A revision of the genus *Deltote* R. L. and its allied genera from Japan and Taiwan (Lepidoptera: Noctuidae; Acontiinae)


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Abstract Thirty-three species of Japanese and Formosan Noctuid moths belonging to *Deltote* and its allied genera of Acontiinae are revised in comparison with two European and North American species. Both of the well-known genera, *Lithacodia* Hübner, 1818 and *Eustrotia* Hübner, [1821] which have been used extensively in entomological works, are found to be new synonyms of *Deltote* R. L., 1817. Four new genera, i.e., Protodeltote, Koyaga, Sugia and Pseudodeltote are erected. The phylogenetic relationships among them are discussed.

1. Introduction

The Acontiinae are one of quadrifid subfamilies of the Noctuidae, and consist of rather small-sized moths. This subfamily is known from 105 species representing 44 genera in Japan (Sugi, 1982). Their larvae are usually semilooper, and the larval foods vary from lichens (*Enispa, Corgatha*, etc.), dead leaves (*Oruza, Hyperstrotia*, etc.), to Graminaceous plants (*Deltote, Naranga*, etc.). This subfamily seems to be heterogenous, as it is rather artificially characterized by the quadrifid type wing venation and the small size for the noctuids. For example the genus *Stenoloba*, which had been classified in the subfamily by having the above-mentioned two characters, was recently transferred from this subfamily to the subfamily Bryophilinae mainly based on the larval structure (Sugi, 1970). Thus the generic revision of this subfamily is necessary not only for the proper phylogenetic classification but to define strictly the subfamily.

In this paper I attempted to revise the species belonging to the genus *Deltote* and its allied genera, formerly assigned to the genera *Lithacodia* Hübner, 1818, *Eustrotia* Hübner, [1821], *Maliattha* Walker, 1863 and *Micardia* Butler, 1878. This group includes about 1/3 of Japanese Acontiinae, which have been considered to be closely related to each other.

Since Hampson (1910) published a revision of the subfamily Acontiinae of
Ozarba Amyna Lithacodia (Maliattha)  
Eustrotia (Micardia)  
Eulocastra Naranga  

Fig. 1. Phylogeny of Acontiinae by Hampson (1910) (part).

the world, the genera Lithacodia, Eustrotia, Maliattha and Micardia have been considered to be closely related to each other (Fig. 1). Although Hampson (1910) treated the genus Maliattha as one of three sections of Lithacodia and the genus Micardia as one of the synonyms of Eustrotia, Warren (1912) regarded these two genera distinct from Lithacodia and Eustrotia, respectively. The Warren's system has been adopted by Japanese authors (Inoue and Sugi, 1958 and others). Recently Sugi (1982) used the name Deltote bankiana (Fabricius) for the species hitherto known as Eustrotia olivana (Fabricius) following Nye (1975), and Pseudeustrotia Warren, 1913 for the candidula group following Warren (1913), and erected two new genera, Neustrotia for the japonica group, and Inabaia for Eustrotia culta.

Japanese species of these genera have been described or recorded by Butler (1878, 1881, 1885), Leech (1889, 1900), Hampson (1910), Wileman (1911), Warren (1912, 1913) and Sugi (1958, 1959, 1982). Thus these 8 genera are known by 30 species in Japan at present.

These species are typical small Noctuid moths. Most of them are common in Japan and distributed from Hokkaido to Amami Is. inhabiting plains or hills covered with various Graminaceous plants. Some of them were recorded as rice-pests (Kawada et al., 1959). Most of them are bivoltine judging from their records of collection, but their early stages remain unknown except for some species (Kawada et al., 1959; Nakatomi, 1959; Yamamoto, 1977, etc.).

In this paper, I tried to clarify the intra- and intergeneric relationships of 37 known and 3 new species of the Deltote group from Japan and Taiwan based mainly on the comparative morphology of the male and female genitalia.

In the course of this study, Nearctic Lithacodia bellicula Hübner (the type-species of Lithacodia), Palaeartic Eustrotia uncula (Clerk) (the type-species of Eustrotia) and Deltote bankiana (Fabricius) (the type-species of Deltote) are con-
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Considered to belong to the same monophyletic genus, together with the Palaearctic *Lithacodia deceptoria* (Scopoli) and *Lithacodia nemorum* (Oberthür). Therefore, *Deltote*, the oldest available name, should be used for the group, and consequently, the well-known *Lithacodia* and *Eustrotia* are sunk as new synonyms of *Deltote*.

The inclusion of the type-species of *Lithacodia* and *Eustrotia* in *Deltote* necessitated the generic classification of many species hitherto assigned to *Lithacodia* and *Eustrotia* to be revised, so I erected the new genera, *Protodeltote*, *Koyaga*, *Sugia* and *Pseudodeltote* for some of them.

According to the Hennig's principles of reconstruction of phylogeny (1966), I attempted to establish the phylogenetic relationships of 35 species under 8 genera based on the morphological characters.

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3. Character states and phylogenetic considerations

In the classification of Acontiinae, the characters used in the grouping of genera or species have been restricted to venation, wing patterns, the number of dorsal crests and shape of labial palpus (Hampson, 1910). In fact, these characters are very useful ones, because we could observe these character states without dissection. However, these characters have rather limited phylogenetic significance, as we could easily find many examples of individual variations and parallelism on these characters, i.e., the individual variation on the venation from the areole on fore wing (Fig. 2), the same number of dorsal crests among many genera, which are apparently not related to each other, and so on. Consequently, each genus of Acontiinae will be often found to embrace heterogeneous elements in them. Therefore I reexamined these character states according to the criteria mentioned below to make tentative judgement of each character state—plesiomorphic or apomorphic. In addition to characters used in Hampson's classification I examined the structure of male external genitalia, their musculature and the structure of female genitalia, because these structures have been used in systematics of Lepidoptera and their validity has been found in many works.

Fig. 2. Individual variations on the venations arising from the areole of fore wing (Koyaga falsa (Butler)).
In the course of this examination, I used the following criteria for judgement of character state, if it is apomorphic or plesiomorphic (Saigusa, 1980).

d. Criteria based on the distribution patterns of each character state in recent species.

Criteria based on the conditions of distribution of character states within the group in question.

(1) If a character state of a morphocline is more frequently distributed in “primitive” subgroups than in “derived” subgroups, this character state is primitive. The “primitive” subgroups are those which have more character states presumed to be primitive based on other criteria than other subgroups (and moreover are “phylogenetically” isolated), or those less differentiated in sexual dimorphism.

Criteria based on the distribution of character states in “related groups”.

(4) It is primitive extreme, when a character state is more frequently distributed in “primitive” subgroups than “derived” subgroups within the “related group”.

(5) It is primitive extreme, when a character state is more frequently distributed in “primitive related groups”.

(6) It is primitive extreme, when a character state is distributed in various or many related groups.

f. Criteria peculiar to the comparative morphology

(3) Criterion based on symmetry

In the structure where symmetry is definitive, asymmetrization of the bilateral character, distortion by twisting of plane of symmetry, sinuation or spiralling caused by elongations in internal organs, etc. are considered to be deviation from symmetry, and they are inferred as apomorphic character states.

3-1-1. Hairs of antenna.

In general, the male antenna of Acontiinae, which were examined in this paper, has minute hairs on each segment of flagellum. The hairs of Koyaga are distinctly longer than those of any other genera and this condition apparently shows an apomorphic state of this character. The male antenna of Deltote is plesiomorphic condition as well as other genera. The female antenna of Koyaga has short hairs as in those of other genera, which are usually sparser and shorter than those of male antenna.

3-1-2. Wing patterns.

Many systems have been proposed to explain the wing patterns of the Noctuidae mainly concerning the fore wing (Herrich-Schäffer, 1843–1856, Forbes, 1954, Heath, 1976, Sergent, 1976 etc.). In this paper, the system of Heath (1976) is adopted for description, because his system is the most comprehensive and useful one. I made the following minor changes in the system, i.e.,
fascia and basal spot are changed to line and basal line respectively, and median shade and costal spot were newly added (Fig. 3-A). The elements of markings in the system are as follows:

**Basal line:** A very short patch at wing base, usually absent in the species of Japanese Acontiinae.

**Subbasal line:** A short and more or less sinous line from costa to inner margin near subbasal portion of wing.

**Antemedial line:** A sinuous, usually double lines running from costa to inner margin a little distad to subbasal line; sometimes this line interrupted or absent.

**Orbicular stigma:** A small annulus or lunule at the middle of cell.

**Claviform stigma:** A small lunule below vein 2.

**Medial line:** Usually absent; if this line is present, it is represented by an excurred weak line from lower angle of cell to inner margin.

**Reniform stigma:** Large annulus surrounding discocellular and usually constricted at the middle.

**Postmedial line:** A distinct line, usually represented by double dark lines and filled with lighter (often white) interspace; this line running from the middle of costa, angled outwards at vein 7, minutely waved to vein 4, then incurved to inner margin.

**Costal spots:** Small light spots on costa between post medial line and subterminal line.

**Subterminal line:** A sinuous line from costa to inner margin near termen and sometimes excurred below vein 7 or vein 4.
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Fig. 3-B. Inferred basic plan of the wing pattern in Noctuidae.

Fig. 4. Fore wing patterns of Notodontidae and Noctuidae, which are tentatively analysed compared with the basic plan (Fig. 3-B). A: *Neocerura tattakana* (Matsumura). B: *Cerura vinula felina* Butler. C: *Trichosea champa* (Moore). D: *Polia goliath* Oberthür. E: *Amphipoea ussuriensis* (Petersen). Large arrows indicate the 2nd cells where two separate striae are still present.
Fig. 5. Fore wing patterns of Acontiinae, which are tentatively analysed compared with basic plan (Fig. 3-B). A: Sugia idiosygia (Sugi). B: Koyaga falsa (Butler). C: Maliattha signifera (Walker). D: Maliattha arefacta (Butler). E: Protodeltole wiscotti (Staudinger). F: Deltole uncula (Clerk). G: Erastroides fentoni (Butler).
Terminal line: Usually represented by a series of striae on the termen.

The basic plan of fore wing pattern of Noctuidae is tentatively inferred as Fig. 3-B. This system consists of twelve lines. Reniform stigma and terminal series of striae are treated as "line" (7th and 12th line, respectively) for the present. This system is based on the wing patterns of Neocerura tattakana (Fig. 4-A), Cerura vinula felina (Fig. 4-B), Trichosea champa (Fig. 4-C), Polia goliath (Fig. 4-D), and so on. These wing patterns are primitive ones, because two separate striae are still present on the terminal portion of 2nd cell (arrows in Fig. 4). In general, the wing patterns of 2nd cell tend to be fused with each other and to be complete line or patch after the loss of vein lc (Cup). Moreover, most of the lines (4th–6th, 8th–11th) could be well traced from costa to inner margin. Therefore these wing patterns are considered as primitive ones and the basic plan is inferred as Fig. 3-B.

The fore wing patterns of Fig. 5 (A–G) are the results applying this system to some of species in this study. The most primitive condition seems to be preserved in Protodeltote distinguenda (Fig. 3-A) and Sugia idiostygia (Fig. 5-A), because each line in basic plan could be traced except for 10th and 11th lines. Median shade is considered to be the enlargement of the 6th line in the discoidal cell. But, these two species are not closely related to each other judging from their male external and female genital structures. Then, this apparent resemblance on fore wing patterns is due to symplesiomorphy.

In Koyaga falsa (Fig. 5-B), the wing patterns are almost same as in the above two species. But the so-called medial line is distinct and broad. This medial line seems to be composed of the union of a part of 6th line below vein 3 and a part of 8th line below vein 3, and is strongly curved inwards and shifted basally from its normal position.

In Maliattha, 6th line tends to be divided into two lines (longitudinal subdivision) (Fig. 5-C, D). In M. arefacta 5th and 6th lines run inwards to inner margin in the contrast with their primitive conditions (Fig. 5-F).

In the wing patterns of Protodeltote wiscotti and Deltole uncula (Fig. 5-E, F), 8th line below vein 6 (in the latter below vein 7) is distinctive; this line is almost straight to inner margin. This condition is also observed in Micardia argentata (Fig. 29-D). However, these species are not closely related to each other judging from their genital structures, and these resemblances will be due to the parallelism.

In Erastroides fentoni* the simplification of wing pattern is characteristic. Most of the patterns are substituted by orange scales.

As shortly discussed above, the considerable modifications could be observed

* As Suoi (1982) suggested, the systematic position of this species is indistinct, and here I tentatively assigned it to the genus Erastroides HAMPSON because of the lack of the areole on the fore wing.
in the wing patterns of *Deltote* and its allied genera, and more examinations are needed to trace the transformation series of each wing pattern and to discuss the phylogenetic relationships of each species based on the wing patterns. Therefore I used Heath's system in descriptions of each species in the present work.


The terms of each structure of the male external genitalia are mainly based on the work of Sibatani et al. (1954–1957). This system has been used frequently by many authors and is most useful to describe a small but important structure. I added to this system the process of uncus in this paper.

Fig. 6. Diagrams showing musculature of male external genitalia. A: Lateral view (left valva removed). B: Frontal view. A; anus, A. p.; anal plate, Co.; costa, De.; ductus ejaculatorius, Fe.; fenestrula, Hrp.; harpe, Jx.; juxta, Ph.; phallus, Scl.; sacculus, Tg.; tegumen, Un.; uncus, Vin.; vinculum.

The tegumen is usually broad and strongly and uniformly sclerotized. But, in *Pseudodeltote*, the tegumen is separated into anterior and posterior parts by a deep groove on its lateral portion. The presence of this groove is only observed in *Pseudodeltote*, and considered to be apomorphic condition. In *Protodeltote*, *Deltote* and some species of *Koyaga*, the tegumen is separated into strongly sclerotized anterior portion and weakly sclerotized posterior portion respectively. In *Sugia* and *Maliattha*, the tegumen is very long and slender, and such a separation is not observed. These character states are also observed among the genera of Japanese Acontiinae. In *Neustrotia* and *Pseudoeustrotia*, the dorsum of tegumen is innerted V-shaped from the dorsal view, being swollen at the middle and narrowing posteriorly. This state is widely observed in the genera of Japanese Acontiinae and Hypeninae, then it is considered to be plesiomorphic. In the
Noctuidae, when the ventral margin of tegumen is bulged, this portion is called peniculus. The peniculus is well developed especially in Koyaga and Delote. In the latter it is developed into a large broad flap with evenly curved ventral margin. The posterior part of the tegumen is sometimes separated into a pair of weakly sclerotized portion by dorsomedian sclerite or concaved area, fenestrua, which is a characteristic structure of the Protodeltote and Delote. But the presence of fenestrua seems to be plesiomorphic state, because this structure tends to be narrowed in Pseudodeltote, Koyaga and finally unrecognized at all in Sugia, Maliattha Neustrotia and Pseudoeustrotia.

The gnathos is usually absent in the Noctuidae except for some species of the subfamily Westermaniinae, consequently no element of gnathos is found in the Acontiinae.

The basic pattern of uncus is a simple and long falciform process with short hairs, and it is completely united with the posterior margin of tegumen or fenestrua. This condition is widely observed in Noctuidae. The uncus is rather uniform in shape, but it often bears small acute process on the apical portion. In Sugia the uncus is short, rather straight and weakly sclerotized. In Delote uncus is more or less twisted in caudal view. A small and flat apodemal process extending fowards from the base of uncus is observed exclusively in Maliattha and it provides the muscle M.1 with the attachment (Fig. 7, B). These character states of uncus mentioned above are considered to be apomorphic.

The vinculum is moderately long and broad. The small triangular process, which is connected with valva by tough membrane, is developed in some species of Sugia. The saccus is usually short and broad.

The valva is almost uniformly sclerotized on its outer wall which is often strengthened proximally by leiste. In Delote, Koyaga and Sugia, the valva is elongated and at least four times as long as wide. The shape of inner wall of valva is complicated. The base of costa is strongly produced dorsally at a right angle to the dorsal margin of costa. This condition is observed in Protodeltote, Delote and Koyaga. In other genera, the base of costa is moderately swollen. The ampulla is usually not developed except for some species of Maliattha and Delote. The anellifer is broad. The small plate or process is present on median region of anellifer in Neustrotia and this peculiar condition seems to be apomorphic. The sacculus is large with its dorsal margin sometimes bearing a large process or small serrations. In Protodeltote this process is broad and well developed, and shows its apomorphic state. Upper portion of posterior margin of sacculus extends posteriorly and forms a long acute process in some species of Delote. In Maliattha, the base of the dorsal margin of sacculus is provided with a slender club-like process. The harpe is usually slender and has a small process on its dorsal margin. The muscle M. 5 from sacculus attaches to the inner ridge of the harpe (Fig. 7, C). The cucullus tends to be elongated and ends in an acute process or rounded distal
margin. The distal margin of cucullus has acute processes in *Maliattha*. The inner wall of the cucullus+harpe of *Koyaga* has many special hairs. In *Micardia*, the inner wall of the cucullus is distinctly concaved. The dorsal margin of cucullus+harpe is irregularly rugged in *Pseudodeltote*. The valvula is designated as semimembranous area or process ventrad of the cucullus (Sibatani et al., 1954), but the distinction among harpe, cucullus and valvula is not definitely maintained in Acontiinae, because of their fusion in various way. Ventral margin of valva is strongly curved upwards in *Protodeltote, Pseudodeltote* and *Micardia*. Considerable asymmetrization between right and left valva is observed in *Pseudodeltote subcoenia* and *Maliattha pulverosa*.

The diaphragma is broad and has a pair of lateral plates (transtilla?) on each side of the manica. The lateral plate is fused with costa basally and extends to manica apically.

The shape of juxta is various and is normally present except for *Neustrotia*, in which the juxta is obliterated and it is functionally substituted by the fused bases of sacculi.

The phallus is long and strongly curved ventrally beyond zone in most genera except for *Maliattha* and *Neustrotia*. This condition is characteristic in Acontiinae. The subzonal sheath forms a small coecum penis in *Maliattha* and *Neustrotia* and it is apomorphic condition. The ventral portion of subzonal sheath sometimes has a concaved area, on the edge of which the muscle M. 7 or M. 7b is inserted (Fig. 7, G). The suprazonal sheath of phallus shows two types: (1) the suprazonal sheath of phallus is uniformly sclerotized and cylindrical in *Neustrotia*, and (2) the dorsal half of suprazonal sheath is entirely membranous in other genera. Judging from the fact that primitive ditrysian Lepidoptera like Cossidae and many species of the Noctuidae has uniformly sclerotized cylindrical suprazonal sheath, this state is plesiomorphic. The sclerotized portion of suprazonal sheath is characteristically narrow in *Sugia*. The vesica is very large in *Neustrotia*. The vesica is usually provided with cornuti, which are furnished with various spines, plates and processes. In *Koyaga*, a plate with long and acute processes is present among cornuti. In *Neustrotia*, a large and acute process is present in vesica.


The musculature of male external genitalia of the Acontiinae has hitherto not been investigated at all. These has been many discussions on the reliability of the muscles as Stekol’nikov stated that “the mobility of many muscles detracts considerable from their value in establishing homology and phylogenetic relations. The criterion of “constancy in the insertion of muscles” in the homologization of sclerites has already been criticized by a number of authors (Du Porte, 1946; Gerasimov, 1952; Medvedev, 1960). In the course of organ modification the muscles may transfer from one sclerite to another (Stekol’nikov, 1967), may
Fig. 7. Male genital musculature of Acontiinae.


pass across other muscles (Medvedev, 1960), and may also alter their function.” (Stekol’nikov, 1967: 406). But he also stated “Nevertheless, this reliability of the muscles does not exclude the possibility of homologization on its basis. Detailed investigation of the muscles within any group makes it possible to establish the range of variability of insertion and functioning of the muscles, and also general trends in the evolution of organ function. This gives rise to the possibility of
evaluating phylogenetic relations within the groups under investigation and of clarifying many disputed aspects of the homologization of sclerites." (ibid.: 406–407). In this section, I also attempt to clarify the musculature of male external genitalia of this group and evaluate some of the character states for phylogenetic analysis. Forbes's system (1939) is adopted for muscle terminology.

M.1 (adductor of uncus) is strong, flat and triangular, and originates from the anterior edge, or sometimes the ventrolateral wall, of tegumen, and is inserted to the base of uncus. But, in Maliattha, it appears to be a large dorsal transverse muscle as a whole, and, as already stated, it is inserted on the apodemal process of uncus (Fig. 7, B). This state is observed only in this genus among Japanese Acontiinae.

M.2 (retractor of anal plate) is long and slender, originates from the antero-dorsal edge of the tegumen, extends caudally under M.1, and is inserted on the posterior part of anal plate. The M.2 in Neustrotia candidula and Erastroides fentoni originates more ventrad, and in the former, it is inserted on the basal edge of anal plate.

M.3 (adductor of valva) originates from the edge of tegumen usually ventrad to M.2, and is inserted on the costa of valva (Fig. 7, D, F).

M.4 (adductor of valva) is short and broad, usually originates from the dorsal end of vinculum, and is inserted on the costa of valva. This muscle is more or less twisted. In Maliattha, M.4 is broad and originates broadly from the dorsal half of vinculum (Fig. 7, F).

M.5 (flexor of harpe) is broad and triangular, originates from the ventro-proximal edge of sacculus and is inserted on the edge of the narrow swelling in the middle of valva, which is the harpe. Sometimes, as already stated, the border of harpe becomes untraceable integumentally by the fusion of cucullus with valvula. In such cases, the inserted point of this muscle is useful for one of the criteria to homologize the harpe (Fig. 7, C).

M.6 (protractor of phallus) is a massive muscle and connects between the dorsal margin of the vinculum and the lateral wall of anterior extremity (usually coecum penis) of subzonal sheath of the phallus. Sometimes M.6 connects the valva and the phallus (Fig. 7, C, E). But the same condition is also observed in many genera of Noctuidae.

M.7 (retractor of phallus) is usually a single muscle from the saccus to the anteroventrad extremity of the subzonal sheath, but in Japanese Acontiinae, this muscle tends to be divided into two parts (M.7a and M.7b). M.7a originates from the saccus and is inserted on the distal portion of subzonal sheath of phallus, and M.7b is the same as the normal M.7 in its origin and inserted portion. In Erastroides fentoni M.7b is inserted on the lateral wall near zone. In Protodeltote M.7b is again divided into two parts (M.7b1 and M.7b2) (Fig. 7, D, G).

M.8 (pronator of juxta) is large and flat, usually originates from the anterior
edge of vinculum and is inserted on the anterior portion of juxta. But, in Japanese Acontiinae, this muscle tends to originate from the posterior portion of sacculus. Only in Sugia, this muscle is divided into two parts, M.8a and M.8b, which originates from the sacculus and the saccus, respectively (Fig. 7, H, I).

3–1–5. Female terminalia and genitalia.

The female genital structure is almost uniform in Japanese Acontiinae, and the differences in its shape and size among species or genera are rather smaller than those of male genitalia. The terms of female genitalia is mainly based on Shirozu and Yamamoto (1956) and Callahan (1960).

A small membranous invagination is sometimes present on the membranous area between 7th abdominal tergum and sternum. This invagination has many special hairs and may be a glandular organ, but its real function is unknown.

The dorsum of the 8th abdominal segment is well sclerotized. But it is usually separated into two lateral tergites by the dorsomedial membranization. Each lateral tergite in Deltote has a narrow membranous area at the middle just behind the base of the apophysis anterioris. In Koyaga, this membranous area is well developed. The apophysis anterioris is slender and extends anteriorly from the ventrodistal margin of the 8th abdominal tergum.

The genital plate is composed of lamella antevaginalis and lamella postvaginalis. These two plates are often fused into a complicated skeleton circumfusing the ostium-copulatory cavity, so that the lamella postvaginalis is not found separately in most species. The shape and size of lamella antevaginalis is very various. It may be a single quadrate plate or transverse band.

The ostium bursae, i.e., the copulatory cavity is deep and trapezoidal in shape. No spines or hairs are found in the ostium bursae.

The ductus bursae is long, membranous, sometimes sclerotized and usually has many minute spines on its inner wall. Some authors (Olsen and Nielsen, 1977, etc.) designate the part of ductus bursae as antrum, ventral margin of antrum and colliculum, etc., according to their shapes and degrees of sclerotization. But, in the present analysis, they are included into ductus bursae as a whole.

The rounded diverticulum may be found on the ventral area of ductus bursae near the ostium.

The ductus seminalis is a slender membranous tube connecting the bursa copulatrix and the vagina. It is often greatly bulged near the vagina.

The spermatheca (receptaculum seminalis) consists of a tubular spermathecal gland, a large lobe (utriculus) and a small lobe (lagena) (Weidner, 1935). The surface of the utriculus is convoluted in some species. The ductus receptaculi is long, twisted twice or three times and consists of a membranous duct and a weakly sclerotized band surrounding the duct.

The bursa copulatrix is very large and its anterior margin almost reaches the
2nd abdominal segment in most species. The shape of bursa copulatrix is various and may be rectangular, or bifurcated, or egg-like. The inner wall of bursa copulatrix often bears one or more signa usually in the form of spines or as dentate patches. When the signa are absent, there are many minute spines at random on the inner wall of bursa copulatrix.

The papilla analis is a weakly sclerotized lobe and bears many setae on its outer surface and apophysis posterioris at the middle of its anterior margin. In *Neustrotia* a large weakly sclerotized triangular plate bearing minute spines is present on the ventral membranous area between the papillae anales.

3–1–6. Character states

The states of each character mentioned above are summarized as follows (p: plesiomorphic, a: apomorphic). The number of each character state also corresponds to the number indicated in Fig. 8.

1. Tip of phallus strongly curved downwards (a) or straight (p).
2. Dorsal half portion of suprazonal sheath entirely membranous (a) or uniformly sclerotized (p).
3. Muscle 7 divided into two parts (a) or single (p).
4. Process of uncus present (a) or absent (p).
5. Muscle 1 inserted on the process of uncus (a) or in base of uncus (p).
6. Muscle 4 originated from the middle of vinculum (a) or from dorsal end of vinculum (p).
7. Slender club-like process present (a) or absent (p) on base of dorsal margin of sacculus.
8. Juxta absent (a) or present (p).
9. Bases of both sacculi fused (a) or separated (p).
10. Small plate or process present (a) or absent (p) on middle region of anellifer.
11. Vesica very large (a) or small (p).
12. A large acute process present (a) or absent (p) in cornuti.
13. Triangular plate present (a) or absent (p) between papillae anales.
14. Ventral margin of valva strongly curved upwards (a) or faintly curved upwards (p).
15. Valva at least four times as long as wide (a) or short (p).
16. A deep groove present (a) or absent (p) on lateral wall of tegumen.
17. Dorsal margin of cucullus irregularly rugged (a) or smooth (p).
18. Inner wall of cucullus concaved (a) or flat (p).
19. Reniform and claviform stigmata absent (a) or present (p).
20. A long and broad process present (a) or absent (p) on middle of dorsal margin of sacculus.
21. Peniculus bulged (a) or slender (p).
22. Hairs of male antenna long (a) or minute (p).
23. A plate with long acute processes (cornuti) present (a) or absent (p).
24. Uncus more or less twisted (a) or straight (p) in caudal aspect.
25. Membranous region present (a) or absent (p) on lateral wall of female 8th abdominal tergum.
26. Muscle 8 divided into two parts (a) or single (p).
27. Fensetrula separated from adjacent sclerites (a) or fused with them (p).
28. Sclerotized portion of suprazonal sheath very narrow (a) or broad (p).
29. Uncus weakly sclerotized and short (a) or well sclerotized and long (p).

Fig. 8. Inferred phylogenetic relationship among the genus *Deltote* and its allied genera mainly occurring in Japan and Taiwan.

3-2. Phylogenetic relationships of each genus.

The phylogenetic relationships among the genera of Japanese Acontiinae have not been fully studied. In this section the inferred phylogenetic relationships of each genus are shortly discussed based on the morphological data stated above.

3-2-1. The systematic position of *Neustrotia* Sugi.

This genus is here for four species, *costimacula noloides*, and *japonica*, which
have been included in the genus *Eustrotia*, and *N. sp. A* from Taiwan. Comparing this genus with other genera of Japanese Acontiinae, many peculiar character states could be pointed out as follows. On the middle portion of anellifer, a small plate or process with minute setae on its apical portion is present. This thin rectangular plate is plesiomorphic in *costimacula* and *noloides*, in which it is faintly attached basally to the border region between costa and cucullus by the weakly sclerotized portion. In *japonica* its surface is slightly swollen and separated from that region by narrow membranous area. This plate of sp. A is peculiarly modified. It is a slender and long process produced dorsally and completely separated from that region.

The juxta is absent in this genus and substituted for the strongly sclerotized ridge which is resulted from the fusion of basal portions of sacculi.

The suprazonal sheath is entirely sclerotized and cylindrical through its length. But, this character state may be plesiomorphic.

The vesica is very large and the cornuti consist of many small spines, plates and an acute process. This process is $1/4$ as long as subzonal sheath in *noloides*. In sp. A, it is rather long and $1/3$ as long as subzonal sheath. In *japonica* and *costimacula*, it is greatly developed and as long as subzonal sheath.

A scent organ (brush organ) is present between the vinculum and 8th abdominal sternum in sp. A.

In female, between the papillae anales, *Neustrotia* has a more or less sclerotized triangular plate, which has many minute spines on its apical portion.

Judging from the above-mentioned character states, which have never found in other genera of Japanese Acontiinae, this genus may be inferred to occupy a peculiar position in this subfamily. As its sister group has not been found, I exclude it from *Deltote* and its allied genera as Fig. 8 at the present.

3-2-2. The systematic position of *Maliattha* Walker

Since Hampson's work (1910), the genus *Maliattha* has been considered to be closely related to the genus *Lithacodia*. But, this genus also has many peculiar character states as the preceding genus *Neustrotia*. The process of uncus seems to be an apomorphic character only common to the species of this genus, even though it is various in shape from flat triangular plate to slender process. Muscle 1 originates from all over the lateral wall of tegumen and inserts on this process. It appears to be transverse muscle in tegumen.

The muscle 4, which originates from the dorsal half of vinculum, is very broad and triangular in its shape.

A slender club-like process bearing sparse setae and dentations is present on the base of the dorsal margin of sacculus except for *bella*. The base of this process is very weakly sclerotized in *culta*. In *bella* more broad and short process is present in this region. The cucullus seems to be fused with the sclerotized valvula or the
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harpe and is curved dorsally. Their separation is distinctive in *rosacea* and *arefacta*, but in *signifera*, *viatis* and *bella*, it is indistinct. The distal margin of cucullus has a series of acute processes. In *culta*, the valva is very different from other species of this genus; costa with a large process on the base, the dorsal margin of cucullus strongly swollen at the middle, the harpe large triangular with a large process and two small processes on the apical portion.

As well as the genus *Neustrotia* this genus has many peculiar character states mentioned above. But, the sister group of the genus *Maliaththa* also has not been found in Japanese Acontiinae. Therefore I treat the genus *Maliaththa* and the genus *Neustrotia* as different genera from the genus *Deltote* and its allied genera at present (Fig. 8).


This group consists of six genera, i.e., *Protodeltote*, *Pseudodeltote*, *Micardia* Butler, *Koyaga*, *Deltote* R. L. and *Sugia*. The monophyly of this group is shown by the following three apomorphic character states: 1) tip to pahllus strongly curved ventrally, 2) upper half of suprazonal sheath entirely membranous, and 3) the muscle 7 divided into two parts. Furthermore this group is divided into two major monophyletic groups. One of them consists of *Protodeltote*, *Pseudodeltote* and *Micardia* and the other consists of *Koyaga*, *Deltote* and *Sugia*. The former group seems to be more primitive than the latter. The monophyly of the former group is shown by the valva with strongly curved ventral margin and that of the latter is shown by long valva (valva at least 4 times as long as wide).

The genus *Protodeltote* represents the most primitive position in the phylogeny of this group. This genus is erected here for four species, i.e., *pygarga*, *distinguenda*, which have been included into the genus *Lithacodia*, *wiscotti*, which has been included into the genus *Micardia* or *Lithacodia*, and sp B. The overall resemblance of these four species, however, is apparently due to sympleisiomorphy on the most characters. But a long and broad process on the middle of the dorsal margin of sacculus is an apomorphic condition only common to this genus. The dense and small serrations on the apical portion of suprazonal sheath, and the cornuti which consist of a slender oblong plate and two congregations of small spines may by apomorphic conditions respectively. But the judgement of these character states needs more careful study.

The genus *Pseudodeltote* is erected here for four species, i.e., *brunnea*, *formosana*, *coenia* and *subcoenia*. They have been included into the genus *Lithacodia*. These species also have some plesiomorphies as those of *Protodeltote*. But they have peculiar apomorphies respectively, in comparison with the species of *Protodeltote*. For example, the dorsal margin of the uncus of *brunnea* is evenly curved upwards and a large slit is present on it, the valvae of *subcoenia* are drastically asymmetrical
each other, the muscle 3 is absent in *formosana* and so on. Such character states are only common to each species. They are included into a monophyletic group for the present based on an apomorphic character state, i.e., the dorsal margin of cuculus+harpe irregularly rugged. Considering peculiar character states mentioned above, they may be divided into some monophyletic groups with other unexamined species of other regions.

The systematic position of the genus *Micardia* has been often changed. Hampson (1910) treated this genus is one of synonyms of the genus *Eustrotia* because of the abdomen with dorsal crest at base only. Warren (1912) separated this genus from the genus *Eustrotia* mainly based on the shape of fore wing, even though he overlooked the dorsal crest of abdomen in these two genera. In the present analysis the genus *Micardia* may be inferred a sister group of the genus *Pseudodeltote* based on the presence of a deep groove on the lateral wall of tegumen. But *Micardia* has other peculiar character states. Especially, the shape of egg is very different from that of other genera of Acontiinae. The egg of *Micardia* is trapezoidal in lateral view.

The genus *Koyaga* is also erected here for five species, i.e., *falsa, numisma, senex, virescens* and *viriditincta*, which have been included into the genus *Lithacodia*. The genus *Koyaga* seems to be related to the genus *Deltote*, because they share well developed penisculus in common. In other characters they differ much from each other. In *Koyaga* the cornuti are present, but they are absent in *Deltote*. The cornuti of *Koyaga* consist of many small spines on a thin plate normally. However this character state is not easily arranged into a transformation series. For example, in the cornuti of *viriditincta*, this thin plate is absent and very slender plate is present on the lateral region of congregation of spines. On the other hand, in *virescens*, the cornuti are highly specialized. The cornuti of this species consist of a wedge-shaped plate which is swollen dorsally, many small spines on this plate and a well sclerotized rod extending posteriorly beneath this plate. These two specialization seem to be developed along different lineages. In addition to these facts, judging from the apomorphic antennal character state and rather plesiomorphic wing patterns, the genus *Koyaga* seems to take so-called "intermediate" position between *Protodeltote* and *Sugia*. It is noteworthy that the base of costa is strongly curved upwards in all species of this genus.

The genus *Deltote* consists of five species, i.e., *bellicula, deceptoria* and *nemorum* which have been included into the genus *Lithacodia, uncula* which has been included into the genus *Eustrotia* and *bankiana*. The twisted uncus and the membranous region on the lateral wall of female 8th abdominal tergum are apomorphic character states which are present only in this genus. Their wing patterns are various and it is very difficult to arrange these characters into a transformation series at the present. As mentioned previously, these wide differences of wing patterns may be ascribed to the result of parallelism or peculiar specialization.
Therefore I place the more reliance on the conformation of structure of male external genitalia than that of wing patterns in the present analysis.

The genus *Sugia* is erected here for five species, i.e., *stygia, stygiodes, idiostygia* which have been included into the genus *Lithacodia* and *elaeostygia* Sugi and sp C. In this group the genus *Sugia* is the most specialized on the male external genital structure. Those are summarized as follows: 1) the elongation of tegumen is remarkable and its most advanced form is observed in *idiostygia*, in which the tegumen is about two times as long as vinculum, 2) the dorsum of tegumen is evenly sclerotized and the fenestrula is not recognizable at all in every species, 3) the uncus is short, weakly sclerotized and almost straight except for *idiostygia* in which the uncus gently curved upwards, 4) the valva is very long, at least four times as long as wide, 5) the sclerotized portion of suprazonal sheath is very narrow, and 6) the muscle 8 is divided into two parts. On the contrary, the wing patterns of this genus are basically the same as those of *Protodeltote*. This resemblance may be ascribed to the symplesiomorphy.

The genus *Pseudeustrotia* was erected by Warren (1913) and its type-species is *Noctua candidula* Denis and Schiffermüller, which had been assigned to the genus *Eustrotia* or *Lithacodia*. Sugi (1982) used this genus for *candidula* and *Eustrotia bipartita* Wileman was also included in this genus by him. As I could not get enough materials of *bipartita* and other species in the genus *Pseudeustrotia* (most of them distributed in Australia), the systematic position of this genus is unknown to me. However, *P. candidula* seems to be sister species of *Eustrotia carneola* (Guèneé) of North America, judging from their wing patterns and male external genital structure.

The inferred phylogenetic relationship of the genus *Deltote* and its allied genera occurring in Japan and Taiwan is shown in Fig. 8.

4. **Key to the genera** (mainly based on the male external genital structure)

1. Process of uncus absent; phallus with well-developed coecum ............ 2
   — Process of uncus present; phallus with small coecum...*Maliaththa* WALKER
2. Accessory cell of fore wing moderate in size .................................. 3
   — Accessory cell of fore wing very minute or absent......*Erastroides* HAMPSON
3. Juxta present and bases of both sacculi not fused; small plate or process absent on median region of anellifer; tip of phallus curved downwards strongly; upper half of suprazonal sheath membranous ...... 4
   — Juxta absent and bases of both sacculi fused; small plate or process present on median region of anellifer; tip of phallus straight; suprazonal sheath cylindrical and entirely sclerotized......*Neustrotia* Sugí
4. Tegumen without lateral groove .................................................... 5
   — Tegumen with a deep groove laterally ........................................... 8
5. Tegumen moderately large; uncus long, slender falciform and strongly sclerotized; fenestrula more or less distinguished from adjoining sclerites by distinctive suture or distinctly concaved when this suture is absent; ventral portion of tegumen enlarged; base of costa strongly produced dorsally ........................................... 6

— Tegumen very long and slender; uncus short and thin; fenestrula not recognizable; ventral portion of tegumen not enlarged; base of costa not produced dorsally ........................................... Sugia gen. nov.

6. Cucullus+harpe long; process of sacculus small or absent, and if it is present, this process is situated on distal corner of sacculus with irregular dentations on its tip ........................................... Sugia gen. nov.

— Cucullus+harpe short; process of sacculus very large and broad, and present on the middle portion of the dorsal margin of sacculus ........................................... Protodeltote gen. nov.

7. Hairs of male antenna long; sacculus very large and swollen at middle; phallus with cornuti ........................................... Koyaga gen. nov.

— Antenna of male minutely ciliated; sacculus moderately large and not swollen at middle; phallus without cornuti .............. Deltote R. L.

8. Dorsal margin of cucullus+harpe smooth; inner margin of cucullus+harpe concaved; reniform and claviform stigmata entirely absent ........................................... Micardia Butler

— Dorsal margin of cucullus+harpe irregularly rugged; inner wall of cucullus+harpe not concaved; reniform, orbicular and claviform stigmata present ........................................... Pseudodeltote gen. nov.

5. Descriptions of the genera

5-1. Genus Protodeltote gen. nov.
(Figs. 9, 10)

Type-species: Phalaena pyrgara Hufnagel, 1766 (Berl. Mag. 3: 408, by present designation.)

Frons smooth without prominences; labial palpus upturned, its tip reaching to vertex and the 2nd fringed with scales in front; antenna ventrally minutely ciliated in male, and more sparsely and shorter ciliated in female. The number of dorsal crests of abdomen varied from the basal one to four among each species. Fore wing with rounded apex; termen excurved at vein 4; 9 and 10 anastomosing with 8 forming an areole. Hind wing with veins 3 and 4 not stalked and from lower angle of cell; 5 well developed and from below middle of disco-cellulars. Wing pattern various from typical noctudis form to much modified one.
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Fig. 9. Male external genitalia of *Protodeltote pygarga* (Hufnagel).


**Male external genitalia:** Tegumen broad and separated into strongly sclerotized anterior portion and weakly sclerotized posterior portion; fenestrula usually strongly sclerotized and deeply concaved; peniculus moderately developed; vinculum about 1.3 times as deep as tegumen and broad; saccus very short. Uncus long falciform and bearing short hairs sparsely. Valva moderately short; costa strongly swollen dorsally at an angle of 45° from its middle portion; cucullus + harpe short, about 2/3 as long as sacculus and the ventral margin of it irregularly rugged or produced; the base of harpe narrow and bearing some small denticles; sacculus large with a large process on its dorsal margin. Juxta strongly sclerotized and spade-shaped. Phallus long; dorsal half of supr-zonal sheath entirely membranous; coecum long; a deep concaved area present ventrally near zone on the subzonal sheath; dense and small serrations on the apical portion of supr-zonal sheath; cornuti composed of a slender rectangular...
plate and two congregations of small spines.

Female terminalia: The ventrolateral portion of 7th abdominal tergum with a large concaved area. The region of special hairs broad on the posterior portion of 7th abdominal sternum.

Female genitalia: The lateral wall of 8th abdominal tergum broad and strongly sclerotized; copulatory cavity deep and triangular; ventral sclerotized portion of copulatory cavity strongly sclerotized and abruptly dilating to evenly curved apex; lamella postvaginalis absent; a small membranous pouch present at the end of copulatory cavity. Ductus bursae membranous and shorter than bursa copulatrix. Bursa copulatrix membranous and composed of curved elongated corpus bursae and a broad, shallow cervix bursae. Signa absent. Ductus seminalis slender and bulged beyond the middle. Papilla analis broad, strongly sclerotized and gently concaved at the middle portion of its distal margin; apophysis posterioris about 2 times as long as apophysis anterioris.

5–2. Genus *Pseudodeltote* gen. nov.
(Fig.s 11, 12)

Fig. 11. Male external genitalia of *Pseudodelote brunnea* (Leech).

A: Dorsum in dorsal view.
B: Ring in lateral view.
C: Uncus in caudal view.
D: Right valva, inner view.
E: Phallus in lateral view (left).
F: Phallus in ventral view. Scale 1mm.

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Head: Frons smooth without prominences; labial palpus upturned, the 2nd joint reaching to vertex of head and the 3rd short; antenna of male with short hairs; antenna of female sparsely ciliated. Dorsal crests of abdomen 2nd–4th or 3rd–5th. Fore wing with veins 3–5 from lower angle of cell; 6 from upper angle; 9 from 10 anastomosing with 8 to from areole; termen evenly curved. Hind wing with the veins 3–4 from the lower angle of cell; 5 from
below middle of discocellulars; 6, 7 from the upper angle. Wing pattern: Basic patterns almost traceable except for some species, which are with modifications on antemedial and medial areas.

*Male external genitalia:* Teguern moderately large, separated into anterior and posterior portions by deep groove or a line; in dorsal view, the lateral portion of tegumen produced posteriorly beyond the base of uncus; fenestrula narrow and well sclerotized; peniculus not developed; vinculum slender, as deep as tegumen; a keel-like inner ridge running through at the middle of vinculum; saccus small. Uncus slender, falciform and densely long-haired beyond the middle. Valva short, 2.5–4.0 times as long as wide; in some species the valvae asymmetrical; costa narrow and moderately curved dorsally at the base, cucullus+harpe short, and its dorsal margin irregularly swollen dorsally; dorsal margin of the base of harpe slightly swollen; sacculus deep and large, and its dorsal margin with a process. Juxta small, tapering towards distal margin. Phallus moderately large; in lateral view phallus curved ventrally near its apical portion; ventral sclerotized portion of suprazonal sheath broad; coecum well developed, more than 1/2 as long as the subzonal sheath; cornuti absent or present.
Female genitalia: Eighth abdominal tergum well sclerotized and broad; copulatory cavity broad, almost triangular and its ventral portion well sclerotized. Ductus bursae short 1/3–1/7 as long as bursa copulatrix. Ductus seminalis slender and bulged near the vagina. Bursa copulatrix large; cervix bursae short. Signa absent. Papilla analis large and densely long-haired.

5–3. Genus *Micardia* Butler, 1878
(Figs. 13–14)


Type-species: *Micardia argentina* BUTLER, 1878, (*ibidem* (5) 1: 81, by original designation.)

Head: Frons smooth without prominences; labial palpus upturned, the 2nd joint reaching to vertex and the 3rd short; antenna of male with dense and short hairs, which are minutely ciliated. Thorax with distinct crests. Dorsal crest of abdomen on 1st–2nd. Fore wing with veins 3–5 from lower angle of

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**Fig. 13.** Male external genitalia of *Micardia argentina* BUTLER.

Fig. 14. Female genitalia and terminalia of *Micardia argentina* BUTLER.


cell; 6 from upper angle, 9 from 10, anastomosing with 8 to form the areole; termen excurred at the middle. Wing patterns very much specialized; subbasal and antemedial lines and claviform absent; orbicular represented by large annulus; postmedial line acutely angled outwards below costa to subterminal line and incurved to inner margin; on postmedial area a broad line running almost parallel to termen below vein 7, and extending to inner margin.

**Male external genitalia:** Tegumen large, separated into anterior and posterior portions by deep lateral groove; in dorsal view the lateral portion of tegumen produced posteriorly beyond the base of uncus; fenestrula well sclerotized narrow groove; peniculus well developed; vinculum slender and almost as deep as tegumen; saccus small. Uncus broad, densely long-haired beyond the middle and dilating towards blunt tip, which bears an acute spine. Valva long,
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5 times as long as wide; costa broad; cucullus+harpe narrow and curved dorsally beyond the middle; inner wall of cucullus+harpe concaved at the apical portion; sacculus broad. Juxta large, oblong and swollen at the ventromedial portion. Phallus moderate; in lateral view apical portion of suprazonal sheath strongly curved ventrally; ventral sclerotized portion of suprazonal sheath broad; coecum large, almost 1/2 as long as subzonal sheath; cornuti composed of some series of minute spines.

**Female genitalia:** Eighth abdominal tergum moderate; apophysis anterioris short and less than 1/2 of width of 8th abdominal tergum; copulatory cavity broad and deep, its ventral portion well sclerotized. Ductus bursae moderate, 1/3 as long as bursa copulatrix. Ductus seminalis slender and bulged beyond the middle. Bursa copulatrix large; cervix bursae short and 1/5 as long as bursa copulatrix. Signa absent. Papilla analis densely long-haired; apophysis posterioris 2.0–4.0 times as long as apophysis anterioris.

5–4. **Genus *Koyaga* gen. nov.**

*(Figs. 15, 16)*

Type-species: *Miana falsa* Butler, 1885, *(Cist. Ent. 3: 132, by present designation.)*

Head: Frons smooth without prominences; labial palpus upturned, 2nd joint reaching to vertex of head and the 3rd moderate; antenna of male ciliated with long and dense hairs. Dorsal crests of abdomen on 3rd–5th or 3rd–4th. Fore wing with veins 3–5 from lower angle of cell; 6 from upper angle; 9 from 10 anastomosing with 8 to form areole; middle portion of termen excurved. Hind wing with veins 3–4 from the angle of cell; 5 from below middle of discocellulars; 6, 7 from the upper angle. Wing pattern: The basic patterns almost traceable with some modifications; reniform open at the below.

**Male external genitalia:** Tegumen moderately large; dorsum well sclerotized and fenestra represented by concaved portion or indistinct; peniculus moderately developed; vinculum broad; saccus large and produced dorsally. Uncus long, falciform and sparsely long-haired. Valva long, 6–9 times as long as wide; base of costa strongly swollen dorsally or moderately produced; base of harpe with some processes dorsally; cucullus+harpe well sclerotized; saccus large and swollen dorsally. Juxta oblong or triangular and pointed posteriorly. Phallus long; ventral sclerotized portion of suprazonal sheath narrow and strongly curved ventrally near the tip; coecum well developed, almost 1/2 of subzonal sheath; cornuti present and typically composed of a plate with many long spines.

**Female genitalia:** Eighth abdominal tergum weakly sclerotized and narrow; apophysis anterioris slender and long; ventral wall of copulatory cavity weakly sclerotized; lamella antevaginalis present or absent. Ductus bursae longer than
bursa copulatrix and sometimes produced dorsally. Bursa copulatrix simple; cervix bursae short. Papilla analis quadrate and long-haired; apophysis posterioris as long as apophysis anterioris.

Fig. 15. Male external genitalia of *Koyaga falsa* (Butler).
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Fig. 16. Female genitalia and terminalia of *Koyaga falsa* (Butler).

A: Whole genitalia in lateral view (left). B: Ostium in ventral view showing lamella postvaginalis. C: Female terminalia in lateral view (left) (arrow indicates the 7th abdominal spiracle). D: 7th abdominal sternum in ventral view. Scales 1 mm.

5-5. **Genus Deltote** R. L., 1817
(Figs. 17–21)


Type-species: *Lithacodia bellicula* Hübner, 1818, *ibidem* 1: 18, figs. 85, 86, by monotypy.


Type-species: *Phalaena uncula* Clerck, 1759, *Icones Insect. rariorum* 1: pl. 3. fig. 7, by monotypy.

Head: Frons smooth without prominences; labial palpus upturned, with 2nd segment reaching about to vertex of head, the 3rd short; antenna minutely ciliated. Number of dorsal crest of abdomen varies from 0 to 4 among

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*...As a result of *Opin. Decl. int. Commn zool. Nom.* (1958) 19 Opinion 516, the Fabrician name has priority and thus the valid name of the type-species is *Deltote bankiana* (Fabricius, 1775), *Syst. Ent.:* 645." (Nye, 1975: 152).
species. Fore wing with moderately produced apex; 9 and 10 anastomosing with 8 forming areole, and its size somewhat variable; termen evenly curved. Hind wing with veins 3 and 4 short stalked or from lower angle of cell; 5 well developed, from below middle of discocellulars.

Male external genitalia: Tegumen broad, separated into strongly sclerotized anterior portion and weakly sclerotized posterior portion; fenestrula reduced; peniculus well developed; vinculum slender and as deep as tegumen; saccus moderately large; uncus long, more or less slightly twisted and falciform. Valva long, about 5 times as long as wide; costa narrow; base of costa strongly projected dorsally at a right angle to the dorsal margin of valva; cucullus + harpe simple and long; sacculus with a large or small process at the posterodorsal edge. Juxta large and strongly narrowed posteriorly. Phallus moderate; sclerotized portion of suprazonal sheath moderate; coecum well developed; cornuti absent.

Female terminalia: A small depression present on the lateral membranous portion of 7th abdominal segment.
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Fig. 18. Male external genitalia of *Deltote bellicula* (Hubner).

Fig. 19. Male external genitalia of *Deltote uncula* (Clerk).
Female genitalia: Eighth abdominal tergum with a membranous incision at anteroventral portion; copulatory cavity small; a small triangular depression on ventromedial portion of ventral sclerotized area of copulatory cavity; ductus bursae moderate, 1/2 as long as bursa copulatrix; bursa copulatrix long; cervix bursae well developed and long. Signa absent. Papilla analis large.

Remarks: McDunnough (1937) had also recognized the resemblance of genitalia between Lithacodia bellicula (H.) and Eustrotia nucula (C.) (in his paper Erastria uncana (C.)).
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5–6. Genus *Sugia* gen. nov.
(Figs. 22, 23)

Type-species: *Jaspidia idiostygia* Sugi, 1958, (*Tinea* 4 (1): 244, figs. 3, 4 and 10, by present designation.)

Head: Frons smooth without prominences; labial palpus upturned, 2nd joint reaching to vertex of head and the 3rd moderate; antenna of male ciliated with short hairs. Dorsal crests of abdomen on 2nd–4th or 3rd–5th. Fore wing with veins 3–5 from lower angle of cell; 6 from upper angle; 9 and 10 anastomosing with 8 forming areole; termen evenly curved. Hind wing with veins 3–4 from lower angle of cell; 5 from below middle of discocellulars. Wing pattern: The basic pattern completely traceable.

Male external genitalia: Tegumen broad, well sclerotized and much flattened; fenestra untraceable; peniculus undeveloped; vinculum slender, 1/2 as deep as tegumen; saccus large and truncated. Uncus short, weakly sclerotized and densely long-haired. Valva very long, 6–10 times as long as wide; costa narrow; base of costa moderately curved dorsally; cucullus + harpe well sclerotized, slender, curved dorsally beyond the middle and ended in a pointed tip; sacculus large. Juxta large with an excavated distal margin. Phallus very long; ventral sclerotized portion of suprazonal sheath very narrow and curved ventrally near the tip; coecum well developed, 1/2 as long as subzonal sheath.
Female genitalia: Eighth abdominal tergum weakly sclerotized; a narrow membranous incision on its anteroventral portion; copulatory cavity broad and deep; ventral sclerotized portion of copulatory cavity narrow. Ductus bursae 1/2 as long as bursa copulatrix and curved dorsally. Ductus seminalis very long, more than 2 times as long as ductus bursae. Bursa copulatrix large; cervix bursae short. Signa absent. Papilla analis weakly sclerotized and densely short-haired.
Revision of the genus *Deltote* R. L.

Fig. 23. Female genitalia and terminalia of *Sugia idiostygia* (Suoi).
A: Whole genitalia in lateral view (left). B: Ostium in ventral view. C: Female terminalia in lateral view (left).
D: 7th abdominal sternum in ventral view. Scales 1 mm.

5-7. Genus *Neustrotia* Sugi, 1982
(Figs. 24, 25)

*Neustrotia* Sugi, Noctuidae, In Inoue, H. et al., Moths of Japan 1: 819.
Type-species: *Eustrotia japonica* Warren, 1912, (in Seitz, Gross-Schmett. Erde 3: 281, t. 52f, by original designation.)

Head: Frons smooth without prominences; labial palpus upturned, 2nd joint reaching to vertex of head, the 3rd very short; antenna of male ciliated with short hairs; antenna of female sparsely ciliated. Dorsal crests absent or on 1st only. Fore wing with 9–11 stalked, or 9 from 8 and anastomosing with 10 to form areole; termen evenly curved. Hind wing with veins 3–4 stalked; 5 fully developed from below middle of discocellulars; 6, 7 from the upper angle. Wing pattern: Large costal patches on antemedial and medial areas; a large suffusion on the submedian fold; reniform stigma modified or untraceable; the basic patterns almost traceable on postmedial, subterminal and terminal areas.

Male external genitalia: Tegumen moderately large; in dorsal view tegumen tapering towards posterior margin and swollen dorsally at the dorsomedial
Fig. 24. Male external genitalia of *Neutrotia japonica* (Warren).


portion; fenestrula untraceable; peniculus undeveloped; vinculum slender and very short; saccus large and deep. Uncus rather short, slender, pointed at the tip and densely long-haired. Valva 2.5–5.0 times as long as wide; cucullus distinctly separated from harpe by membranous incision on anellifer and well developed respectively; a small process on basal portion of cucullus and in some species this process separated from base of cucullus; sacculi moderately large, fused with each other on basal 1/2 of their dorsal margins or not. Juxta absent or present. Phallus very large; the suprazonal sheath completely
sclerotized and cylindrical or membranous dorsally; coecum very short, 1/4 as long as subzonal sheath and rounded; cornuti composed of a large and acute apical process and minute spines on vesica.

**Female genitalia:** Eighth abdominal tergum well sclerotized; its ventral portion projecting ventrally and in some species ventral portions fused with each other on the ventromedial area; copulatory cavity moderate and its ventral portion well sclerotized. Ductus bursae well sclerotized and short. Ductus seminalis slender, long, almost 3 times as long as ductus bursae and bulged beyond the middle. Bursa copulatrix small; cervix bursae long or short. Signa represented by small triangular plate or short spines. Papilla analis quadrate; a triangular process with minute spines on its apical portion present on ventromedial portion between papillae anales.

5–8. **Genus *Maliattha* WALKER, 1863**  
(Figs. 26, 27)

Head: Frons smooth without prominences; labial palpus upturned, 2nd joint reaching to vertex of head; 3rd moderate, antenna of male ciliated with short hairs; antenna of female sparsely ciliated. Dorsal crests variable in number, but normally on 1st–4th. Fore wing with veins 3–5 from lower angle of cell; 6 form upper angle; 9 from 10 anastomosing with 8 to form areole; termen evenly curved. Hind wing with veins 3–4 stalked; 5 fully developed from below middle of discocellulars; 6, 7 from the upper angle. Wing patterns variable in many respects except for rosacea, in which the basic patterns are well preserved; antemedial line represented by oblique line, which is curved inwards; medial area suffused; orbicular and claviform absent; reniform oblique, or absent; postmedial, subterminal and terminal areas almost of basic patterns.

Male external genitalia: Tegumen broad and slender; fenestrela untraceable; peniculus undeveloped; vinculum short; saccus moderate and projecting dorsally.

Fig. 26. Male external genitalia of Maliattha signifera (Walker).
Fig. 27. Female genitalia and terminalia of Maliattha signifera (WALKER).

A: Whole genitalia in lateral view (left). B: Ostium in ventral view, showing large membranous pouch of ductus bursae. C: Female terminalia in lateral view (left). D: 7th abdominal sternum in dorsal view, showing the invaginations from lateral membranous regions between tergum and sternum. E: Spermatophore. Scales 1 mm.

Uncus broad, long and almost straight; basal portion of uncus weakly sclerotized; process of uncus projecting from base of uncus anteriorly and forming a muscle attachment of M.1. Valva large and in some species valvae asymmetrical; costa narrow; cucullus + harpe well developed, broad and curved dorsally; distal margin of cucullus + harpe with acute spines; ampulla developed in some species; sacculus large; in some species the border between sacculus and cucullus + harpe is distinct; a slender and long process at base of dorsal margin of sacculus. Juxta small. Phallus small; in lateral view the sclerotized portion of suprzonal sheath curved ventrally near its apical portion; coecum very small, 1/4 as long as subzonal sheath; cornuti absent.

**Female genitalia:** Eighth abdominal segment well sclerotized; copulatory cavity small; its ventral portion well sclerotized or not. Ductus bursae almost as long as bursa copulatrix; membranous pouch on its posterior portion in some species. Ductus seminalis long, 1.5–2.0 times as long as ductus bursae and bulged near vagina. Bursa copulatrix moderate; cervix bursae very short. Signa, if they are present, represented by small plate or minute spines. Papilla analis small, weakly sclerotized and sparsely short-haired.

(to be continued)
Fig. 28.

A: Deltote bankiana (Fabricius); male; Japan.
B: Deltote bellicula (Hübner); male; Canada.
C: Deltote uncula (Clerk); male; Europe.
D: Protodeltote pygarga (Hufnagel); male; Japan.
E: Protodeltote pygarga (Hufnagel); male; Europe.
F: Koyaga falsa (Butler); male; Japan.
G: Koyaga falsa (Butler); female; Japan.
H: Sugia idiosyginia (Sugi); female; Japan.
Fig. 29.

A: *Pseudodeltote brunnea* (Leech); male; Japan.  
B: *Neustrotia japonica* (Warren); male; Japan.  
C: *Maliattha signifera* (Walker); male; Japan.  
D: *Micardia argentata* Butler; male; Japan.