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ON THE JAPANESE SPECIES OF THE GENERA MACAROSTOLA, ARISTAEA AND SYSTOLONEURA, WITH DESCRIPTIONS OF THREE NEW SPECIES (LEPIDOPTERA: GRACILLARIIDAE)

By TOSIO KUMATA

Abstract

KUMATA, T. 1977. On the Japanese species of the genera *Macarostola*, *Aristaea* and *Systoloneura*, with descriptions of three new species. *Ins. matsum. n. s.* 9: 51 pp., 5 tables, 19 figs. (13 text-figs., 6 pls.).

Three species of *Parectopa* hitherto recorded from Japan are revised, and are transferred to other genera: *Parectopa* sp. (misidentified as *pavoniella* by Issiki, 1950) and *P. pavoniella* (Zeller) to *Aristaea*, and *P. geometropis* Meyrick to *Systoloneura*. The *Parectopa* sp. is newly described as *A. issikii* together with a further new species, *A. asteris*. Furthermore, the genus *Macarostola*, which has also been confused with *Parectopa*, is newly recorded from Japan with a new species, *M. japonica*. The larvae of all the species mentioned above are described. In an appendix a tentative species-list of *Macarostola* is given.

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Contents

Introduction

Until Vâri (1961) clearly defined the genus *Parectopa* Clemens, 1860 and divided it into several genera for the South African species, most of the former authors had treated it in a wide sense. From Japan three species have so far been recorded as members of *Parectopa*: *Parectopa* sp. misidentified as *P. pavoniella* Zeller by Issiki (1950), *P. geometropis* Meyrick recorded by Issiki (1957) and *P. pavoniella* Zeller recorded by Kuroko (1958). After my careful revision of these species, I have come to conclude that all the species should be transferred from *Parectopa* to other genera: *Parectopa* sp. and *P. pavoniella* to the genus *Aristaea* Meyrick, and *P. geometropis* to the genus *Systoloneura* Vâri. Moreover I have found that the *Parectopa* sp. recorded by Issiki is an unnamed species. In the course of this revisional study, I have found another new species of *Aristaea* from Japan. All the species mentioned above should be described or redescribed in this paper.

The genus *Macarostola* has also been confused with *Parectopa*, and sometimes synonymized with the latter by many authors. But Vâri (1961) properly indicated that it is a good genus and is related to the genus *Caloptilia*. On this occasion, as I have collected a new representative of the genus from Japan, I should describe it in this paper together with the members of *Aristaea* and *Systoloneura*.

It is well known that the larvae of the family Gracillariidae are characteristic in going through a heterometamorphosis (Chapman, 1902; DeGryse, 1916; Grandi, 1959, etc.). In the two or more early instars the larvae are sap-feeders with a depressed head-capsule and body, and then they revert to the normal tissue-feeding type with a round head-capsule and a cylindrical body. Owing to the most drastic change occurring upon oral structures, the morphology of the head-capsules is so far well studied by many authors, such as Dimmock (1880), Trägardh (1913), Jayewickreme (1940), etc. On the other hand, the studies on the chaetotaxy of the body are fragmentary, and are reported for a few species by Heinrich & DeGryse (1915), Grandi (1931, 1932), Klimesch (1943), MacKay (1972), etc. Through my limited examination, however, I have been convinced that the chaetotaxy of the larval body is very important as well as the structure of the head to consider the phylogenetic relationship among the genera of this family.

As a first step to the larval study of the Japanese Gracillariidae, I attempt here to describe the larvae of the five species mentioned above. The early stages of the larvae were examined only by exuviated head-capsules picked up through the dissection of mines. For the last instar larvae both the chaetotaxy of the body and the structures of the head are described and illustrated.

Material, measurement, and terminology

The holotypes and most of the paratypes of the new species described in this paper are deposited in the collection of the Entomological Institute, Hokkaidô University. The adult specimens were mostly reared from larvae collected from various localities of Japan by myself; otherwise, collectors are mentioned. When larvae were collected enough in number to get adults, some of them were usually preserved in 75% alcohol solution. At the same time the mines or cones made by them were dissected, and therefrom exuviated head-capsules were picked up carefully under binocular microscope. These exuviated head-capsules were usually

remaining inside the mine-cavity in good condition, but sometimes those of the 1st instar were overlooked owing to their small size. They were immediately stained by 5% solution of acid fuchsin, then mounted on slides with "Neo-shigaral", a modified form of Berlese's fluid. Some of them were dissected on the slide to examine the structure of the mouth-parts.

Whole larvae were prepared by using the method I am adopting in preparing genitalia. First, the larvae were kept in 10% KOH solution at 60°–70°C for two hours, then transferred to a mixed solution of lactic acid 3 parts and phenol 1 part, with a few drops of 10% solution of acid fuchsin, and again heated at 60°–70°C for two or three hours. When it was necessary to cut the body, the larvae were transferred to 80% alcohol solution, then cut by small scissors along the right spiracular line throughout the length. In the next step, the larvae were kept in a mixture of glacial acetic acid 1 part and methyl salicylate 1 part at room temperature for a short time, then cleaned in a mixture of xylol 4 parts and phenol 1 part, and also in pure xylol. On the slide the cut bodies were expanded to make the chaetotactic pattern easy to observe and the head-capsules were dissected. They were mounted in Canada balsam.

In general, the width of the head-capsule has been used to indicate the larval size, but in this paper the length of the frontoclypeus is used for that purpose. As mentioned the head-capsules were dissected in most cases so that the width could not be measured.

In describing the larvae I adopt Hinton's system (Hinton, 1946) for the body setae and Heinrich's system (cf. Peterson, 1951) for the head setae and mouth-parts. The mouth-parts of the sap-feeding larvae are so strongly modified in structure that it is difficult to determine the homologous features between the sap-feeding and the usual tissue-feeding larvae. Therefore, I follow Heinrich & DeGryse (1915) for the names of the mouth-parts, but partly also Matsuda (1965) especially for the labiomaxillary part.

ACKNOWLEDGEMENTS

I wish to express my cordial thanks to Prof. T. Nakashima, Prof. S. Takagi, both of Hokkaidô University, Prof. H. Kuroko and Prof. Emeritus S. Issiki, both of Osaka Prefectural University, for their kindness in giving constant encouragement and helpful suggestions. Special thanks are due to Dr. J. Klimesch of Linz, Austria, Dr. K. Kusigemati of Kagosima University, Mr. F. Komai of Osaka Prefectural University, and Prof. M. Okano of Iwate University, for their kindness in offering valuable material. Last but not least my sincere thanks are also due to Prof. K. Ito of Hokkaidô University for his kindess in identifying food plants.

Genus *Macarostola* Meyrick

Macarostola Meyrick, 1907, Proc. Linn. Soc. N.S.W. 32: 62; Vári, 1961, Transv. Mus. Mem. 12 (South Afr. Lep. I, Lithocolletidae): 1, pls. 24 (1), 44 (1) and 107 (1) [type-species: *Gracilaria formosa* Stainton, 1862].

The present genus had been treated as a synonym of the genus *Parectopa* Clemens, 1860 by many authors, until Vári gave it full generic status in 1961.

Therefore, some species described under the genus *Parectopa* should be transferred to the present genus. At the conclusion of this paper an attempt is made to give a tentative list of species which are supposed to belong to *Macarostola*. The list is mainly based on the literature.

The genus is easily recognized from any other related ones by the following combination of characters: –

Head smooth-scaled or rarely very slightly roughened with occipital scales; antenna usually longer than fore wing; labial palpus smooth-scaled, very slender, upturned. All legs smooth-scaled, very slender except for mid tibia which is slightly expanded with scales at apex alone. Fore wing with a complete venation, or rarely only one vein Cu_{1b} missing; vein R_s distinctly divided into two branches. Hind wing complete in venation; cell closed between stalk of veins Cu_{1a} and M_3 and that of veins M_1 and M_2. Valva nearly obovate in shape, narrowing towards base, covered densely with slender setae on almost entire inner surface and sparsely with very long scent setae on outer surface; anellus prolonged caudally around aedoeagus, with very dense, hairy spines on dorsal surface throughout; aedoeagus rather simple, long, bar-shaped; saccus long, usually longer than valva; 7th abdominal segment of male normally clothed with scales as in preceding segments, without coremata; the 8th segment weakly membraneous, with a pair of coremata. Ventral prong of antapophysis well prolonged towards mid-ventral line, slightly widened at apex; sterigma very weakly sclerotized; ductus bursae membraneous except for short antrum; corpus bursae membraneous, with one or two signa which are variable from xiphoid to sickle-shaped.

As stated by Vári (1961), *Macarostola* is situated near the *Caloptilia*-group taxonomically, and especially related to the genus *Gracillaria* Haworth on account of the 7th abdominal segment of the male being normal in structure. On the other hand, in the venation of the hind wing it exhibits a condition more primitive than in *Gracillaria*; that is, in *Macarostola* the discoidal cell of the hind wing is closed, whereas it is open between veins M_1 and M_2 in *Gracillaria*. The larval chaetotaxy of one Japanese species, which will be described as new herein, also provides a primitive feature; that is, the lateral groups of setae on the 1st to 7th abdominal segments are composed of three setae. This is basic for lepidopterous larvae (Hinton, 1946). In *Caloptilia* and *Gracillaria* the corresponding groups are composed of two setae.

The genus seems to be rich in number of species in the Indo-Australian region in association with the distribution of the food plants. Insofar as known, the food plants all belong to Myrtaceae. Only one exception is the following Japanese species of which the food plant belongs to Staphyleaceae.

Macarostola japonica, sp. nov.

[Figs. 1, 2 and 3; Plates I (H & I), II (A & B) and IV (A & B)]

Adult

Expanse of wings: 9.0–10.0 mm (9.6 mm in average of 7 specimens; 10.0 mm in holotype). Length of fore wing: 4.3–4.8 mm (4.6 mm in average of 9 specimens and in holotype).

♂♀. Head pale crimson-red; face sometimes shaded with white anteriorly (in a few specimens including holotype face entirely white except for sides);

crown on occiput mixed with whitish scales posteriorly. Maxillary palpus moderately rough-scaled apically, crimson-red, with upperside of basal segments white. Labial palpus smooth-scaled in entire length, the 3rd segment being a little longer than the 2nd, upturned; crimson-red, with upper side of 3rd segment white. Antenna about 1.2 times as long as fore wing, reddish-ochreous, shaded with gray towards apex, with three or four apical segments blackish; scape crimson-red, with upper side yellowish; pecten reddish. Thorax crimson-red dorsally, with a transverse median band lemon-yellowish; ventral surface white, with two pairs of blotches crimson-red. Fore and middle legs crimson-red in coxae and femora, with two white blotches or lines; fore tibia blackish, whitish basally; middle tibia whitish, with a median dot black, and with a broad apical ring intermixed with black and ochreous brown; both tarsi white, with a black apical ring in each segment and a similar dot at middle of basal segment only. Hind leg whitish; tibia shaded with gray on upper side; tarsus ringed with black at apex of each segment. Fore wing very narrow, nearly parallel-sided, bluntly pointed apically, with vein Cu_{1b} absent; ground colour crimson-red, with markings whitish-yellow, becoming darker yellow towards dorsum, somewhat variable in shape; 1st dorsal blotch placed near base of wing, elongate-triangular, slightly oblique inwardly, the apex extending well beyond half breadth of wing; 2nd dorsal blotch at middle of wing, isosceles-triangular, sometimes widened along dorsum, occupying nearly half breadth of wing; 3rd dorsal blotch near tornus, subquadrate, strongly oblique inwardly; an L-shaped or V-shaped blotch placed in disc between 1st and 2nd dorsal blotches, the basal arm usually originating in costa; a short longitudinal streak placed beyond middle of wing just below costal margin, nearly parallel with costal margin; a streak placed in disc between 2nd and 3rd dorsal blotches, usually longer than median costal streak, sinuate, sometimes interrupted at its basal 1/3 into two parts, the basal part being always placed nearer to dorsum than the apical part; in a few specimens all or some streaks fused with each other into an irregularly curved or bent mark or marks; an apical fascia curved along costo-apical margin of wing, usually constricted in its central area, shaded with brown at this constriction; cilia around apex of wing brownish or reddish, with their apical half whitish-yellow as to form an apical hook, along termen wholly crimson-red, and along dorsum dark gray. Hind wing blackish-gray on entire surface in female, somewhat becoming paler towards base in male; cilia along entire margin of wing dark gray in female, while in male they become paler towards base of wing to correspond with wing colour.

Male genitalia: Tegumen weakly sclerotized, with three or four pairs of setae on outer surface, and with some microscopic spines at sides of caudal margin; subscaphium narrow, widened towards basal extremity in an elongated triangle. Valva simple, nearly obovate in shape, narrowing basally, with cucullus densely covered with short setae on almost entire inner surface, and sparse, very long setae on outer surface. Vinculum with a saccus very slender, slightly clavate distally and about as long as valva. Diaphragma tubular, much protruded caudally, very densely clothed with fine spines on almost entire dorsal surface. Aedoeagus about twice as long as valva, nearly straight, slightly dilated cephalad; vesica covered with numerous microscopic thorns on almost entire length. Seventh abdominal segment normally clothed with scales, without coremata; a narrow dorsal ridge rather strongly sclerotized, suddenly widened at cephalic end. Eighth abdominal

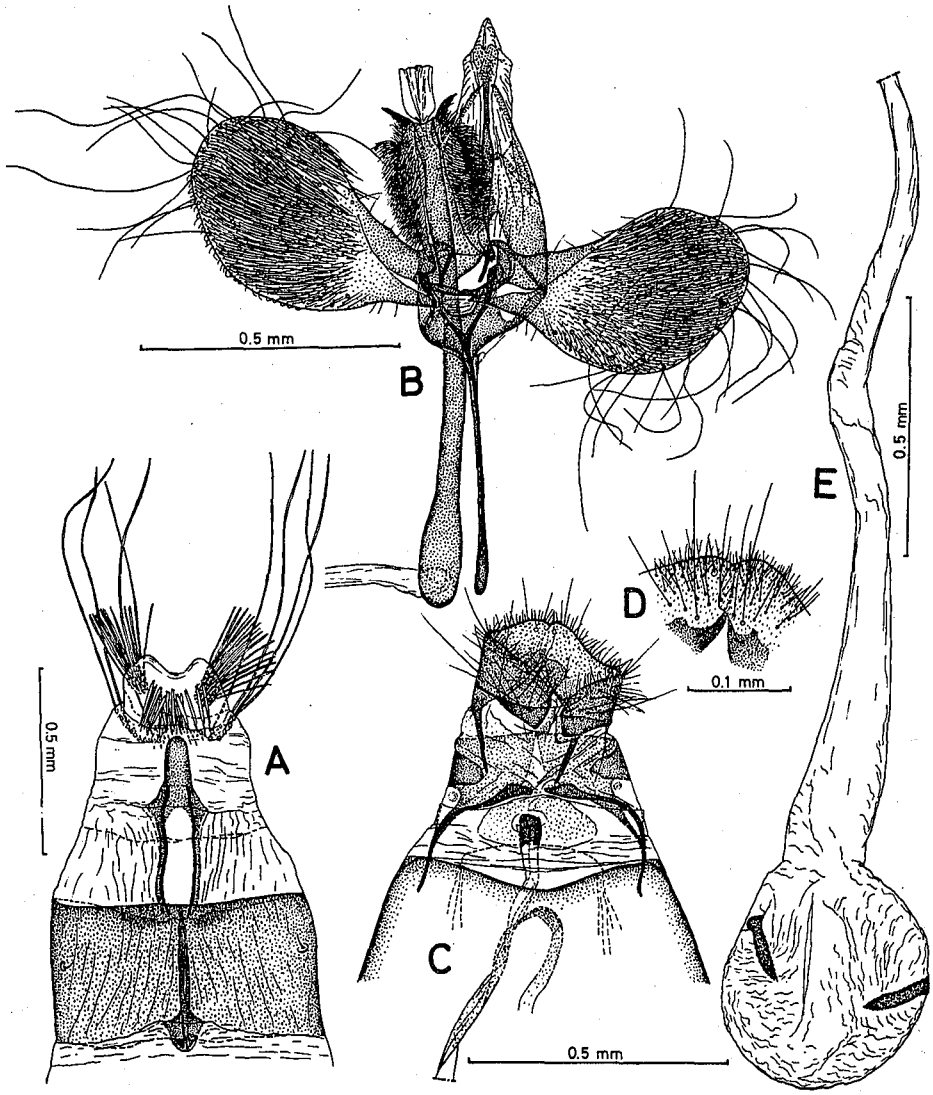


Fig. 1. *Macarostola japonica*, sp. nov. A: 7th and 8th abdominal segments of male, dorsal view — B: male genitalia (holotype), caudal view — C: female genitalia, ventral view — D: apical part of papillae anales, enlarged — E: corpus bursae.

segment membraneous, with a row of very long scales on caudal margin of the sternite, and with some moderately elongated scales on medio-cephalic area of the tergite; coremata rather short; a heavily sclerotized, tongue-shaped projection arising at medio-cephalic area of tergite, pointed caudad, with one pair of prongs projected cephalad within the body and nearly as long as 8th abdominal segment.

Female genitalia: Ventral prongs of antapophyses well prolonged, slightly widened apically. Sterigma around ostium bursae weakly sclerotized, clothed with numerous microscopic spines sparsely. Antrum rather short, slender; ductus bursae long, tubular, membraneous entirely, slightly widened towards corpus bursae;

corpus bursae globular, with two needle-shaped signa, which are covered with acute spines on the entire surface. Ductus seminalis opening at ductus bursae well removed anteriorly from antrum, faintly scattered with micro-spines around its opening area.

Larva

The number of larval instars is uncertain, but the measurements suggest that the last instar is likely the 5th, because there is too wide a gap between the 3rd and last in the length of the frontoclypeus (see Tab. 1). In the first two instars the larvae are of sap-feeding type with a flat head, and in the 3rd to supposed 5th instars they are tissue-feeders, with a round head and a cylindrical body as in usual lepidopterous larvae.

Table 1. Measurements of larvae of *Macarostola japonica*.

Instar	Length of frontoclypeus in micra			Length of body in mm	
	n	range	mean	n	range
1st	3	105-110	108.3		
2nd	18	175-190	186.9		
3rd	13	170-190	180.8		
Last	6	290-340	317.5	4	8.0-8.2

Last instar (supposed 5th) – Colour: Head light brownish-yellow, with a dark pigmentation around ocelli; body evenly creamy-whitish.

Structure: Head (Fig. 2, B) round, with coronal suture about 1/3 as long as frontal suture; adfrontal suture not visible. Epicranial seta A_3 usually postero-lateral to seta A_2; seta P_1 the longest among epicranial setae, directly lateral or slightly antero-lateral to seta Adf_1. Ocelli (Fig. 2, D) in six pairs; 1st and 2nd ocelli set close; 3rd to 5th ocelli also set close together and arranged in a straight line, the 5th positioned immediately posteriorly to antenna; 6th ocellus placed in centre between 1st and 5th; seta O_2 the longest among ocellar setae, situated slightly ventrad of a line between 1st and 6th ocelli; seta O_1 in centre between 2nd and 3rd ocelli; seta O_3 antero-ventral to 6th ocellus. Antenna (Fig. 2, G) three-segmented; 2nd segment distally with a short seta and a very long one, two long, conical papillae and a minute bristle; 3rd segment with a conical papilla a little smaller than those of 2nd segment, a short bristle, and a protuberance carrying a bristle at its top. Labrum (Fig. 2, E) bilobed apically, the lobes being round; median incision rather deep, occupying about 1/3 length of labrum; sclerotized epipharyngeal shield large, heart-shaped, with its mesial part occupying about 1/3 length of labrum; labral seta L_2 about as long as seta M_2, both slightly longer than the others, which are nearly same in length. Mandible (Fig. 2, F) with five teeth, the 1st tooth (numbered from outer side) arising just from ventrum of 2nd one and is the shortest, 3rd to 4th teeth long. Labium and maxilla (Fig. 2, C) as in normal lepidopterous larvae; spinneret about twice as long as labial palpus, with ventro-median ridge sclerotized narrowly on entire length; median sclerite of postmentum oblongate in outline, slightly narrowed both anteriorly and posteriorly, with setae slightly posteriorly to the level of longer seta of maxillary stipes. Thoracic legs all well developed, with a claw as in Fig. 2, H. Ventral prolegs (Fig. 2, I) located

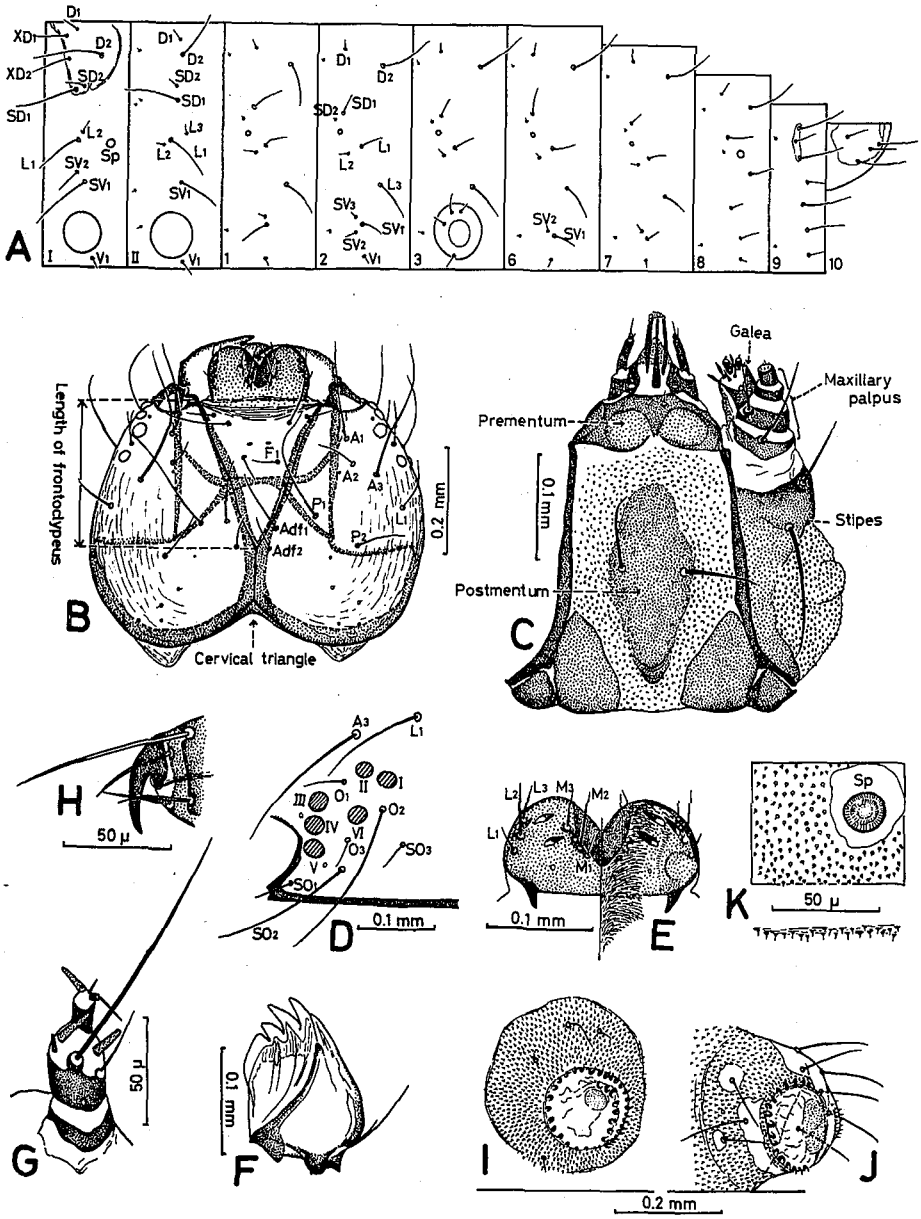


Fig. 2. *Macarostola japonica*, sp. nov. (last instar larva). A: setal patterns of prothorax (I), mesothorax (II), 1st (1) to 3rd (3) and 6th (6) to 10th (10) abdominal segments — B: head-capsule, frontal view — C: labiomaxillary part, ventral view — D: ocelli and adjacent setae — E: labrum, right in dorsal view and left in ventral view — F: mandible, mesial view — G: antenna — H: claw of mesothoracic leg — I: ventral proleg of 5th abdominal segment — J: anal proleg — K: spinules of body surface (sp: spiracle).

on 3rd to 5th abdominal segments, with uniordinal crochets arranged in a circle (25–30) plus a vertical row (6–8); anal proleg with crochets in a semicricle (12–18). Abdominal spiracles all circular, on 8th segment more removed from cephalic margin than on the other segments. Spinules (Fig. 2, K) of body surface minute, pointed, and dense.

Chaetotaxy of body as shown in Fig. 2, A; seta SD_2 of prothorax set closer to seta SD_1 than to seta XD_2; lateral group of prothorax consisting of two setae L_1 and L_2, and that of mesothorax and metathorax three. Seta D_1 of 1st to 8th abdominal segments placed antero-dorsad of seta D_2; seta L_2 of 1st to 8th abdominal segments slightly anterior to seta L_1; relative length of lateral setae: $L_3>L_1>L_2$; subventral group consisting of two setae on 1st, 6th and 7th abdominal segments, three on 2nd to 5th, the setae arranged in a triangle on 2nd segment; seta SV_2 always antero-dorsal to seta SV_1 on 1st, 6th and 7th segments; all the subventral setae on prolegs missing in their basal pinacula. Ninth abdominal segment with 7 setae on each side, setae L_2, L_3, SV_2 and SV_3 missing; seta D_1 slightly ventral to seta D_2, both arising from an elongate pinaculum together with seta SD_1.

Any larvae supposedly belonging to the 4th instar have not been available in the present study. The 3rd instar has been examined only by exuviated head-capsules, which are not different essentially in structure from the supposed 5th described above, except for the frontoclypeus is closed at the depth of the cervical triangle, without coronal suture.

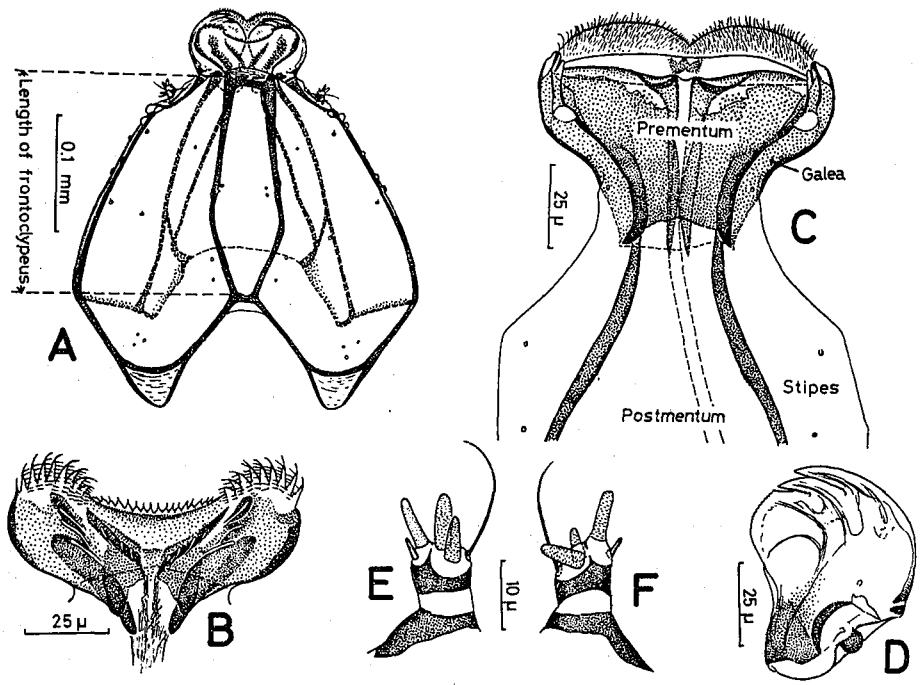


Fig. 3. *Macarostola japonica*, sp. nov. (2nd instar larva). A: head-capsule, dorsal view — B: labrum, ventral view— C: labiomaxillary part, ventral view — D: mandible, mesial view — E & F: antenna.

Second instar — Only exuviated head-capsules examined. Head (Fig. 3, A) very thinly flattened dorso-ventrally, wedge-shaped, prognathous, with posterior dorsal prolongations moderately developed. Frontoclypeus widest at about its posterior 1/3, narrowed posteriorly, then truncated by a short transverse bar at depth of cervical triangle. Epicranial setae diminishing in size, sometimes indicated by basal socket only, therefore their arrangement is not always determined exactly. Ocelli numbering six in each side, scattered along anterior area of lateral margin of head. Antenna (Figs. 3, E & F) with 2nd and 3rd segments not separated by intersegmental membrane; two conical papillae and a long seta seemingly originating in 2nd segment, and a conical papilla and a shorter bristle in 3rd. Labrum (Fig. 3, B) widened anteriorly, concaved shallowly and widely in median area; anterior margin along this median concavity finely serrulate, the serrulations numbering 15–16; apical lobes each with 8–10 acute teeth on anterior margin, the teeth bearing a few fine spines on their inner sides. Mandible (Fig. 3, D) flat, three-toothed; third tooth wide, finely dentated. Labium and maxilla (Fig. 3, C) strongly modified in structure; labium thrusted well forwards, strongly constricted at posterior end of prementum, which is simple, widely truncated apically, without palpi and prominent spinneret; hairy hypophyarynx protruded well beyond apical margin of labium, bilobed apically. Maxilla simple, without palpi; galea slender, with two apical lobes reaching a little beyond apical margin of labium.

First instar – Insofar as exuviated head-capsules are examined, they are not different from those of the 2nd instar in structure except for the following points: — head-capsules becoming slightly wider posteriorly; frontoclypeus with a posterior transverse bar about as long as anterior clypeolabral ridge.

Material examined: Adult – Holotype, ♂ (G. sl. no. Grc–1784), Onoaida, Yaku-sima, Satunan Is., em. 13/xi/1973, ex *Euscaphis japonica*, breeding no. 1223. Paratypes, 1♀, Kii-Ôsima, Wakayama-ken, Honsyû, em. 14/x/1974, ex *E. japonica*, breeding no. 1334; 3♂♂ & 5♀♀, with the same data as in holotype except for date emerged, 6–15/xi/1973.

Larva – One, 5 and 6 exuviated head-capsules of 1st, 2nd and 3rd instars respectively, and 2 larvae of last instar, 24/ix/1974, breeding no. 1334; 2, 12 and 10 exuviated head-capsules of 1st, 2nd and 3rd instars respectively, and 3 larvae of last instar, 17/x/1973, breeding no. 1223. All mounted on slides.

Food plant: *Euscaphis japonica* (Thunb.) Kanitz (Staphyleaceae).

Distribution: Japan (Honsyû; Satunan Is.).

Larval habit: The larval habits of the present species are very similar to those described by Clarke (1971) for *Parectopa pontificalis* Meyrick, 1929. First the larva makes a tortuous serpentine mine, which is located inside the lower epidermis of a leaf and is whitish in colour. The second instar larva expands the linear mine to an elongated blotch along the leaf-margin. In this stage the mine occupies the lower layer of spongy parenchyma. The larva of the third instar feeds on the whole parenchymal tissues remaining inside the blotch-mine, then makes it into a tentiform type. After the 3rd moult, the larva leaves the mine through a round hole and migrates to another leaf, which it cuts from the edge towards the midrib; the cut edge is rolled to form a cone on the underside of the leaf, then the larva continues to feed inside the cone. I believe the larva passes two instars within this cone, but I have failed to find any exuviated head-

capsules there. When full-grown the larva leaves the cone to pupate. Pupation takes place at a margin of the same leaf or another one. The cocoon is whitish, boat-shaped, without any bubbles on its upper side.

Remarks: The present new species may be closely related to *Macarostola callischema* Meyrick, 1908 described from Assam, India. Reading through the original description of *callischema*, I am convinced that *japonica* is distinguished from that species by the crimson-reddish head and by the absence of whitish dots on the costa at the basal 2/3 and 3/4 of the fore wing.

Genus *Aristaea* Meyrick

Aristaea Meyrick, 1907, Proc. Linn. Soc. N.S.W. 32: 52; ibid., 1912, in Wytman, Genera Ins. 128 (Lep. Het. Gracilariadae): 22; Vári, 1961, Transv. Mus. Mem. 12 (South Afr. Lep. I, Lithocolletidae): 58, pls. 29 (1), 46 (5) and 108 (1) [type-species: *Aristaea periphanes* Meyrick, 1907].

The genus *Aristaea* has been confused with the genus *Parectopa* for a long time. This may be due to the fact that the old species *Parectopa pavoniella*, well known in Europe, has long been treated as a species of *Parectopa*, whereas it should be referred in reality to *Aristaea*. In 1961 Dr. Vári also transferred two species of *Parectopa* occurring in South Africa to *Aristaea*. Future studies will probably show that some Indo-Australian species of *Parectopa* should properly be referred to *Aristaea*.

Aristaea is distinctly separated from *Parectopa* by the following characters: – Labial palpus roughened with long, raised scales on lower side; anterior pair of spurs of hind tibia originating near base like in *Caloptilia*; fore wing with all veins free, sometimes veins M_1 and M_2 connate, and vein R_1 arising near middle of discodial cell; hind wing with vein Rs divided into two branches like in *Caloptilia* and *Gracillaria*, but the upper branch supposed to be vein R_{2+3} is sometimes reduced in length; 7th abdominal segment of male membraneous as in *Caloptilia*, not clothed with scales except for short coremata; valva simple, shell-shaped as in *Caloptilia*, but more elongated; cervix bursae usually distinct, small; corpus bursae with two long corniform signa. These adult characters may indicate a close affinity between *Aristaea* and *Caloptilia*. Their affinity is more clearly shown by the larval structures. In chaetotaxy of the last instar larvae, the lateral groups on the mesothorax and metathorax consist of three setae, and the seta D_1 on the 1st to 8th abdominal segments is located dorso-cephalad of the seta D_2 in both the genera. On the other hand, in *Parectopa* the setae of the lateral groups on the mesothorax and metathorax number two (seta L_2 missing), and the seta D_1 is latero-cephalic to the seta D_2 in the abdominal dorsal groups. *Aristaea* is surely related to *Caloptilia*, even so it is recognized from the latter by the following characters of the adult and larva: – Hind wing with vein M_3 always missing; tegumen with a pair of apical setae; ductus seminalis arising from central area of corpus bursae; subventral groups of setae on 1st, 2nd, 6th and 7th abdominal segments of larva each consisting of only one seta SV_1 (in *Caloptilia* consisting of two setae on 1st, 6th and 7th segments, and three on 2nd segment).

At present it is not certain how many species are included in the genus *Aristaea* because of the confusion with *Parectopa*. So far as I am aware, the type-

species is distributed in Tasmania, three species are in South Africa, and *pavoniella* is known from Europe and Japan. In the present report, two new species will be added in the genus. One of them is misidentified by Issiki (1957) as *Parectopa pavoniella*. All the species occurring in Japan are associated with *Aster* spp. (Compositae) as their food plants, whereas the food plant of *A. onychota* (Meyrick, 1908) of South Africa is recorded in Verbenaceae.

Keys to the Japanese species of *Aristaea*

I. Based on adult features

1. Fore wing golden-brown, with silvery-white markings; a narrow streak along costal margin near base of wing always detached from 1st costal striga; ventral margin of valva with a shallow concavation on its apical half, with its apical corner acutely angulated or prominent; scales of anterior coremata gathered in a bundle; ductus bursae short, as long as or slightly shorter than postapophysis. ..... *A. issikii*, sp. nov.
- Fore wing golden-ochreous, with white markings; a narrow white streak along costal margin near base of wing always fused with 1st costal striga into a single mark; ventral margin of valva round throughout, with its apical corner smoothly round or bluntly angulated; scales of anterior coremata arranged in a single row; ductus bursae moderate to long, more than 1.3 times as long as postapophysis. .. 2
2. White markings of fore wing very wide, especially in first two pairs of costal and dorsal strigae; valva parallel-sided on almost entire length, smoothly round at ventro-apical corner; anterior coremata consisting of 10–15 scales; ductus bursae moderate in length, 1.3–1.5 times as long as postapophysis and 1/2–2/3 as long as signa. ..... *A. pavoniella* (Zeller)
- White markings of fore wing all very narrow; valva narrow at base, widest in middle, then parallel-sided on remaining apical half, bluntly angulated at ventro-apical corner, but not projecting; anterior coremata consisting of 50–60 scales; ductus bursae very long, about 3 times as long as postapophysis and 1.5 times as long as signa. ..... *A. asteris*, sp. nov.

II. Based on larval features

1. In last (4th) instar postmentum with two sclerites in its central area; ocellar seta O_2 located ventro-posteriorly to 1st ocellus, and arranged in a straight line together with 1st and 2nd ocelli. In 2nd instar (sap-feeding type) 3rd tooth (numbered from outer side) with only one indentation at apex. ..... *A. asteris*, sp. nov.
- In last instar, postmentum with only one tadpole-shaped or triangular sclerite in its central area; ocellar seta O_2 located ventrad of 1st ocellus, and never arranged in a straight line with 1st and 2nd ocelli. In 2nd instar, 3rd tooth with two or more indentations at its apex. 2
2. In last instar, subventral setae on ventral prolegs each with a basal pinaculum; premental setae set close to each other, located posteriorly to spinneret. In 2nd instar, labrum with apical lobes widely round and ciliated apically. ..... *A. issikii*, sp. nov.
- In last instar, subventral setae on ventral prolegs without any basal pinaculum; premental setae remote widely and located posteriorly to labial palpi. In 2nd instar, labrum with apical lobes pointed apically and ciliated along inner side alone. ..... *A. pavoniella* (Zeller)

Aristaea pavoniella (Zeller), comb. nov.

[Figs. 4, 5, 6 and 9 (G); Plates I (F & G), III (C) and IV (C)]

Gracilaria (*Euspilopteryx*) *pavoniella* Zeller, 1847, Linn. Ent. 2: 362.
Euspilapteryx pavoniella: Herrich-Schäffer, 1855, Schmett. Eur. 5: 293, f. 721.

Gracilaria pavoniella: Stainton, 1864, Nat. Hist. Tin. 8: 184, t. 5(2); Wocke, 1877, in Heineman, Schmett. Dutsch. 2: 629.

Micrurapteryx pavoniella: Spuler, 1910, in Hofmann-Spuler, Schmett. Eur.: 409; Hering, 1957, Bestimm. Blattm. Eur.: 134.

Parectopa pavoniella: Meyrick, 1912, in Wytsman, Gen. Ins. 128 (Lep. Het. Gracilariadae]: 20; ibid., 1912, Cat. Lep. 6: 48; Kuroko, 1958, Tyô to Ga 9: 58.

Adult

Expanse of wings: 8.0–10.0 mm (9.3 mm in average of 10 specimens). Length of fore wing: 3.8–4.8 mm (4.4 mm in average of 10 specimens).

♂♀. Head, face and palpi snow-white; head mixed with a few grayish scales in centre; maxillary palpus with 2nd segment brownish-black outside; 2nd segment of labial palpus with its basal half and tuft brownish-black outside, the apical segment blackish at median area and at apex. Antenna dark brownish-gray above, whitish towards base below; scape white, clouded with golden ochre above, with pecten white. Thorax white, with a narrow median stripe golden-ochreous; tegula golden-ochreous; ventral surface of thorax white, with a pair of golden-ochreous stripes oblique and narrow. Fore and middle legs blackish; fore coxa whitish, slightly darkened both at apex and base; femora and tibiae with two or three whitish patches on lower side; tarsi white, with four blackish rings, one at middle of 1st segment, two at bases of 2nd and 3rd segments and the last on 5th segment. Hind leg whitish; coxa slightly darkened at apex; femur with a dark patch in centre; tibia suffused with brownish gray near apex rather broadly; tarsus with five black rings as in fore and middle legs except for the 1st tarsal segment with two, one at subbase and another at subapex. Fore wing slightly widened apically; ground colour golden-ochreous, with markings shining white and edged with blackish scales; a longitudinal streak extending from base of dorsum to 1/4 length of wing between wing-fold and dorsal margin, broadened apically, slightly upturned, and broadly truncated on fold; 1st costal striga at about basal 1/3 of wing, oblique outwardly, broad, nearly quadrate, the basal extremity extending narrowly along costa towards base of wing; 2nd costal striga located a little beyond middle of wing, parallel with and nearly equal to the 1st one in size and shape; 3rd costal striga at 2/3, narrow, parallel with the 2nd striga, often connected with 4th costal striga in disc before apex of wing, the 4th being inwardly oblique; 1st dorsal striga situated just before middle of wing, oblique outwardly, extending beyond fold of wing; 2nd dorsal striga nearly parallel with the 1st, sometimes connected with 3rd dorsal striga, which is very fine and arises from middle of termen; a small, leaden-metallic patch in disc between apices of 3rd costal and 3rd dorsal strigae; a blackish spot in disc near apex of wing, intermixed with white scales on its lower half; a white streak along costal margin at apex of wing; cilia around apex of wing whitish, tipped with dark gray, with a dark brownish hook forming an upper edge of the white apical streak of wing; cilia along termen brownish, with a white subapical line, and those along dorsal margin yellowish-gray. Hind wing gray, with cilia yellowish-gray.

Male genitalia: Tegumen simple, weakly sclerotized, with a pair of apical setae; tuba analis simple, membraneous entirely. Valva moderate in width, almost parallel-sided, upturned, finely dentated along ventral margin on its apical half, with cucullus and ventral margin haired rather densely. Saccus about 3/5 as long as valva, tapering towards blunt apex. Juxta V-shaped, widened in

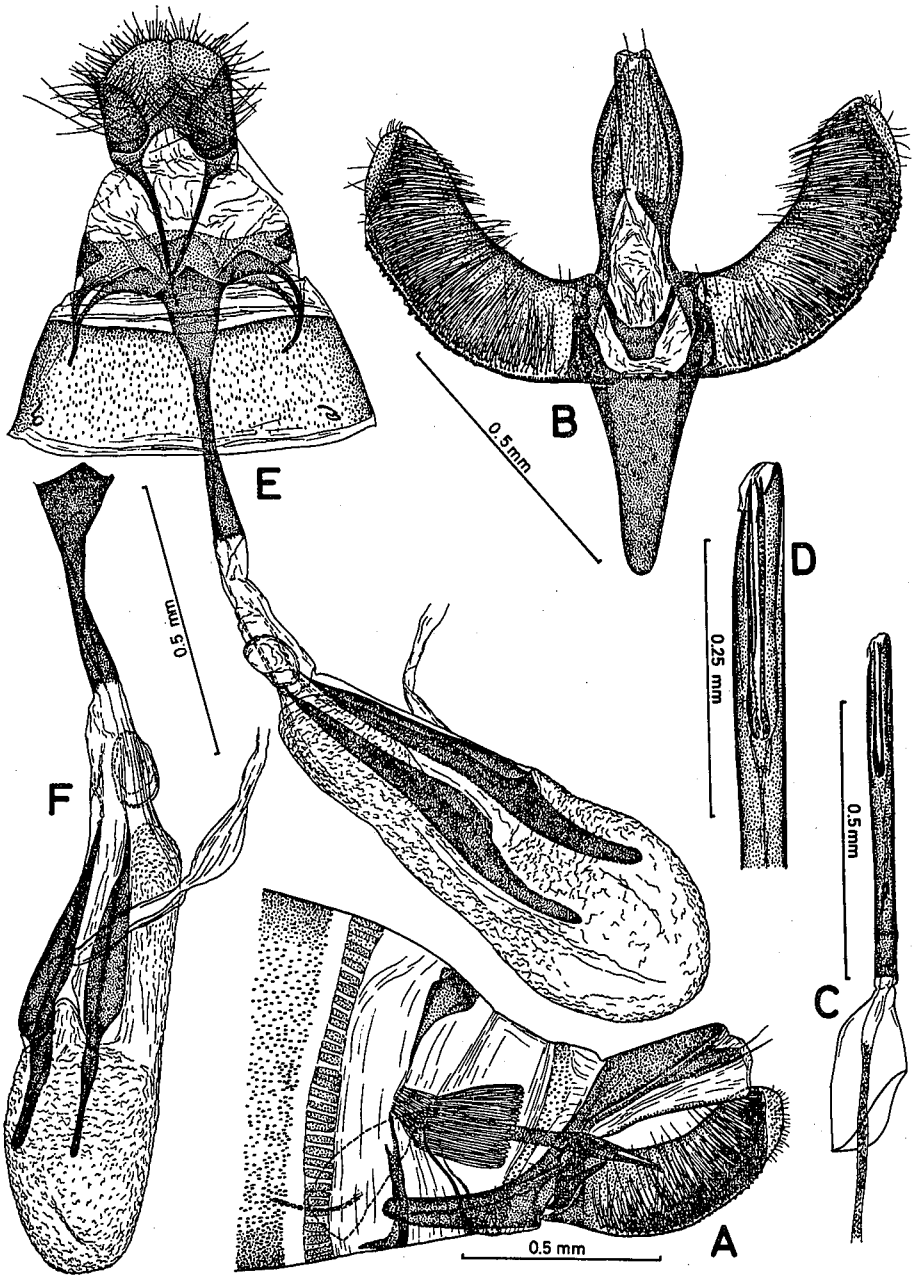


Fig. 4. *Aristaea pavoniella* (Zeller). A: male genitalia, lateral view— B: ditto, caudal view— C: aedoeagus— D: apical part of aedoeagus, enlarged— E: female genitalia, ventral view— F: bursa copulatrix (European specimen).

centre. Aedoeagus a little longer than valva, slender, straight, with a long cleft on its apical 2/5, the cleft bearing fine spines at sides. Seventh and 8th abdominal segments membraneous, not clothed with scales except for caudal margin of 8th segment; anterior coremata very small, consisting of 10–15 scales, which are arranged in a row.

Female genitalia: Postapophysis slender, long, about 3 times as long as stalk of antapophysis, of which the ventral prong extends towards mid-ventral line, is connected with the ostium bursae, and is widened apically. Sterigma weakly sclerotized; ostium bursae covered with a small, triangular flap projecting from ventral wall of antrum. Ductus bursae rather short, heavily sclerotized on almost entire length, 1.3–1.5 times as long as postapophysis. Cervix bursae small; corpus bursae ellipsoidal in form, membraneous, with two long, slightly curved corniform signa, which are 1.3–1.5 times as long as ductus bursae.

Larva

There are four instars in the larval period, the first two are of sap-feeding type with a flat head, and the last two of tissue-feeding type with a round head and a cylindrical body.

Table 2. Measurements of larvae of *Aristaea pavoniella*.

Instar	Length of frontoclypeus in micra			Length of body in mm	
	n	range	mean	n	range
1st	3	120-125	123.3		
2nd	6	190-215	207.5		
3rd	3	190-220	206.6	2	4.5-5.5
Last	10	270-330	294.5	6	7.0-7.8

Fourth instar – Colour: Head light brownish, slightly darkened around ocelli; body creamy-whitish, irregularly spotted with dark brown on prothoracic and anal shields.

Structure: Head round, with posterior dorsal prolongations slightly developed; frontoclypeus narrowed posteriorly, then truncated at the depth of cervical triangle by a short transverse bar; coronal suture absent. Seta A_3 the longest among epicranial setae, directly lateral to seta A_2; seta P_1 slightly anterior to level of seta Adf_1; seta Adf_2 very short, less than 1/5 length of seta Adf_1. Ocelli (Fig. 5, C) in six pairs, the arrangement being similar to that in *Macarostola japonica*, but different in 6th ocellus slightly ventral to a line between 1st and 5th ocelli; seta O_2 about 3 times as long as other ocellar setae, situated in centre between 1st and 6th ocelli; seta O_1 in centre between 2nd and 4th ocelli; seta O_3 slightly dorsal to a line between 5th and 6th ocelli. Antenna (Fig. 5, F) as in the preceding species *Macarostola japonica*. Labrum (Fig. 5, D) a little more than twice as wide as long, bilobed apically, the lobes being broadly round; median incision very shallow, occupying about 1/5 length of labrum; seta L_2 the longest among labral setae; epipharyngeal shield jar-shaped, occupying nearly entire length of labrum; epipharyngeal setae in two pairs, rather small. Mandible (Fig. 5, E) six-toothed, the 3rd to 5th

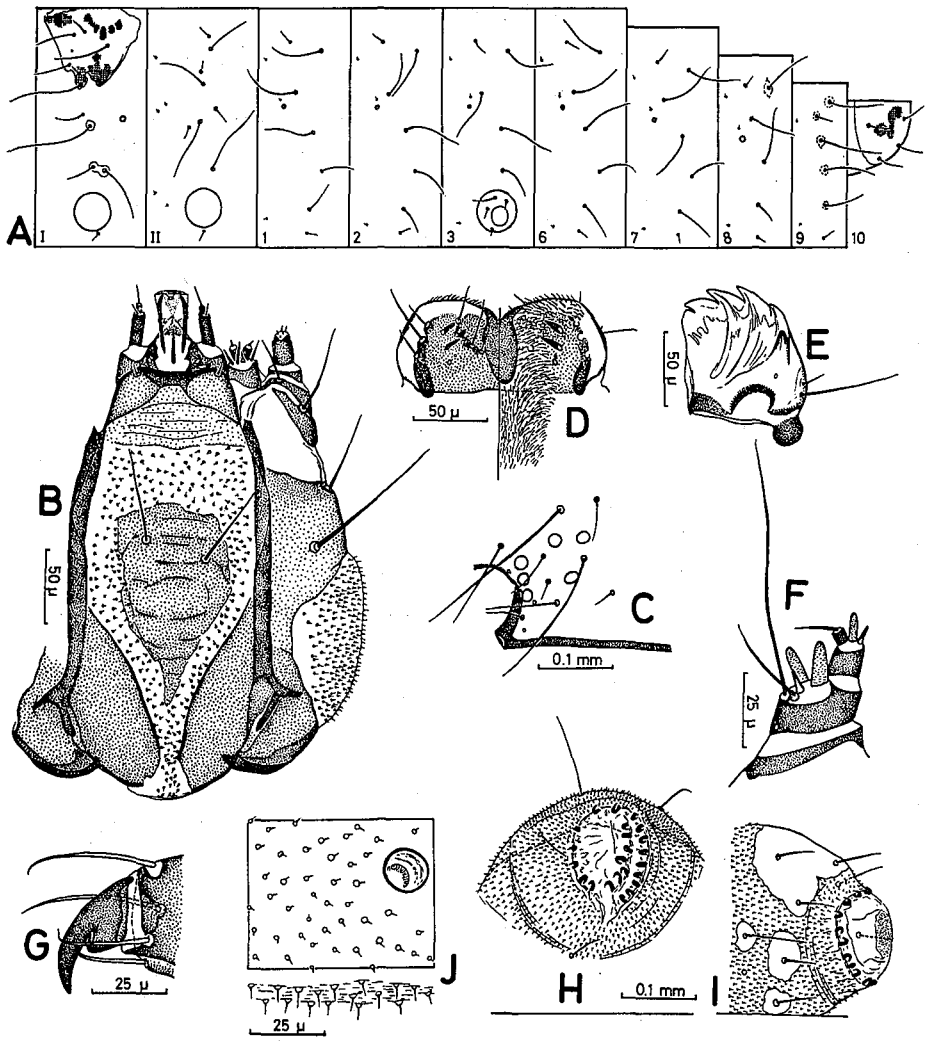


Fig. 5. *Aristaea pavoniella* (Zeller) (last instar larva). A: setal patterns of thorax and abdomen— B: labiomxillary part, ventral view — C: ocelli and adjacent setae— D: labrum, right in dorsal view and left in ventral view — E: mandible, mesial view— F: antenna— G: claw of mesothoracic leg— H: ventral proleg of 5th abdominal segment— I: anal proleg— J: spinules of body surface.

teeth being nearly same in length, and the 1st minute and arising from ventrum of 2nd tooth. Labium and maxilla (Fig. 5, B) as in *Macarostola japonica*; spinneret slightly widened apically, with its ventro-median ridge sclerotized only on its basal half; paired setae of prementum remote widely from one another, and placed posteriorly to bases of palpi; median sclerite of postmentum elongate-triangular. Thoracic legs all well developed, with a claw as shown in Fig. 5, G. Ventral prolegs (Fig. 5, H) located on 3rd to 5th abdominal segments, with uniordinal crochets arranged in a lateral penellipse (16–20) plus a vertical row (7–9); anal proleg (Fig. 5, I) with uniordinal crochets in a semicircle (10–14). Abdominal spiracles

circular, on 8th segment placed at nearly same distance from cephalic margin as in other segments. Spinules (Fig. 5, J) of abdominal surface minute, pointed and rather coarse.

Chaetotaxy of thorax and abdomen as shown in Fig. 5, A; seta SD_2 of prothorax remote from seta SD_2 in nearly same distance from seta XD_2; lateral group consisting of two setae on prothorax and three on mesothorax and metathorax. Seta D_1 of 1st to 8th abdominal segments placed antero-dorsad of seta D_2; seta L_2 absent in all abdominal segments; seta L_1 usually a little longer than seta L_3; subventral group consisting of only one seta on 1st, 2nd and 6th to 9th segments, and three setae on ventral prolegs, all the setae missing in their basal pinacula except for on 9th segments. Ninth abdominal segment with 6 setae on each side, the seta D_1 being located latero-cephalad of seta D_2; seta L_3 missing; setae D_1, D_2, SD_1 and L_1 each having a small basal pinaculum.

Third instar – Crochets on ventral prolegs arranged in a uniordinal circle (9–13) only, and those on anal prolegs in a semicircle (9–10). The other characters are not essentially different from those of the 4th instar.

Second instar – Only exuviated head-capsules examined. Head (Fig. 6, A) about as long as wide, thinly flattened dorso-ventrally, wedge-shaped, prognathous, with posterior dorsal prolongations moderately well developed. Frontoclypeus parallel-sided on its anterior 2/3, then very slightly narrowing posteriorly, with a posterior vertical ridge about 2/3 as long as anterior labroclypeal ridge. Supposed seta O_2 the longest among epicranial setae, the others diminishing in size, and sometimes represented by basal socket only. Ocelli numbering five in each

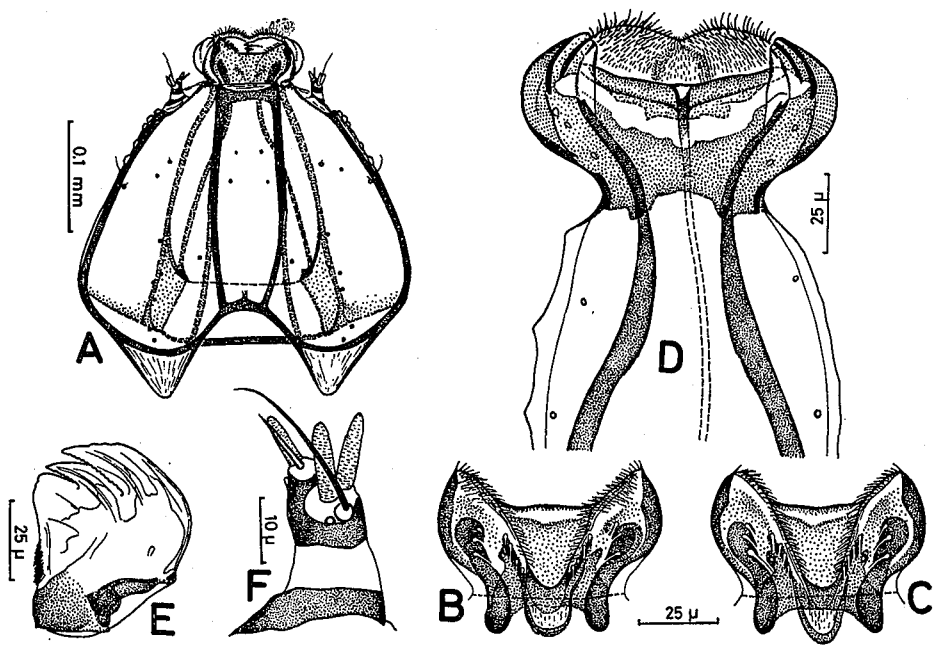


Fig. 6. *Aristaea pavoniella* (Zeller) (2nd instar larva). A: head-capsule, dorsal view— B & C: labrum, ventral view— D: labiomaxillary part, ventral view— E: mandible, mesial view— F: antenna.

side, the anterior three set close and placed just posteriorly to antenna. Antenna (Fig. 6, F) as in the preceding species *Macarostola japonica*; a bristle on 3rd segment slightly longer than conical papilla of the same segment. Labrum (Figs. 6, B & C) widened anteriorly, smoothly round on lateral margins; a median concavation shallow, occupying about 1/4 length of labrum; apical lobes pointed apically, with fine hairs along mesial margin. Mandible (Fig. 6, E) three-toothed; 1st tooth dentated on outer margin near apex, the dentation numbering two or three; 3rd tooth moderately widened, with two to five indentations at apex of inner margin. Labium (Fig. 6, D) very simple, strongly constricted at posterior end of prementum, without palpi and prominent spinneret; prementum trapezoid in form, strongly widened apically, very shallowly concaved on anterior margin. Maxilla (Fig. 6, D) simple, without palpi; supposed galea widened near apex, smoothly round on outer side, with two terminal lobes reaching nearly apex of hypopharynx, which is bilobed apically and rather densely haired.

First instar – Only exuviated head-capsules examined. Head a little wider than long, with frontoclypeus nearly parallel-sided throughout length. The other structures are quite similar to those of the 2nd instar.

Material examined: Adult — 1♂ & 4♀♀, Apoi, Hidaka, Hokkaidô, em. 27/iv-6/v/1975, ex *Aster ageratoides* var. *ovatus* forma *yezoensis*, breeding no. 1377; 1♂, Teine, Hokkaidô, em. 28/vii/1956, ex *Aster glehni*, breeding no. 156; 1♀, Teine, 13/vi/1959; 1♂, Ueda, Morioka, Honsyû, 9/vi/1952 (M. Okano leg.); 2♂♂ & 3♀♀, Ôtaki, Kiso, Nagano-ken, Honsyû, em. 1–17/v/1976, ex *Aster ageratoides* var. *ovatus*, breeding no. 1553; 1♂ & 1♀, Dürnstein n. O., Austr. inf., em. 8–12/iv/1938, ex *Aster amellus* (A. Ortner leg.).

Larva – Three, 6 and 2 exuviated head-capsules of 1st, 2nd and 3rd instars respectively, and 4 larvae of last instar, 17/x/1974, breeding no. 1377; 1 and 2 larvae of 3rd and 4th instars respectively, Teine, Hokkaidô, 23/ix/1959, ex *Aster glehni*; 1 and 3 larvae of 3rd and 4th instars respectively, Teine, 30/ix/1958, ex *Aster glehni*.

Food plant: *Aster ageratoides* Turcz. var. *ovatus* Nakai, *A. glehni* Fr. Schm. and *A. scaber* Thunb. (Compositae) in Japan; *Aster amellus* L. and *A. bellidiastrum* Sc. in Europe (after Hering, 1957).

Distribution: Japan (Hokkaidô; Honsyû; Kyûsyû), South & Central Europe.

Larval habit: The egg is laid singly on the lower surface of the leaf, usually near a small branching vein. Upon emergence from the egg the larva of the 1st instar makes a long irregularly curved, linear mine. The linear mine occupies the inter-parenchyma, usually located nearer to the lower side. The mine sometimes crosses the leaf-face entirely or surrounds a small area completely. Thus the leaf is usually discoloured to yellow, brown or red on the part apical to the mine or the area surrounded by the mine. In the 2nd instar the larva makes an elongate blotch-mine under the vein, often under the mid vein. In the 3rd and 4th instars it feeds on the entire parenchymal tissues within the blotch-mine except for a round area around vein, where it uses as a resting site. The completed mine has a strong keel on either of the upper and lower sides. The full-grown larva leaves the mine through an exit hole, and migrates to the spinning site, which is an upper or lower concavity near the middle vein of the leaf. The cocoon is whitish, boat-shaped, without bubbles on its upper side.

When I collected the larvae in autumn, the full-grown larvae overwintered within the mine-cavity. In the next spring, the larvae emerged from the mine and immediately made a cocoon on filter papers which were laid in rearing plastics.

Aristaea asteris, sp. nov.
[Figs. 7, 8 and 9 (H); Plates II (C & D) and VI (A)]

This new species is closely related to the preceding *A. pavoniella* in both the adult and larva, but distinguished from the latter by the following characters:–

Adult

Expanse of wings: A little smaller, 7.2–8.8 mm (8.0 mm in average of 9 specimens and in holotype). Length of fore wing: 3.5–4.3 mm (3.9 mm in average of 9 specimens; 3.8 mm in holotype).

♂♀. Head on vertex mixed with many dark gray scales in centre. Labial palpus roughened with shorter, raised scales on the 2nd segment alone. Thorax with a dorso-median golden-ochreous stripe wider, about twice as wide as lateral white area. Fore wing a little darker in ground colour; white markings very narrow, about half as wide as those of *pavoniella*, but are quite similar to the latter in configuration.

Male genitalia: Valva narrow at base, widest at middle, then nearly parallel-sided on apical half, bluntly angulated at ventro-apical corner. Saccus becoming suddenly narrower apically to its middle, long, about as long as valva. Aedoeagus slender, about 1.5 times as long as valva, with a cleft occupying apical half of aedoeagus. Anterior pair of coremata consisting of 50–60 scales, which are arranged in a single vertical row. Triangular projection of 7th abdominal sternite elongate, usually longer than anterior coremata.

Female genitalia: Ductus bursae much longer than that of *pavoniella*, about 3 times as long as postapophysis and about 1.5 times as long as signa.

Larva

Fourth (last) instar – Labrum (Fig. 8, C) about twice as wide as long, with apical lobes nearly straightly oblique inwardly on mesial margin. Epicranial seta A_3 about as long as seta P_1, both the longest among epicranial setae; seta P_1 located posteriorly to level of seta Adf_1. Ocellar seta O_2 located postero-ventrally to 1st ocellus, these arranged in a straight line together with 2nd ocellus. Two premental setae set close to one another, placed posteriorly to spinneret; postmentum with two median sclerites, one around postmental setae and nearly quadrate in outline, and the other one elongate-elliptical and situated far posteriorly to the former sclerite. Crochets of ventral prolegs arranged in a lateral penellipse (13–17) plus a vertical row (6–8), those of anal prolegs in a semicricle (8–13). Basal pinaculum of seta SD_1 of prothorax usually separated from dorsal shield. Subventral setae on ventral prolegs each with a small, round basal pinaculum.

Second instar – Labrum (Figs. 8, J. & K) with apical lobes finely dentated anteriorly; median concavation occupying less than 1/5 length of labrum. Mandible (Fig. 8, L) slender; 3rd tooth with only one fine notch at apex.

Material exmained: Adult – Holotype, ♂ (G. sl. no. Grc–1245), Kozagawa, Wakayama-ken, Honsyû, em. 6/vi/1964, ex *Aster ageratoides* var. *ovatus*, breeding

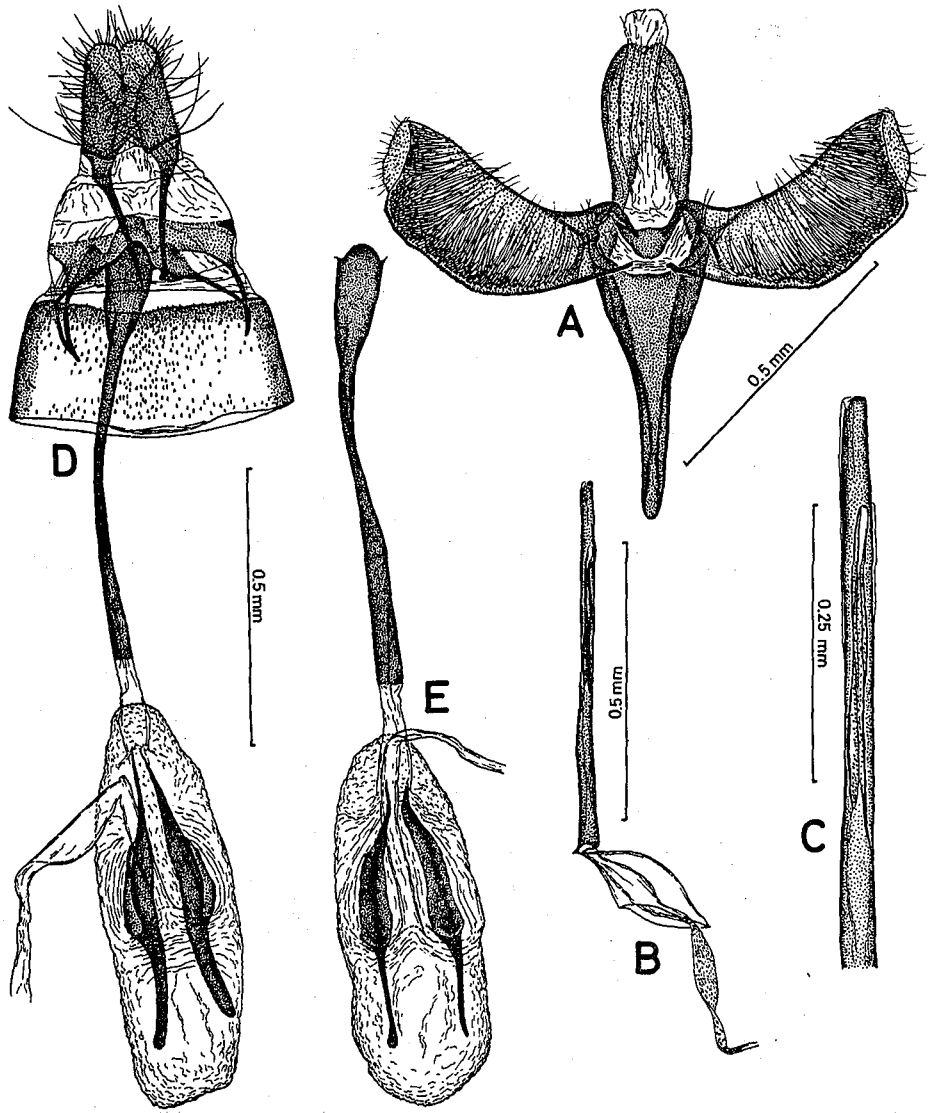


Fig. 7. *Aristaea asteris*, sp. nov. A: male genitalia (holotype), caudal view— B: aedoeagus— C: apical part of aedoeagus, enlarged— D: female genitalia, ventral view— E: bursa couplatrix.

Table 3. Measurements of larvae of *Aristaea asteris*.

Instar	Length of frontoclypeus in micra			Length of body in mm	
	n	range	mean	n	range
1st	11	110~125	115.5		
2nd	12	210~225	215.4		
3rd	11	210~230	223.2		
Last	4	270~300	287.5	3	6.0~6.5

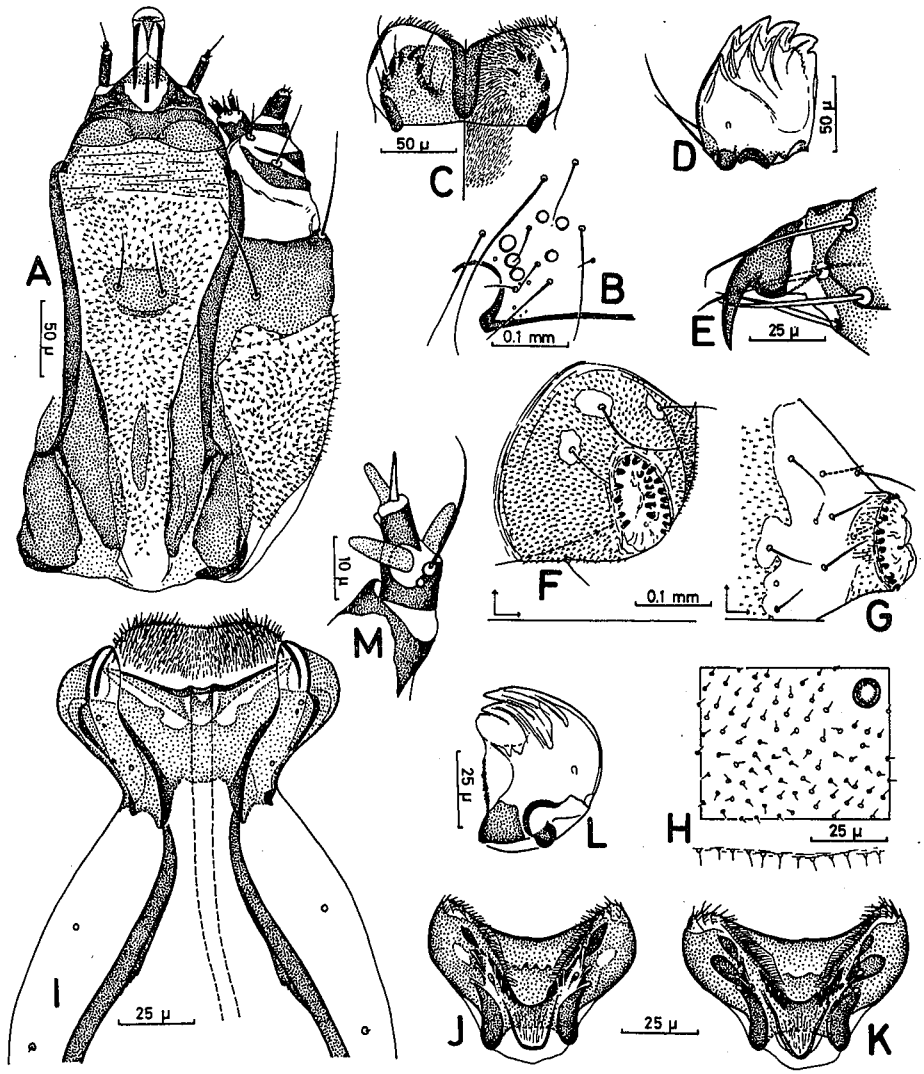


Fig. 8. *Aristaea asteris*, sp. nov. (last instar larva, A–H; 2nd instar larva, I–M). A & I: labiomaxillary part, ventral view— B: ocelli and adjacent setae— C: labrum, right in dorsal view and left in ventral view— D & L: mandible, mesial view— E: claw of mesothoracic leg— F: ventral proleg of 5th abdominal segment— G: anal proleg — H: spinules of body surface— J & K: labrum, ventral view— M: antenna.

no. 680. Paratypes, 1♀, Yugasima, Sizuoka-ken, Honsyû, em. 28/vii/1971, ex *Aster* sp., breeding no. 1097; 3♂♂ & 1♀, with the same data as in holotype except for date emerged, 31/v-11/vi/1964; 1♂ & 1♀, Kozagawa, em. 3–11/x/1974, ex *Aster ageratoides* var. *ovatus*, breeding no. 1311; 1♀, Kii-Ôsima, Wakayama-ken, em. 11/vi/1964, ex *Aster* sp.; 1♂, Yosino, Nara-ken, Honsyû, 3/x/1970 (F. Komai leg.).

Larva – Nine, 9 and 5 exuviated head-capsules of 1st, 2nd and 3rd instars respectively, and 2 larvae of 4th instar, 21/ix/1974, breeding no. 1311; 2, 5 and 6 exuviated head-capsules of 1st, 2nd and 3rd instars respectively, and 2 larvae of 4th instar, 14/vii/1971, breeding no. 1097.

Food plant: *Aster ageratoides* Turcz. var. *ovatus* Nakai (Compositae).

Distribution: Japan (Honsyû).

Larval habit: The egg is laid singly on the lower surface of the leaf, usually at the side of the middle vein. First the larva makes a rather broad linear mine which runs usually along the middle vein or leaf-margin. A short time after it broadens the linear mine into a blotch. This habit seems to continue during the entire period of the 2nd instar. In these stages the mine occupies a thin layer just above the lower epidermis of the leaf, and is whitish-green in colour. In the 3rd and 4th instars, the larva feeds on the upper layers of the tissue within the blotch-mine made during the preceding instar. At the same time, it wrinkles up the lower epidermis of the leaf to form a tentiform mine, which is exactly similar to the tentiform mine of some *Phyllonorycter*-species. After the consumption of the tissues within the mine, the larva leaves the mine through a round exit hole to form a cocoon. The cocoon is usually found on either upper or lower surface at the middle vein near apex of the leaf, whitish, and boat-shaped.

This species seems to overwinter in adult stage, because the moths emerged in the late autumn from cocoons made by larvae which were collected in September.

Remarks: In spite of the fact that this species is very similar to the preceding *pavoniella* in adult and larval structures, the larval habit is quite different from the latter in that the larva of *asteris* makes a tentiform mine. Moreover, it may be noteworthy that this species seems to overwinter in the adult stage, whereas in *pavoniella* the full-grown larva hibernates inside the mine-cavity.

Aristaea issikii, sp. nov.

[Figs. 9 (A-F, I) and 10; Plates I (D & E), III (A & B) and V]

Parectopa pavoniella: Issiki, 1950, in Esaki et al., Icon. Ins. Jap. 2nd ed.: 453, f. 1221 (nec Zeller, 1847).

Adult

Expanse of wings: 8.2–10.5 mm (9.5 mm in average of 16 specimens; 10.5 mm in holotype). Length of fore wing: 4.0–5.0 mm (4.5 mm in average of 16 specimens; 5.0 mm in holotype).

♂♀. Head dark brownish-gray, mixed with a few white scales at sides; face silvery white. Maxillary palpus brownish-black, white at apex; labial palpus as in *pavoniella* in colour and structure, but the raised scales on lower side are a little shorter. Antenna brownish-black, striped with white narrowly towards base of lower side; scape brownish-black above, white below, with a pecten white. Thorax golden-brown dorsally, with two narrow, silvery-white, longitudinal stripes, the ventral surface being silvery-white, with a pair of oblique, narrow, blackish stripes in centre. Fore and middle legs brownish-black; femora and tibiae with two or three silvery-white patches on lower sides; tarsi snow-white, with four broad, blackish rings, one at middle of 1st segment, two at bases of 2nd and 3rd segments and last on 5th segment. Hind leg silvery-white, blackish at apex of

coxa and on apical 2/3 of femur; tibia becoming paler towards base; tarsus snow-white, with five broad, black rings as in fore and middle tarsi except for the first two at subbase and subapex of 1st tarsal segment. Fore wing narrowly lanceolate, nearly parallel-sided; ground colour golden-brown, with markings silvery-white, moderate in width, heavily margined with black scales; a longitudinal streak extending from base of dorsum to basal 2/5 of wing between fold and dorsum, slightly curved, truncated on fold; a short line occupying costal margin from basal 1/20 to 1/5; 1st costal striga at about basal 1/4 of wing, strongly oblique outwardly, nearly reaching half breadth of wing, with its acute apex shortly produced towards apex of wing; 2nd costal striga at middle of wing, similar to the 1st in shape and size; 3rd costal striga at apical 1/4 of wing, very slender, parallel with the 2nd; 4th costal striga at apical 1/8 of wing, oblique inwardly, often confluent with the 3rd costal in disc to form a V-shaped mark; 1st dorsal striga at basal 2/5 of wing, oblique outwardly, slightly curved, narrowing apically; 2nd dorsal striga at basal 3/5 near tornus, strongly oblique outwardly, becoming leaden-metallic in colour towards its apex; a very short striga placed just before middle of termen, erect, often connected with 3rd costal striga through a leaden-metallic discal patch; a rather large blackish blotch in disc between this leaden-metallic patch and apex of wing, sometimes intermixed with white scales below; a small white spot at apical extremity of wing, from this spot distinct white cilia stretching downwards obliquely; cilia around apex of wing brownish-black, with a whitish submarginal line on costal side, and a white dash at apex, the dash being margined with a blackish hook on upper side; cilia along termen fuscous with a pale submarginal line, those along dorsum dark gray. Hind wing and its cilia dark gray.

Male genitalia: Tegumen weakly sclerotized, with a pair of apical setae. Valva slightly upturned, narrow at base, widest in middle; apical half of ventral margin shallowly concaved and finely dentated; ventro-apical corner acutely angulated, sometimes projecting; cucullus and sacculus haired rather densely. Saccus moderate in length, about 4/5 as long as valva, tapering apically. Juxta U-shaped, widened in median area. Aedoeagus about as long as valva, slender, bar-shaped, very slightly dilated near apex, with a long cleft occupying about apical 1/3, the cleft bearing minute spines. Seventh and 8th abdominal segments mostly membraneous, not clothed with scales except for caudal margin of 8th segment; anterior coremata small, consisting of about 20 scales which are gathered in a bundle; triangular projection of 7th sternite minute, about 1/3 as long as anterior coremata.

Female genitalia: Postapophysis very long, about 6 times as long as stalk of antapophysis; ventral prong of antapophysis reaching ostium bursae, widened apically. Ventro-caudal margin of ostium bursae slightly convexed. Ductus bursae very short, heavily sclerotized on entire length, about as long as postapophysis. Cervix bursae globular, prominent; corpus bursae ellipsoidal, membraneous, with two slender, corniform signa, which are nearly as long as ductus bursae.

Larva

Insofar as examined, the larvae of this species are very similar to those of *pavoniella* rather than of *asteris*. The description in the following lines, therefore, should mention the characters by which *issikii* is distinguished from *pavoniella*.

Fourth instar – Epicranial seta A_3 about as long as seta P_1, both being the longest among epicranial setae. Ocellar seta O_2 set closer to 1st ocellus than to

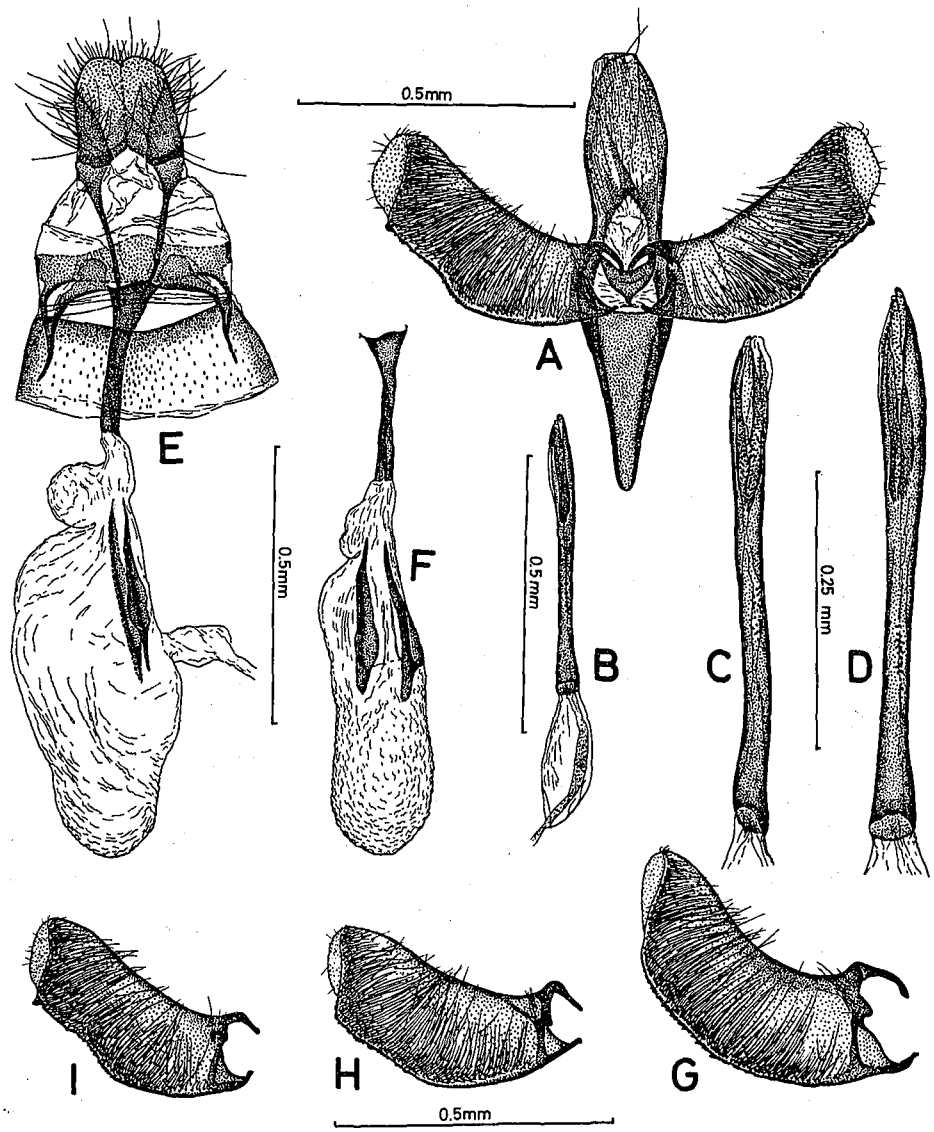


Fig. 9. *Aristaea issikii*, sp. nov. (A-F, and I), *A. pavoniella* (Zeller) (G), and *A. asteris*, sp. nov. (H). A: male genitalia (holotype), caudal view— B: aedoeagus— C & D: ditto, enlarged— E: female genitalia, ventral view— F: bursa copulatrix— G–I: left valva.

6th; 3rd ocellus apart from 4th by its diameter. Labrum (Fig. 10, C) about 2.3 times as wide as long. Two premental setae set close to one another, placed posteriorly to spinneret; median sclerite of postmentum tadpole-shaped, strongly narrowing posteriorly to middle. Crochets of ventral prolegs arranged in a uniordinal, lateral penellipse (19–26) plus a semicircle (9–14), and those of anal prolegs in a semicircle (13–18). Subventral setae on ventral prolegs each with a basal pinaculum, which, however, is smaller than that of *issikii*.

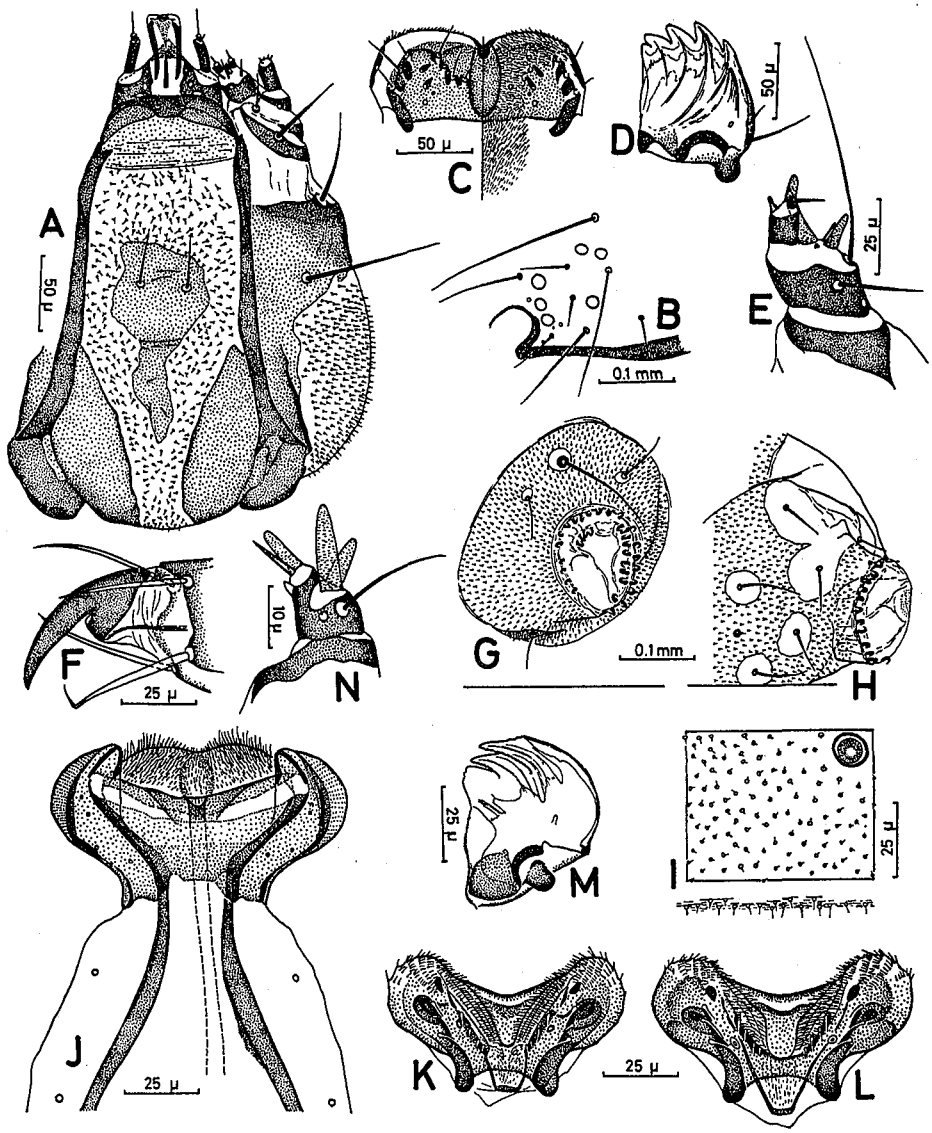


Fig. 10. *Aristaea issikii*, sp. nov. (last instar larva, A-I; 2nd instar larva, J-M). A & J: labiomaxillary part, ventral view— B: ocelli and adjacent setae— C: labrum, right in dorsal view and left in ventral view— D & M: mandible, mesial view— E & N: antenna— F: claw of mesothoracic leg— G: ventral proleg of 5th abdominal segment— H: anal proleg— I: spinules of body surface— K & L: labrum, ventral view.

Third instar – Crochets on ventral prolegs arranged in a uniordinal circle (17–22) only.

Second instar – Labrum (Figs. 10, K & L) with apical lobes finely ciliated around their round apices, the ciliation extending on lateral margin near apex; median concavation shallow, occupying about 1/4 length of labrum.

Table 4. Measurements of larvae of *Aristaea issikii*.

Instar	Length of frontoclypeus in micra			Length of body in mm	
	n	range	mean	n	range
1st	4	90-105	98.7		
2nd	11	170-190	179.5		
3rd	9	190-215	202.8	1	4.2
Last	3	305-315	310.0	3	6.5-7.2

Material examined: Adult – Holotype, ♂ (G. sl. no. Grc–2092), Hukusima, Nagano-ken, Honsyû, em. 11/x/1975, ex *Aster ageratoides* var. *ovatus*, breeding no. 1519. Paratypes, 2♂♂ & 3♀♀, Tunagi, Morioka, Honsyû, em. 20–28/x/1969, ex *Aster ageratoides* var. *ovatus*, breeding no. 1000; 1♂ & 2♀♀, Todai, Ina, Nagano-ken, Honsyû, em. 13–21/x/1975, ex *Aster ageratoides* var. *ovatus*, breeding no. 1600; 1♂ & 2♀♀, Ôtaki, Kiso, Nagano-ken, em. 14–17/x/1975, ex *Aster ageratoides* var. *ovatus*, breeding no. 1554; 4♂♂ & 2♀♀, with the same data as in holotype except for date emarged, 9–20/x/1975.

Larva – Four, 11 and 9 exuviated head-capsules of 1st, 2nd and 3rd instars respectively, and 1 and 3 larvae of 3rd and 4th instars respectively, 8/x/1969, breeding no. 1000; 1 larva of 4th instar, 23/ix/1975, breeding no. 1519.

Food plant: *Aster ageratoides* Turcz. var. *ovatus* Nakai (Compositae).

Distribution: Japan (Honsyû).

Larval habit: The larval habit of this species is similar to that of *pavoniella*, especially in 1st instar. In the 2nd instar, the larva makes a large blotch-mine, which occupies an area between the middle vein and margin of leaf, sometimes almost the entire surface. The larva in the 3rd and 4th instars consumes the leaf-tissues within the blotch-mine almost completely, without a resting site as seen in *pavoniella*. In fully matured condition, the mine becomes a tentiform-type, with irregular longitudinal wrinkles on both the lower and upper sides of the leaf; in this point it is recognized from that of *asteris*. Pupation takes place inside a whitish, boat-shaped cocoon, which is usually located on the lower side of the same leaf or another one. This species also overwinters in adult stage, because the larvae collected in autumn made cocoons a short time after, then the adults emerged from them without any diapausing period. On the other hand, as already mentioned, the larvae of *pavoniella* which were collected from the same locality in the same season as *issikii* overwintered in the full-grown larval stage till the next spring under the same rearing condition.

Remarks: Kuroko (1958) already pointed out that the specimens identified as *Parectopa pavoniella* by Issiki in 1950 are quite different from European material of the true *pavoniella*. Reading through the redescription and figure given by Issiki, I have come to agree with Dr. Kuroko, and been convinced that a new species should be described for Issiki's *pavoniella*. On this occasion, I wish to dedicate the name of the new species to Prof. Emeritus S. Issiki of Osaka Prefectural University.

Issiki (1950) also recorded *Solidago virga-aurea* var. *asiatica* as a food plant of his *pavoniella*. This record is doubtful, because I have found no gracillariid mine on this plant for these twenty years.

Genus *Systoloneura* Vári

Systoloneura Vári, 1961, Transv. Mus. Mem. 12 (South Afr. Lep. I, Lithocolletidae): 34, pls. 25 (4), 45 (2) and 107 (5) [type-species: *Systoloneura randiae* Vári, 1961].

Up to the present, this genus is monobasic, its only known species being distributed in South Africa. After my careful examination of the Japanese material identified as *Parectopa geometropis* Meyrick, I have come to conclude that the species should be referred to the present genus as a second member, although there are some disagreeing characters in venation with the generic description. In *geometropis* the fore wing is 11-veined, the vein M_3 being absent, and the veins R_4 and R_5 long-stalked in a few specimens, especially in smaller-sized ones (Pl. I, C). Moreover, in the hind wing the vein Cu_{1b} is much reduced in length and sometimes coincident with the vein Cu_{1a} into a single vein. The states of other features, such as the head, palpi, antenna, legs and male genitalia, are very close to the original description of *Systoloneura*, and indicate that *geometropis* belongs to this genus. Especially, the colour maculation of the fore wing of *geometropis* resembles that of the type-species, *randiae*. It is also noteworthy that the food plants of both species belong to the same family Rubiaceae; *geometropis* is a leaf-miner of *Gardenia*, and *randiae* mines the leaves of *Randia*.

When he erected the present genus, Vári compared it with the genus *Euspilapteryx* Stephens, 1835 (=*Calybites* Hübner, 1822), and stated that *Systoloneura* is "allied to *Euspilapteryx*, but differing from it by reduced venation in both wings". In my opinion, however, the fact that the vein R_1 of the fore wing and the vein M_3 of the hind wing are absent in *Systoloneura* seems to indicate that this genus is closely related to *Neurolipa* Ely, 1918 rather than to *Euspilapteryx*. The genus *Neurolipa* is monotypic, the type-species *N. randiella* (Busck, 1900) is also a leaf-miner of *Randia* in North America. *Neurolipa* is distinguished from *Systoloneura* in that the labial palpus has a long tuft on the lower side and that the fore wing has a more reduced venation, that is, the veins M_3 and R_2 are absent. As stated above, on account of the vein M_3 being always absent in the fore wing of *geometropis*, this species seems to exhibit an intermediate condition between *randiae* and *randiella* in the reduction of the venation of the fore wing.

On the other hand, the chaetotactic pattern of the last instar larva of *geometropis* almost agrees with that of the Japanese representatives of the genus *Aristaea*. This fact may indicate that *Systoloneura* is also closely related to *Aristaea* taxonomically. In the adult stage, however, the former genus is separated from the latter by the absence of the vein R_1 of the fore wing, and by the smoothly scaled labial palpus.

Systoloneura geometropis (Meyrick), comb. nov.
[Figs. 11, 12 and 13; Plates I (A-C), III(D) and VI (B & C)]

Parectopa geometropis Meyrick, 1936, Exotic Microlep. 5: 37; Issiki, 1957, in Esaki et al., Icones Heterocer. Jap. Color. Natur. 1: 27, pl. 4 (100).

Adult

Expanse of wings: 4.5–6.2 mm (5.5 mm in average of 17 specimens). Length of fore wing: 2.2–3.0 mm (2.7 mm in average of 17 specimens).

♂♀. Head dark gray; face white. Palpi white; maxillary palpus with a

brownish subapical spot on outer side; 2nd segment of labial palpus dark brownish on outer side except for apex, the apical segment with two dark brownish rings, one at subapex and another at middle. Antenna dark brownish, striped with white narrowly on underside; scape slightly thickened, with a pecten of a few white hairs. Thorax dark brownish-gray dorsally, white ventrally. Fore leg dark brownish-gray; coxa white on basal 2/3 and at apex; femur striped with white narrowly on outer side; tibia with two white spots on outer side, one at subbase and the other near middle; tarsus with three rather broad rings, 1st at base, 2nd before middle and last near apex; middle leg with a maculation similar to that of fore leg. Hind leg whitish; coxa with a dark oblique band just before apex; femur with a band similar to that of coxa near middle; tibia suffused with brownish gray, becoming darker towards apex, but the apical extremity being pure white; tarsus white, with five broad, blackish rings located nearly equidistantly from subbase to apex. Fore wing narrowly lanceolate, with vein R_5 usually arising from cell, well-separated from vein R_4, but in smaller specimens veins R_4 and R_5 long-stalked (see Pl. I, C); ground colour blackish-brown, with markings white, narrow and margined with black scales scatteredly; a transverse fascia placed at basal 1/4 of wing, very slightly oblique inwardly from costa, somewhat widened on wing-fold; 1st costal striga at basal 1/3 of wing, oblique outwardly or curved in a Z-shape, usually extending along costa towards base and connected with the subbasal fascia; 2nd costal striga at basal 3/5, oblique outwardly, slightly curved, extending nearly half breadth of wing; 3rd and 4th costal strigae connected with each other at their apices to form a V-shaped mark which is placed just before apex of wing; 1st dorsal striga before middle of wing, oblique outwardly, rather straight, extending beyond half breadth of wing; a longitudinal line placed above termen before apex of wing, its basal end sometimes curved towards costa and connected with apex of 2nd costal striga, and its apical end meeting with a very fine, white striga which arises from the termen just beyond tornus; a leaden-metallic patch placed in disc between apices of costal V-shaped mark and tornal striga; cilia around apex of wing dark ochreous-brown, with a broad whitish subapical line throughout, which is intercepted by a pure white, oblique hook originating in the apex of wing and margined with a blackish hook on the upper edge; cilia along dorsum ochreous-gray. Hind wing dark gray, with cilia ochreous-gray.

Male genitalia: Tegumen weakly sclerotized, with one pair of apical setae and 6–10 fine setae at each side of tuba analis, of which the subscaphium is short and slender. Valva simple, dilated towards apex, with long setae rather thickly along apical and ventral margins; costa slightly curved; ventral margin nearly straight. Vinculum short; saccus long, strongly tapering towards apex, about 3/5 as long as valva. Juxta V-shaped, widened towards median area. Aedoeagus about as long as valva, tubular, very slightly sinuate, slightly tapering towards truncated apex; vesica covered with numerous microscopic spines. Seventh and 8th abdominal segments very weakly membraneous, with a pair of coremata respectively, the anterior pair very short, about 1/4 as long as posterior pair; 8th tergite with a small semicircular sclerite covered with rather long scales, which form an elongate triangle altogether.

Female genitalia: Ventral prong of antapophysis well prolonged towards ostium bursae, connected with a weakly sclerotized, subtriangular lamella post-vaginalis; lamella antevaginalis absent. Ductus bursae well sclerotized, vasiform,

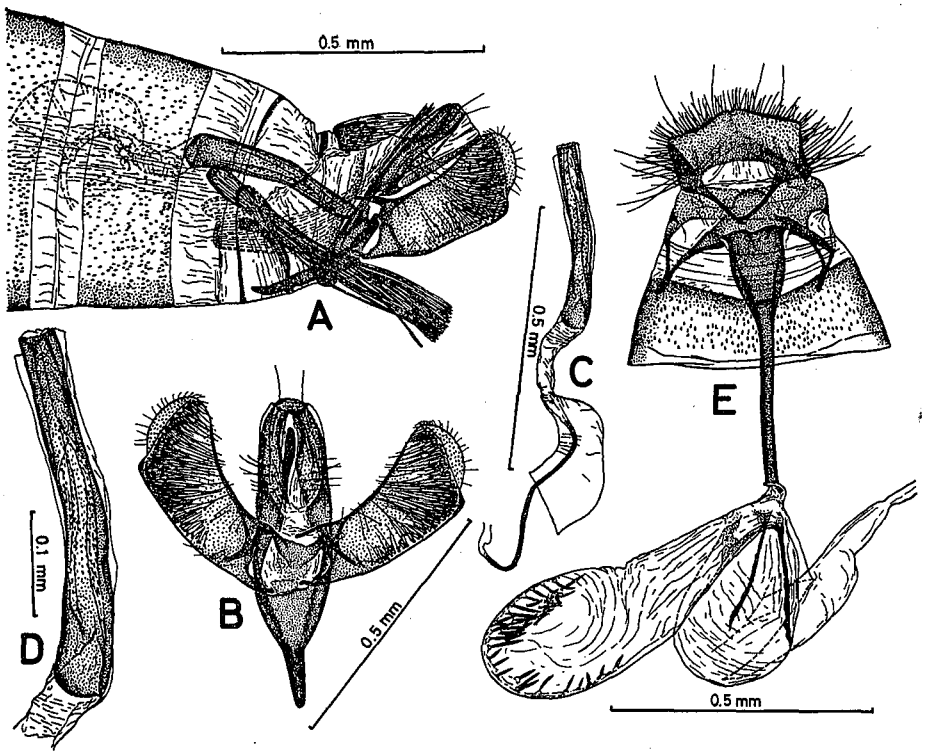


Fig. 11. *Systoloneura geometropis* (Meyrick). A: male genitalia, lateral view— B: ditto, caudal view— C: aedoeagus— D: ditto, enlarged— E: female genitalia, ventral view.

tapering cephalad. Cervix bursae membraneous, oval, with about 30 strongly sclerotized spines; corpus bursae globular, with two long, slender signa, which are more than 5 times as long as the longest spine of cervix bursae. Ductus seminalis arising from median part of corpus bursae, very wide at origin.

Larva

There are four instars in larval period, the first two are of sap-feeding type with a flat head, and the last two are of tissue-feeding type with a round head and a cylindrical body as in *Aristaea*-species.

Fourth (last) instar – Colour: Head pale brownish-yellow, with ocellar area blackish; body evenly creamy-whitish, with crochets of ventral prolegs brownish.

Structure: Head round, with posterior dorsal prolongations very slightly developed and flap-like; frontoclypeus closed posteriorly at depth of cervical triangle; coronal suture absent. Epicranial seta A_3 located latero-posteriorly to seta A_2, and directly anteriorly to seta L_1, about as long as seta P_1; setae A_3 and P_1 the longest among epicranial setae; seta P_1 located on nearly same level of seta Adf_1. Ocelli (Fig. 12, E) in six pairs; 1st and 2nd ocelli set close to one another; 3rd to 5th ocelli arranged in a straight line, and close together, the 5th being posterior to antenna; 6th ocellus just ventral to centre between 1st and 5th ocelli; seta O_2 the longest among ocellar setae, but slightly shorter than epicranial setae P_1 and A_3, and located in centre between 2nd and 6th ocelli; seta O_1 in centre between 2nd and

Table 5. Measurements of larvae of *Systoloneura geometropis*.

Instar	Length of frontoclypeus in micra			Length of body in mm	
	n	range	mean	n	range
1st	12	100-115	107.9		
2nd	14	165-185	173.6		
3rd	12	165-175	171.7	1	3.2
Last	9	230-265	242.2	4	4.5-5.0

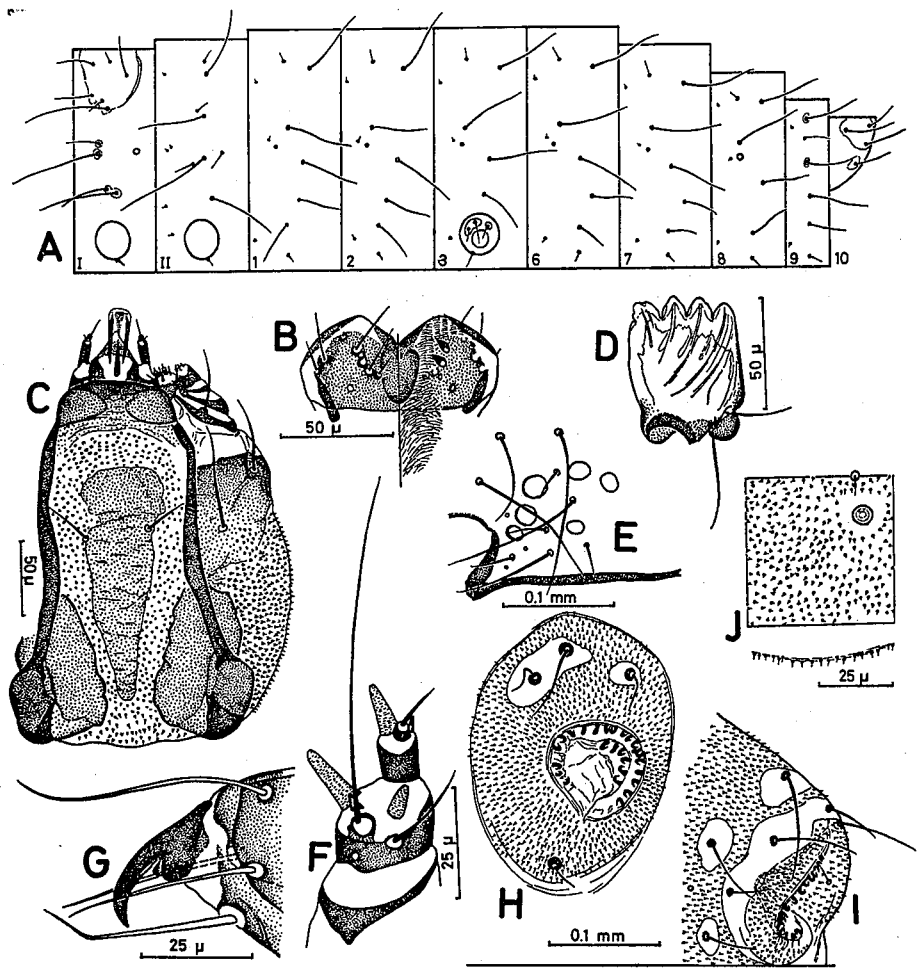


Fig. 12. *Systoloneura geometropis* (Meyrick) (last instar larva). A: setal patterns of thorax and abdomen— B: labrum, right in dorsal view and left in ventral view— C: labiomaxillary part, ventral view— D: mandible, mesial view— E: ocelli and adjacent setae— F: antenna— G: claw of mesothoracic leg— H: ventral proleg of 5th abdominal segment— I: anal proleg— J: spinules of body surface.

3rd ocelli; seta O_3 in centre between 5th and 6th ocelli. Antenna (Fig. 12, F) exactly similar to that of *Macarostola japonica*. Labrum (Fig. 12, B) a little less than twice as wide as long, bilobed apically, the lobes being smoothly round and bearing 7 or 8 rows of hypopharyngeal hairs on ventral surface near apical area; median incision rather acute, occupying about 2/5 length of labrum; three pairs of hypopharyngeal setae rather thick, the outermost one minute and rudimentary; seta M_3 the longest among labral setae, seta L_2 a little shorter than seta M_3, and seta L_3 minute and rudimentary. Mandible (Fig. 12, D) four-toothed, all the teeth nearly equal in length, the 4th tooth with a small notch on median edge below its apex. Labium and maxilla (Fig. 12, C) as in *Macarostola japonica* and usual lepidopterous larvae; spinneret about twice as long as labial palpi, with ventro-median ridge sclerotized narrowly on its basal half; two premental setae set close to one another, and located posteriorly to spinneret; postmentum with a median sclerite elongate-spatulate, and with numerous discoidal spinules on membraneous area; postmental setae located on nearly same level with longer seta of maxillary stipes. Thoracic legs all well developed, with a claw as shown in Fig. 12, G. Ventral prolegs (Fig. 12, H) located on 3rd to 5th abdominal segments, with uniordinal crochets arranged in a lateral penellipse (17–27) plus a vertical row (5–9); anal proleg with crochets in a semicircle (11–15). Spiracles all circular, those on prothorax and 8th abdominal segment about twice as large as those on other segments in diameter. Spinules of body surface (Fig. 12, J) minute, pointed, and very dense.

Chaetotaxy of body as shown in Fig. 12, A, very similar to that in *Aristaea*-species; seta SD_2 of prothorax apart from seta SD_1 in a nearly same distance from seta XD_2, all of these setae originating in thoracic shield. Seta SD_2 of abdominal segments located antero-dorsally to spiracle except for 8th segment, in which it is directly anterior to spiracle; subventral setae SV_1 and SV_2 on ventral prolegs originating in a sinlge elongate, large pinaculum, and seta SV_3 in a circular pinaculum which is separated from the former; pinaculum of seta SD_1 of 10th abdominal segment well apart from anal shield.

Third instar – Distinguished from 4th instar as follows: – Frontoclypeus truncated posteriorly with a very short vertical bar; median sclerite of postmentum triangular; ventral proleg with 11–17 crochets arranged in a lateral penellipse alone.

Second instar – Only exuviated head-capsules examined. Head (Fig. 13, A) a little longer than wide, flat dorso-ventrally, wedge-shaped, prognathous, with posterior dorsal prolongations well developed, and cervical concavation occupying about 1/3 length of head; frontoclypeus nearly parallel-sided, slightly narrowing anteriorly on its anterior 1/4, with clypeolabral ridge about 3/5 as wide as posterior transverse ridge. Supposed seta O_2 alone prominent among epicranial setae, the others being barely represented by basal sockets. Ocelli not apparent. Antenna distinctly three-segmented, the 2nd segment distally with two conical papillae and a moderately long seta, and the 3rd segment with two conical papillae (one minute) and a short bristle at its top. Labrum (Fig. 13, B) about 1.3 times as wide as long, rounded on lateral margins, bilobed anteriorly, the lobes having four or five minute teeth, from which striae stretch posteriorly; median concavation shallow, round, occupying at most 1/6 length of labrum; basal apodemes very long, nearly as long as labrum. Mandible (Fig. 13, D) completely flat, very peculiar in shape, with median edge about twice as long as lateral edge, which is round near apex; two teeth

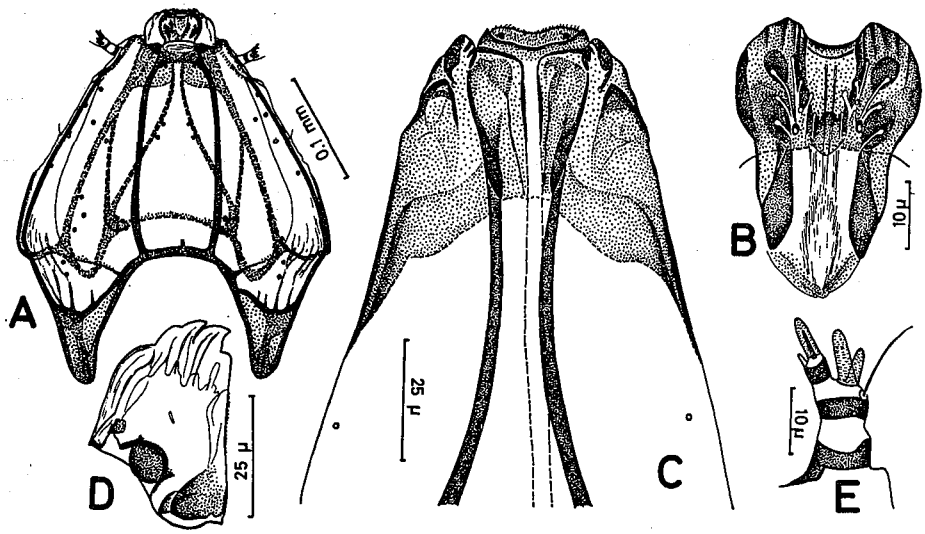


Fig. 13. *Systoloneura geometropis* (Meyrick) (2nd instar larva). A: head-capsule, dorsal view — B: labrum, ventral view— C: labiomaxillary part, ventral view— D: mandible, mesial view— E: antenna.

protruded, the lateral one having a round, prominent lobe on lateral side. Labium and maxilla (Fig. 13, C) much specialized, very flat, both combined to form an elongate-triangular lower lip of mouth-parts; labium rather slender on anterior 3/5; prementum slightly widened anteriorly, shallowly concaved on its anterior margin, with palpi and prominent spinneret completely absent; hypopharynx very slightly protruded beyond anterior margin of labium, emarginated, finely spinose; maxilla very simple, with palpi completely absent; supposed maxillary galea widened posteriorly, with a short apical lobe nearly reaching apex of labium.

First instar – Insofar as the exuviated head-capsules are examined, there are no essential morphological differences between the 2nd and 1st instars except for the smaller size and slightly slenderer dorso-posterior prolongations of head-capsules in the latter instar.

Material examined: Adult – 1♂ (determined as *Parectopa geometropis* by Issiki), Nisinomiya, Ôsaka, Honsyû, 4/viii/1949 (S. Issiki leg.), ex *Gardenia jasminoides*; 2♂♂, Kii-Ôsima, Wakayama-ken, Honsyû, em. 30/v/1964, ex *G. jasminoides*, breeding no. 686; 8♂♂ & 7♀♀, Kagosima-si, Kyûsyû, em. 16–20/viii/1969 (K. Kusigemati leg.), *ex G. jasminoides*, breeding no. 904; 1♂ & 1♀, Ibusuki, Kagosima-ken, Kyûsyû, em. 27/iii/1970 (A. Tanaka leg.), ex *G. jasminoides*, breeding no. 1014.

Larva – Eight, 12 and 13 exuviated head-capsules of 1st, 2nd and 3rd instars respectively, and 1 and 2 larvae of 3rd and 4th instars respectively, 14/viii/1969, breeding no. 904; 9, 12 and 10 exuviated head-capsules of 1st, 2nd and 3rd instars respectively, and 2 larvae of 4th instar, Kagosima-si, 22/x/1973, ex *Gardenia jasminoides*, breeding no. 1246; 14, 18 and 12 exuviated head-capsules of 1st, 2nd and 3rd instars respectively, 25/i/1970, breeding no. 1014; 13, 15, 11 and 6 exuviated

head-capsules of 1st, 2nd, 3rd and 4th instars respectively, and 2 larvae of 4th instar, Miyanoura, Yaku-sima, Satunan Is., 19/x/1973, ex *G. jasminoides*, breeding no. 1238.

Food plant: *Gardenia jasminoides* Ellis in Japan, and *G. radicans* Thunb. (=*G. jasminoides* var. *radicans* Makino) in Taiwan.

Distribution: Japan (Honsyû; Sikoku; Kyûsyû; Satunan Is.) and Taiwan.

Larval habit: The egg is laid singly at the side of vein on the lower surface of the leaf. Upon emergence the 1st instar larva mines the lower layer of spongy parenchymal tissues for feeding, and makes a short linear mine along the vein. A short time after it broadens the mine into a blotch. In the 2nd instar it continues to make a blotch-mine, which finally occupies a more or less full area between two branching veins. In the 3rd and 4th instars the larva, with tissue-feeding mouthparts, feeds on the remaining tissues within the blotch-mine. When fully grown it leaves the mine through an exit hole to pupate. In this stage the mine is tentiformed, with a strong longitudinal wrinkle on the lower side. Pupation takes place inside a whitish, boat-shaped cocoon which is usually located on the lower surface of the leaf near the apex. At the spinning site the leaf is always folded downwardly.

Appendix

A TENTATIVE LIST OF THE WORLD SPECIES OF THE GENUS MACAROSTOLA

The great majority of the gracillariid species described from the Indo-Australian region have not been revised by recent authors. Accordingly, in this list I tentatively assemble the species which are characterized by the crimson-red or rosy ground colour, with yellowish or whitish markings on the fore wing and the thorax, on the basis of the original descriptions or redescriptions. Most of the species have been treated as members of Group B of the genus *Parectopa* by Meyrick (1912), or the *formosa*-group of the genus by Turner (1940).

1. *Macarostola ageta* (Turner)
   Parectopa ageta Turner, 1917, Proc. Roy. Soc. Queensland 29: 87.
   Distribution: Australia.
   Food plant: Unknown.
2. *Macarostola callischema* Meyrick
   Macarostola callischema Meyrick, 1908, Journ. Bomb. Nat. Hist. Soc. 18: 827. *Parectopa callischema*: Meyrick, 1912, Cat. Lep. 6: 50.
   Distribution: Assam, India.
   Food plant: Unknown.
3. *Macarostola ceryx* (Diakonoff)
   Parectopa ceryx Diakonoff, 1955, Verh. Acad. West Amst. (2) 50 (3): 94, figs. 808, 811 and 812.
   Distribution: New Guinea.
   Food plant: Uknown.
4. *Macarostola coccinea* (Walsingham)
   Gracilaria coccinea Walsingham, 1900, in Swinhoe, Cat. Eastern and Australian Lep. Heteroc. in Coll. Oxford Univ. Mus. 2: 576. *Macarostola coccinea*: Meyrick, 1908, Journ. Bomb. Nat. Hist. Soc. 18: 829. *Parectopa coccinea*: Meyrick, 1912, Cat. Lep. 6: 49.
   Distribution: India.
   Food plant: Unknown.

5. *Macarostola eugeniella* (Viette)

Parectopa eugeniella Viette, 1951 Mém. Inst. sci. Madagascar A 5: 132; ibid., 1955, Mém. Inst. sci. Madagascar E 6: 152.

Distribution: Madagascar.

Food plant: *Eugenia jambolana* (Myrtaceae).

6. *Macarostola flora* (Meyrick)

Parectopa flora Meyrick, 1926, Ann. S. Afr. Mus. 23: 340. *Macarostola flora*: Vári, 1961, Transv. Mus. Mem. 12 (South Afr. Lep. I, Lithocolletidae): 2, pls. 1(1), 75 (1).

Distribution: Natal, S. Africa.

Food plant: Unknown.

7. *Macarostola formosa* (Stainton)

Gracilaria formosa Stainton, 1863, Trans. Ent. Soc. London 1863: 291, pl. 10 (1); Meyrick, 1880, Proc. Linn. Soc. N.S.W. 5: 153. *Macarostola formosa*: Meyrick, 1907, Proc. Linn. Soc. N.S.W. 32: 62; Common, 1970, in CSIRO, Insects of Australia: 809, pl. 7(A). *Parectopa formosa*: Meyrick, 1912, Cat. Lep. 6: 50.

Distribution: Australia; New Zealand.

Food plant: *Acmena smithii, Eugenia ventenatii* (Myrtaceae).

8. *Macarostola gamelia* (Meyrick)

Parectopa gamelia Meyrick, 1936, Exotic Microlep. 5: 37.

Distribution: Java.

Food plant: *Eugenia polyantha* (Myrtaceae).

9. *Macarostola haemataula* (Meyrick)

Parectopa haemataula Meyrick, 1912, Gen. Ins. 128: 21.

Distribution: India.

Food plant: Unknown.

10. *Macarostola hieranthes* (Meyrick)

Coriscium hieranthes Meyrick, 1907, Journ. Bomb. Nat. Hist. Soc. 17: 745. *Macarostola hieranthes*: Meyrick, 1908, Journ. Bomb. Nat. Hist. Soc. 18: 827. *Parectopa hieranthes*: Meyrick, 1912, Cat. Lep. 6: 49.

Distribution: Ceylon.

Food plant: Unknown.

11. *Macarostola ida* (Meyrick)

Gracilaria ida Meyrick, 1880, Proc. Linn. Soc. N.S.W. 5: 155; ibid., 1882, Proc. Linn. Soc. N.S.W. 7: 196. *Macarostola ida*: Meyrick, 1907, Proc. Linn. Soc. N.S.W. 32: 62. *Parectopa ida*: Meyrick, 1912, Cat. Lep. 6: 50.

Distribution: Australia.

Food plant: *Eucalyptus piperita* (Myrtaceae).

12. *Macarostola japonica* Kumata (sp. nov.)

Distribution: Japan.

Food plant: *Euscaphis japonica* (Staphyleaceae).

13. *Macarostola miltopepla* (Turner)

Parectopa miltopepla Turner, 1926, Trans. Roy. Soc. S. Aust. 50: 148.

Distribution: Australia.

Food plant: Unknown.

14. *Macarostola miniella* (Felder)

Coriscium miniella Felder, 1875, Reis. Novar. t. 140 (42); Meyrick, 1889, Trans. N. Zeal. Inst. 21: 185. *Macarostola miniella*: Meyrick, 1909, Trans. N. Zeal. Inst. 41: 14. *Parectopa miniella*: Meyrick, 1912, Cat. Lep. 6: 49. *Gracilaria ethela* Meyrick, 1880, Proc. Linn. Soc. N.S.W. 5: 152.

Distribution: New Zealand.

Food plant: Unknown.

15. *Macarostola paradisia* Meyrick

Macrostola paradisia Meyrick, 1908, Journ. Bomb. Nat. Hist., Soc. 18: 826. *Parectopa paradisia*: Meyrick, 1912, Cat. Lep. 6: 49.

Distribution: Ceylon.

Food plant: Unknown.

16. *Macarostola phoenicaula* (Meyrick)

Parectopa phoenicaula Meyrick, 1934, Exotic Microlep. 4: 473.

Distribution: Fiji.

Food plant: Unknown.

17. *Macarostola polyplaca* (Lower)

Gracilaria polyplaca Lower, 1894, Trans. Roy. Soc. S. Austr. 18: 112; Turner, 1900, Trans. Roy. Soc. S. Aust. 24: 20. *Macarostola polyplaca*: Meyrick, 1907, Proc. Linn. Soc. N.S.W. 32: 62. *Parectopa polyplaca*: Meyrick, 1912, Cat. Lep. 6: 50. *Gracilaria ida* var. *rosea* Turner, 1894, Trans. Roy. Soc. S. Austr. 18: 126.

Distribution: Australia.

Food plant: *Tristania conferta*, *T. suaveolens* (Myrtaceae).

18. *Macarostola pontificalis* (Meyrick)

Parectopa pontificalis Meyrick, 1929, Trans. Ent. Soc. London 76, 505; Clarke, 1971, Smiths. Contr. Zool. 56: 182, fig. 142, pls. 2(c) and 23 (e).

Distribution: Rapa I., Austral Is.

Food plant: *Metrosideros collina* (Myrtaceae).

19. *Macarostola pyrelictis* (Meyrick)

Parectopa pyrelictis Meyrick, 1927, Ins. Samoa 3: 108.

Distribution: Samoa.

Food plant: Unknown.

20. *Macarostola rosacea* (Turner)

Parectopa rosacea Turner, 1940, Trans. Roy. Soc. S. Austr. 64: 64.

Distribution: Australia.

Food plant: Unknown.

21. *Macarostola tegulata* Meyrick

Macarostola tegulata Meyrick, 1908, Journ. Bomb. Nat. Hist. Soc. 18: 827. *Parectopa tegulata*: Meyrick, 1912, Cat. Lep. 6: 50.

Distribution: Assam, India.

Food plant: Unknown.

22. *Macarostola thiasodes* (Meyrick)

Parectopa thiasodes Meyrick, 1912, Gen. Ins. 128; 21; ibid., 1912, Cat. Lep. 6: 49.

Distribution: Ceylon.

Food plant: Unknown.

23. *Macarostola thriambica* (Meyrick)

Gracilaria thriambica Meyrick, 1907, Journ. Bomb. Nat. Hist. Soc. 17: 745. *Macarostola thriambica*: Meyrick, 1908, Journ. Bomb. Nat. Hist. Soc. 18: 827. *Parectopa thriambica*: Meyrick, 1912, Cat. Lep. 6: 49.

Distribution: Ceylon

Food plant: Unknown.

24. *Macarostola zehntneri* (Snellen)

Gracilaria Zehntneri Snellen, 1901, Tijdschr. Ent. 44: 91, pl. 6 (6). *Parectopa Zehntneri*: Meyrick, 1912, Cat. Lep. 6: 49; ibid., 1932, Exotic Microlep. 4: 270.

Distribution: Java; India.

Food plant: *Eugenia jambolana* (Myrtaceae).

References

Chapman, T.A. 1902. A classification of *Gracilaria* and allied genera. Entomologist 35: 81–88, 138–142 and 159–164.

Clarke, J.F.G. 1971. The Lepidoptera of Rapa Island. Smiths. Contr. Zoology 56: 1–284.

DeGryse, R.J.J. 1916. The hypermetamorphism of the lepidopterous sap-feeders. Proc. Ent. Soc. Washingt. 18: 164–168.

Dimmock, G. 1880. The trophi and chitinous supports in *Gracilaria*. Psyche 3: 99–103.

Grandi, G. 1931. Morfologia ed etologia comparata di Insetti a regime specializzato, I. La morfologia comparata di alcuni stati larvali di 20 Microlepidotteri minatori.

Boll. Lab. Ent. Bologna 4: 223–337.

———— 1932. Ditto, IV. La morfologia comparata di vari stati larvali di 30 Microlepidotteri minatori apparatenenti a 15 generi ed a 11 famiglie. Boll. Lab. Ent. Bologna 5: 143–307.

———— 1959. The problems of "morphological adaptation" in insects. Smiths. miscell. Coll. 137: 203–230.

Heinrich, C. and DeGryse, R.J.J. 1915. On *Acrocercops strigifinitella* Clemens. Proc. Ent. Soc. Washingt. 17: 6–14.

Hinton, H.E. 1946. On the homology and nomenclature of the setae of Lepidopterous larvae, with some notes on the phylogeny of the Lepidoptera. Trans. Roy. Ent. Soc. London 97: 1–37.

Issiki, S. 1950. In Esaki et al., Iconographia Insectorum Japonicorum, Ed. 2nd.: 451–454. Hokuryûkan, Tôkyô.

———— 1957. In Esaki et al., Icones Heterocerorum Japonicorum in Coloribus Naturalibus, 1. 318 pp. Hoikusha, Ôsaka.

Jayewickreme, S.H. 1940. A comparative study of the larval morphology of leaf-mining Lepidoptera in Britain. Trans. Roy. Ent. Soc. London 90: 63–105.

Klimesch, J. 1943. Zur Chaetotaxie der Raupe von *Lithocolletis joviella* Const. (Lep., Gracilariidae). Ztsch. Wien Ent. Ges. 28: 7–10.

Kuroko, H. 1958. Notes on *Parectopa pavoniella* Zeller (Gracilariidae) from Japan. Tyô to Ga 9: 58–60.

MacKay, M.R. 1972. Larval sketches of some Microlepidoptera, chiefly North America. Mem. Ent. Soc. Canada 88: 1–83.

Matsuda, R. 1965. Morphology and evolution of the insect head. Mem. Amer. Ent. Institute 4: 1–334.

Meyrick, E. 1912. Lepidoptera, Heterocera, Family Gracilariadae. In Wytman, Gen. Ins. 128: 1–36.

Peterson, A. 1951. Larvae of Insects, I, Lepidoptera and Hymenoptera. 315 pp. Edwards Brothers, Ann Arbor.

Trägardh, I. 1913. Contributions towards the comparative morphology of the trophi of the Lepidopterous leaf miners. Ark. Zool. 8: 1–49.

Turner, A.J. 1940. A revision of the Australian Gracilariidae (Lepidoptera). Trans. Roy. Soc. S. Australia 64: 50–69.

Vâri, L. 1961. South African Lepidoptera I, Lithocolletidae. Transv. Mus. Mem. 12: 1–238.

Watson, W.Y. 1956. A description of the immature stages of *Lithocolletis salcifoliella* Cham. (Lepidoptera: Gracillariidae). Canad. Ent. 88: 168–177.

PLATES

Plate I

Fig. 14. Wing venation.

A & B: *Systoloneura geometropis* (Meyrick).
C: Ditto, a variation seen in a small specimen.
D & E: *Aristaea issikii*, sp. nov.
F & G: *Aristaea pavoniella* (Zeller).
H & I: *Macarostola japonica*, sp. nov.

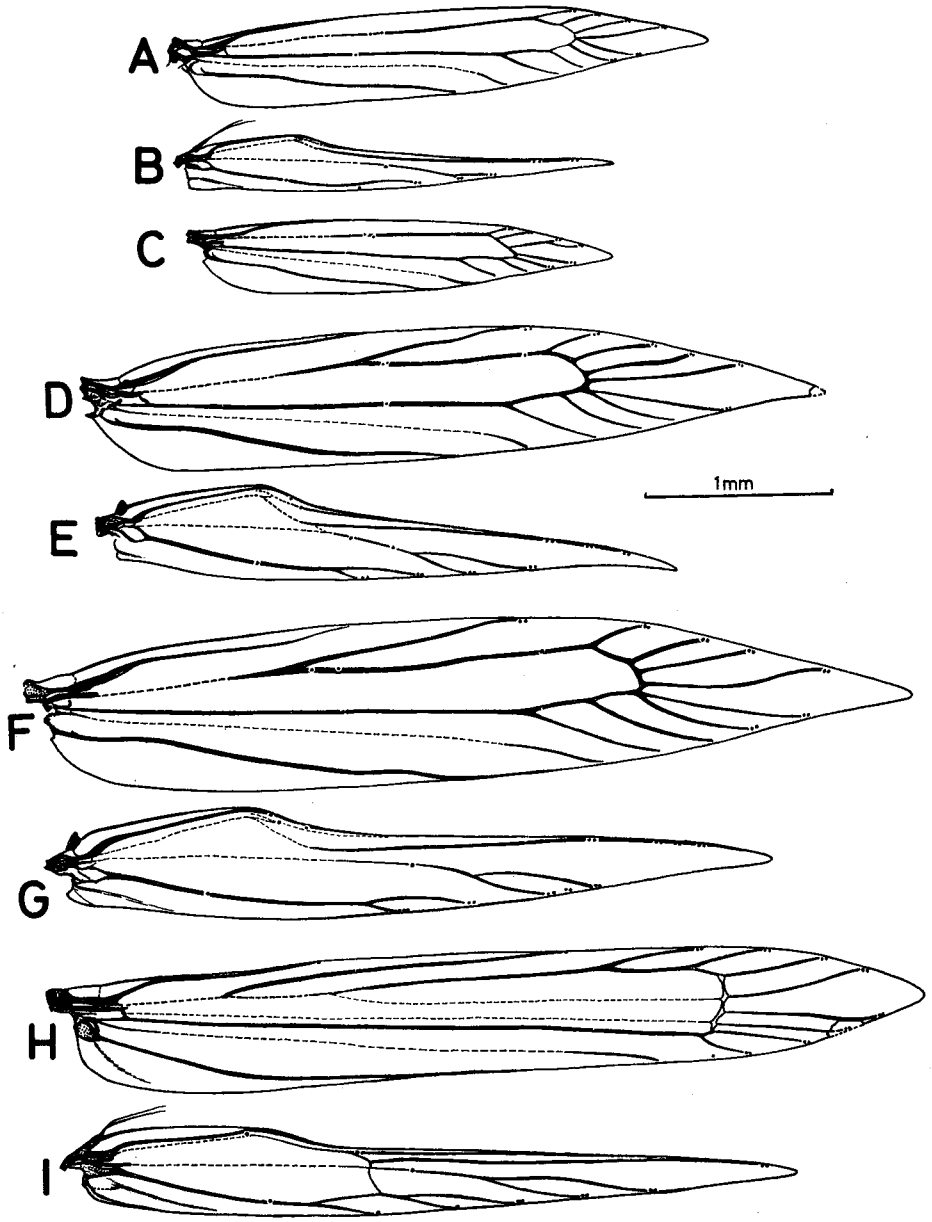

A
B
C
D
1mm
E
F
G
H
I

Plate II

Fig. 15. Adult specimens.

A: *Macarostola japonica*, sp. nov. (♂, holotype).
B: Ditto (♀, paratype, Onoaida, Yaku-sima, Satunan Is.).
C: *Aristaea asteris*, sp. nov. (♂, holotype).
D: Ditto (♀, paratype, Kozagawa, Wakayama-ken, Honsyû).

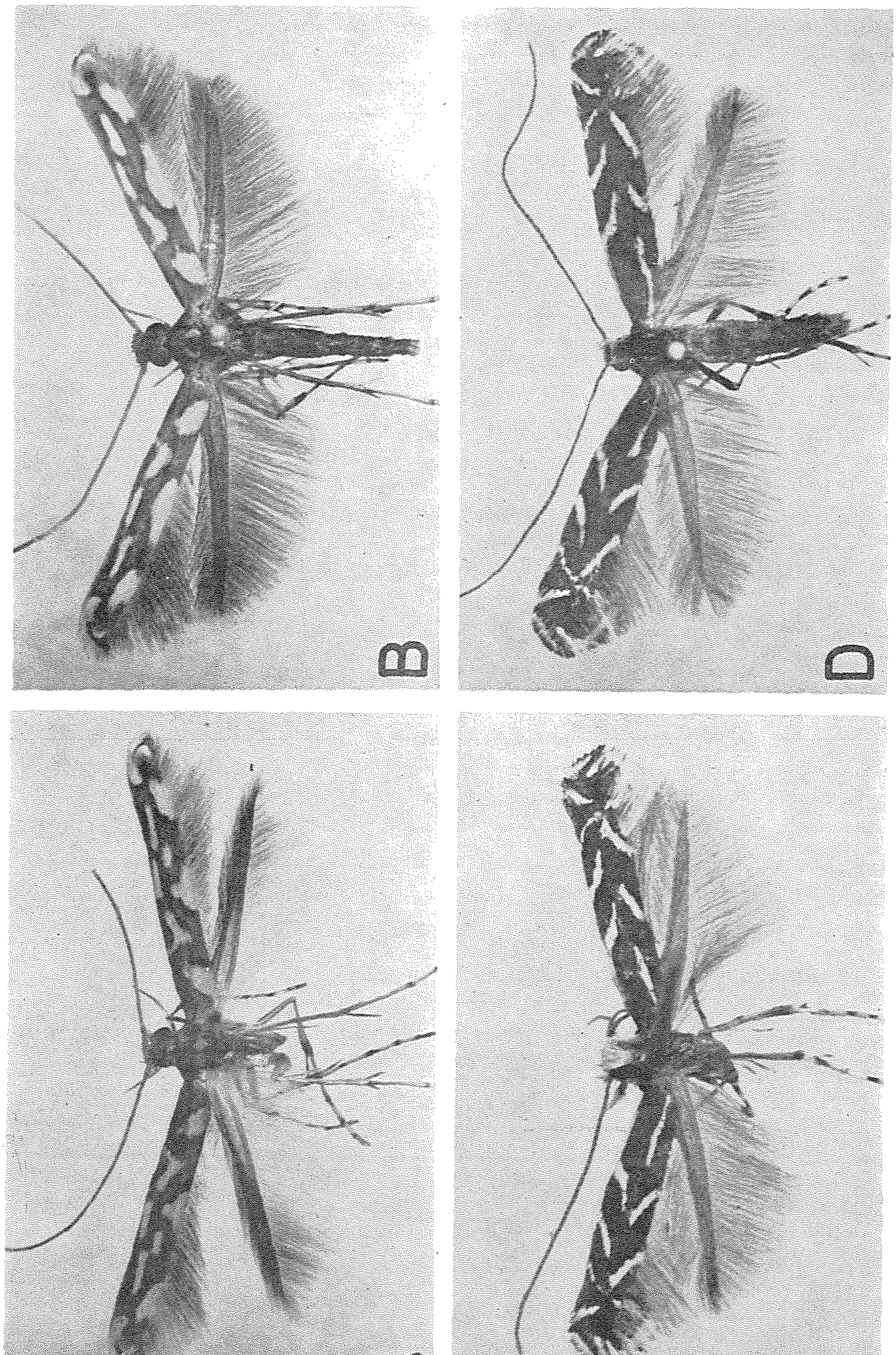
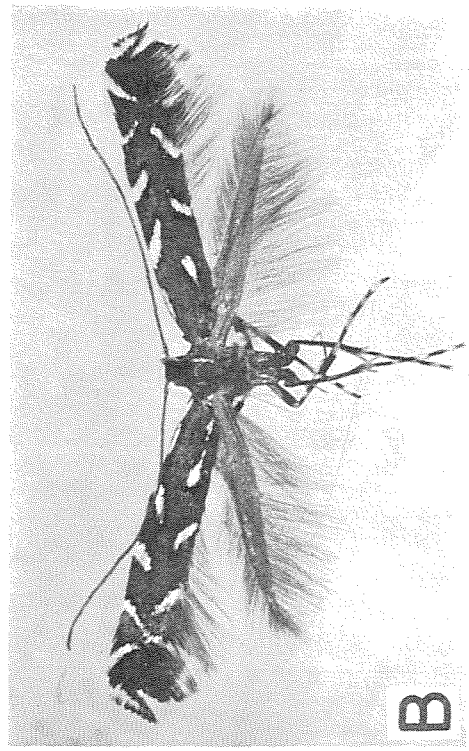

A
B
C
D

Plate III

Fig. 16. Adult specimens.

A: *Aristaea issikii*, sp. nov. (♂, paratype, Todai, Ina, Nagano-ken, Honsyû).
B: Ditto (♀, paratype, Hukusima, Nagano-ken, Honsyû).
C: *Aristaea pavoniella* (Zeller) (♀, Apoi, Hidaka, Hokkaidô).
D: *Systoloneura geometropis* (Meyrick) (♂, Ibusuki, Kagosima-ken, Kyûsyû).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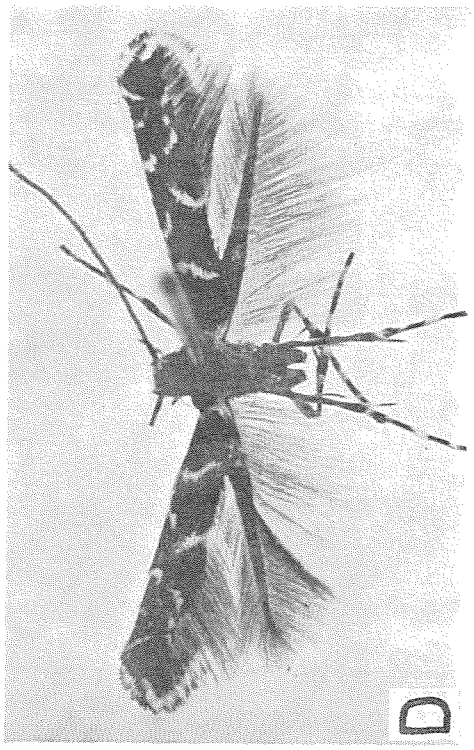
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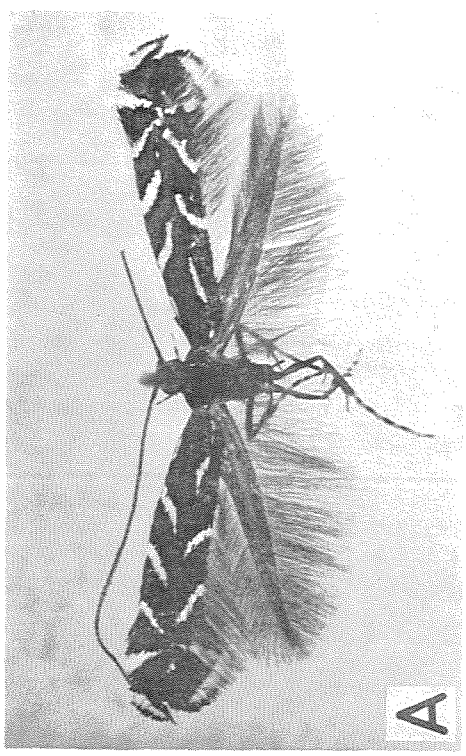
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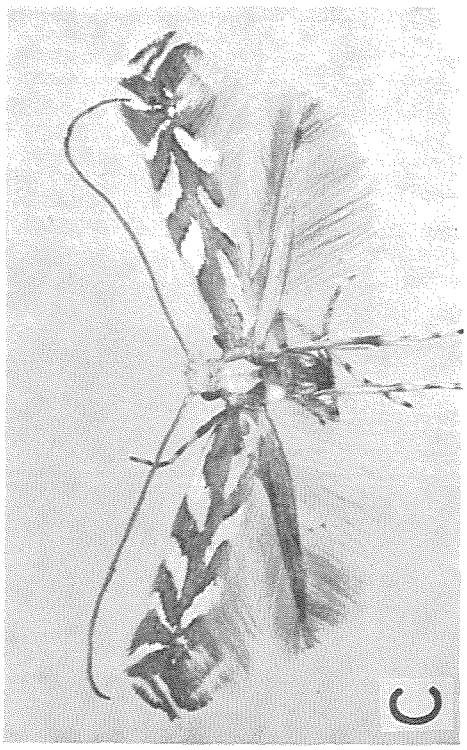

C

Plate IV

Fig. 17. Leaf mined or rolled by larva.

A & B: *Euscaphis japonica* (lower side) mined and rolled by *Macarostola japonica*, sp. nov. (breeding no. 1223).

C: *Aster glehni* (lower side) mined by *Aristaea pavoniella* (Zeller) (breeding no. 156).

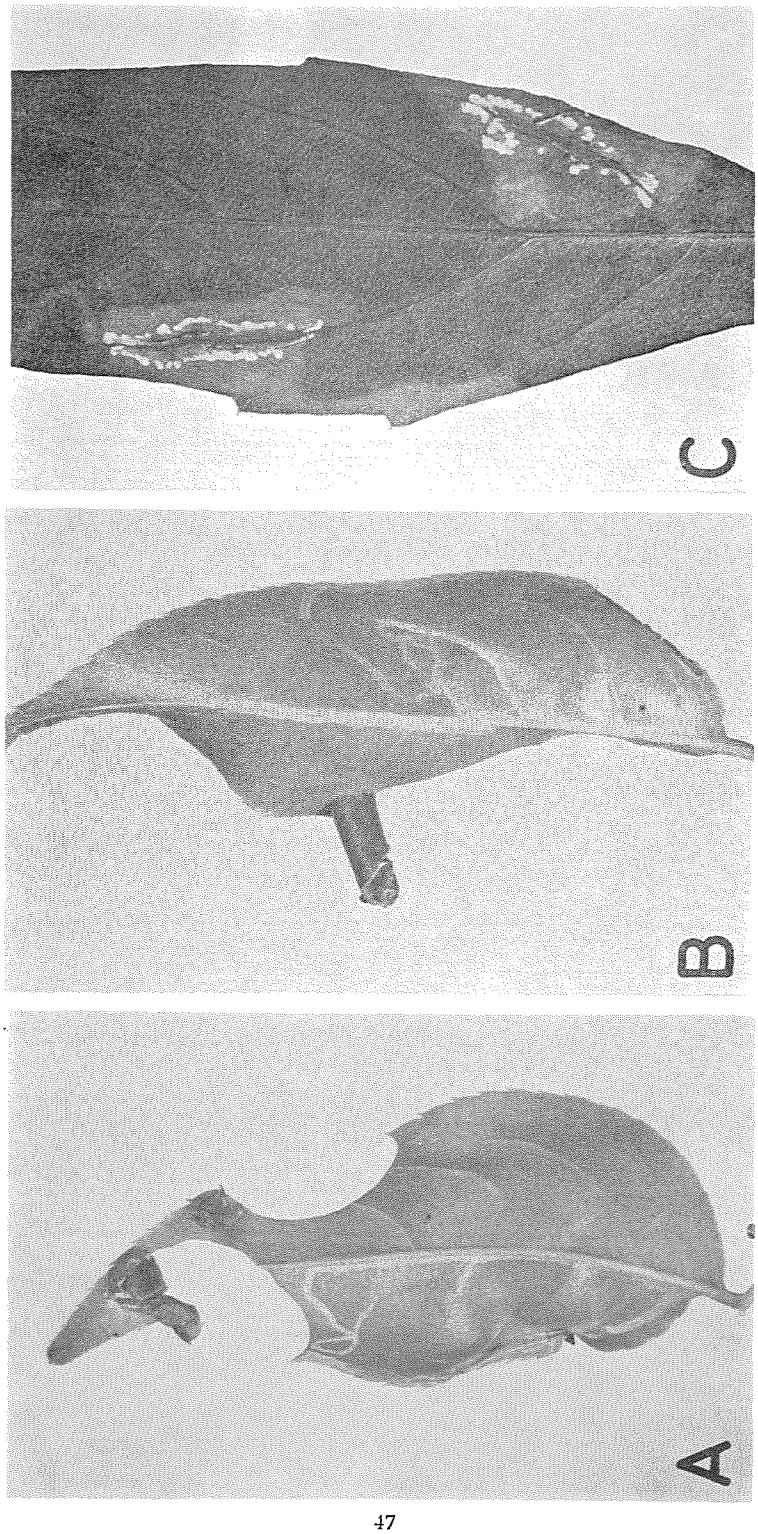

A
B
C

Plate V

Fig. 18. Mine and cocoon of *Aristaea issikii*, sp. nov.
A: Leaf (upper side) of *Aster ageratoides* var. *ovatus* (breeding no. 1519).
B: Ditto (lower side).
C: Ditto (lower side) with cocoon.

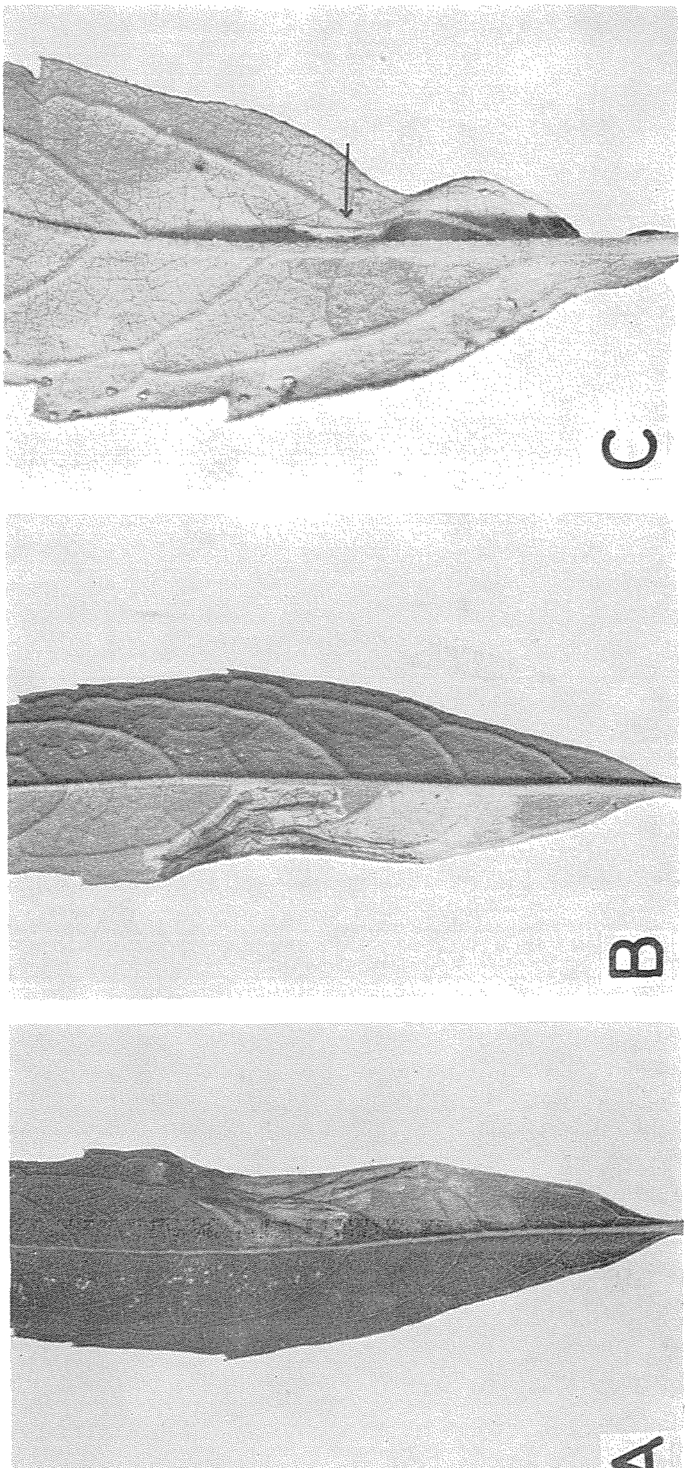

A
B
C

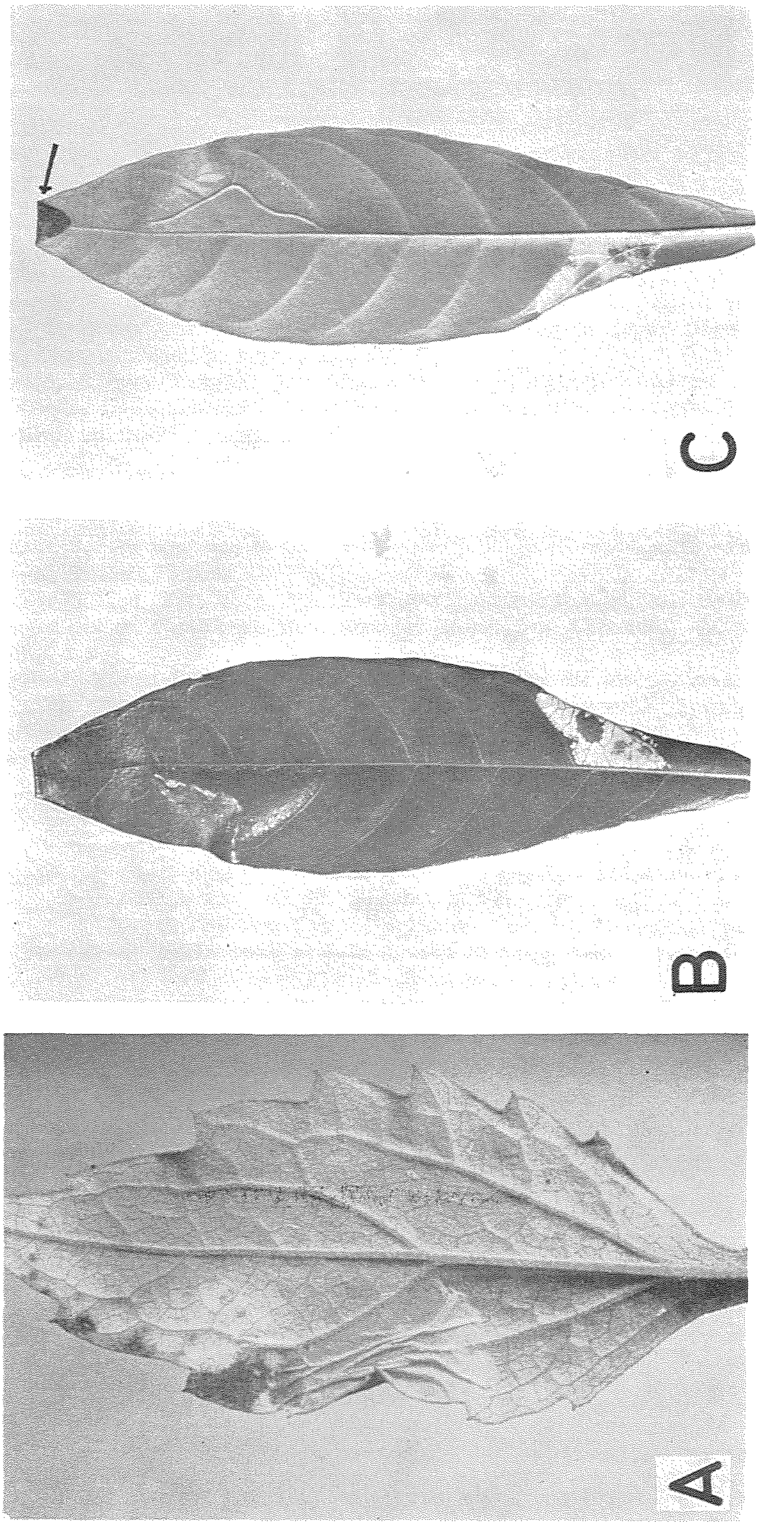
Plate VI

Fig. 19. Leaf mined by larva.

A: *Aster ageratoides* var. *ovatus* (lower side) mined by *Aristaea asteris*, sp. nov. (breeding no. 1311).

B: *Gardenia jasminoides* (upper side) mined by *Systoloneura geometropis* (Meyrick) (breeding no. 1246).

C: Ditto (lower side, arrow showing a spinning site).


A
B
C