

## Female Reproductive Organs of Lepturine Cerambycid Beetles from Japan, with Reference to their Taxonomic Significance (Part 1)

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**Abstract** Brief descriptions with illustrations of female reproductive organs are given for 57 species of lepturine cerambycid beetles belonging to 44 different genera, and their taxonomic significance is scrutinized. Configuration of ovipositor and the presence or absence of bursa copulatrix can be regarded as bearing taxonomic importance at higher levels, the former at generic or subgeneric level and the latter at tribal or generic level. On the other hand, spermatheca with its gland and duct can be employed at a lower level of taxonomy, either subgeneric or specific. Classification suggested by the study of female genitalia mostly accords with the current one based upon external morphology, but in certain cases, there is considerable discrepancy between the two. Such cases are specially noted, but taking taxonomic actions is left for future comprehensive studies.

The first part is devoted to the introductory notes and descriptions of the Xylosteini through the Stenocorini.

### Introduction

The family Cerambycidae is one of the most important and well known groups of the Coleoptera, containing more than 20,000 known species described from all over the world. In Japan alone, more than 700 species belonging to 8 subfamilies have been described, and the number is still increasing bit by bit with the progress of faunal studies.

Unfortunately, however, it cannot be said that the classification of cerambycid beetles has not yet gained consensus of specialists' opinions, mainly because it has been based on external characters which can be observed without making dissections of beautiful specimens. Studies of male genitalic characters have been made in recent years, but nearly always at the species level. Apart from the Cerambycidae, male genitalic characters have been extensively adopted in classifying various Coleoptera, most widely at the species level but also at tribal or still higher levels. As regards female sexual organs, however, very little has been published on their morphology and taxonomic implications.

In 1927, TANNER published the result of his extensive investigation of the female genitalia of the Coleoptera, and noted that major classification of the order should be reconsidered in several points. He studied seven cerambycid species, and gave illustrations of the female genitalia of *Rhagium lineatum* (OLIVIER) (figs. 165–166) as an

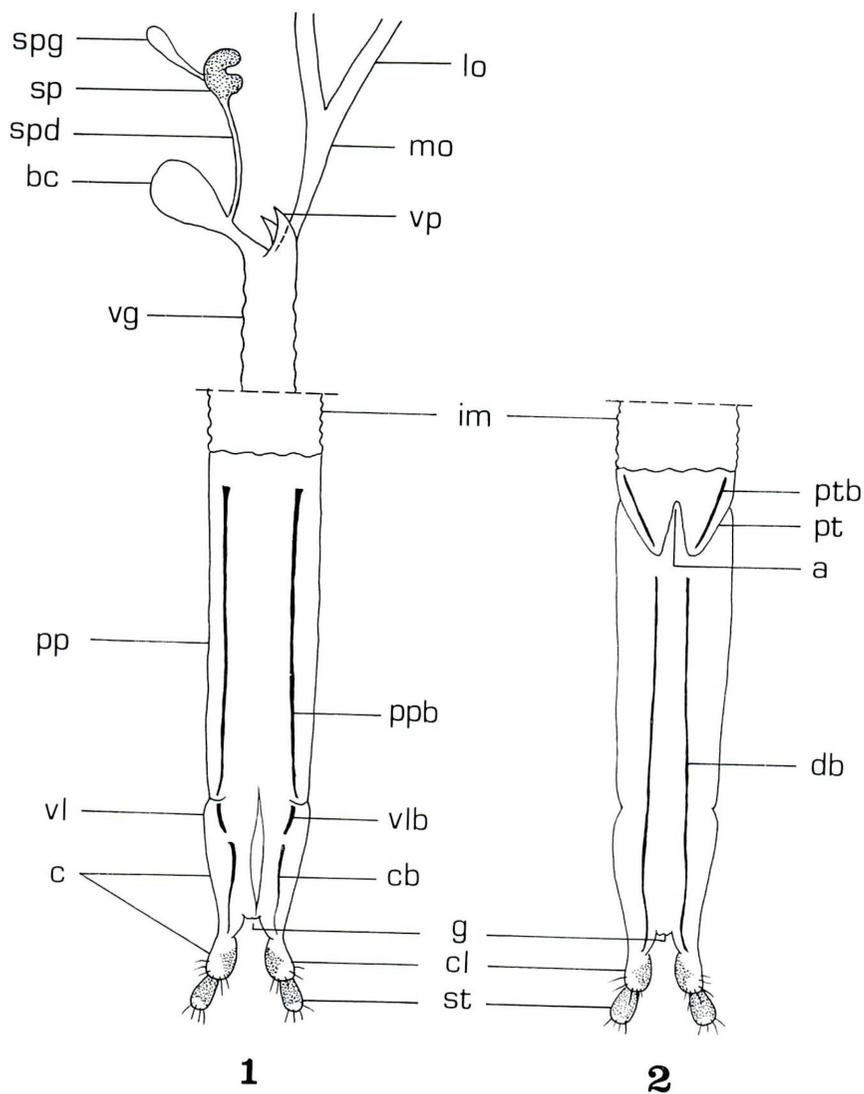
example of the Lepturinae. More studies have been made after the World War II, mainly on curculionid (e.g., ASLAM, 1961, and MORIMOTO, 1962) and chrysomelid (e.g., MANN & CROWSON, 1983) beetles but also carabid (e.g., ISHIKAWA, 1973) and other groups.

As for cerambycid beetles, ARAKAWA (1939) examined reproductive organs of the two sexes of two *Purpuricenus* species, and stated that female genitalia were more useful than male ones in discriminating them. More recently, NISHIO (1956 a-b, 1959, 1968) published four short papers, in which ovipositors of a series of species including four lepturines were described. These are the first reports dealing with the female genitalia of Japanese lepturines. This line of study was followed up by KUBOKI (1980 a-c, 1981 a-b), who put emphasis on the taxonomic importance of female genitalia in cerambycids. He gave illustrations of spermathecae for more than 80 species, the majority of which were lepturines. Whole reproductive systems were, however, described only on five lepturines, one parandrine and six prionines. I myself became aware of taxonomic importance of female reproductive organs in cerambycid beetles (SAITO, 1984 b), and have been describing them from time to time since 1981. As the results, descriptions of ovipositors and/or spermathecae were already given for 13 species of lepturines and 1 lamiine (TAKASU, 1981; SAITO, 1984 a; S. & A. SAITO, 1984, 1986, 1988; MAKIHARA & SAITO, 1985; MAKIHARA & SAITO, in MAKIHARA *et al.*, 1985). Chinese entomologists also became interested in the female genitalia of cerambycids, and recently published the results of their studies on the Lamiinae (DU, 1986 a-b; LI, 1986 a-b).

On the other hand, IUGA and ROŞCA (1962) gave a detailed account of female genitalia of some cerambycids and discussed on the origins of their components. Morphological studies in a similar line were carried out by CHANG (1965), HUTCHESON (1980) and MANN and CROWSON (1983), on the basis of *Monochamus*, *Arhopalus* and *Hylotrupes*, respectively. Their investigations were not primarily concerned with the taxonomic value of female genitalia, but careful terminology based upon detailed analyses is very important not only for morphologists but also for taxonomists.

In the present paper, I am going to describe female reproductive organs of some five dozens of lepturine cerambycid beetles from Japan. Though many other species were also examined, their genitalia were not basically different from the ones to be described and illustrated. Their names will be noted after the descriptions of related species. Terminology of genitalic components mainly follows HUTCHESON's (1980), but other important works such as LINDROTH (1957), LINDROTH and PALMEN (1970) and so on were also cited.

Before going into further details, I wish to express my hearty thanks to the late Professor Hiromasa SAWADA and Professor Yasuaki WATANABE of the Entomological Laboratory, Tokyo University of Agriculture, under whose suggestion and supervision the main part of the present study was carried out. Deep indebtedness should be expressed to Dr. Shun-Ichi UÉNO of the National Science Museum (Nat. Hist.), Tokyo, who kindly read through the original manuscript of this paper and gave me helpful



Figs. 1-2. Diagram of female reproductive organ in lepturine cerambycid beetles; 1, ventral view; 2, dorsal view (only ovipositor). Abbreviations: a, anus; bc, bursa copulatrix; c, coxite; cb, coxite baculum; cl, coxite lobe; db, dorsal baculum; g, gonopore; im, intersegmental membrane of 8th and 9th segments; lo, lateral oviduct; mo, median oviduct; pp, paraproct; ppb, paraproct baculum; pt, proctiger; ptb, proctiger baculum; sp, spermatheca; spd, spermathecal duct; spg, spermathecal gland; st, stylus; vg, vagina; vl, valvifer; vlb, valvifer baculum; vp, vaginal plate.

advice. I am also indebted to many friends of mine, whose names are given under the heading of "Material used", for their kind support in supplying valuable specimens,

above all to Professor Keiichi KUSAMA, Dr. Shûji OKAJIMA and Mr. Tohru SHIMOMURA, without whose aid this study could not have been completed. Last but not least, I have to thank my husband, Shusei, for his support extended to me during the course of this study.

### Materials and Method

Fifty-seven species of Japanese lepturine cerambycid beetles belonging to 44 different genera were used for this study. One to three specimens of each species were dissected, and their genitalia were examined. Only the collecting data of the specimens used for drawings were given next to the headings of respective species.

Female genitalia from dried materials were dissected out from the abdomen boiled in 7% potassium hydroxide solution for about ten minutes, cleansed in 70% ethanol, and then stained with eosin. Observations of the materials thus prepared were mostly carried out in 70% ethanol under a binocular microscope. Sketches were prepared for the ventral and dorsal aspects of ovipositor and the ventral aspects of internal reproductive organ.

### Morphology of Female Genitalia

The female genitalia is roughly divided into two parts, the ovipositor and the internal reproductive organ, the latter of which is composed of ovaries, lateral oviducts, median oviduct, vagina, bursa copulatrix and spermatheca with gland and duct (Figs. 1-2).

The ovipositor is a tubular structure formed by the 8th and 9th segments and their intersegmental membrane. In lepturines, the apical part of the ovipositor is usually strengthened by some baculi which are rod-like sclerotized structure and seem to be useful for protruding the ovipositor. A pair of ventral baculi of the paraproct are almost straight in many cases. The valvifer usually merges with the coxite, but in *Caraphia* of the Xylosteini and *Evodinus* of the Stenocolini, it is distinguished from the coxite because its baculi extend towards the latter without meeting the coxite baculi. The coxite with a pair of baculi is divided into two subcylindrical parts, between the bases of which opens the gonopore. The divided apical parts of coxite, to be called "coxite lobes" in this paper, bear tactile hairs and sensilla, are sclerotized at the inner sides, and surmounted with the styli apically or laterally. Each stylus, possessing tactile hairs at the terminal end, is usually sclerotized except for the apex.

A dorsal pair of baculi extend beyond the apices of the paraproct to the base of the apical part of coxite. At the junction of the intersegmental membrane and the paraproct, there is the proctiger dorsally with a pair of baculi, under which opens the anus. In cerambycid beetles, the proctiger is very short, while it normally extends for the same length as the paraproct in many other families of Coleoptera. HUTCHESON (1980, p. 420) considers that the dorsal baculi functionally replace the baculi that

usually strengthen the lateral margins of the proctiger of normal length.

The median oviduct is a single canal behind the junction of the lateral oviducts, each led from ovary, and opens to the vagina at a point enclosed with a pair of accessory plates or lobes. These plates or lobes, usually membranous but sometimes more or less sclerotized, vary in configuration with species. In previous studies on the female genitalia of cerambycids, however, they were not named nor even recognized. In the present study, therefore, these apparatus will be called "vaginal plates". The vagina opens through the gonopore, while its anterior part forms a membranous bursa copulatrix, which receives the endophallus of median lobe during copulation. The bursa is either narrow or broad, sometimes rudimentary or even absent. Into the bursa copulatrix or directly into the vagina, the spermathecal duct opens from the spermatheca, which is a curved capsule with sclerotized walls, receives sperm after copulation and stores it till the time it is used for fertilization. The spermathecal gland is always attached to the lateral face of the spermatheca, but position of its attachment varies with species. This gland secretes nutrients for the sperm.

## Results

### Subfamily Lepturinae

#### Tribe Xylosteini

#### *Caraphia lepturoides* (MATSUSHITA, 1933)

(Fig. 3)

*Collecting data of the material used.* Amami-Ohshima Is., Ryukyu Islands, 7-V-1977, H. KUSUNOKI leg.

Paraproct short and broad, with straight baculi; valvifer distinct, with its baculi discontinuous to coxite baculi, which are simple; inner distal part of each coxite lobe weakly sclerotized; some tactile hairs present at the apex of the lobe; stylus small and weakly sclerotized, with short tactile hairs; dorsal baculi starting from near the posterior edge of proctiger; proctiger baculi curved at the posterior parts; median oviduct long and narrow, abruptly broadened near the apical end; vaginal plates oval and very broad, constricted at the bases; vagina narrow and more or less broadened anteriorly; bursa copulatrix absent; spermatheca narrow and sharply bent at middle, with thick spermathecal duct lightly constricted 6-8 times, then abruptly curved and directly entering into vagina at the end.

#### Tribe Encyclopini

#### *Encyclops olivacea* BATES, 1884

(Fig. 4)

*Collecting data of the material used.* Nikkawa-rindô, Yamanashi Pref., 1-VI-

1978, A. TAKASU leg.

Paraproct short and narrow, with its baculi almost straight; valvifer baculi continuous to simple coxite baculi; inner distal part of each coxite lobe weakly sclerotized; stylus weakly sclerotized, with short tactile hairs; dorsal baculi long; proctiger baculi straight; vaginal plates short, narrow and pointed; vagina broad; bursa copulatrix tubular in basal half and ovoid at the apical part; spermatheca sigmoidally curved, with narrow basal portion, which is rectangularly bent and evidently constricted, and strongly curved main part which is narrow but obviously broader than the basal; spermathecal duct thin, imperfectly coiled and entering into the apical part of bursa copulatrix.

### Tribe Rhagiini

#### *Rhagium japonicum* BATES, 1884

(Fig. 5)

*Collecting data of the material used.* Shibechea, Hokkaido, 14-VI-1964, H. INOUE leg.

Paraproct rather long, with its baculi feebly sinuate; valvifer indistinct; coxite baculi proximally widened, each coxite lobe ovoid, bearing long tactile hairs and rather heavily sclerotized at the inner part; stylus rather heavily sclerotized except for apex and with long tactile hairs; dorsal baculi short, with their anterior ends widely distant from the posterior edge of proctiger, proctiger baculi long and straight; vaginal plates long and extremely narrow; vagina broad, proximally narrowed but abruptly widened at the anterior end; bursa copulatrix large and elongated ovoid, with narrow basal portion; spermatheca subglobular, transversely folded in at the inner side near the apex, with thin duct entering into bursa copulatrix at its basal third.

*Note.* The bursa copulatrix is similarly large in the other two Japanese species of the genus, *R. heyrovskyi* PODANÝ and *R. pseudojaponicum* PODANÝ. Perhaps this feature can be regarded as being characteristic of *Rhagium*,

#### *Enoploderes bicolor* OHBAYASHI, 1941

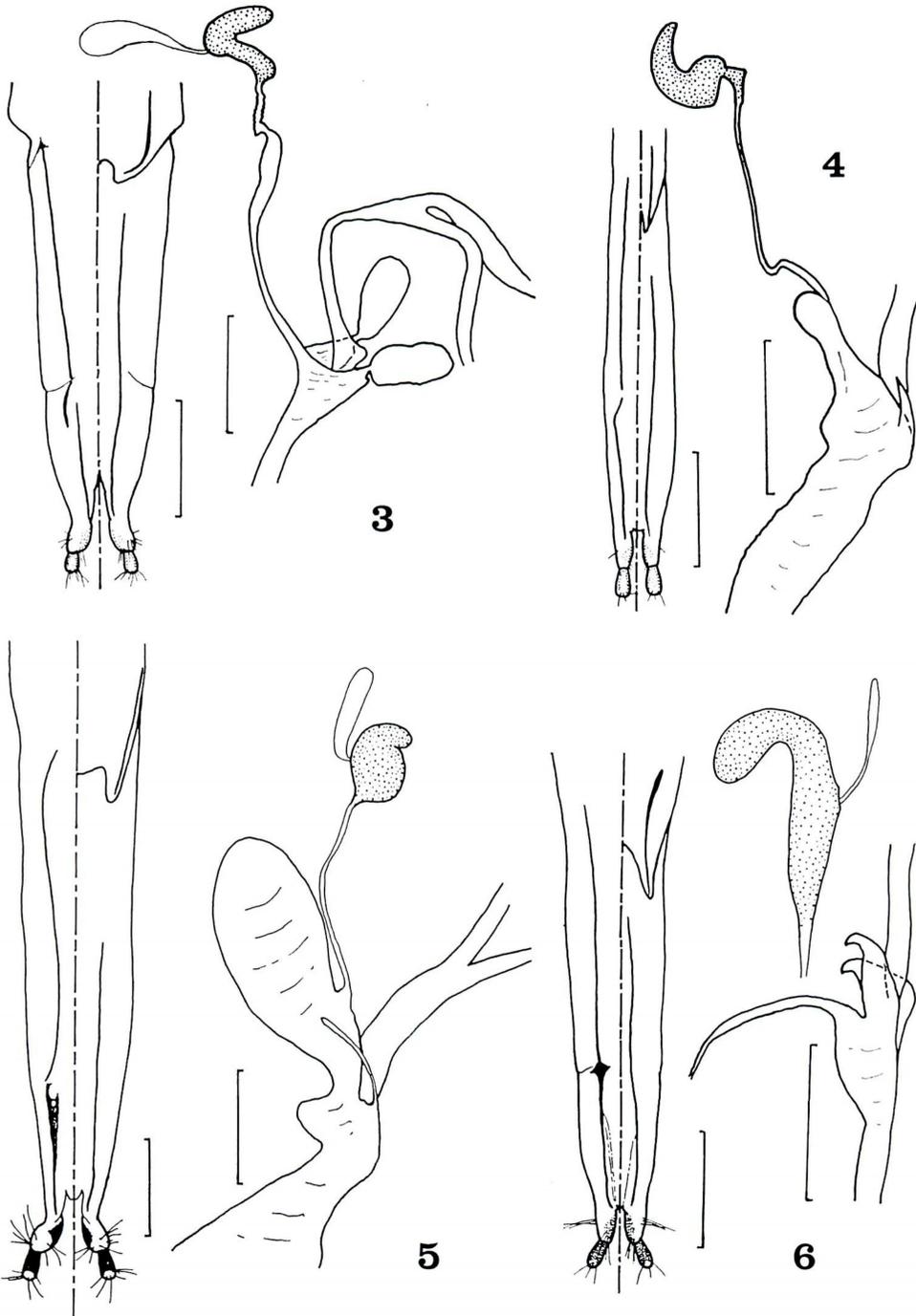
(Fig. 6)

*Collecting data of the material used.* Kominawa, near Mt. Takao, west of Tokyo, 21-IV-1980, M. SAKAI leg.

Paraproct short and narrow; valvifer indistinct; coxite baculi abruptly widened at the base; each apical part of coxite lobe narrow, weakly sclerotized at the inner part and bearing long tactile hairs both laterally and apically; stylus relatively slender

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Figs. 3-6. Ovipositor (left half: ventral view; right half: dorsal view) and internal reproductive organ (ventral view). — 3, *Caraphia lepturoides*; 4, *Encyclops olivacea*; 5, *Rhagium japonicum*; 6, *Enoploderes bicolor*. (Scale: 0.5 mm.)



and weakly sclerotized, with long tactile hairs; dorsal baculi long and very slightly sinuate; proctiger baculi long, rather thick and gently arcuate; vaginal plates broad, sharply hooked at the apices; vagina narrow though widened anteriorly; bursa copulatrix absent; spermatheca large, gradually broadened distad, almost straight in basal two-thirds but strongly curved at the apical part, without visible constriction near the base; spermathecal duct directly entering into bursa copulatrix.

#### Tribe Stenocorini

##### *Sachalinobia rugipennis koltzei* (HEYDEN, 1887)

(Fig. 7)

*Collecting data of the material used.* Sugenuma, Katashina-mura, Gunma Pref., 23-VII-1978, S. SAITO leg.

Paraproct very long, each baculum with a small sclerotized portion at the lateral sides of the base; valvifer indistinct; coxite baculi thick anteriorly, thin and curved posteriorly; each coxite lobe sclerotized at the inner part and with tactile hairs; stylus long and slender, moderately sclerotized and bearing tactile hairs at the apex; dorsal baculi much shorter than paraproct baculi, their anterior ends being very widely distant from proctiger; proctiger baculi straight; median oviduct long, with tumid apical portion; vaginal plates long and very narrow, somewhat falciform; vagina widened anteriorly; bursa copulatrix large and broad; spermatheca strongly bent, fairly thick in basal two-thirds and narrowed towards apex, with the duct entering into the base of bursa copulatrix.

##### *Stenocorus coeruleipennis* (BATES, 1873)

(Fig. 8)

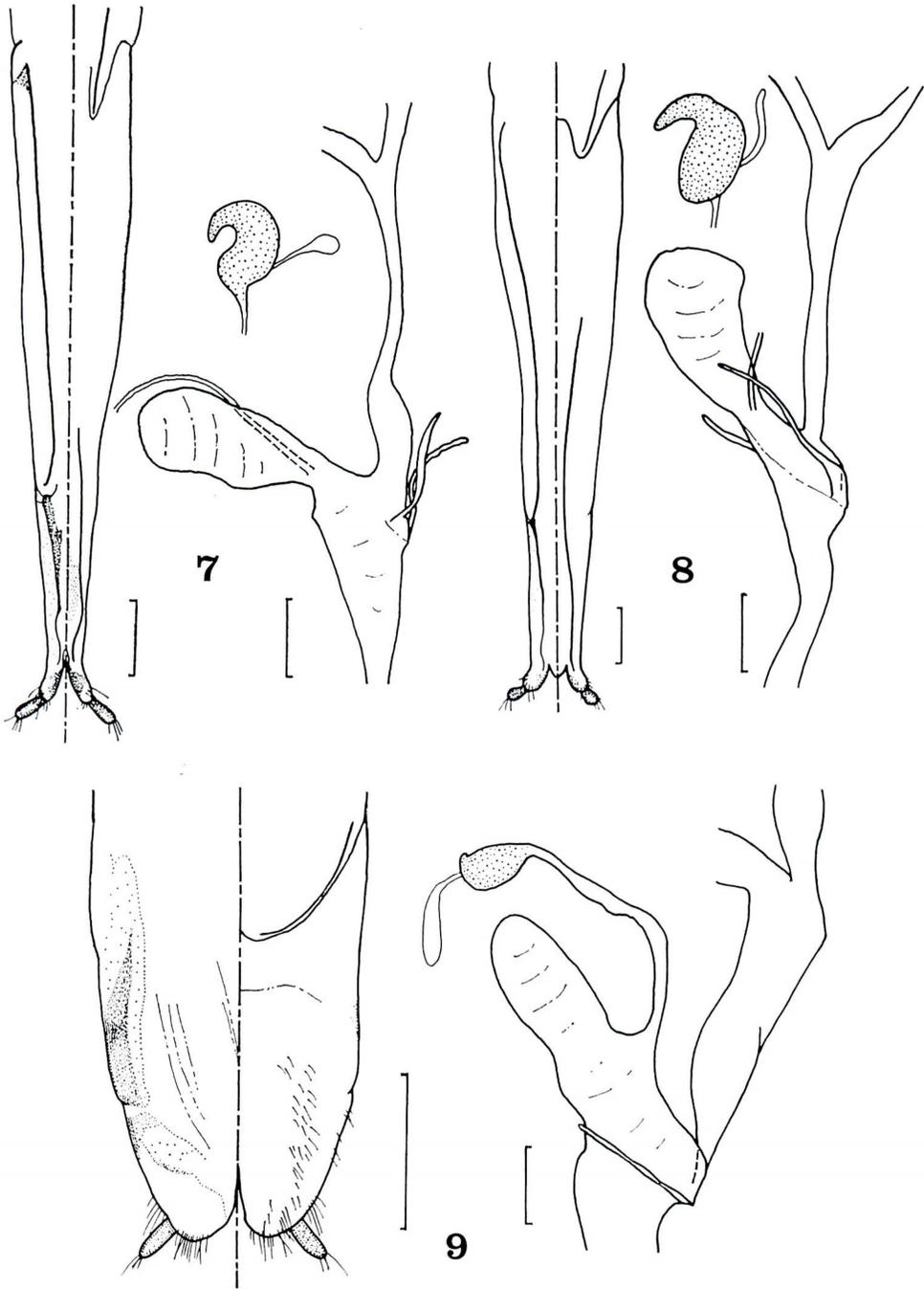
NISHIO, 1959, Kontyû, Tokyo, 27, p. 211, fig. 4 [*Toxotus*]; KUBOKI, 1980, Kita-Kyûshû no Konchû, Kokura, 27, p. 102, pl. 7, fig. 1 [*Toxotus*].

*Collecting data of the material used.* Kohsawa, Katashina-mura, Gunma Pref., 25-VII-1979, A. TAKASU leg.

Paraproct long, with its baculi feebly sinuate; valvifer indistinct; coxite baculi slightly widened at base and curved posteriorly, coxite lobes rather thick, bearing long tactile hairs and weakly sclerotized at the inner part; stylus with tactile hairs small and weakly sclerotized; dorsal baculi short, with their anterior ends widely distant from proctiger and slightly sinuate; proctiger baculi straight; median oviduct long; vaginal plates conspicuously long and narrow, and slightly sinuate; vagina narrow though broadened anteriorly; bursa copulatrix large and narrowed towards basal

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Figs. 7-9. Ovipositor (left half: ventral view; right half: dorsal view) and internal reproductive organ (ventral view). — 7, *Sachalinobia rugipennis koltzei*; 8, *Stenocorus coeruleipennis*; 9, *Toxotinus reini*. (Scale: 0.5 mm.)



portion; spermatheca subglobular at basal two-thirds, with apical part strongly hooked and narrowed towards apex; spermathecal duct clearly distinguished from spermatheca and leading to the basal portion of bursa copulatrix.

*Toxotinus reini* (HEYDEN, 1879)

(Fig. 9)

*Collecting data of the material used.* Nikkawa-rindô, Yamanashi Pref., 18–VI–1978, A. TAKASU leg.; Shimizu Pass, Gunma Pref., 24–VII–1976, T. SASAMOTO leg.

Paraproct very short and broad, sclerotized along lateral margins in posterior half, without baculi; valvifer indistinct; coxite very broad, sclerotized at lateral portions near the base, without baculi, with each coxite lobe remarkably broad and flattened, many tactile hairs on lateral margins, and surmounted with slender stylus which is abaxially articulated to the latero-apical face of coxite lobe and is weakly sclerotized; dorsal baculi absent; apical part of ovipositor furnished with many tactile hairs dorsally; proctiger baculi gently arcuate; median oviduct broad; vaginal plates long, straight and extremely narrow; vagina broad and moderately widened at the anterior portion; bursa copulatrix large, cylindrical, and not constricted at base; spermatheca subovoid, with a transverse impression at the apico-lateral part; spermathecal duct thick, entering into bursa copulatrix at a position a little before middle.

*Pachyta lamed* (LINNÉ, 1758)

(Fig. 10)

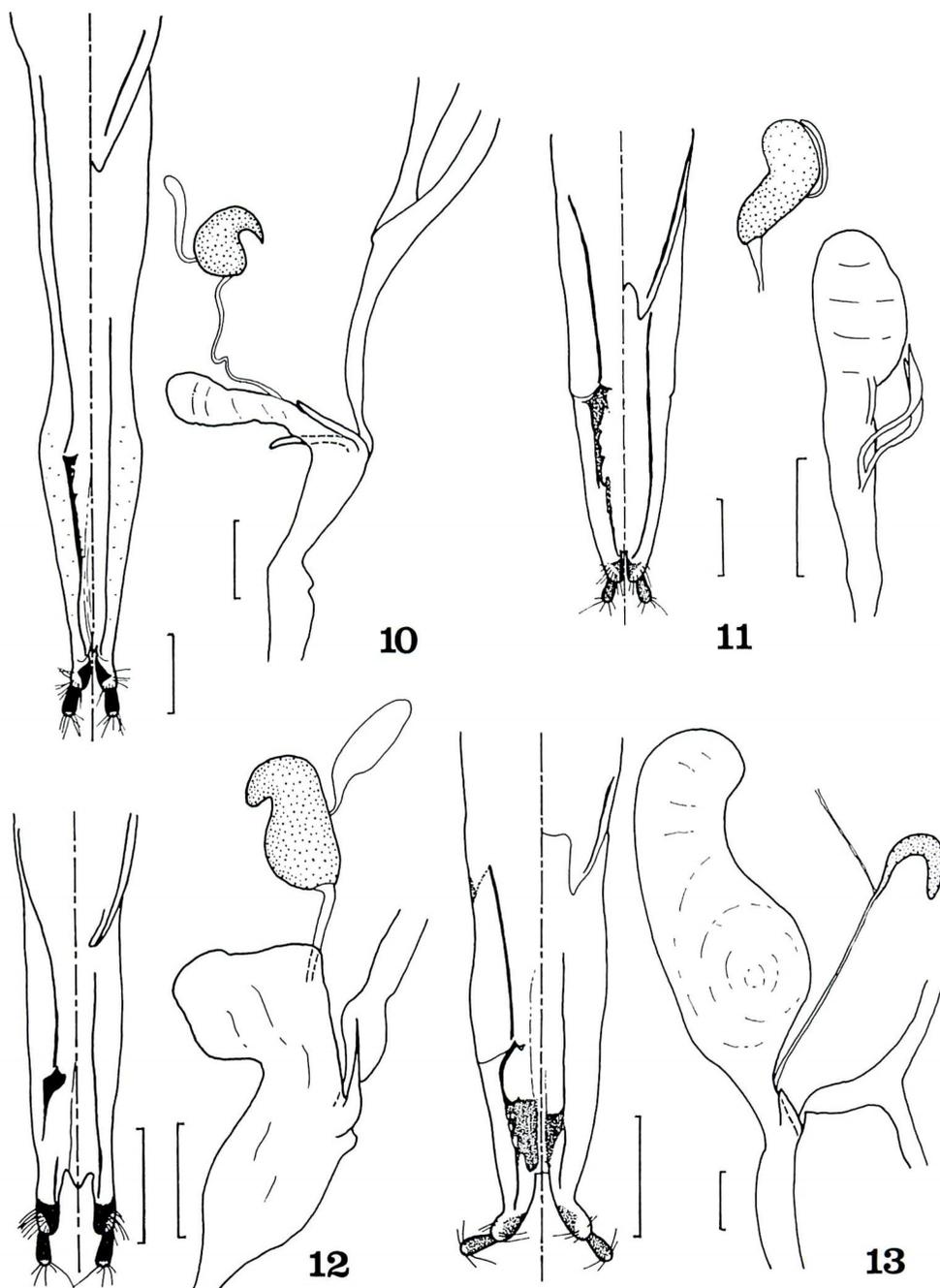
*Collecting data of the material used.* Horoka, Hokkaido, 27–VII–1972, T. SHIMOMURA leg.

Paraproct rather long, with its baculi feebly sinuate; valvifer indistinct; coxite baculi thick anteriorly, thin and slightly sinuate posteriorly; coxite lobes rather heavily sclerotized at each inner part and with long tactile hairs; stylus long and sclerotized, bearing long tactile hairs; dorsal baculi a little shorter than paraproct baculi, their anterior ends being widely distant from proctiger; proctiger baculi straight; median oviduct narrow; vaginal plates long and narrow, mostly straight; vagina narrow, though slightly broadened at base; bursa copulatrix relatively large and widened towards apex; spermatheca clearly distinguished from the duct, subglobular at the basal part, strongly curved at the apical part which is acuminate; spermathecal duct thin, imperfectly coiled and entering into the basal part of bursa copulatrix.

*Brachyta punctata* (FALDERMANN, 1833)

(Fig. 11)

*Collecting data of the material used.* Ohsenjôzawa, Yamanashi Pref., 24–VI–1979, K. SASAKI leg.



Figs. 10-13. Ovipositor (left half: ventral view; right half: dorsal view) and internal reproductive organ (ventral view). — 10, *Pachyta lamed*; 11, *Brachyta punctata*; 12, *Evodinus borealis*; 13, *Gaurotes (Paragaurotes) doris*. (Scale: 0.5 mm.)

Paraproct short with rather thick baculi; valvifer imperfectly separated from coxite, with its baculi thick and more or less discontinuous to rather thick coxite baculi; coxite lobes sclerotized at each inner part, whose edge is not rounded but almost straight, with long tactile hairs; stylus sclerotized and abaxially articulated to coxite lobe, with long tactile hairs; dorsal baculi fairly short, though longer than paraproct baculi, feebly curved; proctiger very long, with long, rather thick and straight baculi; vaginal plates extremely long, narrow and curved, widened at apical third to form a narrowly lanceolate apical part, whose apex is acute; vagina narrow; bursa copulatrix broad and oval; spermatheca fairly elongate, gently curved, and widened at the apical part, its sclerotization becoming weaker towards apex; spermathecal duct entering into the base of bursa copulatrix.

*Note.* The characteristically uneven sclerotization of spermatheca is common to the other member of this genus, *B. bifasciata japonica* (MATSUSHITA). Besides, in these two species, each coxite lobe is not rounded at the inner edge and the proctiger baculi are very long.

*Evodinus borealis* (GYLLENHAL, 1827)

(Fig. 12)

*Collecting data of the material used.* Tsugaike, Hakuba-mura, Nagano Pref., 30-VII-1979, A. TAKASU leg.; Sugenuma, Katashina-mura, Gunma Pref., 23-VII-1980, M. SAKAI leg.

Paraproct short, with feebly sinuate baculi; valvifer distinct, with its baculi discontinuous to short coxite ones and thickened anteriorly; each coxite lobe widely and rather heavily sclerotized at the inner side, distinctly convex at the inner distal portion, and with long tactile hairs; stylus long and rather heavily sclerotized except for apex, abaxially articulated to coxite lobe, and with long tactile hairs; dorsal baculi almost as long as paraproct baculi; proctiger baculi long; vaginal plates relatively wide at the base but becoming thinner and acicular towards the tip; vagina much widened at the anterior part; bursa copulatrix broad and not much constricted at base; spermatheca broad, with straight outer lateral margin, abruptly curved at the apical part, and blunt at the extremity; spermathecal duct very short, entering into the middle part of bursa copulatrix.

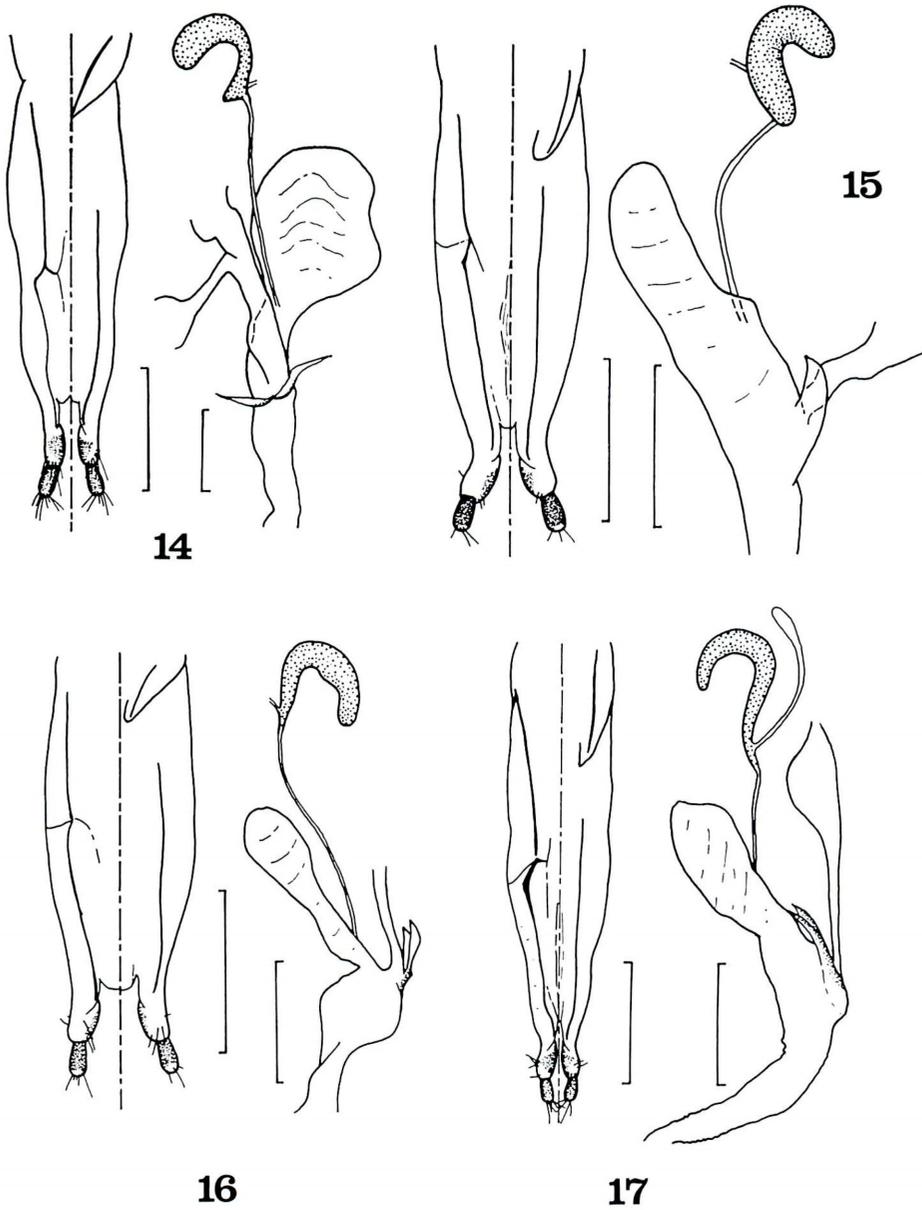
*Gaurotus (Paragaurotus) doris* BATES, 1884

(Fig. 13)

KUBOKI, 1980, Kita-Kyûshû no Konchû, Kokura, 27, p. 102, pl. 10, fig. 27; 1981, Elytra, Tokyo, 9, pp. 59-60, fig. 1; SAITO, 1984, Gekkan-Mushi, Tokyo, (159), p. 35, text-figs.

*Collecting data of the material used.* Marunuma, Katashina-mura, Gunma Pref., 25-VII-1980, M. HARADA leg.

Paraproct very short, with its baculi rather thick and almost straight; valvifer



Figs. 14–17. Ovipositor (left half: ventral view; right half: dorsal view) and internal reproductive organ (ventral view). — 14, *Gaurotes (Carillia) atripennis*; 15, *Lemula nishimurai*; 16, *Dinoptera minuta*; 17, *Acmaeops septentrionis*. (Scale: 0.5 mm.)

indistinct; coxite sclerotized at the median part inside of baculi, which are thick and lightly sinuate in basal third and thin in apical third, coxite lobes rather rounded, sclerotized at each inner side, and with some tactile hairs; stylus rather long, with long tactile hairs; dorsal baculi thin, but with inwardly spread sclerotized part just above the sclerotized median part of coxite; proctiger baculi almost straight; vaginal plates fairly wide at the base and simply narrowed to pointed apex; vagina rather broad; bursa copulatrix very large, swollen, widest at proximal third, curved at the apical part, and well constricted at the base; spermatheca narrow and strongly curved, with the gland attached to the lateral side of the base; spermathecal duct narrow and straight, entering into the basal constricted part of bursa copulatrix.

*Gaurotos (Carillia) atripennis* MATSUSHITA, 1933

(Fig. 14)

KUBOKI, 1980, Kita-Kyūshū no Konchū, Kokura, 27, p. 102, pl. 10, fig. 28 [*aureopurpurea*], fig. 30; SAITO, 1984, Gekkan-Mushi, Tokyo, (159), p. 35, text-fig.

*Collecting data of the material used.* Yunohana Spa, Tateiwa-mura, Fukushima Pref., 12-VI-1972, T. SHIMOMURA leg.

Paraproct short, with thin and rather straight baculi; valvifer indistinct; coxite baculi feebly sinuate, with the apical lobes relatively slender, sclerotized at each inner part, and bearing long tactile hairs; stylus slender and sclerotized, with long tactile hairs; dorsal baculi fairly short though still longer than paraproct baculi, with feebly sinuate posterior portions; proctiger baculi rather long and straight; vaginal plates narrow, pointed at the apex, and slightly sclerotized at the base; bursa copulatrix large and constricted at base; spermatheca narrow and curved though widened towards rounded apex, with conically protruding basal part; spermathecal gland attached to near the duct which enters into the basal constricted part of bursa copulatrix.

*Lemura nishimurai* SEKI, 1944

(Fig. 15)

*Collecting data of the material used.* Odamiyama, Ehime Pref., 14-V-1972, Y. KUSUNOKI leg.

Paraproct very short with thin baculi; valvifer indistinct; coxite baculi thin and almost straight, coxite lobes relatively broad, weakly sclerotized at each inner part, and bearing short tactile hairs; stylus broad and sclerotized, with long tactile hairs; dorsal baculi almost straight and about twice as long as paraproct baculi; proctiger baculi almost straight; vaginal plates broad, curved and pointed at the apex; vagina narrow; bursa copulatrix subcylindrical, broad and not constricted at base; spermatheca fairly broad and nearly U-shaped; spermathecal duct arising from the lateral side near the base of spermatheca, and entering into the middle part of bursa copulatrix.

*Note.* Also in the other two Japanese species of the genus, *L. decipiens* BATES

and *L. rufithorax* PIC, the paraproct is very short, the stylus is broad, and the spermatheca is U-shaped. Perhaps these features can be regarded as being characteristic of *Lemura*.

*Dinoptera minuta* (GEBLER, 1832)

(Fig. 16)

*Collecting data of the material used.* Kotozura, Okutama, west of Tokyo, 17-IV-1980, A. TAKASU leg.; Mizunesawa, Okutama, west of Tokyo, 17-IV-1979, A. TAKASU leg.

Paraproct very short with thin baculi; valvifer indistinct; coxite baculi thin and almost straight; coxite lobes somewhat broad and weakly sclerotized at each inner side, with long tactile hairs; dorsal baculi almost straight and about twice as long as paraproct baculi; proctiger baculi short; vaginal plates somewhat sclerotized at base, narrow, broadened to beyond middle, and then narrowed again towards acute apex; vagina broadened anteriorly, weakly sclerotized at the portion at which attach the vaginal plates; bursa copulatrix long, subcylindrical proximally, and ovoid at the apical part; spermatheca narrow, strongly curved, and slightly broadened at the middle part, with gland attached to near the duct which enters into the basal part of bursa copulatrix.

*Acmaeops septentrionis* (C. G. THOMSON, 1866)

(Fig. 17)

*Collecting data of the material used.* Horoka, Hokkaido, 26-VII-1972, T. SHIMOMURA leg.

Paraproct short, rather narrow, with straight baculi; valvifer indistinct; coxite baculi thickened anteriorly, and feebly sinuate posteriorly; coxite lobes weakly sclerotized at each inner part, with tactile hairs; stylus small, weakly sclerotized and with long tactile hairs; dorsal baculi a little longer than paraproct baculi, proctiger baculi straight; vaginal plates long, narrow, gently arcuate, and pointed at the apex, being weakly sclerotized throughout; vagina narrow, more or less widened anteriorly; bursa copulatrix large, subcylindrical and hardly constricted at base; spermatheca narrow and strongly curved, with reflexed basal part; spermathecal gland attached to the lateral side of the basal part; spermathecal duct very short, entering into the middle part of bursa copulatrix.

*Macropidonia (Macropidonia) ruficollis* PIC, 1901

(Fig. 18)

*Collecting data of the material used.* Azusayama, Kawakami-mura, Nagano Pref., 12~13-VII-1978, T. SHIMOMURA leg.

Paraproct short with straight baculi which are fairly thick; valvifer indistinct; coxite sclerotized at the median part inside baculi which are very thick and broadened anteriorly, with the apical lobes sclerotized at each inner part and bearing tactile hairs; stylus rather heavily sclerotized, with long tactile hairs at the apex; dorsal baculi slightly arcuate, thickened posteriorly; proctiger baculi thick, more or less arcuate; median oviduct long; vaginal plates short and very narrow, acicular; vagina much widened anteriorly; bursa copulatrix broad, continuing to vagina without constriction; spermatheca broad, curved at middle, and angularly produced at the base; spermathecal gland widely open at the outer corner of the capsule; spermathecal duct thick and rather short, entering into the middle part of bursa copulatrix.

*Macropidonia (Pseudosieversia) japonica japonica* (OHBAYASHI, 1937)

(Fig. 19)

*Collecting data of the material used.* Iwanadome, Shimashimadani, Azumi-mura, Nagano Pref., 4-VIII-1974, W. SUZUKI leg.

Paraproct short with straight baculi; valvifer indistinct; coxite weakly and longitudinally sclerotized on each side of median line to the middle of baculum, which is fairly thick, each coxite lobe relatively broad, weakly sclerotized at the inner part, and bearing long tactile hairs; stylus sclerotized, with long tactile hairs; dorsal baculi feebly sinuate; proctiger baculi rather long and straight; vaginal plates short and broad, acute at the apex; vagina narrow, almost rectangularly curved near the base; bursa copulatrix small, subtriangular, with depressed anterior face; spermatheca subovoid, with the small apical part almost rectangularly curved; spermathecal duct thick, sinuate, and entering into the anterior concavity of bursa copulatrix.

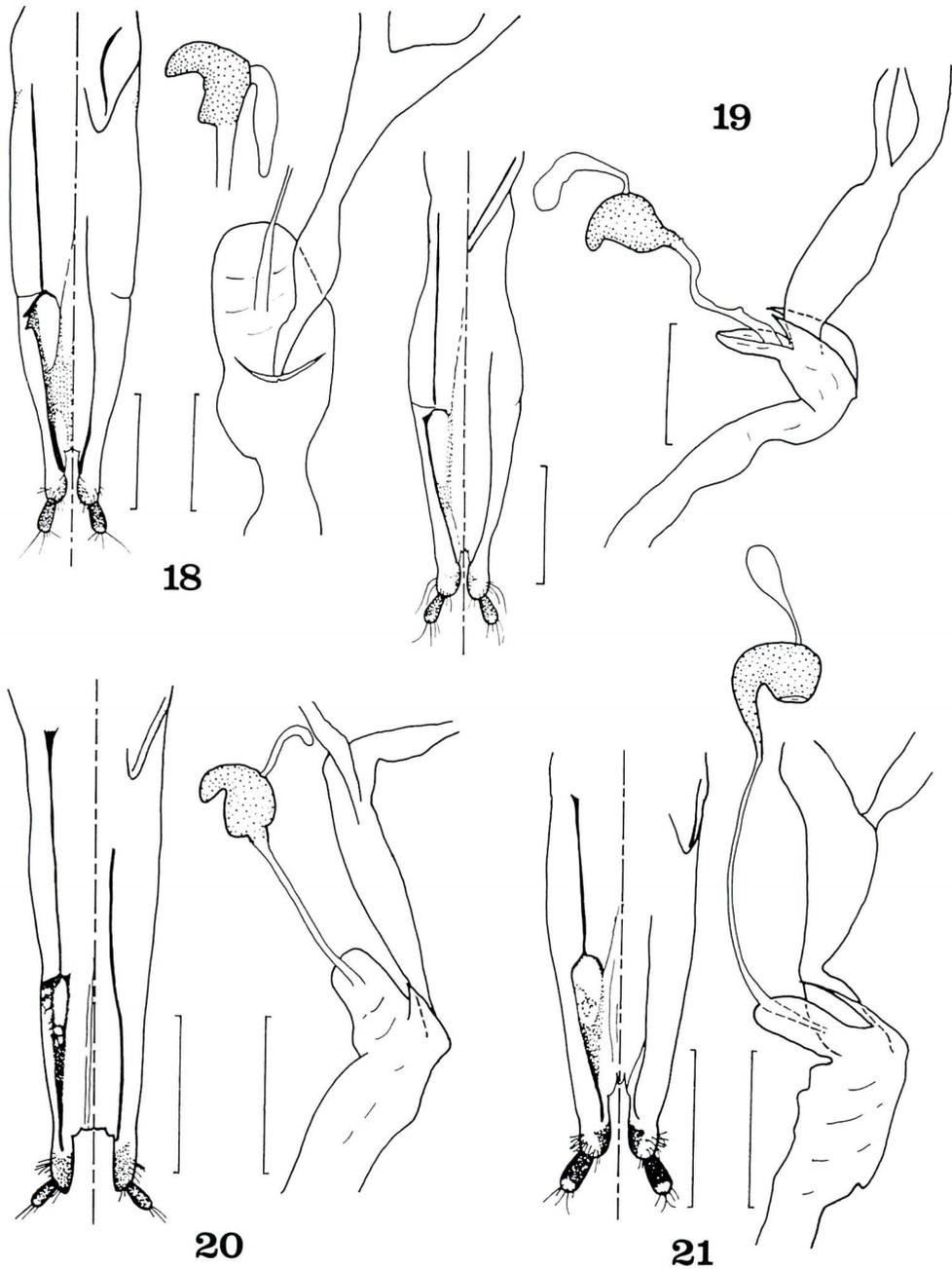
*Pidonia (Pidonia) obscurior obscurior* PIC, 1901

(Fig. 20)

KUBOKI, 1981, Kontyû, Tokyo, 49, p. 527, fig. 3; S. & A. SAITO, 1984, Sayabane, Tokyo, (10), p. 12, fig. 7 S1.

*Collecting data of the material used.* Marunuma, Katashina-mura, Gunma Pref., 24-VII-1978, A. TAKASU leg.; Sugenuma, Katashina-mura, Gunma Pref., 21-VII-1979, A. TAKASU leg.

Paraproct of moderate length, baculi straight and thickened at base; valvifer indistinct; each coxite baculum longitudinally twofold before middle, then gradually narrowed towards apex, forming a wide sclerotized part in median third, the external branch laterally spread out at the basal portion and the sclerotization reaching the side margin; each coxite lobe rather lightly sclerotized at the inner part, obtusely pointed at the apex, and bearing tactile hairs; stylus abaxially articulated to the lateral face of coxite lobe, small and narrow, rather lightly sclerotized, with tactile hairs at the apex; dorsal baculi more or less thick; proctiger baculi straight; vaginal plates short,



Figs. 18–21. Ovipositor (left half: ventral view; right half: dorsal view) and internal reproductive organ (ventral view). — 18, *Macropidonia* (*Macropidonia*) *ruficollis*; 19, *Macropidonia* (*Pseudosieversia*) *japonica japonica*; 20, *Pidonia* (*Pidonia*) *obscurior obscurior*; 21, *Pidonia* (*Cryptopidonia*) *insuturata*. (Scale: 0.5 mm.)

scalene triangular, with acute apex; vagina somewhat broad; bursa copulatrix short and wide, gradually narrowed towards rounded apex; spermatheca ovoid, strongly curved at the apical part, and constricted near the base; spermathecal duct rather thick, entering into the middle part of bursa copulatrix.

*Note.* Besides the species described above, I have examined the female reproductive organs of the following species which include five Taiwanese and one European forms: *P. yamato* HAYASHI et MIZUNO, *P. semiobscura* PIC, *P. matsushitai* OHBAYASHI, *P. shikokuana* HAYASHI, *P. limbaticollis limbaticollis* (PIC), *P. bouvieri* PIC, *P. paradisiacola* KUBOKI, *P. mutata* (BATES), *P. sylvicola* KUBOKI, *P. signifera* (BATES), *P. discoidalis* PIC, *P. shikokensis shikokensis* CHÛJÔ et HAYASHI, *P. meridionalis* KUBOKI, *P. deodara* KUBOKI, *P. bivittata* S. SAITO, *P. signata* MATSUSHITA, *P. grallatrix* (BATES), *P. major* S. SAITO and *P. lurida* (FABRICIUS). They are fundamentally identical with one another at least in basic conformation of spermatheca and ovipositor.

***Pidonia (Cryptopidonia) insuturata* PIC, 1901**

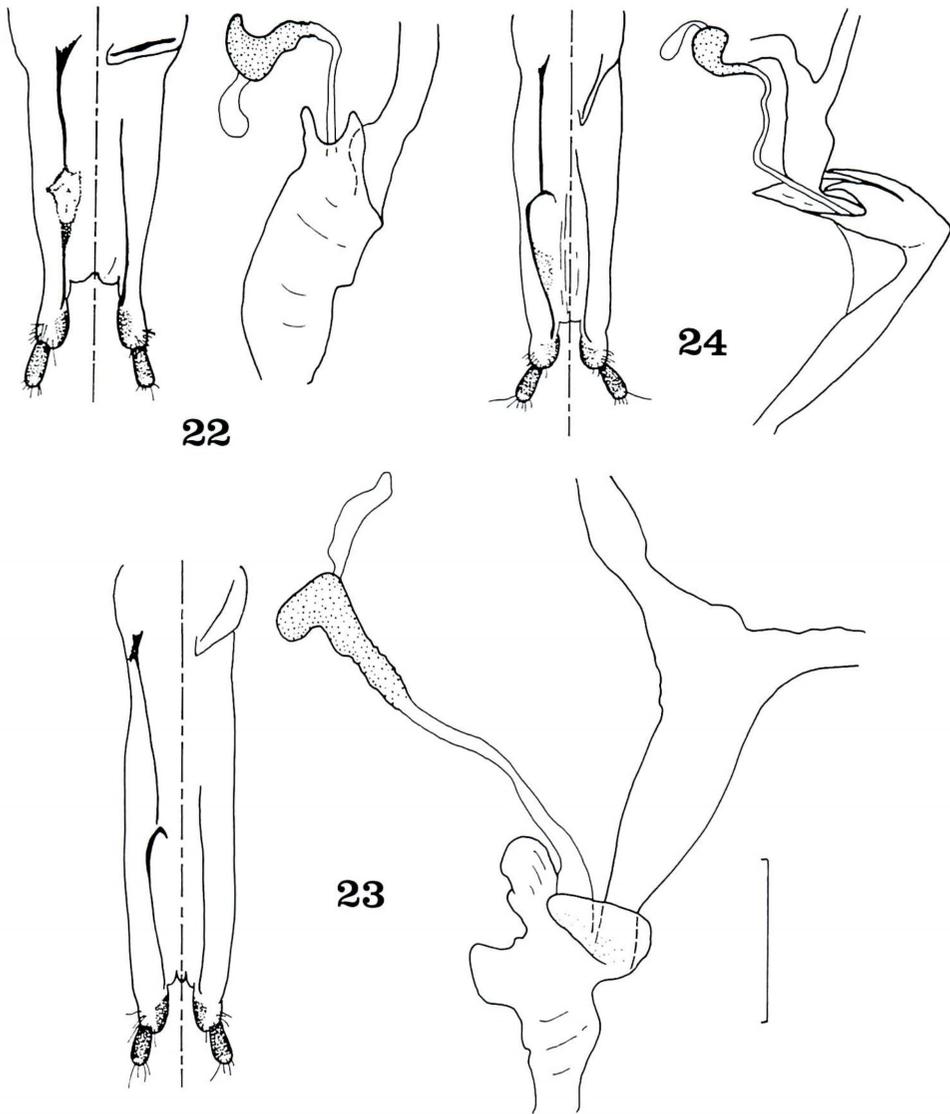
(Fig. 21)

KUBOKI, 1981, Kontyû, Tokyo, **49**, p. 527, fig. 30.

*Collecting data of the material used.* Marunuma, Katashina-mura, Gunma Pref., 22-VII-1978, A. TAKASU leg.; same locality, 25-VII-1979, A. TAKASU leg.

Paraproct short and broad, with straight baculi which are relatively thick; coxite gradually narrowed towards the apical part, each baculum widely divided at the base, the outer branch extending straight to apex, the inner one becoming obscure at a short distance from the base but a lightly sclerotized line is continuous, gradually approaches to the outer branch and joins it at middle, forming an elongate triangular area of sclerotization; coxite lobes broad and rounded, sclerotized at each inner part, with tactile hairs; stylus broad, sclerotized except for apex, and with tactile hairs; dorsal baculi feebly sinuate behind; proctiger baculi relatively short and straight; vaginal plates very narrow, acicular at the apical part; bursa copulatrix small and simple; spermatheca shaped like a tobacco pipe, with the duct entering into bursa copulatrix at its apex but continuing into it for some distance.

*Note.* Besides *P. insuturata* described above, I have examined the female reproductive organs of the following seven species, which are currently considered to belong to two different lineages because of discrepancy in colour pattern and other external characters: *P. hayashii* KOIKE, *P. masakii* HAYASHI, *P. hylophila hylophila* KUBOKI, *P. simillima* OHBAYASHI et HAYASHI, *P. amentata amentata* (BATES), *P. miwai* (MATSUSHITA) and *P. approximata* KUBOKI. The same trend of diversification is observed in the spermathecae, but their ovipositors are basically identical with one another irrespective of the difference of supposed lineages.



Figs. 22-24. Ovipositor (left half: ventral view; right half: dorsal view) and internal reproductive organ (ventral view). — 22, *Pidonia (Cryptopidonia) oyamae*; 23, *Pidonia (Mumon) aegrota aegrota*; 24, *Pidonia (Omphalodera) testacea*. (Scale: 0.5 mm.)

*Pidonia (Cryptopidonia) oyamae* (OYAMA, 1908)

(Fig. 22)

KUBOKI, 1980, Kita-Kyûshû no Konchû, Kokura, 27, p. 104, pl. 10, fig. 4; 1981, Kontyû, Tokyo, 49, p. 427, fig. 37.

*Collecting data of the material used.* Marunuma, Katashina-mura, Gunma Pref., 21–VII–1979, A. TAKASU leg.; same locality, 22–VII–1980, A. TAKASU leg.

Paraproct extremely short, with thick baculi widely dilated anteriorly; valvifer indistinguishable; coxite somewhat narrowed towards apex, its baculum mal-defined in basal half, being represented by an irregularly ring-like line of light sclerotization widely divergent at the basal part and then gradually convergent to the middle, behind which the baculum is rod-like and fairly thick; coxite lobes long, broad and rounded, sclerotized at each inner part, and with short tactile hairs; stylus large, bearing tactile hairs at the apex; dorsal baculi nearly a half as long again as paraproct baculi, slightly sinuate, and gradually thickened towards the posterior end; proctiger baculi rather thick and straight; vaginal plates broad at the base and rapidly narrowed towards blunt apex; vagina broad; bursa copulatrix small and finger-shaped; spermatheca somewhat comma-shaped, broadest at middle and strongly curved, with several constrictions at the narrow portion near the base; spermathecal duct very short and fairly thick, entering into the base of vagina; spermathecal gland rather widely open to the lateral face of spermatheca.

*Note.* I have also examined the female reproductive organs of the following two species and found no fundamental difference from those of *P. oyamae*: *P. chujoi* OHBAYASHI et HAYASHI and *P. fujisana* OBIKA et KUSAMA.

*Pidonia (Mumon) aegrota aegrota* (BATES, 1884)

(Fig. 23)

KUBOKI, 1981, Elytra, Tokyo, 9, p. 60, fig. 2 [*debilis*]; 1981, Kontyû, Tokyo, 49, p. 527, fig. 39 [*debilis*]; S. & A. SAITO, 1986, Sayabane, Tokyo, (11), p. 44, fig. 4 S1 [*aegrota kubokii*].

*Collecting data of the material used.* Nikkawa-rindô, Yamanashi Pref., 16–VII–1978, A. TAKASU leg.

Paraproct short and fairly narrow, with thin baculi dilated at the anterior end; valvifer indistinct; coxite not narrowed before branching into coxite lobes, its baculum thick anteriorly, divided at the base and with very short inner branch, the outer branch simple and slightly sinuate posteriorly; coxite lobes sclerotized at each inner part, and with tactile hairs; stylus of moderate size, sclerotized except for the apex, and bearing tactile hairs; dorsal baculi short and thin, almost as long as paraproct baculi, and slightly sinuate near the two ends; proctiger baculi thin and slightly curved; median oviduct broad; vaginal plates very broad, nearly isosceles triangular with blunt apex, and somewhat sclerotized at the posterior part; vagina broadened at base; bursa copulatrix small and ovoid; spermatheca broad, rectangularly curved at apical

third, and not narrowed towards the apex, with some constrictions at the basal portion, and with the gland attached to the outer corner; spermathecal duct very thick, directly entering into vagina with a wide orifice.

*Note.* Other than the Japanese species described above, I have examined the female genitalia of the two Taiwanese species, *P. amabilis* KUBOKI and *P. confusa* S. SAITO. Their coxites are almost parallel-sided before branching into lobes, and the coxite baculi are relatively simple without bearing accessorially sclerotized area or lines. These can be regarded as being peculiar to the subgenus *Mumon*.

*Pidonia (Omphalodera) testacea* (MATSUSHITA, 1933)

(Fig. 24)

KUBOKI, 1981, *Kontyû*, Tokyo, **49**, p. 527, fig. 42.

*Collecting data of the material used.* Mt. Daibosatsu, Yamanashi Pref., 16-VII-1978, A. TAKASU leg.; Sugenuma, Katashina-mura, Gunma Pref., 22-VII-1979, A. TAKASU leg.

Paraproct short and fairly narrow, with thick baculi somewhat dilated at the anterior end; valvifer indistinguishable; coxite relatively narrow, its baculum thick, divided at the base and with very short inner branch, the outer branch sinuously extending to apex and bearing a subtriangular sclerotized portion at the inner side of the middle; coxite lobes broad and rounded, sclerotized at each inner part, and with tactile hairs; stylus of moderate size, sclerotized except for apex, and with tactile hairs; dorsal baculi longer than paraproct baculi, almost straight for the most part but feebly sinuate near the two ends; proctiger baculi almost straight; vaginal plates unguiform, acute at the apex; vagina narrow, rectangularly bent and compressed near the base, and thinly lobate inside; bursa copulatrix small, subtriangular, with depressed anterior face, and acute at the apex; spermatheca small and comma-shaped, with rounded apical part; spermathecal gland open to near the apex of spermatheca; spermathecal duct wavy, entering into the base of vagina.

*Notes.* The subgenus *Omphalodera* comprises two known Japanese species, *P. testacea* and *P. puziloi* (SOLSKY). I have dissected females of both the species, and found that their genitalia are basically identical.

KUBOKI (1981) gave illustrations of the spermathecae for 42 species of the genus *Pidonia* (including some foreign forms), and erected a new subgenus, *Cryptopidonia*. He noticed in his key to the subgenera that the spermathecae are "minutely striated, funneled proximally" in *Cryptopidonia* but "smooth, truncated proximally, with several constrictions" in *Pidonia* (s. str.). Other than the genitalic features, he only pointed out body form and shape of elytral apices as key characters of these subgenera, so that his chief concern must have been in the difference in conformation of spermathecae.

A similar result was gained by my study of the ovipositor. In the species belonging to the subgenus *Cryptopidonia*, the paraproct is very short, the coxite lobes are broad with rounded apices, and each stylus is large and articulated to the apex of the coxite

lobe. The paraproct is particularly short in the species of the *oyamae* group, a feature which is not comparable with any species of the other groups of *Pidonia*. In the species belonging to the subgenus *Pidonia* (s. str.), the paraproct is rather long, the coxite baculi are definitely twofold at the basal part, the coxite lobes are obtusely pointed at the apices, and each stylus is small and abaxially articulated to the apex of the coxite lobe. In the species of the subgenus *Mumon*, the coxite with its baculi is rather simple in conformation, a feature which appears unique in the whole genus.

In short, the ovipositor can be adopted as an important character for classifying *Pidonia* species into subgenera or species-groups, just like conformation of spermathecae.

[Note] Japanese abstract and references to the present paper will be given at the end of the second part.