

United States
Department of
Agriculture

Animal and Plant
Health Inspection
Service



SCREENING KEY FOR CAPS TARGET LEPIDOPTERA
IN THE EASTERN AND MIDWESTERN UNITED STATES
(MALES)

LAB MANUAL FOR THE LEPIDOPTERA
IDENTIFICATION WORKSHOP
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DRAFT March 2009

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DISCLAIMER: species and characters included in this key
were selected based on the author's experience and may not
reflect current CAPS funding priorities or policies or may not
reflect the opinion or views of the USDA or CAPS



This key is dedicated to Lloyd Knutson and Mary Lacy-Theisen for their efforts in developing a program to distribute pest insect specimens.

Thanks to them, exotic pest reference specimens are common in many institutional collections with red PKNTO or INKTO labels.

Their understanding of the importance of a reference specimen to pest detection was years ahead of its time. To this day no one yet knows how to solve this problem, in spite of the fact everyone knows it is an issue. It not rocket science but

Knutson, L. and M. A. Lacey. 1984. Reference collections for identification of immigrant pest insects. FAO Plant Protection Bulletin vol. 32 (3): 95-103.

Most species encountered in the Cooperative Agricultural Pest Survey (CAPS) program can be divided into four categories: CAPS targets (pests approved and funded for survey); suggested targets (exotic pests with a pathway that merit consideration for funding); low risk targets (exotic pests with no or improbable pathways into the US) and non-targets (native US species encountered in the survey). Non-targets may ("look-alikes") or may not resemble the target pest.

This key emphasizes CAPS targets and their similar native non-targets (named by association with the pest they resemble). Some suggested targets are included because they may be CAPS targets in the future. Low risk targets, while interesting, are usually ignored. Very few common non-targets are included in this key to keep it relatively short. Screening aids for a single CAPS target usually discuss non-target identification in more detail. The intended value of this key rests on the fact that almost no North American collection has all these species represented and the web rarely if ever illustrates genitalia. Thus, a diagnostic lab usually cannot rapidly screen samples for the worst pests, and if they have a suspect, illustrations of the genitalia are usually not easily available.

The accuracy of any specialized or simplified key depends on the context in which the key is utilized. This key is designed to help diagnostic labs recognize suspects more rapidly in USDA pheromone traps. It is not designed for use in non-agricultural settings. Being a screening aid, this key does not contain sufficient detail or cover enough taxa to allow for final identifications. New US records or quarantine significant finds of extreme importance need to be first sent to the appropriate APHIS specialist, then passed on to the Systematic Entomology Lab (SEL) for final confirmation. At least one voucher specimen of any newly established exotic pest should be deposited in the USNM collection at Washington, D.C.

Besides exotic agricultural pests, diagnostic labs need to be aware of potential escapes from butterfly houses and the likely future increase of trade in illegal CITES species. A few couplets include CITES or other protected taxa, but this is only a very small portion of the total number. Should APHIS ever expand the Smuggling Interdiction and Trade Compliance (SITC) program, or their internet surveillance, the number of CITES related issues would no doubt increase proportionately.

The following key only applies only to males and relies heavily on genitalia. While female genitalia are often distinctive and useful, most CAPS target pests are easier to identify as males, and most CAPS sticky traps are designed to capture males. There are several ways to sex moths: the antennae, shape of the abdomen, presence of lobed valves and the frenulum bristles. The males of some species differ from females in having bipectinae antennae. Males often have thin pointed abdomens whereas female abdomens are thicker (being filled with eggs) with a rounded tip. The male valves often do not overlap completely, this results in slit sometimes being visible. Similarly, the female genitalia may have the ovipositor lobes partially visible as two "hairy pads". Although there are exceptions (e.g. some pyraloids), if a frenulum is present, one bristle signifies a male and multiple bristles indicate a female.

Terminology has been kept to a minimum and issues of homology between structures in different families are not addressed. Neutral terms like clasper or basal process are used. Comparison of the unknown with pictures of the target is critical to the accurate use of this key.

The characters used in the key reflect the state of the art. In some cases, one character will allow undisputed recognition (hindwing of *Thaumatotibia leucotreta*). The other extreme is that the pest is poorly defined morphologically and host data is needed (*Phyllocnistis citrella* traps need to be associated with a citrus grove).

Specimens that do not fit the couplets in either direction will likely represent taxa not covered by the key. In a few larger families there is a pathway in the key for discarding miscellaneous samples that are not targets or non-targets for the CAPS program.

Characters used in this key were taken from the Internet, published taxonomic literature, various unpublished APHIS documents and my personal experience. This key is a draft which needs to be tested with a large series of actual specimens and evaluated by members of CAPS.

Consult the reference lists and individual presentations in this workshop for information on female genital characters, distribution, and hosts. In some cases molecular diagnostics are an option for identification. Bucket traps or lightly coated tanglefoot traps can also be used. These can be evaluated on a case by case basis depending on the target.

Julieta Brambila (USDA/APHIS/PPQ), Richard Brown (Mississippi State University) and Marc Epstein (CDFA) provided useful comments on the key. John Brown (USDA/ARS) helped by reading and proofing the tortricid section. Thanks to Todd Gilligan (Colorado State University) for information on laws relating to protected Lepidoptera and E. LaGasa (WSDA) for modifying the target categories.

SCREENING KEY FOR CAPS TARGET LEPIDOPTERA IN THE EASTERN AND MIDWESTERN UNITED STATES (MALES)

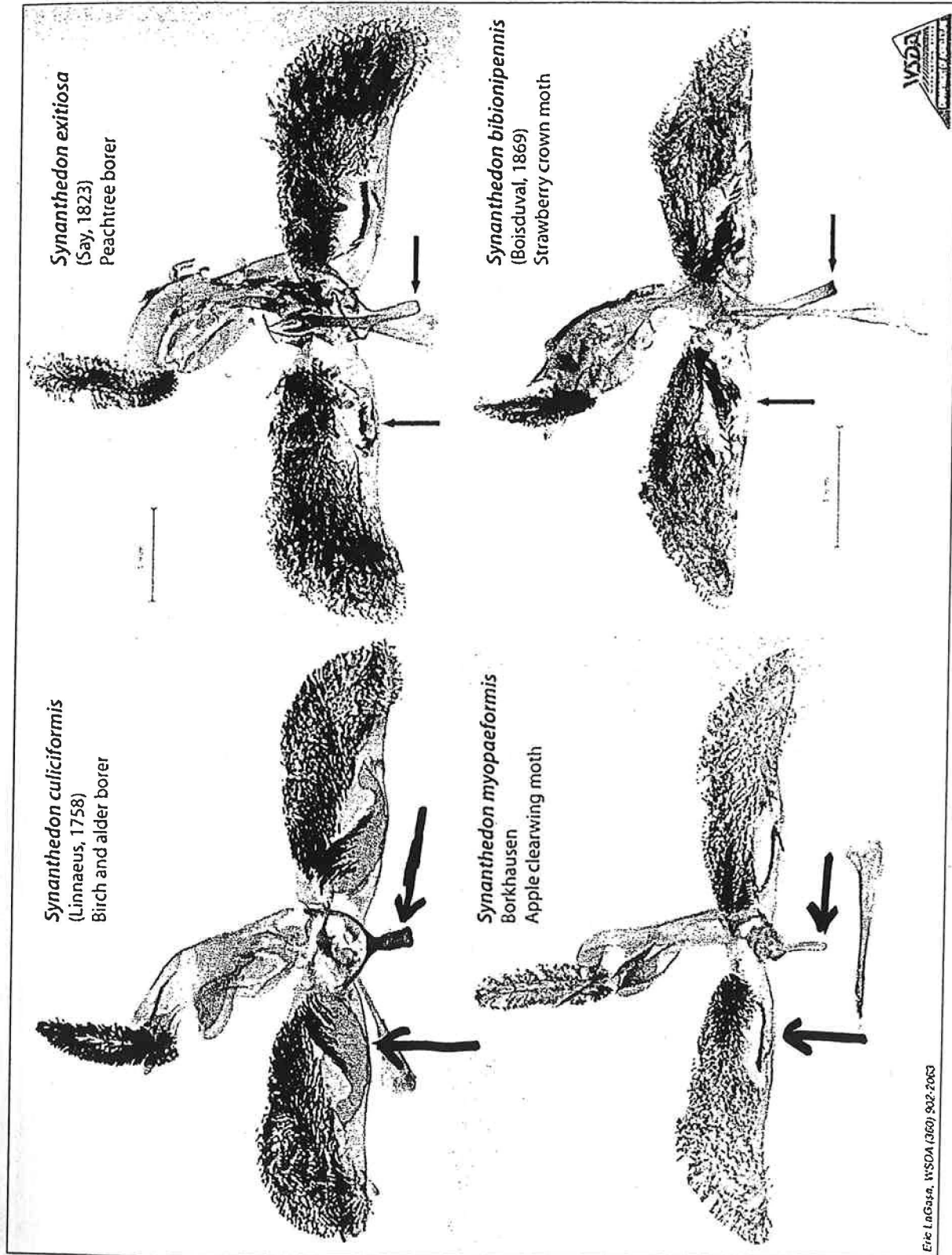
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|---|---------------------------------|
| 1. Antenna gradually thickened or clubbed at tip | 2 |
| 1'. Antenna variable, but not thickened or clubbed at tip | 7 |
| 2. Forewing and hindwing with large clear areas; hindwing with a row of small curved spines on the inner margin; thorax and abdomen with red markings | 3 |
| 2'. Forewing and hindwing without large clear areas; hindwing without a row of small curved spines on the inner margin; thorax and abdomen without red markings | 4 |
| 3. Labial palpi all black; base of valve with a simple ridge; saccus rounded at tip (apple clearwing moth) | <i>Synanthedon myopaeformis</i> |
| 3'. Labial palpi black with the inner surface reddish yellow; base of valve with a rounded lobe; saccus truncate at the tip (non-target exotic for eastern US, large red belted clearwing moth) | <i>Synanthedon culiciformis</i> |
| 4. Underside of forewing bright red; hindwing bright orange with a series of white spots on a dark background (South American palm borer) | <i>Paysandisia archon</i> |
| 4'. Underside of forewing not bright red; hindwing not bright orange with a series of white spots on a dark background | 5 |

5. Forewing with second anal vein reaching the wing margin and a "spur" present on the discal cell near the base; hindwing tail absent 6
 5'. Forewing lacking both the second anal vein and "spur" on the discal cell near the base; rarely a hindwing tail is present a butterfly or skipper not in this key
6. Valve with a marginal process; large usually orange, green, black and yellow butterflies (more rarely blue) lacking eyespots (birdwings, some CITES protected) *Troides, Ornithoptera*, etc.
 6'. Valve lacks a marginal process; two eyespots present on the hindwing (lime swallowtail) *Papilio demoleus* (or the almost identical *P. demodocus*)
7. Tympanum present on either metathorax or abdomen 8
 7'. Tympanum absent on metathorax and abdomen 13
8. Metathoracic tympanum present, not opening downward; HW with Sc and R1 veins widely separated beyond discal cell 9
 8'. Abdominal tympanum present, often opening downward; HW with Sc and R1 veins fused or barely touching beyond discal cell see Pyraloidea key
9. Ocelli present; antenna without spinules at the end of each branch; proboscis well developed; orbicular and/or reniform spot usually circular or oval see Noctuidae key
 9'. Ocelli absent; antenna with spinules at the end of each branch; proboscis poorly developed; orbicular spot absent and reniform spot usually c or v-shaped 10
10. Tegumen with a digitate process; dorsal arm of valve bifurcate; forewing slightly pointed (pink gypsy moth) *Lymantria mathura*
 10'. Tegumen without a digitate process; dorsal arm of valve fingerlike; forewing rounded at the apex 11
11. Costal process as long as valve; basal process present; forewing white with black zigzag lines, sometime black or gray in melanic forms (nun moth) *Lymantria monacha*
 11'. Costal process longer than valve; basal process absent; forewing light brown to dark red brown 12
12. Forewing length 14-22 mm (European gypsy moth) *Lymantria dispar dispar*
 12'. Forewing length greater than 22 mm; (Asian gypsy moth, Japanese gypsy moth) *Lymantria dispar asiatica, Lymantria dispar japonica*
13. Proboscis scaled and well developed; hindwing produced to a point at the apex; gnathos tonguelike or rounded 14
 13'. Proboscis naked, reduced or absent; hindwing without a point at the apex; gnathos rarely tonguelike or rounded 16

14. Antennal scape lacks pecten; uncus rounded, not spined; valve slender and curved apically; aedaegus with a distal spine (South American tomato moth) *Tuta absoluta*
- 14'. Antennal scape with pecten; uncus pointed, spined; valve rounded with deciduous spines and not bent apically; aedaegus lacking a distal spine 15
15. Valve with broad and long deciduous spines arising beneath a membrane (non-target, pink bollworm) *Pectinophora gossypiella*
- 15'. Valve with thin short deciduous spines not arising beneath a membrane (pink spotted bollworm) *Pectinophora scutigera*
16. Proboscis reduced; frenulum absent 17
- 16'. Proboscis usually well developed, sometimes absent; frenulum present 19
17. Wings blue green with veins outlined in red brown; a small eyespot present on the forewing and hindwing; long tails present on the hindwing (Spanish moon moth, IUCN Red List species) *Graellsia isabellae*
- 17'. Wings gray to brown without veins outlined in red brown; no eyespot present on the forewing or hindwing; long tails absent on the hindwing 18
18. Valve with two projections, the smaller one either 1/5 or 3/4 as long as the larger one (European pine moth, Siberian silk moth) *Dendrolimus pini* and *Dendrolimus "superans-sibiricus" complex*
- 18'. Valve with a single projection (*Dendrolimus* non-target) *Gloveria*, etc
19. Chaetosemata present; antenna filiform; costal fold present or absent see Tortricidae key
- 19'. Chaetosemata absent; antenna filiform or bipectinate; costal fold always absent 20
20. Forewing white with rows of black dots; uncus bifid and pointed; valve somewhat oval and apically expanded; saccus long and tubular 21
- 20'. Forewing not white with rows of black dots; uncus not bifid and pointed; valve not oval and expanded apically; saccus not long and tubular 22
21. Forewing with four rows of black spots and white cilia; anal area of hindwing and cilia white; not associated with apple (apple ermine moth non-target) *Yponomeuta multipunctella*
- 21'. Forewing with three rows of black spots and mostly gray cilia; anal area of hindwing and cilia mostly gray; reared from or collected near *Malus* (apple ermine moth) *Yponomeuta malinellus*
22. Very tiny (less than 2 mm) moths with mostly white wings 23
- 22'. Larger moths (more than 2 mm); wings not mostly white 25

23. Eyecap absent; forewing with a faint y-shaped marking; reared from or associated with citrus and related Rutaceae (citrus leafminer) *Phyllocnistis citrella*
- 23'. Eyecap present; forewing lacks a faint y-shaped marking; not reared or associated with citrus 24
24. Head smoothly scaled; valve oval, dorsal lobes rounded (pear leaf blister moth) *Leucoptera malifoliella*
- 24'. Head roughly scaled; valve not oval, dorsal lobes pointed (pear leaf blister moth non-target) *Proleucoptera smilaciella*
25. Palpi upturned; forewing with a large white patch 26
- 25'. Palpi upturned or porrect; forewing lacking a large white patch 27
26. Valve slightly swollen at tip, not boot-shaped; saccus abruptly narrowed, parallel sided, total length of the vinculum and saccus approximately two times that of the valve (leek moth) *Acrolepiopsis assectella*
- 26'. Valve clubbed at tip, almost boot shaped; saccus gradually tapering, total length of the vinculum and saccus less than two times that of the valve (leek moth non-target) *Acrolepiopsis incertella*
27. Antenna bipectinate to the tip 28
- 27'. Antenna not bipectinate to the tip a species not in the key
28. Forewing with at least a single slanted vertical line from the costa to the inner margin; valve not squared shaped with two patches of stout spines 29
- 28'. Forewing without a single slanted vertical line from the costa to the inner margin; valve roughly squared shaped with two patches of stout spines 30
29. Forewing with a vertical subterminal line (*Darna* non-target) *Natada nasoni*
- 29'. Forewing without a subterminal line (nettle caterpillar) *Darna pallivitta*
30. Hindwing dirty white, the apex rounded (butterworm) *Chilecomadia moorei*
- 30'. Hindwing brown, the apex pointed (teboworm) *Chilecomadia valdiviana*

Appendix 1. *Synanthedon* species male genitalic identification characters.



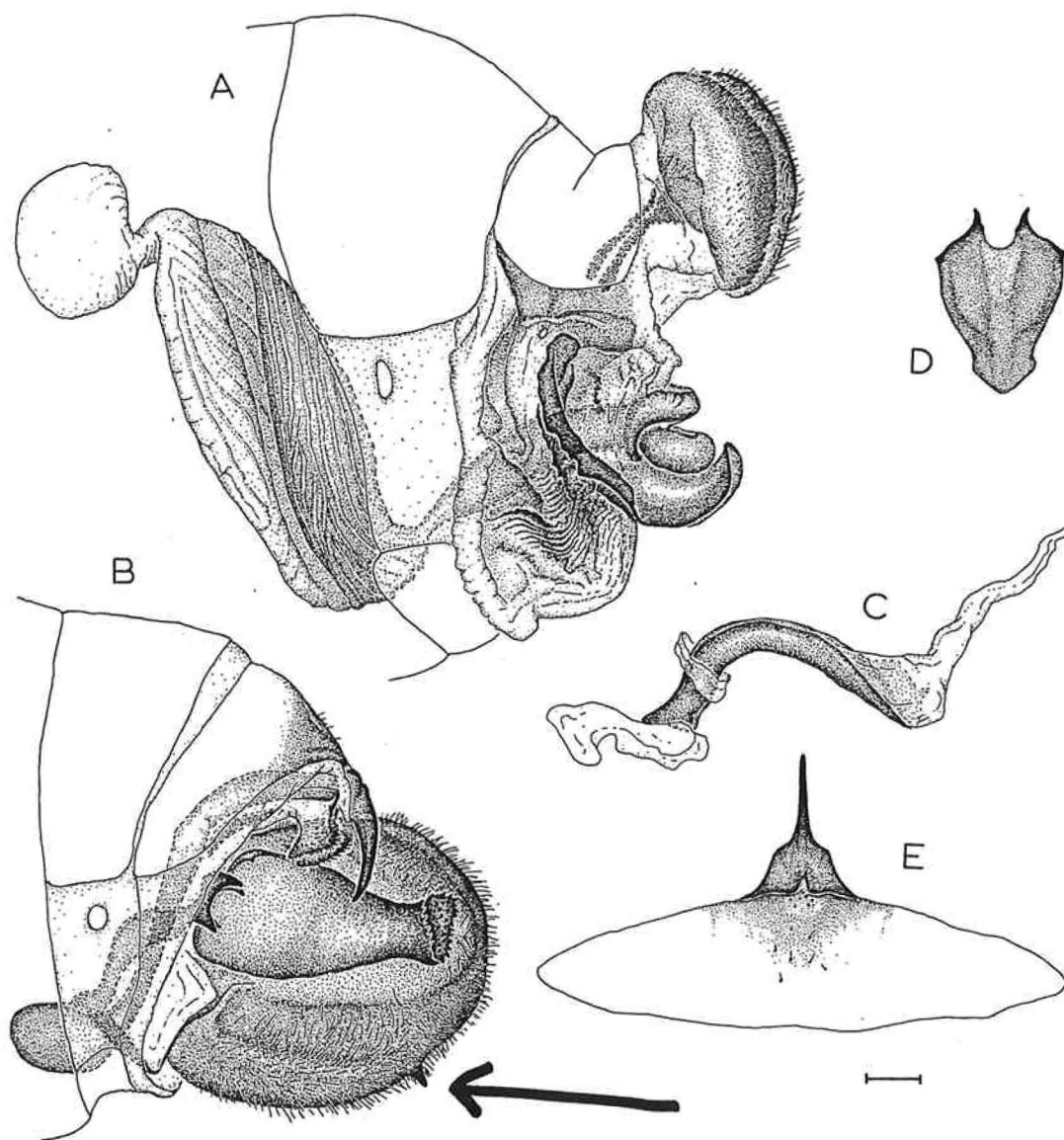


Fig. 58. Male and female genitalia of *Troides (Troides) priamus* (L.). For scale length and key to structures refer to figure 20.

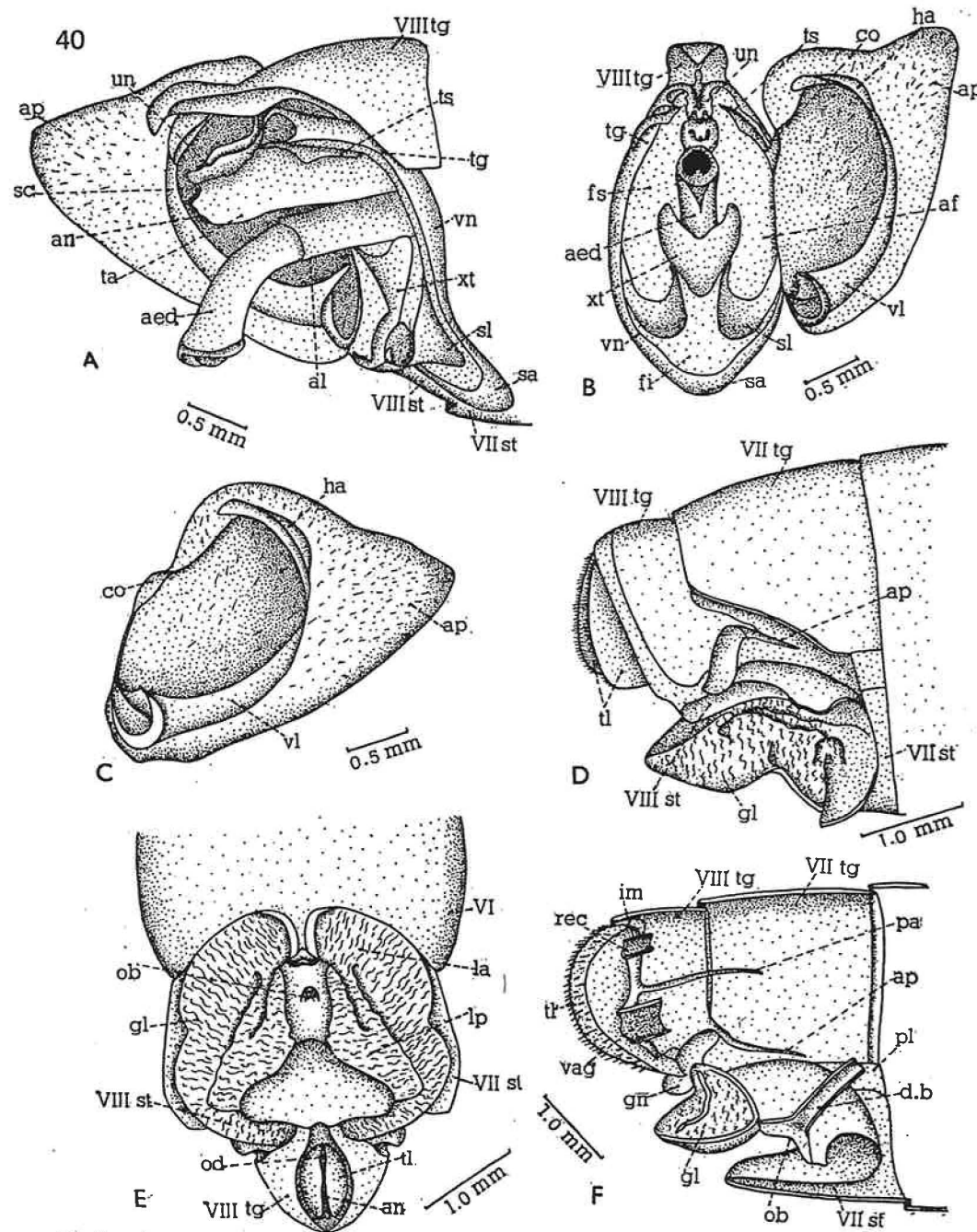


Fig.13. Male genitalia
A. Lateral (rt. valva removed) and

ANATOMY OF THE COMMON LEMON BUTTERFLY

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ANATOMY OF THE COMMON LEMON BUTTERFLY

Papilio demoleus



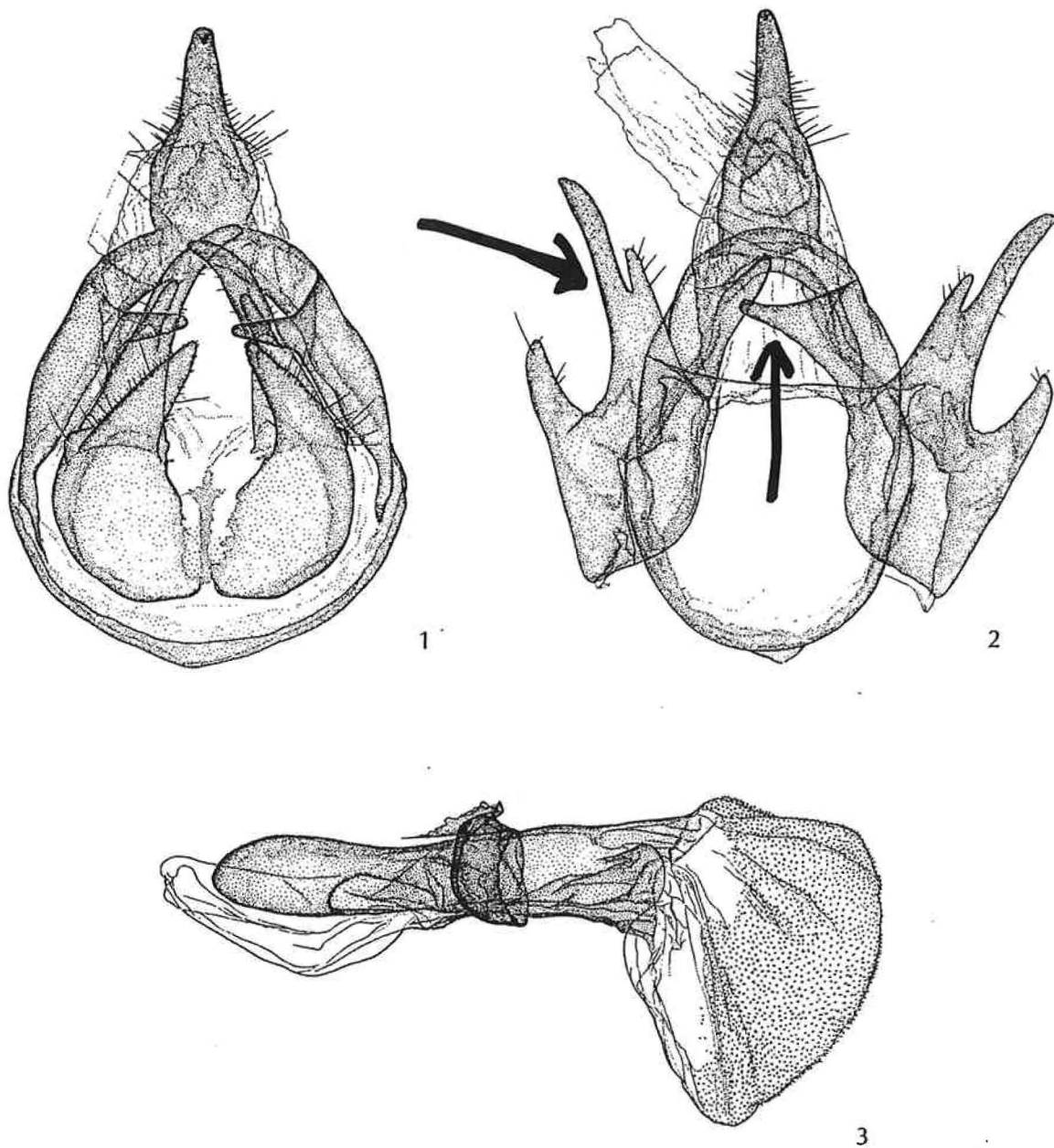


PLATE 19. MALE GENITALIA. *Lymantria (Nyctria) mathura*. Fig. 1. Genital capsule, Taiwan, genitalia slide USNM 59200. Fig. 2. Genital capsule, Russia, Siberia, Kongaus, genitalia slide USNM 58862. Fig. 3. Aedoeagus, genitalia slide USNM 59200.

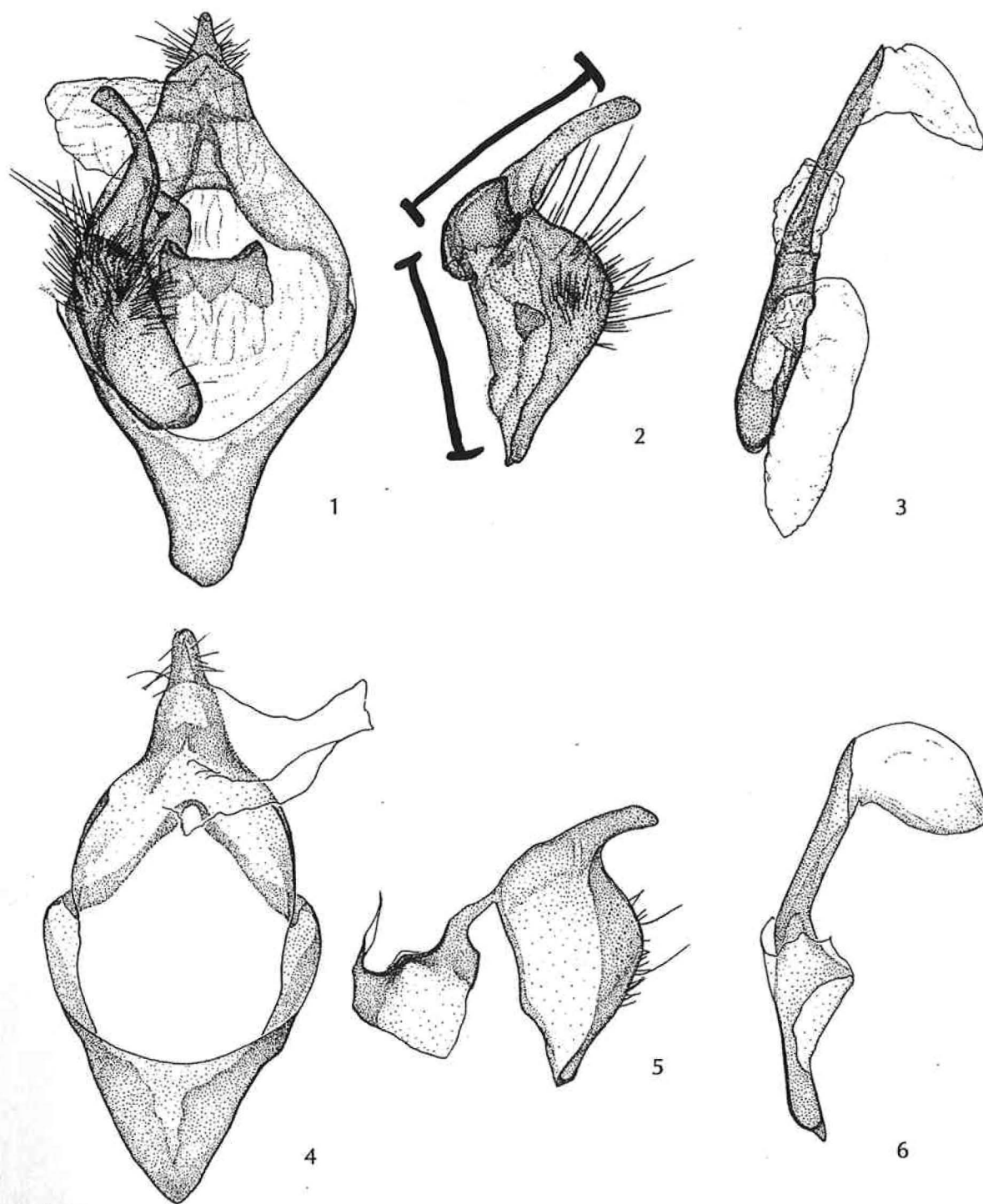


PLATE 14. MALE GENITALIA. Fig. 1. *Lymantria (Lymantria) monacha*, genital capsule, No data, genitalia slide USNM 59108. Fig. 2. *Lymantria (Lymantria) monacha*, valve, Sweden, genitalia slide USNM 58968. Fig. 3. *Lymantria (Lymantria) monacha*, aedoeagus, genitalia slide USNM 58968. Fig. 4. *Lymantria (Lymantria) pulverea*, genital capsule, Taiwan, Tayuling, genitalia slide DCF 1647 (PWS). Fig. 5. *Lymantria (Lymantria) pulverea*, valve, genitalia slide DCF 1647 (PWS). Fig. 6. *Lymantria (Lymantria) pulverea*, aedoeagus, genitalia slide DCF 1647 (PWS).

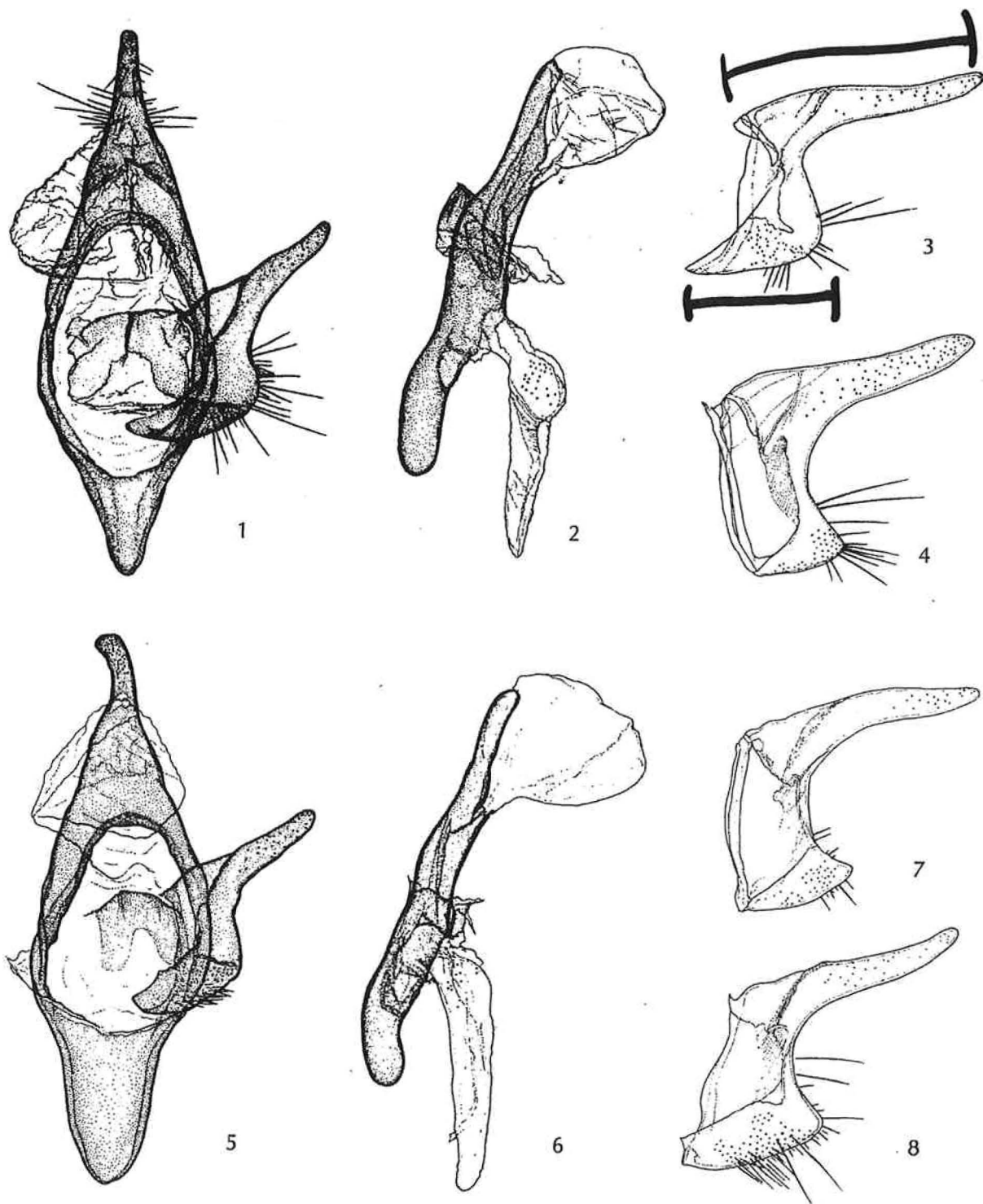


PLATE 7. MALE GENITALIA. *Lymantria (Porthetria) dispar dispar*. Fig. 1. Genital capsule, USA, Maryland, Montgomery Co., genitalia slide USNM 59088. Fig. 2. Aedeagus genitalia slide USNM 59088. Fig. 3. Valve, France, genitalia slide USNM 57648. Fig. 4. Valve, Sardinia, genitalia slide USNM 59165. Fig. 5. Genital capsule, USA, New Hampshire, Portsmouth, genitalia slide USNM 59097. Fig. 6. Aedeagus genitalia slide USNM 59097. Fig. 7. Valve, Russia, genitalia slide USNM 59150. Fig. 8. Valve, Baskin, Kazakhstan, Altai Territory, genitalia slide USNM 59193.

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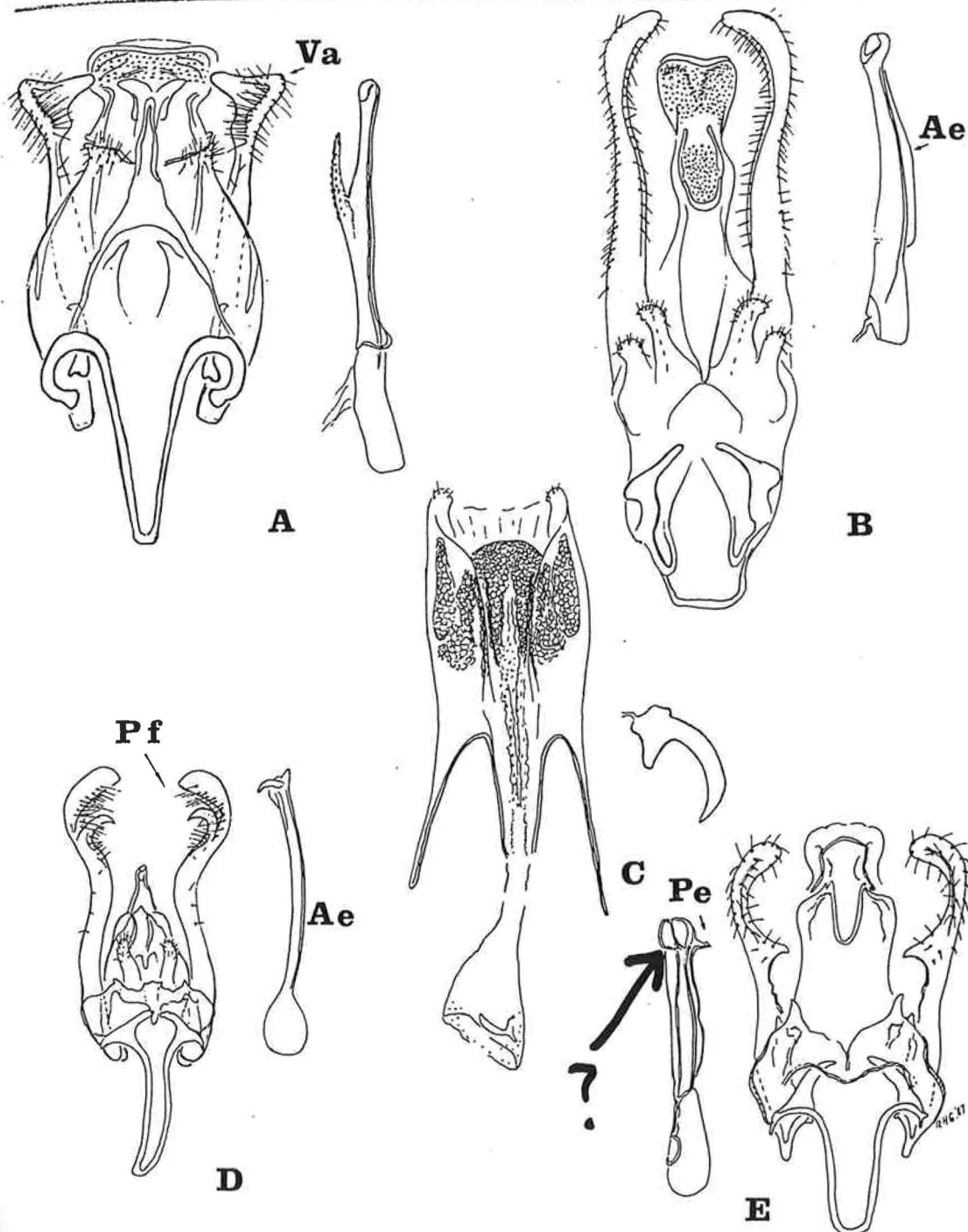
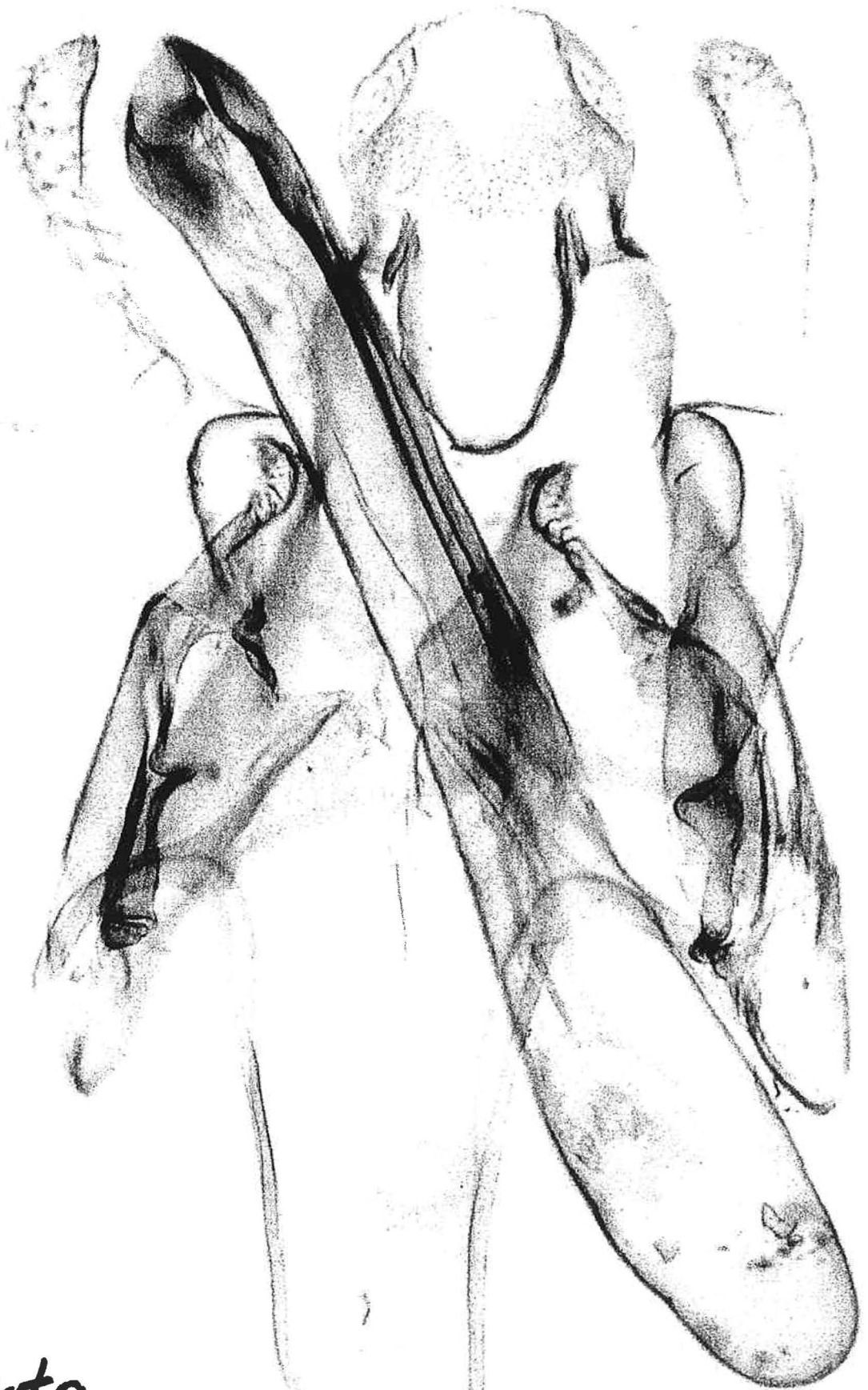


FIGURA 94

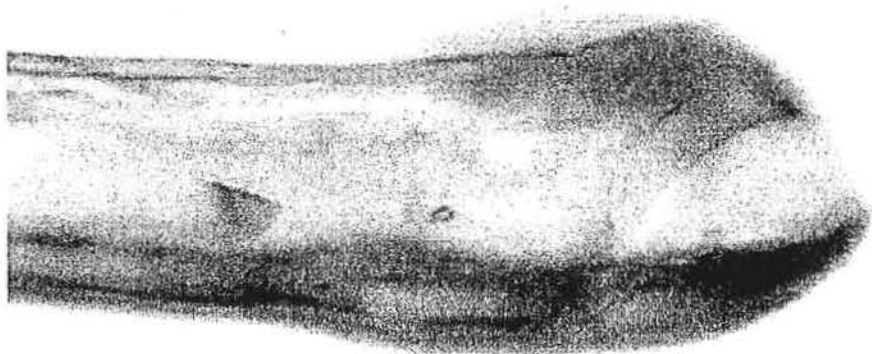
Genitalias: (A) *Symmetrischema plaesiosema*, macho (V. a, valva; ae:edeago); (B) *Phthorimaea oper-*

cullella, macho; (C), *P. operculella*, hembra; (D) *Keiferia lycopersicella*, pf, proceso falciforme; (E) *Scrobipalpa absoluta*; p.e., proceso espiniforme.

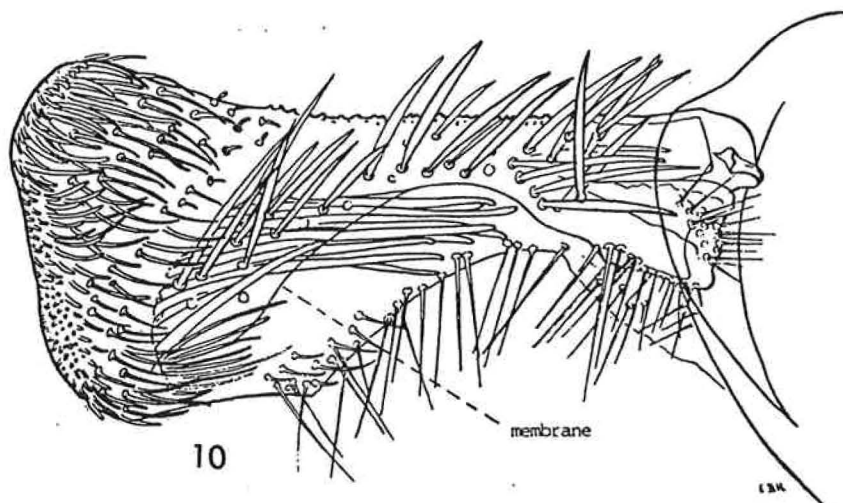
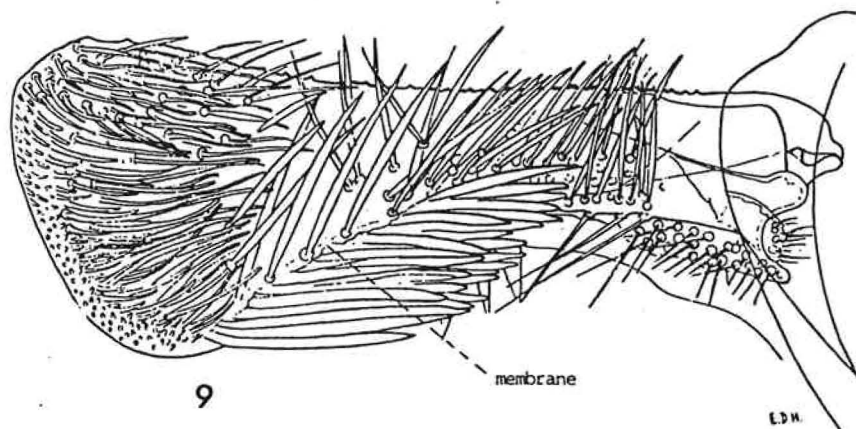
Tuta



Tuta
absoluta



(Figs. 9-10)



Pectinophora species, male genitalia, left valva, mesal view.
 9. P. scutigera, showing exposed, deciduous setae.
 10. P. gossypiella, showing deciduous setae arising beneath membrane (From Holdaway 1929a).

Females. Pectinophora have paired hooklike signa (Figs. 11, 12). Both P. scutigera (Fig. 12) and P. gossypiella (Fig. 11) have the apophyses posteriores longer than the ductus bursae; and P. scutigera (Fig. 12) has strongly curved, somewhat slender signa. P. gossypiella (Fig. 11) has stout, slightly curved signa. P. endema (Fig. 13) has the ductus bursae longer than the apophyses posteriores.

EGGS - Length 0.53-0.64 mm; width 0.30-0.33 mm. White to pale cream, becoming pink, blotched. Surface sculptured with longitudinal ridges joined by oblique lines.

Both the pheromone and the dispensers were manufactured by the Institute of Chemical Means for Plant Protection in Moscow. Five different mixtures of attractant (Table 1) were tested in 10 replicates. The traps were placed in a line 150 m apart in 1-2-3-4-5-1-2 etc. sequence in a park type pine forest. For a period of 40 days traps were checked twice—23 males of *D. pini* and 17 males of *D. superans* were caught. The distribution of catches demonstrated that 1:1 and 1:0.5 mixtures had equal attractivity to both species. The 1:0.1 mixture was not attractive for Siberian moth males and the aldehyde did not attract either species.

The experiment demonstrated the similarity of sex attractants of Siberian moth and pine moth. Possibly the pheromones of these species, in addition to the main components, contain some minor ones which determine the specificity of the communication signal. Males of the two species are morphologically very similar, the only real difference can be found in male genitalia. The lower branch of the valvae of Siberian moth is much longer and thinner than that of the pine moth (Fig. 1).

Table 1. Attractivity of different mixtures and concentrations of Z,E-5,7-dodecadienal (Z5E7DDDAL) and Z,E-5,7-dodecadienol (Z5E7DDDOL) for males of two *Dendrolimus* species in Krasnoyarsk Kray

Attractant components mkg per lure Z5E7DDDAL:Z5E7DDDOL		% of the total males caught	
		<i>Dendrolimus pini</i>	<i>D. superans sibiricus</i>
1	1000 : 1000	30.4	41.2
2	1000 : 500	39.1	47.1
3	1000 : 250	8.7	11.7
4	1000 : 100	21.8	0.0
5	1000 : 0	0.0	0.0
Total		100	100

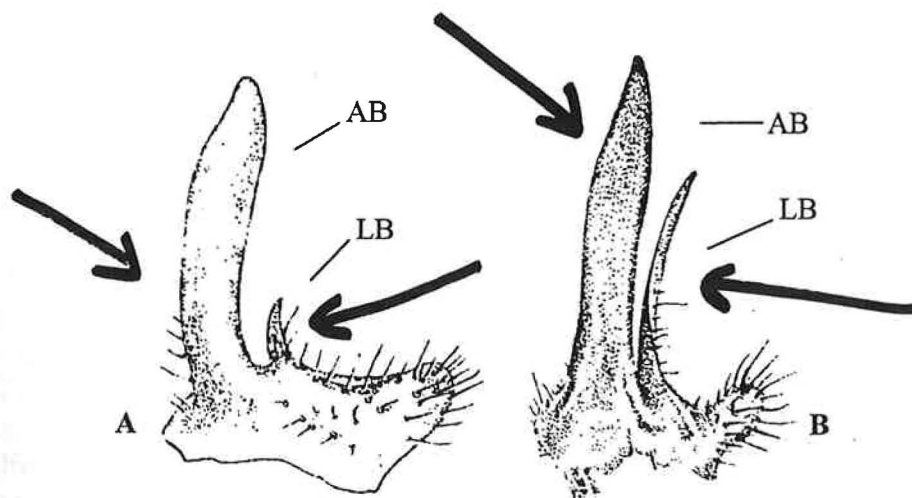


Figure 1. Part of genitalia (valvae) of *Dendrolimus pini* (A) and *D. superans sibiricus* (B) males; AB – upper branch, LB—lower branch of valvae.

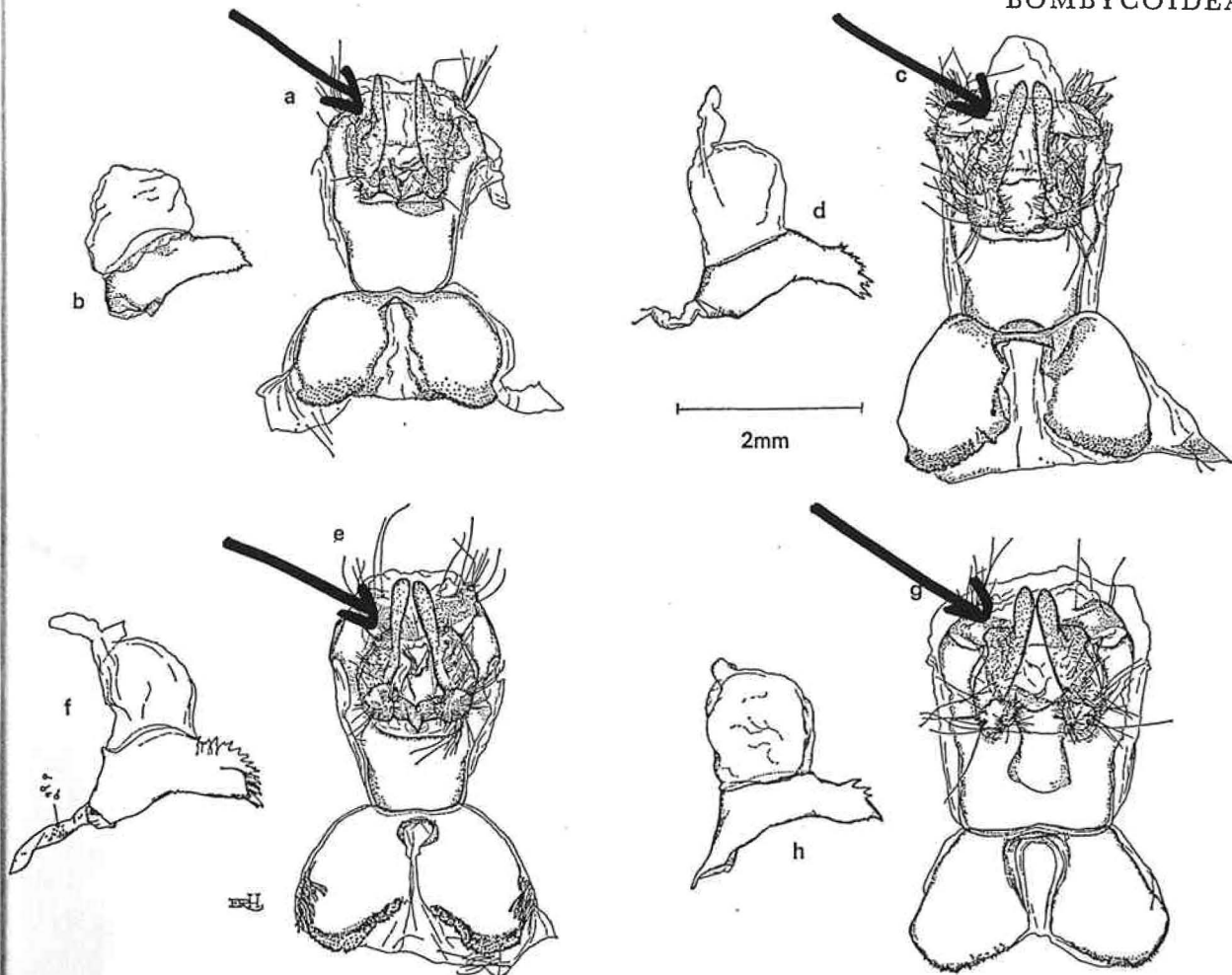


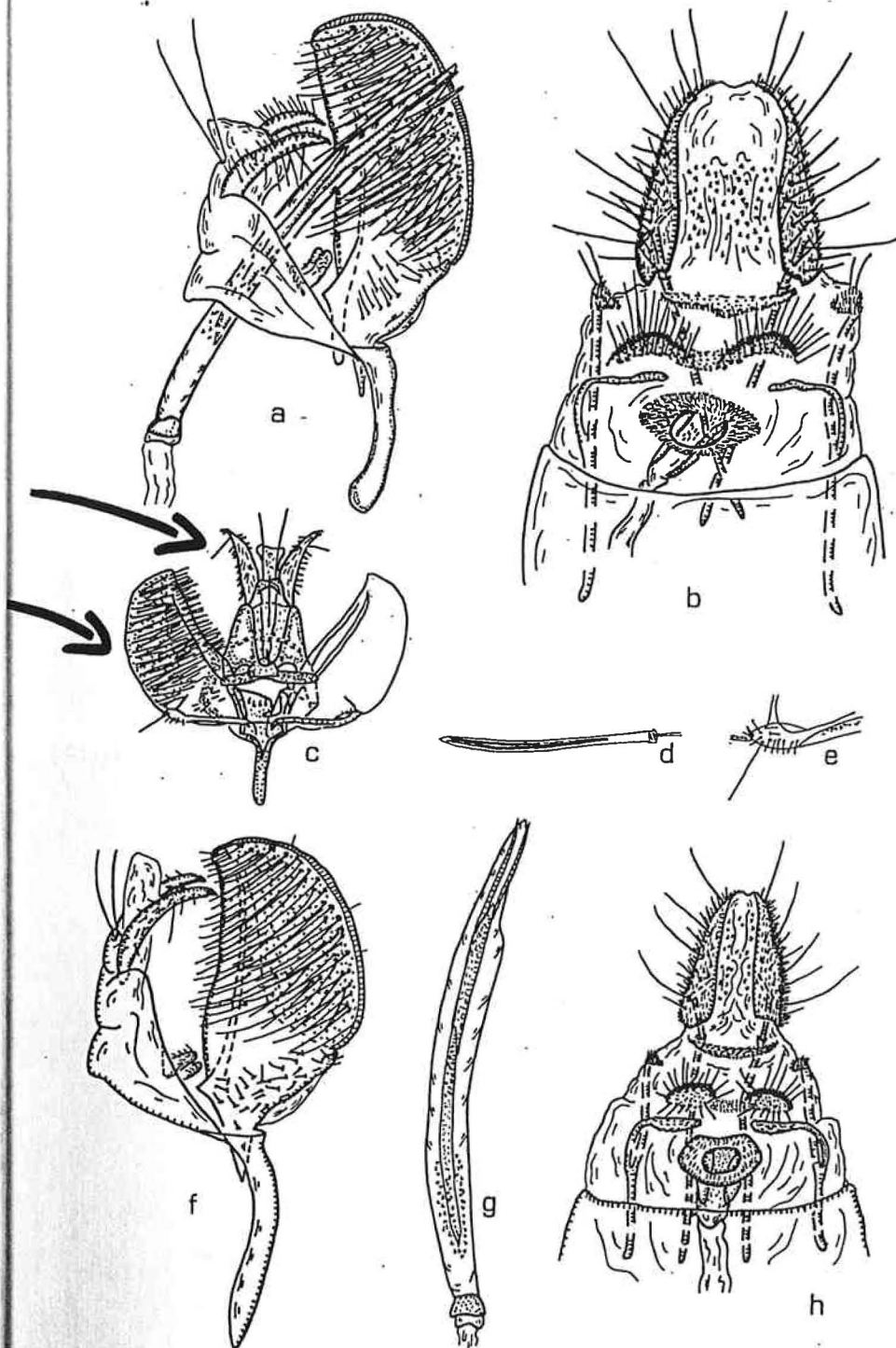
FIGURE 19

- a. Male genitalia of *Gloveria howardi* with aedeagus removed.
 b. Aedeagus of *Gloveria howardi*.
 c. Male genitalia of *Gloveria medusa* with aedeagus removed.
 d. Aedeagus of *Gloveria medusa*.
 e. Male genitalia of *Gloveria gargamelle* with aedeagus removed.
 f. Aedeagus of *Gloveria gargamelle*.
 g. Male genitalia of *Gloveria arizonensis* with aedeagus removed.
 h. Aedeagus of *Gloveria arizonensis*.

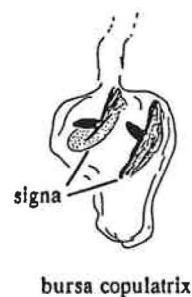
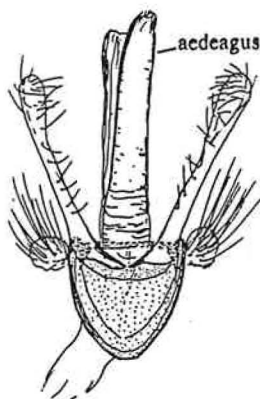
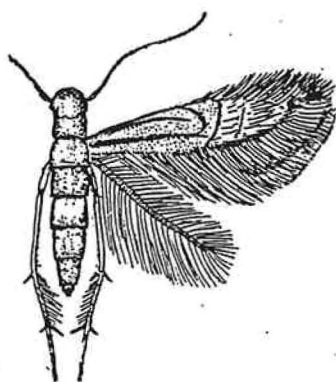
In the male genitalia the most obvious difference is the extent of the teeth or serrations on the apical extension of the aedeagus; in *gargamelle* the teeth extend from the apex to the opening, and in *medusa* they extend for only half the distance from the apex to the opening.

The larva has been described by Comstock (1960: 178). The following description is, in part, from his summary. The head is gray-brown with the adfrontal and epicranial sutures light brown. The middorsal white stripe on the thoracic and abdominal segments is bisected by a black line, and it is bordered a darker shade on each side. There is a paler subdorsal line and a lateral line composed of a series of short black and white stripes. The spiracular area is mottled with dull white, brown, and black. The host plants are recorded as *Eriogonum fasciculatum* Benth., *Ceanothus verrucosus* Nutt., and *Pinus* species. I wonder if this last could be an error in which the larva of *arizonensis* was mistaken for this species.

The moth is known from the coastal areas of southern California, and it has a summer flight period.



Linnaeus, 1758, Synonymes see in: Staudlin Berlin, p. 132 (*cogn* (*Hyponomeuta*); Gebl Obozr. 14(3), p. 64; Hanneman, 1977, T Yponomeutidae. In 314(1), 318(2); Kuch Exper. & Appl. Entomological differentiations Amsterdam, 169 pp Ireland 3, ed. A.M. family Yponomeuta 1996, Entomologia - *variabilis* Zeller, 19



Phyllocnistis citrella

YPONOMEUTOIDEA

YPONOMEUTIDAE

As treated here - in a broad concept - the taxon Yponomeutidae is a heterogeneous family group comprising the subfamilies Acrolepiinae, Argyrethiinae, Plutellinae and Yponomeutinae. These subfamilies differ markedly, especially the Argyrethiinae and Acrolepiinae, and are sometimes separated as families. In general, yponomeutid adults are small to medium-sized narrow-winged micro-moths, often brightly coloured, with a few larger moderately broad-winged species, notably in the Yponomeutinae. Larval feeding habits differ according to the subfamily, some feed exposed (*Plutella*, Plutellinae), some live gregariously in a communal webbing or nest (*Yponomeuta*, Yponomeutinae), some are concealed-feeders, tunnelling in fruit and shoots (*Argyrethia*, Argyrethiinae), or living between the leaves (*Acrolepiopsis*, Acrolepiinae).

The structure of the male genitalia varies greatly with the different subfamilies: tegumen usually narrow, weak; uncus usually reduced, often indefinite; socii strongly developed, prominent and setose, often erect (Yponomeutinae), sometimes with specialised scales on internal surface (Argyrethiinae); gnathos usually present, tongue-like (Yponomeutinae), or recurved and with spines at tip (Argyrethiinae), or absent (Acrolepiinae); anellus present as sclerotised ring (Plutellinae), or membranous; vinculum narrowly rounded, or rectangular, usually with slender saccus, or W-shaped or nearly so in ventral aspect (Argyrethiinae); sternite 8 sometimes in form of V- or Y-shaped plate (Argyrethiinae), or entire segment 8 sometimes divided, forming two lobes enclosing genitalia (Yponomeutinae, *Zelleria*).

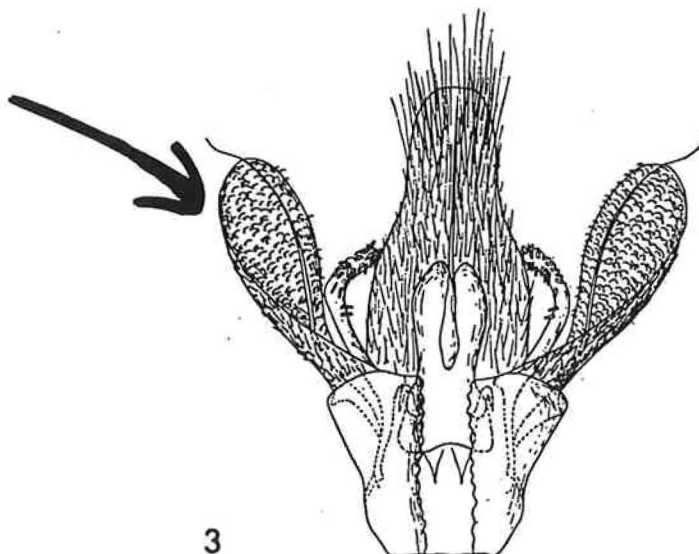
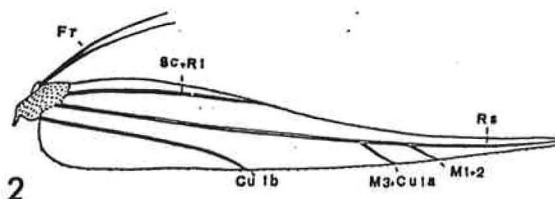
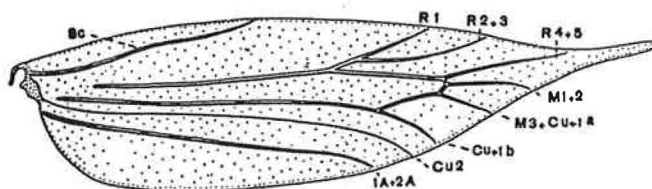
Structural differences between the subfamilies are less marked in the female genitalia than in the male: ovipositor sometimes partially extensile, lobes short or reduced; sternite 8 often with spinulose pads on either side of ostium; signum single or absent; coremata sometimes present.

References: Balachowsky, 1966; Carter, 1984; Freise, 1969; Gaedike, 1970; Hannemann, 1977; Kyrki, 1984; Moriuti, 1969; Zagulyaev, 1981; Zimmerman, 1978.

Characters

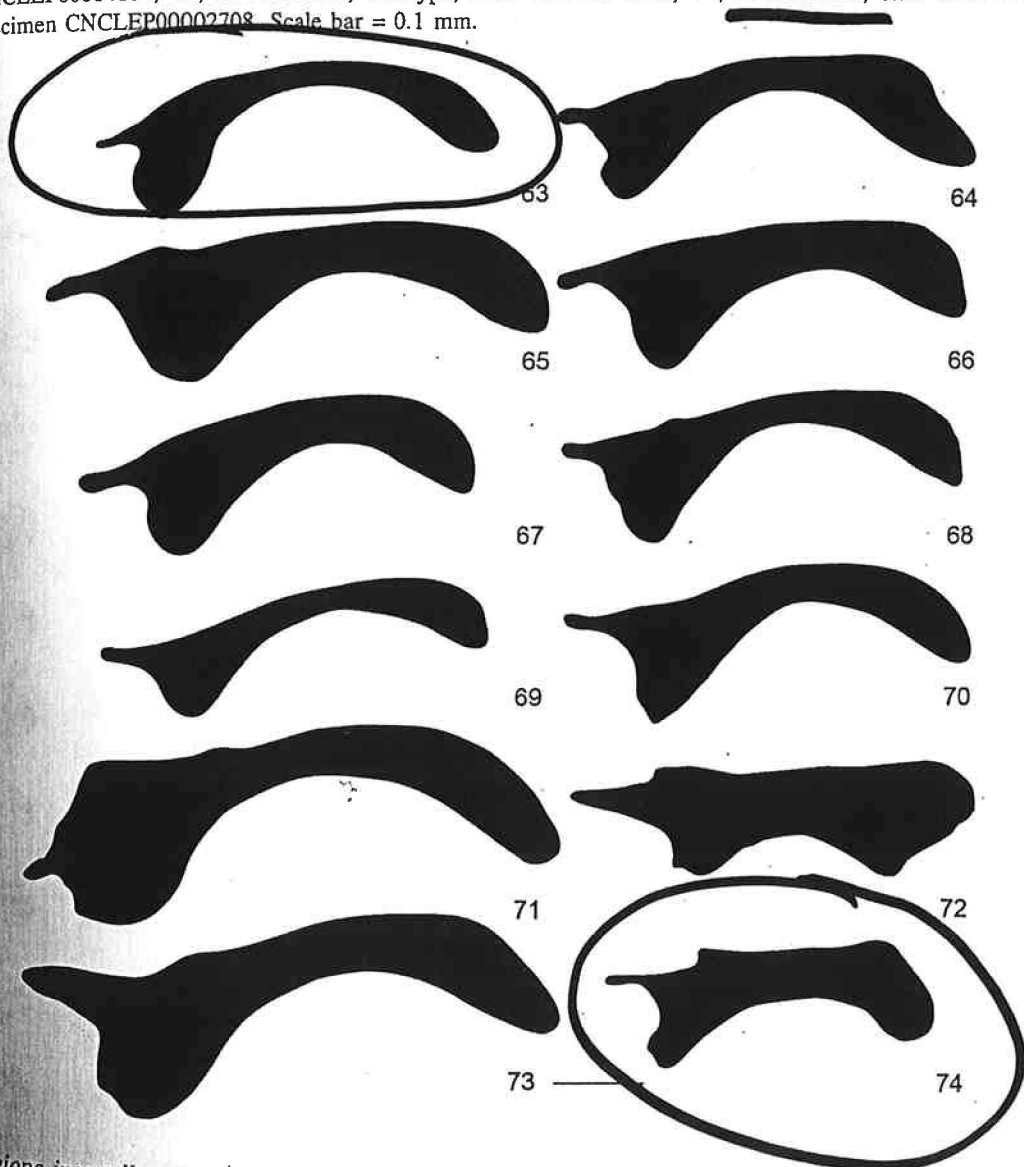
ADULTS (Fig. 1) - Overall shiny metallic gray. Vertex of head with tuft of hair; antenna long and filiform, scape forms eye-cap, antennal segments 28-32 in female, 28-30 in male. Female wingspan 7-8 mm, body length 2.6-3.0 mm; male wingspan 5.5-6.0 mm, maximum body length 2.0-2.3 mm (Ferro 1961). Forewing lanceolate; outer and posterior margin fringed; at rest, apex pointed, upturned in lateral view, divergent outwards in dorsal view (Emmet 1981); fringe with 4 radiating black lines: 2 toward costa, 3d horizontal, 4th directed posteriorly about 45° from long axis of wing; apical half, orange, enclosing 2 white, dark-edged costal spots and post tornal pale violet-golden spot strongly black-margined on both sides (Meyrick 1928, Stainton 1855). Hind wing narrowly lanceolate, evenly leaden gray, fringe longer than width of wing (Réal 1966). Wing venation (Fig. 2). Male genitalia (Fig. 3). Female ovipositor (Fig. 4).

(Figs. 2-3)



Leucoptera malifoliella. 2. Female wing venation. 3. Male genitalia, ventral view (2 from Ferro 1961; 3 from Zangheri and Ravelli 1957).

Figs. 63–74. Outlines of male valvae of *Acrolepiopsis* species, apex directed rightwards, all at same scale. 63, *A. assectella*, slide MIC 5172, specimen CNCLEP00006906; 64, *A. sapporensis*, slide USNM 15937, specimen CNCLEP00018264; 65, *A. californica* (holotype of *A. liliivora*), slide USNM 91630; 66, *A. californica*, paratype, slide USNM 91617; 67, *A. californica*, holotype, slide USNM 91616; 68, *A. californica*, ex *Lilium pardalinum*, slide JFL 1646, specimen CNCLEP00020307; 69, *A. californica*, slide JFL 1645, specimen CNCLEP00020303; 70, *A. californica*, slide JFL 1600, specimen CNCLEP00002317; 71, *A. leucoscia*, slide USNM 15934, specimen CNCLEP00002747; 72, *A. heppneri*, slide MIC 5170, specimen CNCLEP00014105; 73, *A. reticulosa*, holotype, slide Gaedike 2556; 74, *A. incertella*, slide MIC 5171, specimen CNCLEP00002708. Scale bar = 0.1 mm.



Argiope incertella; Chambers 1873: 13.
Acrolepia incertella; Dyar 1903: 568.
Acrolepiopsis incertella; Heppner and Duckworth 1983: 27; Gaedike 1984: 182; Gaedike 1997: 6.
Argiope dorsimaculella Chambers, 1873: 13.
 Synonymized by Dyar 1903: 568.

Acrolepia dorsimaculella; Walsingham 1882: 172.

Diagnosis

Although *A. incertella* is superficially indistinguishable from *A. heppneri*, it is readily separable by its genitalia. The male genitalia

(Fig. 53) have an elongate saccus that is barely longer than the valvae; stubby valvae with a slightly concave dorsal margin and a ventrally rounded apical process; an aedeagus with a distal shorter and less curved than the female genitalia are distinct; a sterigma and an ostium on the plane of the sterigma; an apical section of the ductus bursae that bends leftward (Figs. 78–79); smooth and situated in part of the corpus bursae; a ductus bursae that is about two times longer than the ductus bursae of *A. heppneri*, and are variable (Figs. 97–102). Forewing length (mean 5.2 mm, $n = 30$).

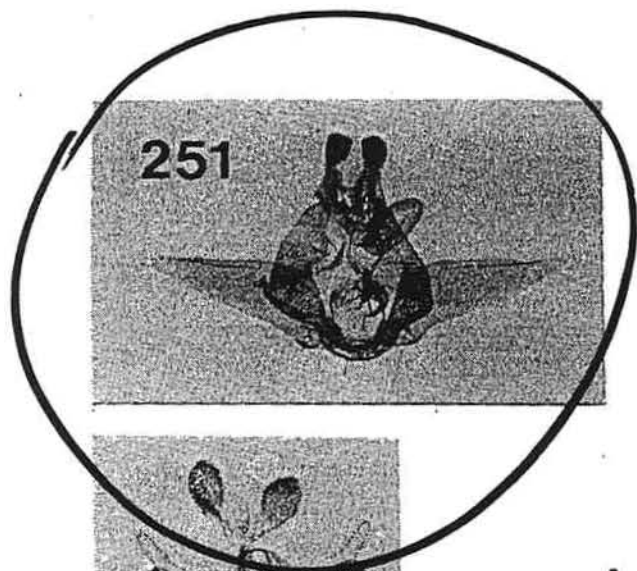
The larva (Fig. 125) are similar to those of that species).

Distribution

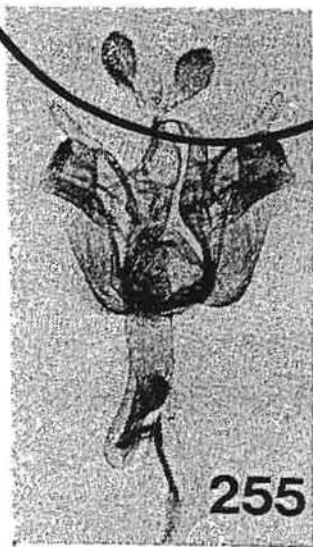
Widely distributed in North America from the Pacific to the Atlantic and Mississippi in the west and Michigan in the east. In the distribution, the species is few scattered records.

Life history

Larvae feed on young plants and have been reared from *S. herbaceum* (INHS) and *S. herbaceum* (account again was Terry Harrison (per 2003), who reared the species on *S. tamnoides*: 'they appear once per year, early in the *Smilax* is starting to grow in a phenologically neutral Illinois, would be in May). The larval damage is easy to spot. Each larva feeds on one of the young green terminal leaves, looks something like a skeletonizing perhaps three to four centimeters in length) (Fig. 125), and in the adult stage a 'window-like' pattern is seen on the external surface.



251

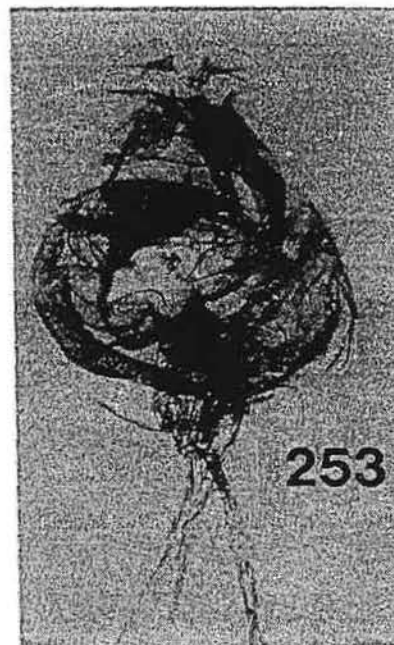


255

Darna



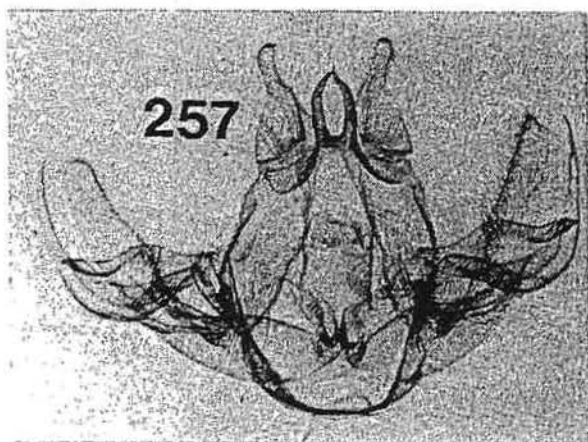
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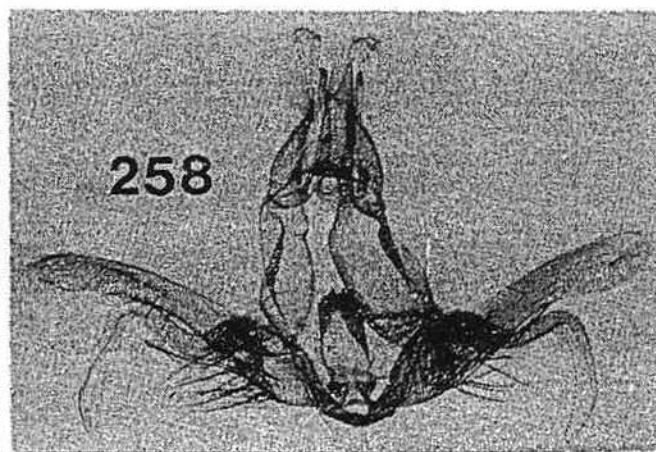
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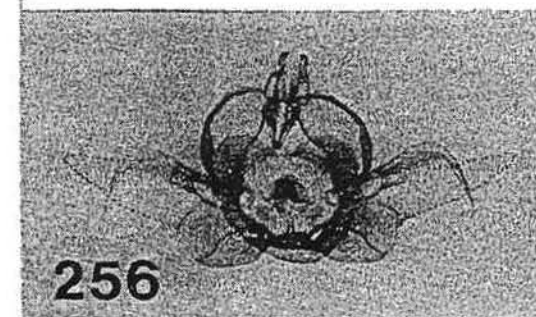
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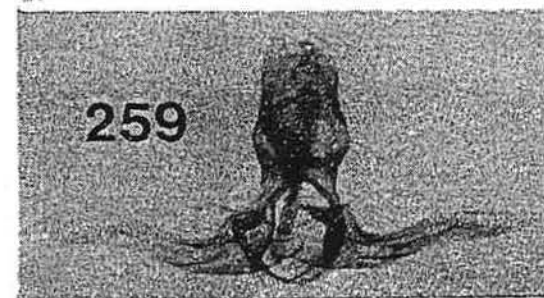
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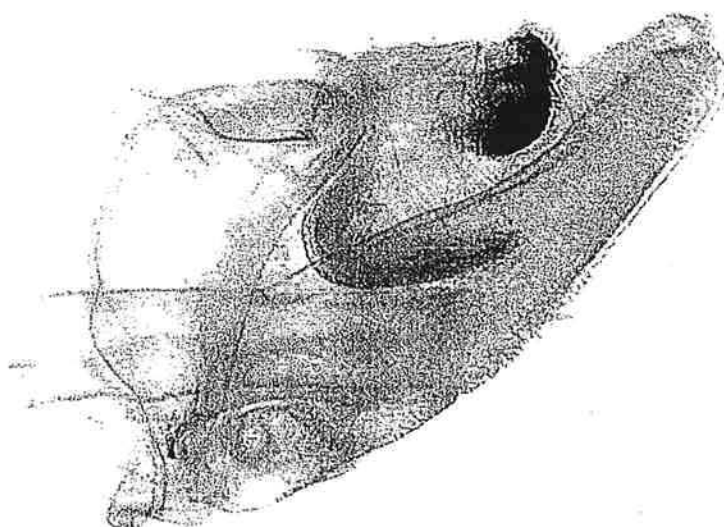
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256

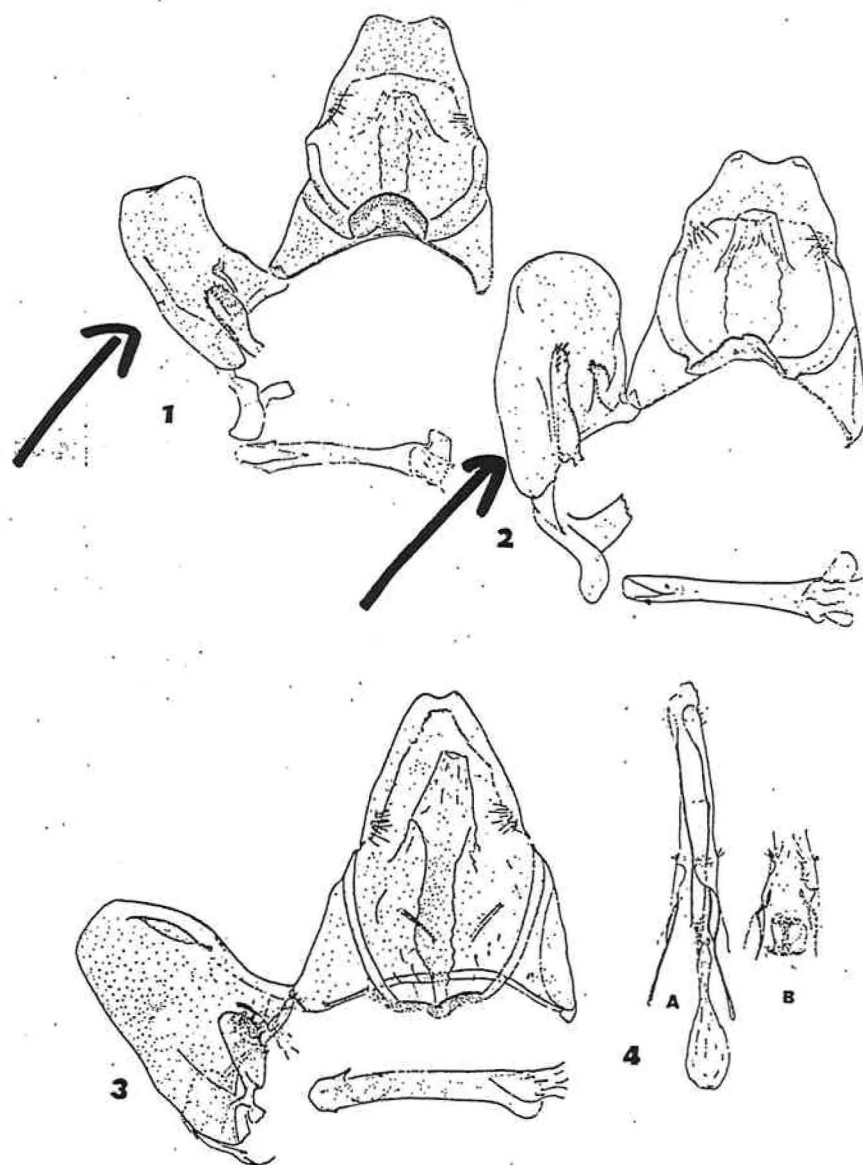


259



Darna





Explanation of Plate IV

- Fig. 1 *Chilecomadia valdiviana* Phil. Male genitalia: vinculum cut on one side and structures opened out; only one valve shown; ventral surface of dorsal structures and mesad face of valve shown; penis directly below.
- Fig. 2 *Chilecomadia moorei* S. Fig. Male genitalia: as in figure 1.
- Fig. 3 *Rhizocossus* n. gen., *munroei* n. sp. Male genitalia: as in figure 1.
- Fig. 4 *Chilecomadia moorei* S. Fig. Female genitalia: A, dorsal view; B, ventral view of region about ostium.

SCREENING KEY FOR CAPS TARGET TORTRICIDAE
IN THE EASTERN AND MIDWESTERN UNITED STATES (MALES)

1. Bottom edge of hindwing with circular patch of black scent scales; tibia of hindleg heavily tufted (false codling moth) *Thaumatotibia leucotreta*
- 1'. Bottom edge of hindwing lacking circular patch of black scent scales; tibia of hindleg not heavily tufted 2

2. Uncus elongate or spatulate 3
- 2'. Uncus absent or bifid 8

3. Membranous lobe present at apex of valve 4
- 3'. Membranous lobe absent at apex of valve 5

4. Costal fold lobed and conspicuous (light brown apple moth) *Epiphyas postvittana*
- 4'. Costal fold vestigial and narrow, or absent (light brown apple moth non-target) *Clepsis* spp.

5. Uncus spatulate; transtilla with stout spinelike setae; costal fold lobed and conspicuous 6
- 5'. Uncus elongate or spatulate; transtilla lacks stout setae; costal fold present or absent 7

6. Uncus two to three times longer than wide; valve with small pointed lobe at apex (summer fruit tortrix) *Adoxophyes orana*
- 6'. Uncus with length equal to width; valve rounded without small pointed lobe at apex (summer fruit tortrix non-target) *Adoxophyes furcatana*

7. Valve with spine at apex of sacculus; antenna not notched native and exotic
Archips spp.
- 7'. Valve lacks spine at apex of sacculus; base of antenna notched native and exotic
Pandemis spp.

8. Forewing uniformly green, even when worn; valve with two small lobes at apex (green oak tortrix) *Tortrix viridana*
- 8'. Forewing not uniformly green; valve lacks two small lobes at apex 9

9. Uncus and socii absent; ventral margin of valve indented to form a "neck" 10
- 9'. Uncus or socii present; ventral margin of valve does not form a "neck" 12

10. Neck strongly constricted so that valve appears bilobed ventrally (bean moth) *Cydia fabivora*
- 10'. Valve does not appear bilobed ventrally 11

11. Valve with a thornlike projection; apex of aedeagus sclerotized and concave, one long thin cornutus present (plume fruit moth) *Grapholita funebrana*

11'. Valve lacks a thornlike projection; apex of aedeagus not sclerotized and concave, several long thin cornuti present (non-target, Oriental fruit moth) *Grapholita molesta*

12. Aedaegus massive, almost as wide and long as the valve, with a thin long cornutus, a patch of cornuti and a circle of cornuti; European grape berry moth *Eupoecilia ambiguella*

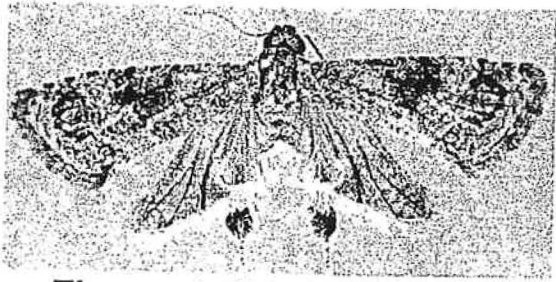
12'. Aedaegus not as wide or long as the valve, without three groups of cornuti 13

13. Black sex scaling on hindwing, abdomen and hindleg; valve broad and quadrate at base, curved upward distally (bean shoot moth) *Crociosema aporema*

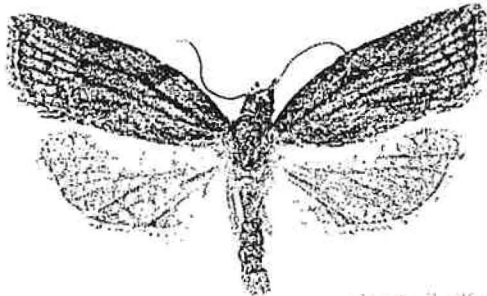
13'. Black sex scales absent on hindwing, abdomen and hindleg; valve not quadrate at base and curved upward distally 14

14. Uncus absent; valve long, thin and notched on the ventral margin, the apex evenly rounded with relatively short and sparse setae; aedeagus without cornuti (grape vine moth) *Lobesia botrana*

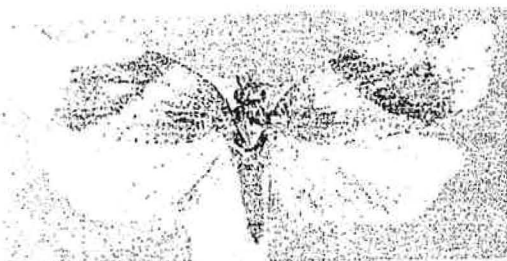
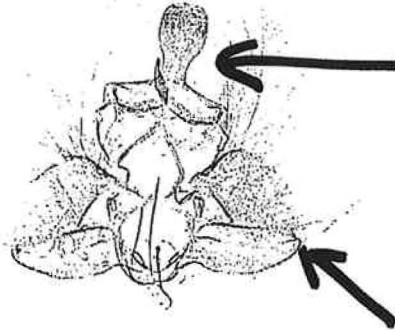
14'. Uncus and cornuti present or absent; if valve long and thin then apex with dense setae and ventral notch absent Tortricidae (not in the key)



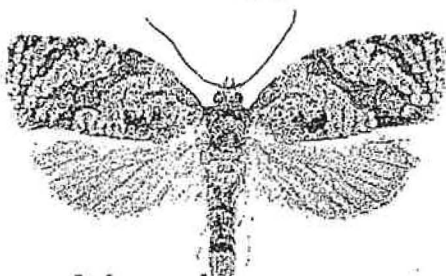
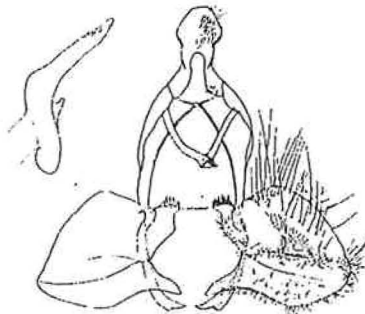
Thaumatotibia leucotreta



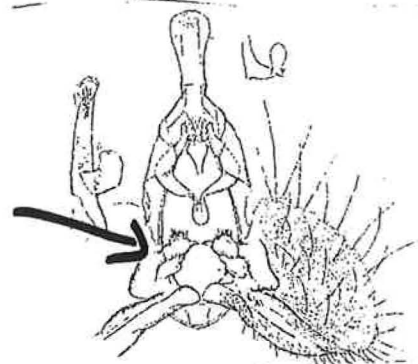
Epiphyas postvittana



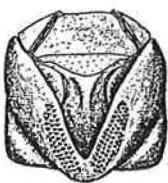
Clepsia fucana



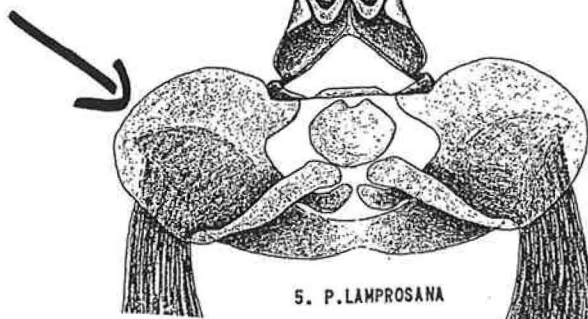
Adoxophyes orana



2A. ANTENNA



2B. ABD. SEG.



5. P. LAMPROSANA



2C. LIMITATA



3. P. PYRUSANA



4. P. PYRUSANA

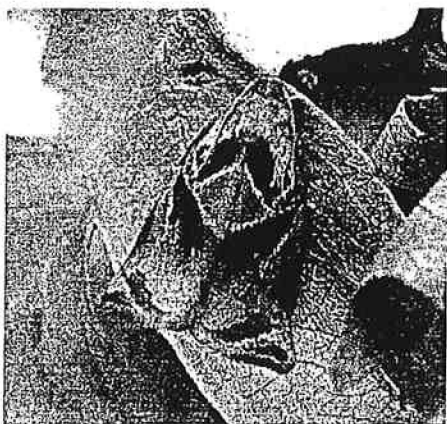


5A. LAMPROSANA

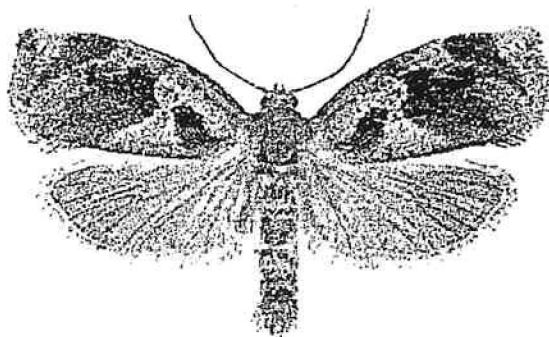
Fruit Tree Tortrix (continued)

Archips podanus (Scopoli)

Tortricidae: Tortricinae: Archipini



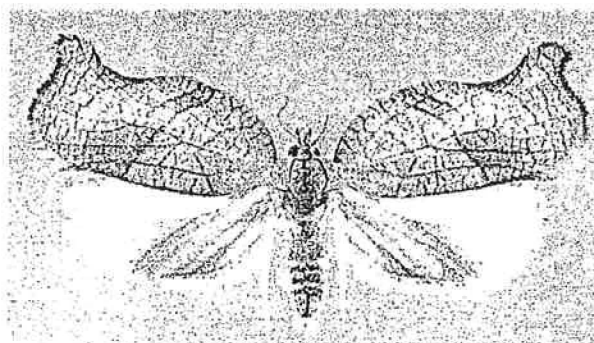
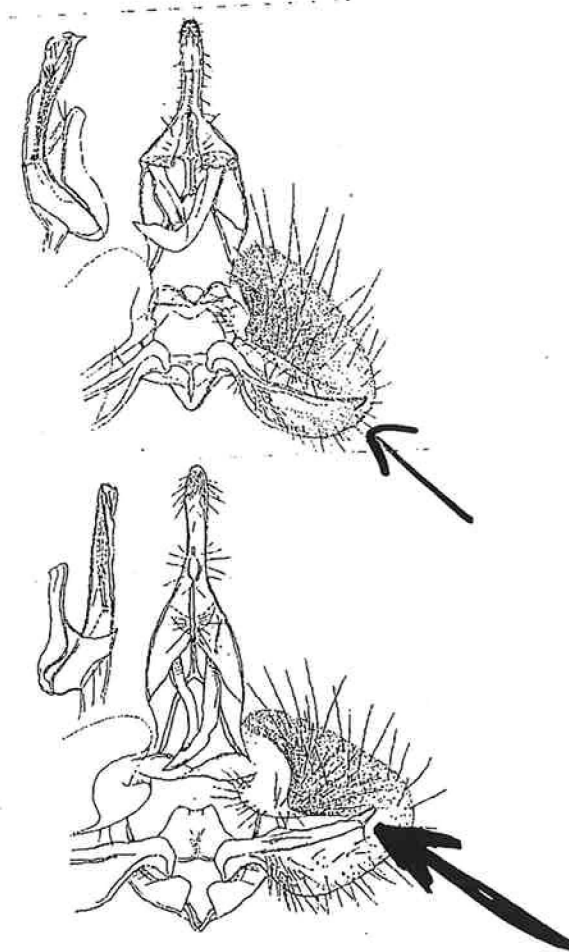
Archips podanus



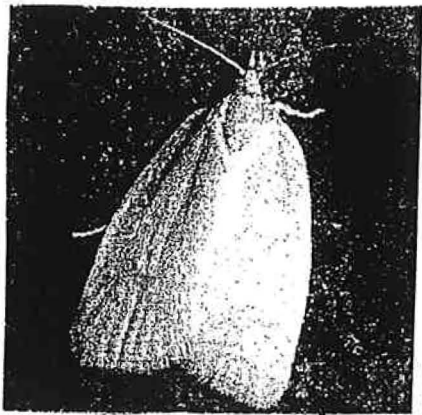
Archips crateageanus



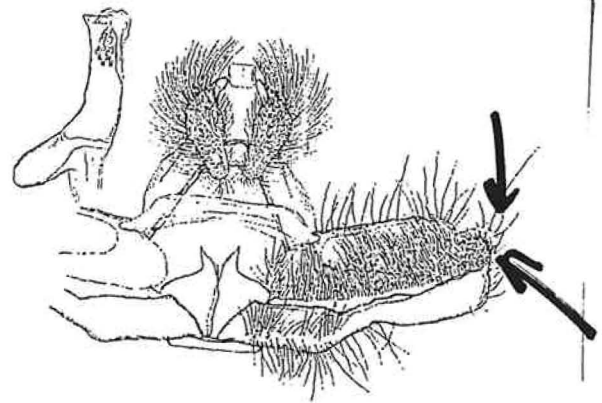
Archips magnolianus (male)



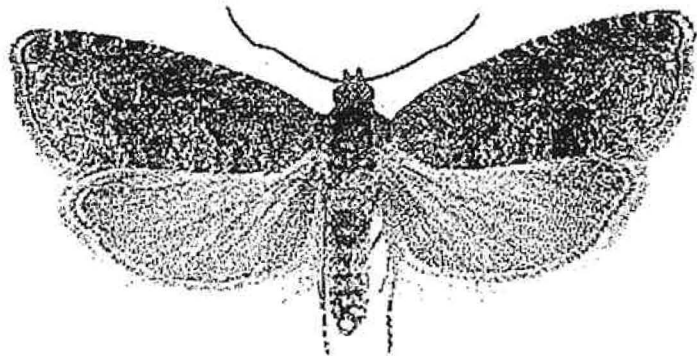
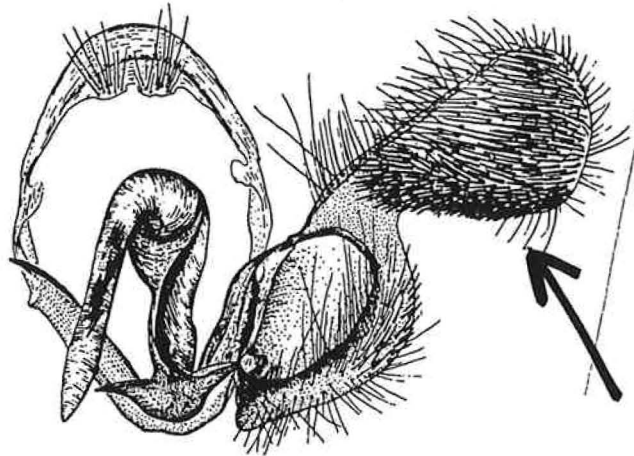
Archips pupuranus (female)



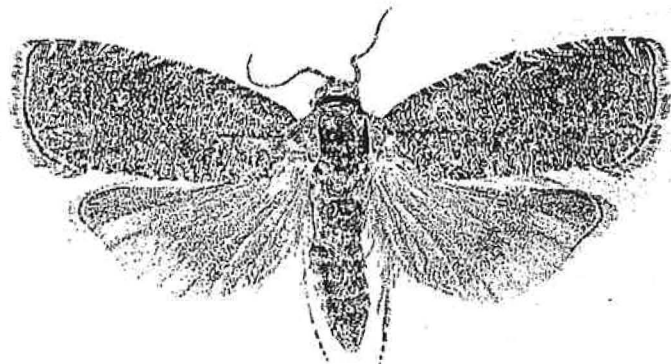
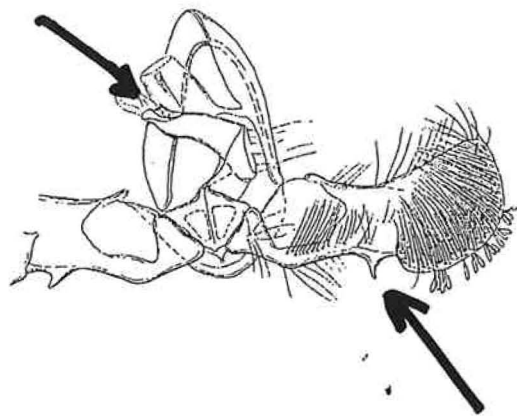
Tortrix viridana



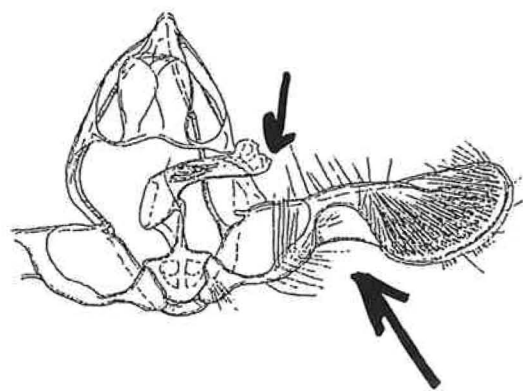
Cydia fabivora

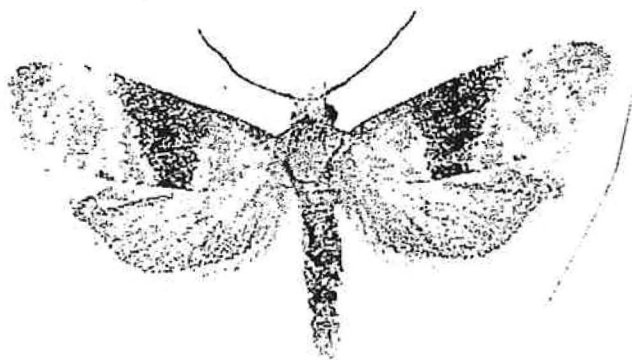


Grapholita funebrana

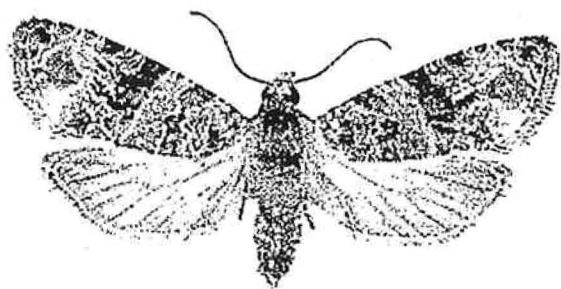
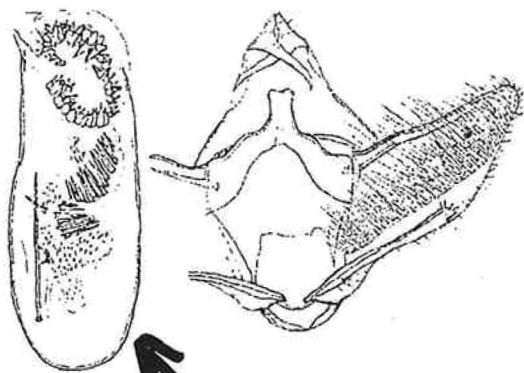


Grapholita molesta

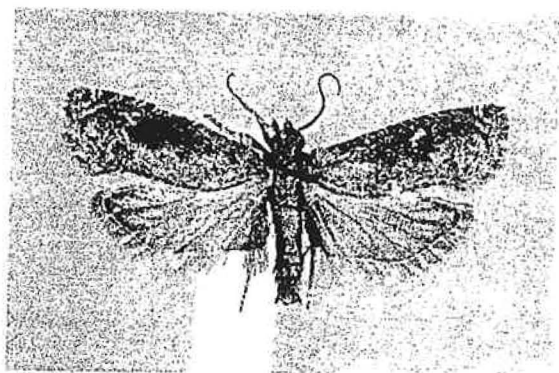
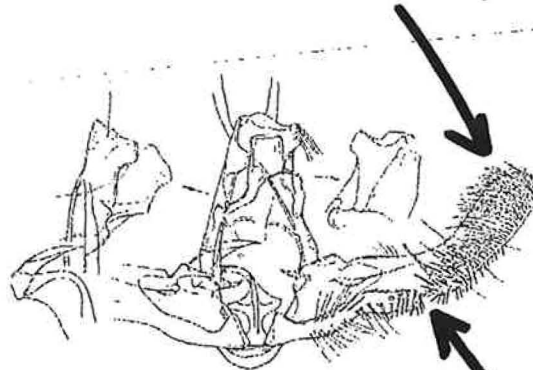




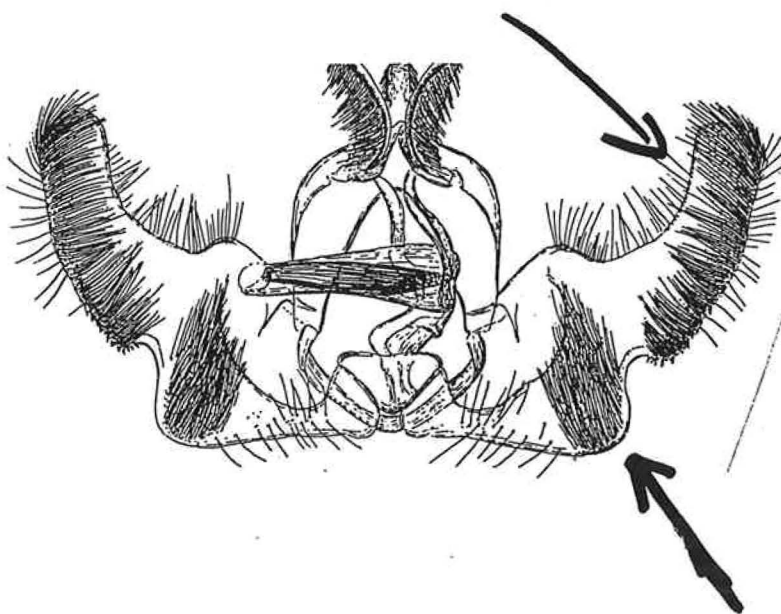
Eupoecilia ambiguella



Lobesia botrana



Crocidosema aporema



SCREENING KEY FOR CAPS TARGET PYRALOIDEA IN THE EASTERN AND MIDWESTERN UNITED STATES (MALES)

1. Chaetosemata absent, if present then moth straw colored; preacinctorium present but may be hard to find; a slide mounted cleared abdomen shows open tympanal cavities medially (Crambidae) 3
- 1'. Chaetosemata present, moths always brown and gray; preacinctorium absent; a slide mounted cleared abdomen shows closed tympanal cavities medially (Phycitinae) 2

2. Forewings narrow and mostly brown; scale and setal tufts present near base of sacculus; apical portion of gnathos hooked; mesotibia without an oblique black dash (honeydew moth) *Cryptoblabes gnidiella*
- 2'. Forewings with pale costal area and black distal dot; apical portion of gnathos bilobed; mesotibia with oblique black dash (cactus moth) *Cactoblastis cactorum*

3. Gnathos and uncus joined like a pincer; middle of hindwing with a row of scales at base of Cu vein 4
- 3'. Gnathos and uncus not joined like a pincer; middle of hindwing lacking row of scales at base of Cu vein 6

4. Ocelli absent; costal process of valve large and flattened apically *Diatraea considerata*
- 4'. Ocelli present; costal process of valve, if present, blunt and triangular 5

5. Frons with upper and lower ridge; triangular costal process of valve absent (Asiatic rice stem borer) *Chilo suppressalis*
- 5'. Frons with single upper ridge; triangular costal process of valve present (spotted stalk borer) *Chilo partellus*

6. Forewing with scale tuft near base of costa; gnathos toothed dorsally *Crocidolomia pavonana (binotalis)*
- 6'. Forewing lacks scale tuft near base of costa; gnathos not toothed dorsally 7

7. Wings white with a thick straight contrasting brown band at the margins 8
- 7'. Wings lack a thick contrasting brown band at the margins 9

8. Brown band at forewing costal margin encloses one to two pale spots (box tree pyralid) *Diaphania perspectalis*
- 8'. Brown band at costal margin solid, without a pale spots 9

9. White lateral margins of frontal area not reaching antennal base; dark band of forewing widens at anal angle; hindtibia not flattened; dorsum of A5-6 dark, the rest white; anal tuft no wider than two times the abdomen (pumpkin caterpillar; established in S. Fla, exotic in rest of US) *Diaphania indica*

- 9'. White lateral margins of frontal area reaching antennal base; dark band of forewing not widened at the anal angle; hindtibia flattened; dorsum of A1-5 white, A6-7 either dark or white; anal tuft 2-3 times wider than the abdomen (non-target, melonworm) *Diaphania hyalinata*
10. Wings and abdomen orange with black dots; uncus elongate, the tip rounded and slightly spatulate, with a small row of spines (yellow peach moth complex) "Conogethes spp." 11
- 10'. Wings and abdomen not orange with black dots; uncus not elongate and slightly spatulate 11
11. Uncus trilobed; valve with mesal spiny patch and comblike spines on sacculus 12
- 11'. Uncus not trilobed; valve lacks mesal spiny patch and comblike spines on sacculus 13
12. Forewing light yellow tan; spined zone of sacculus longer than spineless basal area (Asian corn borer) *Ostrinia furnacalis*
- 12'. Forewing brown to tan with a slight reddish tint; spined zone of sacculus shorter than spineless basal area (non-target, European corn borer) *Ostrinia nubilalis*
13. Forewing with 2-3 white patches, the largest one elongate and open at the costal margin; dark border of hindwing irregular, never straight; (lima bean pod borer) *Maruca vitrata (testulalis)*
- 13'. Forewing without 2-3 white patches and a large one open at the costal margin; dark border of hindwing absent 14
14. Tip of uncus clubbed; tegumen with a sharp notch at apex; forewing with a large oval spot bisected by a pointed spike (pattern may be faded) *Glyphodes onychinalis*
- 14'. Tip of uncus not clubbed; tegumen lacks a sharp notch at apex; forewing without a large oval spot bisected by a pointed spike 15
15. Postmedial line with a medial finger like lobe; aedeagus without cornuti *Duponchelia fovealis*
- 15'. Postmedial line lacks a medial finger like lobe; aedeagus with or without cornuti 16
16. Forewing white with an irregular red brown lobed spot at the middle of the inner margin; aedeagus with a single thin cornutus 17
- 16'. Forewing not white with an irregular red brown lobed spot at the middle of the inner margin; aedeagus with or without a single thin cornutus Crambidae not in the key
17. Tegumen membranous (New World origins) *Neoleucinodes elegantalis*
- 17'. Tegumen sclerotized (Old World origins) *Leucinodes orbonalis*

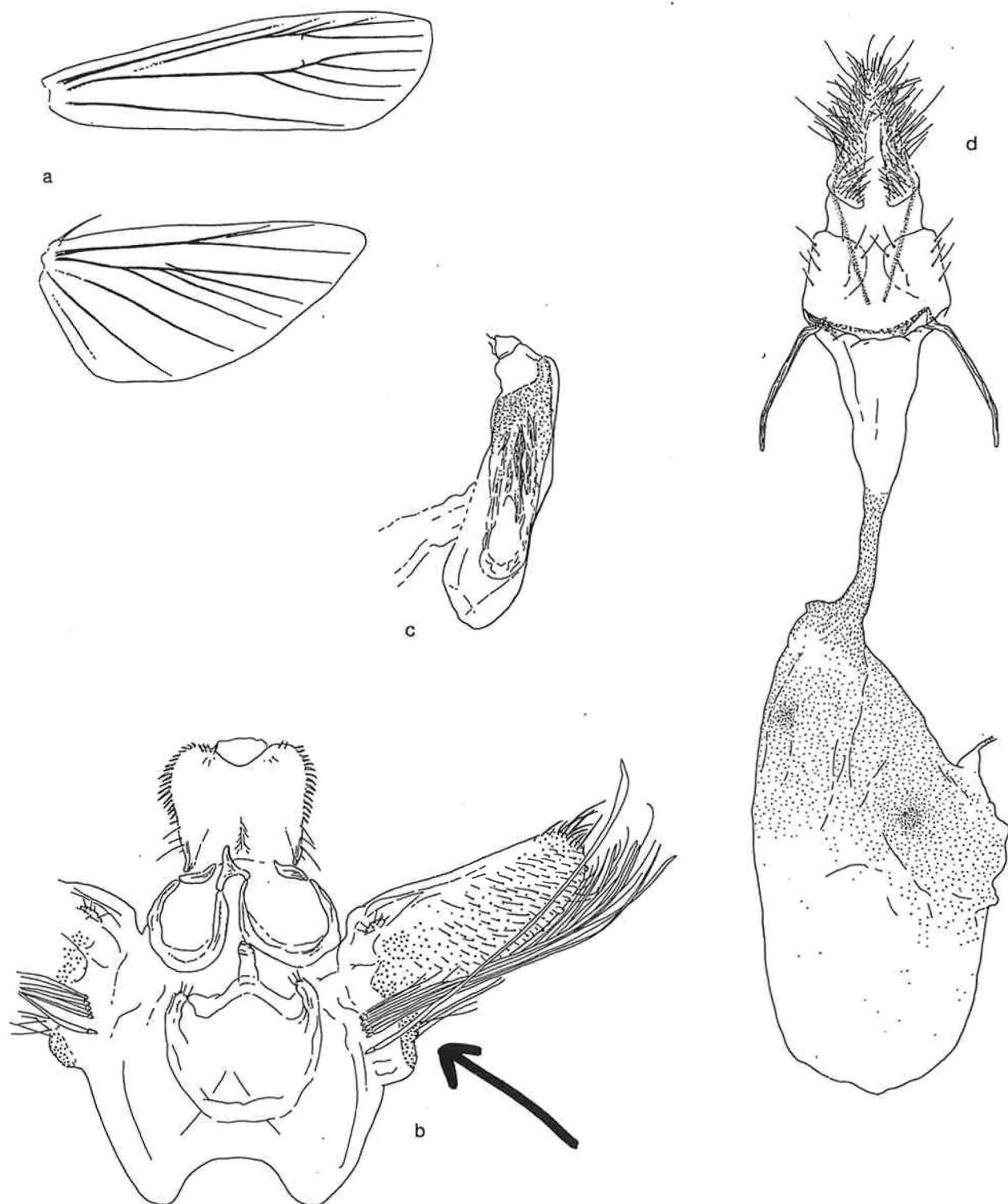


FIGURE 1: *CRYPTOBLABES GNIDIELLA*

a. Male forewing and hindwing; b. Male genitalia (left valva, aedeagus and some scales and setae of tufts near base of sacculus omitted); c. Aedeagus; d. Female genitalia.

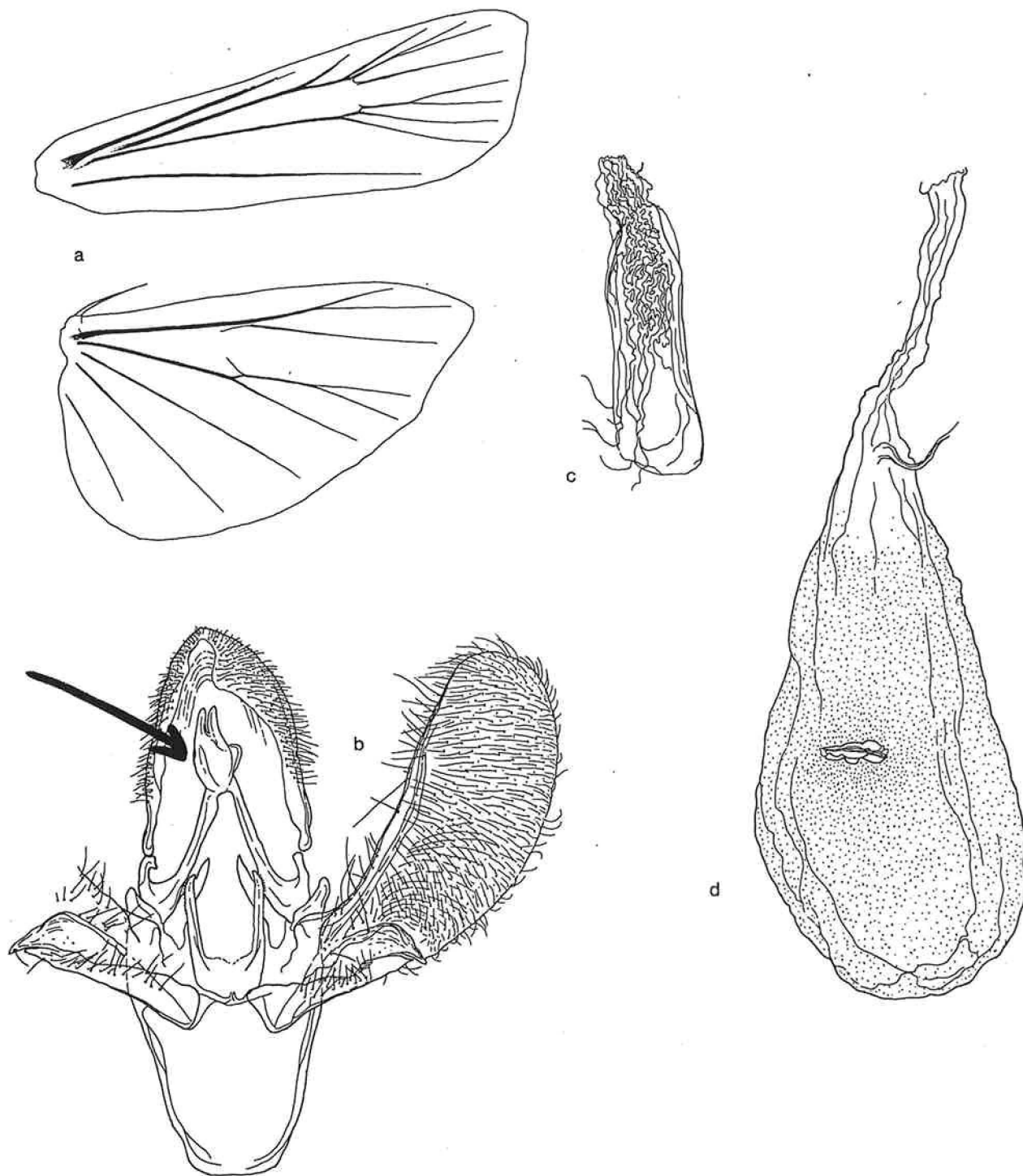
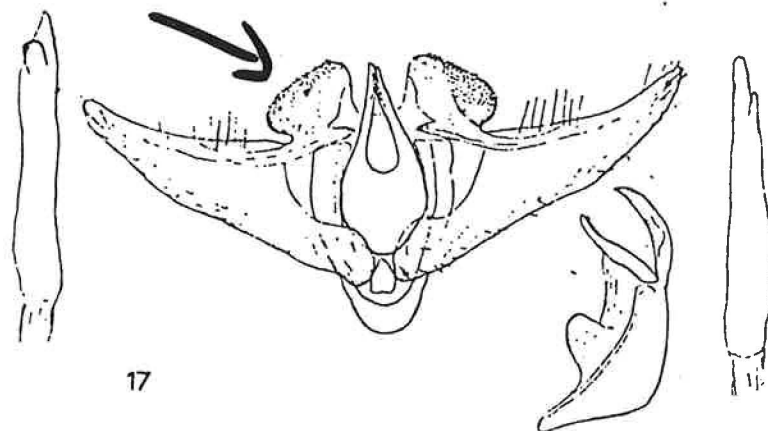
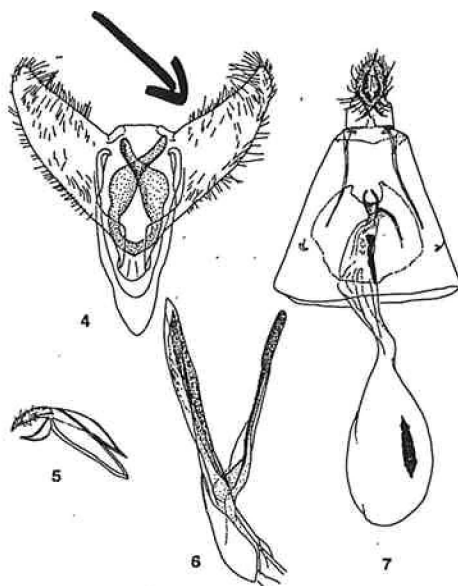


FIGURE 31: VENATION AND GENITALIA OF *CACTOBLASTIS CACTORUM*

a. Male forewing and hindwing. *b.* Male genitalia (most of left valva and aedoeagus omitted) (HHN 3141). *c.* Aedoeagus. *d.* Corpus bursae, ductus bursae, and part of ductus seminalis (HHN 3142).



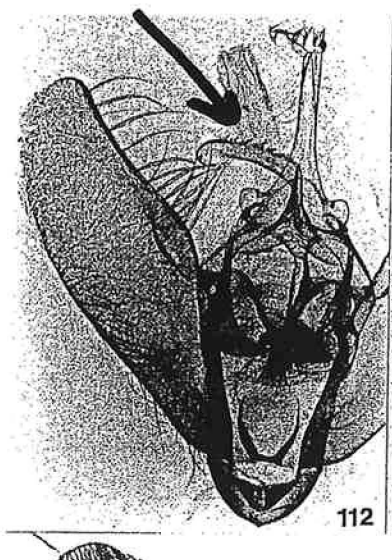
17



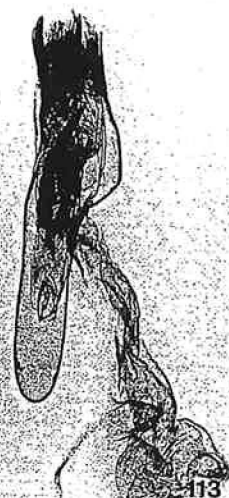
Chilo suppressalis 4-6. Male genitalia. 4. Main part, ventral view. 5. Uncus and vinculum, lateral view. 6. Aedeagus, lateral view. 7. Female genitalia, ventral view (Drawn by Mary Lou Cooley, Systematic Entomology Laboratory, ARS, USDA).



Chilo parcellus genitalia. 4-6. Male genitalia. 4. Main part, ventral view, with complex, sclerotized juxta shown tilted to left. 5. Vinculum and uncus removed and shown in lateral view. 6. Aedeagus, lateral view. 7. Female genitalia, ventral view, but ovipositor twisted to left and shown laterally (Drawings by Mary Lou Cooley, Systematic Entomology Laboratory, ARS, USDA).



112



113



114

Fig. 112-121. Male genitalia. 112, *Crocidolomia pavonana*; 113, aedeagus; 114, uncus tip; lectotype of *comalis*, BMNH slide 1429

medial line, extending from the costa to vein 3, black-brown; both wings with the postmedial line indistinct.

Hab. Khásis; Nágas. *Exp.* 22 millim.

5030. *Glyphodes hermesalis*, *Wlk. Cat. xviii*, p. 518.

Pitama lativitta, *Moore, Lep. Atk.* p. 217, pl. 7, fig. 21; *C. & S.* no. 4230.

♂. Pale yellow; palpi except at base, frons, antennæ, and stripes on shoulders and vertex of thorax black; thorax below with a ridge of large leaden-coloured scales near mid legs; abdomen with the distal half black. Fore wing with the costal area black, with three spots in cell conjoined to it; an outwardly-oblique nearly straight postmedial line with the area beyond it black. Hind wing with postmedial line curved from costa to anal angle, the area beyond it black.

Hab. Sikhim; Khásis; Borneo. *Exp.* 36 millim.

5031. *Glyphodes perspectalis*, *Wlk. Cat. xviii*, p. 515.

Phacellura advenalis, *Led. Wien. ent. Mon.* 1863, pp. 401, 478, pl. 13, fig. 17.

Head fuscous; palpi white below; thorax and abdomen white and fuscous. Fore wing fuscous, with white spot in cell and discocellular lunule; a broad white fascia below the cell from base to marginal area and fasciæ in the interspaces beyond the cell, the two between veins 2-5 short. Hind wing white, with broad fuscous marginal band narrowing to anal angle.

Hab. Japan; China; Dharmasála. *Exp.* 50-54 millim.

5032. *Glyphodes pulverulentalis*, n. sp.

♂. Differs from *negatalis* (p. 347) in being thickly irrorated and striated with black; abdomen with oblique lateral stripes; the anal tuft black with brown middle. Fore wing with all the markings obscured by the spots and striæ; the antemedial, medial, and postmedial bands broader and less irregular, the 1st dentate inwards on vein 2, the 2nd without discocellular spot on it, the 3rd with series of pale specks on its outer edge from vein 4 to inner margin; the dentate submarginal line replaced by a series of diffused black patches in the interspaces. Hind wing thickly irrorated and striated; oblique black-edged brown postmedial and submarginal bands almost meeting at a point near anal angle; cilia of both wings fuscous, with fulvous and brown lines at base.

Hab. Nágas; Tenasserim (*Doherty*). *Exp.* 30 millim. Type in coll. Elwes.

5033. *Glyphodes dysallactalis*, n. sp.

♂. Differs from *negatalis* in being paler. Fore wing with the

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Figura 6. Tibia posterior izquierda de *Diaphania hyalinata* ♂♂ (25X).

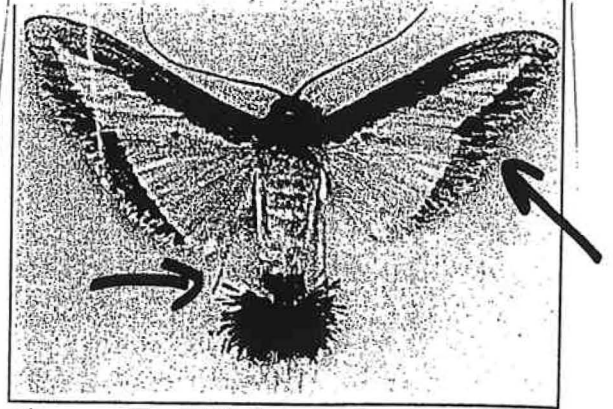


Figura 5. Adultos de *Diaphania hyalinata* ♂♂ (1X).

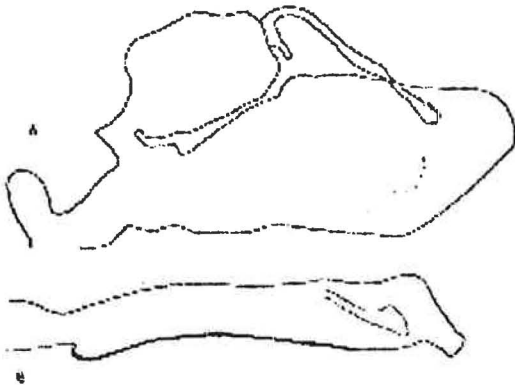


Figura 7. Genitalia masculina de *Diaphania hyalinata*: A) Vista lateral izquierda; B) Aedeagus (25X).



Figura 9. Genitalia femenina de *Diaphania hyalinata*: Vista lateral izquierda de la bursa copulatrix (25X).

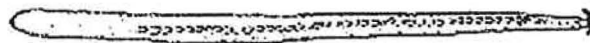


Figura 8. Vista ventral del larso anterior de *Diaphania hyalinata* a mostrando la modificación de las escamas (25X).

Figura 11. Tibia posterior izquierda de *Diaphania indica* o o (25X).

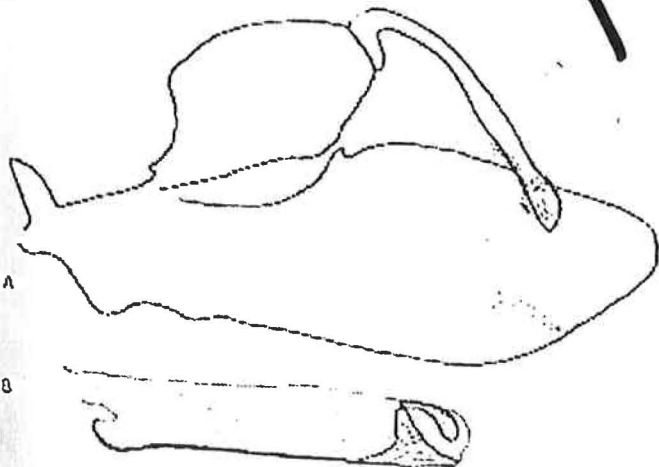


Figura 12. Genitalia masculina de *Diaphania indica*: A) Vista lateral izquierda; B) Aedeagus (25X).

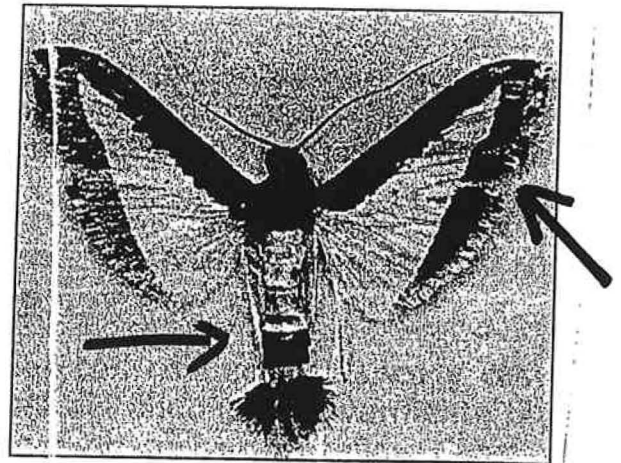


Figura 13. Genitalia femenina de *Diaphania indica*: Vista lateral izquierda de la bursa copulatrix (25X).

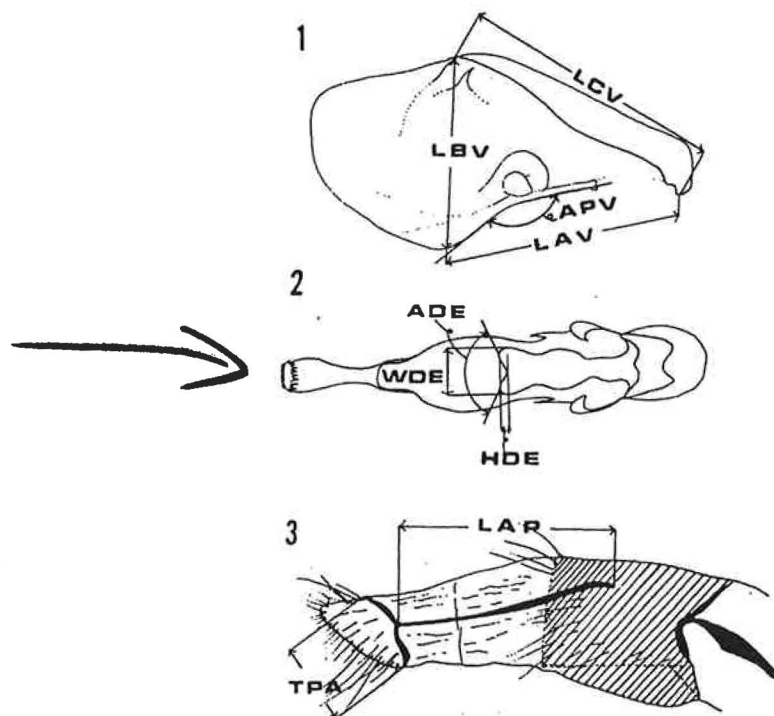


Fig. 2. Selected morphometric characters of the two types of yellow peach moth. 1: Valva of male genitalia, 2: Tegumen of male genitalia, 3: Ovipositor of female. For abbreviations, see text.

kV under a model SE-430 (Hitachi, Tokyo) scanning electron microscope.

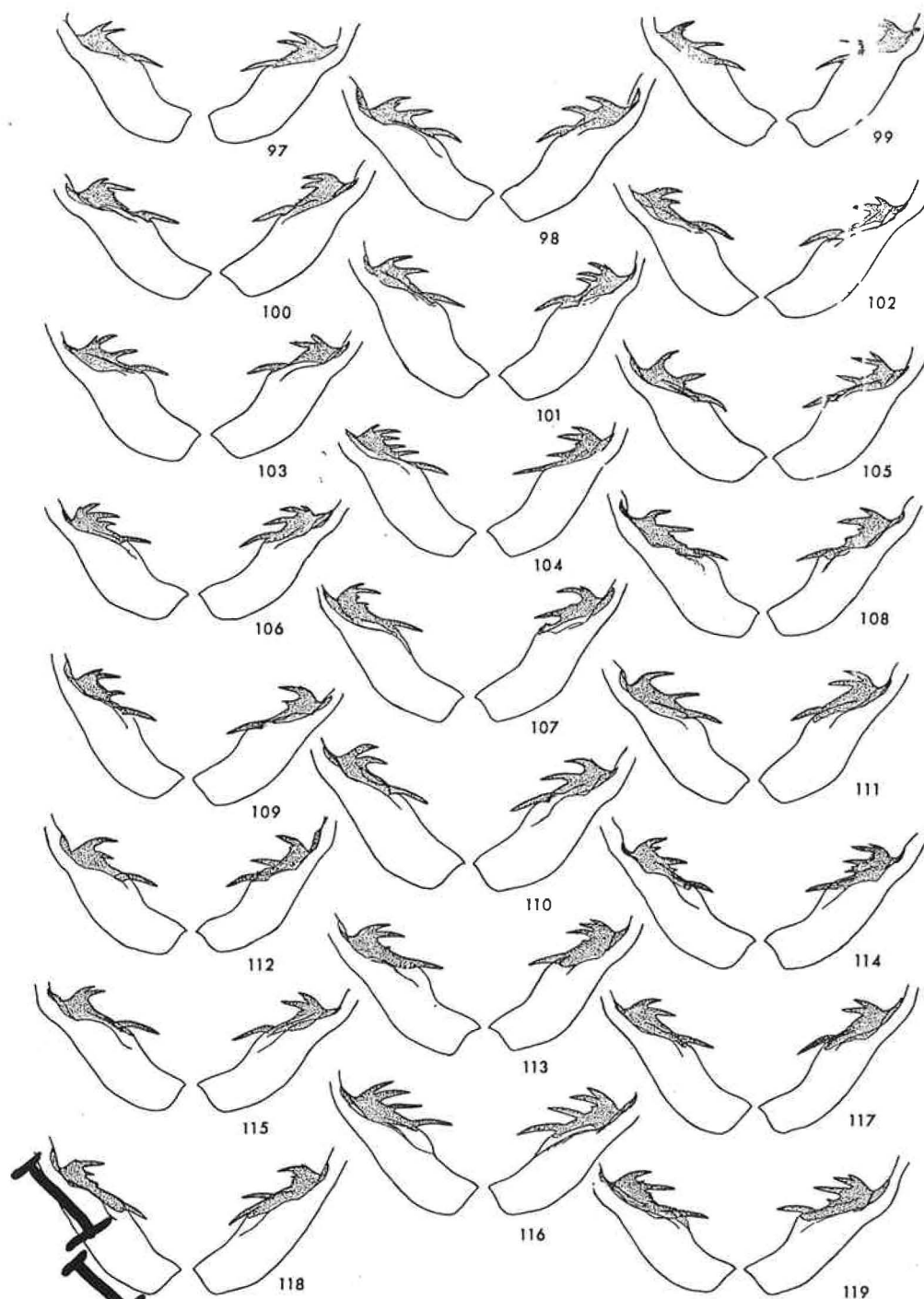
Nine quantitative characters (7 linear and 2 angular) were morphometrically evaluated on the male genitalia and the female ovipositor (Fig. 2). As supplementary characters, structure of the hind tibia and the hind 1st-tarsus of the male moth, papilla analis of the female moth, epipharynx, mandible, labrum and pinacular of the larva and cremaster of the pupa were selected for comparisons between the two types. Some parts of these morphological characters were also compared with those of the cardamom shoot borer, *C. punctiferalis* from India. All morphometrical characters were also compared on photographs.

RESULTS

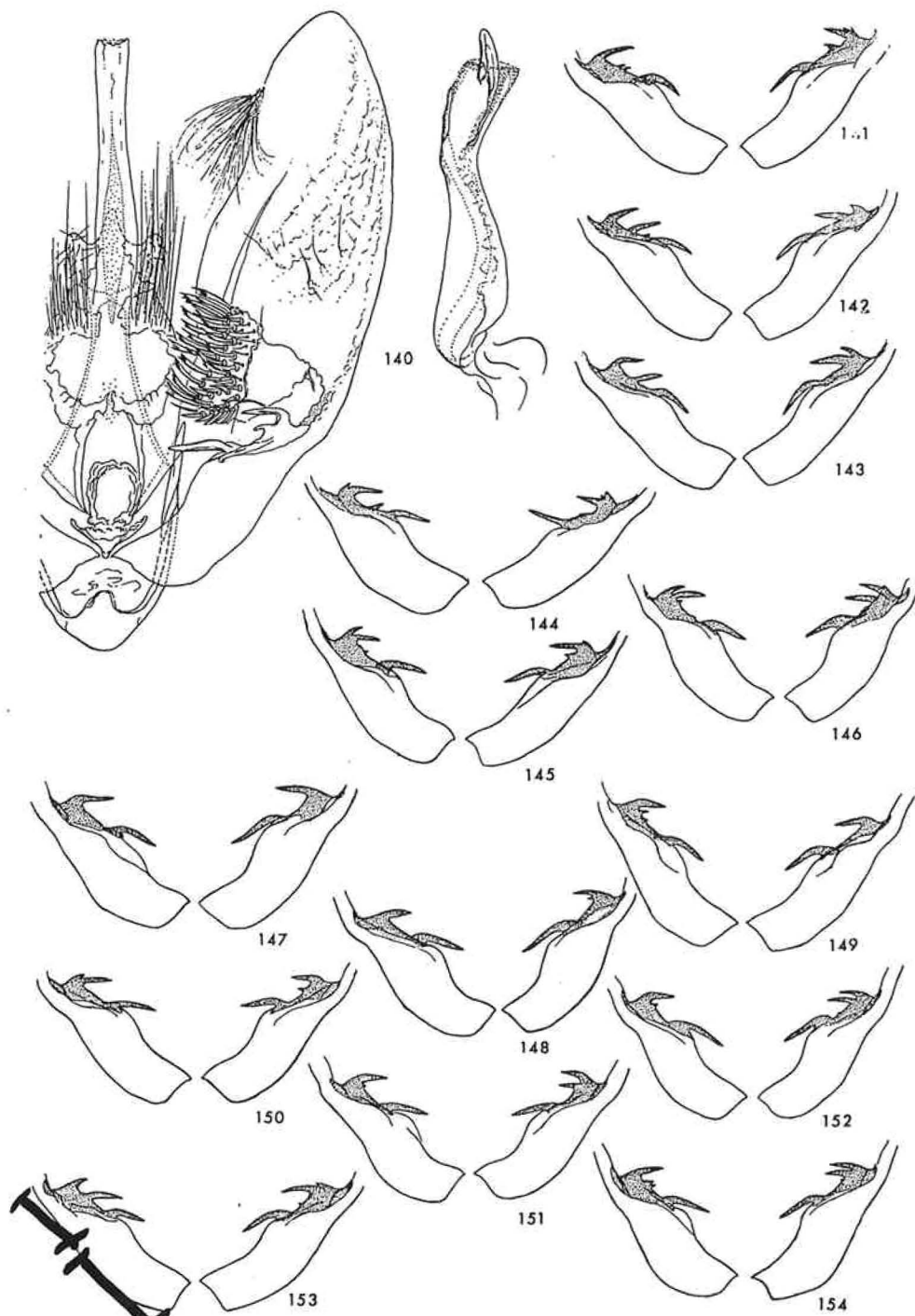
Male genitalia

There were definite differences in three characters of the male genitalia between FFT and PFT although the specimens from various host plants and localities showed a little individual variation. The first discriminating character between the males of the two types was the angle of mesal projection of valva (APV) against costa (Fig. 2). As shown in Table 1, APV was distinctly larger in PFT than in FFT but no difference in this trait was observed among the populations from various host plants in each type.

The second discriminating character on the genitalia was the overall shape of valva,



FIGS. 97-119. *Ostrinia furnacalis* (Guenée), sacculus of male genitalia. 97, Vinogradovka, Ussuri, Slide LM 11 AM; 98, Yokohama, Japan, Slide 572 C, AM; 99, Yakovlievka Spas., Ussuri, Slide LM 10 AM; 100, Yokohama, Japan, Slide 572 E, AM; 101, Yokohama, Japan, Slide 572 A, AM; 102, Yokohama, Japan, Slide 572 H, AM; 103, Yokohama, Japan, Slide 572 G, AM; 104, Yokohama, Japan, Slide 572 F, AM; 105, Yokohama, Japan, Slide 572 D, AM; 106, Yokohama, Japan, Slide 572 I, AM; 107, Tai-shan, Shantung, China, Slide 570 C, AM; 108, Tai-shan, Shantung, China, Slide 570 AM; 109, Tai-shan, Shantung, China, Slide 570 A, AM; 110, Tai-shan, Shantung, China, Slide 570 D, AM; 111, Tai-shan, Shantung, China, Slide 570 G, AM; 112, Bangalore, India, reared from *Polygonum* stems, Slide 1353 AM; 113, Kukjail, U.P., India, reared from *Polygonum* stems, Slide 1354 AM; 114, Kukjail, U.P., India, reared from *Polygonum* stems, Slide 1335 AM; 115, Amboina, Slide BM 50 AM; 116, Malay Peninsula, Slide BM 47 AM; 117, Amboina, Slide BM 49 AM; 118, Puttalam, Ceylon, Slide Pyr. 2540; 119, Malay Peninsula, Slide BM 48 AM.



FIGS. 140-154. *Ostrinia nubilalis nubilalis* (Hübner), male genitalia. 140, genitalia (left side omitted); 141-154, sacculus. 140, Port Washington, Long Island, N.Y., U.S.A., Slide 897 AM; 141, Csehtelek Bihar C., Hungary, Slide BM 38 AM; 142, Csehtelek Bihar C., Hungary, Slide BM 42 AM; 143, Csehtelek Bihar C., Hungary, Slide BM 40 AM; 144, Csehtelek Bihar C., Hungary, Slide BM 36 AM; 145, Csehtelek Bihar C., Hungary, Slide BM 37 AM; 146, Csehtelek Bihar C., Hungary, Slide BM 41 AM; 147, E. Lansing, Mich., U.S.A., Slide 901 AM; 148, Chatham, Ont., Canada, Slide 896 AM; 149, Moose Factory, Ont., Canada, Slide 898 AM; 150, Port Washington, Long Island, N.Y., U.S.A., Slide 897 AM; 151, Indiana Dunes St. Pk., Fremont, Ind., U.S.A., Slide 902 AM; 152, Indiana Dunes St. Pk., Fremont, Ind., U.S.A., Slide 903 AM; 153, Indiana Dunes St. Pk., Fremont, Ind. U.S.A., Slide 900 AM; 154, Indiana Dunes St. Pk., Fremont, Ind., U.S.A., Slide 899 AM.

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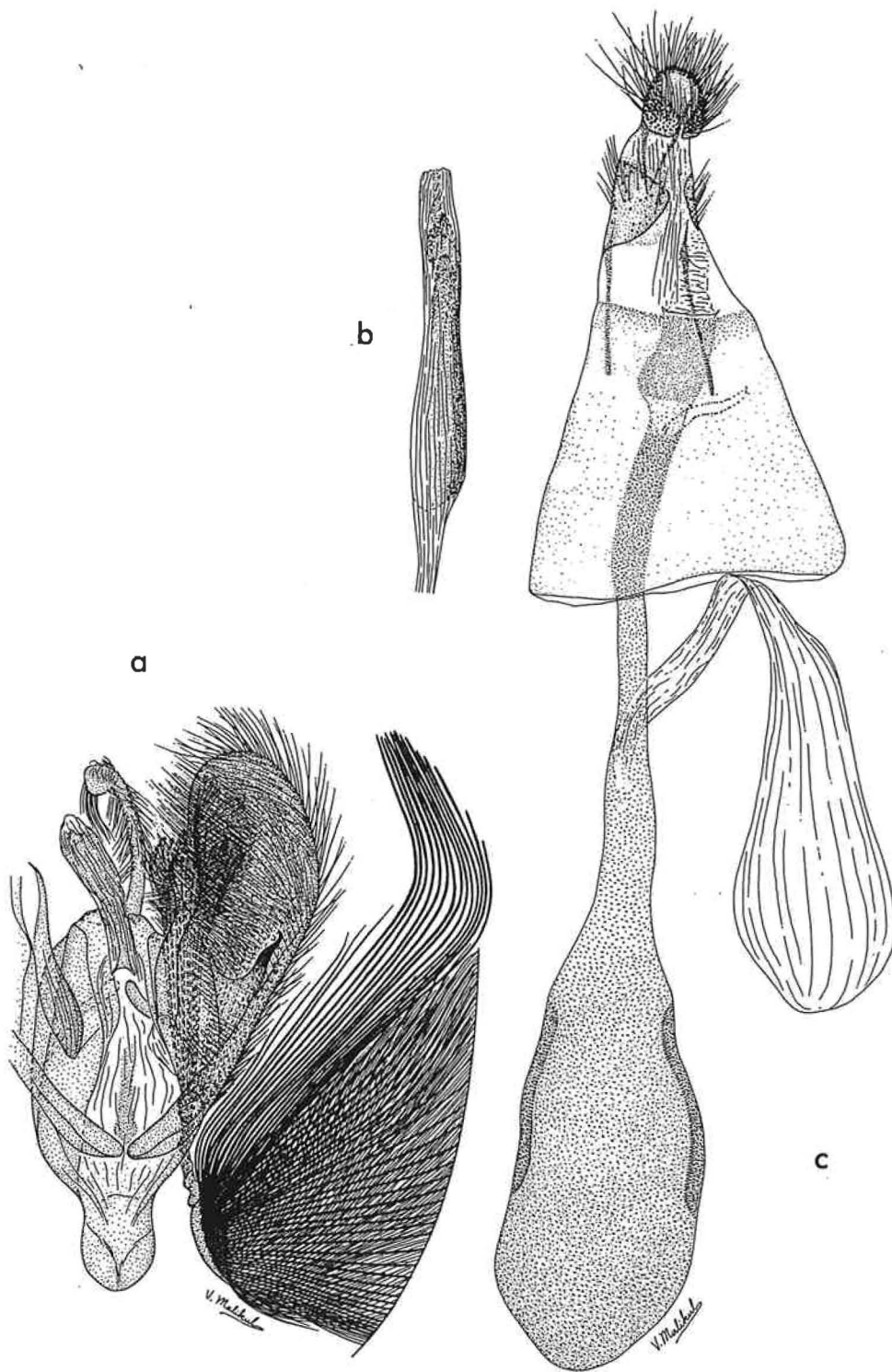
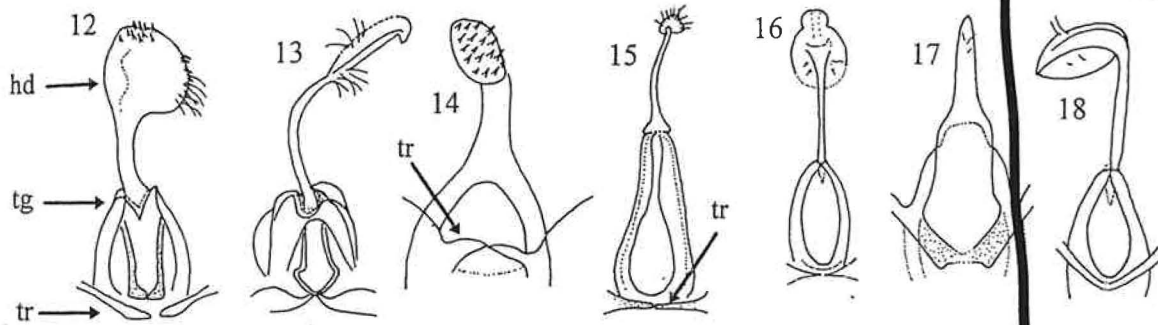
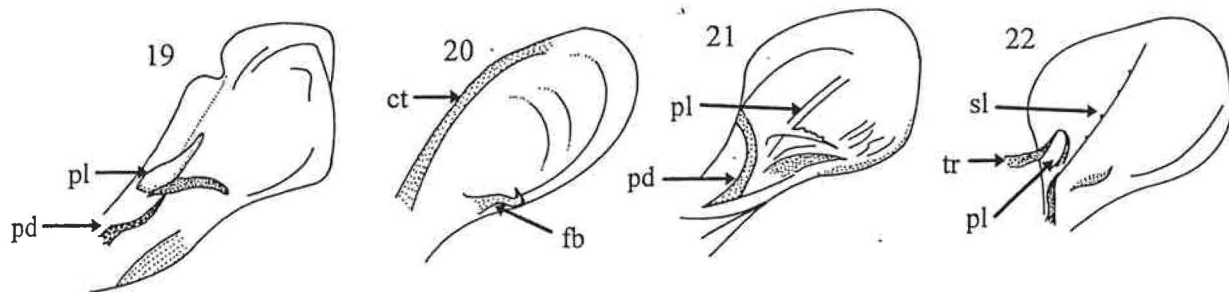


FIGURE 37.—*Maruca testulalis* (Geyer): a, ventral view of male genitalia with left harpe and aedeagus removed; b, aedeagus; c, ventral view of female genitalia.

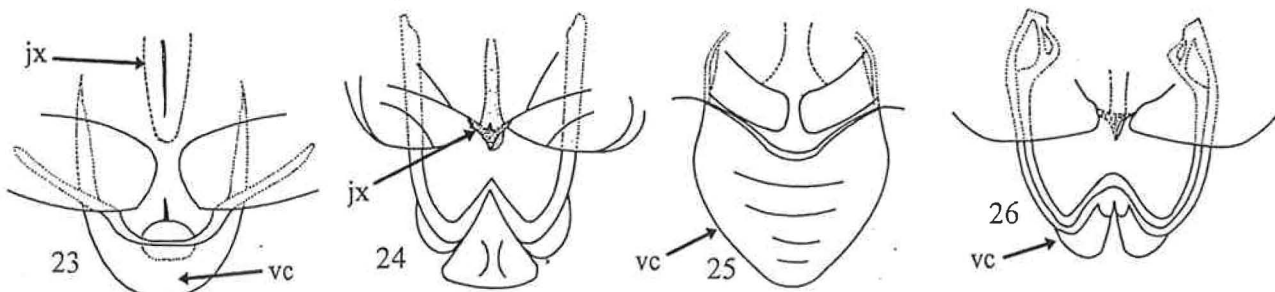
- (1) ciliate.
4. Antemedial line of forewing: (1) absent; (1) present, outwardly oblique at 45° ; (2) present, outwardly oblique at more than 45° .
 5. Triangular marking at middle of forewing costa: (0) absent; (1) present.
 6. Tornus of hindwing: (0) without any spots; (1) with two small spots, surrounded by metallic marking; (2) with a small, triangular dark spot.
 7. Transparent spot at middle of forewing: (0) absent; (1) two, different size; (2) two, nearly the same size.
 8. Sixth abdominal segment of male: (0) without scale tufts; (1) with prominent scale tufts on each side.
 9. Hair pencils on lateral margin of male sixth tergum (T6): (0) absent; (1) present on each lateral side.
 10. Bundle of long hairs on lateral margin of male T8: (0) without any bundle of long hairs; (1) with a bundle of long hairs on each side.
 11. Sclerotized part of male T8: (0) absent; (1) inverted Y-shaped, with posterior portion forming two adjacent, parallel rods (Fig. 3); (2) inverted Y-shaped, with posterior portion forming two outwardly curved rods (Fig. 2); (3) paired longitudinal rods, parallel and widely distant anteriorly then briefly curved towards each other and again parallel and less distant in posterior half (Fig. 4); (4) inverted M-shaped like, strongly sclerotized also between arms (Fig. 1).
 12. Anterior edge of male eighth sternum (S8): (0) rounded (Fig. 6); (1) angled (Fig. 5); (2) sinuate (Fig. 7).



Figs. 12-18. Uncus and tegumen. 12, *Glyphodes doleschalii*; 13, *G. caesalis*; 14, *Metallarcha diplochrysa*; 15, *G. opispila*; 16, *G. conjunctalis*; 17, *Agrioglypta itysalis*; 18, *G. onychinalis*. hd: head of uncus; tg: tegumen; tr: transtilla.



Figs. 19-22. Valvae of male genitalia (ventral view). 19, *Glyphodes cosmarcha*; 20, *G. canthusalis*; 21, *G. doleschalii*; 22, *Dysallacta megalopa*. ct: costa; fb: fibula; pd: pedunculi; pl: plate at medial valvae; sl: sclerotized line; tr: transtilla.



Figs. 23-26. Vinculum of male genitalia. 23, *Glyphodes doleschalii*; 24, *G. cosmarcha*; 25, *Metallarcha eurychrysa*; 26, *Dysallacta megalopa*. jx: juxta; vc: vinculum.

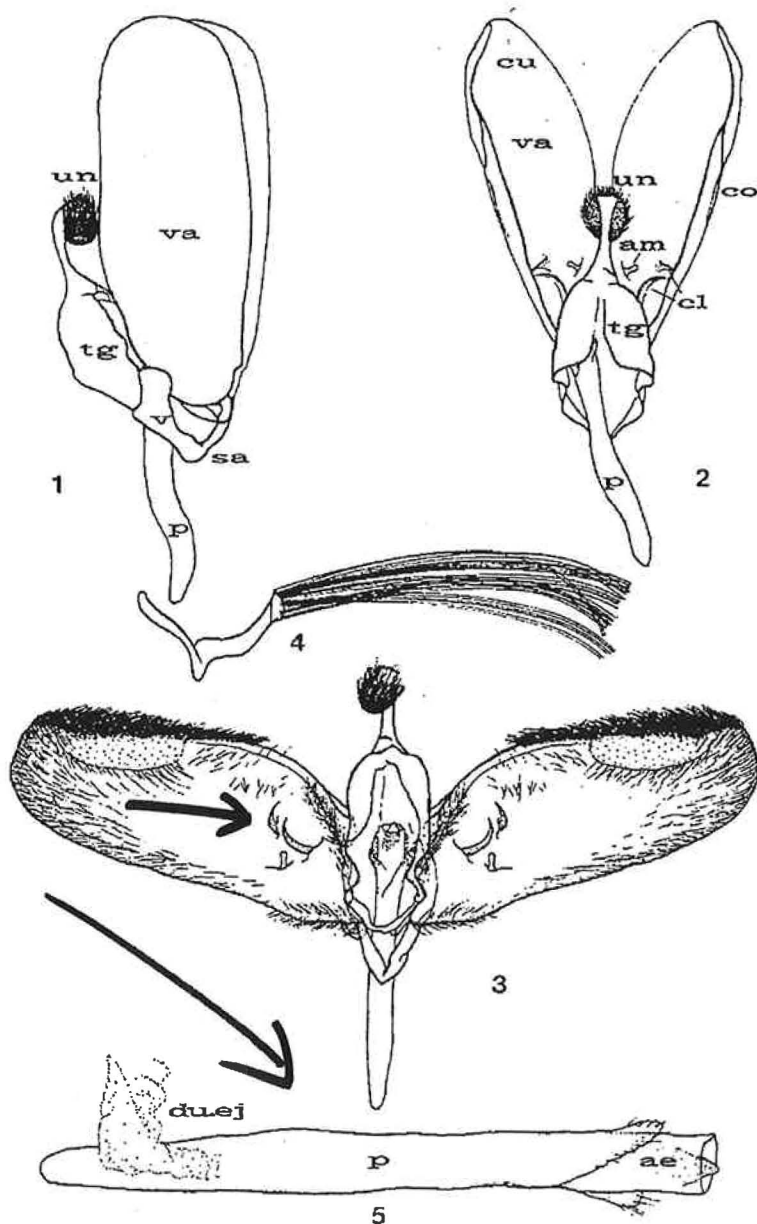


Fig. III

Duponchelia fovealis (Zeller). Apparato genitale maschile di lato (1); dal dorso (2); dal ventre (3); particolare della culcita (4); pene (5).

ae=aedeagus; am=ampulla; cl=clasper; co=costa; cu=cucullus; du.ej=ductus ejaculatorius; p=penis; sa=saccus; tg=tegumen; un=uncus; va=valvae.

Ciascuna valva presenta flessioni sclerificate, dall'aspetto nella parte ventrale, al di sotto della estroflessione digitiforme sin-

Il penis (p) è allungato e drico con il coecum penis più due espansioni del tipo rostr.

Apparato genitale femminile

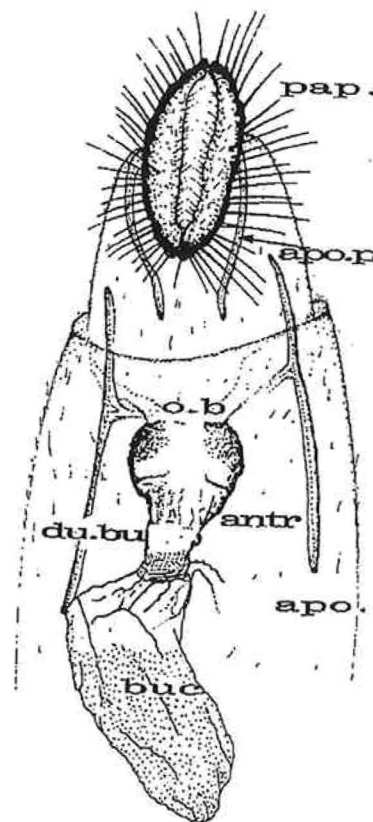
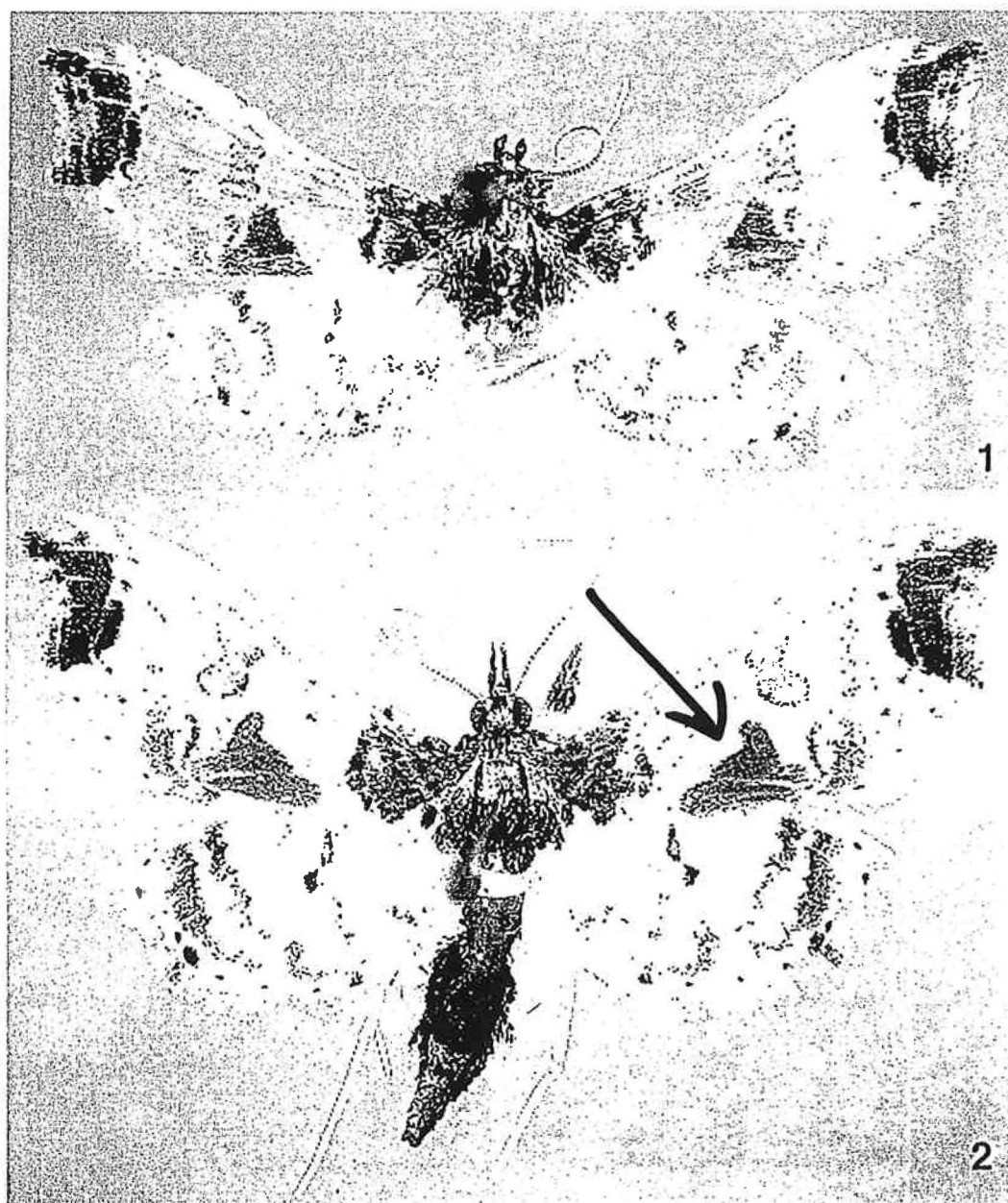


Fig. IV

Duponchelia fovealis (Zeller). Apparato genitale femminile.

antr=antrum; apo.ant=apophyses anteriores; apo.po=apophyses posteriores; bu=bursa copulatrix; du.bu=ductus bursae; o.b=ostium bursae; pap.a=papillae



Figs. 1-2. Male adult dorsal view. 1, *Neoleucinodes silvaniae*. 2, *N. elegantalis*.

with 30% ethanol. The other fifty percent of the infested fruits were placed in separate rearing containers where larvae matured and pupated within cocoons in paper towels. After emergence, the moths were frozen, wings were spread, and specimens were labelled. The specimens are deposited at COPROICA in Palmira.

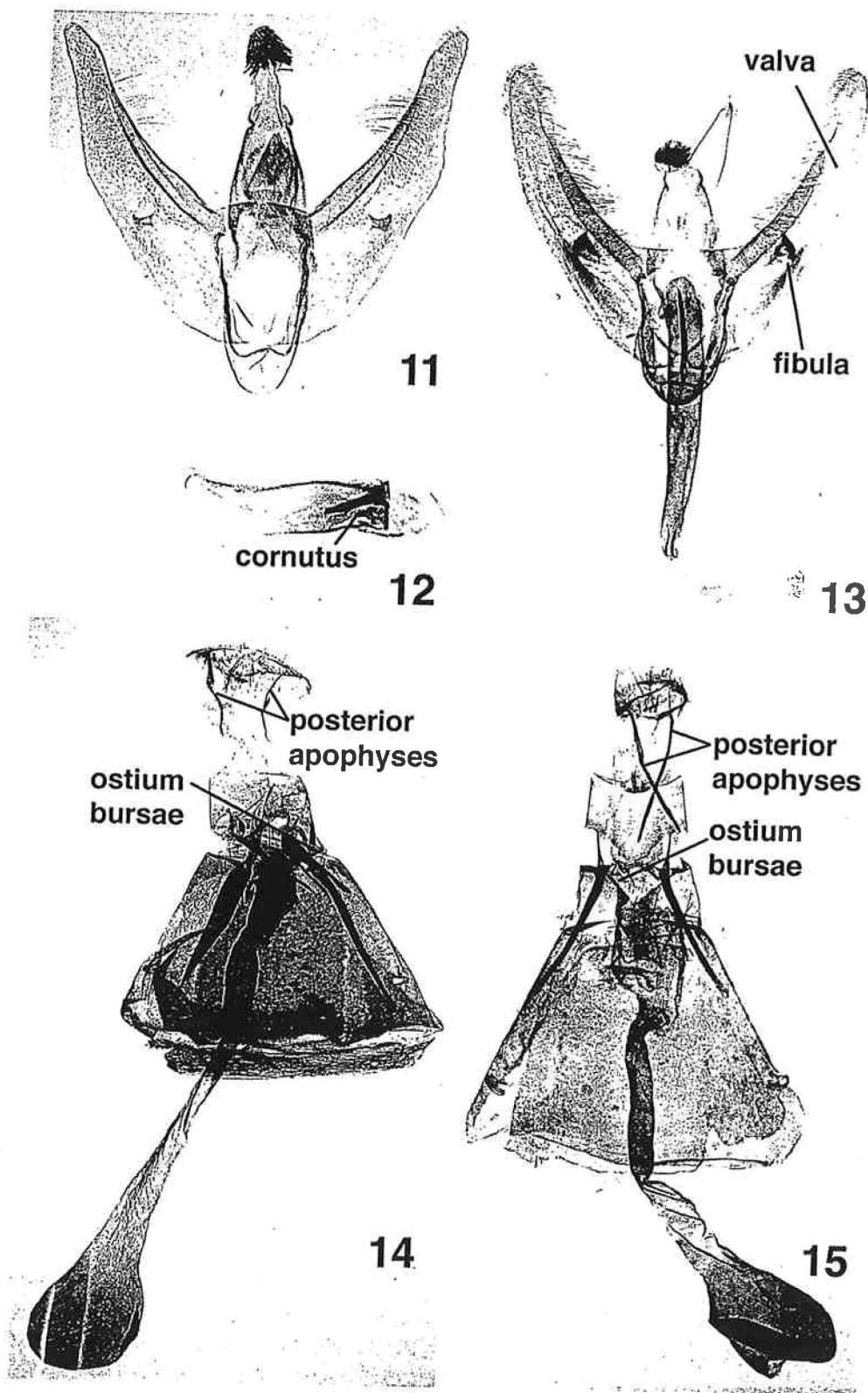
Eighty-eight male and female genitalic preparations (50% males, 50% females) were made from different species feeding on different host plants. The abdomen of the adult was removed, cleared in 10% KOH, transferred to 15% ethanol, and brushed to remove scales. Then they were stained with chlorazol black and the

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Figs. 11-15. Genitalia. 11, Male *Neoleucinodes silvaniae*. 12, Male aedeagus *N. silvaniae*. 13, Male *N. elegantalis*. 14, Female *N. silvaniae*. 15, Female *N. elegantalis*.

subventral setae SV thorax and metathoracic ventral seta, SV1. A seta on pinaculum dorsale. Seta SD2 present borne on pigmented to spiracle (Fig. 19). in same pinaculum position in relation D2, D1, SD1 and highly sclerotized p L3 present, L1 and on prolegs of A6 mesally; an incomplete outwardly on lateral

Biology.—*Neoleuc* reared on a wild *Solanum lanceifolium* Jacq. in Spanish border (Figs. 24-25). One larva of *N. silvaniae* has a scar the oviposition site, and exit hole before pupation. *N. silvaniae* are paired with *S. soma* sp. (Hymenoptera)

Distribution.—Cundinamarca.

Type material.—[Cundinamarca, Cundinamarca: Bajo, Finca Villa 74°37'6.41"W, 1,644 m. Ex. *Solanum lanceifolium* Jacq. Collected by A.E. Diaz] [UNAB]. Paratypes same data as holotype.

Etymology.—The name *silvaniae* is the name of the place where it was found.

Species comparison.—*N. silvaniae* appears identical to *N. elegantalis*, but it can be distinguished by the third labial palpal segment of males of *N. silvaniae* and the labial palpi in *N. elegantalis* are dimorphic, the female labial palpal segment is shorter (Figs. 4,6). The same is true in the females of *N. silvaniae*.

SCREENING KEY FOR CAPS TARGET NOCTUIDAE IN THE EASTERN AND
MIDWESTERN UNITED STATES (MALES)

1. Eyes appear hairy under low power (30x) 2
- 1'. Eyes not hairy under low power 3

2. Foretibia with a single large curved claw; subterminal line of forewing, if present, thin and white without a w-shaped marking; genitalia symmetrical (cabbage moth) *Mamestra brassicae*
- 2'. Foretibia lacking a single large curved claw; subterminal line of forewing with a w-shaped marking; genitalia asymmetrical (cabbage moth non-target) *Dicestra trifolli*

3. Thorax and/or abdomen with scale tufts; forewing with a silver marking often shaped like a "y,v, solid dot or boot" 4
- 3'. Scale tufts on thorax and abdomen present or absent; forewing lacks a silver shaped marking 7

4. Forewing with two solid silver spots; valve without clasper or clavus; saccus longer than valve; A8 with arrow shaped sclerite, toothed apically (golden twin spot) *Chrysodeixis chalcites*
- 4'. If forewing has two solid silver spots, then valve with a clasper or clavus; saccus shorter than valve and A8 without an arrow shaped sclerite 5

5. Forewing with a boot shaped spot connected to a curved line reaching the inner margin; clavus long and thin; hindtibia spined (Essex Y moth) *Cornutiplusia circumflexa*
- 5'. Forewing with a y-shaped spot and no curved line reaching the inner margin; clavus absent; hindtibia without spines 6

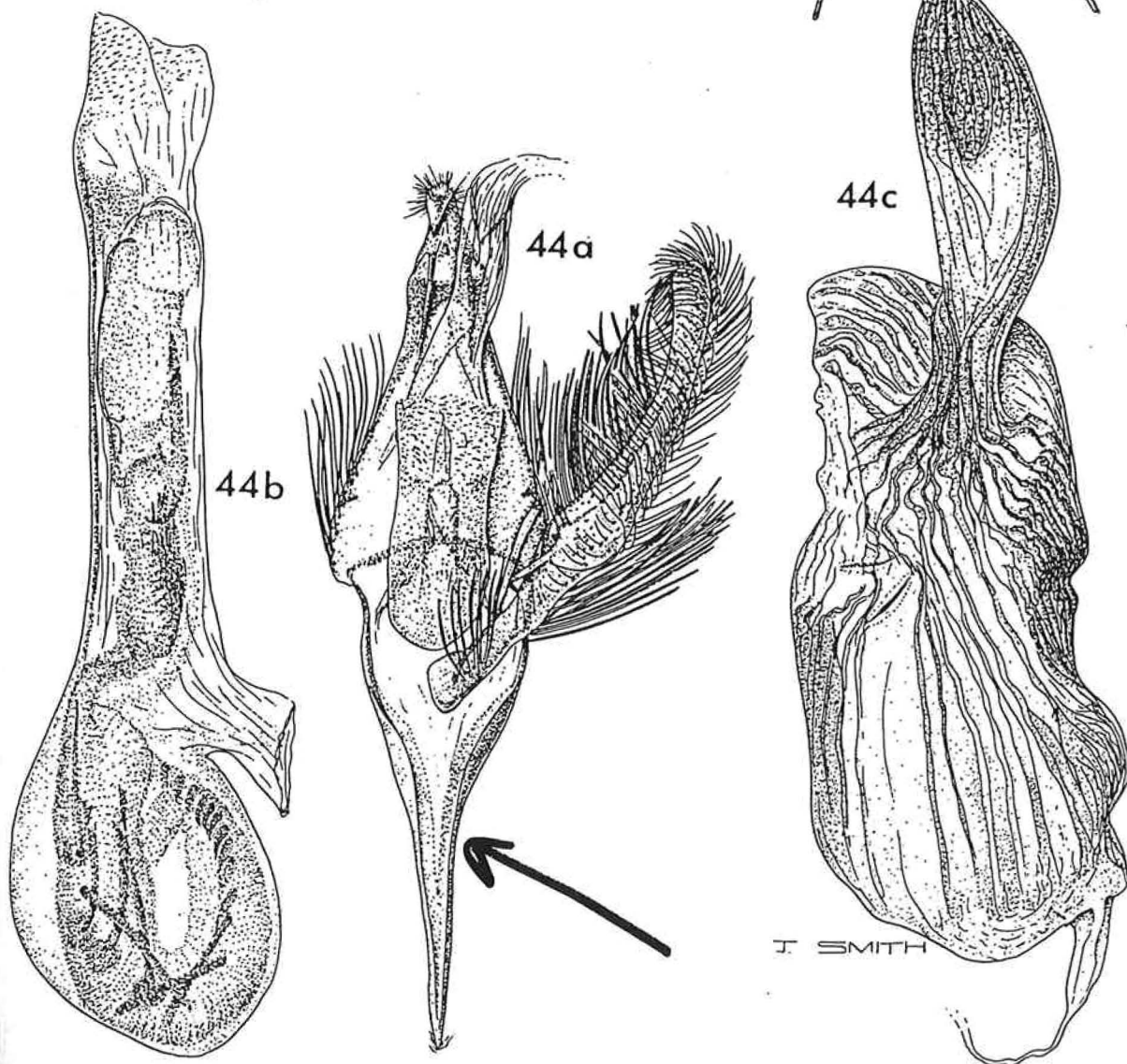
6. Valve with a fingerlike projection on the inner surface; aedoeagus with one curved spine at the base of the vesica and a long curved apical cornutus (silver y moth) *Autographa gamma*
- 6'. Valve lacks a fingerlike projection on the inner surface; aedoeagus without a basal spine and with several apical cornuti in a cluster (silver y moth non-target) *Rachiplusia ou*

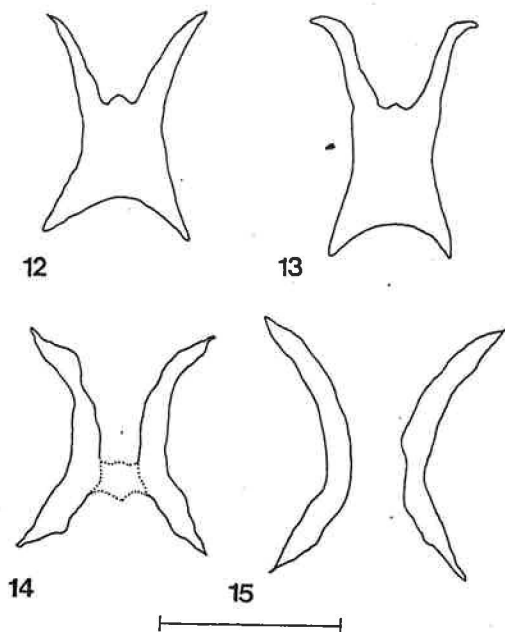
7. Eyes lashed; foreleg tarsus with several strong curved spines; orbicular spot contrasting, round or slightly oval; apex of valve pointed *Copitarsia* spp.
- 7'. If eyes are lashed, the foreleg tarsus has several strong curved spines, and the orbicular spot is round or slightly oval, then valve apex is not pointed 8

8. Hindwing with 1-2 pale spots within a dark border 9
- 8'. Hindwing without spots within a dark border 11

9. Outer surface of foretibia with at least three stout spines; vesica with a large basal spine and other cornuti in a more or less complete row; South American bollworm *Helicoverpa gelotopoeon*
- 9'. Outer surface of foretibia with a single apical spine; vesica lacks a large basal spine and the cornuti are separated into groups 10
10. Ventral margin of 8th sternite truncate; 11-14 cornuti present; vesica with one lobe (requires everting the vesica) (Old World bollworm) *Helicoverpa armigera*
- 10'. Ventral margin of 8th sternite evenly rounded; more than 15 cornuti present; vesica with 3 lobes (requires everting the vesica) (non-target corn earworm) *Helicoverpa zea*
11. Forewing with a highlighted M vein (marking like a silver fork having 3 unequal prongs) which may be partially covered by a white band; apex of forewing with a white marking; hindwing shiny white; cornuti in a dense patch; apex of valve split or notched 12
- 11'. Forewing lacks a highlighted M vein; apex of forewing with or without a white marking; hindwing shiny white or gray; cornuti sometimes in dense patch; apex of valve not split or notched species of Noctuidae not in the key
12. Thorax with two dark black parallel longitudinal lines; (non-target) *Spodoptera dolichos*
- 12'. Thorax lacking two dark black parallel longitudinal lines 13
13. Apex of valve flattened (non-targets) *Spodoptera ornithogalli* (yellow striped armyworm) and *Spodoptera pulchella*
- 13'. Apex of valve rounded 14
14. Valve appearing to have two "windows": one is an upside down equilateral triangle with a large lobe at the apex and the other a more poorly defined small rectangle (rice cutworm) *Spodoptera litura*
- 14'. Valve does not have both a triangle and rectangular "window" 15
15. Clasper very thick and curved (non-target) *Spodoptera latifascia*
- 15'. Clasper forming a triangle with two sides equal and angled about 30 degrees at the base (Egyptian cottonworm) *Spodoptera littoralis*

FIGURE 44.—*Chrysodeixis chalcites* (Esper): a, ventral view of male genitalia with left harpe and aedeagus removed; b, aedeagus; c, ventral view of female genitalia.





FIGS. 12-15. Male eighth tergites. 12, Noctuid slide no. 11884, South Africa: Transvaal, 20.xi.1896, A. Ross. 13, Noctuid slide no. 11885, Canary Islands: near Puerto de la Cruz, Tenerife, 20.iii.-4.iv.1962, Dr Kettlewell. 14, Noctuid slide no. 11865, India: Niligiris, Hampson Coll. 15, Noctuid slide no. 11868, India: Mahabaleshwar, 17.v.1930, Maxwell Coll. Posterior edges uppermost. Note that the two arms are broadly fused in the South African and Canary Islands specimens, while they are either separate (Fig. 15) or joined by a narrow band of weak sclerotization (Fig. 14) in the Indian specimens. Scale bar=1mm.

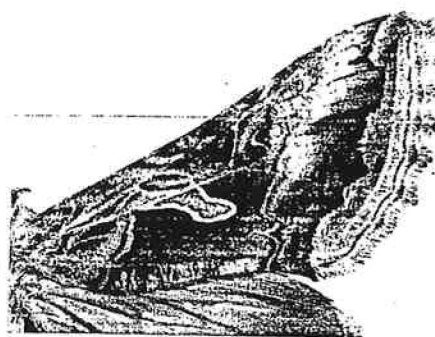
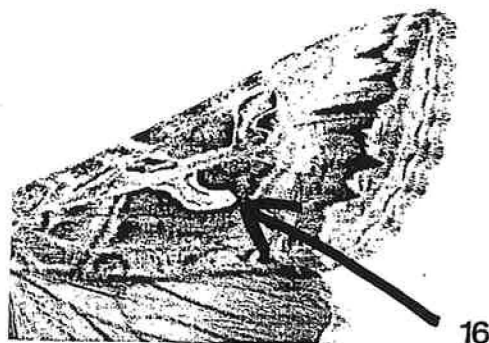
and is discontinuous basally with the saccular margin, while the clavus is shorter and broader. The arms of tergite 8 are separate (Fig. 15) or joined by a narrow band of weak sclerotization (Fig. 14). This form is restricted to southern India (Fig. 7).

No males were available from Sri Lanka or The Gambia and the form of the male genitalia of these populations remains unknown. No consistent differences were found between any of the populations in the structure of the aedeagus, vesica or sternal hairpencils.

Discussion

Intraspecific variation in genitalia has been recognized frequently and, to be sure, there is no intrinsic reason why these structures should

be exempt from displaying such differences. However, there is a persistent conviction among many lepidopterists (Scoble, 1986) that the genitalia are somehow 'special' and that any morphological differences observed must

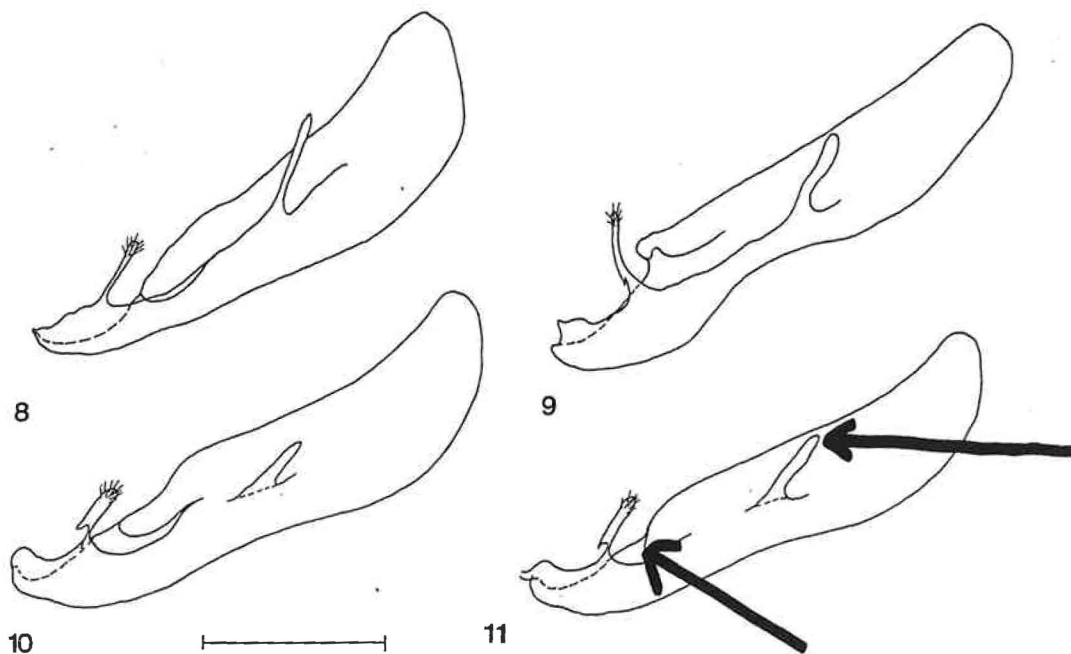


FIGS. 16-18. Forewing patterns. 16, Egypt, G. C. Dudgeon. Note that the subterminal line between veins M_3 and Cu_1 and CuA_1 and CuA_2 is produced into two sharp points. 17, S. Africa: Transvaal, 20.xi.1896, A. Ross. In this form, the subterminal line is linear between veins M_3 and CuA_2 . 18, Lesotho: Machacha, 10,000 ft, 30.i.1902, R. Crawshay. This specimen exhibits a somewhat intermediate form, in which the line is produced into points but these are blunt and poorly developed.

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harpe is shorter,
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FIGS. 8-11. Male genitalia: right valves, inner view. 8, Noctuid slide no. 11884, South Africa: Transvaal, 20.xi.1896, A. Ross. 9, Noctuid slide no. 11877, Ethiopia: Addis Ababa, c. 8100 ft, 2.x.1948, H. Scott. 10, Noctuid slide no. 11865, India: Niligiris, Hampson Coll. 11, Noctuid slide no. 11868, India: Mahabaleshwar, 17.v.1930, Maxwell Coll. Note that the harpes of the Indian specimens are shorter, the sacculus edges basal to the harpes are not continuous with the bases of the clavi, and that the clavi themselves are shorter and broader. Scale bar=1 mm.

out the Middle East and down the African Rift Valley as far as Kenya and Uganda (Fig. 6).

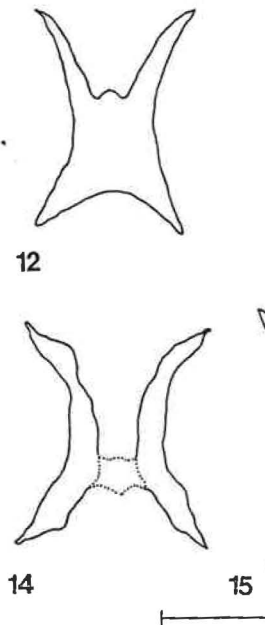
The sole specimen available from Sri Lanka shows a different form of corpus bursae (Fig. 4). The fundus is evenly curved and tapers distally to a blunt point. The apex is much shorter and is barely recurved.

The South African form (Fig. 5) is markedly different from either the Palaearctic or the Sri Lankan form. The fundus is relatively short and broadens distally. The apex, however, is expanded and reflexed anteriorly to form a pouch-like structure, while the origin of the ductus seminalis has moved to a more proximal position, near the base of the pouch. Finally, the ductus bursae opens into the corpus bursae posteriorly, rather than dorsally, as in the other two forms. In addition to South Africa and Namibia, this form of female genitalia also occurs on Grand Comoro (although Dufay (1982) did not record *C. circumflexa* from that island) and, perhaps surprisingly, in The Gambia (Fig. 6).

Male genitalia

Two types of male genitalic structure were found, but they are not as distinctive as those of the females. The vast majority of specimens conformed to the Palaearctic type, which occurs across almost all of the known range of the species from the Canary Islands to Iran and throughout Africa, including Grand Comoro (Fig. 7). In specimens from these areas (Figs. 8, 9), the harpe (terminology of Kitching, 1987) is usually quite long, often exceeding the costal margin of the valve (Fig. 8), while it is continuous basally with the sacculus margin and the base of the clavi. The clavi itself is relatively long and slender. In addition, the two arms of tergite 8 (Figs. 12, 13) are broadly fused, with a small posterior, central projection, giving a somewhat starfish-like appearance.

In contrast, in the other form of the male genitalia (Figs. 10, 11), the harpe is shorter, never exceeds the costal margin of the valve



FIGS. 12-15. Male eighth tergite. 12, Noctuid slide no. 11884, South Africa: Transvaal, 20.xi.1896, A. Ross. 13, Noctuid slide no. 11877, Ethiopia: Addis Ababa, c. 8100 ft, 2.x.1948, H. Scott. 14, Noctuid slide no. 11865, India: Niligiris, Hampson Coll. 15, Noctuid slide no. 11868, India: Mahabaleshwar, 17.v.1930, Maxwell Coll. Note that the harpes of the Indian specimens are shorter, the sacculus edges basal to the harpes are not continuous with the bases of the clavi, and that the clavi themselves are shorter and broader. Scale bar=1 mm.

and is discontinuous basally with the sacculus margin, while the clavi are broader. The arms of the eighth tergite (Fig. 15) or joined by a sclerotization (Fig. 14). This form occurs from southern India (Fig. 7).

No males were available from The Gambia and the form of these populations requires consistent differences were of the populations in the aedeagus, vesica or sternum.

Discussion

Intraspecific variation in *C. circumflexa* is recognized frequently and no intrinsic reason why the

SIMPLIFIED SCREENING AID FOR AUTOGRAPHA GAMMA IN APHIS STICKY TRAPS

Autographa gamma is a common APHIS target pest. Identification of this pest is complicated for non-specialists. The first problem is that line drawings of the genitalia in the PKNTO series do not provide the user with enough detail to recognize *A. gamma*. There is also a lack of information on which non-target Plusiinae are likely to be found in sticky trap samples.

This document illustrates the genitalia of *A. gamma* and compares it to *A. californica* and *Rachiplusia ou* which are sometimes collected in APHIS traps. Both of these species are similar enough to *A. gamma* in wing color to cause concern. Only males are discussed because females are usually not found in trap samples. The genital terminology and characters used to identify these species follows Poole and LaFontaine (1991). Consult Miller et al. (1993) for a procedure on how to prepare genitalia of Lepidoptera from sticky traps.

Autographa gamma, when viewed under low power (20x), has a simple valve with a thin process and two tufts of scent hairs (Fig. 1). The aedoeagus was removed for clarity.

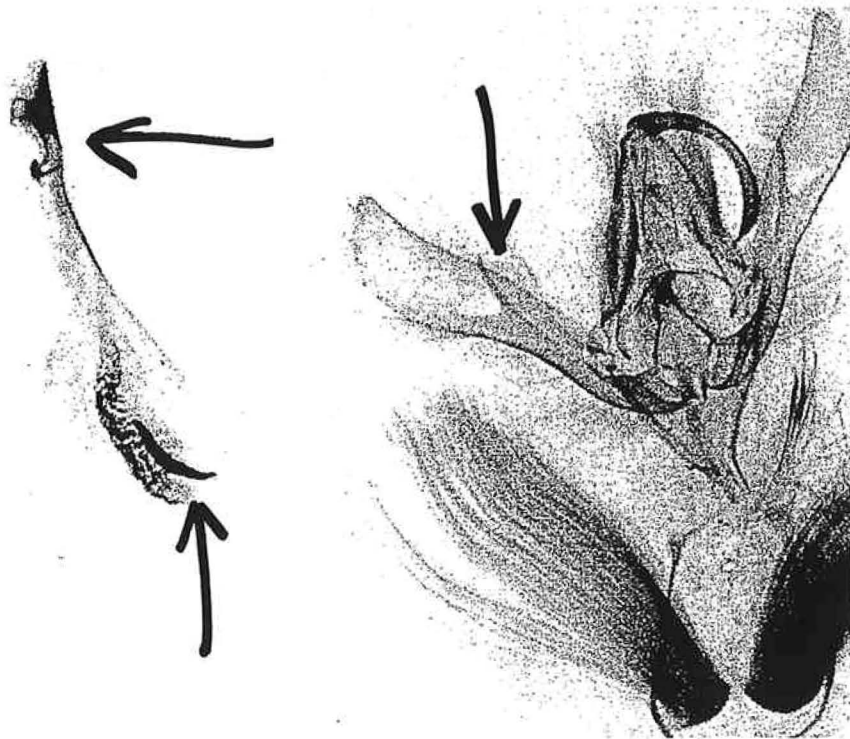


Fig. 1. Male genitalia of *Autographa gamma* (20x).

The aedoeagus of *A. gamma* has two spines, one curved spine at the base of the vesica (Fig. 2), and another longer curved spine called the apical cornutus (Fig. 3).

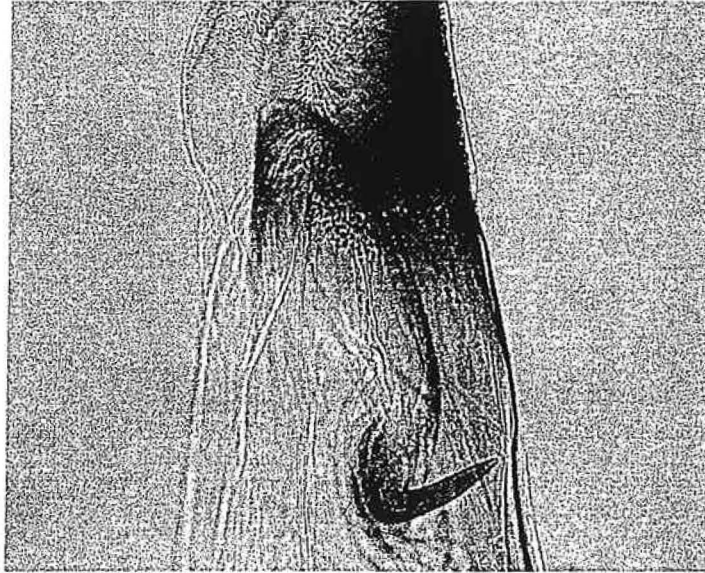


Fig. 2. Curved apical spine on the aedoeagus of *A. gamma* (200x).

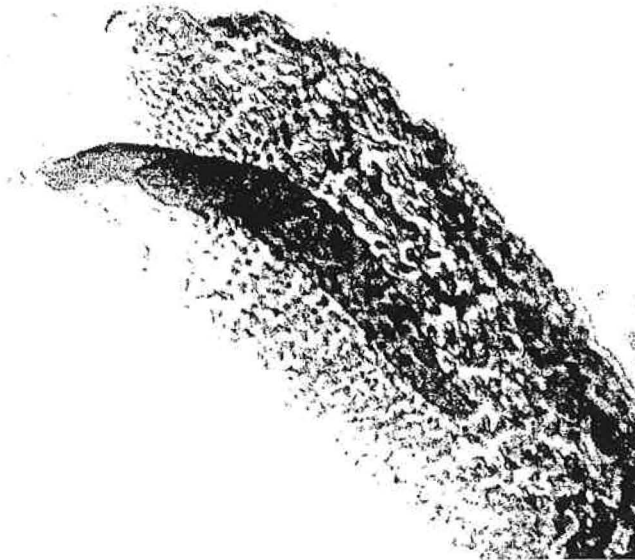


Fig. 3. Apical cornutus of *A. gamma* (200x).

A portion of the vesica of the aedoeagus in *A. gamma* is set with pigmented pointed granules (Fig. 4), stained red in this photograph for clarity. These granules surround the apical cornutus (Fig. 3).

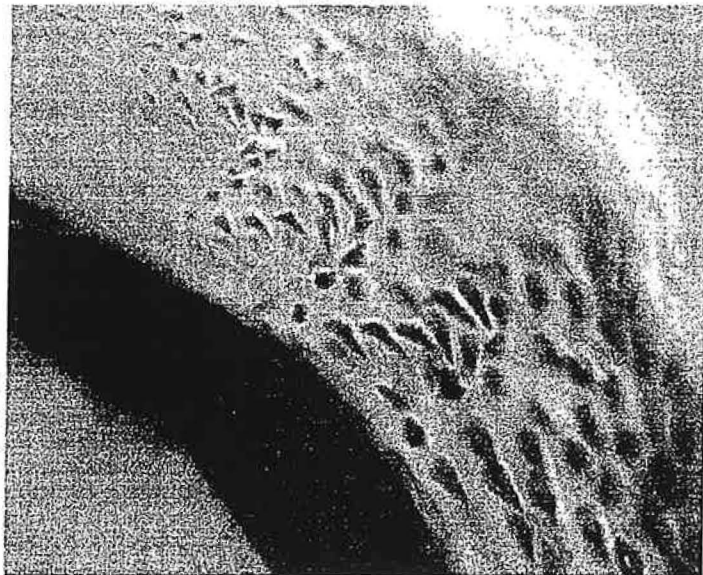


Fig. 4. Pigmented pointed granules of the vesica of *A. gamma* (Rheinburg illumination, 400x).

In the eastern United States, *A. gamma* is most likely to be confused with *Rachiplusia ou*. This species has been found in *A. gamma* sticky traps from Michigan and South Carolina. The valve of *R. ou* lacks a fingerlike projection on the inner surface (Fig. 5) which is present in *A. gamma* (Fig. 1).

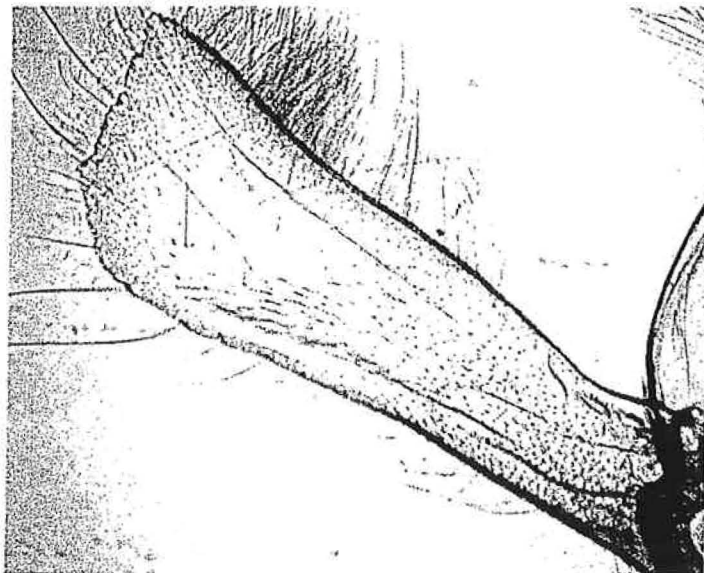


Fig. 5. Valve of *Rachiplusia ou* (100x).

The aedoeagus of *R. ou* has several apical cornuti in a cluster, again stained red for clarity (Fig. 6). Only one is present in *A. gamma* (Fig. 3).



Fig. 6. Apical cornuti of *R. ou* (Rheinburg illumination, 100x).

In the western USA, *A. gamma* is easily confused with *Autographa californica*. The most obvious difference in is the shape of the apical cornutus. In *A. californica* the cornutus has a broad flange on one side (Fig. 7) whereas the cornutus of *A. gamma* is shaped like Fig 3. Otherwise the genitalia are almost identical to a non-specialist. *Autographa californica* has been found in traps from Oregon.



Fig. 7. The cornutus of *Autographa californica*

Autographa ampla and *Anagrapha falcifera* are also found in *A. gamma* traps but their wing color is unlike *A. gamma* (see the color plates in LaFontaine and Poole 1991).

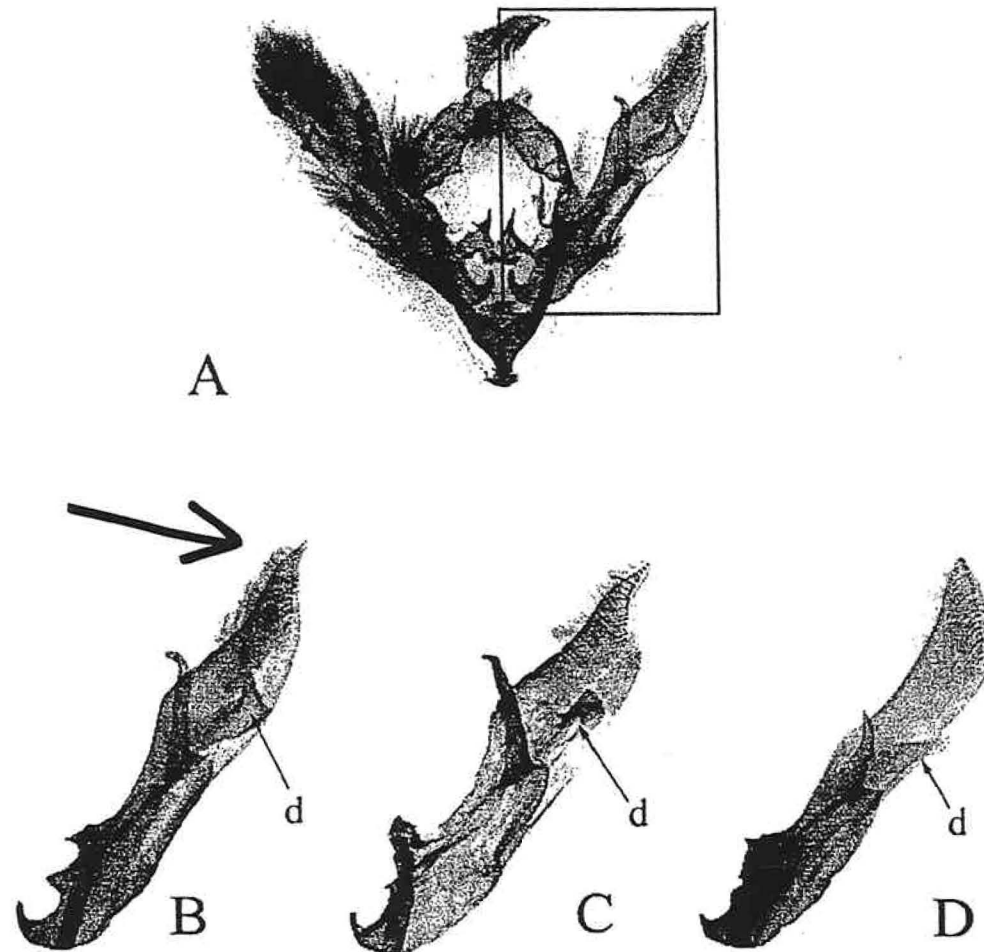
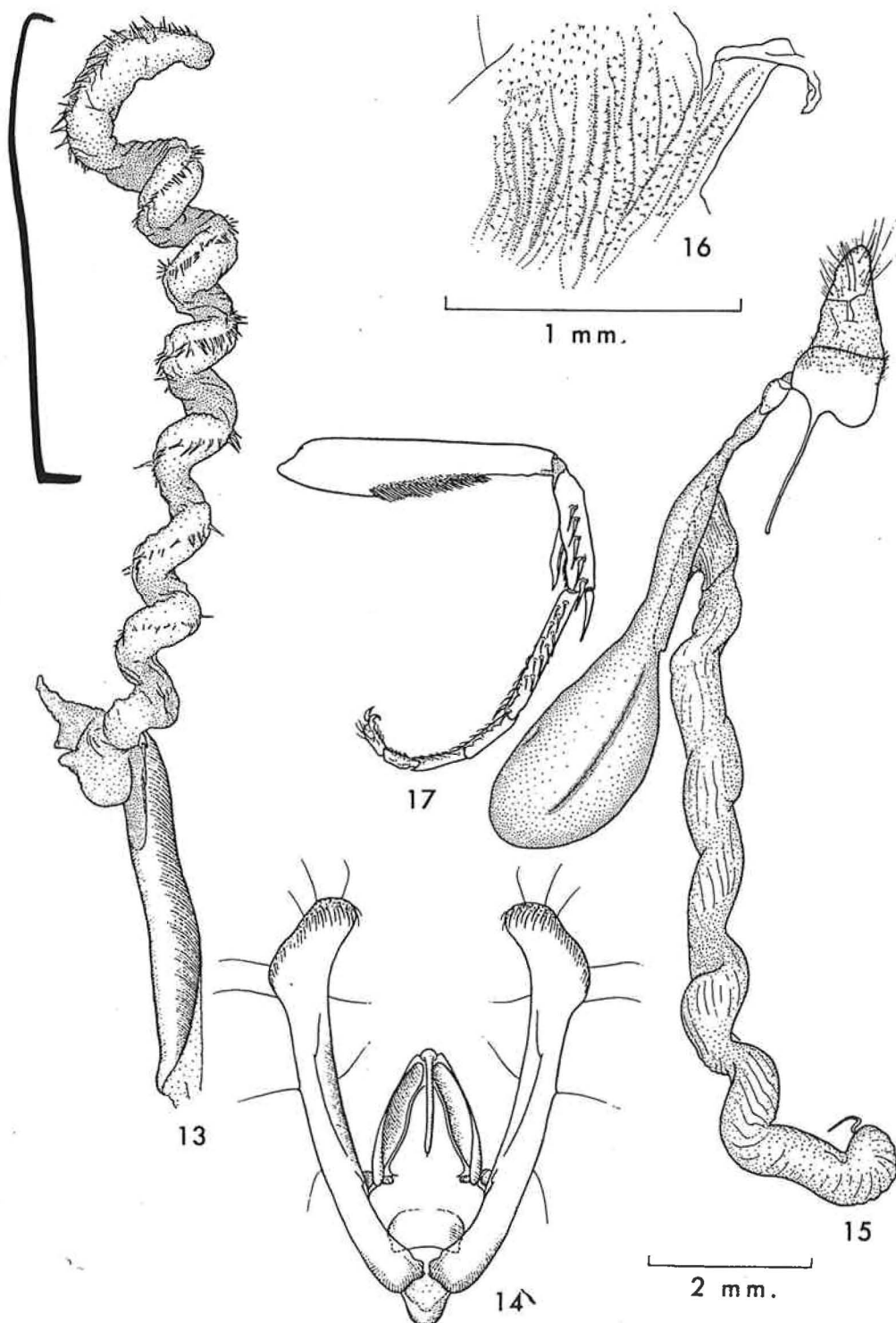


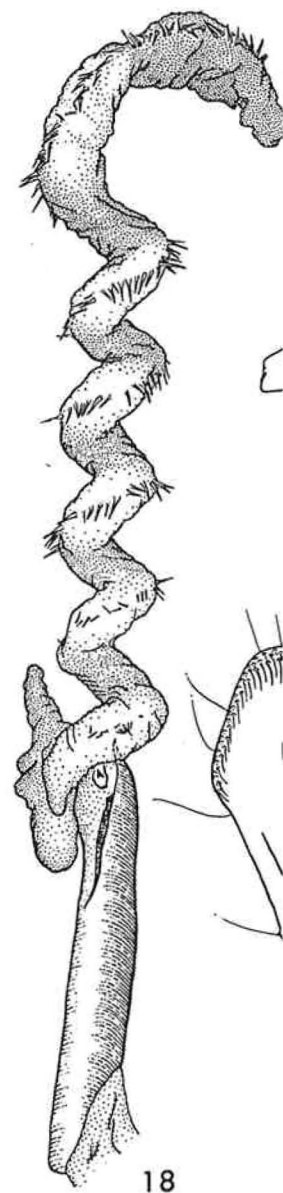
Fig. 4. Male genitalia. (A) *C. decolora* (clade 1; Mexico), entire capsule. (B) *C. decolora* (clade 1; Mexico), valve. (C) *C. decolora* (clade 2; Peru), valve. (D) *C. naenoides* Butler (clade 3; Chile), valve (box = magnified area of valve, d = digit).

48 are phylogenetically informative. Again, the majority of the informative characters are found in third

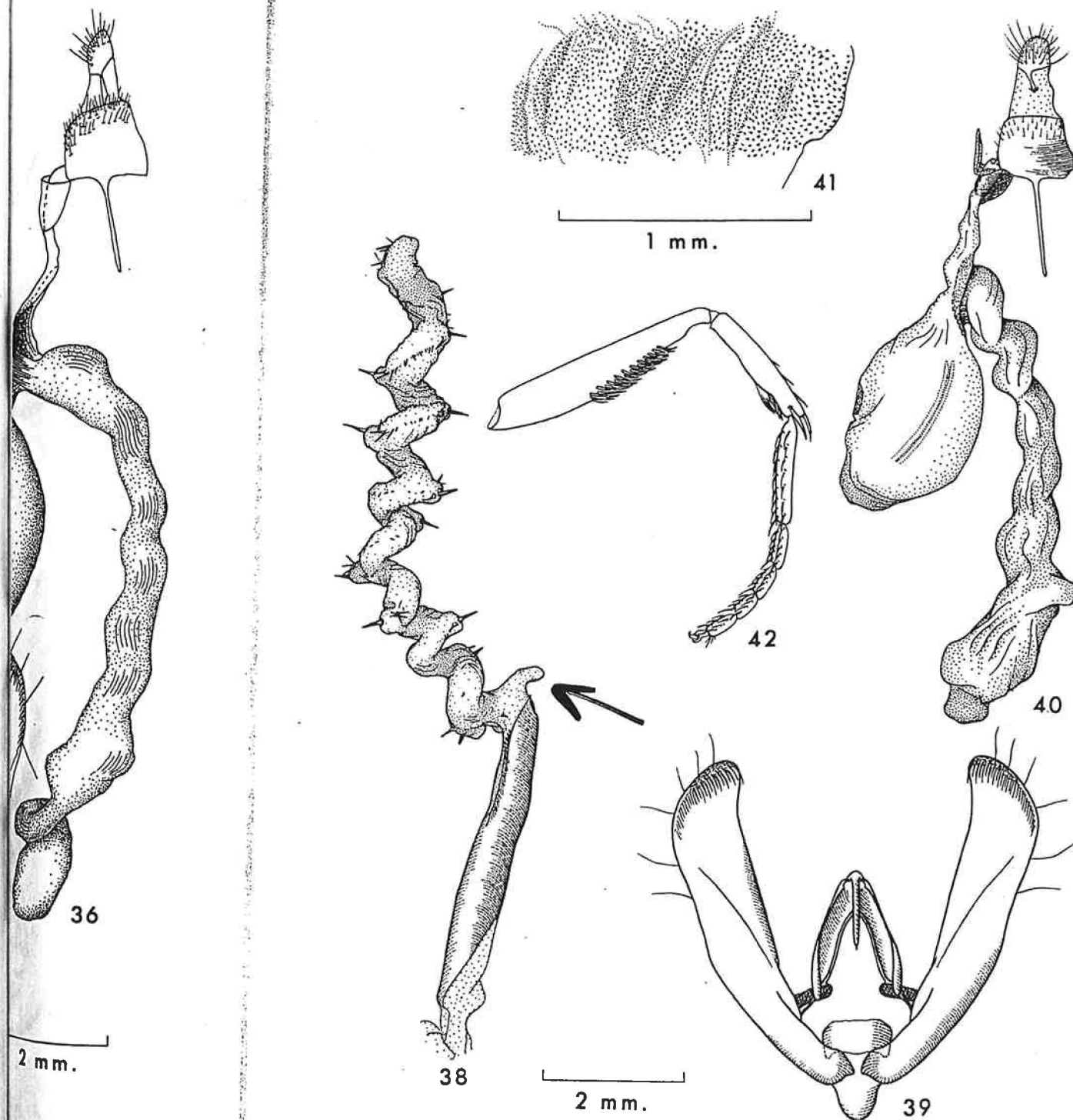
parsimony trees, it is not supported by likelihood methods (Fig. 3). This result is likely because of



Figs. 13-17. *Helicoverpa gelotopoeon* (Dyar). 13, 14, Male genitalia; 15, female genitalia; 16, lumen surface of appendix bursae (at greater magnification than other figures); 17, right foreleg.

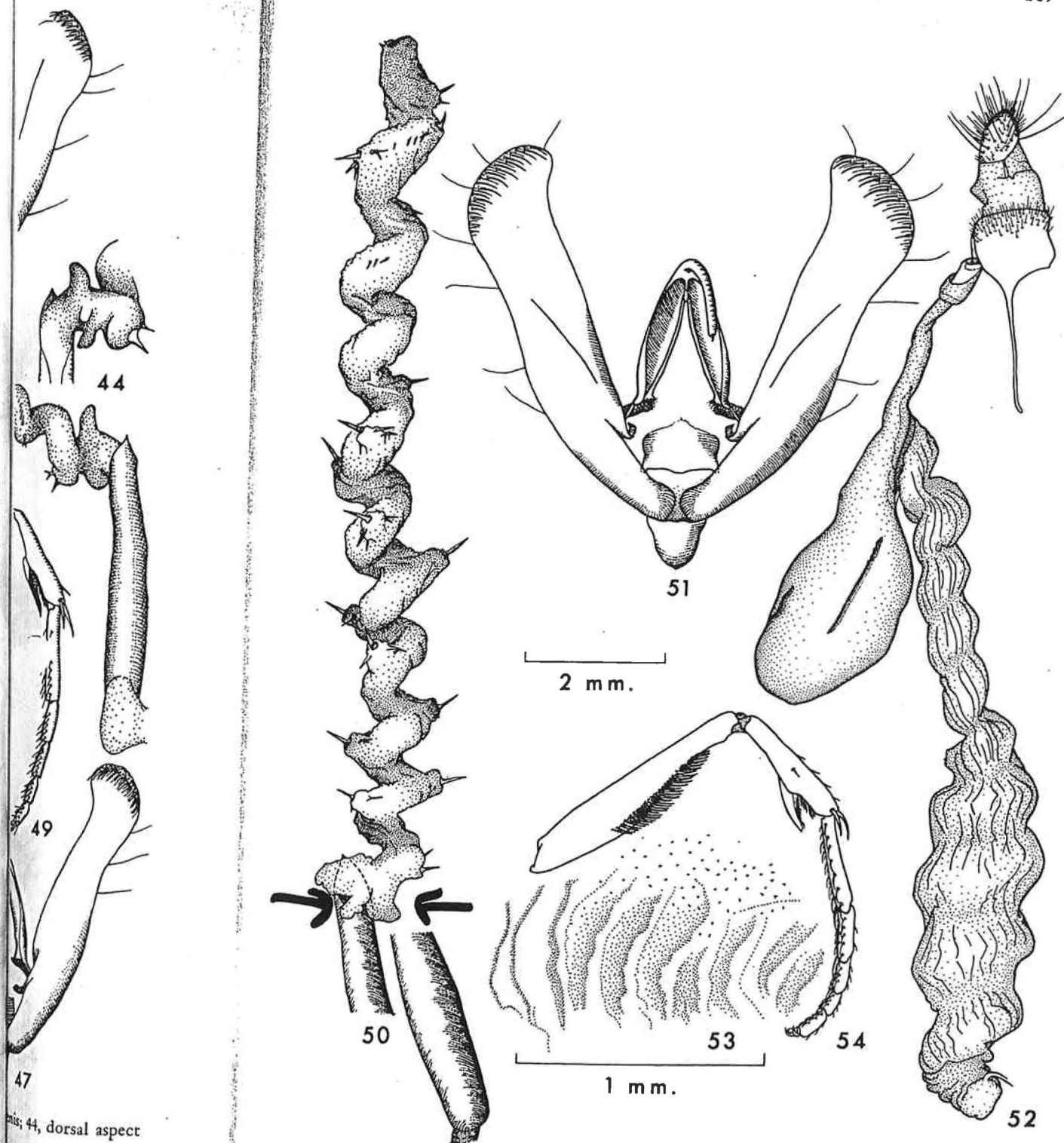


Figs. 18-22. *Helicoverpa gelotopoeon* (Dyar). 18, 19, 20, female genitalia; 21, lumen surface of appendix bursae (at greater magnification than other figures); 22, right foreleg.



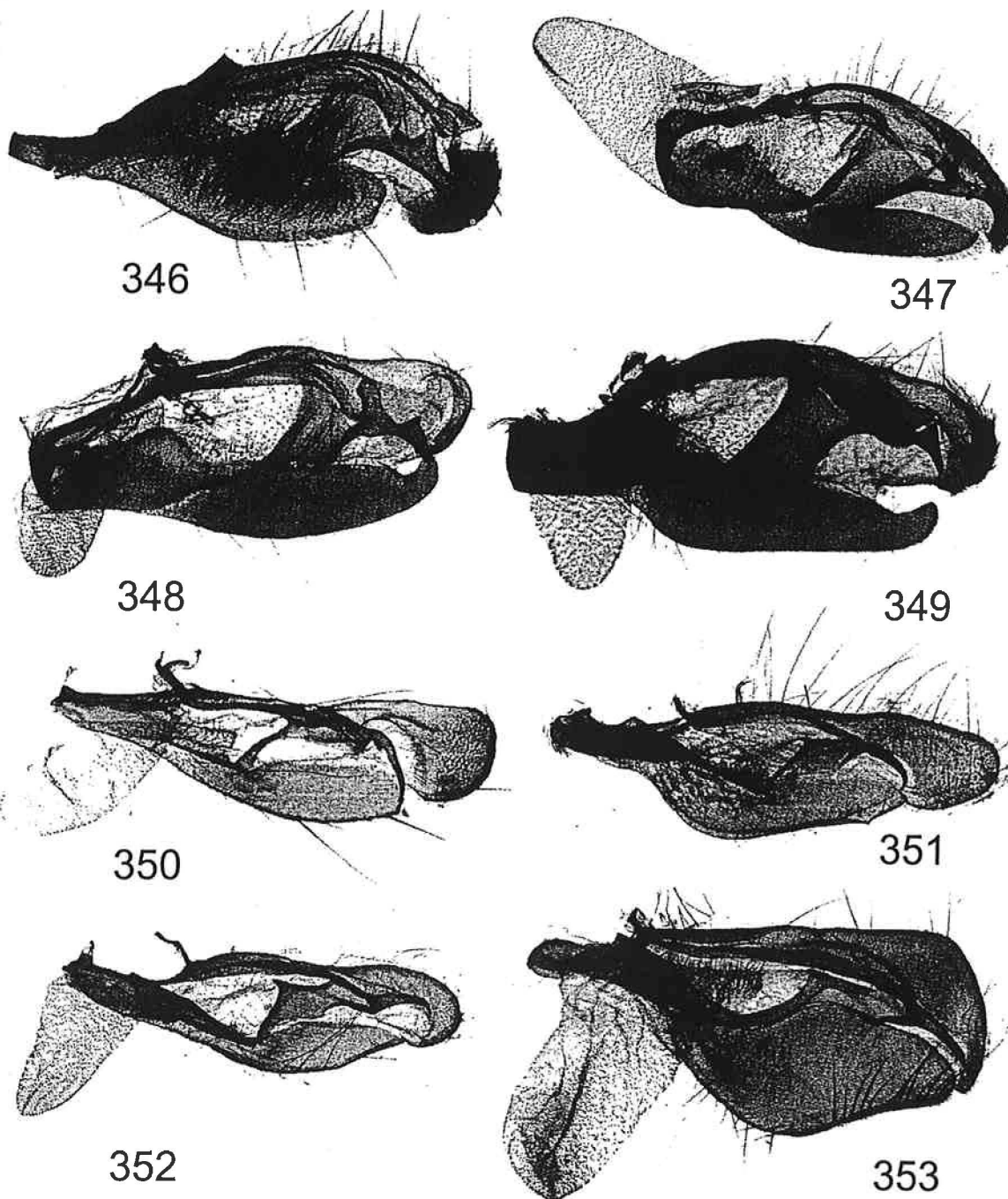
Figs. 38-42. *Helicoverpa armigera* (Hübner). 38, 39, Male genitalia; 40, female genitalia; 41, lumen surface of appendix bursae (at greater magnification than other figures); 42, right foreleg.

Left lateral aspect of
35, female genitalia;

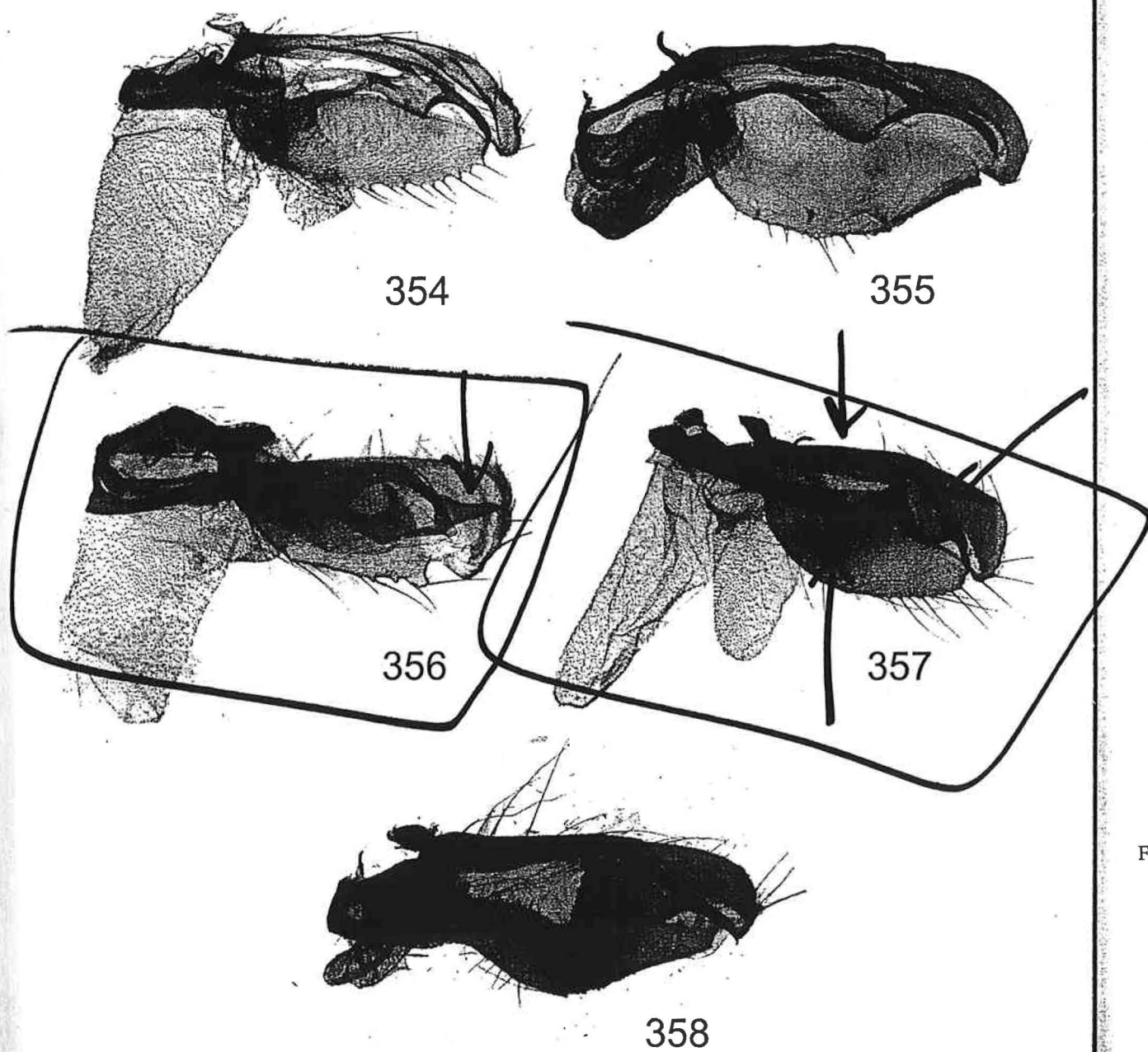


Figs. 50-54. *Helicoverpa zea* (Boddie). 50, 51, Male genitalia; 52, female genitalia; 53, lumen surface of appendix bursae (at greater magnification than other figures); 54, right foreleg.

44, dorsal aspect
47, female genitalia;

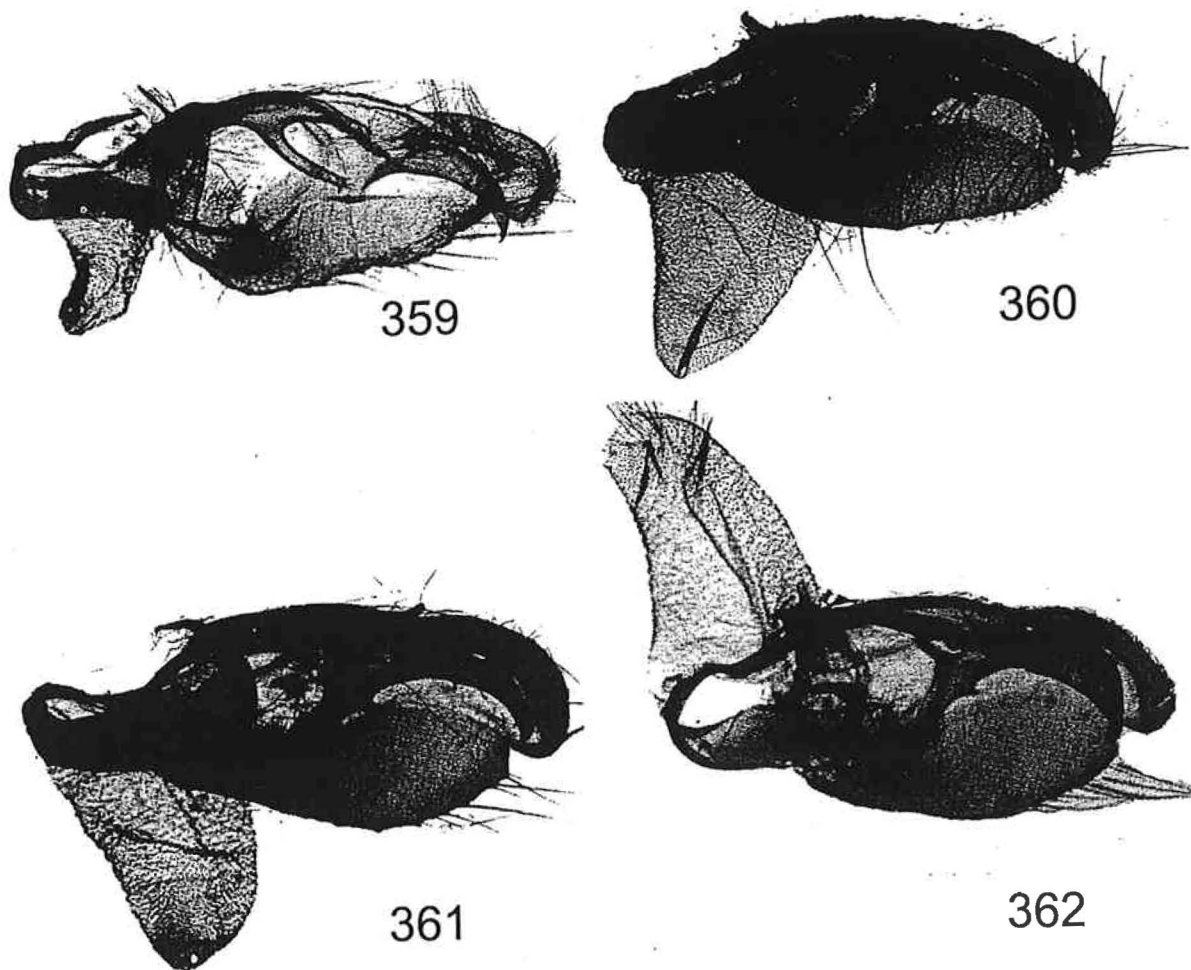


Figs. 346–353. Clade 21 and *S. exempta* clades and *S. frugiperda* male valves. 346, *S. compta*. 347, *S. eridania*. 348, *S. albula*. 349, *S. ochrea*. 350, *S. exempta*. 351, *S. mauritia*. 352, *S. trituratora*. 353, *S. frugiperda*.



Figs. 359–362.

Figs. 354–358. *S. dolichos* and *S. littoralis* clades male valves. 354, *S. dolichos*. 355, *S. androgea*. 356, *S. littoralis*. 357, *S. litura*. 358, *S. picta*.



Figs. 359–362. *S. evanida* clade male valves. 359, *S. evanida*. 360, *S. latifascia*. 361, *S. cosmiodes*. 362, *S. descoinsi*.