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# DESCRIPTIONS OF LARVAE OF GLANDULIFEROUS GROUP OF GALERUCINAE IN JAPAN, WITH NOTES ON SUBDIVISIONS OF THE SUBFAMILY

## (COLEOPTERA : CHRYSOMELIDAE)

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Since the publication of Böving's paper on the larvae of Galerucinae in 1929, no general work in this field has been brought out. On the other hand, taxonomic system of the subfamily based on the adults could not yet be said as settled. Hence an investigation has been made with the purpose not only of enriching our knowledge on the larval stage of the Japanese Galerucinae but also of deriving some clue for reconsideration of taxonomic system of the group. During this investigation I have examined thirty-one species referable to fourteen genera of the Galerucinae including ten species of the glanduliferous group, the members of which have paired defensive glands on the thoracic or abdominal segments. Descriptions of the larvae of these ten species together with a taxonomic revision of the subfamily will be given in this paper. The terminology adopted in this paper is generally the same as that used by Böving (1929) except for tubercles. That of the tubercles is the same as Kimoto's for Chrysomelinae (1962) with slight modifications (see Fig. 12).

Before going further I wish to express my sincere gratitude to Dr. C. Watanabe and to Dr. S. Takagi, both of the Entomological Institute, Hokkaido University, for reading through the manuscript. Thanks are also due to Dr. S. Kimoto, Dr. K. Kurosa, Mr. H. Takenaka and Mr. J. A. Wilcox for their kind help in various ways.

### Larvae of the glanduliferous group

Amongst Japanese Galerucinae, the following genera are included in the glanduliferous group, the members of which have distinct paired defensive glands on the thoracic or abdominal segments in their larval stage: *Agelasa* Motschulsky, *Agelastica* Motschulsky, *Arthrotus* Motschulsky, *Gallerucida* Motschulsky, *Hamushia* Chūjō and *Morphosphaera* Baly. *Sermylassa* Reitter, being represented in our fauna by *S. intermedia* (Jacoby), of which the larva is unknown to me, may be included in the group, because a species of the genus, *S. halensis* (Linné), is glanduliferous in the larval stage as in the other genera mentioned above. The larvae of the species belonging to the group are characterized as follows: Body elongate, somewhat flattened dorso-ventrally, with small head and distinct pygidium; defensive glands in eight to twelve pairs on thoracic or abdominal segments; prothorax with tubercles in *D-DL-EPa* type; meso- and metathorax with five tubercles in dorsal and dorso-lateral regions, *Da*, *Dp*, *DLai*, *DLpi* and *DLe*; abdominal segment with tubercles in dorsal region arranged in three

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transverse rows, *Da*, *Dm* and *Dpi–Dpe*.

Larva living generally on leaves, never under ground; molting twice to attain full growth; pupating under ground.

1) ***Agelasa nigriceps*** Motschulsky, 1860

Last instar larva. Body (Figs. 1 & 2) 10 mm. in length and 2.5 mm. in breadth. Head (Figs. 3 & 4) light brownish; cordal suture short; frontal suture curved; frons weakly depressed medially, with four long and a short setae on each half; vertex with five long and a short setae on each side; labrum (Fig. 5) with anterior margin deeply incised; mandible (Figs. 6 & 7) with five teeth, of which the second to fifth are trapezoid in outline; penicillus composed of a few short setae; lacinia (Fig. 8) undeveloped. Thorax and abdomen yellowish white, each segment with a pair of defensive glands opening as slits in dorso-lateral region; claws (Fig. 10) slender and strongly curved. Prothorax (Fig. 14): defensive gland situated between *D–DL–EPa* (13L)* and *EPp* (2L); *SS–ES* (4L) on both sides united. Meso- and metathorax: *Da* (4L) larger than *Dp* (3L), both transversely oval; *DLpi* (3L) oval, larger than *DLai* (1L); *DLe* (3L4S) largest; the gland situated at the center of *DL* group; *EPa* (2L on mesothorax, 1L on metathorax); *P* (1L) as large as *SS* (1L), both being smaller than *EPp* (1L); *ES* (3S) on both sides united; two weak tubercles present ventrally on intersegmental area of thorax. Abdomen: *Da* (3L) longer and a little narrower than *Dpi* (3L), both being united with the homologous ones on the other side; *Dpe* (1L) larger than *Dm* (1L); *DLai* (2L) as large as *DLp* (2L1S), larger than *DLae* (1L), each of which is oval; the gland situated at the center of *DL* group; spiracle situated postero-laterally to *DLae*, with weak peritreme; *EP* (4L) large and convex; *P* (3L) as large as *PS–SS* (2L); *as 1* appearing secondarily**; *ES* (1L2S) on both sides united; eighth segment with *Dp* (3L); pygidium (30L4S) depressed medially; in fully grown larva, all the tubercles disappearing except for dorsal and dorso-lateral ones, which are sometimes also disappearing.

Pupa. Body (Fig. 66) yellowish white, 7 mm. in length and 4 mm. in breadth; setae long and sparse; vertex (Fig. 75) with three pairs of setae, of which the bases are roundly elevated and tuberculate; prothorax dorsally with nine to thirteen pairs of long setae; meso- and metathorax each dorsally with two pairs of setae; each abdominal segment dorsally with four pairs of setae; ninth segment produced apically into a pair of slender processes, which are inwardly curved and strongly pointed.

Host plants. *Actinidia arguta*.

Specimens examined. Honsyu—Masutomi, Yamanasi, 24-VI-67; Zinba-san, Tokyo, 16-VII-67. Hokkaido—Sapporo, reared from oviposition to pupal stage, VI-66.

Note. Coming out of hibernation in early May, the adult begins to oviposit in late May. The egg is white and oval, clustered together in a mass. The larval stage lasts about a month, molting twice. Near Sapporo the larvae are found in fields till early September. The fully grown larva enters into the soil and pupates there in a cell.

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* Numerals in parentheses show the mean numbers of setae occurring on the tubercles. L, S. M and P mean long, short, minute and pubescent setae respectively.

** 'Primarily' or 'Secondarily' means the tubercle concerned is present in 1st larval instar or appears later.

2) ***Hamushia konishii*** Chūjō, 1956

Last instar larva. Body rather flat, 8 mm. in length and 2 mm. in breadth. Head (Fig. 47) dark brown; cordal suture short; frontal suture short and strongly curved; frons with four pairs of long setae; vertex with five pairs of setae; marginal setae on labrum distinct; mandible (Fig. 65) four-dentate; penicillus composed of about eight setae; lacinia undeveloped. Thorax and abdomen yellowish white, with eleven pairs of defensive glands, ninth abdominal segment lacking the gland; setae short and sparse. Legs dark brown; claws (Fig. 54) slender and strongly curved. Prothorax (Fig. 28): the gland situated between *D-DL-EPa* (10M) and *EPp* (1M); *P* (1M); *SS-ES* (3M) on both sides united. Meso- and metathorax: *Da* (2M) larger than *Dp* (2M); *ad 1* primarily present; *DLpi* (2M) larger than *DLai* (1M); *DLe* (3S1M) convex and largest; the gland situated at the center of *DL* group; *Epa* (1M); *EPp* (1M); *P* (1M) larger than *SS* (1M); *ES* (2M) on both sides united. Each thoracic segment with two weak tubercles ventrally on intersegmental area. Abdomen: *Da* (1M) longer and narrower than *Dpi* (2M), broader than the twice breadth of *Dm* (1M); *ad 1* small, secondarily appearing; *Dpi* (1M), *DLai* (2M) and *DLp* (2M) oval, nearly equal to each other in size; the gland situated at the center of *DL* group; spiracle situated just behind *DLae* (1M), with peritreme; *EP* (3M) convex, larger than *P* (3S); *PS-SS* (2S) larger than *ES* (3S), the latter on both sides united; *as 1* small, secondarily appearing; eighth segment with *Dp* (2M); pygidium (14S) medially depressed.

Pupa. Body (Fig. 69) yellowish white, 6 mm. in length and 3 mm. in breadth; setae long and sparse; vertex (Fig. 79) with two long and a few minute setae on each side; frons with a pair of short setae; prothorax dorsally with about ten pairs of setae; meso- and metathorax dorsally with two pairs of setae respectively; each abdominal segment dorsally with five pairs of long setae; ninth segment produced apically into a pair of slender processes, which are straight and strongly pointed.

Host plants. *Stellaria aquatica.*

Specimens examined. Kyusyu—Hiko-san, Hukuoka, 17-V-67, reared from oviposition to pupal stage.

3) ***Hamushia eburata*** (Harold, 1879)

Last instar larva. The larva of this species resembles that of the preceding species in most characters, but differs from the latter in the following features:

Body rather flat, 8.5 mm. in length and 3 mm. in breadth; head (Fig. 46) light brown except for anterior margin of frons and endocarina dark brown, without ocellus; frontal suture longer, reaching near the base of antenna; labrum with marginal setae finer; claws (Fig. 53) stout; tubercles (Fig. 26) generally larger; abdominal segment with *Dm* large, broader than half the breadth of *Da*; pygidium (16S).

Host plants. *Stellaria aquatica* and *S. monosperma.*

Specimens examined. Honsyu—Tanzawa, Kanagawa, IV-60, H. Takenaka leg.; Takao-san, Tokyo, 12-V-68, reared from oviposition to prepupal stage.

Note. Coming out of hibernation early in April, the adult begins to oviposit in mid May. The eggs are round and orange-yellow in colour, being laid in a mass near the roots of host plants. The egg usually hatches in a week. The larva molts twice and needs about seventeen days to be full-grown. The fully grown larva enters in the soil and pupates.

4) ***Gallerucida lewisi*** (Jacoby, 1885)

Last instar larva. Body 9 mm. in length and 2.5 mm. in breadth. Head (Fig. 43) dark brown; cordal suture short; frontal suture curved; frons with three pairs of long setae; vertex with four pairs of long setae; labrum with anterior margin incised; mandible (Fig. 60) five-dentate, without penicillus; lacinia undeveloped. Thorax and abdomen white, with twelve pairs of defensive glands. Prothorax (Fig. 24): the gland situated between *D–DL–EPa* (9L2M) and *EPp* (1L); a small weak secondary tubercle present antero-laterally to *D–DL–EPa*; *P* (1L); *SS–ES* (1L2S) on both sides united. Meso- and metathorax: *Da* (1L) larger than *Dp* (1L1S); *ad 1* small, primarily present antero-laterally to *Da*; *DLai* (1S) one-third as large as *DLpi* (2L1S); *DLe* (3L1S) largest; the gland situated at the center of *DL* group; *EPa* (2L on mesothorax, 1L on metathorax); *EPp* (1L); *P* (1L); *SS* (1S); *ES* (1L2S) on both sides united; two weak tubercles present ventrally on intersegmental area of thorax, anteriorly to trochantin and to *ES*. Abdomen: *Da* (1S) larger than *Dpi* (1S); *Dm* (1S) slender, longer than *DLpe* (1S); *ad 1* secondarily appearing antero-laterally to *Da*; *DLai* (1L1S) as large as *DLae* (1L), both smaller than *DLp* (1L1S); the gland situated at the center of *DL* group; spiracle situated postero-laterally to *DLae*, with peritreme; *EP* (3L) large and convex; *P* (2L1S); *PS–SS* (1L2S or 2S); *as 1* secondarily appearing anteriorly to *PS–SS*; *ES* (1L2S) on both sides united; eighth segment with *Dp* (2S) larger than *Da*; pygidium (12L).

Pupa. Body (Fig. 72) yellowish white, 8 mm. in length and 4 mm. in breadth; setae long and sparse; vertex (Fig. 77) on each side with three long and one short setae, the bases of which are tuberculate; prothorax dorsally with about nine pairs of setae; meso- and metathorax each dorsally with two pairs of setae; each abdominal segment dorsally with four pairs of setae; ninth segment produced apically into a pair of straight, pointed processes.

Host plants. *Chrysoplenium macrostemon*.

Specimens examined. Honsyu—Takao-san, Tokyo, 12–V–68, reared from oviposition to pupal stage.

Note. The overwintered adult begins to oviposit late in May. The egg is round and orange-yellow in colour, being deposited under the ground in a mass. The egg period takes about ten days. The larva takes about a fortnight and molts twice to become fully grown. Pupation takes place under the ground after two weeks of the prepupal stage.

5) ***Gallerucida flavipennis*** (Solsky, 1872)

Last instar larva. The larva of this species resembles that of the preceding species in most characters, but differs from the latter in the following characters: Body 9 mm. in length and 2.5 mm. in breadth; setae longer; tubercles (Fig. 21) smaller and weakly demarcated, in epipleural to sternal regions nearly disappearing. Prothorax: small secondary tubercle antero-laterally to *D–DL–EPa* (12L), weak, hardly chitinized. Meso- and metathorax: *Da* (4L) larger than *Dp* (1L); *ad 1* absent; *DLe* (5L). Abdomen: *Da* (3L) larger than *Dpi* (2L); *Dm* (1L) shorter than *Dpe* (1L); *ad 1* absent; peritreme very weak; *EP* (4L); pygidium (32L). Fully grown larva with epipleural, pleural and sternal tubercles very weak.

Pupa. Body yellowish white, 8 mm. in length and 4 mm. in breadth; vertex (Fig.

78) with three pairs of long setae; labrum much deeply incised; ninth abdominal segment (Fig. 74) apically produced into a pair of straight pointed processes.

Host plants. *Vitis* sp.

Specimens examined. Honsyu—Takao-san, Tokyo, 31-V-67, reared from oviposition to pupal stage.

Note. The eggs are like those of *G. lewisi*, round and orange-yellow. The pupation takes place under the ground.

6) ***Gallerucida bifasciata*** Motschulsky, 1860

Last instar larva. The larva of this species also resembles that of *G. lewisi*, but differs from the latter in the following characters: Body larger, 13–16 mm. in length and 2.5–3 mm. in breadth. Head (Fig. 41) dark brown; frons largely depressed medially, with a pair of short setae besides three pairs of long setae; labrum with anterior margin much deeply incised. Thorax (Fig. 20) and abdomen weakly elevated and darkened around the glands; tubercles antero-laterally to *D–DL–EPa* (10L3S) primarily present, as large as *SS* on mesothorax. Meso- and metathorax; *Dp* (2L) nearly as large as *Da* (1L); *DLe* (4L). Abdomen: *Dm* (1L) large, as long as *Da* (1L); peritreme as large as *ad 1*; *PS–SS* (4L); pygidium (18L).

Pupa. Body yellowish white, 9.5 mm. in length and 4.5 mm. in breadth; head (Fig. 76) without brownish band; ninth segment (Fig. 75) produced into a pair of curved pointed processes, which are strongly chitinized.

Host plants. *Polygonum cuspidatum* and *P. sachalinense*.

Specimens examined. Honsyu—Zinba-san, Tokyo, 16-VI-67; Mitake, Tokyo, 20-V-66. Hokkaido—Sapporo, VII-65~66; Sibetu, Tesio, 24-VII-66.

Note. The adult comes out of hibernation early in April near Tokyo and late in April near Sapporo. The eggs are similar to those of *G. lewisi*, laid in a mass from May to July, needing about two weeks for hatching. The larval stage lasts for about a fortnight. The pupation takes place under the ground.

Literature. Kurosa, K., 1959: 609.

7) ***Arthrotus niger*** Motschulsky, 1857

Last instar larva. Body 10 mm. in length and 1.5 mm. in breadth. Head (Fig. 40) light brown, without ocellus; cordal suture rather long; frontal suture indistinct; frons with three pairs of setae; occipit triangularly emarginate at posterior margin; vertex with four pairs of setae; labrum with anterior margin not incised; mandible (Fig. 58) five-dentate, without penicillus; lacinia developed. Thorax and abdomen dirty yellowish white, with twelve pairs of defensive glands, of which two pairs are situated on each of meso- and metathorax and the rest situated one on each of first eight abdominal segments; tubercles (Fig. 18) light brown and weak; setae long, some of which are pubescent. Prothorax without defensive gland; *D–DL–EPa* (12PL1S); *EPp* (1PL); trochantin (1PL); *SS–ES* (4S) on both sides united. Meso- and metathorax with two pairs of defensive glands respectively; *Da* (2PL1L) and *Dp* (2PL) united with the homologous ones on the other side; a defensive gland situated at the center of *DL* group; the other gland situated just anteriorly to *DLai* (1PL); *DLpi* (3PL, of which one is longer and stouter); *EPa* (1PL) as large as *EPp* (1PL); *P* (1L); *SS* (1L) large; *ES* (4S) on both sides united; two weak, rather larger tubercles present on inter-

segmental area of thorax anteriorly to trochantin and to *P*. Claws (Fig. 49) not deeply grooved subapically on ventral side. Abdomen: *Da* (1PL1L) longer and narrower than *Dpi* (1PL); *Dm* (1L) smaller than *Dpe* (1 very long PL); *ad 1* small, secondarily appearing; *DLai* (2PL), *DLae* (2PL) and *DLp* (2PL, one of which is longer and stouter) nearly in equal size to each other; the gland situated at the center of *DL* group; spiracle situated antero-laterally to *DLp*, with peritreme; *EP* (4PL, one of which is very long and stout) as large as *P* (4L); *PS-SS* (2L3S) large, as large as *ES* (5S), the latter on both sides united; two weak, rather large tubercles present on intersegmental area, anteriorly to *EP* and to *P*; eighth segment with *Dp* (2PL, one of which is longer and stouter); pygidium (10PL14L); tubercles on ventral side nearly disappearing.

Pupa. Body (Fig. 68) dirty white in colour, 8 mm. in length and 2.5 mm. in breadth; setae long and sparse; vertex (Fig. 71) with three pairs of setae, the bases of which are elevated; prothorax dorsally with about twelve pairs of setae; meso- and metathorax dorsally with two pairs of setae respectively; each abdominal segment dorsally with about four pairs of setae; ninth segment ending in subquadrate apex with eight setae.

Host plants. *Alnus hirsuta* and *A. japonica*.

Specimens examined. Honsyu—Mt. Amagi-san, Sizuoka, 17-V-66; Takao-san, Tokyo, V-67, reared from oviposition to pupal stage.

Note. The adult comes out of hibernation in April and begins to oviposit in mid May. The eggs are round and yellow, being laid under the ground in a mass composed of twenty to eighty ones. The larva appears after a week or so and seems to live on the surface of the ground. The larva takes about three weeks to become fully grown through two molts. After a week of the prepupal stage, the larva pupates under the ground in a cell. The range of food plants in the adult stage seems rather wide, the adult having been found to feed on *Lespedeza* sp., *Quercus* sp. and *Alnus* spp.

8) ***Agelastica coerulea*** Baly, 1874

Last instar larva. Body 12 mm. in length and 2.5 mm. in breadth. Head (Fig. 39) dark brown with both clypeus and labrum yellowish anteriorly; cordal suture rather long; frontal suture strongly curved; endo-carina indistinct anteriorly; frons medially depressed, with three pairs of setae; vertex with five pairs of setae; mandible four-dentate, without penicillus; lacinia developed. Thorax and abdomen dark brown dorsally, yellowish white ventrally, each of first eight abdominal segments with a pair of defensive glands surrounded by *DLa* and *DLp*. Prothorax (Fig. 16): *D-DL-EPa* (13L8S) depressed medially; *EPp* (1L) smaller than *P* (1L); large *SS-ES* (3S) on both sides united. Meso- and metathorax: *Da* (1L2S) nearly as long as *Dp* (2L3S); *DLae* (3S) smaller than *DLpi* (2L); *DLe* (5L2-3S) convex and largest; *EPa* (6S) as large as *DLpi*; *EPp* (1S); *SS* (1S) hardly chitinized; *P* (1S); *ES* (1S2-3M) on both sides united; several minute setae present in sternal region. Abdomen: *Dai* (2L3S) a little longer than *Dpi* (2L3S); *ad 1* (1S) small and weak, secondarily appearing antero-laterally to *DLa*; *Dpi* (1L) small, as large as *Dm* (1S); *DLa* (2L1S) as large as *DLp* (2L2S); spiracle situated just exteriorly to the gland; *EP* (6L) as large as *P* (2L3S); ventral side with about twenty short setae, the bases of which are sometimes tuberculate; posterior segments sometimes with *PS-SS, as 1* and *ES* developed; eighth segment with *Dp* (4L) larger than *Dai*; pygidium (18L8S).

Pupa. Body (Fig. 67) yellowish white, 7 mm. in length and 3 mm. in breadth; frons (Fig. 70) with a pair of setae, the bases of which are elevated; vertex with three or four pairs of setae; labrum with anterior margin deeply notched; prothorax dorsally with eleven to fourteen pairs of setae, the bases of which are elevated; mesothorax with four and metathorax with three pairs of setae dorsally, on either segment two mesalmost setae on each side being situated on a small tubercle; each abdominal segment dorsally on each side with four long and a few short setae, the bases of which are tuberculate; spiracle visible on first six segments, on sixth segment vestigial; ninth segment quadrate at apex, with a pair of slender processes, which are curved inwardly at apex and strongly pointed.

Host plants: *Alnus hirsuta* and *Alnus* spp.

Specimens examined. Honsyu—Mt. Amagi-san, Sizuoka, 17-V-66, reared from oviposition to prepupal stage; Sayama, Tokyo, 11-VI-67 and 20-VI-68; Takao-san, Tokyo, 29-V-68.

Note. This species overwinters under the ground in the stage of adult. Coming out of hibernation, the adult soon begins to oviposit in April. The eggs are round and white in colour and laid in a mass on the leaf-surface, needing about ten days to hatch. The larvae are gregarious on leaves and take twenty to thirty days to become fully grown. The pupation takes place under the ground. The larva of this species may be distinguished from that of *A. alni* Linné (Böving, 1929; 38) by *EPa* which is well developed and provided with six short setae on the meso- and metathorax and by the sternal region with many minute setae.

9) ***Morphosphaera coerulea*** (Schönfeldt, 1890)

Last instar larva. Body subcylindrical, 13 mm. in length and 3 mm. in breadth. Head (Fig. 44) dark brown, with a pair of ocelli; cordal suture rather long; frontal suture strongly curved; frons a little depressed medially, with two pairs of long setae; vertex with about four pairs of long setae; labrum membranous anteriorly, with anterior margin entire; mandible (Fig. 64) four-dentate, without penicillus, first teeth being small and indistinct; lacinia not fully developed, being represented by a few stout setae intero-basally to galea. Thorax and abdomen yellowish white; each of first eight abdominal segments with a pair of defensive glands surrounded by *DLa* and *DLp*. Legs blackish brown with stout claws. Prothorax (Fig. 31): *D-DL-EPa* (9L2S) separated from *D-DL-EPa* on the other side by distinct median line; *EPp* (1L) smaller than *P* (1L); large *SS-ES* (2L) on both sides united. Meso- and metathorax: *Da* (1L) a little smaller than *Dp* (2L); *ad 1* secondarily appearing antero-laterally to *Da*; *DLai* (2L2S) smaller than *DLpi* (2L); *DLe* (3L2-3S) convex and largest; *EPa* (2L1S) nearly united with peritreme of mesothoracic spiracle; *EPp* (1L); *SS* (1S); *ES* (1L) on both sides united; a small secondary tubercle (1S) present antero-laterally to *ES*; each thoracic segment with a small tubercle anteriorly to trochantin. Abdomen; *Da* (1L) much longer and narrower than *Dpi* (1L), separated from *Da* on the other side; *Dm* (1L) about half as wide as *Dpe* (1L); anterior portion of *DLa* (2L2-3M) sometimes isolated in a small round tubercle; *DLp* (2L2-3S) medially constricted; *EP* (4L1S) larger than *P* (2L2S); *PS-SS* (2L3S) as large as *Dm*; *ES* (1S) round and small, separated from *ES* on the other side; *as 1* small, primarily present anteriorly to *PS-SS*; eighth segment with *D* (2L) and with *ES* on both sides united; pygidium (14L).

Pupa. I could not examine complete specimens of the pupa, and only the following characters are available:

Prothorax dorsally with about eight pairs of setae; meso- and metathorax each with two pairs of setae dorsally; each abdominal segment with three long and a short setae dorsally on each side; all those setae situated on round elevated tubercles; spiracle visible on first five segments; ninth segment with a pair of stout processes, which are acutely curved inwardly at the apex.

Host plants. *Ficus erecta.*

Specimens examined. Ryukyu Is. —Sinmura and Yuwan, Amami-Osima, 3~5-V-67.

Note. In early May, both adults and larvae were found on the host plant, the adults laying round yellow eggs.

10) ***Morphosphaera japonica*** (Hornstedt, 1788)

Last instar larva. The larva of this species resembles that of the preceding species in most characters, but differs from the latter in the following characters: Body 11 mm. in length and 3 mm. in breadth; head (Fig. 45) rather light brownish; frons with three pairs of setae; clypeus much narrower, almost wholly chitinized; labrum with anterior margin straight; mandible (Fig. 65) with first teeth stronger; lacinia represented by four sword-like setae; tubercles, especially of ventral side, generally weak; prothorax (Fig. 29) with *D-DL-EPa* (10L5S) wholly disappearing, leaving irregular dark patches in fully grown larva; meso- and metathorax without *ad 1*, and with *SS* and *ES* disappearing; abdomen with *Dp* narrower than the twice breadth of *Dm*; *DLa* (2L) and *DLp* smaller and rather quadrate in shape; pygidium (20L).

Host plants. *Ficus nipponica.*

Specimens examined. Kyusyu—Saiki, Oita, V-57, K. Kurosa leg.

Literature. Kurosa, K., 1959: 508

**Key to the species based on the larvae**

1. Larva with paired defensive glands on thoracic or abdominal segments; abdominal segments with *Dm*. . . . . Glanduliferous group 2
- Larva without such defensive glands; abdominal segments with or without *Dm*. . . . . Non-glanduliferous group
2. Larva with paired defensive glands on thoracic and abdominal segments. . . . . 3
- Larva with paired defensive glands only on abdominal segments. . . . . 9
3. Larva with a pair of defensive glands on each of three thoracic and eight or nine abdominal segments. . . . . 4
- Larva with two pairs of defensive glands on each of meso- and metathorax, one pair on each of first eight abdominal segments. . . . . *Arthrotus niger*
4. Larva with setae extremely short; tubercles generally narrower; ninth abdominal segment without defensive glands. . . . . 5
- Larva with setae longer; tubercles broader; ninth abdominal segment with paired defensive glands. . . . . 6
5. Larva without ocellus; frontal suture longer, reaching near the base of antenna; abdominal segment with *Da* narrower than the twice breadth of *Dm*. . . . . *Hamushia eburata*
- Larva with a pair of ocelli; frontal suture short and strongly curved; abdominal segment with *Da* broader than the twice breadth of *Dm*. . . . . *Hamushia konishii*
6. Larva with ventral tubercles weak, nearly disappearing in fully grown larva, dorsal ones

sometimes disappearing; meso- and metathorax without *ad 1*. . . . . 7
- Larva with all tubercles well chitinized; meso- and metathorax with distinct *ad 1*. . . . . 8

7. Larva without a small tubercle antero-laterally to *D-DL-EPa* on prothorax; abdomen with *Dm* nearly as long as *Dpe*, with *Da* and *Dpi* always united with the homologous ones on the other side; all the tubercles sometimes disappearing. . . . . *Agelasa nigriceps*
- Larva with tubercles generally weakly demarcated; prothorax with such tubercle; abdomen with interior parts of *Da* and *Dpi* weak or disappearing; *Dm* shorter than *Dpe*. . . . . *Gallerucida flavipennis*

8. Body larger, 13–16 mm. in length; prothorax with a small tubercle situated antero-laterally to *D-DL-EPa*, as large as *SS* on mesothorax; abdomen with *Dm* as long as *Da*; *ES* on both sides combined together, distinctly larger than *PS-SS*. . . . . *Gallerucida bifasciata*
- Body smaller, 8–9 mm. in length; the tubercle on prothorax smaller; abdomen with *Dm* shorter than *Da*; *ES* on both sides combined together, slightly larger than *PS-SS*. . . . . *Gallerucida lewisi*

9. Body yellowish white in colour; setae shorter and sparser; abdomen with *Da* separated from *Da* on the other side; *Dpe* large, distinctly larger than *Dm*; sternal region with tubercles. . . . . 10
- Body rather strongly chitinized, dorsally blackish in colour; setae long and rather dense; abdomen with *Da* and *Dpi* united with the homologous ones on the other side; *Dpe* small, nearly as small as *Dm*; sternal region with many short setae, with *ES* disappearing. . . . . *Agelastica coerulea*

10. Body with tubercles generally weaker; prothorax with *D-DL-EPa* wholly disappearing; meso- and metathorax without *ad 1*; abdomen with *Dpe* narrower than the twice breadth of *Dm*; *DLa* and *DLp* rather quadrate in shape. . . . . *Morphosphaera japonica*
- Prothorax with *D-DL-EPa* not disappearing; meso- and metathorax with *ad 1*; abdomen with *Dm* about half as wide as *Dpe*; *DLa* and *DLp* not quadrate in shape. . . . . *Morphosphaera coerulea*

## Taxonomic note on the subfamily

In the preceding lines, descriptions of Japanese glanduliferous larvae of Galerucinae are given. The followings will be devoted to a taxonomic note on the subfamily Galerucinae chiefly on the basis of the larvae of Japanese species including both glanduliferous and non-glanduliferous groups. As in Chrysomelinae, the arrangement of the tubercles and the defensive glands are found most useful in classifying the larvae. The major differences in the tubercle types are as follows:

TABLE 1. Groups of larvae in Galerucinae.

| Features \ Groups | | Glanduliferous group | | | Non-glanduliferous group | |
|---|---|---|---|---|---|---|
| | | I | II | III | IV | V |
| Abdomen | *Dm* | present | | | | absent |
| | *DL* group | *DLai, DLae, DLp* | | *DLa, DLp* | *DLai, DLae, DLp* | |
| Prothoracic shield | | *D-DL-EPa* | | | | *D-DL* |
| Defensive glands | abdomen | 8 or 9 pairs | | 8 pairs | absent | |
| | meso- & metathorax | 2 pairs | 4 pairs | absent | | |
| | prothorax | 1 pair | absent | | | |

Prothorax: Prothoracic shield composed of *D*, *DL* and *EPa* (*D–DL–EPa* type) or *D* and *DL* (*D–DL* type). Meso- and metathorax without marked differences. Abdomen: dorsal tubercles composed of two or three rows on account of an extra tubercle *Dm*; *DL* group is composed of two (*DLa* and *DLp*) or three (*DLai*, *DLae* and *DLp*) tubercles.

With regard to the defensive glands, there are also marked diversities among species, that is their presence or absence, number and situation. When these characters are considered together, the larvae examined fall into the following five groups (Table 1).

**Group I.** In this group the genera *Agelasa* Motschulsky, *Gallerucida* Motschulsky, *Hamushia* Chūjō and *Sermylassa* Reitter are included, being characterized by the following characters:

Larva with twelve or eleven pairs of defensive glands, each pair situated on each of twelve or first eleven segments; prothorax with tubercles in *D–DL–EPa* type; abdomen with tubercles on dorsal region composed of three rows, *Da*, *Dm* and *Dpi–Dpe*; head with lacinia undeveloped.

Pupa with ninth abdominal segment produced apically into a pair of strong processes.

Larva living on foliage, molting twice to attain full growth; pupation under ground.

Published species. *Agelasa nigriceps* Motschulsky; *Gallerucida bifasciata* Motschulsky; *G. lewisi* (Jacoby); *G. flavipennis* (Solsky); *Hamushia konishii* Chūjō; *H. eburata* (Harold); *Sermylassa halensis* (Linné) (Paterson, 1931: 905; Böving, 1929: 35).

**Group II.** This group includes a single genus, *Arthrotus* Motschulsky, which is characterized by the following characters:

Larva with twelve pairs of defensive glands, two pairs of which are on each of the meso- and metathorax and one pair on each of first eight abdominal segments; prothorax with tubercles in *D–DL–EPa* type; abdomen with tubercles of dorsal region composed of three rows, *Da*, *Dm* and *Dpi–Dpe*; dorsal to epipleural tubercles with particular pubescent setae; head with lacinia developed.

Pupa with ninth abdominal segment subquadrate at apex, without apical processes.

Larva very active, perhaps living on ground and feeding on fallen leaves; molting twice to attain full growth; pupation under ground.

Published species. *Arthrotus niger* Motschulsky.

**Group III.** In this group the genera *Agelastica* Motschulsky and *Morphosphaera* Baly are included, being characterized as follows:

Larva with eight pairs of defensive glands surrounded by *DLa* and *DLp* on each of first eight abdominal segments; prothorax with tubercles in *D–DL–EPa* type; abdomen with tubercles of dorsal region composed of three rows, *Da*, *Dm* and *Dpi–Dpe*; head with lacinia developed.

Pupa with ninth abdominal segment produced apically into a pair of slender processes.

Larva living on foliage, molting twice to attain full growth; pupation under ground.

Published species. *Agelastica coerulea* Baly; *A. alni* (Linné) (Böving, 1927: 38); *Morphosphaera coerulea* (Schönfeldt); *M. japonica* (Hornstedt).

**Group IV.** In this group the following genera are included: *Aulacophora* Mots-

chulsky, *Atrachya* Dejean, *Fleutiauxia* Laboissière, *Paridea* Baly, *Acalymma* Barber, *Calomicrus* Stephens, *Cerotoma* Chevrolat, *Diabrotica* Chevrolat, *Exosoma* Jacoby, *Luperus* Geoffroy, and *Phyllobrotica* Chevrolat. The genus *Scelolyperus* Crotch, of which the larva is figured by Wilcox (1965 : 209), may be included in this group. The group is characterized as follows:

Larva without defensive glands; prothorax with tubercles in *D–DL–EPa* type; abdomen with tubercles of dorsal region composed of three rows, *Da*, *Dm* and *Dpi–Dpe*; tubercles weak or disappearing among the species living under ground, leaving three rows of primary setae; head with lacinia developed.

Pupa with ninth abdominal segment produced posteriorly into a pair of slender processes.

Larva living under ground or on foliage, molting twice to attain full growth; pupation under ground.

Published species. *Aulacophora femoralis* Motschulsky; *A. nigripennis nigripennis* Motschulsky; *Atrachya menetriesi* (Faldermann); *Fleutiauxia armata* (Baly); *Paridea angulicollis* Motschulsky; *Exosoma lustanica* (Linné) (Peterson, 1951 : 154–156; Böving & Craighead, 1930 : 308; Mayet, V., Bull. Soc. ent. Fr., 1907 : 145); *Luperus rufipes* Scopoli (Paterson, 1931 : 995); *L. luperus* Sulzer (Laboissière, 1934 : 26); *L.* (*Calomicrus*) *circumfusus* Marshal (Laboissière, 1934 : 26); *Phyllobrotica quadrimaculata* (Linné) (Böving, 1927 : 200); *Diabrotica duodecimpunctata* (Fabricius), *D. sorer* LeConte, *D. balteata* LeConte, *D. longicornis* (Say) and *D. vittata* (Fabricius) (Böving, 1927 : 193–200); *D. unidecimpunctata howardi* Barber (Peterson, 1951 : 156); *Acalymma vittata* Fabricius (Peterson, 1951 : 156); *Cerotoma trifurcata* Forster (Böving, 1930 : 51–58).

**Group V.** In this group the following genera are included: *Galeruca* Geoffroy, *Galerucella* Crotch, *Lochmaea* Weise, *Pyrrhalta* Joannis, *Oides* Weber, *Periclitena* Crotch, *Arima* Chapuis, *Monoxia* LeConte, *Monocesta* Clark and *Trirhabda* LeConte.

The genus *Schematiza* Guerin, of which the larva is described by Simonds (1949, Can. Ent. 81 : 275), may be placed in this group. The inclusion of the genus *Oides* Weber is rather tentative: the larva of *O. bowringii* Baly is characterized by *DLpi* divided into two small tubercles on abdomen besides the common features of the group. The group is characterized as follows: Larva without defensive glands; prothorax with tubercles in *D–DL* type; abdomen without *Dm*, tubercles of dorsal region composed of two rows, *Da* and *Dpi–Dpe*; head with lacinia developed.

Pupa with or without ninth abdominal processes, which are sometimes vestigial.

Larva living on foliage except for *Monoxia consputa* mining inside the leaves of *Chenopodium* spp., molting twice to attain full growth; pupation generally under the ground except in *Galerucella*, of which the species pupate on leaf-surface like those of *Chrysomela* group in Chrysomelinae.

Published species. Many species belonging to *Galeruca*, *Galerucella*, *Lochmaea* and *Pyrrhalta* are described, which are found in the literature cited in this paper. *Galeruca extensa* Motschulsky; *G. dahli japonica* Weise; *Galerucella nipponensis* Laboissière; *G. grisescens* Geoffroy; *Lochmaea capreae* (Linné); *Pyrrhalta semifulva* (Jacoby); *P. fuscipennis* (Jacoby); *P. annulicornis* (Baly); *P. seminigra* (Jacoby); *P. maculicollis* (Motschulsky); *P. humeralis* (Chen); *P. lineola* (Fabricius); *Pyrrhalta tibialis* (Baly); *Oides bowringii* Baly; *Periclitena vigorsi* Hope (Maulik, 1936 : 35); *Arima marginata* Laboissière (Laboissière, Bull. Soc. ent. Fr. 1935 : 176); *Monoxia consputa*

LeConte (Böving, 1929: 28); *Monocesta coryli* Baly (Böving, 1929: 10); *Trirhabda canadensis* Kirby, *T. virgata* LeConte, *T. brevicollis* LeConte, *T. nitidicollis* LeConte, *T. tomentosa* Linné and *T. attenuata* Say (Böving, 1929: 12–15).

Several attempts to divide this large subfamily on the basis of the adults have been made by Chapuis (1875), Weise (1924), Laboissière (1934), Gressitt & Kimoto (1963) and recently by Wilcox (1965). Reading through those works, I have found no agreement on the subject among authors. For example Weise regarded the characteristics of claws as of first importance, with four groups resulting from this procedure, then he subdivided them according to the condition of the anterior coxal cavities. With this procedure he got seven groups, which were treated as tribes. Laboissière divided the subfamily into two tribes on the basis of the structure of the head and the last visible abdominal sternite in the male, then subdivided these tribes into nine subtribes according to the nature of the claws. Gressitt & Kimoto, working on the Chinese species, accepted four tribes, Galerucini, Gallerucidini, Luperini and Capulini, which roughly correspond to Laboissière's Galerucini, Hyalspina (subtribe of Luperini) and Luperini (excluding Hylaspina), respectively; the tribe Capulini was originally erected by Ogloblin (1936) for the single genus *Capula* Jacobson. Gressitt & Kimoto's divisions disagree with Laboissière's in the subdivisions of the Luperini. Their subdivisions of the Luperini are based chiefly on the combination of the characters of the anterior coxal cavities and the claws. The divisions proposed by Wilcox (1965 and in press), which are based chiefly on the male genital characters, are quite different. His system may be summarized as follows: Tribe Oidini; Tribe Galerucini with five sections; Tribe Metacyclini; Tribe Sermylini with five sections; Tribe Agelasticini; Tribe Luperini with eight subtribes and fifteen sections. His system agrees rather well with my grouping based on the larval characters as given below:

| | |
|---|---|
| Tribe Sermylini | **Glanduliferous group** |
| Section Sermylites, Hylaspites | Group I |
| Section Antiphites | Group II |
| Section Bonesiites, Tribe Agelasticini | Group III |
| | **Non-glanduliferous Group** |
| Tribe Luperini | Group IV |
| Tribe Galerucini | Group V |
| Tribe Oidini | (Genus *Oides* Weber) |

The major difference lies in the group III, of which two genera *Agelastica* Motsch. and *Morphosphaera* Baly are placed in two different tribes by Wilcox. In my opinion the similarity between the larvae of *Agelastica* species (*coerulea* Baly and *alni* L.) and *Morphosphaera* species (*coerulea* Schönfeldt and *japoncia* Hornstedt) is close beyond doubt, so the two genera should be included together in Sermylini. I have no idea concerning the status of *Sermylassa* Reitter, of which the larva is unknown to me; however, the larva of *S. halensis* L. seems to have no marked differences from those of group I. I have not enough materials to discuss with regard to the subdivisions in other tribes. In conclusion, the differences are not so great as to deny a general agreement between Wilcox's opinion and mine, and future discoveries of the larvae of many other species, especially of Luperini, will improve, and give support to, his system.

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## EXPLANATION OF PLATES

**Plate 1.** Fully grown larva of *Agelasa nigriceps.*

Figs. 1 & 2, dorsal & ventral views of larva (py.: pygidium); Figs. 3 & 4, dorsal & ventral views of head capsule (ant.: antenna; cl.: clypeus; cs.: cordal suture; ec.: endo-carina; fr.: frons; fs.: frontal suture; lb: labrum; oc.: ocellus; vt.: vertex); Fig. 5, clypeus & labrum; Figs. 6 & 7, lateral & buccal views of right mandible (pn.: penicillus); Fig. 8, maxilla, labium & mentum (ca.: cardo; ga.: galea; lm.: labium; lp.: labial palpus; mp.: maxillary palpus; mt.: mentum; os.: oesophagus; pf.: palpifer; sl.: superlingae; st.: stipes); Fig. 9, epipharynx; Fig. 10, posterior view of mesothoracic leg (cl.: claw; co.: coxa; fe.: femur; pu.: pulvillus; ti.: tibia; tr.: trochanter); Fig. 11, pygidium.

**Plate 2.** Tubercles of larvae.

Fig. 12, nomenclature of tubercles (Böving's nomenclature in parentheses), above: prothorax; middle: mesothorax; bottom: 2nd abdominal segment. *Da* (interior prescutal sclerite); *Dp* (interior scuto-scutellar one); *Dm* (scutal one); *Dpi* (interior scutellar one); *Dpe* (exterior scutellar one); *DLai* (exterior prescutal one); *DLpi* (exterior scuto-scutellar one); *DLae* (anterior parascutal one); *DLp* (posterior parascutal one); *DLe* (alar one); *EP* (epipleural one); *EPa* (spiracular or anterior parascutal one); *EPp* (epipleural one); *P* (post hypopleural one); tr. (prehypopleural one): trochantin; *SS* (sternellar one); *ES* (eusternellar one); *PS-SS* (sternellar one); sp.: spiracle; g.: defensive glands.

First instar & fully grown larvae of: Figs. 13 & 14, *Agelasa nigriceps*; Figs. 15 & 16, *Agelastica coerulea*; Figs. 17 & 18, *Arthrotus niger*; Figs. 19 & 20, *Gallerucida bifasciata.*

**Plate 3.** Tubercles of 1st instar & fully grown larvae of:

Figs. 21 & 22, *Gallerucida flavipennis*; Figs. 23 & 24, *G. lewisi*; Figs. 25 & 26, *Hamushia eburata*; Figs. 27 & 28, *H. konishii*; Fig. 29, *Morphosphaera japonica* (fully grown larva).

**Plate 4.** Tubercles of 1st instar & fully grown larvae of:

Figs. 30 & 31, *Morphosphaera coerulea*; Fig. 32, *Sermylassa halensis* (last instar larva, redrawn from Peterson, 1931); Figs. 33 & 34, *Aulacophora femoralis*; Figs. 35 & 36 *Pyrrhalta maculipennis*; Figs. 37 & 38, *Oides bowringii.*

**Plate 5.** Head capsule of:

Fig. 39, *Agelastica coerulea*; Fig. 40, *Arthrotus niger*; Fig. 41, *Gallerucida bifasciata*; Fig. 42, *G. flavipennis*; Fig. 43, *G. lewisi*; Fig. 44, *Morphosphaera coerulea*; Fig. 45, *M. japonica.*

**Plate 6.** Head capsule of:

Fig. 46, *Hamushia eburata*; Fig. 47, *H. konishii.*

Tibia of mesothoracic leg of:

Fig. 48, *Agelastica coerulea*; Fig. 49, *Arthrotus niger*; Fig. 50, *Gallerucida bifasciata*; Fig. 51, *G. lewisi*; Fig. 52, *G. flavipennis*; Fig. 53, *Hamushia eburata*; Fig. 54, *H. konishii*; Fig. 55, *Morphosphaera coerulea*; Fig. 56, *M. japonica.*

Right mandible (left: lateral view, right; buccal view) of:

Fig. 57, *Agelastica coerulea*; Fig. 58, *Arthrotus niger*; Fig. 59, *Gallerucida bifasciata*; Fig. 60, *G. lewisi*; Fig. 61, *G. flavipennis*; Fig. 62, *Hamushia eburata*; Fig. 63, *H. konishii*; Fig. 64, *Morphosphaera coerulea*; Fig. 65, *M. japonica.*

**Plate 7.** Pupa of:

Fig. 66, *Agelasa nigriceps*; Fig. 67, *Agelastica coerulea*; Fig. 68, *Arthrotus niger*; Fig. 69, *Hamushia konishii.*

Pupal head of:

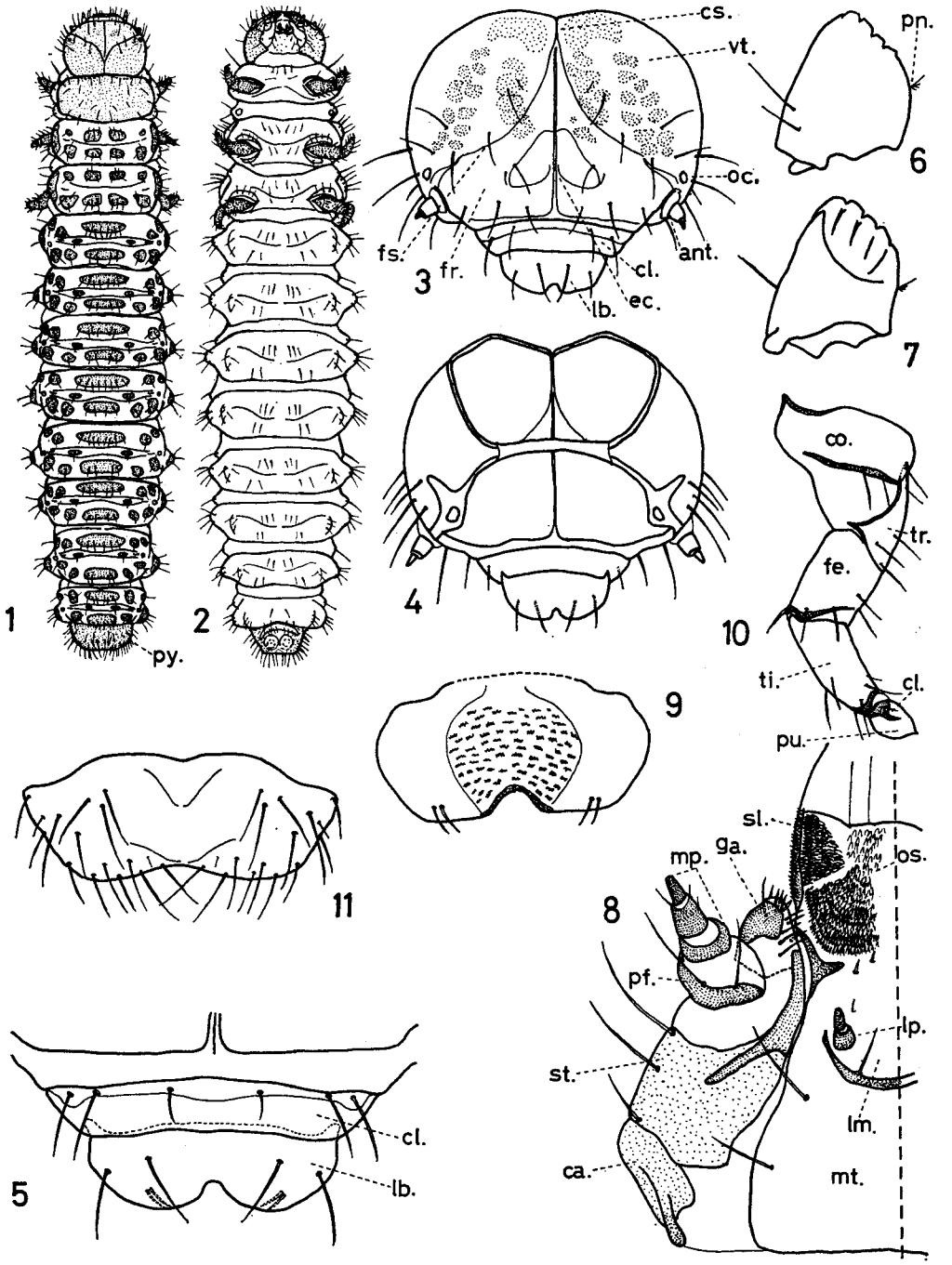
Fig. 70, *Agelastica coerulea*: Fig. 71, *Arthrotus niger.*

**Plate 8.** Pupa of:

Fig. 72, *Gallerucida lewisi*; 6th to 9th abdominal segments of: Fig. 73, *G. bifasciata*; Fig. 74, *G. flavipennis.*

Pupal head of:

Fig. 75, *Agelasa nigriceps*; Fig. 76, *Gallerucida bifasciata*; Fig. 77, *G. lewisi*; Fig. 78, *G. flavipennis*; Fig. 79, *Hamushia konishii.*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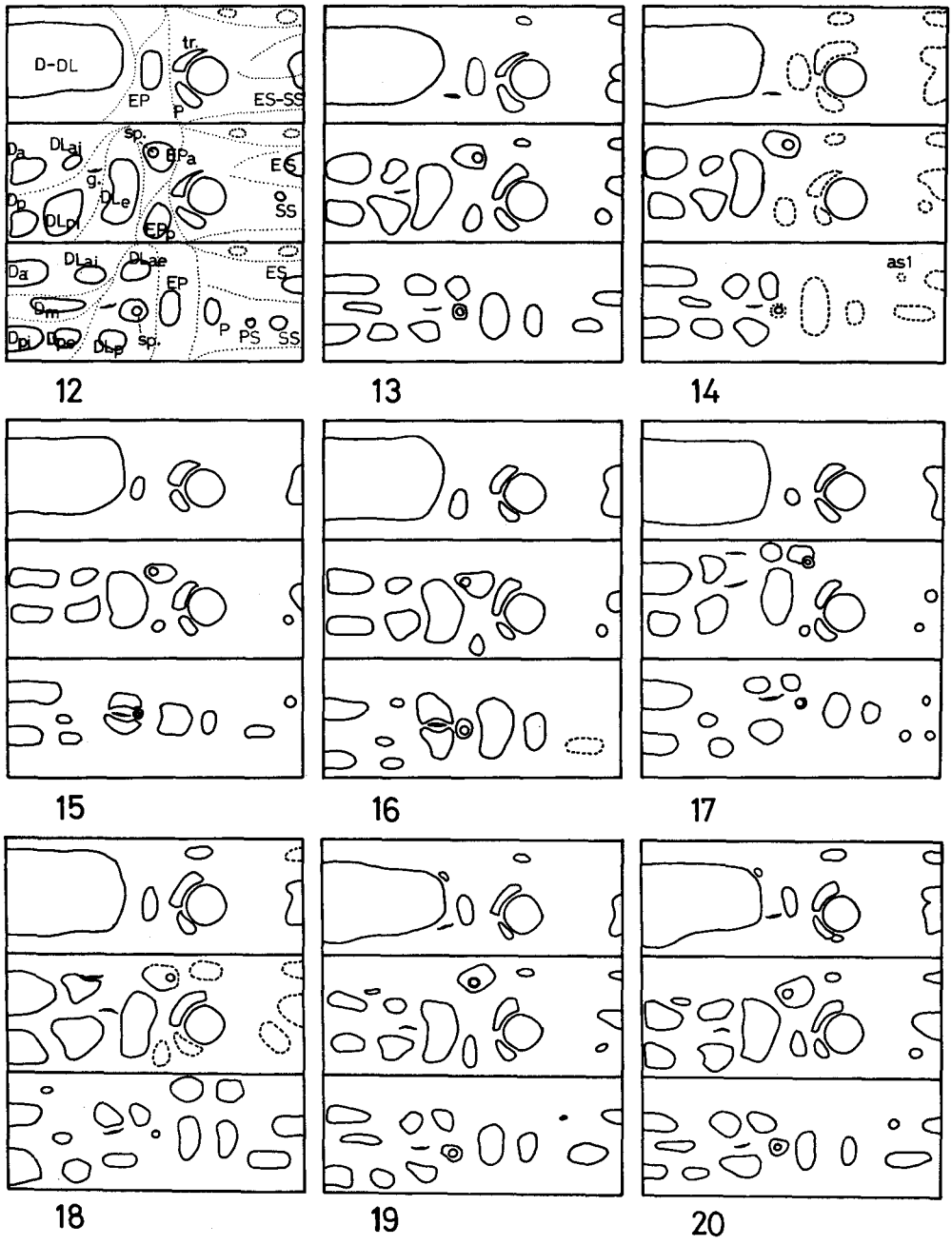
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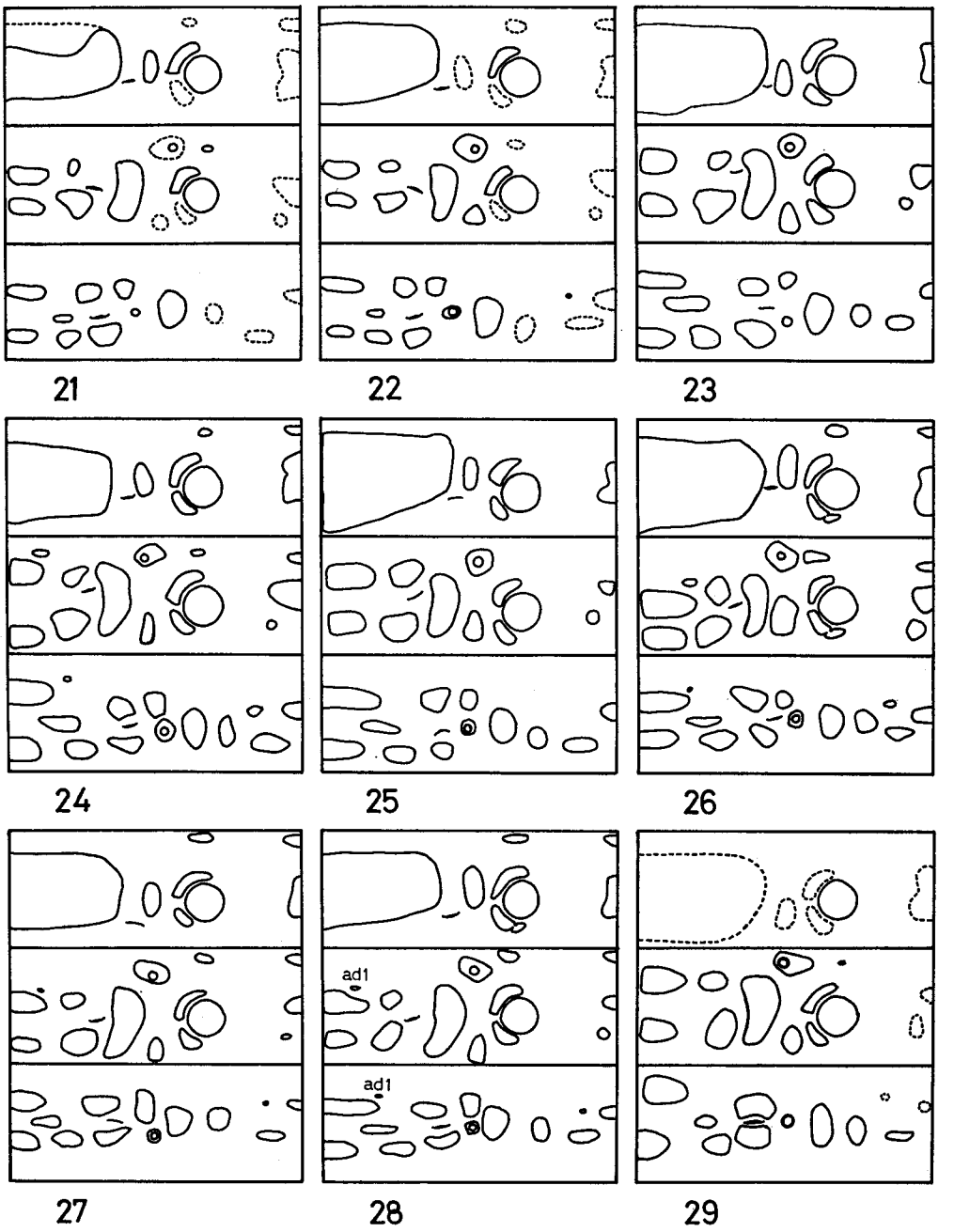
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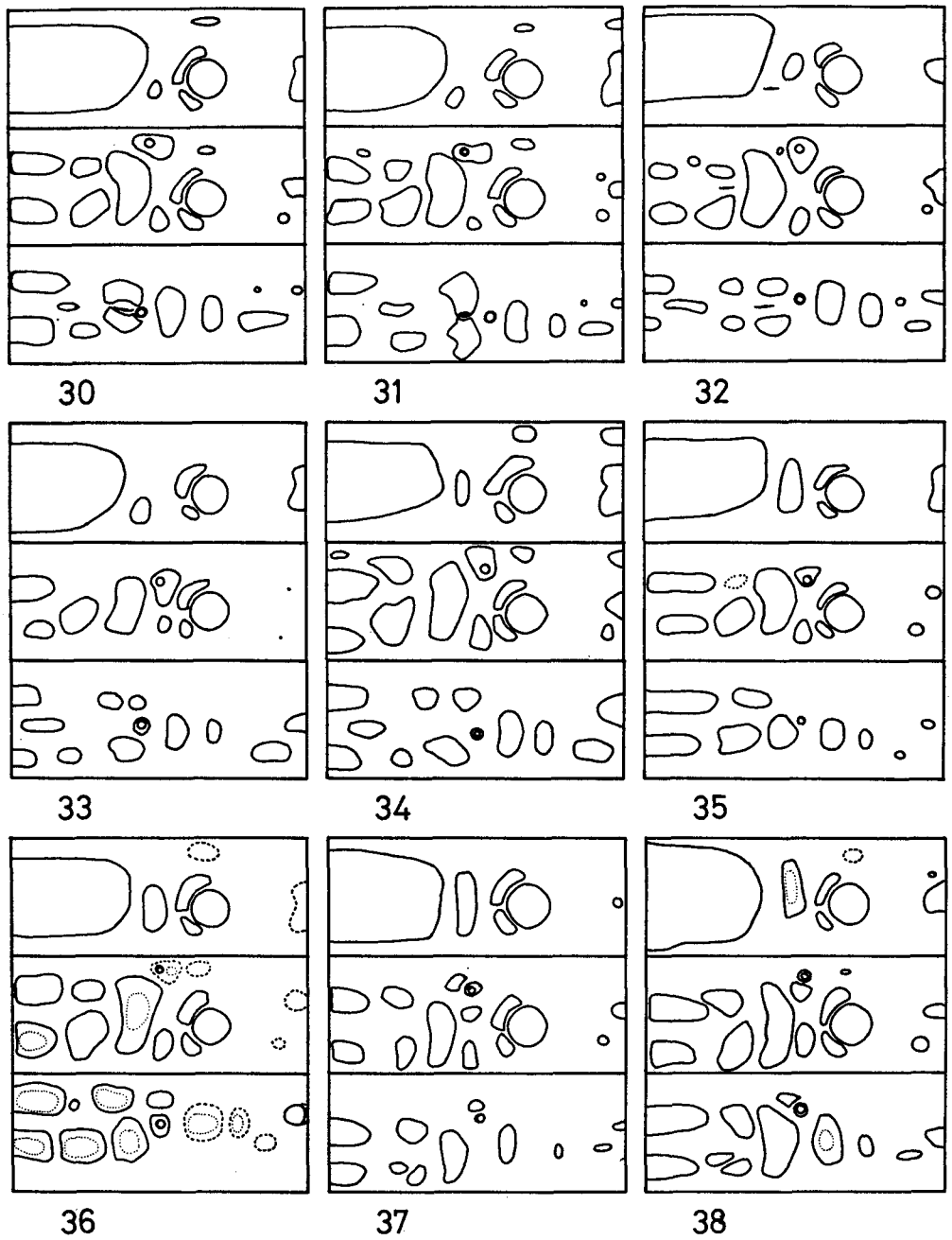
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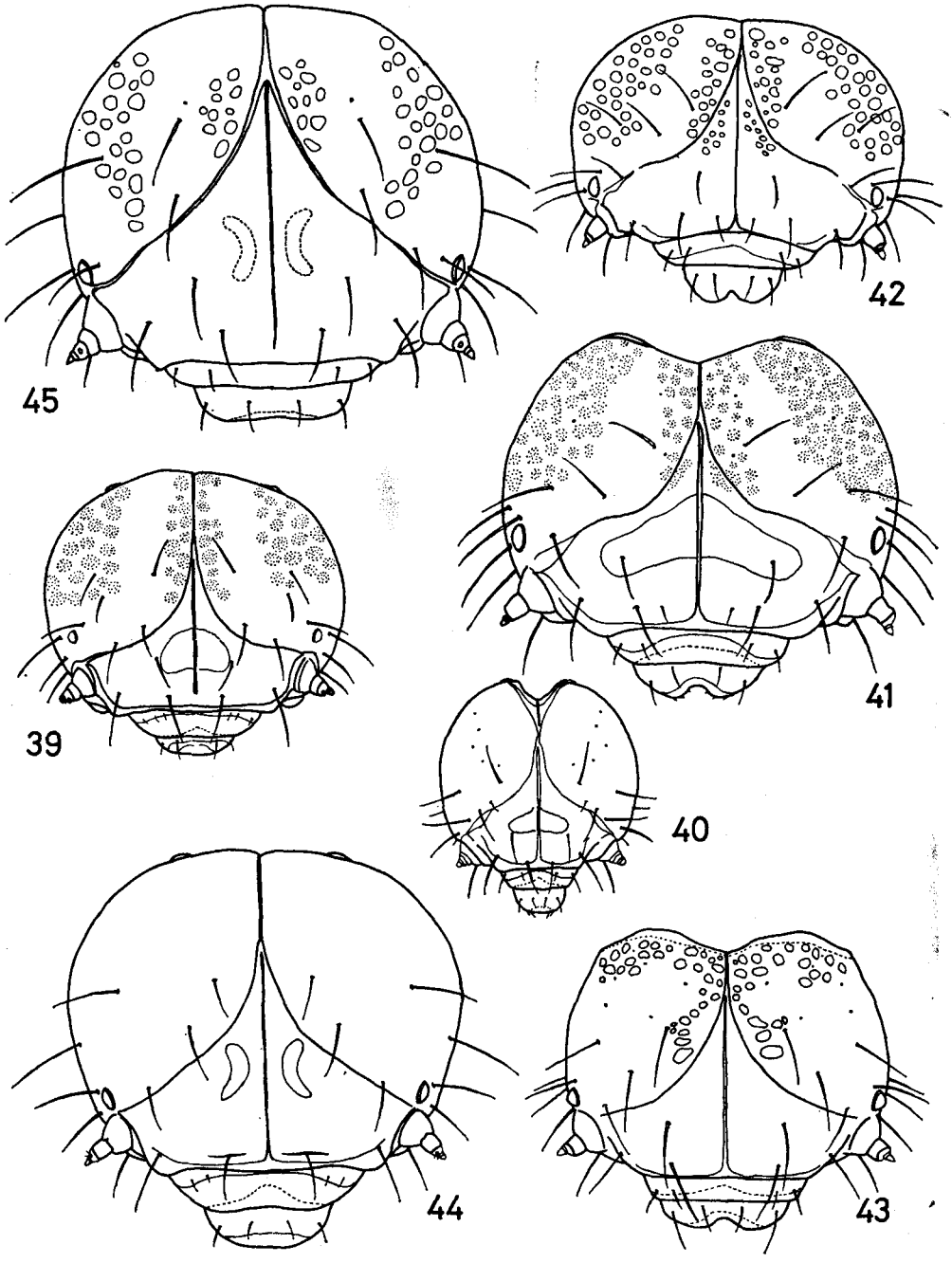
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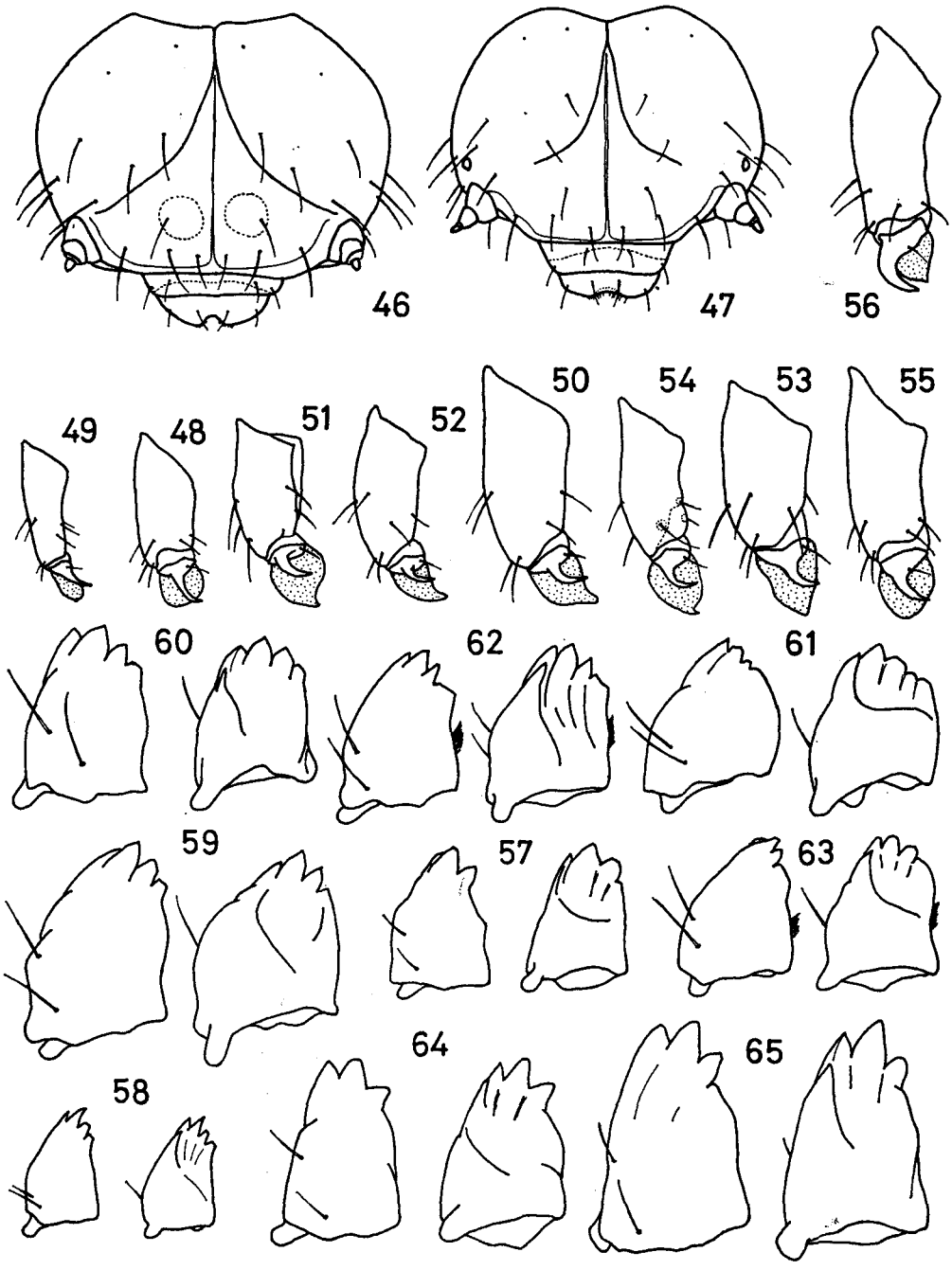
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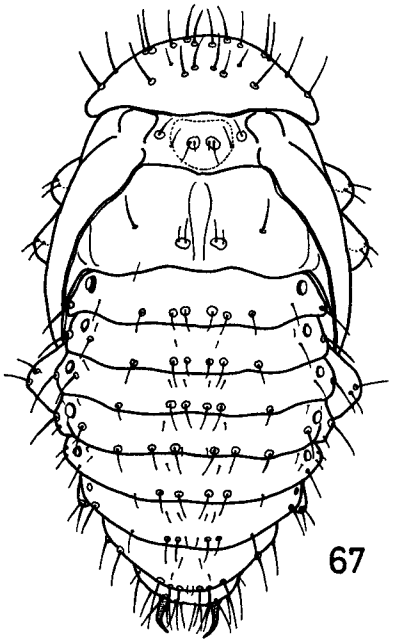

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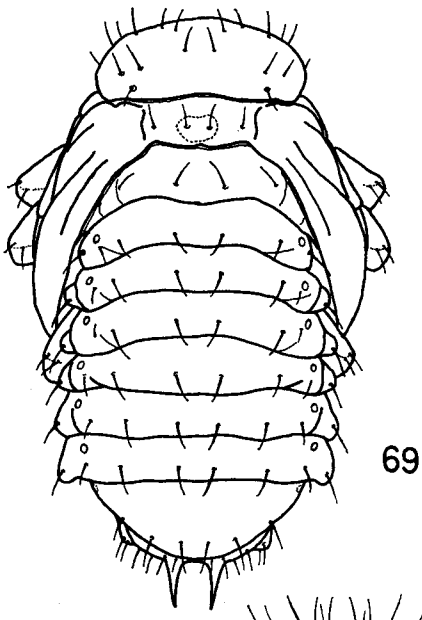

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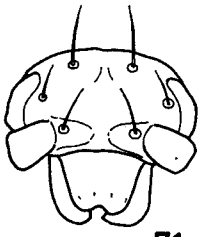

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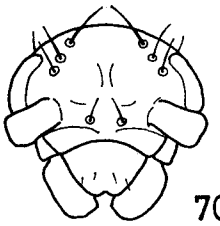

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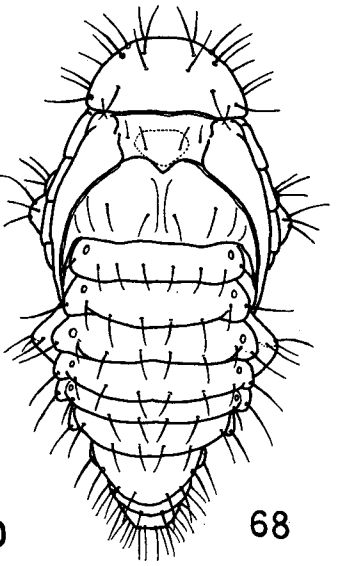

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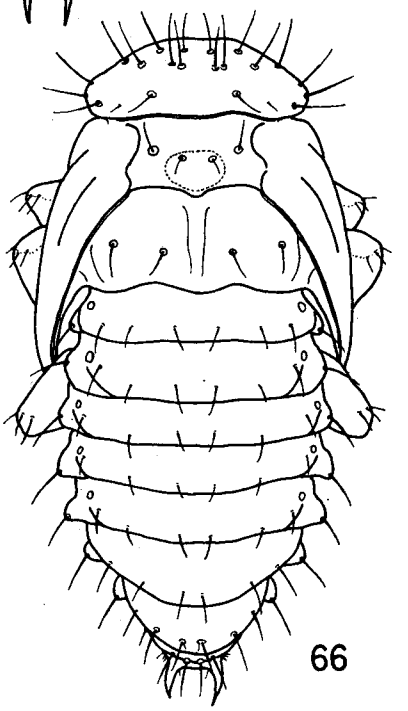

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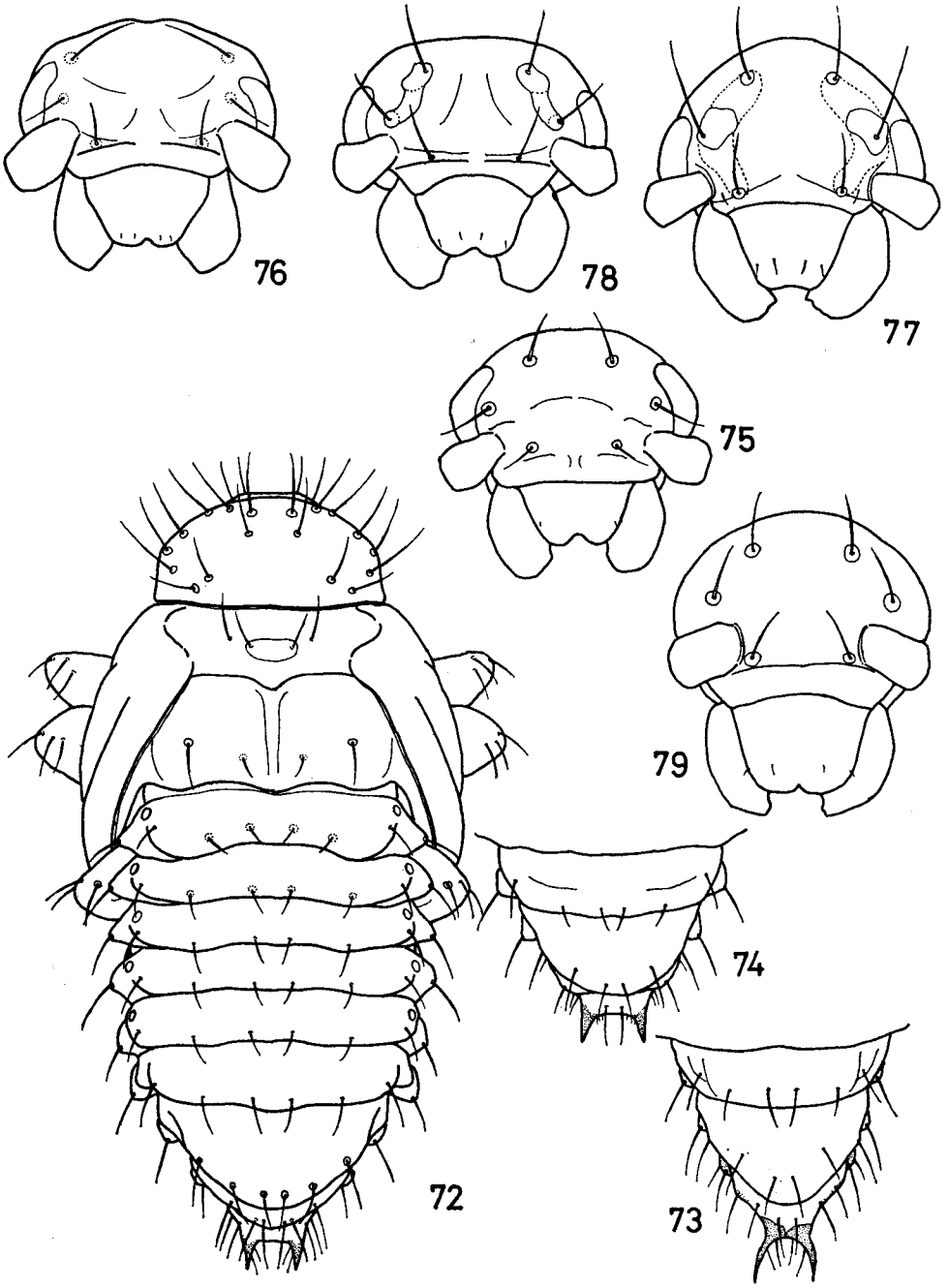
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