, mottled with relatively large, pale, grayish-brown spots especially along wing margin from Sc1 to CuA1; a triangular spot present on costa between Sc1 and 2; an elongate costal spot situated between Sc2 and apex, and a third large spot along termen between M1 and 3. Hindwings with basal half pale brown; outer half whitish with an irregular series of light-brown spots along outer margin; apical spot between Sc and R4 the largest.

Abdomen: Sparsely clothed with slender, brownish scales. Median process of seventh sternite in male triangular, acute; median process of eighth sternite absent.

Male genitalia (Figures 69–73): Gnathos a large, stout, uncinate process projecting ventrally from a triangular base between socii. Valvae with ventral margin extended caudally to form a short, spinelike process. Lateroposterior lobes of anellus corneate heavily sclerotized and curved inward toward each other, extending to base of gnathos. Juxta with a bilateral pair of curved, basal processes extending laterally around opening of ejaculatory duct to anellus and an elongate, broadly compressed median process projecting anteriorally beyond lateral arms of vinculum. Parameres similar to *N. calliglauca*, consisting of a pair of slender, unsclerotized, relatively inconspicuous, digitate processes extending caudally about halfway to apex of anellar lobes.

Holotype.—♂, Mt. Omei, 4400 feet [1351 m], Szechuan, China, D.C. Graham coll., USNM 72100; in the National Museum of Natural History, Smithsonian Institution.

Distribution (Map 1).—Known only from the type-locality, Mt. Omei, located in the southwestern area of Szechuan Province, China.

Discussion.—The discovery of this species, along with *Neoposeustis sinensis*, new species, represents the first report of Neopseustidae from mainland China. Their occurrence in Szechuan Province is not surprising, however, since this area is largely an extension of the main Himalayan Plateau and general habitat of the genus *Neopseustis*. The type locality of *N. bicornuta* is located approximately 80 miles [50 km] south of Chengtu, near the village of Omei. The area is quite mountainous, with the maximum elevation of Mt. Omei listed at 9957 ft. [3064 m]. All specimens of *N. bicornuta* and *N. sinensis* were collected by the Rev. David C. Graham, an American missionary who lived in this area of Western China from 1910 to 1948.

Neopseustis bicornuta may be distinguished most easily from its supposed nearest relative, *N. calliglauca*, on the basis of the male genitalia. Whereas the gnathos of *N. bicornuta* is a single, uncinate process, that of *N. calliglauca* is bifid with flared apices. The lateral processes of the anellus also differ with those of *N. bicornuta*, being more slender and corneate (hence the specific epithet, *bicornuta*).

Neopseustis archiphenax Meyrick

FIGURES 1, 5, 7–10, 15, 21–22, 35, 53, 55

Neopseustis archiphenax Meyrick, 1928:404.—Fletcher, 1933: 83.—Mutuura, 1971:1129.

ADULT (Figure 15).—*Wing expanse*: ♂, 26–27 mm.

Head: Largely devoid of scales (badly rubbed) exposing dark fuscous integument. Maxillary and labial palpi similarly sparsely scaled, fuscous.

Thorax: Dorsum mostly naked, dark fuscous, sparsely covered with slender brownish scales. Forewings light brown to stramineous, heavily mottled with various shades of fuscous; basal two-thirds of wing dull white to stramineous, with 3 or 4 rather indistinct fuscous spots along costal cell; a large, slightly curved fuscous spot extending between M2 and CuA1; two triangular fuscous spots situated along hind margin at CuA1 and CuA2; a series of smaller, transverse spots scattered over posterior half of wing; a few broad, silvery white scales scattered somewhat randomly over basal two-thirds though concentrated along major veins; outer third of wing whitish, with numerous irregular spots of light brown; a series of mostly confluent spots bordering apex and termen. Hindwings considerably paler; basal two-thirds light grayish brown; outer third whitish with a nearly continuous, broad row of light grayish brown spots bordering outer margin from apex to CuA1.

Abdomen: Thinly covered with slender, hairlike, brownish scales. Seventh sternite of male with a prominent median, conical process bearing 6 minute, closely appressed spines; eighth sternite with low median ridgelike lobe bearing approximately 23 irregular, rather elongate, blunt spines along its caudal margin.

Male genitalia: Gnathos a slender, uncinate process arising between socii and projecting ventrally. Valvae with a small, slender, bilateral pair of clavate lobes arising from base of sacculus and nearly contiguous along midline. Lateroposterior lobes of anellus bilaterally symmetrical, deeply forked near base, giving rise to two elongate, asymmetrical processes; inner branch more stout, roughly serrated along entire length of outer (lateral) edge. Parameres greatly lengthened, surpassing apex of uncus, densely pubescent over ventral half.

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

TYPE-LOCALITY.—Kangtang [?], upper Burma.

DISTRIBUTION (Map 1).—Presently known from upper Burma and Szechuan Province in southwestern China.

MATERIAL EXAMINED.—2 males.

BURMA. Kangtang: 1♂ (holotype), coll E. A. Swann (BMNH).

CHINA. Szechuan Province: Sungpan: 1♂, July, D. C. Graham coll. (USNM).

DISCUSSION.—An examination of the holotype of this species unfortunately revealed that the specimen at one time had been partially damaged and the abdomen lost. A search in the drawer containing the holotype did not reveal the missing abdomen. Consequently, it is now difficult to establish beyond question the identity of the species. Figure 15 was developed from an old negative in the British Museum's files, obviously taken prior to the loss of the abdomen.

A male specimen in the collection of the Smithsonian Institution from Sungpan, China, closely agrees with the holotype in size and maculation. Because the outer marginal band of the hindwings is not as heavily pigmented as the holotype, it could represent yet another undescribed species of *Neopseustis*. However, in lieu of better preserved material from the type locality and because of the above similarities, this specimen has been considered conspecific with *N. archiphenax*. Consequently, all remarks concerning the genitalic characters of *N. archiphenax* are based upon the specimen from China.

The species most resembling *N. archiphenax* appears to be *N. meyricki*. In the male genitalia of both species the lateroposterior lobes of the anellus are deeply divided to form two slender branches; however, in *N. archiphenax* the two branches are heavier with the inner branch coarsely serrated along one edge, as compared to the completely smooth condition in the Formosan species. The difference in wing expanse between the two is probably significant, although little is known regarding the size variation in *N. archiphenax*.

Meyrick (1928) lists the type locality for the species as Kangtang, in upper Burma. A search for this locality, including a query to the Burmese Embassy in Washington, D.C., has thus far proved futile. However, the names of two towns whose spellings approximate Meyrick's rendering have been located in the southern Shan State near the Laotian border. The towns, Keng Tung and Keng Tawng (or Kengtawng) are situated approximately 125 air miles [78 km] apart, and one may actually represent the type locality of *N. archiphenax*. Thus, in Map 1, the occurrence of this species has been provisionally indicated in the Shan State.

Neopseustis meyricki Hering

FIGURES 16, 36, 47, 50, 52, 74–78, 88–91, 92–93

Neopseustis meyricki Hering, 1925:146–147.—Kristensen, 1968: 137, 141–147.—Mutuura, 1971:1129, 1133; 1972:1065.
Formopseustis takamukui Matsumura, 1931:1115, new synonym.

ADULT (Figure 6).—*Wing expanse*: ♂, 20 mm; ♀, 20–22 mm.

Head: Vertex and frons brownish fuscous. Antennae brownish fuscous; underside of scape pale brown. Maxillary palpi pale brown to stramineous. Labial palpi brownish fuscous, becoming lighter, more stramineous on underside toward base (first segment).

Thorax: Dorsum brownish fuscous with a small, bilateral tuft of whitish scales arising anteriorly near margins of tegulae; venter stramineous, without conspicuous banding. Forewings with basal two-thirds predominantly light brown, mottled with irregular patches of darker brown to dark fuscous and with a sparse scattering of broad, silvery white scales, particularly along veins; distal third primarily whitish, mottled with rather large spots of brownish fuscous bordering outer margin; largest and most conspicuous spot extending along costa from Sc2 almost to apex. Hindwings with basal two-thirds pale grayish brown; distal third primarily whitish with series of partially contiguous spots of pale grayish brown bordering wing margin from R1 to CuA1.

Abdomen: Sparsely clothed with slender, brownish scales. Male with a relatively long (3 times its width in length) stout, median spinelike process arising from caudal margin of seventh sternite; apex of process minutely bidentate; caudal margin of eighth sternite with a median, low, broad, indistinctly bilobed process bearing a single transverse row of coarse, irregular teeth. Female with median spine of seventh sternite stout, acute, and serrulate along its ventral margin; caudal margin of seventh sternite with a median, rugose patch of 40–60 blunt teeth; bilateral pair of pads on fourth sternite nearly 0.5 the length of segment in diameter.

Male genitalia (Figures 74–78): Gnathos a slender, uncinate process arising between socii and projecting ventrally. Valvae with a small, slender, bilateral pair of clavate lobes arising from sacculus and nearly contiguous along midline. Lateroposterior lobes of anellus rather symmetrical in outline, deeply forked near base, giving rise to two slender processes (Figure 77); a relatively short, bilateral pair of processes arising nearly contiguous to one another from median posterior margin of anellus; apices of these processes not acute, instead, irregularly serrate. Parameres greatly lengthened, surpassing apex of uncus, densely pubescent over ventral half, slightly enlarged near acute apices.

Female genitalia (Figures 88–91): Apex of ovipositor broad, heavily sclerotized, with a triangular, tricuspidate, and bluntly rounded median lobe and a bilateral pair of more acute lobes. Lateral margin of ninth tergite produced into a bilateral pair of bilobed, somewhat scalloped, ridgelike processes. Caudal margin of eighth sternite deeply excavated, with lateral margins extending posteriorly as rather broad, triangular lobes. Ductus bursae relatively long, strongly curved in a sagittal plane so as to appear sigmoid in outline viewed laterally; walls heavily thickened. Corpus bursae completely membranous, spherical in outline.

TYPES.—Holotype, ♀ (*Neopseustis meyricki*); in the Zoologisches Museum of Humboldt-Universität, Berlin. Lectotype, ♀ (*Formopseustis takamukui*, present designation), bearing the following labels: Horisha, Formosa, 1917; *Formopseustis takamukui* M.; type, Matsumura; ♀ genitalia on slide 2940, D. R. Davis; lectotype ♀, *Formopseustis takamukui* Mats., by Davis 1975.

TYPE-LOCALITIES.—Kosempo, Formosa (*Neopseustis meyricki*); Horisha, Formosa (*Formopseustis takamukui*).

DISTRIBUTION (Map 1).—This species has been collected only from the central highlands of Taiwan (Formosa), where it appears to occur rather widely at elevations exceeding 1000 meters.

MATERIAL EXAMINED.—2 males and 6 females.

TAIWAN. Horisha [Pu-li]: 1 ♀ (lectotype, *F. takamukui*), 1 ♂ (paralectotype, *F. takamukui*), 1917 (HU); 1 ♀ (paralectotype, *F. takumukui*), 1917 (USNM). Kanshirei [Kuan-tzu-ling]: 2♀, 3 April 1909 and 7 July 1908 (BMNH). Kosempo [Chia-hsien]: 1♀ (holotype, *N. meyricki*), 1♂ (paratype, *N. meyricki*), Sept. 1909 (ZMHU). Raisya [Lai-i-ts'un]: 1♀, 23 Nov. 1934 (USNM).

DISCUSSION.—As many specimens have been collected of this species as of any other member of the family. With the exception of a single female of *Apoplania chilensis*, new species, this small series of eight specimens contains the only known females collected in this group. As is true for the Neopseustidae in general, very little is known concerning the biology or behavior of this species. Through recent discussions with Prof. Syuti Issiki, I was able to learn that the specimen he found at Raisya in southern Taiwan was collected in a horticultural garden for medicinal plants. Prof. Issiki further informed me that the three specimens collected by Matsumura at Horisha were found near floodlights of a hydroelectric station. It is possible that the species may be bivoltine as adults have been collected in April and July as well as later in September and November.

Although *N. meyricki* has never been found on the Chinese mainland, its closest relatives, *N. archiphenax* and *N. sinensis*, new species, do occur there. The male genitalia of these species bear striking similarities, particularly in the peculiar development of the pubescent parameres and in the clavate saccular lobe that arises from the base of the valve. The three may be easily distinguished by the different form of their anellar lobes.

Neopseustis meyricki was described from two specimens, supposedly both males as stated originally by Hering (1925). An examination of both of these specimens, however, has revealed some discrepancies in Hering's description. The holotype, for example, is not a male but instead a female. More significantly, it was discovered that the male genitalia was damaged in Hering's slide preparation of the paratype, with the gnathos, juxta, and lateral processes of the anellus, obviously broken and missing. This discrepancy can be noted in Hering's rather crude sketches (Figures 3, 4) of the male genitalia.

A review of the literature has revealed a second species of Neopseustidae, *Formopseustis takamukui*, described from Taiwan which western entomologists have apparently overlooked. An examination of the two females and one male comprising the syntypic series of this moth has resulted in the synonymizing of both the generic and specific names. The "rediscovery" of this series in the collections of Hokkaido University has enabled me to correct the faulty description of the male genital structure by Hering.

Neopseustis sinensis, new species

FIGURES 17, 26–27, 79–83

ADULT (Figure 17.)—*Wing expanse*: ♂, 23–24 mm.

Head: Vertex and frons brownish fuscous with a slight suffusion of whitish scales near lateral margin of occiput. Antennae brownish fuscous, underside of scape light brown to stramineous. Maxillary palpi whitish to pale stramineous. Labial palpi brownish fuscous below, pale brown to stramineous above.

Thorax: Dorsum light brown; venter pale stramineous. Legs light brown to stramineous, without distinct banding on tarsi. Forewings primarily whitish to stramineous, heavily mottled with various shades of fuscous; basal two-thirds of wing dull white to stramineous, with 3 or 4 rather large, indefinite spots of dark fuscous along costal cell, two or more very irregular areas of dark fuscous transversing wing from near apex of discal cell to middle of cell M3; numerous scattered patches of broad, silvery white scales concentrated mainly along costal cell and some of the major veins; outer third of wing thinly covered with narrow, whitish scales except for infusion of light brown, partially confluent spots along apex and termen, as well as an irregular series of brownish striae scattered across outer third of wing. Hindwings whitish to pale grayish brown over basal two-thirds and whitish over outer third except for a series of light grayish brown spots along outer margin at termination of principal veins.

Abdomen: Sparsely clothed with slender, pale grayish brown scales. Male with median process of seventh sternite sharply acute. A broader, median, sometimes bilobed process present near caudal margin of eighth tergite; lobes shallow, each bearing 3 or 4 minute peglike spines.

Male genitalia (Figures 79–83): Gnathos a slender uncinate process arising between socii and projecting ventrally. Valvae with a bilateral pair of clavate lobes arising from sacculus and nearly contiguous along midline. Lateroposterior lobes of anellus irregular in outline, spicate in appearance with numerous, acute, secondary projections of various sizes; an elongate, bilateral pair of sharp processes arising posteriorly and closely parallel from median area of anellus. Parameres greatly lengthened, surpassing apex of uncus, densely pubescent over ventral half, gradually tapering to acute apices.

HOLOTYPE.—♂, Beh Luh Din, 30 mi [18:5 km] north of Chengtu, Szechuan Prov., China, D. C. Graham coll., USNM 72099; in the National Museum of Natural History, Smithsonian Institution.

PARATYPE.—CHINA: Szechuan Prov.: Same data as holotype, 1 ♂ (USNM). Described from two males.

DISTRIBUTION (Map 1).—Known only from Szechuan Province of southwestern China.

DISCUSSION.—This species approximates *Neopseustis archiphenax* in size, and it may eventually be shown, whenever a large series of both are obtained, that their wing spans may actually overlap to some extent. The wing maculation of the two differ, however, and this should provide a ready means of identification. The principal distinction can be observed in the hindwing with the marginal, pale grayish brown markings of *N. sinensis* being more reduced and separated than those of *N. archiphenax*. A more reliable means of separating these two species, as well as *N. meyricki*, is in the form of the lateroposterior lobes of the anellus. In *N. sinensis* these lobes are very stout and not deeply divided; in *N. archiphenax* they are more slender and are divided for most of their length with one branch coarsely serrated on one side. As pointed out under the discussion for the latter species, however, the genital descriptions of *N. archiphenax* are based on a questionably identified specimen.

***Apoplania*, new genus**

TYPE-SPECIES.—*Apoplania chilensis*, new species.

ADULT.—Relatively small, moderately heavy bodied moths with very thinly scaled wings.

Head (Figures 28–32): Antennae with minute intercalary sclerite present between scape and pedicel (Figure 29); segments submoniliform, of similar form over most of flagellum; sensory scales arranged mostly in longitudinal rows of 4 or 5 contiguous sockets each (Figure 20). Chaetosemata well developed on frons and vertex of head. Galeae short, subequal to entire labial palpus and slightly surpassing third segment of maxillary palpus. Maxillary palpi very long, nearly doubling the length of labial palpi; fourth and fifth segments the greatest in length and of equal size.

Thorax: Epiphysis present but extremely reduced in size, approximately twice its width in length (Figure 48); metathoracic tibia with basal spurs arising from distal fourth of segment. Forewings (Figure 34) 13-veined; R2 and 3 completely fused, usually connate with R4+5, but occasionally stalked for a short distance; M1 and 2 stalked approximately 0.3 their total length; discal cell relatively long, extending more than half the length of the wing; base of anal area raised to form a prominent depression underneath wing at base of discal cell and a poorly developed pocket at base of anal veins; fused portion of CuA over 0.3 the length of CuA1; distal end of A1+2 gradually curving to hind margin. Hindwings 12-veined; crossvein present at base of costa; R2 and 3 completely fused; crossvein r-m slanted obliquely inward toward M1+2; M1 and 2 stalked over one-third their length; M3 arising approximate to r-m crossvein.

Abdomen: Relatively short and broad. Seventh sternite of male without median lobe. Female with a bilateral pair of setigerous dark-shaped pads present near caudal margin of fourth sternite; seventh sternite strongly sclerotized, with caudal margin curved posteriorly at middle and bearing a small spinose lobe.

Male genitalia: Uncus well developed, elongate, deeply clefted. Tegumenal lobes broadly rounded. Gnathos a relatively simple, median plate without elongate processes. Valvae simple, bases widely separated. Vinculum with anterior margin moderately convex, lateral arms reduced. Juxta broad, platelike. Anellus primarily consisting of a bilateral pair of long, slender processes. Aedeagus heavily sclerotized, with a prominent array of stout and rigid exophallic spines.

Female genitalia: Posterior apophyses stout, relatively short, extending anteriorly to broad, internal vulva; apex of ovipositor strongly tapering, relatively narrow. Ninth tergite with caudal margin deeply concave; lateral lobes without secondary ridges. Ductus spermathecae nearly straight, only slightly sinuate; annular vesicle prominent; lateral lagena absent; utriculus slender, reduced in size; receptacular gland present, filamentous. Ductus bursae very short, walls heavily thickened with bilaterally paired, internal pockets or folds. Corpus bursae elongate, completely membranous. Anterolateral angles of eighth tergite with short processes, perhaps representing rudimentary anterior apophyses.

Discussion.—Although the two taxa superficially resemble one another closely, several major features separate *Apoplania* from its closest known Old World ally, *Neopseustis*. Prominent among these are: the greatly reduced epiphysis, heavily sclerotized aedeagus, and strongly developed uncus in *Apoplania*; the differential development of the saccus between the two genera; and the presence of paired parameres and the more extended, armlike tegumenal lobes in *Neopseustis*. The two resemble each other rather closely in venation, although the peculiar anal pocket at the base of the forewing in this group is much better developed in *Neopseustis*.

The generic name *Apoplania* is treated as feminine and is derived from the Greek, apoplanias, meaning wanderer or fugitive.

Apoplania chilensis, new species

Figures 2–4, 6, 18–19, 20, 28–32, 34, 40–42, 48, 51, 54, 57, 84–87, 94–95, 96–98

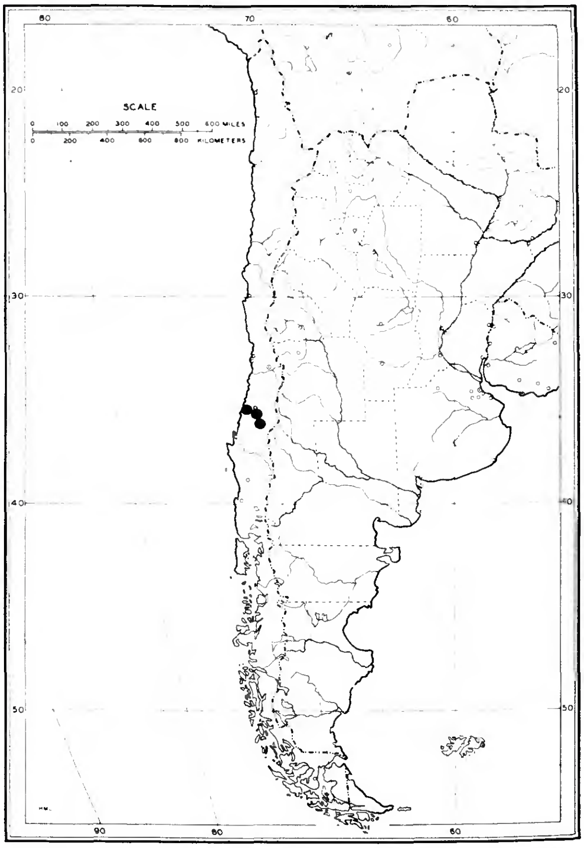
Adult (Figure 18).—*Wing expanse*: ♂ 15–19 mm.; ♀, 20 mm.

Head (Figures 28–32): Vestiture stramineous to pale ochreous. Eyes large, interocular index approximately 1.35. Antennae whitish below, light tan above, 94–96 segmented; sensory scales arranged mostly in two bands (distal and medial) of alternating longitudinal rows; each row usually with 4 or 5 raised sockets (Figure 20); interspersed between distal rows at edge of segment are solitary sockets containing large sensory setae; microtrichiae largely restricted to basal third of each segment. Maxillary palpi and galeae whitish. Labial palpi whitish ventrally, pale tan dorsally.

Thorax: Dorsum pale tan, venter whitish. Legs pale tan to whitish; tibial and tarsal segments ringed with brown; usually two rings present on each tibia; distal ring the broadest; tarsal segments predominantly brown. Forewings translucent, thinly scaled, mottled with irregular patches of brown and white; scales slender with acute apices; a conspicuous brownish patch at wing apex and a slender, oblique streak of brown from outer third of costa across radial veins to M1. Hindwings similarly clothed, less mottled with brown, with two conspicuous brownish patches corresponding to those mentioned in forewing; namely, a slender, triangular patch from outer third of costa to M1, an apical patch extending from R1 to M1.

Abdomen: Sparsely clothed with slender scales; pale tan above, more whitish beneath. Female with caudal margin of seventh sternite bearing approximately 30 stout, short, spinules on and around median lobe.

Male genitalia (Figures 84–87): Uncus broad and ventrally concave at base; apex narrowly divided nearly 0.5 its length. Socii reduced, nar-



Map 2.—Distribution of *Apoplania chilensis*, new species.

rowly separated, and situated on a bulbous, membranous anal pad. Tegumenal lobes evenly rounded, approximately 0.3 the length of valves. Gnathos a relatively flat plate, without any median process projecting ventrally, but with a median extension of plate caudad bearing numerous short, stout spines. Valvae relatively narrow, without lobes or processes; apex subacute. Median excavation of vinculum shallow, lateral arms short, broadly rounded. Juxta peltate, with a bilateral pair of compressed arms extending caudad. Anellus a narrow ring, developed dorsally (of aedeagus) into a bilateral pair of sinuate processes projecting ventrally, surpassing length of valvae. Apex of aedeagus with an irregular series of approximately five large spines radiating outward in a somewhat spiral manner from main shaft of aedeagus; ejaculatory duct with heavy, sclerotic thickenings for a distance of 1.5 times the length of the adeagus.

Female genitalia (Figures 96–98): Apex of ovipositor with a bluntly rounded median lobe and a bilateral pair of minute, acute lobes. Lateral margins of ninth tergite produced into a bilateral pair of rounded, setigerous lobes on either side of ovipositor apex. Caudal margins of eighth sternite truncate. Ductus bursae short, very broad, heavily thickened internally by three bilaterally symmetrical pockets or folds. Corpus bursae long and rather narrow, over 3.0 the length of posterior apophysis.

HOLOTYPE.—Chile, Nuble Province, Recinto, elevation approximately 1000 m, ♂, 4–6 Mar. 1968, coll. Flint and Peña, USNM 72098; in the National Museum of Natural History, Smithsonian Institution.

PARATYPES.—CHILE: Linares Province: Fundo Malcho [50–60 km east of Parral], Cordillera

FIGURE 11.—Habitat of *Apoplania chilensis*, new species, Linares Province Chile. (Photograph courtesy of Mr. L. Peña.)

Parral, elevation approximately 600–1000 m, 3 ♂, 11–20 Nov. 1964 (USNM); 2 ♂, same data (LEP); 1 ♂, same data (BMNH). Maule Province: Costa Maule, Pelluhue, 600 m, 1 ♀, 2 Dec. 1953 (USNM). Described from a total of seven males and one female.

Distribution (Map 2).—Known only from heavily forested areas of central Chile between latitudes of 35°S to 37°S at elevations of 600 to 1000 m.

Discussion.—This species occurs in forest habitats dominated by such genera as *Nothofagus* and *Chusquea.* Most of its known range lies within the faunal region characterized by Peña (1966) as the Northern Valdivian Forest, such as shown in Figure 11. The holotype of *Apoplania chilensis* was collected by O. S. Flint during the day by sweeping bushes bordering a mountain stream near Recinto. All paratypes were collected by L. Peña at night from a white sheet suspended before a gasoline pressure lantern.

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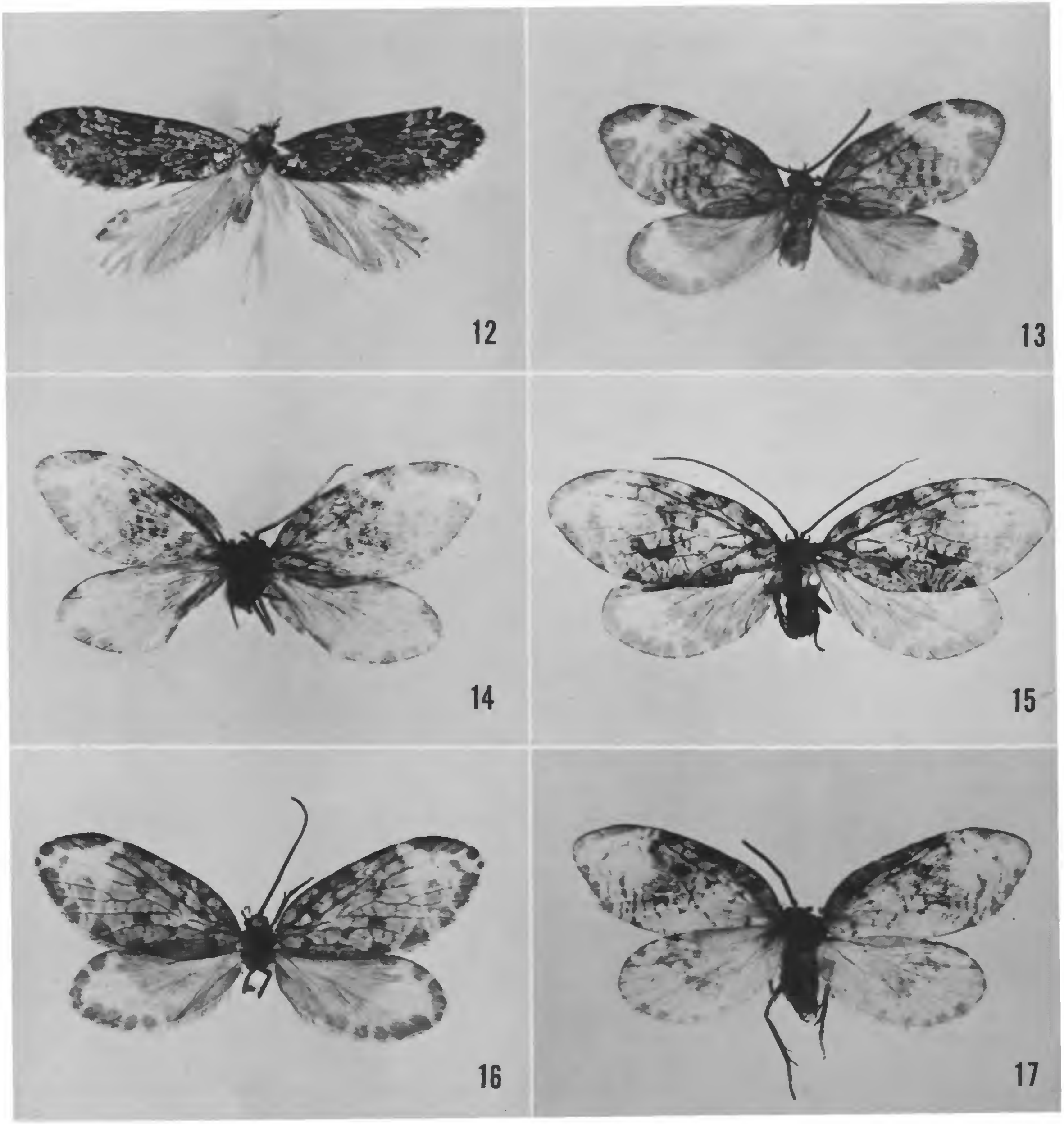
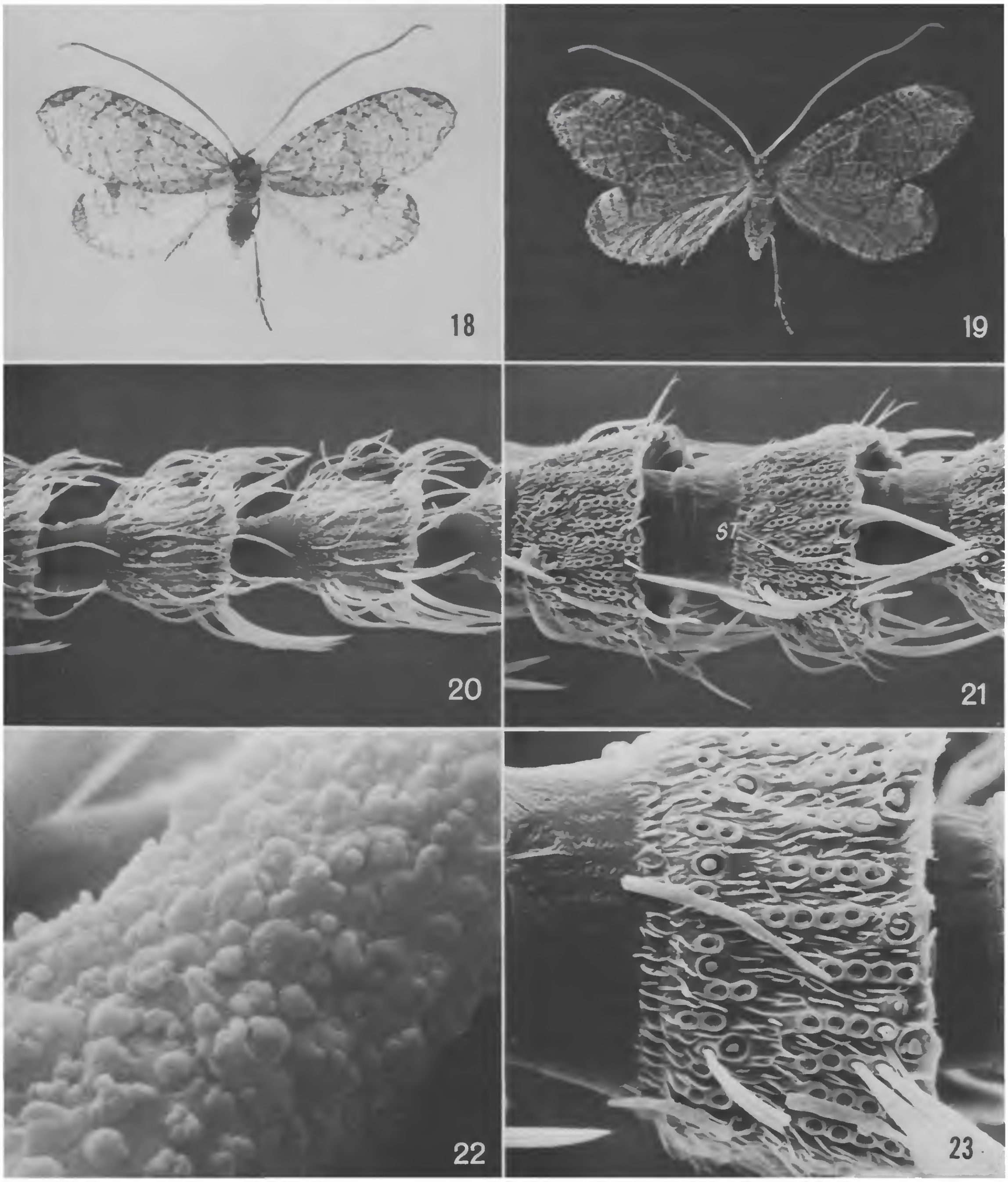
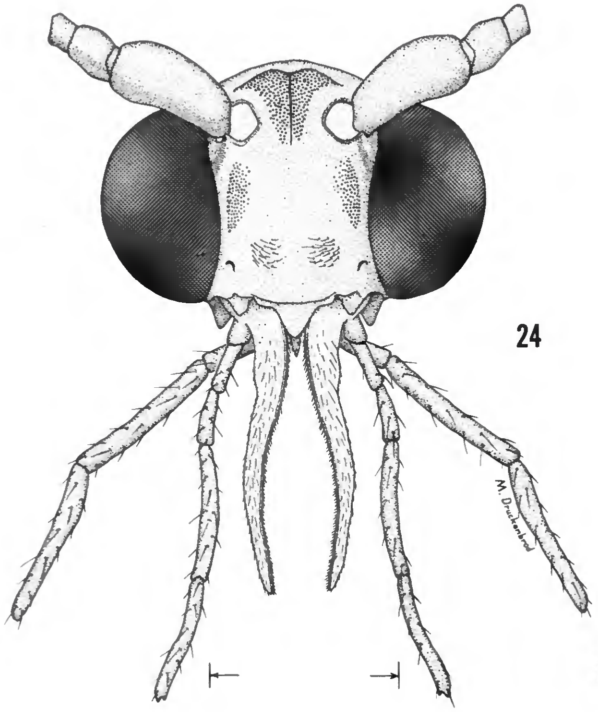


FIGURES 12–17.—12, *Archepiolus schmidi* Mutuura, ♂ holotype, wing expanse 16 mm; 13, *Neopseustis calliglauca* Meyrick, ♂, wing expanse 16 mm; 14, *N. bicornuta*, new species, ♂ holotype, wing expanse 19 mm; 15, *N. archiphenax* Meyrick, ♂ holotype, wing expanse 27 mm; 16, *N. meyricki* Hering, ♂, wing expanse 22 mm; 17, *N. sinensis*, new species, ♂ holotype, wing expanse 23 mm.



FIGURES 18–23.—Adults: 18–19, *Apoplania chilensis*, new species, ♂ holotype, wing expanse 18 mm. Antennae: 20, *A. chilensis*, new species, antennal segments 40–43, × 200; 21, *Neopseustis archiphenax* Meyrick, antennal segments 27–29, × 230; 22, *N. archiphenax* Meyrick, surface detail of sensillum trichodea (see Figure 21, ST), × 12,000; 23, *N. bicornuta*, new species, antennal segment 21, × 600.



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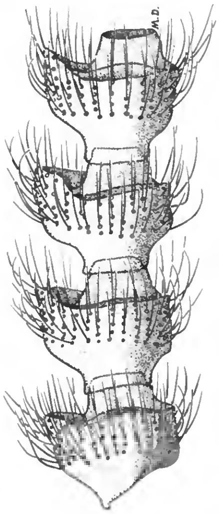

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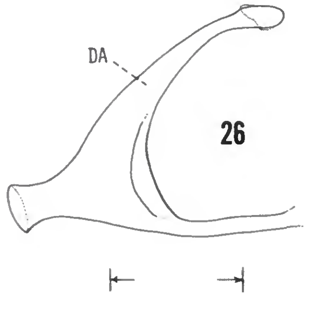

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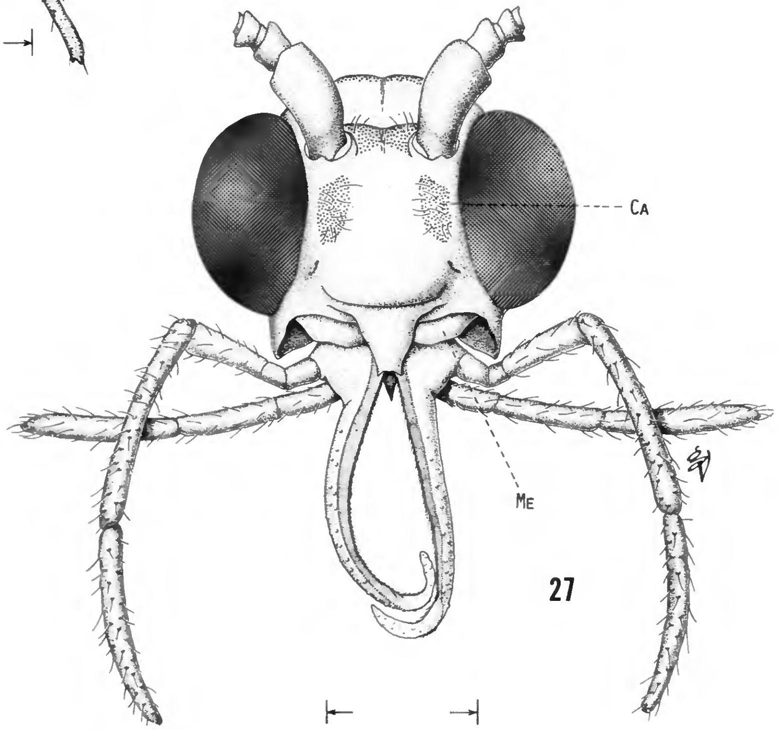

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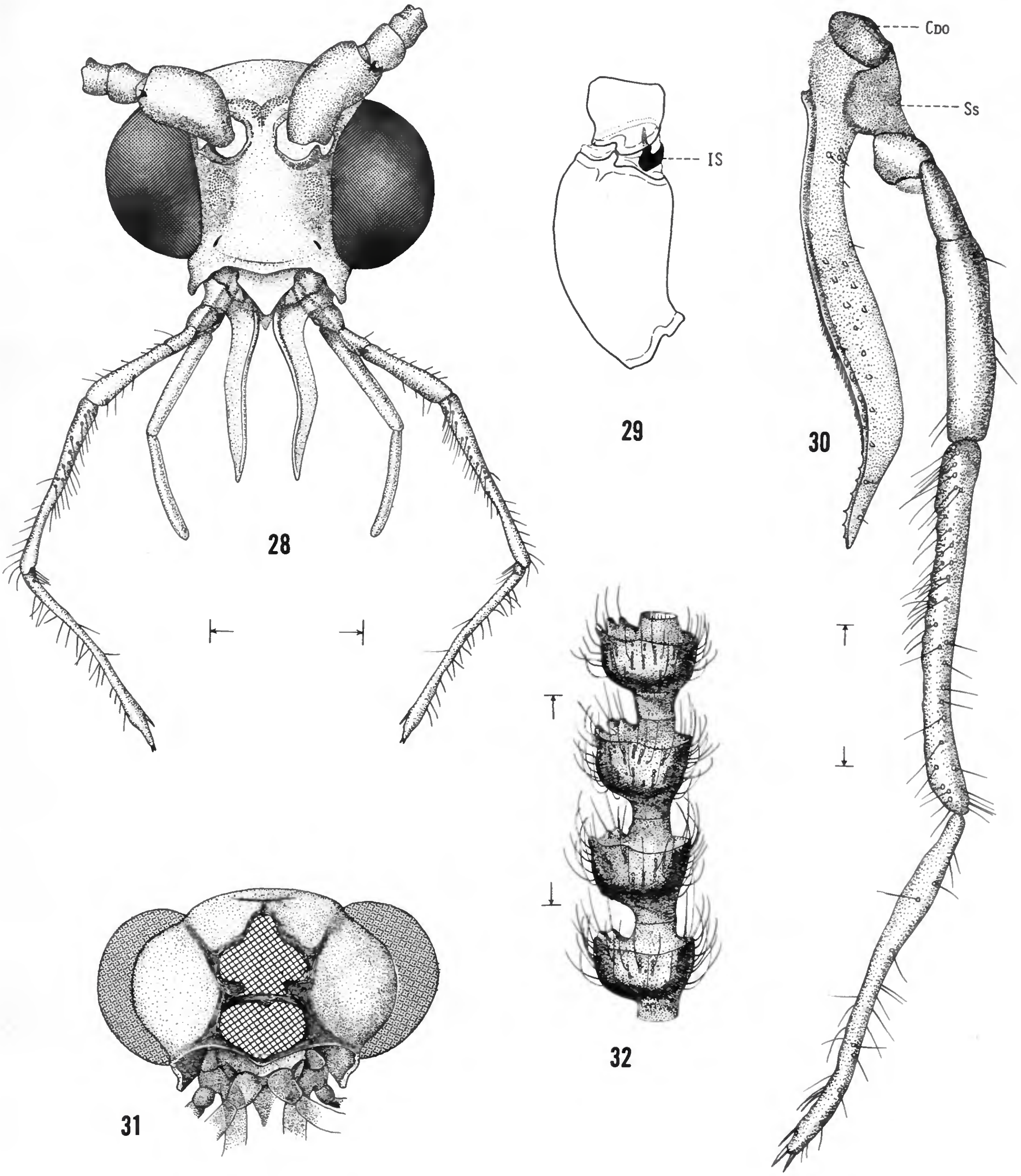
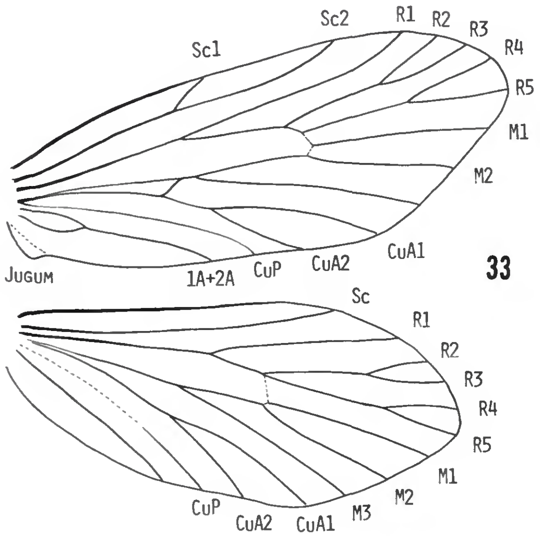
FIGURES 24–27.—Head structure: 24, *Archepiolus schmidi* Mutuura, anterior view of head (scale=0.5 mm); 25, *A. schmidi* Mutuura, antennal segments 15–18; 26, *Neopseustis sinensis*, new species, lateral view of tentorium (scale=0.2 mm); 27, *N. sinensis*, new species, anterior view of head (scale=0.5 mm).



FIGURES 28–32.—*Apoplania chilensis*, new species, head structure: 28, anterior view of head (scale=0.5 mm); 29, intercalary sclerite (IS) between scape and pedicel; 30, maxilla (scale=0.25); 31, caudal view of head; 32, antennal segments 25–28 (scale=0.25 mm).



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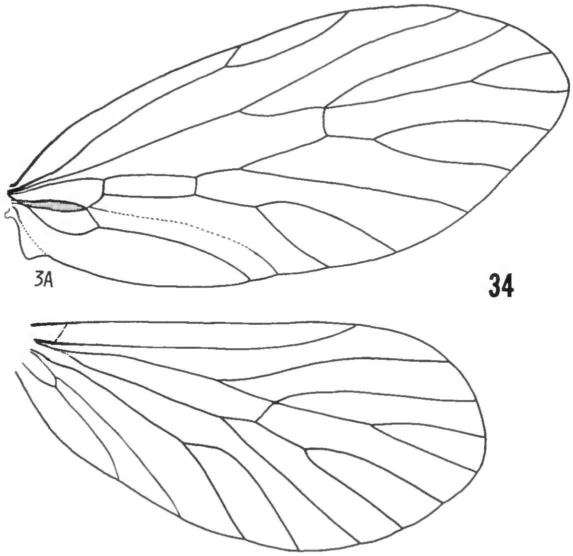

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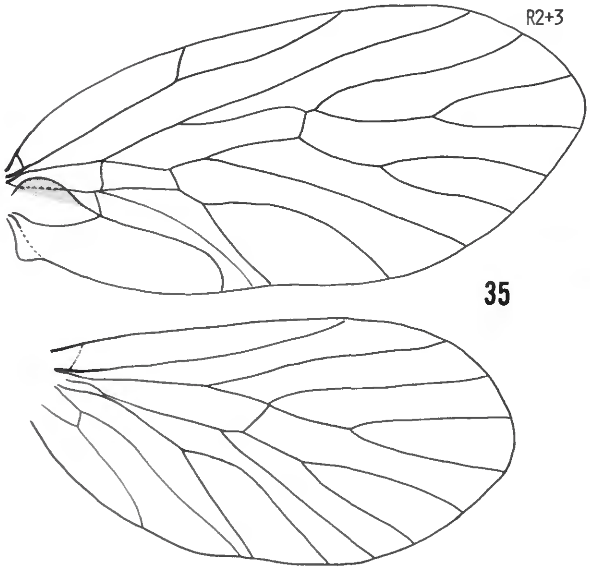

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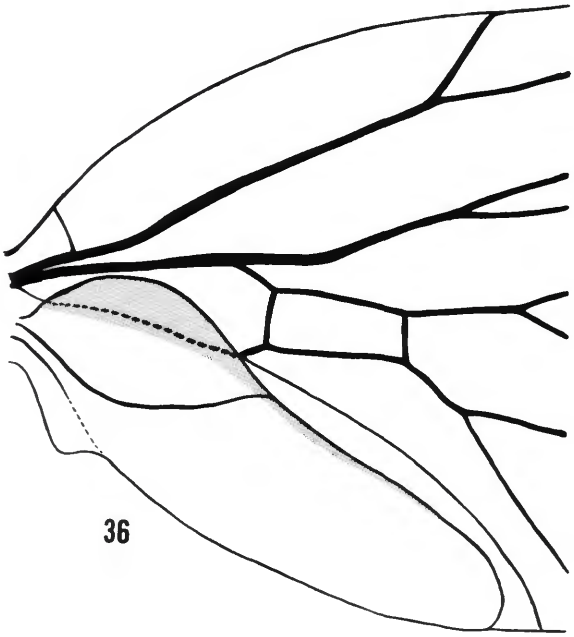

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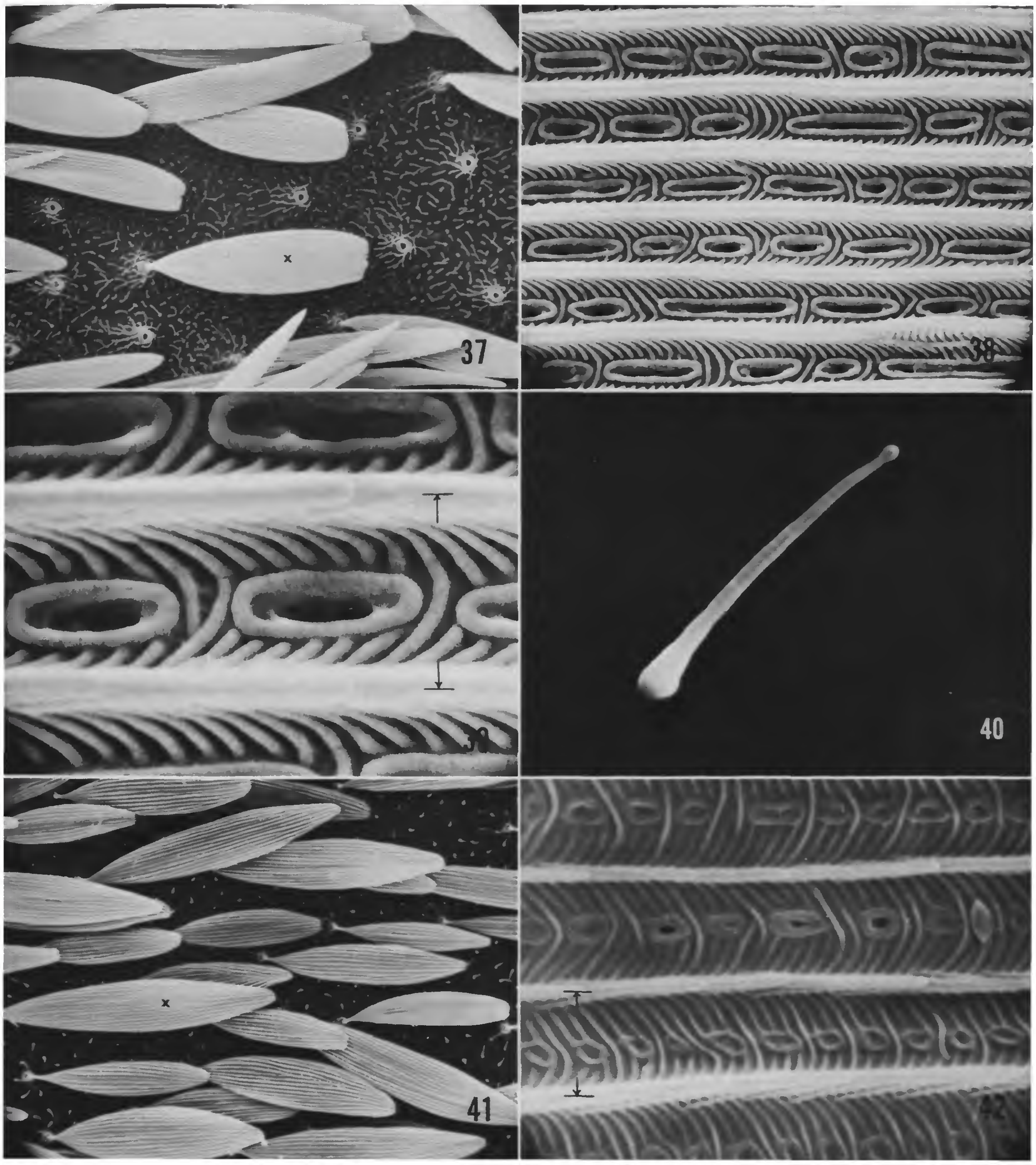
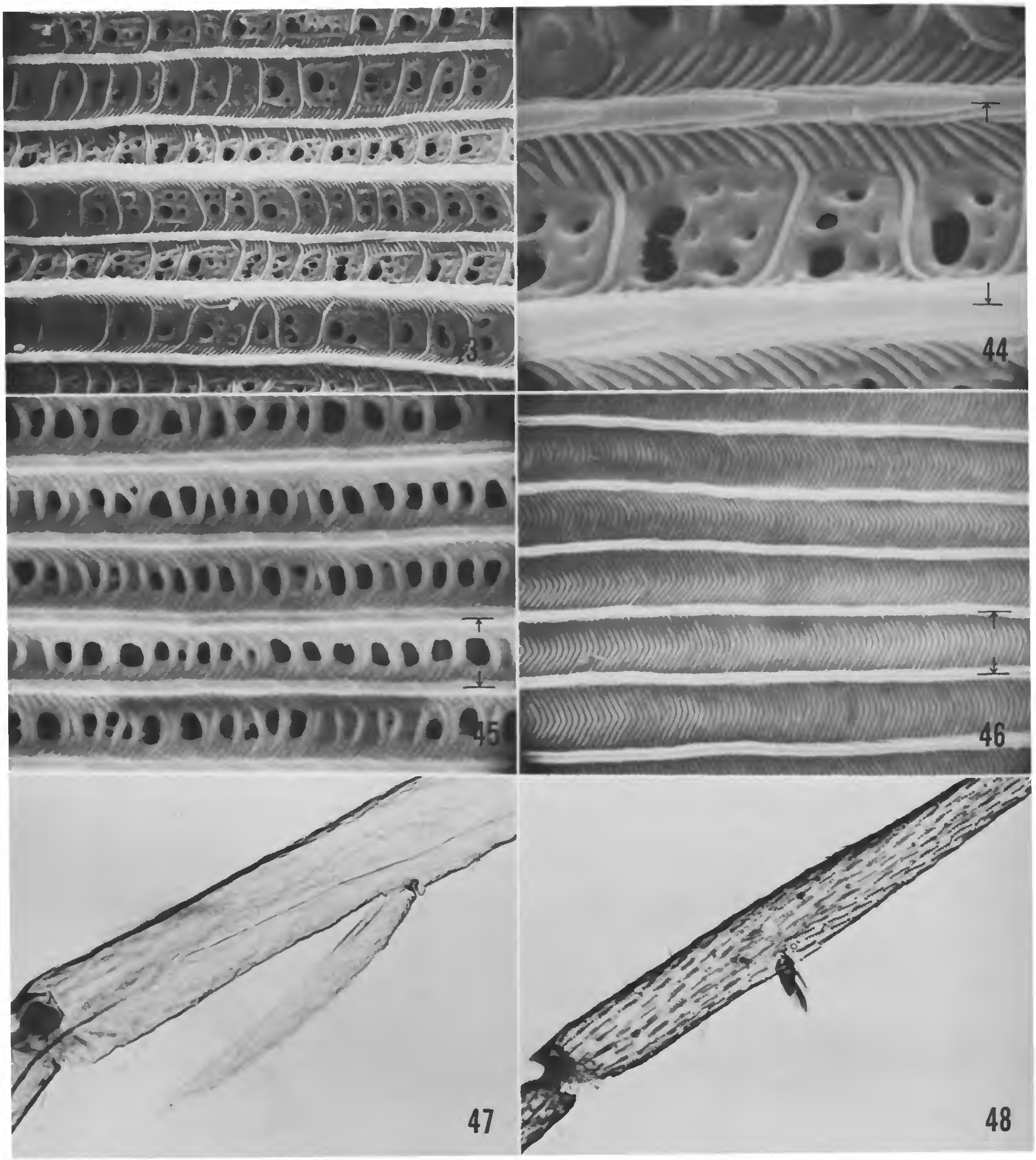
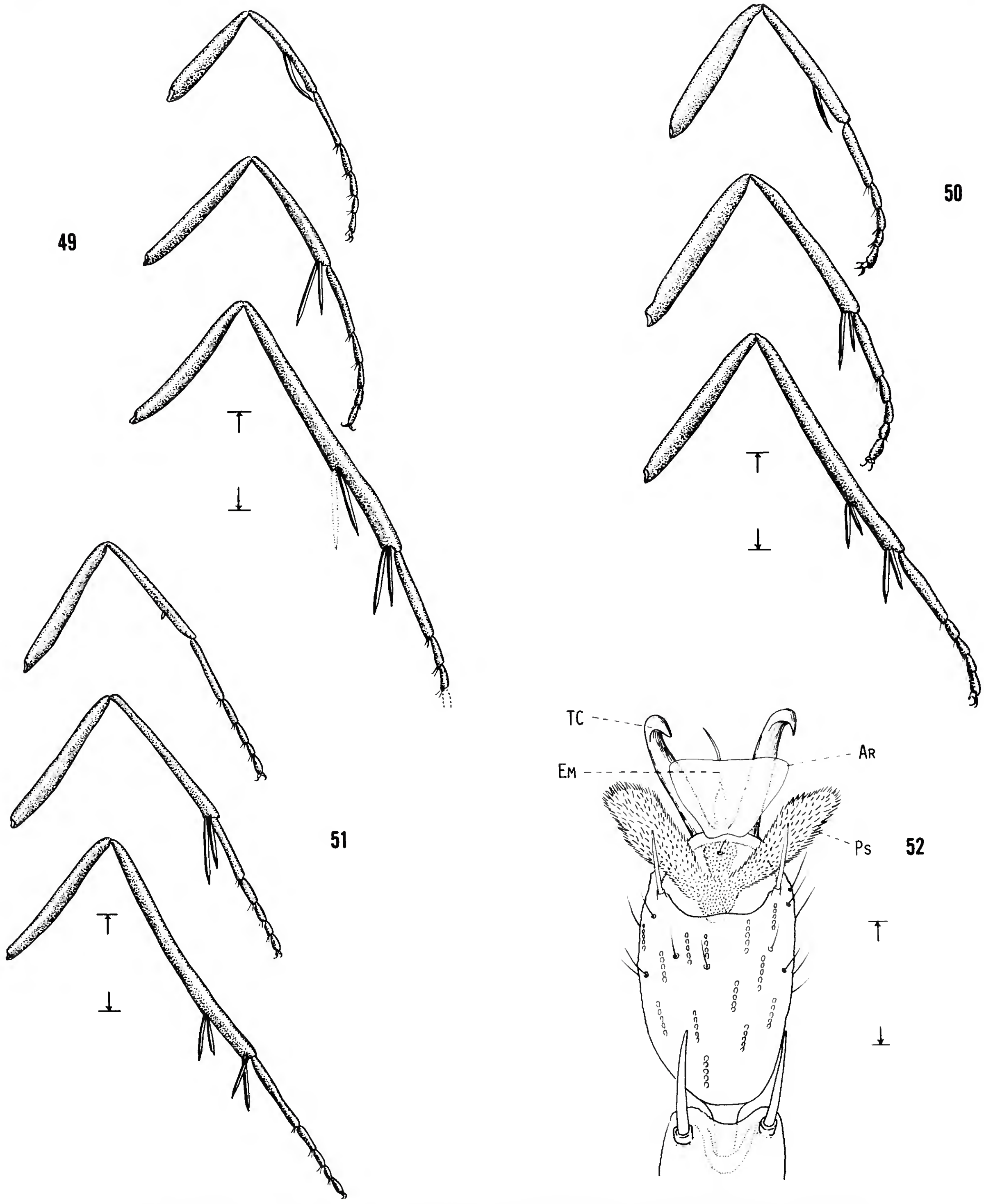
Figures 33–36.—Wing venation: 33, *Archepiolus schmidi* Mutuura; 34, *Apoplania chilensis,* new species; 35, *Neopseustis archiphenax* Meyrick; 36, *N. meyricki* Hering, detail of anal pocket (shaded area).



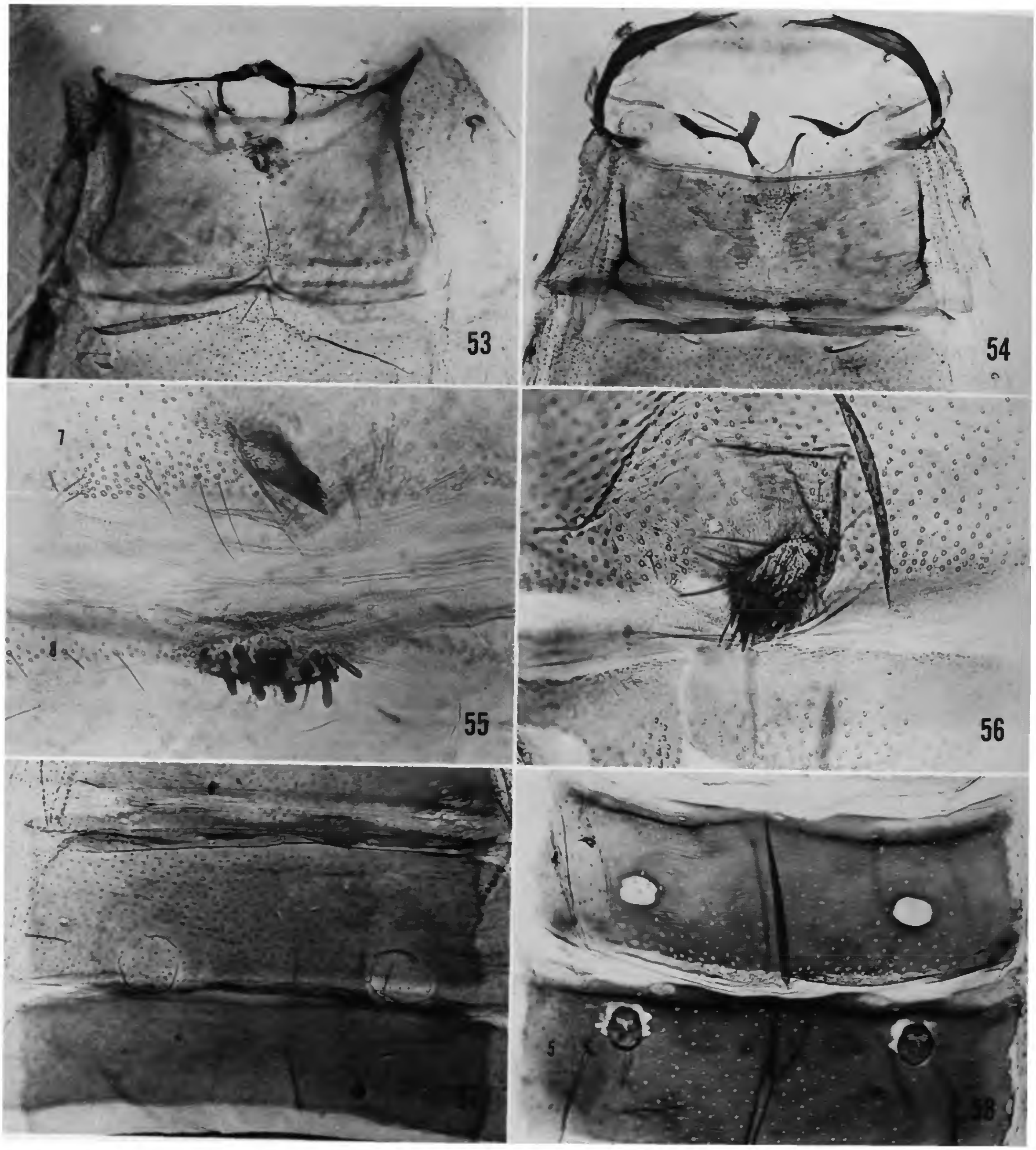
FIGURES 37–42.—Scale structure: 37, *Neopseustis calliglauca* Meyrick, dorsal scales of discal cell, forewing, × 500; 38, detail of Figure 37 (x), × 10,000; 39, detail of Figure 38, × 30,000, scale=1.3 μm; 40, *Apoplania chilensis*, new species, microtrichium (aculea) from discal cell of hindwing, × 12,500; 41, *A. chilensis*, new species, dorsal scales of discal cell, hindwing, × 500; 42, detail of Figure 41 (x), × 15,000, scale=2 μm.



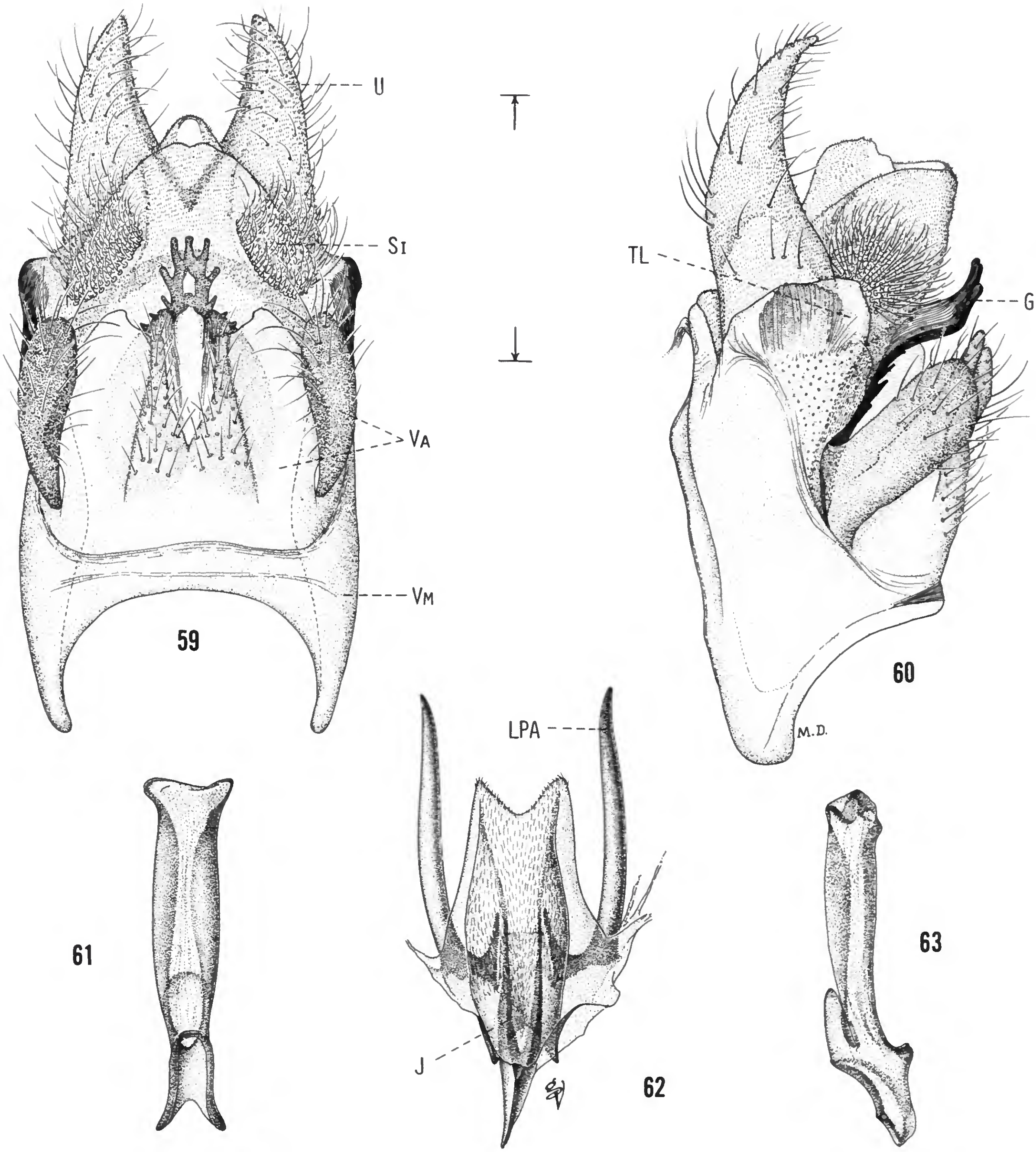
FIGURES 43–48.—Scale structure: 43, *Hepialus sequoilus* Behrens, Hepialidae, detail of a dorsal scale from discal cell of forewing, × 5000; 44, detail of Figure 43, × 20,000, scale=2 μm; 45, *Mnesarchea loxoscia* Meyrick, Mnesarchaeidae, detail of a dorsal scale from discal cell of forewing, × 10,000, scale=1.5 μm; 46, *Eriocraniella aurosparsella* (Walsingham), Eriocraniidae, detail of a ventral scale from discal cell of forewing, × 7000, scale=1.7 μm. Leg structure: 47, *Neopseustis meyricki* Hering, epiphysis; 48, *Apoplania chilensis*, new species, epiphysis.



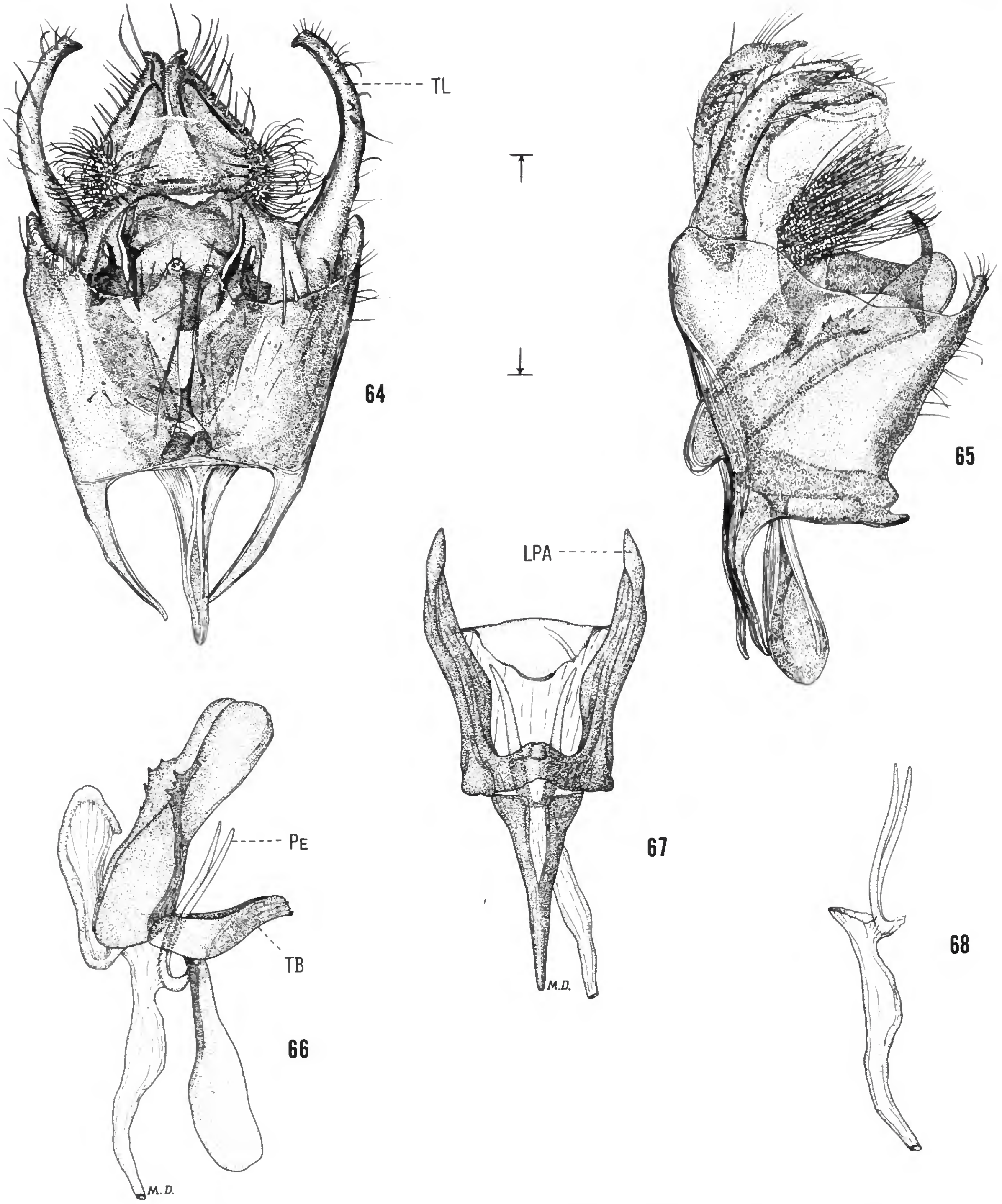
FIGURES 49–52.—Leg structure: 49, *Archepiolus schmidi* Mutuura, scale=0.5 mm; 50, *Neopseustis meyricki* Hering, scale=0.5 mm; 51, *Apoplania chilensis*, new species, scale=0.5 mm; 52, *Neopseustis meyricki* Hering, terminal tarsal segment of metathoracic leg, scale=0.1 mm.



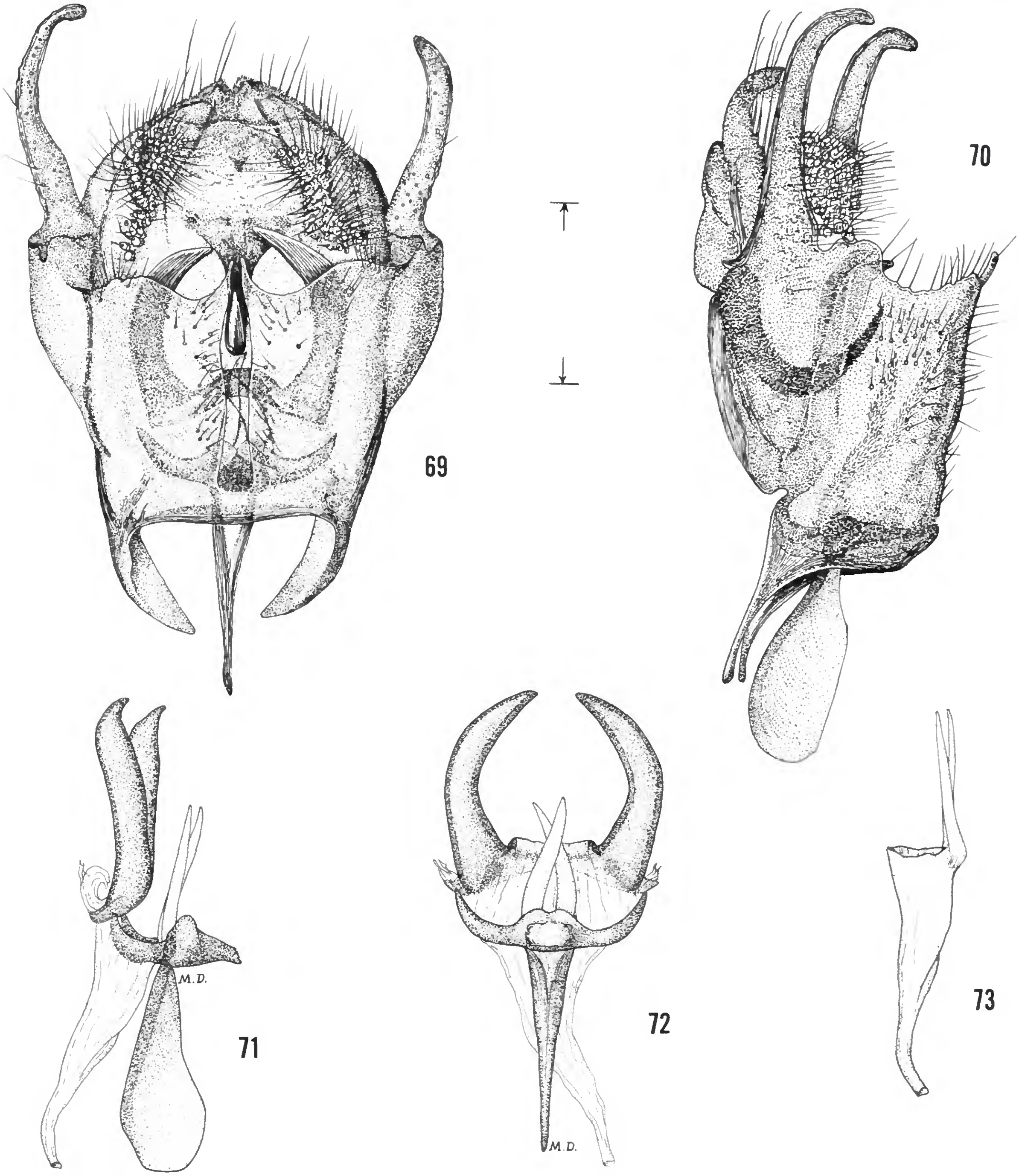
FIGURES 53–58.—Abdominal structure: 53, *Neopseustis archiphenax* Meyrick, first and second sternites; 54, *Apoplania chilensis*, new species, first and second sternites; 55, *N. archiphenax* Meyrick, sternal process of seventh (7) and eighth (8) segments of male; 56, *Archepiolus schmidi* Mutuura, sternal process of seventh segment of male; 57, *Apoplania chilensis*, new species, sensory organs of fourth sternite of female; 58, *Eriocraniella aurosparsella* (Walsingham), sensory organs of fourth (4) and fifth (5) sternites.



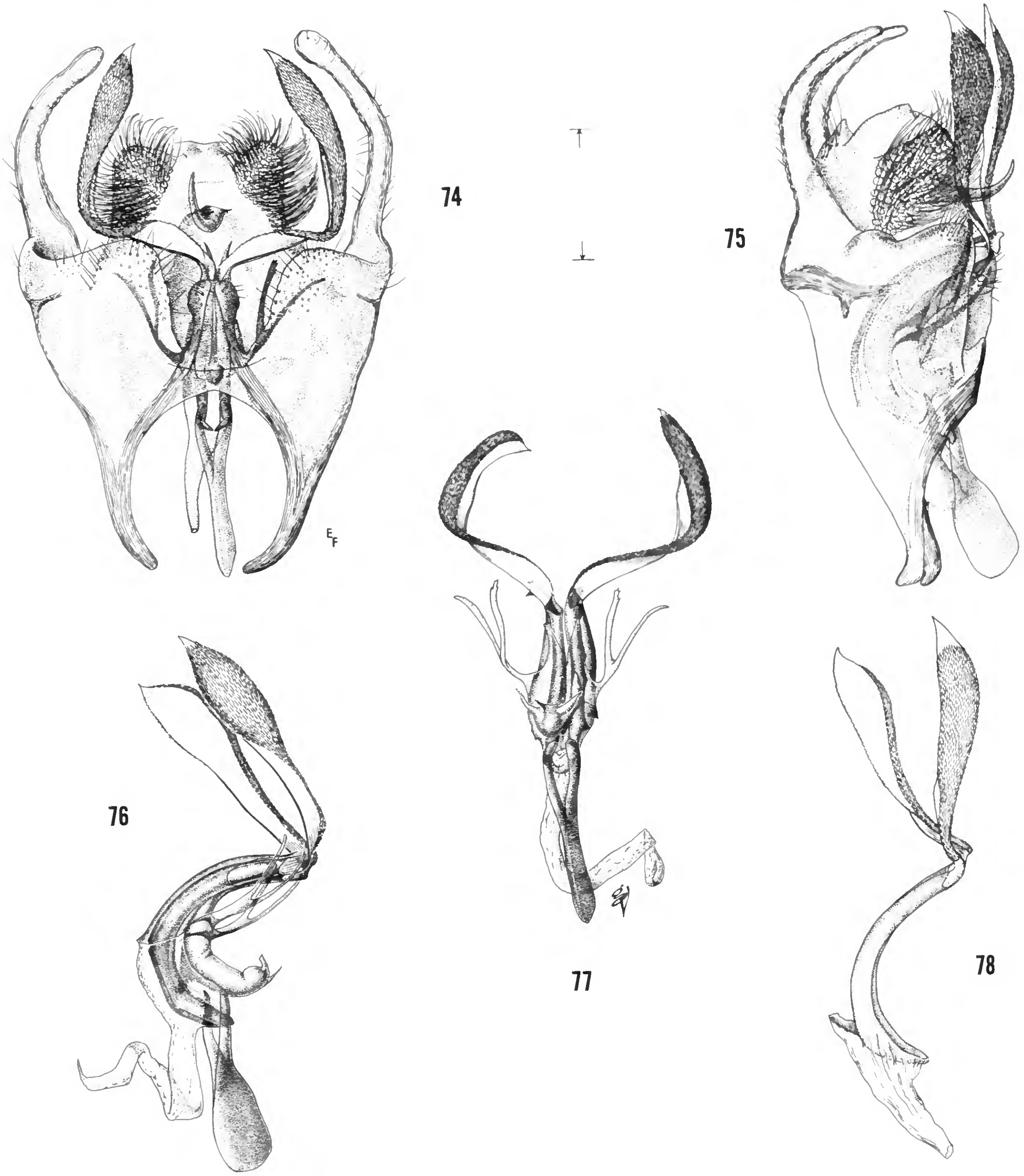
FIGURES 59–63.—*Archepiolus schmidi* Mutuura, male genitalia, scale = 0.5 mm: 59, ventral view; 60, lateral view; 61, aedeagus, ventral view; 62, anellus-juxta, ventral view; 63, aedeagus, lateral view.



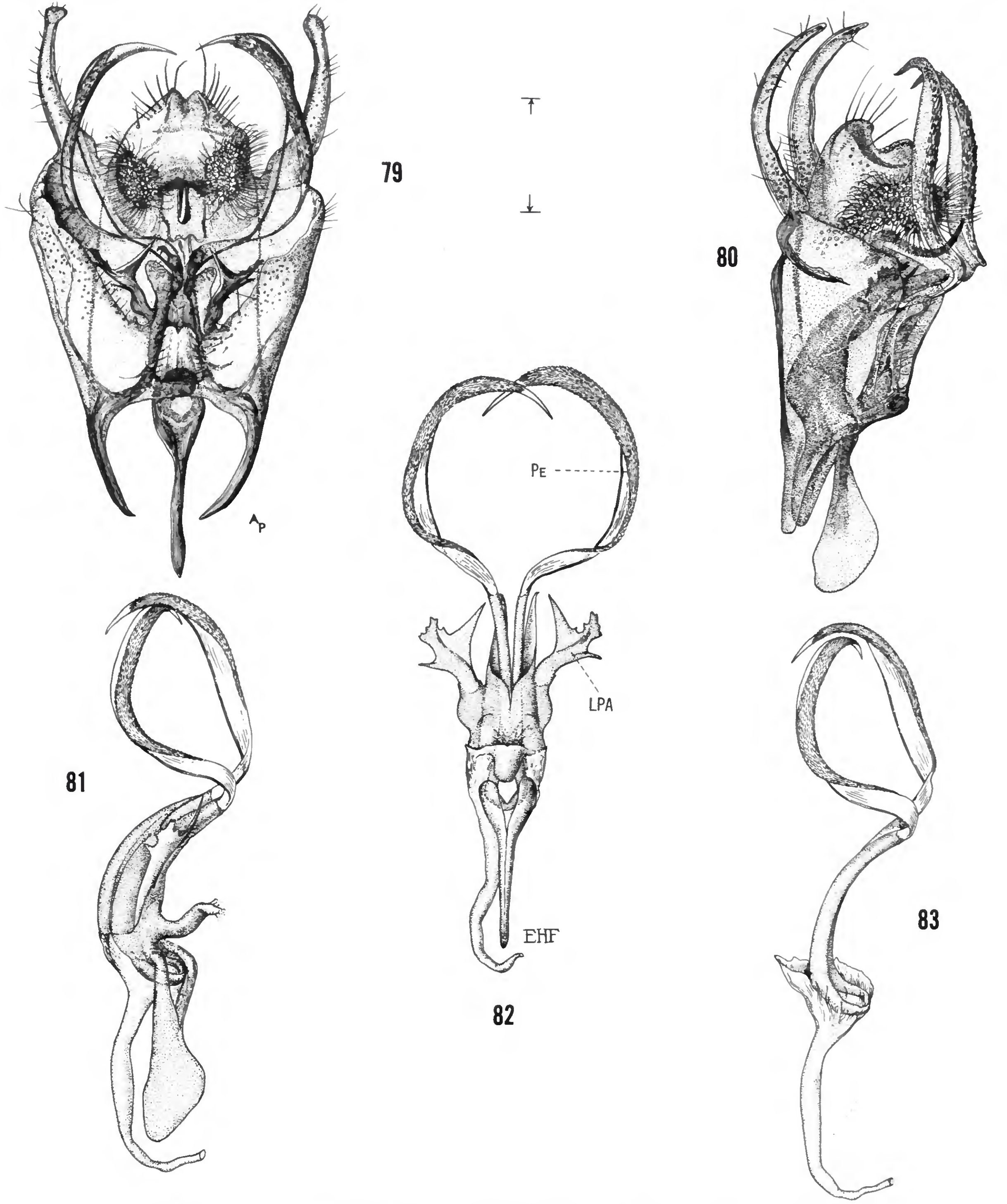
FIGURES 64–68.—*Neopseustis calliglauca* Meyrick, male genitalia, scale=0.5 mm: 64, ventral view; 65, lateral view; 66, anellus-juxta-parameres, lateral view; 67, ventral view of Figure 66; 68, ductus ejaculatorius-parameres, lateral view.



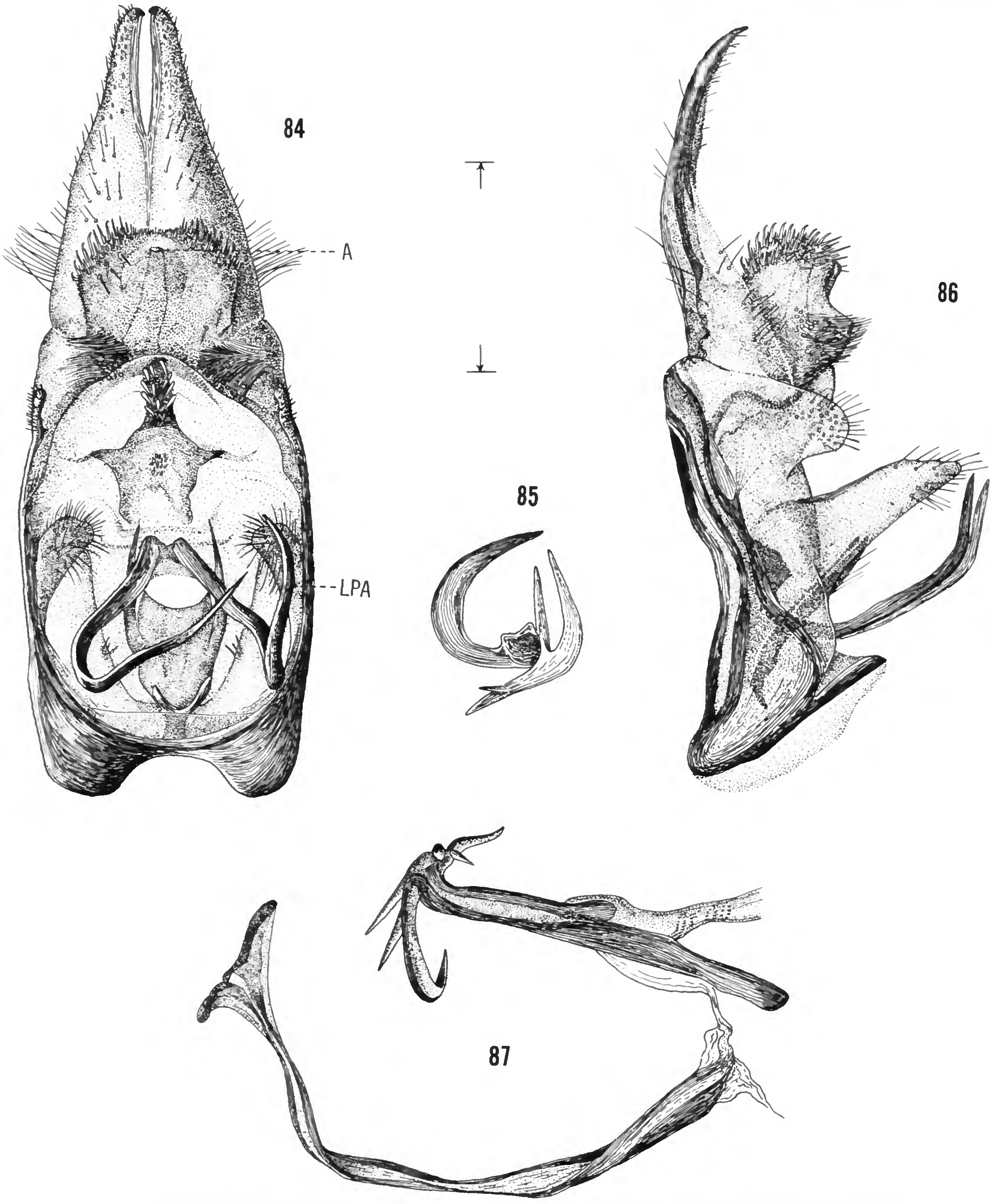
Figures 69–73.—*Neopseustis bicornuta*, new species, male genitalia, scale=0.5 mm: 69, ventral view; 70, lateral view; 71, anellus-juxta-parameres, lateral view; 72, ventral view of Figure 71; 73, ductus ejaculatorius-parameres, lateral view.



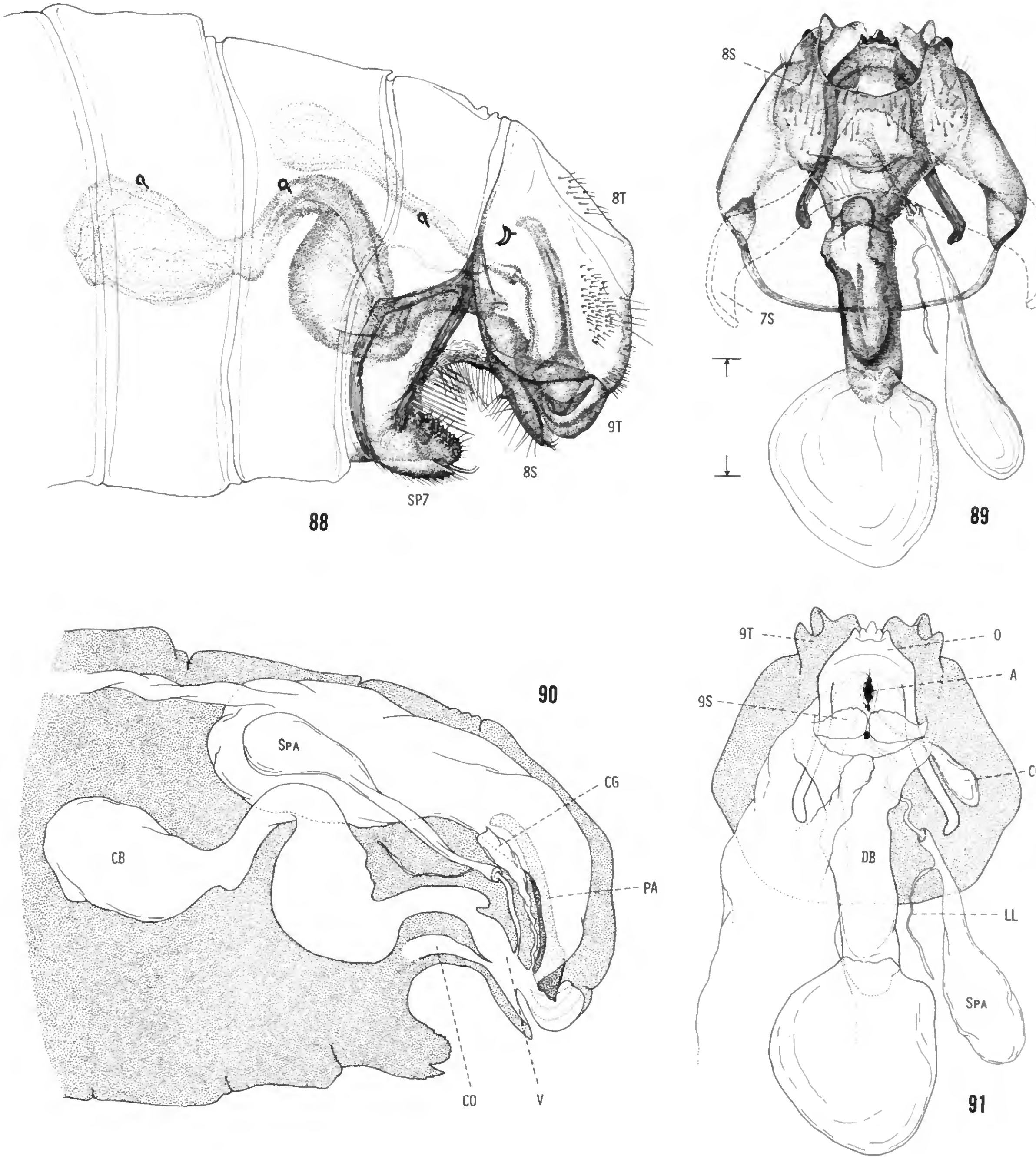
FIGURES 74–78.—*Neopseustis meyricki* Hering, male genitalia, scale=0.5 mm: 74, ventral view; 75, lateral view; 76, anellus-juxta-parameres, lateral view; 77, ventral view of Figure 76; 78, ductus ejaculatorius-parameres, lateral view.



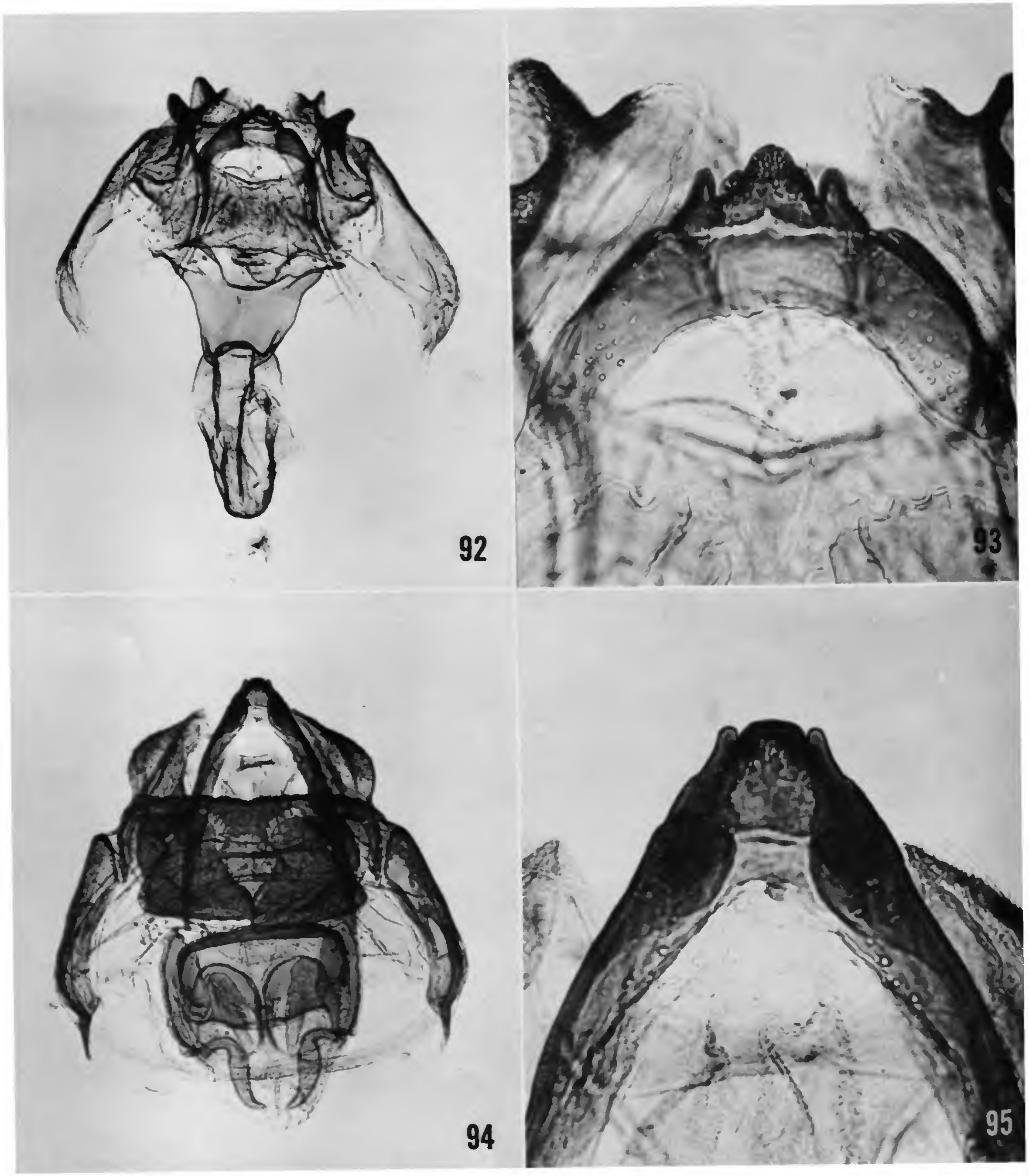
FIGURES 79–83.—*Neopseustis sinensis,* new species, male genitalia, scale=0.5 mm: 79, ventral view; 80, lateral view; 81, anellus-juxta-parameres, lateral view; 82, ventral view of Figure 81; 83, ductus ejaculatorius-parameres, lateral view.



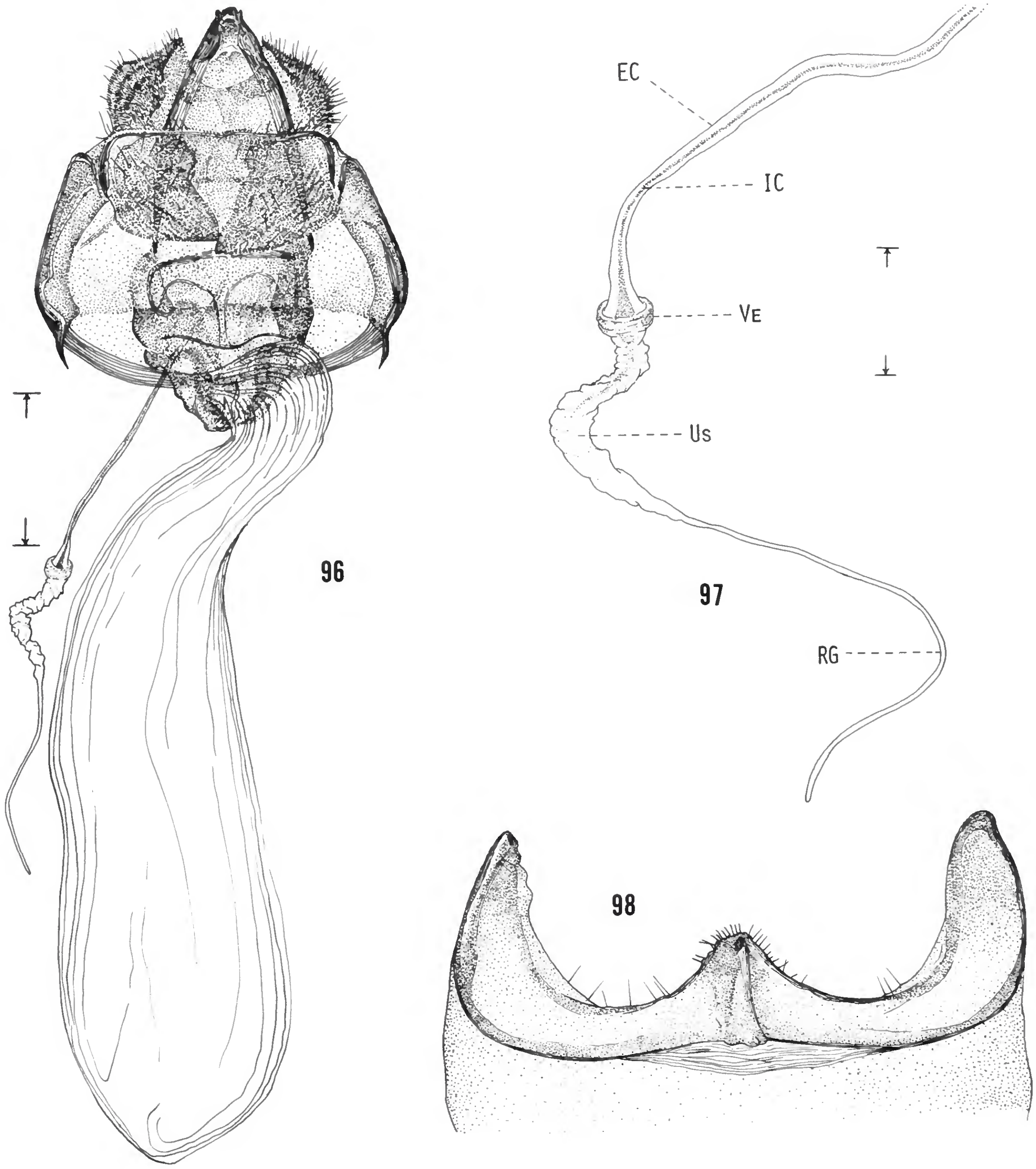
Figures 84–87.—*Apoplania chilensis*, new species, male genitalia, scale = 0.5 mm: 84, ventral view; 85, caudal view of aedeagus; 86, lateral view; 87, aedeagus and ductus ejaculatorius, lateral view.



FIGURES 88–91.—*Neopseustis meyricki* Hering, female reproductive system, scale=0.5 mm: 88, external genitalia, lateral view; 89, ventral view of Figure 88; 90, median sagittal view of reproductive system; 91, ventral view of Figure 90.



FIGURES 92–95.—Female genitalia: 92, *Neopseustis meyricki* Hering, ventral view; 93, *N. meyricki* Hering, apex of ovipositor, ventral view, × 200; 94, *Apoplania chilensis*, new species, ventral view; 95, *A. chilensis*, new species, apex of ovipositor, ventral view, × 210.



FIGURES 96–98.—*Apoplania chilensis*, new species, female genitalia: 96, ventral view, scale=0.5 mm; 97, spermatheca, scale=0.2 mm; 98, seventh abdominal sternite, ventral view.

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