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Title	A CONTRIBUTION TO THE KNOWLEDGE OF THE MALAYSIAN LITHOCOLLETINAE (GRACILLARIIDAE, LEPIDOPTERA), WITH A REVISION OF INDIAN CAMERARIA ASSOCIATED WITH LEGUMINOSAE
Author(s)	Kumata, Tosio
Citation	Insecta matsumurana. New series : journal of the Faculty of Agriculture Hokkaido University, series entomology., 48, 1-85
Issue Date	1993-02
Doc URL	https://hdl.handle.net/2115/9867
Type	departmental bulletin paper
File Information	48_p1-85.pdf



**A CONTRIBUTION TO THE KNOWLEDGE OF THE MALAYSIAN
LITHOCOLLETINAE (GRACILLARIIDAE, LEPIDOPTERA),
WITH A REVISION OF INDIAN CAMERARIA
ASSOCIATED WITH LEGUMINOSAE**

By TOSIO KUMATA

Systematic and Ecological Surveys on Some Plant-Parasitic Microarthropods
in Southeast Asia, Scientific Report No. 16.

Research Trips for Agricultural and Forest Insects in the Subcontinent of India,
Scientific Report No. 47.

Abstract

KUMATA, T. 1993. A contribution to the knowledge of the Malaysian Lithocolletinae (Gracillariidae, Lepidoptera), with a revision of Indian *Cameraria* associated with Leguminosae. *Ins. matsum. n. s.* 48: 1-85, 47 figs. (32 text-figs., 15 pls.).

Sixteen species of the subfamily Lithocolletinae collected from Malaysia and other places are classified in four genera, that is, two species in *Neolithocolletis*, seven in *Cameraria*, five in *Phyllonorycter*, and two in *Porphyrosela*. Eleven species are described as new. *Lithocolletis pentadesma* and *Lithocolletis conista* are transferred to *Neolithocolletis* and *Phyllonorycter*, respectively. *Lithocolletis clarisona* is synonymized with *Phyllonorycter conista*. Taxonomic discussion based on larval as well as adult characters is given under each genus.

Some Indian species associated with Leguminosae are also revised (Appendix I): One species of *Cameraria* is described as new, and *Lithocolletis bauhiniae* and *L. virgulata* are transferred to *Cameraria*. A tentative list of the world species of *Porphyrosela* is given (Appendix II), and the following species are transferred to *Porphyrosela*: *Lithocolletis aglaozona*, *L. demochrysa*, *L. neodoxa* and *L. hardenbergiella*.

The fore wing and the genitalia of both sexes whenever available are illustrated for the species except for *Phyllonorycter triarcha* treated in the main part and in Appendix I. Wing venations and larval setal maps are also illustrated for some species. Photographs of leaf-mines are provided for some species.

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INTRODUCTION

So far as I am aware, only one species of the subfamily Lithocolletinae, *Phyllonorycter triarcha* (Meyrick), has been recorded from Malaysia (Yunus & Ho, 1980). In this paper are added to the fauna two species of *Neolithocolletis*, seven of *Cameraria*, four of *Phyllonorycter*, and two of *Porphyrosela*. The specimens used were collected by me in connection with the Japan-Malaysia joint project "Systematic and Ecological Surveys on Some Plant-Parasitic Microarthropods in Southeast Asia". Trips were made in 1986 in Peninsular Malaysia, in 1988 in Sabah, in 1990 in P. Malaysia, and in 1991 in Sarawak and P. Malaysia. Another specimen was borrowed from the collection of Mr. H.S. Barlow.

The Malaysian lithocolletine fauna recorded here is rather poor in comparison with the fauna of the Palaearctic Region. This is partly due to the paucity of the genus *Phyllonorycter* which is particularly rich in north temperate areas. In this genus three of the five species recorded were collected from mountain areas higher than 700 m above sea level. In this connection the poor known fauna of the subfamily in Malaysia might also be caused by insufficient surveys on high mountain areas. Anyway, it is evident that *Phyllonorycter* is poor in the lowland of tropical Asia, because more than 200 species of the subfamily Gracillariinae were collected from Malaysia during the joint survey trips.

It is noteworthy that seven species of *Cameraria* are discovered from Malaysia. The genus had been believed to be indigenous to the Nearctic Region (Opler & Davis, 1981), and has only recently been recorded from the Palaearctic Region (Kumata, 1963; Noreika & Puplesis, 1992). Moreover, all the Malaysian species are associated with Leguminosae, while no species has yet been recorded from this plant family in the Holarctic Region.

The discovery of two legume-feeding species of *Neolithocolletis*, which was erected to receive only the type species known from Japan, suggests that the main distributional area of the genus is in tropical and subtropical Asia in association with the rich flora of Leguminosae.

In the course of the present study, I have revised the Indian species of the subfamily that are associated with leguminose plants; the result is given in Appendix I. Further, I have prepared a tentative list of the world species of the genus *Porphyrosela* in Appendix II. So far as known, this genus is also associated with Leguminosae.

MATERIALS, METHODS AND TYPE DEPOSITORIES

The specimens used were reared by me from larvae mining in leaves of their food plants, including those collected by me in India and Nepal under the project "Research Trips for Agricultural and Forest Insects in the Subcontinent of India", 1978 and 1983. One Malaysian specimen undetermined and two Indian ones determined by T.B. Fletcher as *Lithocolletis conista* were borrowed from the collection of Mr. H.S. Barlow at Kuala Lumpur and that of the Zoological Survey of India at Calcutta, respectively.

The methods of breeding larvae and of mounting genital organs, wings and larvae are same with those adopted in my previous work (Kumata, 1992). A

biological microscope with a camera lucida was used for preparing drawings of genitalia and wing venations. A stereomicroscope with an ocular micrometer was used to measure and to observe adult specimens. Expanse of wings was measured between the apices of fore wings including cilia in specimens with expanded wings. The length of fore wing measured from the base to the apex is also given.

Depositories of the specimens including holotypes are indicated under "Specimens examined" in each species and abbreviated as follows :

EDAK = Entomological Division, Department of Agriculture, Nepalese Government, Kathmandu, Nepal.

EOUS = Entomological Laboratory, University of Ôsaka Prefecture, Sakai, Japan.

FDKS = Forest Department, Kuching, Sarawak, Malaysia.

FRIM = Forest Research Institute of Malaysia, Kuala Lumpur, Malaysia.

SEHU = Systematic Entomology (formerly Entomological Institute), Faculty of Agriculture, Hokkaidô University, Sapporo, Japan.

ZSIC = Zoological Survey of India, Calcutta, India.

SUBFAMILY LITHOCOLLETINAE

The subfamily Lithocolletinae is well defined (Chapman, 1902 ; Kumata, 1961 ; Watkinson, 1985 ; etc.), but the most important character in wing venation has long been overlooked though Ely (1917) stated in hind wing venation that "*Phyllonorycter* and its allies do not show a close relationship to any of the other genera and the parallel condition of 7 [Rs] with 5 [M_2], 6 [M_1], is a great departure from the form of venation found in *Gracilaria*" (symbols in brackets are added by me). Further he continued : "It may be that this group is worthy of the family rank that is given it by some authors".

The parallel condition of the vein Rs with the vein M_1 or M_{1+2} towards base of the hind wing is seen in the genera *Phyllonorycter* Hübner, 1822 (= *Lithocolletis* Hübner, [1825]), *Cameraria* Chapman, 1902, *Cremastobombycia* Braun, 1908, *Porphyrosela* Braun, 1908, *Protolithocolletis* Braun, 1929, *Chrysaster* Kumata, 1961, *Neolithocolletis* Kumata, 1963, and *Hylaconis* Kumata, 1963. In this respect all these genera are referable to this subfamily.

Besides the hind wing venation mentioned above, the following characters may also serve to separate Lithocolletinae from the other subfamily Gracillariinae : — Tiny moths (less than 10 mm in wing expanse) with fore wing brilliantly ochreous-, orange- or reddish-brownish in ground colour, with white or silvery-white, striate and/or wedge-shaped marks ; head with a tuft or crown of long and slender scales ; fore wing with seven to nine veins, the veins R_1 , Cu_{1b} and M_3 being usually absent ; hind wing with five to six veins, the vein Cu_{1b} and M_3 being always absent ; eighth abdominal sternite of male produced caudally, forming a large flap laying under valvae except in *Chrysaster* and perhaps also in *Protolithocolletis* ; larva habitually pupates inside the mine without any opening or tear except in *Chrysaster*.

Sixteen species of the subfamily collected or recorded from Malaysia are arranged under four genera which are separated by the following key.

Key to the Malaysian genera of Lithocolletinae

1. Fore wing with vein R_2 present. *Neolithocolletis*
- Fore wing with vein R_2 absent. 2
2. In male genitalia, tegumen with a pair of apical setae. 3
- Tegumen without any apical setae. *Phyllonorycter*
3. Hind wing with three pairs of sensory pores (campaniform sensillae) on its dorsal margin ; in female genitalia, eighth abdominal segment and its apophyses absent. . . . *Porphyrosela*
- Hind wing with two pairs of sensory pores on its dorsal margin ; in female genitalia, eighth abdominal segment definite, with its apophyses usually present. *Cameraria*

GENUS NEOLITHOCOLLETIS KUMATA

Neolithocolletis Kumata, 1963, Ins. matsum. 26 : 21.

Type-species : *Neolithocolletis hikomonticola* Kumata, 1963.

This genus was originally erected for the type species alone which is known to mine in leaves of *Pueraria* in Japan. In the course of the present study, further two species referable to the genus have been found in Malaysia : one is a leaf-miner of *Pterocarpus indicus*, locally called "angsana", and has recently caused a heavy infestation to this plant on the roadside in Malaya, Sarawak and other places ; the other one has been reared from leaf-mines of *Calopogonium*.

The genus may be separated from the other genera by the following characters. Fasciate whitish marks of fore wing margined with black scales on inner edge alone (by this character it is separated from *Cameraria*). Fore wing with venation similar to that of *Hylaconis*, *Protolithocolletis* and *Cremastobombycia* in having vein R_2 , but different from that of the last two genera in the absence of vein M_2 . Hind wing with venation similar to that of *Phyllonorycter*, *Cameraria* and *Chrysaster* and different from that of *Hylaconis*, *Protolithocolletis* and *Cremastobombycia* in the absence of vein M_2 . In male genitalia, tegumen with two pairs of apical setae (this is characteristic of *Neolithocolletis*, for in *Phyllonorycter* the tegumen has no apical setae, in *Cameraria*, *Chrysaster* and *Porphyrosela* it has only one pair, and in *Hylaconis* and *Cremastobombycia* it has many, more than four, apical setae) ; transtilla complete as in *Phyllonorycter*, *Cremastobombycia*, *Chrysaster* and *Porphyrosella* (it is incomplete in *Hylaconis* and most species of *Cameraria*). In female genitalia, corpus bursae with many microscopic, spine-like signa which are scattered on inner side (in the other genera it bears other types of signa).

As larvae of the last instar have been available for two species, the type species and *N. pentadesma*, comb. nov., main characters of this stage are described here : —Abdomen with a series of subtriangular or elliptical shields both on dorsal and ventral surfaces. Thoracic legs all reduced into a small protuberance with six minute cones on the top. Ventral prolegs well developed on third and fourth abdominal segments in type species and on third to fifth in *N. pentadesma*, having no crochets as in anal proleg on tenth. Seta XD2 absent on prothorax as usual in Lithocolletinae ; seta D2 posterodorsal to D1 on abdomen except on sixth and seventh segments, on which it is posterolateral to and far remote from D1, and very thickened ; D2 on mesothorax and metathorax also very thickened, and set close to D1. Lateral group of setae represented by two on all body segments except on eighth and ninth abdominal segments, and L1 longer than L2 in abdominal segments.

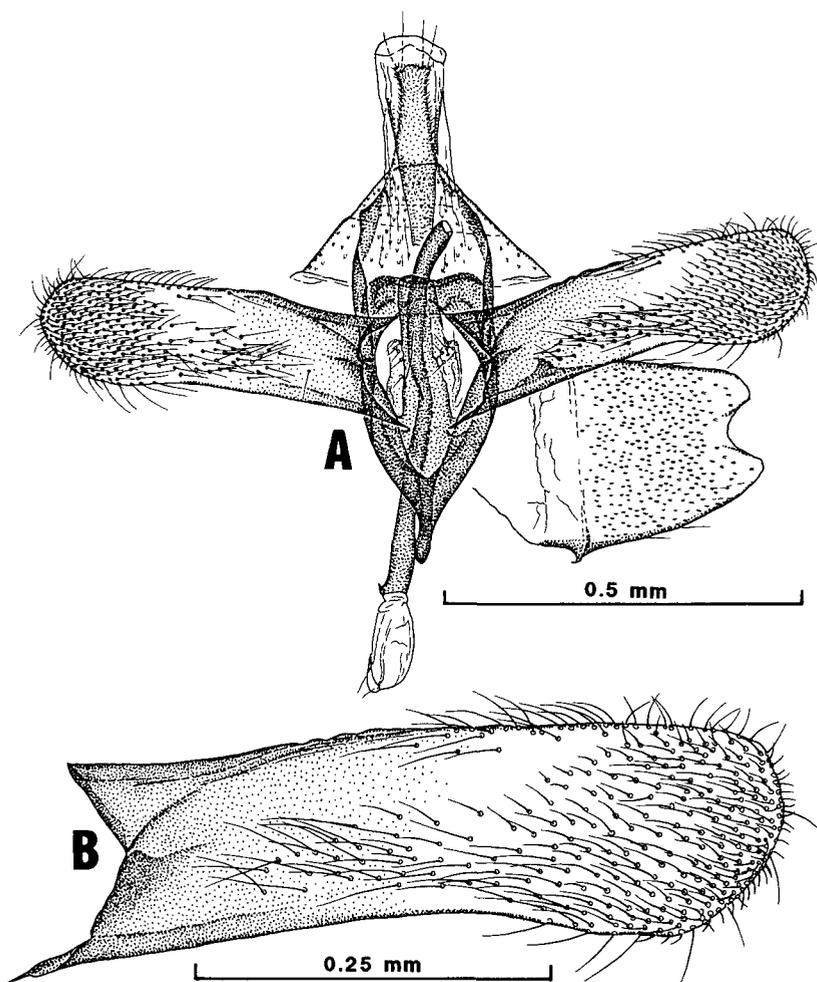


Fig.1. *Neolithocolletis hikomonticola* Kumata. A: Male genitalia in ventral view [Grc-2701, Todai, Ina, Nagano-ken, Honsyū, Japan, em. 19/v/1976, ex *Pueraria lobata* (1604)] — B: Right valva [ditto].

Subventral group of setae represented by a single seta (SV1) on all abdominal segments even on ventral prolegs. Seta V1 absent on sixth to ninth abdominal segments. Proprioceptor MD1 absent on eighth and ninth abdominal segments; MV3 also absent on all abdominal segments.

The larval characters mentioned above indicate that *Neolithocolletis* is very closely related to *Hyloconis* (see Fig. 39, A), but the former is distinguished from the latter by the reduced thoracic legs. It is more easily distinguished from *Cameraria* and *Chrysaster* by the position of the seta D2 and by the presence of the single subventral seta on ventral prolegs: in *Cameraria* and *Chrysaster*, the seta D2 is always posterolateral to D1 on all the abdominal segments and the ventral prolegs have two or three subventral setae. Further, *Neolithocolletis* is essentially distin-

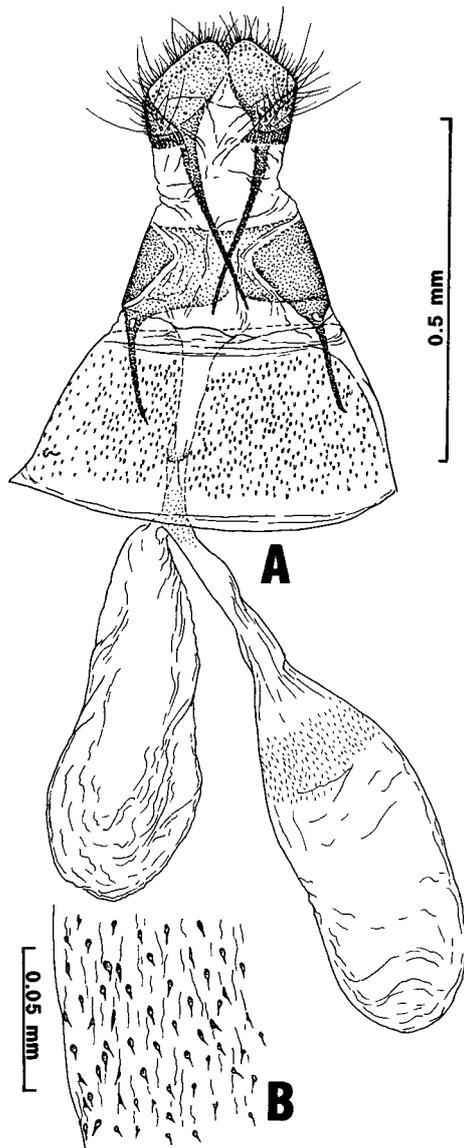


Fig. 2. *Neolithocolletis hikomonticola* Kumata. A: Female genitalia in ventral view [Grc-2702, Todai, Ina, Nagano-ken, Honsyū, Japan, em. 26/v/1976, ex *Pueraria lobata* (1604)] — B: A part of corpus bursae [ditto].

guished from *Phyllonorycter* by the presence of two lateral setae, L1 and L3 on mesothorax and metathorax and L1 and L2 on prothorax and abdominal segments; in larvae of *Phyllonorycter*, so far as some Japanese species examined are concerned, the lateral group is represented by only one seta (L1) on the mesothorax, metathorax and all the abdominal segments.

The known species of the genus *Neolithocolletis* are all associated with

Leguminosae, and separated from each other by the following key.

Key to the species of *Neolithocolletis*

1. First white fascia at about basal fourth of fore wing detached from dorsum ; tuft on head black ; larval mine on *Calopogonium* ; distributed in Malaysia. *N. kangarensis* sp. nov.
- First white fascia completely crossing the wing ; tuft on head brownish ; larval mine on legumes other than *Calopogonium*. 2
2. Inner black edges of white fasciae of fore wing wider than the white part ; a black mark placed on base of fore wing ; larval mine on *Pterocarpus* ; distributed in Malaysia and Indonesia. *N. pentadesma* (Meyrick)
- Inner black edges of fasciae narrower than the white part ; no black mark on base of fore wing ; larval mine on *Pueraria* ; distributed in Japan. *N. hikomonticola* Kumata

Neolithocolletis pentadesma (Meyrick), comb. nov.

[Figs. 3, 5(A & B), 33(A), 35(B), 38(B), 43(D)]

Lithocolletis pentadesma Meyrick, 1918, Exot. Microlep. 2: 230 [Indonesia (Java); host, *Pterocarpus indicus*].

Original description. "♂ ♀. 4-5 mm. Head ochreous-brownish, face white. Thorax reddish-ochreous-brown, with transverse bar of black irroration. Abdomen grey. Forewings lanceolate ; reddish-ochreous-brown ; a fine angulated basal fascia of blackish irroration ; three slender fasciae of black irroration, rather inwards-oblique from costa, curved-angulated above middle, slightly edged with white posteriorly, more strongly towards costa, an oblique bar of scattered black scales from angle of third beyond its white margin to costa ; a slender streak of black irroration along termen, preceded on costa by a white mark : cilia whitish-grey tinged reddish-ochreous, three lines of black points. Hindwings grey ; cilia whitish grey.

Java, Buitenzorg, bred from roundish blotch-mines on undersurface of leaves of *Pterocarpus indicus* (Leguminosae), sometimes 30-40 larvae in a leaf, mines coalescing (Dr. W. Roepke) ; nine specimens."

Additional description. ♂ ♀. Expanse of wings : 4.4-5.0 mm (4.73 mm on average of 18 specimens). Length of fore wing : 2.0-2.3 mm (2.15 mm on average of 19 specimens).

Labial palpus whitish, with a blackish streak below. Antenna fuscous, faintly annulated with white at base of each segment ; scape brownish above, white below, with pecten white. Fore leg blackish, with coxa, a spot on upper side of tibia and three rings on tarsus whitish. Mid and hind legs whitish, with three oblique stripes on mid tibia, three rings on mid tarsus, two spots on hind femur, a basal spot on hind tibia and three rings on hind tarsus blackish ; hind tibia infuscated on apical half. Abdomen with spiracular and subventral lines whitish.

Fore wing as described originally, but the last line of blackish irroration rather wide and running in parallel to termen, the costal part forming an outer margin of subapical white mark ; cilia around apex brownish, and those on termen whitish, with a subapical line of blackish points and a similar, but irregular, subbasal line, both running in parallel to termen.

Male genitalia (Fig. 3) : Tegumen moderately long, subconical, very shortly biforked apically, with two pairs of slender apical setae ; tuba analis widely, but weakly, sclerotized and densely spinulose on ventral surface. Valva much longer

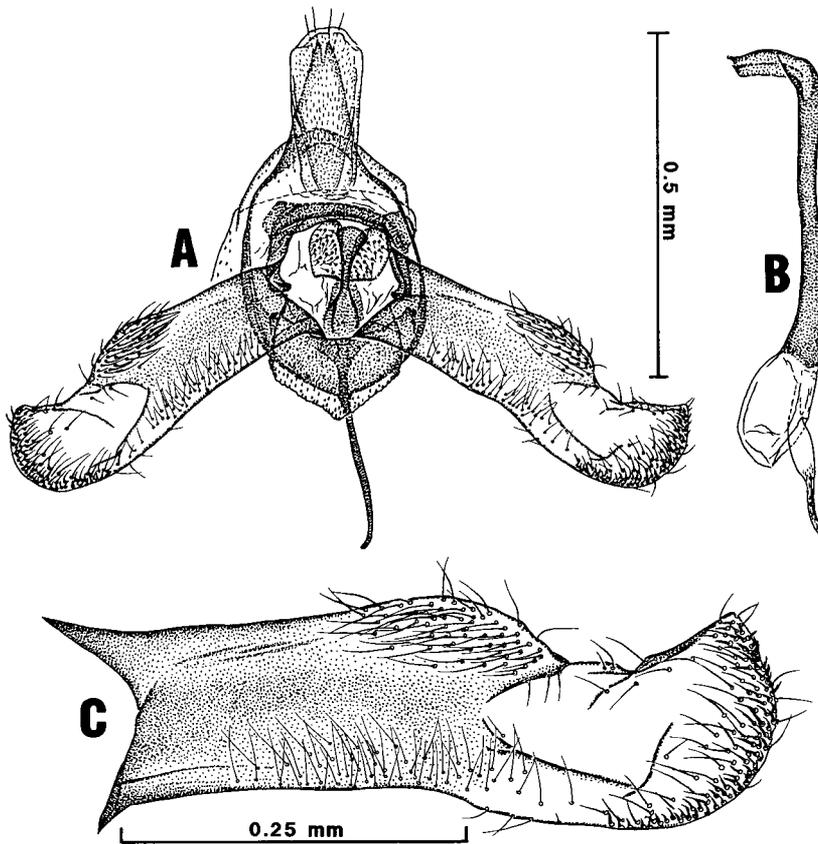


Fig. 3. *Neolithocolletis pentadesma* (Meyrick). A: Male genitalia in ventral view, aedeagus omitted [Grc-5890, E. Malaysia, ex *Pterocarpus indicus* (4241)] — B: Aedeagus [ditto] — C: Right valva [ditto].

than tegumen, about one-third as wide as long, with costal margin more or less tuberculate on median third, then shallowly concave on apical third; apex round, with a blunt angle at costal side; thick and short setae occurring along apical margin densely, moderately thick setae on tuberculate area of costa densely, and slender setae near ventral margin rather sparsely; transtilla complete, with a pair of small laterocephalic lobes. Vinculum shortly crescent-shaped, with a long and slender saccus, which is about two-fifths as long as valva. Aedeagus slender, tubular, sinuate, nearly rectangularly bent at apical fifth; vesica without cornutus. Juxta well sclerotized, elongate-rectangular, constricted medianly, with a pair of setose lateral lobes on apical half. Flap-like eighth sternite small, a little longer than vinculum, subpentagonal with an angulate apex (in specimens from Sarawak, E. Malaysia) or semielliptical with a round apex (in specimens from W. Malaysia). (Four preparations examined.)

Female genitalia (Fig. 5, A & B): Papilla analis moderate in length, setose and spinulose as usual; apophysis posterioris slightly widened basally, about three-fifths

as long as seventh abdominal segment. Eighth abdominal segment moderate in length, not squamose; apophysis anterioris about half as long as apophysis posterioris. Seventh abdominal segment normally separated from eighth, with sternite not modified into genital organs, but very strongly sclerotized on cephalic margin narrowly, the sclerotization being sinuate into a widened M-shape. Ostium bursae placed on ventrum between seventh and eighth segments, simple without sclerose genital plate; ductus bursae moderate in length, with a very weakly sclerotized antrum in middle caudad of opening of ductus seminalis; corpus bursae large, pyriform, sparsely spinulose on inner surface except at caudal and cephalic ends, the spinules being acute, with a slender basal plate. (Three preparations examined.)

Specimens examined. 58♂ & 38♀. WEST MALAYSIA — 34♂ & 21♀, Petaling Jaya, Kuala Lumpur, em. 27/ix-3/x/1991, ex *Pterocarpus indicus* (4240). EAST MALAYSIA (SARAWAK) — 24♂ & 17♀, Kuching-city, em. 29/ix-9/x/1991, ex *P. indicus* (4241). 24♂ & 15♀ deposited in FRIM, 5♂ & 5♀ in FDKS, and the rest in SEHU.

Distribution. Indonesia (Java); West Malaysia; and East Malaysia (Sarawak).

Food plant. *Pterocarpus indicus* (Leguminosae).

Mine (Fig. 43, D). Irregular blotch-mines occurring on lower side of leaf, but very rarely on upper side, whitish at a glance, flat and small (less than 2 cm in longest diameter) at mature stage. Pupation takes place within a circular, white cocoon, which is placed inside the mine-cavity and usually in the centre.

When I collected the present material, more than 40 mines occurred on a single leaflet, occupying almost the whole lower surface. Heavy defoliation was observed at the collection sites.

Remarks. The mine of this species is very similar to that of the *Hylcoconis*-species known in Japan, but some adult features, the hind wing with a single median vein, the transtilla which is complete, the tegumen with two pairs of apical setae, and the corpus bursae lined with many acute spinules, indicate that this species belongs to the genus *Neolithocolletis*. Further, the reduced thoracic legs of the last instar larva are a common character with the type species of the genus, *N. hikomonticola* Kumata (see Fig. 38, A). On the other hand, this species is very different from *N. hikomonticola* and all the members of *Hylcoconis* in the presence of the ventral prolegs on the third to fifth abdominal segments instead of the presence of two pairs of ventral prolegs, each pair on the third and fourth. This fact may arouse some doubts about its position in the genus *Neolithocolletis*. In this paper, however, it is referred to the genus on the basis of the adult characters.

Neolithocolletis kangarensis sp. nov.

[Figs. 4, 5(C & D), 33(B), 35(C), 43(A & B)]

Description. ♂ ♀. Expanse of wings: 4.2–4.5 mm (4.3 mm in holotype). Length of fore wing: 1.9–2.1 mm (1.9 mm in holotype).

Head with tuft blackish; face leaden-gray with a strong metallic lustre, narrowly whitish laterally. Palpi whitish. Antenna fuscous, faintly annulated with paler colour; scape fuscous above, white below, with pecten white. Thorax blackish dorsally, becoming brownish posteriorly; pleural and ventral surfaces grayish-

white, tinged with a leaden lustre. Fore leg blackish, with a narrow, longitudinal line on ventral side of femur, a spot on tibia and three rings on tarsus white. Mid and hind legs whitish, tinged with leaden-gray, with apical spot on mid femur, two oblique stripes on mid tibia, two rings on mid tarsus, a subbasal spot and a larger median blotch on hind tibia and three or four rings on hind tarsus blackish; all tibial spurs with a blackish subapical ring. Abdomen fuscous-gray dorsally, gray-whitish ventrally, with three or four fuscous spots laterally.

Fore wing dull ochreous-brown in ground colour, slightly tinged with a golden gloss; a small, triangular black spot placed at base of costa; a narrow, white costal strigula at basal fourth, vertical or slightly oblique inwards from costa, usually extending beyond wing-fold, but never reaching dorsal margin, margined with black irroration on inner edge; a narrow, transverse, white fascia in middle, straight or

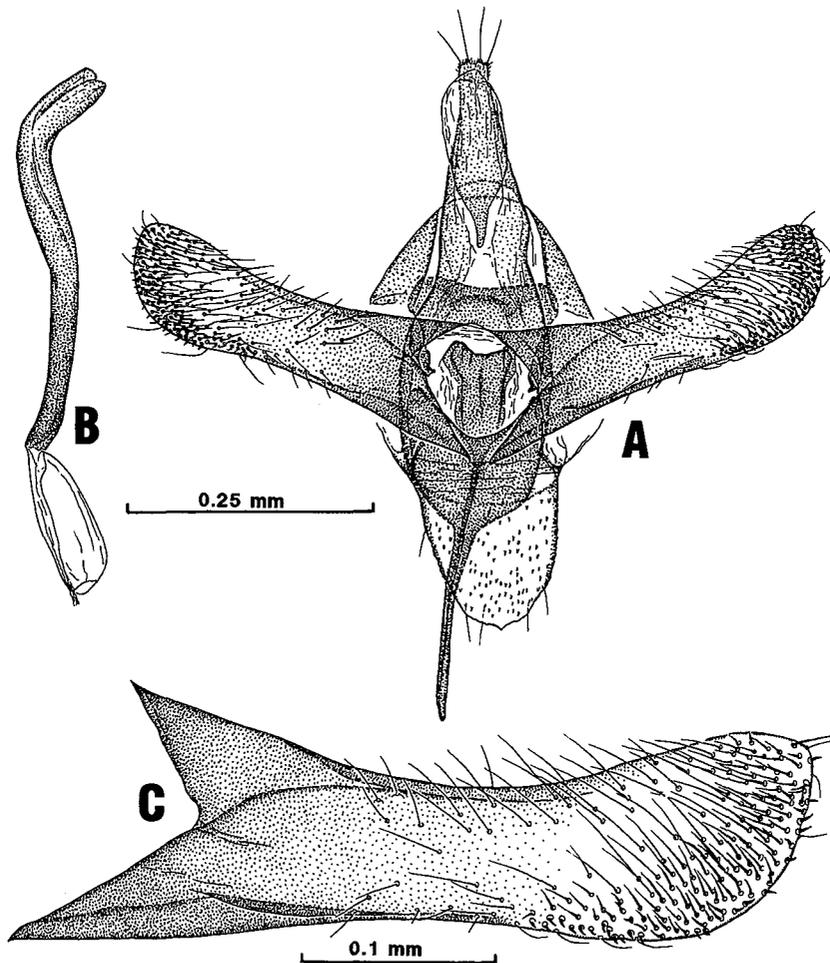


Fig. 4. *Neolithocolletis kangarensis* sp. nov. A: Male genitalia in ventral view, aedeagus omitted [Grc-5830, holotype] — B: Aedeagus [ditto] — C: Right valva [ditto].

very slightly angulated outwards near costa, slightly oblique inwards from costa, margined with black on inner edge, the black margin on costal half always expanding inwards to form a triangular costal blotch; a white costal strigula and a dorsal one opposed at apical fourth, both nearly triangular and margined with black irroration on inner edges; a further white costal spot placed near apex of wing in three specimens excluding holotype; apical area distal to the opposed strigulae almost wholly suffused with black irroration; cilia gray-whitish, with a fringe-line

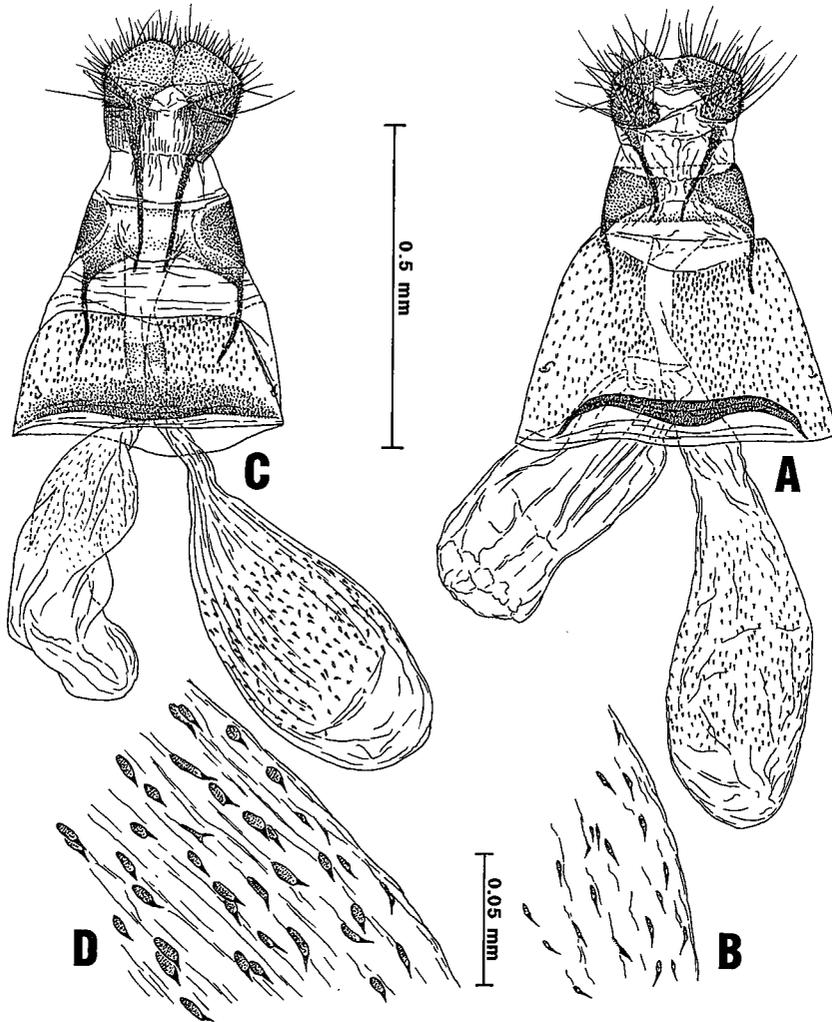


Fig. 5. A-B: *Neolithocolletis pentadesma* (Meyrick). A: Female genitalia in ventral view [Grc-5826, E. Malaysia, ex *Pterocarpus indicus* (4241)] — B: A part of corpus bursae [ditto].

C-D: *Neolithocolletis kangarensis* sp. nov. C: Female genitalia in ventral view [Grc-5832, W. Malaysia, ex *Calopogonium* sp. (4704)] — D: A part of corpus bursae [ditto].

of black irroration around apex and termen. Hind wing dark gray, with cilia gray-whitish.

Male genitalia (Fig. 4): Tegumen moderately long, subconical, truncate or very shortly biforked apically, spinulose on apical area, with two pairs of slender apical setae; tuba analis weakly sclerotized ventrally, but not covered with spinules. Valva elongate-quadrangular, about one-fourth as wide as long at widest part, slightly narrowed medianly, round on apical margin, and sparsely covered with setae on apical two-thirds, the setae along apical margin being shorter and stouter; transtilla complete, rather wide, with a pair of large, laterocephalic lobes. Vinculum U-shaped, with a slender, long apical saccus, which is two-fifths to one-second as long as valva. Aedeagus about as long as valva, narrowly tubular, sinuate, moderately bent at apical fifth; vesica without cornuti. Juxta well sclerotized, dilated near apex, but without setose lobes or projections. Flap-like eighth sternite rather small, about 1.5 times as long as vinculum, spatulate, and round on apical margin. (Two preparations examined.)

Female genitalia (Fig. 5, C & D): Papilla analis elongated, setose and spinulose as usual; apophysis posterioris slender, widened towards base, and about 1.5 times as long as seventh abdominal segment. Eighth abdominal segment moderate in length, not squamose; apophysis anterioris slender, about half as long as apophysis posterioris. Seventh abdominal sternite normal in form, not modified into genital organs, but weakly sclerotized on its cephalic area, the sclerotization being weakened caudad without clear caudal edge unlike that of *N. pentadesma*. Ostium bursae simply membranous, without genital plate; ductus bursae tubular, shortly and weakly sclerotized at median part, beyond which the ductus seminalis is branched off; corpus bursae large, pyriform, sparsely spinulose on inner surface except on caudal and cephalic areas, the spinules having basal plate larger than that of *N. pentadesma*. (One preparation examined.)

Specimens examined. 2♂ and 3♀. Holotype: ♂, Anak Chelong, Kangar, Perlis, Malaysia, em. 24/xi/1991, ex *Calopogonium* sp. (4704), Gen. sl. no. Grc-5830, deposited in FRIM. Paratypes: 1♂ & 3♀, with same data as holotype except for emergence dates, 19-26/xi/1991, 2♀ in FRIM and 1♂ & 1♀ in SEHU.

Distribution. West Malaysia.

Food plant. *Calopogonium* sp. (Leguminosae).

Mine (Fig. 43, A & B). An oblong blotch-mine occurring on disc between two lateral veins of lower side of leaf, whitish and flat at immature stage; at maturity it is discoloured into ochreous on its half area, usually distally, by the consumption of leaf-tissue, then distal margin of this part is cut out semicircularly, finally the cut part being folded down to cover a circular, white cocoon, which is placed inside the mine-cavity. This mining pattern is very similar to that of *N. hikomonticola* in details (Fig. 43, C).

Remarks. This new species is related rather to *N. hikomonticola* Kumata described from Japan than to the preceding species in the colour pattern of fore wing and the male genitalia, but is distinguished from *N. hikomonticola* by the blackish tuft of the head, by the fore wing with a white mark detached from the dorsal margin at the basal fourth and with a large blackish mark at apex, by the longer saccus, by the apically round flap-like eighth sternite of the male, and by the widely spinulose corpus bursae. In *N. hikomonticola*, the tuft of head is brownish; the first white

mark at basal fourth of the fore wing completely crosses the wing to form a fascia ; the apical area of the fore wing is brownish ; the saccus is shorter than one-seventh of the valval length ; the flap-like eighth sternite of the male is notched apically ; and the corpus bursae is spinulose merely on the caudal area.

From *N. pentadesma* this new species is more easily distinguished by the colour-pattern of the fore wing and by the shape of the valva.

GENUS CAMERARIA CHAPMAN

Cameraria Chapman, 1902, Entomologist 35 : 141 ; Ely, 1917, Proc. Ent. Soc. Washington 19 : 38 ; Busck, 1909, ditto 11 : 100 ; Kumata, 1963, Ins. matsum. 26 : 73 ; Opler & Davis, 1981, Smiths. Contr. Zool. 333 : 5.

Type-species : *Lithocolletis guttifinitella* Clemens, 1859.

Most members of this genus are distributed in the Nearctic Region (Opler & Davis, 1981 ; Davis, 1983), and some others in Japan (Kumata, 1963) and Central Asia (Noreika & Puplesis, 1992). In this paper seven species from Malaysia, together with three from India in Appendix I, will be added to the genus ; among them two, *bauhiniae* and *virgulata*, are removed from *Lithocolletis* (= *Phyllonorycter*) to the genus. It is noteworthy that these tropical Asian species are, so far as known, associated with Leguminosae. The Holarctic species have been recorded from Oleaceae, Betulaceae, Fagaceae, Aceraceae, Ulmaceae, Salicaceae, Caprifoliaceae, Ericaceae, Juglandaceae, etc., and yet none of them from Leguminosae.

The genus *Cameraria* is very similar to the genus *Phyllonorycter* in adult features, particularly in wing venation and hind leg structure. It is, however, separated from *Phyllonorycter* usually by the outwardly black-margined white mark of the fore wing, the incomplete transtilla and the tegumen with a pair of apical setae. Moreover, it may be separated by making rather flat mines in contrast with tentiform mines of *Phyllonorycter*.

So far as four Japanese species (including an undescribed one feeding on *Aesculus*) examined are concerned, *Cameraria* is also distinguished from *Phyllonorycter* by the combination of the following characters of the last instar larva : — Abdomen with a series of sclerotized shields both on dorsal and ventral surfaces as in the preceding *Neolithocolletis*. Thoracic legs reduced into ventral protuberances except in one species, *C. hikosanensis*. In body chaetotaxy, the lateral group is bisetose on body segments except on ninth and tenth abdominal segments, and the subventral group bisetose (SV1 and SV2) on ventral prolegs.

The species described or redescribed here from tropical Asia are slightly different from the Japanese species in having well-developed thoracic legs and three subventral setae on the ventral prolegs except in *C. bauhiniae*. Further, the transtilla of the male genitalia is complete, as in *Phyllonorycter*, in *C. virgulata* (Meyrick), *C. pongamiae* (sp. nov.), *C. magnisignata* (sp. nov.), *C. milletiae* (sp. nov.) and *C. borneensis* (sp. nov.). Inclusion of these species in the genus *Cameraria* may be questionable, but they have many common characters with the Japanese species of *Cameraria* such as the outwardly black-margined white fasciae of the fore wing, the apically bisetose tegumen of the male genitalia and the bisetose lateral group in the chaetotaxy of the last instar larva.

Anyhow, *C. virgulata*, *C. pongamiae*, *C. magnisignata*, *C. milletiae* and *C.*

borneensis are related to each other and form a species-group, the *virgulata*-group. At the present stage of our knowledge on the tropical Asian Lithocolletinae, it may be better to avoid establishing a new genus for them.

Key to the Malaysian species of *Cameraria*

1. Fasciate whitish marks of fore wing containing a line of black irroration in their dorsal arm in addition to an outwardly black-edged line. 2
- Whitish marks of fore wing margined with black on outer edge alone or both on inner and outer edges. 4
2. Male aedeagus at apex with a pair of acute lateral processes; female corpus bursae with a horseshoe-shaped signum, which bears four or five minute projections on inner margin; larval mine on upper side of leaf of *Pongamia*. *C. pongamiae* sp. nov.
- Aedeagus with a pair of minute, round plates near apex; female corpus bursae with signum represented by a round, spinulate patch or without any signum; larval mine on lower side of leaf of legumes other than *Pongamia*. 3
3. Male transtilla incomplete; male vinculum subtriangular, with apex obtuse; female ductus bursae sclerotized on its basal third, the sclerotized part being about twice as long as apophysis anterioris; corpus bursae with a signum of round, spinulate patch; larval mine on *Archidendron*. *C. borneensis* sp. nov.
- Transtilla complete; vinculum acutely acuminate apically; ductus bursae shortly sclerotized at base, the sclerotized part being about as long as apophysis anterioris; corpus bursae without any signum; larval mine on *Milletia*. *C. milletiae* sp. nov.
4. White fasciae of fore wing margined with black both on inner and outer edges; larval mine on lower side of leaf of *Spatholobus*. *C. fasciata* sp. nov.
- White fasciae margined with black on outer edge alone; larval mine on upper side of leaf of *Bauhinia*. 5
5. Fore wing with three oblique white fasciae; male tegumen with two short apical processes (probably socii). *C. trizosterata* sp. nov.
- Fore wing with four very oblique white fasciae; tegumen simply round or truncate apically. 6
6. Fore wing lightly ochreous-brownish in ground colour; male vinculum long biforked apically; valva bar-shaped, slightly swollen ventrally beyond middle, and covered densely with spinules on swollen part; flap-like eighth sternite of male deeply concave apically. *C. barlowi* sp. nov.
- Fore wing dark brownish in ground colour; male vinculum very short, round apically; valva bifurcated apically, the upper process having a large hook-shaped seta near apex and the lower process covered with slender setae alone; flap-like sternite spatulate, convex apically. *C. quadrifasciata* sp. nov.

Cameraria quadrifasciata sp. nov.

[Figs. 6, 8(A), 34(B), 36(C), 40(B), 44(C)]

Description. ♂ ♀. Expanse of wings: 4.2–5.1 mm (4.9 mm in holotype, 4.65 mm on average of 16 specimens). Length of fore wing: 1.9–2.5 mm (2.2 mm in holotype, 2.15 mm on average of 16 specimens).

Head with tuft brownish, slightly darkened anteriorly; face and palpi whitish, with a leaden lustre. Antenna fuscous dorsally, faintly annulated with paler colour; scape fuscous on dorsum and whitish on ventrum including pecten. Thorax dark brownish dorsally, somewhat mixed with white scales anteriorly; pleural and ventral surfaces ochreous-whitish, with a leaden lustre. Fore leg blackish, with

tarsus ringed with white at base, middle and apex. Mid leg ochreous-whitish, the tibia with two blackish, oblique stripes, and the tarsus with two broad blackish rings. Hind leg ochreous-whitish, the tibia clouded with fuscous apically and the tarsus with three blackish rings, of which the apicalmost one is about twice as long as the others. Abdomen fuscous dorsally, grayish-white ventrally, with two or three oblique fuscous bands.

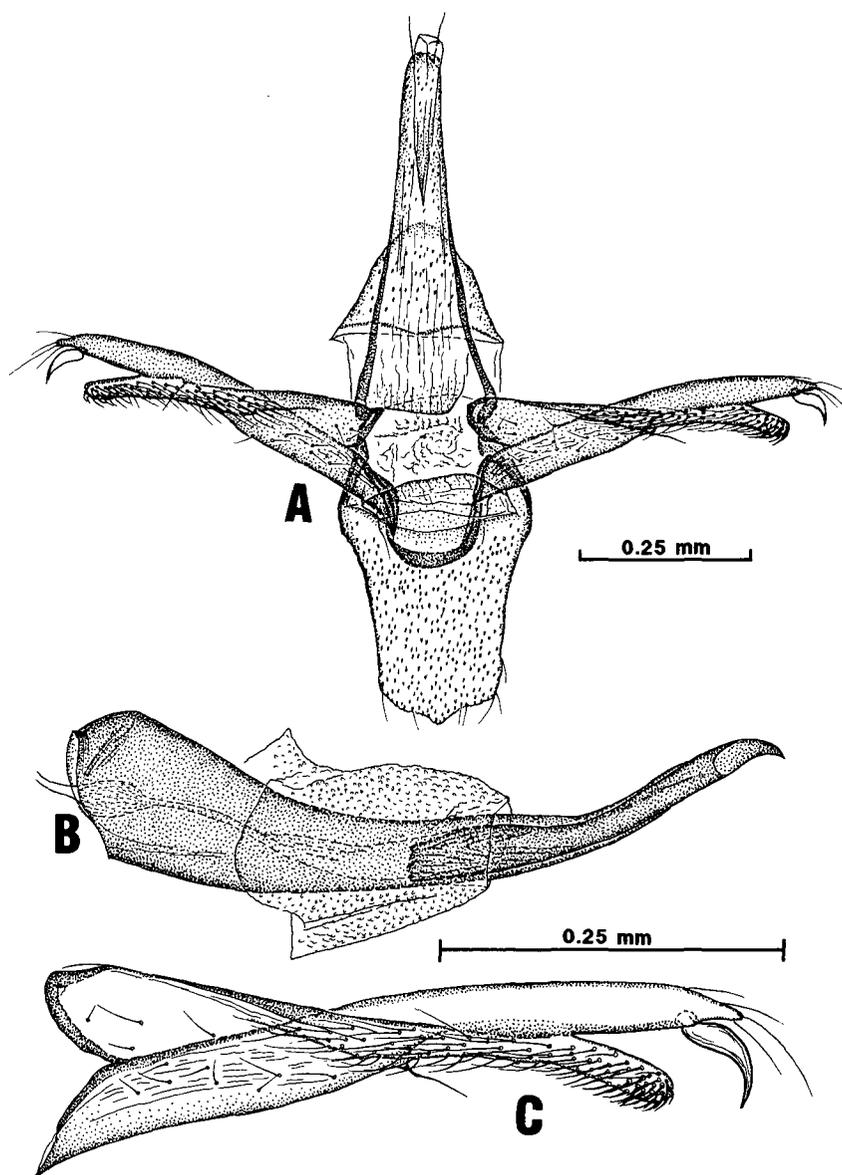


Fig. 6. *Cameraria quadrifasciata* sp. nov. A: Male genitalia in ventral view, aedeagus omitted [Grc-5882, holotype] — B: Aedeagus [ditto] — C: Right valva [ditto].

Fore wing dark brownish with a golden lustre in ground colour, with four very oblique, slender, white fasciae, which are nearly parallel to each other and edged with a blackish line on their outer edges; first fascia placed near base of wing, slightly arched inwards and detached far from costa; the second at basal fourth, and slightly detached from costa; the third in middle, reaching apical one-fourth of costa, sometimes bifurcated near its apex, thus it touches costa at two points, apical two-fifths and one-fourth; the fourth extending from tornus to apex of costa and usually sinuate; apical area beyond the last fascia is irrorated with black scales to form an irregular apical spot; cilia along apex of costa wholly brownish, and those along termen grayish, mixed with shorter, black-tipped scales, which form one or two fringe lines; cilia on dorsal margin dark grayish. Hind wing dark gray or fuscous, with cilia dark grayish.

Male genitalia (Fig. 6): Tegumen long, conical, sparsely squamose on dorsum, with a pair of apical setae; tuba analis membranous, not spinulose. Valvae symmetrical, nearly as long as tegumen, slender, but widened basally and bifurcated apically into two slender processes; the upper process (probably apical part of sacculus) a little longer than the lower, rather sharpened, with a large, hook-shaped seta near apex of ventral margin; the lower process (probably cucullus) parallel-sided, round apically, densely setose in disc from basal third of valva to apex of the process; transtilla incomplete, with proximal end of costa round. Vinculum narrowly U-shaped, laterally fused with bases of sacculi. Aedeagus about as long as valva, well swollen towards base, curved, sharply hook-shaped apically; vesica with its apical part weakly sclerotized and cylindrical. Juxta absent. Flap-like eighth sternite elongate-pentagonal, with apex slightly mucronate. (Five preparations examined.)

Female genitalia (Fig. 8, A): Papilla analis moderate in length, obliquely truncate on caudal margin in lateral view, with apophysis posterioris long, about thrice as long as apophysis anterioris and widened basally. Eighth abdominal segment normal in shape, squamose, with a pair of short apophyses anteriores. Seventh abdominal sternite deeply emarginate caudally, the emargination reaching about half length of the segment. Ostium bursae placed at depth of this emargination; antrum shortly U-shaped; ductus bursae long, tubular, very shortly sclerotized at opening of ductus seminalis; corpus bursae globular, with a large, elliptical area set with fine and round spines; signum sclerotized in a smaller, circular plate, which is surrounded by eight to ten minute, cone-shaped processes. (Four preparations examined.)

Specimens examined. 14♂ & 20♀. Holotype: ♂, FRIM, Kepong, Selangor, Malaysia, em. 10/xi/1991, ex *Phanea* sp. (4512), Gen. sl. no. Grc-5882, deposited in FRIM. Paratypes: WEST MALAYSIA — 1♂, FRIM, Kepong, em. 11/ix/1986, ex *Bauhinia* sp. (2593); 1♂ & 5♀, ditto, em. 7-19/viii/1990, ex *Bauhinia* sp. (3712); 6♂ & 11♀, ditto, em. 3-13/ix/1990, ex *Bauhinia* sp. (3957); 2♂ & 2♀, ditto, em. 6-11/x/1990, ex *B. griffithiana* (4134); 1♂, with same data as holotype except for emergence date, 7/xi/1991; 2♂ & 2♀, Templer Park, Selangor, em. 29/viii-12/ix/1990, ex *Bauhinia* sp. (3988); 6♂ & 10♀ in FRIM and 7♂ & 10♀ in SEHU.

Distribution. West Malaysia.

Food plants. *Bauhinia* (= *Phanea*) spp., including *B. griffithiana* (Leguminosae).

Mine (Fig. 44, C). A small, oblong blotch-mine occurring on upper side of leaf,

usually on leaf-veins, whitish and flat at first, then discoloured into brown and deformed into a tentiform type; about 1 cm in length and 5 mm in width. Leaf-tissues within mine are finally consumed by the larva; in this point this species is very different from most other species of the genus *Cameraria*. Pupation taking place inside mine, without a distinct cocoon.

Remarks. I have some doubts about the generic position of this species, because the last instar larva is different from that of the Japanese species of *Cameraria* in having well-developed thoracic legs and in having three subventral setae on the ventral prolegs instead of two. On the basis of adult characters, however, this new species is referable to the genus *Cameraria*.

C. quadrifasciata is well characterized by the four white fasciae of the fore wing, by the apically bifurcated male valva, and by the circular signum surrounded by minute processes. By these characters it can be separated from the Indian *C. bauhiniae* (Stainton) (comb. nov.), which is another leaf-miner of *Bauhinia*.

Cameraria trizosterata sp. nov.

[Figs. 7, 8(B), 34(D), 36(D)]

Description. ♂ ♀. Expanse of wings: 3.7-4.9 mm (4.7 mm in holotype, 4.50 mm on average of nine specimens). Length of fore wing: 1.7-2.3 mm (2.2 mm in holotype, 2.13 mm on average of ten specimens).

Head with tuft brownish; face silvery-gray, narrowly whitish laterally. Palpi whitish with a silvery lustre. Antenna fuscous dorsally, with fourth, eighth and twelfth segments from apex whitish to form three whitish rings; scape brownish on dorsum and whitish on ventrum including pecten. Thorax golden-brownish on dorsum including tegulae, without any whitish mark; pleural and ventral surfaces ochreous-whitish, with a metallic lustre. Fore leg blackish, with a white spot on tibia laterally and three white rings on tarsus. Mid and hind legs ochreous-whitish to whitish; both femora faintly blackish at apex; mid tibia with two blackish, oblique stripes, and the tarsus with two blackish rings; hind tibia clouded with fuscous towards apex, and the tarsus with four blackish rings, of which the last one is placed at apex and very minute. Abdomen fuscous dorsally, ochreous-whitish ventrally, with caudal margin of each segment narrowly darkened.

Fore wing dark bronzy-brownish with a golden lustre in ground colour, a little darker than that of *C. quadrifasciata*, with three narrow, white fasciae, which are margined with a black line on their outer edges; the first fascia placed at about basal fourth of wing, completely crossing the wing, slightly oblique inwards from costa, and very slightly arched inwards; the second in middle, moderately oblique inwards from costa, and straight; the third extending from tornus to costa near wing-apex in parallel with termen, always interrupted by ground colour in disc just above middle, thus the costal part (costal strigula) shorter than the dorsal part (dorsal strigula); a short, transverse, blackish streak placed near wing-base, detached far from costa; infraternal and apical areas irregularly irrorated with fuscous scales; cilia around wing-apex brownish basally and gray-whitish apically, with a blackish fringe-line; cilia on dorsal margin grayish. Hind wing dark grayish or fuscous, with cilia dark fuscous.

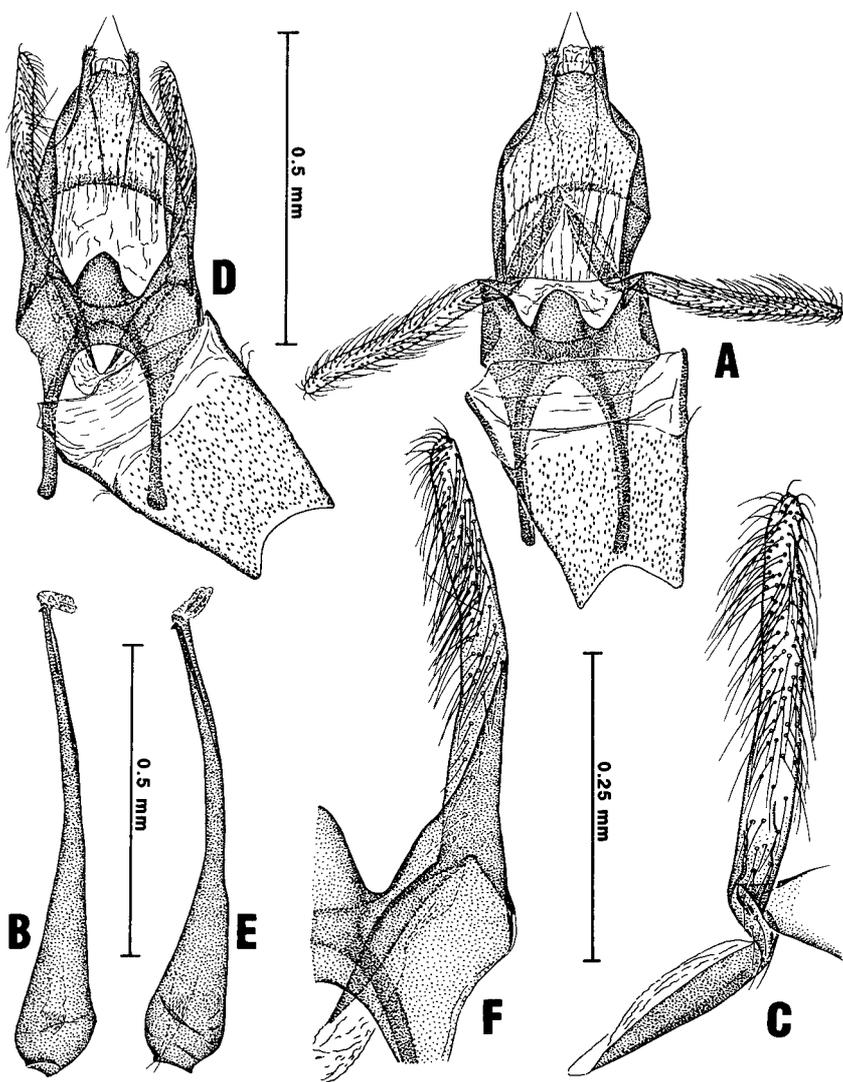


Fig. 7. *Cameraria trizosterata* sp. nov. A: Male genitalia in ventral view, aedeagus omitted [Grc-5877, holotype] — B: Aedeagus [ditto] — C: Right valva [ditto] — D: Male genitalia in ventral view [Grc-5838, W. Malaysia, ex *Bauhinia* sp. (3988)] — E: Aedeagus [ditto] — F: Right valva [ditto].

Male genitalia (Fig. 7): Tegumen moderate in length, squamose basally, with two slender, short apical processes (probably socii), which are spinulose apically and each has one apical seta arising from the mesal side; tuba analis produced between these processes, not spinulose. Valvae symmetrical, bar-shaped, slightly widened towards base, rather densely setose on discal area throughout its length; transtilla incomplete, narrowed in middle and interrupted there. Vinculum rather widened laterally, biforked apically, with each branch long, slender and somewhat knobbed

apically; caudolateral part of vinculum tightly confluent to base of sacculus. Aedeagus about 1.5 times as long as valva, tapering apically, round basally, with a minute barb at apex; vesica without cornutus. Flap-like eighth sternite a little shorter than valva, elongate-trapeziform, shallowly emarginate apically. (Four preparations examined.)

Female genitalia (Fig. 8. B): Papilla analis very short, setose and spinulose as usual, with apophysis posterioris moderate in length, and slender. Eighth abdominal segment very short, the sclerotized part being shorter than papilla analis; apophysis anterioris about as long as apophysis posterioris. Seventh abdominal segment normal in form, not deformed into genital organs. Ostium bursae situated near caudal margin of seventh sternite, simple in structure; ductus bursae long, tubular, slightly dilated towards ostium bursae, on its caudal four-fifths being weakly sclerotized and impressed with many transverse lines; corpus bursae ellipsoidal,

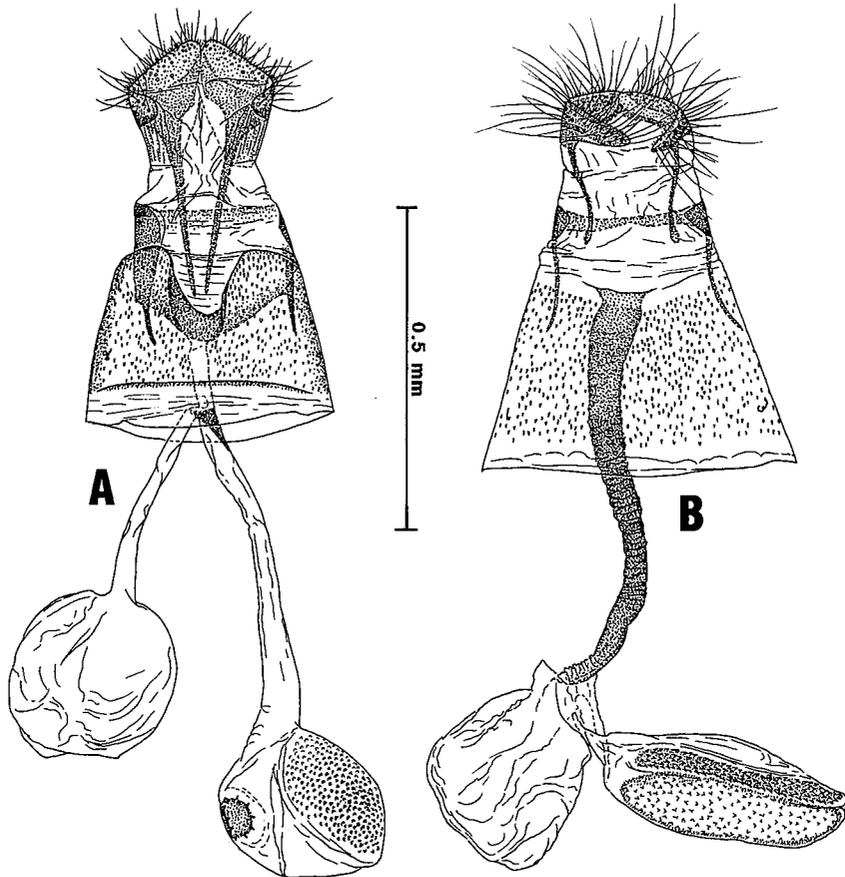


Fig. 8. A: *Cameraria quadrifasciata* sp. nov., female genitalia in ventral view [Grc-5884, W. Malaysia, ex *Bauhinia* sp. (3988)].

B: *Cameraria trizosterata* sp. nov., female genitalia in ventral view [Grc-5880, W. Malaysia, ex *Bauhinia* sp. (3988)].

with a large, spinulose, elliptical patch and a long, bar-shaped, sclerotized signum, which is densely covered with cone-shaped spines. Ductus seminalis branched off at cephalic end of sclerotization of ductus bursae, very short; bulla seminalis globular or pyriform, nearly as large as corpus bursae. (Two preparations examined.)

Specimens examined. 7♂ & 3♀. Holotype: ♂, Templer Park, Selangor, Malaysia, em. 6/ix/1990, ex *Bauhinia* sp. (3988), Gen. sl. no. Grc-5877, deposited in FRIM. Paratypes: WEST MALAYSIA — 6♂ & 3♀, with same data as holotype except for emergence dates, 2-18/ix/1990; 3♂ & 1♀ in FRIM and 3♂ & 2♀ in SEHU.

Distribution. West Malaysia.

Food plant. *Bauhinia* sp. (Leguminosae).

Mine. The mine should be quite similar to that of the preceding *C. quadrifasciata*, because both the species emerged from the same breeding case, breeding no. 3988.

Remarks. *C. trizosterata* may be included in the same species-group with *C. quadrifasciata*. It is distinguished from the latter by the three white fasciae of the fore wing, the male tegumen with two apical processes, the simply bar-shaped male valva, the biforked male vinculum, the well-sclerotized female ductus bursae, and the long and spiniferous female signum.

Cameraria barlowi sp. nov.

[Figs. 9, 34(C)]

Description. ♂ (♀ unknown). Length of fore wing: 3.2 mm in holotype.

Head with tuft ochreous-brownish, sparsely mixed with darker hairs anterolaterally and paler ones posteriorly; face and palpi white with an iridescent lustre; labial palpus ringed with fuscous at apex of second segment and at subapex of third segment. Antenna ochre-whitish, annulated with dark brown dorsally; scape brownish on dorsum and white on ventrum including pecten. Thorax ochre-brownish on dorsum including tegulae, with a transversely U-shaped white stripe; pleural and ventral surface whitish, slightly tinged with ochre. Fore leg fuscous, with coxa whitish basally and tarsus with two white rings at apex and in middle. Mid and hind legs whitish, with three oblique stripes on mid tibia, three rings on mid tarsus, apical area of hind tibia and five rings on hind tarsus blackish.

Fore wing ochreous-brownish with a strong golden lustre, much lighter than in preceding two species, with four oblique white fasciae, which are similar in position and shape to those of *C. quadrifasciata*; first fascia placed near wing-base, slightly arched inwards, and detached from costa; second at basal fourth, nearly parallel to the first, very slightly detached from costa; third in middle, angulated outwards near costa, with dorsal arm almost parallel to the second; fourth extending from just before tornus almost to apex of costa, nearly parallel to termen, slightly sinuate; a white spot placed on costa between third and fourth fasciae, in right wing it narrowly reaches apex of dorsal arm of third fascia, while in left wing it is isolated; all the fasciae and dot conspicuously margined with black on their outer edges; a transverse streak of black irroration placed in disc just below apex of fourth fascia and connected with a supraternal patch of black irroration; cilia on

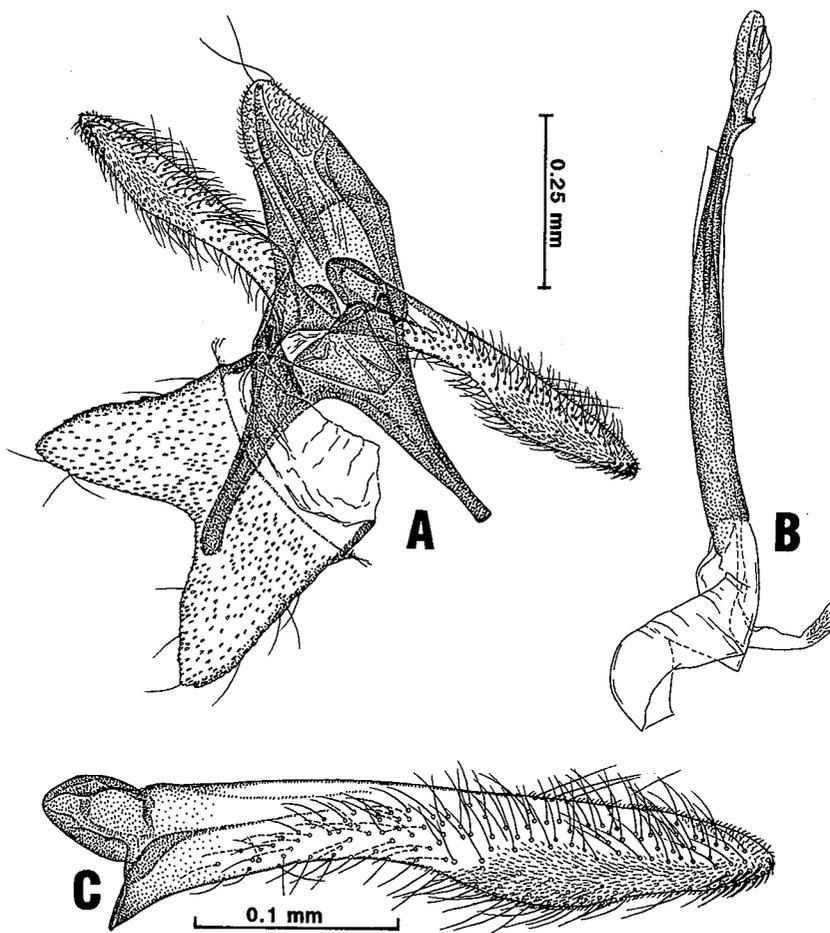


Fig. 9. *Cameraria barlowi* sp. nov. A: Male genitalia in ventral view, aedeagus omitted [Grc-3697, holotype] — B: Aedeagus [ditto] — C: Right valva [ditto].

costa brownish, those on termen whitish mixed with black-tipped shorter scales to form a fringe-line, and those on dorsal margin whitish to pale grayish. Hind wing gray, with cilia pale grayish.

Male genitalia (Fig. 9): Tegumen moderate in length, subconical, not squamose, but densely covered with hook-shaped spinules on apical third of lateral and dorsal surfaces, with a pair of setae at apex. Valva about 1.5 times as long as tegumen, bar-shaped, partly swollen on ventral area beyond middle, covered with slender setae on costal half of inner surface and on dorsal side of outer surface, and some short, bristly setae on apical area of ventral margin; further, the valva is peculiarly covered with fine and dense spines on the apical half of the inner surface; transtilla incomplete, with basal process of costa knobbed. Vinculum about as long as tegumen, deeply biforked, with branches divergent apically. Aedeagus about 1.5 times as long as valva, slender, but slightly dilated towards base, slightly curved,

with a minute barb near apex ; vesica without cornutus. Flap-like eighth sternite about as long as tegumen, reversed trapeziform, rather deeply emarginate apically. (One preparation examined.)

Specimen examined. 1♂ (holotype), Genting Tea Estate, Pahang, Malaysia, 25/i/1982, H.S. Barlow leg., Gen. sl. no. Grc-3697, deposited in Barlow's collection.

Distribution. West Malaysia.

Food plant and mine. Unknown.

Remarks. In colour pattern of the fore wing this new species resembles *C. quadrifasciata* and *C. bauhiniae*, but it is distinguished from the latter two by the genital structures as follows : the vinculum is deeply biforked apically ; the flap-like eighth sternite is emarginate apically ; and the valva is densely spinulose on the inner surface. In *C. bauhiniae*, the vinculum is widened apically and shallowly emarginated apically ; the flap-like eighth sternite is round apically ; and the valva is not spinulose on the surface at all.

This new species is named after Mr. H. S. Barlow, Malaysia, who collected the unique specimen used here.

Cameraria fasciata sp. nov.

[Figs. 10, 11, 34(E), 35(D), 45(D)]

Description. ♂ ♀. Expanse of wings : 4.2 mm in holotype. Length of fore wing : 1.9 mm in holotype to 2.3 mm in paratype.

Head dark silvery-gray, with tuft small and mixed with brownish and fuscous, short, hairy scales ; face silvery-gray with a strong metallic lustre, but narrowly whitish laterally ; palpi grayish-white. Antenna fuscous to blackish above, narrowly whitish below, without annulation ; pecten on scape white. Thorax dark bronzy-ochreous dorsally, with a strong metallic lustre ; pleural and ventral surfaces silvery-whitish. All legs silvery-whitish, with black marks as follows : a narrow stripe on fore femur and tibia, two oblique stripes on mid tibia, two broad rings on fore and mid tarsi, an apical spot on hind coxa, a large median blotch and a small apical spot on hind tibia, and five rings on hind tarsus, the rings being successively longer towards base.

Fore wing with vein R_2 as in the genus *Neolithocolletis* (Fig. 35, D) ; ground colour bronzy-ochreous, darkened towards costa, with a strong metallic lustre ; two blackish, narrow, transverse fasciae placed at base and near base, the interspace between them forming a pale bronzy-ochreous fascia, which is slightly detached from costa ; three metallic-white fasciae rather broadly margined with black on both inner and outer edges ; the first placed at basal fourth, perpendicular or slightly oblique inwards from costa ; the second in middle, moderately oblique inwards, more or less arched inwards, and tinged with ochre near costa ; the third before tornus, nearly parallel to the second, narrowed in its middle, where it is tinged with ochre, the dorsal part being wider than the costal part and triangular ; a round, metallic-white costal spot placed near apex, surrounded by black line ; a narrow, black apical streak transversely running below the costal spot ; cilia around apex and on termen dark brownish basally and whitish apically, with a fringe-line of black irroration, those on dorsal margin dark gray. Hind wing and its cilia dark gray to fuscous.

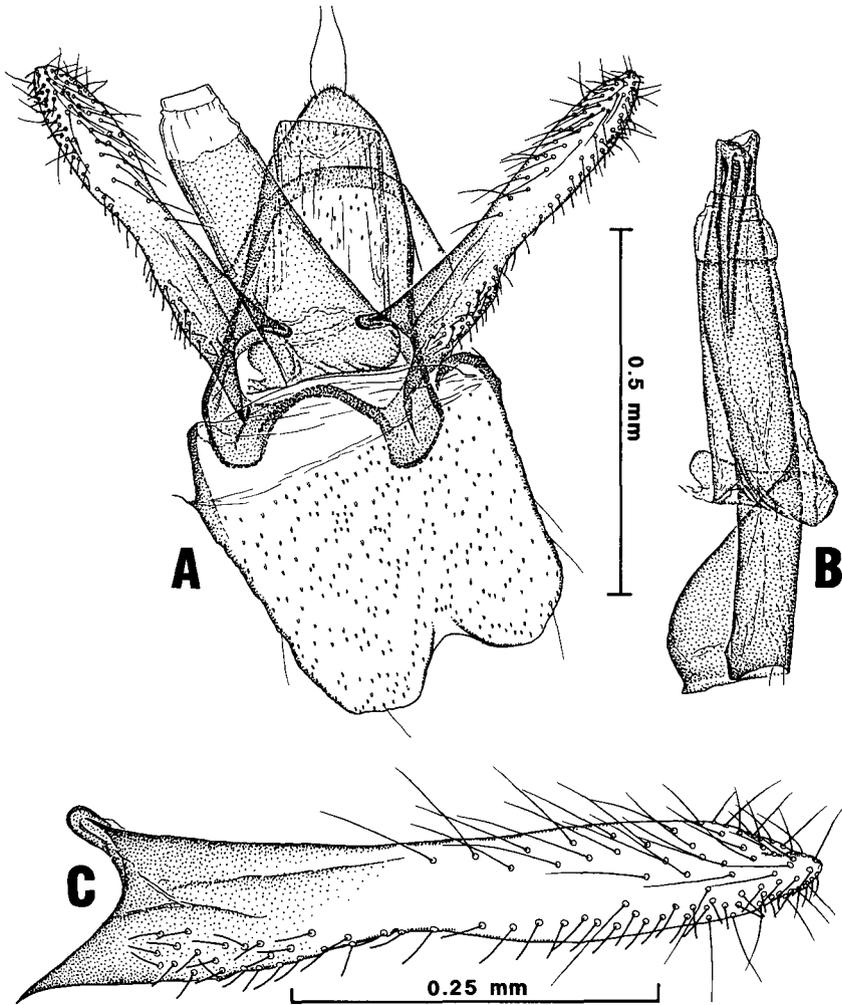


Fig. 10. *Cameraria fasciata* sp. nov. A : Male genitalia in ventral view, aedeagus omitted [Grc-5849, holotype] — B : Aedeagus [ditto] — C : Right valva [ditto].

Male genitalia (Fig. 10): Tegumen rather short, subconical, round apically in ventral view, sparsely squamose dorsally, finely spinulose around apex, with a pair of apical setae; tuba analis membranous, not spinulose. Valva about 1.3 times as long as tegumen, bar-shaped, slightly constricted medianly, with apex blunt; slender, acute setae scattered on apical half of inner surface near costa of valva and shorter and truncate setae along ventral margin; transtilla incomplete, with basal process of costa small and round; base of sacculus united with latero-caudal area of vinculum. Vinculum short, much widened apically, moderately emarginate apically, thus lateroapical areas forming large, round lobes. Aedeagus about 1.5 times as long as valva, thickly tubular, slightly tapering apically, and much swollen basally;

vesica with a bundle of three well-sclerotized ridges invaginated into aedeagus. Anellus tubular, weakly sclerotized, but without distinct juxta. Flap-like eighth sternite large, nearly as long as valva, subrectangular in outline, with apical margin medianly concave. (One preparation examined.)

Female genitalia (Fig. 11): Papilla analis very short, narrowly crescent-shaped in lateral view, rather densely setose and spinulose; apophysis posterioris slender, long, about as long as seventh abdominal segment. Eighth abdominal segment very short in sclerotized part, nearly as long as papilla analis, not squamose; apophysis anterioris slender, about as long as apophysis posterioris. Seventh abdominal sternite rather deeply emarginate caudally, the tergite having a pair of stripped lateral areas, which are margined with large scales densely on mesal edges and with six to eight similar scales on lateral edges; these stripped areas seem to be receptors of valvae during copulation. Ostium bursae membranous, without sclerotized

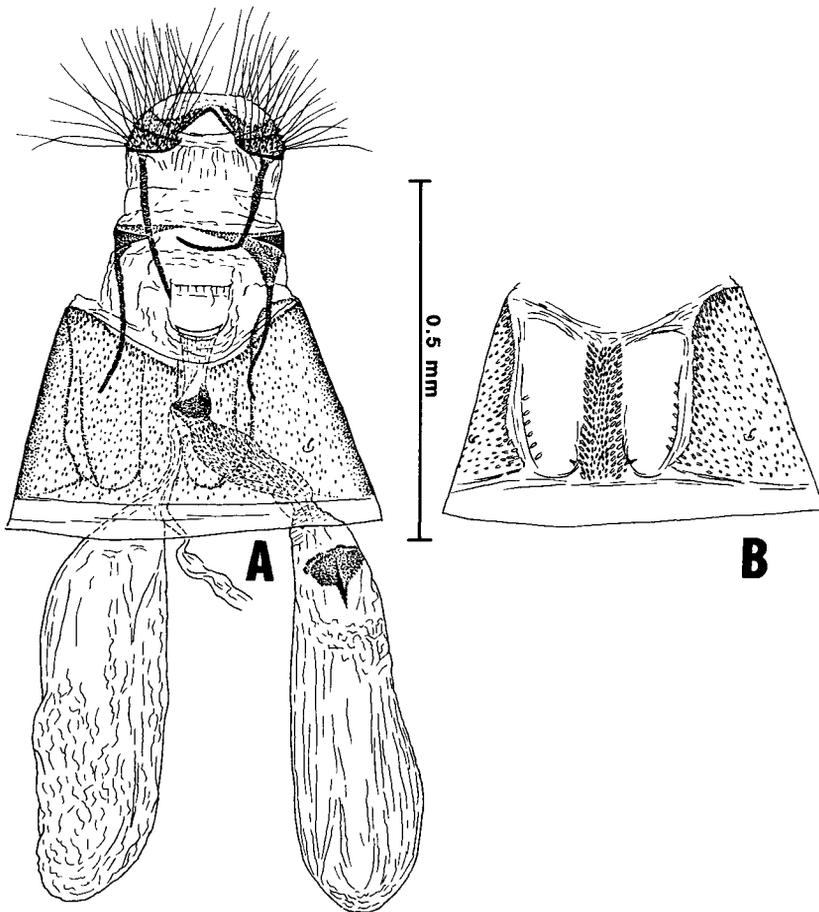


Fig. 11. *Cameraria fasciata* sp. nov. A: Female genitalia in ventral view [Grc-3694, W. Malaysia, ex *Spatholobus* sp. (2859)] — B: Seventh abdominal segment in dorsal view [ditto].

genital plate; ductus bursae with a shortly sclerotized antrum near ostium bursae; the main part beyond this antrum being densely lined with spinules; corpus bursae elongate-ellipsoidal, longer than ductus bursae, with a single thorn-like signum, which has a large, wing-shaped basal plate. Bulla seminalis well swollen, about as large as corpus bursae. (One preparation examined.)

Specimens examined. 1♂ & 1♀. Holotype: ♂, Beserah F.R., Kuantan, Pahang, Malaysia, em. 30/ix/1990, ex *Spatholobus ferrugineus* (4097), Gen. sl. no. Grc-5849, deposited in FRIM. Paratype: WEST MALAYSIA — 1♀, Pasoh F.R., Negeri Sembilan, em. 10/x/1986, ex *Spatholobus* sp. (2859), deposited in SEHU.

Distribution. West Malaysia.

Food plants. *Spatholobus* spp., including *S. ferrugineus* (Leguminosae).

Mine (Fig. 45, D). A tentiform blotch-mine placed on space between two lateral veins of lower side of leaf, oblong, 1.5 cm in long diameter; lower epidermis of mining part strongly contracted by silken threads, with a longitudinal wrinkle as in most species of *Phyllonorycter*. Pupation taking place within a whitish, ellipsoidal cocoon, which is placed inside the mine.

Remarks. The venation of the fore wing (Fig. 35, D) indicates that this new species belongs to the genus *Neolithocolletis*: the presence of the vein R_2 and the absence of vein M_2 are characteristic of the genus in the subfamily Lithocolletinae. On the other hand, some genital structures, such as the incomplete transtilla, the tegumen with a pair of apical setae, the bilobate vinculum, the large eighth sternite of male, the corpus bursae having only one signum, etc., indicate that it belongs to the genus *Cameraria*, whereas in the characters of the mine it is similar to the members of the genus *Phyllonorycter*. Considering all the characters mentioned above, I could not decide the generic position of the new species. In this paper, however, I tentatively place it in *Cameraria* based on the genital structures rather than on the wing venation and the mine. I hope that the larval characters will clarify its true generic position.

C. fasciata is distinguished at once from the known members of the genera *Cameraria*, *Neolithocolletis* and *Phyllonorycter* by the unique colour-pattern of the fore wing.

Cameraria pongamiae sp. nov.

[Figs. 12, 13, 34(F), 36(A), 41(A), 45(A)]

Description. ♂ ♀. Expanse of wings: 3.8-4.8 mm (4.5 mm in holotype, 4.45 mm on average of 19 specimens). Length of fore wing: 1.8-2.3 mm (2.1 mm in holotype, 2.11 mm on average of 20 specimens).

Head with tuft ochreous-brownish, mixed with whitish hairs on posterior area; face and palpi white, with labial palpus lined with fuscous on ventral face. Antenna fuscous, becoming paler towards base, with first, third, seventh and eleventh segments from apex entirely whitish and the other segments faintly annulated with paler colour at base of each segment; scape brownish on dorsum and white on ventrum including pecten. Thorax chestnut-brownish dorsally, mixed with whitish scales anteriorly, with a blackish transverse band in middle; pleural and ventral surfaces whitish. Fore leg fuscous to blackish, with coxa whitish and tarsus with

three whitish narrow bands on dorsal side. Mid leg whitish, with tibia narrowly blackish dorsally, and tarsus ringed with black before and beyond middle. Hind leg whitish, with coxa and femur spotted with black apically, tibia blackish basally and widely infuscated medianly on outer side, tarsus with four blackish rings, and spurs blackish subapically.

Fore wing chestnut-brown in ground colour, very slightly tinged with a metallic lustre, with markings white; a very narrow medio-basal streak reaching one-sixth of wing length, near its apex it is crossed by a curved line of black irroration, which

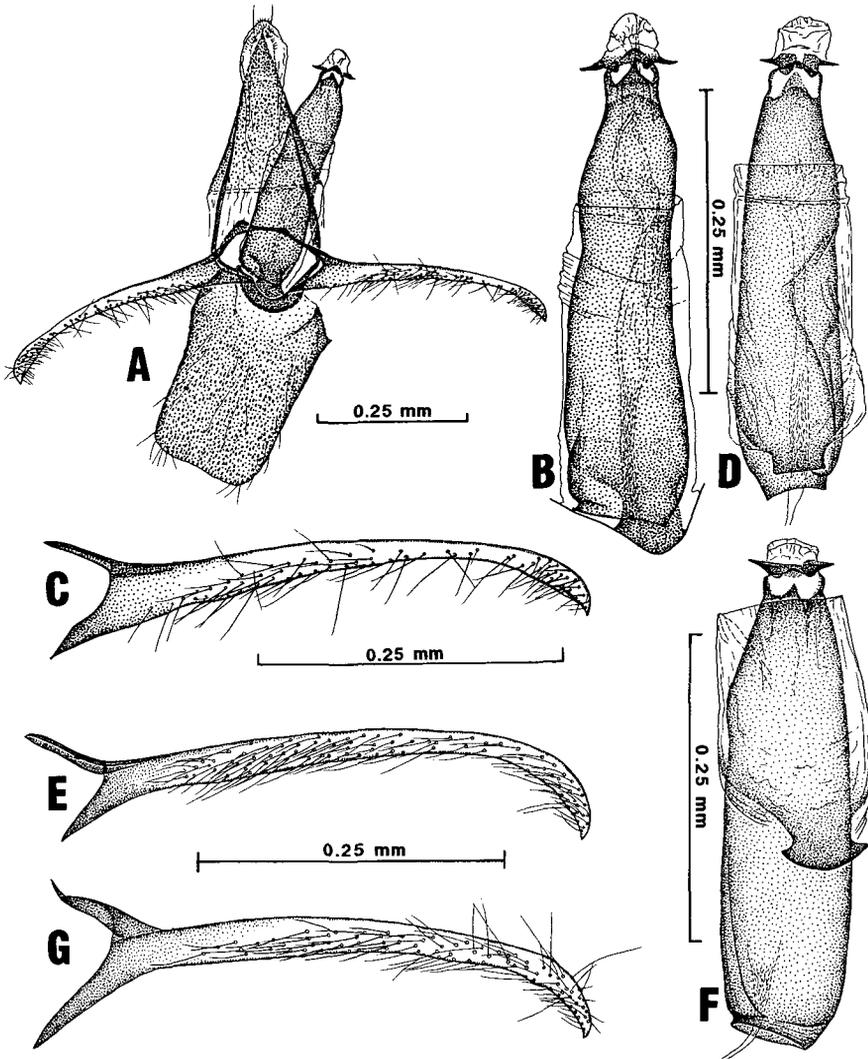


Fig. 12. *Cameraria pongamiae* sp. nov. A: Male genitalia in ventral view [Grc-2493, holotype] — B: Aedeagus [ditto] — C: Right valva [ditto] — D: Aedeagus [Grc-3704, W. Malaysia, ex *Pongamia glabra* (2671)] — E: Right valva [ditto] — F: Aedeagus [Grc-5256, E. Malaysia, ex *P. pinnata* (3275)] — G: Right valva [ditto].

obliquely runs from base of dorsum to a portion beyond wing-fold ; three inwardly oblique fasciae at about basal fourth, in middle and near apex of wing, first two fasciae angulated outwards near costa, the costal arms being margined with black irroration both on inner and outer edges (black irroration of outer edge usually indistinct), and the dorsal arms containing a line of black irroration in their middle and margined with a wider line of black irroration on their outer edge, sometimes both the lines of black irroration being confluent to form an irregular, wide outer edge ; third fascia very obliquely running from tornus almost to apex of costa, usually sinuate, widely margined with black irroration on outer edge alone ; a white, small spot placed on costa between second and third fasciae, margined with black irroration on outer edge, the black irroration being always connected with outer black line of dorsal arm of second fascia ; cilia around apex chestnut-brownish, those on termen whitish with a median fringe line of black irroration, and those on dorsal margin grayish-white. Hind wing pale grayish, with cilia grayish-white.

Male genitalia (Fig. 12) : Tegumen simply subconical, sparsely squamose dorsally, finely spinulose apically, with a pair of slender setae at apex. Valva about as

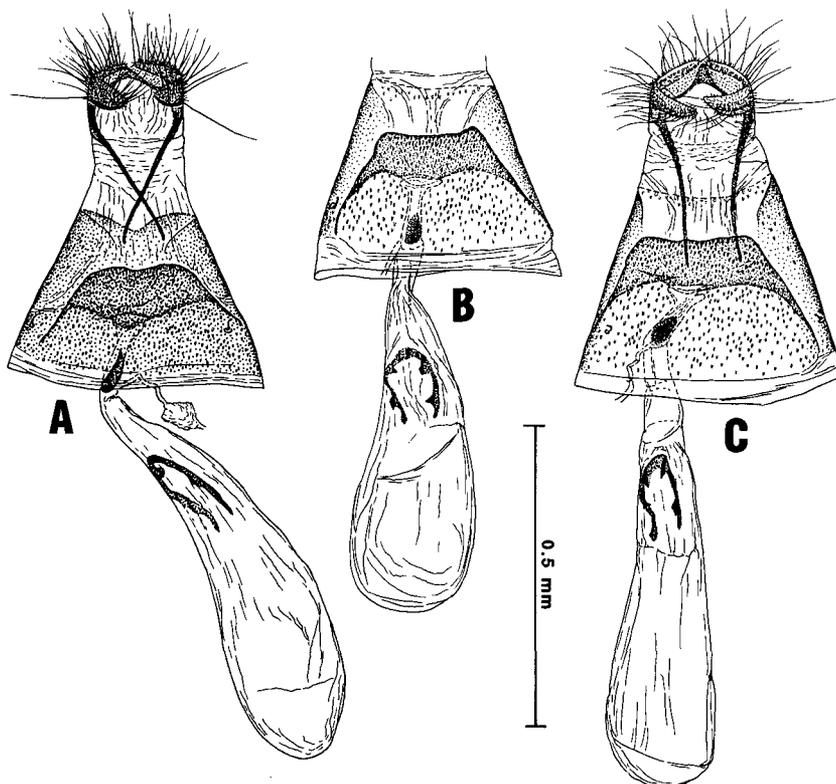


Fig. 13. *Cameraria pongamiae* sp. nov. A : Female genitalia in ventral view [Grc-2494, Taiwan, ex *Pongamia pinnata* (2001)] — B : Ditto, papillae anales omitted [Grc-5902, W. Malaysia, ex *P. glabra* (2671)] — C : Ditto [Grc-5902, E. Malaysia, ex *P. pinnata* (3275)].

long as tegumen, very slender, slightly dilated basally, slightly curved downwards, with an acute apex ; slender setae scattered in disc throughout ; transtilla complete, very slender, somewhat angulated on laterocephalic corners. Vinculum very short, round apically, without any produced saccus. Aedeagus about as long as valva, thickly tubular, tapering near apex, with a pair of acute barbs at apex, the barbs being perpendicular to the axis of aedeagus and each having a round basal plate ; vesica without cornutus. Flap-like eighth sternite elongate-quadrangular, nearly parallel-sided, with apical margin straight or very shallowly emarginate. (Five preparations examined).

Female genitalia (Fig. 13) : Papilla analis short, setose and spinulose on caudal area narrowly ; apophysis posterioris long, slender, widened near base. Eighth abdominal segment tightly united with seventh, squamose, with apophysis anterioris absent. Seventh abdominal sternite produced caudally to form a flap covering ostium bursae, the flap being trapeziform, with its caudal margin straight or very slightly emarginate. Ostium bursae opening under flap-like seventh sternite, membranous ; ductus bursae short, tubular, with a small sclerous antrum, the length of antrum being nearly equal to or shorter than a distance between antrum and ostium bursae ; corpus bursae elongate-oval, much longer than ductus bursae, with a weakly sclerotized, horseshoe-shaped signum, which has four or five minute, round or acute projections on its inner margin. (Seven preparations examined.)

Specimens examined. 15♂ & 13♀. Holotype : ♂, Oulampi, Pintung, Taiwan, em. 16/vii/1979, ex *Pongamia pinnata* (2001), Gen. sl. no. Grc-2493, deposited in SEHU. Paratypes : WEST MALAYSIA — 7♂ & 2♀, Port Dickson, Negeri Sembilan, em. 19-24/viii/1986, ex *Pongamia glabra* (2671) ; 1♂, Pulau Tioman, Pahang, em. 15/ix/1990, ex *P. pinnata* (4076). EAST MALAYSIA (SABAH) — 3♂ & 4♀, Pulau Selingan (Turtle Is.), nr. Sandakan, em. 27/x-15/xi/1988, ex *P. pinnata* (3275). TAIWAN — 3♂ & 2♀, with same data as holotype except for emergence dates, 16-27/vii/1979. 5♂ & 3♀ paratypes of Malaysian material are deposited in FRIM, and the other paratypes in SEHU.

Distribution. West Malaysia ; East Malaysia (Sabah) ; and Taiwan.

Food plant. *Pongamia pinnata* (= *P. glabra*) (Leguminosae).

Mine (Fig. 45, A). An oval or elliptical blotch-mine (1-1.5 cm in long diameter) occurring upon upper side of leaf, usually on leaf-vein, flat and somewhat transparent through upper epidermis at young stage, then discoloured into white and deformed into a tentiform type with a finely shrunk upper epidermis at maturity. Pupation taking place inside mine-cavity without a particular cocoon. More than ten mines are often found on a single leaflet at all the collecting sites.

Remarks. As discussed under the genus, this new species is rather peculiar among the members of the genus *Cameraria* in having the well-developed larval thoracic legs, in lacking the seta V1 on abdomen except for the third to fifth segments, in lacking the proprioceptor MV3 on all the abdominal segments in the last instar larvae, and in having the complete transtilla in the male genitalia. Based on these characters, it may form a species-group together with *C. milletiae* (sp. nov.), *C. borneensis* (sp. nov.), *C. virgulata* (Meyrick) (comb. nov.), *C. magnisignata* (sp. nov.), and perhaps "*Lithocolletis*" *bascanaula* Meyrick described from Java, all of which are associated with Leguminosae in subtropical and tropical Asia. It might be better to erect a new genus for this species-group, though in this paper it is

provisionally included in the genus *Cameraria* on the basis of the colour-pattern of the fore wing, the male tegumen with a pair of apical setae, and the presence of two lateral setae on all the body segments of the last instar larvae.

C. pongamiae is very similar to *C. virgulata* (comb. nov.), which will be re-described in the following pages, in many respects, especially in the colour-pattern of fore wing, but is distinguished from the latter by the apical structure of the aedeagus, by the shorter ductus bursae and by the shorter signum having four or five minute projections. In *C. virgulata*, the aedeagus has a pair of round projections besides a pair of acute ones, the basal part of ductus bursae between the ostium bursae and the sclerous antrum is about twice as long as the antrum itself, and the signum is a little longer and has seven to eight projections. Moreover, *C. virgulata* is associated with herbaceous legumes, such as *Butea*, *Desmodium*, *Pueraria*, etc., while *C. pongamiae* is exclusively associated with *Pongamia pinnata*, a ligneous legume, so far.

Cameraria milletiae sp. nov.

[Figs. 14, 16(A), 34(H), 45(C)]

Description. ♂ ♀. Expanse of wings: 4.5-5.3 mm (5.3 mm in holotype). Length of fore wing: 2.3-2.4 mm (2.4 mm in holotype).

Head, antenna, thorax and wings are very similar to those of the preceding *C. pongamiae* in colour-pattern, and I have failed to discriminate clearly between the two species by external characters except for the following points: — Fore tarsus with a long, blackish median ring which occupies almost half length of the tarsus; hind tarsus with three black rings, of which the third one is much longer than the others. In *C. pongamiae*, the fore tarsus has two blackish rings, and the hind tarsus has four rings which are nearly equal in length.

Male genitalia (Fig. 14): Tegumen elongate-subconical, squamose dorsally, spinulose around apex, with a pair of slender setae near apex; tuba analis wholly membranous, not spinulose. Valva about as long as tegumen, narrowly bar-shaped, very slightly arched upwards, very slightly swollen before acute apex, and setose on discal area as usual; transtilla complete, slender on median area, without laterocephalic angles. Vinculum moderate in length, round laterally, and mucronate apically. Aedeagus about as long as valva, tubular, moderately thick, simple in shape without any apical projection; vesica with a pair of minute, subquadrate, sclerous plates near apex. Anellus tubular, with a narrow and long ventral sclerite (fultura inferior or juxta). Flap-like eighth sternite about three-fourths as long as valva, elongate-quadrangular, with lateral margins slightly arched, and apical margin sinuate with blunt lateroapical angles. (Two preparations examined.)

Female genitalia (Fig. 16, A): Papilla analis very short, setose and spinulose on caudal area as usual; apophysis posterioris long, slender, slightly widened on basal third. Eighth abdominal segment tightly united with the seventh, squamose dorsally, with apophyses anteriores very short, shorter than one-tenth length of apophyses posteriores. Seventh abdominal sternite produced caudad to form a small flap covering ostium bursae, the flap being round on caudal margin with a very shallow median emargination. Ostium bursae opening at depth of a funnel-shaped invagination under the flap; ductus bursae long, tubular, with a small sclerotized antrum

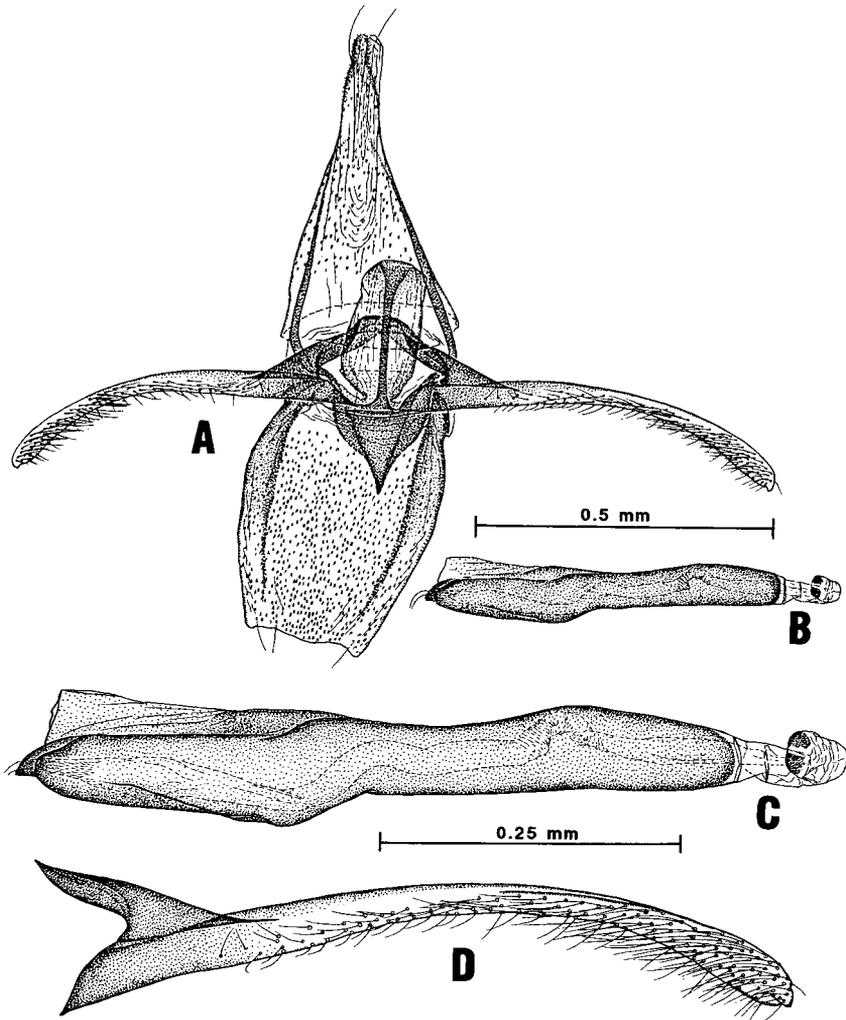


Fig. 14. *Cameraria milletiae* sp. nov. A: Male genitalia in ventral view, aedeagus omitted [Grc-5885, holotype]—B: Aedeagus [ditto]—C: Ditto [ditto]—D: Right valva [ditto].

near base ; corpus bursae not well swollen, wholly membraneous, without signum. (One preparation examined.)

Specimens examined. 3♂ & 1♀. Holotype: ♂, Damai, Santubong, nr. Kuching, Sarawak (Borneo), Malaysia, em. 25/x/1991, ex *Milletia sericea* (4453), Gen. sl. no. Grc-5885, deposited in FRIM. Paratypes: WEST MALAYSIA—1♀, Sg. Buloh F.R., Selangor, Malaysia, em. 4/ix/1990, ex *Milletia sericea* (3977). EAST MALAYSIA (SARAWAK)—2♂, with same data as holotype. 1♂ paratype in FRIM and 1♂ & 1♀ paratypes in SEHU.

Distribution. West Malaysia ; and East Malaysia (Sarawak).

Food plant. *Milletia sericea* (Leguminosae).

Mine (Fig. 45, C). The mine is very similar to that of most species of the genus *Phyllonorycter* in all respects. An oval or elliptical blotch-mine occurring on lower side of leaflet, rather large (1.5-2 cm in long diameter), light brownish on mining part in lower view and mottled with pale green in upper view, very slightly tentiform, but without wrinkles on lower epidermis. Pupation taking place inside mine-cavity; pupa encircled with a whitish, ellipsoidal, rough cocoon.

Remarks. This species is hardly distinguishable from *C. pongamiae* by the colour-pattern, but is distinguished at once from the latter by the genital characters as follows: — In male, vinculum longer and mucronate apically, and aedeagus simply tubular without any apical projection; in female, flap-like caudal lobe of seventh abdominal sternite smaller, with a funnel-shaped, deep invagination under it, and corpus bursae without signum. In *C. pongamiae*, on the other hand, the vinculum is short and round on distal margin, the aedeagus has a pair of acute apical projections, the flap-like caudal lobe of the female seventh sternite is much larger, trapeziform, without a funnel-shaped invagination under it, and the corpus bursae has a horseshoe-shaped signum.

Cameraria borneensis sp. nov.

[Figs. 15, 16(B), 34(G), 36(B)]

Description. ♂ ♀. Expanse of wings: 4.2 mm. Length of fore wing: 2.0 mm.

Head with tuft ochreous-brownish; face and palpi white, labial palpus with a brownish stripe on underside. Antenna ochreous-whitish, annulated with fuscous, the annulation being conspicuous towards apex, without wholly whitish segments; scape ochreous-brownish on dorsum, whitish on ventrum including pecten. Thorax chestnut-brownish dorsally, ochreous-whitish ventrally. Fore leg fuscous, with coxa whitish, and tarsus with a long, blackish median ring and a ochreous basal one. Mid and hind legs whitish, with hind coxa infuscated apically, mid and hind tibiae also infuscated medianly, the latter having a further blackish basal spot; mid and hind tarsi having three black rings, of which the basal one is the smallest and the apical one is about twice as long as the median one.

Fore wing chestnut-brown with a golden lustre slightly in ground colour, with white markings; a basal streak obliquely running from base of dorsum to two-thirds width of wing, slightly arched inwards, sparsely margined with black irroration on outer edge; three inwardly oblique fasciae placed at about basal fourth, in middle and near apex; the first fascia nearly straight or very slightly angulated outwards near costa, containing a line of black irroration in middle, and widely margined with black irroration on its outer edge; the second fascia distinctly angulated outwards near costa, the costal arm margined with black irroration both on inner and outer edges (the irroration of outer edge being sparser), and the dorsal arm having a black line in middle and a black line along outer edge like the first fascia, but the outer black line always extending to basal three-fourths of costa, where a small white costal spot is placed; the third fascia running from tornus almost to apex of costa in parallel with termen, sinuate, and widely margined with black irroration on its outer edge; a discal area apical to the third fascia more or less suffused with dark

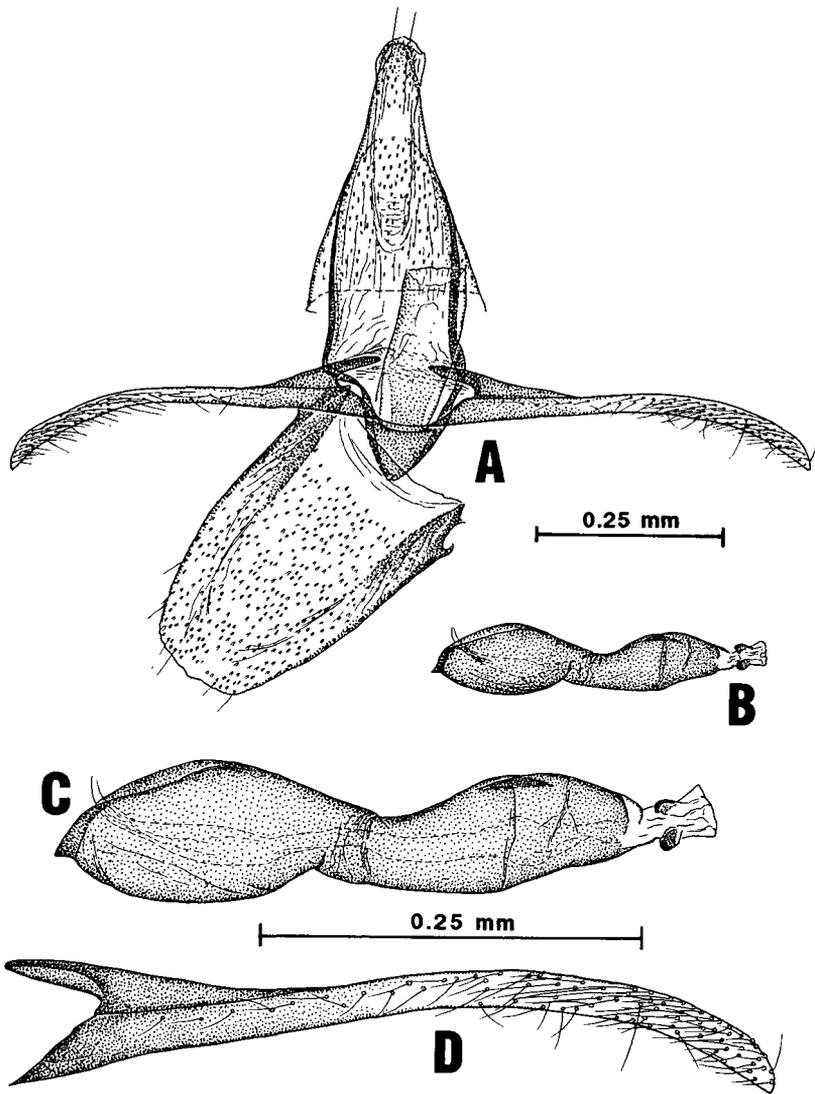


Fig. 15. *Cameraria borneensis* sp. nov. A: Male genitalia in ventral view, aedeagus omitted [Grc-5258, holotype] — B: Aedeagus [ditto] — C: Ditto [ditto] — D: Right valva [ditto].

brown irroration; cilia whitish, with a fringe-line of black irroration. Hind wing grayish, with cilia grayish-white.

Male genitalia (Fig. 15): Tegumen elongate-subconical, blunt at apex, squamose dorsally, spinulose at apical area, with a pair of apical setae; tuba analis membranous, without spinules. Valva about as long as tegumen, very slender, slightly arched upwards, bluntly pointed apically, with slender setae on almost whole discal surface sparsely; transtilla incomplete, with bases of costae narrowly produced, but

never connected with each other. Vinculum small, triangular, bluntly pointed apically. Aedeagus about four-fifths as long as valva, thickly tubular, well dilated basally, tapering apically (a median constriction in Fig. 15 (B & C) is caused in the course of the preparation), without any projection; vesica with a pair of minute, sclerotized protuberances near apex. Anellus tubular, with a short ventral sclerite (fultura inferior or juxta). Flap-like eighth sternite about four-fifths as long as valva, somewhat spatulate, round on apical margin. (One preparation examined.)

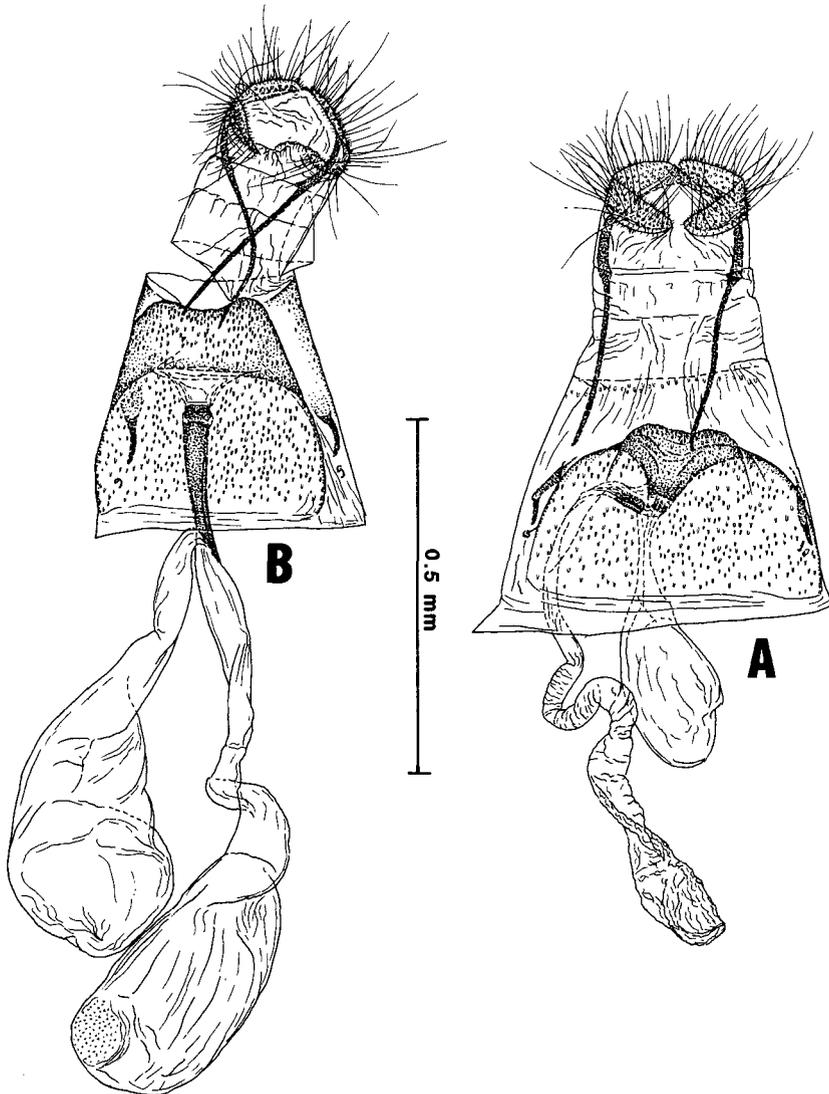


Fig. 16. A: *Cameraria milletiae* sp. nov., female genitalia in ventral view [Grc-5850, W. Malaysia, ex *Milletia sericea* (3977)].

B: *Cameraria borneensis* sp. nov., female genitalia in ventral view [Grc-5259, E. Malaysia, ex *Archidendron* sp. (3050)].

Female genitalia (Fig. 16, B): Papilla analis very short, setose and spinulose on caudal area as usual; apophysis posterioris long, slender, slightly widened on basal third. Eighth abdominal segment tightly united with the seventh, squamose dorsally, with a pair of apophyses anteriores short, about one-sixth as long as apophysis posterioris. Seventh abdominal sternite produced caudad to form a flap covering ostium bursae, the flap being large trapeziform, with apical margin shallowly emarginate. Ostium bursae opening at depth of trapeziform flap, membranous; antrum short, ring-shaped; ductus bursae tubular, rather long, with its basal third well sclerotized, the sclerotized part being shortly detached from antrum and slightly tapering apically; corpus bursae well swollen, pyriform, with a small spinulate patch placed near cephalic end. Ductus seminalis branched off from cephalic end of sclerotized ductus bursae; bulla seminalis pyriform, about as large as corpus bursae. (One preparation examined.)

Specimens examined. 2♂ & 1♀. Holotype: ♂, Danum Valley, nr. Lahad Datu, Sabah (Borneo), Malaysia, em. 23/viii/1988, ex *Archidendron* sp. (3050), Gen. sl. no. Grc-5258, deposited in FRIM. Paratypes: EAST MALAYSIA (SABAH) — 1♂ & 1♀, with same data as holotype, deposited in SEHU.

Distribution: East Malaysia (Sabah).

Food plant. *Archidendron* sp. (Leguminosae).

Mine. No herbarium specimen with mines was prepared, but, according to field notes, blotch mines of this species occur on the lower side of leaf, and are slightly tentiformed at mature stage as in the preceding *C. milletiae*.

Remarks. *C. borneensis* is very similar to *C. milletiae* in all respects including the genitalia, but is distinguished from the latter by the incomplete transtilla, by the shorter aedeagus, by the apically round male flap-like eighth sternite, by the larger female flap-like seventh sternite, by the longer sclerotized part of the ductus bursae, and by the presence of a signum in the shape of a spinuliferous patch on the corpus bursae.

GENUS PHYLLONORYCTER HÜBNER

Phyllonorycter Hübner, 1822, Syst.-alph. Verz.: 66; Walsingham, 1908, Proc. Zool. Soc. London 1907: 976; Watkinson, 1985, Moths Butterflies G. Britain and Ireland 2: 294-298.

Type-species: *Tinea alnifoliella* Hübner, [1796], = *Phyllonorycter rajella* (Linné, 1758).

Lithocolletis Hübner, [1825], Verz. Bek. Schmett. 27: 423; Vári, 1961, Transv. Mus. Mem. 12: 206-207; Kumata, 1963, Ins. matsum. 26: 70.

Type-species: *Tinea alnifoliella* Hübner, [1796].

Eucestis Hüber, [1825], Verz. Bek. Schmett. 27: 423.

Type-species: *Tinea ulmifoliella* Hübner, [1817].

The genus *Phyllonorycter*, known as *Lithocolletis* for a long time, is particularly rich in species in the Holarctic Region while rather poor in the tropical areas and the southern hemisphere. In fact, in the collection from Malaysia only five out of 16 species of the subfamily Lithocolletinae belong to this genus. Moreover, three of them have been collected at mountain areas such as Cameron Highlands, Mt. Jerai and Penang Hill. The remaining two are associated with Malvaceae cultivated or growing in lowlands.

The concept of the genus based on the adult is well established by many authors

(Meyrick, 1927; Vári, 1961; Watkinson, 1985; etc.), but no comprehensive one based on the larva has not yet been proposed. On this occasion, the body features of the last instar larva characteristic of this genus are mentioned mostly on the basis of the Japanese species.

In the larval stage, the last instar means the fifth or sixth instar in this genus. Body cylindrical, without dorsal and ventral sclerous shields except on prothorax and tenth abdominal segment. Thoracic legs well developed. Prolegs developed on third to fifth and last abdominal segments, with crochets varying from uniserial to multiseriate, but are usually uniordinal and circular, in arrangement. Seta XD2 absent on prothorax; seta D2 posterior or posterolateral to D1 on abdominal segments except on ninth and tenth; lateral group bisetose (L1 and L2) on prothorax and unisetose (L1) on mesothorax, metathorax and all abdominal segments; subventral group bisetose (SV1 and SV2) on prothorax, unisetose (SV1) on mesothorax, metathorax, and first, second and sixth to ninth abdominal segments, while trisetose (SV1, SV2 and SV3) on ventral prolegs located on third to fifth abdominal segments; seta V1 present on all body segments. Proprioceptor MD1 absent on ninth abdominal segment and MV3 also absent on eighth and ninth abdominal segments.

Phyllonorycter is very similar to *Cameraria* in adult external features (except for the inwardly black-margined white marks of the fore wing), particularly in wing venation, but it may be distinguished from other genera of the Lithocolletinae including *Cameraria* by the simple tegumen without apical setae in male genitalia and by the single lateral seta (L1) on the mesothorax, metathorax and all abdominal segments in the last instar larva. However, I have not yet examined larvae of *Cremastobombicia*, *Protolithocolletis* and *Porphyrosela*.

In larval chaetotaxy the loss of the primary setae L2 and L3 on the body segments (except on the prothorax) is the most peculiar state of the genus *Phyllonorycter*, and this suggests that the genus is an advanced group in the subfamily.

Key to the Malaysian species of *Phyllonorycter*
(Excluding *P. triarcha*)

1. Fore wing with two rather broad, slightly oblique, wide, silvery-white fasciae at basal fourth and in middle, besides costal and dorsal strigulae; larval leaf-mine on *Rubus*.
.....*P. penangensis* sp. nov.
- Fore wing with a narrow white fascia in middle or without any transverse fascia, besides costal and dorsal strigulae. 2
2. Fore wing without a mediobasal streak, but with a very narrow, outward-angulated fascia in middle, besides costal and dorsal strigulae; male valva narrowly bar-shaped, about 10 times as long as wide; lamella antevaginalis of female ostium bursae somewhat M-shaped on its caudal margin; larval leaf-mine on *Urena*.*P. conista* (Meyrick)
- Fore wing with a narrow, whitish mediobasal streak along fold, but without such a median fascia besides costal and dorsal strigulae; male valva wider, two or three times as long as wide; female lamella antevaginalis absent. 3
3. Fore wing with three very oblique, whitish dorsal strigulae and four very short costal ones; male valvae symmetrical, elliptical, with a linear fold in disc of apical half; flap-like eighth sternite of male deeply biforked apically; larval leaf-mine on *Engelhardtia*.
.....*P. malayana* sp. nov.
- Fore wing with two moderately oblique dorsal strigulae and four or five short costal ones; male valvae asymmetrical, right one being a little narrower than the left, both having a

ventral projection with a filament-like long seta at top; flap-like eighth sternite of male round or obtusely angulated apically; larval leaf-mine on *Myrica*. . . . *P. myricae* sp. nov.

Pyllonorycter conista (Meyrick), comb. nov.

[Figs. 17, 18, 10, 20, 33(F), 37(A), 46(A)]

Lithocolletis conista Meyrick, 1911, Ent. Mon. Mag. 47: 212 [India (W. Bengal); host: *Triumfetta neglecta*]; *ibid.*, 1916, Exot. Microlep. 1: 622 [some characters added to the original description]; Fletcher, 1920, Mem. Dept. Agr. India, Ent. Ser. 6: 138, pl. 35 (fig. 1) [life-history].

Lithocolletis clarisona Meyrick, 1916, Exot. Microlep. 1: 622 [Sri Lanka; host: *Urena lobata*]; Fletcher, 1920, Mem. Dept. Agr. India, Ent. Ser. 6: 140. SYN. NOV.

Original description of *conista*. "♂ ♀. 6 mm. Head ochreous-whitish. Thorax bronzy-ochreous. Fore-wings lanceolate; shining bronzy-ochreous; two slender, white, transverse fasciae slightly beyond one-fourth and in middle, angulated in middle, suffusedly edged anteriorly with black irroration; two whitish streaks irrorated with blackish from costa before and beyond three-fourths, connected together in disc, and with a similar streak from tornus; cilia whitish, basal half round apex and termen pale shining bronzy-ochreous sprinkled with black. Hind wings grey; cilia grey-whitish.

Hab.: Pusa, Bengal, bred in June from larvae mining leaves of *Triumfetta neglecta* (Tiliaceae); two specimens (Fletcher)."

In 1916, based on six further specimens, Meyrick amended his original description as follows: "Thorax more or less suffused with white; marking of fore wing described as first fascia is really only a streak from costa, lower arm of fascia being absent; sometimes more or less extended whitish longitudinal mark in disc towards apex."

Original description of *clarisona*. "♂. 5 mm. (Head lost.) Thorax bronzy-ochreous mixed with whitish. Forewings lanceolate; golden-bronzy-ochreous; a very short cloudy whitish basal mark in middle; a rather oblique white strigula from costa at 1/4, edged anteriorly with black irroration; an obtusely angulated slender white median fascia, edged anteriorly with black irroration; three small triangular white spots on costa posteriorly, edged anteriorly with black, first two connected beneath by a patch of black irroration above tornus, third almost apical; two or three white and black scales on tornus; a white longitudinal mark connecting supratornal patch with an apical spot of black irroration; cilia pale golden-ochreous, towards base sprinkled with black points. Hindwings grey; cilia light greyish-ochreous.

Ceylon, Peradeniya, bred in July from mines in leaves of *Urena lobata* (Malvaceae) (Rutherford); one specimen."

Additional description. ♂ ♀. Expanse of wings: 4.7-5.3 mm (4.97 mm on average of 20 specimens) in material from Malaysia; 4.5-5.8 mm (5.21 mm on average of 11 specimens) in that from Nepal. Length of fore wing: 2.2-2.5 mm (2.36 mm on average) in material from Malaysia; 2.1-2.7 mm (2.45 mm on average) in that from Nepal.

Head with tuft whitish, sparsely mixed with ochreous hairs between antennae; face and palpi white. Antenna whitish, annulated with fuscous above; scape with a rather thick pecten below. Thorax anteriorly with a narrow whitish band in most specimens examined. All legs whitish except for the following points: fore femur and tibia fuscous, fore and mid tarsi with two rather broad, blackish bands, hind tibia apically fuscous on lateral side, and hind tarsus with three blackish bands.

Fore wing as described originally, but first fascia at basal fourth is represented by costal arm only as described for *clarisona* and not for *conista*, basal whitish mark

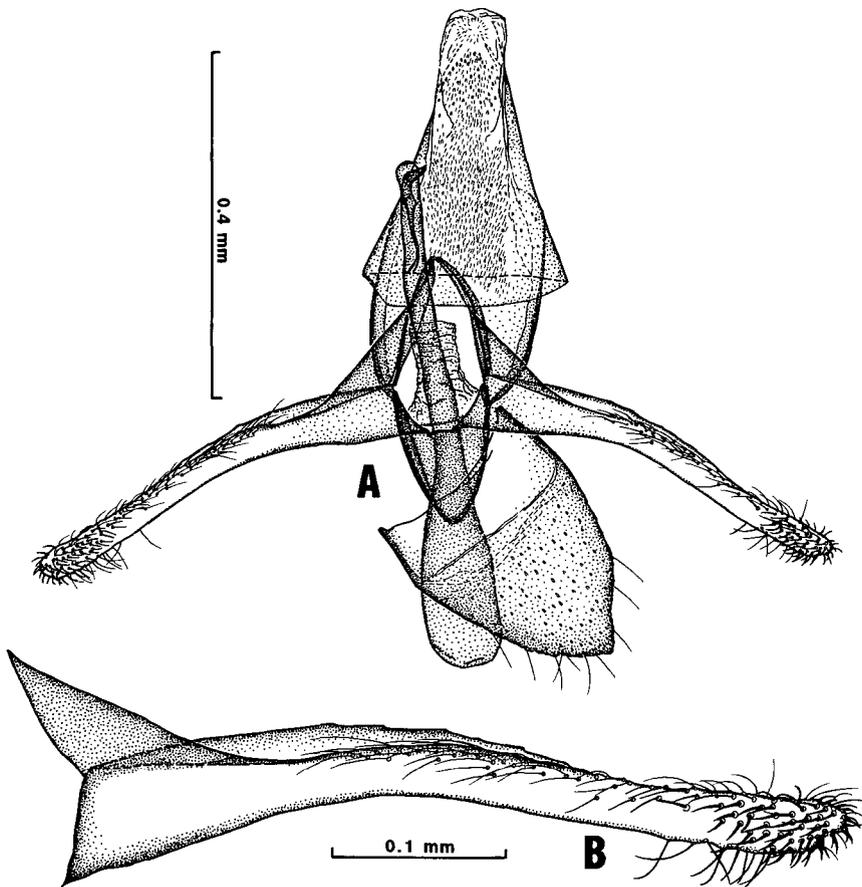


Fig. 17. *Phyllonorycter conista* (Meyrick). A: Male genitalia in ventral view [Grc-2237, determined as *Lithocolletis conista* by T.B. Fletcher, India, ex *Triumfetta neglecta*] — B: Right valva [ditto].

is absent in all specimens examined, and three white costal spots on the apical area are indistinct in most specimens examined and sometimes they are merely represented by blackish irrorations which form anterior edges of the spots.

Male genitalia (Figs. 17 & 18): Tegumen long, subconical, squamose dorsally, spinulose apically; tuba analis densely spinulose on ventral surface. Valvae symmetrical, a little longer than tegumen, slender, slightly sinuate, setose sparsely on discal area and densely on apical area; transtilla complete, slender, without any cephalic lobe. Vinculum short, about one-fourth as long as valva, round apically, without produced saccus. Aedeagus a little longer than valva, well swollen towards base, slightly curved near apex, with a minute hook near apex; vesica without any distinct cornutus, but with two shortly sclerotized bars as shown in Fig. 18 (B & D). Juxta absent. Flap-like eighth sternite two-thirds to three-fourths as long as valva, elongate-subtriangular. (Six preparations examined.)

Female genitalia (Figs. 19 & 20): Papilla analis comparatively long, setose and

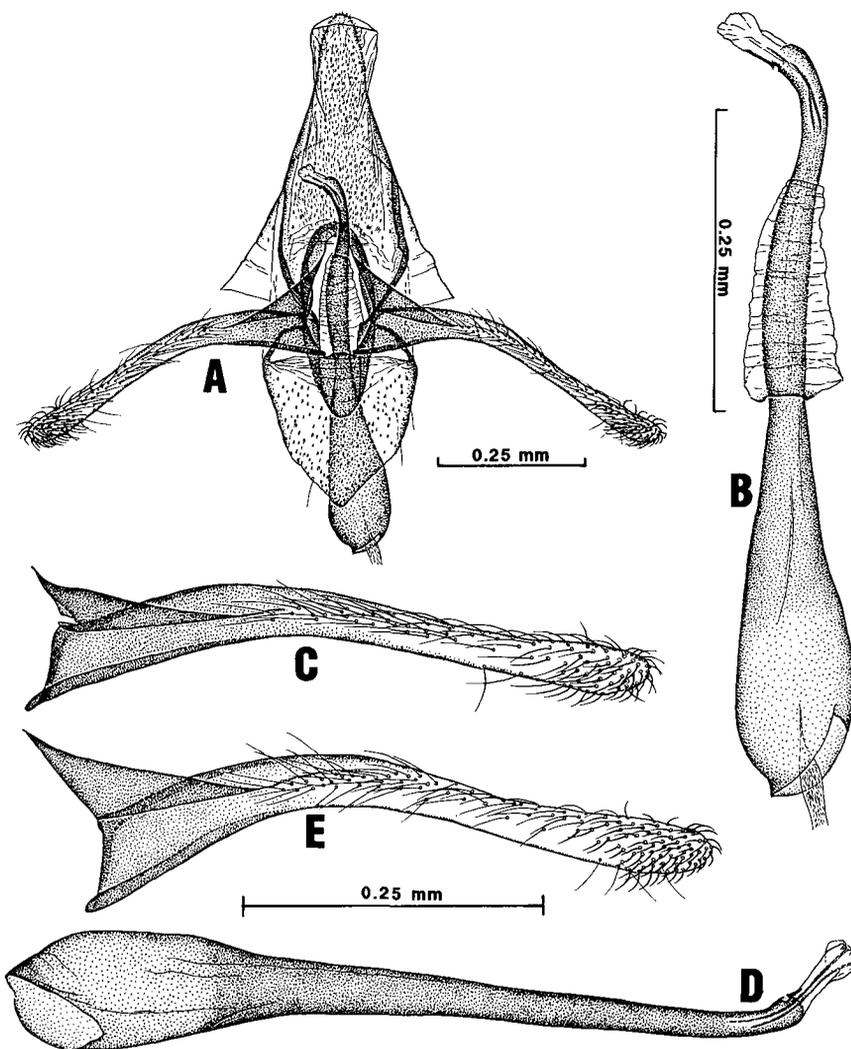


Fig. 18. *Phyllonorycter conista* (Meyrick). A: Male genitalia in ventral view [Grc-3416, Nepal, ex *Urena lobata* (Npl-412)] — B: Aedeagus [ditto] — C: Right valva [ditto] — D: Aedeagus [Grc-5819, W. Malaysia, ex *Urena lobata* (3872)] — E: Right valva [ditto].

spinulose as usual, with a very long apophysis, which is about five times as long as apophysis anterioris and about twice as long as seventh abdominal segment. Eighth abdominal segment densely squamose except on ventral area, with apophysis short. Seventh abdominal segment well sclerotized along cephalic margin, with caudal margin of sternite medianly sinuate in an M-shape, under which the ostium bursae is placed. Antrum weakly sclerotized, thickly tubular, truncated cephalad; ductus bursae long, membranous on whole length; corpus bursae globular, with a large patch of imbrication and paired cone-shaped signa which are surrounded by a large,

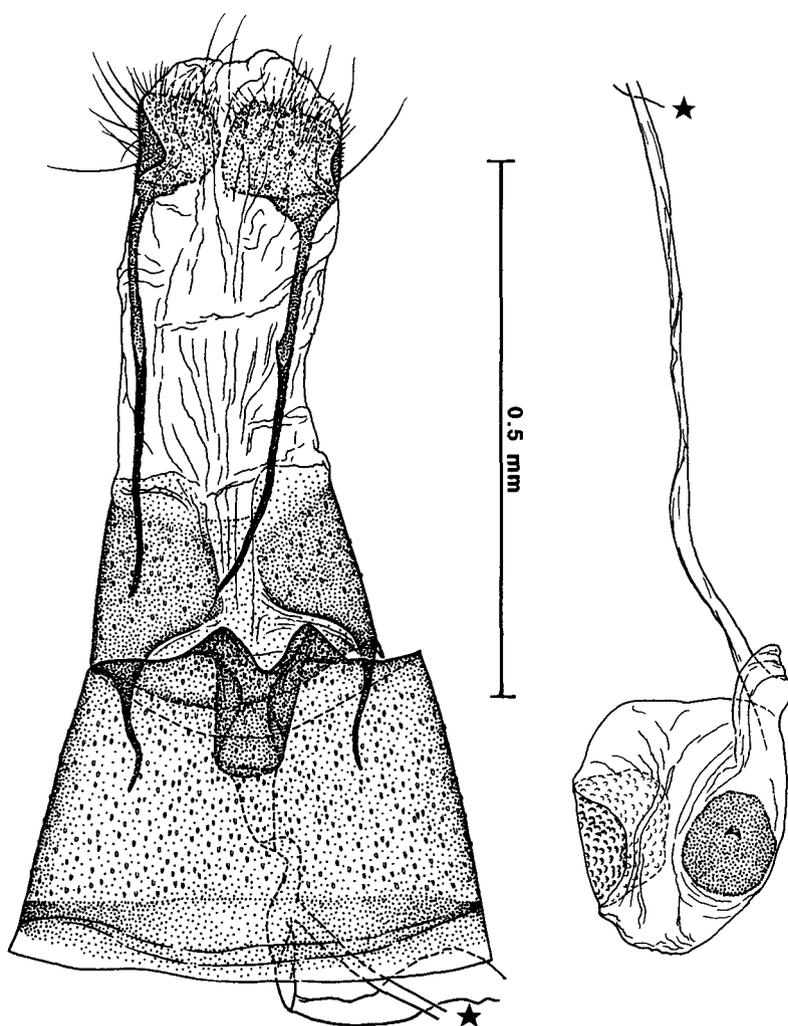


Fig. 19. *Phyllonorycter consista* (Meyrick), female genitalia in ventral view [Grc-2238, determined as *Lithocolletis consista* by T.B. Fletcher, India, ex *Triumfetta neglecta*].

circular plate. Bulla seminalis pyriform, much larger than corpus bursae, spinulose sparsely. (Six preparations examined.)

Specimens examined. 65♂ & 68♀. WEST MALAYSIA — 51♂ & 44♀, Mencali F. R., Rompin, Pahang, em. 18-26/viii/1990, ex *Urena lobata* (3870), 25♂ & 22♀ deposited in FRIM and the rest in SEHU. INDIA — 1♂ & 1♀, labelled "*Lithocolletis consista*, Meyr., Named by T.B.F.; 8. vi. 10, *Triumfetta neglecta*, c.s.-838", Gen. sl. nos. Grc-2237 in ♂ and Grc-2238 in ♀, deposited in ZSIC. NEPAL — 1♂ & 2♀, Malipu—Suri Dhoiban (alt. 1,000-1,100 m), Janakpur, em. 21-18/viii/1983, ex *Urena lobata* (Npl-308); 12♂ & 21♀, ditto, em. 1-7/ix/1983, ex *U. lobata* (Npl-412); 4♂ & 5♀ deposited in EDAK and the rest in SEHU.

Distribution. West Malaysia; India; Nepal; and Sri Lanka.

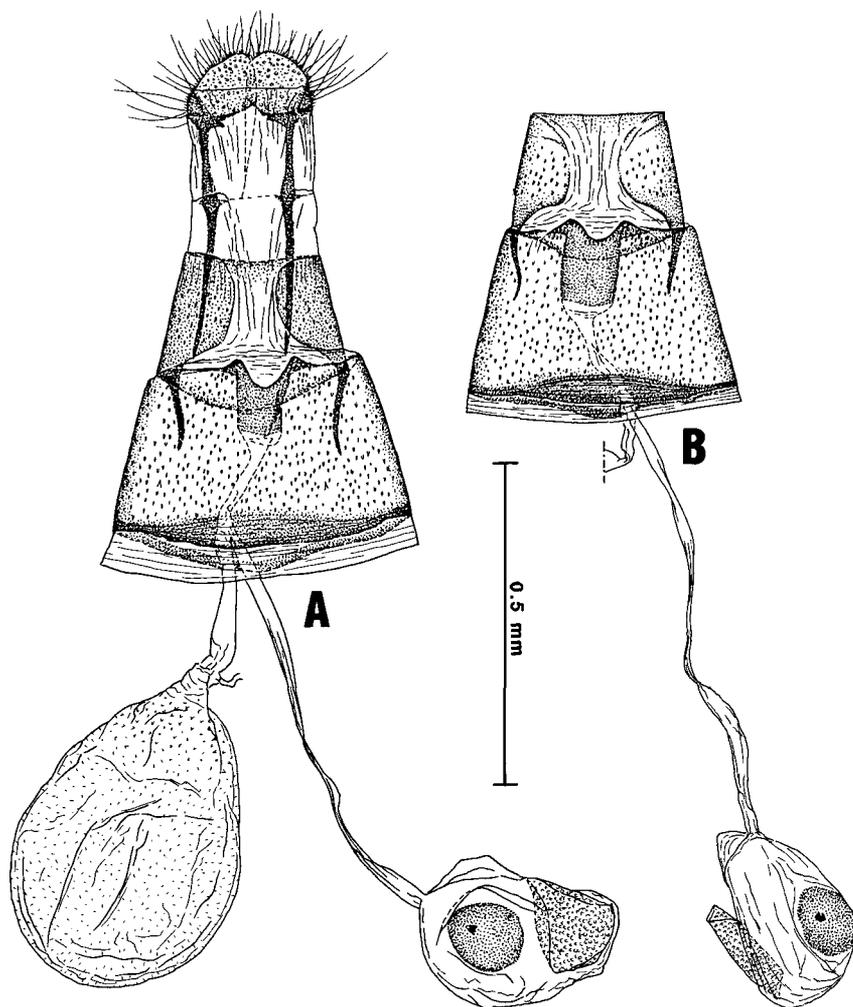


Fig. 20. *Phyllonorycter conista* (Meyrick). A: Female genitalia in ventral view [Grc-5822, W. Malaysia, ex *Urena lobata* (3870)] — B: Ditto, papillae anales omitted [Grc-3418, Nepal, ex *Urena lobata* (Npl-412)].

Food plant. *Urena lobata* (Malvaceae). Records from *Triumfetta neglecta* are very doubtful, because the figure of mined leaf given by Fletcher (1920) for *Lithocolletis conista* is very similar to the leaf of *Urena lobata*.

Mine (Fig. 46, A). A subtriangular or trapeziform mine placed on lower side of leaf, mostly on basal area of disc between two lateral veins, flat and pale greenish at young stage, then discoloured into brown and deformed into a tentiform type at mature stage, with lower epidermis on mining part strongly contracted by silken threads to form some weak, longitudinal wrinkles. Interparenchymal tissues within mine are finally almost consumed by the larva. Pupation takes place inside the mine-cavity without a particular cocoon.

Remarks. Having examined the Indian specimens determined as *Lithocolletis conista* by T.B. Fletcher, deposited in the collection of Zoological Survey of India, Calcutta, I have found that they cannot be distinguished from the specimens emerged from *Urena lobata* in Malaysia and Nepal. As stated under "Food plant", the records from *Triumfetta* might be caused by a misidentification of the food plant. As to *clarisona*, no specimen from the type series has been available. However, reading through the original description, I have been convinced that it is conspecific with *conista*.

P. conista is characterized by the sinuate and simply bar-shaped male valva and by the peculiarly sinuate caudal margin of the female seventh sternite. In the shape of the valva it is somewhat similar to the *virgulata*-group of the genus *Cameraria*, but it is essentially different from the members of the group by the tegumen (uncus) without any apical setae.

Phyllonorycter malayana sp. nov.

[Figs. 21, 33(G), 37(B), 46(C & D)]

Description. ♂ (♀ unknown). Expanse of fore wings: 6.2-6.8 mm (6.8 mm in holotype, 6.46 mm on average of five specimens). Length of fore wing: 2.9-3.3 mm (3.3 mm in holotype, 3.03 mm on average of six specimens).

Head including tuft, face and palpi white; labial palpus narrowly darkened on ventral surface basally. Antenna whitish, narrowly darkened on dorsal side, without distinct annulation; scape bronzy-ochreous on dorsum, pure white on ventrum including pecten. Thorax brilliantly bronzy-ochreous dorsally, with three longitudinal white stripes, the median one a little broader; lateral and ventral surfaces whitish. All legs whitish except for following points: fore femur and tibia blackish above, mid tibia with two oblique blackish bands, fore and mid tarsi with two blackish bands, hind tibia becoming ochreous towards apex of outer surface, hind tarsus with three blackish bands, and all spurs medianly blackish. Abdomen grayish dorsally and whitish ventrally, with ochreous-gray, triangular patches on lateral sides.

Fore wing bronzy-ochreous with a golden lustre in ground colour, with markings white; a slender mediobasal streak reaching one-third of wing-length along fold, bent upwards near its apex, and margined with fuscous irroration on its upper edge; a small spot or short streak placed near base along dorsum; three slender dorsal strigulae arranged in parallel with each other on median third of wing, very oblique outwards, reaching two-thirds of wing-width, where they are shortly bent outwards; three costal strigulae opposed to the dorsal ones, but never connected with them, the first two being strongly oblique outwards and third perpendicular; a further costal strigula placed just before wing-apex, ill-defined in outline; all the dorsal and costal strigulae narrowly margined with fuscous irroration on their inner edges; a transverse streak of black irroration placed near wing-apex, and sometimes connected with an ill-defined supratornal patch of blackish irroration; cilia around wing-apex pale bronzy-ochreous basally and whitish apically, with a narrow, blackish fringe-line; cilia along dorsal margin whitish. Hind wing pale gray, with cilia whitish to whitish-gray.

Genitalia (Fig. 21): Tegumen long, cylindrical, elongate-quadrangular in ventral

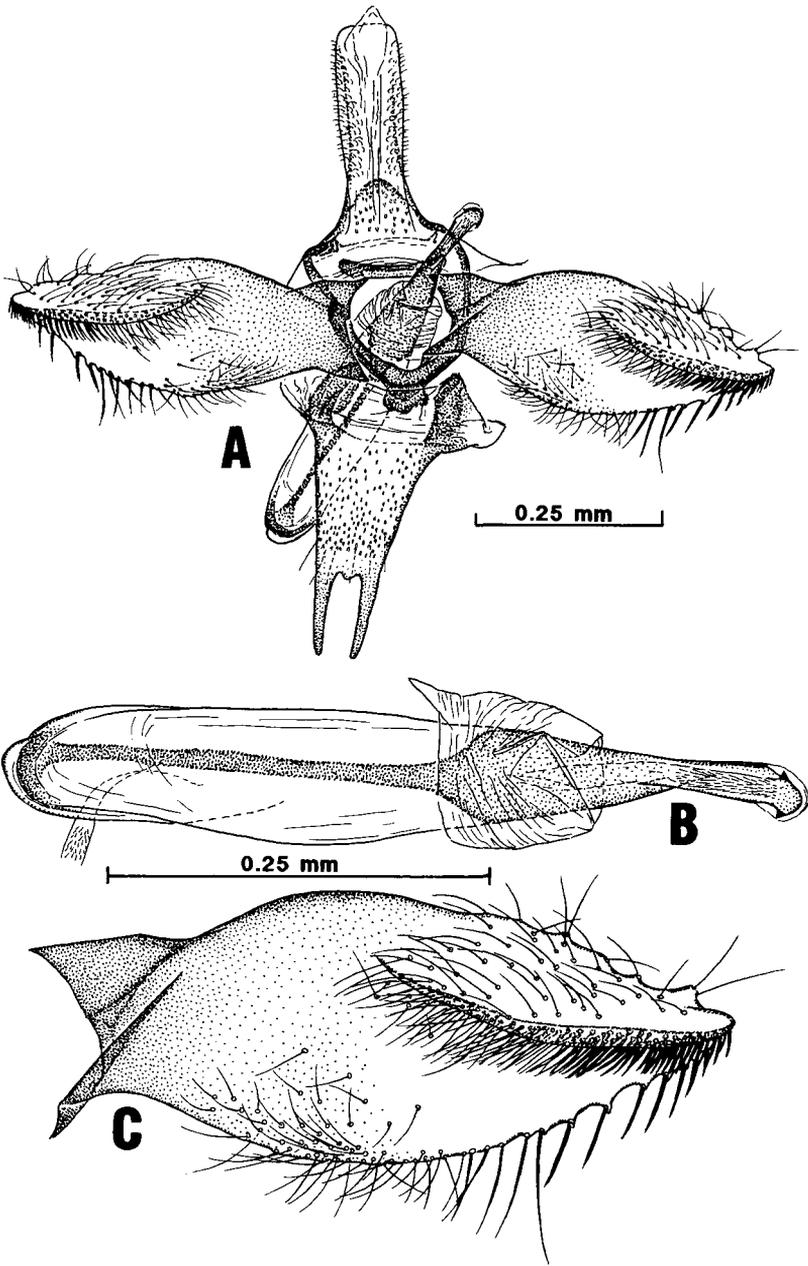


Fig. 21. *Phyllonorycter malayana* sp. nov. A: Male genitalia in ventral view [Grc-5837, holotype] — B: Aedeagus [ditto] — C: Right valva [ditto].

view, densely covered with hook-shaped spinules on dorsal and lateral surfaces. Valvae symmetrical, somewhat elliptical with obtuse apex in caudal view, with a longitudinal, linear fold, which occupies apical half of valva; inside the fold there are dense, bristly setae, of which basal ones become slenderer; some further bristly setae occurring along ventral margin of valva, and slender ones on costal area beyond middle and on ventral area before middle; transtilla complete, with a pair of lateral lobes on cephalic margin. Vinculum short, crescent-shaped, with a short, pentagonal apical saccus. Aedeagus a little longer than valva, well swollen on basal three-fourths, with a pair of minute hooks near apex; vesica with a patch of very minute spine-like cornuti near apex. Juxta absent. Flap-like eighth sternite about three-fifths as long as valva, narrowing apically, with two long, narrow apical prongs, which are nearly parallel with each other. (Five preparations examined.)

Specimens examined. 6♂. Holotype: ♂, Tanah Rata, Cameron Highlands, Pahang, Malaysia, em. 30/viii/1986, ex a seedling determined as *Castanopsis* sp. (2718), Gen. sl. no. Grc-5837, deposited in FRIM. Paratypes: WEST MALAYSIA — 4♂, with same data as holotype except for emergence dates, 30/viii-1/ix/1986; 1♂, Bkt. Fraser (Fraser's Hill), Pahang, em. 11/x/1990, ex *Engelhardtia spicata* (4143); 2♂ in FRIM and 3♂ in SEHU.

Distribution. West Malaysia.

Food plant. *Engelhardtia spicata* (Juglandaceae). The determination of the seedling, from which the most specimens emerged, seems to be erroneous; in fact the herbarium specimen for this determination had only one incomplete leaf.

Mine (Fig. 46, C & D). An elliptical or oblong, typically tentiform blotch-mine found on upper side of leaf, usually on leaf-vein, 1-1.5 cm in long diameter, with upper epidermis of mining part having a longitudinal wrinkle in middle. Pupation takes place inside the mine-cavity, with the pupa enclosed with a whitish, ellipsoidal cocoon, which is covered with grains of frass.

Remarks. *P. malayana* may belong to the *pterocaryae*-group, of which the known members are associated with Juglandaceae in Japan and Nepal (Kumata, 1963 and 1973). Indeed it is very similar to *P. engelhardiae* Kumata, 1973, and *P. drepanota* (Meyrick, 1928), both of which are upper leaf-miners on *Engelhardtia spicata* in Nepal. However, it is distinguished from the latter two by the smaller costal strigulae of the fore wing, by the male valva with a longitudinal, linear fold lying on the apical half of the disc and with long, bristly setae on the inside of the fold and along the ventral margin of the valva, and by the deeply biforked apex of the male flap-like eighth sternite.

Phyllonorycter myricae sp. nov.

[Figs. 22, 23(A), 33(H), 46(E)]

Description. ♂♀. Expanse of wings: 5.1-5.7 mm (5.1 mm in holotype). Length of fore wing: 2.3-2.6 mm (2.3 mm in holotype).

Head with tuft bronzy-ochreous, slightly mixed with white anteriorly; face and palpi whitish. Antenna ochre-whitish, annulated with fuscous dorsally; scape ochreous on dorsum, ochreous-whitish on ventrum including pecten. Thorax bronzy-ochreous dorsally, with two narrow, white lateral stripes, which are anteriorly united through a white band; pleural and ventral surfaces whitish with a silky

lustre. All legs whitish ; fore femur and tibia fuscous on mesal side ; mid tibia with two fuscous oblique bands on lateral surface ; fore and mid tarsi with two blackish bands ; hind tibia becoming fuscous apically ; and hind tarsus with three blackish bands. Abdomen metallic gray dorsally, silky-whitish ventrally.

Fore wing brownish-ochreous with a golden lustre in ground colour, with markings brilliantly whitish ; a mediobasal streak slender, reaching one-third of wing-length, bent towards costa at its apical third, margined with fuscous speckles on its upper edge throughout and on lower edge near apex alone ; two rather large dorsal strigulae, the first placed just basad to middle and the second before tornus, both oblique outwards, and reaching two-thirds of wing-width ; four or five smaller costal strigulae, the first at basal third or just opposite to apex of the mediobasal streak, second opposite to apex of the first dorsal, third at apical third, fourth at a point just apical to apex of the second dorsal, and fifth near apex of wing and sometimes indistinct, all much smaller than dorsal strigulae ; the first two costal

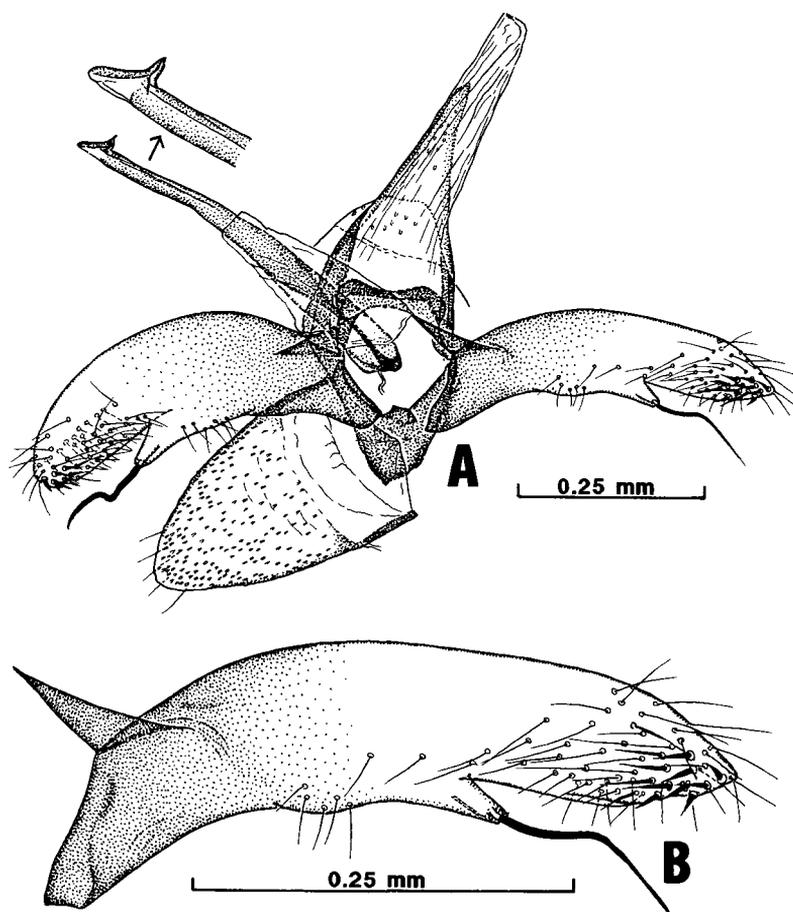


Fig. 22. *Phyllonorycter myricae* sp. nov. A : Male genitalia in ventral view [Grc-5827, holotype] — B : Right valva [ditto].

ones being oblique outwards, while the others oblique inwards; these costal and dorsal strigulae edged with a fuscous line inwards and shading into ground colour outwards; an ill-defined mark of blackish irroration placed at apex of wing, and usually confluent into a similar, but larger, mark at supratornus; cilia around apex whitish-ochreous basally and whitish apically, with a fine, blackish fringe-line, and those on dorsal margin whitish. Hind wing pale gray, with cilia whitish-gray.

Male genitalia (Fig. 22): Slightly asymmetrical in width of valvae and tegumen. Tegumen long, subconical, with right pedunculus slightly shorter than the left; tuba analis not spinulose. Right valva about as long as tegumen, somewhat banana-shaped with a bluntly pointed apex, slightly arched upwards; sacculus apically produced into a large, conical projection just beyond middle of valva, with a long, sinuate, filament-like seta at top; some slender and a few bristly setae occurring on discal area apical to the conical projection, and a few slender setae on ventral area basal to the projection. Left valva about 1.2 times as wide as the right, otherwise it is very similar to the right in shape and structure. Transtilla complete, with a pair of wide lateral lobes on cephalic margin. Vinculum V-shaped, with median part lengthened and pointed apically, without a distinctly produced saccus. Aedeagus a little longer than valva, very slightly swollen towards base, with a small, beak-shaped subapical barb. Flap-like eighth sternite slightly shorter than valva, subtriangular with an obtuse apex. (One preparation examined.)

Female genitalia (Fig. 23, A): Papilla analis moderate in length, with a slender sclerous dorsal band connected with bases of apophyses posteriores, which are slender and moderate in length. Eighth abdominal segment tightly fused with seventh segment, without any trace of apophyses anteriores. Ostium bursae situated at left side of ventromesal line, without sclerous genital plate and antrum; ductus bursae long, tubular, partly sclerotized on basal area cephalic to opening of ductus seminalis; corpus bursae globular or ellipsoidal, with a spinuliferous, large patch and a pair of cone-shaped signa, which are set close and surrounded by a large, oval basal plate. Bulla seminalis ellipsoidal, a little larger than corpus bursae, not spinulose. (Two preparations examined.)

Specimens examined. 1♂ & 4♀. Holotype: ♂, Gng. Jerai (alt. 900 m), Kedah, Malaysia, em. 21/xi/1991, ex *Myrica esculenta* (4580), Gen. sl. no. Grc-5827, deposited in FRIM. Paratypes: WEST MALAYSIA — 4♀, with same data as holotype except for emergence dates, 19/xi-2/xii/1991, 2♀ in FRIM and 2♀ in SEHU.

Distribution. West Malaysia.

Food plant. *Myrica esculenta* (Myricaceae).

Mine (Fig. 46, A). A tentiform blotch-mine occurring upon upper side of leaf, usually situated on disc between two lateral veins, oval or elliptical in outline, about 1.5 cm in long diameter. Upper epidermis of mine brownish, with a longitudinal, strong wrinkle at maturity. Pupation taking place inside mine-cavity, without a particular cocoon.

Remarks. This new species undoubtedly belongs to the *japonica*-group in having asymmetrical valvae, which bear a filament-like, long seta at the top of the produced sacculus (Kumata, 1973).

It is related to *P. oreas* Kumata, 1973, described from Nepal and associated with *Myrica esculenta*, not with *Odina* sp. as stated in the original description. It is

distinguished from *P. oreas* by some characters of the genitalia as follows: — In *P. myricae*, the valval sacculus is well produced at the apex; the male flap-like eighth sternite is comparatively short and shorter than the valva; and the female ductus bursae is weakly sclerotized near the base. In *P. oreas*, on the other hand, the valval sacculus is not produced towards its apex, and the filament-like seta directly arises from the median area of the valva; the male flap-like eighth sternite is tongue-shaped and nearly as long as the valva; and the female ductus bursae is wholly membranous without a sclerotized part.

Phyllonorycter penangensis sp. nov.

[Figs. 23(B & C), 33(I), 46(B)]

Description. ♀ (♂ unknown). Expanse of wings: 6.0–6.3 mm (6.3 mm in holotype). Length of fore wing: 2.7–2.9 mm (2.9 mm in holotype).

Head with tuft ochreous-brownish; face grayish-white with a silvery lustre; palpi whitish, the apical segment of labial palpus with a blackish streak on lower side. Antenna fuscous, very slightly annulated with paler colour; scape brownish above and whitish below, with pecten whitish. Thorax ochre-brownish on dorsum including tegulae, with a pair of very narrow whitish stripes just inside tegulae; pleural and ventral surfaces grayish-white, with a leaden lustre. Fore and mid legs ochreous-whitish in ground, with blackish marks as follows: fore coxa, femur and tibia clouded with fuscous on lower or lateral side, mid tibia with two oblique stripes, and both tarsi with two wide bands. Hind leg silvery-whitish, with coxa apically and tibia wholly dark grayish, tarsus rather whitish, with three blackish bands, and all spurs blackish subapically.

Fore wing golden-brownish with a strong metallic lustre in ground colour, much darker than the preceding species, with silvery-white marks; a mediobasal streak narrow, very short, occupying about basal fourth of wing, sometimes divided into two spots, sparsely margined with fuscous irroration on its upper edge; two transverse fasciae, first at basal fourth and second in middle, both rather wide, slightly oblique inwards from costa, and more or less angulated outwards near costa; interspace between these fasciae darkened, but shading into ground colour towards first fascia; a pair of costal and dorsal strigulae placed at apical third or at tornus, triangular, the costal one being a little smaller than the dorsal; a further costal strigula placed near apex of wing, slightly oblique inwards; all the fasciae and strigulae narrowly margined with black scales on their inner edges except for the costal strigulae which are margined on both edges; discal area just apical to the paired strigulae widely irrorated with fuscous scales, the irroration being confluent to a supratornual patch of blackish irroration; a transverse band of blackish irroration placed near apex of wing just below the last costal strigula, usually reaching termen; cilia around apex brownish basally and whitish-gray apically, mixed with black-tipped scales along termen to form a fringe-line; cilia on dorsal margin grayish. Hind wing dark gray, with cilia grayish.

Female genitalia (Fig. 23, B & C): Papilla analis moderate in length, setose and spinulose as usual, with apophysis very long, about thrice as long as apophysis anterioris, and widened towards base. Eighth abdominal segment moderate in length, about as long as its apophysis, covered with lanceolate scales. Seventh

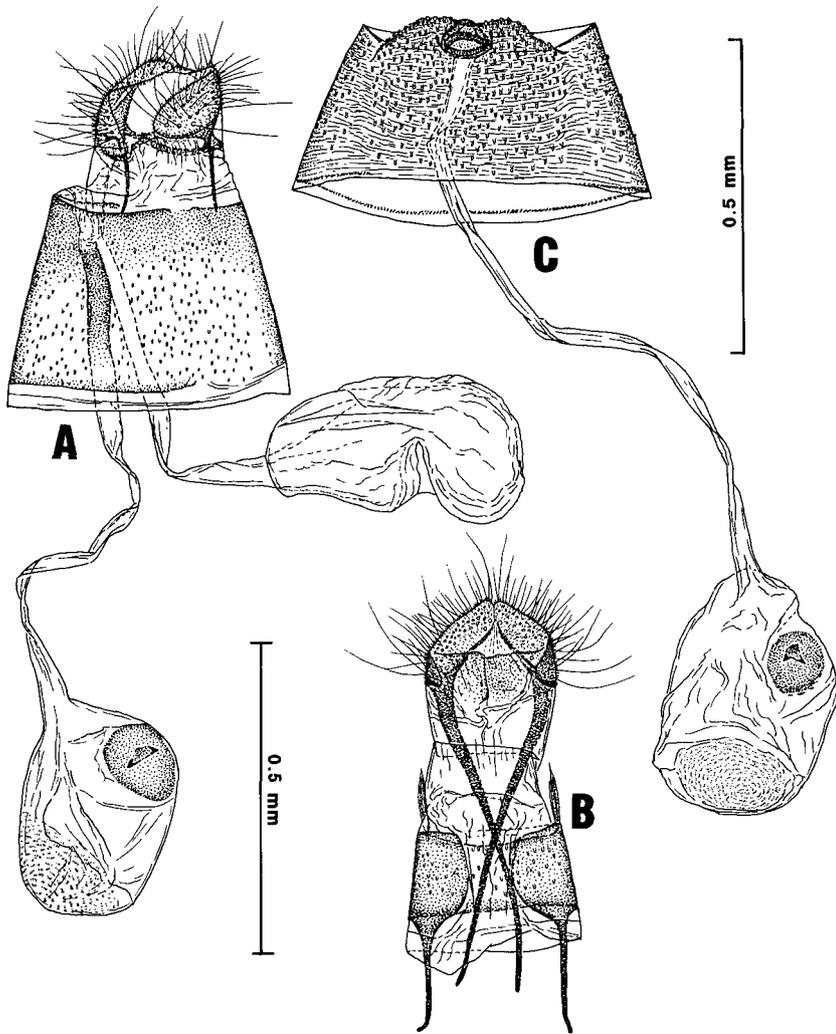


Fig. 23. A: *Phyllonorycter myricae* sp. nov., female genitalia in ventral view [Grc-5829, W. Malaysia, ex *Myrica esculenta* (4580)].

B-C: *Phyllonorycter penangensis* sp. nov. B: Female papillae anales and eighth abdominal segment in ventral view [Grc-5904, W. Malaysia, ex *Rubus moluccanus* (4761)] — C: Female seventh abdominal segment and bursa copulatrix [ditto].

abdominal segment well sclerotized, with sternite widely, but shortly, lobated caudad, and covered with lanceolate scales as in the eighth segment. Ostium bursae located under the caudal lobe of the eighth sternite, surrounded by a short, ring-shaped sterigma. Ductus bursae long, tubular, membraneous wholly; corpus bursae globular or pyriform, with a large, spiniferous patch at cephalic end and a sclerous, circular plate, which has a pair of cone-shaped signa in the centre. (Two preparations examined.)

Specimens examined. 2♀. Holotype: ♀, Penang Hill (alt. 700 m), Pulau

Penang, Malaysia, em. 22/xi/1991, ex *Rubus moluccanus* (4761), Gen. sl. no. Grc-5904, deposited in FRIM. Paratype: WEST MALAYSIA — 1 ♀, with same data as holotype excepted for emergence date, 26/xi/1991, deposited in SEHU.

Distribution. West Malaysia (Penang Is.).

Food plant. *Rubus moluccanus* (Rosaceae).

Mine (Fig. 46, B). The mine of this species is similar to that of *P. pulchra* (Kumata, 1963) described from Japan and *P. rubicola* Kumata, 1973, from Nepal, both of which also attack the leaf of *Rubus*. A rather large, star-like mine occurring upon upper side of leaf, rather flat, but its central area slightly swollen in a circle, and never forming a tentiform type at maturity. Mining part of leaf whitish-green in young stage and brownish in mature stage. Pupation taking place inside mine, usually at the circularly swollen part; cocoon ellipsoidal, whitish, and covered with grains of frass.

Remarks. Although I have examined only female specimens, the new species seems to be included in the *trifasciella*-group. It is related to *P. rubicola* and *P. pulchra*, both of which are true members of the *trifasciella*-group and leaf-miners of *Rubus*. It is, however, distinguished from *P. pulchra* by the absence of a blackish, triangular mark at the costal base and the presence of a simply wedge-shaped last costal mark in the colour-pattern of fore wing, and by the longer apophysis anterioris and shortly and widely produced seventh sternite in the female genitalia. It is also distinguished from *P. rubicola* by the presence of the mediobasal streak in the colour-pattern of fore wing, and by the shortly lobated seventh sternite in the female genitalia (based on unpublished observation of the female of *P. rubicola*). In a further specimen of *P. rubicola* collected from Nepal (♀, Thankot (alt. 1,700 m), Kathmandu Valley, Bagmati, em. 2/x/1983, ex *Rubus* sp. (Npl-687), Gen. sl. no. Grc-3426), the seventh sternite of the female is narrowly produced caudad, and the produced part is about three times as long as the apophysis anterioris.

Phyllonorycter triarcha (Meyrick)

Lithocolletis triarcha Meyrick, 1908, Journ. Bomb. Nat. Hist. Soc. 18 : 811 [India (Bihar); host : *Gossypium*]; ibid., 1921, Ann. Transv. Mus. 8 : 121 [South Africa]; Fletcher, 1920, Mem. Dept. Agr. India, Ent. Ser. 6 : 137, pl. 33; Diakonoff, 1967, Bull. U.S. Nat. Museum 257 : 264 [Philippines (Luzon; Negros); host : *Gossypium*].

Lithocolletis triarcha [sic] : Yunus & Ho, 1980, Ministry Agr. Malaysia, Bull. 153 : 74 [Malaysia; host : *Gossypium herbaceum*].

Phyllonorycter triarcha : Kuroko & Lewvanich, 1983, Bull. Univ. Osaka Pref., Ser. B, 35 : 5, figs. 2, 10 & 15 [Thailand; host : *Gossypium herbaceum*].

This well-known pest of cotton was recorded by Yunus & Ho (1980) from Malaysia, but I could not collect any representatives of this species during my collecting trips in Malaysia.

Distribution. West Malaysia; The Philippines; Thailand; India; and South Africa.

Food plants. *Gossypium* spp., including *G. herbaceum* (Malvaceae).

GENUS PORPHYROSELA BRAUN

Porphyrosela Braun, 1908, Trans. Amer. Ent. Soc. 34: 348; Ely, 1917, Proc. Ent. Soc. Washington 19: 38; Vári, 1961, Transv. Mus. Mem. 12: 224.

Type-species: *Lithocolletis desmodiella* Clemens, 1859.

The genus *Porphyrosela*, containing smallest moths in Lepidoptera, is represented by 10 species, including a new species from tropical Asia (see Appendix II). So far as known, all the species are associated with Leguminosae, and the larvae mine in leaves or leaflets of their food plants.

It has been postulated that *Porphyrosela* is distinguished from *Phyllonorycter* by the absence of the vein R_3 of the fore wing, by the absence of the pecten of the antennal scape and by the absence of raised hairy scales of the hind tibia (Braun, 1908; Ely, 1917). As correctly claimed by Vári (1961), however, it is not clearly distinguished from *Phyllonorycter* by these characters. In my observation of the specimens of *P. teramni* Vári and *P. aglaozona* (Meyrick) in addition to the two species mentioned below, the antennal scape has a hairy, not scaly, pecten, the hind tibia is tufted with hairy scales on its upper side as in *Phyllonorycter*, and the fore wing on its costal margin near apex has three pairs of sensory organs (campaniform sensillae), which are probably associated with three radial veins. In fact, in *P. aglaozona*, *P. teramni* and *P. dorinda* the fore wing obviously has the veins R_3 , R_4 and R_5 as in *Phyllonorycter* (see Fig. 37, C). In *P. alternata* (sp. nov.) one of the three radial veins, probably R_4 , is invisible, but a pair of campaniform sensillae are found at the corresponding portion (see Fig. 37, D). On the other hand, in the hind wing of *Porphyrosela* there are three pairs of campaniform sensillae on the dorsal margin. These paired sensillae are probably associated with the veins Cu_1 , M_2 and M_3 . If this is true, *Porphyrosela* might be distinctly separated as a good genus from *Phyllonorycter* by this character. In genital organs it is easily separated from *Phyllonorycter* by the male tegumen with a pair of apical setae and by the reduced female eighth abdominal segment without apophyses anteriores. The larval structures may more definitely clarify the relationship between the two genera, but no larvae of *Porphyrosela* have been available.

Two Malaysian species are separated by the following key.

Key to the Malaysian species of *Porphyrosela*

1. Fore wing with four silvery-white costal strigulae, of which the first three from base are strictly opposite to three dorsal ones; male valva round apically; male vinculum subtriangular, with saccus shorter and widened basally; female apophysis posterioris widened on its basal third; larval mine on lower side of leaflet of *Calopogonium* in Malaysia. *P. dorinda* (Meyrick)
- Fore wing with three silvery-white costal strigulae alternated with three dorsal ones; male valva obtusely angulated apically, with costal margin more or less oblique at apex; male vinculum subpentagonal, with saccus slightly longer and evenly slender; female apophysis posterioris widened on its basal fourth; larval mine on upper side of leaflet of *Desmodium* in Malaysia. *P. alternata* sp. nov.

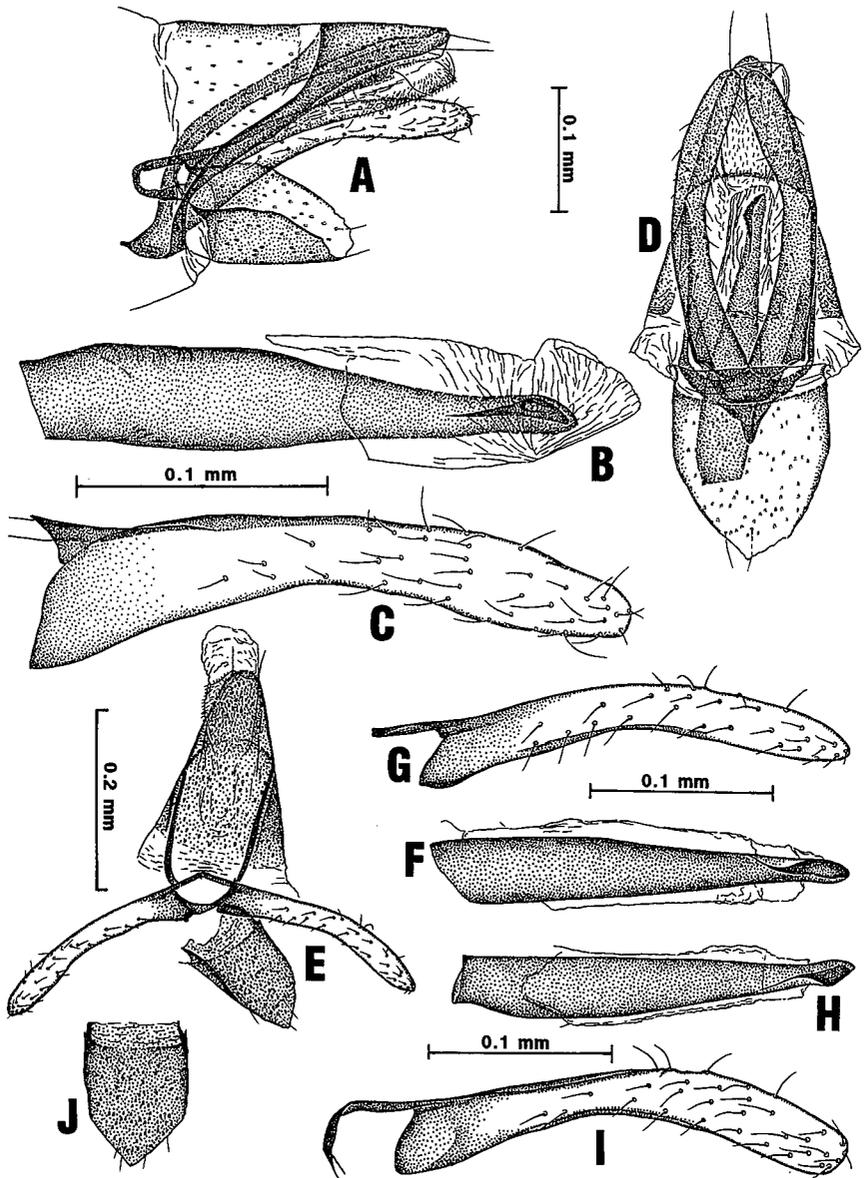


Fig. 24. *Porphyrosela dorinda* (Meyrick). A: Male genitalia in lateral view, aedeagus omitted [Grc-5886, W. Malaysia, ex *Calopogonium* sp. (4703)] — B: Aedeagus [ditto] — C: Right valva [ditto] — D: Male genitalia in ventral view [Grc-5851, ditto] — E: Ditto, aedeagus omitted [Grc-1270, Taiwan, ex *Pueraria thunbergii*] — F: Aedeagus [ditto] — G: Right valva [ditto] — H: Aedeagus [Grc-2680, India, ex *Desmodium gangeticum* (Ind-40)] — I: Right valva [ditto] — J: Flap-like eighth sternite of male [ditto].

Porphyrosela dorinda (Meyrick)

[Figs. 14, 15, 33(D), 37(C), 47(A-C)]

Lithocolletis dorinda Meyrick, 1912, Exot. Microlep. 1: 21 [India (Bihar); host: *Desmodium*]; Fletcher, 1920, Mem. Dept. Agr. India, Ent Ser. 6: 140; Meyrick, 1935, Exot. Microlep. 4: 595 [India (Uttar Pradesh); host: *Uvaria neglecta*]; *ibid.*, 1936, ditto 5: 33 [Taiwan; host: *Pueraria thunbergiana*].

Original description. "♂. 3 mm. Head and thorax shining bronzy-metallic, hairs of crown blackish. Forewings lanceolate, acute; orange; three pairs of opposite costal and dorsal shining violet-white, black-edged spots, and a fourth costal spot before apex: cilia grey, basal third black round apex. Hindwings rather dark grey; cilia grey.

Bengal, Pusa, in August (Fletcher); one specimen. Larva mining leaves of *Desmodium* (Leguminosae) (Fletcher)."

Additional description. ♂ ♀. Expanse of wings: 3.0-4.1 mm (3.33 mm on average of nine specimens) in material from Malaysia, while a little larger in that from other countries, 3.1-4.3 mm (3.87 mm on average of seven specimens). Length of fore wing: 1.4-1.8 mm (1.53 mm on average of ten specimens) in material from Malaysia, and 1.4-1.9 mm (1.75 mm on average of nine specimens) in that from other countries.

Palpi ochre-grayish. Antenna blackish, with apical nine segments white; scape dark grayish on ventrum including hairy pecten. Pleural and ventral surfaces of thorax leaden-whitish with a strong metallic lustre. Fore leg metallic-fuscous entirely. Mid and hind legs dark gray-whitish with a strong metallic lustre, with hind tibia tinged with bronzy colour, and mid and hind tarsi fuscous on dorsum in whole length.

Fore wing as described originally, but base of costa rather widely black, and apical area of wing distad of third dorsal spot and fourth costal one suffusedly purplish-black; four costal and three dorsal spots shining metallic-white, subquadrangular, and surrounded by black, the second pair of them being confluent to form a fascia in some specimens.

Male genitalia (Fig. 24): Tegumen subconical, blunt apically, very sparsely squamose dorsally, with a pair of fine subapical setae; tuba analis densely covered with spinules on ventral surface. Valva nearly as long as tegumen, bar-shaped, very slightly arched upwards, slightly constricted medianly, round apically, with fine setae scattered on inner surface; transtilla complete, narrow in whole length, without laterocephalic lobes. Vinculum subtriangular, with an apical saccus very short. Aedeagus nearly as long as valva, thickly tubular, slightly tapering apically beyond middle, then round apically but one side being oblique, with a small blade-shaped sclerous plate near apex. Anellus membranous, without sclerous juxta. Flap-like eighth sternite about two-thirds as long as valva, somewhat subtriangular in outline, and more or less angulated apically. (Eight preparations examined.)

Female genitalia (Fig. 25): Papilla analis short, narrowed dorsally and ventrally in lateral view, setose as usual, and spinulose on caudal margin alone; apophysis posterioris long, straight, slender, with basal third slightly widened. Eighth abdominal segment and its apophyses anteriores not visible. Seventh abdominal segment normal in structure, rather long. Ostium bursae opening near caudal margin of

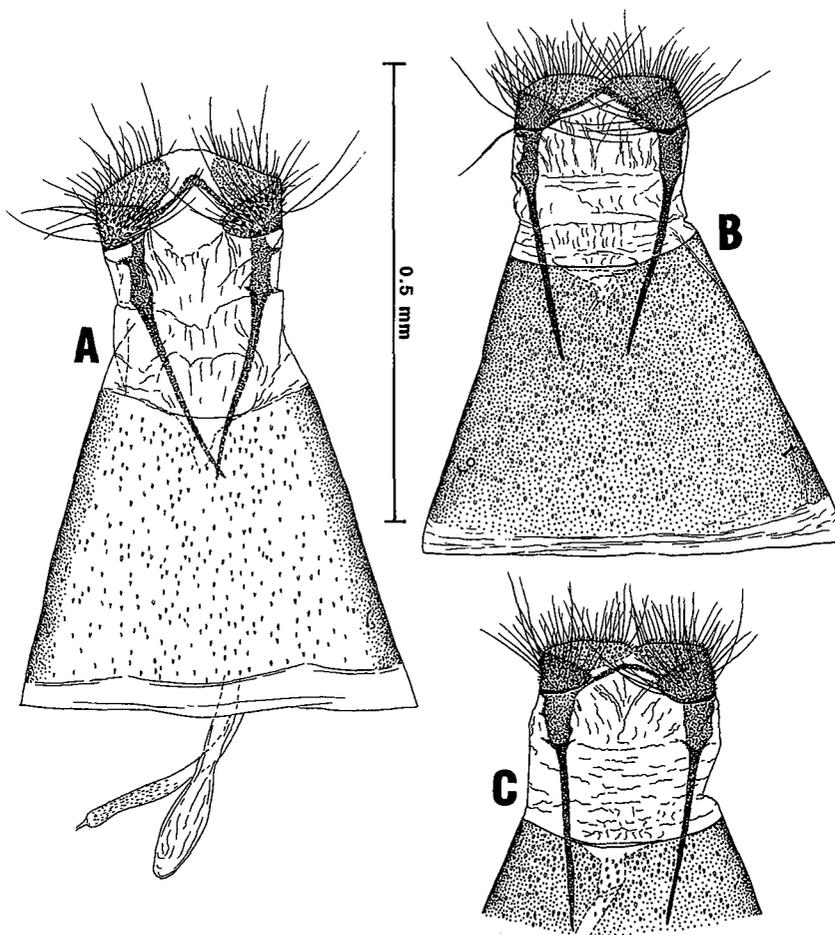


Fig. 25. *Porphyrosela dorinda* (Meyrick). A: Female genitalia in ventral view [Grc-5852, W. Malaysia, ex *Calopogonium* sp. (4703)] — B: Ditto [Grc-2684, Taiwan, ex *Desmodium heterophylla* (1998)] — C: Ditto [Grc-2681, India, ex *Desmodium gangeticum* (Ind-40)].

seventh abdominal sternite, completely membraneous without genital plate; ductus and corpus bursae not definitely visible owing to confusion with other internal organs, probably entirely membraneous, without antrum and signum. (Eleven preparations examined.)

Specimens examined. 16♂ & 36♀. WEST MALAYSIA — 4♂ & 7♀, Anak Chelong, Kangar, Perlis, em. 17-22/xi/1991, ex *Calopogonium* sp. (4703), 2♂ & 3♀ deposited in FRIM and 2♂ & 4♀ in SEHU. INDIA — 3♂ & 16♀, Krishnagar, W. Bengal, em. 7-17/ii/1978, ex *Desmodium gangeticum* (Ind-40), 1♂ & 6♀ in ZSIC and 2♂ & 10♀ in SEHU. TAIWAN — 2♂ & 2♀, Taihoku, 7/xi/1940, ex *Desmodium buergeri*, S. Issiki leg., determined as *Lithocolletis dorinda* by Issiki; 1♂, ditto, 30/x/1925, ex *Pueraria thunbergiana*, S. Issiki leg., determined as *L. dorinda* by Issiki; 1♂ & 3♀, Oulampi, Pintung, em. 16-20/vii/1979, ex *Desmodium heterophylla* (1989);

3♂ & 2♀ in EOUS and 1♂ & 3♀ in SEHU. JAPAN — 5♂ & 8♀, Isigaki-si, Isigaki Is., Ryūkyūs, em. 6/xi/1989, ex *Pueraria montana* (3618), in SEHU.

Distribution. West Malaysia ; India ; Taiwan ; and Japan.

Food plants. *Calopogonium* sp. in Malaysia ; *Desmodium* spp., including *D. gangeticum*, and *Uraria neglecta* in India ; *Desmodium heterophylla*, *D. buergeri* and *Pueraria thunbergiana* in Taiwan ; and *Pueraria montana* in Japan. All belong to Leguminosae.

Mine (Fig. 47, A-C). An irregular blotch-mine placed on space between large veins of lower surface of leaflet ; mining part whitish-green and flat at first, changed into whitish-brown in colour and a tentiform type at maturity. Lower epidermis of mining part finely wrinkled, with a strong, longitudinal median ridge. Size of mine variable depending on the number of larvae inhabiting a single mine : sometimes more than two larvae are seen in a single mine. Pupation taking place inside mine ; pupa enclosed within a whitish, silken cocoon, which is ellipsoidal in form as in most members of the genus *Phyllonorycter*.

Remarks. *P. dorinda* is very similar to *P. aglaozona* (Meyrick), described from Australia, in colour-pattern and mine, and probably it is conspecific with the latter. I have had, however, no opportunity to examine the genitalia of the latter species.

P. dorinda is also similar to *P. teramni* Vári, but is distinguished at once from the latter by the presence of the blackish basal blotch and by the strictly opposed first two pairs of the costal and dorsal silvery-white spots on the fore wing.

Porphyrosela alternata sp. nov.

[Figs. 26, 27, 33(E), 37(D), 47(D)]

Lithocolletis dorinda : Kuroko, 1961, Sci. Bull. Fac. Agr. Kyushu Univ. 18 : 320 [Japan ; host : *Desmodium buergeri*] (nec Meyrick, 1912).

Porphyrosela dorinda : Kuroko, 1982, Moths of Japan I : 202 & II : 193, pl. 7 (45) (nec Meyrick, 1912).

Description. ♂ ♀. Expanse of wings : 2.6-4.3 mm (2.8 mm in holotype, 3.51 mm on average of 18 specimens). Length of fore wing : 1.2-2.0 mm (1.3 mm in holotype, 1.61 mm on average of 18 specimens).

Head brilliantly dark leaden-gray, with tuft black ; face concolorous with head ; palpi leaden-gray. Antenna dark fuscous to black, with apical nine segments white ; scape silvery-gray on ventrum including hairy pecten. Thorax brilliantly dark leaden-gray, more or less darkened on dorsum anteriorly. All legs dark leaden-gray, but hind tibia becoming paler gray basally and apically and tinged with brown medianly ; mid and hind tarsi becoming paler towards apex. Abdomen dark fuscous dorsally and brilliantly metallic-gray ventrally.

Fore wing orange-brownish with a metallic lustre in ground colour ; a triangular black spot placed at base of costa, below it there is a brilliant and leaden-gray spot on dorsum ; three silvery-white costal spots placed at basal third and three-fifths and near apex, subquadrangular, surrounded by black, the first of them being slightly oblique outwards, and the last oblique inwards ; three similar dorsal spots placed at basal fourth, in middle and on tornus, more or less alternate with the costal spots, usually smaller and semicircular ; apical area distad of the last costal and dorsal spots purplish black ; cilia around apex and on termen blackish basally and grayish-

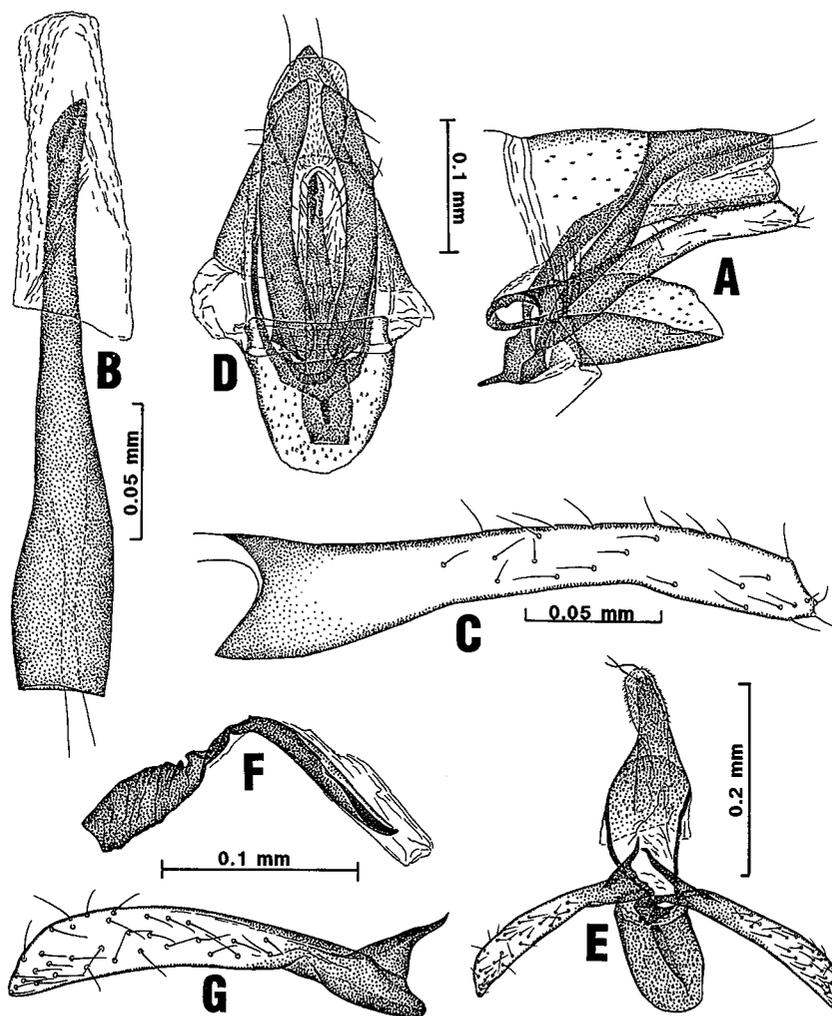


Fig. 26. *Porphyrosela alternata* sp. nov. A: Male genitalia in lateral view, aedeagus omitted [Grc-5888, holotype] — B: Aedeagus [ditto] — C: Right valva [ditto] — D: Male genitalia in ventral view [Grc-5854, W. Malaysia, ex *Desmodium heterophylla* (4092)] — E: Ditto, aedeagus omitted [Grc-141, Taiwan, ex *Desmodium buergeri*] — F: Aedeagus [ditto] — G: Left valva [ditto].

white apically, with a round blackish fringe-line; cilia on dorsal margin dark gray. Hind wing dark fuscous, with cilia dark gray.

Male genitalia (Fig. 26): Tegumen subconical, bluntly angulated apically in ventral view, very sparsely squamose and spinulose near apex dorsally; tuba analis densely spinulose on ventral surface. Valva as long as tegumen, slender, bar-shaped, slightly arched upwards, more or less angulated apically, not round as in *P. dorinda*, with dorsal side of apex more or less oblique and ventral side nearly straight; fine setae scattered on inner side more sparsely than those of *P. dorinda*;

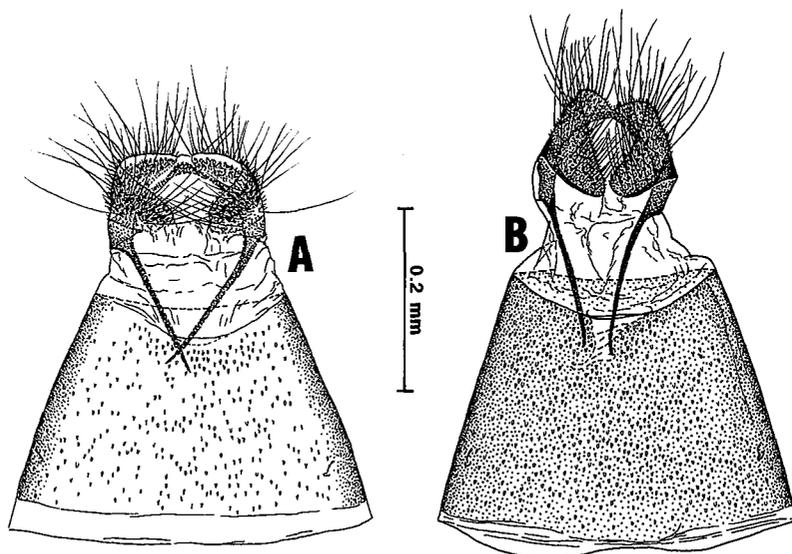


Fig. 27. *Porphyrosela alternata* sp. nov. A: Female genitalia in ventral view [Grc-5856, W. Malaysia, ex *Desmodium heterophylla* (4092)] — B: Ditto [Grc-425, Taiwan, ex *Desmodium buergeri*].

transtilla complete, slender on whole length. Vinculum subpentagonal in ventral view, somewhat angulated laterally; apical saccus evenly slender, about half as long as vinculum itself, slightly longer than that of *P. dorinda*. Aedeagus about as long as valva, thickly tubular, but becoming narrower beyond basal fourth, with apex obliquely truncated; a subcrescent-shaped, sclerous plate seen along obliquely truncated apical margin. Anellus tubular, membranous, without a sclerotized juxta. Flap-like eighth sternite semielliptical in outline, round on apical margin. (Six preparations examined.)

Female genitalia (Fig. 27): Papilla analis moderate to short in length, setose as usual, and densely spinulose on almost whole surface; apophysis posterioris long, about four-fifths as long as seventh abdominal segment, but relatively short in comparison with that of *P. dorinda*, well widened on basal fourth. Eighth abdominal segment and its apophyses absent. Ostium bursae seems to open near caudal margin of seventh abdominal sternite, but bursa copulatrix not well observed by the same reason described under *P. dorinda*. (Six preparations examined.)

Specimens examined. 34♂ & 51♀. Holotype: ♂, Beserah F.R., Kuantan, Pahang, Malaysia, em. 24/ix/1990, ex *Desmodium heterophylla* (4092), Gen. sl. no. Grc-5888, deposited in FRIM. Paratypes: WEST MALAYSIA — 8♂ & 12♀, with same data as holotype except for emergence dates, 23-26/ix/1990; 5♂ & 6♀, Templer Park, Selangor, ex 16-17/ix/1990, ex *D.h.* var. *strigosum* (4042); 1♂ & 3♀, FRIM, Kepong, Selangor, em. 19/viii/1986, ex *Desmodium* sp. (2614); 1♀, ditto, em. 14/viii/1990, ex *Desmodium* sp. (3720); 7♂ and 11♀ deposited in FRIM and the rest in SEHU. NEPAL — 18♂ & 27♀, Balaju (alt. 1,400 m), Kathmandu Valley, em. 30/ix-6/x/1983, ex *Dessmodium* sp. (Npl-630), 8♂ & 10♀ in EDAK and the rest in

SEHU. TAIWAN — 1♂ & 1♀, Taihoku (Taipei), 14/viii/1946, ex *Desmodium buergeri*, S. Issiki leg., determined as *Lithocolletis dorinda* by Issiki, in EOUS. JAPAN — 1♀, Onoaida, Yaku-sima, Satunan Is., 1/xii/1959, ex *D. buergeri*, H. Kuroko leg., determined as *L. dorinda* by Kuroko, in EOUS.

Distribution. West Malaysia; Nepal; Taiwan; and Japan (Satunan Is.).

Food plants. *Desmodium* spp., including *D. heterophylla* and *D.h.* var. *strigosum*, in Malaysia; *Desmodium* sp. in Nepal; and *D. buergeri* in Taiwan and Japan. Belonging to Leguminosae.

Mine (Fig. 47, D). An irregular linear-blotch-mine occurring upon upper side of leaflet; it is usually started as a linear, flat type, then suddenly widened into a blotch, nearly occupying whole surface of a small leaflet. Mining part whitish-green in colour with an irregular brownish line of frass at young stage, and discoloured into brownish at mature stage. When completed, upper epidermis on blotch-part strongly contracted with silken threads to form an upward-folded leaflet. Larvae often gregarious as in *P. dorinda*: sometimes more than three adults emerged from one mine.

Remarks. *P. alternata* is distinguished at once from the preceding *P. dorinda* by the fore wing with three silvery-white costal spots which are alternated with three silvery-white dorsal ones, in addition to the differences of genitalia mentioned in the description of the former species. Such an alternate appearance of silvery-white spots on the fore wing is also seen in *P. neodoxa* (Meyrick) (comb. nov.) described from India. However, *P. neodoxa* is distinguished from *P. alternata* by the absence of the basal black mark and the presence of merely two silvery white dorsal spots, besides three costal ones, on the fore wing according to the original description and the figure given by Fletcher (1933, pl. 36).

Having examined a specimen determined by Kuroko as *Lithocolletis dorinda* in 1961 and *Porphyrosela dorinda* in 1982, I have concluded that his records should be corrected to *P. alternata*.

A LIST OF FOOD PLANTS OF THE MALAYSIAN LITHOCOLLETINAE

Food plant	Leaf-miner
<i>Archidendron</i> (Leguminosae)	<i>Cameraria borneensis</i> sp. nov.
<i>Bauhinia</i> (Leguminosae)	<i>Cameraria quadrifasciata</i> sp. nov.
	<i>Cameraria trizosterata</i> sp. nov.
<i>Calopogonium</i> (Leguminosae)	<i>Neolithocolletis kangarensis</i> sp. nov.
	<i>Porphyrosela dorinda</i> (Meyrick)
<i>Desmodium</i> (Leguminosae)	<i>Porphyrosela alternata</i> sp. nov.
<i>Engelhardtia</i> (Juglandaceae)	<i>Phyllonorycter malayana</i> sp. nov.
<i>Gossypium</i> (Malvaceae)	<i>Phyllonorycter triarcha</i> (Meyrick)
<i>Milletia</i> (Leguminosae)	<i>Cameraria milletiae</i> sp. nov.
<i>Myrica</i> (Myricaceae)	<i>Phyllonorycter myricae</i> sp. nov.
<i>Pongamia</i> (Leguminosae)	<i>Cameraria pongamiae</i> sp. nov.
<i>Pterocarpus</i> (Leguminosae)	<i>Neolithocolletis pentadesma</i> (Meyrick)
<i>Rubus</i> (Rosaceae)	<i>Phyllonorycter penangensis</i> sp. nov.
<i>Spatholobus</i> (Leguminosae)	<i>Cameraria fasciata</i> sp. nov.
<i>Urena</i> (Malvaceae)	<i>Phyllonorycter consista</i> (Meyrick)
[Food plant unknown]	<i>Cameraria barlowi</i> sp. nov.

APPENDIX I :

A REVISION OF INDIAN SPECIES OF THE GENUS CAMERARIA
ASSOCIATED WITH LEGUMINOSAE

In connection with the present study on the Malaysian fauna of the subfamily Lithocolletinae, I have revised the legume-feeders of the subfamily recorded from India. In this revision I have concluded that *Lithocolletis dorinda* Meyrick, 1912, and *L. neodoxa* Meyrick, 1916, are members of the genus *Porphyrosela* as mentioned above and in Appendix II. Further, *L. bauhiniae* Stainton, 1856, and *L. virgulata* Meyrick, 1914, are referable to *Cameraria*. I have found another undescribed species of *Cameraria*, associated with *Pongamia pinnata* (Leguminosae) in India.

Key to the Indian species of *Cameraria*
associated with Leguminosae

1. Three white fasciae of fore wing margined with black on outer edges alone ; male transtilla incomplete ; male valva club-shaped, straight, with apex round ; female corpus bursae with a single cone-shaped signum, which is situated in centre of a round plate ; larval mine on *Bauhinia*. *C. bauhiniae* (Stainton)
- Three white fasciae of fore wing with a black central line and an outwardly black-edged line in their dorsal arms ; transtilla complete ; valva narrowly bar-shaped, slightly arched upwards, with apex acute ; corpus bursae with a horseshoe-shaped signum, which bears projections on inner margin ; larval mine on legumes other than *Bauhinia*. 2
2. Male vinculum rather round apically ; male aedeagus with two pairs of round processes at base of paired, acute lateral projections ; horseshoe-shaped female signum smaller, with seven to eight projections ; larval mine on *Butea* and *Desmodium*. . . *C. virgulata* (Mayrick)
- Vinculum angulated apically ; aedeagus with a caudally serrulated, trapeziform plate between paired, acute lateral projections ; horseshoe-shaped signum much larger, almost occupying corpus bursae, with 20-25 acute projections ; larval mine on *Pongamia*.
. *C. magnisignata* sp. nov.

Cameraria bauhiniae (Stainton), comb. nov.

[Figs. 28, 29(A), 34(A), 40(A), 44(A & B)]

Lithocolletis bauhiniae Stainton, 1856, Trans. Ent. Soc. Lond. (2) 3 : 303 [India (W. Bengal) ; host : *Bauhinia purpurea*] ; Fletcher, 1920, Mem. Dept. Agr. India, Ent. Ser. 6 : 140 ; *ibid.*, 1933, Imp. Council Agr. Res. India, Sci. Monograph 4 : 38, pl. 33 ; Meyrick, 1934, Exot. Microlep. 4 : 470 [Salsette Is.].

Original description. "Expansion of the wings 2 1/2 lines.

Head dark ochreous, with a ferruginous tinge. Face and palpi whitish. Antennae whitish, with fuscous annulations. Hind tarsi whitish, broadly annulated with dark fuscous.

Anterior wings brownish, with a slender, short, whitish basal streak, margined beneath, and at its end with black. Before the middle is a slender, angulated, whitish fascia, much nearer the base on the inner margin than on the costa ; the costal arm of this fascia is very short ; beyond the middle is a second angulated fascia precisely similar ; both these are margined with black scales externally, but only on the longer dorsal arm ; towards the hinder margin is an oblique whitish fascia, terminating in the apex, externally margined with black, and between it and the second fascia, is a small whitish spot on the costa, which is sometimes connected with the angulation of the second fascia by a series of black scales ; cilia greyish, with a dark fuscous hinder marginal line.

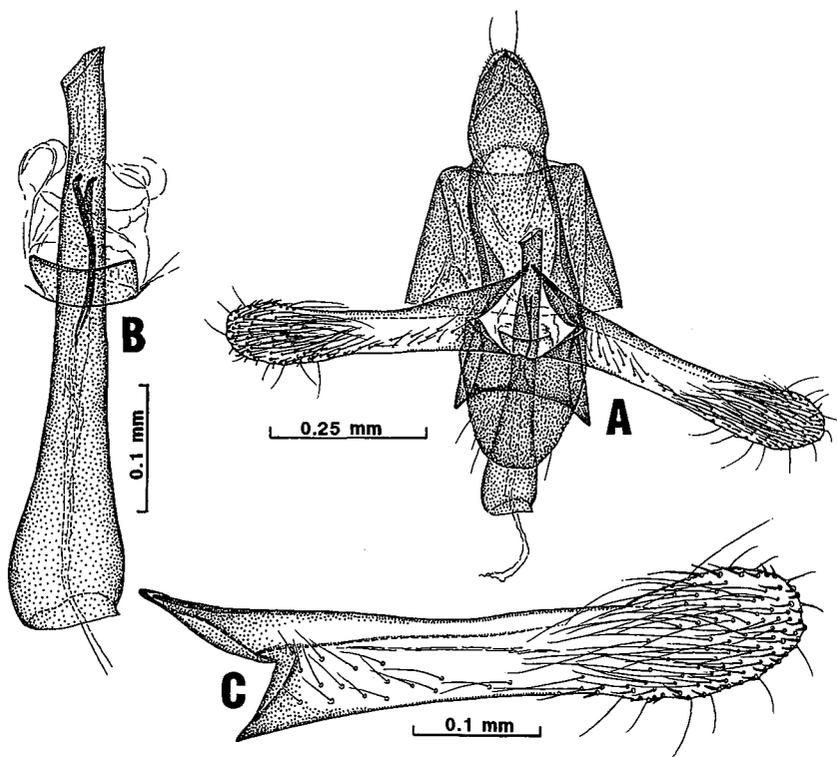


Fig. 28. *Cameraria bauhiniae* (Stainton). A: Male genitalia in ventral view [Grc-2227, India, ex *Bauhinia acuminata* (Ind-8)] — B: Aedeagus [ditto] — C: Right valva [ditto].

Posterior wings grey, with paler cilia.

Of this I have received several specimens from Mr. Atkinson."

Additional description. ♂ ♀. Expanse of wings: 5.3-5.9 mm. Length of fore wing: 2.4-2.7 mm.

Head with tuft dark ochreous, mixed with white hairy scales. Apical segment of labial palpus narrowly fuscous below. Antenna with first, third, seventh and eleventh segments from apex entirely whitish and not annulated; pecten on scape white. Thorax dark ochreous-brown dorsally, mixed with whitish scales anteriorly and fuscous scales medianly; pleural and ventral surfaces whitish. Fore leg fuscous, but the coxa being whitish basally and tarsus with three white rings. Mid and hind legs whitish, but mid tibia with two oblique stripes, mid tarsus with two broad blackish rings, hind tibia blackish basally and brownish subapically, and hind tarsus with four blackish rings.

Fore and hind wings as described originally, but the whitish basal streak of fore wing extending towards dorsal margin along base of wing, and infuscated on dorsum outside this streak.

Male genitalia (Fig. 28): Tegumen long, with its apical third (uncus) somewhat

ovate in ventral view, sparsely squamose dorsally, spinulose on apical area, with a pair of fine subapical setae; tuba analis membranous, not spinulose at all. Caudal margin of eighth abdominal tergite unusually straight or shallowly emarginate, with lateral angulations in dorsoventral view. Valva nearly as long as tegumen, nearly straight, somewhat club-shaped, with slender setae on inner surface, especially densely on clavate apical area; transtilla incomplete, with basal process of costa acutely tapering. Vinculum short, somewhat trapeziform, with lateral margins

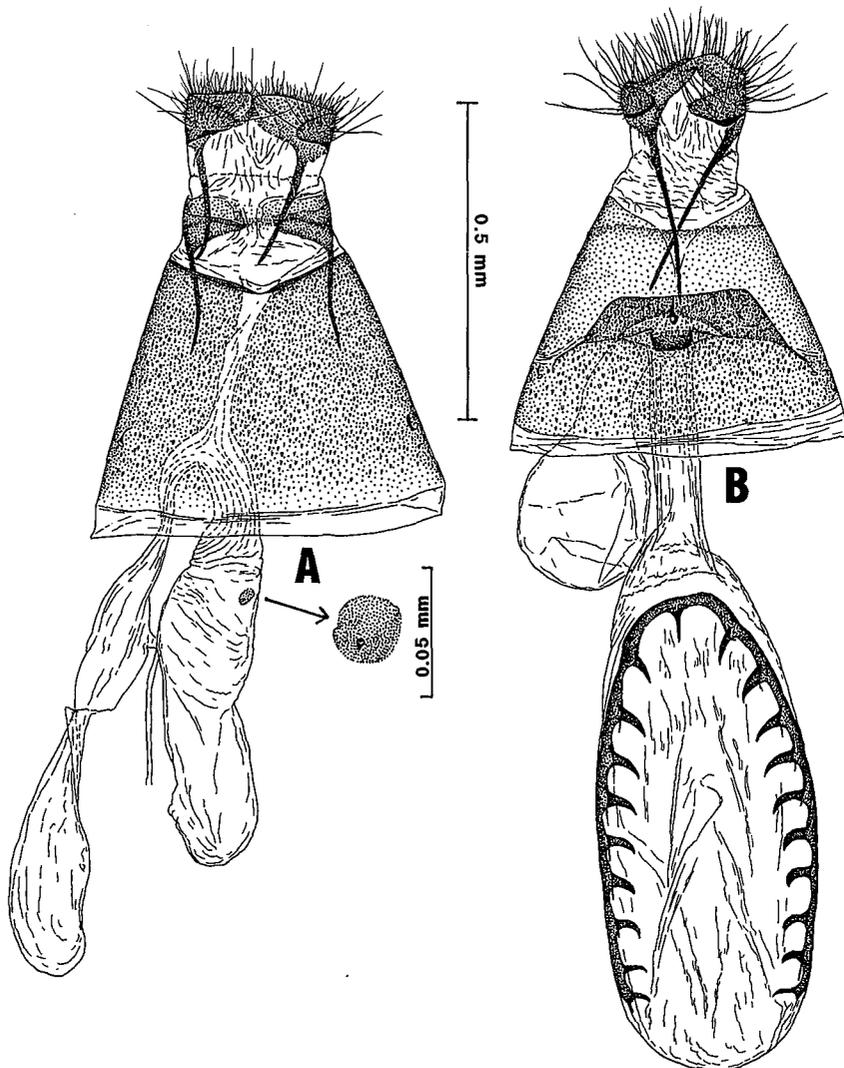


Fig. 29. A: *Cameraria bauhiniae* (Stainton), female genitalia in ventral view [Grc-2245, India, ex *Bauhinia acuminata* (Ind-8)].

B: *Cameraria magnisignata* sp. nov., female genitalia in ventreal view [Grc-2416, India, ex *Pongamia pinnata* (Ind-107)].

divergent and apical margin shallowly emarginate, thus the lateroapical corners being sharply angulated. Aedeagus about as long as valva, straightly cylindrical, well swollen at base and obliquely truncated at apex; vesica with two linear sclerites (cornuti). Anellus shortly tubular, with weakly sclerotized trapeziform sclerite (probably juxta) at base of ventral surface. Flap-like eighth sternite about half as long as valva, spatulate in outline. (One preparation examined.)

Female genitalia (Fig. 29, A): Papilla analis moderate in length, wide-triangular in lateral view, setose and spinulose as usual; apophysis posterioris moderate in length, about as long as apophysis anterioris, slender, but widened at base. Eighth abdominal segment about as long as or a little shorter than papilla analis in sclerotized part. Seventh abdominal segment normal in form, not modified into genital organs. Ostium bursae opening near caudal margin of seventh sternite, simply membraneous without genital plate; ductus bursae rather short, tubular, membraneous, without sclerous antrum; corpus bursae elongate-ellipsoidal, with a single minute, thorn-like signum, which has a round basal plate. Ductus seminalis branched off from cephalic end of ductus bursae; bulla seminalis ellipsoidal, larger than corpus bursae. (Two preparations examined.)

Specimens examined. 1♂ & 3♀. INDIA—1♂ & 3♀, Bangalore, Karnataka, em. 28/i-10/ii/1978, ex *Bauhinia acuminata* (Ind-8), deposited in SEHU.

Distribution. India (W. Bengal; Karnataka); and Salsette Is.

Food plants. *Bauhinia purpurea* and *B. acuminata* (Leguminosae).

Mine (Fig. 44, A & B). The mine of this species was described and illustrated in detail by Fletcher (1933). It is placed either on upper or lower side of leaf, usually on space between veins, flat or very slightly tentiform when completed. Pupation taking place within a thin, whitish cocoon placed inside mine. Cocoon is nearly orbicular as in members of the genera *Hyloconis* and *Neolithocolletis*.

Remarks. Adult features in all respects indicate that this species is a member of the genus *Cameraria*. However, the larval features slightly disagree with those of the Japanese members of the genus in the well-developed thoracic legs, in the absence of the proprioceptor MV3 on the abdomen, and in the seta D2 located posterodorsal to D1 on the abdomen except on the sixth segment. This species is referred to *Cameraria* with emphasis on the adult characters.

C. bauhiniae is characterized by the oval uncus, the trapeziform vinculum, the club-shaped valva and the smaller signum.

Cameraria virgulata (Meyrick), comb. nov.

[Figs. 30, 31, 34(I), 44(D)]

Lithocolletis virgulata Meyrick, 1914, Journ. Bomb. Nat. Hist. Soc. 23: 118 [India (Karnataka); host: *Ficus*]; *ibid.*, 1916, Exot. Microlep. 2: 5 [India (W. Bengal); host: *Butea frondosa*, cancelling *Ficus* from host record]; Fletcher, 1920, Mem. Dept. Agr. India, Ent. Ser. 6: 138, pl. 34.

Original description. "♂. 6 mm. Head and palpi whitish. Forewings narrow-lanceolate; ochreous-chestnut-brown; an irregular whitish median basal streak to 1/4, irregularly irrorated with black, and connected with dorsum near base by a mark of black irroration; three somewhat inwardly oblique whitish transverse fasciae, angulated above middle, lower portion sometimes mostly suffused with ground colour, their margins marked with black irroration, posterior margins strongest but interrupted above angle, posterior margin of third running into apex: cilia whitish-

ochreous, round apex irrorated with black points. Hindwings grey; cilia pale greyish-ochreous. Manchikeri, Kanara, bred in May, from cocoons found on a *Ficus* ((Maxwell); two specimens.”

Although I have had no opportunity to examine the Indian specimens, I will give descriptive notes based on the Nepalese material.

Additional description. ♂ ♀. Expanse of wings: 5.1–6.1 mm (5.47 mm on average of eight specimens). Length of fore wing: 2.4–2.9 mm (2.57 mm on average of eight specimens).

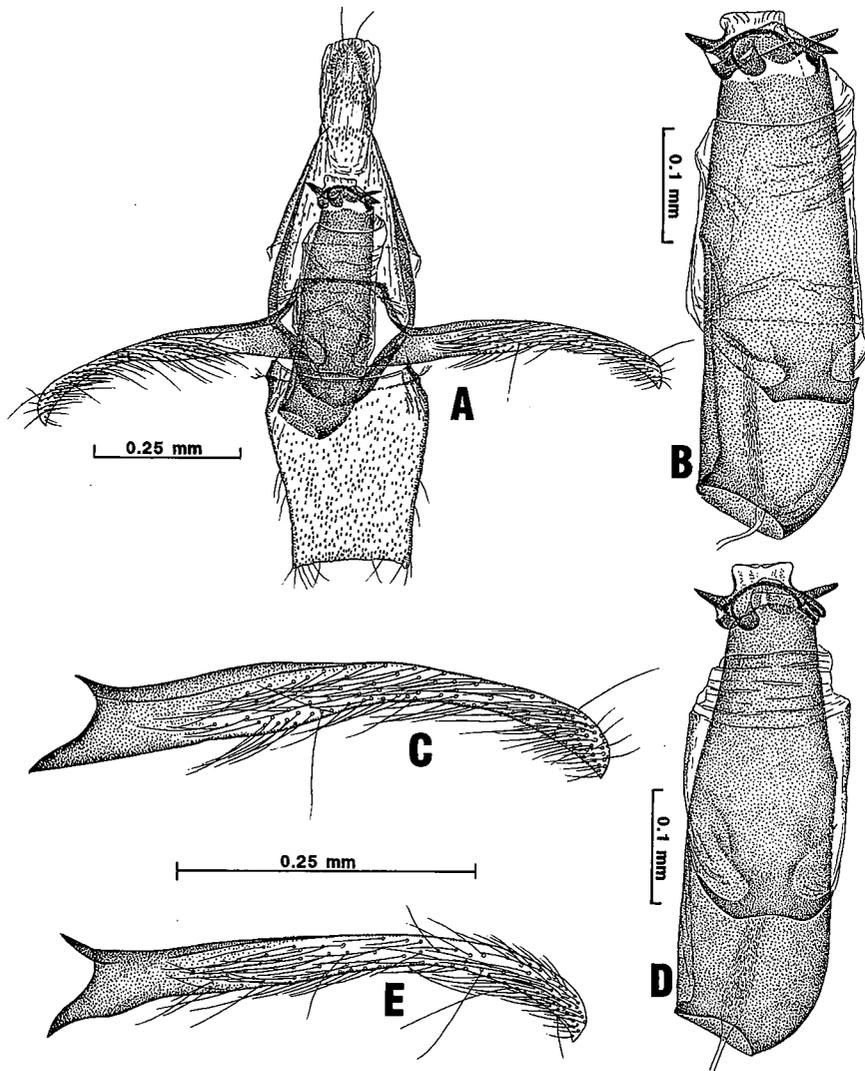


Fig. 30. *Cameraria virgulata* (Meyrick). A: Male genitalia in ventral view [Grc-3444, Nepal, ex *Butea* sp. (Npl-40)] — B: Aedeagus [ditto] — C: Right valva [ditto] — D: Aedeagus [Grc-3449, Nepal, ex *Desmodium* sp. (Npl-316)] — E: Right valva [ditto].

Head with tuft ochreous, mixed with whitish hairy scales posteriorly; labial palpus with a fuscous subapical ring. Antenna whitish below, ochreous above, each segment spotted with fuscous above except for third, seventh and eleventh segments from apex. Thorax ochreous-brownish dorsally, sparsely mixed with whitish scales anteriorly, with a transverse median band of fuscous irroration; pleural and ventral surfaces brilliantly whitish. Fore leg dark fuscous, but coxa grayish and tarsus whitish basally and apically leaving a median blackish ring. Mid and hind legs whitish, but mid tibia with two oblique, blackish streaks, mid tarsus with two rather wide blackish rings, hind tibia blackish basally and dark brownish medianly, and hind tarsus with three blackish rings. Abdomen dark grayish on dorsum, whitish on ventrum, with ventromesal and lateral areas narrowly fuscous.

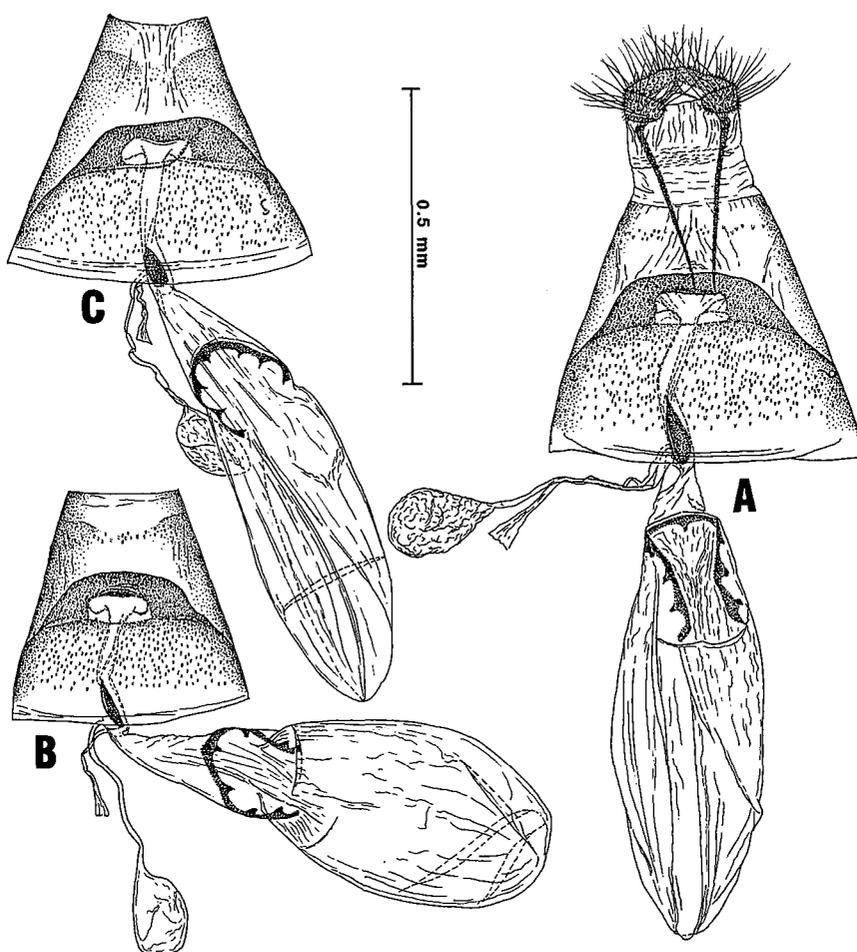


Fig. 31. *Cameraria virgulata* (Meyrick). A: Female genitalia in ventral view [Grc-3445, Nepal, ex *Butea* sp. (Npl-410)] — B: Ditto, papillae anales omitted [Grc-3450, Nepal, ex *Desmodium* sp. (Npl-316)] — C: Ditto [Grc-5339, Iriomote Is., Ryūkyūs, Japan, ex *Pueraria montana* (3596)].

Fore wing as described originally, but dorsal arms of the whitish fasciae containing a line of black irroration and their inner edges not margined with black irroration; outer blackish edge of the second fascia bifurcated at angle, then the outer branch reaching apical fourth of costa, where it is margined with white internally; cilia with a subapical fringe-line of blackish irroration nearly parallel to termen.

Male genitalia (Fig. 30): Tegumen long, subconical, sparsely squamose dorsally, spinulose apically, with a pair of fine apical setae; tuba analis membranous, not spinulose at all. Valva about as long as tegumen, slender on whole length, very slightly constricted around apical third, with apex acutely pointed downwards; slender setae occurring on inner surface rather densely; transtilla complete, slender, very slightly widened and angulated at laterocephalic areas. Vinculum narrowly crescent-shaped, with apical margin round. Aedeagus a little shorter than valva, thickly tubular, slightly tapering apically, with a pair of acute, slightly oblique lateral processes and with two pairs of round, shorter processes situated just basad of the acute ones. Anellus tubular, with a reversed T-shaped, short ventral sclerite (probably juxta). Flap-like eighth sternite elongate-quadrangular, about three-fourths as long as valva, with apical margin shallowly emarginate. (Three preparations examined.)

Female genitalia (Fig. 31): Papilla analis short, wide-subtriangular in lateral view, setose and spinulose as usual; apophysis posterioris long, slender. Eighth abdominal segment tightly united with the seventh, without intersegmental membrane between them, squamose dorsally; apophysis anterioris absent. Seventh abdominal sternite produced caudally to form a wide-trapeziform flap, of which the caudal margin is rather straight. Ostium bursae opening at a quadrate, unsclerotized area under the flap of seventh sternite; ductus bursae shortly tubular, about as long as seventh abdominal segment, with a shortly sclerotized antrum on cephalic end, the distance between ostium bursae and antrum being longer than length of antrum itself; corpus bursae elongate-ellipsoidal, longer than ductus bursae; a narrowly horseshoe-shaped signum with seven to eight short projections, which are arranged at nearly regular intervals. Ductus seminalis about as long as ductus bursae, very thin; bulla seminalis small, globular. (Four preparations examined.)

Specimens examined. 4♂ & 5♀. NEPAL—1♂ & 1♀, Malipu—Suri Dhoban (alt. 1,000–1,100 m), Janakpur, em. 17/viii-1/ix/1983, ex *Desmodium* sp. (Npl-315); 1♂ & 1♀, Gongar (alt. 1,400 m), Janakpur, em. 29/vii-7/ix/1983, ex *Butea* sp. (Npl-410); 2♀ & 2♀, Dolakha—Charikot (alt. 1,700–2,000 m), Janakpur, ex an undetermined legume (Npl-426); 2♂ & 2♀ deposited in EDAK and the rest in SEHU. JAPAN—1♀, Uehara, Iriomote Is., Ryūkyūs, em. 15/xi/1989, ex *Pueraria montana* (3596), in SEHU.

Distribution. India (Karnataka; W. Bengal); Nepal; and Japan (Ryūkyū Is.).

Food plants. *Butea frondosa* in India; *Butea* sp. and *Desmodium* sp. in Nepal; *Pueraria montana* in Japan. All belong to Leguminosae.

Mine (Fig. 44, D). Mines of the present species were described and illustrated in detail by Fletcher (1920), and the Nepalese material, from which the adult specimens emerged, well agrees with them except that most of the mines are situated on the lateral vein.

Remarks. *C. virgulata* is related to *C. pongamiae* described from Malaysia and

Taiwan, and hardly distinguishable from the latter by the colour-pattern alone. It is, however, distinct in the genital characters as already mentioned under the latter species.

Cameraria magnisignata sp. nov.

[Figs. 29(B), 32, 34(J), 41(B), 45(B)]

Description. ♂ ♀. Expanse of wings: 5.5–6.4 mm (6.3 mm in holotype, 5.97 mm on average of 20 specimens). Length of fore wing: 2.6–3.0 mm (2.9 mm in holotype, 2.77 mm on average of 20 specimens).

Head, face and palpi brilliantly white; a tuft on head ochreous-brownish, mixed with darker, hairy scales anteriorly and whitish ones posteriorly. Antenna whitish below, ochreous above, with each segment spotted with fuscous above except for third, seventh and eleventh segments from apex; pecten of scape white. Thorax ochreous-brownish dorsally, mixed with whitish scales anteriorly and fuscous ones medianly; pleural and ventral surfaces whitish. Fore leg fuscous, with coxa wholly and tarsus at base, in middle and at apex white. Mid and hind legs white, but mid tibia with two blackish, oblique stripes, mid tarsus with three blackish rings, hind tibia infuscated at base and on apical half, and hind tarsus with four blackish rings. Abdomen leaden-grayish dorsally, whitish ventrally, with a fuscous ventromesal line and a series of fuscous lateral spots.

Fore wing light chestnut-brownish in ground colour, a little lighter than that of *C. virgulata*; markings very similar to those of *C. virgulata* in colour and situation, but marginal black speckles of white fasciae are much smaller and sparser; a narrow, irregular, whitish basal streak extending to basal sixth of wing along wing-fold, intermixed or margined below with blackish irroration, which is extending towards dorsal margin through wing-base; three inwardly oblique, whitish fasciae placed at about basal fourth, in middle and at apical fifth; first two of them angulated outwards near costa, the dorsal arms tinged with ochre, containing an irregular line of black irroration and widely margined with black irroration on outer edges, and the costal arms very sparsely margined with black irroration both on inner and outer edges; the outer black irroration of the second fascia always extending from angle to apical fourth of costa, where it is edged with white internally; third fascia most oblique, running from tornus almost to apex of costa, somewhat sinuate, and margined with black irroration on outer edge rather widely, the irroration being usually interrupted in its middle; termen widely whitish, with three or four lines of black speckles running in parallel to margin; cilia on costa brownish, those on termen whitish, with a fringe-line of black irroration, and those on dorsal margin pale grayish. Hind wing grayish, with cilia pale grayish.

Male genitalia (Fig. 32): Tegumen long, subconical, rather acute apically, sparsely squamose dorsally, spinulose around apex, with a pair of fine subapical setae; tuba analis membranous, not spinulose. Valva about as long as tegumen, very slender, but slightly swollen before middle and near apex, with a shortly pointed apex which is directed downwards; rather dense, slender setae occurring on inner surface of valva except on base; transtilla complete, slender on whole length. Vinculum wide-triangular, with apex shortly acuminate. Aedeagus thickly tubular, very slightly tapering apically; a pair of hook-shaped lateral projections at apex,

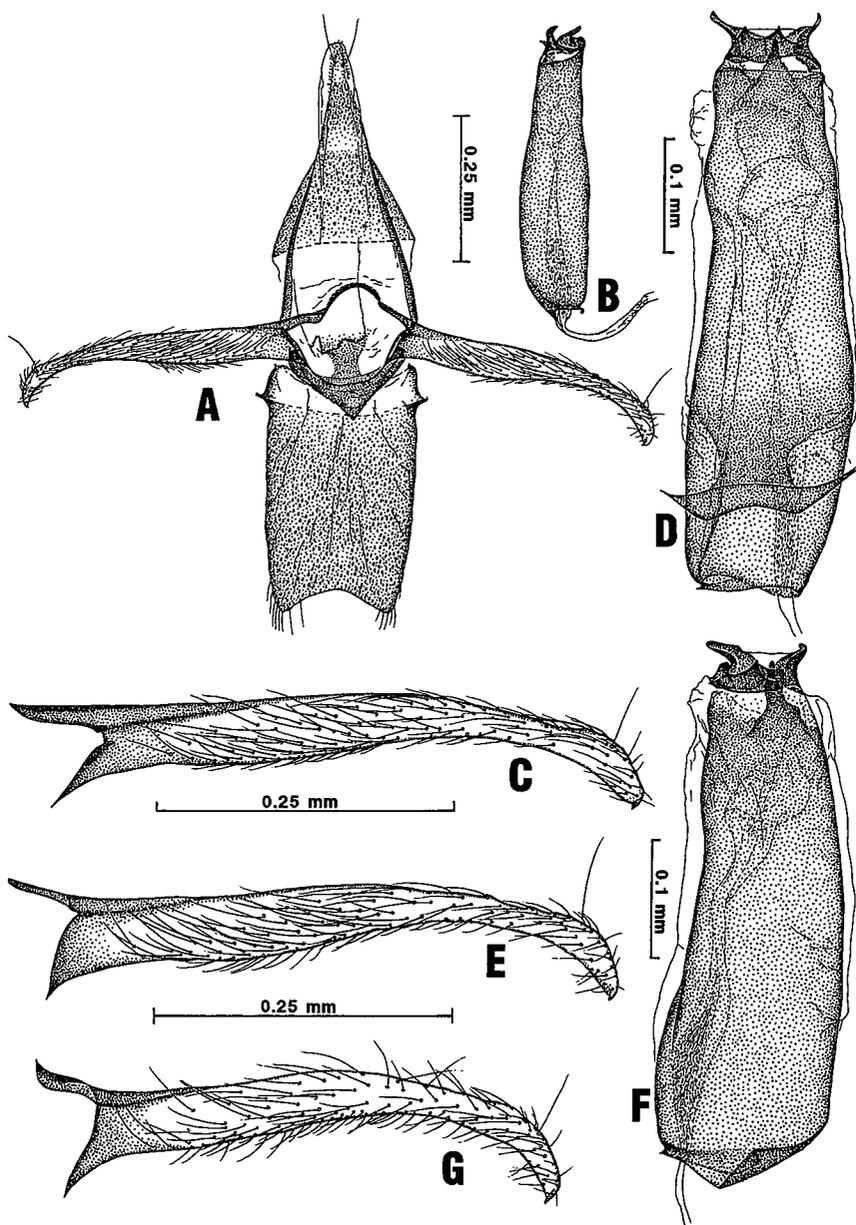


Fig. 32. *Cameraria magnisignata* sp. nov. A: Male genitalia in ventral view, aedeagus omitted [Grc-2414, holotype] — B: Aedeagus [ditto] — C: Right valva [ditto] — D: Aedeagus [Grc-2413, India, ex *Pongamia pinnata* (Ind-107)] — E: Right valva [ditto] — F: Aedeagus [Grc-2224, India, ex *P. pinnata* (Ind-1)] — G: Right valva [ditto].

the projections being rather oblique; a small plate placed between the paired projections, with two minute, acute processes on its apical margin; an acute apical process of aedeagus seen on a side opposite to the small plate; vesica without cornuti. Anellus tubular, with a short ventral sclerotization (juxta) at base. Flap-like eighth sternite a little shorter than valva, elongate-quadrangular, nearly parallel-sided, shallowly emarginate apically. (Four preparations examined.)

Female genitalia (Fig. 29, B): Papilla analis short, wide-subtriangular in lateral view, setose and spinulose as usual; apophysis posterioris long, slender, slightly widened near base. Eighth abdominal segment tightly united with the seventh without intersegmental membrane between them, squamose dorsally; apophysis anterioris absent. Seventh sternite shortly produced caudally to form a wide-triangular flap, of which the caudal margin is straight. Ostium bursae opening at a luniform, unsclerotized area under the flap of seventh sternite; ductus bursae moderately thick, tubular, with a shortly sclerotized antrum at caudal end; corpus bursae large, ellipsoidal, much longer than ductus bursae; a narrowly sclerotized, horseshoe-shaped signum very large, occupying almost whole corpus bursae, with 20-25 hook-shaped projections, which are arranged at nearly regular intervals on the inner margin. Ductus seminalis shorter than ductus bursae, rather thick; bulla seminalis globular, larger than that of *C. virgulata*. (Two preparations examined.)

Specimens examined. 45♂ & 28♀. Holotype: ♂, New Delhi, Delhi, India, em. 11/xi/1878, ex *Pongamia pinnata* (Ind-107), Gen. sl. no. Grc-2414, deposited in SEHU. Paratypes: INDIA—42♂ & 27♀, with same data as holotype except for emergence dates, 4-13/xi/1978; 2♂ & 1♀, New Delhi, em. 23/i-1/ii/1978, ex *Pongamia* sp. (Ind-1); 15♂ & 10♀ in ZSIC and the rest in SEHU.

Distribution. India (Delhi).

Food plants. *Pongamia* spp., including *P. pinnata* (Leguminosae).

Mine (Fig. 45, B). The mine of this new species is very similar to and hardly discriminated from that of *C. virgulata* and *C. pongamiae*.

A circular or oblong blotch-mine occurring upon upper side of leaflet, usually placed on veins, very flat and whitish-green with a brownish central patch of frass at young stage, then deformed into a slightly tentiform type and discoloured into white at fully mature stage, about 1.5 cm in diameter. Loosened upper epidermis of mine slightly contracted by silken threads, but no distinct wrinkles are visible. Pupation taking place within a thin, whitish, ellipsoidal cocoon, which is placed in the centre of the mine.

Remarks. This new species is undoubtedly related to the preceding *C. virgulata* and also to *C. pongamiae* described from Malaysia and Taiwan in this paper. It is, however, distinguished from the latter two by the much sparser and smaller marginal black speckles of the whitish fasciae of the fore wing, by the aedeagus with a small biserrulated apical plate in addition to the paired, acute lateral projections, and by the much larger signum with 20-25 hook-shaped projections.

APPENDIX II :

A TENTATIVE LIST OF THE SPECIES OF PORPHYROSELA BRAUN

Species are arranged in the order of publication. Most of them have not been

examined by me, and new combinations proposed are based on their original descriptions and available redescrptions.

1. *P. desmodiella* (Clemens, 1859)

Lithocolletis desmodiella Clemens, 1859, Proc. Acad. Nat. Sc. Philad. : 220.

Porphyrosela desmodiella : Braun, 1908, Trans. Amer. Ent. Soc. 34 : 348, pl. 24 (14, 15).

Lithocolletis gregariella Murtfoldt, 1881, Can. Ent. 13 : 245.

Distribution. North America.

Food plants. *Centrosema* spp., *Desmodium* spp., *Lespedeza* spp., and *Phaseolus* spp. (Leguminosae).

2. *P. aglaozona* (Meyrick, 1882), comb. nov.

Lithocolletis aglaozona Meyrick, 1882, Proc. Linn. Soc. N. S. Wales 7 : 199 ; *ibid.*, 1907, ditto 32 : 52 ; Turner, 1940, Trans. Roy. Soc. Austr. 64 : 51.

Distribution. Australia.

Food plants. *Desmodium* spp. and *Kennedya* spp. (Leguminosae).

3. *P. desmochrysa* (Lower, 1897), comb. nov.

Lithocolletis desmochrysa Lower, 1897, Proc. Linn. Soc. N. S. Wales 22 : 23 ; Turner, 1940, Trans. Roy. Soc. S. Austr. 64 : 51.

Nepticula nigricansella Tepper, 1899, Trans. Roy. Soc. S. Austr. 13 : 280.

Distribution. Australia.

Food plants. *Hardenbergia* spp. (Leguminosae).

4. *P. dorinda* (Meyrick, 1912)

Lithocolletis dorinda Meyrick, 1912, Exot. Microlep. 1 : 21.

Porphyrosela dorinda : Kumata, 1993, present paper.

Distribution. India, Malaysia, Taiwan, and Japan.

Food plant. *Calopogonium* spp., *Desmodium* spp., *Pueraria* spp., and *Uraria* spp. (Leguminosae).

5. *P. neodoxa* (Meyrick, 1916), comb. nov.

Lithocolletis neodoxa Meyrick, 1916, Exot. Microlep. 1 : 621 ; Fletcher, 1933, Imp. Council Agr. Res. India, Sci. Monogr. 4 : 40.

Distribution. India.

Food plants. *Cajanus* spp. and *Rhynchosia* spp. (Leguminosae).

6. *P. minuta* Clarke, 1953

Porphyrosela minuta Clarke, 1953, Acta Zool. Lilloana 13 : 69.

Distribution. Argentina.

7. *P. hardenbergiella* (Wise, 1957), comb. nov.

Lithocolletis hardenbergiella Wise, 1957, Proc. R. Ent. Soc. Lond. (B) 26 : 26.

Distribution. New Zealand.

Food plants. *Hardenbergia* spp. (Leguminosae).

8. *P. teramni* Vári, 1961

Porphyrosela teramni Vári, 1961, Transv. Museum, Mem. 12 : 224.

Distribution. South Africa.

Food plants. *Teramnus* spp. and *Vigna* spp. (Leguminosae).

9. *P. homotropha* Vári, 1963

Porphyrosela homotropha Vári, 1963, Dtsch. Ent. Z. (N. F.) 10 : 11.

Distribution. South Africa.

Food plants. *Glycine* spp. (Leguminosae).

10. *P. alternata* Kumata, 1993

Porphyrosela alternata Kumata, 1993, present paper.

Distribution. Nepal, Malaysia, Taiwan, and Japan.

Food plants. *Desmodium* spp. (Leguminosae).

ACKNOWLEDGEMENTS

During my collecting trips in Malaysia, India and Nepal in connection with the projects "Systematic and Ecological Surveys on Some Plant-Parasitic Microarthropods in Southeast Asia" and "Research Trips for Agricultural and Forest Insects in the Subcontinent of India", I received much help from the following persons : the late Dr. Tho Yow Pong, Mr. Laurence G. Kirton, Miss Jurie Intachat and Mr. Azmi Mahyudin of the Forest Research Institute of Malaysia, Kuala Lumpur ; Dr. Khoo Soo Ghee of the Department of Zoology, University of Malaya, Kuala Lumpur ; Mr. Chey Vun Khen and Mr. Saikeh Lantoh of the Forest Research Centre, Sandakan, Sabah ; Mr. Abang Abdul Hamid of the Forest Department of Sarawak, Kuching, Sarawak ; the late Dr. D.N. Raychaudhuri, Dr. Dinendra Raychaudhuri and Dr. Basant K. Agarwala of the Zoological Department, University of Calcutta, Calcutta ; Dr. T.N. Ananthkrishnan and Dr. G.S. Arora, formerly of the Zoological Survey of India, Calcutta ; Dr. V.K. Thapa of the Tribhuvan University, Kathmandu ; Dr. K.C. Sharma, Mr. N.R. Sharma and Mr. J. Kumar KC of the Department of Agriculture of Nepal, Kathmandu ; and all the Japanese members of the projects. I am grateful to all the persons mentioned above.

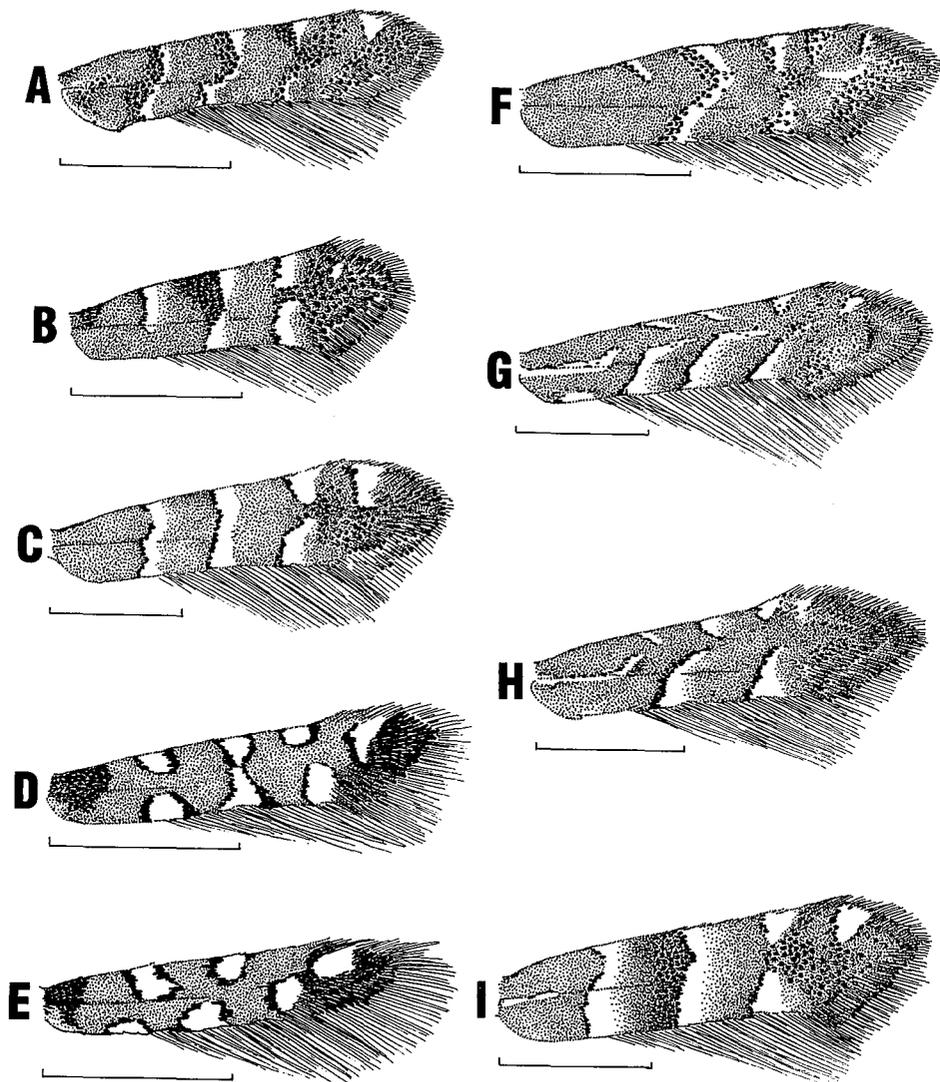
I also express my thanks to the authorities of the Botanical Survey of India, Calcutta, and also of the Herbarium Section of Nepalese Government, Godawari, Kathmandu, and Mr. K.M. Kochummen, ex-Botanist of the Forest Research Institute of Malaysia, for their kindness in identifying the food plants of gracillariid moths.

Last but not least, I express my sincere thanks to Prof. S. Takagi and Dr. M. Suwa of Systematic Entomology, Hokkaidô University, for their kindness in reading through the manuscript.

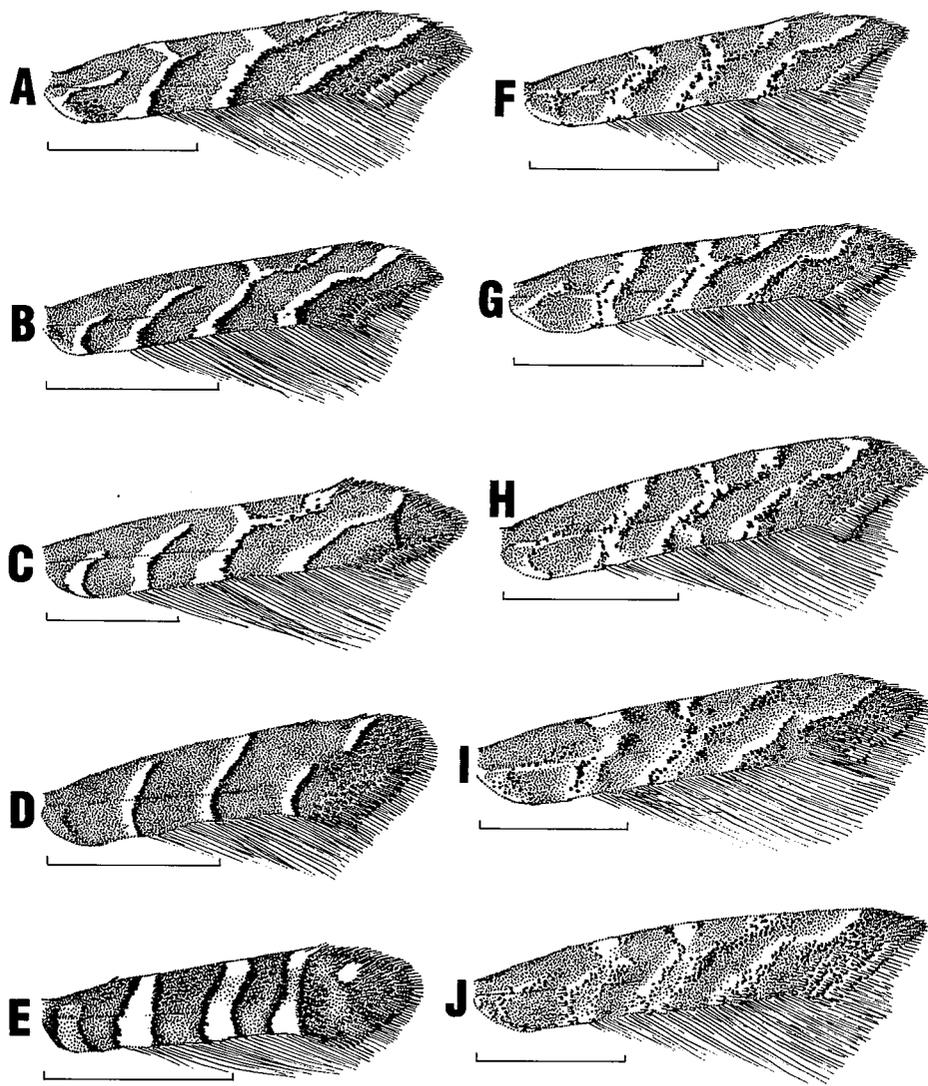
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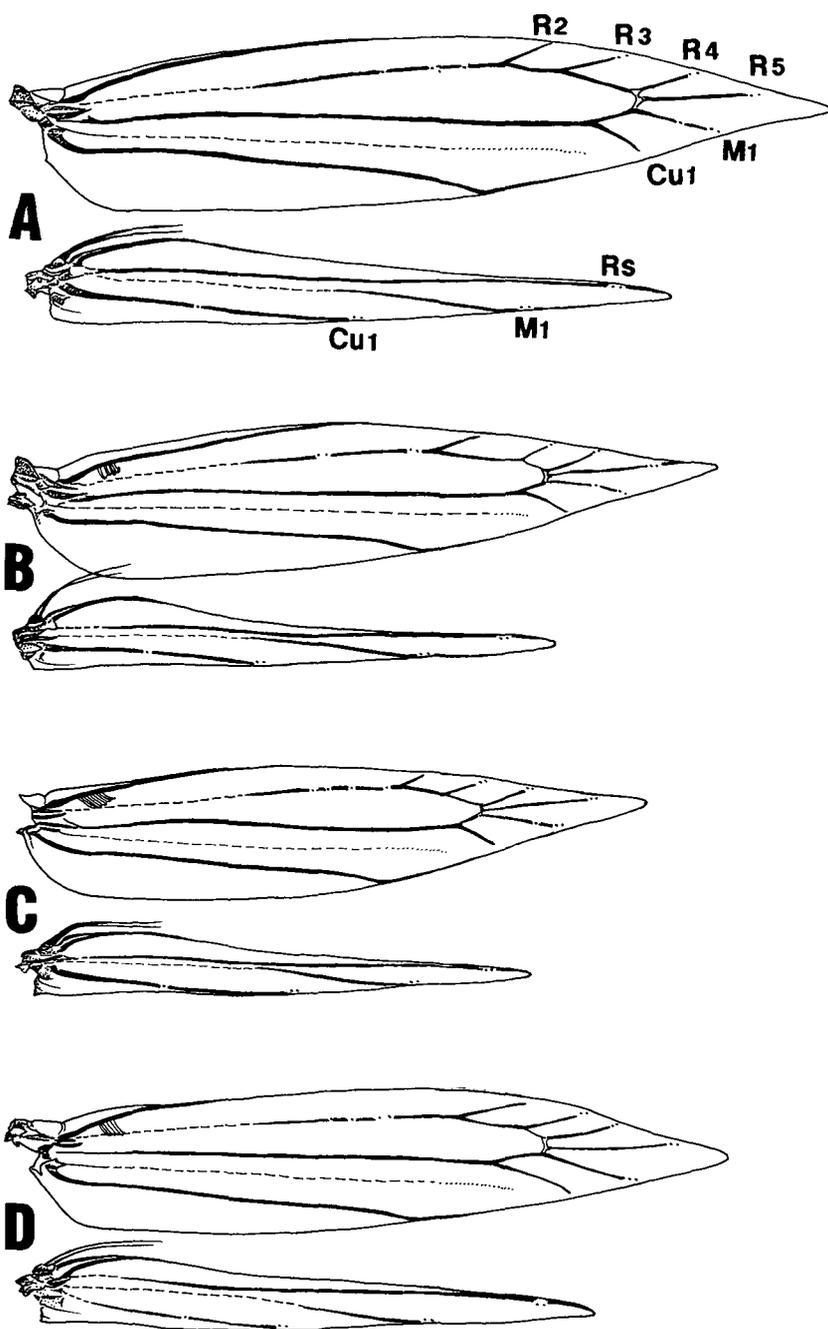
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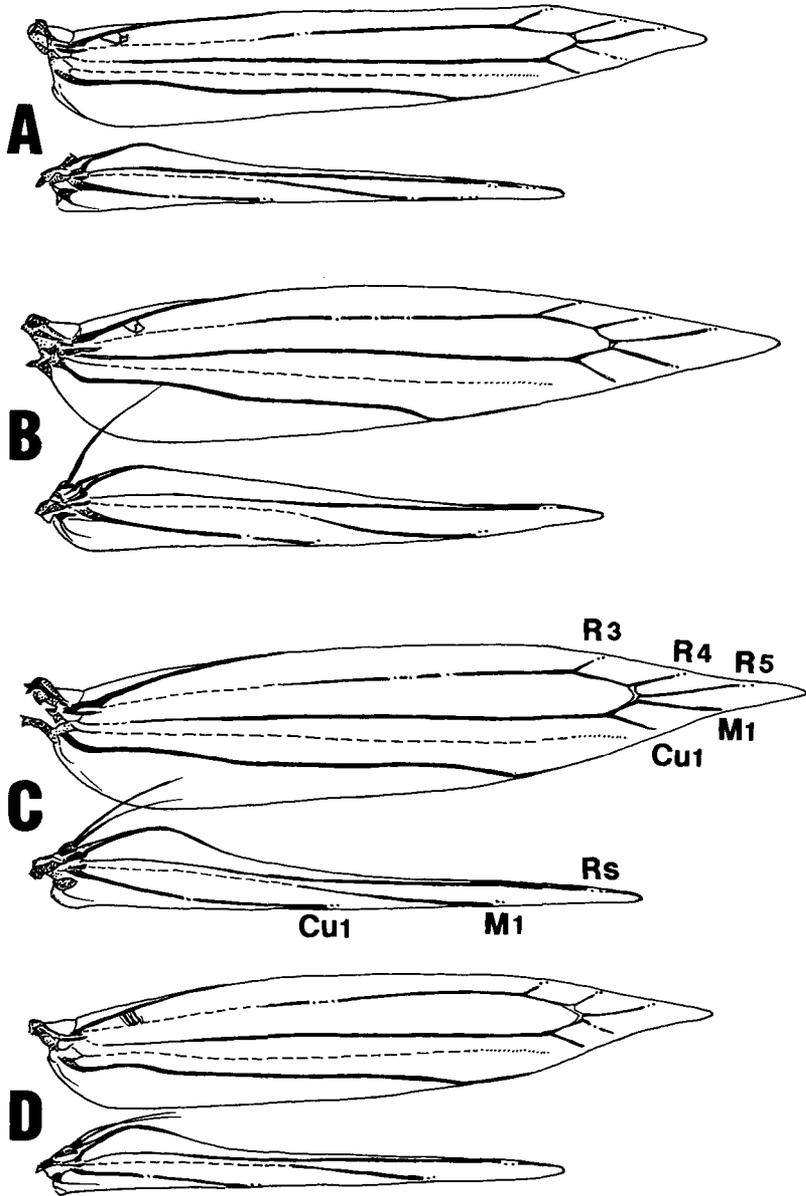
Pl. I: Fig. 33. Fore wing. A: *Neolithocolletis pentadesma* (Meyrick) — B: *N. kangarensis* sp. nov. — C: *N. hikomonticola* Kumata — D: *Porphyrosela dorinda* (Meyrick) — E: *P. alternata* sp. nov. — F: *Phyllonorycter conista* (Meyrick) — G: *P. malayana* sp. nov. — H: *P. myricae* sp. nov. — I: *P. penangensis* sp. nov. (Scale, 1 mm.)



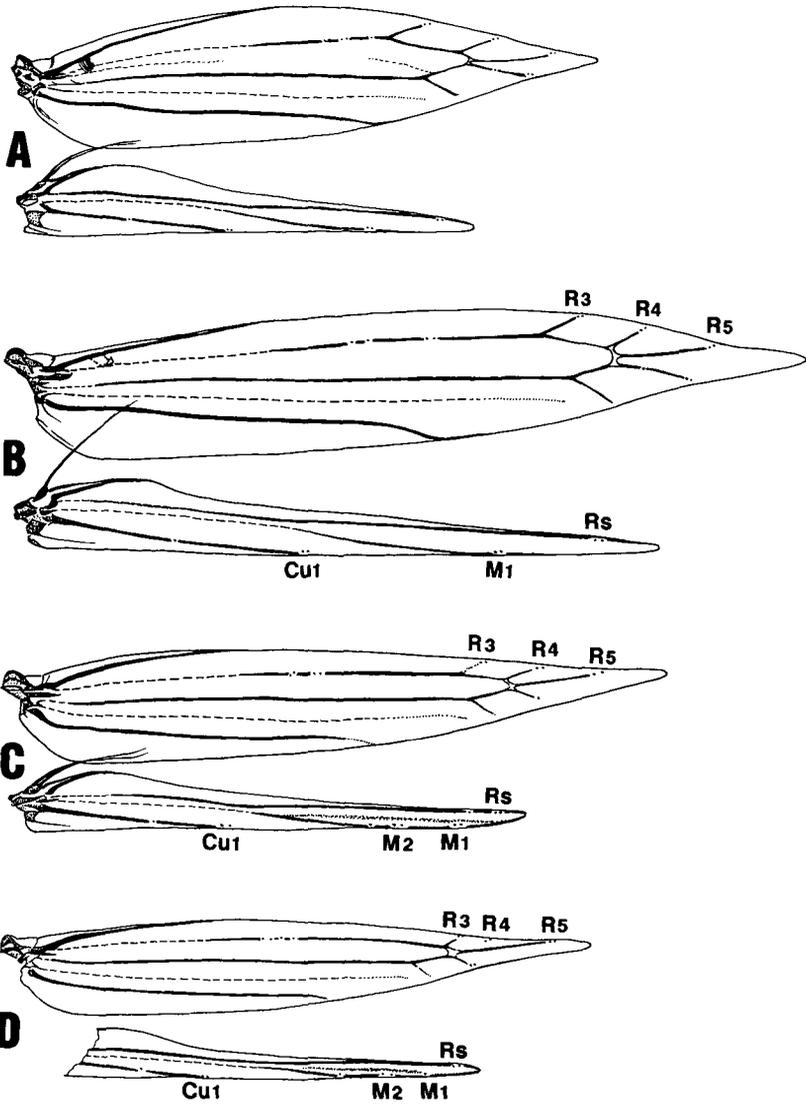
Pl. II: Fig. 34. Fore wing. A: *Cameraria bauhiniae* (Stainton) — B: *C. quadrifasciata* sp. nov. — C: *C. barlowi* sp. nov. — D: *C. trizosterata* sp. nov. — E: *C. fasciata* sp. nov. — F: *C. pongamiae* sp. nov. — G: *C. borneensis* sp. nov. — H: *C. milletiae* sp. nov. — I: *C. virgulata* (Meyrick) — J: *C. magnisignata* sp. nov. (Scale, 1 mm.)



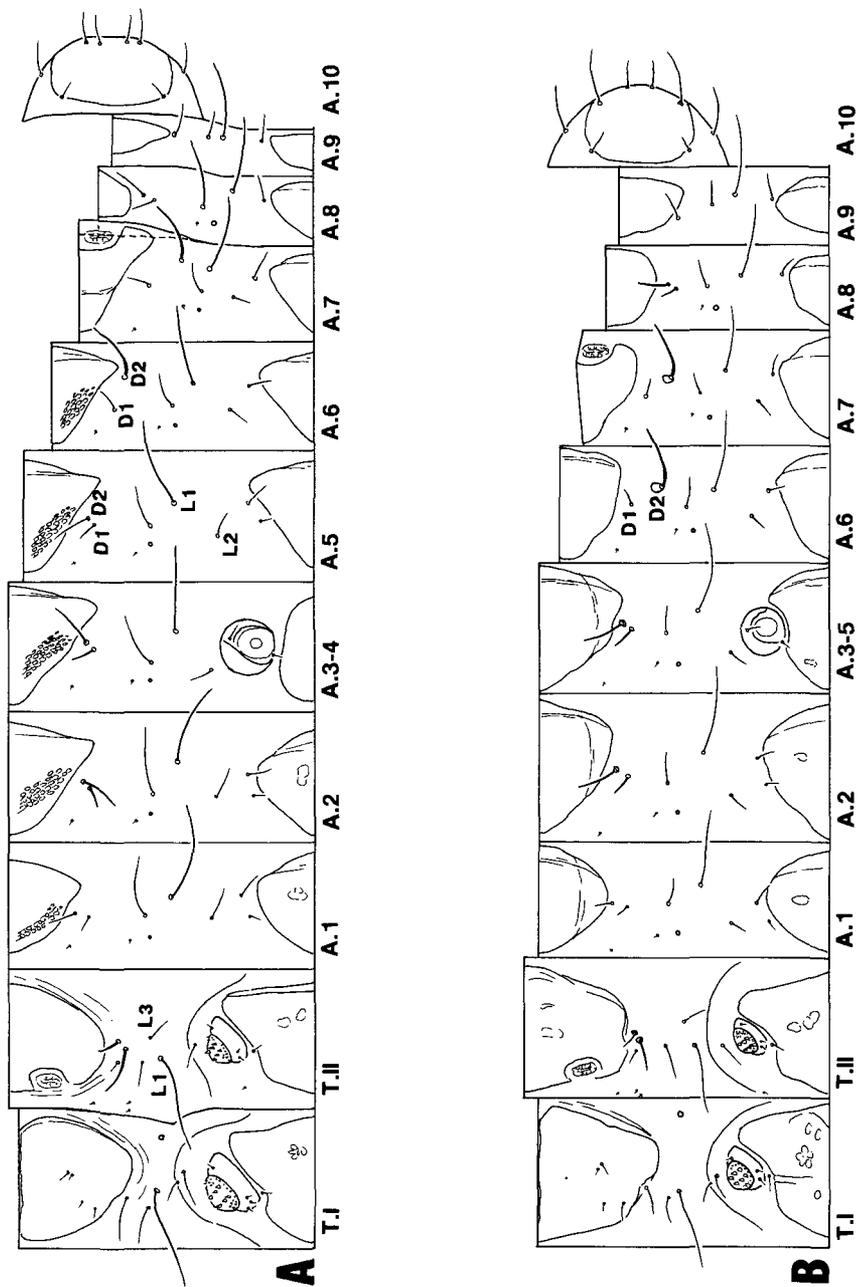
Pl. III : Fig. 35. Wing venation. A: *Neolithocolletis hikomonticola* Kumata [Grc-86] —
 B: *N. pentadesma* (Meyrick) [Grc-5900] — C: *N. kangarensis* sp. nov. [Grc-5832] —
 D: *Cameraria fasciata* sp. nov. [Grc-3694].



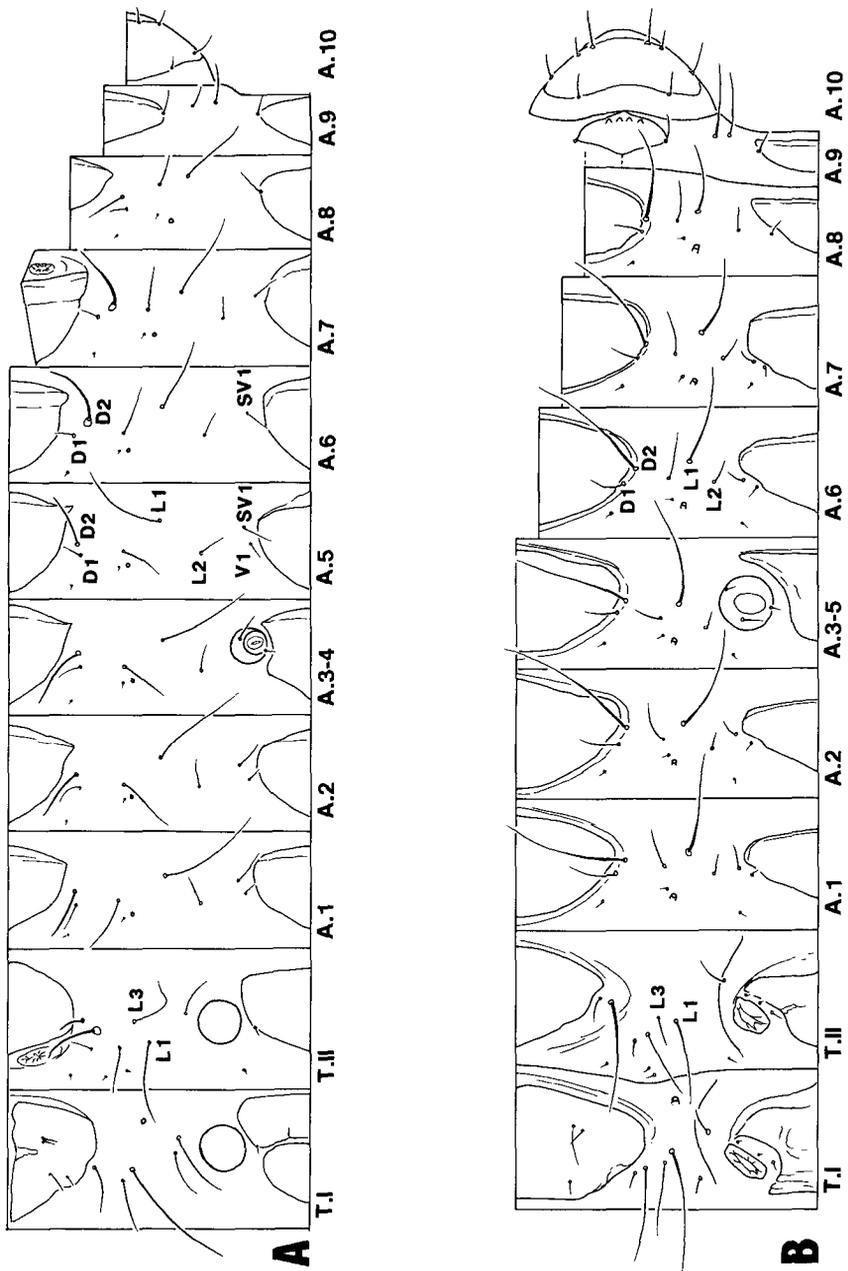
Pl. IV : Fig. 36. Wing venation. A: *Cameraria pongamiae* sp. nov. [Grc-5857] — B: *C. borneensis* sp. nov. [Grc-5259] — C: *C. quadrifasciata* sp. nov. [Grc-5896] — D: *C. trizosterata* sp. nov. [Grc-5838].



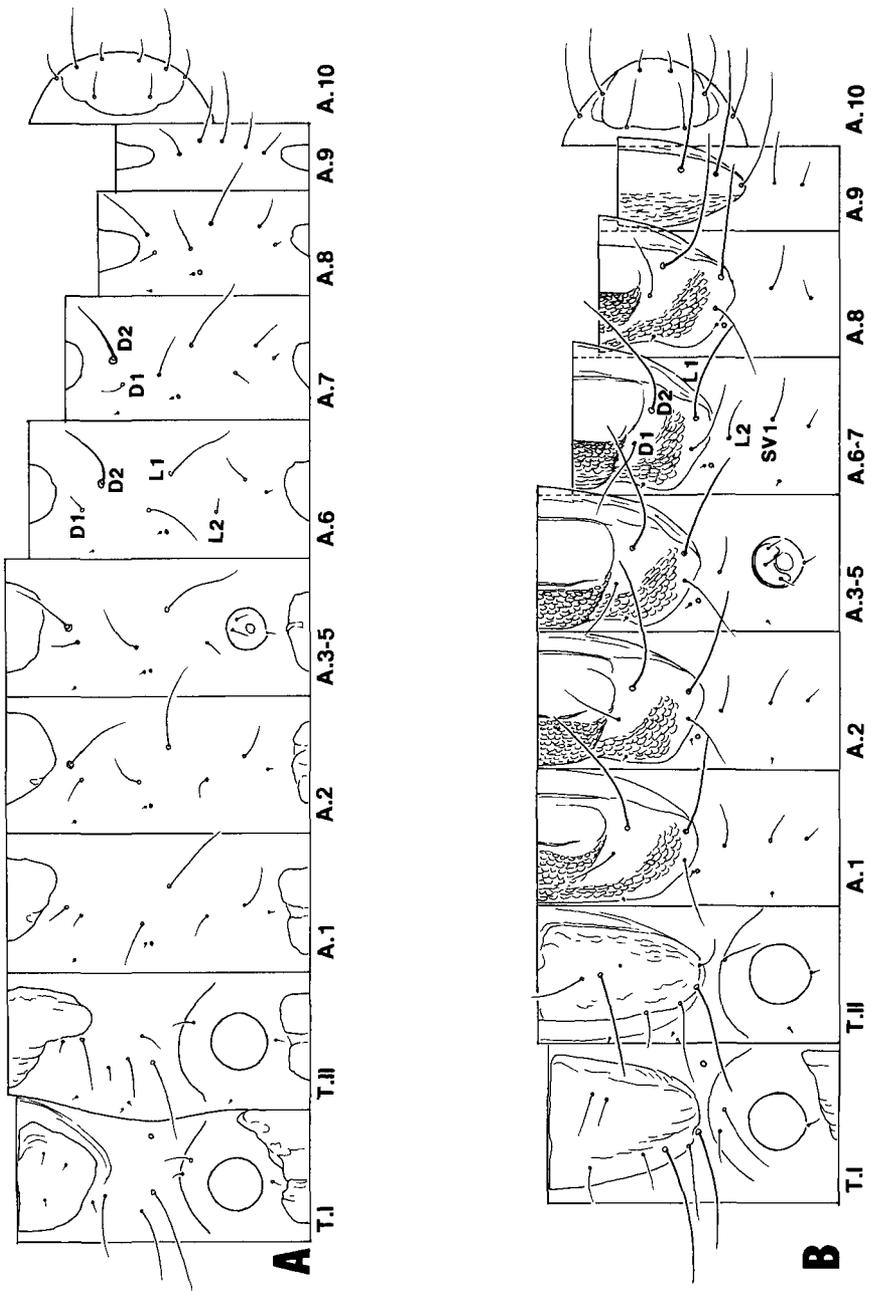
Pl. V: Fig. 37. Wing venation. A: *Phyllonorycter conista* (Meyrick) [Grc-5897] — B: *P. malayana* sp. nov. [Grc-3703] — C: *Porphyrosela dorinda* (Meyrick) [Brc-5898] — D: *P. alternata* sp. nov. [Grc-5899].



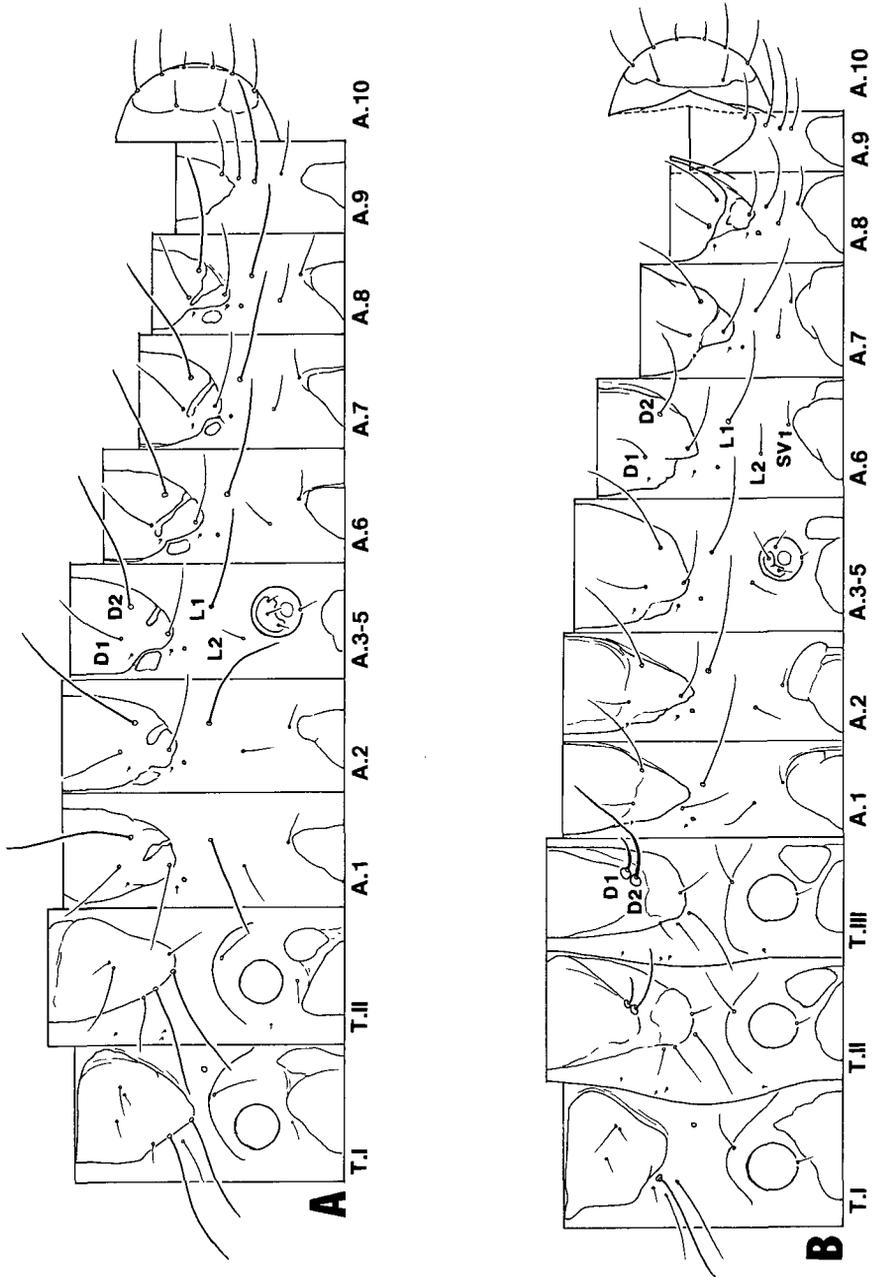
Pl. VI: Fig. 38. Setal map of last instar larva. A: *Neolithocolletis hikomonticola* Kumata [Moiwa, Sapporo, Hokkaidô, Japan, 15/ix/1969, ex *Pueraria lobata* (916)] — B: *N. pentadesma* (Meyrick) [Kuching, Sarawak, E. Malaysia, 27/ix/1991, ex *Pterocarpus indicus* (4241)].



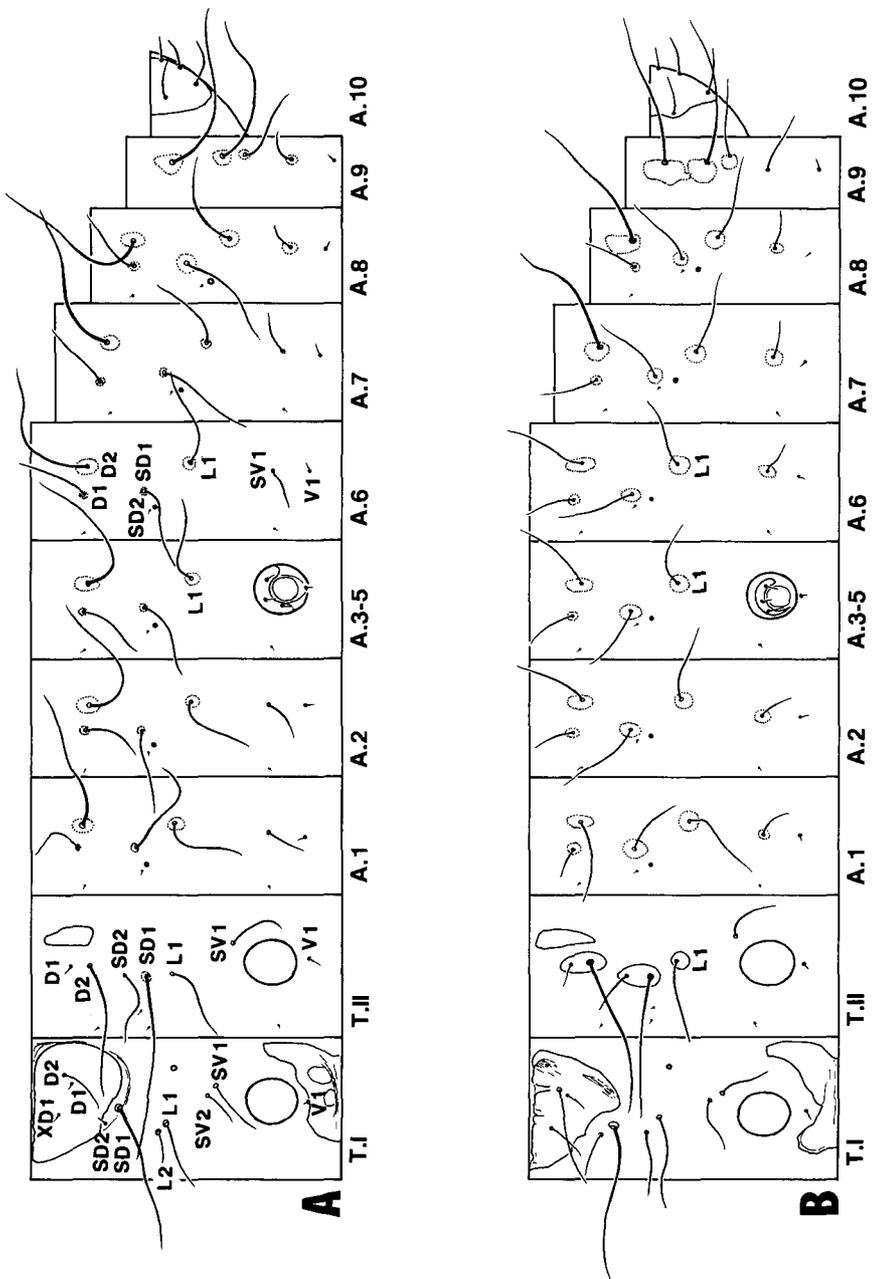
Pl. VII: Fig. 39. Setal map of last instar larva. A: *Hyloconis puerariae* Kumata [Moiwa, Sapporo, Hokkaido, Japan, 30/ix/1966, ex *Pueraria lobata* (798)] — B: *Cameraria* sp. [Kozagawa, Wakayama-ken, Honsyû, Japan, 21/ix/1974, ex *Aesculus turbinata* (1316)].



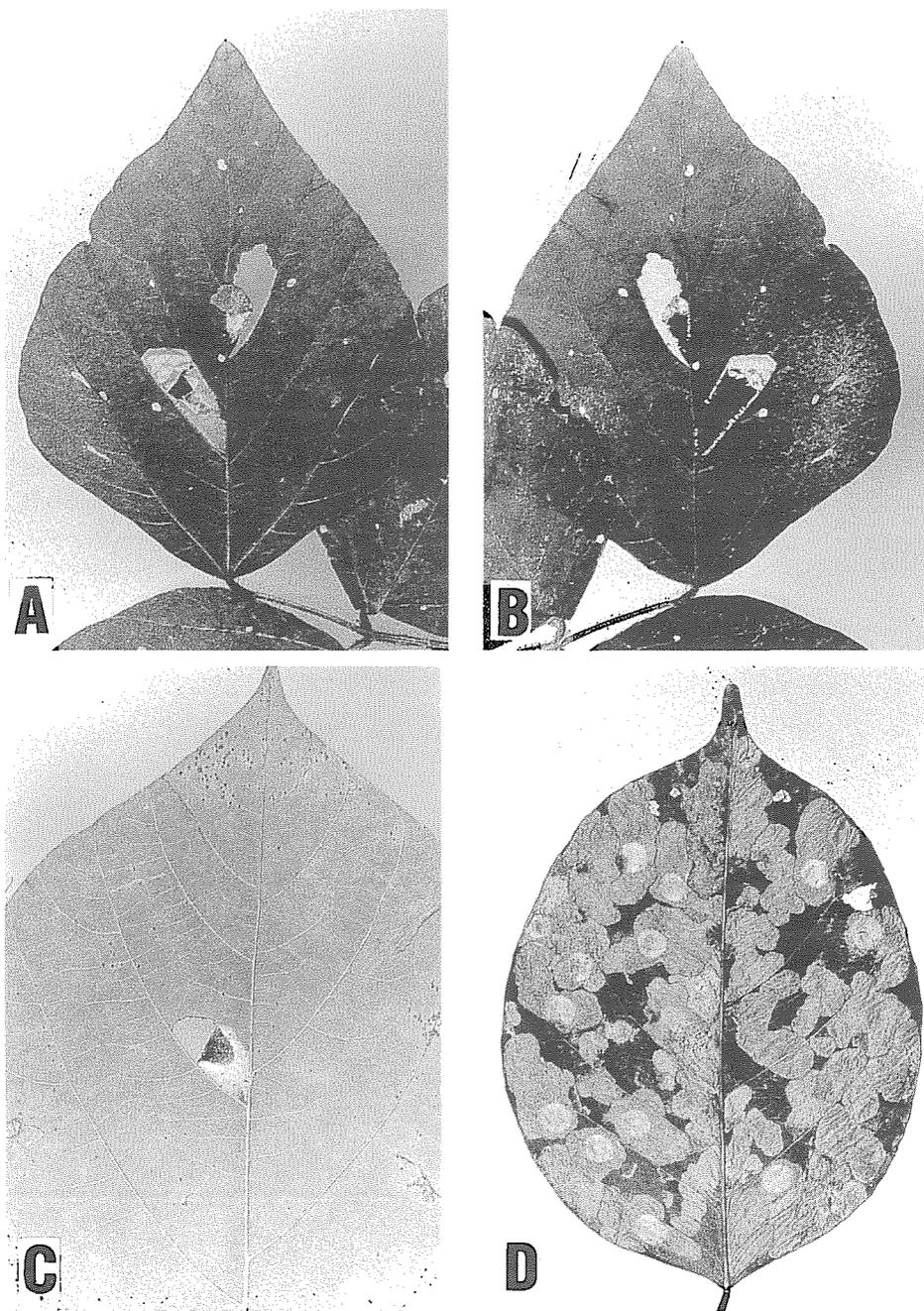
Pl. VIII: Fig. 40. Setal map of last instar larva. A: *Cameraria bauhiniae* (Stainton) [India, ex *Bauhinia acuminata* (Ind-8)] — B: *C. quadrifasciata* sp. nov. [W. Malaysia, ex *Bauhinia* sp. (3988)].



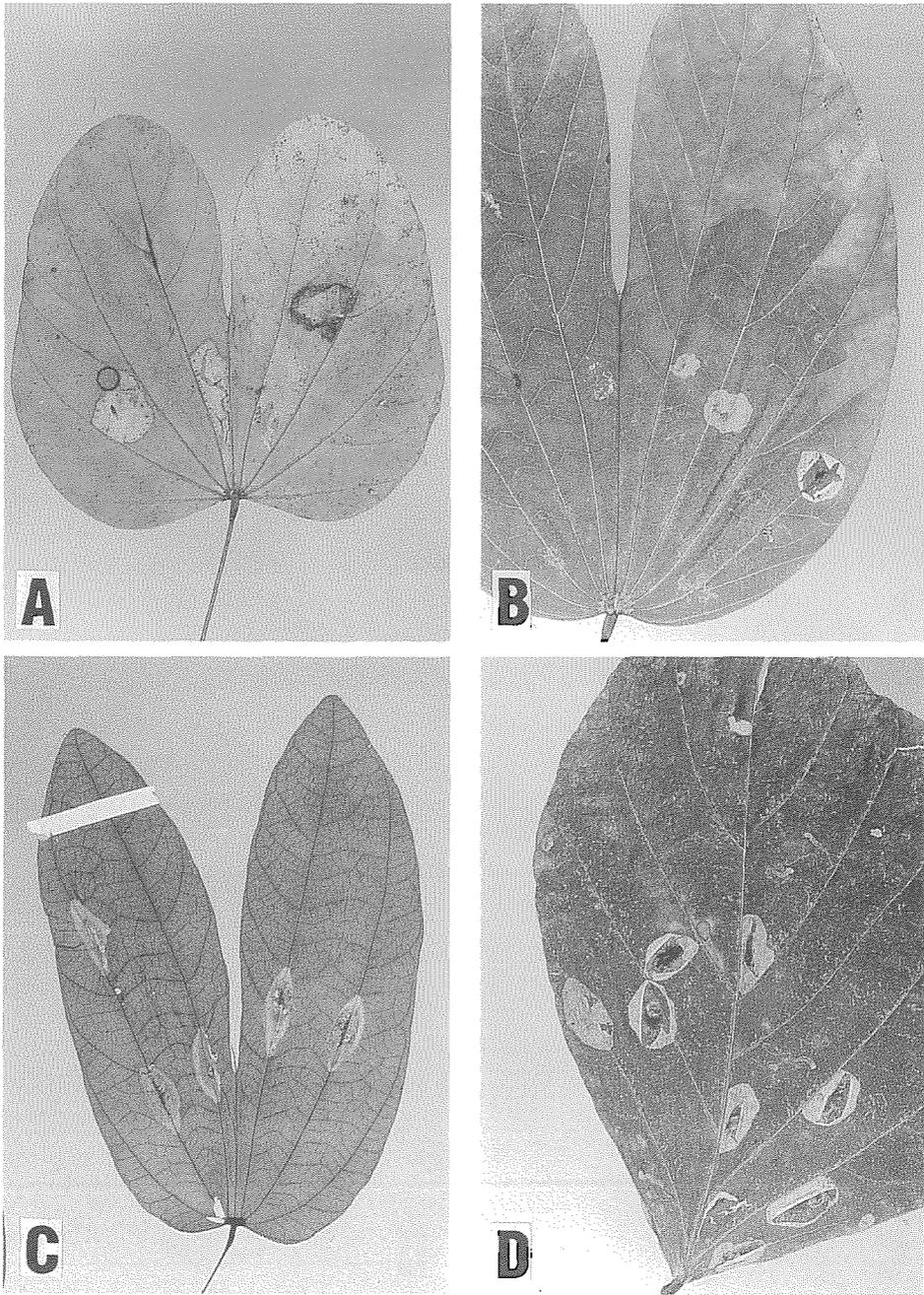
Pl. IX: Fig. 41. Setal map of last instar larva. A: *Cameraria pongamiae* sp. nov. [E. Malaysia, ex *Pongamia pinnata* (3275)] — B: *C. magnisignata* sp. nov. [India, ex *Pongamia pinnata* (Ind-107)].



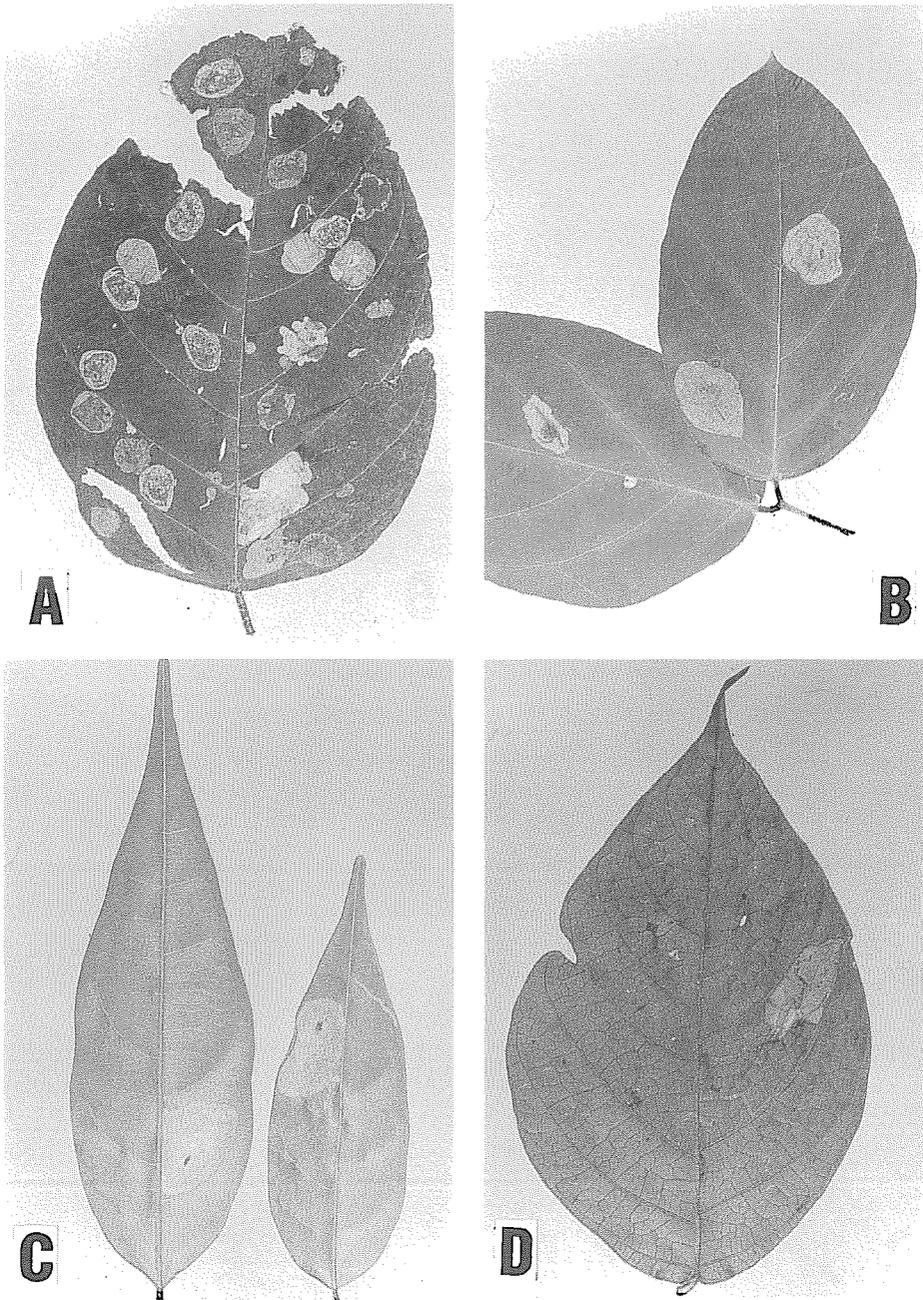
Pl. X: Fig. 42. Setal map of last instar larva. A: *Phyllonorycter issikii* (Kumata) [Sapporo, Hokkaidô, Japan, 7/vii/1958, ex *Tilia japonica*]—B: *P. juglandis* (Kumata) [Moiwa, Sapporo, Hokkaidô, Japan, 15/ix/1969, ex *Juglans ailanthifolia* (924)].



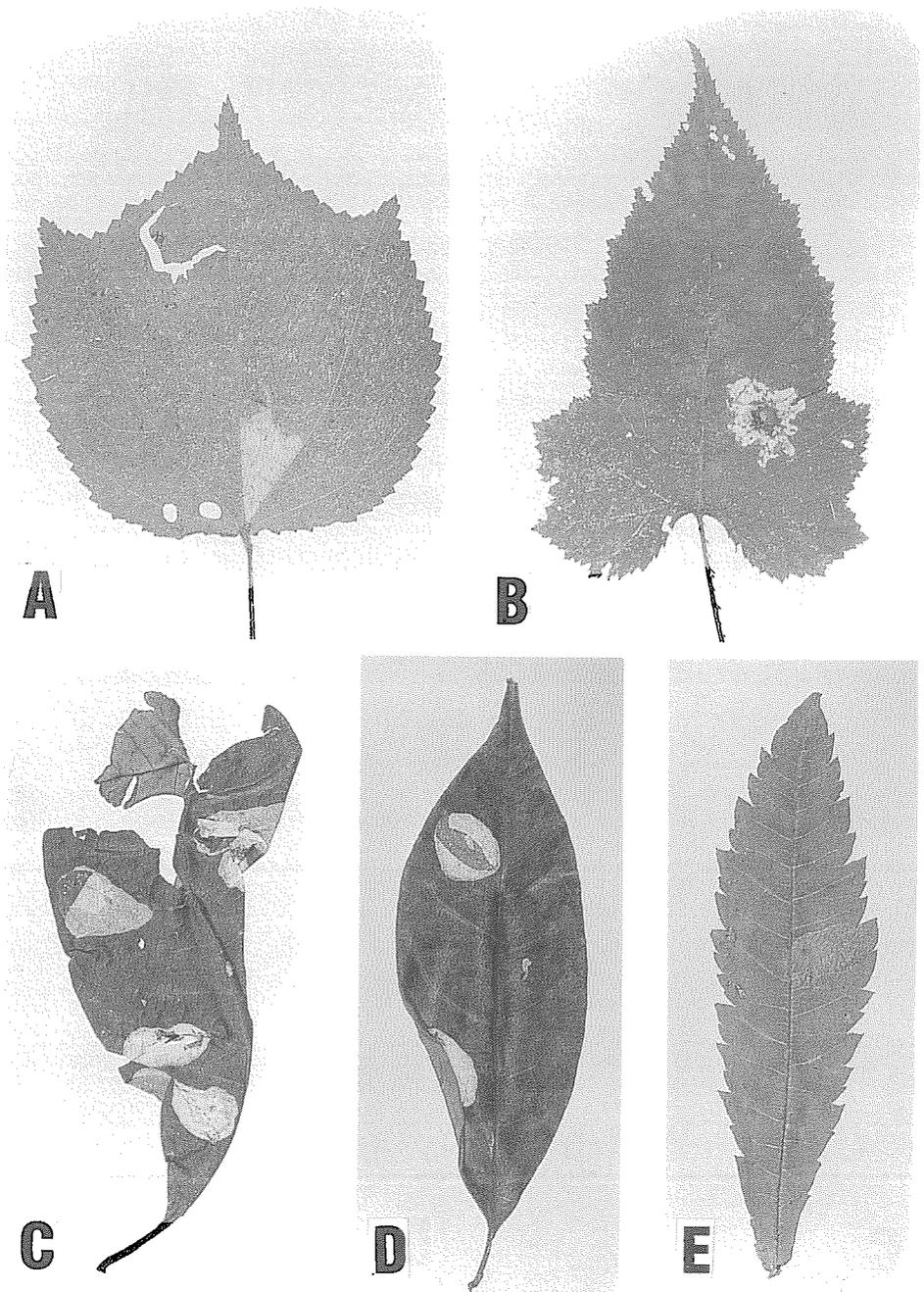
Pl. XI: Fig. 43. Leaf-mine. A: *Neolithocolletis kangarensis* sp. nov. on *Calopogonium* sp. (lower side) [breeding no. 4704]—B: Ditto (upper side) [ditto]—C: *N. hikomonticola* Kumata on *Pueraria lobata* (lower side) [breeding no. 916, Moiwa, Sapporo, Hokkaidô, Japan, 15/ix/1969]—D: *N. pentadesma* (Meyrick) on *Pterocarpus indicus* (lower side) [breeding no. 4240].



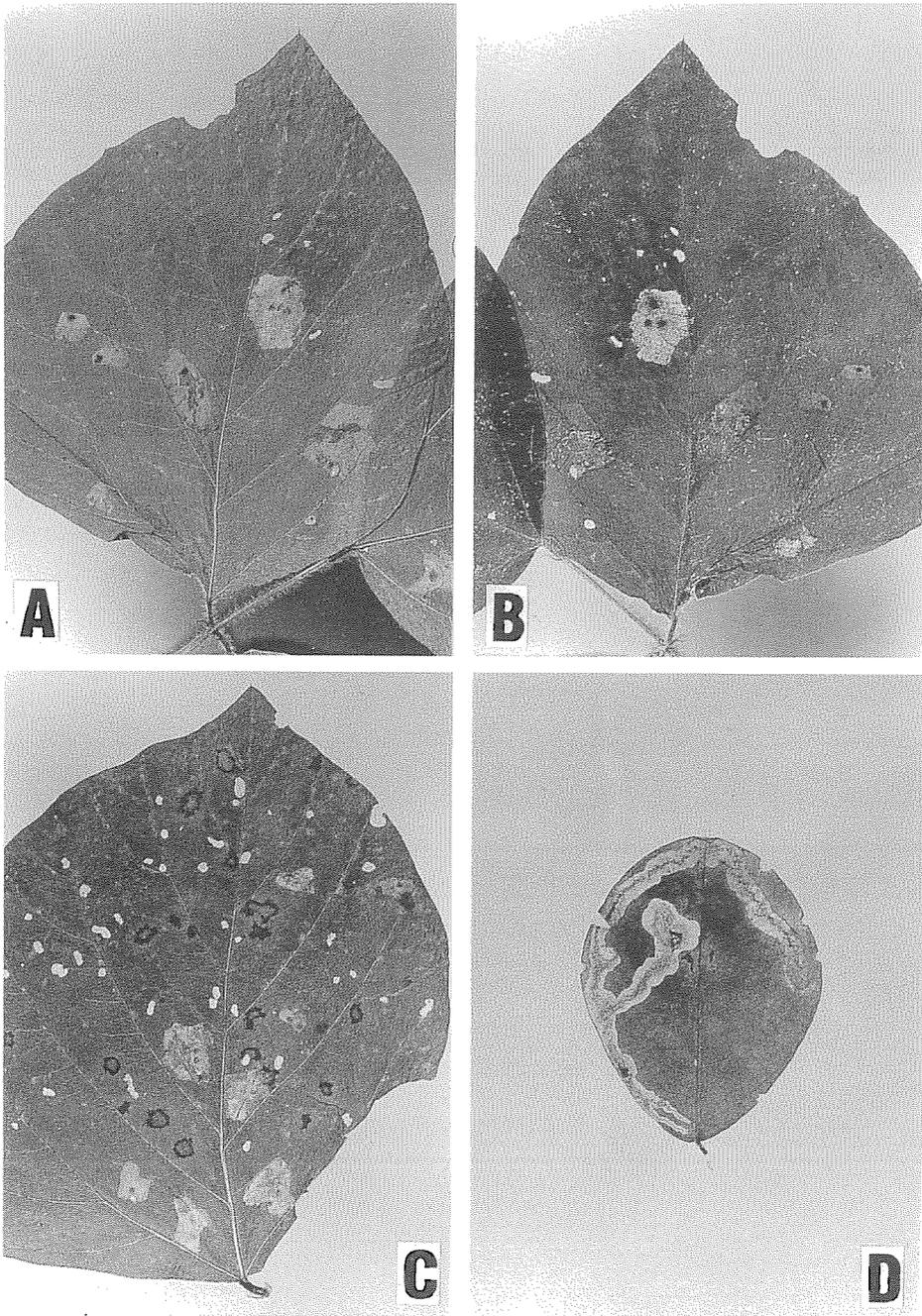
Pl. XII: Fig. 44. Leaf-mine. A: *Cameraria bauhiniae* (Stainton) on *Bauhinia acuminata* (lower side) [breeding no. Ind-8] — B: Ditto (upper side) [ditto]—C: *C. quadrifasciata* sp. nov. on *Bauhinia* sp. (upper side) [breeding no. 2593]—D: *C. virgulata* (Meyrick) on *Butea* sp. (upper side) [breeding no. Ind-128, Lachiwala, Dehra Dun, Uttar Pradesh, India, 8/xi/1978].



Pl. XIII: Fig. 45. Leaf-mine. A: *Cameraria pongamiae* sp. nov. on *Pongamia pinnata* (upper side) [breeding no. 2001] — B: *C. magnisignata* sp. nov. on *Pongamia pinnata* (upper side) [breeding no. Ind-107] — C: *C. milletiae* sp. nov. on *Milletia sericea* (lower side) [breeding no. 4453] — D: *C. fasciata* sp. nov. on *Spatholobus* sp. (lower side) [breeding no. 2859].



Pl. XIV : Fig. 46. Leaf-mine. A : *Phyllonorycter conista* (Meyrick) on *Urena lobata* (lower side) [breeding no. 4636, Bkt. Perangi, Sik, Kedah, W. Malaysia, 9/ix/1991] — B : *P. penangensis* sp. nov. on *Rubus moluccanus* (upper side) [breeding no. 4761] — C : *P. malayana* sp. nov. on? *Castanopsis* sp. (upper side) [breeding no. 2718] — D : Ditto [ditto] — E : *P. myricae* sp. nov. on *Myrica esculenta* (upper side) [breeding no. 4580].



Pl. XV : Fig. 47. Leaf-mine. A : *Porphyrosela dorinda* (Meyrick) on *Calopogonium* sp. (lower side) [breeding no. 4703] — B : Ditto (upper side) [ditto] — C : Ditto (lower side) [ditto] — D : *P. alternata* on *Desmodium* sp. (upper side) [breeding no. 2614].