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**ON THE GENUS PHYLLONORYCTER OR LITHOCOLLETIS  
FROM CENTRAL NEPAL, WITH DESCRIPTIONS OF TWELVE  
NEW SPECIES—NOTES ON GRACILLARIIDAE  
(LEPIDOPTERA) OF NEPAL, I**

Scientific Results of Hokkaido University Expeditions  
to the Himalaya, Entomology No. 13

By TOSIO KUMATA

*Abstract*

KUMATA, T. 1973. On the genus *Phyllonorycter* or *Lithocolletis* from Central Nepal, with descriptions of twelve new species—Notes on Gracillariidae (Lepidoptera) of Nepal, I. *Ins. matsum. n. s.* 1: 45 pp., 1 table, 17 figs. (13 text-figs., 4 pls.)

Thirteen species of the genus *Phyllonorycter* (= *Lithocolletis*) collected from Central Nepal are dealt with. Of these the following 12 species are described as new to science: *humilitatis* (♂), host unknown; *ovalifoliae*, ex *Lyonia ovalifolia*; *pruni*, ex *Prunus cerasoides*; *tribhuvani* (♀), ex *Prunus cerasoides*; *himalayana* (♂), ex *Quercus semecarpifolia*; *yamadai*, ex *Engelhardia spicata*; *engelhardiae*, ex *Engelhardia spicata*; *pseuditeina* (♂), ex an undetermined shrub; *nepalensis*, ex *Alnus nepalensis*; *oreas*, ex ? *Odina* sp.; *cinctata*, ex *Viburnum erubescens*; and *rubicola* (♂), ex *Rubus paniculata*. The rest, *drepanota* (Meyrick) ex *Engelhardia spicata*, is redescribed and new to the fauna of Nepal. The genitalia of one or both sexes are illustrated. Descriptions and photographs of the leaf-mines are given for 12 species.

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## INTRODUCTION

The present paper is the first part of taxonomic studies on Gracillariidae, a leaf-mining microlepidopterous family, based on the material collected by the writer in Central Nepal when he joined the Hokkaido University Scientific Expedition to Nepal Himalaya, 1968. The gracillariid material comprises 215 specimens classified into 57 species. Most specimens were bred from larvae in leaf-mines or leaf-rolls, but the mines or rolls from which moths emerged occupy only part of those that the writer could discover in Nepal. Successful mines and rolls are estimated at half the species number expected from the collection.

Up to the present time no species of this family is recorded from Nepal at all, though about 60 species are described by E. Meyrick (1908, 1912-37) from the Himalayas lying in Sikkim, Kumaon and Kashmir districts. Thus, this is the first step to clarify the gracillariid fauna of Nepal. In this part the writer deals with 13 species of the genus *Phyllonorycter* Hübner (= *Lithocolletis* Hübner), of which 12 are described as new to science and the rest, *P. drepanota* (Meyrick), is redescribed and new to the fauna of Nepal.

All the holotypes and some paratypes are deposited in the Entomological Institute, Faculty of Agriculture, Hokkaido University, and other paratypes in the Entomological Division, Nepal Agricultural Association, Lalitpur, Nepal.

*Acknowledgements.* The writer wishes to express his thanks to the former Prof. C. Watanabe, Prof. T. Nakashima and Dr. S. Takagi, all of the Entomological Institute, Hokkaido University, for their kindness in giving him the chance to make the present work and in giving constant encouragement. The writer wishes also to express his hearty thanks to the members of the expedition party, in which he participated, for their kind help to the writer in various ways during the trips.

The writer is grateful to Drs. A. P. Kapur and K. S. Pradhan of Zoological Survey of India, Calcutta, for giving him the permission to examine some types of Indian Gracillariidae, described by E. Meyrick, during his stay in Calcutta. Last but not least, the writer is grateful to Prof. T. Yamazaki of Department of Botany, Tokyo University, for his kindness in identifying many plants, including the hosts of the Gracillariidae reported here, collected by the party.

### Family Gracillariidae: Subfamily Lithocolletinae

#### Genus *Phyllonorycter* Hübner

*Phyllonorycter* Hübner, 1822, Syst.-alphab. Verz.: 66 [type-species: *Phalaena Tinea rajella* Linné, 1758].

*Lithocolletis* Hübner, 1825, Verz. bek. Schmett.: 423 [type-species: *Tinea alni-foliella* Hübner, 1796].

*Eucetis* Hübner, 1825, Verz. bek. Schmett.: 423 [type-species: *Tinea ulmi-foliella* Hübner, 1817].

Although the present writer has adopted the name *Lithocolletis* for this genus and treated the name *Phyllonorycter* as a forgotten name in his previous paper (1963)<sup>1)</sup>, the latter name has priority over the former as treated by J. D. Bradley (1966)<sup>2)</sup>.

This genus is one of the largest groups in the family and nearly world-wide in distribution. It includes more than 400 species described mainly from the Holarctic region. In regard to the Indian subcontinent, 23 species have been known to occur, but none from Nepal. In the course of the present study, the writer has found 13 species from Central Nepal, of which 12 are new to science and the rest was first recorded from Kumaon, North West India.

The species dealt with in this paper will be arranged into the following species-groups, which are erected for the Japanese species by the writer (1963)<sup>1)</sup>.

1. *Ulmifoliella*-group [=Group A of Pierce & Metcalfe, 1935<sup>3)</sup> (in part)]. This group is easily characterized by the following combination of the male genital characters:— Valva lacking in any process of costa or sacculus; anellus wholly membranous, without sclerotized juxta; aedoeagus slender in whole length. It may be rather heterogenous, since the members exhibit various structures in their female genitalia, and their host plants are scattered widely in various families. The following Nepalese species belong to this group.

*P. humilitatis* n. sp. (host: unknown).

*P. ovalifoliae* n. sp. (host: Ericaceae—*Lyonia ovalifolia*).

*P. pruni* n. sp. (host: Rosaceae—*Prunus cerasoides*).

*P. tribhuvani* n. sp. (host: Rosaceae—*Prunus cerasoides*).

*P. himalayana* n. sp. (host: Fagaceae—*Quercus semecarpifolia*).

2. *Pterocaryae*-group. This group is closely related to the preceding one, but is easily distinguished by the corpus bursae with a single cone-shaped signum in the centre of a round sclerite (in other species-groups the corpus bursae bears two or more cone-shaped signa in the centre of a round sclerite). It was established on the basis of a single species, *P. pterocaryae* (Kumata), but now it contains the following Nepalese species. All the members of this group are associated with Juglandaceae in their host plants.

*P. drepanota* (Meyrick) (host: Juglandaceae—*Engelhardia spicata*).

*P. yamadai* n. sp. (host: Juglandaceae—*Engelhardia spicata*).

*P. engelhardiae* n. sp. (host: Juglandaceae—*Engelhardia spicata*).

3. *Uliciolella*-group [=Group B of Pierce & Metcalfe, 1935]. Valvae asymmetrical, the left valva being ordinarily wider than the right, with a very long, curved seta at apex of ventral margin; right valva also with an erected, shorter seta just before apex of ventral margin; aedoeagus wholly slender, long, with an acute barb near apex; anellus wholly membranous; ductus bursae opening under lamella antevaginalis which is situated on ventrum of eighth abdominal segment.

The members belonging to the present group are mostly leaf-miners of

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1) Kumata, T. 1963. Taxonomic studies on the Lithocolletinae of Japan (Lepidoptera: Gracillariidae), part III. Ins. matsum. 26: 69–88.

2) Bradley, J. D. 1966. Some changes in the nomenclature of British Lepidoptera, part 4. Ent. Gazette 17: 213–235.

3) Pierce, F. N. & Metcalfe, J. W. 1935. The genitalia of the tineid families of the Lepidoptera of the British Islands. London.

Salicaceae, Leguminosae and Aceraceae. The following Nepalese species belongs to this group.

*P. pseuditeina* n. sp. (host: an unidentified shrub).

4. *Japonica*-group. This group is rather related to the preceding *ulicicolella*-group in the asymmetrical valvae, but can easily be distinguished from the latter by the following features:— Valvae with a long, stout filament-like seta arising from top of widened, produced or dilated sacculus which occupies the basal half of the valva; tegumen asymmetrical, the left apodeme being longer than the right; eighth abdominal segment of female much reduced in size, sometimes not visible, usually without apophyses anteriores; ostium bursae usually opening on left side of body. Most species of the group feed on Betulaceae, and some on Rosaceae, Ericaceae, Styracaceae or Juglandaceae. Among the species known to occur in Nepal the following two fall into this group.

*P. nepalensis* n. sp. (host: Betulaceae—*Alnus nepalensis*).

*P. oreas* n. sp. (host: Anacardiaceae—? *Odina* sp.).

5. *Rajella*-group [=Group A of Pierce & Metcalfe, 1935 (in part)]. This group is characterized by the valva having on its base a costal process which bears a long, stout, filament-like seta. The process is ordinarily cone-shaped; those sometimes asymmetrical between on the left and right valvae, which are symmetrical except in a few species. The sterigma of the female genitalia is located on the ventrum near the caudal margin of the seventh segment with a few exceptions.

This group is especially rich in species in the Holarctic region, and the host plants belong mainly to Fagaceae, Rosaceae, Betulaceae and Caprifoliaceae. Of the known Nepalese species the following one belongs to this group.

*P. cinctata* n. sp. (host: Caprifoliaceae—*Viburnum erubescens*).

6. *Trifasciella*-group [=Group C of Pierce and Metcalfe, 1935]. Valvae usually symmetrical, rather short, without any process of costa or sacculus; aedeagus short, stumpy, with its basal half conspicuously swollen; juxta long, heavily sclerotized.

Most species of this group feed on Ulmaceae, and some on Rosaceae or Caprifoliaceae. The following species, which attacks a rosaceous plant, belongs to this group among the Nepalese *Phyllonorycter*.

*P. rubicola* n. sp. (host: Rosaceae—*Rubus paniculata*).

#### DESCRIPTIONS OF SPECIES

*Phyllonorycter humilitatis* n. sp.

(Fig. 1, A—C; Plate I, A)

Colour: ♂. Face and labial palpus dark grey, with a leaden-metallic luster; tuft of head brownish-black, mixed with whitish hairs posteriorly. Antenna, including pecten, brilliant grey. Thorax dark metallic grey, with golden reflections under some light; tegula golden-ochreous. Legs grey, with a golden luster. Forewing very narrowly lanceolate, golden-ochreous in ground colour, darkened

along costal margin towards base, with silvery-white markings; a medio-basal streak very elongately lanceolate, straight, extending about one-third length of wing, surrounded by black scales; a transverse antemedian fascia strongly arched outwardly, shading into ground colour externally, distinctly margined with black scales internally; first costal strigula and first dorsal one paired at apical one-third of wing, both being vertical, triangular, slightly detached from each other at half width of wing, conspicuously margined with black scales internally; second pair of similar strigulae placed near apex of wing, about as large as preceding pair, slightly oblique inwardly; a black spot placed at apex of wing,

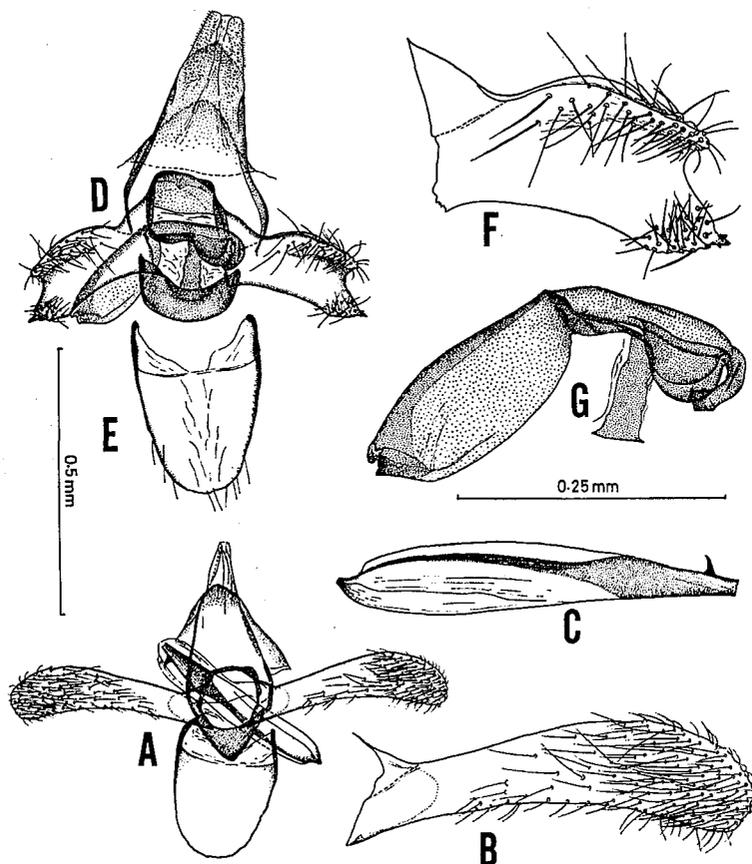


Fig. 1. *Phyllonorycter humilitatis* n. sp. (A—C) and *Phyllonorycter rubicola* n. sp. (D—G). A & D: male genitalia in caudal view— B & F: right valva—C & G: aedeagus—E: ventral flap.

small, oval; cilia around apex of wing greyish-white, with a blackish, broad basal line, those along dorsal margin ochreous-grey. Hindwing grey; cilia pale ochreous-grey.

Alar expanse: 5.5 mm.

Male genitalia: Symmetrical as shown in Fig. 1, A—C. Valva simple, some-

what clavate, rounded apically, slightly arched upwardly, setose densely on almost whole inner surface; transtilla slender. Tegumen elongately conical; tuba analis scarcely produced, without micro-spines. Saccus short, triangular, bluntly pointed apically. Ventral flap oval in outline. Aedoeagus about as long as valva, straight, gradually narrowed apically, with an acute, beak-shaped subapical barb.

Holotype: ♂ (G. sl. Grc-1474), Ghasa (ca. 2000 m.), Palpa, 4/V/1968. Paratype: 1♂, with the same data as in holotype.

Host plant & mine: Unknown.

Remarks: The new species belongs to the species-group of *ulmifoliella*, and may be closely related to *P. ulmifoliella* (Hübner), which is known as a leaf-miner of *Betula* in Europe and Japan. It is, however, distinguished from *ulmifoliella* by the following points:— The forewing lacks a whitish spot near the base of the dorsal margin and a dark apical dash of the cilia; the face is dark grey entirely (it is whitish in *ulmifoliella*); the valva of the male genitalia is slightly widened towards the apex (it is evenly slender in *ulmifoliella*); there are no micro-spines on the ventral surface of the tuba analis; etc.

*Phyllonorycter ovalifoliae* n. sp.

(Fig. 2; Plate I, B & C)

Colour: ♂♀. Face and labial palpus brilliant whitish, with a yellowish tinge; tuft of head pale ochreous, mixed with whitish hairs centrally. Antenna whitish, distinctly spotted with blackish brown above; scape white beneath, golden ochreous above; pecten yellowish-white. Thorax golden ochreous-brown dorsally, with two narrow lateral stripes and a small posterior spot white. Foreleg blackish, spotted with white outside; midleg and hindleg whitish, the tarsi with two or three blackish rings. Forewing golden ochreous-brown, with markings brilliant white, narrow, and almost all margined with blackish scales internally; a medio-basal streak extending one-third length of wing, very sinuate, with its apical half strongly arched downwardly; a dorso-basal streak shorter than medio-basal one, extremely narrow, but sometimes widened at its apex to form a small dorsal spot; a short costal strigula situated obliquely at basal one-fourth of wing, the apex being almost confluent with that of medio-basal streak; a transverse median fascia sharply angulated outwardly, sometimes interrupted at the angle by ground colour, the dorsal arm being about twice as long as the costal one; a pair of dorsal and costal strigulae opposed at apical one-third of wing or just before tornus, nearly parallel with median fascia, with its inner margin most strongly bordered with blackish scales; two indistinct, wedge-shaped costal strigulae placed near apex of wing; one or more rows of blackish speckles arranged in parallel with termen; cilia ochreous-white to pale grey, with a basal line of blackish speckles around apex of wing. Hindwing grey; cilia pale ochreous grey.

Alar expanse: 7.0—7.5 mm.

Male genitalia: Symmetrical as shown in Fig. 2, A—C. Valva rather slender, bluntly pointed apically, very slightly curved, sparsely setose on inner

surface; a group of setae near apex of valva thickened and spine-like. Transtilla narrow, X-shaped. Tegumen elongately conical; tuba analis projecting far beyond apex of tegumen, without micro-spines. Saccus long, rounded apically. Ventral flap spatulate, rounded apically. Aedoeagus shorter than valva, tubular, with an apical barb short and conical.

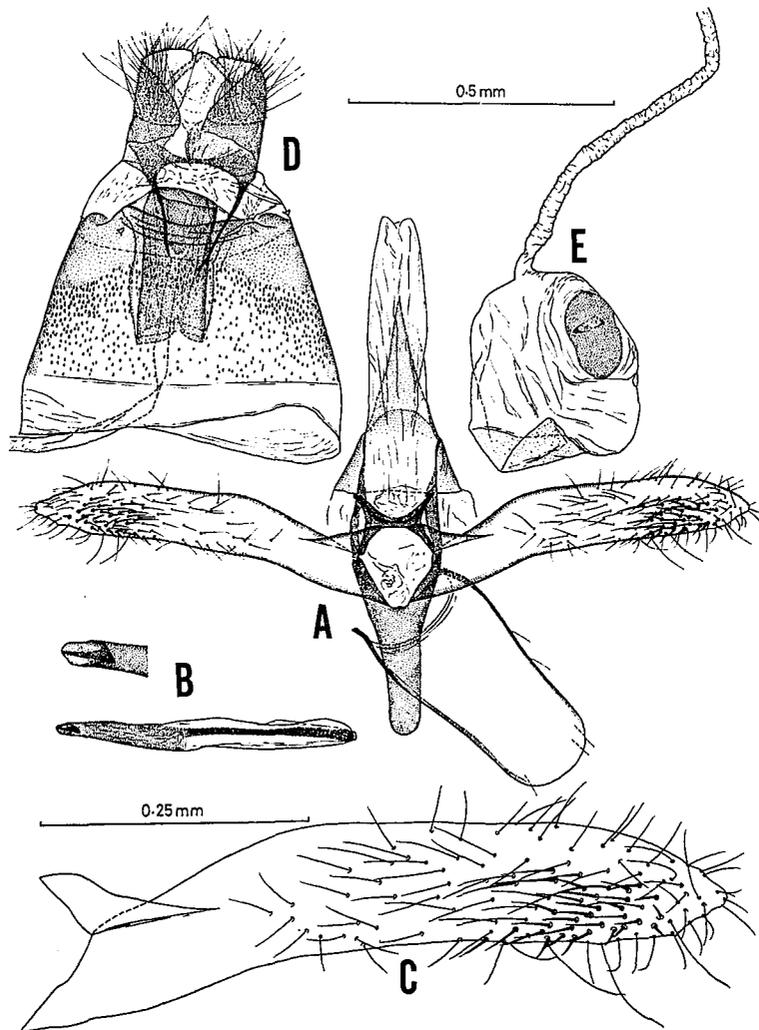


Fig. 2. *Phyllonorycter ovalifoliae* n. sp. A: male genitalia in caudal view—B: aedoeagus—C: right valva—D: female genitalia in ventral view—E: corpus bursae.

Female genitalia: Symmetrical as shown in Fig. 2, D & E. Eighth abdominal segment tightly fused with the seventh one without an intersegmental membrane between them, and not covered with scales; apophysis anterioris absent.

Sterigma weakly sclerotized in a long chamber, which is a little shorter than length of eighth and seventh abdominal segments united. Corpus bursae globose, with a pair of minute conical signa in centre of an elliptical sclerite.

Holotype: ♂ (G. sl. Grc-1445), Khurumsang (ca. 2500 m.), No. 1 West, 21/VI/1968, ex *Lyonia ovalifolia*, breeding no. Npl-71. Paratypes: 1♂ & 2♀♀, with the same data as in holotype.

Host plant: *Lyonia ovalifolia* (Wallich) Drude (Ericaceae).

Mine (Pl. III, A): A very elongate, tentiformed blotch (15—20 mm. in longest diameter) occurring upon lower side of leaf, always situated along leaf-margin; lower epidermis of leaf at mining part dark brownish and much wrinkled in well-matured stage, thus the leaf being almost folded downwardly at this part.

Remarks: Apart from the very sinuate medio-basal streak of the forewing, the colour-pattern of the new species is much similar to that of *P. lyoniae* (Kumata) which is also a leaf-miner of *Lyonia ovalifolia* in Japan. The former species, however, is immediately distinguished from the latter by the symmetrical structure of the genitalia in both sexes. The new species belongs to the species-group of *ulmifoliella* in having the simple valva without a costal process or a long, filament-like seta, whereas *lyoniae* is a member of the species-group of *japonica* in having the asymmetrical valvae, each of which bears a long, filament-like seta arising from the ventral margin.

*Phyllonorycter pruni* n. sp.

(Figs. 3 & 4, A & B; Plate II, A)

Colour: ♂♀. Face and labial palpus white; tuft of head golden ochreous, mixed with whitish hairs centrally. Antenna whitish, spotted with dark brown above; scape white beneath, golden ochreous above; pecten white. Thorax golden brown dorsally, with two narrow, white stripes. Foreleg blackish, the tarsus with two white median rings broad; midleg and hindleg ochreous white, the tarsi with two blackish median rings narrow. Forewing golden brown, with narrow, white markings, most of which are very weakly margined with dark scales internally; a medio-basal streak extending nearly one-third length of wing, almost straight, often gently bent upwardly near its apex; a short costal strigula situated at basal one-fourth of wing, slightly oblique outwardly, with its apex nearly touching that of medio-basal streak; a transverse median fascia sharply angulated outwardly, often divided into two opposite strigulae by ground colour at angle, the dorsal arm being about 1.5 times as long as costal one; three costal strigulae arranged outside median fascia nearly equidistantly from the fascia and from each other, all extremely short, sometimes reduced into semi-circular spots; a dorsal strigula situated just before tornus, extending one-third width of wing, hook-shaped or triangular, the internal edge being nearly parallel to dorsal part of median fascia; some brownish-black scales irregularly scattered on apical area of wing; cilia pale yellowish-grey, with a dark brown basal line along termen. Hindwing dark grey; cilia pale grey.

Alar expanse: 6.0—6.5 mm.

Male genitalia: Symmetrical as shown in Fig. 3. Valva slender, fusiform, very slightly curved, moderately densely setose on inner surface; transtilla rather wide, almost straight in dorsal margin. Tegumen elongately conical; tuba analis moderately projecting beyond apex of tegumen, without micro-spines. Saccus very short. Ventral flap gently narrowed apically, with an acutely pointed apex. Aedoeagus a little shorter than valva, tubular, with a short, conical subapical barb.

Female genitalia: Symmetrical, with a much simplified structure as shown in Fig. 4, A & B. The eighth abdominal segment might be wholly membranous

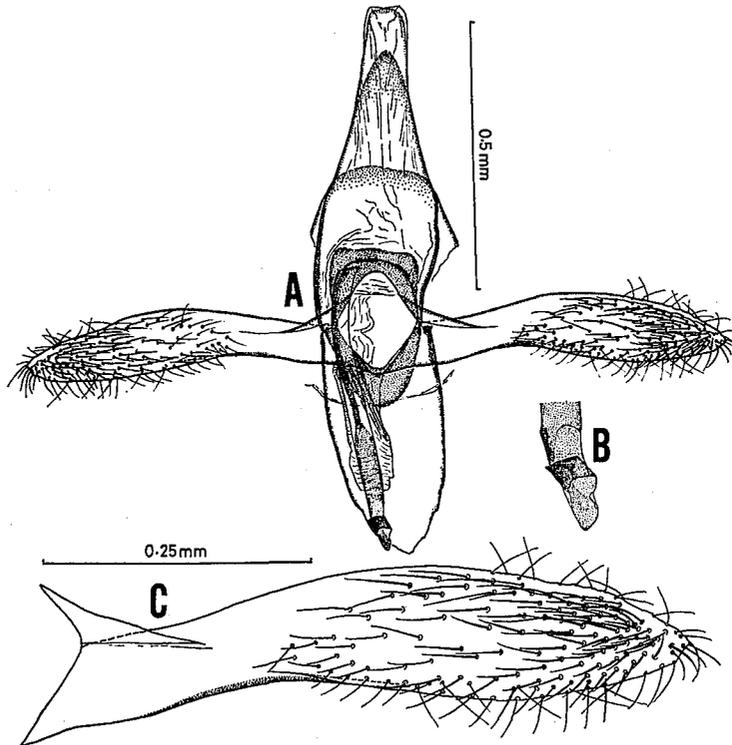


Fig. 3. *Phyllonorycter pruni* n. sp. A: male genitalia in caudal view—B: apex of aedoeagus—C: right valva.

or completely fused with the seventh one, since the writer could not determine it on area between the papillae anales and the seventh segment, which is normal in form. Apophysis anterioris absent. Sclerous genital plate or sterigma absent. Corpus bursae with a pair of minute, cone-shaped signa in centre of an elliptical sclerite.

Holotype: ♂ (G. sl. Grc-1433), Godavari (Botanic Gardens), Nepal Valley, 21/VI/1968, ex *Prunus cerasoides*, breeding no. Npl-77. Paratypes: 3♀♀, with the same data as in holotype except in date emerged, 30/VI/1968 & 22/VII/1968.

Host plant: *Prunus cerasoides* D. Don (Rosaceae).

Mine (Pl. III, B): An elongate, narrow, tentiformed blotch (14—18 mm. in longest diameter) occurring upon lower surface of leaf, usually situated on space between two lateral veins or rarely along leaf-margin; lower epidermis of leaf on fully developed mine brownish-white with minute dark brown spots in colour, with a single longitudinal central ridge.

Remarks: The new species belongs to the species-group of *ulmifoliella*. It is very closely related to the preceding species, *ovalifoliae*, in general feature, but is distinguished from the latter by the following points:— In forewing: 1) medio-basal streak less sinuate; 2) dorso-basal streak completely absent; and 3) costal strigulae on apical area of wing much smaller and sometimes reduced into semicircular spots. In male genitalia: 4) valva somewhat fusiform, with all setae nearly uniformly slender; 5) ventral flap with an acute apex; and 6) saccus much shorter. In female genitalia: 7) sclerous genital plate or sterigma absent.

*Phyllonorycter tribhuvani* n. sp.

(Fig. 4, C & D; Plate II, B)

Colour: ♀. Face, labial palpus and legs white; mid and hind tarsi with one or two blackish rings. Tuft of head whitish, mixed with some ochreous-yellow hairs anteriorly and laterally. Antenna greyish-white, distinctly spotted with dark greyish-brown above; scape and pecten white. Thorax golden ochreous dorsally, with two longitudinal stripes narrow, white. Forewing golden brown, with a medio-basal streak, five costal and two dorsal strigulae white, all the strigulae being narrowly margined with blackish scales internally; medio-basal streak extending about one-third length of wing along fold, straight in its whole length; first costal strigula placed just before basal one-third of wing, extending slightly less than half way across wing; second costal strigula opposed with first dorsal one just beyond middle of wing, sometimes joined with the latter to form an outwardly angulated fascia, the dorsal strigula being about 1.5 times as long as the costal one; third to fifth costal strigulae arranged between apical one-third and one-sixth of wing, very short, wedge-shaped, erect or slightly oblique inwardly; second dorsal strigula just before tornus, triangular, with its internal margin parallel to that of the first one, and its apex nearly reaching that of fourth costal mark; discal area between apices of two dorsal strigulae sparsely scattered with blackish speckles; two or three rows of blackish speckles running on whitish area of termen; cilia greyish-white, with a basal line of blackish speckles around apex of wing. Hindwing grey; cilia pale grey.

Alar expanse: 6.5 mm.

Female genitalia: Symmetrical as shown in Fig. 4, C & D. Eighth abdominal segment not visible, perhaps completely fused with seventh one or wholly membranous; apophysis anterioris absent. Seventh tergite deeply concaved in its caudal margin. Sclerous genital plate or sterigma absent. Corpus bursae with a pair of cone-shaped signa in centre of an elliptical or oval sclerite.

Holotype: ♀ (G. sl. Grc-1438), Godavari (Botanic Gardens), Nepal Valley,

10/VII/1968, ex *Prunus cerasoides*, breeding no. Npl-78. Paratype: 1♀, with the same data as in holotype except in date emerged, 1/VIII/1968.

Host plant: *Prunus cerasoides* D. Don (Rosaceae).

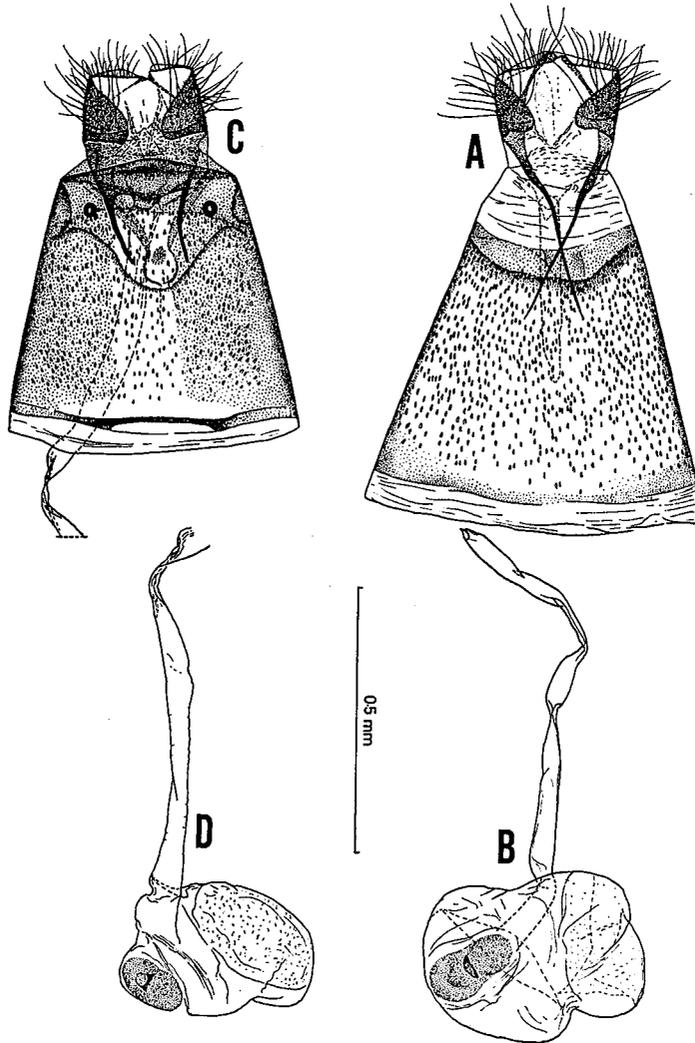


Fig. 4. *Phyllonorycter pruni* n. sp. (A—B) and *Phyllonorycter tribhuvani* n. sp. (C—D). A & C: female genitalia in ventral view—B & D: bursa copulatrix.

Mine (Pl. III, C): A tentiform blotch (15—18 mm. in longest diameter) occurring upon upper surface of leaf, usually very much elongated along middle vein or sometimes along lateral vein of leaf; upper epidermis of leaf on mining part whitish with minute, brown to blackish-brown spots, much constricted longitudinally, with a single large central ridge.

Remarks: Although no male has been examined, this species seems to belong to the species-group of *ulmifoliella*. It can be separated from the preceding species, *pruni*, by the slightly more complicated structure of the female genitalia, especially by the deeply concaved caudal margin of the seventh tergite, and also by the different situation of the mine. This and the preceding species, both of which are leaf-miners of *Prunus cerasoides* in Nepal, are easily distinguished from any *Prunus*-miners of the genus *Phyllonorycter* known from other countries by the first dorsal strigula opposed with the second costal one at or near the middle of the forewing. In any other *Prunus*-miners the first dorsal strigula is always opposed with the first costal one at or a little before the middle of the forewing.

*Phyllonorycter himalayana* n. sp.

(Fig. 5; Plate I, D)

Colour: ♂. Face and labial palpus brilliant white, the latter speckled with a few fuscous scales outside; tuft of head pale ochreous, mixed with whitish hairs laterally. Antenna greyish-white, slightly spotted with dark brown above; scape brilliant white, golden ochreous above. Thorax golden brownish dorsally, with two white lateral stripes and a fuscous central blotch. Legs white; all tarsi with two fuscous median rings. Forewing rather slender, golden ochreous, with narrow, brilliant white markings; a medio-basal streak extending one-third length of wing, parallel with costal margin, gradually narrowed distally, without any marginal dark scales; four costal strigulae arranged nearly equidistantly from basal one-third to three-fourths of wing, all very short and wedge-shaped, the first being oblique outwardly, the second bent outwardly at its middle, and the third and fourth slightly oblique inwardly; among these costal marks the second alone margined internally with a few dark scales on its basal half; three dorsal strigulae opposed with first three costal ones respectively, all very long, strongly oblique outwardly, almost parallel to each other, heavily margined with blackish speckles internally; blackish speckles rather densely scattered along termen; cilia yellowish-white, with a blackish, narrow basal line around apex of wing. Hindwing grey; cilia greyish-white.

Alar expanse: 9.0 mm.

Male genitalia: Symmetrical as shown in Fig. 5. Valva elongate-quadrangular in shape, arched in costal margin, slightly dentated in terminal and ventral margins, setose densely on costal area near apex and also sparsely along terminal and ventral margins; transtilla very large, strongly concave in dorsal margin. Tegumen elongately conical; tuba analis projecting far beyond apex of tegumen, with rather dense micro-spines on inner surface. Ventral flap elongately pentagonal in outline. Aedoeagus about 1.5 times as long as valva, tubular, slightly sinuate, with a long cleft near apex.

Holotype: ♂ (G. sl. Grc-1427), Balaju peak (ca. 2000 m.), Kathmandu, 18/VII/1968, ex *Quercus semecarpifolia*, breeding no. Npl-108. Paratype: 1 ♂, with the same data as in holotype except in date emerged, 23/VII/1968.

Host plant: *Quercus semecarpifolia* Smith (Fagaceae).

Mine (Pl. III, D): A rather large, elliptical or circular, slightly tentiformed blotch (15—20 mm. in longest diameter) occurring upon upper surface of leaf, usually situated on space between middle vein and leaf-margin; upper epidermis of leaf on mining part whitish-brown, smeared with irregular, dark reddish-brown blotches or lines, with many minute, longitudinal ridges in fully matured stage.

Remarks: This species seems to belong to the species-group of *ulmifoliella* in having a simple valva without a costal process or a filament-like, long seta.

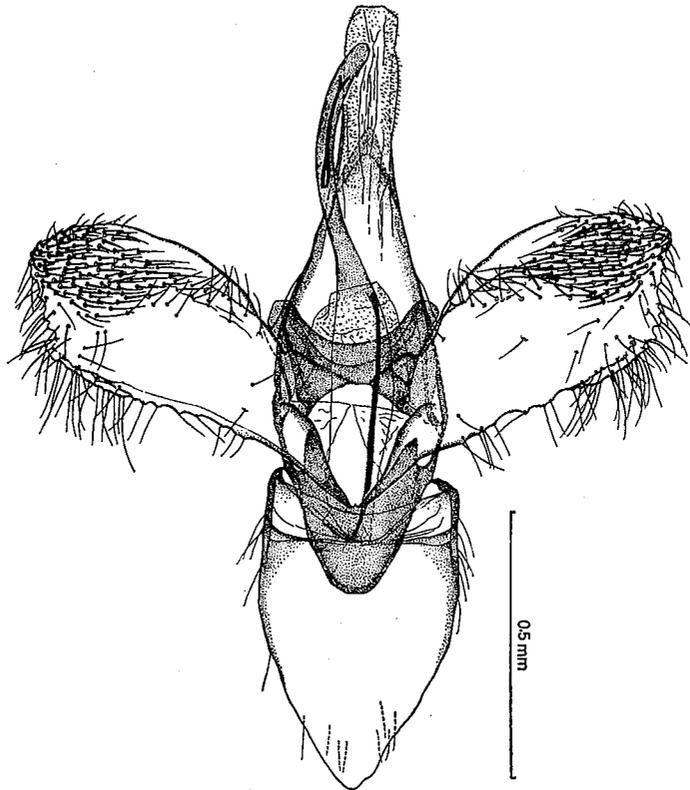


Fig. 5. *Phyllonorycter himalayana* n. sp. Male genitalia in caudal view.

In this character of the male genitalia, it may be at once distinguished from any other quercivorous species of the genus *Phyllonorycter*.

*Phyllonorycter drepanota* (Meyrick)

(Fig. 6; Plate I, E & F)

*Lithocolletis drepanota* Meyrick, 1928, Exotic Microlep. 3: 406.

On the basis of Nepalese material, a redescription is given below.

Colour: ♂♀. Face and labial palpus brilliant white, the latter with one or two minute, ochreous spots on outside; tuft of head ochreous-yellow, mixed with some whitish hairs centrally. Antenna whitish, poorly spotted with dark brown above; scape golden ochreous above; pecten white. Thorax golden ochreous dorsally, with two white, longitudinal stripes. Legs whitish; mid tibia with two fuscous, oblique, narrow stripes on outside; fore and mid tarsi with two and hind one with three fuscous rings. Forewing golden ochreous, with two

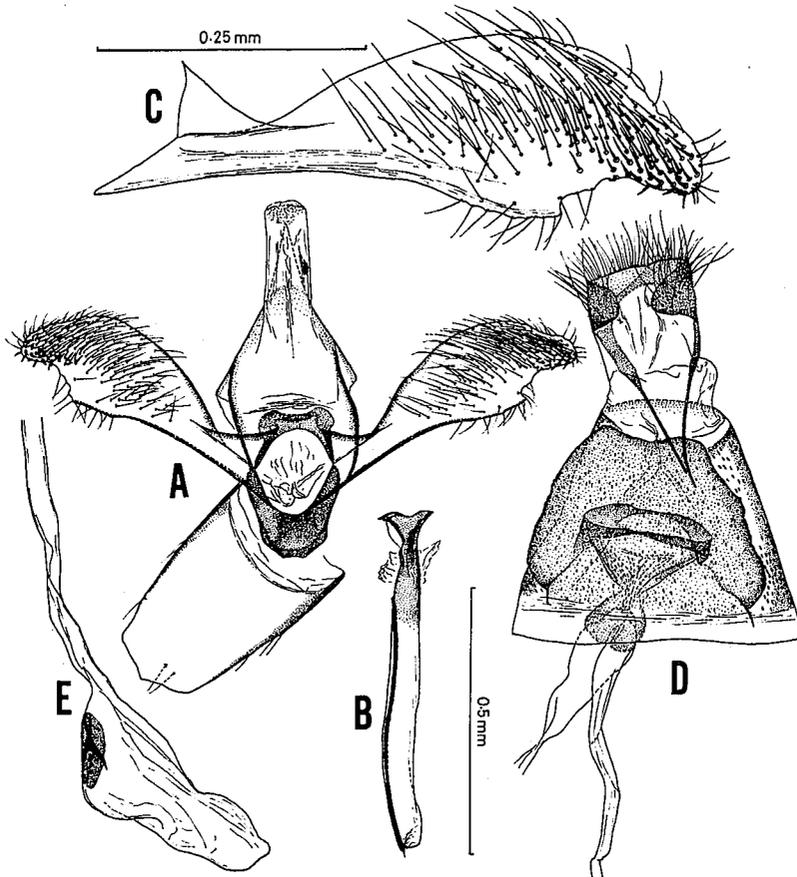


Fig. 6. *Phyllonorycter drepanota* (Meyrick). A: male genitalia in caudal view—B: aedeagus—C: right valva—D: female genitalia in ventral view—E: corpus bursae.

yellowish-white, longitudinal basal streaks, four or five white costal strigulae and three pale ochreous-yellow dorsal ones; a medio-basal streak extending one-third length of wing along fold, narrow, straight, margined heavily with blackish speckles along its upper edge and also a few on lower edge; a dorso-basal streak very narrow, shorter than medio-basal one, margined with blackish speckles along its upper edge; first three costal strigulae placed equidistantly from basal

one-third to three-fourths of wing, very short, wedge-shaped, margined with blackish speckles internally, the first two being very oblique outwardly, and the third erect or slightly oblique inwardly; fourth to fifth costal strigulae small, sometimes indistinct; three dorsal strigulae opposed with first three costal ones respectively, very long, outwardly oblique or curved, extending three-fourths breadth of wing, margined heavily with blackish speckles internally and also a few externally; a few blackish speckles occurring along termen and at apex of wing; cilia greyish-white, with a narrow, blackish basal line around apex of wing. Hindwing grey; cilia greyish-white.

Alar expanse: 5.5—7.0 mm. (in most specimens, 6.5 mm.).

Male genitalia: Symmetrical as shown in Fig. 6, A—C. Valva clavate in form, deeply emarginate near apex of ventral margin, setose on inner surface, the setae on apical area being shortened and spine-like; transtilla strongly widened dorso-laterally. Tegumen elongately triangular; tuba analis slightly produced, with a few micro-spines on its apical area. Ventral flap spatulate in form. Aedoeagus a little longer than valva, tubular, pointed apically, with a pair of large hook-shaped barbs at apex of dorsal side.

Female genitalia: Symmetrical as shown in Fig. 6, D & E. Eighth abdominal segment tightly fused with the seventh, both being clothed with elongate scales; seventh sternite produced over ostium bursae into a large, semicircular flap. Apophysis anterioris very minute, often not visible. Ostium bursae surrounded by a very short, ring-shaped sterigma. Corpus bursae with a single cone-shaped signum in centre of an oblong sclerite.

Specimens examined: 2♂♂, 29/V/1968 & 15/VI/1968, breeding no. Npl-55, and 5♂♂ & 4♀♀, 8-18/VII/1968, breeding no. Npl-104, Balaju, Kathmandu, ex *Engelhardia spicata*.

Distribution: Himalayan region (Kumaon and Nepal).

Host plant: ? *Ailanthus malabarica* (Simarubaceae) in Kumaon, and *Engelhardia spicata* Lechenault (Juglandaceae) in Nepal.

Mine (Pl. IV, A): A rather small blotch (12—15 mm. in longest diameter) occurring upon upper surface of leaf, oval or elliptical, always elongate along middle vein; upper epidermis of leaf on mining part brownish-white, with a longitudinal ridge in accomplished condition.

Remarks: There is some doubt about the present identification. The specimens from Nepal slightly differ from the original description of *drepanota*, based on five specimens from Kumaon, in the colour-pattern of the apical part of the forewing and in the host plant. However, the essential characters such as the colour-maculation of the main part of the forewing and in the form and situation of the mine, both the series of specimens from Nepal and Kumaon may belong to a single species. Especially, the occurrence of the ochreous-yellow dorsal strigulae in contrast to the white costal ones in the forewing is a quite unique character among the members of the genus *Phyllonorycter*, and in this point the specimens at hand agree well with the description of *drepanota*.

*Phyllonorycter yamadai* n. sp.

(Fig. 7; Plate I, G)

Colour: ♂♀. Face and labial palpus brilliant white, the latter being lined with brown outside; tuft of head whitish, mixed with pale ochreous hairs anterolaterally. Antenna whitish, poorly spotted above with dark grey; scape golden ochreous above; pecten white. Thorax golden ochreous dorsally, with two white stripes which are connected with each other through white patagia. Legs whitish; fore and mid tarsi with two and hind one with three blackish rings. Forewing golden ochreous, with brilliant white markings; a medio-basal streak extending one-third length of wing along fold, narrow, straight, margined with

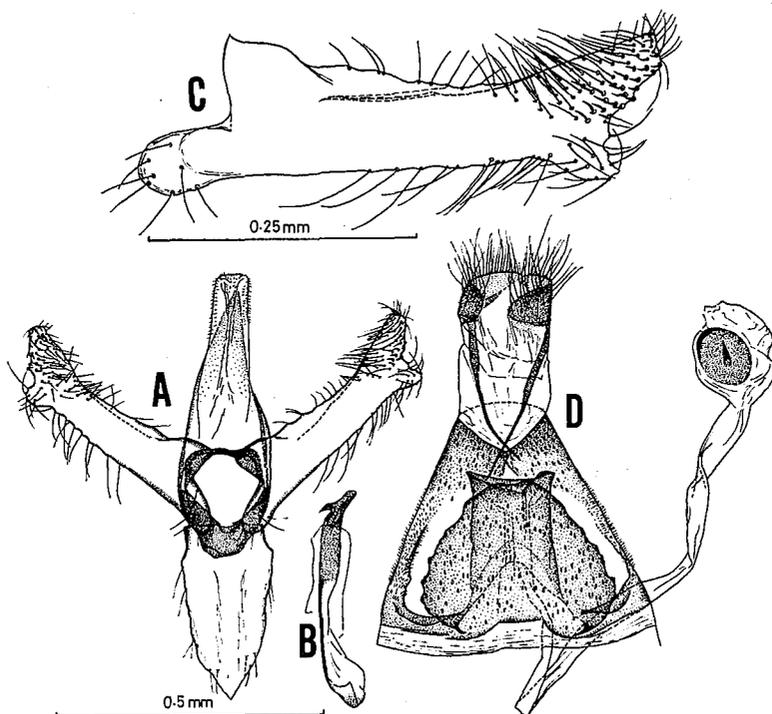


Fig. 7. *Phyllonorycter yamadai* n. sp. A: male genitalia in caudal view—B: aedeagus—C: right valva—D: female genitalia in ventral view.

blackish speckles on upper edge; a small spot placed on dorsum near base of wing, preceded and followed by a few blackish speckles; five costal strigulae situated nearly equidistantly between basal one-third and subapex of wing, wedge-shaped, the first two being rather elongate and oblique outwardly, and the rest shorter and erect or oblique inwardly; three dorsal strigulae much longer than costal marks, strongly oblique outwardly, nearly parallel to each other, the first two being opposed with the first two costal ones respectively, and the third placed just before tornus; all strigulae conspicuously margined with blackish

speckles internally; an ill-defined, white spot situated on discal area just beyond apex of third dorsal strigula; some blackish speckles occurring at apex of wing and also along pale ochreous termen; cilia greyish-white, with a narrow, blackish basal line around apex of wing. Hindwing grey; cilia greyish-white.

Alar expanse: 5.5—6.0 mm.

Male genitalia: Symmetrical as shown in Fig. 7, A—C. Valva elongately quadrangular, emarginate on terminal margin, setose on apical area and along margins, the setae along terminal margin above middle being spine-like; sacculus circular at basal extremity. Tegumen elongately conical; tuba analis slightly produced, sparsely spinose on apical half. Ventral flap elongately triangular. Aedoeagus a little shorter than valva, tubular, with a pair of acute, hook-shaped barbs near apex of dorsal side.

Female genitalia: Symmetrical as shown in Fig. 7, D. Eighth abdominal segment clothed with normal scales, tightly fused with the seventh which is covered with spines on its lateral surfaces. Sterigma long, cup-shaped, and almost wholly covered with a triangular, flap-like seventh sternite. Apophysis anterioris very minute, sometimes not visible. Corpus bursae with a single cone-shaped signum in centre of a circular sclerite.

Holotype: ♂ (G. sl. Grc-1443), Balaju, Kathmandu, 12/VII/1968, ex *Engelhardia spicata*, breeding no. Npl-103. Paratypes: 2♀, with the same data as in holotype.

Host plant: *Engelhardia spicata* Lechenault (Juglandaceae).

Mine (Pl. IV, B): A very small blotch (9—11 mm. in longest diameter) occurring upon lower surface of leaf, situated on space between two lateral veins or rarely along leaf-margin, elliptical to quadrangular in form; lower epidermis of leaf on mining part dark brown, slightly constricted longitudinally, but without distinct wrinkles or ridges even in accomplished condition.

Remarks: This species is closely related to *L. drepanota* Meyrick, and the characters by which it is distinguished from the latter species are given in Table 1.

The new species is named in honour of the leader of our expedition party, Prof. Mayumi Yamada of Zoological Institute, Faculty of Science, Hokkaido University.

*Phyllonorycter engelhardiae* n. sp.

(Fig. 8; Plate I, H)

Colour: ♂♀. Face and labial palpus brilliant white; tuft of head white, mixed with pale ochreous hairs antero-laterally. Antenna pale grey, poorly spotted with darker grey above; scape brilliant white beneath, golden ochreous above; pecten white. Thorax golden ochreous dorsally, with a U-shaped, white stripe. Legs whitish; fore and mid tarsi with two and hind one with three dark brown rings. Forewing golden ochreous, with brilliant white marks; a narrow medio-basal streak extending one-third length of wing, a dorso-basal streak a little shorter than medio-basal one, both the streaks being distinctly margined

with dark brown scales on their upper edges; three costal strigulae short, wedge-shaped, the first being situated at basal one-third of wing and strongly oblique outwardly, the second near middle and nearly parallel with the first, the third at basal three-fourths and erect or slightly oblique inwardly; three dorsal strigulae long, widened basally, strongly oblique outwardly, the first two being sometimes joined with first two costal marks respectively into an angulated fascia, and the rest placed at tornus and triangular; all strigulae conspicuously margined with blackish-brown scales internally; blackish scales scattered at apex of wing in a spot and also along termen in one or more irregular lines; cilia greyish-white,

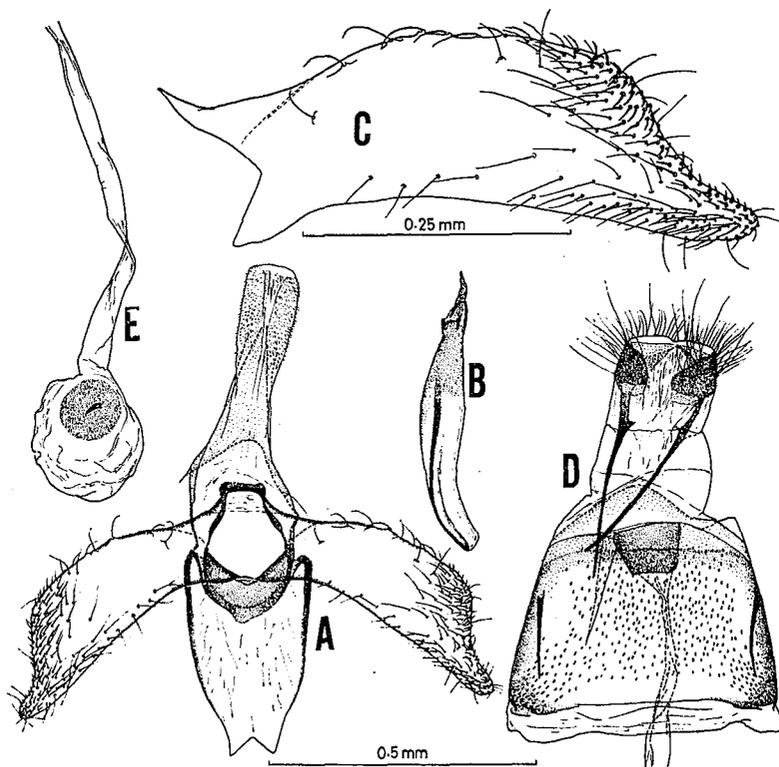


Fig. 8. *Phyllonorycter engelhardiae* n. sp. A: male genitalia in caudal view—B: aedeagus—C: right valva—D: female genitalia in ventral view—E: corpus bursae.

with a narrow blackish line around apex of wing. Hindwing grey; cilia greyish-white.

Alar expanse: 6.0 mm.

Male genitalia: Symmetrical as shown in Fig. 8, A—C. Valva moderately narrow, arched upwardly, suddenly narrowed near apex, setose on apical area and along margins, the setae on costal area beyond middle being shortened and spine-like; transtilla slender. Tegumen elongate-conical; tuba analis projecting far beyond apex of tegumen, spinose on almost whole lower surface. Ventral

Table 1. Comparison of main characters (1, colour; 2 & 3, male genitalia; 4—6, female genitalia; and 7, mine) among three species of *Phyllonorycter* attacking *Engelhardia spicata* in Nepal.

Feature	Species	<i>drepanota</i>	<i>yamadai</i>	<i>engelhardiae</i>
1. Dorsal strigulae of forewing		ochreous-yellow	brilliant white	brilliant white
2. Ventral flap		spatulate, with round apex	elongately subtriangular, with acutely pointed apex	gradually narrowed distally, with apex acutely and deeply notched
3. Valva		clavate, emarginated near apex of ventral margin	elongately subquadrangular, with sacculus circular at basal extremity	rather wide on median area, suddenly narrowed near apex
4. Seventh abdominal segment		not covered with spines, with sternite developed into a flap-like ventral lobe	distinctly covered with spines laterally, with sternite developed as in <i>drepanota</i> , but smaller	not covered with spines, normal in form
5. Sterigma		very short, ring-shaped	long, chamber-like	short, cup-shaped
6. Apophysis anterioris		very minute, often not visible	very minute, sometimes absent	long, about half as long as apophysis posterioris
7. Mine		situated along middle vein of upper side of leaf	situated on space between lateral veins of lower side of leaf	situated on space between lateral veins or along leaf-margin of upper side of leaf

flap gradually narrowed distally, deeply and acutely notched at apex. Aedoeagus about as long as valva, tubular, suddenly depressed and narrowed on apical one-sixth.

Female genitalia: Symmetrical as shown in Fig. 8, D & E. Eighth and seventh abdominal segments tightly combined with each other, without an inter-segmental membrane between them; apophysis anterioris arising from near caudal area of this combined segment, about half as long as apophysis posterioris. Sterigma short, cup-shaped. Corpus bursae globose, with a cone-shaped signum in centre of a weakly sclerotized, circular plate.

Holotype: ♂ (G. sl. Grc-1441), Balaju, Kathmandu, 9/VII/1968, ex *Engelhardia spicata*, breeding no. Npl-105. Paratypes: 2♀♀, with the same data as in holotype except in date emerged, 8 & 13/VII/1968.

Host plant: *Engelhardia spicata* Lechenault (Juglandaceae).

Mine (Pl. IV, C): A rather small blotch (about 12 mm. in longest diameter) occurring upon upper side of leaves, usually situated along leaf-margin or on space between two lateral veins, oval or circular in form; upper epidermis of leaf on mining part whitish, blistered or weakly wrinkled, without any distinct ridges in accomplished condition.

Remarks: The present species and the preceding two, viz. *engelhardiae*, *drepanota* and *yamadai*, are very closely related to each other in general feature, especially in the configuration of the costal and dorsal strigulae of the forewing. Furthermore, they mine the leaf of the same kind of plant, *Engelhardia spicata*, in Nepal, and the mines of these insects have been often found on the same tree at the same time. These insects, however, are easily distinguished from each other by the structure of the genitalia in the adult stage and by the form and situation of the mines in the immature stage as given in Table 1.

The three species belong to the species-group of *pterocaryae* in having a single cone-shaped signum in their female genitalia.

*Phyllonorycter pseuditeina* n. sp.

(Fig. 9; Plate II, C)

Colour: ♂. Face brilliant white, broadly covered with long, silvery white scales which hang from the vertex; tuft of head pale ochre-yellowish. Antenna yellowish-white, poorly spotted with dark brown above; scape and pecten silvery white. Labial palpus and legs brilliant whitish; mid and hind tarsi spotted above with dark brown at apices of the first and second segments. Tegula at base golden ochreous, at apex and along margin brilliant white (main part of thorax damaged by pin). Forewing very narrowly lanceolate, pale ochreous-yellow with golden reflections in ground colour, with markings brilliant white, extremely very narrow and somewhat obscure in outline; a medio-basal streak extending two-fifths to half length of wing along fold, gently bent upwardly at its apical third; a dorso-basal streak a little shorter than medio-basal one, more or less blurred by dark brown intermixing scales on its distal half; four costal strigulae

arranged between middle and subapex of wing, rather short, the first being hook-shaped and strongly oblique outwardly, the rest indistinctly wedge-shaped and slightly oblique inwardly; these costal strigulae sparsely margined with greyish-brown speckles on inner and outer edges; two dorsal strigulae much longer than the costal ones, the first running from basal two-fifths of dorsal margin to apical third of discal area in an outwardly oblique, narrow line, the second placed just before tornus, triangular and shading into yellowish white outwardly, both the strigulae sparsely margined with dark greyish-brown speckles on inner

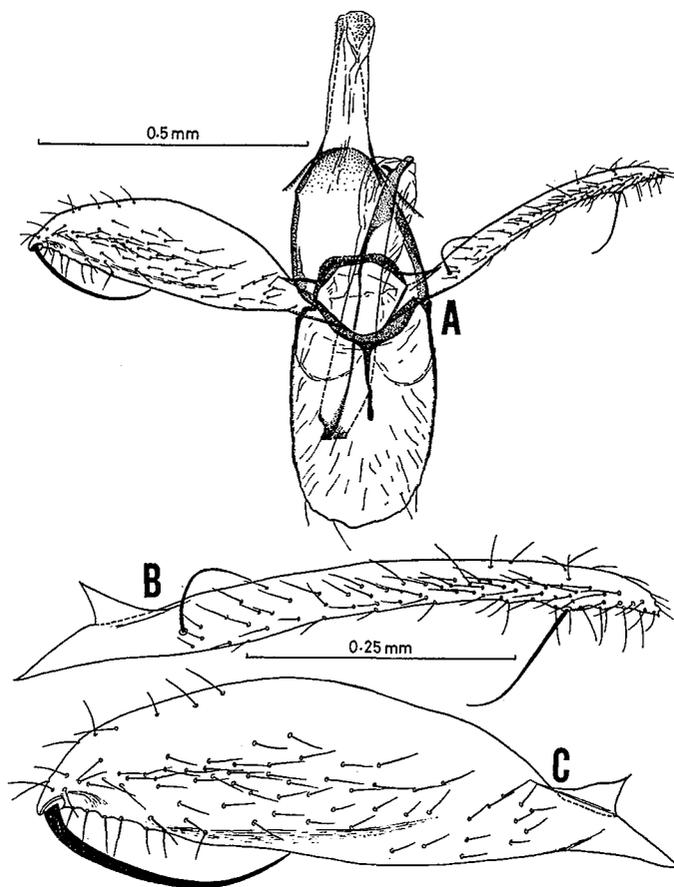


Fig. 9. *Phyllonorycter pseuditeina* n. sp. A: male genitalia in caudal view—B: right valva—C: left valva.

edges wholly and on outer edges apically; discal area between apical third and apex of wing sparsely scattered with greyish-brown speckles irregularly; cilia whitish, with a narrow basal line along termen. Hindwing pale grey; cilia greyish-white.

Alar expanse: 5.0—5.2 mm.

Male genitalia: Asymmetrical in valvae as shown in Fig. 9. Left valva

fusiform, pointed apically, about four times as wide as right one at widest part, sparsely setose on almost whole inner surface, with a very strong, curved seta at apex; right valva evenly slender, setose as well as the left besides a strong, long seta near base. Transtilla slender. Tegumen elongately conical; tuba analis scarcely produced, spinose on apical extremity. Saccus very short, with a long apical projection which is about one-fourth as long as aedeagus. Ventral flap spatulate in form, rounded apically. Aedeagus nearly as long as valva, tubular, with a beak-shaped subapical barb.

Holotype: ♂ (G. sl. Grc-1487), Balaju, Kathmandu, 31/V/1968, breeding no. Npl-59. Paratype: 1♂, with the same data as in holotype.

Host plant: The present specimens were bred from larvae mining leaves of an undetermined shrub, and the writer believes that the plant does not belong to Salicaceae or Leguminosae. The leaf mined by the larva is shown in Fig. 16, E (Pl. III).

Mine (Pl. III, E): A rather small, tentiformed blotch (10—12 mm. in longest diameter) occurring upon lower surface of leaf, always situated on space between two lateral veins; lower epidermis of leaf on mining part whitish, very much wrinkled longitudinally, while without any distinct ridges even in fully developed condition.

Remarks: This species belongs to the species-group of *ulicicolella*, of which most species are leaf-miners of Salicaceae and Leguminosae. In colour-pattern it is somewhat allied to *P. iteina* (Meyrick) described from India as a leaf-miner of *Salix tetrasperma*, but may be distinguished from the latter by the presence of a dorso-basal streak of the forewing, and by the more distinct white markings. On the other hand, in genital structure it is also closely related to *P. viminiella* (Stainton) known from Europe as a leaf-miner of *Salix* spp., from which it may be separated by the right valva being evenly slender almost in the whole length and by the very narrow first dorsal strigula of the forewing being strongly oblique outwardly and never joined with the first costal one.

*Phyllonorycter nepalensis* n. sp.

(Fig. 10, A—E; Plate II, D)

Colour: ♂. Face and labial palpus brilliant white, the latter being sprinkled with brown outside; tuft of head ochreous-brown, darkened anteriorly, mixed with whitish hairs centrally. Antenna ochreous-white, distinctly spotted with dark greyish brown above; scape brilliant white, narrowly dark ochreous-brown above; pecten ochreous. Thorax golden brown dorsally, darkened centrally, with a U-shaped, silvery white stripe; tegula whitish on its apical half. Legs ochreous-white, distinctly spotted with blackish brown above and outside; mid and hind tarsi broadly ringed with blackish brown at apices of first and second segments. Forewing golden brownish, with six costal and four or five dorsal strigulae moderately broad, brilliant white, more or less margined with blackish speckles internally; a small patch of ground colour enclosed with white scales at base

of dorsal margin of wing; first costal strigula placed near base of wing, always detached from costal margin; second costal strigula at basal one-fourth of wing, joined with first dorsal one, forming an outwardly angulated fascia, the dorsal arm being about twice as long as the costal; third costal strigula at about middle of wing, joined with second dorsal one, forming a fascia which is nearly

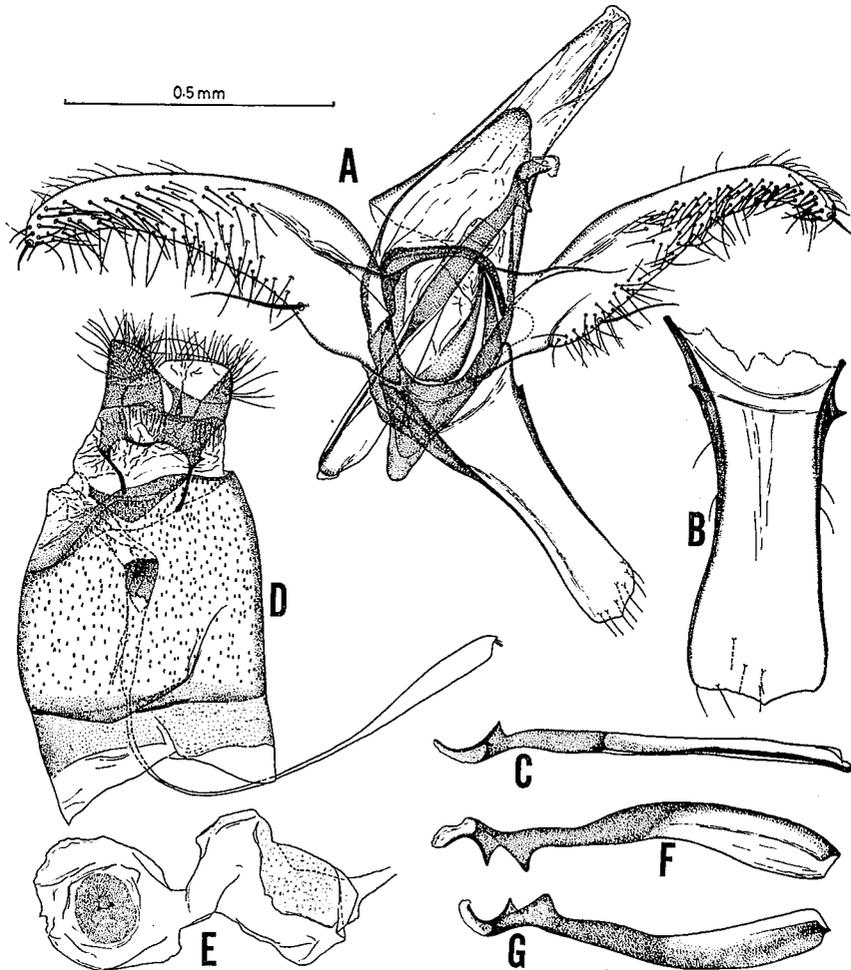


Fig. 10. *Phyllonorycter nepalensis* n. sp. (A—E) and *Phyllonorycter hancola* (Kumata) (F—G). A: male genitalia in caudal view—B: ventral flap—C, F & G: aedoeagus—D: female genitalia in ventral view—E: corpus bursae.

parallel to the preceding fascia; third dorsal strigula just before tornus, triangular; fourth costal strigula at basal five-eighths of wing, short, erect; remaining strigulae near apex of wing, indistinct in outline, slightly oblique inwardly; a short streak of blackish speckles at apex of wing, parallel to termen; cilia ochreous-grey. Hindwing dark grey; cilia pale grey.

♀. Slightly differs from the male in the following points:— Thorax not darkened centrally. First costal strigula of forewing much reduced into a short bar which runs along the wing-fold; second costal and first dorsal strigulae separated widely, never forming a fascia; apical streak of blackish speckles shorter. Blackish spots of legs much smaller, hardly visible.

Alar expanse: 7.2 mm. in male, 6.0 mm. in female.

Male genitalia: Slightly asymmetrical as shown in Fig. 10, A—C. Left valva a little wider than the right, arched upwardly, sparsely setose on inner surface, the setae near apex being thickened and spine-like, and a seta at basal third of ventral margin long, filament-like; right valva similar to the left in shape and setal occurrence. Transtilla short, slender. Tegumen elongately conical, with left apodeme a little longer than the right; tuba analis scarcely produced, not spinose. Saccus moderately long, triangular; ventral flap tongue-shaped, slightly narrowed at middle, partially convex medio-distally. Aedoeagus nearly as long as valva, tubular, with a triangular subapical barb.

Female genitalia: Asymmetrical in form of seventh abdominal segment as shown in Fig. 10, D & E. Papilla analis comparatively long, about half as long as seventh abdominal segment; apophysis posterioris rather short. Eighth abdominal segment with tergite alone visible, crescent-shaped; apophysis anterioris absent. Ostium bursae situated at left side between papillae anales and seventh abdominal segment, which is much narrowed on this side. Sclerous genital plate or sterigma absent. Ductus bursae weakly sclerotized at its caudal end; corpus bursae with a pair of cone-shaped signa in centre of an elliptical sclerite.

Holotype: ♂ (G. sl. Grc-1436), Balaju, Kathmandu, 28/IV/1968, ex *Alnus nepalensis*, breeding no. Npl-9. Paratype: 1♂, with the same data as in holotype; 1♀, Godavari, Nepal Valley, 22/VII/1968, ex *A. nepalensis*.

Host plant: *Alnus nepalensis* D. Don (Betulaceae).

Mine (Pl. III, F): A rather small, oblong or quadrate blotch (8—12 mm. in longest diameter) occurring upon lower side of leaf, usually placed on space between two lateral veins; lower epidermis on mining part greenish-white in early stage and brownish in fully developed stage, with many weak, longitudinal ridges in tentiformed stage.

Remarks: The difference of the colour-pattern between the male and female appears to be merely a seasonal variation rather than sexual, since the series of male specimens emerged in April (dry season), whereas that of the female in July (wet season).

*P. nepalensis*, which belongs to the species-group of *japonica*, is closely related to *P. hancola* (Kumata), a leaf-miner of *Alnus* spp. in Japan, but is immediately distinguished from the latter in the form of the aedoeagus as compared in Fig. 10; C, F & G. Moreover, the medio-distally convexed ventral flap of the male and the comparatively long seventh abdominal segment of the female will serve to separate *nepalensis* from *hancola*, in which the ventral flap is always concave medio-distally and the seventh abdominal segment of the female is short and about as long as papillae anales.

*Phyllonorycter oreas* n. sp.

(Fig. 11; Plate II, E)

Colour: ♂♀. Face, labial palpus and legs yellowish-white; mid tarsus with two and hind one with three blackish rings. Tuft of head ochreous-white, mixed with some ochreous-brown hairs antero-laterally. Antenna greyish-white, with each segment conspicuously darkened on apical half; scape brilliant white, narrowly golden ochreous above; pecten white. Thorax golden brown dorsally, with two narrow, white stripes. Forewing golden brown, with a medio-basal streak, three costal and three dorsal blotches brilliant white, these blotches being transverse, and rather widely margined with blackish scales internally; medio-

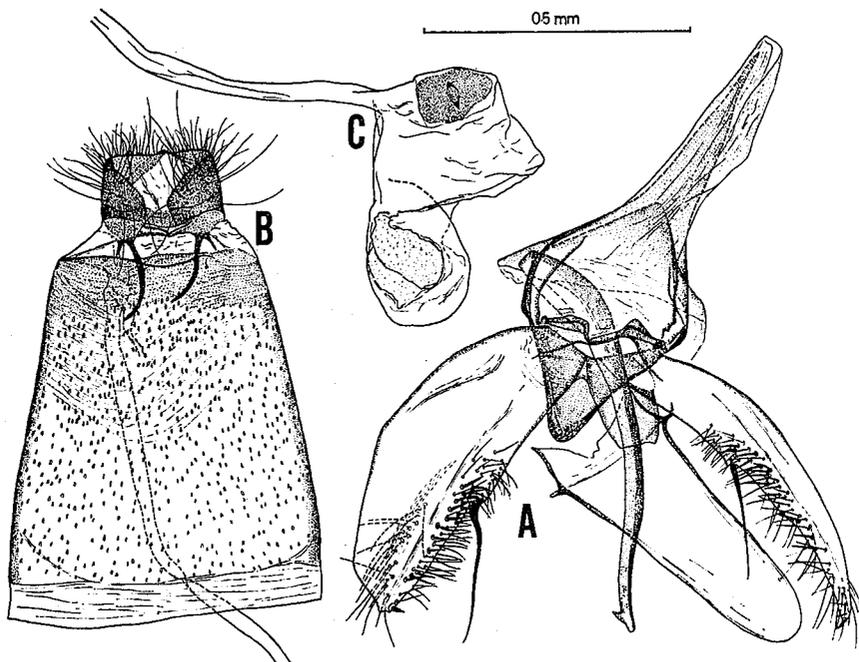


Fig. 11. *Phyllonorycter oreas* n. sp. A: male genitalia in caudal view—B: female genitalia in ventral view—C: corpus bursae.

basal streak extremely narrow, straight, extending about one-fourth length of wing along fold; first costal blotch placed at basal one-third of wing, the second at middle and the third at basal two-thirds, all small, extending at most one-third width of wing; dorsal blotches alternated with costal ones, a little larger and longer than the latter; first costal and first dorsal marks often diminishing, only indicated by internal dark margin; some hint of fourth pair of blotches obscurely indicated or only expressed by some blackish speckles near apex of wing; two or more rows of blackish speckles parallel to termen; cilia pale ochreous-grey. Hindwing grey; cilia pale ochreous-grey.

Alar expanse: 6.0—6.5 mm.

Male genitalia: Asymmetrical as shown in Fig. 11, A. Left valva fusiform, about twice as wide as right one at widest part, rather densely setose along ventral margin; a seta at apex being short and spine-like, and a seta at middle of ventral margin very long, filament-like and slightly sinuate. Right valva slightly arched upwardly, setose as in left one, with a filament-like seta a little shorter and straight. Transtilla slightly widened dorso-laterally. Tegumen very elongately conical, with left apodeme a little longer than right one; tuba analis scarcely produced. Saccus moderately long, triangular; ventral flap tongue-shaped. Aedoeagus longer than valva, tubular, curved, with an acute subapical barb.

Female genitalia: Very slightly asymmetrical as shown in Fig. 11, B & C. Papillae anales slightly elongated, with left apophysis posterioris a little longer than right one and nearly as long as papillae anales. Eighth abdominal segment tightly fused with seventh one to form a single, long segment; apophysis anterioris absent. Sclerous genital plate or sterigma absent. Ostium bursae situated at left side of ventrum; ductus bursae wholly membranous; corpus bursae with a pair of minute, cone-shaped signa which occur in centre of an oblong sclerite.

Holotype: ♀ (G. sl. Grc-1434), Balaju, Kathmandu, 18/VI/1968, ex ? *Odina* sp., breeding no. Npl-26. Paratype: 1♂, with the same data as in holotype.

Host plant: ? *Odina* sp. (Anacardiaceae).

Mine (Pl. IV, D): A very large, irregularly oblong, tentiformed blotch (20—25 mm. in longest diameter) occurring upon upper surface of leaf, usually situated on space between two lateral veins; upper epidermis of leaf on mining part brownish-white in colour, with one or two strong, longitudinal ridges in fully matured state.

Remarks: The new species belongs to the species-group of *japonica*. In configuration of the white marks of the forewing it is somewhat similar to *P. neodoxa* (Meyrick) known from India, but differs clearly from the latter in the ground colour of the head, thorax and forewing. On the other hand, in the male and female genitalia it is very closely related to *P. dakekanbae* (Kumata), a leaf-miner of *Betula ermani* in Japan, from which it can be immediately separated by the absence of the median white fascia of the forewing.

*Phyllonorycter cinctata* n. sp.

(Fig. 12; Plate II, F)

Colour: ♂♀. Face silvery white, slightly tinged with yellow; labial palpus white; tuft of head ochreous-yellow, darkened anteriorly. Antenna greyish-black; scape whitish, narrowly dark grey above; pecten ochreous-yellow. Thorax golden chestnut-brown dorsally, darkened centrally, with indistinct silvery stripes along inner margins of tegulae. Legs dark grey, spotted with yellowish-white above and outside. Forewing rather widely lanceolate, golden chestnut-brown, somewhat darkened on apical third, with a medio-basal streak, a median fascia, two

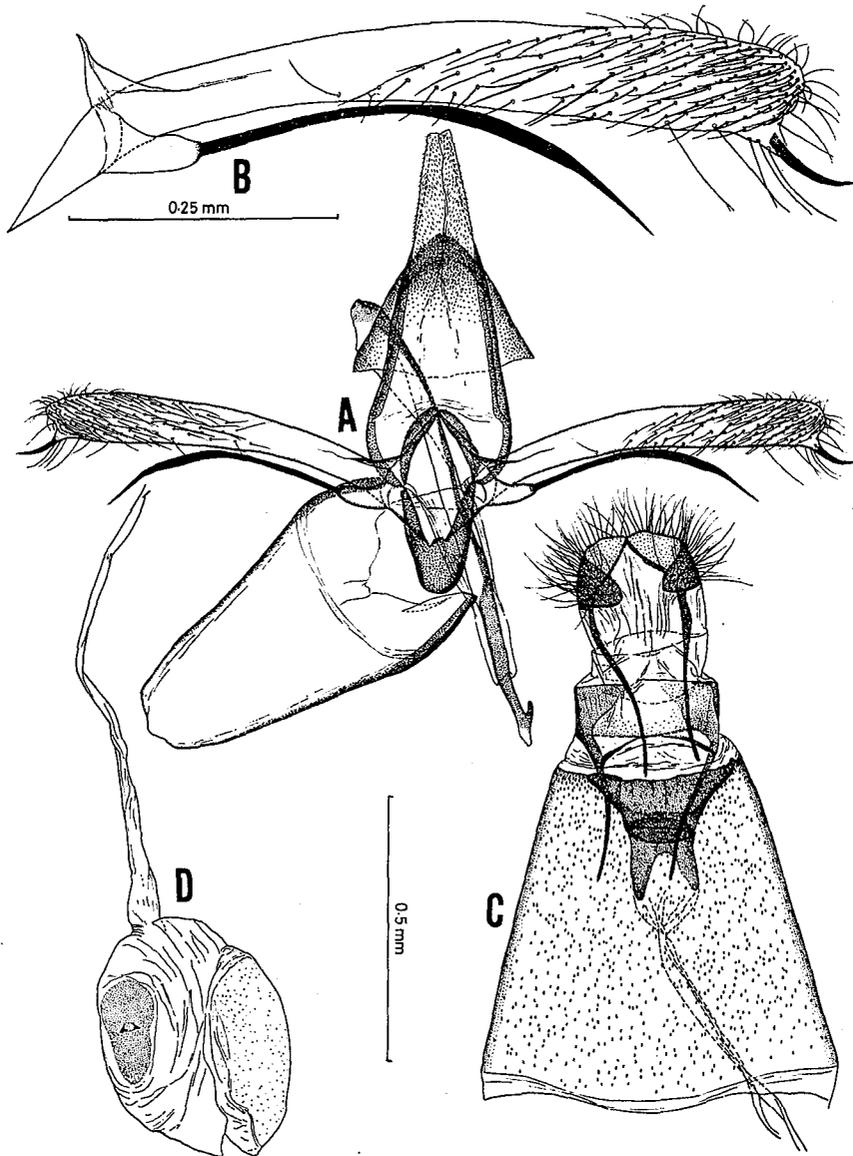


Fig. 12. *Phyllonorycter cinctata* n. sp. A: male genitalia in caudal view—B: right valva—C: female genitalia in ventral view—D: corpus bursae.

costal strigulae and a dorsal one silvery white; medio-basal streak narrow, straight, extending about one-third length of wing in parallel with costal margin, clearly margined with black almost on whole edge; median fascia broad, slightly arched outwardly, externally shading into ground colour, internally margined with black and then suffused with dark brown very widely; dorsal strigula placed just before tornus, triangular; first costal strigula just opposed with dorsal one, hook-shaped; second costal strigula at apical one-fifth of wing, wedge-shaped, erect or slightly oblique inwardly; all the strigulae internally margined with black conspicuously; an apical black streak parallel to termen; wing-margin around apex from second costal strigula to dorsal one widely dark purplish-grey; cilia pale ochreous-grey. Hindwing grey; cilia pale grey.

Alar expanse: 7.0—8.0 mm.

Male genitalia: Symmetrical as shown in Fig. 12, A & B. Valva slender in whole length, very slightly arched upwardly, densely setose on apical half of inner surface, a seta at apex of ventral margin being long, outwardly curved and spine-like; costal process small, cone-shaped, with a filament-like seta long, arched upwardly, and reaching about apical one-fifth of valva. Tegumen elongately conical; tuba analis hardly produced, spinose on almost whole ventral surface. Saccus short, rounded apically. Ventral flap gradually narrowed towards round apex. Aedoeagus fairly longer than valva, tubular, pointed apically, with a minute, blunt subapical barb.

Female genitalia: Symmetrical as shown in Fig. 12, C & D. Papillae anales short as usual; eighth abdominal segment normally joined with seventh one through intersegmental membrane. Apophysis anterioris long, about three-fourths as long as apophysis posterioris. Sterigma cup-shaped, much widened posteriorly, bilobed anteriorly. Corpus bursae globose, with a pair of minute, cone-shaped signa which are situated in centre of an oval sclerite.

Holotype: ♂ (G. sl. Grc-1428), Khurumsang (ca. 2500 m.), No. 1 West, 18/VI/1968, ex *Viburnum erubescens*, breeding no. Npl-63. Paratypes: 2♂♂ & 8♀♀, with the same data as in holotype except in date emerged, 9-18/VI/1968.

Host plant: *Viburnum erubescens* Wallich (Caprifoliaceae).

Mine (Pl. IV, E): A rather small, elongate, tentiformed blotch (10—14 mm. in longest diameter) occurring upon lower surface of leaf, usually situated on space between two lateral veins; in fully developed state, upper epidermis of leaf on mining part brownish, much constricted longitudinally, with five or more moderate ridges.

Remarks: This species belongs to the species-group of *rajella* in having a costal process and a long, filament-like seta on the valva. So far as the colour-maculation is concerned, it is very closely allied to *P. eratanta* (Meyrick) and *P. philerasta* (Meyrick), both of which are described from the Himalayan region of Punjab. Based on the original descriptions of *eratanta* and *philerasta*, the present species may be distinguished from the former two by the number of whitish strigulae of the forewing besides the median fascia; i. e. in *philerasta* the forewing has three costal and two dorsal strigulae and in *eratanta* the costal

and dorsal strigulae are provided by two respectively, whereas in the present species the forewing has one dorsal and two costal strigulae.

*Phyllonorycter rubicola* n. sp.

(Fig. 1, D—G; Plate II, G)

Colour: ♂. Face silvery white; labial palpus white, the apical segment being fuscous outside; tuft of head golden yellow. Antenna yellowish-white, distinctly spotted above with brownish grey; scape and pecten golden yellow. Thorax silvery white dorsally (the median area damaged by pin); tegula golden yellow. Legs yellowish-white; mid tarsus with two and hind one with three blackish rings. Forewing golden yellow in ground colour, with a basal spot, two transverse fasciae, two costal strigulae and a dorsal one silvery white; basal spot situated at basal extremity below wing-fold, ill-defined in outline; first fascia placed at basal one-fourth of wing, straight, without any dark marginal scales; second fascia just before middle, scarcely curved, externally shading into ground colour, internally margined with black speckles; almost whole space between these fasciae suffused with dark brown speckles, specially densely on costal area above wing-fold; dorsal strigula placed at tornus, triangular, just opposed with first costal one, both the strigulae internally margined with a few black speckles, externally suffused with dark brown speckles very widely; second costal strigula at apical one-seventh, wedge-shaped, oblique inwardly, externally margined with black speckles; cilia pale yellowish-grey, with a basal line of blackish speckles along termen. Hindwing grey; cilia pale yellowish-grey.

Alar expanse: 6.0 mm.

Male genitalia: Symmetrical as shown in Fig. 1, D—G. Valva small, quadrate in shape, concaved on distal margin, acutely pointed at apex of ventral margin, setose at apical area of ventral margin and along costal margin. Transstilla short, slender. Tegumen rather wide, bluntly pointed apically; tuba analis produced, spinose on ventral surface. Saccus widely crescent-shaped. Ventral flap oval in outline. Aedoeagus about 1.5 times as long as valva, bent at middle and at apical one-sixth, much thickened on basal half, with a pair of large, semicircular lobes near apex of ventral side; juxta heavily sclerotized, long, connected with aedoeagus at middle of the latter.

Holotype: ♂ (G. sl. Grc-1439), Balaju, Kathmandu, 8/VII/1968, ex *Rubus paniculatus*, breeding no. Npl-110.

Host plant: *Rubus paniculatus* Smith (Rosaceae).

Mine (Pl. IV, F): A rather large, irregularly star-like mine (asteronome) occurring upon upper surface of leaf; upper epidermis of leaf on mining part brownish, somewhat orbicularly swollen in centre where the pupation takes place.

Remarks: On account of the basally much thickened aedoeagus and the long, sclerotized juxta, the new species, *rubicola*, belongs to the species-group of *trifasciella*. It is immediately distinguished from *P. pulchra* (Kumata), another

leaf-miner of *Rubus* and a member of *trifasciella*-group, by the colouration of the antenna (yellowish-white and spotted above with brownish-grey on all the segments in *rubicola*, while blackish-brown except for ten to twelve white segments from the apex in *pulchra*), by the absence of a blackish triangular spot at the base of the costal margin of the forewing, and by the shape of the valva (quadrate in *rubicola*, whereas somewhat lanceolate in *pulchra*).

## Appendix

### NOTES ON THE HOKKAIDO UNIVERSITY SCIENTIFIC EXPEDITION TO NEPAL HIMALAYA, 1968

In 1968 from March to July a biological expedition was made in Central Nepal by members of the Hokkaido University Scientific Expedition to the Nepal Himalaya, dispatched by the Hokkaido University Himalayan Committee. The party of the expedition consisted of seven members: Mayumi Yamada, the leader, two entomologists (T. Kumata and T. Matsumura), two zoologists (M. Masatomi and H. Abe), one botanist (M. Watanabe), and one cameraman (I. Ushiroyama).

The purpose of the expedition was to collect material and data on the fauna and flora of the hitherto comparatively little known Himalayan region of Nepal in connection with the faunal and floral problems of Japan. It is generally accepted that the Japanese fauna and flora are partly closely related phylogenetically to those of the Himalayan region.

Main part of the material collected and brought by the party will be preserved in the following places on the grounds of Hokkaido University:— Vertebrate animals in the Natural History Museum of Faculty of Agriculture; invertebrates other than insects in the Zoological Institute, Faculty of Science; insects in the Entomological Institute, Faculty of Agriculture; flowering plants in the Herbarium of Faculty of Agriculture (SAPA); and fresh water algae in the Botanical Institute, Faculty of Science (SAP).

#### ITINERARY

Two members (M. M. and T. M.) first arrived at Kathmandu on 12th March, and all the members met there on 14th April. The trips of the expedition party within Nepal consisted of three major trekking routes, namely, (A) Pokhara—Tukucha, (B) Kathmandu—Gosainkund, and (C) Kathmandu—Namche Bazar. The first two were taken by all the members except M. W., and the last by one member (T. M.). The main collecting and investigative localities within the trekking routes are indicated on a map of Central Nepal (Fig. 13).

##### A. Pokhara—Tukucha

- 25 April - The members arrived at Pokhara (830 m.), No. 3 West, from Kathmandu by flight.  
26 Pokhara.  
27 Pokhara—Yangja (1140 m.), No. 3 West—Swinket (1150 m.), No. 3 West.  
28 Swinket—Naudhara (1400 m.), No. 3 West—Kangre Deorali (1700 m.), No. 3 West—Lumley (1600 m.), No. 3 West—Biratanti (1150 m.), No. 4 West.  
29 Biratanti.  
30 Biratanti—Heele (1450 m.), No. 4 West—Ulleri (2010 m.), No. 4 West. M. W.: went back towards Pokhara, Biratanti—Swinket.  
1 May Ulleri—Nangitanti (2480 m.), No. 4 West—Gorapani (2780 m.), No. 4 West. M. W.: Swinket—Pokhara.  
2 Gorapani—Gorapani Deorali (2850 m.), No. 4 West—Chitare (2400 m.), No. 4

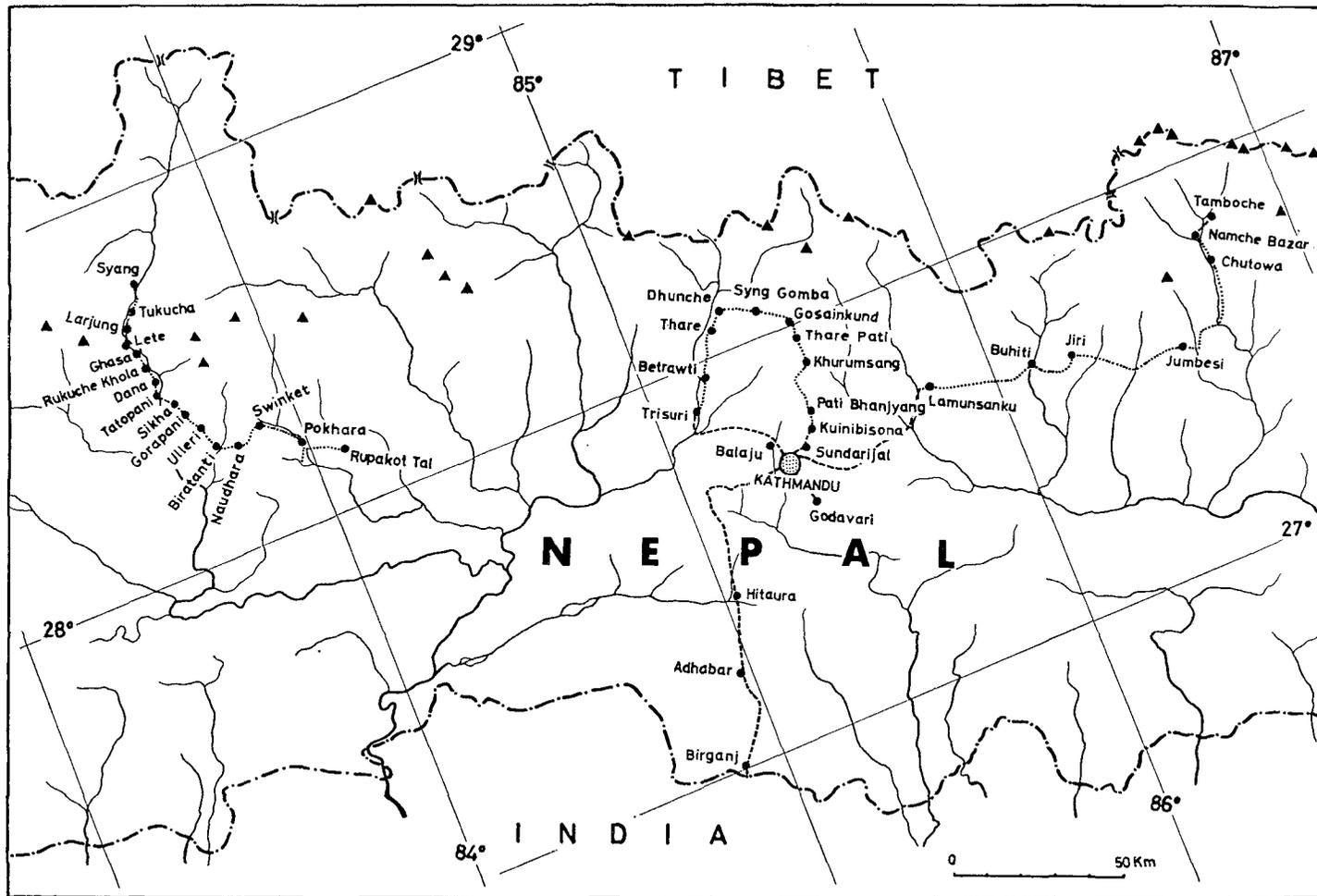


Fig. 13. Map of Central Nepal. ●: main collecting localities. .....: trekking route. ----: by car.

- West—Sikha (2000 m.), No. 4 West—Sikhaghara (1950 m.), No. 4 West—Ghara (1820 m.), No. 4 West—Tatopani (1260 m.), Palpa. M. W.: Pokhara—Begnas Tal.
- 3 Tatopani—Dana (1420 m.), Palpa—Rukuche Khola (1600 m.), Palpa—Ghasa (2090 m.), Palpa. M. W.: Begnas Tal—Pokhara.
- 4 Ghasa.
- 5 Ghasa—Lete (2440 m.), Palpa—Dhumpu (2420 m.), Palpa—Larjung (2550 m.), Palpa—Tukucha (2600 m.), Palpa.
- 6 Four members (H. A., M. M., M. Y. and T. K.): Tukucha. Others (I. U. and T. M.): Tukucha—Syang (2700 m.), Palpa—Tukucha. M. W.: Kathmandu.
- 7 Tukucha—Larjung (2530 m.), Palpa.
- 8 Larjung—Dhumpu—Lete—Ghasa.
- 9 Ghasa—Rukuche Khola—Dana—Tatopani. M. W.: started to Gosainkund, Kathmandu—Betrawati.
- 10 Tatopani—Ghara—Sikhaghara—Sikha—Chitare. M. W.: Betrawati—Guran.
- 11 Chitare—Gorapani Deorali—Nangitanti—near Ulleri (2290 m.), No. 4 West. M. W.: Guran—Syng Gomba.
- 12 Ulleri—Heele—Biratanti. M. W.: Syng Gomba—Gosainkund.
- 13 Biratanti. M. W.: Gosainkund—Thare Pati.
- 14 Biratanti—Lumley—Kangre Deorali—Naudhara—Swinket. M. W.: Thare Pati—Pati Bhanjyang.
- 15 Swinket. M. W.: Pati Bhanjyang—Kathmandu.
- 16 Swinket—Yangja—Pokhara.
- 17 Pokhara.
- 18 Pokhara—Arunkunpohwa (750 m.), No. 3 West—Rupakot Tal (750 m.), No. 3 West.
- 19—20 Rupakot Tal.
- 21 Rupakot Tal—Arunkunpohwa—Pokhara.
- 22 Pokhara.
- 23 Returned to Kathmandu by flight.

#### B. Kathmandu—Gosainkund

- 27 May Arrived at Trisuli Bazar (620 m.), No. 1 West, from Kathmandu by bus.
- 28 Trisuli Bazar—Betrawati (770 m.), No. 1 West—Bonuwa (910 m.), No. 1 West—Ramche (1670 m.), No. 1 West.
- 29 Ramche—Thare (2000 m.), No. 1 West—Bokajhunda (2000 m.), No. 1 West.
- 30 Bokajhunda—Dhunche (2000 m.), No. 1 West.
- 31 Dhunche.
- 1 June Dhunche—Syng Gomba (3250 m.), Gosainkund.
- 2 Syng Gomba.
- 3 Syng Gomba—Gosainkund (4300 m.).
- 4 Gosainkund.
- 5 Gosainkund—Thare Pati (3570 m.), Gosainkund.
- 6 Thare Pati. M. W.: Kathmandu—Birganj.
- 7 Thare Pati—Bangel Kharka (3180 m.), No. 1 West—Khurumsang (2500 m.), No. 1 West. M. W.: Birganj—Kathmandu.
- 8 Khurumsang.
- 9 Khurumsang—Gulbu Bhanjyang (2200 m.), No. 1 West—Mamche Danda (2540 m.), No. 1 West—Pati Bhanjyang (1840 m.), No. 1 West.
- 10 Pati Bhanjyang—Mulkharka (1800 m.), No. 1 West—Sundarijal (1450 m.), Kathmandu—Kathmandu.

#### C. Kathmandu—Namche Bazar (by T. M.)

- 23 June Kathmandu—Lamuṅsanku (880 m.), No. 1 East.

- 24 Lamunsanku—Nigali (2550 m.), No. 2 East.  
 25 Nigali—Sherabesi (1460 m.), No. 2 East—Buhiti (980 m.), No. 2 East.  
 26 Buhiti—Namuto (1450 m.), No. 2 East—Laptsa (2500 m.), No. 2 East—Shikuri (1950 m.), No. 2 East.  
 27 Shikuri—Jiri (1900 m.), No. 2 East—Kasurbas (2450 m.), No. 2 East.  
 28 Kasurbas—Chembu (1860 m.), No. 3 East—Seti (2560 m.), No. 3 East.  
 29 Seti—Jumbesi (2600 m.), No. 3 East—Salung (2800 m.), No. 3 East.  
 30 Salung—Taksing La (2900 m.), No. 3 East—Kali Khola (2000 m.), No. 3 East.  
 1 July Kali Khola—Kali La (3000 m.), No. 3 East—Chuto (2600 m.), No. 3 East—Chutawa (2530 m.), No. 3 East.  
 2 Chutawa—Namche Bazar (3400 m.).  
 3—7 Namche Bazar.  
 8 Namche Bazar—Kyanzuma (3560 m.), No. 3 East—Tamboche (3800 m.), No. 3 East.  
 9 Tamboche—Namche Bazar.  
 10 Namche Bazar—Kyanzuma—Zorusale.  
 11 Zorusale—Kali La—Karte (2600 m.), No. 3 East.  
 12 Karte—Kali Khola—Salung.  
 13 Salung—Jumbesi—Seti—Koramu (1650 m.), No. 2 East.  
 14 Koramu—Changma La—Jiri.  
 15 Jiri—Laptsa—Namuto—Buhiti.  
 16 Buhiti—Sherabesi—Nigali.  
 17 Nigali—Sanupaka (1600 m.), No. 1 East—Lamunsanku—Kathmandu.

D. Short trips to suburbs of Kathmandu and to Terai Forest

- 18—20 April All the members: Godavari (1450 m.), Nepal Valley.  
 15—17 June Do.  
 24—27 June H. A., M. M. and T. K.: Adhabar (300 m.), Terai Forest.  
 5—7 July H. A. and T. K.: Kuinibisona (1890 m.), No. 1 West.  
 11—12 July T. K.: Godavari, Nepal Valley.  
 14—17 July T. K.: Adhabar, Terai Forest.

In addition Balaju (1400 m.) and Balaju Peak (2129 m.) were frequently visited by individual members.

On 21st June three members (I. U., M. W. and M. Y.), on 14th July two (H. A. and M. M.) and on 22nd July the rest (T. K. and T. M.) left Kathmandu towards Japan.

A LIST OF CONTRIBUTIONS TO THE  
 "SCIENTIFIC RESULTS OF HOKKAIDO UNIVERSITY EXPEDITIONS  
 TO THE HIMALAYA, ENTOMOLOGY"

The entomological collection brought by the expedition comprises more than 20,000 specimens which spread over almost all the orders. Some results of taxonomic studies based on the collection were already published by authorities as listed below.

No. 1. Takada, Hajimu 1970. A new species of *Binodoxys* Mackauer from Nepal (Hymenoptera, Aphidiidae). *Kontyû* 38: 42-44.

No. 2. Takada, Haruo 1970. *Scaptomyza* (*Parascaptomyza*) *pallida* (Zetterstedt) and two related new species, *S. (P.) elmoi* n. sp. and *S. (P.) himalayana* n. sp. (Diptera: Drosophilidae). *Annot. Zool. Jap.* 43: 142-147.

No. 3. Takagi, S. 1972. Four new species of *Diostracus* Loew from Nepal (Diptera,

Dolichopodidae). *J. nat. Hist.* 6: 521-546.

No. 4. Kuwayama, S. 1970. On the genus *Eubasilissa* from Central Nepal (Trichoptera: Phryganeidae). *Mushi* 43: 149-151.

No. 5. Matsumura, T. 1970. Bees from Nepal, I. *Thyreus* Panzer (Hymenoptera, Apoidea). *Kontyû* 38: 314-317.

No. 6. Matsumura, T. & Sakagami, S. F. 1971. Bees from Nepal, II. *Lasioglossum albescens*, with some bionomic notes (Hymenoptera, Halictidae). *Annot. Zool. Jap.* 44: 47-55.

No. 7. Nakane, T. 1972. Coleoptera of Nepal collected by the Hokkaido University Scientific Expedition to Nepal Himalaya: Lucanidae and Passalidae. *Kontyû* 40: 41-46.

No. 8. Habu, A. 1973. On a collection of Carabidae from Nepal made by the Hokkaido University Scientific Expedition to Nepal Himalaya, 1968 (1). *Bull. Natl. Inst. Agr. Sci., Ser. C* 27: 81-132. Ditto (2). In preparation.

No. 9. Takagi, S. 1972. A micropterous dolichopodid fly from Nepal Himalaya (Diptera). *Kontyû* 40: 90-99.

No. 10. Nakane, T. 1972. Coleoptera of Nepal collected by the Hokkaido University Scientific Expedition to Nepal Himalaya: Scarabaeidae I—Cetoniinae, Valginae and Dynastinae. *Kontyû* 40: 112-118.

No. 11. Kimoto, S. & Takizawa, H. 1972-73. Chrysomelid-beetles of Nepal, collected by the Hokkaido University Scientific Expedition to Nepal Himalaya, 1968. Part I. *Kontyû* 40: 215-223. Ditto Part II. *Kontyû* 41: 170-180.

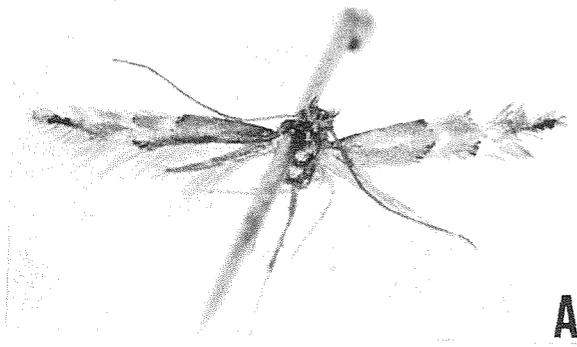
No. 12. Uéno, S. 1972. Two new trechine beetles from Nepal Himalaya obtained by the Hokkaido University Scientific Expedition 1968. *Annot. Zool. Jap.* 45: 178-186.

**PLATES**

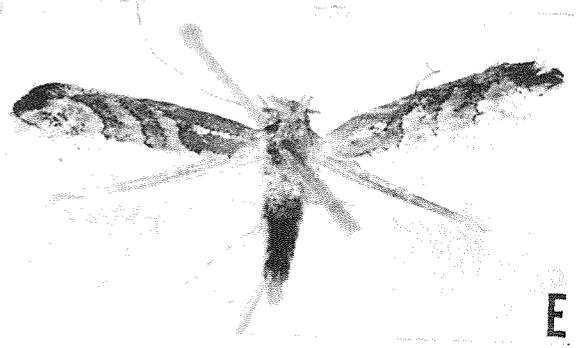
Plate I

Fig. 14. Specimens of *Phyllonorycter* spp.

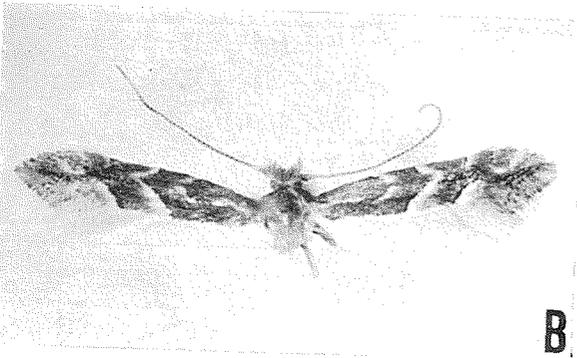
- A : *Phyllonorycter humilitatis* n. sp. (holotype).
- B : *Phyllonorycter ovalifoliae* n. sp. (holotype).
- C : Ditto (paratype).
- D : *Phyllonorycter himalayana* n. sp. (holotype).
- E : *Phyllonorycter drepanota* (Meyrick).
- F : Ditto.
- G : *Phyllonorycter yamadai* n. sp. (holotype).
- H : *Phyllonorycter engelhardiae* n. sp. (holotype).



A



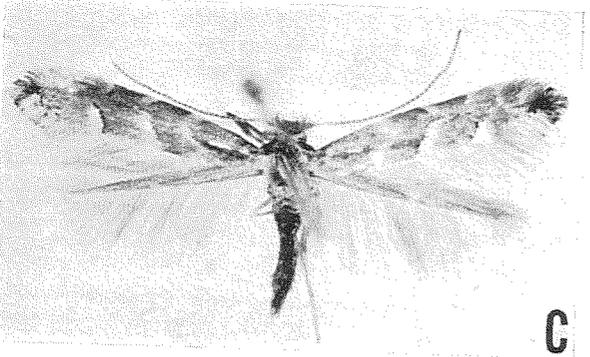
E



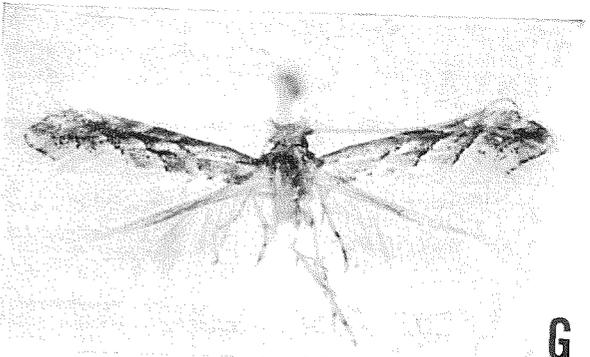
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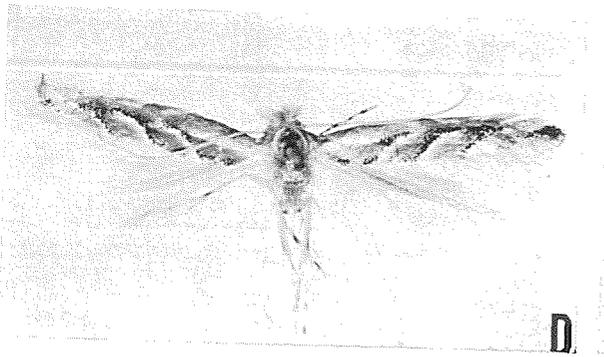
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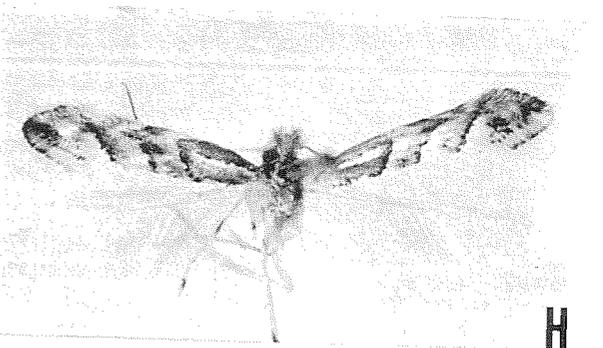
C



G



D



H

Plate II

Fig. 15. Specimens of *Phyllonorycter* spp.

- A : *Phyllonorycter pruni* n. sp. (holotype).
- B : *Phyllonorycter tribhuvani* n. sp. (holotype).
- C : *Phyllonorycter pseuditeina* n. sp. (holotype).
- D : *Phyllonorycter nepalensis* n. sp. (holotype).
- E : *Phyllonorycter oreas* n. sp. (holotype).
- F : *Phyllonorycter cinctata* n. sp. (holotype).
- G : *Phyllonorycter rubicola* n. sp. (holotype).
- H : *Phyllonorycter hancola* (Kumata) (Sapporo, Hokkaido, Japan, ex *Alnus hirsuta*).

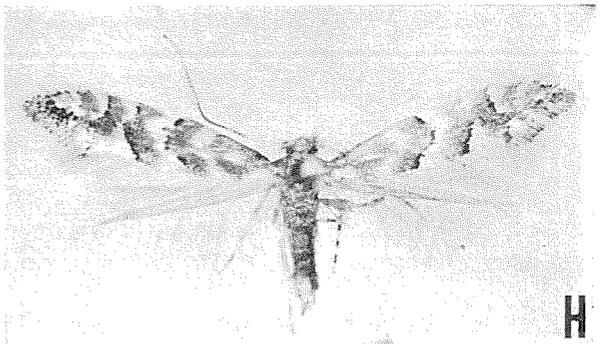
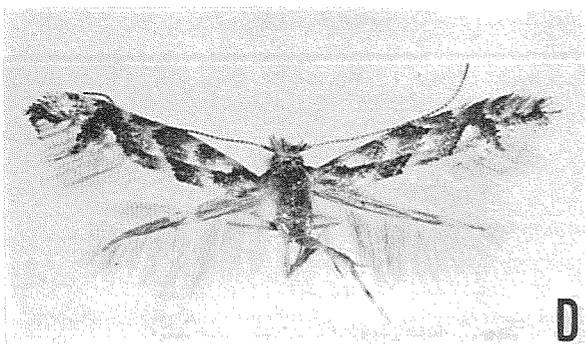
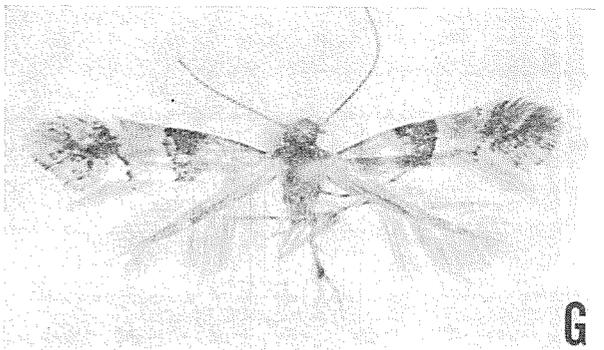
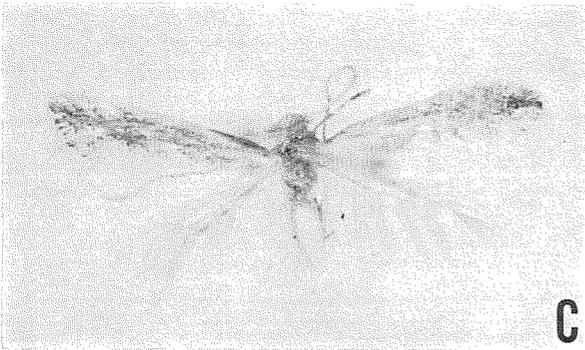
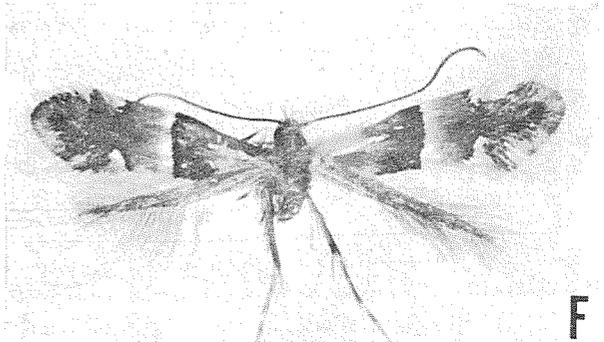
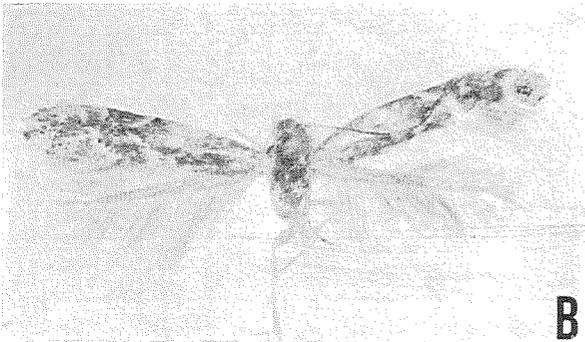
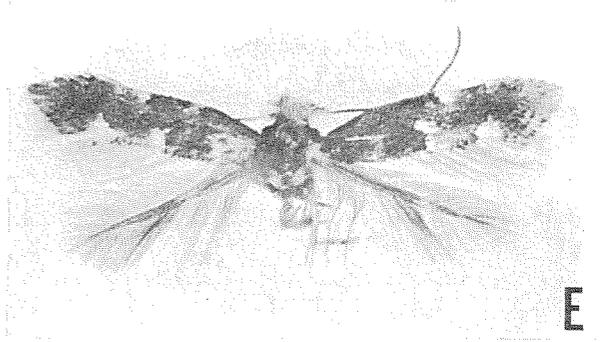
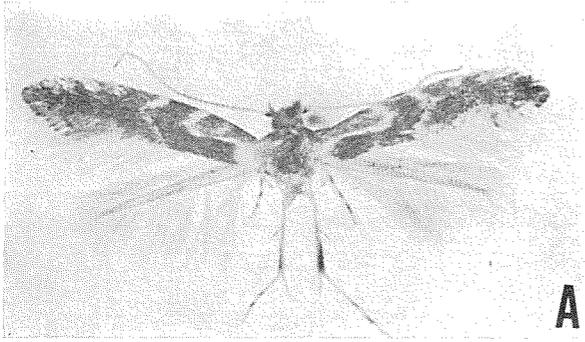
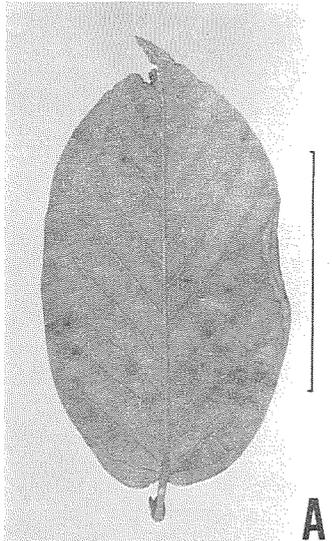


Plate III

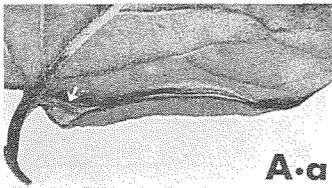
Fig. 16. Leaf or leaflet mined by larva.

- A : *Lyonia ovalifolia* (lower side) mined by *Phyllonorycter ovalifoliae* n. sp.
- B : *Prunus cerasoides* (lower side) mined by *Phyllonorycter pruni* n. sp.
- C : Ditto (upper side) mined by *Phyllonorycter tribhuvani* n. sp.
- D : *Quercus semecarpifolia* (upper side) mined by *Phyllonorycter himalayana* n. sp.
- E : An undetermined shrub (lower side) mined by *Phyllonorycter pseuditeina* n. sp.
- F : *Alnus nepalensis* (lower side) mined by *Phyllonorycter nepalensis* n. sp.
- a : Mined part enlarged.

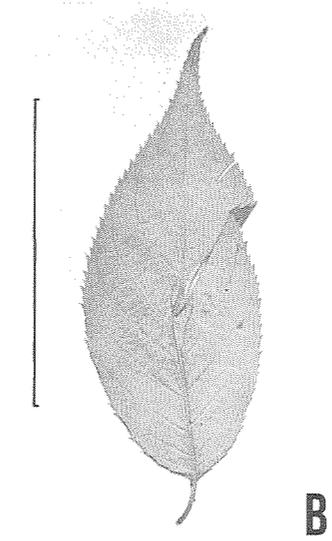
Scale, 5 cm. ; arrow showing pupal exuviae.



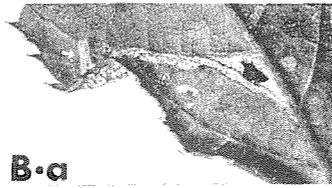
**A**



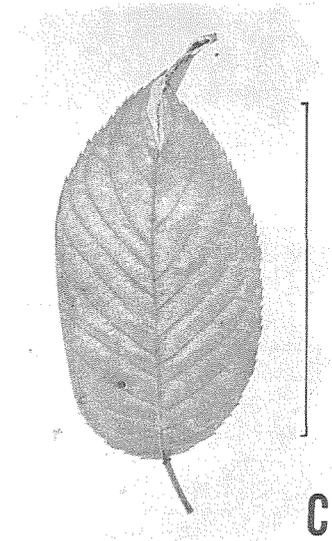
**A-a**



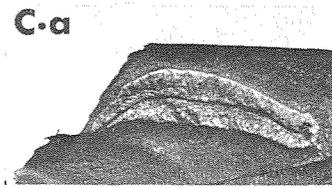
**B**



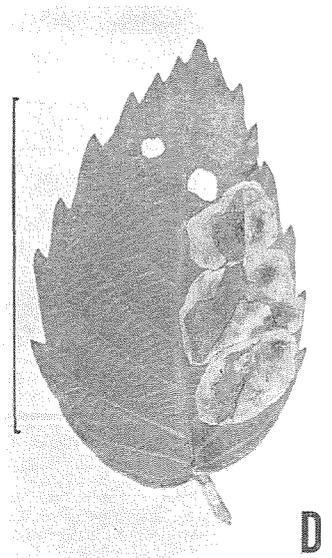
**B-a**



**C**



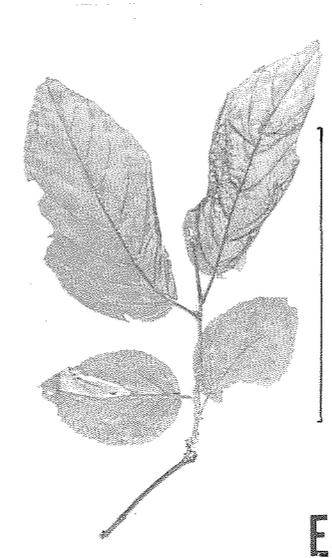
**C-a**



**D**



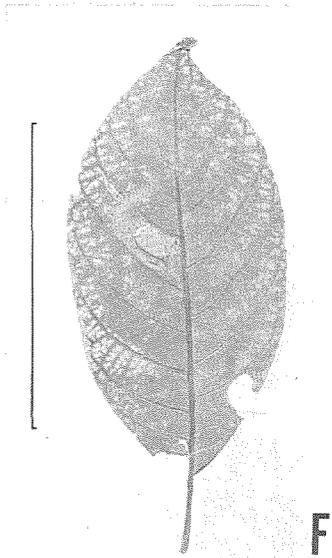
**D-a**



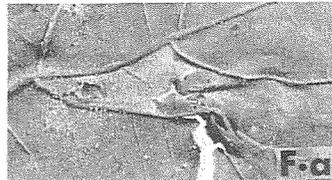
**E**



**E-a**



**F**



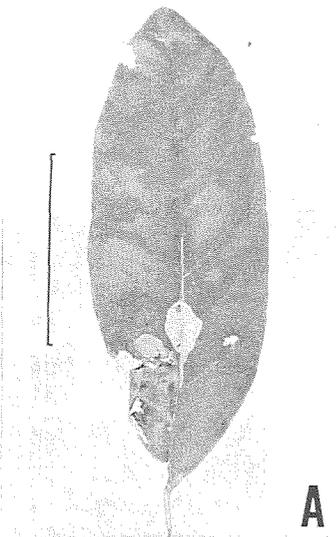
**F-a**

Plate IV

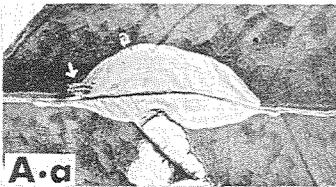
Fig. 17. Leaf or leaflet mined by larva.

- A: *Engelhardia spicata* (upper side) mined by *Phyllonorycter drepanota* (Meyrick).
- B: Ditto (lower side) mined by *Phyllonorycter yamadai* n. sp.
- C: Ditto (upper side) mined by *Phyllonorycter engelhardiae* n. sp.
- D: ? *Odina* sp. (upper side) mined by *Phyllonorycter oreas* n. sp.
- E: *Viburnum erubescens* (lower side) mined by *Phyllonorycter cinctata* n. sp.
- F: *Rubus paniculatus* (upper side) mined by *Phyllonorycter rubicola* n. sp.
- a: Mined part enlarged.

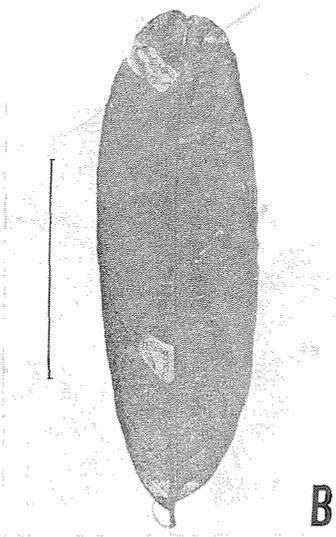
Scale, 5 cm.; arrow showing pupal exuviae.



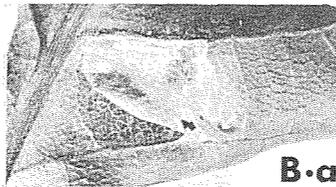
**A**



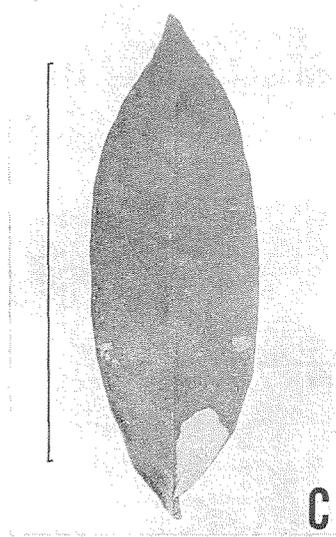
**A.a**



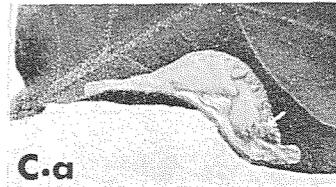
**B**



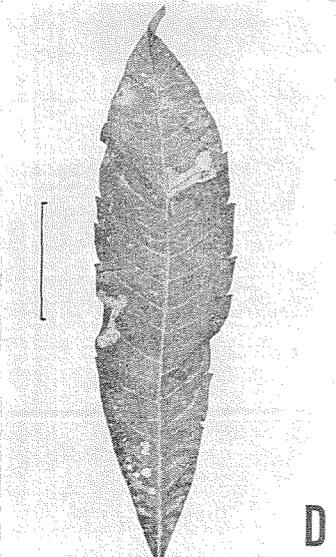
**B.a**



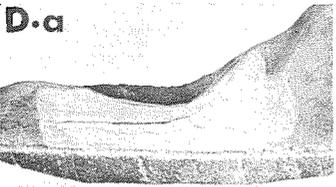
**C**



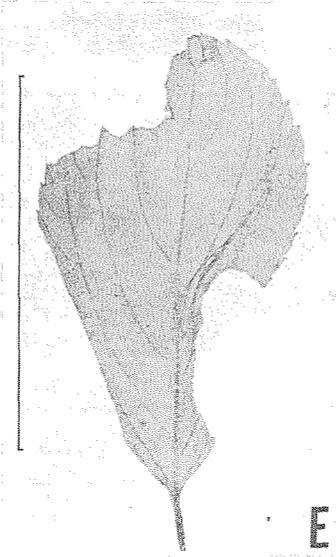
**C.a**



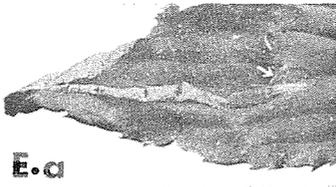
**D**



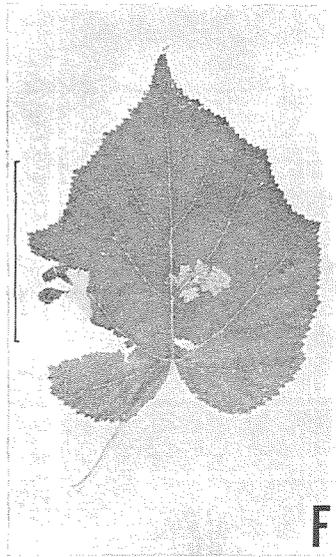
**D.a**



**E**



**E.a**



**F**



**F.a**