

# BIOLOGY AND SYSTEMATICS OF THE NEOTROPICAL LEAFMINER GENUS *EUCOSMOPHORA* (LEPIDOPTERA: GRACILLARIIDAE)

DONALD R. DAVIS<sup>1</sup> AND DAVID L. WAGNER<sup>2</sup>

1. Dept. of Entomology, Smithsonian Institution, Washington, D.C. 20560, USA

2. Dept. of Ecology & Evolutionary Biology, University of Connecticut, Storrs, CT 06269, USA

**ABSTRACT.**—The Neotropical moth genus *Eucosmophora* Walsingham 1897 is revised. Sixteen species are recognized: *E. atlantis* (Meyr.) n. comb., *E. chrysocosma* (Meyrick) n. comb., *E. dives* Walsingham (the type of the genus), *E. eclipsis* (Durrant), n. comb., *E. eurychalca* (Meyrick) n. comb., *E. melanactis* (Meyrick) n. comb., *E. sideroxylonella* Busck, *E. trimetalla* (Meyrick) n. comb., and the following new species, *E. aspila* n. sp., *E. echinulata* n. sp., *E. ingae* n. sp., *E. manilkarae* n. sp., *E. paraguayensis* n. sp., *E. pithecellobiae* n. sp., *E. pouteriae* n. sp., and *E. prolata* n. sp. An additional species from Venezuela is described and illustrated, but is not named because of its poor condition. The genus is composed of two morphologically and biologically distinct groups: the *sideroxylonella* group (*aspila*, *atlantis*, *chrysocosma*, *eurychalca*, *manilkarae*, *melanactis*, *paraguayensis*, *pouteriae*, *prolata*, *sideroxylonella*, and possibly *eclipsis*), which includes species whose larvae are known to mine the leaves of Sapotaceae; and the *dives* group (*dives*, *ingae*, *pithecellobiae*, and possibly *echinulata* and *trimetalla*), whose larvae are known or suspected to mine leaves of Fabaceae. *Eucosmophora ornata* Walsingham is retained in *Acrocercops* as placed by Meyrick (1912a). *Eucosmophora cuprella* Walsingham is transferred to *Neurostrota*: *N. cuprella* (n. comb.). The genus occurs through the Neotropical Region, from southern Florida and Texas and the West Indies south to Paraguay in shrubland and forest habitats. As is typical for the Gracillariidae, the larva is hypermetamorphic. The body of the first three sap-feeding instars is apodal, flattened, and the mouthparts prognathous. The body of the two tissue-feeding instars possesses thoracic legs, prolegs on abdominal segments 3-5 and 10, are cylindrical, and hypognathous. The last instar larva exits the mine and forms an oval cocoon whose outer surface is ornamented with a vesture of short, erect silken spikes.

**KEY WORDS:** *Acrocercops*, biology, Brazil, Caribbean, Central America, Costa Rica, Cuba, Dominican Republic, *E. aspila* n. sp., *E. echinulata* n. sp., *E. ingae* n. sp., *E. manilkarae* n. sp., *E. paraguayensis* n. sp., *E. pithecellobiae* n. sp., *E. pouteriae* n. sp., *E. prolata* n. sp., Florida, Grenada, Guyana, hostplants, hypermetamorphosis, immature stages, larvae, leafmining moths, life history, morphology, Neotropical, Panama, Paraguay, Peru, Puerto Rico, pupae, South America, taxonomy, Texas, USA, Venezuela, Virgin Islands, West Indies.

Field studies over the last decade by the authors on the leaf-mining Lepidoptera of southern Florida and Costa Rica have resulted in numerous collections of gracillariid species in the genus *Eucosmophora* previously unknown or regarded as rare. In this report we recognize 16 species in the Neotropical genus *Eucosmophora*, eight of which are new. Three species are recorded from the southern United States: *E. sideroxylonella* Busck (Florida and Cuba) and two new species, *E. manilkarae* (Florida and Texas) and *E. pithecellobiae* (Florida and Belize).

*Eucosmophora* occurs widely through the Neotropical Region, although as is generally true for most leafminers, the genus has been poorly sampled. Neotropical records include *E. dives* Walsingham and *E. sideroxylonella* Busck from the West Indies; *E. chrysocosma* (Meyrick), *E. melanactis* (Meyrick), and *E. trimetalla* (Meyrick) from Guyana; *E. atlantis* (Meyrick) from Costa Rica, *E. eclipsis* (Durrant) from Panama; *E. eurychalca* (Meyrick) from Brazil; and seven new species, including *E. pithecellobiae*, from Central America south to Paraguay. Other, probably undescribed species have been examined in the course of this study, but were not named because of their poor condition. Such was the case with an undescribed member of the *dives* group, represented by a single, unreared female (Fig. 193-194) from southern Venezuela. '*Eucosmophora*' *cuprella* Walsingham is not congeneric with *E. dives* and is hereby transferred to *Neurostrota* Ely. '*Eucosmophora*' *ornata* Walsingham is believed to represent a new genus. Pending further study, it has been retained in *Acrocercops* as placed by Meyrick (1912a).

Not long after its recognition by Walsingham (1897), *Eucosmophora* was synonymized by Meyrick (1912a,b) into his broad concept of *Acrocercops*. Kumata *et al.* (1988) proposed the *Acrocercops* group as one of four principal components within the Gracillariinae. Seventeen genera were recognized within this group as occurring in Japan. Members may be characterized by their (1) bristly-scaled hind tibia; (2) shortened anal vein of forewing; (3) extended intersegmen-

tal membrane between the eighth abdominal segment and genitalia in males; (4) presence of specialized androconial scales on the valvae; and (5) bisetose L group on the larval meso- and metathorax.

Within the *Acrocercops* group, six Old World genera, centered around *Gibbovalva*, are similar to *Eucosmophora* in possessing a prominent digitate process midway along the costal margin of the male valva; the male genitalia of *Amblyptila* Vári, *Gibbovalva* Kumata & Kuroko, and *Sauterina* Kuznetsov are particularly similar in overall morphology. A few of the principal diagnostic characters of these taxa, as discussed by Kumata *et al.* (1988), are compared to *Eucosmophora* in Table 1. *Eucosmophora* differs from all six genera in possessing relatively longer labial palpi and a distinctly different, forewing pattern. *Amblyptila* consists of two South African species that mine Asclepiadaceae and Apocynaceae, and at least one Nearctic species that mines *Arbutus* (Ericaceae). The females lack a signum but may have a spiculate corpus bursae (Vari, 1961). *Gibbovalva* includes several southeast Asian-Australian species apparently restricted to Lauraceae. The walls of the corpus bursae are usually membranous but occasionally can be spiculate. A signum is lacking in all species except *G. civica* (Meyrick), where it is densely spinose as in some *Eucosmophora* miners of Fabaceae. *Sauterina* Kuznetsov currently consists of a single European species, *S. hoffmanniella* (Schleich), which feeds on Fabaceae (Kuznetsov, 1981). The female possesses a small pair of spinose signa. Of the remaining genera with a costal process on the valva, *Borboryctis euryae* Kumata & Kuroko appears to have the most in common with *Eucosmophora*. For example, the male seventh abdominal sternite of this species is similar to that of several *Eucosmophora* that mine Sapotaceae — both possess a median, caudal, truncate brush of stout scales.

The fiery orange, black, and metallic gold forewing pattern of *Eucosmophora* is perhaps the most striking autapomorphy of the genus. Within the *Acrocercops* group, the wing pattern of the Asian genus *Chrysocercops* Kumata & Kuroko most closely approaches

TABLE 1.— Diagnostic Characters among *Gibbovalva* Generic Group

Genera	Adult R4/5	Adult Cu1a	Adult Scape	Larva XD2	Larva A6/SV3	Hosts
<i>Eucosmophora</i>	separate	+	smooth	+-	+	Fabaceae Sapotaceae
<i>Amblyptila</i>	separate	-	smooth	?	?	Ericaceae Apocynaceae Asclepiadaceae
<i>Gibbovalva</i>	stalked	+(-)	tuft	+	+	Lauraceae
<i>Sauterina</i>	separate	-	smooth	?	?	Fabaceae
<i>Borboryctis</i>	stalked	+	smooth	-	+	Theaceae
<i>Melanocercops</i>	stalked	-	smooth	+	-	Moraceae
<i>Phodoryctis</i>	stalked	-	smooth	-	+	Fabaceae Menispermaceae

that of *Eucosmophora* (see Kumata, 1992). Fourteen species of *Chrysocercops* have been described, mostly from southeast Asia. Twelve species mine the leaves of various members of Dipterocarpaceae and two are known to mine Fagaceae. The forewing venation of most species of *Chrysocercops* differs from that of *Eucosmophora* in lacking R1 and with Cu1a arising more basal to M3. Their wings agree in having R2-5 usually arising separately and in being among the most slender among the *Acrocercops* group. While the male genitalia of *Chrysocercops* differs from that of *Eucosmophora* in having a valva with an attenuated apex and the absence of a costal process (also lost in Fabaceae-mining *Eucosmophora*), the two genera appear to be closely related, and possibly sister taxa.

*Eucosmophora* consists of two morphologically distinct groups, each evidently restricted to one plant family. The Fabaceae-mining *dives* group, including *E. dives*, *E. ingae*, *E. pithecellobiae*, and possibly *E. echinulata* and *E. trimetalla*, is characterized by males with relatively large, triangular eighth abdominal sternite, a seventh sternite without caudal scale tufts, a valva lacking a costal lobe, and the female corpus bursae bearing a pair of spinulose signa. The *sideroxylonella* group includes *E. aspila*, *E. atlantis*, *E. chrysocosma*, *E. eurychalca*, *E. manilkarae*, *E. melanactis*, *E. paraguayensis*, *E. pouteriae*, *E. prolata*, *E. sideroxylonella*, and possibly *E. eclampsia*, three of which have been reared from Sapotaceae. The males possess smaller, more slender eighth sternite, a seventh abdominal sternite usually bearing a median, caudal brush of appressed scales or setae, and a valva with a digitate costal lobe; the paired signa of the female are long, often lacinate, and prominently serrated to spinose.

## BIOLOGY

**Egg:** The egg is oval, flat, glassy with subtle iridescent reflections, without frass inclusions: 0.21-0.34 x 0.36-44 mm. Presumably the incubation period is very brief, as the eggs are laid on new leaves and the caterpillars must finish feeding before the host leaves harden.

**Larva:** There are three sap-feeding and two tissue-feeding instars. The larvae are white to cream initially but may take on an orange tint by the third or fourth instar. As in many genera of the *Acrocercops* group, the last instar turns bright red prior to exiting the mine.

All *Eucosmophora* confine their mining to the lamina. Either leaf surface may be mined. Commonly the mined tissue is silvery to waxy white, with virtually all photosynthetic tissues removed from the outer surface. The mine starts off as a narrow, tortuous track that may repeatedly cross itself. In either the late second or early third instar, the mine is abruptly enlarged into a blotch which often obscures the earlier serpentine track. In the fourth and fifth instars

the floor of the mine is eaten, frequently all the way to the opposite side of the leaf. Larvae preferentially remove parenchyma from about the periphery of the mine, leaving an “island” of intact tissue over which the larva often positions itself when not feeding.

The genus shows a decided preference for young leaves that have not yet fully hardened. Efforts to locate active mines should focus on new growth, seedlings, and saplings, and especially, regrowth from stems or branches that have been cut back. In some cases the leaves are so young when they are mined, that the mine is torn open as the leaf matures, usually resulting in the desiccation of the caterpillar. Even if the mine remains intact there seems to be a high failure rate of early instar mines. *E. pithecellobiae* mines somewhat older leaves, i.e., those that are fully expanded but not yet hardened.

**Pupa:** The larva may pupate on the under side of a leaf near the abandoned mine, but more commonly the larva drops into leaf litter. Initial silk deposition causes the leaf upon which the cocoon is being made to buckle shallowly. It is in this pucker that the oval cocoon is spun and pupation takes place. The cocoon may be white, orange-brown, or chocolate brown. Its outer surface is densely set with short, vertical spikelets of silk — how the larva goes about making these has not been studied. Some species produce 1-3 anally-extruded, frothy white balls that are positioned on the outer surface of the cocoon (see discussion in Wagner *et al.*, 2000). The pupal stage is brief, lasting approximately 10-14 days.

**Adult Resting Posture:** Unlike most gracillariines, both ends of the body are held above the substrate. The head is elevated 1.1-1.4 mm above the substrate and the caudal end 0.7-0.8 mm. The antennae are held forward, out from the midline by about 15°, curving slightly outward, and drooping downward distally; if agitated the antennae are flicked backward, often alternately — not twirled as in *Marmara* Clemens, *Leucospilapteryx* Spuler, *Telamoptilia* Kumata & Kuroko, and other gracillariid genera. The profemora are held outwards, in the plane of body, 15-45° forward of perpendicular; the tibiae and tarsi are bent directly downward at 65-80° angle; the tarsi curve slightly outward. The midlegs are held apart from the forelegs, directed forward of a perpendicular line to the body, and may extend past the profemora; the mesotibiae and tarsi are directed downward, backward, and outward. The metafemora and proximal half of metatibiae are positioned under the edge of the wings (and are not visible from above); the metatibiae and metatarsi are directed backwards and outwards.

## EUCOSMOPHORA Walsingham

*Eucosmophora* Walsingham, 1897:148.— Meyrick, 1912a:18; 1912b:46 (synonym of *Acrocercops*).— Fletcher, 1929:88 (synonym of *Acrocercops*).— Vári, 1961:

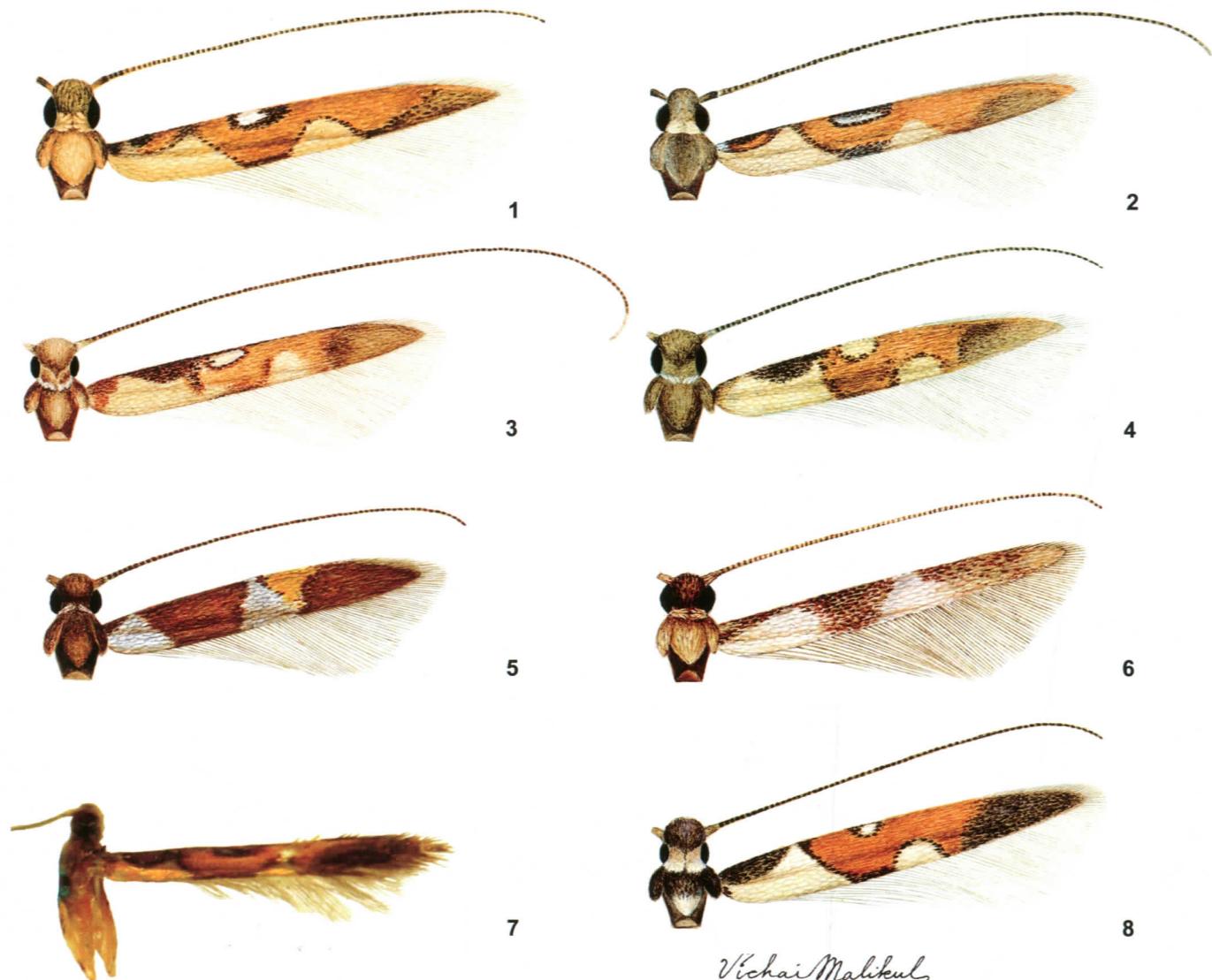


Fig. 1-8. *Eucosmophora* adults. 1. *E. atlantis* (4.8 mm). 2. *E. pouteriae*, paratype (3.4 mm). 3. *E. prolata*, holotype (3.7 mm). 4. *E. chrysocosma*, lectotype (3.8 mm). 5. *E. aspila*, holotype (3.5 mm). 6. *E. eurychalca*, lectotype (3.0 mm). 7. *E. melanactis*, holotype (3.5 mm). 8. *E. paraguayensis*, paratype (3.7 mm). (Length of forewing in parentheses.)

40.—Davis, 1984:6,26.—Nye and Fletcher, 1991:121. Type-species: *Eucosmophora dives* Walsingham, 1897, *ibidem*.

**MALE.**—Length of forewing 3-5 mm. **Head** (Fig. 31): Vestiture smooth, completely covered with moderately broad, shiny gold to silvery white scales; collar with whorl of moderately broad scales directed mesally. Eye red, large, interocular index ~1.7. Antenna filiform, elongate, 1.1-1.6x length of forewing, smoothly-scaled; scape elongate, 3.0-4.0x length of pedicel, pecten absent, posteriorly concave; flagellum with single annulus of slender scales encircling each segment. Mandible absent. Haustellum greatly elongate, ~1.5x length of labial palpus. Maxillary palpus smoothly-scaled, 4-segmented; ratio of segments from base: 1.0:2.0:4.0:5.3. Labial palpus smoothly-scaled, extremely long and upturned; ratio of segments from base: 1.0:6.5:7.6. **Thorax:** Smoothly-scaled. Forewing (Fig. 36) lanceolate, L/W index 8.0-8.2; discal cell 0.6x length of wing; R 5-branched; all veins arising separate from cell except shortly-stalked  $M_{2+3}$ ; accessory cell and base of M absent within cell; Cu 2-branched. Hindwing extremely slender, index ~11.7; cell open between M and Cu; M 2-branched; CuP present; frenulum a single stout bristle. Metafurcasternum as illustrated (Fig. 32-34); furcal apophyses broad

across base, fused most of their length, terminating in pair of short acute, anterior arms; secondary arms broad at base, then abruptly narrowing; tergal rim produced medially as relatively narrow, rounded ridge. Foreleg (Fig. 37) short; tibia subequal to tarsomere I in length; epiphysis present, reduced, ca. 1/6 length of tibia. Hindleg extremely long, metatibia nearly 3.0x length of protibia with bristles along dorsal surface; spur formula 0-2-4; long, paired spurs of unequal length. **Abdomen** (Fig. 35): Sternum 7 variously modified, caudal margin varying from truncate to produced into median lobe, with or without dense medial scale or setal cluster (Fig. 125-126, 130). Tergum 8 with long, slender anteromedial process projecting forward under tergum 7; sternum 8 mostly membranous and expandable, with bilateral pair of slender to broadly triangular sclerites. Coremata absent.

**MALE GENITALIA.**—Tegumen elongate, slender, weakly sclerotized. Uncus absent. Vinculum U-shaped; lateral margins sclerotized, membranous internally. Valva slender with relatively straight costa; short, digitate lobe arising between 1/3 and 1/2 of costa in *sideroxylonella* group (Fig. 123, 127); sacculus with a pouch-like lobe extending anteriorly along vinculum, bearing a cluster of long, piliform, androcon-

Vichai Malikul

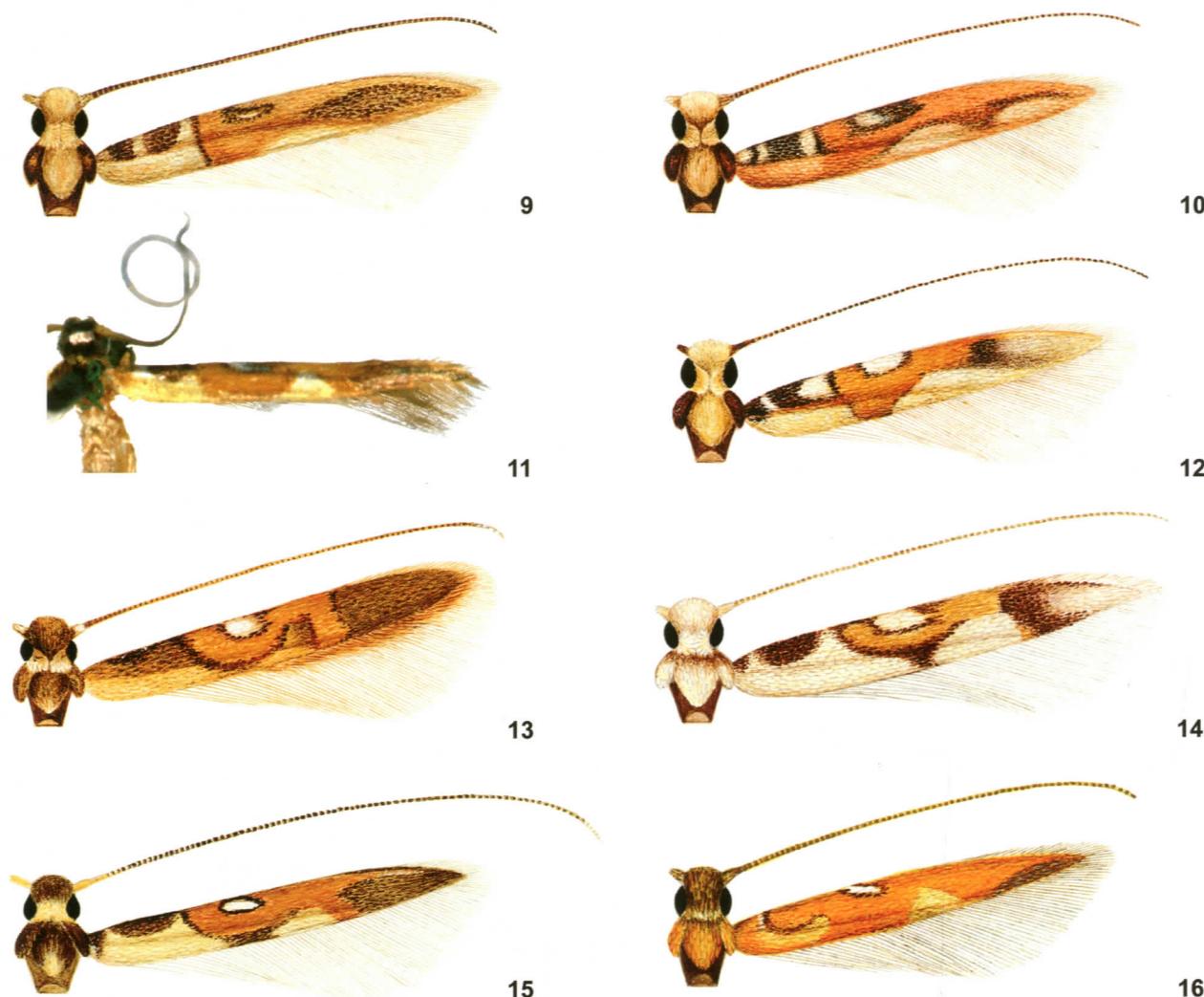


Fig. 9-16. *Eucosmophora* adults. 9. *E. sideroxylonella*, holotype (3.8 mm). 10. *E. manilkarae*, holotype (3.5 mm). 11. *E. eclampsis*, holotype (3.5 mm). 12. *E. pithecellobiae*, holotype (3.5 mm). 13. *E. echinulata*, paratype (4.1 mm). 14. *E. dives*, lectotype (3.5 mm). 15. *E. ingae*, paratype (3.5 mm). 16. *E. trimetalla*, lectotype (3.7 mm). (Length of forewing in parentheses.)

ial setae that extend beyond apex of valva (Fig. 159); exterior surface of valva with short, oval, easily deciduous androconial scales (Fig. 161). Aedeagus simple, usually apically acute, elongate, without cornuti but sometimes with minute, exogenous spines.

**FEMALE.**—Similar to male. Antenna 1-1.6x length of forewing. Frenulum consisting of two slender bristles. **Abdomen:** Seventh segment unmodified, without corethrogynae.

**FEMALE GENITALIA.**—Ovipositor short; anterior and posterior apophyses short, either similar in length or with anterior pair slightly longer (Fig. 163-164). Ductus bursae elongate, slender, variously lined with minute spicules; corpus bursae relatively small, walls often minutely spiculate, usually with paired signa in form of long, lacinate rods or oval plates variously armed with prominent spines; signa rarely absent.

**LARVA** (Fig. 38-59, 65-104, 112-119).—Hypermetamorphic; instars 1-3 highly modified sap-feeders with strongly depressed bodies and reduced chaetotaxy; white in color; length: to 3.4 mm, width 0.45 mm. Instars 4-5 tissue-feeding, with cylindrical bodies; length: to 5.8 mm, width: 0.9 mm. Last instar becoming red in prepupal phase.

#### Sap-feeding Instars

**Head:** Greatly depressed, triangular. Most setae reduced or lost except

from lateral margin (Fig. 38, 44, 49-50, 56, 73, 75); each side of head with 4 stemmata arranged in two widely spaced pairs; fifth stemma sometimes present ventral to anterior pair (Fig. 44-45, 80-81). Labrum ~ half the width or more of labium; anterior margin subtruncate, variably concave (Fig. 39, 74); primary labral setae absent; minute secondary setae scattered along anterior margin. Mandibles large, circular with finely serrated margins (Fig. 39-40, 74). Labium smooth, with anterior end broadly flared (Fig. 42, 75-76); anterior margin slightly concave at middle; spinneret vestigial, reduced to small tubular opening on venter of labium near anterior margin (Fig. 42, 76, 78). Maxillary palpi absent. Labial palpi present but variably reduced to small lateral lobes bearing one minute and three longer sensilla, arising near median constriction of labium (Fig. 42-43, 76-77). Hypopharynx as broad as labium, densely covered with minute spines along anterior margin. Antenna reduced, 3-segmented, with 6 moderately well-developed sensilla as shown (Fig. 41, 79).

**Body:** Setae generally reduced except for SV1 and those of L group. Thorax with intersegmental membrane covered with rows of small peg-like spines (Fig. 82, 84). Legs absent, but paired ambulatory callosities present on venter of T1-3 (Fig. 82-83); prosternal callosities protruding

Vichai Malikul



Fig. 17-25. *Eucosmophora* leafmines. 17. *E. manilkarae*, upper leaf surface of mined leaf on *Manilkara bahamensis*, No Name Key, Monroe County, FL. 18. Lower surface of the same; note prepupal larva spinning cocoon on adjacent blade. 19. *E. sideroxylonella*, upper surface of late instar mine on *Dipholis salicifolia*, Key Largo, Monroe County, FL; note edges of leaf are pulled upward over mine. 20. Opened mine of same. 21. *E. pithecellobiae*, upper surface mine on *Pithecellobium guadalupense*, Key Largo, Monroe County, FL. 22. *E. pithecellobiae*, upper surface mine on *Pithecellobium unguis-cati*, Key Largo, Monroe County, FL; prepupal larvae turn bright red. 23. *E. manilkarae*, upper and lower surface mines on *Bumelia celastrina*, Key Largo, Monroe County, FL. 24. *E. manilkarae*, last instar mine of the same; note frass visible about periphery of mine. 25. *E. ingae*, uppersurface (gregarious) mine on *Inga oerstediana*, La Selva Biological Station, Puerto Viejo, Provincia de Heredia, Costa Rica; four larvae were present in larger mine.

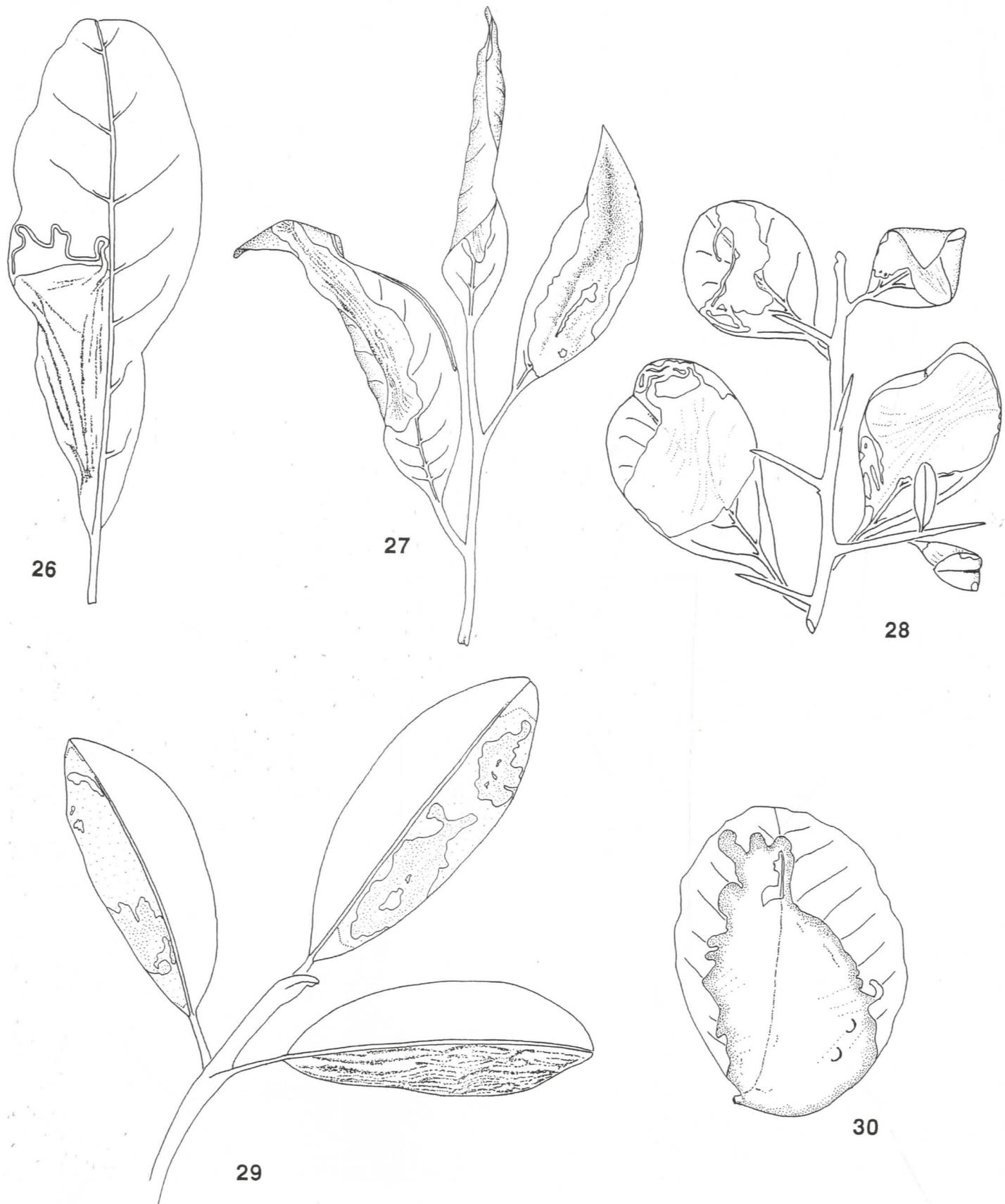


Fig. 26-30. *Eucosmophora* leafmines. 26. *E. sideroxylonella* mine on lower leaf of *Mastichodendron foetidissimum*. 27. *E. sideroxylonella* on *Dipholis salicifolia*, all upper leaf surface mines. 28. *E. manilkarae* on *Bumelia celastrina*, upper and lower leaf surfaces shown. 29. *E. manilkarae* on *Manilkara bahamensis*. 30. *E. pithecellobiae* on *Pithecellobium unguis-cati*. Note (two) larval exit slits in upper mine surface at lower right.

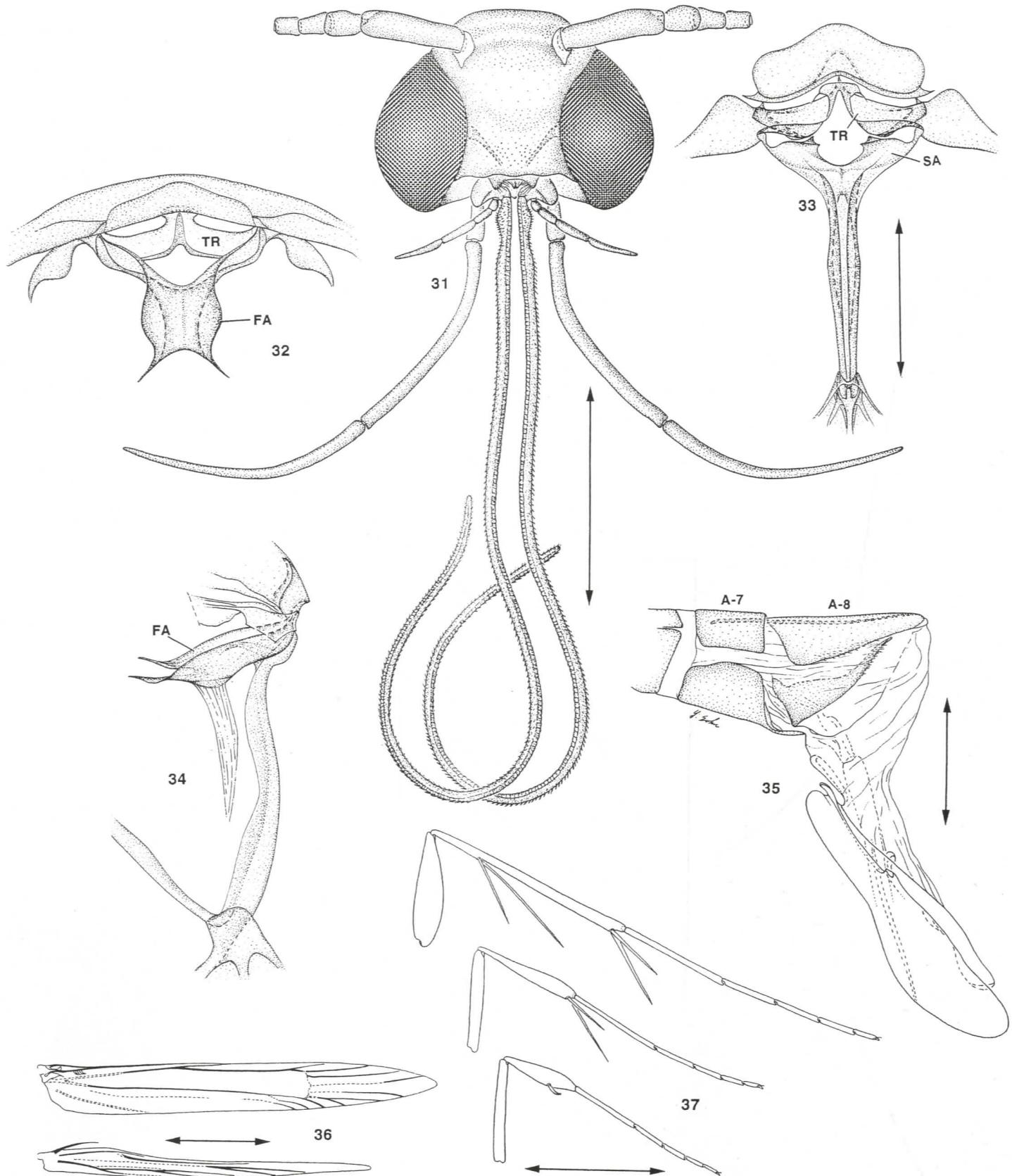


Fig. 31-37. Head and thoracic morphology of *Eucosmophora dives*. 31. Head, anterior view (0.5 mm). Fig. 32-34, Metafurcasternum: 32. Dorsal view. 33. Posterior view (0.25 mm). 34. Lateral view. 35. A7, A8, and anterior portion of male genitalia, lateral view (0.5 mm). 36. Wing venation (0.5 mm). 37. Fore-, mid-, and hindlegs (1.0 mm). (FA = furcal apophysis; SA = secondary arm of furca; TR = transphragma, dorsal thoracic-abdominal articulation; length of scale in parentheses.)

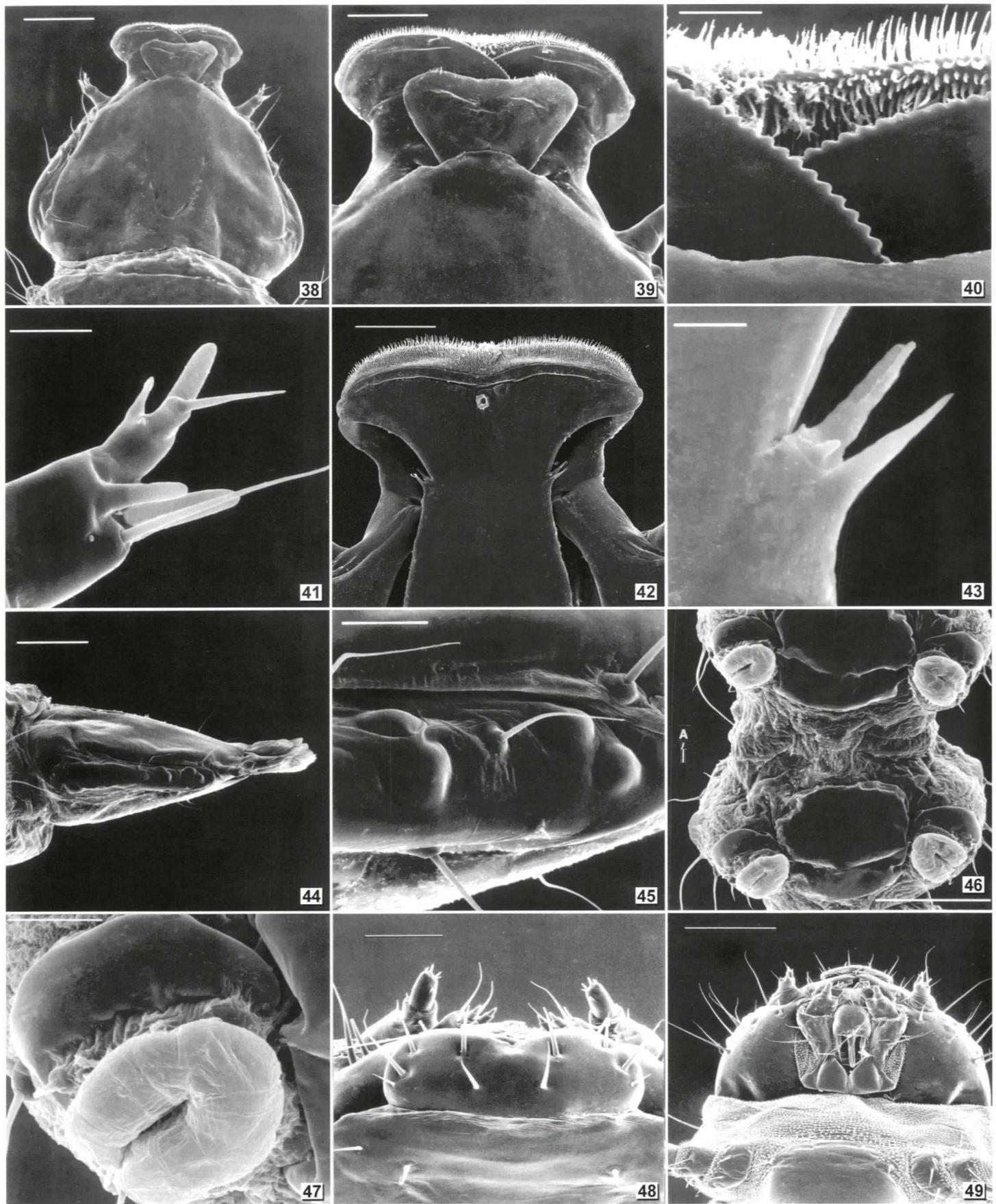


Fig. 38-49. *Eucosmophora pithecellobiae*, third (sap-feeding) (Fig. 38-47) and fifth instar (tissue-feeding) larvae (Fig. 48-49). 38. Head of third instar larva, dorsal view (100  $\mu\text{m}$ ). 39. Labrum and mandible, dorsal view (50  $\mu\text{m}$ ). 40. Detail of serrated edge of mandible (10  $\mu\text{m}$ ). 41. Antenna, dorsal view (10  $\mu\text{m}$ ). 42. Labium, ventral view (50  $\mu\text{m}$ ). 43. Labial palpus (5  $\mu\text{m}$ ). 44. Head, lateral view (100  $\mu\text{m}$ ). 45. Stigmata, lateral view (20  $\mu\text{m}$ ). 46. Ambulatory callosities, A3-4 (100  $\mu\text{m}$ ). 47. Ambulatory callosity, A3 (20  $\mu\text{m}$ ). 48. Fifth instar larva, labrum (50  $\mu\text{m}$ ). 49. Head and prosternum, ventral view (200  $\mu\text{m}$ ). (A = anterior; length of bar scale in parentheses.)

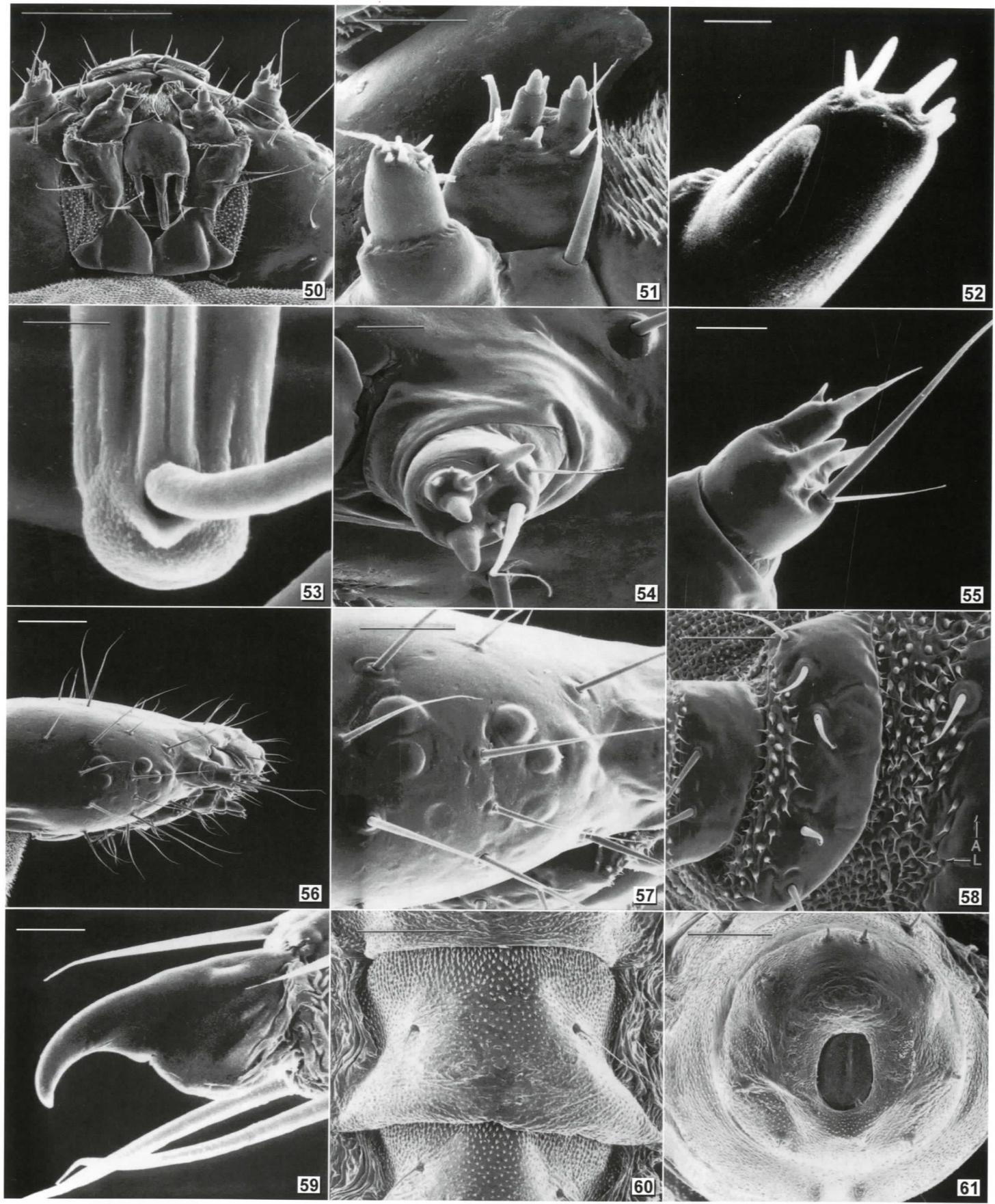


Fig. 50-61. *Eucosmophora pithecellobiae*, fifth instar (tissue-feeding) larva (Fig. 50-59) and pupa (Fig. 60-61). 50. Head, ventral view (200  $\mu\text{m}$ ). 51. Right maxillary lobe and palpus (20  $\mu\text{m}$ ). 52. Left palpus (5  $\mu\text{m}$ ). 53. Apex of spinneret, with silk strand (5  $\mu\text{m}$ ). 54. Left antenna (20  $\mu\text{m}$ ). 55. Left antenna, ventral view (20  $\mu\text{m}$ ). 56. Head, lateral view (100  $\mu\text{m}$ ). 57. Stemmata, lateral view (50  $\mu\text{m}$ ). 58. Procoxal setae (50  $\mu\text{m}$ ). 59. Tarsal claw (10  $\mu\text{m}$ ). 60. Tergal spines of pupa, abdominal segment 4 (200  $\mu\text{m}$ ). 61. Abdominal segment 10, caudal view (100  $\mu\text{m}$ ). (A = anterior; L = lateral; length of bar scale in parentheses.)

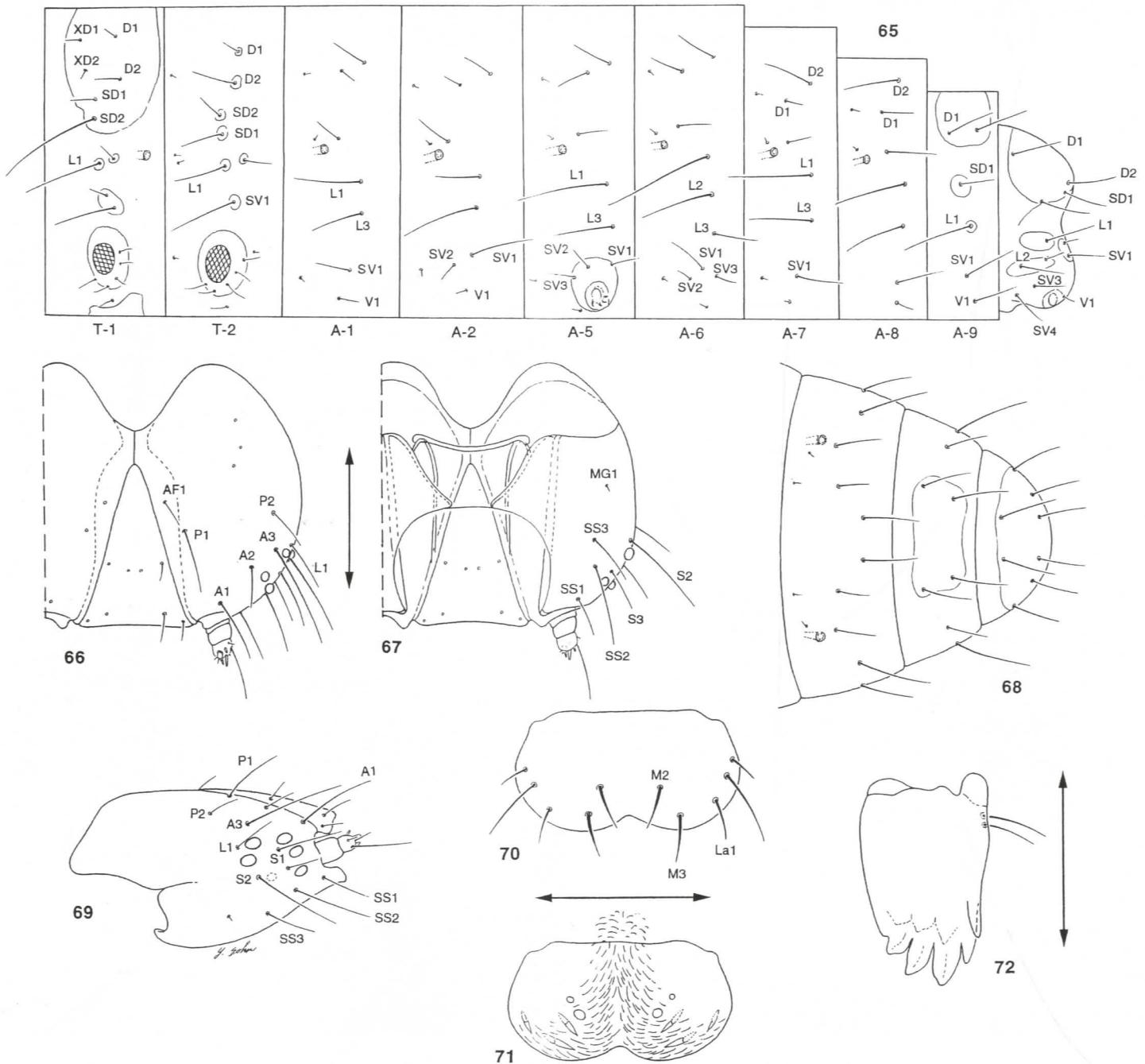
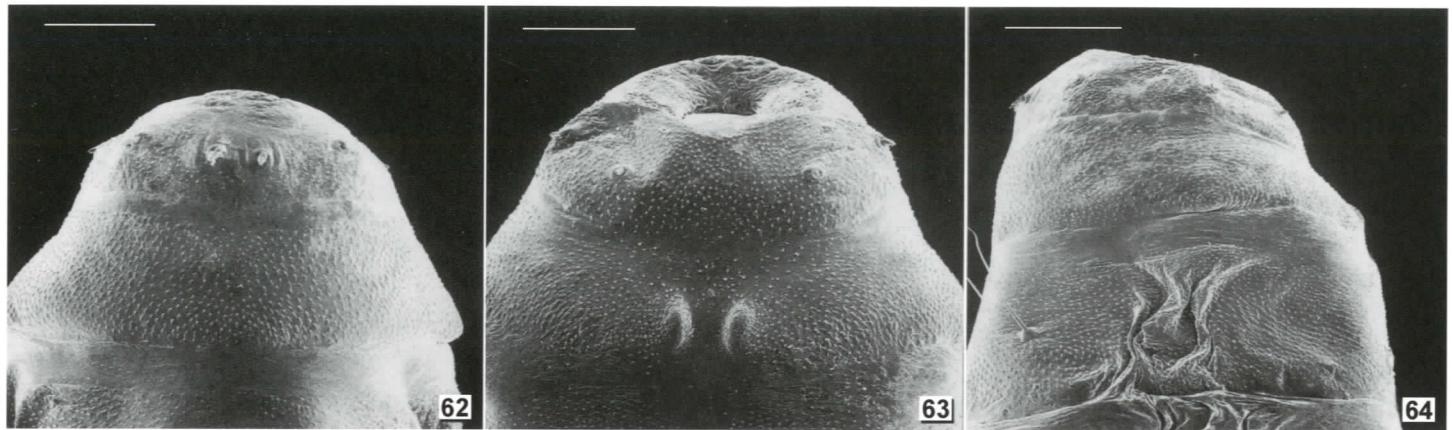


Fig. 62-64. *Eucosmophora pithecellobiae* pupa and chaetotaxy of fifth instar larva. 62. Pupa abdominal segments 9-10, dorsal view (100  $\mu\text{m}$ ). 63. Ventral view of Fig. 58 (100  $\mu\text{m}$ ). 64. Abdominal segments 8-10, lateral view (100  $\mu\text{m}$ ). 65. Lateral schematic of larval prothorax, mesothorax, and abdominal segments 1, 2, 5-10. 66. Head, dorsal view (0.2 mm). 67. Ventral view. 68. Dorsal view of abdominal segments 8-10. 69. Head, lateral view. 70. Labrum, dorsal view (0.1 mm). 71. Ventral view of Fig. 70. 72. Mandible (0.1 mm). (Scale length in parentheses.)

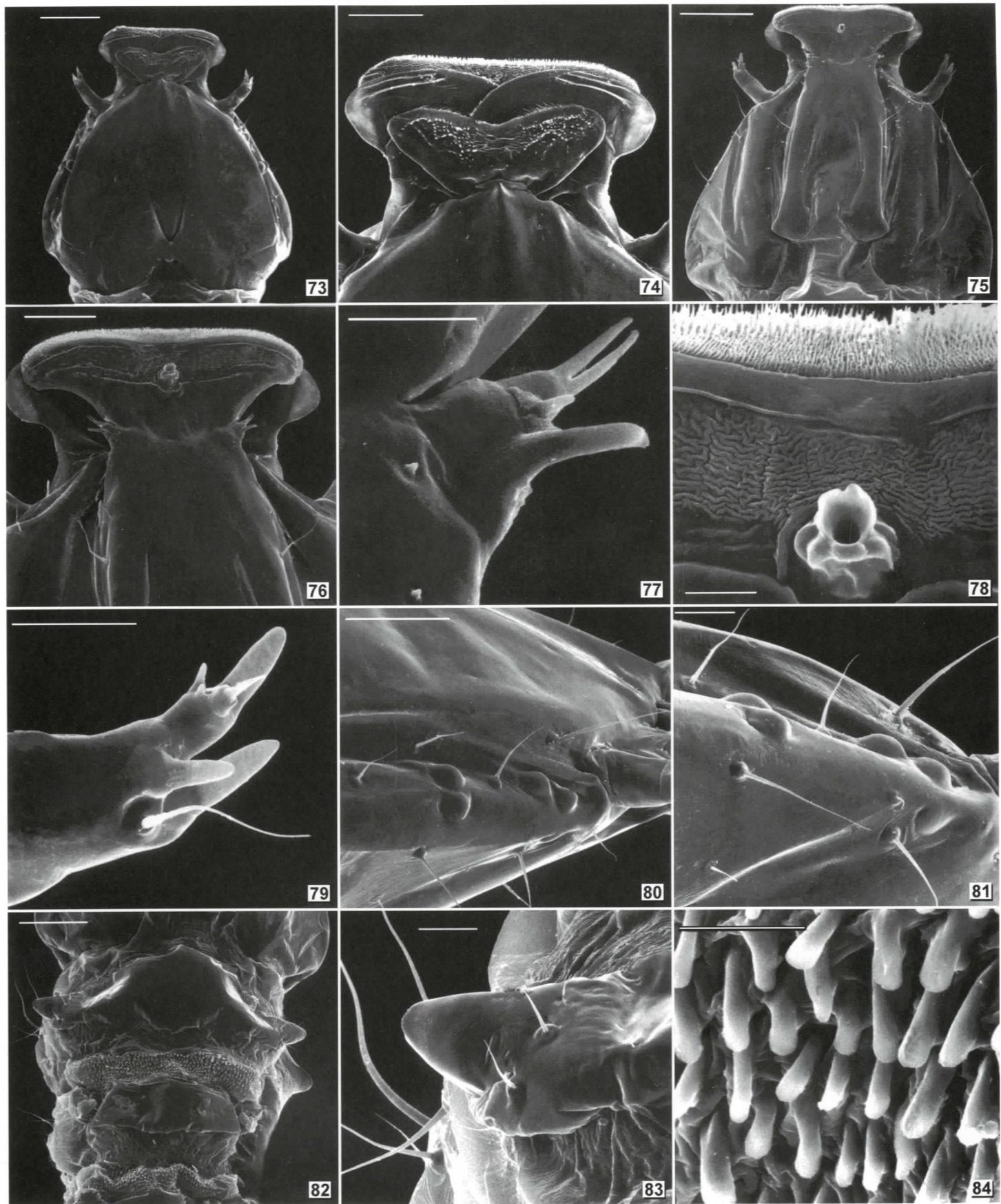


Fig. 73-84. *Eucosmophora ingae*, third instar (sap-feeding) larva. 73. Head, dorsal view (100  $\mu\text{m}$ ). 74. Labrum and mandibles, dorsal view (50  $\mu\text{m}$ ). 75. Head, ventral view (100  $\mu\text{m}$ ). 76. Labium (50  $\mu\text{m}$ ). 77. Labial palpus (10  $\mu\text{m}$ ). 78. Spinneret (10  $\mu\text{m}$ ). 79. Left antenna, ventral view (20  $\mu\text{m}$ ). 80. Stigmata, lateral view (50  $\mu\text{m}$ ). 81. Lateral-ventral view of Fig. 80 (20  $\mu\text{m}$ ). 82. Pro- and mesosterna, head at top (100  $\mu\text{m}$ ). 83. Prosternal callosity (20  $\mu\text{m}$ ). 84. Integumental spinules of thoracic venter (10  $\mu\text{m}$ ). (Length of bar scale in parentheses.)

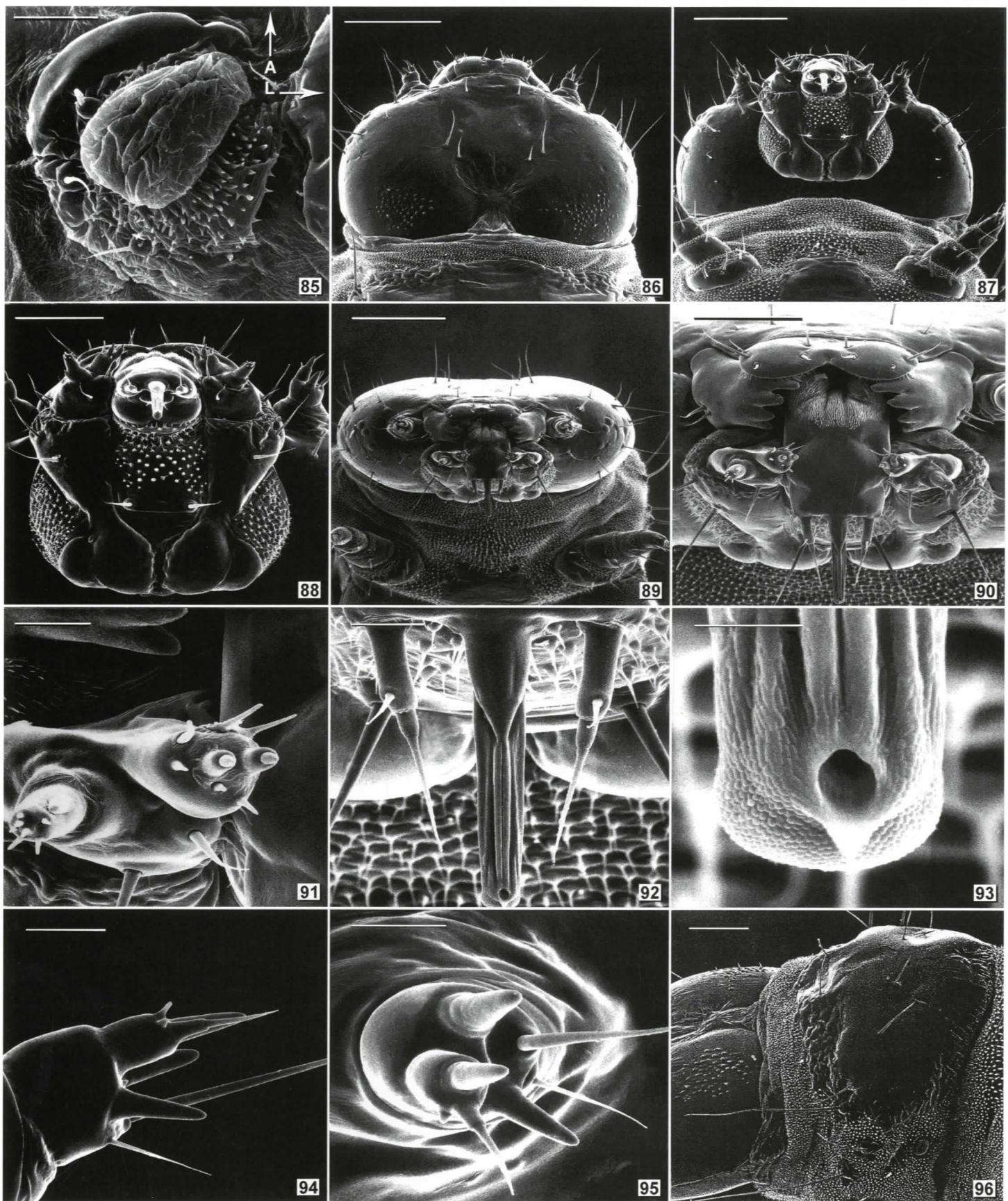


Fig. 85-96. *Eucosmophora ingae*. Third (sap-feeding) (Fig. 85) and fifth instar (tissue-feeding) larvae (Fig. 86-96). 85. Ambulatory callosity on A3 (A = anterior; L = lateral). 86. Head of fifth instar larva, dorsal view (200  $\mu\text{m}$ ). 87. Head, ventral view (200  $\mu\text{m}$ ). 88. Labium and maxillae (100  $\mu\text{m}$ ). 89. Head, anterior view (200  $\mu\text{m}$ ). 90. Mouthparts (100  $\mu\text{m}$ ). 91. Right maxillary lobe and palpus (20  $\mu\text{m}$ ). 92. Spinneret and labial palpi (20  $\mu\text{m}$ ). 93. Apex of spinneret (5  $\mu\text{m}$ ). 94. Left antenna, ventral view (20  $\mu\text{m}$ ). 95. Apical view of Fig. 94 (20  $\mu\text{m}$ ). 96. Prothorax, lateral view, head to left (100  $\mu\text{m}$ ). (Length of bar scale in parentheses.)

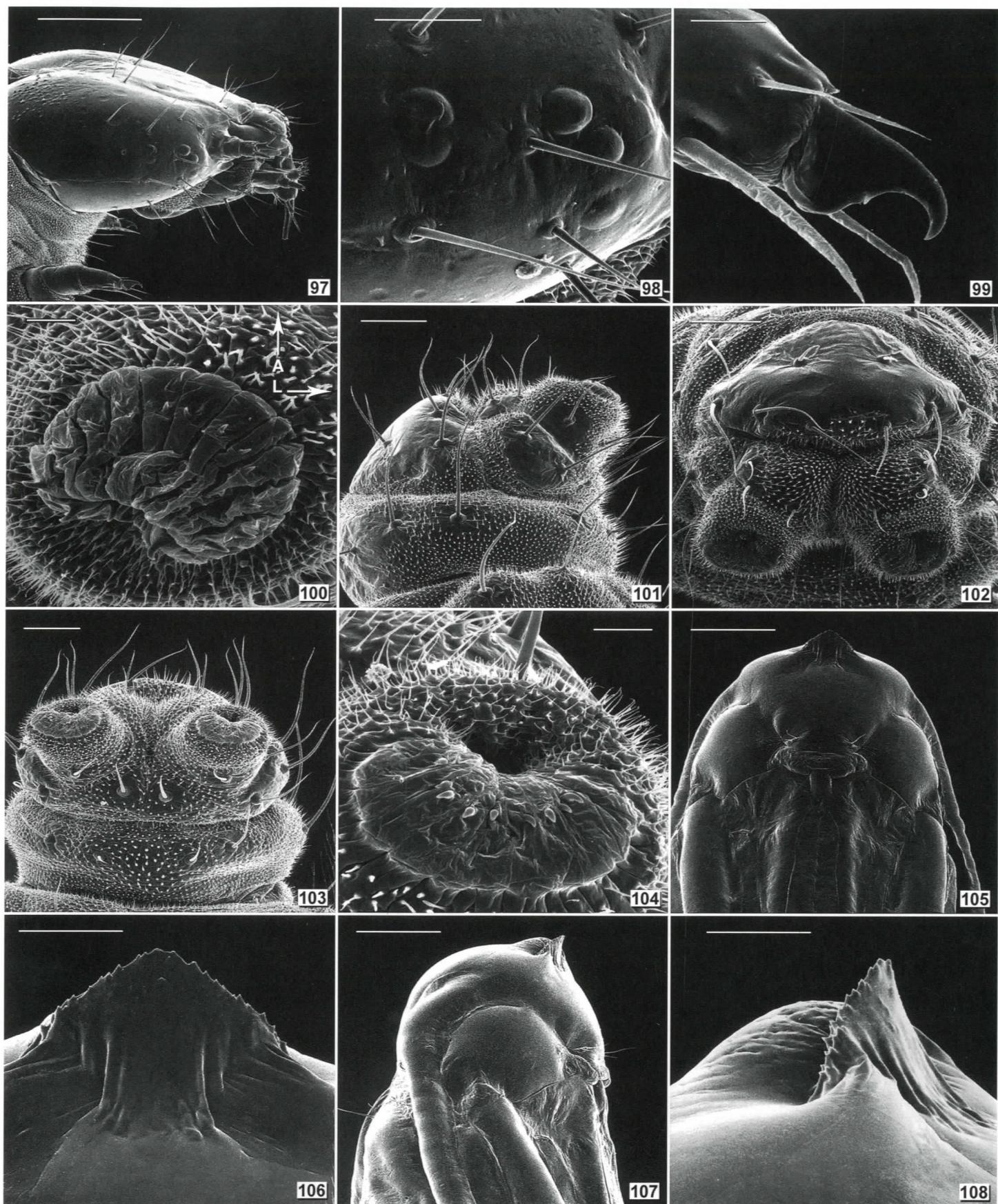


Fig. 97-108. *Eucosmophora ingae*, fifth instar (tissue-feeding) larva (Fig. 97-104) and pupa (Fig. 105-108). 97. Head, lateral view (200 µm). 98. Stemmata, lateral view (100 µm). 99. Tarsal claw (20 µm). 100. Proleg on A4 (A = anterior; L = lateral) (20 µm). 101. A9-A10, lateral view (100 µm). 102. A10, caudal view (100 µm). 103. A9-A10, ventral view (100 µm). 104. Anal proleg (20 µm). 105. Pupa, ventral view of anterior third (200 µm). 106. Frontal process (cocoon-cutter), ventral view (50 µm). 107. Anterior end, lateral view (200 µm). 108. Lateral view of Fig. 106 (50 µm). (Length of bar scale in parentheses.)

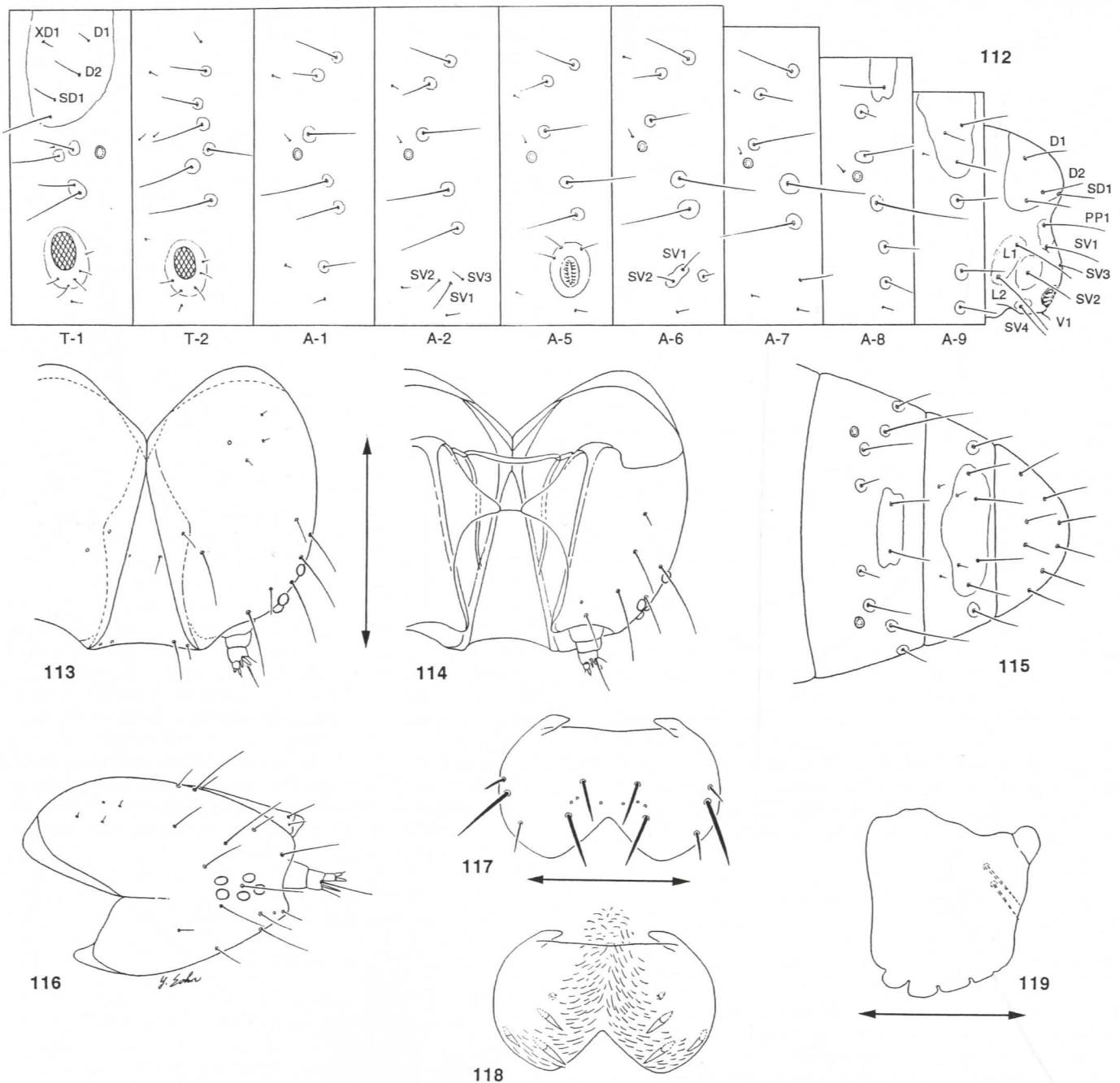
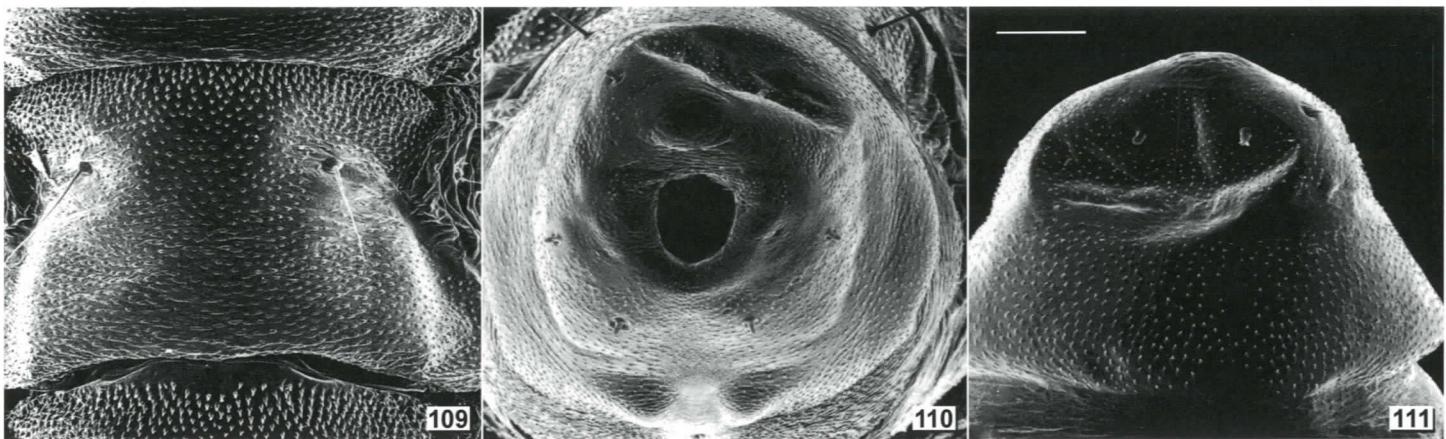


Fig. 109-111. *Eucosmophora ingae*, pupa and chaetotaxy of fifth instar larva. 109. Tergal spines of pupal abdominal A4. 110. A10, caudal view. 111. Dorsal view of Fig. 110 (50  $\mu\text{m}$ ). 112. Lateral schematic of larval prothorax, mesothorax, and abdominal segments 1, 2, 5-10. 113. Dorsal view of head. 114. Ventral view. 115. Dorsal view of abdominal segments 8-10. 116. Head, lateral view. 117. Labrum, dorsal view (0.1 mm). 118. Ventral view. 119. Mandible, outer face (0.1 mm). (Scale length in parentheses).

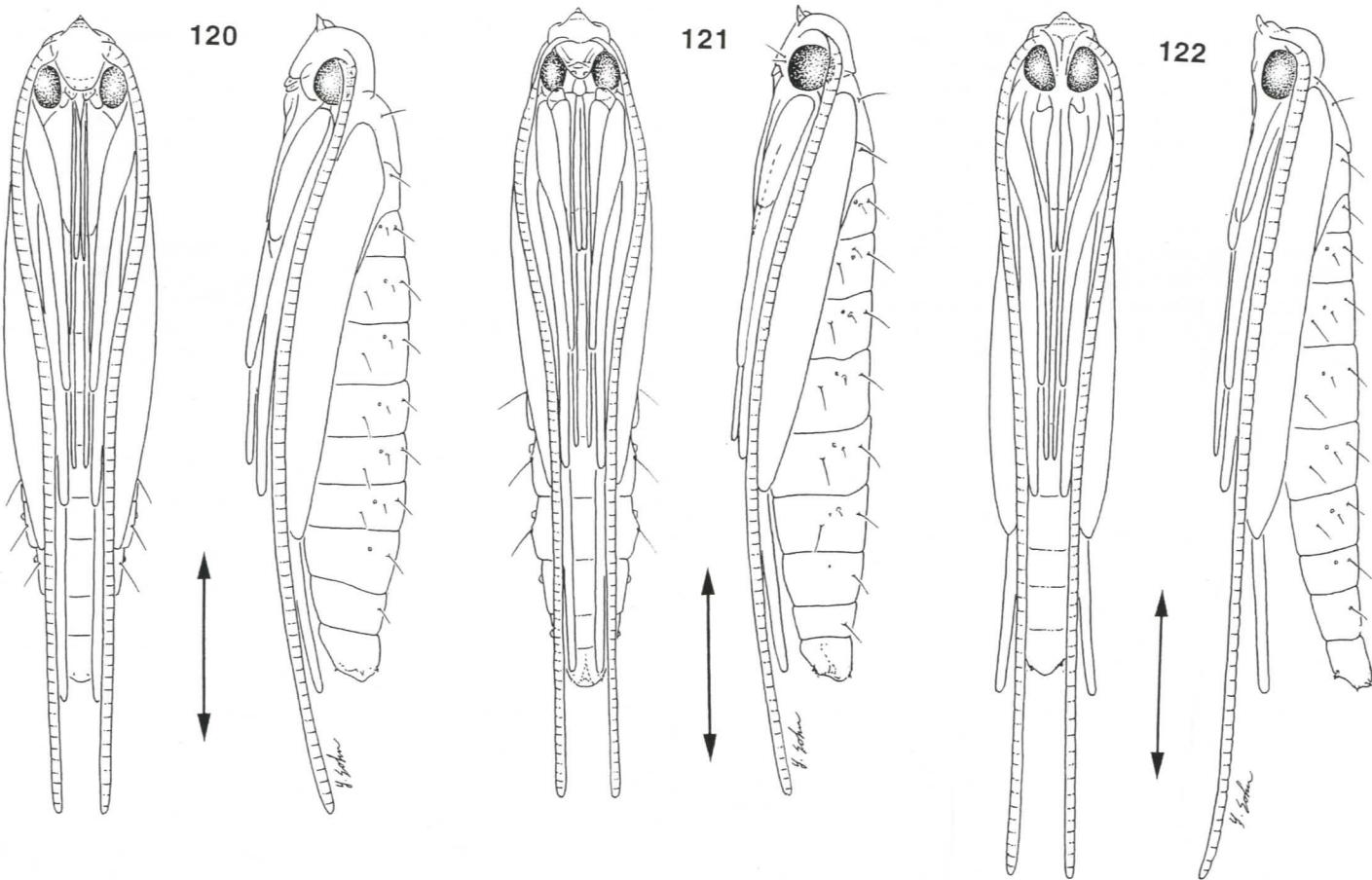


Fig. 120-122. *Eucosmophora* pupae. 120. *E. pithecellobiae*. 121. *E. ingae*. 122. *E. manilkarae*. (Scales = 0.5 mm.)

as conical lobes (Fig. 83). Abdomen with ventral ambulatory callosities instead of prolegs on A3-6 (Fig. 46-47, 85) and A10; crochets absent.

#### Tissue-Feeding Instars

**Head:** Somewhat dorsoventrally flattened and hypognathous (Fig. 50, 56, 66-67, 86-87, 89, 97, 113, 114) with full complement of mouthparts; pale brown in color; maximum width (fifth instar) 0.7 mm. Frons (Fig. 66, 86, 113) elongate, about 0.8 distance to epicranial notch. Ecdysial line terminating at epicranial notch. Chaetotaxy relatively well developed; all three MD setae present. P1 arising close to ecdysial line. P2 widely separated from P1, arising nearer and caudad to A3. Five stemmata, arranged in relatively open semi-circle with vestige of stemma 6 evident (Fig. 56-57, 69, 97-98, 116). Antenna 3-segmented, with sensilla as shown (Fig. 54-55, 94-95). Labrum (Fig. 48, 70-71, 90, 117-118) with M1 absent; three pairs of epipharyngeal spines present; epipharyngeal sclerite not observed. Mandible variable, with 3 large inner cusps and 2 small lateral cusps (Fig. 72), or with cusps reduced (Fig. 119). Maxilla as in Fig. 51-52 and 91. Spinneret (Fig. 50, 53, 90, 92-93) relatively slender, elongate, with moderately broad, dorsal ridge; apex rounded, densely covered with minute papillae. Labial palpi (Fig. 92) with basal segment ~ 3.75x length of smaller apical segment and bearing short subapical sensillum; apical segment bearing elongate apical sensillum, exceeding length of basal segment.

**Thorax:** Pronotal plate unpigmented, indistinct, smooth. XD2 present or absent. L group bisetose on T1-3. SV bisetose on T1, unisetose on T2-3 (Fig. 65, 96, 112). Legs well developed; 5 coxal setae present (Fig. 58); coxae widely separated; pretarsal claw (Fig. 59) short, relatively stout, with axillary spine reduced, indistinct.

**Abdomen:** Dorsal plates indistinct, smooth. Both D setae present on A9. L bisetose on A1-5, bi- or trisetose on A6, bisetose on A7-8; unisetose on A9. SV group unisetose on A1, bisetose or trisetose on A2, and trisetose on A3-6, unisetose on A7-9; A2 with SV3 either present or absent (Fig. 65, 112). Prolegs present on A3-5 and A10; crochets

arranged in a circle of ~ 14-16 hooks on A3-5, with caudal 4 or 5 hooks most enlarged (Fig. 100). A10 with crochets arranged in a semi-circle of ~ 10 small spines (Fig. 103-104). Chaetotaxy of A10 as shown in Fig. 65, 68, 101-103, 112, and 115. Anal plate with 4 pairs of setae.

**PUPA** (Fig. 60-64, 105-111, 120-122).—Length to 5 mm and width 1 mm, often with orange or red tints when alive; preserved color paler. Frontal process (cocoon cutter) a low triangular transverse ridge bearing numerous minute teeth; dorsal side bounded by bulge (Fig. 106-108). Antenna long extending about 10-15% its length beyond end of abdomen. Labial palpi long, extending about half length of proleg. Proboscis to A5, two halves well separated. Forewings narrow, well separated, extending to abdominal segment A5, A6, or A7. Prolegs to A3-4; midlegs to A5 or anterior of A6; and hindlegs to caudal end or beyond A10. D1, SD1, and L1 present on A1-6; some setae on A1 often obscured by wings as in Fig. 120-122; D1 and L1 setae relatively long, about half length of segment upon which they arise; only D1 present on A7-8. Dorsum of abdomen modestly roughened, with minute spines scattered in rows, especially across anterior fourth of A2-8 (Fig. 60, 109). Sternum of A7 relatively smooth, without accessory cremaster. Cremaster consisting of a ring of four pairs of small recurved spines, with those over dorsum more closely set (Fig. 61-64, 110-111).

#### KEY TO THE SPECIES OF *EUCOSMOPHORA*

1. Forewing with a small, silvery white, dark-margined, costal spot immediately before middle (spot greatly reduced in *melanactis*) (Fig. 1) . . . . . 3
- Forewing without silvery white costal spot . . . . . 2
2. Forewing with small triangular, pale orange spot immediately beyond middle of costa (Fig. 5) . . . . . *aspila*
- Forewing without pale orange costal spot (Fig. 6) . . . . . *eurychalca*

3. Valva of male with a small digitate lobe arising about midway along coastal margin (Fig. 123, 127); sternum 7 often with median caudal scale cluster (absent in *E. eurychalca*, *melanactis*, *paraguayensis*) (Fig. 125, 130); sternum eight slender, short, less than sternum 7 in length (Fig. 125). Female with paired signa usually in form of spinose or uniserrated, elongate rods (Fig. 164-165), or sometimes in the form of small, oval plates (Fig. 183-184). Larva on Sapotaceae ..... 4
- Valva entire, coastal margin without lobe (Fig. 153); sternum 7 with simple median caudal lobe, without scale cluster (Fig. 155, 158); sternum eight larger, approximately equal to sternum 7 in length (Fig. 35, 158). Female with paired signa usually in the form of large spinose plates (Fig. 192); signa absent in *E. ingae* and *trimetalla*. Larva on Fabaceae ..... 12
4. Antenna more than 1.2x forewing length ..... 5
- Antenna approximately equaling forewing length ..... 6
5. Antenna more than 1.6x length of forewing, white-tipped. Costal apex of forewing fuscous, without orange scaling extending beyond fuscous patch along costal margin (Fig. 3). Larva unknown ..... *prolata*
- Antenna less than 1.4x length of forewing, dark-tipped. Costa with orange scaling extending to apex of forewing (Fig. 2). Larva on *Pouteria* ..... *pouteriae*
6. Caudal margin of male sternum 7 bearing median cluster of appressed scales (Fig. 125). Female signa variable, consisting either of paired, elongate, spinose rods, or small, oval plates bearing 1-2 spines ..... 7
- Caudal margin of male sternum 7 without scale cluster (Fig. 140, 146). (Female unknown) ..... 11
7. Costal lobe of male valva partially covered dorsolaterally by costal margin of valva (Fig. 123). Female signa robust, caudal half with 3-4 small, rounded lobes (Fig. 165) ..... *atlantis*
- Male valva with costal lobe projecting free (Fig. 127). Female signa either with paired rods more slender and with caudal half smooth, or signa consisting of small, paired, spinose plates ..... 8
8. Male with caudal margin of sternum 7 evenly rounded, not produced. Female signa consisting of a pair of slender, elongate rods with 4 short barbs arising from anterior third (Fig. 174) ..... *chrysocosma*
- Caudal margin of male sternum 7 produced into a median lobe (Fig. 149, 152). Female signa consisting either of a pair of short, strongly barbed rods, or a pair of small, spinose plates ..... 9
9. Male with caudal lobe of sternum 7 ~ 0.5x length of entire sternum; lateral angles of sternum produced caudally (Fig. 149). Female signa consisting of a pair of short, strongly barbed rods (Fig. 180); largest spine ~ 0.7x length of rod. Larva on *Dipholis* and *Mastichodendron* ..... *sideroxylonella*
- Caudal lobe of sternum 7 ~ 0.2x length of entire sternum; lateral angles not produced (*manilkarae*; Fig. 152). Female signa sometimes highly variable, usually with 1-2 spines arising from pair of elongate to lenticular, oval plates (Fig. 183-187, 190) ..... 10
10. Junction of corpus bursae and ductus bursae of female with a relatively large, sclerotized ring (Fig. 190); signa consisting of a pair of small lenticular plates bearing a pair of small spines from one end. (Male and larva unknown) ..... *eclampsis*
- Corpus bursae without ring; signa highly variable, with 1-2 spines of variable size arising from a pair of elongate to oval disks (Fig. 183-187). Larva on *Bumelia* and *Manilkara* ..... *manilkarae*
11. Male with bulbus ejaculatorius less than half the length of aedeagus; caudal margin of sternum 7 produced as a prominent, complex, median process bearing wing-like lateral appendages (Fig. 146) ..... *paraguayensis*
- Bulbus ejaculatorius of male nearly 2x length of aedeagus; caudal margin of sternum 7 relatively simple, broadly acute (Fig. 143) ..... *melanactis*
12. Female with single, densely spined signum. Male valva with 2-3 small spines approximately midway along ventral margin (Fig. 156); caudal margin of sternum 7 with slender, digitate, medial lobe, nearly 0.3x length of entire sternum (Fig. 158) ..... 13
- Signum either paired or absent. Valva with cluster of 6-10 slender spines midway along ventral margin (Fig. 153); caudal margin of sternum 7 broadly rounded with shorter and stouter medial lobe (Fig. 155) ..... 14
13. Signum consisting of an enlarged, spinose, anterior half, tapering to slender, rod-like caudal half that extends into ductus (Fig. 198). Male as described in couplet 12a. Larva on *Inga* ..... *dives*
- Signum densely spinose, lining almost entire inner wall of corpus bursae (Fig. 196). (Male and larva unknown) ..... *echinulata*
14. Apex of male valva relatively acute (Fig. 153); aedeagus longer than genital capsule (from anterior end of vinculum to caudal end of tegumen), slightly sinuate in lateral view (Fig. 154); tegumen without conspicuous setae. Female signa consisting of a pair of large, spinose plates (Fig. 192). Larva on *Pithecellobium* ..... *pithecellobiae*
- Male (*ingae*) valva broadly rounded (Fig. 159); aedeagus less than length of genital capsule and relatively straight in lateral view (Fig. 160). Female signa absent (Fig. 202) ..... 15
15. Female with a strongly arched projection from one side of caudal margin of corpus bursae (Fig. 203); ductus bursae with spicules uniformly minute ..... *ingae*
- Corpus bursae without arch; inner wall of ductus bursae densely covered with spicules which increase in size from anterior fourth to junction with corpus bursae (Fig. 205) (Male unknown) ..... *trimetalla*

***Eucosmophora atlantis* (Meyrick), new comb.**

Fig. 1, 123-126, 163-165; Map 3

*Acrocercops atlantis* Meyrick, 1924:85.*Acrocercops atalantis* [sic] Davis, 1984:26.

MALE.—Length of forewing 3.6-4.5 mm. Head: Frons golden (below) to silvery white (above); vertex shiny gray; collar orange. Antenna ~ 1.1x length of forewing, light orange to reddish brown over scape, pedicel, and basal flagellomeres; remainder of flagellum dark fuscous to gray. Maxillary and labial palpi pale orange to buff laterally, whitish cream mesally. Thorax: Reddish brown dorsally, with shiny gray suffusion across pronotum and anterior half of tegula; mesoscutellum yellow; coppery brown to fuscous under wings and mostly pale gold and silver below. Forewing with prominent, sinuate streak of pale orange extending along costa to apex, broadest across wing near basal 2/5 and distal 3/4; small but variable black spot near base of costa, bounded inwardly and below with gold, followed distally by variable costal orange spot bordered with fuscous (orange scaling variably suffused with fuscous); silvery white spot along costa at 2/5 comparatively large, elongate, bordered with fuscous; golden patch over basal 1/3 (anal area) and at 3/5 along inner margin, edged with fuscous; dark patch over outer 1/4 of wing with strong purplish reflections. Fringe dark gray along hind margin, becoming orange-brown, especially basally, around apex. Hindwing uniformly dark gray. Legs as in *pouteriae* but less dark scaling about femerotibial joint of hindleg and more fuscous suffusion over outer surface of tibiae and tarsomeres. Abdomen: Dark fuscous dorsally and entirely over A7-8; brown, sometimes with coppery reflections laterally on A3-4; cream ventrally, especially about venter of A4 and A5. Sternum 7 pentangu-

lar with oblique lateral angles (Fig. 125); dense medial setal tuft along caudal margin tapering to blunt apex. Sternum 8 consisting of pair of slender sclerites, each with short, acute, dorsal process. Tergum 8 broadly rounded and weakly sclerotized except for elongate median rod that extends to anterior edge of sternum 7; anterior end of rod broadly T-shaped.

**MALE GENITALIA** (Fig. 123-124).— Valva with blunt-tipped costal process arising just before middle and partially covered laterally by costal fold; aedeagus apically acute with a row of 3-5 minute exogenous denticles along distal half.

**FEMALE** (Fig. 1).— Length of forewing 4 - 4.8 mm. Abdomen with A7 mostly bronzy brown.

**FEMALE GENITALIA** (Fig. 163-165).— Ductus bursae lined with minute transverse bands of spicules almost to corpus bursae. Signa consisting of pair spinose, laciniate rods relatively firmly connected caudally by irregular, broad, sclerotized band that encircles anterior end of ductus bursae; anterior half of signum bearing 4 elongate, apical, unilateral spines and 2 stouter, more medial spines; caudal reach of signum variously lobed, with 3-4 pairs of distinct denticles.

**TYPE.**— Holotype, ♂; San José, Costa Rica.

**MATERIAL EXAMINED.**— COSTA RICA: Guanacaste Province: Estación Pitilla, 9 km S. of Santa Cecilia, 700 m, Parque Nacional Guanacaste: 1♂, 1♀, Apr 1991, C. Moraga; 2♂, 1♀, Jul 1991, L-N-330200, 380200, P. Rios, slides DRD 4057, 4058; 4♂, 1♀, 23-26 Jun, 1991, Taller, slides USNM 31999, 32000; 3♂, 3♀, 19-23, 1993, P. Rios, slides USNM 32001, 32974, (INBio, USNM). SAN JOSÉ: San José: 1♂ (holotype), slide BMNH 30830, (BMNH).

**HOST.**— Unknown; probably Sapotaceae.

**DISTRIBUTION** (Map 3).— Known only from two sites in Costa Rica, including San José and Estación Pitilla, a wet, montane forest habitat in Guanacaste Province.

**REMARKS.**— This large species closely resembles *E. pouteriae* in color pattern and male abdominal morphology. Sternum 7 of male *E. atlantis* is pentangular and possesses more oblique caudolateral angles (Fig. 125) than does *E. pouteriae*. The costal lobe of the valva is partially covered in *E. atlantis* by a lateral fold that is lacking in *E. pouteriae*. The female signum of *E. atlantis* differs in being generally stouter, with an irregularly lobed, dentate caudal region (Fig. 165).

#### *Eucosmophora pouteriae* Davis & Wagner, new sp.

Fig. 2, 126-127-130, 166-168; Map 2

**MALE** (Fig. 2).— Length of forewing 3.2 - 3.6 mm. **Head:** Frons golden below, silvery white above; vertex shiny dark gray with narrow collar of buff to orange scales around posterior margin of head. Antenna predominantly shiny gray, generally paler ventrally, tending to be pale orange over anterior surface of scape, pedicel, and basal flagellomeres. Maxillary palpus somewhat roughened; labial palpus orange, smooth. **Thorax:** Dorsum shiny fuscous with intermixed orange scales, becoming yellow over mesoscutellum; coppery brown below wings, becoming silvery white ventrally. Forewing: Basal 1/3 mostly shiny gold with orange and black along costa, black spot reduced to minute spot, edged inwardly with gold and outwardly with orange; large gold basal patch with concave outer margin edged with black; silver spot at 2/5 elongate, edged with black, continuing along costa to apex; fuscous cilia sometimes with orange bases. Hindwing uniformly fuscous. Fore- and midlegs pale bronze with subtle fuscous shading over tibiae and first four tarsomeres; hindcoxa and femur silvery buff with slight golden sheen; conspicuous black suffusion about femerotibial joint; outer surface of tibia mostly orange with vague fuscous shading over distal half, apex with buff scales; first tarsomere with diffuse fuscous scaling. **Abdomen:** Fuscous dorsally with dark suffusion extended ventrally on A3-4 and A7; off white ventrally, especially about A4-6. Sternum of A7 quadrangular, with caudal margin truncate, bearing a moderately broad, truncate brush of short setae (Fig. 130). Eighth sternite reduced, ~ 0.3x length of main body of tergum 8, somewhat concave near middle with broadly acute projection from ventral margin. Tergum 8 with slender rod-like process extending nearly to anterior margin of sternum 7; anterior apex of tergal rod flared, triangular.

**MALE GENITALIA** (Fig. 127-129).— Valva slender with small, somewhat twisted, digitate process arising near middle of costal margin (Fig. 127);

mesal surface with setae densest over distal half. Tegumen conspicuously setose. Aedeagus with ~ 10 minute denticles arranged in a partially spiraled, longitudinal row along caudal half; apex acute.

**FEMALE.**— Length of forewing 3.7 mm. Color pattern similar to male.

**FEMALE GENITALIA** (Fig. 166-168).— Ductus bursae lined with minute bands of spicules almost to corpus bursae. Signa consisting of a pair of spinose, laciniate rods weakly connected caudally; smooth except for six stout, unilateral spines along anterior half; caudal (inner) margin of spines minutely serrulate; apical four spines longest.

**HOLOTYPE.**— ♂; Estación Biología La Selva, 10° 26'N, 84° 01'W, Heredia Prov., Costa Rica, larva 17 Feb 1997, em[erged]. 2 Mar 1997, D.L. Wagner, DLW Lot 97B152, ex *Pouteria campechiana*, slide DRD 4041, (INBio).

**PARATYPE.**— COSTA RICA: Same data as holotype: 1♂, emerg. 1 Mar 1997, (DLW). 2♂, 1♂, 23 Mar 1999, emerg. 10 Apr 1999, D.L. Wagner & D. Brenes, DLW Lot 99C64, ex *Pouteria*, slide DRD 4071, (DLW, INBio, USNM).

**OTHER MATERIAL EXAMINED.**— COSTA RICA: Guanacaste Prov., 2 mi [3.2 km] S. of Dos Ríos, ca. 500 m: 2♂, 5 Feb 1998, found dead 11 Mar 1999, D.R. Davis, DRD 2086, ex ?*Pouteria*, slide USNM 31969, (USNM).

**HOST.**— SAPOTACEAE: *Pouteria campechiana* (H.B.K.) Baehni and other *Pouteria* species.

**PARASITOIDS.**— *Apanteles sensu stricto* (Braconidae).

**DISTRIBUTION** (Map 2).— Lowland wet forest habitats of La Selva, Heredia Province, Costa Rica. Also believed to occur in the wet, mid-elevation forests of Guanacaste Province.

**ETYMOLOGY.**— The specific name is derived from the generic name, *Pouteria*, of the only recorded larval host.

**REMARKS.**— Superficially, this species and the preceding, *E. atlantis*, are nearly inseparable. They can be distinguished by characters of the male and female genitalia as discussed under *E. atlantis*. In particular, the male costal process is not shielded laterally by the valva as it is in *E. atlantis*, and the female signa are generally less robust. The sternum of A7 is quite distinct in the males: in *E. pouteriae* it is quadrangular but distinctly pentangular in *E. atlantis*. It is also interesting to note that the relatively broad, truncate, scale brush of sternum 7 in the males of both species is similar to that found in *Borboryctis euryae*, the only genus other than *Eucosmophora* in which this specialization has been observed. *E. pouteriae* shares numerous similarities with *E. chrysocoma*. Male *E. pouteriae* may be reliably distinguished by their broader valvae; more slender, curved, eighth sternites; and longer anterior eighth sternal process. The female signa of *E. pouteriae* are more reduced than those of *E. chrysocoma*.

Two females reared from leafmines on a probable species of *Pouteria* collected in February 1998 near Dos Ríos, Guanacaste Province, agree with the females of *E. pouteriae* from La Selva. Because of their poor condition, they have not been included in the type series. The locality consisted of a wet, montane forest that was cleared for agriculture later that same year.

Larvae of this species may be found by searching the new leaves of saplings growing in the seed shadow of mature trees. The egg chorion is very thin, transparent, with iridescent reflections. It is laid on the lower surface of young leaves that are fully expanded although not yet hardened. The early mine is serpentine, yellow-tan, with a dark central frass line. The lower surface of the blotch mine is yellow-brown, and appears to be made well into the parenchyma as it is inconspicuous from both leaf surfaces initially. Mines are often formed close to the midrib; the blotch runs between adjacent lateral veins, but may cross over the veins when situated peripherally on the lamina. Tissue-feeding instars remove patches of parenchyma to the upper leaf surface. Mine dimensions are 5-18 x 21-33 mm (n=7). The cocoon is chocolate brown with 2 to 3 white anal balls on the outer surface.

#### *Eucosmophora prolata* Davis & Wagner, new sp.

Fig. 3, 169-171; Map 3

MALE.—Unknown.

FEMALE (Fig. 3).—Length of forewing 3.7 mm. *Head*: Frons white with silvery golden luster, becoming dark silvery gray over vertex. Antenna long, ~ 1.5x length of forewing, mostly fuscous except scape and pedicel which are orange above, basal 7-8 segments white to buff ventrally; and apical 4-7 segments entirely white. Maxillary and labial palpi pale, smooth, without dark scaling. *Thorax*: Dorsum shiny black becoming brown posteriorly; tegula black with brown caudal margin; pleuron coppery, without distinct fuscous scales; venter silvery white with suffusion of golden brown over prosternum. Forewing with prominent black costal spot at basal 1/4 with smaller silver spot basad and another, at 2/5, distinctly elongated, bordered with black; basal third of wing mostly golden, except at extreme base where orange and black scales predominate; outer side of gold patch edged with fuscous line that runs almost perpendicular to inner margin; middle third of wing with sinuate band of orange and silver-yellow spot on hind margin beyond middle; apical third dark fuscous with purplish luster; cilia fuscous. Hindwing uniformly fuscous. Foreleg: Coxa shiny black over basal third, distal 2/3 bronze; femur mostly buff; tibia buff with two, fuscous bands; tarsomeres buff with fuscous suffusion over midsegment. Midleg similar in color except coxa pale and tibia with three fuscous bands. Hindleg: Coxa white, streaked with black; femur black dorsally and over outer face, except for narrow band of silver along ventral edge; tibia mostly black to dark gray over outer surface, buff at apex; tarsomeres buff with fuscous suffusion over middle of first 4 segments. *Abdomen*: Segments A1-3 and A6-7 black, gradually becoming light golden brown laterally to venter; most of A4-5 and venter of A6-7 white.

FEMALE GENITALIA (Fig. 169-171).—Ductus bursae lined with minute, evenly distributed spicules over entire length. Signum consisting of a strongly serrated, lacinate rod with 6-7 relatively large, unilateral teeth; caudal arm of signum with 2-3 small denticles.

HOLOTYPE.—♀; Basecamp, 140 m, Cerro de la Neblina, 0° 50'N, 66° 10'W, near Rio Baria, T. F. Amazonas, Venezuela, 1-9 Feb 1985, W. E. Steiner, slide USNM 31829, (USNM).

HOST.—Unknown; probably Sapotaceae.

DISTRIBUTION (Map 3).—Known only from the holotype, collected in southwestern Venezuela near the Brazilian border in lowland rainforest.

ETYMOLOGY.—The specific epithet is derived from the Latin *prolatus* (extended, elongated), in reference to the unusually long antenna of this species.

REMARKS.—The antennae of this species are the longest of any *Eucosmophora*, extending at least half their length beyond the forewing. This feature, together with the broader, more spinose signa, distinguish it from the closely allied species, *E. chrysocosma*. The paired, uniserrate, and lacinate signa of the females indicate that both species are well placed in the section of the genus known to mine leaves of the Sapotaceae. The minutiae obscured the color of the mesoscutellum.

#### *Eucosmophora chrysocosma* (Meyrick), new comb.

Fig. 4, 131-134, 172-174; Map 1

*Acrocercops chrysocosma* Meyrick, 1915:225.—Davis, 1984:26.

MALE (Fig. 4).—Length of forewing 3.4-4.0 mm. *Head*: Frons silvery white to pale yellow, gradually becoming light to dark bronze over vertex. Antenna with scape and basal 3-4 flagellomeres predominantly silvery white with slight metallic luster; remainder of flagellum dark brown. Maxillary palpus pale with faint banding over outer face; labial palpus shiny golden silver white. *Thorax*: Fuscous dorsally, tegula dark bronze; pleuron shiny golden, without conspicuous fuscous scaling. Forewing with extreme base suffused with coppery brown; basal third mostly pale golden yellow with large dark fuscous spot on costa at 1/4; middle third of wing predominantly orange with comparatively small silver costal spot edged with fuscous and more distal, larger golden spot along hind margin; inner margin sparsely edged with black between two golden spots; distal fourth and fringe fuscous silvery gray except for narrow costal streak of orange. Hindwing uniformly pale fuscous. Legs predominantly shiny buff suffused with dark coppery brown, especially on basal dorsal half of femora; tibiae with pale fuscous

bands near base and apex; tarsomeres usually suffused with brown to pale fuscous dorsally, especially over first tarsomere. *Abdomen*: Terga mostly fuscous, becoming dark golden brown laterally over A3, caudal portion of A2, and anterior portion of A4; A8 mostly pale brown; remainder of pleural and ventral area white. Sternum 7 with caudal margin slightly convex, bearing small, medial patch of short scales (Fig. 134). Eighth sternite triangular, reduced, length ~ 0.2x that of main body of tergum 8. Median rod of tergum 8 extending anteriorly into A7 about 1/2 length of sternum 7; anterior end of rod slightly flared, triangular caudal margin with medial notch and rounded lobes.

MALE GENITALIA (Fig. 131-133).—Valva slender, with narrow, bilobed, digitate process arising from basal third of costal margin (Fig. 131-132); length of apical lobe ~ equal to basal stalk. Aedeagus without exogenous spines; apex relatively truncate (Fig. 133).

FEMALE.—Length of forewing 3.7-5.0 mm. Similar to male in color pattern. *Abdomen*: Similar in color to male except pale fuscous over most of A7.

FEMALE GENITALIA (Fig. 172-174).—Corpus bursae with prominent caudal lobe containing numerous minute spicules. Signa consisting of pair of long, lacinate rods bearing 4-5 sharp, unilateral barbs (Fig. 174); caudal ends of signa extending into (anterior) end of ductus bursae.

TYPE.—Lectotype (present designation), 1♂, Bartica, Guyana, 1.13 [Jan 1913], Parish, (BMNH).

HOST.—Unknown; probably Sapotaceae.

DISTRIBUTION (Map 1).—Known only from the type locality (Bartica), a lowland site located near the coast at the junction of the Cuyuni, Mazaruni, and Essequibo Rivers and Mallali, Guyana.

MATERIAL EXAMINED.—GUYANA: Bartica: 1♂ (lectotype), 2♀ (paralectotypes), 1. 13 [Jan 1913], Parish; 1♂, (paralectotype), 2.13. [Feb 1913], Parish, (BMNH); 1♂, 2.13, Parish, (USNM).

REMARKS.—This species shows nearest affinities to *E. prolata*, particularly in forewing pattern. The two are easily distinguished by the more slender, less spinose signa of *chrysocosma* females. The costal lobes of the male valvae of *chrysocosma* and *aspila* are similar in being the most slender of any other *Eucosmophora*, with a small, subapical, secondary lobe also developed in both species (Fig. 132, 135). *Eucosmophora chrysocosma* is most easily distinguished from *aspila* by the midcostal silver spot, which is lacking in the latter. According to Meyrick (1915), the type series consists of 24 specimens, of which 5 were examined.

#### *Eucosmophora aspila* Davis & Wagner, new sp.

Fig. 5, 135-137, 175-177; Map 1

MALE.—Length of forewing 3.3 mm. *Head*: Frons brassy silver with anterior and dorsal rim of eye bordered with fuscous scales; vertex (partially denuded) similar in color, with cream white scales along occipital margin. Antenna with scape and pedicel buff; flagellum grayish brown dorsally, slightly paler ventrally. Maxillary palpus white with coppery brown suffusion laterally over basal half. Labial palpus golden buff laterally, white mesally.

*Thorax*: Dorsum and tegula dark brownish fuscous; pleura beneath wings dark coppery brown; venter whitish cream. Forewing with short, slender, dark brownish fuscous spot along base of costa; large, trapezoidal, brownish fuscous fascia extending along costa from basal 1/8 to middle of wing and about half this distance along dorsal margin; dark fascia bordered basally and distally by large, irregular, silver to golden silver fasciae the shape of inverted triangles; small costal silver spot absent; an elongate, triangular, pale orange costal spot at 2/3 extending halfway across wing; apical third of wing mostly dark grayish brown with slight purplish luster; fringe dark grayish brown; forewing dark brown ventrally except for whitish anal area. Hindwing dark grayish brown dorsally and ventrally. Foreleg predominantly silvery cream, with two brownish spots dorsally near base and apex of tibia; apices of tarsomeres with brownish bands; midleg with 3 small, brown, dorsal spots on tibia, and with broader brown bands on tarsomeres; hindleg silvery cream ventrally, with most of dorsal surface of tibia and first tarsomere brown; apices of tarsomeres 2-5 brown-banded. *Abdomen* (Fig. 137): Terga of A1-4, most of pleura of A2 and A4, and entire segment of A3 dark bronzy brown; terga of A5-8, most of A5 and A8 pleura, and entire segments of A6-7 lighter

bronzy brown; venter of A2, A4-5, A8, part of A4-5 pleura, and the caudal piliform scales of A8 cream white. Sternum 7 approximately pentangular, abruptly narrowing to broad; subacute to rounded caudal apex bearing a broadly triangular caudal tuft of densely appressed, slender scales (Fig. 137). Eighth sternite slender, triangular, reduced, ~ 0.5x length of tergum 8. Tergum 8 with elongate, slender, median rod extending nearly to anterior margin of sternum 7; anterior apex of rod slightly expanded laterally.

MALE GENITALIA (Fig. 135-136).—Valva slender with apex of cucullus more triangular than in *E. chrysocoma*; costal lobe slender, bilobed, basal stalk more elongate, ~ twice length of apical lobe. Aedeagus with ~ 15 minute spines mostly aligned in longitudinal row along distal half; apex broadly acuminate (Fig. 136).

FEMALE (Fig. 5).—Length of forewing 3.5 mm. Color pattern similar to male.

FEMALE GENITALIA (Fig. 175-177).—Ductus bursae ~ 2.7x length of corpus bursae, very slender, densely and approximately uniformly covered internally with minute, mostly tear-shaped spicules; anterior 1/4 of ductus gradually expanding to lateral junction with corpus bursae. Corpus bursae relatively small, oval in form; signa consisting of a pair of elongate rods ~ 2/3 length of bursa; each signum with row of 8-9 serrations rather evenly spaced along entire length of one side; serrations becoming abruptly lengthened and more spinose anteriorly, with 3 anterior spines more than twice the length of posterior 5-6 serrations (Fig. 177).

HOLOTYPE.—♀; BRAZIL: Parintins, 10-19 [Oct 1919], Parish, slide BMNH 30833, (BMNH).

PARATYPE.—PERU: Jurimaguas: 1♂, Mar 1920, Parish, slide BMNH 3084, (BMNH).

HOST.—Unknown.

DISTRIBUTION (Map 1).—Known from two somewhat disjunct localities, Parintins, Brazil and Jurimaguas, Peru.

ETYMOLOGY.—The specific name is derived from the Greek *a* (without) and *spilos* (spot, speck, stain) in reference to the absence of the small, elongate, costal spot typically present in members this genus.

REMARKS.—The two specimens comprising the type series of this species had been identified by Edward Meyrick as *E. eurychalca*, a Brazilian species that most closely resembles the forewing pattern of *E. aspila*, particularly in the absence of a silver costal spot present in all other known members of the genus. *Eucosmophora aspila* differs in wing pattern from *E. eurychalca* by possessing a triangular, golden spot at the distal third of the costa (absent in *E. eurychalca*) and by the broader, basal, brownish fuscous fascia. Although the male and female specimens of *E. aspila* were collected from different localities, they have been considered conspecific on the basis of their identical, unique forewing pattern.

The male genitalia of *E. aspila* closely resembles that of *E. chrysocoma*, particularly in the form of the costal lobe of the valva, but differs in possessing a more elongate lobe and in the presence of a row of minute spines along the aedeagus. The forewing patterns of these two species also differ in the absence of the costal spot in *aspila*, as mentioned above. The female signa of *E. aspila* are most similar to those of *E. atlantis*, with those of *E. atlantis* differing in the form and irregular distribution of the smaller, posterior serrations (Fig. 165).

#### *Eucosmophora eurychalca* (Meyrick), new comb.

Fig. 6, 138-140; Map 1

*Acrocercops eurychalca* Meyrick, 1920:240.—Davis, 1984:26.

MALE (Fig. 6).—Length of forewing 3.0 mm. Head: [partially denuded] Frons pale golden silver; vertex dark bronzy brown. Antenna with flagellum pale golden brown dorsally and ventrally, [scape, pedicel denuded]. Maxillary and labial palpi mostly white with golden hue, with dark brown suffusion ventrally on basal segment of maxillary palpus and basal two segments of labial palpus.

Thorax: Dorsum (largely denuded) and tegula pale golden brown; pleura with slight coppery luster. Forewing [partially denuded] with predominantly

dark brown pattern consisting of 3 variable spots; dark brown spot at wing base slender, mostly extended along basal 1/6 of costa; a large, brown, trapezoidal fascia extending across wing near basal third; largest brown spot extending over most of distal third of wing, fading over distal 1/5 to pale golden buff with brownish suffusion along termen; costal silver spot absent; most of remaining dorsal half of forewing silvery white with slight golden hue, separated by large brown fascia near basal 1/3; fringe uniformly light brown; forewing light brown ventrally except for pale yellowish white anal area. Hindwing light brown dorsally and ventrally. Foreleg pale brown to cream, without obvious banding; midleg cream ventrally with brown medial and subapical bands present dorsally on tibia; tarsomeres with faint, brown bands; hindleg cream, with dark brown suffusion at base of tibia. Abdomen: Mostly bronzy brown dorsally and laterally, except cream white ventrally on A2, A4-5 and most of A8, and laterally over most of A4-5; venter of A3 dark brown; venter and sides of A6-7 lighter bronzy brown; terminal piliform scales of A8 white. Sternum 7 abruptly narrowing caudally to minute, acuminate apex without scale brush (Fig. 140). Eighth sternites well defined, triangular, reduced, ~ 0.4x the length of main body of tergum 8. Tergum 8 with slender median rod extending nearly to anterior margin of sternum 7; anterior apex of rod only slightly enlarged.

MALE GENITALIA (Fig. 138-139).—Valva with stout, acute lobe arising from basal 1/3 of costa; lobe with relatively prominent, minutely rugose bulge from costal margin. Aedeagus smooth, without minute, exogenous spines; vesica with slender, tubular sclerotization within distal third of aedeagus; apex of sclerotization asymmetrical, acute; bulbous ejaculatorius short, less than half the length of aedeagus (Fig. 139).

FEMALE.—Unknown.

TYPE.—Lectotype ♂ (present designation); Para, Brazil, 20.6.1919, Parish, ♂ slide BMNH 30832; (BMNH).

HOST.—Unknown.

DISTRIBUTION (Map 1).—Known only from the type locality, Para Brazil.

MATERIAL EXAMINED.—BRAZIL: Para: 1♂ (lectotype), 20 Jun 1919, Parish, slide BMNH 30832; 1♂ (paralectotype), 30 Jul 1919, Parish, (BMNH).

REMARKS.—This species was described from two males collected by Parish from Para, Brazil. One male is now missing a forewing and head. The other male, in better but imperfect condition, has been selected as lectotype. The wing pattern of the lectotype appears partially denuded and faded; consequently, fresher specimens could be generally darker in color. The forewing pattern of *E. eurychalca* most resembles that of *E. aspila*, particularly in the absence of the midcostal silver spot. The complete absence in *E. eurychalca* of the triangular, pale orange costal spot present in *E. aspila* appears to be a reliable character and not simply due to the partially denuded forewings of the type specimens of *E. eurychalca*.

The males of this species most resemble *E. melanactis* and *E. paraguayensis* in genital morphology, particularly in the similar, stout form of the costal lobe of the valva. Moreover, male sterna 7 of *E. eurychalca* and *E. melanactis* are unusual in lacking a terminal brush of slender scales. The male of *E. melanactis* is distinguished by the greatly lengthened bulbous ejaculatorius (nearly twice the length of the aedeagus) and the male of *E. paraguayensis* by the unique structure of sternum 7 (Fig. 146). Both species lack the tubular, subapical sclerotization present within the vesica of *E. eurychalca*.

#### *Eucosmophora melanactis* (Meyrick), new comb.

Fig. 7, 141-143; Map 2

*Acrocercops melanactis* Meyrick, 1915:226.—Davis, 1984:26.

MALE (Fig. 7).—Length of forewing 3.5 mm. Head: Frons silvery white over middle, pale brown along eye margin; vertex dark metallic gray. Antenna with scape, pedicel, and flagellum light metallic gray dorsally slightly paler ventrally. Maxillary palpus light brown laterally, cream mesally, with apical segment darker brown. Labial palpus brown laterally, white to cream mesally.

Thorax: Dorsum and tegula fuscous with coppery luster; cream white

ventrally. Forewing predominantly pale brownish orange over much of costal half of wing to apex; basal 1/3 of wing from dorsal margin nearly to costa pale gold; much smaller, semicircular, pale gold spot near 2/3 on dorsal margin; brownish orange and pale golden areas largely separated by narrow, sinuate, fuscous border; an elongate, fuscous spot present at base of costa; small silver spot near costal margin before middle greatly reduced, darkly outlined by fuscous; apical fourth of forewing heavily suffused with purplish fuscous along termen to apex; fringe dark gray; forewing fuscous ventrally, except for pale grayish white anal area. Hindwing dark gray dorsally and ventrally. Foreleg predominantly cream, with two dark gray bands dorsally on tibia, dark gray over most of tarsus; mid and hindlegs dark gray dorsally over femur, tibia, and most of tarsus, cream ventrally and at apices of tibia and tarsomeres. *Abdomen*: Dark fuscous dorsally and laterally along A2-5, and A8; cream white ventrally and laterally along A5-7, and terminally on A8. Sternum 7 abruptly narrowing caudally to minute, acuminate apex without setal brush. Eighth sternites poorly defined, slender, narrowly triangular, reduced, ~ 0.4x the length of main body of tergum 8 (Fig. 143). Tergum 8 with slender median rod extending nearly to anterior margin of sternum 7; anterior apex of rod only slightly enlarged.

**MALE GENITALIA** (Fig. 141-142).— Valva slender, broadest near middle, gradually tapering to moderately narrow apex; relatively stout digitate process arising from basal third of costa; process moderately broad at base, with slightly swollen, rugose bulge at middle, then abruptly constricted at apical third to slender, rod-like apex. Aedeagus smooth, without minute, exogenous spines; apex terminating in single, minute apical spine; bulbus ejaculatorius extremely long, nearly twice the length of aedeagus (Fig. 142).

**FEMALE.**— Unknown.

**TYPE.**— Holotype ♂; Mallali, Brit. Guiana, March, Parish, slide BMNH 30828, (BMNH).

**HOST.**— Unknown.

**DISTRIBUTION** (Map 2).— Known only from the type locality, Mallali, Guyana, located near sea level along the Demerara River.

**MATERIAL EXAMINED.**— GUYANA: Mallali: 1♂ (holotype), (BMNH).

**REMARKS.**— Meyrick described *E. melanactis* from a unique male collected at Mallali near the Demerara River, Guyana. The forewing pattern of this species most closely resembles that of *E. atlantis*, which differs in possessing less dark gray scaling at the wing apex. The forewings of the other Guyanese species, *E. chrysocosma* and *E. trimetalla*, differ even more in pattern (see Fig. 4 and 16 respectively). The male genitalia of *E. melanactis* most resembles *E. eurychalca*, but *E. melanactis* can be easily recognized by its greatly lengthened bulbous ejaculatorius (Fig. 142). The stout, costal lobe arising from the valva of *E. melanactis* may also be more attenuated than in *E. eurychalca*, although the relative intraspecific variation of this structure is unknown.

#### *Eucosmophora paraguayensis* Davis & Wagner, new sp.

Fig. 8, 144-146; Map 1

**MALE** (Fig. 8).— Length of forewing 3.0-3.7 mm. **Head**: Frons silver with slight golden hue, edged outwardly with fuscous; vertex dark gray. Antenna with scape and pedicel golden yellow; flagellum shiny fuscous to gray. Maxillary palpus smooth, pale, with basal segment mostly fuscous; labial palpus uniformly golden yellow. **Thorax**: Dorsum, including tegula, mostly fuscous, with pale yellow mesoscutellum; collar pale yellow; pleuron fuscous with coppery reflections; venter silvery white. Forewing with bright orange band across middle, widest along costal margin where it extends ca. half length of wing; band interrupted on costa by small silvery fuscous-bordered spot and on hind margin by much larger silvery and pale yellow spot; basal fourth of wing mostly golden yellow, outer edge evenly oblique, bounded by fuscous; fuscous costal spot at wing base well developed (without proximal tooth of golden scales that reaches costa common to most other *Eucosmophora*); fuscous edging along inner margin connecting both golden patches; apical 1/3-1/4 fuscous; cilia pale gray to fuscous. Legs pale yellow to yellowish white with fuscous banding on tibial and some tarsal segments; dorsum and outer face of metatibia entirely fuscous. **Abdomen**: Fuscous dorsally with slight purplish luster, pale yellowish white ventrally; segments A7-8 pale shiny gray. Caudal margin of sternum 7 with relatively broad,

winged thickening, largely separated from main sternum except for slender median stalk and associated membrane (Fig. 146). Eighth sternite moderately enlarged, about 1/3 length of main body of tergum 8. Median rod of tergum 8 extending anteriorly into A7 about 3/4 length of sternum 7; caudal margin narrowly notched.

**MALE GENITALIA** (Fig. 144-145).— Valva with an angulate lobe arising from basal 1/3 of costa; lobe with minutely wrinkled outer margin. Aedeagus with vesica containing a strongly sclerotized rod bearing slender acute apex and more than 50 minute denticles along nearly 2/3 the length of aedeagus; denticles decreasing in number anteriorly (Fig. 145).

**FEMALE.**— Unknown.

**HOLOTYPE.**— ♂; Parque Nacional Cerro Cora, 22° 39'S, 56° 01'W, Depto. Amambay, Paraguay, 7-10 Apr 1986, M. Pogue & A. Solis, slide USNM 31824, (USNM).

**PARATYPES.**— PARAGUAY: Same data as holotype: 2♂, (USNM).

**HOST.**— Unknown; probably Sapotaceae.

**DISTRIBUTION** (Map 1).— Known only from the type locality, which is situated in a seasonally dry forest habitat in northeastern Paraguay.

**ETYMOLOGY.**— The specific name refers to the origin of the type series, Paraguay, and the Latin suffix -ensis, denoting place, locality.

**REMARKS.**— The general forewing pattern of *E. paraguayensis* resembles that of *E. chrysocosma* and *E. ingae*. The forewing differs from that of the other Paraguayan species described herein, *E. echinulata*, in possessing a generally paler, brighter anal area. The costal lobe of the male valva is among the stoutest known for the genus. Sternum 7 of the male is especially diagnostic in having the broadly tapered, winged caudal lobe largely separated from the main body of the sternum and the absence of a medial scale patch. The general habitat for this species was characterized by its collectors, M. Pogue and A. Solis, as being distinctly drier than that of *E. echinulata*. While we place this species within the Sapotaceae-feeders, the black-edged frons, unusual modifications of sternites 7 and 8, and a forewing pattern intermediate between the two species groups leaves open the possibility that *E. paraguayensis* represents a distinct lineage within *Eucosmophora*.

#### *Eucosmophora sideroxylonella* Busck

Fig. 9, 19-20, 26-27, 147-149, 178-180; Map 1

*Eucosmophora sideroxylonella* Busck, 1900:250.

*Acrocercops sideroxylonella* (Busck).— Meyrick, 1912a:18; 1912b:46.— Ely, 1917:69.— Davis, 1983:10.

*Acrocercops sideroxylella* Meyrick, emend., 1912a:18; 1912b:46.

**MALE:** Length of forewing 3.4 mm. **Head**: Frons pale golden yellow below, silvery above; vertex with bright brassy iridescence; collar brassy orange. Antenna with pale orange scape, pedicel, and basal flagellomeres, pale yellowish bronze ventrally, darker bronze dorsally. Maxillary and labial palpi pale yellowish bronze, maxillary palpus short, rough. **Thorax**: Dorsum golden or brassy; tegula darker with purple reflections; pleuron brassy under forewing base; venter silvery white. Forewing peach to orange with more brassy than golden scale patches and reduced black edging; black costal spot at wing base distinctively broken and bounded by gold scales; costal silver spot at 2/5 elongate, 3x longer than broad, with reduced black edging; brassy scale patch along inner margin at 3/5 more poorly defined, flattened, and elongate than that of other *Eucosmophora*; orange ground continuing to apex; apical fuscous patch with brassy, silver, and purple reflections; cilia dull orange-fuscous, especially about apex. Hindwing uniformly gray; cilia gray with slight brownish hue. **Legs**: Foreleg pale except for dark suffusion over tibia and basal tarsomeres; midleg pale without distinct markings, slightly darker above; hindleg coppery with minute black spot about femerotibial joint, outer surface of tibia vaguely suffused with fuscous, especially distally; first tarsomere darkened above. **Abdomen**: Fuscous dorsally and down sides of A3-5, with coppery reflections laterally. Sternum 7 with caudal half abruptly constricted and tapered to narrow caudal margin bearing cluster of short, stout setae (Fig. 149). Eighth sternite reduced, about 0.4x length of main body of tergum 8 with acute process arising midway along ventral margin. Tergum 8 acorn-shaped, with slender rod-like process extending into

A7 for approximately 2/3 of its length; anterior apex of this rod relatively broad with reflexed margins.

**MALE GENITALIA** (Fig. 147-148).—Valva slender, with cucullus slightly expanded; small, acute, digitate process arising from basal third of costal margin. Aedeagus with series of 6-7 small spines along one side of apical third; apex acute (Fig. 148).

**FEMALE** (Fig 9).—Similar to male in color pattern. Length of forewing 3.8 mm.

**FEMALE GENITALIA** (Fig. 178-180).—Antrum sclerotized, length ca. equal to free end of anterior apophyses; internal walls of caudal 1/3 of ductus bursae lined with minute, oblong, densely packed spicules; corpus bursae with a pair of deeply serrated, relatively short signa comprised of four large spines of increasing length progressing anteriorad (Fig. 180).

**TYPE**.—Holotype ♀; No. 4960, Florida, Palm Beach Co: Palm Beach, emerg. 24 Feb. 1900, H. G. Dyar, host: *Sideroxylon pallidum* [= *Mastichodendron foetidissimum*], slide USNM 31648, (USNM).

**HOST**.—SAPOTACEAE: *Diphonis salicifolia* (L.) A. DC.; *Mastichodendron foetidissimum* (Jacq.) Lam.

**PARASITOIDS**.—Braconidae (DRD 1639.1).

**DISTRIBUTION** (Map 1).—Subtropical Florida, in Collier, Dade, Monroe, and Palm Beach Counties and Cuba.

**MATERIAL EXAMINED**.—CUBA: Pinar del Rio, Sierra Rosario, 400 m: 1♂, 5-15 Jun 1990, V.O. Becker, DRD 4045, (VOB). USA. FLORIDA: Collier Co: Royal Palm Hammock: 1♀, [mine] 18, 21 Mar 1994, emerg. 6 Apr 1994, D.L. Wagner, DLW Lot 94C34, host: *Diphonis salicifolia*, slide 4025, (DLW). Dade Co: Redland City, Castellow Hammock Park: 8♂, 6♀, [mines] 10 Mar 1991, emerg. 26 Mar - 6 Apr 1991, D.L. Wagner, DLW Lot 91C46, host: *Mastichodendron foetidissimum*, slide DRD 4026, (DLW). Homestead: 1♀, 28 Jun 1994, R.E. Duncan, host: *Diphonis salicifolia*, (USNM). Everglades National Park, Long Pine Key Campground, 25°24'N 80°41'W: 1♀, [mine] 16 Apr 1995, emerg. 8 May 1995, D.R. Davis, DRD 1639.1, host: *Diphonis salicifolia*, (USNM). Monroe Co: Bell Hammock, pole 181: 1♂, [mine] 11 Feb 1992, adult DOA 2 Mar 1992, D.L. Wagner, DLW Lot 92B56, host: *Diphonis salicifolia*, slide 4024, (DLW). North Key Largo, jct. routes 905 and 1: 1♂, 24-25 Apr 1998, D.L. Wagner, DLW Lot 98D64, host: *Diphonis salicifolia*, (DLW).

**REMARKS**.—Three of our four reared specimens from *Diphonis* are considerably larger than our reared specimens from *Mastichodendron*. In addition the orange ground color of the 14 reared specimens from *Mastichodendron* is more peach or salmon than that seen in other *Eucosmophora* species, which are often fiery orange in color. But because we could not find differences in the genitalia of the reared adults from the two hosts, we conservatively regard the two as conspecific. Additional reared material or molecular comparisons are needed.

Similar specializations of male A7 and A8, particularly the midcaudal lobe of the seventh sternite and shared wing patterning, suggest closer affinities between this species and *E. manilkarae* than with any other *Eucosmophora*. The sternal lobe as well as the lateral angles of the seventh sternite are more produced in *E. sideroxylonella* than in other *Eucosmophora*. The shortened, strongly spikate female signa are likewise diagnostic for this species. Both *E. sideroxylonella* and *E. manilkarae* have been reared from two genera of Sapotaceae: *E. sideroxylonella* from *Mastichodendron* and *Diphonis* and *E. manilkarae* from *Manilkara* and *Bumelia*.

Fourteen adults and more than that many braconids were reared from sucker shoots that had grown up after a trail had been cleared in Castellow Hammock Park in Redland, FL. Some of the active mines had small tears, which in other gracillariids, would have suggested that the mines were inactive. The white cocoon bears numerous upright silken spikes on its outer surface. The three cocoons that we have examined have but a single anal bubble among them.

On *Diphonis salicifoliella* the egg is laid on the upper leaf surface of new leaves. The mine begins as a silvery white serpentine track that is gradually enlarged to a blotch that usually runs over the

midrib. Frass is laid down in a conspicuous irregular track that snakes about the mine. In the last two instars, silk is used to draw the upper surface of the mine into a set of closely set creases, which in turn pulls one or both leaf edges over the mine.

Mines may be locally common in southern Florida, especially along roads and trails that have been cut and where there is an abundance of new, regrowth shoots. Curiously, the moth is difficult to rear—the dozens of active mines that we have collected have yielded only modest numbers of adults. Perhaps the cocoons and slender pupae are damaged as the leaves and mines dry out after their collection; alternatively there may be an extended pupal stage during which many of our pupae are lost.

#### *Eucosmophora manilkarae* Davis & Wagner, new sp.

Fig. 10, 17-18, 23-24, 28-29, 122, 150-152, 181-187; Map 3

**MALE** (Fig. 10).—Length of forewing 3.3 - 3.5 mm. **Head**: Frons silvery; vertex pale golden yellow to bronze. Antenna with pale orange scape and pedicel, flagellomeres white to cream ventrally, pale brown to brownish fuscous dorsally. Maxillary palpus short, rough. Labial palpus cream to buff dorsally, mostly pale orange below and over outer face. **Thorax**: Dorsum pale orange, with brassy to gold reflections, tegula darkened with purple reflections; pleuron coppery beneath forewing; venter silver white. Forewing generally orange or brassy without much of the fuscous scaling of other *Eucosmophora*; rounded black spot along costa bounded outwardly with gold bars that are in turn outwardly edged with black; extreme wing base, adjacent to tegula, gold; basal patch over anal portion of wing brassy orange to gold, lacking bright yellow gold scales common to other members of genus, and lacking black edging along distal margin; costal spot at 2/5 elongate, lacking silvery scales and prominent thick black edging; apical patch poorly defined with few fuscous scales, mostly brassy scales with strong purple reflections; cilia tan along outer margin. Hindwing uniformly gray. Legs as in *E. sideroxylonella* but without black femerotibial joint spot and more conspicuous fuscous scaling over outer surface of metatibia. **Abdomen**: Fuscous dorsally, sides of segments A3-5 with strong coppery reflections. Sternum 7 abruptly constricted near caudal 1/4 to form small lobe bearing cluster of short, stout scales (Fig. 152). Eighth sternite reduced, about 0.4x the length of main body of tergum 8; broad, acute process arising midway along ventral margin. Tergum 8 balloon-shaped with slender rod-like process that extends 2/3 the distance into sternum 7; anterior end of rod T-shaped.

**MALE GENITALIA** (Fig. 150-151).—Valva slender but with relatively broad cucullus; slender, simple digitate process with straight, parallel sides arising from below middle of costal margin. Aedeagus without exogenous spines; apex acute (Fig. 151).

**FEMALE**.—Similar to male in color pattern; length of forewing 3.0-4.0 mm.

**FEMALE GENITALIA** (Fig. 181-187).—Anterior 1/3 of ductus bursae with minute spicules along inner wall. Corpus bursae reduced in size, ~ 0.15 mm in diameter, with pair of variable signa that bear internally directed spines, ranging from small oval plates each bearing single, short, stout spine (Fig. 182-184), to narrow, elongate plates bearing 1-2 longer spines (Fig. 185-187).

**PUPA** (Fig. 122).—As illustrated; similar to that of *E. ingae* and *pithecellobiae* except antenna longer, approximately 1.25x length of body and exceeding caudal end of abdomen by 1 mm.

**HOLOTYPE**.—♂, No Name Key, 25°41'53"N, 81°19'18"W, Monroe County, Florida, [mine] 14 Apr 1995, em[erged]. 28 Apr 1995, D.R. Davis, DRD 1651, host: *Manilkara bahamensis*, (USNM).

**PARATYPES**.—FLORIDA: Collier Co: Collier Seminole State Park: 5♂, 14♀, 14 Mar 1994, D.L. Wagner, MV light, slide USNM 32267, (DLW, USNM); 1♂, 2 May 1987, L. C. Dow, slide USNM 31834, (USNM). Royal Palm Hammock: 28♂, 23♀, [mines] 18, 21 Mar 1994, emerg. 1-12 Apr 1994, D.L. Wagner, DLW Lot 94C16, host: *Bumelia celastrina*, slides DRD 4023, USNM 32209, (DLW, USNM). Monroe Co: Bahia Honda Key State Park, Recreation Area: 3♂, 3♀, [mines] 4 Mar 1993, emerg. 23-25 Mar 1993, D.L. Wagner, DLW Lot 93C84, host: *Bumelia celastrina* (DLW); near camp-ground bathhouse: 2♀, [mines and pupa] 15 Apr 1998, emerg. 4, 8 May 1998, D.R. Davis, DRD 2159, host: *Bumelia celastrina*, slide USNM 32215,

(USNM). Key Largo, John Pennekamp State Park: 1♀, [mine] 24-25 Apr 1998, emerg. 14 May 1998, D. L. Wagner, DLW Lot 98D53, host: *Bumelia celastrina*, (DLW). North Key Largo, power pole 185: 5♂, 6♀, [mines] 25 Apr 1998, emerg. 5-17 May 1998, D.L. Wagner, DLW Lot 98D71, host: *Manilkara bahamensis*, (DLW); same data as holotype: 12♂, 9♀, [mines] 14 Apr 1995, emerg. 28-30 Apr 1995, 2♂, emerg. 3 May 1995, 1♂, 1♀ emerg. 8 May 1995, D.R. Davis, DRD 1651, host: *Manilkara bahamensis*, slides USNM 31614, 31643-44, 31807, 31814, 31997, 32020 (USNM); 1♀, [mine] 16 Apr 1998, emerg. 23 Apr 1998, D.R. Davis, DRD 2162, host: *Manilkara bahamensis*, (USNM); 6♂, 7♀, [mines] 23 Nov 1991, emerg. 5-18 Dec 1991, 20 Jan 1992, D.L. Wagner & D.R. Davis, DLW Lot 91L90, host: *Manilkara bahamensis*; 1♀, 18 Dec 1987, T. Dickel, host: *Bumelia celastrina* (USNM); 3♂, 1♀, [mines] 20 Apr 1998, emerg. 9-12 May 1998, D.L. Wagner, DLW Lot 98D31, host: *Manilkara bahamensis* (DLW). Sarasota Co., Siesta Key: 3♂, 1♀, 3, 26, 31 Mar, 2 Apr 1952, 4♂, 6♀, 4-17 Apr 1953, C.P. Kimball, slides USNM 30371, 30835, 31834, 31835, (USNM). TEXAS: Cameron Co: Southmost Sabal Palm Sanctuary, vic. Brownsville: 16♂, 1♀, [mines] 23/24 Dec 1991, emerg. 12-19 Jan 1992, D.L. Wagner, DLW Lot 91M20, host: *Bumelia celastrina*, (DLW, USNM); 10♂, 22♀, [mines] 27 Dec 1994, emerg. 15 Jan - 2 Feb 1995, D.L. Wagner, DLW Lot 94M52, host: *Bumelia celastrina*, slides DRD 4021, 4022, USNM 32208, (DLW); 1♂, 3♀, [mines] 29, 31 Dec 1986, emerg. 26 Jan - 8 Feb 1987; D.L. Wagner, DLW Lot 86M24, host: *Bumelia celastrina*, (DLW); 7♂, 7♀, [mines] 21/22 Dec 1998, emerg. 9/22 Jan 1989, DLW Lot 88M22, host: *Bumelia celastrina*, (DLW).

HOSTS.— SAPOTACEAE: *Bumelia celastrina* H.B.K.; *Manilkara bahamensis* (Baker) H.J. Lam. & Meeuse.

PARASITOIDS: Eulophidae; Braconidae.

DISTRIBUTION (Map 3).— Southern Florida from Sarasota County south to Collier and Monroe County and Cameron County, Texas.

ETYMOLOGY.— The specific name is derived from the generic name, *Manilkara*, one of two principal larval hosts.

REMARKS.— The male seventh abdominal sternite of this species resembles that of *E. sideroxylonella* in general form, but differs in having the median caudal lobe less pronounced. Like the latter, *E. manilkarae* has also been reared from two genera of Sapotaceae. The females of *E. manilkarae* possess the smallest corpus bursae of any member of the genus. The signa consist of paired, slender to oval plates, each usually armed with one but occasionally two spines of variable size. The complete range of variation, as illustrated from specimens all reared from *Manilkara* (Fig. 182-187), shows no obvious correlation with host or locality.

This species was common at both sites where we found *Manilkara* growing in the Florida Keys. It has also been reared from *Bumelia celastrina* in subtropical Florida and Texas. On *Manilkara bahamensis* the mines occur on the underside of young, yellow-green, still-expanding leaves (Fig. 17-18, 29). The serpentine early track often has a reddish orange frass stain that occasionally zigzags from side to side. The mine tends to be dirty brown and more opaque than that of other *Eucosmophora*. Often there are numerous small tears in the mine that may or may not be sealed over by the larva with a thin webbing of silk. The last two instars mine deeply into the parenchyma, causing discoloration which is visible from above. Mature mines may have an abundance of minute creasing over the lower leaf surface (Fig. 18). Dimensions (of blotch mine): 8-10 x 24-32 mm, n=5.

The egg is oval, glassy, measures 0.21-0.30 x 0.36-40 mm, (n=4). On *Bumelia celastrina* it is laid on the upper or lower leaf surface of new leaves. Fully expanded leaves are unsuitable. The mine begins as a narrow track that follows a leaf edge or snakes about the lamina. This portion of mine appears almost free of frass except for some subtle staining on the outer mine surface. By the second instar, the mine, often with a dark central channel stained by frass, may repeatedly cross itself, especially in smaller leaves (Fig. 28). In the third instar the mine is enlarged into a blotch that occupies most of the lamina. The dark, tacky frass that adheres to the outer mine

surface renders most of the mine opaque. In the last two instars, silk is used to draw the edges of the mine together. Many upper surface mines abort possibly because the larva is unable to draw the leaf edges upward. In lower surface mines the leaf tip is drawn back toward the petiole (Fig. 28, lower right leaf); so much silk may be deposited within the mine that the lower leaf surface appears white. Silk deposition within the mine may give it as much as 4-5 mm of depth.

Shed head capsule widths were as follows: 1<sup>st</sup> (sap-feeding), 0.15-0.16 mm, n= 4; 2<sup>nd</sup> (sap-feeding), 0.22-0.26 mm, n=6; 3<sup>rd</sup> (sap-feeding), 0.31-0.36, n=4; 4<sup>th</sup> (tissue-feeding), 0.32-0.36, n=5; and 5<sup>th</sup> (tissue-feeding), 0.40, n=1.

The cocoon is oval, light to orange-brown (Fig. 18, upper left leaf), and often bears 0-2 bubbles on its outer surface, with bubble(s) positioned at either end of the cocoon. If spun on a *Bumelia* leaf, the edge is drawn inward and about the cocoon.

#### *Eucosmophora eclampsis* (Durrant), new comb.

Fig. 11, 188-190; Map 2

*Acrocercops eclampsis* Durrant, in Walsingham, 1914:339.— Davis, 1984:26.

MALE.— Unknown.

FEMALE (Fig. 11).— Length of forewing 3.5 mm. Head: Frons silvery white; vertex and scales along inner margin of eye light bronzy gold. Antenna with scape, pedicel, and flagellum light gray dorsally, paler and more whitish to pale buff ventrally. Maxillary palpus white basally, becoming pale buff laterally and over entire apical segment. Labial palpus pale buff to cream laterally, more white mesally.

Thorax: Dorsum (largely obliterated by pin) and tegula brownish orange; venter white. Forewing predominantly brownish orange; fuscous costal spot at wing base roughly triangular, much broader along costal margin; costal silver spot at 2/5 slightly curved from costa, very slender, ~4x longer than broad, edged with black; basal 1/4 of wing golden silver over anal area, continuing as a slender dorsal margin along brownish orange ground color to a second, golden spot ~ half the length of basal spot along dorsal margin 3/5 immediately before tornus; elongate subapical fuscous patch with purplish luster and enclosing slender golden silvery streak extending most the length of termen; fringe uniformly light brown; forewing dark brown ventrally except for pale yellowish white anal area. Hindwing uniformly gray dorsally and ventrally. Foreleg predominantly whitish cream with brownish suffusion dorsally over most of tibia and encircling apices of tarsomeres; midleg whitish cream ventrally, very pale buff dorsally with faint banding dorsally on tarsomeres; hindleg whitish cream with dark fuscous suffusion laterally; tibia predominantly fuscous laterally and dorsally, with faint brown banding over tarsomeres. Abdomen: Mostly bronzy brown dorsally and laterally, except white laterally over A5 and caudal half of A4; white ventrally.

FEMALE GENITALIA (Fig. 188-190).— Ductus bursae elongate, ~ 3.1x length of corpus bursae, very slender, anterior 1/4 gradually expanding to half the diameter of corpus bursae at their juncture, lined internally with evenly distributed, minute, triangular spicules over most of length, with spicules gradually becoming larger and more irregular over most of expanded anterior end. Corpus bursae relatively small, sharply set off from termination of ductus bursae by a slender, sclerotized, ovoid ring nearly equal in size to diameter of corpus bursae; signa consisting of pair of small, ~ round, flattened disks, each bearing pair of short spines near caudal rim; wall of corpus bursae membranous, without spicules (Fig. 190).

TYPE.— Holotype, ♀; Panama, III. 1860, R. H. Stretch, slide BMNH 30829, type ♂ [sic], (BMNH).

HOST.— Unknown.

DISTRIBUTION (Map 2).— Known only from Panama (specific locality unknown).

MATERIAL EXAMINED.— PANAMA: 1♀ (holotype).

REMARKS.— Durrant described *E. eclampsis* from a single female (erroneously sexed as a male) from an unspecified site in Panama. The forewing pattern of this species is similar to that of *E. ingae* in most respects, including the development of an elongate, fuscous spot

along the base of the costal margin. The presence of an annular sclerotization at the junction of the ductus bursae and corpus bursae, as well as the unique structure of a pair of small, lenticular signa are diagnostic for the female of this species.

***Eucosmophora pithecellobiae* Davis & Wagner, new sp.**

Fig. 12, 21-22, 30, 38-72, 120, 153-155, 191-192; Map 2

MALE (Fig. 12): Length of forewing 3.0-3.9 mm. *Head*: lower frons silver, upper frons golden, with gray to fuscous suffusion over vertex, and often with purplish reflections in some specimens; collar scales orange. Antenna with scape and pedicel orange; flagellum fuscous dorsally, pale gray ventrally. Maxillary and labial palpi mostly pale golden to orange; maxillary palpus somewhat roughened, occasionally with subtle fuscous scaling dorsally. *Thorax*: Dorsum pale golden, shiny; tegula fuscous and golden, with coppery or purple reflections; venter silvery with purple-red coppery reflections on pleuron under wings. Forewing with prominent pale orange band across middle that narrows to inner margin and extends along costa, as slender spur, to apex. Silver spot at 2/5 with little fuscous scaling; hind margin mostly golden except where interrupted by orange band; base of costa with narrowly divided fuscous spot; diffuse fuscous patch at 3/4; apex of wing suffused with fuscous to pale yellow; cilia pale brown to gray; forewing generally darker, more fuscous in Belize specimens. Legs mostly pale golden brown except for silvery white over femora; black scaling present over dorsolateral surface of tibia and basal tarsomeres. *Abdomen*: Gray to fuscous dorsally and down sides of A3-5, becoming decidedly coppery laterally, pale yellowish white ventrally. Sternum 7 nearly 2x as long as broad, somewhat pentangular, with digitate midcaudal lobe (Fig. 155). Eighth sternites elongate-triangular, approximately equaling length of main body of tergum 8. Tergum 8 with rod-like process extending into A7 over 3/4 length of sternum 7; apex of tergal rod rounded-triangular.

MALE GENITALIA (Fig. 153-154).—Valva without midcostal lobe; small patch of 6-8 thickened setae near midventral margin and row of 6-9 spinose setae more basally. Aedeagus, gradually tapered, apex acute with 4-5 minute apical spines (Fig. 154).

FEMALE.—Length of forewing 3.3-4.0 mm. Similar to male in color pattern.

FEMALE GENITALIA (Fig. 191-192).—Antrum sclerotized, length ca. 2/3 length of free end of anterior apophysis. Internal wall of ductus bursae sparsely covered with minute spicules; ventral half of wall sclerotized across its entire length; signa consisting of pair of relatively large oval plates ca. half length of corpus, each bearing ca. 30 stout inward-projecting spines.

LARVA (Fig. 38-59, 65-72).—Length 3.1 mm; width 0.45 mm. Instar 5 maximum length: 5.4 mm, width: 0.9 mm.

Sap-feeding Instars

*Head*: Two pairs of stemmata in widely spaced pairs (Fig. 44-45). Labrum ~ half width of labium; anterior margin subtruncate, slightly concave (Fig. 39). Labial palpi reduced with basal segment barely evident (Fig. 42-43).

Tissue-Feeding Instars

*Head*: Three pairs of stemmata arranged laterally in two widely spaced rows (Fig. 56-57), that closest to S2 reduced. Labrum shallowly emarginated. Mandible with 3 large inner cusps and 2 small lateral cusps (Fig. 72).

*Thorax*: Pronotum with XD2 present.

*Abdomen*: A2 with SV3 absent. Crochets as described for *E. ingae*.

PUPA (Fig. 60-64, 120).—As illustrated; very similar to that described for *E. ingae* except dorsal pair of cremasteral spines arising closer together (Fig. 61-62).

HOLOTYPE.—♂; Upper Key Largo, Dynamite Hammock, Monroe Co. Florida, mine 11 Mar 1991, em[erged]. 28-31 Mar 1991, D.L. Wagner & D.R. Davis, DLW Lot 91C93, host: *Pithecellobium unguis-cati*, slide 4020, (DLW).

PARATYPES.—BELIZE: Cockscomb Wildlife Sanctuary, 12 km W of Kendal, 16°47'N, 88°26'W: 2♂, 3♀, [mines] 22 Jan 1991, emerg. 18 Feb 1991, D.R. Davis, host: *Pithecellobium* sp., DRD 865, slides USNM 31805, 31806, (USNM). Las Cuevas, Chiquibul Forest, 550 m: 1♂, 18 Feb 1998, 1♀, 4 Mar 1998, 2♀, 9-10 Mar 1988, 1♂, 6 Apr 1988, O.T. Lewis, host: *Pithecellobium macrandrium*, USNM 32207, (OTL, USNM). USA: FLORIDA: Broward Co., Hollywood: 5♂, [mines] 8-9 Mar 1991, emerg. 27-

31 Mar 1991, D.L. Wagner, DLW Lot 91C11, host: *Pithecellobium guadalupense*, (DLW). Monroe Co: Key Largo: 1♀, 19 Oct 1964, 3♂, 1♀, 2-17 Nov 1964, S. Kemp, slide USNM 31832, (USNM); Key Largo, Dynamite Hammock: 2♀, [mines] 11 Feb 1992, emerg. 27-28 Feb 1992, D.L. Wagner, DLW Lot 92B71, host: *Pithecellobium unguis-cati*, (DLW), 2♂, 3♀, [mines] 11 Mar 1993, emerg. 28 Mar - 4 Apr 1993, D.L. Wagner & D.R. Davis, DLW Lot 91C93, host: *Pithecellobium unguis-cati*, (DLW); 1♂, [mines] 13 Apr 1998, found dead 29 Apr 1998, D.R. Davis, DRD 2144, host: *Pithecellobium unguis-cati*, (USNM); Key Largo Hammock Botanical Site, 25°16'N, 80°17'W: 1♀, [mine] 17 Apr 1995, emerg. 15 May 1995, D.R. Davis, DRD 1641.2, host: *Pithecellobium guadalupense*, slide USNM 31649, (USNM); north Key Largo, jct. routes 905 and 1♂, 1♀, [mines] 24-25 Apr 1998, emerg. 12-16 May 1998, D.L. Wagner, DLW Lot 98D67, host: *Pithecellobium guadalupense*, (DLW); 4♂, 2♀, [mines] 24-25 Apr 1998, emerg. 8/16 May 1998, D.L. Wagner, host: *Pithecellobium unguis-cati*, DLW Lot 98D69, (DLW).

HOSTS.—FABACEAE: *Pithecellobium guadalupense* (Pers.) Champ.; *Pithecellobium macrandrium* Donn. Sm.; *P. unguis-cati* (L.) Benth.

DISTRIBUTION (Map 2).—Monroe County, Florida and southern Belize.

ETYMOLOGY.—The species name is derived from the generic name, *Pithecellobium* [occasionally misspelled *Pithecolobium*, Willis, 1973], of the larval host plant.

REMARKS.—This species is one of three members of *Eucosmophora* known to feed on Fabaceae - the others being *E. dives* and *E. ingae*, which have been reared from *Inga*. The large, oval, spinose, platelike signa of *E. pithecellobiae* constitutes the most diagnostic character. The signa resemble those of the following unnamed species from southern Venezuela.

On *Pithecellobium unguis-cati* the egg is laid on the upper surface along the lateral vein or a non-vascular portion of the lamina. It is oval, flattened, glassy with subtle iridescent reflections, without frass inclusions, with the following dimensions: 0.28-0.34 x 0.42-0.44 mm, (n = 6). The initial serpentine track often is obliterated by the blotch fashioned by third instar larva. The upper surface of the mine is waxy translucent—the larva remains visible within the mine throughout its development. Portions of the upper mine surface are discolored by the liquidy frass excreted by the sap-feeding instars. The larva removes patches of parenchyma from the floor of the mine, especially about the periphery. The dark green frass is concentrated along the edges of the mine. Mature mines measure 13-25 x 28-32 mm, (n=10).

Shed head capsule widths were as follows: 1<sup>st</sup> (sap-feeding), 0.15-0.20 mm, n=7; 2<sup>nd</sup> (sap-feeding), 0.25-0.30 mm, n=7; 3<sup>rd</sup> (sap-feeding), 0.37-0.41 mm, n=7; 4<sup>th</sup> (tissue-feeding), 0.40-0.42 mm, n=6; and 5<sup>th</sup> (tissue-feeding), 0.45-0.50 mm, n=2.

The larva exits the mine through a hemispherical slit in the upper mine surface and then, presumably, drops into leaf litter to pupate. The oval cocoon, of light orange-brown silk, is free of bubbles: 3 x 6 mm (n=4).

Although this species may be locally common, with more than 30 mines being located on some plants, we have had difficulty rearing adults from harvested leaves. Our collections begin to smell of almonds after a few days, and we wonder if the excised foliage might produce toxic compounds lethal to the immature stages.

***Eucosmophora* species**

Fig. 193-194; Map 2

This unidentified species is represented by a single female in poor condition that was collected in a UV canopy trap (~ 15 m high) near the basecamp site of *E. prolata*. Although the forewings are rubbed, its general wing pattern appears similar to *prolata*, a suspected leafminer on a species of Sapotaceae. Because both antennae are broken, length comparisons with those of *prolata* are impossible.

The female genitalia differ markedly from *prolata* in possessing

a pair of large, elliptical platelike signa bearing numerous stout spines in several, longitudinal rows. The antrum of this species also differs from the more membranous antrum of *prolata* in possessing a short, sclerotized collar partially encircling the caudal end of the ductus. Anterior to the antrum, the walls of the ductus bursae are densely covered with minute ovoid-triangular spicules; one side of the ductus bursae is sclerotized for nearly half of the anterior end as shown (Fig. 194). The overall morphology of the female genitalia suggests an affinity to *E. pithecellobiae*.

HOST.—Unknown; probably Fabaceae.

DISTRIBUTION (Map 2).—Southwestern Venezuela.

MATERIAL EXAMINED.—VENEZUELA: T. F. AMAZONAS: Basecamp, 155 m, 0°50'N, 66°9'44"W, canopy UV trap, Cerro de la Neblina: 1♀, 23-29 Feb 1984, D.R. Davis and T. McCabe, slide USNM 31830, (USNM).

#### *Eucosmophora echinulata* Davis & Wagner, new sp.

Fig. 13, 195-196; Map 1

MALE.—Unknown.

FEMALE (Fig. 13).—*Head*: Length of forewing 4.1 mm. Vertex silvery gray, becoming darker, shiny fuscous caudally to narrow, straw occipital fringe; frons silvery with slight golden luster. Antenna mostly silver overscape and pedicel with dorsoanterior surface of flagellum pale shiny gray; ventroposterior surface of flagellum darker gray. Maxillary palpus similar to frons in color; apical segment suffused with yellowish brown. Labial palpus slender with segments 1-2 similar in color to frons; apical segment (3) with pale brownish suffusion especially ventrally, long, nearly 1.5x length of middle segment. *Thorax*: Dark shiny gray dorsally and over tegula; mostly white ventrally, except for coppery brown pleural patch beneath wings. Forewing with an irregular, sinuate streak of pale orange resembling a horizontal number 5 across middle third of wing; distal margin nearly perpendicular to costa, edged with fuscous; elliptical, silvery spot before middle of costa edged with fuscous; basal third of wing dark fuscous along costa, becoming more gray over subcostal area, gradually becoming pale gray with golden luster over anal region and continuing irregularly along hind margin to termen; apical third of wing almost entirely dark gray; fringe mostly dark gray with dull orange suffusion along termen. Hindwing uniformly dark gray. Foreleg predominantly buff, with two fuscous, dorsal bands across tibia; tarsi with fuscous suffusion dorsally over most segments, forming band across first and second tarosmeres. Midleg similarly marked but with fuscous scaling over tarsi inconspicuous; lateral (shorter) tibial spur with fuscous suffusion dorsally over distal half. Hindleg buff with proximal surface of tibia entirely fuscous except for buff apex and spurs; tarsi with slight fuscous suffusion dorsally. *Abdomen*: Dark fuscous with slight purplish luster dorsally and continuing laterally as a gradually narrowing, oblique band to midventer on A3-5; last (eighth) segment entirely fuscous to gray; ventral area pale yellow between dark bands.

FEMALE GENITALIA (Fig. 195-196).—Ductus bursae lined internally with evenly distributed, relatively faint, minute spicules; antrum with pair of small, sclerotized rods. Corpus bursae relatively small, turned sharply posteriorly near small appendix-like protrusion; almost entire inner wall of corpus bursae densely lined with elongate spines with stellate bases.

HOLOTYPE.—1♀; Itapua: El Tirol, 27°10'S, 55°45'W, Paraguay, 22-23, 25-26 Apr 1986, M. Pogue & A. Solis, slide USNM 31825, (USNM).

PARATYPES.—PARAGUAY: Same data as holotype: 1♀, [abdomen missing], (USNM).

HOST.—Unknown, probably Fabaceae.

DISTRIBUTION (Map 1).—Known only from the type locality, which is moist forest habitat located in extreme southern Paraguay.

ETYMOLOGY.—The specific epithet is derived from the Greek *echinulatos* (with small spines), in reference to the dense concentration of spines within the corpus bursae.

REMARKS.—This species is currently represented by two females collected at UV light from a moist forest habitat in southern Paraguay. Several adult characters distinguish *E. echinulata* from its congeners: the slender labial palpi, with elongated distal segment (maxillary palpus ca. 1.5x length of procoxa); the orange '5' on the

forewing, with perpendicular distal margin; the poorly defined fuscous patch at the wing base; and the absence of yellow or metallic gold scales along the inner margin at the base of the wing. The highly apomorphic spinose signum lining much of the interior wall of the corpus bursae, which somewhat resembles the signum of *E. dives*, suggests affinities with the other Fabaceae miners of *Eucosmophora*.

#### *Eucosmophora dives* Walsingham

Fig. 14, 31-37, 156-158, 197-200; Map 3

*Eucosmophora dives* Walsingham, 1897:149.—Vari, 1961:40.—Davis, 1984:26.—Nye and Fletcher, 1991:121.

*Acrocercops dives* (Walsingham).—Meyrick, 1912a:18; 1912b:46.—Fletcher, 1929:88.—Forbes, 1930:141.

MALE.—Length of forewing 3.3 - 3.7 mm. *Head* (Fig. 31): Frons shiny white; vertex pale yellow with golden to grayish brown luster. Antenna with scape mostly pale yellow; flagellum predominately brown dorsally, pale yellow ventrally. Maxillary and labial palpi whitish to pale yellow. *Thorax*: Mostly pale yellow, grayish to brown over pronotum, silvery white ventrally. Forewing with orange scales reduced, confined mostly to anterior half of wing; basal fuscous patch oval, not divided; silver spot at 2/5 edged with fuscous; subtended by field of scattered fuscous scales that divide two large metallic gold patches along inner margin; fuscous over most of distal third of wing; cilia pale fuscous. Hindwing uniformly pale fuscous. Fore- and midlegs mostly buff, with two fuscous bands over tibiae and fuscous suffusion over dorsum of tarsomeres; outer surface of metatibia darkened from base to first tibial spur, other fuscous scaling inconspicuous. *Abdomen*: Brownish fuscous above with slight golden luster down sides of segments A3-5, white ventrally. Sternite 7 somewhat pentangular with slender, midcaudal digitate process (Fig. 158). Eighth sternite moderately enlarged, approximating an elongate triangle nearly as long as main body of tergum 8. Tergum 8 with rod-like process extending anteriorly into A7 about 3/4 length of sternum 7 (Fig. 35, 158), its anterior end rounded.

MALE GENITALIA (Fig. 156-157).—Valva broadly oval, widest at midlength, without costal lobe; 2-3 moderately large spinose setae arising from ventral margin near basal third; mesal surface with numerous moderately long setae. Aedeagus acute, narrowing appreciably subapically (Fig. 157).

FEMALE (Fig. 14).—Similar to male in color pattern; length of forewing 3.5-4 mm. *Abdomen*: Similar to male in pattern but generally darker dorsally, with pleuron of A5 more dark brown.

FEMALE GENITALIA (Fig. 197-200).—Corpus bursae with accessory sac (less than half volume of main bursa) arising from anterior end; signum an irregular, elongate and somewhat folded plate bearing numerous, short, stout, peg-like spines from inner surface; caudal half of signum reduced to slender rod extending into anterior end of ductus bursae. Spermatophore (Fig. 200) similar to signum in outline, consisting of elliptical sac with tubular extension (only one spermatophore observed).

TYPE.—Holotype ♀ [erroneously sexed as ♂ by Walsingham]; Balthazar, windward side, 250 ft [76.2 m], Grenada, 5 May, H.H. Smith, slide BM 27922 (BMNH).

HOST.—FABACEAE: *Inga fagifolia* (L.) Willd. [= *Inga laurina* (Swartz) Willd.]

DISTRIBUTION (Map 3).—West Indies from Puerto Rico to Grenada.

MATERIAL EXAMINED.—BRITISH VIRGIN ISLANDS: Tortola Island: Mt. Sage National Park, 460 m: 4♂, 7-8 Jul 1985, S. & P. Miller *et al.*, blacklight trap in "aridulate" rain forest, USNM slide 31815, same data except: 9♂, 5♀, 22-24 Jul 1986, S. Miller & M. Pogue, slides USNM 31811-31813, (USNM). DOMINICAN REPUBLIC: St. Domingo, San Francisco Mts: 1♀, Sep 1905, A. Busck, slide USNM 31831, (USNM). GRENADA: Balthazar, windward side, 250 ft [76.2 m]: 1♀ [type, erroneously sexed as ♂ by Walsingham], 5 May, H.H. Smith, slide BM 27922 (BMNH). PUERTO RICO: Mayaguez: 1♀, 1 Apr 1917, 1u, 17 Apr, 1917, R. H. van Zwelenburg, leafminer on *Inga laurina*, slide USNM 31808, (USNM).

REMARKS.—Originally described from Grenada, this widespread insular species has subsequently been collected from several islands in both the Greater and Lesser Antilles. According to data on

specimens in the USNM from Mayaguez, Puerto Rico, the larva feeds on *Inga fagifolia*. The type series consists of 6 specimens from Balthazar, 250 ft., and Chantilly Estate, 350 ft., windward side, Grenada (Walsingham, 1897).

The orange scaling is reduced relative to other *Eucosmophora*. In most specimens there is no line or path of orange scales that extends from the costal to inner margins. The shape and position of the black basal spot is also distinctive; most individuals lack the small black spot at the extreme wing base, adjacent to the tegula, shown in Fig. 14. Substantial phenotypic variation is represented among the 22 adults we had available for study; unfortunately nearly all of the specimens are worn or otherwise damaged making it difficult for us to know which scaling characters are diagnostic for *E. dives*.

#### *Eucosmophora ingae* Davis & Wagner, new sp.

Fig. 15, 25, 73-119, 121, 159-162, 201-203; Map 1

MALE (Fig. 15).—Length of forewing 3.1 - 3.6 mm. *Head*: Frons silver; vertex dark shiny gray with collar of pale yellow scales. Antenna with scape and pedicel uniformly orange-brown; flagellum dark gray dorsally, paler gray ventrally, distal segments appearing whitened. Maxillary and labial palpi pale orange-brown. *Thorax*: Pronotum and tegula dark fuscous with coppery and purple reflections; scutellum yellow; venter mostly silvery white, except for coppery patch on pleuron below forewings. Forewing with metallic basal third and gold patch at 3/5 separated by line of fuscous along hind margin; small fuscous spot at extreme base (near tegula) narrowly separated from larger, more elongate, fuscous costal spot; middle third mostly pale orange, with slender spur along costa; silver spot at 2/5 elongated, bordered with fuscous; distal fourth mostly fuscous; cilia fuscous. Hindwing dark fuscous. Foreleg pale golden brown, with three fuscous spots dorsally on tibia and weak suffusion of fuscous over first tarsomere; midleg similar except with reduced suffusion on tarsomeres; hindleg with femur silvery white except for apical black scales along lateroventral margin; hindtibia white to off white, with black scales laterally from base to first spurs, fading slightly to fuscous along outer side of most of tibia; tarsomeres off white except for fuscous dorsally on first segment. *Abdomen*: Shiny fuscous dorsally and down sides of A3-5 and A7-8; silvery white to off white ventrally. Sternum 7 quadrate anteriorly and broadly rounded caudally, with short, stout midcaudal process; process about 0.15x length of main body of sternum. Eighth sternite relatively large, elongate and triangular in shape, nearly as long as main body of tergum 8 (Fig. 162). Tergum 8 with rod-like process extending anteriorly into A7 about 3/4 length of sternum 7; process clavate, terminating in small round knob.

MALE GENITALIA (Fig. 159-161).—Valva without costal lobe; somewhat, scattered concentration of ~ 15 moderately large, spinose setae arising near midventral margin; lateral surface of valva with moderately large sex scales on basal half and much smaller sex scales over distal half. Aedeagus elongate, narrowing abruptly to apex, without exogenous spines (Fig. 160).

FEMALE.—Similar to male in color pattern; length of forewing 3.1-3.4 mm.

FEMALE GENITALIA (Fig. 201-203).—Corpus bursae with prominent, rigid, V-shaped, indented, ventral fold near junction with ductus bursae. Signa absent.

LARVA (Fig. 73-104, 112-119).—Similar to that described for *E. pithecellobiae*. Instar 3 maximum length 3.4 mm; width 0.45 mm. Instar 5 maximum length: 5.8 mm; width: 0.8 mm.

#### Sap-feeding Instars

*Head*: Four pairs of well developed stemmata as in *E. pithecellobiae*, with an additional fifth stemma at least partially developed ventral to anterior pair (Fig. 80-81). Labrum broader and more V-shaped with anterior margin more deeply incised (Fig. 74).

#### Tissue-feeding Instars

*Head*: Mandible with cusps shorter and more truncate (Fig. 119) than *E. pithecellobiae*.

*Thorax*: Pronotum with XD2 absent (Fig. 96). *Abdomen*: A2 with SV3 present.

PUPA (Fig. 105-111, 121).—As illustrated; similar to *E. pithecellobiae*

except dorsal cremasteral spines more widely separated.

HOLOTYPE.—♂; Estación Biología La Selva, 50-150 m, 10°26'N, 84°01'W, Heredia, Costa Rica, mine 10 Feb 1997, em[erged]. 6 Mar 1997, D.L. Wagner, DLW Lot 97B22, host: *Inga oerstediana*, slide DRD 4039, (INBIO).

PARATYPES.—COSTA RICA: Same locality as holotype: 2♂, 2♀, [mines] 16-28 Apr 1996, D.L. Wagner & D.R. Davis, emerg. 30 Apr 1996, 3 May 1996, DLW Lot 96D9, host: *Inga*, 2 larvae, pupae, slides DRD 4038, 4040, (DLW); 1♂, [mine] 17 Apr 1996, emerg. 30 Apr 1996, D.R. Davis & D.L. Wagner, DRD 1750, host: *Inga*, 1 larva, [mines], (USNM); 1♂, [mine] 10 Feb 1997, emerg. 9 Mar 1997, David L. Wagner, DLW Lot 97B22, host: *Inga oerstediana*, (DLW); 7♂, [mines] 19-30 Jan 1998, emerg. 7 Feb 1998, D.L. Wagner & D.R. Davis, DLW Lot 98A23, host: *Inga oerstediana*, (DLW); 2♂, 1♀, [mines & cocoons] 19 Jan 1998, emerg. 11 Feb 1998, D.L. Wagner, DLW Lot 99A155, host: *Inga oerstediana*, (DLW); 2♂, 1♀, [mines] 19-30 Jan 1998, emerg. 15-17 Feb 1998, D.L. Wagner & D.R. Davis, DLW Lot 98A169, host: *Pithecellobium catenatum*, slides USNM 32197, 32198, (DLW); 4 larvae, [mines] 21 Jan - 3 Feb 1998, D.R. Davis & D.L. Wagner, DRD 1906, host: *Inga oerstediana*, (USNM); 2♂, 13 Apr 1999, UV trap, secondary forest, slide USNM 32195, (INBIO); 1♂, 6 May 1999, UV trap, primary forest, (INBIO).

HOSTS- FABACEAE: *Inga oerstediana* Benth. ex Seemann; *Pithecellobium catenatum* Donn. Sm.

PARASITOIDS.—*Gnampydon* sp. (Braconidae).

DISTRIBUTION (Map 1).—Adults currently known only from the lowland rain forest site at the La Selva Biological Station, Heredia Province, Costa Rica. Leaf mines believed to represent this species have also been collected (DRD lot 2090) in mid-elevation forests along the road to Brasilia, Guanacaste Province, Costa Rica.

ETYMOLOGY.—The species name is derived from the generic name, *Inga*, of the plant hosts.

REMARKS.—This is one of two *Eucosmophora* species known to mine leaves of *Inga*, the other being the West Indian *E. dives*. Adults of *E. ingae* have also been reared from *Pithecellobium* at La Selva, Costa Rica (DLW Lot 98A169). The forewings are generally darker than in *E. dives*, and the antennae longer by nearly 1/4 their length. The caudal lobe of the male seventh sternum is relatively shorter than that of *E. dives* and more slender than that present in *pithecellobiae*. The females of *E. ingae* and *E. trimetalla* are distinctive in being the only two species of the genus lacking a signum. The female of *E. ingae* differs from *E. trimetalla* in possessing a rigid, V-shaped fold at the junction of the ductus bursae and corpus bursae.

On *Inga oerstediana*, the egg is laid on the upper surface of new leaves. The early mine is serpentine, glassy, and winds about the lamina; later it is abruptly enlarged into an irregular blotch. The upper surface of the mine is nearly translucent, the larvae being visible within the mine through their development. Frequently two to five or more mines may anastomose into a single large blotch. Mines formed by a single larva measure 11-18 x 18-31 mm, (n=3); one large communal mine measured 135 x 170 mm. The larva exits through a hemispherical slit in the upper leaf surface. The cocoon is orange-brown.

#### *Eucosmophora trimetalla* (Meyrick), new comb.

Fig. 16, 204-205; Map 3

*Acrocercops trimetalla* Meyrick, 1915:226.

*Acrocercops trimetalla* [sic] - Davis, 1984:26.

MALE.—Length of forewing 3.7 mm. Color pattern similar to female. Abdomen and genitalia missing.

FEMALE (Fig. 16).—Length of forewing 3.7 mm. *Head*: Frons pale silvery buff; vertex bronzy brownish gray, with occipital fringe of cream. Antenna with scape and pedicel pale golden buff; flagellum bronzy brownish gray, paler, more cream ventrally over basal 10-12 flagellomeres. Maxillary palpus mostly creamy white, with suffusion of pale buff over apical segment.

Labial palpus whitish cream, lightly irrorated with pale brown laterally and ventrally.

**Thorax:** Dorsum and tegula pale brownish orange; venter cream with slight golden luster. Forewing predominantly orange continuing from basal 1/7 of costa to apex; base of wing brownish orange along costal half, gradually fading to paler orange near anal margin; small black costal spot near basal 1/7, bordered basally by equally small silvery white, costal spot; costal silvery white spot bordered with black at 2/5 elongate, length ~3x width; elongate, lustrous, dark gray spot extending full length of termen; fringe uniformly light brown; forewing brown ventrally except for pale grayish white anal area. Hindwing uniformly gray dorsally and ventrally. Foreleg predominantly whitish cream with light brownish suffusion dorsally over basal 1/3 and apical 1/3 of tibia and apices of tarsomeres; midleg missing; hindleg similar in color pattern to foreleg but with brownish suffusion even fainter. **Abdomen:** Mostly dark bronzy brown dorsally and laterally, except pale, whitish yellow ventrally and laterally over most of A4-6; terminal, piliform scales of A8 pale whitish yellow.

**FEMALE GENITALIA** (Fig. 204-205).—Ductus bursae elongate, nearly 3.5x length of corpus bursae, very slender, anterior 1/4 gradually expanding to half the diameter of corpus bursae at their juncture; walls extremely rugose, lined internally with evenly scattered, minute, predominantly triangular spicules over entire length; spicules becoming rather abruptly enlarged and more aligned in longitudinal rows over anterior fourth; spicules on one side of gradually inflated anterior fourth much larger and variable in shape than those on opposite side. Corpus bursae relatively small, without any sclerotizations, sharply set off from termination of ductus bursae; walls of bursa with faint, slightly irregular, longitudinally striated folds.

**TYPE.**—♀ (lectotype, present designation); Bartica, Brit. Guiana, [Jan 13], Parish, slide BMNH 30831, (BMNH).

**HOST.**—Unknown.

**DISTRIBUTION.**—Known only from the type locality, Bartica, Guyana, which is located near the junction of the Essequibo and Mazaruni Rivers.

**MATERIAL EXAMINED.**—**GUYANA:** Bartica: 1♀ (lectotype), Jan 13, Parish, slide BMNH 30831; 1♂ (paralectotype), Dec, Parish, (BMNH).

**REMARKS.**—Meyrick described this species from two specimens — a male now missing its abdomen and an intact female — collected at Bartica, Guyana. Because of its better condition, the female has been selected as the lectotype. The generally paler color of the forewings, with a proportionately greater area of pale brownish orange scales, distinguishes *E. trimetalla* from all other *Eucosmophora*, particularly from the other two species described from Guyana, *E. chrysocosma* and *E. melanactis*. The female genitalia of *E. trimetalla* is unusual in lacking a signum, a feature shared with *E. ingae*. Females of the latter are readily distinguished by the rigid, V-shaped, ventral fold at the junction of the ductus bursae and corpus bursae (Fig. 203).

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#### LITERATURE CITED

- Busck, A.**  
1900. New species of moths of the superfamily Tineina from Florida. *Proc. U.S. Nat. Mus.* (Washington), 23 (1208):225-254, pl. 1.
- Davis, D. R.**  
1983. Gracillariidae. In R. W. Hodges et al. (eds.), *Check List of the Lepidoptera of America North of Mexico*, 9-11. London: E.W. Classey and Wedge Ent. Res. Foundation.
1984. Gracillariidae. In J. B. Heppner (ed.), *Atlas of Neotropical Lepidoptera, Checklist: Part 1. Micropterigoidea-Immoidea*, 25-27. The Hague: Dr. W. Junk Publ.
- Ely, C. R.**  
1917. A revision of the North American Gracillariidae from the standpoint of venation. *Proc. Ent. Soc. Washington*, 19:29-77.
- Fletcher, T. B.**  
1929. A list of the generic names used for Microlepidoptera. *Mem. Dept. Agri. India. Ent. Ser.* (Calcutta), 11:ix + 246 p.
- Forbes, W. T. M.**  
1930. Insects of Porto [sic] Rico and the Virgin Islands. Heterocera or moths (excepting the Noctuidae, Geometridae, and Pyralidae). *Sci. Surv. Porto [sic] Rico and Virgin Islands*. 2(1):1-171, pls. 1-2. New York: N.Y. Acad. Sci.
- Kumata, T.**  
1992. Descriptions of thirteen new species of the genus *Chrysocercops* Kumata et Kuroko, 1988, from Malaysia and Nepal (Lepidoptera: Gracillariidae). *Ins. Matsum.* (Sapporo), (n.s.) 46:73-131.
- Kumata, T., H. Kuroka, and V. P. Ermolaev.**  
1988. Japanese species of the *Acrocercops*-group (Lepidoptera: Gracillariidae), parts 1-2. *Ins. Matsum.* (Sapporo), (n.s.) 38:1-111; 40:1-133.
- Kuznetsov, V. I.**  
1981. Family Gracillariidae. In G. S. Medvedev (ed.), *Keys to the Insects of the European Part of the USSR*. Vol. 4. Lepidoptera, Part 2:199-410. Akad. Nauk SSSR, Zool. Inst. [in Russian; English translation by U. S. Dept. of Agriculture, 1989. New Delhi: Amerind Publishing].
- Meyrick, E.**  
1912a. Lepidoptera Heterocera (Tineae), Fam. Gracillariidae [sic]. In *Genera Insectorum*, 1912:1-36, 1 col. pl.  
1912b. Adelidae, Micropterigidae, Gracillariidae [sic]. In *Lepidopterorum Catalogus*, pars 6:25-68. Berlin.  
1915. Descriptions of South American Micro-Lepidoptera. *Trans. Ent. Soc. London*, 1915:201-256.  
1920. *Exotic Microlepidoptera*, 2:289-320 [Mar]. Marlborough.  
1924. *Exotic Microlepidoptera*, 3:65-96 [Nov]. Marlborough.
- Nye, I. W. B., and D. S. Fletcher**  
1991. *The Generic Names of Moths of the World. Microlepidoptera*. Vol. 6. London: Nat. Hist. Mus. Publications. 368 pp.
- Vari, L.**  
1961. *Lithocolletidae. South African Lepidoptera*. Vol. 1. Pretoria: Transvaal Museum. 238pp, 112 pl. (*Mem.* 12)
- Wagner, D. L., J. L. Loose, T. D. Fitzgerald, J. A. De Benedictis, and D. R. Davis**  
2000. A hidden past: The hypermetamorphic development of *Marmara arbutiella* (Lepidoptera: Gracillariidae). *Ann. Ent. Soc. Amer.* (London), 93:59-64.
- Walsingham, T. de Grey, Lord**  
1897. Revision of the West-Indian Micro-Lepidoptera, with descriptions of new species. *Proc. Zool. Soc. Lond.* (London), 1897:54-183.  
1914. In F. D. Godman and O. Salvin, *Biology Centrali-Americana*, 42. *Lepidoptera-Heterocera*, 4:225-392. London.
- Willis, J. C. (Revised by H. K. Airy Shaw)**  
1973. *A Dictionary of the Flowering Plants and Ferns* (8th ed.). Cambridge: Cambridge Univ. Pr. 1243pp.

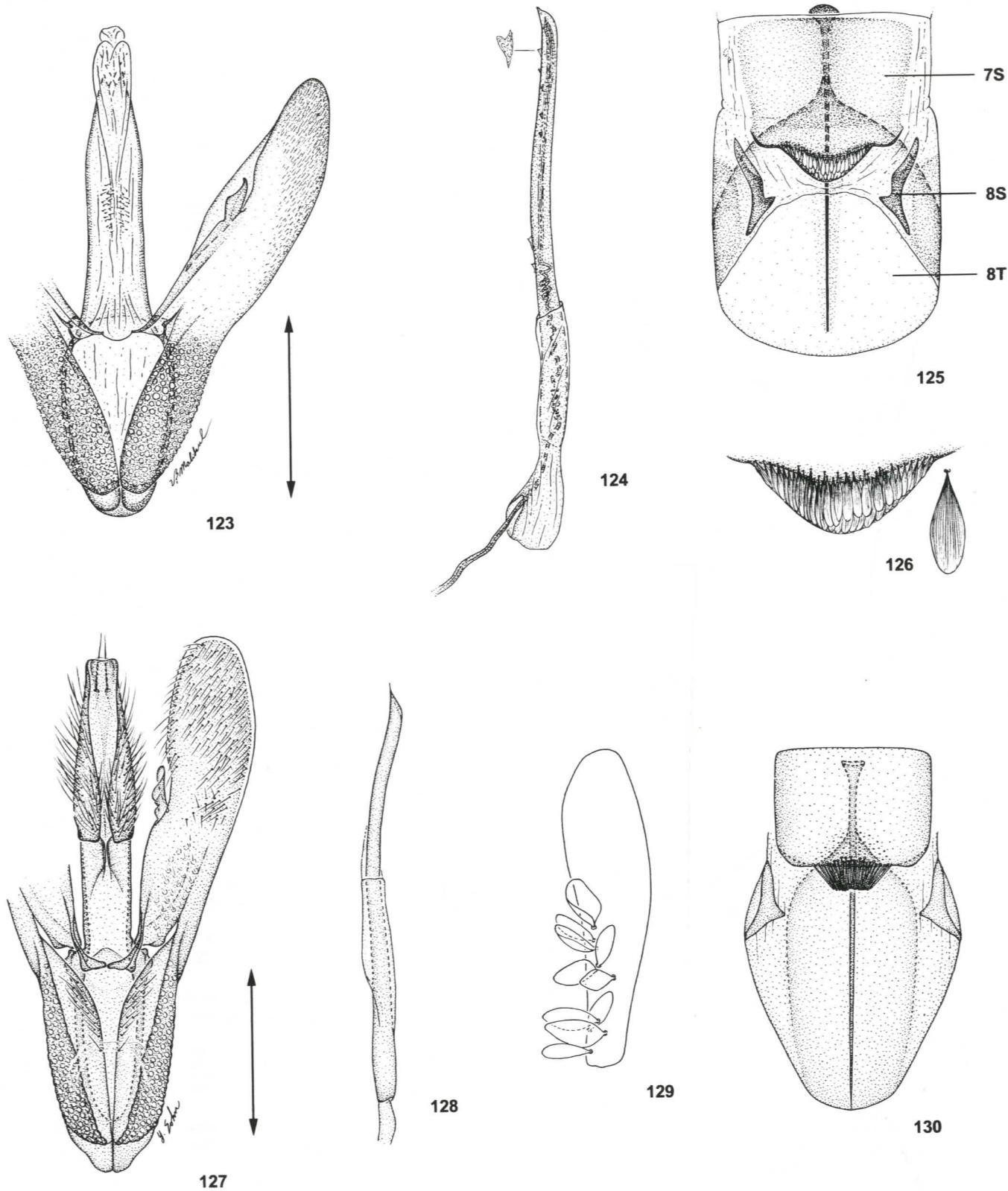


Fig. 123-130. *Eucosmophora* male genitalia and abdominal segments 7-8. 123. *E. atlantis*, ventral view. 124. Aedeagus. 125. Ventral view. 126. Detail of scale tuft at caudal margin of S7, with single scale enlarged. 127. *E. pouteriae*, ventral view. 128. Aedeagus. 129. Broad androconial scales of valva, lateral view. 130. Ventral view. (S = sternum; T = tergum; scales = 0.5 mm.)

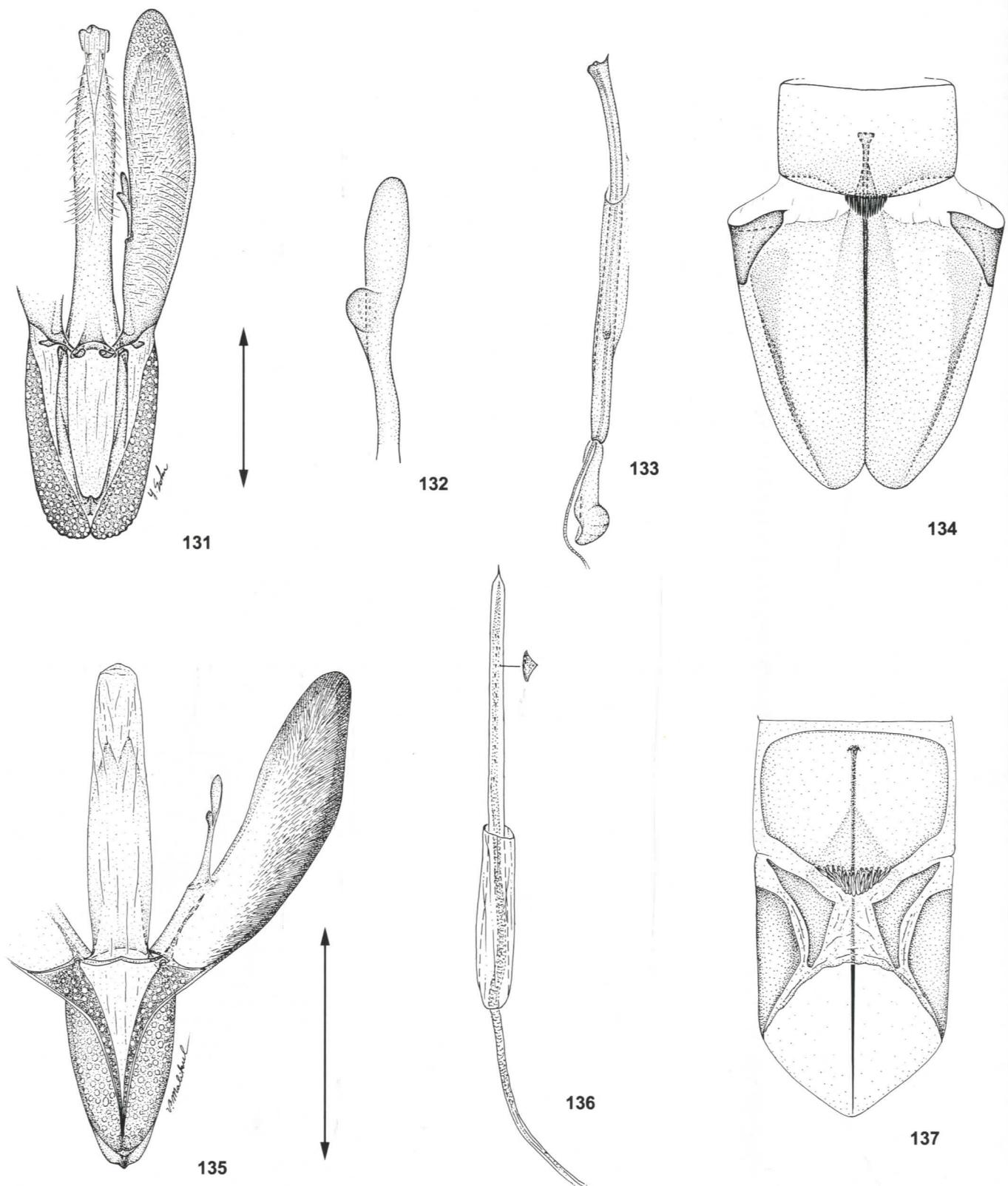


Fig. 131-137. *Eucosmophora* male genitalia and abdominal segments 7-8. 131. *E. chrysocosma*, ventral view. 132. Enlarged view of costal lobe of valva. 133. Aedeagus. 134. Ventral view. 135. *E. aspila*, ventral view. 136. Aedeagus. 137. Ventral view. (Scales = 0.5 mm.)

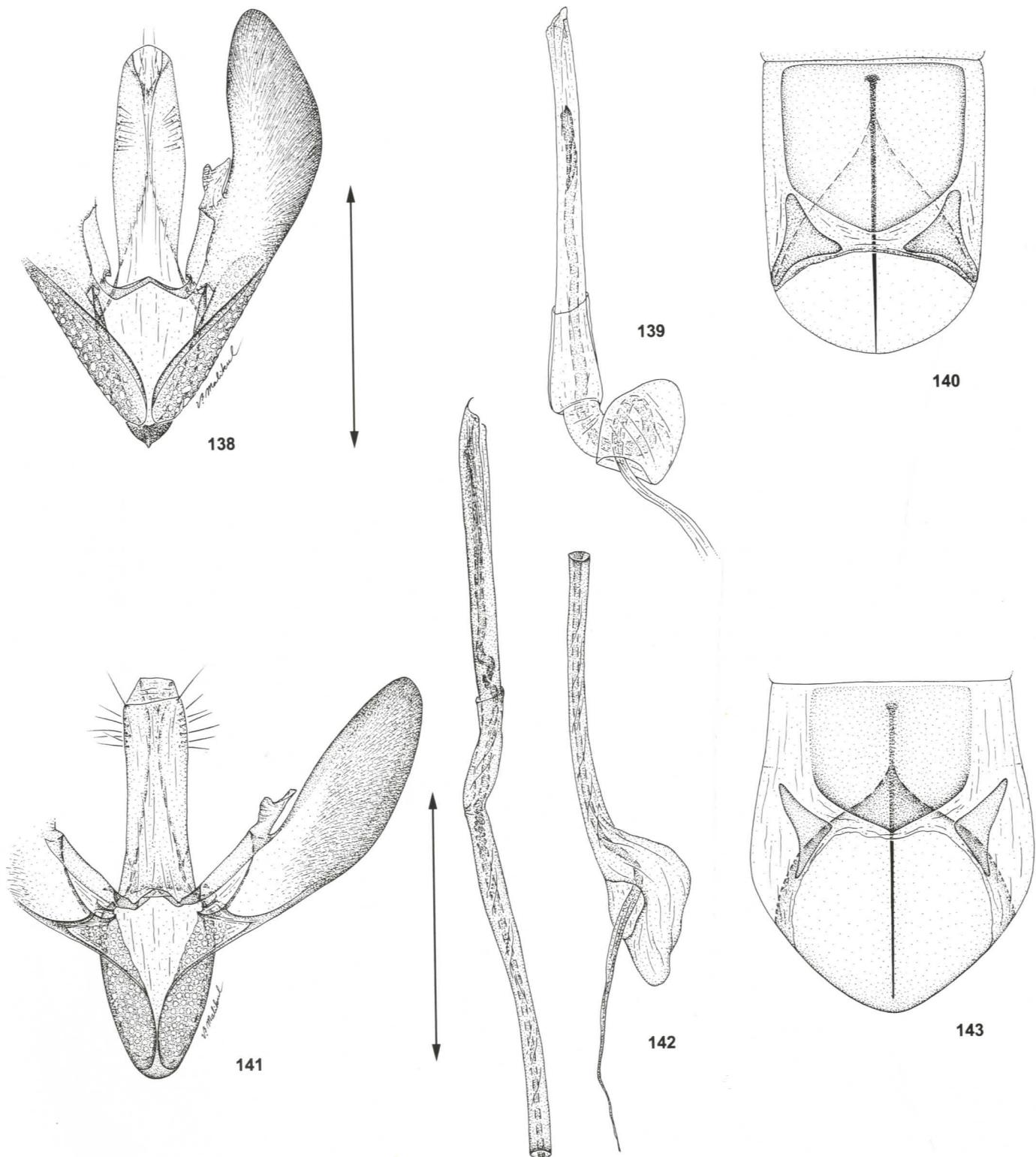


Fig. 138-143. *Eucosmophora* male genitalia and abdominal segments 7-8. 138. *E. eurychalca*, ventral view. 139. Aedoeagus. 140. Ventral view. 141. *E. melanactis*, ventral view. 142. Aedoeagus. 143. Ventral view. (Scales = 0.5 mm.)

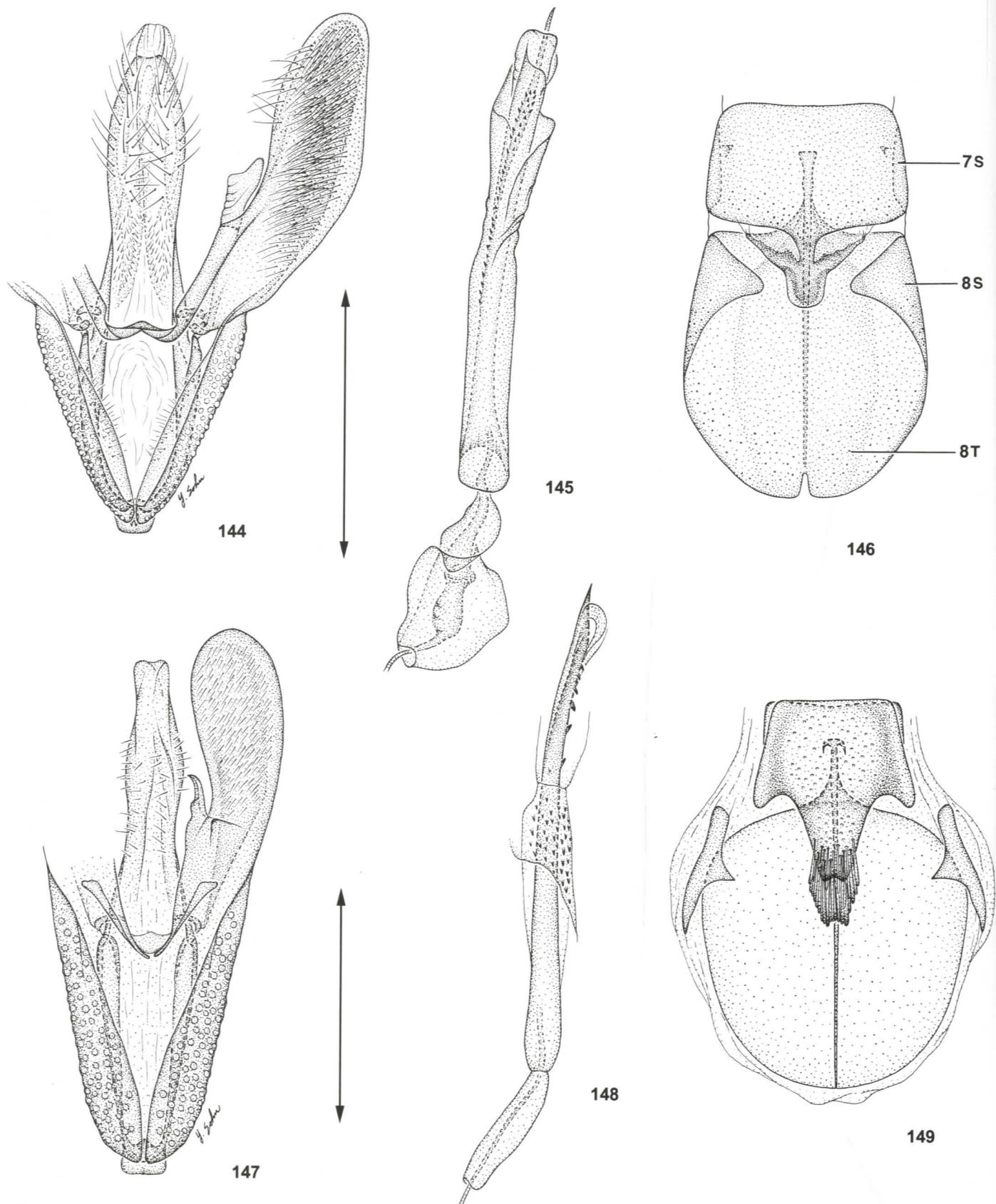


Fig. 144-149. *Eucosmophora* male genitalia and abdominal segments 7-8. 144. *E. paraguayensis*, ventral view. 145. Aedoeagus. 146. Ventral view. 147. *E. sideroxylonella*, ventral view. 148. Aedoeagus. 149. Ventral view. (S = sternum; T = tergum; scales = 0.5 mm)

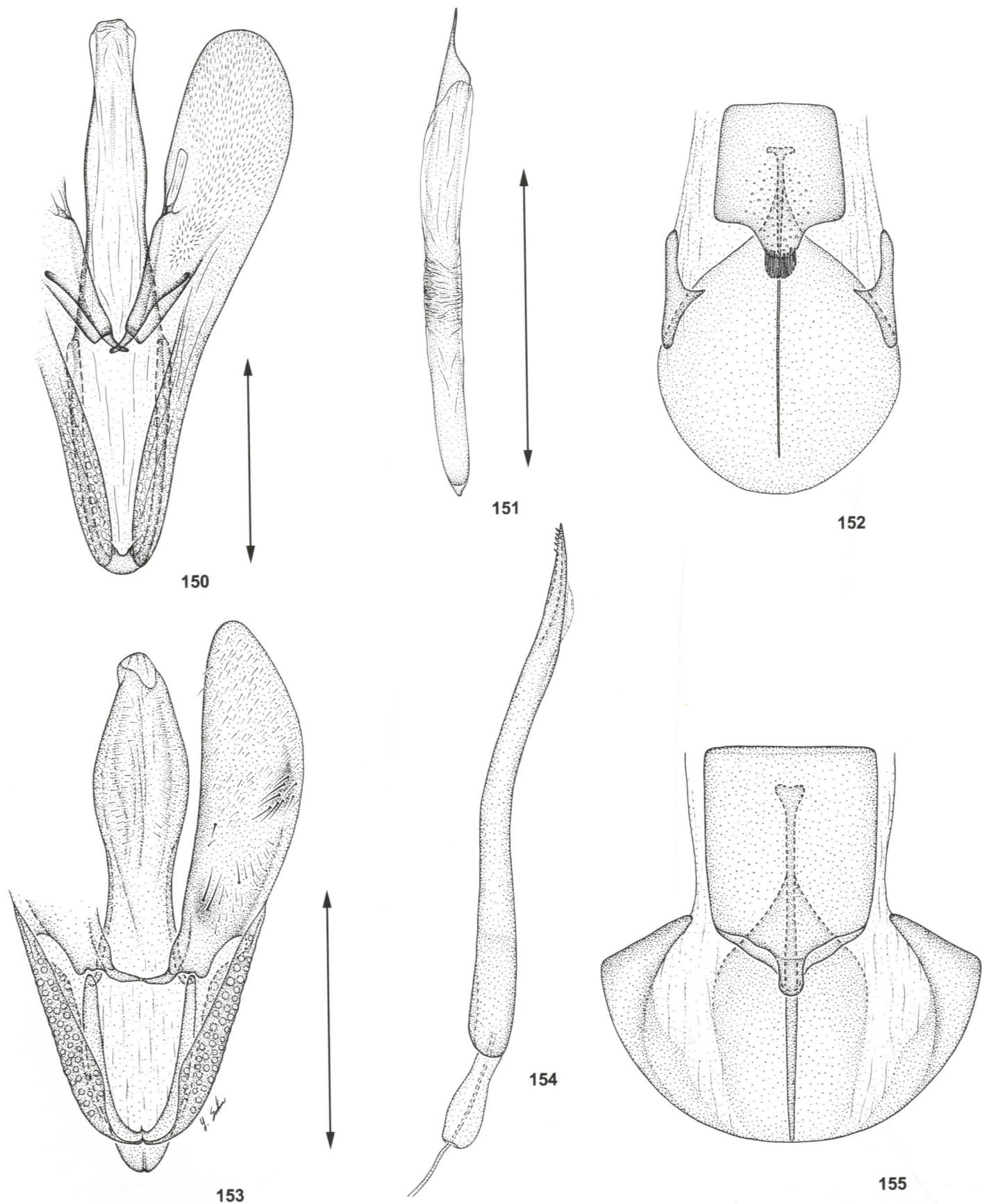
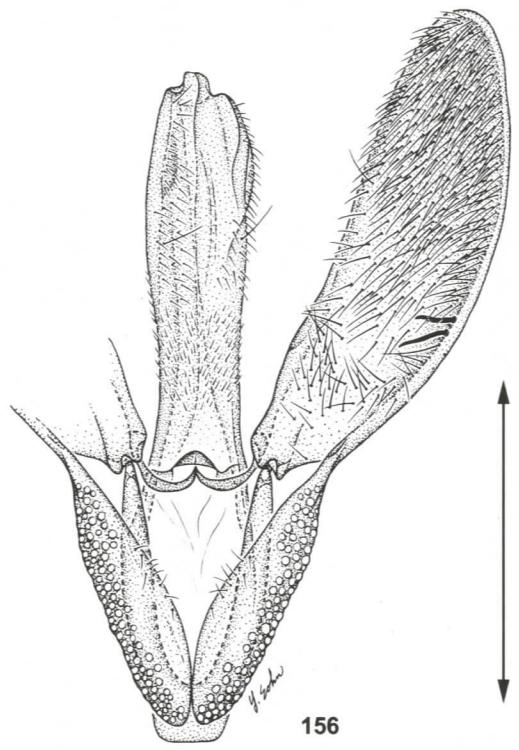


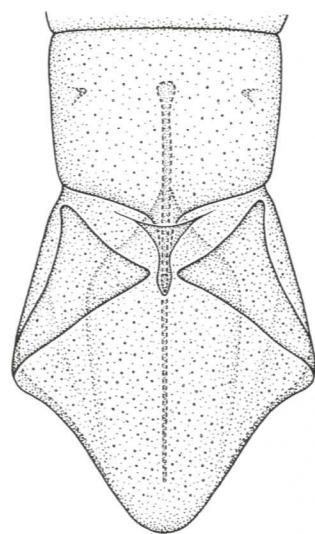
Fig. 150-155. *Eucosmophora* male genitalia and abdominal segments 7-8. 150. *E. manilkarae*, ventral view. 151. Aedeagus. 152. Ventral view. 153. *E. pithecellobiae*, ventral view. 154. Aedeagus. 155. Ventral view. (Scales = 0.5 mm.)



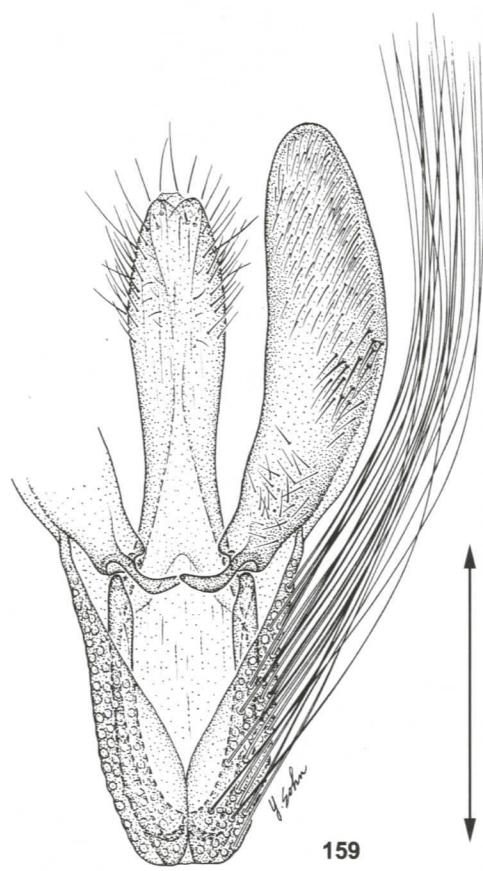
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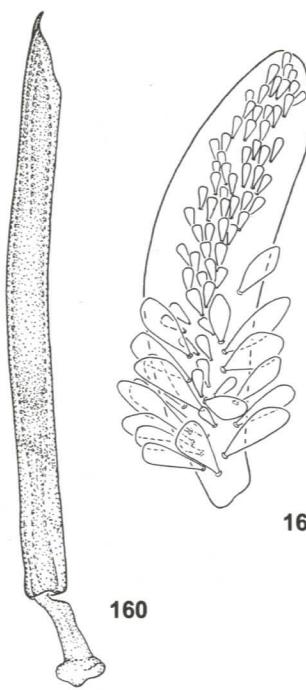
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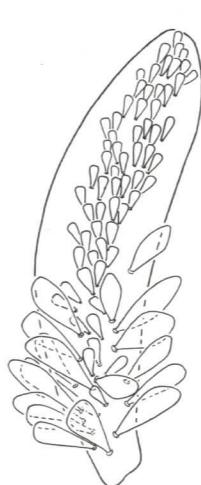
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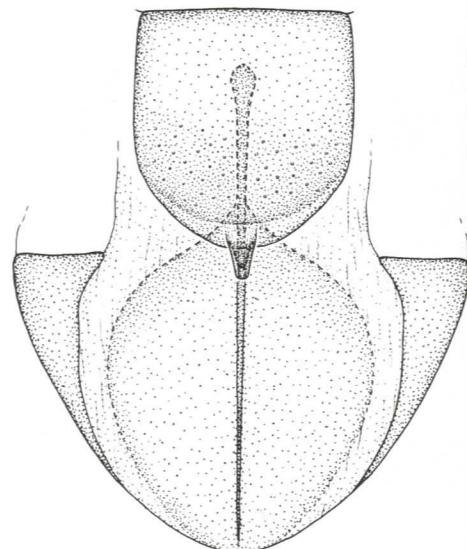
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162

Fig. 156-162. *Eucosmophora* male genitalia and abdominal segments 7-8. 156. *E. dives*, ventral view. 157. Aedoeagus. 158. Ventral view. 159. *E. ingae*, ventral view. 160. Aedoeagus. 161. Androconial scales of valva, lateral view. 162. Ventral view. (Scales = 0.5 mm.)

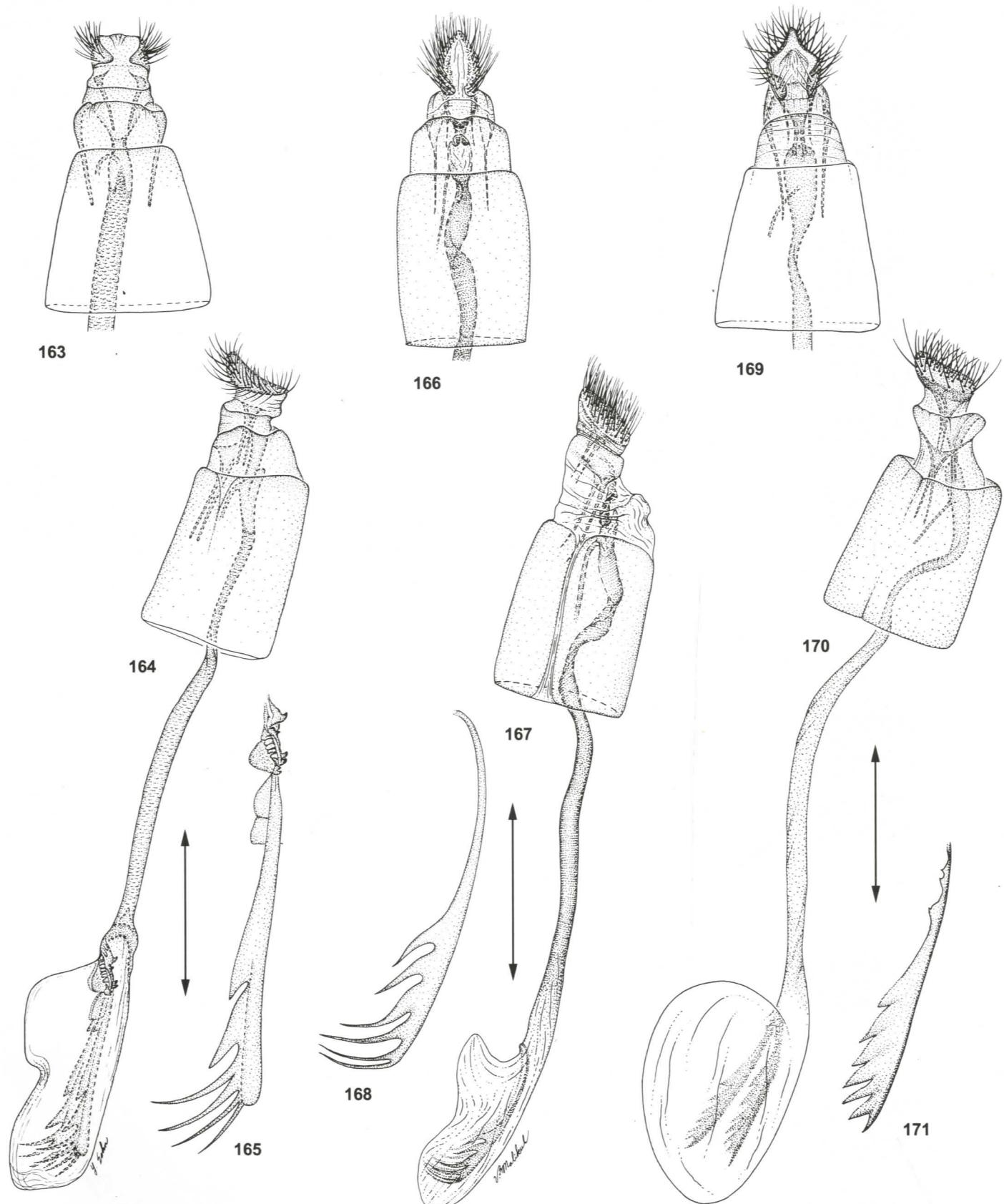


Fig. 163-171. *Eucosmophora* female genitalia. 163. *E. atlantis*, ventral view. 164. Lateral view. 165. Enlarged view of signum. 166. *E. pouteriae*, ventral view. 167. Lateral view. 168. Enlarged view of signum. 169. *E. prolata*, ventral view. 170. Lateral view. 171. Enlarged view of signum. (Scales = 0.5 mm.)

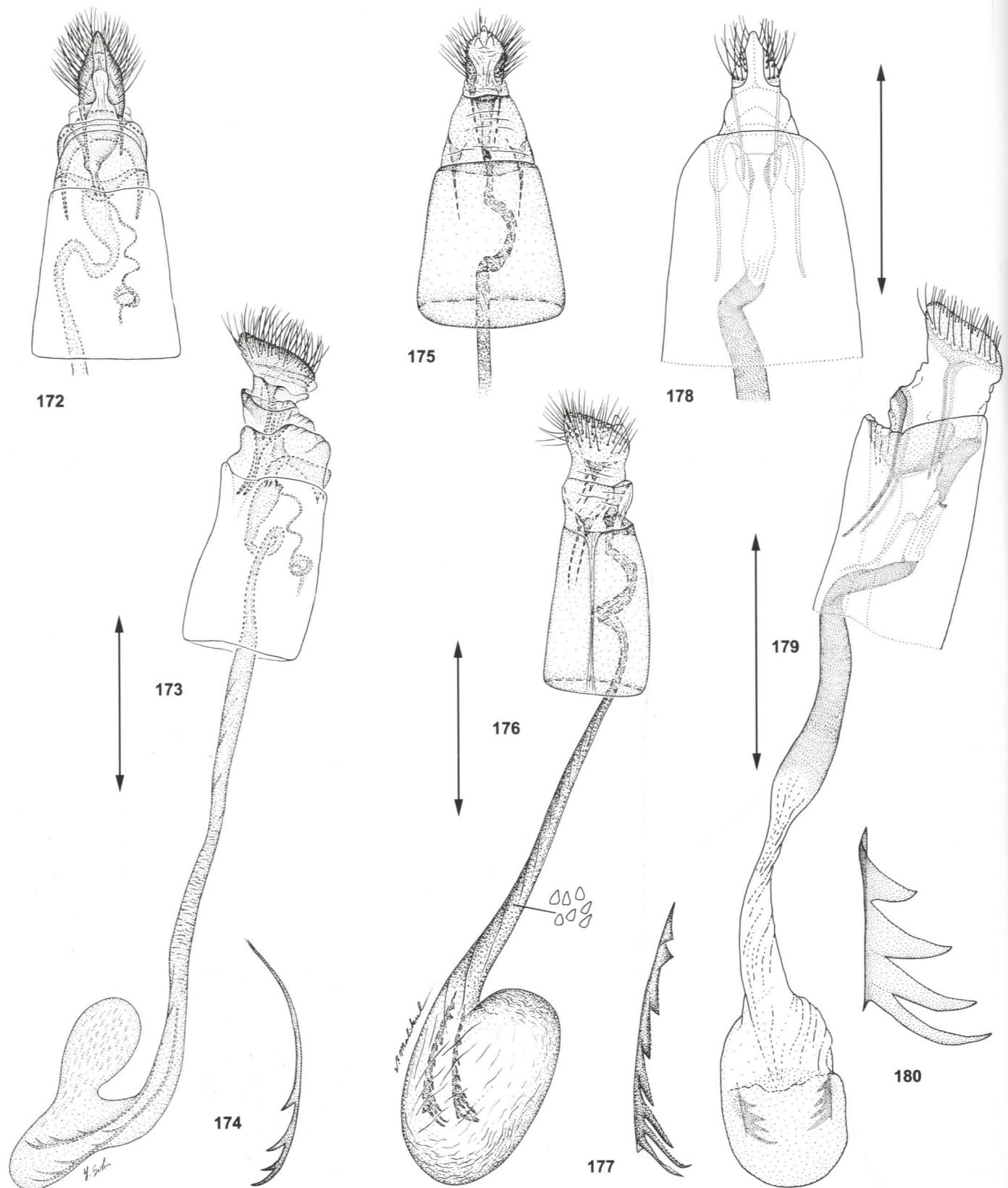


Fig. 172-180. *Eucosmophora* female genitalia. 172. *E. chrysocosma*, ventral view. 173. Lateral view. 174. Enlarged view of signum. 175. *E. aspila*, ventral view. 176. Lateral view. 177. Enlarged view of signum. 178. *E. sideroxylonella*, ventral view. 179. Lateral view. 180. Enlarged view of signum. (Scales = 0.5 mm.)

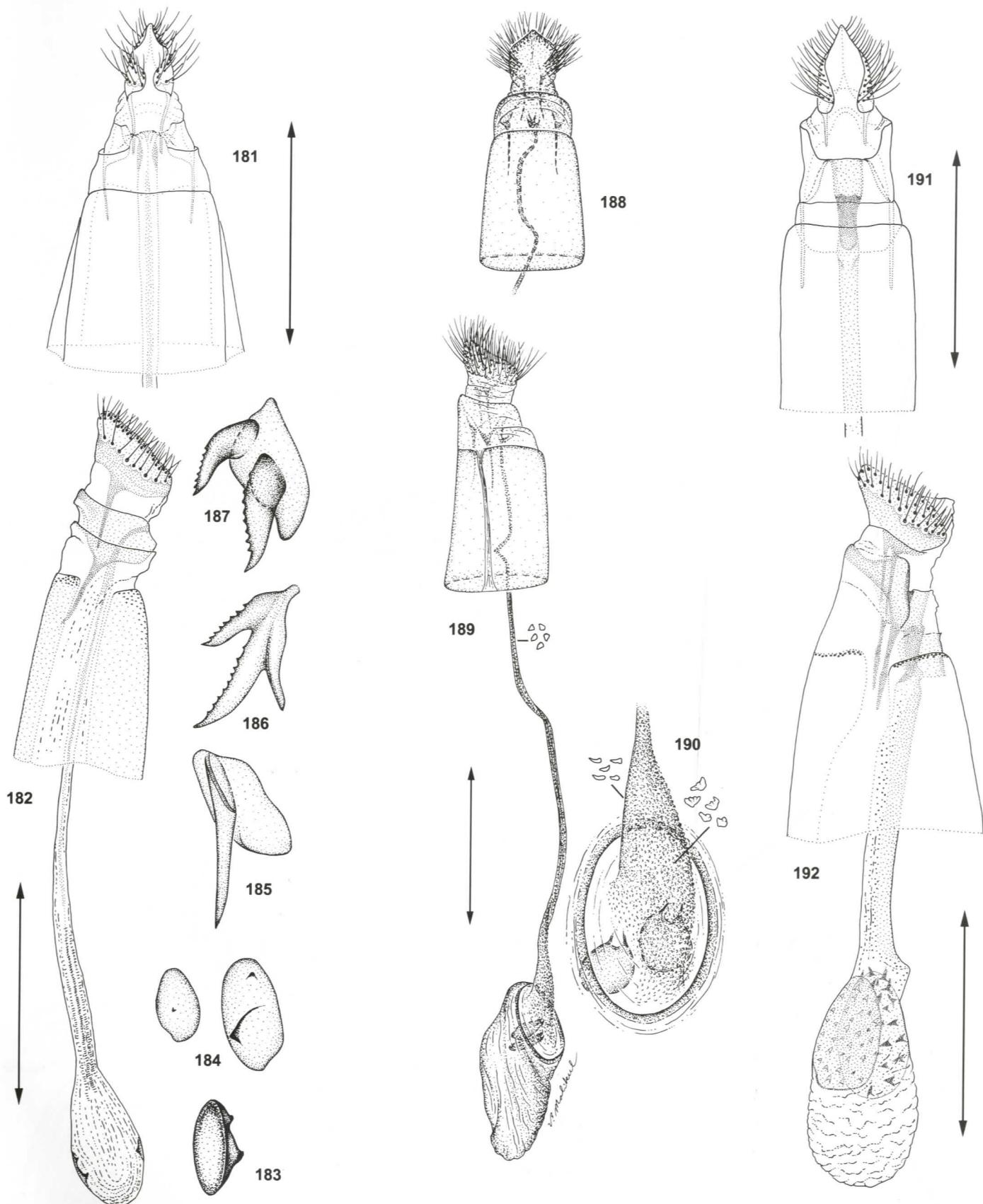


Fig. 181-192. *Eucosmophora* female genitalia. 181. *E. manilkarae*, ventral view. 182. Lateral view. 183. Enlarged lateral view of signum from Fig. 182. 184. Enlarged frontal view of signa from Fig. 182. 185. Enlarged view of signum. 186. Enlarged view of signum. 187. Enlarged view of signum. 188. *E. eclipsis*, ventral view. 189. Lateral view. 190. Enlarged view of ductus bursae and signa. 191. *E. pithecellobiae*, ventral view. 192. Lateral view. (Scales = 0.5 mm.)

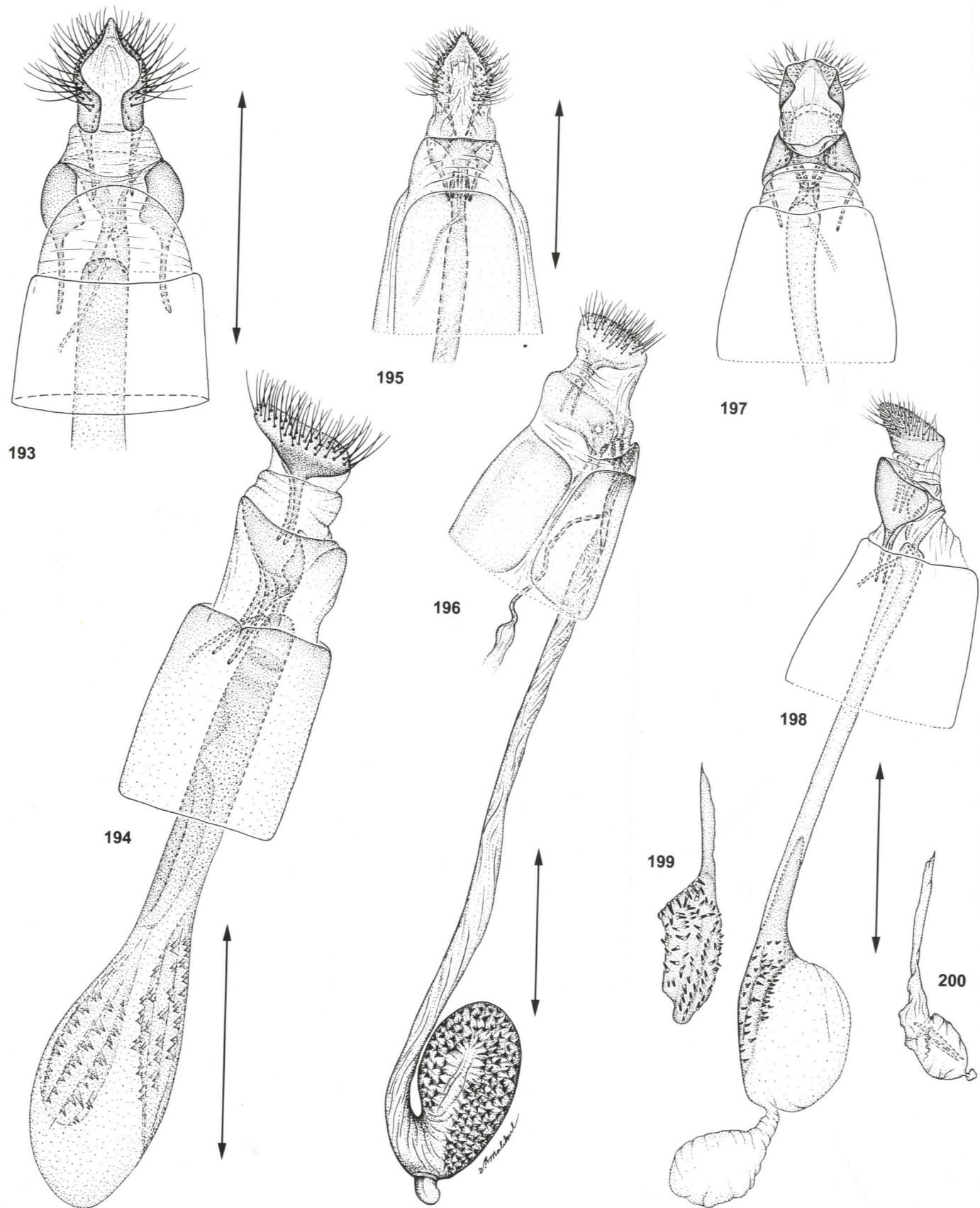


Fig. 193-200. *Eucosmophora* female genitalia. 193. *E.* species (Cerro de Neblina, T. F. Amazonas, Venezuela), ventral view. 194. Lateral view. 195. *E. echinulata*, ventral view. 196. Lateral view. 197. *E. dives*, ventral view. 198. Lateral view. 199. Enlarged view of signum. 200. Spermatophore. (Scales = 0.5 mm.)

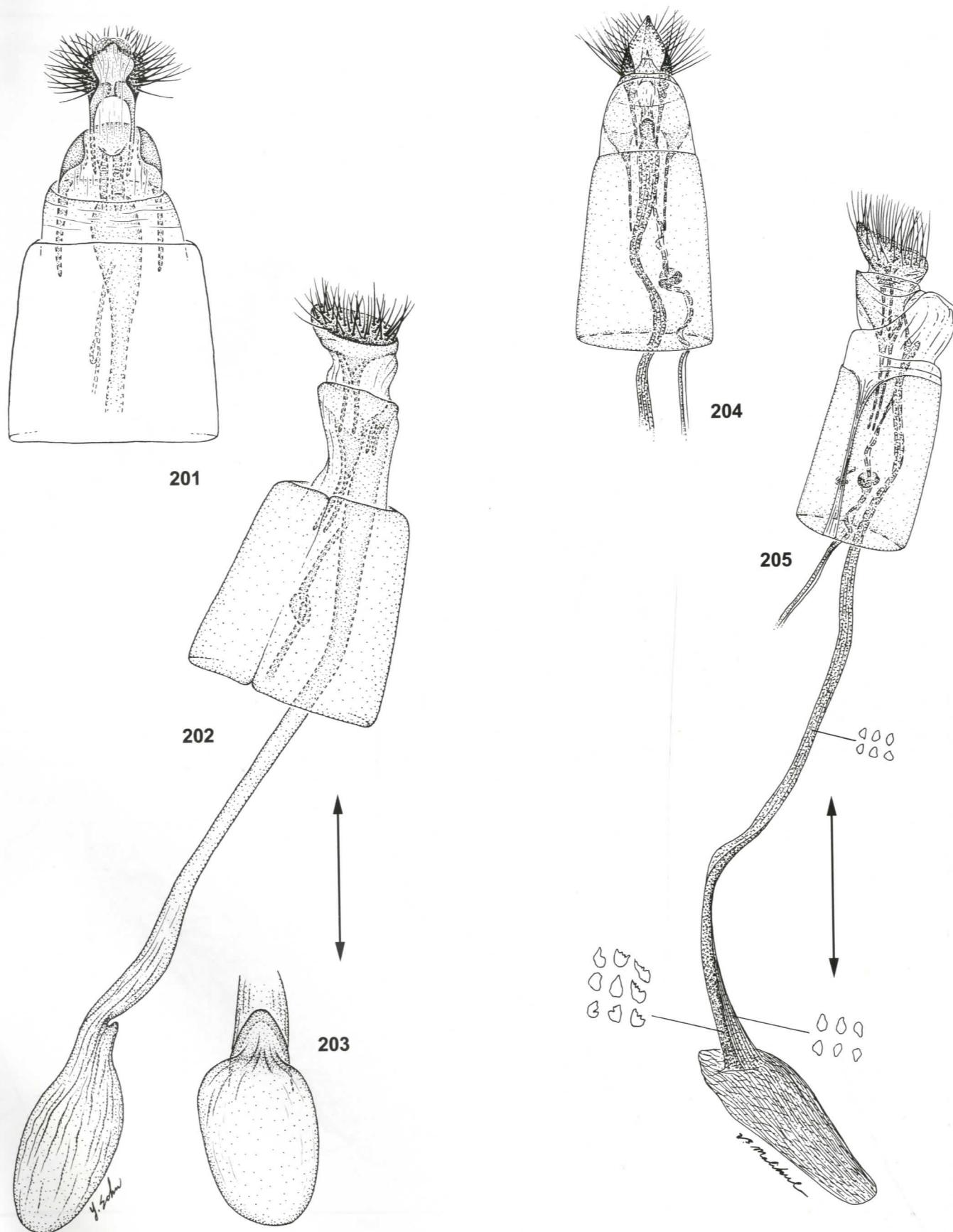
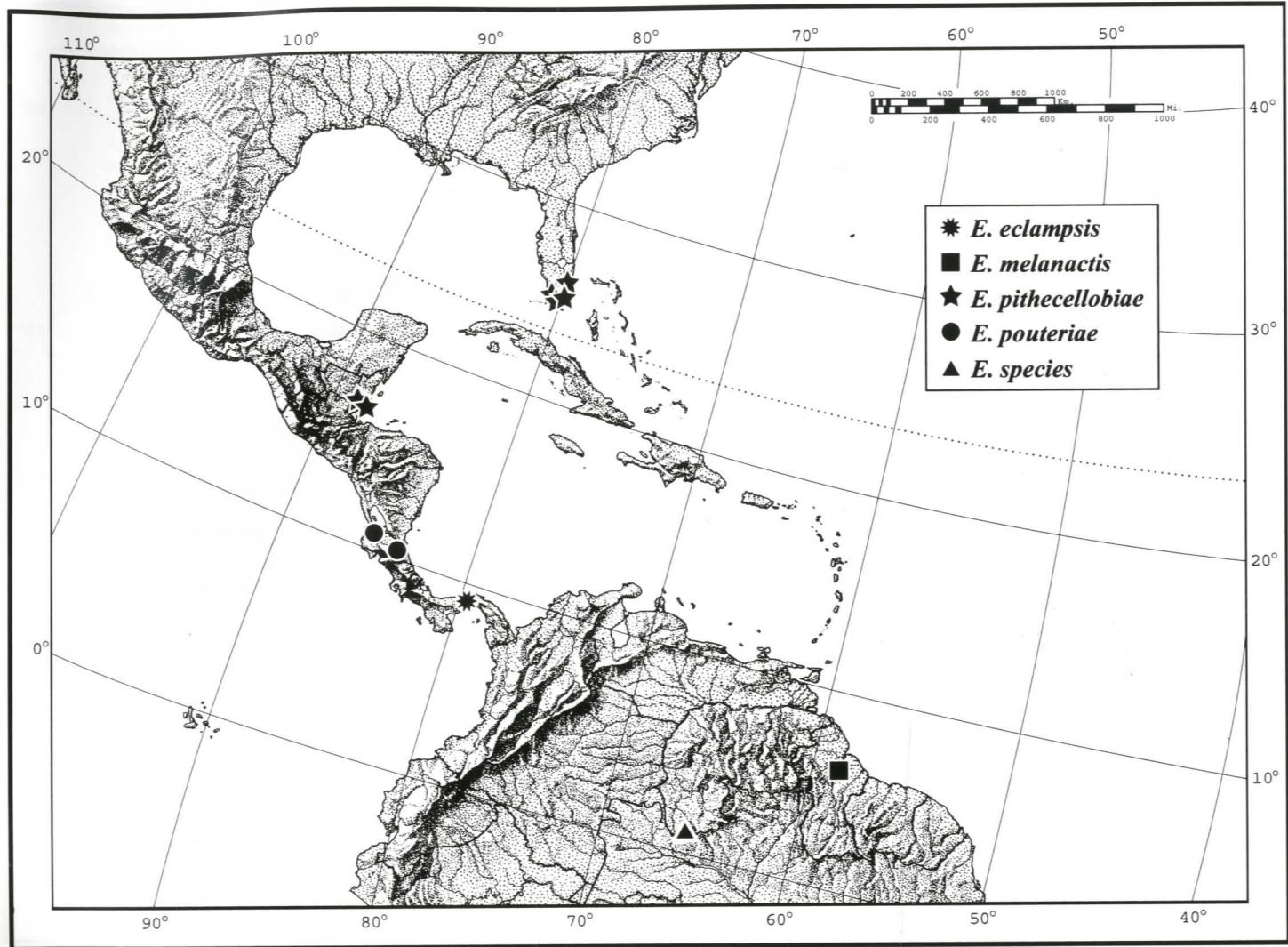


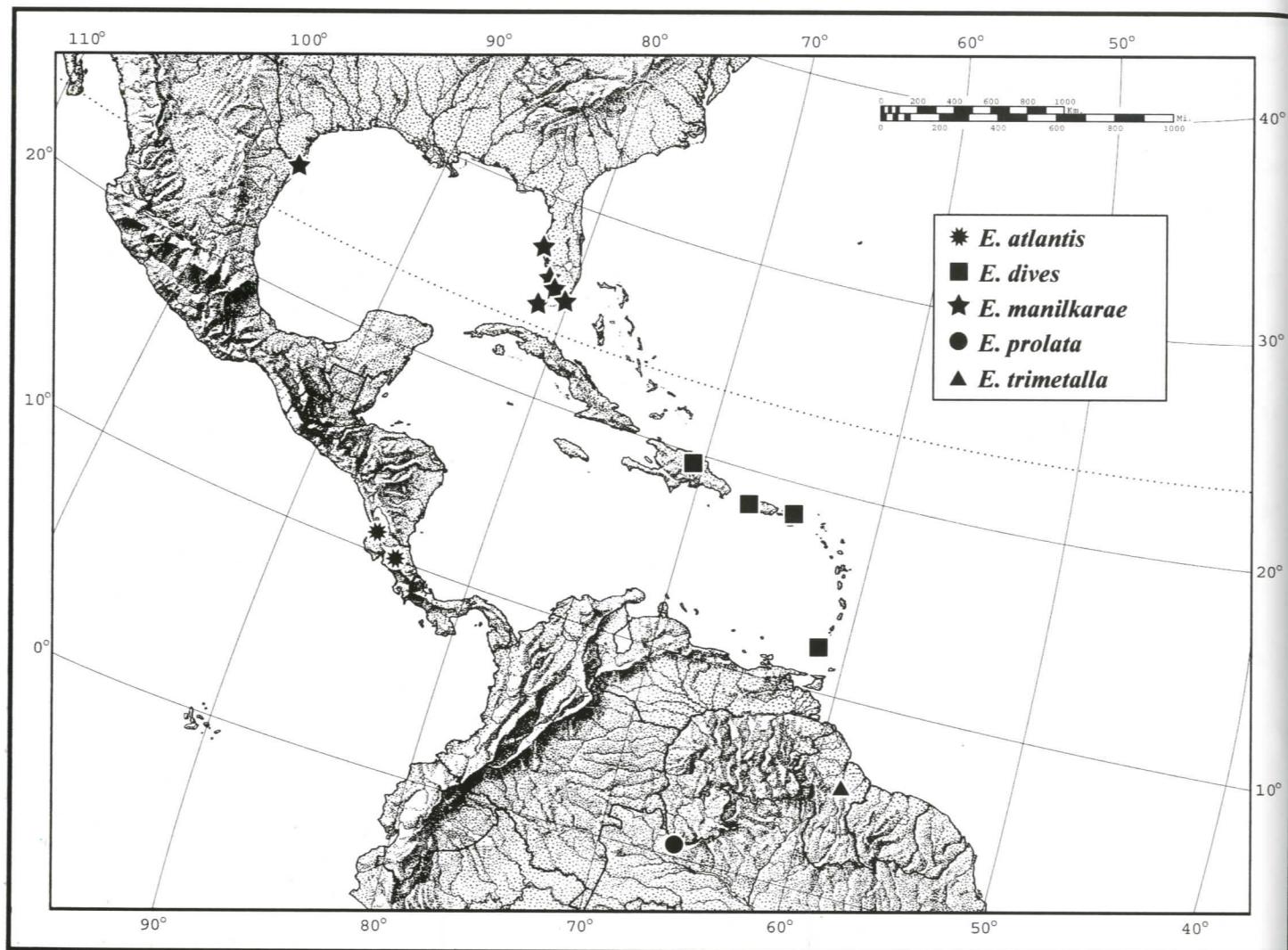
Fig. 201-205. *Eucosmophora* female genitalia. 201. *E. ingae*, ventral view. 202. Lateral view. 203. Ventral view of corpus bursae. 204. *E. trimetalla*, ventral view. 205. Lateral view. (Scales = 0.5 mm.)



Map 1. *Eucosmophora aspila*, *E. chrysocosma*, *E. echinulata*, *E. eurychalca*, *E. ingae*, *E. paraguayensis*, and *E. sideroxytonella*.



Map 2. *Eucosmophora eclampsis*, *E. melanactis*, *E. pithecellobiae*, *E. pouteriae*, and *E. species*.



Map 3. *Eucosmophora atlantis*, *E. dives*, *E. manilkarae*, *E. prolata*, and *E. trimetalla*.