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Description of a new genus and two new species of Neopseustidae from South America, with discussion of phylogeny and biological observations (Lepidoptera: Neopseustoidea)

by

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**Abstract.** One new genus, *Synempora*, and two new species, *Synempora andesae* and *Apoplania penai*, of the Neopseustidae are described from temperate South America. The systematic position of the family Neopseustidae is reviewed: The family represents the sister-group of the Neolepidoptera, and a new suborder, Neopseustina, is proposed to accommodate it. A cladistic analysis of the four genera of the family is given; it demonstrates monophyly of a group comprising the two South American genera, *Synempora* gen. n. and *Apoplania* Davis, 1975. Also included are biological observations dealing with diurnal and nocturnal flight activity, resting posture, and bamboo or its debris as the possible larval feeding substratum.

## 1. Introduction

In a revision of the archaic moth family Neopseustidae, Davis (1975b) recognized three genera and seven species, of which all species except one were restricted to the southeast Asian areas: Taiwan, India: Assam, Burma and China: Szechuan. The unique South American species, *Apoplania chilensis*

Davis, 1975, was known only from the northernmost temperate areas in Chile, the provinces Nuble, Linares, and Maule, and has not been recorded since.

Recent collecting activities in the Patagonian region of South America by the above authors as well as by Dr. O. S. Flint of the Smithsonian Institution and Mr. L. E. Peña of the Instituto de Molina, has resulted in the discovery of one new genus and two new species of Neopseustidae. Sufficient series of these taxa are now available to permit several new observations to be offered regarding the systematics and biology of this interesting family.

Davis' fieldwork was supported by a grant from the Smithsonian Institution's Fluid Research Fund. His efforts were concentrated in the *Nothofagus-Araucaria* forests of southern Chile during the months of January and February 1979. He was greatly assisted in the field by his wife Mignon Davis, his assistant Biruta Akerbergs and Mr. Luis E. Peña G.

Nielsen's fieldwork was undertaken together with members of the staff of the Department of Entomology, Zoological Museum, Copenhagen, participating in The Danish Scientific Expedition to Patagonia and Tierra del Fuego 1978-79, an expedition predominantly operating in the Argentine andine temperate forest areas (Nielsen 1980).

We wish to express our deep appreciation to Mr. Luis E. Peña G. and his associates at Instituto de Molina for courtesies too numerous to be mentioned. We are indebted to Dr. N. P. Kristensen, ZMUC, for valuable discussions; likewise we wish to thank Ms. B. Akerbergs, USNM, for preparing most line illustrations, and Mr. O. Martin, Mr. B. W. Rasmussen, and Mr. R. Nielsen, ZMUC, and Mr. J. Fuglsang Nielsen for help in preparing the remaining illustrations.

The following abbreviations are used for deposition of material:

BMNH	British Museum (Natural History), London, England.
CSIRO	Commonwealth Scientific and Industrial Research Organization, Division of Entomology, Canberra City, Australia.
IPCN	Instituto Patagonico de Ciencias Naturales, S. M. de los Andes, Argentina.
LEP	Collection of Luis E. Peña G., Instituto de Molina, Santiago, Chile.
MACN	Museo Argentino de Ciencias Naturales, Buenos Aires, Argentina.
MARC	Department of Scientific and Industrial Research, Mt. Albert Research Center, Auckland, New Zealand.
USNM	United States National Museum of Natural History, Smithsonian Institution, Washington, D. C.
ZMUC	Zoological Museum, University of Copenhagen, Copenhagen, Denmark.

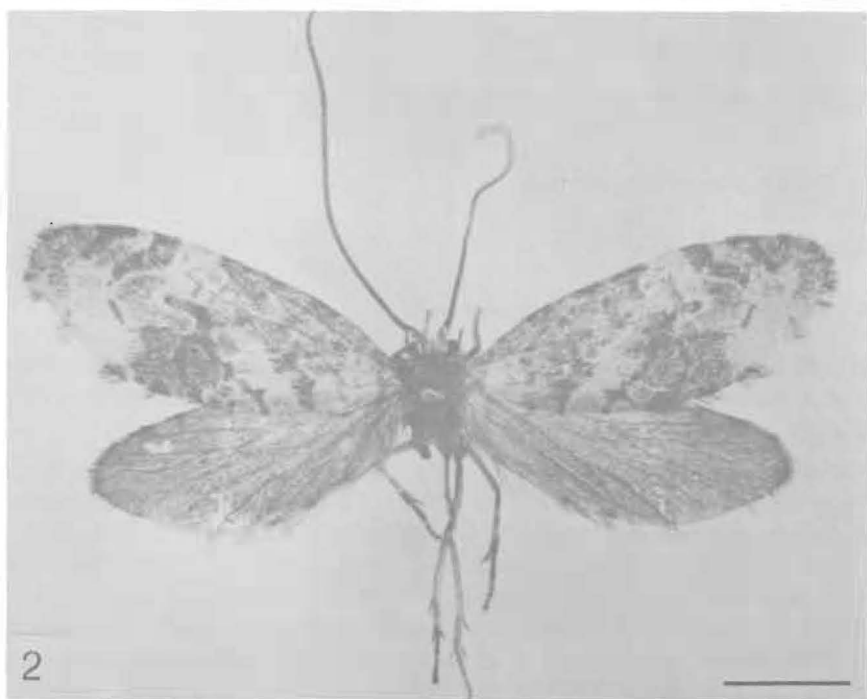
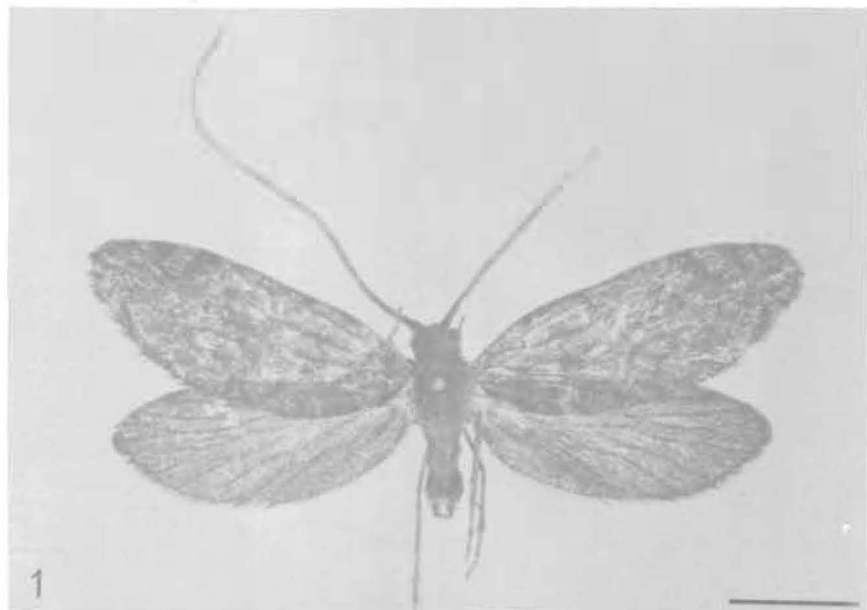




Fig. 3. *Apoplania penai* sp. n. Male, holotype. Scale: 3 mm.

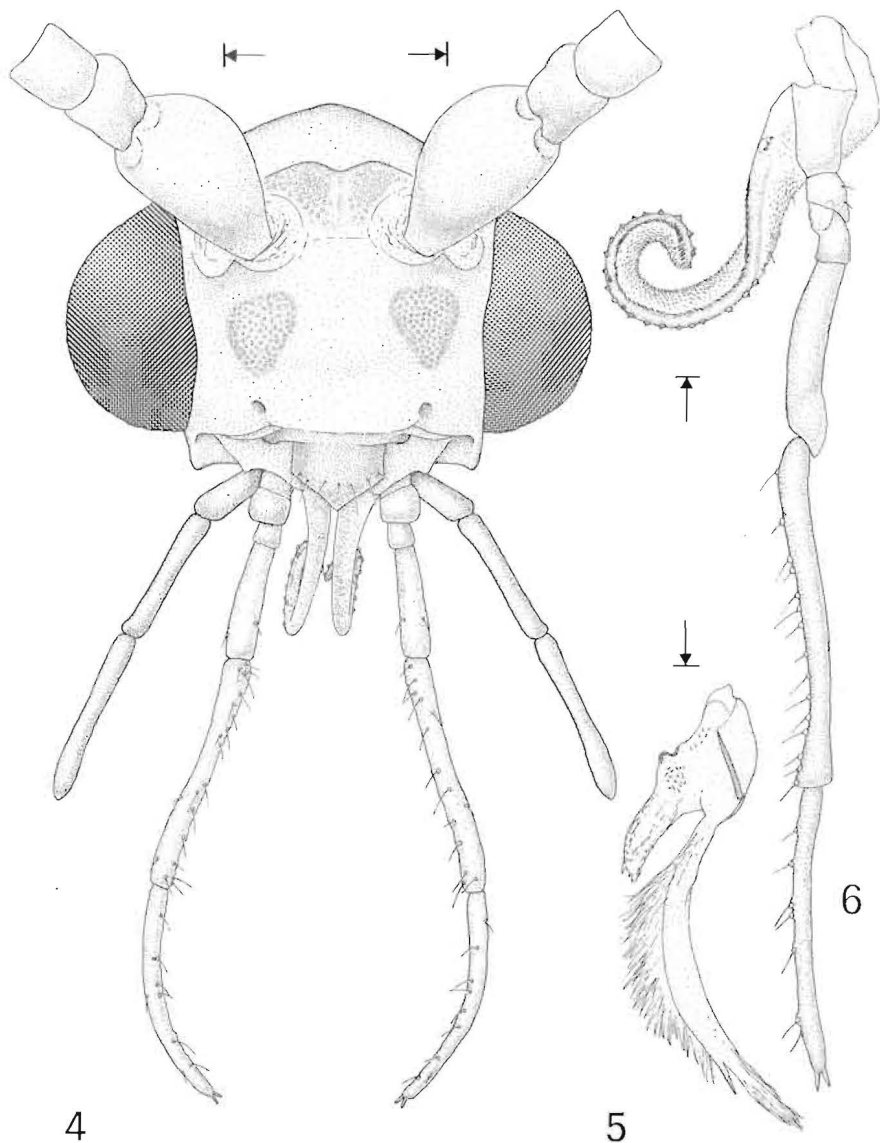
## 2. Descriptions of the new taxa

### *Synempora* gen. n.

Type-species: *Synempora andesae* sp. n.

Adult (Figs 1, 2). Relatively small, moderately heavy-bodied moths, with fully scaled, moderately broad wings. Antennae usually exceeding length of forewing slightly.

Head (Figs 4-11). Antennae long, approximately 0.9-1.2 the length of forewing. Scape long, intercalary sclerite present. Flagellum segments with piliform scales arranged in longitudinal rows of 2-4 contiguous, raised sockets (Figs 7-9); longitudinal ridges of scales with scutes, flutes distinct (Fig. 11); segments with numerous short sensilla trichodea (Figs 9, 10), many long sensilla trichodea (Fig. 8) and few sensilla chaetica along distal margin (Fig. 10); some sensilla of the two first mentioned types with tip divided. Eyes somewhat reduced, interocular index (Davis 1975a): 0.81; supraocular index (Kristensen & Nielsen



Figs 4-6. *Synempora andesae* sp. n., head and head structures. 4: Head, anterior view. 5: Mandible. 6: Maxilla. Scales: 4: 0.5 mm; 5, 6: 0.5 mm.

1979): 0.30; eye index (Powell 1973): 1.0. Chaetosemata well developed on frons and vertex. Mandibles relatively large; both adductor and abductor apodemes well developed (Fig. 5). Galeae with scattered scales on the proximal

third, otherwise naked, short, subequal to entire labial palpus and about 0.5 the length of maxillary palpus. Maxillary palpi five segmented with fourth segment the longest and slightly exceeding length of fifth. Labial palpi three segmented, nearly reaching apex of fourth segment of maxillary palpus; second and third segments approximately equal in length. Prementum elongate, separated and divergent for most its length with free arms nearly as long as basal segment of labial palpus.

**Thorax.** Protibial epiphysis present but extremely reduced in size (Fig. 12), its length approximately X3 its greatest width; metathoracic tibia with basal spines arising from distal third. Forewings (Fig. 14) slightly more slender than in *Apoplania*, forewing index: 0.40; venation approximately similar to that of *Apoplania*, but  $CuA_1$  diverges gradually from  $CuA_2$  from the point of furcation in both fore- and hindwing, not abruptly as in *Apoplania*.

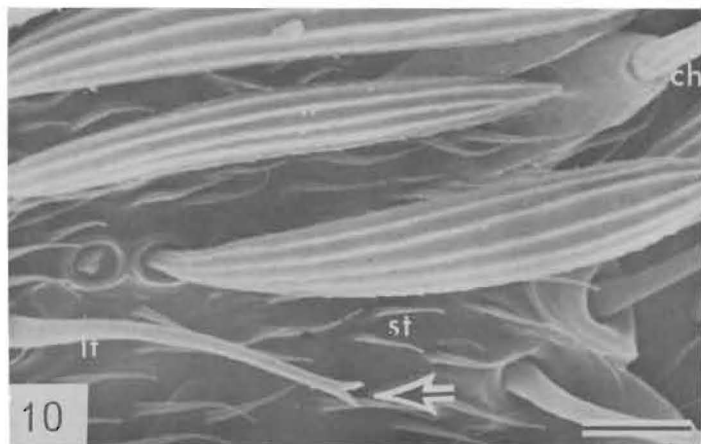
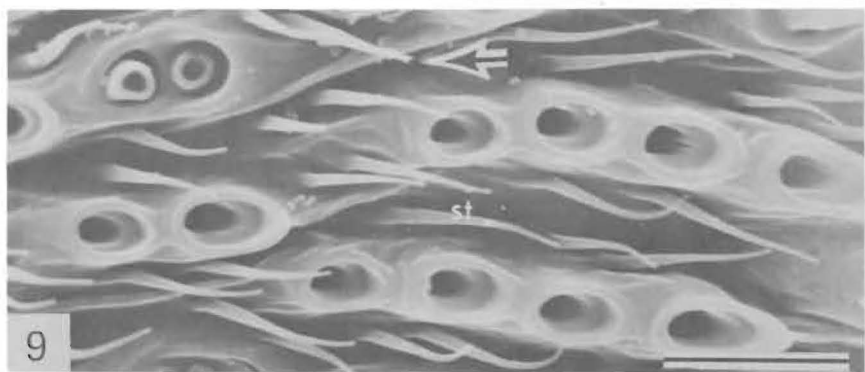
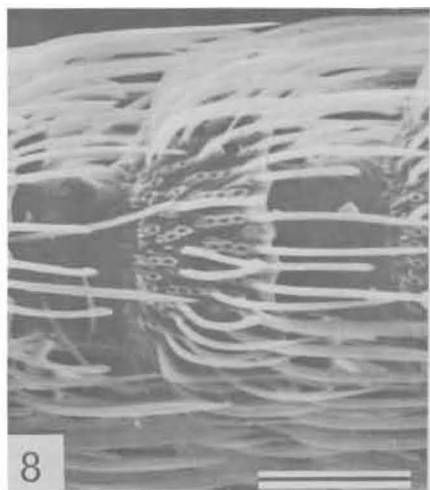
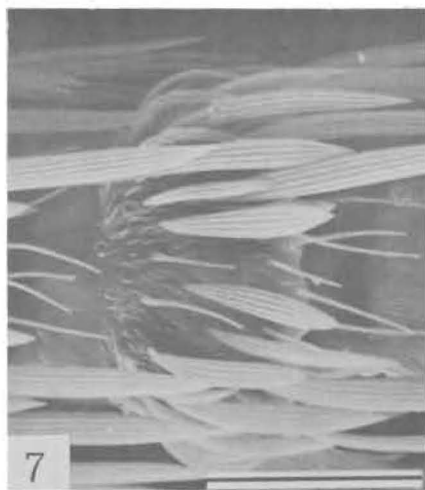
**Pregenital abdomen.** Relatively short and broad. Seventh sternite of male with a slightly raised median oval pad bearing a few scattered short, acute spines. Female with fenestrae of fourth sternite vestigial (Fig. 30); seventh sternite heavily sclerotized, strongly curved to produce a large, median, caudal lobe bearing numerous minute spines. A large ventral pocket present between seventh and eight sternites.

**Male genitalia (Figs 23-25)<sup>1</sup>.** Uncus well developed, exceeding length of valvae, divided almost its entire length into two inwardly curved lobes. Tegumental lobes triangular, relatively short. Socii prominent, densely setose. Gnathos a small median plate bearing several stout caudal spines. Valvae relatively short, simple and undivided. Vinculum a relatively narrow ring ventrally with a pair of well-developed, slender, widely separated anterior apophyses. Anellus a darkly sclerotized, symmetrically lobed, spinose sclerite dorsad and laterad to slender, rodlike aedeagus. Juxta likewise a deeply bilobed sclerite with a closely associated pair of acute lobes situated more laterally and ventrally.

**Female genitalia (Figs 30, 32, 34).** Posterior apophyses stout, relatively

<sup>1</sup>The terminology here applied in the description of the male and female genitalia is in accordance with Davis (1975b). The true nature of these generally highly specialized structures of the Neopseustidae is still insufficiently understood.

Figs 7-11. *Synempora andesae* sp. n., antennal structures. 7: Flagellum segment with scales. 8: Flagellum segment with scales partly removed. 9: Detail of 8: Scale sockets and short sensilla trichodea, some with tip divided (arrow). 10: Detail of 7; ch: sensillum chaeticum, lt: long sensillum trichodeum, st: short sensillum trichodeum; note: divided tip of lt (arrow). 11: Detail of lamellar flagellum scale. Scales: 7, 8: 0.08 mm; 9-11: 0.004 mm.



short, approximately twice the length of ninth tergite; caudal end of ovipositor abruptly narrowing to a relatively broad trilobed apex. Ninth tergite divided medially and forming a pair of lateral lobes. Ductus spermathecae relatively straight to vesicle; utriculus beyond vesicle elongate, sinuate, and terminating in a slightly enlarged receptacular gland; lagena present. Ductus bursae very short, with membranous walls. Corpus bursae completely membranous, small, not extending cephalad further than seventh segment.

**Etymology.** The generic name is derived from the Greek *synemporos* which means fellow traveller, in reference to its sister group *Apoplania* (wanderer). It is to be treated as feminine.

### *Synempora andesae* sp. n.

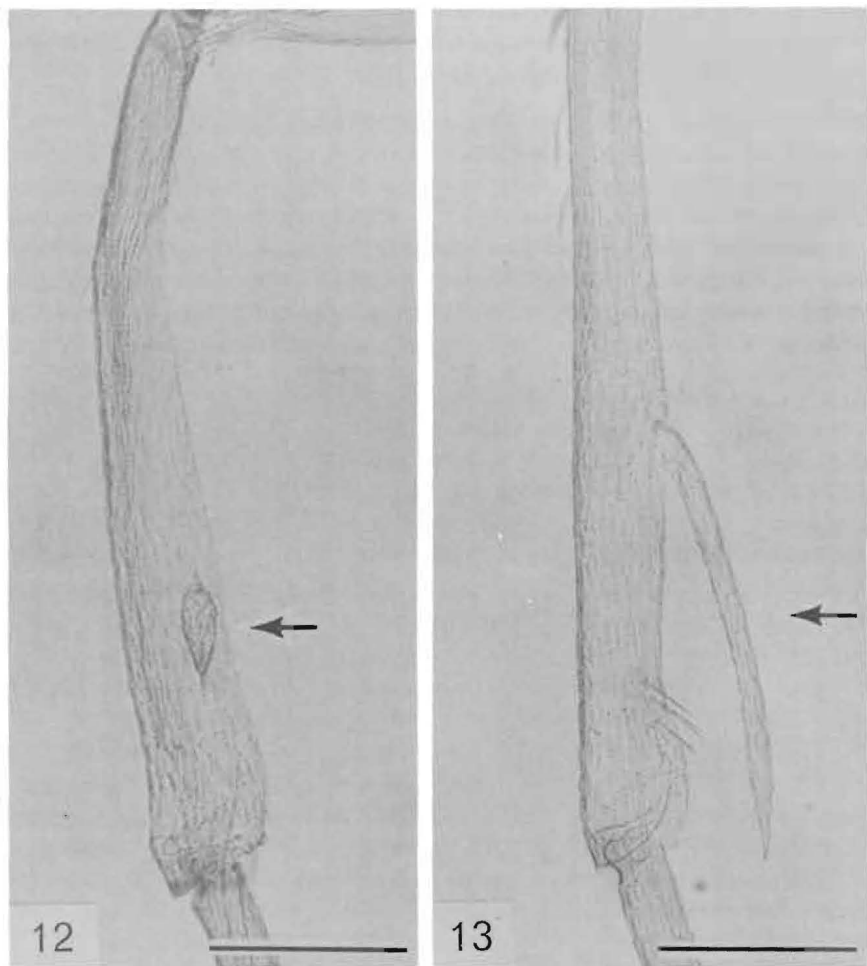
**Adult** (Figs 1, 2). Wing expanse: ♂, 15-16 mm; ♀, 18-20 mm.

**Head** (Fig. 4). Vestiture white to pale grey, sometimes heavily suffused with brown in female; dark brown to nearly black in male. Antennae with 93-107 segments; scape pale grey to brown in female, dark brown in male; flagellum light brown. Maxillary palpi and labial palpi greyish to brown in female, dark brown in male.

**Thorax.** Dorsum dark brown in female with a median caudal tuft of elongate white scales; tegulae dark brown with lighter brown apices; male with dorsum and tegulae uniformly darker brown, nearly black. Venter thinly scaled, greyish in female, more brown in male. Prothoracic legs pale brown in female with darker brown banding evident at apex of femur, three dark bands on tibia, and a single band around each tarsal segment; banding darker in male. Meso and metathoracic legs paler in color, with similar banding. Forewings brownish to fuscous in female mottled with lighter shades of brown and white; tornal and anal areas often with white scaling predominate; forewings of male mostly dark fuscous, marked with irregular black and metallic spots and with a sparse scattering of whitish scales. Hindwings uniformly fuscous in female with a short uniformly brownish fringe.

**Wing scales** (Figs 16, 17). Scale cover on dorsal wing surface dense. Microtrichia present. Forewing scales gradually expanding in width from base outwards, apical margin with a medial notch. Metallic scales not different in shape from nonmetallic ones. Longitudinal ridges with scutes, flutes distinct. Inter-ridge plates relatively large, with a marginal thickening, the marginal flute, and from one to three irregular placed flutes in center of plate, thus giving a pretzel-like appearance (Fig. 17). Areas enclosed by marginal flutes mostly nonperforated. Scales of hindwing similar to those of forewing but apices rounded instead of notched.





Figs 12, 13. Protibia with epiphysis (arrow). 12: *Synempora andesae* sp. n. 13: *Apoplania penai* sp. n. Scales: 12, 13: 0.2 mm.

Pregenital abdomen. Sparsely clothed with slender, piliform scales: uniformly stramineous in female, brown in male.

Male genitalia (Figs 23-25). Lobes of uncus widely separated for most of their length, then converging caudally; tapering gradually to subacute apices. Gnathos elongate, consisting of a narrow plate terminating in a connate mass of approximately 8-10 stout setae. Anterior apophyses of vinculum very slender. Anellus deeply divided into a pair of bilobed, densely spinose lobes; the most lateral lobe with its apex curving anteriorly. Juxta complex, with a deeply

divided dorsal sclerite bearing a pair of spinose lateral arms, and a more ventrad, more membranous sheet bearing a lateral pair of hornlike lobes. Aedeagus reduced to a slender sclerotized rod dorsal to the ejaculatory duct.

Male reproductive system (Fig. 22). Simplex ejaculatory duct with a posterior slender portion about twice as long as aedeagus, abruptly widening into a broad portion about twice as long as slender part; duplex ejaculatory ducts broad and short; accessory glands broad and short; vesicula seminalis similar broad, slightly longer than accessory glands. Broad ejaculatory ducts, accessory glands and vesicula forming a twisted H-shaped structure. Vasa deferentia long and slender, somewhat irregular in width and forming an anterior curve. Testes small, separate and oval structures.

Female genitalia (Figs 30, 32, 34). Apex of ovipositor with a relatively blunt median lobe and a bilateral pair of shorter, more acute lobes. Ninth tergite deeply divided into a pair of mostly lateral pads on either side of ovipositor. Spermatheca extremely long, approximately X2 the length of bursa copulatrix. Corpus bursae reduced, only slightly larger than ductus bursae and approximately equalling posterior apophyses in length.

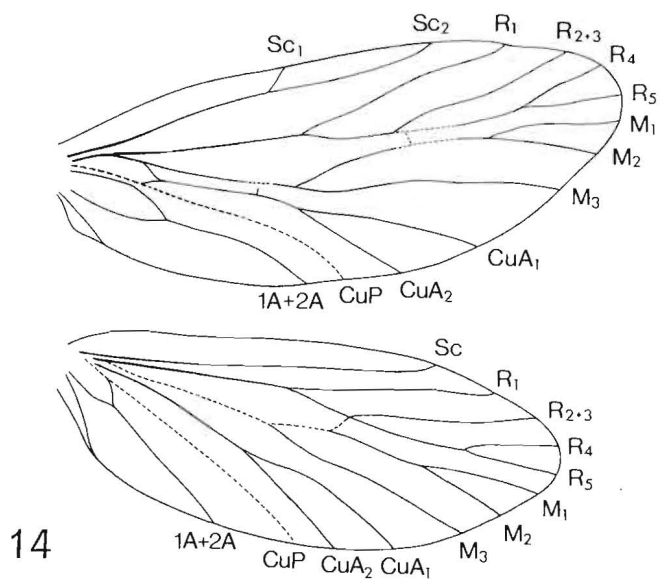
Material examined. Holotype ♂: Argentina: Chubut Province, Esquel, Lago Menendez, El Sagrario Puerto, 550 m, 21. ii. 1979 (Mision Cientifica Danesa, Sta. 49) (ZMUC).

Paratypes: Argentina: Same locality as holotype: 3♂, 20. ii. 1979 (ZMUC); 15♂, 19♀, 21. ii. 1979 (ZMUC); 1♂, 1♀, 21. ii. 1979 (BMNH); 1♂, 1♀, 21. ii. 1979 (CSIRO); 1♀, 21. ii. 1979 (LEP); 1♂, 21. ii. 1979 (IPCN); 1♀, 21. ii. 1979 (MACN). Chile: Osorno Province, Parque Nacional de Puyehue, Aguas Calientes to 2 km S., 600 m: 1♀, 6. ii. 1978 (C. and O. Flint) (USNM), 1♂, 1♀, 10.-22. ii. 1979 (D. and M. Davis, B. Akerbergs) (USNM).

Additional material preserved in alcohol and not to be included in the type series: Argentina: same locality as holotype: 1♂, 1♀, 20. ii. 1979; 16♂, 11♀, 21. ii. 1979 (ZMUC).

Distribution (Fig. 36). Only known from the above mentioned two localities which both are situated in the Valdivian Cordillera forest area (term of Peña 1966).

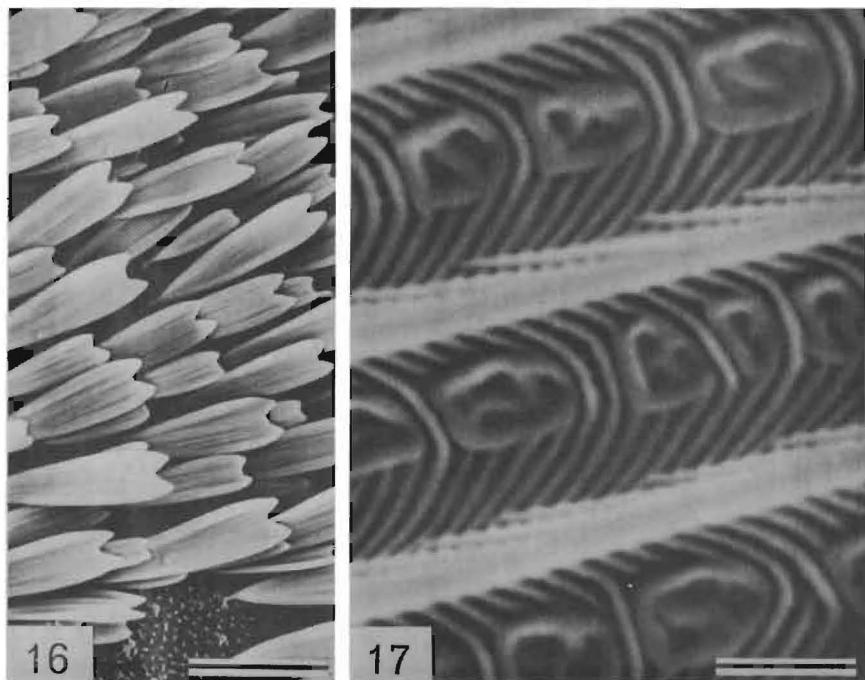
Habitat. The entire Argentinian series was collected in the very moist forests of El Sagrario Puerto between the western end of Brazo Norte of Lago Menendez and Lago Cisne in Parque Nacional Los Alerces, west of Esquel. These forests are very dense and rich in plant species; however, collecting in the more diverse parts of the forest was unsuccessful for *S. andesae*. Instead, a habitat characterized by a dominance of *Nothofagus dombeyi* (Mirb.) Blume with a very dense understorey of *Chusquea culeou* E. Desv. (Fig. 43) produced the entire series.



15



Figs 14, 15. Wing venation. 14: *Sympetora andesae* sp. n. 15: *Apoplania penai* sp. n. Scale: 2 mm.



Figs 16, 17. *Synempora andesae* sp. n., wing and scale structures. 16: Forewing upperside vestiture; scales removed on lower part; note: microtrichia and medial notch in the apical margin of scales. 17: Detail of lamellar scale; note: pretzellike structures on inter-ridge plates. Scales: 16: 0.1 mm; 17: 0.002 mm.

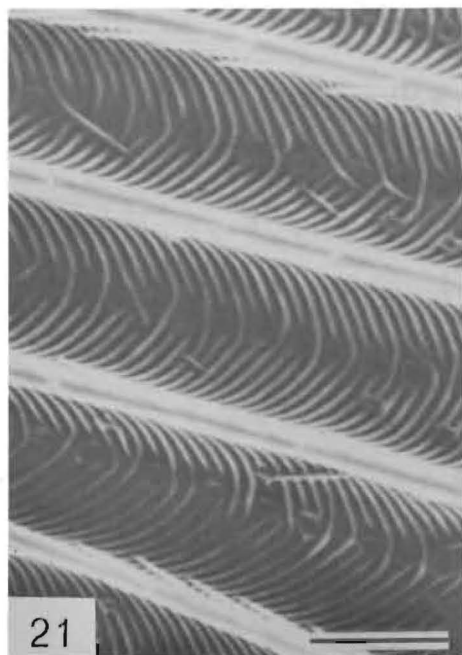
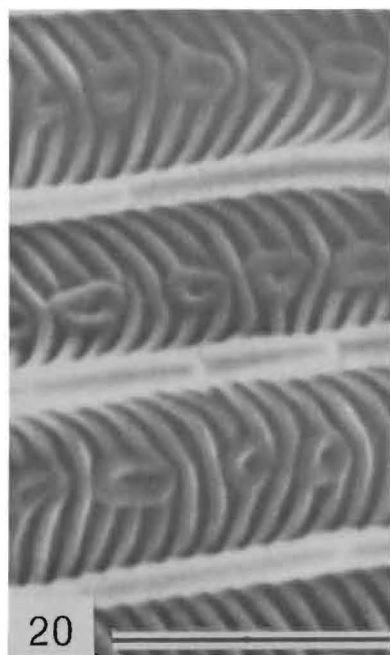
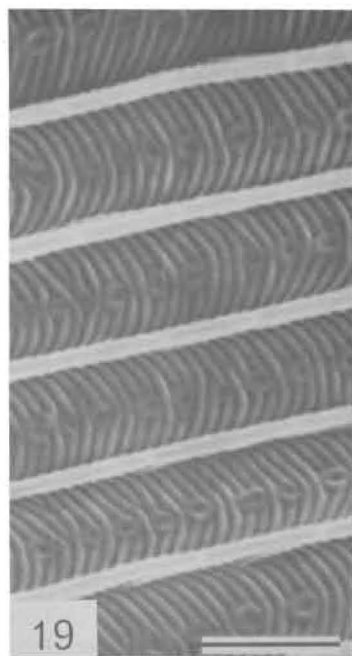
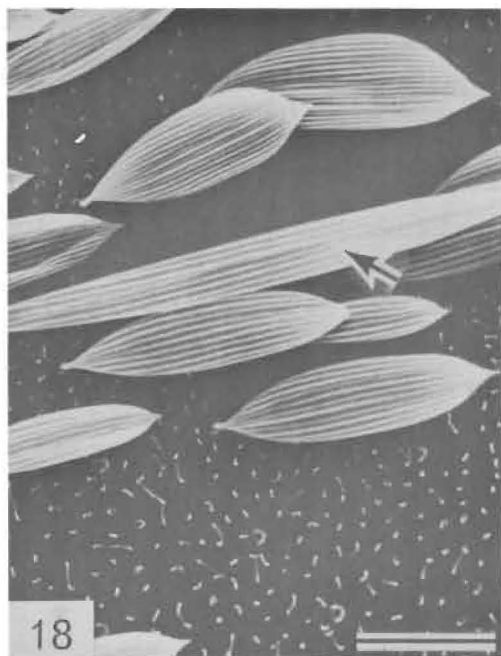
The few specimens from Chile were mostly collected along the Rio Chanleufu, near dense stands of *Chusquea*.

#### *Apoplania penai* sp. n.

Adult (Fig. 3). Wing expansion: ♂, 17-19.5 mm; ♀, 16 mm.

Head. Vestiture dull white to very pale stramineous. Eyes large, interocular index approximately 1.2, eye index 1.1. Antennae uniformly stramineous, approximately 1.1-1.2 the length of forewing, 93-114 segmented; vestiture similar to that described for *A. chilensis*, arising from raised sockets arranged in

Figs 18-21. *Apoplania penai* sp. n., wing and scale structures. 18: Forewing upperside vestiture; scales removed on lower part; note: microtrichia, acute lamellar scales and pili-form scale (arrow). 19: Detail of lamellar scale. 20: Detail of lamellar scale at higher magnification. 21. Lamellar scale with oblique crests. Scales: 18: 0.04 mm; 19-21: 0.002 mm.



scattered longitudinal oriented rows of 2 to 6 sockets; socket rows concentrated toward distal end of each cupuliform flagellomere; irregularly interspersed between socket rows are solitary sensory sensilla with an enlarged socket. Maxillary palpi stramineous with dark brown scales concentrated at distal third of third, most of fourth, and at base of fifth segments. Labial palpi stramineous with dark brown scales scattered over most of distal two segments.

**Thorax.** Dorsum pale brown, tegulae stramineous, venter whitish to stramineous. Prothoracic and mesothoracic legs mostly dark brown dorsally with scattered stramineous scales; tarsi appearing ringed with stramineous; most of ventral surfaces stramineous. Metathoracic legs paler with tarsal banding less evident. Protibial epiphysis prominent in size, approximately 0.4 the length of tibia (Fig. 13). Wing venation illustrated on Fig. 15; forewing index: 0.46. Forewing translucent, thinly scaled, mostly a dull white color, mottled with irregular but symmetrically arranged patches and slender transverse streaks of dark brown, giving the forewing a somewhat barred appearance; most prominent spots of forewing consisting of a subapical, crescent shaped brown bar from costa and fading toward termen; a less prominent brown bar from distal third of costa; and an obscure, oval patch of black scales at apex of discal cell. Hindwings less heavily marked, nearly transparent, with a slight darkening at apex of cell and numerous transverse bars of dark brown presenting an overall barred pattern.

**Wing scales (Figs 18-21).** Forewing scales medially with lateral margins parallel, distally with margins tapering to an acute point, thereby obliterating a distinct apical margin. Black scales forming dark spot on cross-vein R-M in forewing broader and shorter than normal scales and similarly acute. Longitudinal ridges disappear just at scale margin. Flutes distinct, inter-ridge plates relatively small (Figs 19, 20). Dorsal side of wings beyond relatively short acute scales also provided with scattered, relatively long scales (Fig. 18). Ultrastructure of long and short scales similar. Some short scales with oblique crests overlaying flutes (Fig. 21). Hindwing scales similar in structure to forewing scales.

**Pregenital abdomen.** Sparsely clothed with slender, piliform scales; stramineous above and more whitish ventrally. Female with a pair of large oval fenestrae present near caudal margin of fourth sternite; seventh sternite heavily sclerotized, with over 30 minute, peg-like setae concentrated over apex of median lobe. A large ventral pocket present between seventh and eighth sternites (Fig. 31).

**Male genitalia (Figs 26-29).** Uncus broad and rounded, with a short pair of blunt caudal processes separated by a shallow median cleft. Socii reduced to a pair of lateral setal patches. Tegumen without caudolateral lobes. Gnathos

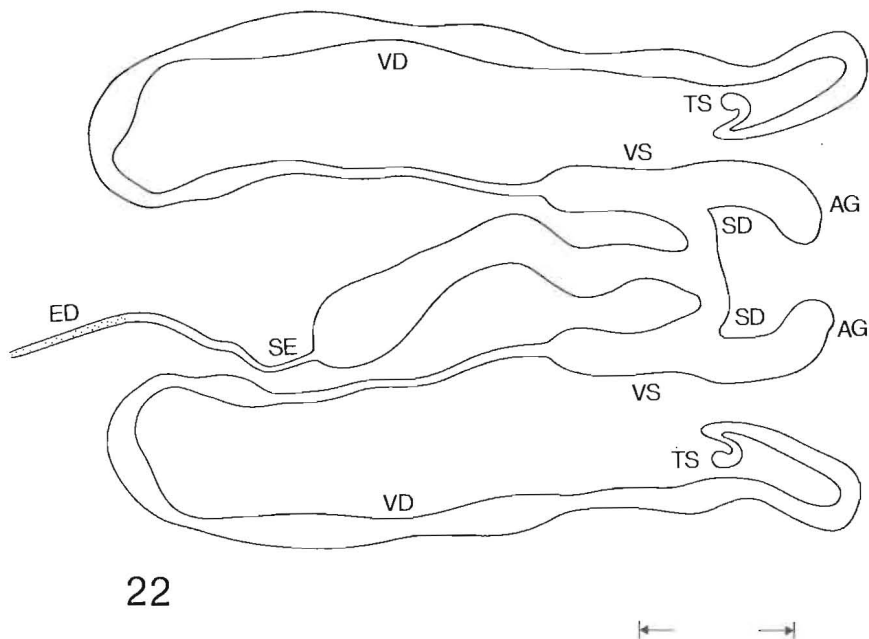
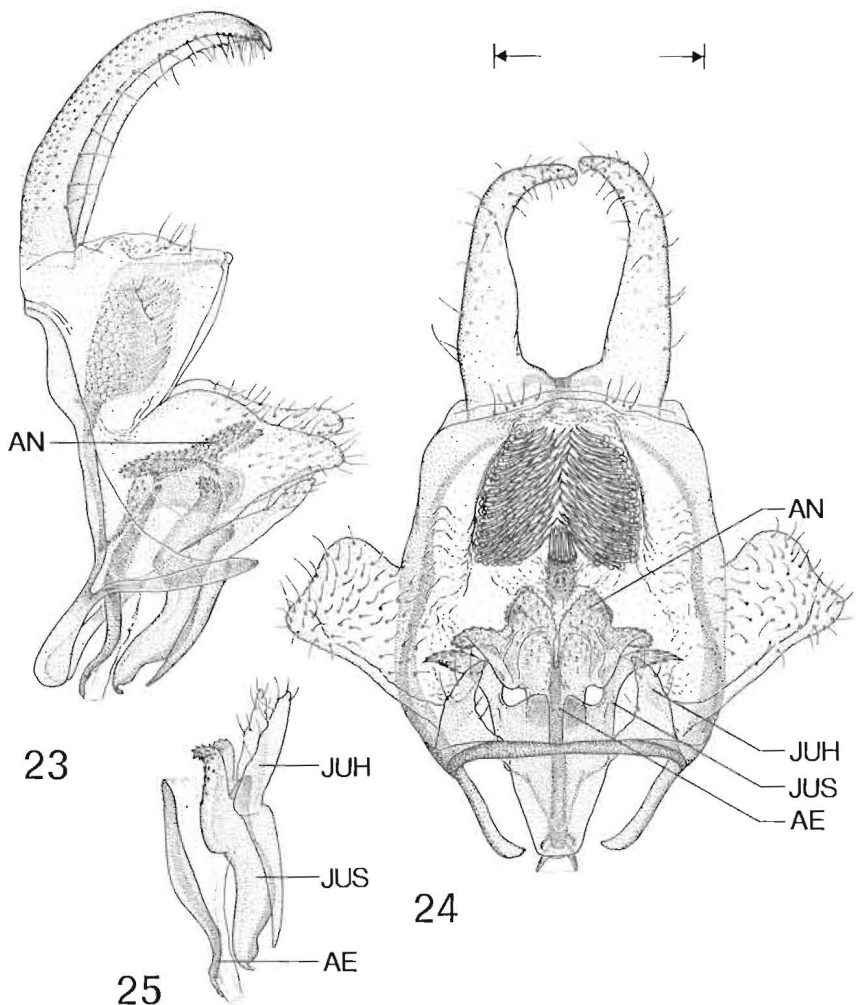


Fig. 22. *Synempora andesae* sp. n. Reproductive system of male: schematic drawing to scale; ag: accessory glands, ed: ejaculatory duct, se: simplex ejaculatory duct, sd: duplex ejaculatory duct, ts: testes, vd: vas deferens, vs: vesicula seminalis. Scale: 0.5 mm.

reduced, divided into a ventral and a dorsal part, bearing a series of relatively large, acute spines arranged in two median rows. Valvae relatively long, simple, without lobes or processes; apex evenly rounded. Vinculum with a pair of anterior apophyses, approximately 0.5 the length of valvae. Anellus a membranous sheet dorsally with a prominent pair of heavily sclerotized lobes arising lateral to aedeagus; each lobe with three or two (the medial reduced) small acute lobes arising from caudal margin of distal half. Juxta a relatively broad sclerite narrowing noticeably caudad; caudal margin irregular, deeply serrated; a median row of 4-5 minute spines arising ventrally from caudal half. Aedeagus consisting of a prominent, heavily sclerotized rod sharply curved dorsally at distal third and from that point projecting caudad beyond gonopore; apex of aedeagus broad and flattened, heavily armed with a pair of short spinose apical processes directed laterad and a pair of much larger setose lanceolate processes directed cephalad.

Female genitalia (Figs 31, 33, 35). Apex of ovipositor with a bluntly rounded median lobe. Ninth tergite hoodlike, largely covering ovipositor dorsally and laterally; caudal margin deeply divided exposing apex of ovipositor. Ninth sternite divided medially into two symmetrical, ventrally concave scler-

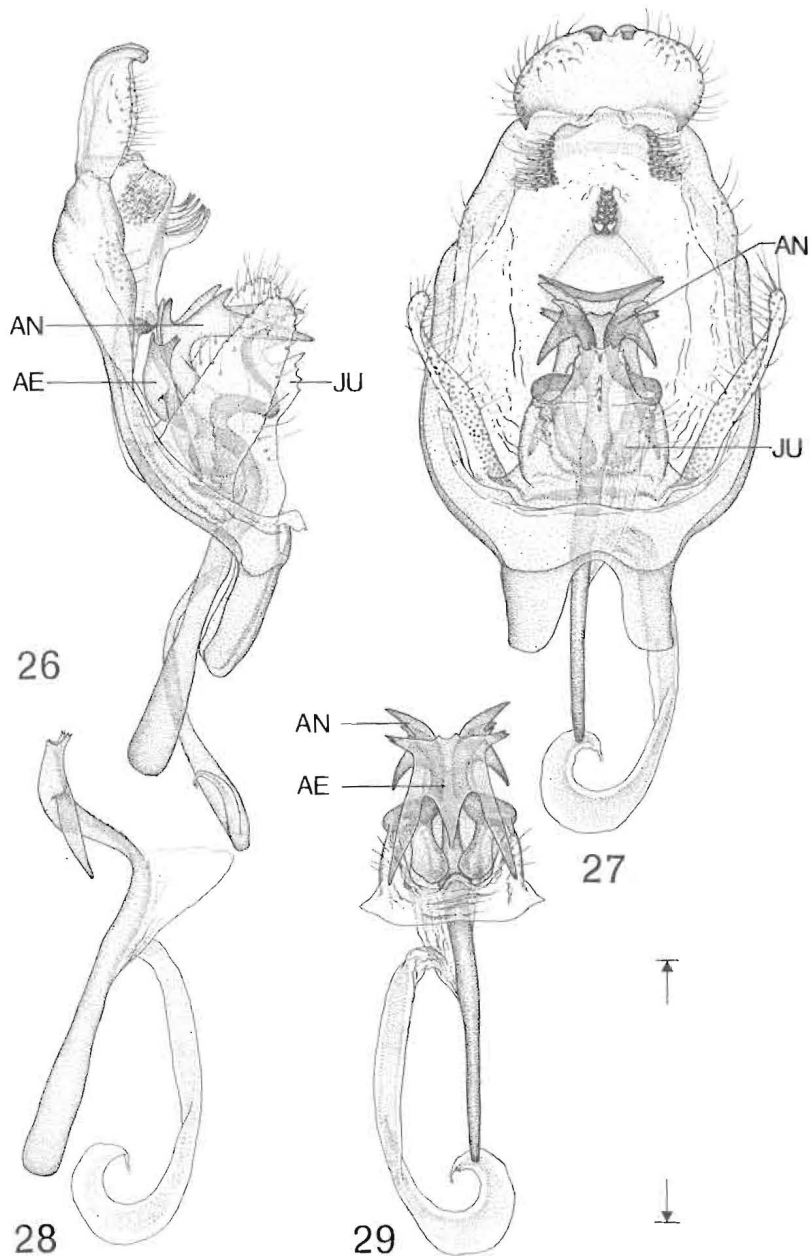


Figs 23-25. *Synempora andesae* sp. n., male genitalia. 23: Lateral view. 24: Ventral view. 25: Aedeagus and juxta in lateral view. ae: aedeagus, an: anellus, juh: juxta, hornlike lobe, jus: juxta, spinose arm. Scale: 0.5 mm.

ites of highly irregular form. Ductus bursae relatively long, extending anteriorly to sixth segment, without internal folds or thickened walls. Corpus bursae elongate, approximately X3 the length of posterior apophyses, and slender.

Material examined. Holotype ♂: Chile: Osorno Province, Parque Nacional de Puyehue, Aguas Calientes to 2 km south, 600 meters, 10-22.ii.1979 (D. and M. Davis, B. Akerbergs), USNM 76464 (USNM).





Figs 26-29: *Apoplania penai* sp. n., male genitalia. 26: Lateral view. 27: Ventral view. 28: Aedeagus, lateral view. 29: Aedeagus and anellus, dorsal view. ae: aedeagus, an: anellus, ju: juxta. Scale: 0.5 mm.

Paratypes: Argentina: Rio Negro Province, Lago Nahuel Huapi, Puerto Blest, 770 m: 2♂, 17.xii.1978; 1♂, 26.xii.1978 (Mision Cientifica Danesa, Sta. 8) (ZMUC). Chile: Malleco Province, Cordillera Nahuelbuta, Cabreria, 1100 meters: 1♂, 21.i.1977 (L. Peña) (LEP); 1♂, 9-15.i.1977 (USNM); 1♂, 1♀, 15-20.i.1977 (USNM); Cordillera Nahuelbuta, Pichinahuel, 1300 meters: 1♂, 9-15.i.1977 (USNM). Osorno Province, same data as holotype: 1♂ (BMNH), 1♂ (CSIRO), 1♂ (MARC), 9♂ (USNM); 1 km S. Aguas Calientes, Rio Chanleufu: 1♂, 8-9.ii.1978, (C. & O. Flint) (USNM); Valdivia Province, Sto. Domingo, Rincon de Piedra, ca. 23 km SE Valdivia: 1♂, 3.ii.1975 (E. Kraemer) (USNM). Described from a total of 22 males and 1 female.

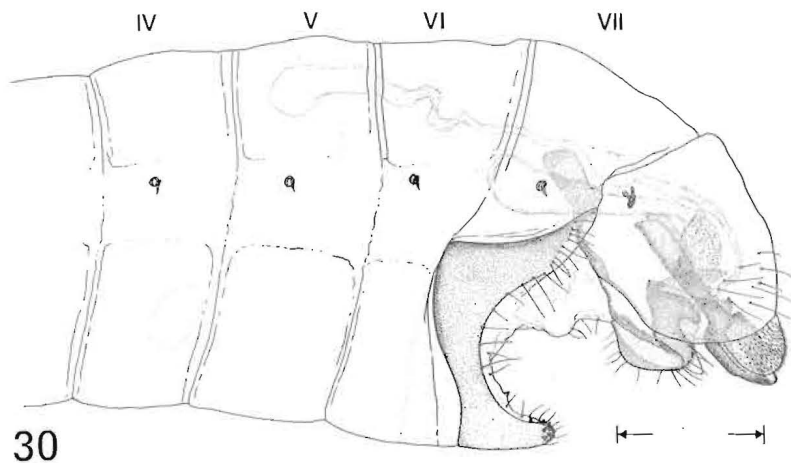
Additional material preserved in alcohol and not included in the type series: Argentina: Rio Negro Province, Lago Nahuel Huapi, Puerto Blest 770 m: 6 ♂, 7.xii.1978 to 3.i.1979 (Mision Cientifica Danesa, Sta. 8) (ZMUC).

Comparative notes. The adults of *Apoplania chilensis* Davis and *A. penai* new species are very similar superficially. In maculation they may be distinguished by the heavier brown scaling at the apex of the forewing and along the termen of the hindwing in *A. chilensis*, as well as by the rather diffused black spot at the apex of the cell in *A. penai*; the latter is absent in *A. chilensis*. In contrast, the male genitalia of the two species differ considerably. Another means of easily distinguishing the two species, particularly helpful in the females, is by the well developed epiphysis of *A. penai* (Fig. 13), as compared to the vestigial condition in *A. chilensis* (Davis 1975b, fig. 48).

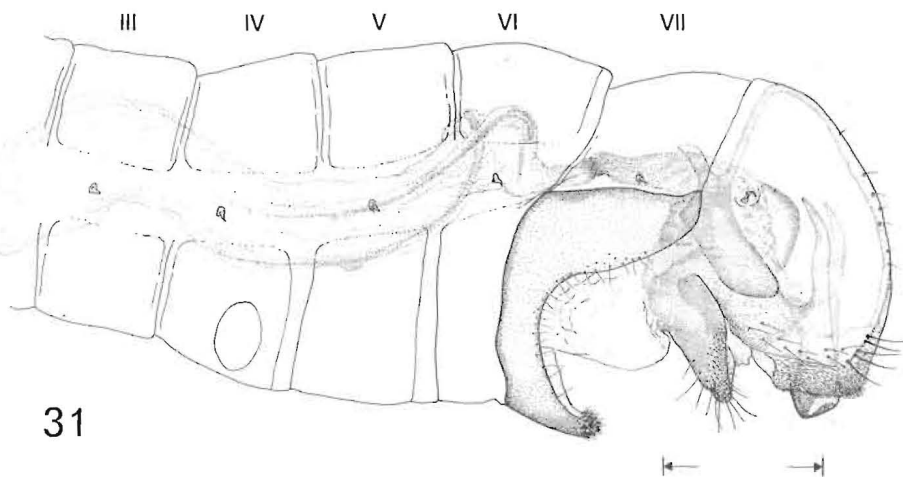
The wing scale morphology of *A. penai* differs somewhat from that of *A. chilensis*, which has the lamellar wing scales obtuse, with an apical margin distinct from the lateral margins of the scale. This is also the case in *Neopseustis calliglauca* Meyrick, 1909, in which the distal margin is much wider than in *A. chilensis* (Davis 1975b). As described above, the scales in *A. penai* taper distally into an acute point. The oblique crests which are observed overlaying the flutes on some of the scales (Fig. 21) seem to be remnants of a herringbone crest pattern. This pattern has previously been recorded only from the non-Glossatan suborders Zeugloptera and Aglossata (Davis 1978, Kristensen & Nielsen 1979). The hindwing scales are similar in structure to the forewing scales.

Distribution (Fig. 36). This species appears restricted to *Chusquea-Nothofagus* habitats in certain montane areas of Patagonia between 37° and 41° south latitude. In the coastal mountains of Chile, it has been found to range from almost sea level near Valdivia to 1300 meters in the Cordillera Nahuelbuta. In the Andes of Chile and Argentina it has only been found in the lake region at two sites less than 100 airline km apart.

Habitat. The series of *A. penai* collected in Argentina consisted of 9 males,



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Figs 30, 31. Postabdomen and female genitalia in lateral view; Roman numerals denote segmental numbers; note: fenestrae on fourth sternite. 30: *Synempora andesae* sp. n. 31: *Apoplania penai* sp. n. Scales: 30, 31: 0.5 mm.

all from the very moist woods at Puerto Blest at the western end of Brazo Puerto Blest of Lake Nahuel Huapi. The forest here is rich in species of trees and shrubs; however, the area where the *A. penai* specimens were collected is strongly dominated by *Nothofagus dombeyi* (Mirb.) Blume and *Chusquea culeou* E. Desv. Collections from more open areas with a richer and more diverse flora did not produce any Neopseustidae at all. The general impression was that *A. penai* was rare at this locality, because only a few individuals were collected in spite of great efforts with from one to five traps operating nearly

every night during the flying period. All specimens were collected in UV light traps.

In Chile, a total of 20 specimens of *A. penai* have been collected at three different montane sites representing both sides of the central valley. Luis Peña, to whom this species is dedicated, first collected the species at two camp sites situated in the higher reaches of the Cordillera Nahuelbuta, a costal range rising to 1400 meters and located west of the city of Angol. The wet forests here are dominated by extensive stands of *Araucaria araucana* (Molina) C. Koch and *Nothofagus obliqua* (Mirb.) Blume, the branches of which are typically festooned with epiphytic lichens. The bamboo genus *Chusquea* is present but largely restricted to certain forest clearings and streams borders. Further south in the low hills east of Valdivia, a single male was collected by Ernesto Kraemer at an elevation of less than 200 meters. Although this area has been greatly disturbed by agriculture and lumbering, *Nothofagus* and *Chusquea* still remain quite common. The largest number (14) of specimens collected thus far are from Aguas Calientes in the Parque Nacional de Puyehue, a densely forested area less than 100 airline kilometers from the lake Nahuel Huapi collecting site in Argentina. The forests near Aguas Calientes is rich in species (Fig. 44): *Nothofagus dombeyi* (Mirb.) Blume and *Eucryphia cordifolia* Cav. are abundant, as are *Drimys winteri* Forst, *Myrceugenella apiculata* (DC.) Kausel and *Myrceogenia planipes* Berg. *Chusquea culeou* E. Desv. and *C. montana* Phil. are also common but are largely encountered bordering forest clearings and river banks. The forests here are thus somewhat similar to that of the Puerto Blest area but there *Eucryphia* and *C. montana* are missing. As many as 4 separate UV light traps and 4 malaise traps were operated in a total of 8 and 7 different sites, respectively, within an area of less than 4 square kilometers. The site which produced the greatest number of *A. penai* per night consisted of a dense forest with a heavy undergrowth of ferns and bryophytes but little or no *Chusquea*. Thirteen of the specimens of *A. penai* were collected in light traps and one was captured in a malaise trap. As is generally true for most nocturnal insects, collecting for neopseustids yielded best results during those nights subject to a light rainfall. As was observed for the collections in Argentina, the field work in Chile suggested that *A. penai* was rare at all localities it was found to occur.

### 3. The systematic position of the Neopseustidae

The Neopseustidae have previously been regarded as a member of the suborder Dacnonypha by several authors, but no significant synapomorphies have so far been discussed for the Neopseustidae and the other constituent families of this suborder. Davis (1975b) stressed the isolated position of the Neopseustidae and proposed a new superfamily, Neopseustoidea, for the family.

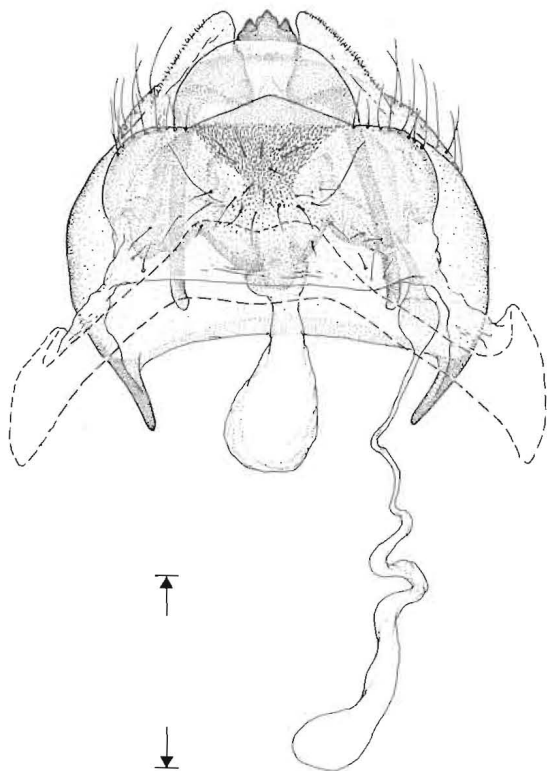
This superfamily was recently (Davis 1978: 36) regarded as representing a grade above the level of the Dacnonypha (as Eriocraniioidea, comprised of the families Eriocraniidae, Acanthopteroctetidae and Lophocoronidae), thus in cladistic terms representing the possible sister-group of Neolepidoptera (= Exoporia + Heteroneura (= Frenata)).

This suggested sister-group relationship of the Neopseustidae and the Neolepidoptera is now substantiated by two possible synapomorphies: (1) proboscis with intrinsic musculature and (2) presence of "normal type" scales (i. e., lacunate, perforated) on the wings, and the ensuing clade is termed Myoglossata (Kristensen & Nielsen 1980b).

Within the Myoglossata, the Neopseustidae represent the grade in which the following two lepidopterous ground-plan character states are retained: (1) Free arm in prothoracic furca slender from base and arising dorsally from an undisputedly ventral position (Davis 1975b, fig. 2). Recently Kristensen (1978b) suggested the lateral displacement of the free arm of the prothoracic furca to be a possible neolepidopteran autapomorphy, a character which may be difficult to evaluate in species with a broad base of the free prothoracic furcal arm (Kristensen & Nielsen 1979). (2) Mandibular adductor and abductor muscles well-developed. The mandibular muscles in those Neolepidoptera which have retained rudimentary mandibles are much reduced, while Neopseustidae, as the pre-myoglossatan groups, have retained well-developed adductor and abductor muscles. As discussed by Kristensen & Nielsen (1980b) the reduced mandibular musculature is undoubtedly related to the adecticious condition of the neolepidopterous pupae. Even if the immature stages of the Neopseustidae so far are unknown, the presence of well-developed mandibular muscles in the adults indicate that the neopseustid pupae are decticious.

The Neopseustidae share with the Eriocraniidae some characters which deserve comments. These are (1) presence of dorsal tentorial arms, (2) deeply excavate anteroventral margin of IX in male and (3) reduced ventral diaphragm.

The two first-mentioned characters seem to be genuine symplesiomorphies, probably pertaining to the lepidopterous ground-plan. The dorsal tentorial arms are present in several homoneurous groups: Eriocraniidae, Acanthopteroctetidae, Mnesarchaeidae and the hepialoid families. In many other groups remnants of the dorsal arms are present as short processes. Segments IX is excavated in males of the Agathiphagidae, Eriocraniidae, Acanthopteroctetidae, several *Mnesarchaea* (Philpott 1927), *Anomoses hylecoetes* Turner (Kristensen 1978b; this species also has a small medial anterior extension), some Opostegidae, many Nepticulidae and representatives of the Tineidae, i. e., many Meessiinae. Moreover, a deeply emarginate ventral margin of IX is also present in representatives of primitive Trichoptera, i. e., in several Philopotamidae (Annulipalpia), some Rhyacophilidae and many Glossosomatidae and Hydroptilidae (Integrupalpia). The reduction of the ventral diaphragm in



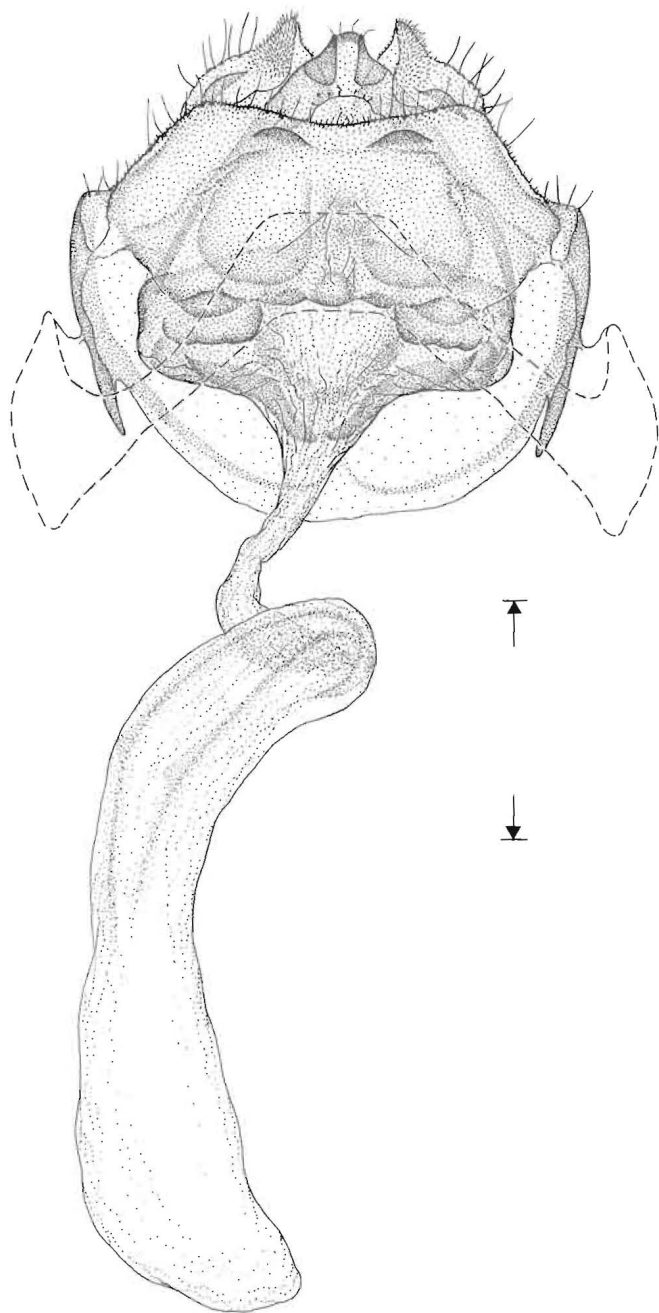
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Fig. 32. *Synempora andesae* sp. n., female genitalia, ventral view. Scale: 0.5 mm.

the Eriocraniidae and its absence in the Neopseustidae are discussed by Kristensen & Nielsen (1980a), and regarded as parallel specializations.

Apart from reduced ventral diaphragm, the Neopseustidae and Eriocraniidae do not to our knowledge share any derived traits that will contradict the assignment of the Neopseustidae to the Myoglossata. There is thus a strong evidence of a sister-group relationship between the Neopseustidae + Neolepidoptera, in which case the Neopseustidae represent a clade with suborder status for which we hereby propose the name *Neopseustina*<sup>2</sup>.

<sup>2</sup>Footnote added in press. Küppers & Speidel (1980) have discussed the systematic position of the family Neopseustidae and full comments on their phylogenetic interpretations are included in Kristensen & Nielsen (1980b). Küppers & Speidel also recognize the monophyly of the Neopseustidae and they formally proposed the suborder name Archifrenata to accommodate the family. We regard this name to be misleading because the Neopseustidae in all characters belongs to the non-frenate grade of Lepidoptera. Therefore we would reject the suborder name Archifrenata, and uphold the name *Neopseustina* proposed in our present paper.



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Fig. 33. *Apolonia penai* sp. n., female genitalia, ventral view. Scale: 0.5 mm.

#### 4. The systematic position of *Synempora*

In the discussion of the phylogeny of the three neopseustid genera known at the time of his revision, Davis (1975b) recognized the genus *Archepiolus*<sup>3</sup> Mutuura to display the highest number of plesiomorphic character states, and *Neopseustis* Meyrick and *Apoplania* Davis to represent an overall more specialized pair of genera. In the cladogram on Fig. 37 we have further evaluated and substantiated the phylogeny of the presently known four genera.

The apomorphies 1 and 2 are shared by all four genera, and are consequently regarded as autapomorphies of the family Neopseustidae:

1. Segments of antennal flagellum strongly cupuliform. Among non-ditrysian lepidoptera a similar condition is only known from some members of the Micropterigidae possessing submoniliform flagellar segments (Kristensen & Nielsen 1979).

2. Male sternum VII with a medial, conical, spinose process. A similar process has not been reported from any other palaeolepidopterous group.

As we find the assignment of *Archepiolus* to the Neopseustidae sufficiently well founded on the basis of characters 1 and 2, we have not undertaken the task of reexamining *Archepiolus schmidi* Mutuura, 1971, for characters 3-11. We therefore cannot decide whether these are autapomorphies of the Neopseustidae or synapomorphies of *Neopseustis* + (*Synempora* + *Apoplania*).

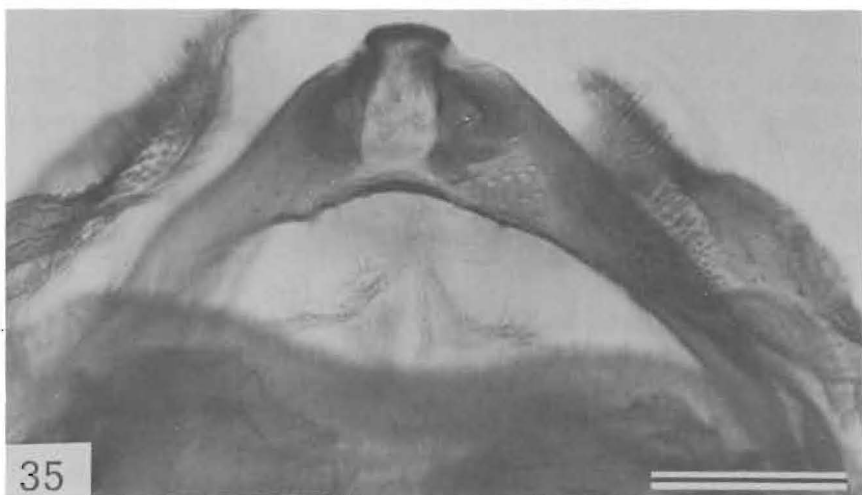
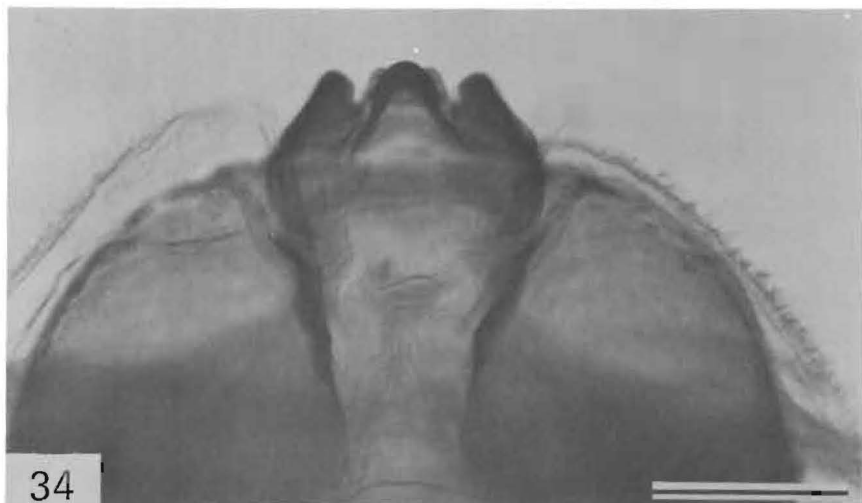
3. Proboscis specialized. Each galea with a functional, closed food-channel, and the two galeae held together by "zip-scales" (Figs 38, 39) and curved spines on the medial galeal surfaces (Kristensen & Nielsen in prep.). The "zip-scales" are visible in the light microscope.

4. Monocondylar scape-pedicle articulation. Kristensen (1968) described this feature from *Neopseustis meyricki* and stressed its uniqueness among primitive Lepidoptera. The same mode of articulation has now been observed in *Apoplania chilensis* (Davis 1975b, fig. 29), *A. penai* and *Synempora andesae*.

5. Antennae as long as or longer than forewings. A similar condition among non-ditrysian Lepidoptera is only found in the heteroneurous monitrysian Adelidae, while it occurs in a limited number of apparently phylogenetically remote groups of Ditrysia.

<sup>3</sup> Footnote added in press. Küppers & Speidel (1980) have synonymized *Nematocentropus* Hwang, 1965 and *Archepiolus* Mutuura, 1971, without examination of representatives of either of the two genera. Davis examined the extant type of the former genus in Beijing, China and will elsewhere formally confirm the above mentioned synonymy.





Figs 34, 35. Apex of ovipositor, ventral view. 34: *Synempora andesae* sp. n. 35: *Apoplania penai* sp. n. Scales: 34, 35: 0.1 mm.

6. Wings relatively broad and short, forewing index about 0.4. In Zeugloptera, Aglossata and Dacnonypha the forewing index is between 0.29 and 0.35, while in some groups of Hepialidae it reaches 0.4, but this high index probably cannot be an exoporian ground-plan character, as the Hepialidae are currently regarded subordinate in the Exoporia (Kristensen 1978a). The index of *Archepiolus* varies between 0.35 and 0.38 pending on which of the available illustrations has been used for the measurements.

7. Upper forewing surface only provided with one type of scales, interpreted by us as "normal type" scales. The shape of the scales varies considerably as described above, but the ultrastructure seems uniform. As reported by Kristensen (1978a), three of the hepialoid families similarly lack the "primitive type" scales.

8. Lamellar scales on upper surface of wings with circular or elliptic perforated or nonperforated plates in the inter-ridge areas. A somewhat similar structure is only observed in one other lepidopterous group, Micropterigidae - Heterobathmiinae, where the inter-ridge plates are unperforated (Kristensen & Nielsen 1979).

9. Third axillary sclerite strongly melanized, seen as distinct black dot at base of forewing. We have not observed this character in other Lepidoptera.

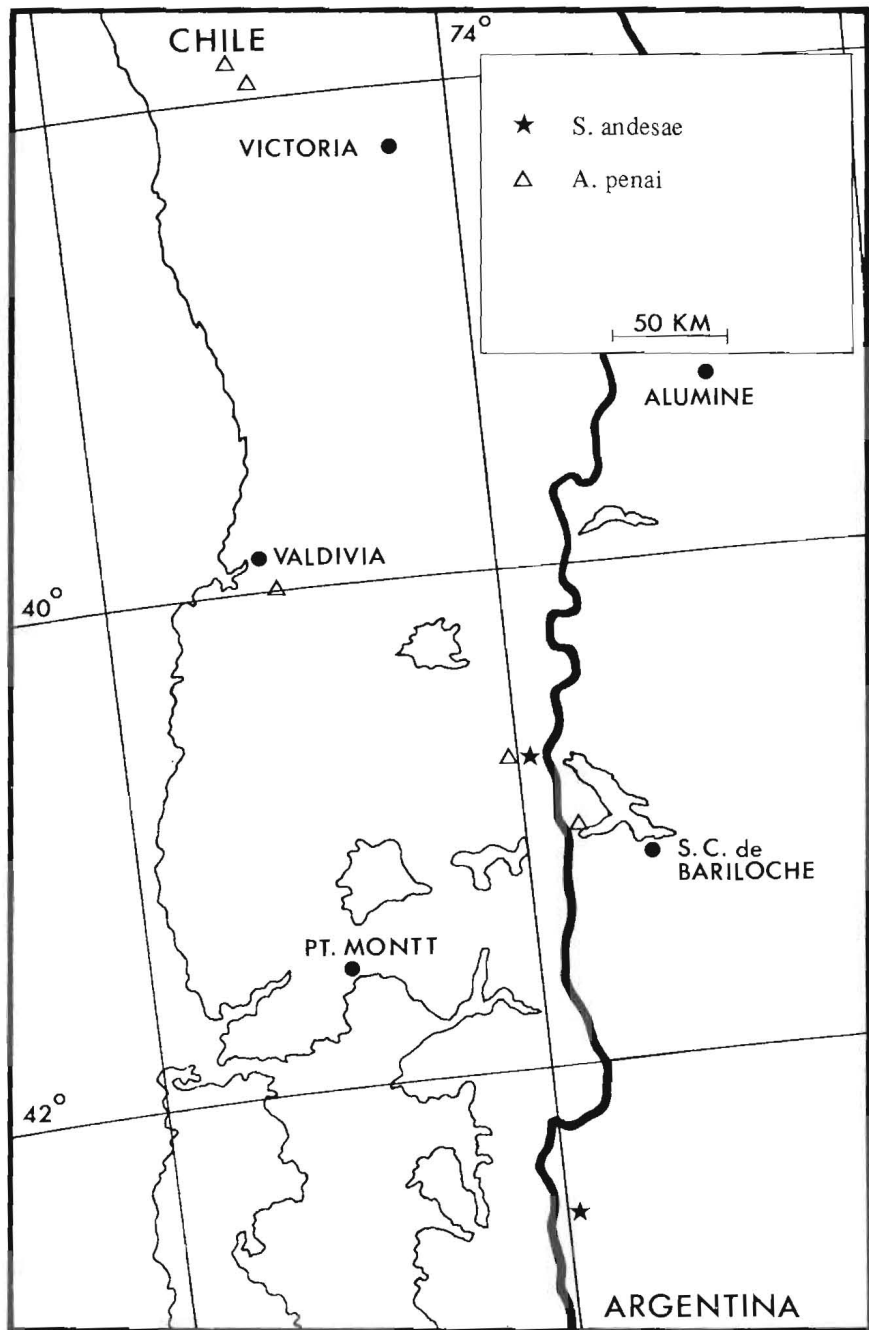
10. Costal margin of hindwing without frenular bristles. These bristles are reported from the Agathiphagidae, Micropterigidae, Eriocraniidae, Lophocoridae (Common 1973), and Mnesarchaeidae (Philpott 1922), while modified frenular bristles are absent in the hepialoid families (Philpott 1925, Kristensen 1978a). Frenular bristles are also present in many heteroneurous non-ditrysians.

11. Mesothoracic apophyses forming an internal bridge (Davis 1975b). This character is to our knowledge not known in any other lepidopterous group.

The absence of a ventral diaphragm has been reported from *Synempora andesae* (Kristensen & Nielsen 1980a), which also has the abdominal interganglionic connectives paired (Kristensen & Nielsen 1980c). Both these features are considered apomorphous among primitive Lepidoptera, but since representatives for the other neopseustid genera have not been examined for these characters, it is not possible to state whether they apply to the whole family or to subordinate groups only.

Characters 12-13 are interpreted as autapomorphies of the genus *Archepiolus*:

12. Intercalary sclerite between antennal scape and pedicel absent. The presence of this sclerite is a feature of the lepidopterous ground-plan (Kristensen 1978a) and is known from all higher groups of non-Ditrysia and several groups of Ditrysia.



13. Valva divided. The valva is otherwise simple and undivided in Neopseustidae (Davis 1975b).

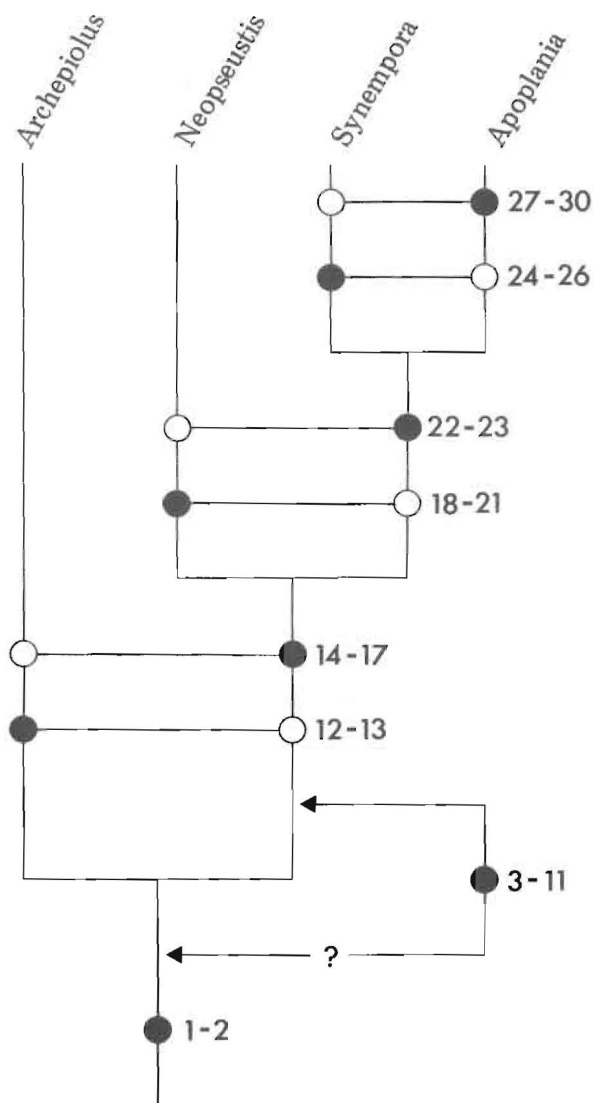
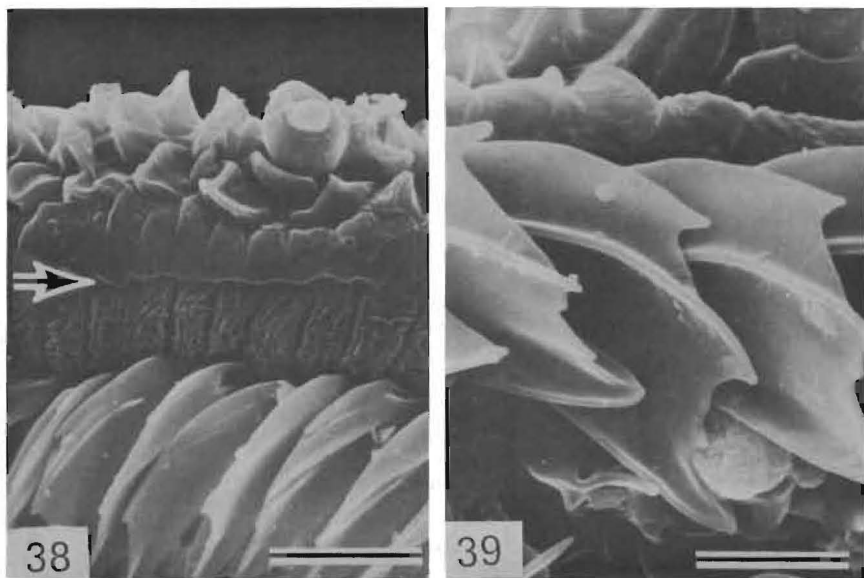


Fig. 37. Cladogram demonstrating the monophyly of the Neopseustidae and the phylogeny of the neopseustid genera. Numbers refer to characters discussed in the text, section 4. Filled circles: apomorphies, open circles: plesiomorphies.



Figs 38, 39. *Apoplania penai* sp. n., proboscis structures. 38: Dorso-medial surface of galea at the level of the food-channel; "zip-scales" at bottom and assumed slit to food-channel indicated by the arrow. 39: "Zip-scales" at higher magnification. Scales: 38: 0.01 mm; 39: 0.005 mm.

Characters 14-17 are regarded as synapomorphies of *Neopseustis* + (*Synem-pora* + *Apoplania*).

14. Chaetosemata on head present on prominently swollen areas. In *Archeptiolus* these areas are only slightly elevated (Davis 1975b), a condition similar to what is observed in most other palaeolepidopterous groups.

15. Forewing and hindwing with  $R_2$  and  $R_3$  totally coalescent. In *Archeptiolus* these two veins are "stalked", forking between cross-vein and margin. The condition of five radial forewing veins reaching the margin is the plesiomorphic state known from all palaeolepidopterous groups.

16. Forewing with  $M_1$  and  $M_2$  basally coalescent ("stalked") beyond cross-vein inter-M. In *Archeptiolus* and most other palaeolepidopterous groups the three medial veins are free beyond the inter-M cross-vein; this state is therefore regarded as primitive.

17. Forewing with an anal pocket. An anal pocket similar to that described by Davis (1975b) is not known from any other homoneurous Lepidoptera. A somewhat similar structure is reported from some Hepialidae (Tindale 1942).

Characters 18-21 are autapomorphies of *Neopseustis*:

18. 1A+2A in forewing distally strongly curved towards CuP. A similar curvature of 1A+2A is not known from any other Neopseustidae or other homoneurous Lepidoptera.

19. Uncus a moderate lobe. In other Neopseustidae the uncus is large and hood shaped or produced into two prominent elongate lobes.

20. Teguminal lobes long. In all other species of Neopseustidae (see Davis 1975b) the lobes are relatively much shorter.

21. Intromittent organ highly specialized. The aedeagus is absent and functionally replaced by a pair of parameres (see discussion by Davis 1975b).

Characters 22 and 23 are synapomorphies of the genera *Synempora* + *Apoplania*:

22. Anteromedial process from metathoracic furcal stem directed ventrally, reaching almost to or fused with intercoxal lamella. As described by Davis (1975b, fig. 6), the anteromedial process from the metathoracic stem is prominent, directed ventrally and distally fused to the intercoxal lamella. This fusion, described from *Apoplania chilensis*, has now also been confirmed from *A. penai* by serial sectioning. Seen in lateral view the

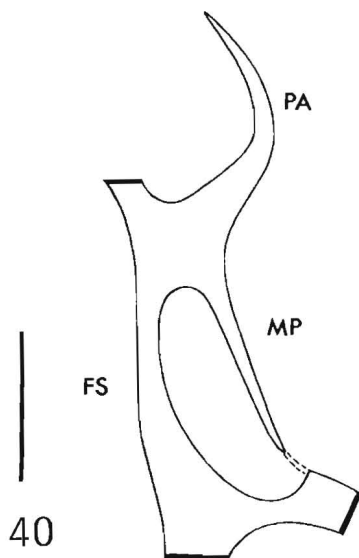


Fig. 40. *Synempora andesae* sp. n., metathoracic furca in lateral view; fs: furcal stem, mp: anteromedial process, pa: primary furcal arm. Scale: 0.2 mm.

metafurca of the two *Apoplania* species looks similar, having a relatively small lumen between the stem and anteromedial process and a large zone between the lumen and dorsal margin of primary furcal arms. Whereas in *Neopseustis archiphenax* Meyrick, 1928, the anteromedial process is very poorly developed (Davis 1975b, fig. 5), in *Synempora* it is a long slender process almost parallel to the furcal stem and reaching almost to the intercoxal sclerite to which the tip is attached by a weak connective (Fig. 40). This condition in *Synempora* is interpreted as a trend towards the fused condition observed in *Apoplania*. To our knowledge the fused condition is unique in Lepidoptera, as when present, the anteromedial process is directed anteriorly or anteroventrally.

23. Gnathos with short, stout spines. In *Archeptiolus* the gnathos is a bluntly serrate lobe and in *Neopseustis* a slender uncinatate process.

Characters 24-26 are autapomorphies of the genus *Synempora*:

24. Sexual dimorphism very pronounced (see description above). In *Neopseustis* and *Apoplania* the wing pattern and size of the sexes differs very little. The female of *Archeptiolus* is unknown.

25. Forewing lamellar scales of *Synempora* with a notch in apical margin. The apical margin of *Neopseustis calliglauca* Meyrick is almost straight and the scales of *Apoplania* are either produced into an acute point or have a short straight margin. Scales of *Archeptiolus* have not been examined.

26. Inter-ridge plates on forewing lamellar scales with pretzellike structure, i. e., one or more flutes present inside the marginal flute. In *Apoplania* and *Neopseustis calliglauca* each of the plates is surrounded by a simple marginal flute only.

Characters 29-30 are autapomorphies of the genus *Apoplania*:

27. Zone between M and CuA proximal to inner cross-vein M-CuA on forewing without scale cover. A similar condition is not observed in any other Neopseustidae.

28. Aedeagus long, rodlike and heavily armed at tip.

29. Spermathecal lagena absent. The lagena is present in females of *Neopseustis* and *Synempora*, wherefore the absence here is regarded as a secondary specialization in *Apoplania*.

30. Anteriorly directed anterolateral lobes of vinculum very broad. In species of *Archeptiolus*, *Neopseustis* and *Synempora* these lobes are relatively long and slender, wherefore this condition is ascribed to the neopseustid ground-plan.

The following character is one whose significance cannot yet be evaluated: In both the forewings and hindwings of *Neopseustis* and *Apoplania*,  $CuA_1$  diverges strongly from  $CuA_2$  at the  $CuA_1/CuA_2$  bifurcation point, the resulting two veins being almost parallel shortly beyond this point. In *Archepiolus* and *Synempora* the two veins gradually diverge from the point of bifurcation. The strongly diverging state is known also from Lophocoronidae (Common 1973), whereas in Eriocraniidae and Acanthopteroctetidae both conditions are observed (Davis 1978), and in some species the condition is different in fore- and hindwings. The strongly diverging condition is apparently often linked with the presence of a distal cross-vein  $M_3 - CuA_1$ . As the distal cross-vein  $M - CuA_{1+2}$  is proximal to the  $CuA$  bifurcation point in the forewing and totally absent in the hindwing of the Neopseustidae, it is not possible to state whether the strongly diverging condition in *Neopseustis* and *Apoplania* is a secondary specialization (and thus a convergence) or a retained plesiomorphic state, the specialized state being that observed in *Archepiolus* and *Synempora*.

### 5. Biological observations on Neopseustidae

As noted by Davis (1975b) information available on Neopseustidae indicated the adults to be primarily crepuscular or nocturnal, based on the fact that they are readily attracted to light and had not been seen active during the day. A primarily nocturnal habit is further suggested by the enlarged eyes of most neopseustid species, a feature not typical of most families of non-ditrysian moths. The eye index of most neopseustid species is approximately 1.2, which agrees with Powell's (1973) measurements on other nocturnal moths.

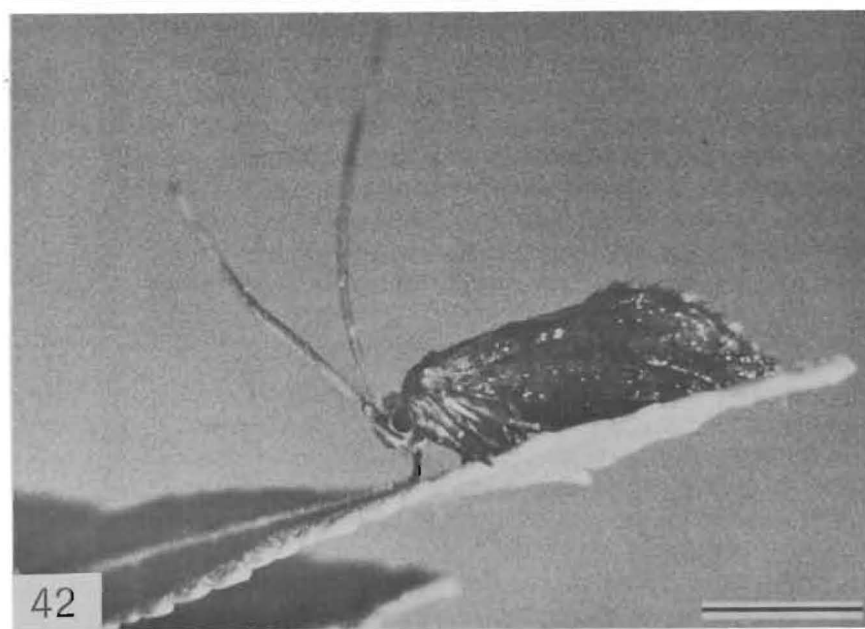
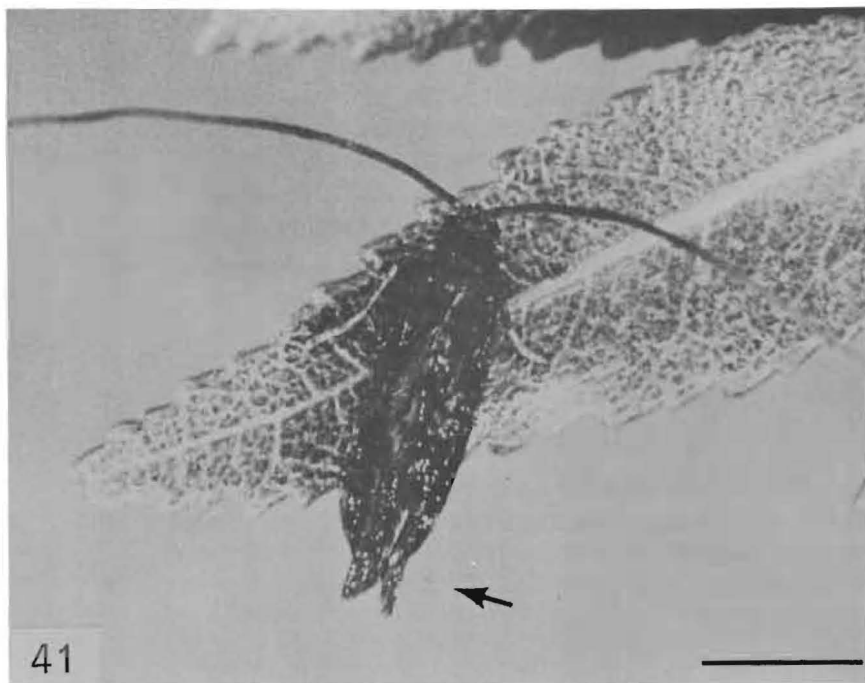
*Synempora andesae* has been observed in Argentina to be rather active during the day. Approximately 10 specimens were observed active around noon or early afternoon on bright sunny days. They were flying from one to two meters above the ground relatively fast and undulating, with the antennae held dorsally over the head in a posterolateral position. Consequently, the specimens strongly resembled flying adelids and were difficult to observe owing to the sun-shadow mosaic pattern in the rain forest. When not flying they probably rested on the upper leaves of *Chusquea culeou* or on the lower branches of trees. The light-colored females probably closely resemble bird droppings when resting.

In both Argentina and Chile, *S. andesae* was also somewhat active at night and was attracted to ultraviolet collecting lights. This "dual" activity is not too surprising, considering the somewhat intermediate size range of the eyes in this species (eye index, 1.0).

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Figs 41, 42. *Synempora andesae* sp. n., male resting on leaf of *Nothofagus dombeyi*. 41: Dorsal view; note: subapical inflection of wings (arrow). 42: Antero-lateral view. Scales: 41, 42: app. 3 mm.







Figs 43, 44. Habitats of *Synempora andesae* sp. n. and *Apoplania penai* sp. n. 43: Between W-end of Brazo Norte of Lago Menendez and Lago Cisne, Parque Nacional "Los Alerces", Chubut, Argentina, where *S. andesae* was collected. Area dominated by *Chusquea culeou* (understorey), *Nothofagus dombeyi* and *Fitzroya cupressoides* (overstorey). 44: Parque Nacional de Puyehue, Osorno, Chile, where both the two new neopseustid species were collected. Area with *Chusquea montana*, *C. culeou* (understorey), *Eucryphia cordifolia* and *Nothofagus dombeyi* (overstorey).

The typical resting position is illustrated in figures 41, 42. As can be seen, the wings are steeply reflexed and the hind wings entirely hidden under the forewing. This is the typical resting posture observed in the most primitive Lepidoptera - the primitive stegopterous posture of Graham (1950). A characteristic feature of the resting *Synempora andesae* is the subposterior inflexion of the wings (Fig. 41). In the resting specimen the body and the dorsum of the wings are held in a position almost parallel to the surface of the substratum, the thorax being slightly elevated. The palpi are appressed to the head: segments 2 and 3 of the maxillary palpi are appressed to the front of the head and 4 and 5 to the front and ventral part of the head, with the flexing taking place between segments 1-2 and 3-4. The labial palpi are curved under the head in a position lateral to the maxillary palpi, being appressed to the

front. The antennae are directed dorso-laterally and slightly curved. The fore-leg is held at the level of the head and not stretched directly forward and the mid and hind legs are directed backwards.

As stated by Davis (1975b), nothing is known about the biology of any neopseustid species, although it was suggested that the eggs were probably inserted into relatively firm tissue of the plant host. The larvae were thus suspected of being endophagous. It was further observed that the preferred habitat for *Apoplania* was in forests dominated by *Nothofagus* and *Chusquea*.

Evidence is now beginning to indicate that the latter may actually be the host for at least some Neopseustidae.

Because (1) South American Neopseustidae have, with one exception, only been encountered in habitats associated with *Chusquea* and attempts to collect these moths in areas of more diverse flora with little or no bamboo were generally unsuccessful; and (2) the highest single day's catch (i. e., 53) was in a stand of almost pure *Chusquea culeou*, it appears probable that this bamboo, or its debris, could be the food plant for the South American Neopseustidae. Moreover, the present known range of the Neopseustidae lies within the range of the grass subfamily Bambuseae. Thus, it is hypothesized that other genera of bamboos may serve as hosts for the old world genus *Neopseustis*.

The Bambuseae possesses a broad pantropical distribution, although presently it is poorly represented in the floras of continental Africa and Australia. Among the grasses there is in general little evidence of direct dispersal across land, but bambusoids are generally considered the group in which such dispersal most likely could have occurred (Raven & Axelrod 1974). Present knowledge of bamboo and neopseustid biogeography does therefore not seemingly contradict the hypothesis of Neopseustidae being associated with bamboo. As almost nothing is known about ecological tolerance and requirements of Neopseustidae, it might be such factors which govern the relatively limited distribution of Neopseustidae compared to that of the bamboo. Further collecting activities, especially in tropical South America and Asia might easily clarify the distributional pattern of Neopseustidae.

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