

## Morphological and phylogenetic studies on the larvae and male genitalia of the East Asiatic Tingidae (Heteroptera)

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<https://doi.org/10.5109/22784>

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出版情報：九州大学大学院農学研究院紀要. 15 (2), pp.137-256, 1969-06. Kyushu University  
バージョン：  
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Morphological and phylogenic studies on the larvae  
and male genitalia of the East Asiatic  
Tingidae (Heteroptera)\*

Chang Eon LEE

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\* Contribution Ser. 2, No. 308, Entomological Laboratory, Kyushu University.

## I. Introduction

The body of the adult Tingidae is so peculiarly differentiated that the external characters have been generally and exclusively used as tools in the taxonomy of the family. Virtually very little is known about the microscopic structures of the genital organs of Tingidae because the group is very minute in body size, about 2 to 3 mm long even in the adult stage.

On the other hand, some valuable works on the larvae of Tingidae have been published in Europe and the other countries, but in the Korea-Japan area the knowledge concerning the larvae still remains very insufficient.

It is especially difficult to interpret the phylogenetic relationship only by the specialized external characters of the Tingidae as in the cases of the other insects.

The Tingid larvae are generally furnished with particular body processes and covered with many tiny dermal structures which are extremely peculiar, and the change of such processes or structures during the course of postembryonic development is worthy of observation.

To analyze the evolutionary process of the family, it is very important to understand the developmental process of such differentiated structures and the details of the life history of each species including its habits, mode of life as well as its morphology from the comparative aspect.

The morphology of the Tingid genitalia and the developmental stages have been too little investigated nowadays to interpret the phylogeny of the family. The present study was undertaken to throw some light on the phylogeny of the family with special reference to those of the genus *Stephanitis* based upon my investigation on the subjects introduced above.

In this paper I treated the larvae of 24 species belonging to 11 genera and 2 subfamilies of the family. Among them 8 species are described on all 5 instars; 4 species on 2 later instars and the remainders on the last instar only.

The male genital organs of 43 species belonging to 17 genera and 2 subfamilies of the family were examined and it was proved that endosoma possesses distinct sclerotized appendages, and the morphology of them may be used as a characteristic criterion in distinguishing the groups.

The following sources of materials from the East-Asiatic area were investigated for the present study: the collection of the Entomological Laboratory of Kyushu University, the collection of Professor S. Miya-

moto which contains many forms of larvae and my collection which includes the Korean and Japanese materials taken by myself or donated by many persons.

The materials of the larvae and male genital organs were mounted on the slides for microscopic observations and are preserved in the Biological Laboratory, Liberal Arts and Sciences College, Kyungpook National University.

The materials used here were carefully determined after making comparisons with the specimens in the collection of the Entomological Laboratory of Kyushu University, in which the Takeya's types and specimens determined by Takeya are kept, and rechecked by Professor S. Miyamoto.

## II. Techniques and methods

The larvae are figured under the stereoscopic microscope with a squared micrometer, but the measurements of the parts of body were made under the monocular microscope with a linear micrometer, and all the measurements in the descriptions were shown in  $\mu$ . And the fine dermal structures of the larvae were observed under high magnification (about 800-1200 x).

In the case of genitalia, the pygophore was figured under the stereoscopic microscope, but the parameres and endosomes were observed under the highly magnified monocular microscope.

The larvae were observed on the specimens which were preserved in alcohol, but in case the specimen was dried, it was first soaked in warm water to ensure an even penetration of potash, and then heated in 10 % solution of caustic potash, using double water bath, for about 20 minutes. It was again soaked in warm water to remove the potash, and observed in light glycerin under the microscope. After observation the materials were run through alcohol for dehydration and xylol in the usual method and mounted in balsam on the slides for permanent preparations. If there were enough specimens for observing genitalia, the whole body was heated in the solution of caustic potash, using double water bath, for about 20 minutes, or left it in the solution for a period varying from 20 hours to a day until the abdomen became soft and semitransparent. Then the abdomen was first separated from the other parts of body. The abdomen was washed in warm water, and dissected to pull out the pygophore. From the pygophore the parameres were separated and the phallus was extracted on the slide glass, finally dissected the phallus so as to extend it forwards and backwards, and a cover glass was put on it.

If the specimens were rare, the insects, enveloped in double "triangle"



(parchment paper), was firstly steamed until the body became soft, and then the abdomen was separated from the other parts of body, and treated as in the former case. In case there is only 1 specimen, after the treatment with steam or potash, the abdomen and pygophore were reconstructed as in the original dried state, so that only the phallus and one paramere of the pair were mounted on the slideglass. The delicate processes mentioned above were examined under the stereoscopic microscope.

The other detailed methods were followed after the Singh-Pruthi's, 1925.

### III. Acknowledgments

It is with great pleasure that I take this opportunity of expressing my sincere gratitude to Professor K. Yasumatsu of the Entomological Laboratory, Kyushu University and Professor S. Miyamoto of the Biological Laboratory of the same university, for their great interests in and valuable suggestions to my work and for the gift of very valuable materials. This research was made under their supervision.

This investigation was chiefly made during my stay in the Entomological Laboratory of Kyushu University from 1966 to 1967, and completed after my return to Korea.

I have to express my sincere gratitude to the late Professor T. Mori, and to Professor Sa-Yeup Kim, who firstly introduced me to the Professors of the Entomological Laboratory of Kyushu University.

I am also particularly grateful to Mr. H. Hasegawa of the Laboratory of Insect Identification and Taxonomy, National Institute of Agricultural Sciences, Tokyo, Dr. M. Yamada, Nishio, Aichi (near Nagoya) and Mr. I. Hiura of Osaka Museum, Mr. Y. T. Noh of Korea University, Seoul, for their kindness in giving me many valuable specimens.

I have been very much indebted to Jun Sup Han of Kyung-Sang-Puk-Do Provincial Board of Education, Professor Hoon Soo Kim, of Dept. of Zoology, Liberal Arts and Sciences College, Seoul National University, Professor Won Soo Kim in U.S.A. for their kind encouragement and help in many ways.

I am indebted to Professor T. Shirôzu, Biological Laboratory, College of General Education, Professor Y. Hirashima, Dr. K. Yano, Entomological Laboratory of Kyushu University, Professor S. Nakao of Kurume University, Mr. M. Tanaka, Maebashi, Gunma, Dr. S. Kaku, Mr. Y. Konagamitsu, Mr. T. Saigusa of the Biological Laboratory, College of General Education, Mr. H. Araki, Biological Laboratory, Faculty of Science, Kyushu University and Mr. Y. T. Kim, Kurume, Fukuoka, Japan, for

their kind help in various ways.

My hearty thanks are also due to the following persons, Mr. M. Y. Lee, Mr. S. O. Park, Mr. W. C. Choi, Mr. Y. C. Lee, Mr. S. K. Kim, Mr. J. H. Park and Mr. W. H. Park, for their assistance in collecting the materials and in various other ways.

#### IV. Historical review

1. **Studies on the larvae:** About half a century ago, the life history of *Leptoypha mutica* (Say) was already reported (by Dickerson & Wess, 1966). So far as I know, it was the first work of treating the larval instars of Tingidae. Since then, several valuable papers on the larval instars of Tingidae have been published, and among them the following works are remarkable:

In 1923, Butter and Later described *Tingis ampliata* (H.-S.) and *T. cardui* (L.), and in 1956 Southwood & Scudder gave more precise descriptions of them. In 1930, Dr. Takeya described and figured the last instar larva of *Cysteochila salicorum*. In 1946, Dr. Usinger described and figured the larvae of all 5 instars of *Leptoypha minor* McAtee. In 1953, Dr. Góñez-Menor illustrated the larvae of all 5 instars of *Stephanitis pyri* and *Monostira unicastata*. In 1955, Dr. Mathur described and figured the larvae of all 5 instars of *Tingis beesonii*. In 1957, Dr. Maa reported the larvae of *Tingis populi*, *Monanthia formosa*, *M. sp. A.*, *M. sp. B.*, *M. seorsa*, *Stephanitis esakii*, *S. typica*, *S. aperta*, *S. pyrioides*, *S. nashi*, *S. subfasciata*, and *Dulinus conchatus* from Formosa and South China, but without giving any figures. Since 1957, Dr. Stusak, have done some very excellent works on the morphology of the Tingid larvae from Czechoslovakia; i. e., in 1957, he described and figured the last instar larvae of *Acalypta marginata*, *A. parvula*, *Catoplatus carthuscanus*, *Derephysia foliacea*, *Lasiacantha capucina*, *Monanthia echii*, *M. humuli* and *Tingis cardui*; in 1959, he published the description and figures of the larvae of all 5 instars of *Tingis grisea*; in 1959, he described the last instar larvae of *Agramma intermedia*, *Tingis reticulata*, *T. buddleiae*, *Galeatus scrophicus* and *Stephanitis pyri*; and in the same year he reported the results of studies on the larval characters of some species of the genus *Monanthia* in collaboration with Stys. In 1958, Dr. Cobben described and figured the last instar larvae of *Physatocheila quadrimaculata*, *P. dumetorum*, *Oncochila simplex*, *Monanthia symphiti*, *M. humuli*, and *M. echii*. In their paper of 1960 Drs. Drake and Davis showed the figures of the last instar larvae of *Litadea delicatula* and *Diconocoris capsul*. In 1965, Drs. Drake and Ruhoff figured the last instar larvae of *Australotingis franzeni* and *Ammianus alberti* in their catalog.

2. **Studies on the male genitalia:** Very few were reported about the

male genital organs of Tingidae. In the paper of Dr. Singh-Pruthi (1925) we find the brief descriptions and rough figures of the male genital organs of *Urentius echinus* and *Dictyonota fuliginosa* along with those of many other hemipteran species. But, in 1960, Drs. Drake and Davis dealt with general descriptions and figures of the pygophore and the stereoscopic aspects of the male genital organs of *Tingis cardui* and *Cantacader quadricornis*, and noted that "the endosoma may be further characterized by its lack of appendages and, as is characteristic of other cimicomorphs, it is not differentiated into vesica and conjunctiva" (1960, p. 24). Although the endosomal appendages have been overlooked by the authors, the structure is developed actually in various degrees in the *Tingid phalli* and will be treated in detail in the present article. In 1958, Dr. Cobben treated the pygophores, parameres and phalli of *Stephanitis rhododendri*, *S. oberti* and *S. pyrioides*; but only the outlines of the pygophores and parameres were figured and the phalli were dealt with roughly in the stereoscopic aspects.

## V. General morphology

### 1. Larvae

#### (1) *Antennae and Rostrum* (Fig. 1)

Antennae: 5 instars are apparently distinguishable in the Tingid larvae through the postembryonic larval development. Each instar larva differs in size—the proportions of various body parts also change. On the other hand, some of the characteristics develop instar by instar but some disappear.

Proportion of the antenna to the length of the body is variable among the species. The antennal length of most of the species of the genus *Stephanitis* is approximately equal to the body length, or somewhat less than the body length, but the length of the antenna of *S. nashi nashi* is the shortest of all species of the genus (146: 185). In *Galeatus spinifrons*, *Cochlochila lewisi*, *Cantacader lethierryi*, and *Cysteochila fieberi*, the antenna is approximately half the body length. But, in *Tingis ampliata* and *T. comosa*, the antennae are comparatively short and nearly one-third of the body length; but in *T. populi*, antennae are long and the ratio to the body length is about 3:4; relative length of the antennae of *T. grisea* is very short and about a quarter of its body length. Four antennal segments are apparently distinguishable: the 1st one is the thickest, the 2nd is the shortest, the 3rd is the longest and most slender, and the distal one is pointed at the apex. The distal segment is furnished with such various kinds of hairs as a few immovable hairs, slender earpick-

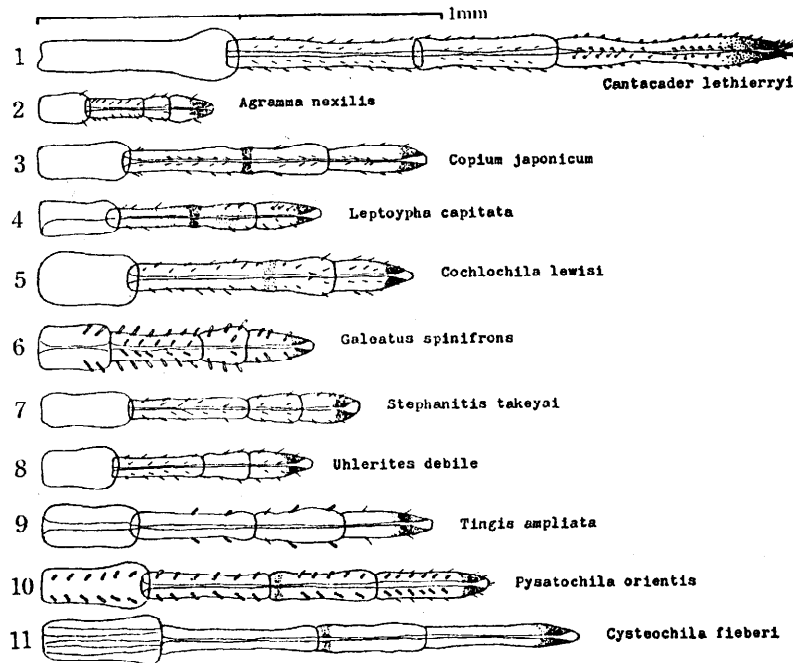


Fig. 1. Rostra of the 5th instar larvae of various genera.

shaped hairs, and many simple hairs, but hairs of the earlier stages usually of clubbed type. In the genus *Stephanitis*, only *ambigua* and *nashi nashi* have the distal segment less than half the length of the 3rd one, but in the other *Stephanitis* species the distal segment is mostly much longer than half the length of the 3rd. The genera, of which the 3rd antennal segment is longer than twice the distal one, are *Cochlochila* and *Cysteochila*; in *Cantacader* and *Physatocheila*, the 3rd segment is about twice the length of the 4th one. Meanwhile, in *Tingis comosa* and *T. ampliata*, the 3rd segment is approximately equal to the 4th one. But in *T. grisea* and *Copium japonicum*, the 3rd segment is shorter than the 4th one. The 3rd segment of *T. populi* is remarkably longer than the 4th.

**Rostrum:** Generally the basal segment is thicker than the succeeding segments, and the distal segment is pointed and darkened at the apex. In most genera, the total length of rostrum is shorter than the length of antenna. In the genera *Stephanitis* and *Uhlerites*, the length of rostrum is much shorter than half the antennal length. But in the other genera, the rostral length is variable; in *Cantacader* and *Cysteochila* the rostrum is longer than the antenna. The rostrum is elongated

and the length growth from the 1st to the 5th instars is double that of the 1st. This means that the rate of antennal growth is less than that of the body length or the antennal one. In most genera, the segmental lengths are  $2nd > 1st > 4th > 3rd$ : the 2nd is the longest and the 3rd is the shortest, and it is just inverse to the order of antennal segments. But there are some exceptions: in *Cantacader*, the 4th segment is the longest and the other segments are in the following order—2nd, 1st and 3rd; In *Cysteochila* and *Physatocheila*, the order is  $2nd > 4th > 1st > 3rd$ , and in *Copium japonicum* it is  $2nd > 4th > 3rd > 1st$ .

## (2) Head processes and Eyes (Fig. 2)

Head processes: Tingid larva generally bears 4 or 5 processes on the

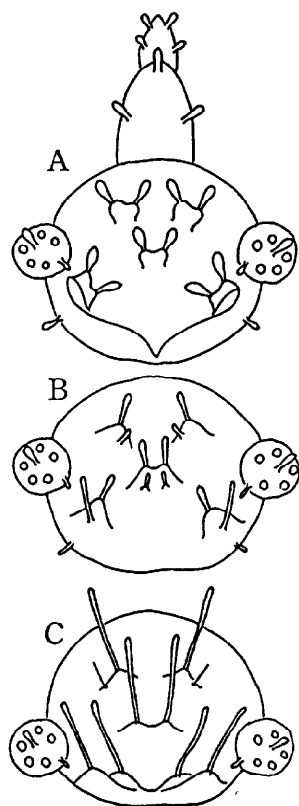


Fig. 2. Head processes and eyes of the 1st instar larva. A: *Tingis ampliata*; B: *Stephanitis nashi*; C: *Cochlochila lewisi*.

head. In the case of 4 processes they are grouped in 2 pairs, 1 anterior and 1 posterior, and all are very poorly developed in the Tinginae, but they are remarkably developed in *Cantacader lethierryi*. On the other hand, the case of having 5 head processes is also well known (except a few species), the anterior 2 in pair, single one somewhat before the middle, and the posterior 2 in pair. In the 1st instar each process is pronounced as a small protuberance and 2 conspicuous hairs are seen on the protuberance. The unpaired median process is supposed that it was originally paired and the paired processes were closely situated each other and finally fused into one process, because of the bifurcated median process and 2 apical and 2 basal hairs on it in the 1st instar larva of *Stephanitis nashi nashi* (Fig. 2-B). And in most of the fully developed larva of the same species, the unpaired head process is bifurcated at its apex and with 2 apical hairs. In *Tingis ampliata*, each process of the head bears 2 clubbed hairs in the 1st instar larva (Fig. 2-A), but in the 2nd instar larva the processes are somewhat elongated and each of the

paired processes bears one hair apically and a few hairs laterally, but the unpaired process is bifurcated and furnished with 2 hairs apically and a few hairs laterally. It is thought that in the 1st instar larva of *Tingis ampliata* (Fig. 2-A) and *Cochlochila lewisi* (Fig. 2-C), 2 basal hairs (of the unpaired process) which are seen in the 1st instar of *S. nashi nashi*, are obsolete. And it seems reasonable to explain that each of the paired processes bears one pair of 2 clubbed hairs on its apex, of which 1 clubbed hair becomes to be replaced by a simple lateral hair as the instar progresses, and so in the later instars the apex bears a single clubbed hair; the unpaired head process is originally derived from two or a fusion of the processes, thus bearing 4 hairs, of which the 2 hairs disappear at the early period, while 2 hairs remain on the apex in the later instar.

Eyes: In the 1st and 2nd instar larvae, each eye is composed of 5 facets arranged pentagonally and furnished with 2 hairs, one of which is longer and located centrally while another is smaller and peripheral in position. In the 3rd instar larva, the eye is composed of 5 initial facets and a few secondary ones which are newly added to the outside of the initial pentagon. In the 4th instar larva, about 10 facets are distinguishable besides the initial pentagon. In the 5th instar larva, many facets are recognizable in 3 degrees by different colors, i. e. the 5 initial facets of violet, some secondary ones of reddish and many tertiary ones of much paler or nearly colorless.

### (3) Thorax and abdomen and their processes (Fig. 3)

In the 1st instar larva, the shape of 3 thoracic segments and 9 abdominal segments resemble to each other. In *Uhlerites* spp., *Stephanitis* spp., and *Cochlochila lewisi*, the border line between the 1st abdominal segment and the 2nd one is apparently distinguishable, although the two segments resemble with each other both in size and shape. But in *Tingis ampliata* and *Cysteochila* spp., the line between the 1st abdominal segment and the 2nd one is narrow and obsolete at the sides, or the 1st abdominal segment is laterally tapered and spindle shaped, thus completely surrounded between the metanotum and the 2nd abdominal segment.

In the 4th instar larvae, the hemelytral lobes are elongated to the middle or the posterior portion of the 2nd abdominal tergite, and the metathoracic alar lobes are completely covered with the hemelytral lobes in *Cochlochila lewisi*, *Cysteochila fieberi*, *Uhlerites* spp. and *Stephanitis* spp. But in *Tingis ampliata*, *T. comosa*, *Copium japonicum* and *Galeatus spinifrons*, the metathoracic alar lobes are partially covered with the hemelytral lobes.

Through the postembryonic development, the thoracic segments are

greatly modified. Pronotum becomes larger progressively, especially the posterior margin is produced into a triangular projection, and the shape of the pronotum becomes pentagonal. Mesonotum projects to form hemelytral lobes and the metanotum also protrudes to form metathoracic alar lobes.

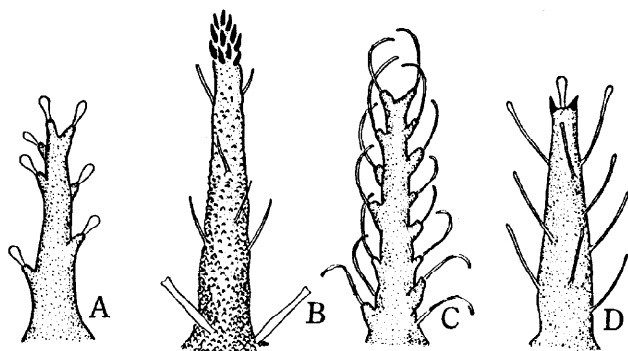


Fig. 3. Various types of the large processes. A: median dorsal process on the 8th abdominal tergite of the 5th instar larva of *Cysteochila consueta*; B: lateral process on the 6th abdominal segment of the 5th instar larva of *Cochlochila lewisi*; C: unpaired head process of the 5th instar larva of *Tingis comosa*; D: lateral process on the 7th abdominal segment of the 4th instar larva of *Stephanitis nashi nashi*.

Dorsal median processes of the thorax and abdomen, in fully developed state, are summarizable as follows: Anterior and posterior pairs on pronotum, mesonotal, metanotal and 1st abdominal processes are always in pair. But the other posterior ones are usually single, except in *Australotingis franzeni* and *Tingis buddleiae*, whose dorsal median processes are all in pair except only the process on the 2nd abdominal tergite of the latter. The median dorsal processes are represented by very small paired tubercles in the 1st instar larvae, and the paired tubercles are usually situated close to each other, and each tubercle has one specialized hair. As the development preceeds, these paired tubercles become closer to each other and contiguously fused into one. Therefore, in the unpaired dorsal median processes of the later instar larvae, each apex is slightly bifurcated and bears 2 specialized hairs. On the other hand, each of the paired processes is simply tipped bearing a single hair on its apex. In any case, the median processes are lacking both on the 3rd and 4th abdominal tergites. The pronotum and wing pads usually bear 4 or 5 processes on each side. But in the *Stephanitis*, *Uhlerites*, *Galeatus*, *Physatocheila* species and in *Tingis comosa*, only one process is situated on each side of the pronotum and wing pads. In the case of having multiprocesses, the numbers of the processes are in-

creased through the process of instars and the processes are generally becoming longer towards the later stages and those of the posterior parts are becoming longer than the anterior ones.

The sides of the abdomen are generally protruded in various ways. In *Litadea delicatula*, each abdominal segment expanded outwardly in a rectangular flap-like structure on each side; in *Cantacader lethierryi*, each segment bears 4 spinous processes; and in the species of Tinginae, each segment bears a single process on each side. In the 1st instar larvae, the lateral processes are of a small protuberance as in those of the median row, and from each protuberance one specialized hair grows out. But in the *Stephanitis*, *Uhlerites*, *Cochlochila* species, it is accompanied by one much smaller special hair on the base of the protuberance, and the basal hairs generally become indistinguishable from the lateral simple hairs in the later instar larvae. But the basal hairs on the processes of caudal segment are well developed and become an apical hair, thus the caudal processes bearing 2 apical hairs which are easily recognizable in the *Stephanitis* and *Uhlerites* species. These body processes are variously developed as in Fig. 3.

#### (4) Dermal tiny structures (Fig. 4)

The entire body surface, except legs, rostrum and antennae in the later instar larvae, is covered with very interesting dermal structures which are differentiated into different shapes as shown in Fig. 4.

Three (2 to 4) tipped tiny asterisks are seen in *Cantacader lethierryi*, *Lasiacantha capucina*, *Derephysia foliaces*, *Physatocheila quardimaculata*. But in *Tingis buddleiae* the tiny star has 3 or 4 very long and narrow tips and is fixed on a very long stalk (Stusak, 1959), *T. comosa* possesses sharply bitipped ones only. Two or 3 flapped ribbon structures are found in *Agramma nexilis*, but Stusak (1959) reported the presence of an asterisk structure on the body surface of *A. intermedia* as observed in *Cantacader lethierryi* in the present study.

In the *Acalypta* species, the tiny star has very short 4 or 5 tips and this condition is generalized in the genus. The tiny star resembles a plum-blossom in *Leptopypha capitata* and *Physatocheila orientalis*, but the structure is somewhat triangular, square or pentagonal in *Cysteocheila fieberi*, and simply hemispherical in *Tingis ampliata*, etc. Such various characteristic structures may be derived from the simple semispherical or semiglobular structures which are represented in the earlier instars of these species. Other dermal structures are as follows: Long slender rod-shaped hairs of *Cochlochila lewisi* and *Copium japonicum*; short, thick rod or bullet-shaped hairs of *Cysteocheila salicorum*; short ampulla-form hairs of *Cysteocheila consueta*; elongated slender ampulla-form hairs



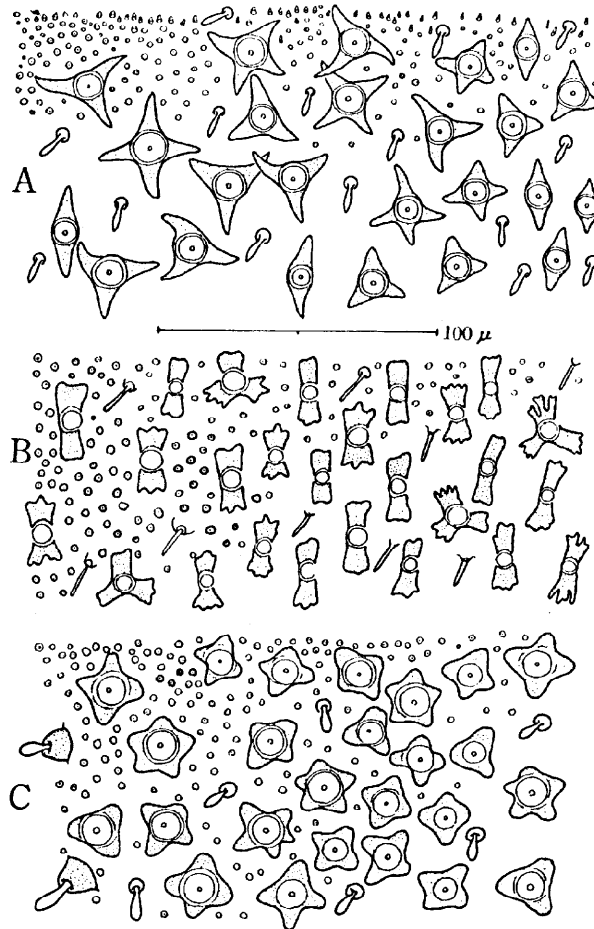


Fig. 4. Tiny dermal structures of the 5th instar larvae. A: the little star-shaped structures of *Cantacader lethierryi*; B: the ribbon-shaped structures of the *Agramma nexilis*; C: the plum-blossom-shaped structures of *Leptoypha capitata*.

of the *Stephanitis*, *Uhlerites* and *Galeatus* species, and generally they are grouped, but in *Galeatus* they are not grouped and much slender. Body surface generally covered with extremely minute conical tubercles or small clubbed hairs besides the special structures mentioned above.

## 2. Male genitalia

(1) *Pygophore*: The ninth abdominal segment is generally shaped

like a short elliptical tube, dorso-ventrally flat, excavated anterior and posterior sides of the dorsal wall, and the ventral wall is distally protruded into a posterior expansion, from which the inner wall runs forwards and forms a paired suspensory arms. The arms are articulated with the apodemes of phallus to hold the phallus. Lateral walls are generally inflated at a certain level, even in the case of having straight sides. The ventral or dorsal walls are inflated, so that the pygophore is not deeply telescoped into the preceding segments of abdomen, and the distal part from the inflated portion is exposed dorsally where the portion is furnished with fine or small stout hairs. The distal margin of the dorsal wall is excavated and bears the proctiger which is sclerotized and quadrate in dorsal view, and as in the other Heteroptera it represents the 10th segment and bears the anus. In this study all of the pygophores were examined by removing the proctiger. The shape of pygophore may be characterized by the genus or by the species, and the chief characters are the outline from the dorsal view, the form of the posterior expansion, the excavation of the basal margin of the dorsal wall, the protrusion of the proximal margin of the ventral wall and the transparent window of the ventral wall and others. Certain characteristics of the pygophore are very useful in distinguishing some genera or a part of the species.

(2) *Parameres*: Both parameres are attached to the sockets between the sides of suspensory arms and the postero-lateral edges of the dorsal wall of the pygophore. They are generally curved, basally thickened and gradually tapered distally and the apex is pointed. In some species they are very slender, gently curved, and the outline is streamlined, but in some other genera, they are strongly or rectangularly curved. In other cases, the middle portion is strongly inflated and the apical portion is so narrowed that it is apparently divided into 3 portions—the basal stalk portion, the middle main portion and the apical narrow portion. In general, the main portion and the apical portion are furnished with hairs, especially the inner and the outer sides bear some setaceous hairs. In the genus *Stephanitis*, the subdistal area on the dorsal side of the main portion bears some long bristles, but on the ventral surface evenly with fine hairs. Parameres are rarely armed with one or two minute tubercles near the apex, one in *Tingis populi* and two in *Stephanitis ambigua*.

(3) *Phallus* (Figs. 5, 6): This is held within the pygophore and connected to the suspensory arms by the phallic apodemes. The phallus is composed of well-sclerotized basal plates and partially sclerotized phalotheca (theca) and the phalotheca is differentiated into the basal bulbous portion and the apical tubular portion. The latter portion generally curves backward over the back and juts out through the space

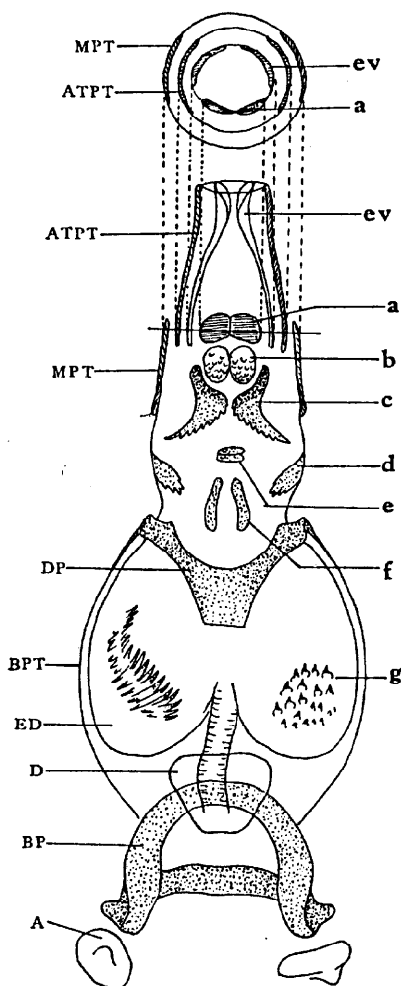


Fig. 5. Schema of Tingid phallus. A: apodeme; ATPT: apical tubular portion of theca; BP: basal plate; BPT: bulbous portion of theca; D: ductifer; DP: dorsal plate; ED: endosomal diverticula; ev: endosomal thickening; a-g: endosomal sclerites and appendages (a: sclerite; b, c, d: sclerotized appendages; e: sclerotized bulges; f: sclerotized bars g: sclerotized pricles).

between the suspensory arms.

The basal plates are stirrup-shaped and provided with a pair of apodemes near the upper ends, and the capitate disk of apodeme is attached by a promotor muscle.

The ductifer is situated at the lower rounded edge of the basal foramen, sclerotized and serves as a bridge through which the ejaculatory duct passes into the phallus.

Dorsal wall of the basal bulbous portion of phallotheca, just behind the basal plates, is sclerotized into a semi-circular dorsal plate.

The other areas of the wall of bulbous portion are transparent, membranous and somewhat strengthened, but feebly sclerotized areas are expanded posteriorly from the apices of both lateral arms of dorsal plate. Apical half of the phallotheca is composed of 2 parts—the middle portion and apical tubular one. The former conceals the basal part of the apical tubular portion in retraction; but, when the phallus is fully everted, it is situated between the apical tubular and basal bulbous portions. The middle portion is partially sclerotized or is provided with paired curved plates, but the other areas of the portion are membranous. The apical tubular portion is usually longer than the middle portion, and also partially sclerotized, with paired 2 semitubular plates.

Endosoma is wholly invaginated within the phallotheca. Through the basal foramen the ejaculatory duct passes into the phallus, and the duct is lead to the endosoma between the endosomal diverticula, which are pair-

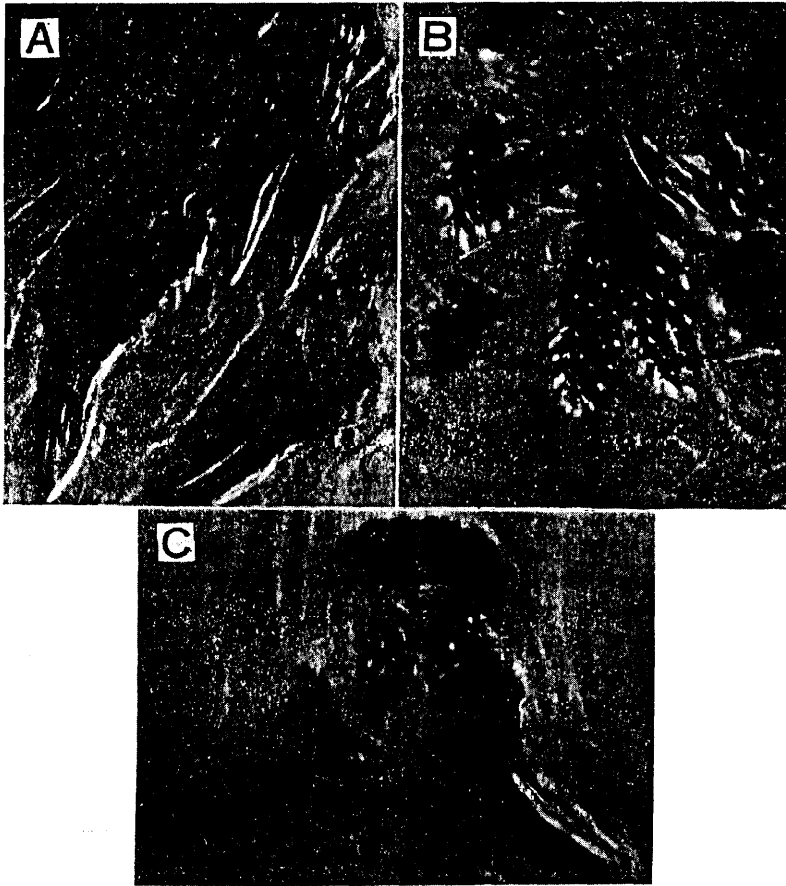


Fig. 6. Photographs of endosomal sclerites and appendages. A: *Uhlrites debile*; B: *Stephanitis nashi nashi*; C: *Stephanitis takeyai*.

ed and broad sac-like. The endosoma, occupying within the middle portion of the phallotheca, often expanded into a bulge. The distal portion of endosoma is slender ampulla-form and partially stiffened in 2 semitubular plates, which are apparent in *Stephanitis yasumatsui*, and it is thought to be the proper intromittent organ,

Endosomal wall usually bears a few kinds of sclerites and appendages (named for well-projected sclerites from the endosomal wall into the cavity) on different parts and they may be situated on the endosomal diverticulum, the median portion and on the proximal part of endosoma which is lying within the apical tubular portion. Sometimes the endosomal appendages are pointed at their apices and the apices are

directed distally (superficially towards the base of the phallus), when the phallus is retracted,

In Fig. 5, "a-g" indicate the endosomal sclerites and appendages, and "a-c" are characteristic to the species of *Stephanitis*, "d" to *S. nashi* and its subspecies, "e" to *Cochlochila lewisi*, "f" to *Physatocheila orientis*, and "g" to *Tingis comosa* and *T. yasumatsui*. In some species of the genera *Stephanitis* and *Uhlerites*, these appendages are modified.

## VI. PHYLOGENIC CONSIDERATIONS

1. *Interpretation of the relationships between the genera and some species of the genus Tingis based on the larval structure* (Fig. 7): So far as the consideration of the relationships between the genera especially in connection with the larval structure is concerned, it is logical to assume that the head processes may become proper characters because of their presence from the larvae through the adults. On the other hand, the thoracic and abdominal processes of the larvae are not brought to their adult stage, but the dorsal median abdominal processes are rather important characters which seem to be useful in dividing the Tingid larvae into several groups. The thoracic processes are most variable, even though the variation range is infrageneric, but in the adult stage, the thoracic region is extremely specialized in various forms of paronota, hoods and carinae among the groups.

The developmental processes of the several characters, which should be taken into consideration to analyze the larval phylogeny, the following characters seem to be important: Head processes, dorsal median processes and lateral processes of thorax and abdomen, for example, in *Cantacader lethierryi* and *Diconocoris capsui*, the head processes and lateral processes are well developed but the dorsal median processes are entirely obsolete; in *Ammianus alberti* the head processes and lateral processes are prominently developed and ramified but the dorsal median processes are very small; in *Tingis ampliata* only the head processes are developed but the median dorsal and lateral processes are entirely lacking. But the various processes are generally developed or stunted together with each other, but in any case, the head processes are most evident even though the other processes are entirely obsolete, except *Australotingis franzeni*—the lateral and dorsal processes except the discopronotal ones are extremely developed and ramified but the head processes are entirely stunted (Drake & Ruhoff, 1965).

Head processes are usually 4 or 5 in number in any species examined so far, the median unpaired head process is supposed to be a fused one as mentioned above (V-1-2), and it is verified by the 1st instar larva

of *Stephanitis nashi*; therefore, it is supposed that the head processes are originally composed of 3 pairs of tubercles, of which the middle ones are normally fused into a single one, or disappeared entirely in its embryonic developmental stage. Therefore, the nature of the middle pair is already fixed at the 1st instar and then the other head processes are developed in various degrees between the groups or species.

The dorsal median processes of thorax and abdomen are most variable between the groups or genera. In the 1st instar larvae they are also started from 1 pair of tubercles on each thoracic and the abdominal segments except the 3rd and 4th abdominal ones which are lacking the tubercles.

Though the processes increase in size during the development of instars, some of the tubercles disappear in certain genera. But the tubercles on the pronotum, mesonotum and the 2nd, 5th and 8th abdominal tergites constantly develop into spinous processes; but in some other genera, the process on the 6th abdominal tergite also develops, or all the processes develop; but the tubercles on the 7th tergite disappear frequently.

In some species, another pair of discopronotal processes may develop from the 2nd instar larvae besides the primary pair. The thoracic and 1st abdominal tubercles develop into paired processes, but the abdominal tubercles on each of the posterior abdominal segments develop into a single process just like the middle unpaired process of the head.

Lateral processes seem to have developed by protruding the posterolateral corners of each thoracic or abdominal segments except the 1st abdominal one, and so hypothetically 3 thoracic and 8 abdominal processes are supposed to have developed on each side; in the 4th instar larvae of *Galeatus spinifrons*, *Cystechila fieberti*, *Tingis comosa* and *Cochlochila lewisi*, these principal processes are well developed equally, but in the last instar larva the lateral processes of the 2nd and 3rd segments are concealed under the wing pads, consequently they are entirely stunted and remained only by the minute tubercles, each provided with an apical clubbed hair. But in the *Stephanitis-Uhlerites* group, the lateral processes of the 2nd and 3rd abdominal tergites are stunted earlier at the 2nd instar.

As the age proceeds, the enlargement of the lateral margins of pronotum and the outer side of each wing pad accompanied by the growth of the other small processes which increase in number from moult to moult, viz. 2 processes in the 2nd instar, 3 in the 3rd, and so on.

In the 5th instar larva of *Cantacader lethierryi*, lateral margin of each abdominal segment from IV to IX bears 4-5 spinous processes which are shorter anteriorly and longer posteriorly and seemed to grow longer

as the instar proceeds. Among them, the most posterior longest one seems to be the primary one or is regarded as already present in the first instar, but the other processes are supposed to be added anteriorly one by one as the instar proceeds.

But the lateral processes may be supposed to have developed from the simple protrusion of each posterolateral corner of abdominal segments, but these protrusions are generally small and these processes are becoming shorter or almost reduced towards the more anterior segment, and such example is seen in the 5th instar of *Tingis populi*, *T. ampliata*, *T. grisea*, *T. beesoni*, *Oncochila simplex* and *Monostira uncostata*. On the other hand, the secondary morphological character is pronounced by the development of one long spinous process on each side of the abdominal segment. These processes are longer basally and shorter posteriorly and the imaginal bud of this character is thought to be originated already in the earlier stage of the postembryonic development. The typical examples may be found in the *Stephanitis-Uhlerites* group.

On the developmental process of the dermal tiny structures, it is thought that the various types of dermal structures may be derived from simple semispherical structures which are originated from the earlier instars of those species and retained on the later instar larvae of *T. ampliata*. And they may be arranged in 2 series as follows; A- series: ① semispherical form (*T. ampliata*, *Dictyla* spp.)→② plum-blossom form (*Leptoypha capitata*, *Physatocheila orientis*, *Cysteochila fieberi*)→③ little star form (*Acalypta* spp.)→*Cantacader lethierryi*→*Lasiacantha capitata*→*T. comosa*→*T. buddleiae*, or ①→④ two flapped ribbon form (*Agramma nexilis*); B-series: ①→⑤ short rod form (*Cysteochila salicorum*, *T. populi*)→⑥ short ampulla form (*Cysteochila consueta*)→⑦ elongate ampulla form (*Stephanitis*, *Uhlerites*, *Galeatus*)→⑧ slender rod form (*Copium japonicum*, *Cochlochila lewisi*).

If the reasonings for the various characters above mentioned are agreeable, it may be summarized as follows:

(1) Subfamily Cantacaderinae. In *Cantacader lethierryi* the 4 spinous, lateral processes arise from the sides of each abdominal segment from IV to IX, and the rostrum is extremely long and the 4th segment is the longest among the rostral segments. Such characters may be peculiar to this subfamily and have never been found in the subfamily Tinginae

(2) *Litadea delicatula* is extremely characteristic in having each abdominal segment expanded into a rectangular flap on the sides, and the similar structure has never been found in the other genera of Tinginae.

(3) The main branch "A" is characterized by the lack of the unpaired process of head. The 4 genera belonging to this type are not

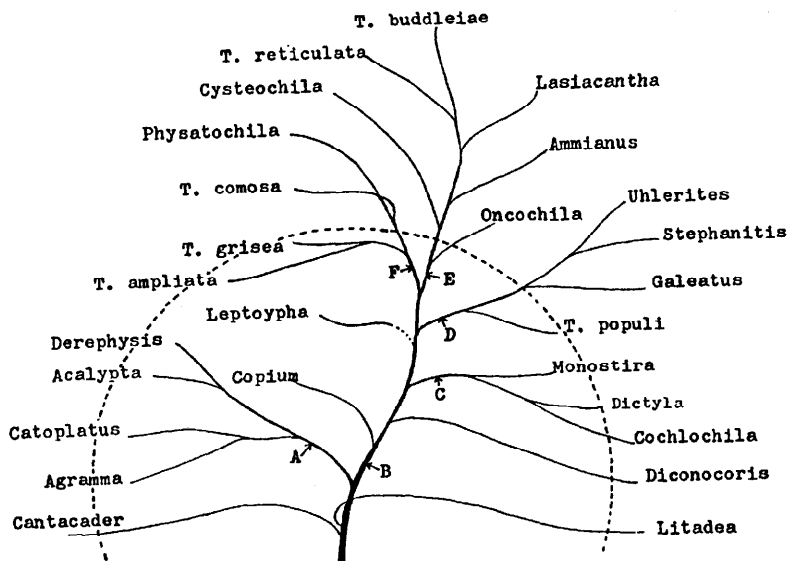


Fig. 7. Supposed relationships of the genera and some species of the genus *Tingis* based on the larval structures.

armed with any processes on the thorax and abdomen, and the head processes are also very weakly developed. This group is subdivided into the *Agramma-Catoplatus* and *Acalypta-Derephysis* complexes by the larval features.

(4) The main branch "B" is characterized by having the unpaired head process. This is subdivided into many secondary branches as follows:

(5) *Copium japonicum*: The 5 head processes are fairly developed but the other body processes are unrecognizable.

*Diconocoris capsui*: The 5 head processes and lateral processes of thorax and abdomen are strongly developed but the median dorsal processes of the body are entirely unrecognizable.

(6) Branch "C" is characterized by 3 dorsal, median processes on the abdominal terga, one being found on the 2nd, 5th and 8th respectively.

(7) Branch "D" is characterized by 4 dorsal, median processes on the abdominal terga, one being found on the 2nd, 5th, 6th and 8th respectively.

(8) Branch "E" is characterized by 5 dorsal, median processes on the abdominal terga, one being on the 1st, 2nd, 5th, 6th and 8th respectively.



(9) Branch "F" is characterized by 6 dorsal, median processes on the abdominal terga, one being on the 1st, 2nd, 5th, 6th, 7th and 8th respectively. This group is subdivided into the *Physatocheila-Tingis comosa* and *T. grisea* - *T. ampliata* complexes and in the former the thoracic and abdominal processes are fairly developed. But in the latter these processes are extremely atrophied in the 5th instar larva.

In the genera or the species (Fig. 7) of which the branches are outside the dotted line, the thoracic and abdominal processes are well developed; but in the inside groups, these processes are stunted or entirely obsolete.

## 2. Interpretation of the relationships between the species of the genus *Stephanitis* based on the structures of larvae and male genitalia. (Fig. 8)

The genus is one of the most differentiated groups, and is the largest of the Oriental genera. The male genital organs of 20 species belonging to the genus from Korea, Japan and Formosa were examined. Among them, the larvae of 4 species are studied on all 5 instars, 1 species on the 2 later instars and 4 species on the last instar, besides the male genital organs.

The pygophore, parameres and phallus of the *Stephanitis* - species are most characteristic of all the Tingid groups examined so far. The pygophore may be arranged in order from the primary square form of *nashi* to the distally inflated form of *takeyai* in dorsal view, and the

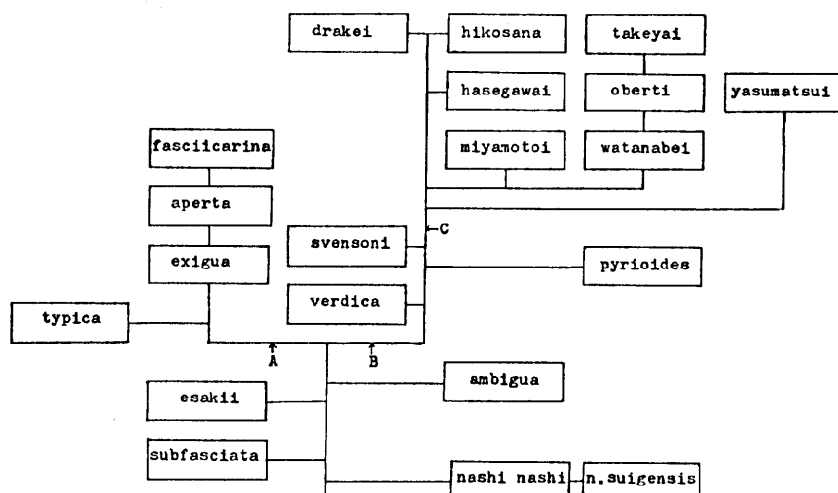


Fig. 8. Supposed relationships of the species of the genus *Stephanitis*, based on the larval structures and male genitalia.

other various forms may be arranged between the two.

The developmental trend of parameres is supposed as follows: from the paramere which is thin and has the middle portion gently tapered as seen in *subfasciata* to the paramere which is strongly inflated and has a sinuated middle portion as seen in *takeyai*.

The *c*-endosomal appendages of the genus *Stephanitis* are differentiated in various degrees, and the simple sclerotized small appendages seen in *T. populi* are supposed to be the prototype of the specialized forms of the genus *Stephanitis*. From this prototype the following deviated types are thought to have differentiated, i. e. strongly sclerotized basal portion and serrated distal portion in the *takeyai* group, and weakly sclerotized basal portion and the slender distal portion in the *fasciatarina* group, and some intermediate forms such as the leaf form in *yasumatsui* and long brush form in *pyrioides*.

If the assumption mentioned above is acceptable, the following conclusions may be derived:

1) *S. nashi nashi* and *S. nashi suigensis* are apparently separated from the other species by the differences of roof-shaped excavature of the proximal margin of the dorsal wall of pygophore, 4 pairs of endosomal appendages, and the characteristic larval structure which is peculiar in having the round inflation of lateral margins of pronotum, relatively short antennal length to the body length, and the 4th antennal segment apparently shorter than half the length of the 3rd one.

2) *S. ambigua* is also different from the other species in the shape of the posterior rim of the pygophore, the conical protuberances of the apices of the parameres and the chestnut-shaped *c*-endosomal appendages. And these characters resemble remarkably those of *Tingis populi*. On the other hand, the larva does not closer to that of *T. populi* than to those of the other *Stephanitis*-species. The larva is characterized by the inflated lateral margins and the strongly protrudent posterior triangle of pronotum, and by the 4th antennal segment nearly equal to half the length of the 3rd one.

3) *S. esakii* and *S. subfasciata*: The distal margin of the posterior rim of the pygophore is narrowed. And *b*- and *c*-endosomal appendages are obsolete in *S. subfasciata*, but they are of special bulge-shaped in *S. esakii*. These two species are different from the main group and seem to be developed towards the opposite direction to *S. nashi* and *S. ambigua* group. Their larvae were not examined.

4) A-group: the pygophore is typically square or nearly rectangular, the *c*-endosomal appendages are elongate, and the basal part of the appendages is not sclerotized at all.

Among the species belonging to the group, the larvae of *S. typica*

and *S. fasciicarina* were examined; they are characterized by the anterior margin of pronotum which is wider than the width of head including eyes and provided with 4 shallow sinuations, and by the comparatively short abdominal processes.

5) B-group: the sides of pygophore are inflated distally. Besides the C-group three species are belonging to this group, and they are occupying very interesting positions basing upon their respective characteristics. It seems that they are differentiated in each peculiar direction; i. e. *S. veridica* is characterized by the lack of the *b*-endosomal appendages and by the presence of the discopronotal processes which are strongly stunted in the 5th instar larva; in *S. svensoni*, the proximal margin of the ventral wall of pygophore is not so protruded and the caudal processes of the 5th instar larva are very short; in *S. pyrioides*, the *c*-endosomal appendages are not curved but shaped like a brush, and various processes of the 5th instar larva are extremely long.

6) C-group: In this group there are some uniformities in the curved *c*-endosomal appendages, characteristic parameres (3 portions are apparently distinguishable) and the shape of pygophores.

Among the species belonging to the group, the larvae of *S. miyamotoi* and *S. takeyai* were examined; they are identical in having a short posterior projection of pronotum.

Besides the above mentioned distinctions for the major groups, the specific differences may be seen in the keys to the species of the genus.

## VII. SPECIAL MORPHOLOGY

### 1. Larvae I

A key to determine the 5th instar larvae of lace-bugs.

1. The sides of abdominal segments entire or armed with spinous processes ..... 2
  - The sides of abdominal segments expanded in a rectangular flap in each segment ..... *Litadea delicatula*
2. Head armed with 4 spinous processes ..... 3
  - Head armed with 5 spinous processes ..... 7
3. Each of 6 posterior abdominal segments armed with 4 processes on each side ..... *Cantacader lethierryi*
  - Each of 6 posterior abdominal segments entire or armed with 1 spinous process on each side ..... 4
4. Posterior triangular projection of pronotum extending over posterior margin of mesonotum ..... 5
  - Posterior triangular projection of pronotum not reaching posterior margin

- of mesonotum ..... 6
5. Abdominal segments with some tubercular processes on their median-line .....  
     ..... *Agramma nexilis*
- Mediodorsal-line of abdomen without tubercular processes .....  
     ..... *Catoplatus carthusianus*
6. Body surface covered with 5- or 4-tipped star-shaped dermal structures .....  
     ..... *Acalypta* spp.
- Body surface covered with 2- or 3-tipped tiny structures of which the tips  
   are sharply prolonged. Body margins with very small tuberculate excrescences  
     ..... *Derephysia foliacea*
7. Thorax and abdomen entire, and paired frontal processes of head extremely  
   curved..... *Copium japonicum*
- Thorax and abdomen armed with processes..... 8
8. Dorsal median processes of abdomen absent, but lateral processes very long ...  
     ..... *Diconocoris capsui*
- Dorsal median processes developed ..... 9
9. Besides dorsal median processes, 4 pronotals (2 anterior & 2 posterior), 2 me-  
   sonotals and 1 on each abdominal segment of II, V & VIII..... 10
- More than 3 dorsal median processes on abdomen ..... 12
10. Head processes developed but median dorsal processes tuberculate and lateral  
   processes stunted..... *Monostira unicastata*
- Various processes well developed except *Dictyla echii* ..... 11
11. Pronotum nearly rectangular, with anterior pair of large dorsal median pro-  
   cesses ..... *Cochlochila lewisi*
- Pronotum anteriorly narrowed, with anterior pair of small dorsal median  
   processes ..... *Dictyla* spp.
12. Dorsal median processes of abdomen tuberculate, among them 1 pair of clubbed  
   hairs or small bifurcated process on each of (1) II, V, VI & VIII tergites.....  
     ..... *Leptoypha* spp.
- Dorsal median processes of abdomen single on each tergite of II, V, VI & VIII  
   segments ..... 13
- Dorsal median processes of abdomen single or paired on each tergite of I,  
   II, V, VI & VIII, or I, II, V, VI, VII & VIII ..... 15
13. Pronotum not armed with processes ..... *Tingis populi*
- Pronotum armed with processes ..... 14
14. Pronotum with special bulges of its median portion ..... *Galeatus* spp.
- Pronotum without special bulges ..... 15
15. Lateral margins of pronotum and wing pads with conspicuous protuberances...  
     ..... *Uhlerrites* spp.
- Lateral margins of pronotum and wing pads without protuberances .....  
     ..... *Stephanitis* spp.
16. Dorsal median processes of abdomen on each tergite of I, II, V, VI, & VIII ...  
   segments ..... 17
- Dorsal median processes of abdomen on each tergite of I, II, V, VI, VII &  
   VIII ..... 22
17. The sides of thoracic segments not armed with processes..... *Oncochila simplex*
- The sides of thoracic segments armed with processes ..... 18
18. Body processes not ramified ..... *Cystechila* spp.

- Body processes ramified ..... 19
- 19. Dorsal median processes of abdomen paired, and on each tergite of V, VI & VIII segments..... *Tingis buddleiae*
- Dorsal median processes of abdomen single and on each tergite of V, VI & VIII ..... 20
- 20. Dorsal median processes on thorax and abdomen very small... *Ammianus alberti*
- Dorsal median processes on thorax and abdomen very long ..... 21
- 21. Body surface covered with 2-or 3-tipped dermal structures ..... *Lasiacantha capucina*
- Body surface covered simply with tiny conical tubercles... *Tingis reticulata* .....
- 22. Dorsal median processes developed in earlier instars, but completely disappeared in the last instar larva ..... *T. ampliata*
- Dorsal median processes of abdomen developed ..... 23
- 23. Thoracic segments without processes but abdominal segments with tubercular dorsal median processes ..... *T. grisea*
- Thoracic segments armed with processes and abdominal segments with spinously developed dorsal median processes ..... 24
- 24. Tiny dermal structures uniformly bitipped and with tips very sharp and enlarged ..... *T. comosa*
- Dermal surface covered with tiny asteroid structures, each aster with 4 or 5, not sharply pointed but somewhat round tips... *Physatocheila* spp.

### 1. *Cantacader lethierryi* Scott, 1874

#### Fifth instar (Fig. 9)

Measurements, in  $\mu$ : Body length 3116; width of body across wing pads 1667; width of head with eyes 517; length of pronotum 417; width of pronotum 1000; lengths of antennal segments I to IV=191, 120, 1059, 285; lengths of segments of rostrum I to IV=463, 498, 356, 669. Lengths of segments of legs: fore femora 774, fore tibiae 935, middle femora 703, middle tibiae 832, hind femora 810, hind tibiae 1019 and hind 2nd tarsi 169.

Coloration: General color ochreous, eyes dully reddish, distal antennal segments and the 2nd tarsi blackish, the 3rd antennal segment and tibiae slightly darker. Anterior area and lateral margins of pronotum darker. In some specimens, pronotal processes darkened. Anterior dorsal gland clearly reddish. Rostrum brownish but apex darkened.

Head: very long, armed with 2 pairs of very long processes, frontal paired processes stout, nearly equal to the width of head including eyes in length. Posterior paired processes situated on the sides of head near inner margin of eyes, slightly curved, approximately equal in size to the former pair. All of head processes directed frontally and not upwardly, and furnished with very small clubbed hairs and with very tiny warts. Clypeus projected frontally slightly over tip of the 2nd antennal segment. Bucculae very long, projecting forward far beyond apex of clypeus and visible from dorsum. Antenniferous tubercles pointed into processes. Basal segment of antenna the thickest, slightly curved outwardly, the 2nd segment the shortest and globose, the 3rd the most slender and the 4th spindle-shaped, swollen near apex and with some long special hairs of earpick-shape. Rostrum very long,

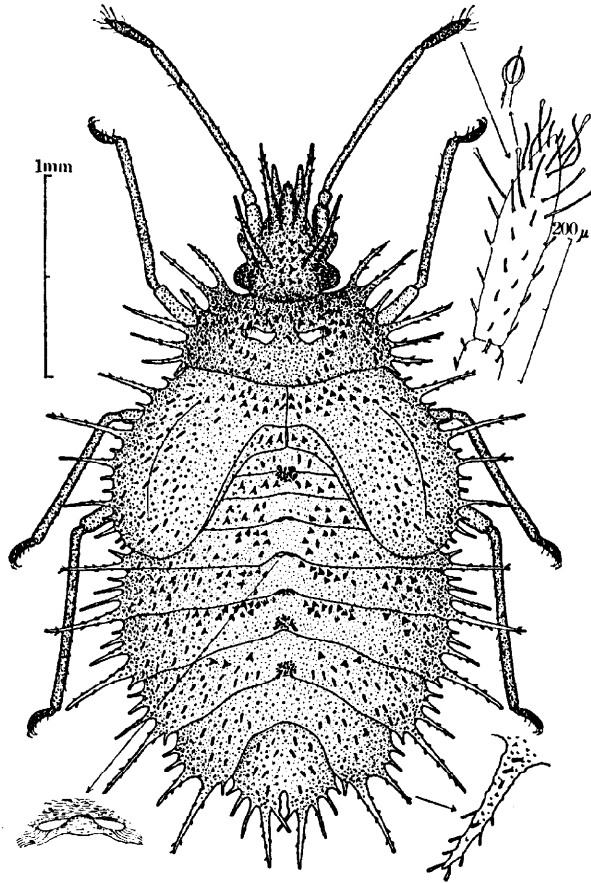


Fig. 9. *Cantacader lethierryi*, 5th instar larva.

reaching the middle of the 5th abdominal segment, but width nearly equal to that of tibiae.

**Thorax:** Pronotum transverse, lateral margins of pronotum armed with 7 long spinous processes, among them 4 are comparatively long and the rest are shorter. Posterior margin of pronotum slightly protruded backwards but almost parallel to the anterior margin. Mesothoracic hemelytral lobes relatively short and reaching the hind part of the 4th abdominal tergite. Outer lateral margins of each lobe with 4 long spinous processes, and some smaller and shorter processes between the longer ones. Metathoracic alar lobes protruded approximately to the same level as the hemelytral lobes.

**Legs** relatively short, hind tibiae shorter than the 3rd antennal segment, but thicker than the antennal segment.

**Abdomen:** One special bulge is present on the median line of each of the 2nd

abdominal tergite, 6th and 7th abdominal tergites, among them the bulge on the 2nd only pronounced near the anterior margin and those on the 6th and 7th distinct only on the posterior margin. Each of these bulge with 1 pair of small clubbed hairs. Opening of posterior dorsal gland wider than that of the anterior. Lateral margins of each abdominal segment from IV to IX with 4 or 5 spinous processes, the more posterior one becoming much longer, but in case of 5 processes, the last one the smallest; the last process is fairly elongated on the 9th segment.

Dermal structure: Entire surface of body excepting legs, antennae, rostrum and body processes, but including vertex, showing very interesting structures, which look like tiny stars, usually 3- or 4-tipped, sometimes mixed with 2-tipped ones and rarely with 5-tipped ones. Under monocular microscope, these tiny stars with double circles which represent a very short cylindrical stalk between extreme base and head of star-like projection. Ventral surface of thorax (especially on acetabula, but except beneath of paranota and median fascia) and abdomen (anterior 4 segments) also furnished with these tiny stars. Among these tiny stars there are mixed with very small and fine hairs staff- or club-shaped. Not only the body surface but also all processes of head, thorax and of abdomen furnished with small clubbed hairs.

## 2. *Agramma nexilis* (Drake, 1948)

### Fifth instar (Fig. 10)

Measurements, in  $\mu$ : Body length 1600-1725; width of body at the 2nd abdominal segment 750; width of head with eyes 350; lengths of antennal segments I to IV=155, 111, 196, 191; lengths of segments of rostrum I to IV=111, 142, 89, 102. Lengths of segments of legs: fore femora 334, fore tibiae 231, middle femora 378, middle tibiae 245, hind femora 356, hind tibiae 231 and hind 2nd tarsi 111.

Coloration: General color dark brown. Distal antennal segment, the 2nd tarsi and tibiae darker. Eyes brownish black. Frontal paired processes on head yellowish but occipital ones remarkably black. Dorsal abdominal tubercles also blackish brown. Distal margin of antenniferous tubercles yellowish. Ventral surface generally dark ochreous, abdomen and outer lobes of acetabula more blackish. Tip of rostrum darkened.

Head: Generally testaceous, 2 longitudinal silvery whitish stripes on each side of head, outer ones alongside of inner margins of eyes, and inner ones so curved interiorly as to surround vertex. Two pairs of tubercular processes on head, frontal pair very small, elongate and elliptical, appressed to head, tip of the processes beyond antenniferous tubercles but never reaching tip of clypeus, and occipital pair very short, simply tuberculate. Antenniferous tubercles pointed. Antennae stout, furnished sparsely with tiny tubercles and a fine hair is found on each tubercle. The 1st antennal segment the widest, the 2nd wider than the apical, the 3rd nearly cylindrical, the 4th spindle-shaped.

Thorax: Pronotum pentagonal, approximately 1.6 times as wide as long, 556  $\mu$ : 350  $\mu$ . Anterior margin of pronotum deeply concaved and anterolateral corners so projected as to surround the occiput. Lateral margins of pronotum actually straight. Posterior margin of pronotum protruded into a triangular projection which is reach-

ing the anterior margin of metanotum. 2 pairs of dark brown moderate bulges on posterolateral margins of pronotum, one pair near posterolateral angles, the other near tip of posterior projection. One of the bulges shown in Fig. 10-B is seen under high magnification. The anterior bulge on each side larger than the posterior one, and each bulge with one hair. Pronotal disk with one pair of patches which are dark, transverse and moderately curved anteriorly, lateral and posterior margins of the disk sparsely covered with fine hairs. Mesothoracic hemelytral lobes reaching the anterior margin of the 5th abdominal tergite, and distally wrinkled and usually darker. Mesonotal disk with one pair of brown very small tubercles, each of which is bearing a single short hair, tip of the posterior projection of pronotum placed between the mesonotal tubercles. Distal and lateral areas of wing pads furnished sparsely with fine hairs. Metanotal disk with one pair of minute tubercles, each of which is provided with a short hair.

Legs stout and thick, the 2nd tarsi thick, with some tape-like hairs on their innersides.

Abdomen: Abdomen broader than thorax. Abdominal dorsum along the median line furnished with tubercles of variable size, the 1st abdominal tergite with one pair of small bulges with a single hair on each side, the bulges are composed of many pale minute and very closely set tubercles. Abdominal tergites II, V, VI & VIII each with one median tubercular bulge, which is bearing 2 fine hairs. These bulges also composed of closely set tiny tubercles. Peripheral margin of abdomen furnished sparsely with fine hairs.

Dermal structure: Entire body surface except legs, rostrum and antennae covered with very characteristic dermal structures. Especially on head such characteristic dermal structures are white in color and look like tiny ribbons, usually 2-pieced but sometimes 3-pieced, and arranged to make 4 distinct longitudinal stripes. Tiny dermal ribbons distributed not only on dorsal surface but also on ventral surface, especially on intersegmental areas and submarginal areas around stigmata. Double

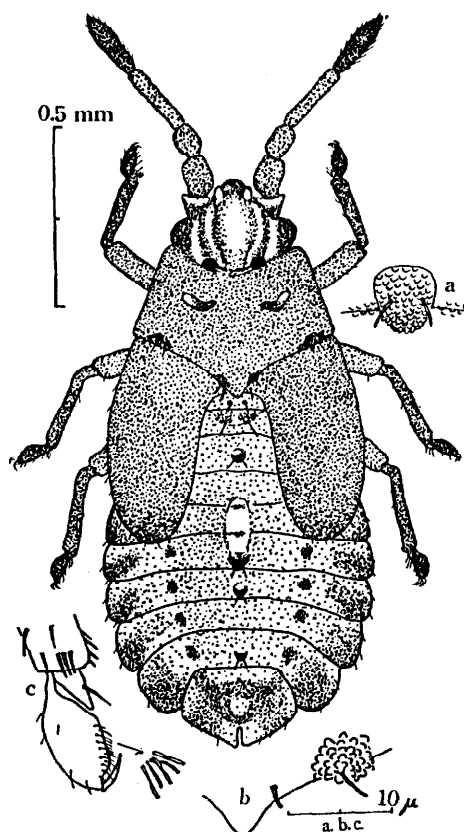


Fig. 10. *Agramma nexilis*, 5th instar larva. a: median tubercular process on the 8th abdominal tergite; b: tip of posterior projection of pronotum with a side bulge; c: tarsus of hind leg.



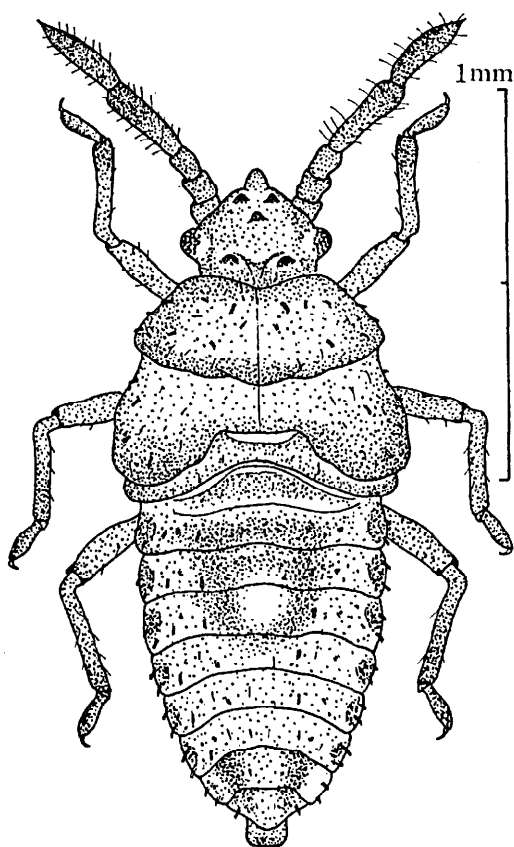
circles in center or the ribbon representing stalks of the ribbon. The dermal ribbons on pronotum, wing pads and abdominal tergites, set nearly parallel to the major axis of body, but those on vertex irregularly directed. Besides these dermal ribbons, very small simple staff-shaped hairs and very minute warts are scattered.

### 3. *Copium japonicum* Esaki, 1931

#### Fourth instar (Fig. 11)

Measurements, in  $\mu$ : Body length 1638-1731; width of body across wing pads 750-818; width of head with eyes 388-409; width of pronotum 625-640; width of abdomen 639; lengths of antennal segments I to IV=138, 107, 223, 298. Lengths of segments of legs: fore tibiae 329, middle tibiae 324, hind tibiae 369 and hind 2nd tarsi 152.

Structure: Head transverse, clypeus strongly protruded forwardly and reaching the level of anterior margin of the 1st antennal segment. Five head processes very



small, tubercle-like, the frontal pairs not reaching the anterior end of head. Unpaired one as large as the former, and occipital pair smaller than the frontal three. Antenniferous tubercles wide and slightly pointed at the outer corners, 2 basal antennal segments somewhat widened distally, 2 distal segments long and thick, the 3rd distally thickened, the 4th pointed at the apex, spearhead-shaped, with the base remarkably asymmetric.

Pronotum transverse, anterior margin gently grooved, lateral margins almost straight, posterior margin widely rounded but waved and with a posterior projection. Mesothoracic hemelytral lobes imperfectly covering the metanotal alar lobes. Metanotum gently extended sideways as to originate the wing pads of the 2nd pair, moderately covering the 1st abdominal tergite on the sides.

Abdomen long, about 1.5 times as long as wide. The 9th abdominal tergite posteriorly terminated in a triangular form.

Body surface covered with sparsely distributed slender staff-

Fig. 11. *Copium japonicum*, 4th instar larva.

shaped hairs, but antennae and legs with normal hairs.

**Fifth instar (Fig. 12)**

Measurements, in  $\mu$ : In alcoholic specimen, body length with clypeus 2463; width of body across the wing pads 1200; width of head with eyes 500; width of pronotum 1000, width of anterior margin of pronotum 450; length of pronotum in middle 625; lengths of antennal segments I to IV=160, 151, 496, 641; lengths of segments of rostrum I to IV=134, 334, 156, 223. Lengths of segments of legs: fore and middle tibiae 552, hind tibiae 632 and hind 2nd tarsi 235.

Coloration: General color dull yellowish, pale and dark areas as in Fig. 12.

Structure: Head transverse, with paired frontal processes characteristically bent

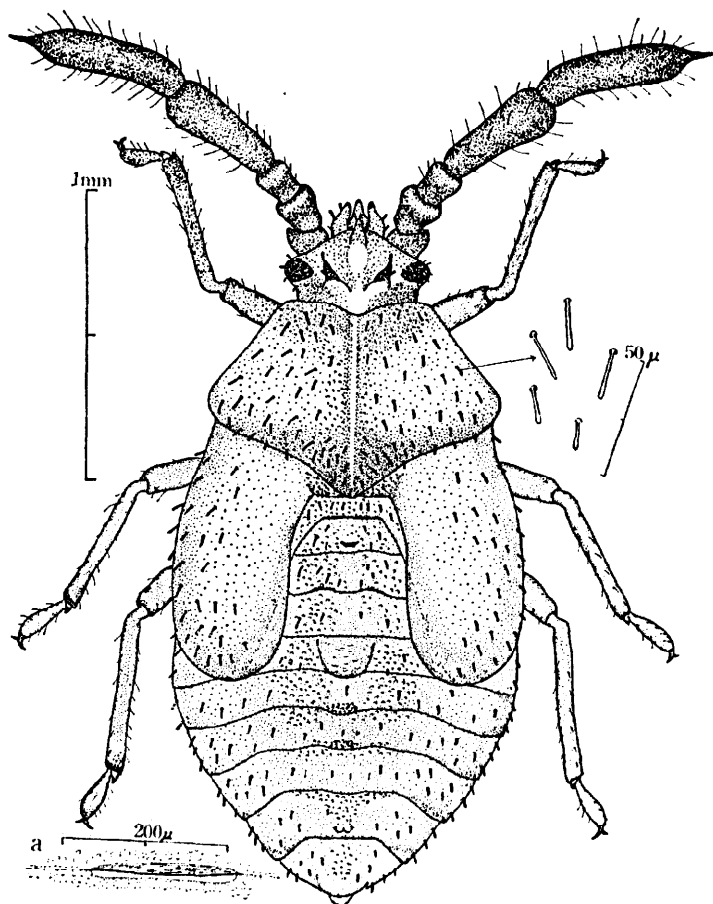


Fig. 12. *Copium japonicum*, 5th instar larva. a: opening of anterior abdominal gland.

inward and bent just like thumbs in profile. The frontal pair a little longer than posterior processes, but not reaching the level of tip of clypeus. Unpaired process long conical and with 2 terminal hairs. Occipital processes obliquely set to head. The apices not over the level of anterior margin of eyes, with one staff-shaped hair on the apex and one more small hair on lateral base of the respective processes. Antenniferous tubercles thick and pointed outwards. The 1st antennal segment strongly widened on distal half. The 2nd one the narrowest but apical half also widened. The 3rd one long, distally thickened and pestle-shaped. The 4th one much incrassate but the distal portion abruptly tapered and sharply pointed to form a fairly long simple spine. Basal portion of the 4th and distal portion of the 3rd segment characteristically asymmetric as in the adult.

Pronotum nearly pentagonal but apparently transverse, 5 corners gently rounded. Anterior margin of pronotum moderately concave at middle. Posterior triangular projection reaching the anterior margin of metanotum. Mesothoracic hemelytral lobes reaching the anterior margin of the 5th abdominal segment.

Abdomen comparatively wide but caudally astringed and shaped like a large triangle. 1st abdominal tergite with one transverse small tubercle at the middle near posterior margin. Posterior margin of the 2nd tergite slightly waved twice. Opening of anterior dorsal gland very wide, more than twice the posterior one,  $178\ \mu$ ;  $89\ \mu$ . On median-line of the 8th tergite near posterior margin situated continuously 2 small tubercles.

Entire surface of body except antennae, rostrum and legs, furnished evenly and sparsely with slender staff-shaped hairs. But inner sides of hemelytral lobes and dorsal glandular portion without such hairs. In addition, minute dermal warts are found on humeral areas, triangular portion of pronotum and mid-dorsal area of body. Antennae and legs furnished with simple hairs.

#### 4. *Leptoypha capitata* (Jakovlev, 1876)

##### Fifth instar (Fig. 13)

Measurements, in  $\mu$ : Body length 2363; width of body across wing pads 1350; width of head with eyes 550; width of pronotum 1025; length of pronotum 638; length of abdomen 1238; width of abdomen 1188; lengths of antennal segments I to IV=178, 134, 445, 269; lengths of segments of rostrum I to IV=187, 254, 116, 160. Lengths of segments of legs: fore femora 450, fore tibiae 516, middle femora 454, middle tibiae 516, hind femora 480, hind tibiae 596, and hind 2nd tarsi 160.

Coloration: General color reddish dark brown or coppery blackish brown. Head processes and midvertex pale red. Clypeus darkened. Eyes reddish dark brown. Antenniferous tubercles and antennae blackish except the middle of major part of the 3rd segment. Especially bucculae clear red. Central portion of pronotum and wing pads darkly colored but variegated. Legs and ventral surface of body generally blackish red brown, but the 2nd tarsi and both ends of tibiae black.

Structure: Head with clypeus largely protruded. Frontal paired processes the largest of all body processes, directed obliquely forward and reaching the middle of clypeus, and separated from each other, so clypeus is entirely visible in dorsal view. Unpaired processes very small and bifurcated, each tip with one tiny clubbed

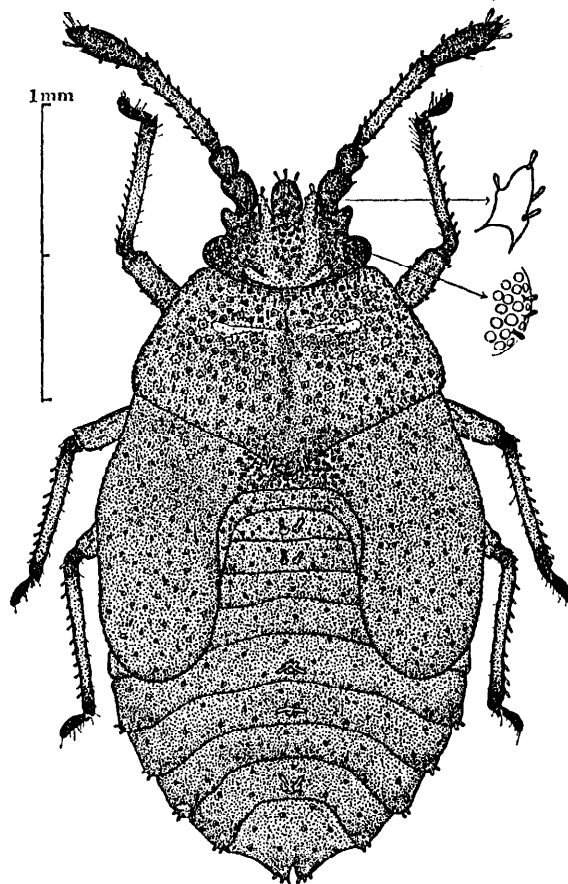


Fig. 13. *Leptoypha capitata*, 5th instar larva.

hair. Occipital processes directed laterally a little smaller than the frontal pair. Paired processes of head with one clubbed hair on each tip, and frontal paired processes with a few such hairs on the sides, but occipital processes with no lateral hairs. Vertex with a very large U-shaped pale, bald stripe, the arms of which are originated from the bases of paired frontal processes and astringed between occipital processes. Antenniferous tubercles very wide and protruded outwardly. The 1st antennal segment strongly bent outwardly near base, and distally widened. The 2nd globose, the 3rd the narrowest and the 4th spindle-shaped.

Pronotum almost pentagonal, anterior margin gently curved, lateral margins straight but finely rippled. Apex of posterior projection is between the mesonotal processes, and the apex never reaching the posterior margin of mesonotum. Pronotal disk with one pair of elongate, transverse, bald furrows at about anterior fourth. Mesothoracic hemelytral lobes relatively long, nearly reaching the basal

third of the 5th abdominal tergite, and lateral margins minutely rippled. Mesonotal disk with one pair of very small but conspicuous tubercles, each of which is bearing one clubbed hair.

Abdomen nearly as wide as long. One pair of tiny tubercles present on each of tergites I & II at the middle but near the posterior margin, and each tubercle with one pestle-shaped hair, and tubercles are closed to each other. Abdominal tergites V, VI & VIII each with one small bulge which is bearing 2 small similar hairs. Opening of posterior dorsal gland wider than the anteriors,  $78\mu$ :  $61\mu$ . The 9th abdominal segment truncate. Posterolateral corners of tergites IV to IX each with one puckered bulge, which is composed of tiny closely set warts. Two very small clubbed hairs grown out from each bulge, but 3 such hairs on the caudal bulges.

Entire body surface including clypeus, especially anterior portion of pronotum and wing pads, covered with tiny plum-blossom shaped dermal structures, which are generally 4 cornered, but intermixed with 5 or 3 cornered ones and with some clubbed hairs. On the lateral areas of pronotum and wing pads situated semiglobular tubercles, and each tubercle with one such hair. Moreover, very minute simple tubercles scattered over the body surface, especially densely on apex of pronotal posterior projection. Ventral surface of thorax and submarginal areas of abdominal venter also with plum-blossom shaped structures, but median part of abdominal venter adorned with clubbed hairs only.

#### 5. *Cochlochila lewisi* (Scott, 1880)

##### First instar (Fig. 14)

Measurements, in  $\mu$ : Body length without hairs 892; width of body at the 3rd abdominal segment without hairs 317; width of head with eyes 242; pronotum as wide as that of head; length of pronotum 75; width of the 9th abdominal tergite 117; lengths of antennal segments I to IV=45 to 53, 44.5, 116 to 125, 130 to 133. Lengths of segments of legs: femora of all legs 182, fore and middle tibiae 223, hind tibiae 229 and hind 2nd tarsi 95.

Structure: Clypeus strongly prominent and the apex reaching the distal margin of the 2nd antennal segment. Paired frontal processes very low and tuberculate, and each process with one very long somewhat capitate hair and an outer small basal hair. Unpaired frontal process still bifurcate and tuberculate, and with 2 very long somewhat capitate hairs divergently. Occiput with a pair of tubercles which are united with each other at their bases and each tubercle is bearing occipital process, and one rod-shaped hair arisen from each tubercle, consequently in total 4 such hairs are seen on the occipital tubercles. Eyes composed of 5 facets situated in pentagonally, with one fairly long hair in the center of the pentagon, another shorter hair situated slightly behind the former one, and one much shorter hair on each side of occipital area. Antennae sparsely furnished with rod-like hairs which are becoming longer towards apex, but apex of the 4th segment densely with short and simple hairs, and with 2 immovable short hairs.

Each lateral margin of thoracic nota and of abdominal tergites except the 1st and 9th abdominal segments, with a small triangular tubercle which is bearing a very slender somewhat capitate hair. But each of the 2nd to 6th abdominal tergites with another shorter similar hair on the posterior submarginal portion of each side. The 9th

abdominal segment with one pair of such hairs on each posterior corner. II, V & VIII abdominal tergites each with one bifurcated thick tubercle in the middle but near the posterior margin, and each tubercle with 2 short hairs, but the hairs on tubercle of the 8th tergite apparently longer than those on anterior ones. Two anterior thoracic nota and I, IV, V, VI, VII & VIII abdominal tergites each with one pair of long similar hairs besides median tubercles. In addition, pronotum provided with two pairs of similar long hairs as shown in the text-figure. Middle of each side of mesonotum, metanotum and the 1st abdominal tergite each with a very small rod-like hair. 6th and 7th abdominal tergites each with one pair of very small simple hairs anterior to the long hairs on the median line.

#### Second instar (Fig. 15)

Measurements, in  $\mu$ : Body length without hairs 1142; width of body at the 3rd abdominal segment without processes 500; width of head with eyes 317; width of pronotum

without processes 400, with processes 533; length of pronotum 108; width of the 9th abdominal tergite 200; lengths of antennal segments I to IV=75, 62, 191, 149. Lengths of segments of legs: fore femora 254, fore and middle tibiae 283, middle femora 247, hind femora 270, hind tibiae 298 and hind 2nd tarsi 109.

Structure: Paired frontal processes of head short, and one small tubercle attached to the base of each process, and one slender rod-like hair at the tip of each process and tubercle. Unpaired process with 2 rod-like hairs apically. Occipital processes thick, with the tip bearing 2 conical denticles, and 2 rod-like hairs. Eyes composed of 5 facets and with 2 small hairs as in the 1st instar. Antennae furnished with long simple hairs, but a few erect and capitate hairs are also present.

Pronotum much wider than head with eyes. Pronotal disk with 2 pairs of small tubercles, the posterior pair much smaller and more closed to each other than in the anterior pair, and the tubercles with very small hairs on the tip. Discomesonotal processes on the middle of mesonotum fairly larger than the discopronotal's on the middle of pronotum. Pronotum and mesonotum armed with one fairly large process on each posterolateral corner, and with one small tubercular process somewhat anterior to the middle of each side.

The abdominal tergites II, V & VIII each with one large and thick process along

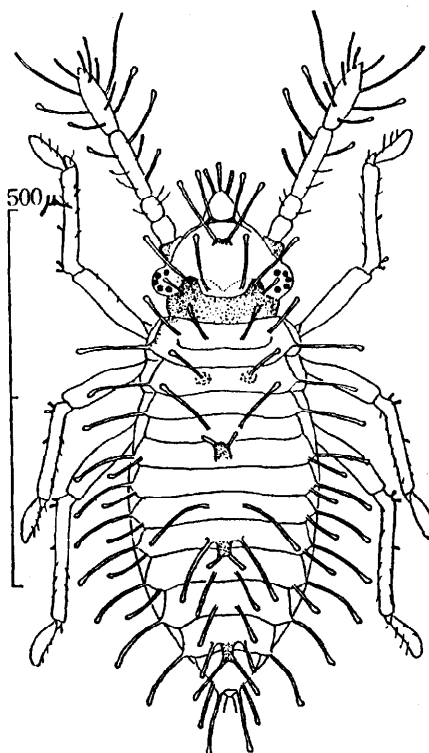


Fig. 14. *Cochlochila lewisi*, 1st instar larva.

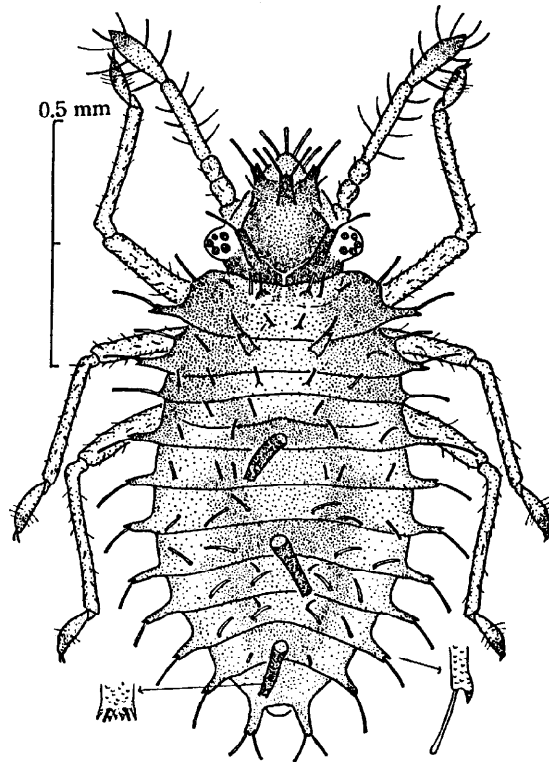


Fig. 15. *Cochlochila lewisi*, 2nd instar larva.

the median line, and each process with a few conical denticles and 2 short hairs on the tip, and the denticles and hairs are of equal length. Posterolateral corners of abdominal tergites except the 1st segment, with one moderate process. Tip of the processes with one short conical denticle and one long rod-like hair. But caudal processes at the tip with one conical denticle centrally and 2 rod-like hairs peripherally and oppositely.

Dorsal surface of thorax and abdomen except the caudal segment, furnished symmetrically with some long rod-like hairs on each segment.

#### Third instar (Fig. 16)

Measurements, in  $\mu$ : Body length without processes 1483; width of body at the 3rd abdominal segment without processes 733; width of head with eyes 367; width of pronotum without processes 600, with processes 830; length of pronotum 192; width of the 9th abdominal segments 270; lengths of antennal segments I to IV= 89, 84, 329, 189: Lengths of segments of leg: fore femora 369, fore tibia 425, middle femora 369, middle tibiae 417, hind femora 376, hind tibiae 467 and hind 2nd tarsi 141.

Structure: Paired frontal processes projecting forwardly beyond apex of clypeus,

but in the preceding instar these processes never reaching to its apex. Length of occipital processes subequal in length to the distal antennal segment.

Pronotum transverse, anterior margin curved weakly and concavely, posterior margin sinuate and middle of the margin slightly protruded backwardly. Lateral margins of pronotum and mesonotum armed with one long process on each posterolateral corner, one moderate process on middle of the margin, and one small tubercular process on antero-lateral corner on each side, so the process increased one more from the 2nd to 3rd instars.

The other body processes of thorax and abdomen situated on the corresponding areas to the 2nd instar, but differed from the 2nd instar by greater length and apical structures of the processes: the tip of lateral processes with 2 short conical denticles peripherally and oppositely, and one long rod-like hair centrally, but tip of median dorsal process with some conical denticles and one or two stunted hairs, the former situated apically and subapically. Lateral surface of proximal portions of unpaired head process, occipital processes and median dorsal processes of body covered with tri- or bicuspidate very minute denticles. On the other hand, body surface furnished with simple conical denticles. But some areas remain bald. Several long and short rod-like hairs distributed sparsely on each segment, and a few ones on proximal portion of the unpaired and occipital processes of head.

#### Fourth instar (Fig. 17)

Measurements, in  $\mu$ : Body length without processes 1900; width of body at the

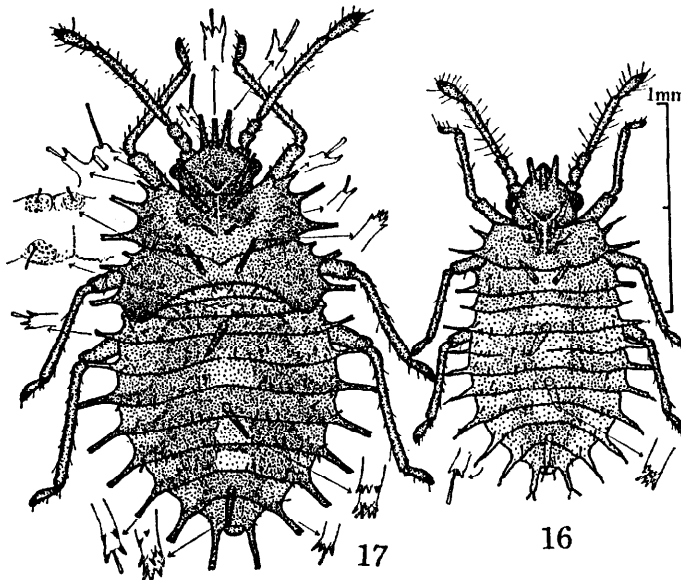


Fig. 16. *Cochlochila lewisi*, 3rd instar larva.

Fig. 17. *Cochlochila lewisi*, 4th instar larva.



3rd abdominal segment without processes 1033; width of head with eyes 433; width of pronotum without processes 767, with processes 1100; length of pronotum 333; lengths of antennal segments I to IV=111, 102, 534, 249. Lengths of segments of legs: fore femora 489, fore tibiae 569, middle femora 490, middle tibiae 560, hind femora 534, hind tibiae 623 and the 2nd tarsi 160.

Structure: Paired frontal processes the smallest of all head processes but projecting at length beyond apices of the 2nd antennal segment, but in the preceding instar those processes not reaching the apical level of the segment. Length of distal antennal segment much shorter than occipital processes,  $249\mu$ :  $294\mu$ .

Pronotum transverse, humeral areas expanded anteriorly. Posterior margin of pronotum protruded into a small triangle. Lateral margins of pronotum and mesothoracic wing pads armed with one tubercular and 3 moderate processes, which are becoming longer posteriorly.

The other body processes situated on the corresponding areas to the 3rd instar, but differed from the 3rd instar by much elongated lateral processes than the dorsal median ones. But lateral processes of the 2nd and 3rd abdominal segments apparently stunted in comparison with the posterior ones. Tip of lateral process with one long rod-like hair centrally and some short conical denticles apically and subapically. Long rod-like hairs grouped into submedian and sublateral on each abdominal tergite.

#### Fifth instar (Fig. 18)

Measurements, in  $\mu$ : Body length without processes 2850; width of body across the wing pads without processes 1500; width of head with eyes 567; width of pronotum without processes 1200, with processes 1700; length of pronotum 750; width of caudal segment 550; lengths of antennal segments I to IV=134, 102, 859 to 899, 312 to 316. Lengths of segments of legs: fore femora 712, fore tibiae 854, middle femora 712, middle tibiae 837, hind femora 730, hind tibiae 961 and hind 2nd tarsi 196.

Structure: Width of head nearly equal to the width of caudal segment, but in the earlier instars width of head apparently wider than caudal segment. Occipital processes directed remarkably forward and obliquely upward and apparently longer than distal antennal segment,  $410\mu$ :  $314\mu$ .

Pronotum almost rectangular, humerolateral margins armed with one tubercular process and 4 moderate processes which are becoming longer posteriorly. Posterior projection of pronotum reaching the posterior margin of mesonotum. Mesothoracic hemelytral lobes approached to the posterior margin of the 4th abdominal tergite, and armed with processes as in the lateral processes of pronotum. The other body processes situated on the corresponding areas to the preceding instar, but lateral processes of the 2nd and 3rd abdominal segments strongly atrophied to become mere tubercles that are concealed beneath hemelytral lobes. Tip of long processes of body somewhat capitate and armed apically and subapically with several conical or tiny claw-shaped denticles, and increased in number to the preceding instar. Lateral surface of the long processes densely furnished with simply cuspidate tiny denticles, which are simplified from bi- or tricuspidate ones of the 3rd or 4th instars.

Entire surface of body furnished densely with simple conical tubercles, and sparsely with long rod-like hairs which are grouped in submedian and sublateral areas

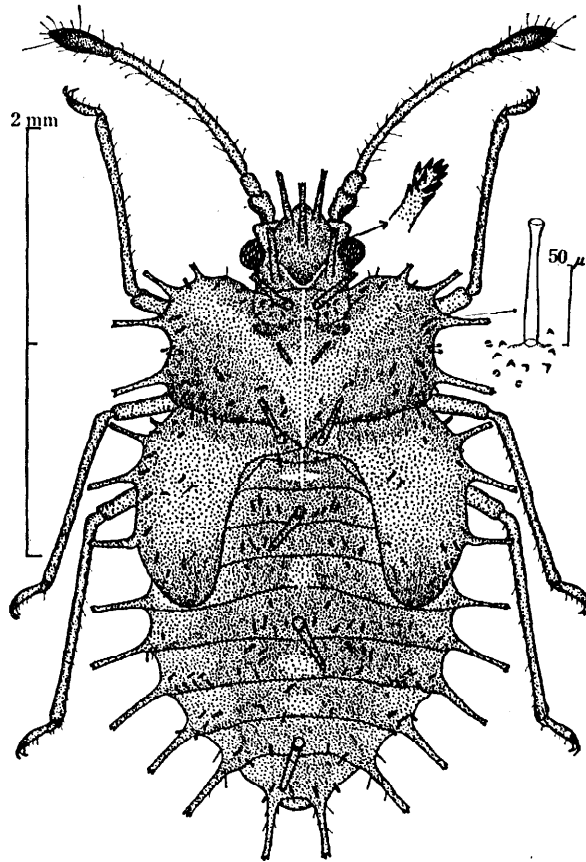


Fig. 18. *Cochlochila lewisi*, 5th instar larva.

of each abdominal tergite. And anterior middle portion and posterolateral areas of pronotum and outer lateral areas of hemelytral lobes provided also with such hairs.

#### 6. *Galeatus spinifrons* (Fallén, 1896)

##### Fourth instar (Fig. 19)

Measurements, in  $\mu$ : Body length without processes 1513, with processes 1875; width of body at the 3rd abdominal segment without processes 838, with processes 1262; width of head with eyes 410; length of pronotum 269; width of pronotum without processes 700; width of mesonotum 800; width of metanotum 825; lengths of antennal segments I to IV=120, 60 to 76, 375 to 409, 244 to 245; lengths of segments of rostrum I to IV=169, 196, 89, 125. Lengths of segments of legs: fore tibiae 445, middle tibiae 423, hind tibiae 481 and the 2nd tarsi 147.

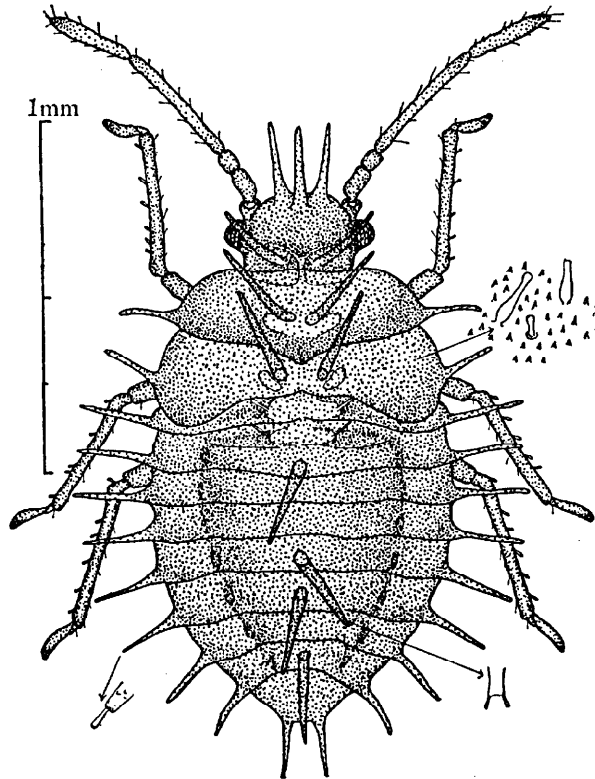


Fig. 19. *Galeatus spinifrons*, 4th instar larva.

**Structure:** Head armed with 5 long processes, paired frontal processes projected forward, unpaired process directed obliquely upwards and frontally, frontal 3 processes extending far beyond apex of the 2nd antennal segment. Occipital ones projected obliquely to the sides. Antenniferous tubercles pointed, the 4th antennal segment slightly longer than frontal head processes but shorter than occipital ones.

Pronotum armed with 2 median and 2 lateral processes, median ones very long, rather closely situated to each other and projected divergently upwards, lateral ones apparently smaller than the medians. Mesothoracic hemelytral lobes reaching not to the posterior margin of metanotum, armed with paired long median and 2 smaller lateral processes. Lateral corners of metanotum also armed with one long process on each side. One transverse light bulge situated at the middle of the tergite, and each lateral sides of the bulge with one slender hair. The 1st abdominal tergite also with such a bulge.

Abdominal tergites II, V, VI & VIII each with 4 long processes along the median line, each posterolateral corners of abdominal segments II to IX with one long process.

Entire surface of body except legs, antennae, rostrum and long processes, covered

very densely with tiny conical dermal spines. Slender staff-shaped or somewhat ampullaceous hairs sparsely dispersed on dorsum and proximal portion of long processes.

**Fifth instar (Fig. 20)**

Measurements, in  $\mu$ : Body length without processes 2162, with processes 2600; width of body at the 4th abdominal segment without processes 1215, with processes 1950; width of head with eyes 485; length of pronotum 550; width of pronotum without processes 1000; lengths of antennal segments I to IV=125 to 138, 94 to 115, 500 to 601, 300 to 343; lengths of segments of rostrum I to IV = 191, 267, 94, 160. Lengths of segments of legs: fore tibiae 557, middle tibiae 525, hind tibiae 812 and hind 2nd tarsi 175.

Coloration: General color dully dark ochreous. Pale and dark areas as in the text-figure.

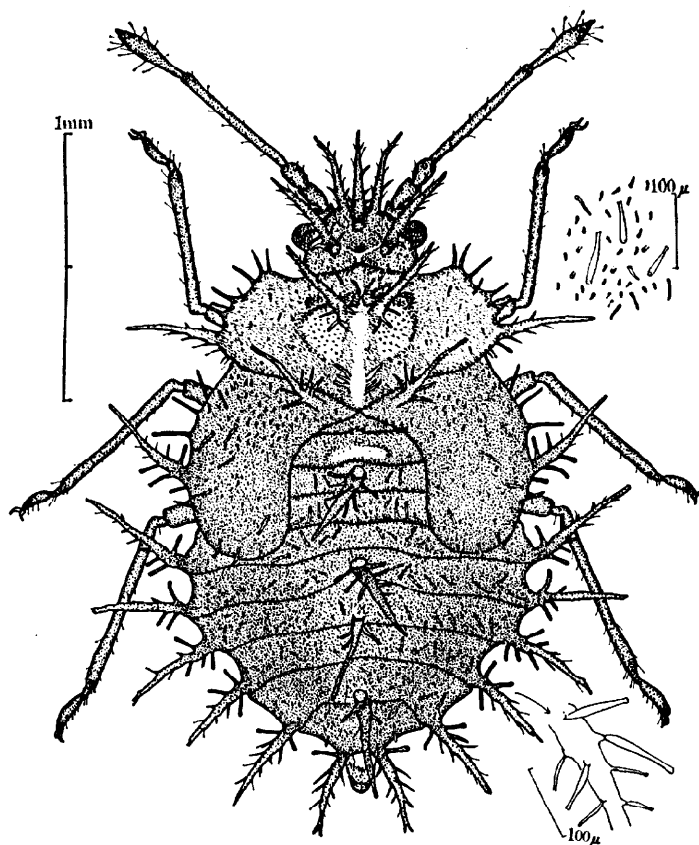


Fig. 20. *Galeatus spinifrons*, 5th instar larva.

Structure: Head armed with 5 long processes, distal portion of paired frontal processes slightly curved obliquely to the sides, about  $263\mu$  long; unpaired process about  $397\mu$  long; occipital processes about  $487\mu$  long. Antenniferous tubercles short and pointed at apex, the 1st and 2nd antennal segments thick, the 3rd comparatively slender and the 4th swollen at distal half but pointed at apex.

Anterior margin of pronotum broadly protruded triangularly, somewhat elevated and covering the occiput. Anterolateral corners of pronotum fairly prolonged forward. Lateral margins of pronotum covered with some slender staff-shaped or somewhat ampullaceous elongate hairs, and each posterolateral angle armed with one very long process. Posterior pronotal projection approaching the posterior margin of mesonotum. Pronotal disk on apical third with one pair of transverse bald stripes, which are in contact with each other at the median line. Approximately in the middle of pronotal disk situated one pair of kidney-shaped, very large bulges. Near center of pronotal disk, on a distinct elevation a pair of long closely set processes projecting divergently to the sides. The median spindle-shaped bulge arisen from the base of the long processes and extended to the end of the posterior projection. Middle of mesonotum armed with one pair of long processes, hemelytral lobes extending or closed to posterior margin of the 4th abdominal tergite, outer lateral margins of the lobes furnished with some slender ampullaceous hairs on anterior half, and armed with a large process a little behind middle.

Abdominal processes situated on the corresponding areas to the former instar, but lateral processes of the tergites II and III entirely disappeared in correlation with the elongation of wing pads. Body surface also furnished with conical processes and ampullaceous hairs as in the preceding instar.

#### 7. *Uhlerites debile* (Uhler, 1896)

##### First instar (Fig. 21)

Measurements, in  $\mu$ : Body length 531 to 570; width of body at the pronotum 175; width of head with eyes 163; widths of thoracic segments, pronotum and mesonotum 175, metanotum 150; lengths of antennal segments I to IV = 45, 40, 209, 116. Lengths of segments of legs: fore and hind tibiae 138; middle tibiae 131 and hind 2nd tarsi 71.

Coloration: General color very pale amber or almost colorless. Distal segment of antennae except basal portion, distal portion of the 3rd antennal segment, occipital portion of head, and dorsal middle portion and lateral sides of abdomen darkened.

Structure: Head comparatively large, clypeus strongly protrudent, paired frontal processes very short and only tuberculate, and with one long rod-like hair which is longer than the basal tubercular process. Unpaired process thick and slightly bifurcated at the tip, and with paired rod-like hairs. Occipital processes conical but the apices blunt and each with a single hair. Eyes composed of 5 apparently reddish facets. Antennae long, cylindrical, the 3rd and 4th segments sparsely with vertical simple hairs, but the 2nd with a few such hairs together with a short rod-like hair.

Pronotum nearly equal to mesonotum in shape and size, but metanotum resembling abdominal segment in shape. Thoracic nota and abdominal tergites so protruded posterolaterally or laterally as to form a triangular process, with a long rod-like

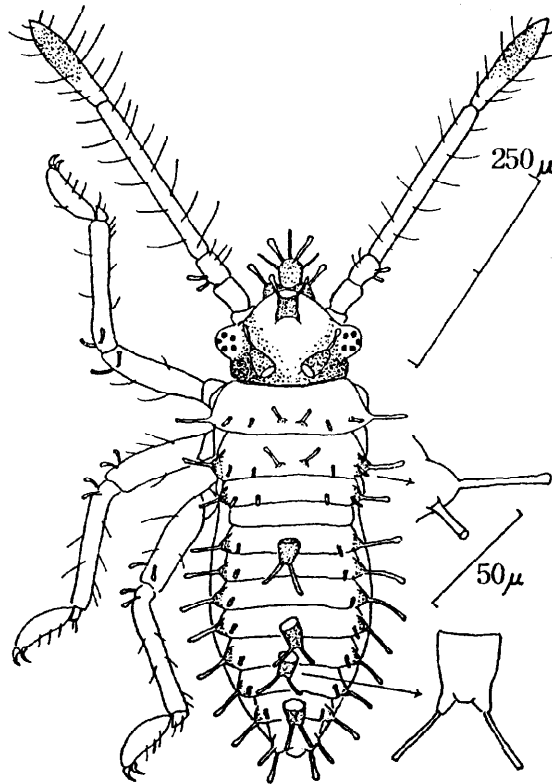


Fig. 21. *Uhlerites debile*, 1st instar larva.

hair on each tip, and one more small rod-like hair sublaterally. \* Exceptionally, the 1st abdominal segment typically rectangular and bald, and caudal segment with 2 long hairs on each posterolateral corner. One small rod-like hair situated on either side of the submedian line of respective thoracic segment. One pair of very small tubercles on the median line of pronotum and mesonotum and each tubercle with a long rod-like hair.

Each of the abdominal tergites II, V, VI & VIII, with one comparatively thick tubercle, which is bifurcated, and each apex is bearing two long rod-like hairs.

Legs very stout, and tibiae at base with a paired rod-like hairs, but the other portion of legs with a few simple hairs.

#### Second instar (Fig. 22)

Measurements, in  $\mu$ : Body length without processes 712 to 765, with processes 763 to 819; width of body at the 4th abdominal segment with processes 313; width of head with eyes 201; widths of thoracic segments, pronotum without processes 231, with processes 288, mesonotum without processes 237, with processes 313, metanotum

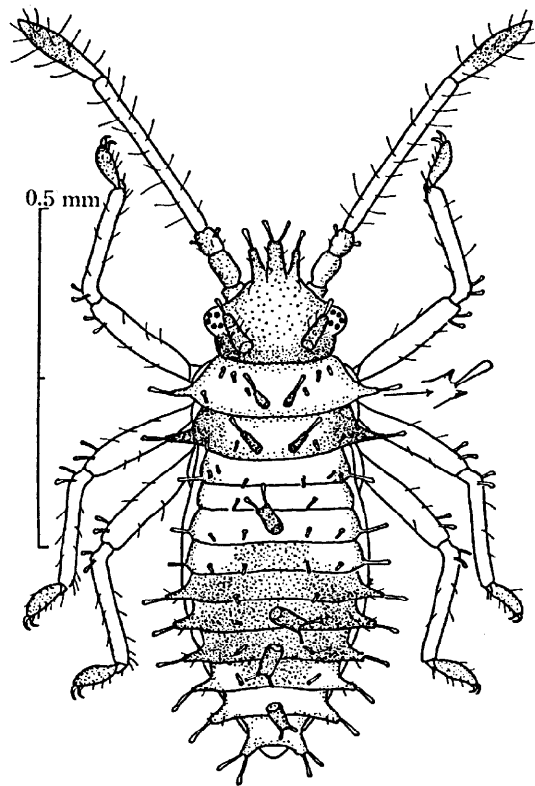


Fig. 22. *Uhlerites debile*, 2nd instar larva.

without processes 213; lengths of antennal segments I to IV=49, 45, 267, 134. Lengths of segments of legs: fore and hind tibiae 178, middle tibiae 169 and hind 2nd tarsi 76.

Structure: Head armed with 5 processes, paired frontal processes reaching the level of anterior margin of the 1st antennal segment. The 4th antennal segment nearly spindle-shaped, the 2nd segment with one pair of clubbed hairs. Eyes composed of 5 facets as in the 1st instar.

Pronotum longer than mesonotum, mesonotum at the middle wider than the former. Median and lateral processes of thorax and abdomen fairly developed from the corresponding areas to the preceding instar, but metanotal and the 2nd and 3rd abdominal lateral ones atrophied and remained in a tubercle-like projection as in the preceding instar. A single median process and unpaired head process with one pair of clubbed hairs on each tip. But paired processes of head and thorax and all lateral processes each with a single clubbed hair on the tip, but exceptionally 2 clubbed hairs are seen on caudal processes. And each tip of lateral processes blunt and with 2 tiny, conical denticles peripherally and oppositely, but a

long clubbed hair centrally. Body surface, on submedian lines and sublateral sides bearing small ampullaceous hairs.

**Third instar (Fig. 23)**

Measurements, in  $\mu$ : Body length without processes 938 to 950, with processes 1063 to 1125; width of body across mesothoracic wing pads without processes 378 to 413, with processes 525 to 550; width of head with eyes 245; lengths of antennal segments I to IV=71, 62, 409 to 425, 174 to 187. Lengths of segments of legs: fore and middle tibiae 270, hind tibiae 280 and hind 2nd tarsi 98.

Coloration: Pale and dark areas colored in grayish brown as in the text-figure.

Structure: Head armed with 5 processes. Eyes composed of about 8 facets, of which 5 are initial and deeply reddish, and the rest ones secondary, peripheral in position and almost colorless. Antenniferous tubercles pointed at the apex.

Anterior margin of pronotum gently concave and the posterior margin gently rounded and running parallel with the anterior margin. Lateral margins of mesonotum extended and convexly rounded, and forming rudimentary wing pads on each

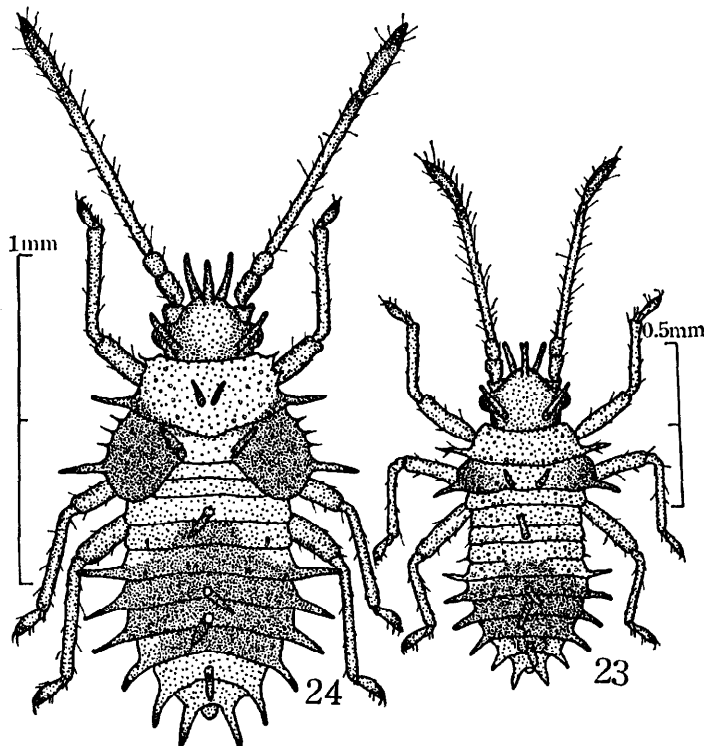


Fig. 23. *Uhlerrites debile*, 3rd instar larva.

Fig. 24. *Uhlerrites debile*, 4th instar larva.



side. Thoracic processes placed on the same areas as in the 2nd instar, but differed from that of the 2nd instar by greater length and presence of a very small spine-shaped process in front of each posterolateral process of mesonotum.

Abdominal processes situated on the corresponding areas to the 2nd instar but longer, and with some simple hairs on the sides. On body surface, the ampullaceous hairs increased in number than in the 2nd instar, and in addition, very tiny minute conical structures are seen on the same areas where were seen hairs in the preceding instar.

#### Fourth instar (Fig. 24)

Measurements, in  $\mu$ : Body length without processes 1175 to 1350, with processes 1500 to 1562; width of body across wing pads without processes 575 to 620, with processes 800 to 900; width of head with eyes 338; lengths of antennal segments I to IV=89, 76, 575 to 583, 236. Lengths of segments of legs: fore tibiae 378, middle tibiae 360, hind tibiae 406 and hind 2nd tarsi 116.

Coloration: Pale and dark areas as in the 3rd instar, but dark areas more developed, or wing pads entirely colored in grayish brown and all of body processes darkly colored except only median pronotal processes.

Structure: Eyes composed of 17-18 facets, 5 initial ones deep red but the other additional ones very pale orange to colorless and peripherally positioned. Anterior margin of pronotum nearly straight, posterior margin protruded into the posterior projection of pronotum. Mesothoracic wing pads reaching the anterior area of the 2nd abdominal tergite. Thoracic and abdominal processes situated on the corresponding areas to the 3rd instar, but small tubercular processes newly added, 2 on each pronotal side and 3 on each mesonotal side.

#### Fifth instar (Fig. 25)

Measurements, in  $\mu$ : Body length without processes 1750, with processes 212; width of body across wing pads without processes 820 to 925, with processes 1200 to 1250; width of head with eyes 412; lengths of antennal segments I to IV=178, 98, 850 to 890, 300 to 313. Lengths of segments of legs: fore tibiae 534 to 561, middle tibiae 516 to 543, hind tibiae 587 to 596 and hind 2nd tarsi 134.

Coloration: Pale and dark areas grayish brown, as in the text-figure.

Structure: Various processes situated on the corresponding areas to the preceding instar. Distal antennal segment spindle-shaped and curved outwards. Eyes composed of many facets, among them inner 5 initial facets violet colored, secondary facets pale orange colored and tertiary facets almost colorless and peripherally located.

Anterior margin of pronotum broadly protrudent, anterolateral angles prominent. Each lateral margin with several tubercular processes besides the long process situated on each posterolateral corner. Posterior pronotal projection approaching the posterior margin of mesonotal disk.

One moderately high carina originated from central paired processes, and extended to the end of posterior projection of pronotum. Mesothoracic hemelytral lobes reaching approximately the middle of the 5th abdominal tergite. On outer margin of each hemelytral lobe, besides the long process, situated several tubercular processes on

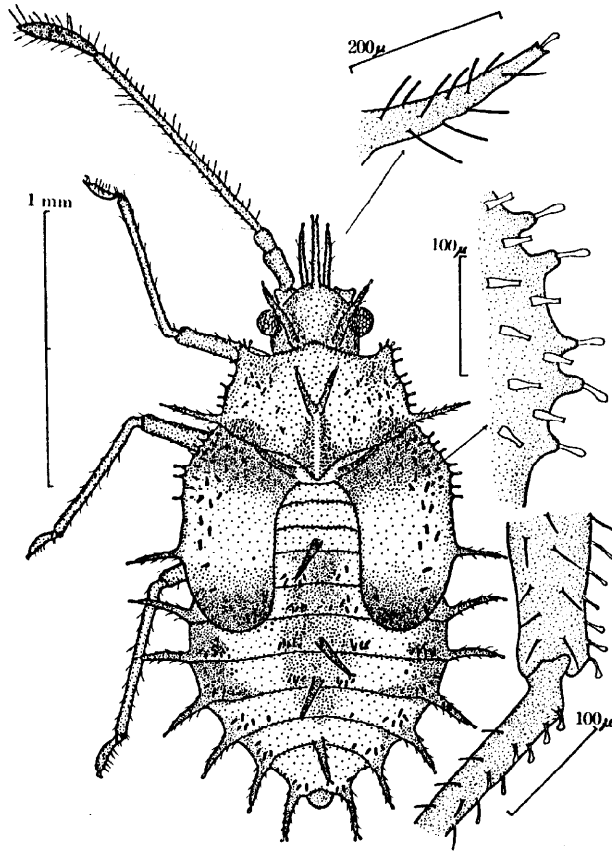


Fig. 25. *Uhlerites debile*, 5th instar larva.

basal third of the margin, each tubercular process with a clubbed hair. Mesonotal processes directing divergently upward.

Body surface: Tiny ampullaceous hairs scattered over pronotum, basal outer areas of wing pads and on sublateral and submedian areas of abdomen, and hence each abdominal tergite covered with 4 tufts which are composed of several ampullaceous hairs respectively.

#### 8. *Uhlerites latius* Takeya, 1931

##### Fourth instar (Fig. 26)

Measurements, in  $\mu$ : Length of body without processes 1500, with processes 1763; width of head with eyes 350; length of pronotum 225; width of pronotum 537; width of body across wing pads without processes 688, with processes 975; width of abdomen 513; length of abdomen 994; lengths of antennal segments I to IV=124, 71,

695, 276. Lengths of segments of legs: fore tibiae 445, middle tibiae 427, hind tibiae 463 and hind 2nd tarsi 134.

Coloration, specimen in alcohol: General color pale ochreous, outer sides of the 1st antennal segment darkly ochreous. Brownish black areas as in the text-figure.

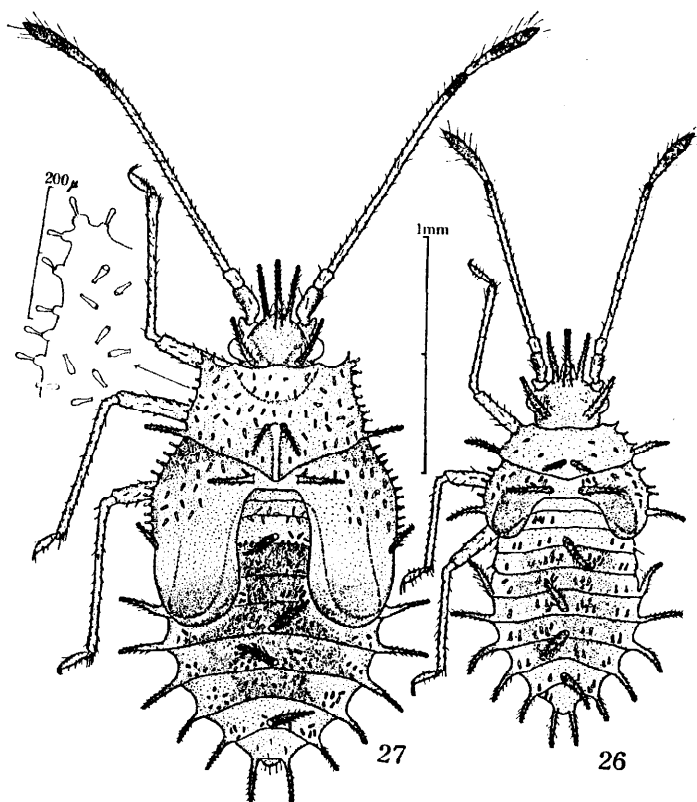


Fig. 26. *Uhlerites latius*, 4th instar larva.

Fig. 27. *Uhlerites latius*, 5th instar larva.

Structure: Head armed with 5 processes which are longer than 2 basal antennal-segments combined. Unpaired frontal process the longest, and paired frontal processes the shortest of head processes.

Pronotum transverse, posterior margin gently protruded into a triangular projection, each lateral margin armed with 3 tubercular processes anteriorly and one long process on each posterolateral corner. Median discopronotal processes situated on posterior one-third, closely approaching to each other and directed divergently upward. Mesothoracic wing pads prolonged to middle of the 2nd tergite, and armed with 3 tubercular processes anteriorly, and with one long process which is upward but outwardly curved on distal portion.

Discomesonotal processes fairly separated from each other and directed divergently upward. Metathoracic wing pads reaching the anterior margin of the 2nd abdominal tergite.

Median abdominal processes situated near the posterior margins of tergites II, V, VI & VIII respectively, tapered apically and somewhat ampullaceous. The 1st abdominal lateral processes of sigmoid form in profile or proximal portion curved anteriorly and distal portion bent obliquely upward and laterally. Each postero-lateral corner of abdominal segments II & III with one tubercular process, but that of segments IV to IX with one long process.

Among the above mentioned processes, unpaired median one with 2 clubbed hairs on each blunt tip, but paired median and lateral ones with a single hair on each blunt tip. Pronotum and proximal areas of the wing pads covered with tiny ampullaceous hairs, and sublateral and submedian areas of abdominal segments, except the caudal segment, also with similar hairs.

#### Fifth instar (Fig. 27)

Measurements, in  $\mu$ : Length of body without processes 1964, with processes 2286; width of head with eyes 404; length of pronotum 400; width of pronotum 490; width of body across wing pads 1025; length of abdomen without processes 1138; width of abdomen without processes 875; lengths of antennal segments I to IV=161, 98, 1050, 365. Lengths of segments of legs: fore and middle femora 516, fore tibiae 676, middle tibiae 659, hind femora 587, hind tibiae 703 and hind 2nd tarsi 151.

Coloration: Pale and dark areas as in the figure. Apex of the 3rd antennal segment narrowly, and middle portion of distal segment broadly dull ochreous. All body processes brownish black. Outer lobes of acetabula of legs dark gray. Apex of rostrum also black.

Structure: Processes of head, thorax and abdomen situated on the corresponding areas to the 4th instar. Anterior margin of pronotum almost flat but 4 times concaved so as to form 3 small convexities, and humeral angles more prolonged forward than in the preceding instar. Posterior pronotal projection closed to the posterior margin of mesonotum. Posterior portions of the sides of pronotum moderately swollen. Humeral corners and lateral margins of pronotum with several tubercular processes, each process with a small clubbed hair. Pronotum along the median line with a very high carina which is originated from the central paired processes and extending to the apex of posterior projection. Median anterior portion of pronotal disk slightly elevated into tectiform.

Mesothoracic hemelytral lobes nearly reaching the middle of the 5th abdominal tergite, on outer lateral margins, anterior to the lateral process of the lobe, with about 10 small tubercular processes, and each process with one clubbed hair. Tiny ampullaceous hairs evenly distributed on pronotum and outer proximal portion of hemelytral lobes, but in abdomen, on sublateral and submedian areas of each tergite and grouped in 4 tufts each of which is composed of several tiny hairs. On the other hand, antennae, legs and various processes furnished with simple hairs.

9. *Tingis populi* Takeya, 1932

## Fifth instar (Fig. 28)

Measurements, in  $\mu$ : Body length 2029 to 2136; width of body across wing pads 979 to 1068; lengths of antennal segments I to IV=133, 98, 908, 392; lengths of segments of rostrum I to IV=178, 245, 89, 111. Lengths of segments of legs: fore and middle femora 676, fore and middle tibiae 691, hind femora 730, hind tibiae 747 and hind 2nd tarsi 142.

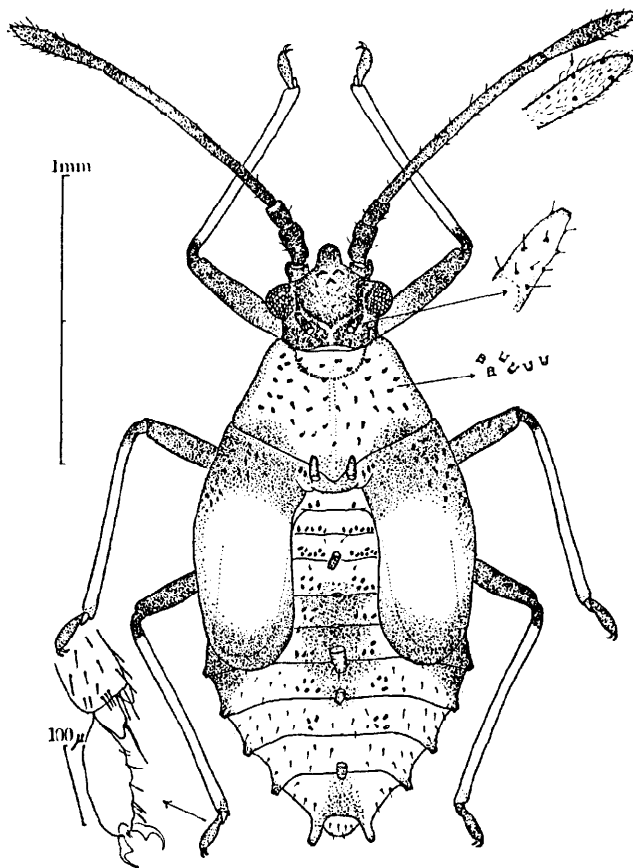


Fig. 28. *Tingis populi*, 5th instar larva.

Coloration: In dried specimen ground color light amber, somewhat transparent, but specimen in alcohol somewhat paler than the dried ones, and ground color whitish yellow. Pale and dark areas as in the figure. Outer sides of hind acetabula blackish, lateral areas of ventral surface of the 5th and 6th abdominal segments also colored brown to black.

**Structure:** Body form nearly elongate oval but extremely flattened dorsoventrally. Clypeus remarkably prominent. Occipital portion marked with a Y-shaped pale stripe, therefore head divided into 3 parts. Three frontal head processes very small and tuberculate, and triangular in position. Paired occipital processes moderately long, widely separated from each other, and set on the clearly defined swellings. Antenniferous tubercles distally widened and making edges, the 1st antennal segment somewhat narrowed in middle and widened to distal portion.

Pronotum unarmed, nearly pentagonal, and the anterior part somewhat elevated just like tectiform, the anterior margin gently sinuated. Posterior pronotal projection being between the mesonotal processes, not extending posteriorly further more. Mesonotum armed with one pair of fairly developed erect processes. Mesothoracic hemelytral lobes very long and reaching the anterior portion of the 6th abdominal segment. Metathoracic alar lobes also very long but a little shorter than the former. Lateral margins of pronotum and wing pads with several small clubbed hairs.

Along median line of body and near posterior margin of each abdominal tergite (II, V, VI & VIII) situated one small process, and the process on the 2nd tergite small and the slenderest, and that on the 5th tergite thick and stout. Posterolateral corners of each abdominal segment from V to IX angulated but more protruded on hinder segments and posterolateral corners of the 9th segment distinctly projecting and forming fairly long processes which are directed posteriorly and horizontal in position. These lateral projections, in dried specimens, are characterized by truncate apices unlike median processes which are rounded at apices, but in specimens in alcohol they are all simply terminated, and with one small clubbed hair on each apex, exceptionally each of the caudal ones provided with two of such hairs.

Body surface furnished with special capitate or truncate rod-like hairs, very minute warts and very fine simple hairs. The truncate rod-like hairs distributing evenly on pronotum, but few on mesonotum and metanotum, several on outer basal regions of hemelytral lobes and submedian areas of abdominal tergites I to VII, and on abdominal tergites some hairs are grouped. Fine simple hairs found on head, antennae, the sides of hemelytral lobes and on the posterior portion of each abdominal tergite and legs.

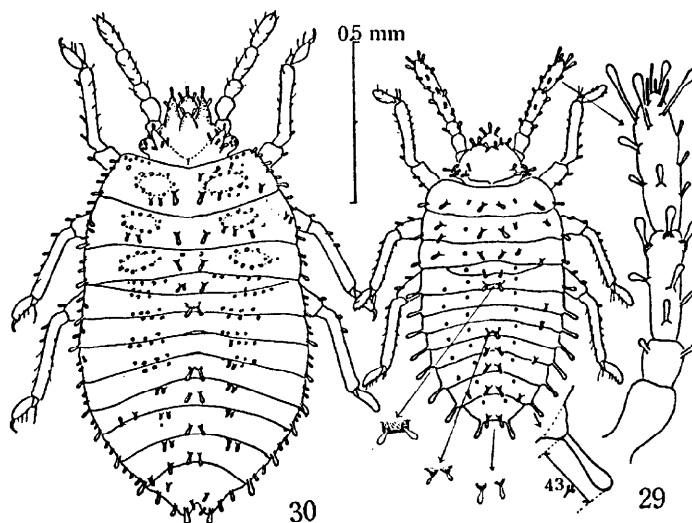
#### 10. *Tingis ampliata* (Herrich-Schäffer, 1839)

##### First instar (Fig. 29)

Measurements, in  $\mu$ : Body length without hairs 900; width of body at the metanotum 438 to 450; width of head with eyes 238; width of anterior margin of pronotum 275; length of thorax 313; length of abdomen 516; lengths of antennal segments I to IV=45 to 49, 45 to 47, 89 to 94, 107 to 112; lengths of segments of rostrum I to IV=76, 107, 85, 103. Lengths of segments of legs: fore femora 187, fore tibiae 220, middle femora 182, middle tibiae 210, hind femora 187, hind femora 187, hind tibiae 230 and hind 2nd tarsi 94.

Coloration, specimen in alcohol: Ground color pale yellowish or pale fawn, underside much paler. Tip of distal antennal segment, apex of rostrum and apices of tarsi slightly darkened to brown. Each facet remarkably reddish.

**Structure:** Head armed with 5 bifid tubercular processes, 3 in frontal area, 2 in occipital area, each process furnished with 2 clubbed hairs of equal size. Clypeus

Fig. 29. *Tingis ampliata*, 1st instar larva.Fig. 30. *Tingis ampliata*, 2nd instar larva.

projecting, slightly beyond the level of anterior margin of the 1st antennal segment, and with 3 clubbed hairs in a triangular position. Labrum small and with 4 such hairs bilaterally. Eyes composed of 5 facets and with 2 clubbed hairs: one in central and the other smaller ones on the posterior side of the eye. Antennal segments except the basal one furnished with clubbed hairs, and the 4th segment with 4 long hairs of about  $49\ \mu$  long on distal area. Thoracic segments resemble abdominal segments in shape, the 1st abdominal segment small, laterally pointed and entirely encompassed between metanotum and the 2nd abdominal tergite. On the median line and near posterior margin of each notum or tergite, except the 3rd and 4th abdominal ones, one pair of clubbed hairs sets on a very small tubercle respectively. Posterolateral corners of thoracic nota and abdominal tergites except the 1st abdominal one, also each adorned with one clubbed hair, and the hairs becoming longer caudally, and larger than the median ones. Median clubbed hairs on the 2nd abdominal tergite slightly longer and sets on a single common tubercle. Clubbed hairs on the 5th tergite also set on small tubercles which are closed to each other but not contiguous as those of the 2nd tergite. The other median tubercles separated from each other. Also small clubbed hairs situated on submedian and sublateral-lines of the nota and tergites; each of the submedian hairs situated near the anterior margin, and each of the sublateral ones situated near the posterior margin of each segment. On the ventral surface of thorax, near each acetabulum situated 4 or 5 clubbed hairs. Underside of abdomen with a very pale median longitudinal area, and also 6 rows of clubbed hairs. Outer side of femora and tibiae with some clubbed hairs, but inner side of tibiae with some simple hairs.

### Second instar (Fig. 30)

Measurements, in  $\mu$ : Body length 1300; width of body at the 3rd abdominal segment 700; width of head with eyes 300; width of anterior margin of pronotum 375; length of thorax 325; length of abdomen 721; lengths of antennal segments I to IV=80, 55, 114, 131. Lengths of segments of legs: fore femora 250, fore tibiae 285, middle femora 245, middle tibiae 272, hind femora 254, hind tibiae 298 and hind 2nd tarsi 111.

Structure: Head processes fairly well developed, paired frontal processes and each process with an apical and one or two lateral clubbed hairs, tip of unpaired process with 2 clubbed hairs, but each of occipital processes with a single clubbed hair at apex and a few such hairs on the sides. Clypeus with 5 clubbed hairs, one central and 4 square in arrangement and labrum with 4 hairs. Apex of distal antennal segment with some fairly long hairs, which are slender and rod-like, but not clubbed.

Anterior margin of pronotum roundly curved and the posterior margin parallel to the former.

One pair of clubbed hairs present on the median line of thoracic nota and abdominal tergites, and hairs situated on the corresponding areas to the 1st instar, but stunted and smaller than in the 1st instar. Each tergite except the 1st abdominal one, furnished with a few clubbed hairs on each side, hairs on the postero-lateral corners larger than those of the anterior corners in each segment.

Body surface with minute dermal structures, which may be seen as circular patches from dorsal view, situated on the submedian areas of each segment, near anterior and posterior margins, but rare on the posterior abdominal segments. Abdominal tip fairly incised.

### Third instar (Fig. 31)

Measurements, in  $\mu$ : Body length without processes 1750; width of body at the 3rd abdominal segment 1000; width of head with eyes 416; width of anterior margin of pronotum 558; length of thorax 500; length of abdomen 1000; lengths of antennal segments I to IV=120, 72, 178, 187. Lengths of segments of legs: fore femora 342, fore tibiae 374, middle femora 329, middle tibiae 360, hind femora 354, hind tibiae 409 and hind 2nd tarsi 138.

Structure: Head processes well developed, the occipital ones remarkably longer than the frontal ones and as long as the 4th antennal segment. Unpaired frontal process directed upwards, obliquely and frontally directed, so looked shorter than its real length from dorsal view, terminated in blunt apex and with 2 clubbed hairs. But the paired processes apically tapered and with a single hair on each apex. Antennae sparsely with hairs which are distally simplified and losing clubbing character.

Anterior margin of pronotum roundly concave, and the posterior margin showing a slight indication of the posterior projection which is developed in later instar. Mesonotum not yet protruded as apparent lobes, but at outer hind corners only the traces recognized.

Body surface furnished with small clubbed hairs and dermal semiglobular structures; the former situated on the corresponding areas to the 2nd instar, but stunted and very small but increased in number; on the other hand the latter which are



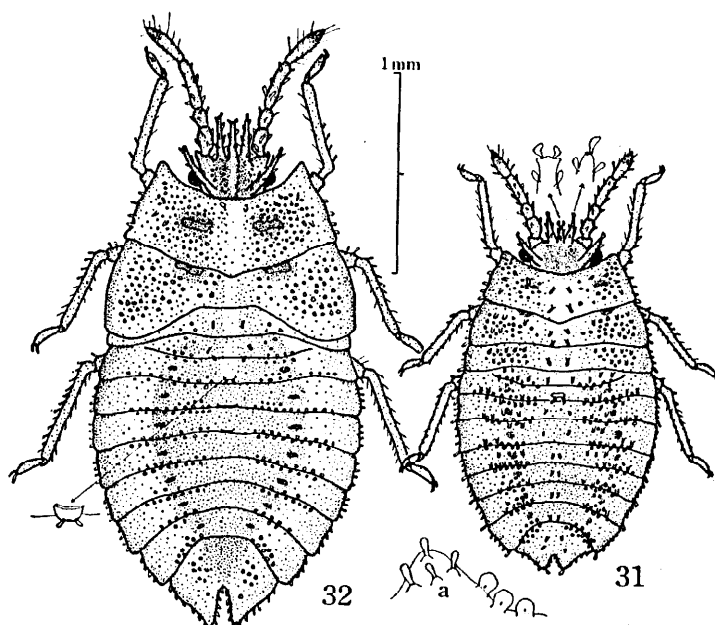


Fig. 31. *Tingis ampliata*, 3rd instar larva; a: dermal structures of antenniferous tubercle.

Fig. 32. *Tingis ampliata*, 4th instar larva.

seen only as circular patches in the 2nd instar, developed into half-ball-shape. The semiglobular structures more clearly recognizable on an ecdysis line of head in lateral view; but the ground plan only circular and spotted in the center. Ventral surface of thorax furnished with dermal semiglobular structures at submarginal areas, but ventral side of abdomen with only small clubbed hairs. Coxae, trochanters and femora furnished with clubbed hairs but tibiae with a few rod-like hairs near knee-joint, and mainly with many sharp setiform hairs.

#### Fourth instar (Fig. 32)

Measurements, in  $\mu$ : Body length without processes 2450; width of body at the 3rd abdominal tergite 1333; width of head with eyes 433; width of anterior margin of pronotum 700; length of abdomen 1467; lengths of antennal segments I to IV=140, 93, 258, 241. Lengths of segments of legs: fore femora 480, fore tibiae 507, middle femora 462, middle tibiae 480, hind femora 495, hind tibiae 569 and hind 2nd tarsi 160.

Structure: Head processes long, occipital processes apparently longer than the 4th antennal segment. Antenniferous tubercles extremely pointed outwardly. The 3rd antennal segment longer than the 4th one but in earlier instars so far the 4th longer than the 3rd.

Anterior margin of pronotum extremely concave and humeral angles sharply

projected to the level of bases of frontal processes. Pronotal disk and mesonotum each with one pair of dark, transverse, glabrous patches, mesonotal patches partially covered with a pronotal projection. Mesothoracic wing pads not reaching the posterior margin of metanotum, and then metathoracic wing pads visible as a very narrow band. Only the 2nd abdominal tergite with one small transverse tubercle which is bearing 2 stunted hairs.

Entire dorsal surface, except subperipheral areas of abdomen, with semiglobose dermal structures and clubbed hairs, and the latter extremely stunted or disappeared.

**Fifth instar (Fig. 33)**

Measurements, in  $\mu$ : Body length without processes 3333; width of body across wing pads 1900; width of head with eyes 560; distance between anterolateral points of pronotum 867; length of abdomen 1967; lengths of antennal segments I to IV=231, 134, 407, 365. Lengths of segments of legs: fore femora 610, fore tibiae

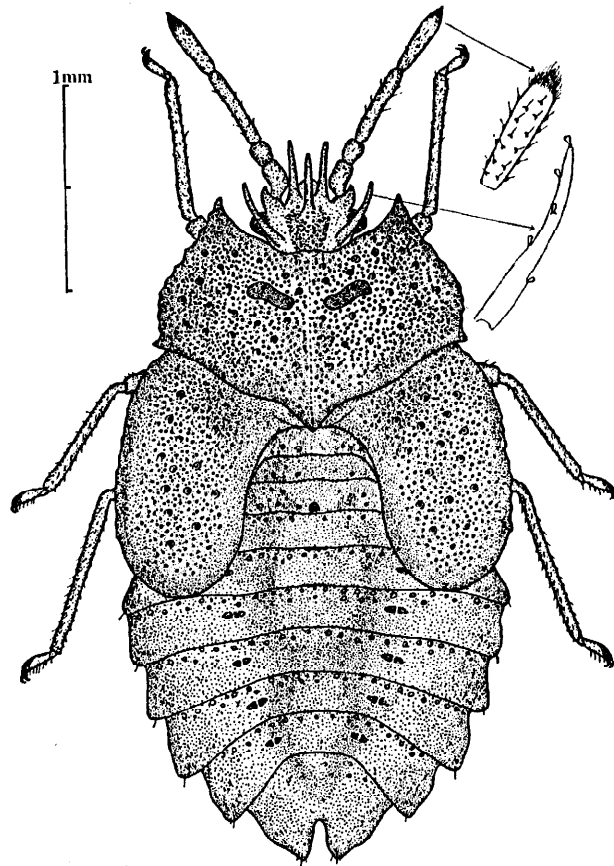


Fig. 33. *Tingis ampliata*, 5th instar larva.

712, middle femora 610, middle tibiae 658, hind femora 720, hind tibiae 818 and hind 2nd tarsi 195.

Structure: Head comparatively small. Antennae short, sparsely covered with very minute hairs which are set on tiny tubercles, but the apex densely covered with fine hairs of which the bases are not tuberculate.

Anterior margin of pronotum deeply and broadly sinuated and somewhat waved as shown in the text-figure. Pronotal disk with one pair of glabrous patches, the shape of each patch being stretched-sigmoidal. Lateral margins of pronotum fairly inflated and somewhat indented, posterolateral corners precipitously pointed and each forming a small triangular projection. Posterior pronotal projection extending over mesonotum and to the anterior margin of metanotum. Mesothoracic hemelytral lobes extending posteriorly to the border between 4th and 5th tergites and lateral margins weakly indented.

Posterolateral corners of abdominal tergites much extended posterolaterally, and then the 9th abdominal segment deeply concave, therefore forming 2 processes.

Semiglobular dermal structures dispersed over vertex, pronotum, mid-portion of wing pads, metanotal disk, and the 1st and 2nd abdominal tergites; such structures of the other abdominal tergites demonstrated only on the anterior margins but diminished towards posteriorly. Two sizes of dermal structures recognizable, larger ones distributed sparsely and very minute tiny ones densely.

Body surface also sparsely covered with stunted, small, clubbed hairs on dorsum and venter.

#### 11. *Tingis comosa* (Takeya, 1931)

##### Fourth instar (Fig. 35)

Measurements, in  $\mu$ : Body length without processes 1625, with processes 2000; width of body across wing pads 800; width of head with eyes 350; length of pronotum 300; width of pronotum 640; width of abdomen 700; length of abdomen 975; lengths of antennal segments I to IV=96, 80, 231, 196. Lengths of segments of legs: fore and middle femora 267, fore tibiae 298, middle tibiae 289, hind femora 294, hind tibiae 361 and hind 2nd tarsi 120.

Structure: Head armed with 5 long processes, frontal processes as long as distal antennal segment but occipital ones as long as the 3rd antennal segment. Antennae very short, the 4th segment spindle shaped and the 3rd tapered distally. Rostrum reaching the posterior margin of the base of middle legs.

Pronotum transverse, anterior margin extremely concave, posterior margin protruded into a triangular projection, each lateral margin gently rounded and furnished with several short processes which are ramified and with some curved flagellate hairs, and the processes on the posterolateral corners slightly larger than the anteriors. Mesothoracic wing pads approaching the posterior margin of metanotum, and the lateral margins typically straight, also with the same processes to the pronotal laterals.

Along the median line of body, paired short processes present near the anterior margin and about middle of pronotum, near the posterior margin of mesonotum, metanotum and the 1st abdominal tergite. And a single short process seen on abdominal

tergites II, V, VI, VII & VIII. Posterolateral corners of metanotum and abdominal segments except the 1st one, each with a long process, and the processes becoming longer caudally and apparently longer than the median ones. Various processes above mentioned ramified and bearing a few curved flagellate hairs.

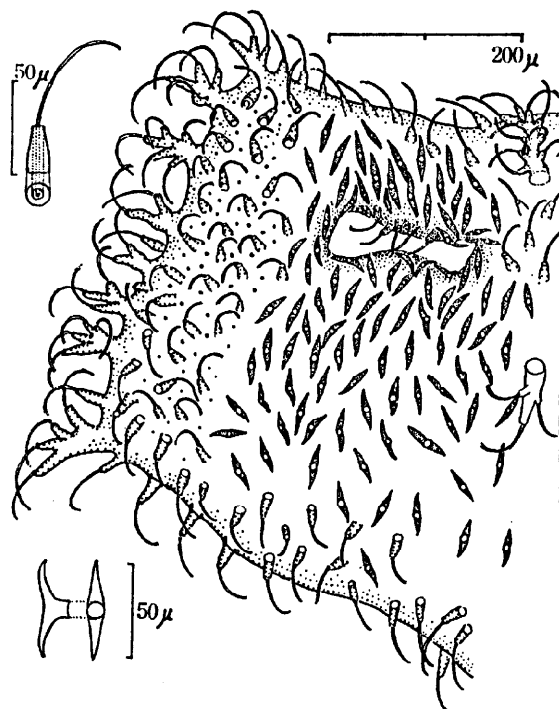


Fig. 34. *Tingis comosa*, lateral half of pronotum of the 5th instar larva.

Body surface, including legs, antennae, and various processes, furnished with short rod-like or ampullaceous tubercles, each of which bears a curved flagellate hair. Pickax-shaped dermal structures seen on vertex, sublateral areas of pronotum and of the anterior portion of abdomen, major portion of wing pads, the sides of posterior portion of abdomen and central area of abdomen.

#### Fifth instar (Figs. 34, 36)

Measurements, in  $\mu$ : Body length without processes 2225, with processes 2688; width of body across wing pads 1178; width of head with eyes 425; length of pronotum 642, width of pronotum 875; length of abdomen 1500; lengths of antennal segments I to IV=135, 102, 289, 240. Lengths of segments of legs: fore and middle femora 378, fore and middle tibiae 400, hind femora 441, hind tibiae 490 and hind 2nd tarsi 134.

Coloration, specimen in alcohol: Antennae, legs, the sides of pronotum and wing pads yellowish; but vertex of head, pronotal disk and abdomen pale brown. Ventral

surface generally dull brown but middle portion of posterior abdomen paler, claws brown.

Structure: Antennae short, the 3rd segment distally tapered and longer than head processes. Head processes and dorsal median processes of thorax and abdomen situated on the corresponding areas to those of the preceding instar. But lateral processes of metathorax and the 2nd and 3rd abdominal segments disappeared in correlation with the elongation of wing pads.

The processes on posterolateral corners of pronotum fairly developed and distinguishable from the anterior shorter ones.

Lateral abdominal processes longer than the median ones, and the more posterior one the longest. Among the above mentioned processes which are all ramified, the unpaired ones along the median line of body, bifurcated on each tip, but paired median and lateral processes of abdomen terminated by a single tip respectively.

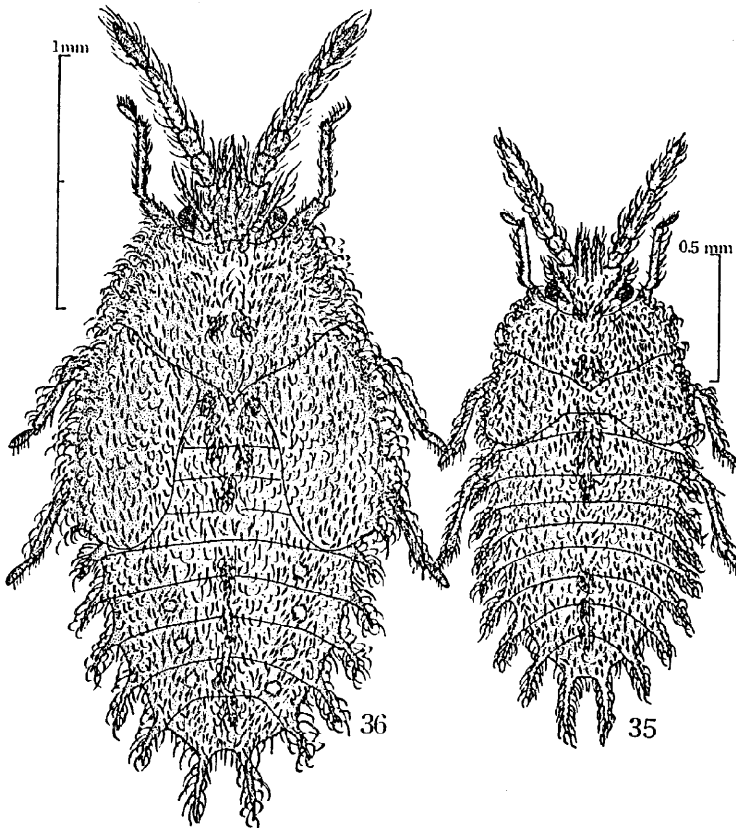


Fig. 35. *Tingis comosa*, 4th instar larva.

Fig. 36. *Tingis comosa*, 5th instar larva.

Body surface furnished with flagellate tubercles and pickax-shaped dermal structures as in the 4th instar, but different by the disappearance of pickax structure on vertex of head.

## 12. *Physatocheila orientis* Drake, 1942

### Fifth instar (Fig. 37)

Measurements, in  $\mu$ : Body length without processes 2733, with processes 3083; width of body across wing pads without processes 725; width of head with eyes 575; width of pronotum 1184; length of pronotum 695; length of abdomen 1200; lengths of antennal segments I to IV=200, 138, 1032, 378; lengths of segments of rostrum I to IV=267, 312, 267, 276. Lengths of segments of legs: fore femora 712, fore tibiae 854, middle femora 729, middle tibiae 854, hind femora 783, hind tibiae 926 and hind 2nd tarsi 205.

Coloration: General color yellowish brown. Antennae dark gray and distal segments distinctly black. Eyes reddish brown. Clypeus, head processes and vertex yellowish brown. Disk of pronotum brownish but lateral areas yellowish, and distal area of posterior projection of pronotum especially pale yellow. Wing pads yellowish brown but distal area darkened. Abdomen brownish yellow. Various processes generally the same color as the respective base. Femora brownish dark gray, tibiae brownish gray with a black distal end, and the 2nd tarsi black and shimmery.

Structure: Head armed with 5 long processes, frontal paired ones projected obliquely forward and shorter than the unpaired process which is directing obliquely upwards and frontally. Paired occipital ones gently bent inward, projecting obliquely to the sides and the longest of head processes, and as long as distal antennal segment. U-shaped glabrous stripe on vertex. Antenniferous tubercles pointed outward.

Anterior margin of pronotum gently incised. Lateral margins of pronotum fairly convex, and armed with several semiglobular tubercles anteriorly and one fairly long process on each posterolateral corner; one clubbed hair on each of the former one and the latter protruding posteriorly and somewhat bent. Posterior projection of pronotum sharply extended posteriorly and the apex inserted between the discomesonotal processes and reaching the anterior margin of metanotum.

Pronotum with one pair of transverse glabrous patches on the anterior third. Mesothoracic hemelytral lobes long, reaching the anterior of the 5th abdominal tergite, and the lateral margins armed with the same kind of tubercles and processes as in the pronotal laterals, but the long processes situated near the posterolateral corners and bent archedly and posteriorly.

Along the median-line of body on middle of pronotum, near the posterior margin of mesonotum, metanotum, and the 1st abdominal tergite, paired processes situated respectively. Among them, discopronotal processes very small and the posterior 3 pairs arranged regularly, viz., the more posterior pair the smaller and the more closely situated to each other. And unpaired processes, which are subequal in size, situated on each of the abdominal tergites II, V, VI, VII & VIII. The median process above mentioned gently bent archedly and directed posteriorly.

Each posterolateral corner of abdominal tergites IV to IX with one process, that

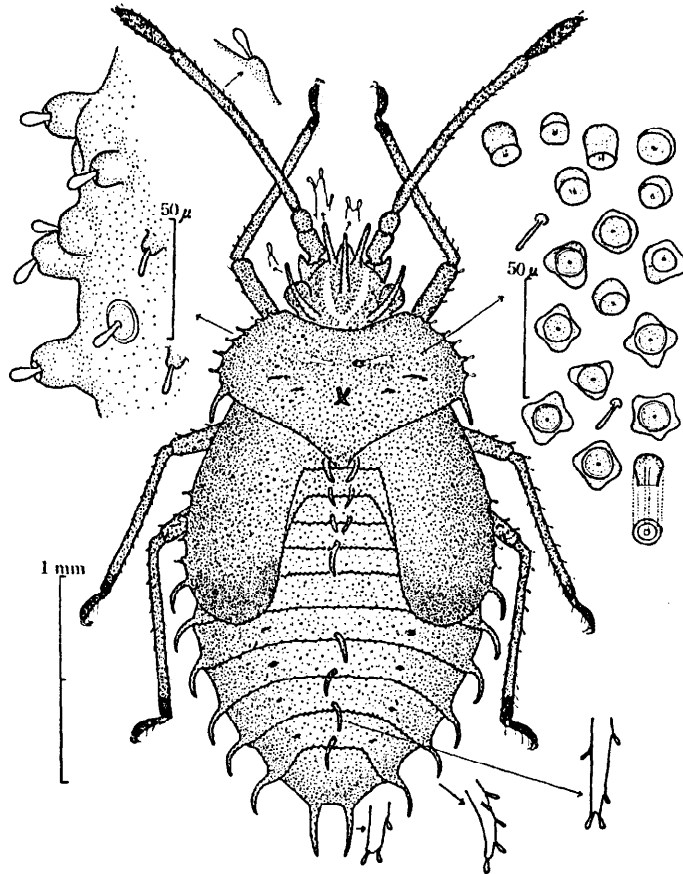


Fig. 37. *Physatocheila orientis*, 5th instar larva.

is curved archedly, pointed hindward and becoming much larger on posterior segments but exceptionally caudal pair nearly straight and parallel to each other.

Among the above mentioned processes, unpaired processes on the median line of the body and 2 caudal processes each with 2 small clubbed hairs at the apex. But each of the paired median processes and lateral processes with a single hair. Each process furnished laterally with some clubbed hairs, each of which is set on a small tubercle. But in the lateral processes the clubbed hairs situated only on the outer side of the bend.

Entire body surface, including head, very densely covered with such interesting dermal structures as tiny semiglobular, triangular, square or pentagonal one, but each corner slightly juttied out but not sharp and smoothly rounded and shaped like a plum-blossom. Under the monocular microscope, these dermal structures with

inscribed little circles, each of which represent a very short stalk between the extreme base and head of the structure. The dermal structures on head semiglobular and somewhat smaller; and pronotal and hemelytral ones comparatively larger, commonly of 3 or 4 corners and rarely of 5-corners; but abdominal ones mostly semiglobular and medium-sized. Clypeus and gena also with clubbed hairs which are set on remarkable tubercles.

The shape of antennal hairs very variable, being clubbed, rod-like and simple and becoming more simple distally. Hairs on the apical segment thin and those on the extreme apex becoming spines.

Ventral surface of thorax and submarginal areas of abdomen also with semiglobular structures, but on the median portion of abdomen dispersed only tiny clubbed hairs.

Femora and outer sides of tibiae with clubbed hairs, but innerside and distal portion of tibiae with simple or setaceous hairs.

### 13. *Cysteochila saricorum* (Baba, 1925)

#### Fifth Instar (Fig. 38)

Measurements, in  $\mu$ : Body length without processes 2741, with processes 3026; width of body across wing pads without processes 1334, with processes 1602; width of head with eyes 570; lengths of antennal segments I to IV=142, 107, 641, 276. Lengths of segments of legs: fore and middle femora 552, fore tibiae 659, middle tibiae 668, hind femora 570, hind tibiae 712 and hind 2nd tarsi 183.

Coloration, in dried specimen: Antenniferous tubercles and 3 basal antennal segments dull yellow but distal one dull brown. Head amber, eyes reddish, head processes pale yellow. Lateral portions of pronotum whitish yellow. Pronotal disk, distal and basal inner portions of wing pads amber, but their basal outer portion and middle portion pale yellow. Middle portion of abdomen dull amber but the sides pale yellow. Portion of dorsal glands brown. Dermal hairs whitish yellow. Middle portions of femora and basal portions of tibiae darkened, the 2nd tarsi darkened distally. Rostrum darkened at the tip.

Structure: Head prominent frontally, clypeus extremely protrudent. Head armed with 5 long processes, which are somewhat curved, frontal paired ones directing forward, unpaired one large, obliquely upwards, and occipital ones obliquely sideward. Occipital area with an obtuse Y-shaped pale narrow stripe, its stem being extended to the 1st abdominal tergite. Antenniferous tubercles very wide and outer corners prominent. Rostrum long and reaching the anterior margin of the 5th abdominal segment.

Pronotum expanded laterally and the humerolateral margins armed with several tubercles anteriorly and one large process on each posterolateral corner. The former with a clubbed hair on each tip, varied in size, and processes on humeral corners somewhat larger than the others; the latter obliquely hindwards.

Posterior projection of pronotum strongly protruded and reaching the anterior area of metanotum.

Mesothoracic hemelytral lobes reaching the anterior area of the 5th abdominal tergite, and each outer lateral margin with one small process near the posterolateral



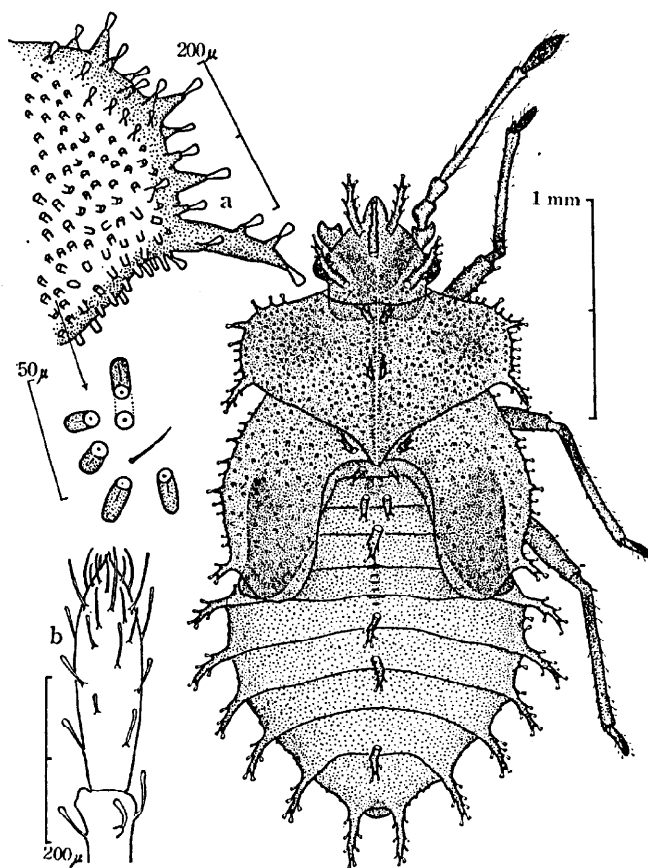


Fig. 38. *Cysteochila salicorum*, 5th instar larva.

corner and several tubercles as in the pronotal laterals. Metathoracic alar lobes narrow and directing distally and sideward, and only visible at their apices from dorsal view.

Along the median line of body, one pair of small processes situated near anterior margin and middle of pronotum, mesonotal disk, metanotal disk, and the 1st abdominal tergite respectively. An unpaired process situated near each of the posterior margin of abdominal tergites II, V, VI & VIII. Each posterolateral corner of abdominal tergites IV to IX also with one long process. All processes above mentioned slightly curved and each with a few conical tubercles laterally, and a clubbed hair on each lateral tubercle and tip of the process. Among the median processes of body, the unpaired ones terminated in bifurcate tubercles, but paired ones and lateral processes simply pointed at the apex.

Body surface, especially, on dorsal side, covered densely with short rod-like der-

mal structures, and much slender rod-like hairs mixed sparsely except on the pronotum; ventral surface also with similar structures. Femora with rod-like slender hairs, but hairs on tibiae more or less simplified, and the 2nd tarsi with somewhat longer simple hairs.

#### 14. *Cysteochila consueta* Drake, 1948

##### Fifth instar (Fig. 39)

Measurements, in  $\mu$ : Body length without processes 2075, with processes 2300; width of body across wing pads without processes 1100; width of head with eyes 525; length of pronotum 563; width of pronotum 975; length of abdomen 1112; width of abdomen 1000, lengths of antennal segments I to IV=134, 102, 694 to 712, 303 to 312. Lengths of segments of legs: fore and middle femora 504, fore and middle tibiae 564, hind femora 570, hind tibiae 653 and hind 2nd tarsi 151.

Coloration: General color whitish yellow. Pronotal and mesonotal disks, distal areas of wing pads and middorsum of abdomen pale grayish brown. Area of dorsal glands, distal antennal segments and the 2nd tarsi blackish. Median processes of body somewhat darkened. Special ampullaceous dermal structures distinctly whitish.

Structures: Head transverse, clypeus protruded beyond apex of antenniferous tubercles. Paired frontal processes as long as 2 basal segments of antenna combined. Occipital processes situated on the sides of head. Unpaired and occipital processes as long as distal antennal segment. Antenniferous tubercles very wide, the 3rd antennal segment much longer than posterior tibia which is the longest of all leg segments. Antennae furnished with various hairs—clubbed, rodlike or setaceous, the shape of antennal hairs very variable, being clubbed, rod-like and simple and becoming more simple distally. Hairs on the apical segment thin and those on the extreme apex becoming spines.

Pronotum transverse, humerolateral margins broadly rounded, and posterior projection of pronotum reaching the posterior margin of mesonotum. Pronotal disk marked with one pair of transverse, glabrous patches at the anterior one-fourth. Mesothoracic hemelytral lobes prolonged to the anterior area of the 5th abdominal tergite. Humerolateral margins of pronotum and outer lateral margins of hemelytral lobes armed with 4 or 5 processes, the more posterior one the longer, and the hindmost process on each postero-lateral corner ramified into a few tubercles, but the anterior ones simple, and several small tubercles situated between the larger processes.

Along the median line of body, one pair of small processes situated near anterior margin and middle of pronotum, mesonotal and metanotal disks and the 1st abdominal tergite respectively; posterior 3 pairs of the median processes arranged regularly, and the more posterior pair the smaller and the more closely situated to each other. But single process situated near posterior margin of abdominal tergites II, V, VI & VIII, the more posterior processes the longer.

Posterolateral corners of abdominal tergites IV to IX each with one large process. Tip of unpaired median processes bifurcated into moderate tubercles, but paired median processes and lateral processes simply terminated. Head processes,

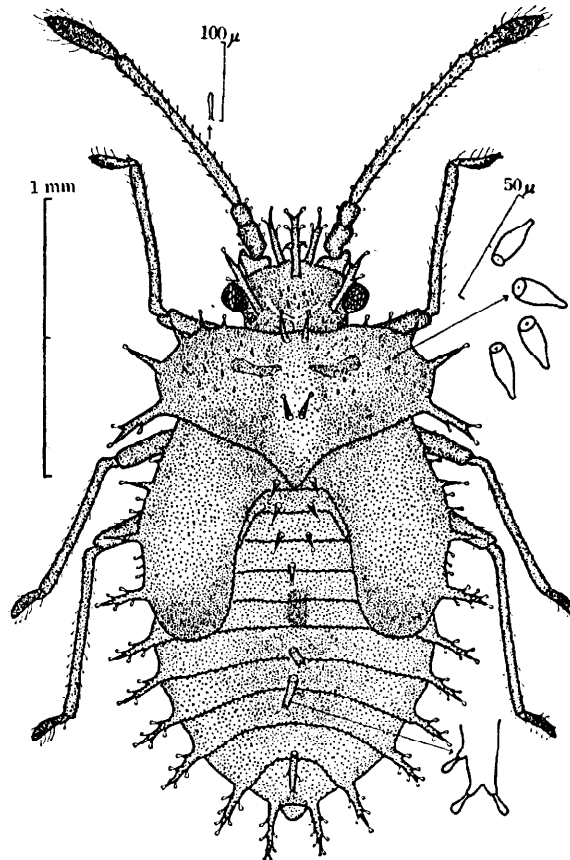


Fig. 39. *Cystechila consueta*, 5th instar larva.

anterior discopronotal processes, 2 posterior median abdominal processes and lateral processes ramified into some lateral small tubercles. Tubercles on lateral margin of pronotum and wing pads, simple spinous processes and tubercles of ramified processes with one clubbed hair on each tip.

Dorsal surface of body including head covered densely with ampullaceous dermal structures, excepting antennae, spinous processes, legs, U-shaped stripe of vertex, pronotal transverse patches and middle portion of abdomen where dorsal gland are situated.

15. *Cystechila fieberi* (Scott, 1874)

First instar (Fig. 40)

Measurements, in  $\mu$ : Body length without processes 783, with processes 850; width

of head with eyes 208; length of pronotum 84; width of pronotum without processes 283; width of mesonotum 292; width of metanotum 300; length of abdomen 408; width of abdomen 317; lengths of antennal segments I to IV=64, 40, 109, 120; lengths of segments of rostrum I to IV=80, 138, 85, 151. Lengths of segments of legs: femora of all legs 142, fore and middle tibiae 178, hind tibiae 186 and hind 2nd tarsi 94.

Coloration: General color fair, yellowish-ochreous. But the occipital region, the 4th segment and apex of the 3rd segment of antennae and tarsi darkened. Eyes reddish.

Structure: Head distinctly large in comparison with the other body parts. Clypeus broadly protrudent, bearing 3 round-headed hairs. Paired frontal processes seen on 2 primary tubercles which are fused to each other at their bases and, the inner one apparently larger than the outer one. Each tubercle with one fairly long clubbed hair which is distinctly longer than the basal tubercle. Unpaired processes a little more developed than the other head processes, bifurcated and with two such hairs. Each tubercle with one round-headed hair. Occipital region marked with a prominent Y-shaped pale stripe where is seen one pair of occipital processes.

Occiput posterior to eyes with a pair of similar hairs, and eyes with 2 pairs of large and small hairs. Antennae furnished with round-headed hairs, rod-like hairs and distal portion with some simple hairs.

No differences are found in shape between thoracic nota and abdominal tergites except pronotum and caudal segment. Pronotum apparently longer than the hinder segments, and the hindmost segment of an inversed trapezoidal in shape and the posterior end simply truncate.

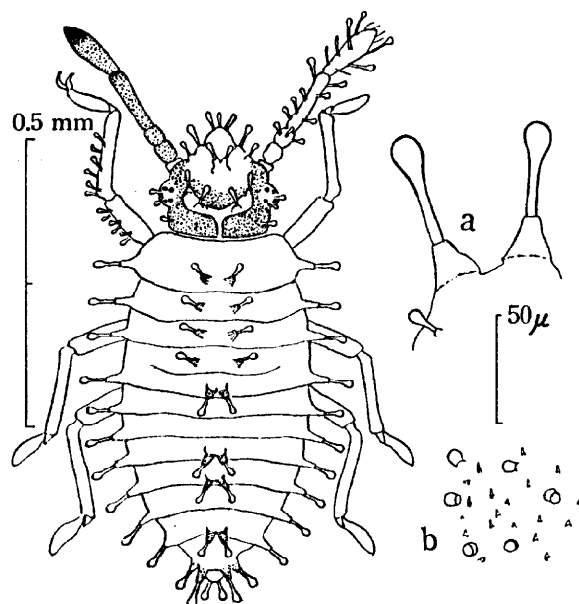


Fig. 40. *Cysteoichila fieberl*, 1st instar larva. a: left pair of occipital tubercles; b: dermal tiny structures.

Along the median line of body, near posterior margins of thoracic nota and abdominal tergites I, II, V, VI & VIII, situated one pair of small tubercles respectively. Among them, the anterior 4 pairs arranged regularly, and the more posterior tubercles the more separated from each other, and each tubercle directing towards the sides. On the other hand, the posterior 4 pairs closely contiguous in each pair and directed obliquely and posteriorly. Each posterolateral corners of thoracic and abdominal segments except the 1st abdominal segment, with one tubercular process, but exceptionally the caudal segment with two tubercular processes on each side—the ordinary processes on the posterolateral corners and the additional processes subterminally located to the former. Median and lateral tubercular processes provided with one long round-headed hair on each tip.

Legs also furnished with similar small hairs on outer sides of femora and tibiae, but their inner side and tarsi with some simple hairs.

Body surface furnished sparsely with tiny semiglobular or papillary, very minute, sharp conical dermal structures.

#### Second instar (Fig. 41)

Measurements, in  $\mu$ : Body length without processes 875, with processes 925; width of head with eyes 235; length of pronotum 117; width of pronotum 350; width of mesonotum 400; width of metanotum 417; length of abdomen 434; width of abdomen 425; lengths of antennal segments I to IV=58, 49, 174, 147; lengths of segments of rostrum I to IV=129, 191, 107, 178. Lengths of segments of legs: fore and middle femora 196, fore tibiae 240, middle tibiae 234, hind femora 198, hind tibiae 251 and hind 2nd tarsi 102.

Structure: Paired frontal processes of head the smallest of all head processes, conical, and each with 2 clubbed hairs one at the tip and another from a small tubercle on proximal outside of process and smaller than the apical one. Unpaired process longer than the former processes and typically bifurcated. Occipital processes, the largest of all head processes, curved inward, and unequally bifurcated and one more small tubercle situated on proximal outside of the processes, naturally each tubercle with one clubbed hair.

Each eye composed of 5 facets and 2 clubbed hairs as in the preceding instar. Thoracic and abdominal processes situated on the corresponding areas to the 1st instar, but differed from those of the 1st instar by greater length, occurrence of one more hindward bending tubercle laterally. But the metanotal lateral processes just like a simple tubercle similar to that of the preceding instar. Caudal processes with 2 lateral tubercles, i. e. one more tubercle as compared with the other lateral processes. Some conical processes newly added to this instar as compared with those of the preceding instar—one pair of conical processes on the anterior margin along the median line of pronotum, and a conical process at the middle of lateral margins of pronotum and mesonotum respectively.

Each tip of the processes and tubercles above mentioned bearing one clubbed hair.

Entire body, except antennae, legs and various processes, covered with semiglobular or papillary dermal structures together with very minute sharp conical structures.

Outer half of the ventral surface of each segment also furnished with a similar structure, namely two closely set clubbed hairs on each side of sternum.

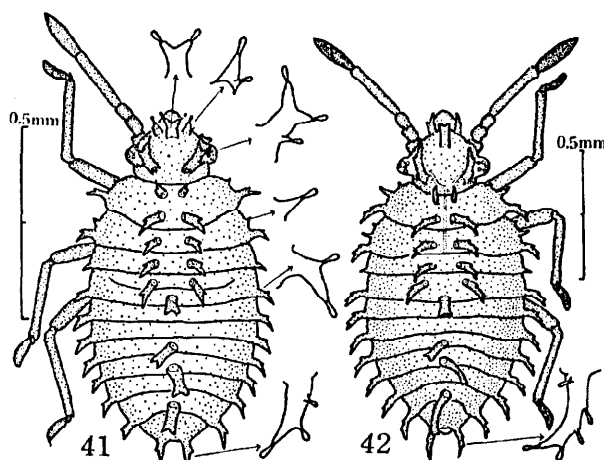


Fig. 41. *Cysteochila fieberi*, 2nd instar larva.

Fig. 42. *Cysteochila fieberi*, 3rd instar larva.

#### Third instar (Fig. 42)

Measurements, in  $\mu$ : Body length without processes 1263, with processes 1356; width of head with eyes 356; length of pronotum 144; width of pronotum 463; width of mesonotum 575; width of metanotum 600; length of abdomen 675; width of abdomen 600; lengths of antennal segments I to IV=89, 67, 254, 194. Lengths of segments of legs: fore femora 276, fore tibiae 316, middle femora 267, middle tibiae 318, hind femora 274, hind tibiae 345 and hind 2nd tarsi 116.

Processes of body situated on the corresponding areas to the 2nd instar, but differs from the 2nd instar by greater length and occurrence of one more tubercle on outer side of the bend of each process; but metanotal lateral process exceptionally more stunted as compared with those of the earlier instars. And one more small conical process respectively added to the anterior of lateral processes of pronotum and mesonotum. Median unpaired abdominal processes bifurcated, and the more posterior ones becoming much longer and the hindmost process as long as distal antennal segment. Lateral processes curved posteriorly and with a few tubercles on outer side of the bend respectively.

Body surface covered with the same structures as in the 2nd instar, and additionally dispersed a few very slender, staff-shaped hairs on each segment.

#### Fourth instar (Fig. 43)

Measurements, in  $\mu$ : Body length without processes 1888, with processes 2094; width of head with eyes 438; length of pronotum 325; width of pronotum 738; width of mesonotum 900; length of abdomen 975; width of abdomen 875; lengths of antennal segments I to IV=109, 79, 427, 271. Lengths of segments of legs: fore and middle femora 414, fore and middle tibiae 480, hind femora 427, hind tibiae 516 and hind 2nd tarsi 151.

Structure: Frontal paired processes of head projected forwardly and far beyond

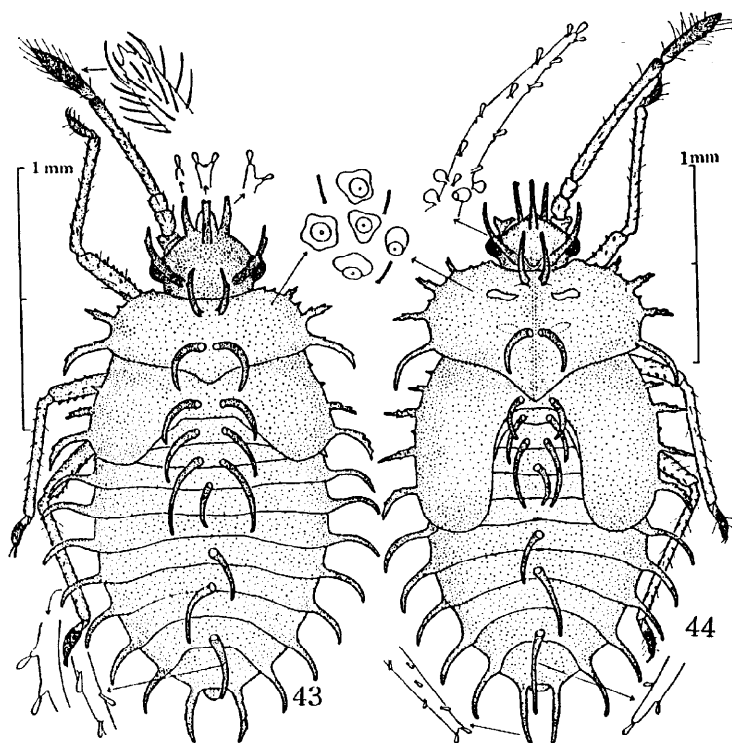


Fig. 43. *Cysteochila fieberi*, 4th instar larva.

Fig. 44. *Cysteochila fieberi*, 5th instar larva.

clypeus.

Pronotum posteriorly protruded into a triangular form, but yet transverse, and about 2.3 times as wide as long. Mesothoracic wing pads reaching the level of posterior margin of the 1st abdominal segment. Processes of the body situated on the corresponding areas to the 3rd instar, but differs from the instar by greater length and occurrence of one more tubercle on the outside of the bend of each process. Some small processes newly added to those of the preceding instar—one more small process added to each of the anterior of the lateral processes of pronotum and wing pads, thus each side of pronotum and wing pads armed with 4 processes, which are arranged regularly, and the more hinder process the more smaller, and the hindmost process naturally the longest and curved hindwards, but anterior ones nearly straight.

Entire body surface, except antennae, legs and various processes, covered with papillary dermal structures and plum blossom-shaped structures, the latter generally triangular, square or pentagonal, but the corners rounded. Proximal portion of head processes and dorsal median processes with a few papillary structures but not on the proximal portion of lateral processes.

### Fifth instar (Fig. 44)

Measurements, in  $\mu$ : Body length without processes 2442, with processes 2867; width of head with eyes 470; length of pronotum 667; width of pronotum 1058; width of mesonotum 1200; length of abdomen 1367; width of abdomen 1100; lengths of antennal segments I to IV=147, 107, 719, 387. Lengths of segments of legs: fore and middle femora 605, fore and middle tibiae 676, hind femora 668, hind tibiae 790 and the 2nd tarsi 185.

Structure: Occipital processes as long as distal antennal segment. U-shaped narrow stripe between the bases of occipital processes. Posterior projection of pronotum approaching the posterior margin of mesonotum.

Mesothoracic hemelytral lobes prolonged to the anterior area of the 5th abdominal tergite. Various processes of the body situated on the corresponding areas to the earlier instars, naturally the lengths of the processes more prolonged and one more process added in this instar to the number of lateral processes of pronotum and wing pads in the preceding instar.

Among the processes above mentioned, tip of the unpaired ones of head and abdomen bifurcated and with 2 small clubbed hairs on each tip, but the paired and lateral processes of thorax and abdomen terminated by a simple tip which is bearing one small clubbed hair. Each process furnished also with several clubbed hairs on the lateral sides, but in case of the curved processes the hairs situated on outside only.

Body surface covered with the same dermal structures as the 3rd and 4th instars—the semiglobular, papillary or plum blossom-shaped (3 to 5 petalled) dermal structures, clubbed hairs and simple rod-like hairs.

## 2. Larvae II (*Stephanitis*)

A key to the 5th instar larvae of the species of the genus *Stephanitis*.

1. Lateral margins of pronotum roundly inflated and width at level of paranotal processes nearly equal to or apparently narrower than the width in inflated portion ..... 2
  - Lateral margins of pronotum nearly straight ..... 4
2. Anterior margin of pronotum apparently narrower than the width of head including eyes, and the sides strongly inflated ..... *S. nashi nashi*
  - Anterior margin of pronotum wider than the width of head with eyes..... 3
3. Anterior margin of pronotum nearly straight and hind triangular projection extending over posterior margin of mesonotum ..... *S. ambigua*
  - Anterior margin sinuate and anterolateral corners sharply projected triangularly, head remarkably black ..... *S. typica*
4. Anterior margin of pronotum wider than the width of head with eyes ..... 5
  - Anterior margin narrower than or nearly equal to the width of head with eyes ..... 6



5. Body small, abdominal processes shorter ..... *S. fasciicarina*
- Body much larger, discopronotal processes extremely small but abdominal processes comparatively long ..... *S. veridica*
6. Mesothoracic hemelytral lobes not reaching the anterior margin of the 5th abdominal segment ..... *S. svensoni*
- Hemelytral lobes reaching the middle of the 5th abdominal segment ..... 7
7. Pronotal posterior projection extending over the posterior margin of mesonotum...  
..... *S. pyrioides*
- Posterior projection not reaching the posterior margin of mesonotum ..... 8
8. Width of anterior margin of pronotum nearly equal to the width of head including eyes ..... *S. miyamotoi*
- Width of anterior margin of pronotum distinctly narrower than the width of head with eyes, and lateral margins of wing pads smoothly concave near middle ..... *S. takeyai*

### 1. *Stephanitis nashi nashi* Esaki et Takeya, 1931

#### First instar (Fig. 45)

Measurements, in  $\mu$ : Length of body without hairs 625; width of head with eyes 150; width of pronotum 163; width of mesonotum 150; width of metanotum 125; width of abdomen 169; lengths of antennal segments I to IV=49, 40, 183, 129; lengths of segments of rostrum I to IV=67, 89, 53, 71. Lengths of segments of legs: femora of all legs 120, fore tibiae 147, middle tibiae 138, hind tibiae 140 and hind 2nd tarsi 67.

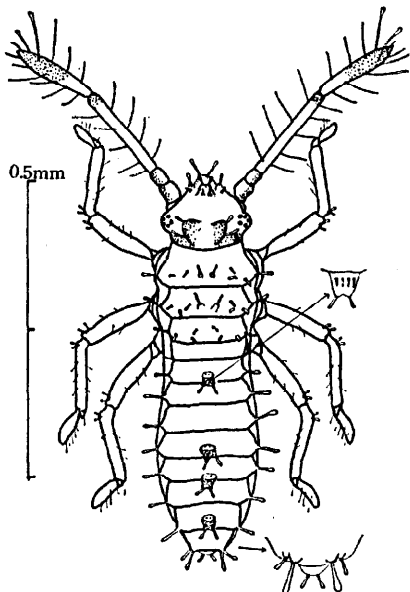


Fig. 45. *Stephanitis nashi*, 1st instar larva.

Structure: Frontal paired processes of head tubercular and with one more small tubercle on each proximal side, and one clubbed hair on each apex of the main and the small tubercles. Unpaired process with the tip bituberculate and bearing 2 clubbed hairs, and at the posterior base of the process are seen 2 more very small tubercles which have a minute rod-like hair respectively. Occipital processes also tubercular, with a rod-like hair on the tip and another slender hair on the posterior base.

Posterior portions of pronotum and mesonotum on median line each with a pair of small tubercles, but the pronotal pair very small, each tubercle with a small clubbed hair. Abdominal tergites II, V, VI and VIII each with a thick process which resembles an unpaired head process.

Thoracic nota with small rod-like hairs sublaterally and submedially. Thoracic and abdominal segments except the 1st and last

abdominal ones, with a fairly long clubbed hair on each side, but the 1st abdominal segment lacking the lateral hairs, caudal segment with 2 hairs on each posterolateral corner, of which the interior one is larger and the outer smaller. Various clubbed hairs above mentioned arisen from the respective weak tubercle.

#### Second instar (Fig. 46)

Measurements, in  $\mu$ : Body length without processes 800, with processes 844; width of body at the mesonotum 281; width of head with eyes 219; length of pronotum 94; width of pronotum 250; lengths of antennal segments I to IV=58, 48, 267, 165; lengths of segments of rostrum I to IV=111, 125, 76, 120. Lengths of segments of legs: femora of all legs 160, fore tibiae 191, middle tibiae 174, hind tibiae 185 and hind 2nd tarsi 82.

Structure: Head armed with 5 processes with tip terminated in one small conical denticle and one long clubbed hair, and frontal paired processes moderately separated from each other, the smallest of all head processes. Unpaired process of head longer than the former and tip with a few conical denticles peripherally and 2 clubbed hairs subcentrally, these two kinds of terminal structures of the same length. Occipital processes the longest of all head processes.

Discopronotal processes comparatively stunted and only tuberculate. Discomesonotal processes as long as the frontal processes of head.

Unpaired dorsal processes situated on median line of abdominal tergites II, V, VI & VIII, the 1st small but the 2nd the largest, thick and ampullaceous. Posterolateral corners of pronotum, mesonotum and abdominal tergites IV to IX, each with a lateral process.

In the above mentioned processes, unpaired head processes and median dorsal processes each with two short hairs, on the other hand, paired processes and lateral processes each with a long clubbed hair. But caudal processes each with 2 similar hairs, and apical hair longer and subapical one somewhat shorter.

The 1st abdominal segment devoid of lateral hairs, but metanotum and 2nd and 3rd abdominal segments each with lateral processes stunted and only with small clubbed hairs.

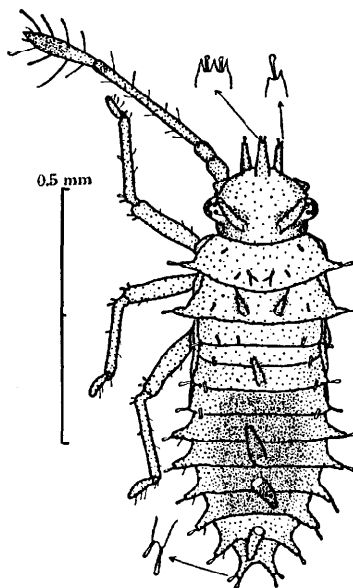


Fig. 46. *Stephanitis nashi*, 2nd instar larva.

#### Third instar (Fig. 47)

Measurements, in  $\mu$ : Body length without processes 1088, with processes 1313; width of body at the mesonotum without process 388; width of head with eyes 275;

length of pronotum 115; width of pronotum 350; lengths of antennal segments I to IV=76, 60, 381, 216; lengths of segments of rostrum I to IV=147, 156, 67, 151. Lengths of segments of legs: femora of all legs 222, fore tibiae 274, middle tibiae 267, hind tibiae 276 and hind 2nd tarsi 89.

Structure: Eyes composed of 7 or 8 facets, of which 5 initial facets apparently distinguishable from a few secondary ones by deep reddish color. Distal portion of the 4th antennal segments furnished with hairs of 3 forms—a few immovable short hairs which are forward, some earstick-shaped hairs and rod-like or simple hairs which are long and vertical.

Processes of dorsum situated on the corresponding areas to the 2nd instar but differing from the preceding instar by prolongation of length and terminal structures.

Head processes and dorsal median processes of body except the discopronotals, terminated in a few conical denticles and small clubbed hairs, the former nearly as long as the latter, which is seen by one on paired processes, by two on unpaired ones. Discopronotal processes each furnished with a small clubbed hair, but lateral

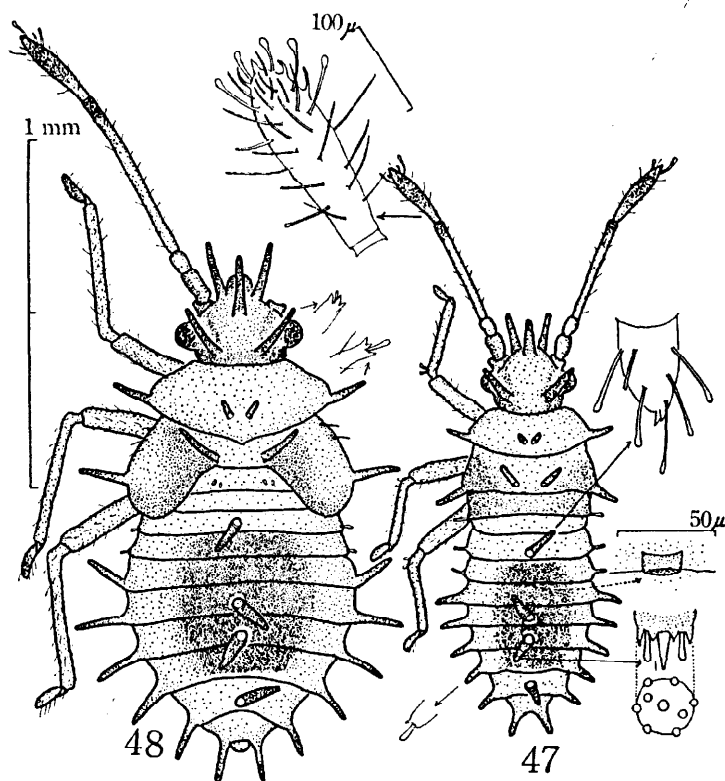


Fig. 47. *Stephanitis nashi*, 3rd instar larva.

Fig. 48. *Stephanitis nashi*, 4th instar larva.

processes at apex with one long clubbed hair centrally and a few small conical denticles peripherally, and the hair about thrice as long as the denticle.

Body processes furnished with several very long, earstick-shaped hairs on lateral sides.

Thoracic nota and 3 anterior abdominal tergites each furnished with a few very short rod-like hairs, and covered with very minute conical tubercles.

#### Fourth instar (Fig. 48)

Measurements, in  $\mu$ : Body length without processes 1363, with processes 1550; width of body across wing pads 325; width of head with eyes 373; length of pronotum 225; width of pronotum 500; width of abdomen 318; lengths of antennal segments I to IV=107, 80, 516, 267. Lengths of segments of legs: femora of all legs 308, fore tibiae 378, middle tibiae 369, hind tibiae 398 and hind 2nd tarsi 111.

Structure: Eyes composed of about 15 facets, of which 5 initial facets deeply reddish, but the rest ones become paler peripherally.

Head, thorax and abdomen armed with processes on the corresponding areas to the preceding instar.

Posterior margin of pronotum triangularly protruded. Mesothoracic wing pads approaching the middle of 2nd abdominal tergite, and anterior portion of outer lateral sides of the wing pads each with one or 2 hairs. Metathoracic wing pads also prolonged and with one short rod-like hair on distal end respectively.

Body surface covered sparsely with short rod-like hairs and very minute tubercles, especially on pro-, meso- and metanota, sublateral areas of abdominal tergites except 2 posterior ones and submedian areas of anterior tergites of abdomen.

#### Fifth instar (Fig. 49)

Measurements, in  $\mu$ : Body length without processes 1850, with processes 2325; width of body across wing pads without processes 1050; width of head with eyes 400; length of pronotum 500; width of pronotum 813; width of abdomen 995; lengths of antennal segments I to IV=156, 102, 823, 378. Lengths of segments of legs: fore and middle femora 498, fore tibiae 623, middle tibiae 587, hind femora 516, hind tibiae 659 and hind 2nd tarsi 118.

Coloration, specimen in alcohol: General color very light orange. Pale and darkened areas as in the figure, blackish mediodorsal abdominal area very characteristic. Basal encircled area of 2 dorsal processes on the 5th and 6th abdominal tergites conspicuous by their colorless, and the blackish area neither reaching anteriorly to the anterior margin of the 3rd tergite, nor posteriorly to the posterior margin of the 7th tergite.

Outer halves of ventral surface of abdominal segments IV, V & VI blackish.

Structure: Body armed with processes on the corresponding areas to the earlier instars. Anterior margin of pronotum apparently narrower than head including eyes. Lateral margins of pronotum distinctly rounded, but humeral areas not inflated in dorsal aspect. Hood comparatively small, in dorsal view the outline nearly circular but somewhat transverse. Median carina higher than hood, archedly curved in profile and apparently separated from hood. Posterior projection of pronotum approaching the posterior margin of mesonotum, subapical margins

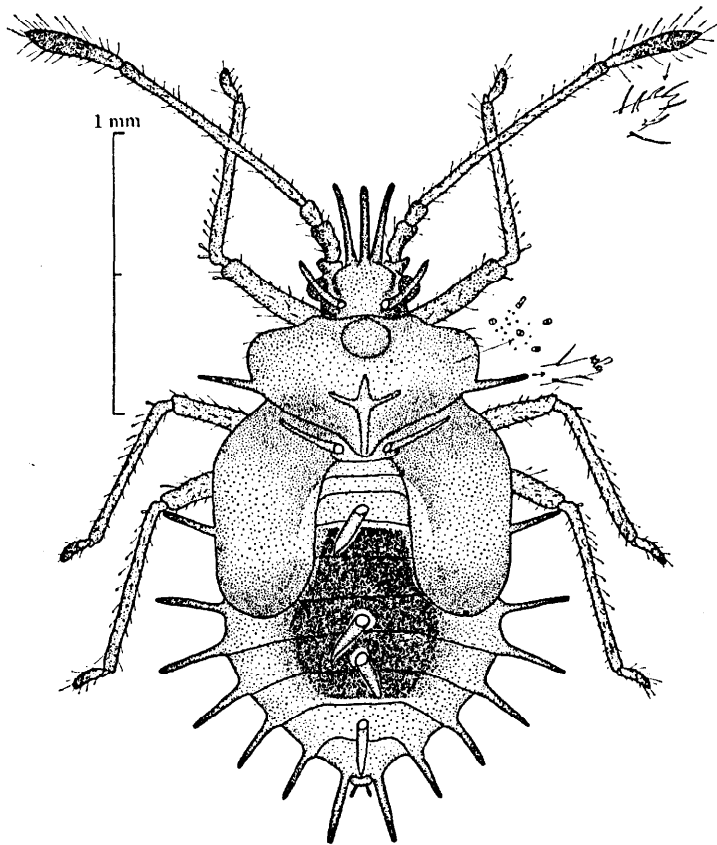


Fig. 49. *Stephanitis nashi*, 5th instar larva.

of the projection minutely indented.

Mesothoracic hemelytral lobes long, extending to the anterior area of the 5th abdominal tergite and with several hairs on anterior outer margins.

Dermal short rod-like hairs situated sparsely on pronotum. But abdominal tergites except caudal one, each with similar hairs in groups on sublateral areas singularly on submedian areas.

## 2. *Stephanitis ambigua* Horváth, 1912

Fourth instar (Fig. 50)

Measurements, in  $\mu$ : Body length without processes 1313, with processes 1600; width of body across wing pads without process 663; width of head with eyes 350; length of pronotum 231; width of pronotum without processes 500; lengths of antennal segments I to IV=125, 53, 623, 329. Lengths of segments of legs: fore and hind

tibiae 427, middle tibiae 401 and hind 2nd tarsi 125.

Coloration, specimen in alcohol: General color pale yellow, pale and dark areas as in the figure.

Structure: Various processes situated in the regular position of usual *Stephanitis* type.

Paired frontal processes of head at least as long as 2 basal antennal segments combined, unpaired process the largest of all processes of body and occipital processes nearly as the preceding.

Antenniferous tubercles pointed, the 4th antennal segment at least longer than half the length of the 3rd antennal segment. Humeralateral margins of pronotum gently rounded, posterior projection overlapping mesonotum in part. Discopronotal processes situated near the posterior margin of posterior projection, very small, directed upward and divergent to each other. Pronotal lateral processes very long.

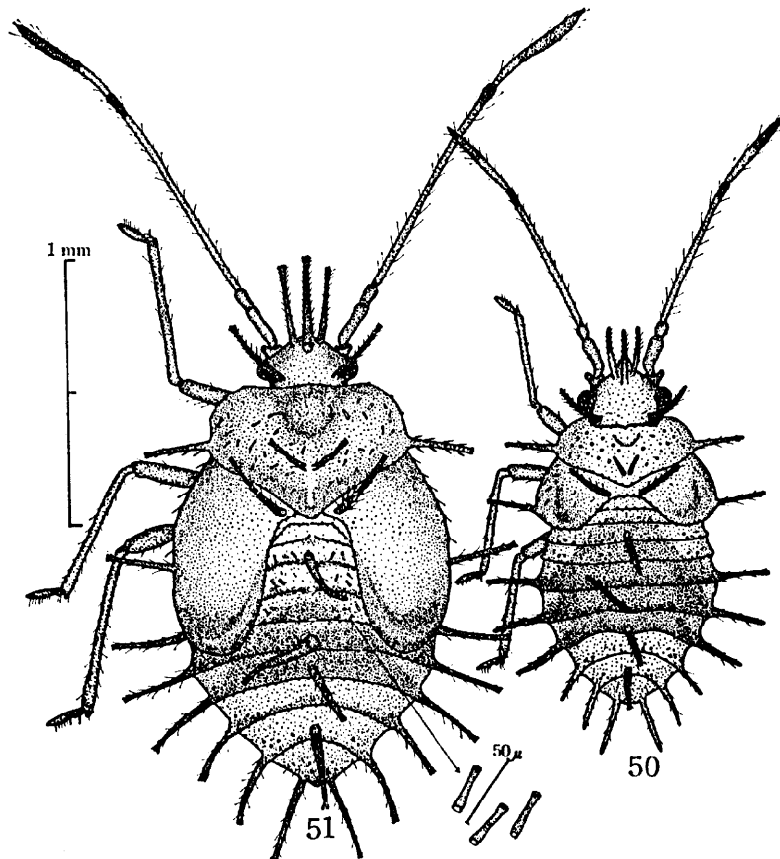


Fig. 50. *Stephanitis ambigua*, 4th instar larva.

Fig. 51. *Stephanitis ambigua*, 5th instar larva.

Mesothoracic wing pads prolonged to the anterior margin of the 2nd abdominal tergite. Mesonotal disk armed with one pair of long processes, which are fairly separated, directed upwardly, and divergently projected. Wing pads also with a long process on the outer side. Median process on the 5th abdominal tergite thick, long and curved. Of the lateral abdominal processes, anterior 3 longer but posterior 2 shorter and caudal processes the longest of the abdominal ones.

Dermal rod-like hairs fairly long and sparsely and evenly distributed on pronotal surface. And the similar hairs situated in groups on lateral sides of wing pads and sublateral and submedian areas of abdominal tergites. Posterolateral corners of the 2nd and 3rd abdominal segments with a vestigial tubercle respectively.

#### Fifth instar (Fig. 51)

Measurements, in  $\mu$ : Body length without processes 1713, with processes 2275; width of body across wing pads without processes 1125; width of head with eyes 375; width of pronotum 725; length of pronotum 502; lengths of antennal segments I to IV=175, 81, 894, 447. Lengths of segments of legs: fore tibiae 676, middle tibiae 641, hind tibiae 659 and hind 2nd tarsi 142.

Coloration, specimen in alcohol: General color pale yellow. Pale and darkened areas as in the figure. Especially median abdominal processes deep brown. Posterior acetabula remarkably dark brown. Rostrum darkened towards apex.

Structure: Various processes of body situated on the corresponding areas to the former instar. Unpaired process of head very long, occipital processes slightly curved.

Pronotum comparatively longer than that of the other *Stephanitis* species, anterior margin distinctly wider than the width of head including eyes, posterior triangular projection very large and extending nearly to the posterior margin of metanotum. Mesothoracic hemelytral lobes long, approaching the posterior margin of the 5th abdominal tergite.

Humeralateral margins of pronotum and outer lateral margins of hemelytral lobes furnished with several hairs. Pronotal surface covered evenly with rod-like hairs, similar hairs also situated on abdominal tergites in groups — submedian and sublateral areas of each tergite. Very minute dermal tubercles dispersed on anterior side and hind portion of the triangular projection of pronotum and median areas of abdomen.

### 3. *Stephanitis typica* (Distant, 1903)

#### First instar (Fig. 52)

Measurements, in  $\mu$ : Body length without processes 659; width of head with eyes 185; width of pronotum 185; width of abdomen 190; lengths of antennal segments I to IV=62, 40, 242, 182; lengths of segments of rostrum I to IV=89, 129, 67, 85. Lengths of segments of legs: fore femora 151, fore tibiae 187, middle femora 138, middle tibiae 174, hind femora 134, hind tibiae 180 and hind 2nd tarsi 82.

Coloration: Pale and dark areas as in the figure. Head distinctly black, with a T-shaped pale stripe on vertex.

Structure: Head comparatively large, frontal paired processes tuberculate and

simple. Unpaired process thick, with the apex blunt and terminated in 2 small tubercles, from which one clubbed hair grows out respectively. Occipital processes somewhat curved and each with 2 hairs, one clubbed hair on the apex and another slender rod-like hair on outer lateral side. The 4th antennal segment about as long as anterior tibiae, also approximately equal to the width of head including eyes. Posterior portions of pronotum and mesonotum on median line each with a pair of clubbed hairs, which are set on a small tubercle. Abdominal tergites II, V, VI & VIII each with a thick blunt tubercular process, which is provided with 2 slender clubbed hairs.

Lateral margins of thoracic nota and abdominal tergites except the 1st and caudal abdominal ones, each with one long clubbed hair, each hair arising from a small tubercle.

But the 1st abdominal tergite lacking such hairs, and the caudal one provided with 2 similar hairs on each postero-lateral corner, the inner hair longer and the outer one smaller.

Sublateral areas of thoracic nota and abdominal tergites V, VI & VIII, each with one short rod-like hair. And one small simple hair situated on the submedian area of both pronotum and mesonotum. One pair of clubbed hairs situated near base of each tibia on outer side.

#### Second instar (Fig. 53)

Measurements, in  $\mu$ : Body length without processes 765, 825 (a); width of head

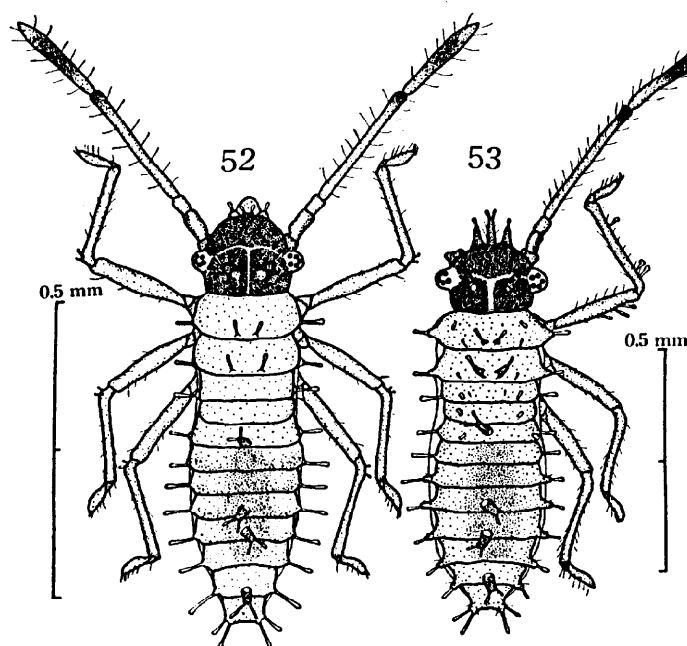


Fig. 52. *Stephanitis typica*, 1st instar larva.

Fig. 53. *Stephanitis typica*, 2nd instar larva.



with eyes 236, 250 (a); width of pronotum without processes 242 (a); width of mesonotum 233 (a); width of abdomen 233 (a); lengths of antennal segments I to IV=85, 45, 327, 240; lengths of segments of rostrum I to IV=116, 147, 171, 89. Lengths of segments of legs: fore femora 204, fore tibiae 240, middle femora 195, middle tibiae 231, hind femora 196, hind tibiae 231 and hind 2nd tarsi 93.

Structure: Head processes elongated. Paired frontal processes about as long as a half of the unpaired one, and with a small clubbed hair on each apex, but no lateral hairs. Unpaired process of head longer than the 2nd antennal segment and the apex with 2 rod-like hairs and 2 small conical denticles. Occipital processes as long as the unpaired one, and the apex with a rod-like hair and 2 small denticles. These terminal hairs of the head processes twice as long as the denticles.

Median processes of body situated on the corresponding areas to the former instar. Posterolateral corners of thoracic nota and abdominal tergites projected in small tubercular processes, each of which the tip is provided with a clubbed hair. But each lateral tubercle on metanotum and the 2nd and 3rd abdominal tergites so stunted as to leave it only in a simple tubercle with a clubbed hair, similarly to that of the former instar. And the 1st abdominal tergite primarily without any tubercle or hair. But the caudal processes with 2 clubbed hairs on each posterolateral corner. Median unpaired processes of abdomen with 2 clubbed hairs on each tip. But paired median and lateral processes of thorax and abdomen furnished with one rod-like hair on tip, and a few simple hairs on lateral sides respectively. But caudal processes with 2 rod-like hairs on tip and a few simple hairs on the sides respectively, also short rod-like hairs situated on thoracic nota and anterior tergites of abdomen.

### Third instar (Fig. 54)

Measurements, in  $\mu$ : Body length without processes 1068, 1050 (a); width of head with eyes 334, 325 (a); width of pronotum without processes 401, 325 (a); width of mesonotum 445, 375 (a); width of abdomen 363 (a); lengths of antennal segments I to IV=111, 67, 494, 336; lengths of segments of rostrum I to IV=147, 200, 80, 102. Lengths of segments of legs: fore femora 289, fore tibiae 340, middle femora 276, middle tibiae 325, hind femora 277, hind tibiae 333 and hind 2nd tarsi 110.

Structure: Various processes of body situated on the corresponding areas to the 2nd instar. Paired frontal processes of head shorter than the 1st antennal segment but the unpaired head process and occipital processes apparently longer than the 1st antennal segment.

Discopronotal processes very small and projected divergently from the posterior submarginal area of pronotum. But discomesonotal processes long and grown out divergently from the middle of posterior margin of mesonotum. Tips of unpaired processes of head and abdomen each with 2 small rod-like hairs and a few conical denticles. And similar denticles also found on tips of occipital processes.

Lateral abdominal processes becoming much shorter towards posteriorly. Caudal processes with 2 clubbed hairs, one at extreme apex and another on subapical portion.

Dorsum of thoracic segments partly covered with minute, conical dermal structures, and very sparsely with a few short rod-like hairs.

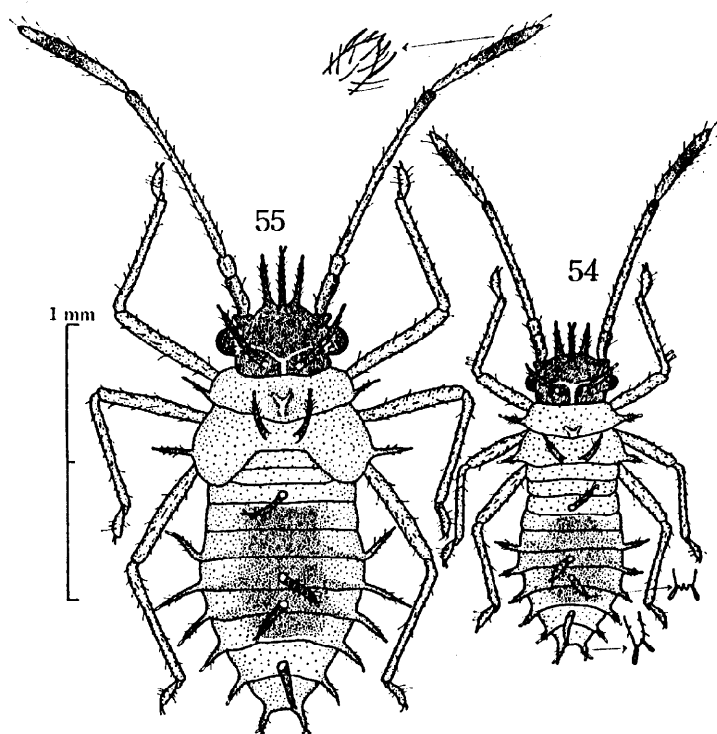


Fig. 54. *Stephanitis typica*, 3rd instar larva.

Fig. 55. *Stephanitis typica*, 4th instar larva.

#### Fourth instar (Fig. 55)

Measurements, in  $\mu$ : Body length without processes 1246, 1463 (a); width of head with eyes 374, 465 (a); width of pronotum without processes 481, 500 (a); width of body across wing pads 587, 625 (a); width of abdomen 516, 575 (a); length of antennal segments I to IV = 158, 82, 676, 438; lengths of segments of rostrum I to IV = 178, 245, 89, 111. Lengths of segments of legs: fore femora 385, fore tibiae 474, middle femora 383, middle tibiae 449, hind femora 384, hind tibiae 478 and hind 2nd tarsi 129.

Structure: Head, thorax and abdomen armed with processes and various hairs on the corresponding areas to the former instar as shown in the figure.

Paired frontal processes of head nearly as long as the 1st antennal segment. Unpaired process of head approximately as long as 2 basal antennal segments combined. Apex of distal antennal segment pointed to form a very sharp conical spine, and furnished with a few immovable sharp hairs and some long simple hairs.

Anterior margin of pronotum sinuate, humeral margins slightly dented and furnished with anterolateral projections which are conspicuous in the 5th instar. Discopronotal processes very small and projecting divergently from the anterior portion

of median carina. Mesothoracic wing pads reaching the anterior margin of the 2nd abdominal segment. Lateral margins of the 3rd abdominal tergite each with an atrophied hair. But the lateral processes becoming shorter posteriorly and the hindermost caudal processes the shortest of all.

Fifth instar (Fig. 56)

Measurements, in  $\mu$ : Body length without processes 1958, 2000 (a); width of head with eyes 463, 512 (a); width of pronotum without processes 792, 775 (a); width of body across wing pads 1015, 988 (a); lengths of antennal segments I to IV=223, 109, 1015, 614; lengths of segments of rostrum I to IV=223, 294, 93, 129. Lengths of segments of legs: fore femora 587, fore tibiae 737, middle femora 587, middle tibiae 694, hind femora 605, hind tibiae 748 and hind 2nd tarsi 143.

Coloration, specimen in alcohol: General color yellowish, pale and brownish black areas as in the figure. Head and all processes distinct in black color, and central

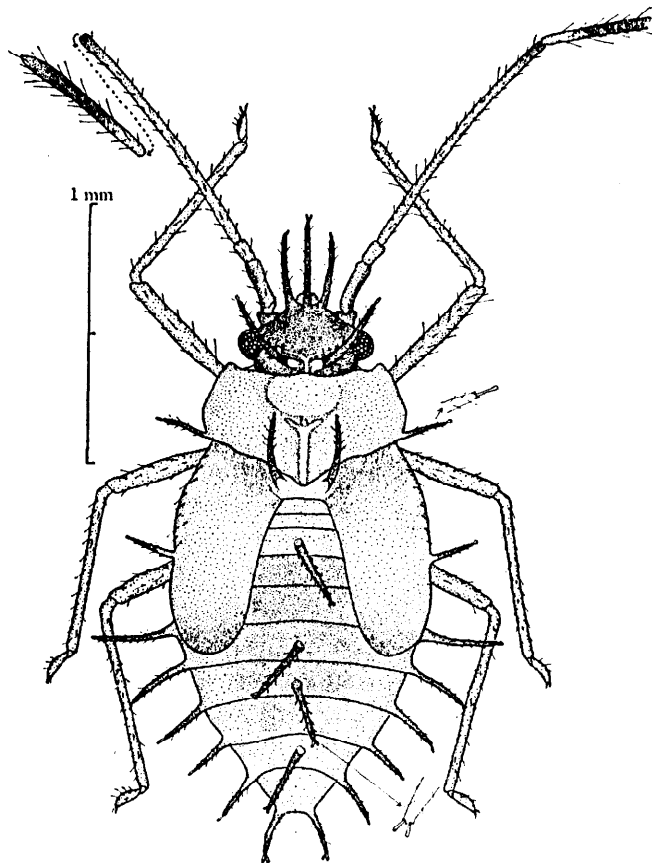


Fig. 56. *Stephanitis typica*, 5th instar larva.

portion of abdomen blackish and eyes reddish.

Structure: Processes and various hairs of body situated on the corresponding areas to the earlier instars as in the figure. Three frontal processes of head closely situated, the paired ones directing forwards and unpaired one obliquely and frontally upwards. Occipital processes comparatively close to each other in comparison with the other *Stephanitis* larvae, and directing divergently upwards and obliquely forward.

Anterior margin of pronotum sinuated and anterolateral angles apparently prominent, and the width between both projections more than the width of head including eyes. Lateral margins of pronotum inflated at posterior portion and width at the level of inflated portion apparently more than the width between posterolateral corners where one long process is situated on each side, and the processes longer than the 1st antennal segment. Hood gibbous, and transversely elliptic in outline, median carina high and the subapical portion with 2 very small processes which are directing divergently upward and as long as the 2nd antennal segment.

Discomesonotal processes very long, directed obliquely forward and nearly parallel with each other. Mesothoracic hemelytral lobes reaching at least to the middle of the 5th abdominal tergite. Anterior outer margins of the lobes furnished with several hairs on each side. Metathoracic alar lobes narrow and short, and each subapical area with one small rod-like hair, which is set on a small tubercle. One or 2 short rod-like hairs situated on each of the submedian areas of pronotum and abdominal tergites IV to VII. Very minute conical dermal structures densely dispersed on pronotum except lateral areas, posterior surroundings of hood and meso- and metanotal disks.

#### 4. *Stephanitis fasciicarina* Takeya, 1931

##### Fifth instar (Fig. 57)

Measurements, in  $\mu$ : In dried specimen: body length without processes 1625, with processes 1963; width of body across wing pads without processes 875; width of head with eyes 415; width of pronotum across lateral processes but without processes 675; width of anterior margin of pronotum 495; length of pronotum 400. In alcoholic specimen: length of antennal segments I to IV=162, 81, 825, 556; in another specimen, 160, 89, 837, 570; in exuviae, 187, 97, 887, 600; lengths of segments of rostrum I to IV=160, 205, 102, 125. Lengths of segments of legs: in exuviae, femora of all legs 518, fore tibiae 645, middle tibiae 617, hind tibiae 668 and hind 2nd tarsi 127.

Coloration, in dried specimen: General color yellowish, pale and dark areas as in the figure.

Structure: Various processes situated on the regular position of usual *Stephanitis* type. Paired frontal processes of head as long as the 1st antennal segment, unpaired head process a little stouter and longer than the former and occipital processes as long as the preceding, and somewhat thickened at its distal half. Distal antennal segment furnished subapically with 2 immovable short hairs, a few long rod-like hairs and some simple hairs.

Anterior margin of pronotum so sinuated as to form 5 small protrusions including both anterolateral corners, and the middle one protruded between 2 occipital pro-

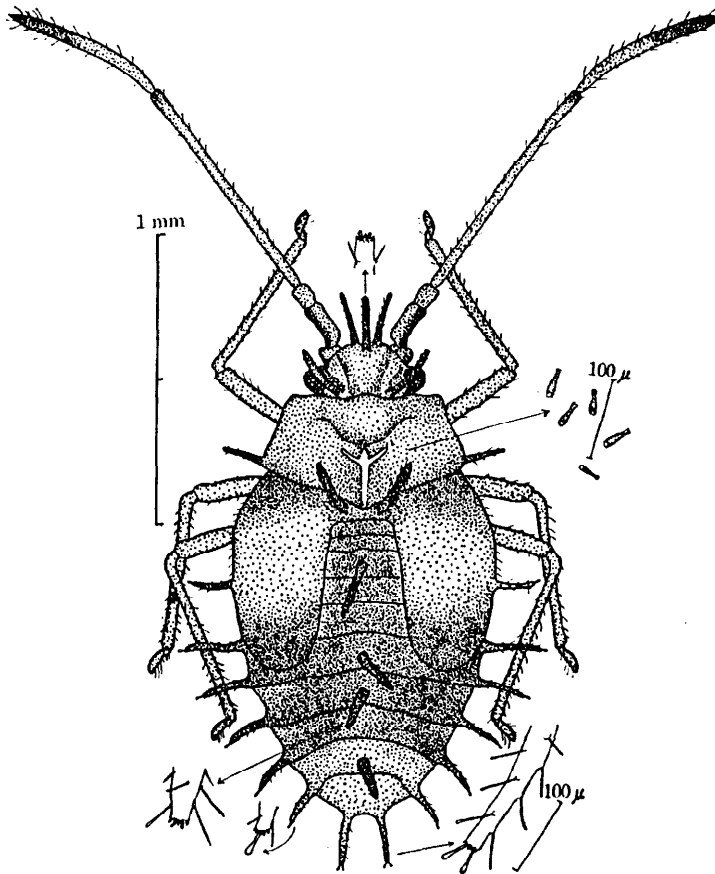


Fig. 57. *Stephanitis fasciolaria*, 5th instar larva.

cesses. Lateral margins of pronotum nearly straight but slightly concave somewhat anterior to the middle. Posterior margin of pronotum gently projected in an obtuse triangle and the tip lying between discomesonotal processes, not extending more posteriorly, and not reaching the posterior margin of mesonotum. Subapical highest point of median carina of pronotum with upwardly divergent discopronotal processes. Lateral pronotal processes directing obliquely and upwardly. Mesothoracic hemelytral lobes projecting very long at least to the middle of the 5th abdominal tergite. Outer lateral margins of each lobe armed with one long process and several short hairs, the former situated somewhat posterior to the middle and directed obliquely and upwardly, but the latter on the anterior portion of the margins.

Head processes and median processes of dorsum terminated in some small conical denticles and small clubbed hairs, one hair on paired processes, 2 hairs on unpaired processes; these denticles and hairs about equal in length. On the other hand, the tip of each lateral process with some small denticles and one long clubbed hair. But

caudal processes with 2 clubbed hairs on each tip.

Body surface furnished with small ampullaceous hairs and minute conical dermal structures, the former situated on hood and submedian areas of pronotum, and submedian and sublateral areas of abdominal tergites except 2 posterior ones, each with submedian groups of 2 to 4 hairs, but sublaterals one or 2.

5. *Stephanitis veridica* Drake, 1948

Fifth instar (Fig. 58)

Measurements, in  $\mu$ : Body length without processes 2225, with processes 2738; width of body across wing pads without processes 1225; width of head with eyes 500; width of anterior margin of pronotum 588; width of pronotum 888; length of pronotum 538; lengths of antennal segments I to IV=214, 125, 1050, 587; lengths of

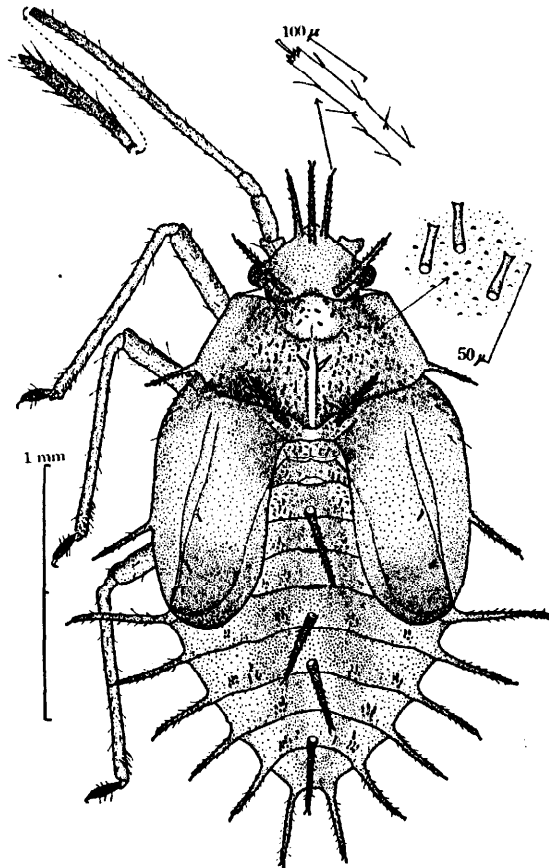


Fig. 58. *Stephanitis veridica*, 5th instar larva.

segments of rostrum I to IV=196, 267, 107, 142. Lengths of segments of legs: fore femora 712, fore tibiae 872, middle femora 694, middle tibiae 819, hind femora 729, hind tibiae 890 and hind 2nd tarsi 160.

Coloration, in dried specimen: General color dull yellowish, eyes reddish, pale and dark areas as in the text-figure.

Structure: Head armed with 5 processes, which are apparently longer than the 1st antennal segment.

Pronotum transverse, anterior margin sinuate and the middle portion somewhat elevated and protruded in a small triangle so as to become a tectiform hood. Lateral margins distinctly straight, and each of the posterolateral corners with one long process projecting nearly upwardly. Tip of pronotal posterior projection is between discomesonotal processes, not extending more posteriorly, and not reaching to the posterior margin of mesonotum. Posterior margin of pronotal hood with a high carina which is extending to the end of triangular projection. Approximately in the middle of pronotum, one pair of very small processes situated on anterior portion of carina; but in the other 2 specimens, the discopronotal processes so stunted as to become only tubercular or vestigial. Mesothoracic hemelytral lobes approaching the middle of the 5th tergite, each lateral outer margins armed with one long nearly upward process somewhat posterior to the middle. Dorsal and lateral processes situated on the regular position of usual *Stephanitis* type. These lateral processes, except caudal processes, much shorter towards posteriorly. Posterolateral angles of abdominal segments II & III, each with one vestigial tubercle which is bearing one small rod-like hair. Tips of various processes above mentioned terminated with some small conical denticles, and the tip of paired processes with respectively one rod-like hair, but the tip of unpaired processes with 2 similar hairs.

Ampullaceous, rod-like hairs distributed evenly over pronotum except the sides, but grouped in small tufts on submedian and sublateral areas of each abdominal tergite. Simple hairs situated on the processes, antennae, rostrum, legs and proximal portion of outer lateral margins of hemelytral lobes.

#### 6. *Stephanitis svensoni* Drake, 1948

##### Fifth instar (Fig. 59)

Measurements, in  $\mu$ : Body length without processes 2700 to 1777; width of body across wing pads 1280; width of head with eyes 567; length of pronotum 550; width of pronotum 933; lengths of antennal segments I to IV = 240, 117, 1217, 817; in another specimen, 258, 125, 1157, 819. Lengths of segments of legs: fore and hind tibiae 943, middle tibiae 890 and hind 2nd tarsi 160.

Coloration, in dried specimen: General color ochreous, amberous or dried gelatinous, pale and dark areas as in the text-figure.

Structure: Various processes situated on the regular position of usual *Stephanitis* type. Paired frontal processes of head as long as the 1st antennal segment. Unpaired processes approximately equal to the length of 2 basal antennal segments combined. Occipital processes a little longer than the unpaired one.

Pronotum transverse, posterior margin gently protruded in an obtuse triangle but the apex lying between discomesonotal processes, not extending more posteriorly, and

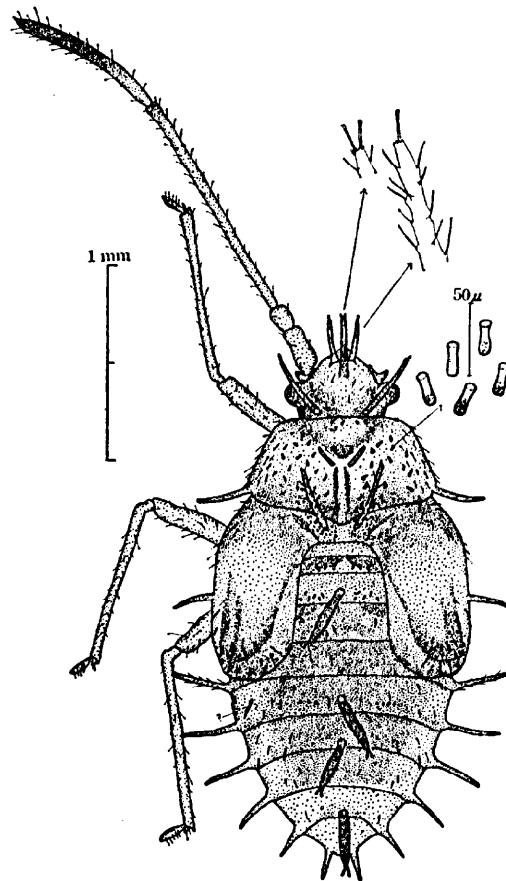


Fig. 59. *Stephanitis svensoni*, 5th instar larva.

not reaching the posterior margin of mesonotum. Lateral pronotal processes long but discopronotal processes very small. Mesothoracic hemelytral lobes approaching the posterior margin of the 4th abdominal tergite, and the posterolateral corners slightly pointed. But metathoracic alar lobes narrow and short but posterolateral corners extremely pointed.

Median dorsal processes of abdomen as long as unpaired process of head. Lateral abdominal processes becoming shorter posteriorly and the hindermost caudal processes the shortest, and the foremost lateral processes on the 4th abdominal tergite nearly twice as long as the caudal one. Tips of unpaired head process and median unpaired abdominal processes, each with 2 short rod-like hairs. But in paired processes and lateral abdominal processes, the tip with a single rod-like hair.

Small ampullaceous hairs dispersed on pronotum except the sides, and submedian areas of abdominal segments except the caudal one. Simple hairs situated on an-



tennae, vertex, lateral sides of pronotum, lateral outer margins of wing pads and lateral sides of all body processes.

### 7. *Stephanitis pyrioides* (Scott, 1874)

#### First instar (Fig. 60)

Measurements, in  $\mu$ : Body length without hairs 623; width of head including eyes 178; width of pronotum without tubercles 160, with tubercles 178; lengths of antennal segments I to IV=40, 36, 200, 138; lengths of segments of rostrum I to IV=101, 113, 54, 73. Lengths of segments of legs: fore femora 120, fore tibiae 142, middle and hind femora 113, middle and hind tibiae 138 and hind 2nd tarsi 71.

Head large in comparison with the other body parts, and wider than pronotum without tubercles. Paired frontal processes only tuberculate. Unpaired process as long as the 2nd antennal segment, and with 2 clubbed hairs. Occipital processes with a clubbed hair on each tip and a simple long hair on outer lateral side. 2 distal antennal segments furnished with long vertical hairs, which are longer than thickness of the segment and not so sharply pointed. But apical portion of distal antennal segment with 2 immovable hairs and 2 long clubbed hairs.

Thoracic nota resemble in shape abdominal tergites. Median line of pronotum and mesonotum each with one pair of small tubercles, each provided with one clubbed hair, and the mesonotal tubercles somewhat larger than the pronotals. Abdominal tergites II, V, VI & VIII, each with one fairly thick and bifurcate process which has the tip with 2 clubbed hairs. And paired very minute hairs situated on the middle of metanotum and the 3rd and 4th abdominal tergites respectively; and each metanotal hair grows out from a small tubercle closed to each other, but each abdominal hair having a common base. These hairs and tubercular bases atrophied and rudimentary.

Lateral margins of thoracic nota and abdominal tergites except the 1st and caudal abdominal ones, each with a small tubercle, on which is seen one fairly long clubbed hair, of about 27  $\mu$  long; only the metanotals smaller than the others. But the 1st abdominal segment without lateral tubercles and hairs, on the other hand, the caudal segment provided with 2 similar hairs, of about 31  $\mu$  long, on each posterolateral corner. Base of lateral tubercles of thoracic nota and abdominal tergites except the 1st and 2nd posterior abdominal ones, each with one small clubbed hair of about 16  $\mu$  long.

Submedian areas of thoracic segments each with 2 tiny rod-like hairs, and the 1st abdominal tergite with a single hair on each submedian area.

#### Second instar (Fig. 61)

Measurements, in  $\mu$ : Body length without processes 808; width of head with eyes 250; width of pronotum without processes 250; width of mesonotum 267; width of abdomen 292; lengths of antennal segments I to IV=60, 40, 300, 200; lengths of segments of rostrum I to IV=125, 136, 67, 85. Lengths of segments of legs: fore femora 169, fore tibiae 205, middle and hind femora 160, middle tibiae 198, hind tibiae 202 and hind 2nd tarsi 85.

Structure: Head large, as wide as pronotum without processes. The 4th antennal

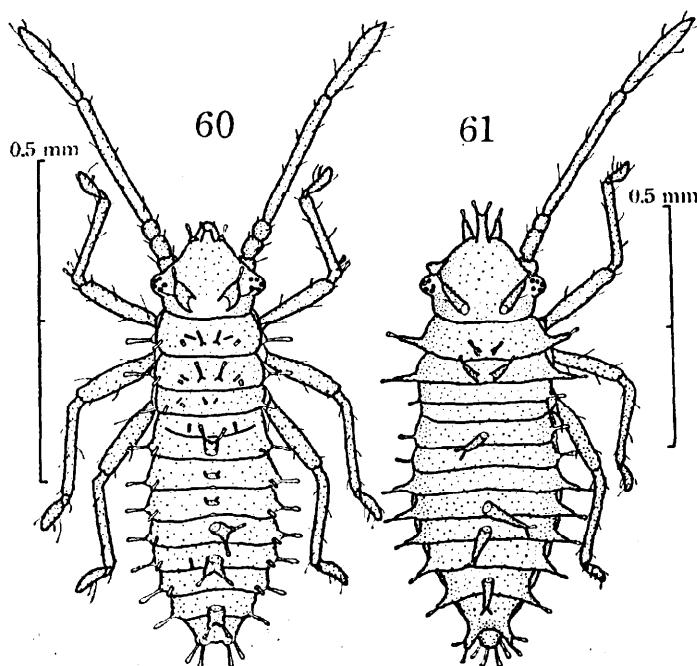


Fig. 60. *Stephanitis pyrioides*, 1st instar larva.

Fig. 61. *Stephanitis pyrioides*, 2nd instar larva.

segment as long as tibiae. Various processes developed in regular position of usual *Stephanitis* type. And so the abdominal dorsal processes of the tergites II, V, VI & VIII, fairly developed, but the other median paired hairs, which are represented in the former instar, perfectly disappeared.

Pronotum, mesonotum and posterior 6 segments of abdomen, with each postero-lateral tubercle developed in a lateral process. But the lateral tubercles of metanotum and the 2nd and 3rd abdominal tergites so stunted and not developing into a process. Tips of median unpaired processes of the body with 2 small clubbed hairs, but tips of paired processes of the body and all lateral processes each with a single, long, clubbed hair. But the caudal processes each with 2 similar long hairs.

Body surface covered with some short rod-like hairs and many, minute, conical dermal structures which are dark brown.

#### Third instar (Fig. 62)

Measurements, in  $\mu$ : Body length without processes 1125; width of head with eyes 338; width of pronotum without processes 375; width of mesonotum 425; width of abdomen 400; lengths of antennal segments I to IV=89, 60, 440, 294; lengths of segments of rostrum I to IV=156, 174, 71, 98. Lengths of segments of legs: femora of all legs 236, fore tibiae 305, middle tibiae 285, hind tibiae 307 and hind 2nd tarsi 105.

Coloration, specimen in alcohol: General color yellowish, pale and dark areas as in the figure. Discopronotal processes entirely colorless, lateral pronotal and lateral mesonotal processes darkened only at their apices.

Structure: Various processes of the body situated on the corresponding areas to the 2nd instar.

Tips of paired frontal processes of head each provided with simply one rod-like hair, but tip of unpaired process of head blunt and with 2 rod-like hairs and a few minute conical denticles. Tip of each occipital process with one minute denticle on one edge and one long rod-like hair on the other.

Posterior margin of pronotum only slightly protruded into a triangular projection which becomes evident in later instars. Posterolateral corners of mesonotum so inflated as to become the wing pads. Dorsal abdominal processes with 2 rod-like hairs on each tip, but tips of paired processes and lateral processes of body each with one rod-like hair. Lateral abdominal processes with one minute denticle and one rod-like hair on each tip as in the occipitals. But caudal processes with 2 rod-like hairs, one on apical tubercle and another on subapical tubercle.

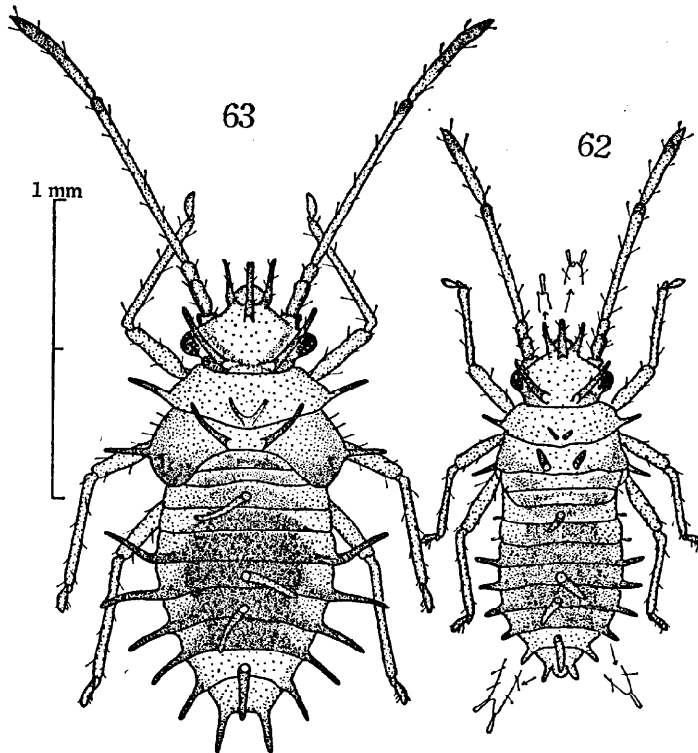


Fig. 62. *Stephanitis pyrioides*, 3rd instar larva.

Fig. 63. *Stephanitis pyrioides*, 4th instar larva.

#### Fourth instar (Fig. 63)

Measurements, in  $\mu$ : Body length without processes 1425; width of body across wing pads 625; width of head with eyes 438; length of pronotum 188; width of pronotum without processes 525; width of abdomen 575; lengths of antennal segments I to IV=142, 80, 641, 401; lengths of segments of rostrum I to IV=198, 223, 80, 111. Lengths of segments of legs: femora of all legs 356, fore tibiae 464, middle tibiae 434, hind tibiae 472 and hind 2nd tarsi 116.

Coloration: Pale and dark areas as in the figure. All processes darkened but the discopronotal ones darkened only at the apices.

Structure: Body armed with processes and various hairs on the corresponding areas to the earlier instars.

Mesothoracic wing pads prolonged to the anterior area of the 2nd abdominal tergite, and furnished with some hairs on the anterior portion of outer lateral margins.

Body surface furnished with short, rod-like dermal hairs, especially on submedian and sublateral areas of abdominal tergites except caudal segment.

#### Fifth instar (Fig. 64)

Measurements, in  $\mu$ : Body length without processes 1938; width of body across wing pads 1000; width of head with eyes 430; length of pronotum 481; width of pronotum 725; width of abdomen 910; lengths of antennal segments I to IV=238, 88, 888, 644, in another specimen 223, 107, 890, 610; lengths of segments of rostrum I to IV=211, 267, 111, 134. Lengths of segments of legs: fore and middle femora 498, fore tibiae 668, middle tibiae 632, hind femora 516, hind tibiae 700 and hind 2nd tarsi 143.

Coloration, specimen in alcohol: General color yellowish, pale and dark areas as in the figure. Ventral side, outer halves of abdominal tergites IV, V and VI darkened, and outer lobe of each acetabulum somewhat dark, especially the posterior ones deeply colored. Tip of rostrum also darkened.

Structure: Processes and various hairs of the body situated on the corresponding areas to the earlier instars, as shown in the figure. Paired frontal processes of head as long as 2 basal antennal segments combined. Unpaired processes about 416  $\mu$  long, occipital processes as long as the width of head including eyes.

Posterior projection of pronotum reaching the anterior portion of metanotum. Hood extremely gibbous in profile, the outline nearly circular in dorsal view. Anterior portion of median carina very high but apparently defined from hood, so that anteriorly strongly sloped and posteriorly gently sloped. Discopronotal processes based on the anterior highest point of the carina and directed divergently upward, and about half as long as discometanotal processes. Lateral pronotal and lateral wing processes directed upward and apically curved outward, discomesonotal processes the longest of all processes of the body. Median abdominal processes also longer than the lateral ones.

Pronotum furnished with several very small ampullaceous dermal hairs, and submedian and sublateral areas of abdomen also with similar hairs but larger than the former. Ampullaceous hairs above mentioned darkly colored basally.

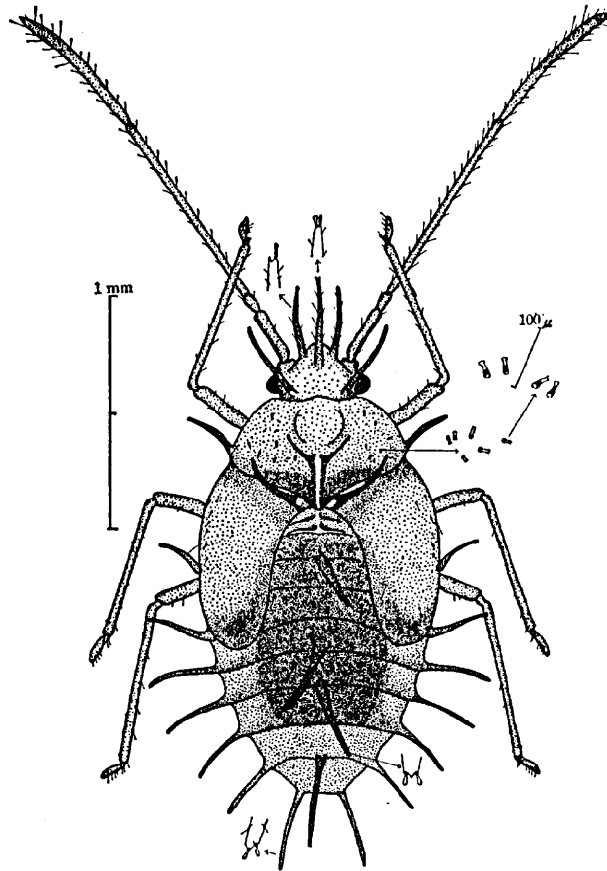


Fig. 64. *Stephanitis pyrioides*, 5th instar larva.

8. *Stephanitis miyamotoi* Takeya, 1963

Fifth instar (Fig. 65)

Measurements, in  $\mu$ : Body length without processes 1925; width of body across wing pads 950; width of head with eyes 438; length of pronotum 400; width of pronotum without processes 662; lengths of antennal segments I to IV=178, 89, 801, 552; in another specimen 175, 100, 831, 575. Lengths of segments of legs: fore femora 552, fore tibiae 659, middle femora 516, middle tibiae 694, hind femora 659, hind tibiae 730 and hind 2nd tarsi 142.

Coloration, in dried specimen: Ground color yellowish. Pale and dark areas vary from pale yellow to blackish brown as shown in the figure.

Structure: Various processes and hairs situated on the regular position of usual *Stephanitis* type as shown in the figure. But metanotal disk with one pair of very

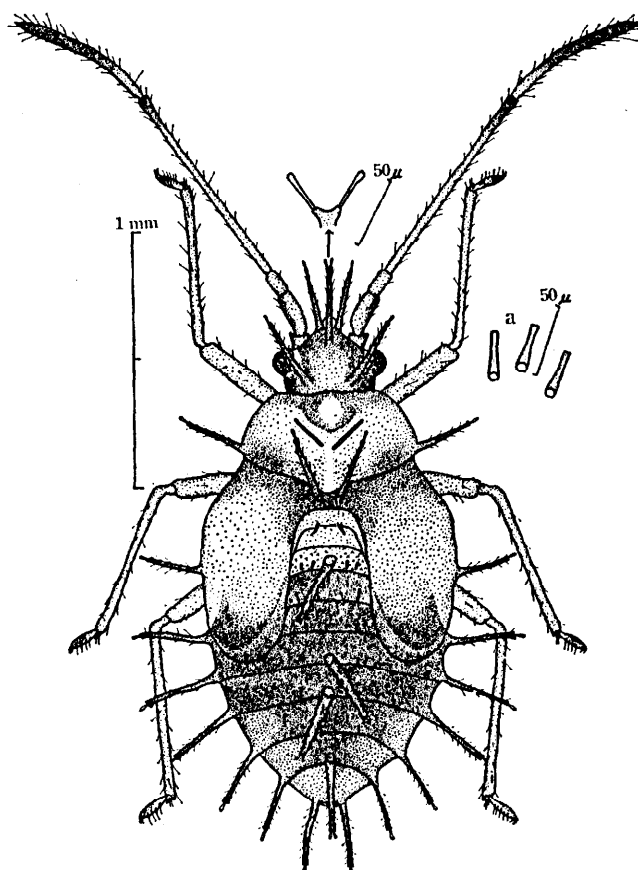


Fig. 65. *Stephanitis miyamotoi*, 5th instar larva.  
a: dermal hairs of abdominal tergum.

small tubercles, which is provided with very stunted, rudimentary and rod-like hair. Paired frontal head processes as long as 2 basal antennal segments combined, unpaired process and occipital ones very long, about  $338\ \mu$  long.

Apex of posterior projection of pronotum lying between the discomesonotal processes, neither extending more posteriorly and nor reaching the posterior margin of mesonotum. Hood circular in outline in dorsal view, but in profile strongly gibbous. Median posterior carina, in profile, anteriorly well defined from hood, posteriorly gently sloped caudoventrally. From the highest point of the carina discopronotal processes upwardly and divergently growing out, and being the smallest of all the processes of the body. Mesothoracic hemelytral lobes prolonged far beyond the middle of the 5th abdominal tergite. Pronotal and lateral wing processes as long as paired frontal processes of head. Discomesonotal processes and 4 median dorsal abdominal processes very long, as long as the occipital processes, Lateral abdom-

inal processes becoming much shorter posteriorly except the caudal ones.

Tip of unpaired head process and median abdominal processes slightly bifurcated in 2 small tubercles, each tubercle with a rod-like hair. But paired processes of head and median thoracic and lateral processes of body simply terminated and each with one rod-like hair.

Submedian areas of abdominal segments II to VII each with 2 ampullaceous dermal hairs, sometimes lateral areas of abdominal tergites having similar hairs. Rod-like hairs of apex of various processes and ampullaceous dermal hairs about  $31\ \mu$  long. Antennae, legs, and body processes furnished with simple hairs, but hairs on the abdominal dorsum very thin.

### 9. *Stephanitis takeyai* Drake et Maa, 1953

#### First instar (Fig. 66)

Measurements, in  $\mu$ : Body length 681; width of head with eyes 182, 175 (a); width of pronotum without lateral tubercles 178, 175 (a), with tubercles 187, 188 (a); width of abdomen without tubercles 187, 200 (a), with tubercles 200, 213 (a); lengths of antennal segments I to IV=47, 35, 191, 149; lengths of segments of rostrum I to IV=80, 93, 62, 76. Lengths of segments of legs: femora of all legs 115, fore tibiae 160, 166 (a), middle and hind tibiae 148, 160 (a) and hind 2nd tarsi 76.

Structure: Paired frontal processes of head tuberculate and about  $10\ \mu$  long, and with one rod-like hair on each tip. Unpaired process about  $36\ \mu$  long, and the tip blunt and with 2 rod-like hairs. Occipital processes about  $47\ \mu$  long, with a rod-like hair on tip and one simple hair on posterolateral side respectively.

Somewhat posterior, lateral margins of thoracic nota and abdominal tergites except the 1st abdominal one, each furnished with one small tubercle, which is provided with a long clubbed hair, about  $31\ \mu$  long. Base of each lateral tubercle with one similarly shaped hair, of about  $27\ \mu$  long. But the 8th abdominal segment without the basal hairs. Generally the thoracic hairs shorter than the abdominals, and the apical hair of each tubercle somewhat longer than the basal one.

In the following instars, of the posterolateral corners of caudal segment, the basal rudimental tubercle fused with the main tubercle so as to become a bifid process which possesses 2 apical hairs brought from the two tubercles. Thoracic tergites with short clubbed hairs on their submedian lines. Posterior portions of pronotum and mesonotum on their median line, each with one pair of minute hairs, the discopronotal hairs very much closed to each other but the discomesonotal hairs moderately separated from each other. Four median abdominal processes thick and short, and the tip blunt and bearing 2 rod-like hairs. Simple hairs situated on legs and antennae, but one pair of long clubbed hairs situated on apical portion of the 4th antennal segment, and one pair of similar but shorter ones near base of tibiae.

#### Second instar (Fig. 67)

Measurements, in  $\mu$ : Body length without processes 825, 872 (a); width of head with eyes 238, 256 (a); width of pronotum without processes 250, 284 (a); width of mesonotum 263, 307 (a); lengths of antennal segments I to IV=85 (with root), 47,

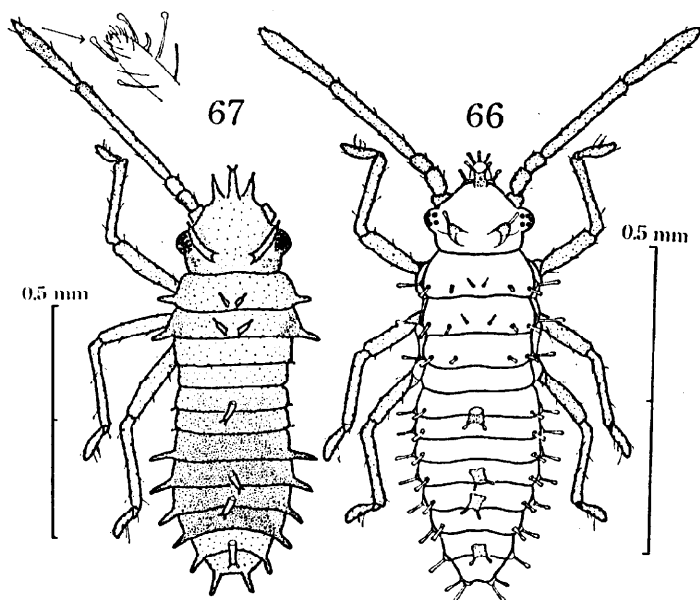


Fig. 66. *Stephanitis takeyai*, 1st instar larva.  
Fig. 67. *Stephanitis takeyai*, 2nd instar larva.

278, 202; lengths of segments of rostrum I to IV=102, 125, 67, 78. Lengths of segments of legs: fore and hind femora 168, fore tibiae 214, middle femora 160, middle tibiae 205, hind tibiae 209 and hind 2nd tarsi 89.

Paired frontal processes of head with 2 clubbed hairs of  $49\ \mu$  long, one on apex and another on lateral side, unpaired process of head about  $111\ \mu$  long and the tip bifurcated, and occipital processes about  $134\ \mu$  long.

Thorax as wide as abdomen. Posterolateral corners of pronotum, mesonotum and abdominal tergites IV to IX each armed with lateral processes. But lateral tubercles of metanotum and the 2nd and 3rd abdominal segments rudimentary. The 2nd lateral hairs which were represented in the former instar, changed to a lateral fine hair of lateral processes. But in case of stunted tubercles the 2nd clubbed hairs still remaining.

Dermal short rod-like hairs also situated on submedian line of thoracic and abdominal tergites except 2 posterior ones. Paired median processes of pronotum and mesonotum fairly developed, and 4 median abdominal processes fairly prolonged, and longer than the laterals.

#### Third instar (Fig. 68)

Measurements, in  $\mu$ : Body length without processes 1225, 1191 (a); width of head with eyes 363, 316 (a); width of pronotum without processes 400, 371 (a); width of mesonotum 500, 445 (a); lengths of antennal segments I to IV=89, 62, 400, 300; 89, 58, 425, 312; 89, 72, 445, 334; lengths of segments of rostrum I to IV=156,



178, 89, 93. Lengths of segments of legs: fore and hind femora 263, fore tibiae 320, middle femora 249, middle tibiae 310, hind tibiae 316 and hind 2nd tarsi 105.

Structure: Body armed with processes and various hairs on the corresponding areas to the preceding instar. Paired frontal processes of head about  $89\ \mu$  long, unpaired process  $151\ \mu$  long, occipital processes  $156\ \mu$  long.

Discopronotal processes growing out divergently from a common base. Postero-lateral corners of mesonotum inflated so as to form mamma-like wing pads in dorsal view. Tips of unpaired head process and median dorsal abdominal processes with 2 clubbed hairs and a few minute conical denticles. But lateral processes terminated in one clubbed hair and one small denticle, the former centrally and the latter on an edge. And caudal processes with two clubbed hairs one on the apex, another on the subapical portion, and a few simple hair on the lateral area.

#### Fourth instar (Fig. 69)

Measurements, in  $\mu$ : Body length without processes 1584, 1414 (a); width of body across wing pads 694, 636 (a); width of head with eyes 418, 387 (a); width of pronotum without processes 570, 516 (a); lengths of antennal segments I to IV=178, 89, 649, 484; lengths of segments of rostrum I to IV=178, 223, 98, 125. Lengths of segments of legs: fore femora 392, fore tibiae 490, middle femora 400, middle tibiae 467, hind femora 409, hind tibiae 490 and hind 2nd tarsi 138.

Structure: Processes and various hairs of body situated on the corresponding areas to the preceding instar, but differed from the earlier instars by the change in the proportions of body parts, and in the shapes of pronotum and mesonotum. Frontal paired processes of head  $178\ \mu$  long, unpaired process  $267\ \mu$ , and occipital processes  $251\ \mu$  long.

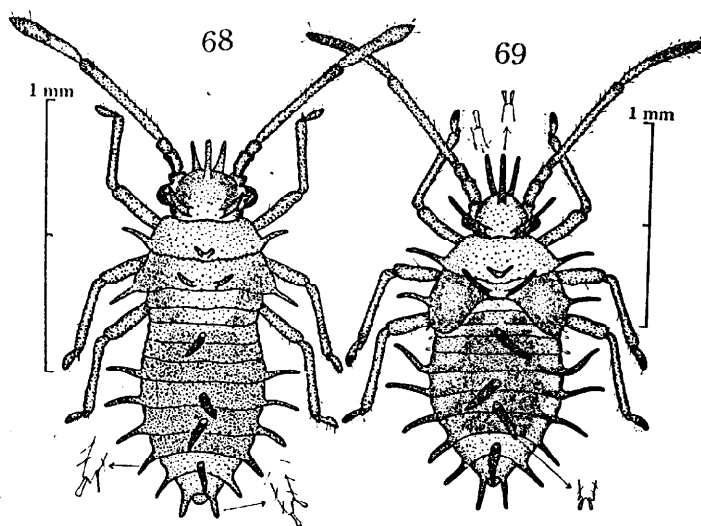


Fig. 68. *Stephanitis takeyai*, 3rd instar larva.

Fig. 69. *Stephanitis takeyai*, 4th instar larva.

Pronotum slightly protruded posteriorly so as to make posterior projection which becomes distinct in the next instar, pronotal disk with a narrow, curved, transverse stripe which is bald and without any dermal structures. Mesothoracic hemelytral lobes prolonged and approaching the posterior margin of the 2nd abdominal tergite and metathoracic alar lobes also prolonged, and the apices bearing a small clubbed hair. The sides of the 2nd and 3rd abdominal tergites each with a stunted small tubercle which is provided with one clubbed hair.

Body surface except hemelytral lobes and 2 posterior abdominal tergites furnished with short ampullaceous hairs and minute conical dermal structures.

#### Fifth instar (Fig. 70)

Measurements, in  $\mu$ : Body length without processes 2261 to 2300, with processes 2900 to 2990; width of head with eyes 502 to 517; length of pronotum 533; width of pronotum without processes 880; width of body across wing pads 1217; lengths of antennal segments I to IV=242, 102, 868, 685; lengths of segments of rostrum I to IV=223, 285, 125, 147. Lengths of segments of legs: fore femora 543, fore tibiae

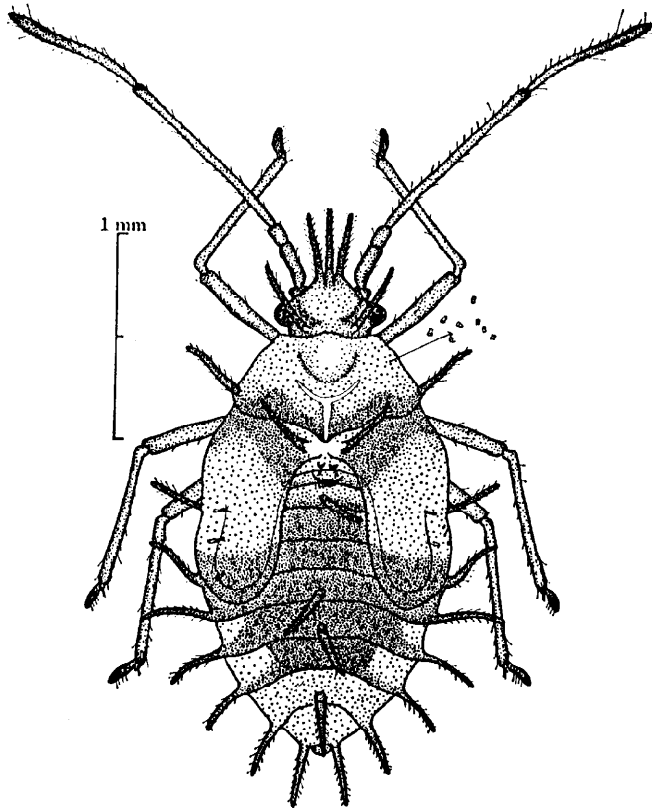


Fig. 70. *Stephanitis takeyai*, 5th instar larva.

694, middle femora 561, middle tibiae 701, hind femora 587, hind tibiae 743 and hind 2nd tarsi 160.

Coloration, specimen in alcohol: General color yellowish, pale and dark areas as in the figure. The 4th antennal segment darkened at the proximal point, and apical half deeply colored but the apex pale, discopronotal processes not darkened.

Structure: Processes and various hairs of body situated on the corresponding areas to the earlier instar. Frontal paired processes of head  $254\mu$  long, unpaired process  $334\mu$  long, and occipital processes  $314\mu$  long. Pronotal hood nearly circular in outline, and posteriorly surrounded by a curved glabrous stripe. Anterior portion of median carina very high but apparently defined from hood by a transverse stripe. Discometanotum with one pair of small tubercles, each of which is provided with a small rod-like hair. A transverse small bulge situating near the posterior margin of the 1st abdominal tergite, and provided with 2 minute, extremely stunted, rod-like hairs.

Outer lateral margins of pronotum and hemelytral lobes furnished with some simple hairs. Pronotal disk including hood and carina furnished sparsely with very short ampullaceous hairs, of about  $13\mu$  long. Submedian and sublateral areas of abdominal tergites except 2 posterior ones, each with generally 2 ampullaceous hairs, of about  $29\mu$  long.

### 3. Male genitalia I

A key to some genera and species of the lace bugs  
by pygophore and male genital organs.

1. Sides of pygophore evenly inflated at the basal third in dorsal view, posterior rim projected to form a distinct caudal lobe. Caudal portion of parameres comparatively thick. Endosomal diverticula furnished evenly with many tiny protuberances ..... *Cantacader lethierryi*
- Sides of pygophore straight or inflated distally or basally in dorsal view, posterior rim projected not as above. Caudal portion of parameres comparatively slender ..... 2
2. Parameres bent like a sickle. Dorsal plate of phallus annular ... *Agramma nexilis*
- Caudal portion of parameres roundly curved and gradually tapered, or middle portion of parameres extremely thickened ..... 3
3. Endosomal wall proximal to diverticula with a pair of brush-like sclerites ..... *Dictyonota koreana*
- Endosomal wall without brush-like sclerites ..... 4
4. Endosomal wall not or very weakly sclerotized ..... 5
- Endosomal wall furnished with sclerotized structures ..... 9
5. Parameres slender, transparent window on ventral wall of pygophore very large and piriform ..... 6
- Parameres comparatively thick and caudal portion rather short ..... 7
6. Posterior rim of pygophore fairly projected roundly and basal border of transparent window reaching basal margin of the wall ..... *Acalypta sauteri*

- Posterior rim projected rectangularly and basal border of transparent window not reaching basal margin of the wall ..... *Derephysia foliacea*
- 7. Middle of the sides of pygophore inflated in dorsal view ..... *Baeochila occasa*
- Middle of the sides of pygophore not inflated in dorsal view ..... 8
- 8. Sides of pygophore nearly straight in dorsal view ..... *Eteoneus yasumatsui*
- Sides of pygophore on distal halves inflated in dorsal view ..... *Leptoypa* spp.
- 9. Parameres extremely slender ..... *Idiocysta* sp.
- Middle portion of parameres inflated ..... 10
- 10. Dorsal plate of phallotheca U-shaped and extremely broad at base ..... 11
- Dorsal plate of phallotheca V- or Y-shaped ..... 12
- 11. Endosomal diverticula with 1 pair of large sclerotized structures... *Dictyla formosa*
- Endosomal diverticula without any sclerotized structures. Endosomal wall with small sclerotized bulges within the middle portion ..... *Cochlochila lewisi*
- 12. Endosomal diverticula furnished with sclerotized structures ..... 13
- Endosomal diverticula without any sclerotized structures ..... 15
- 13. Sclerotized structures composed of many prickle-shaped projections ..... 14
- Sclerotized structures of paired long bars ..... *Physatochila orientis*
- 14. Prickle-shaped sclerites arranged in some groups ..... *Tingis yasumatsui*
- Prickle-shaped sclerites arranged in a curved band ..... *T. comosa*
- 15. Endosomal sclerites of a semitubular bulge occupying within tubular portion... 16
- Endosomal sclerites more than 2 kinds ..... 18
- 16. Endosomal sclerites very slender, and middle portion of parameres strongly inflated outside ..... *Copium japonicum*
- Endosomal sclerites short and parameres evenly inflated ..... 17
- 17. Sides of pygophore inflated at the middle ..... *Tingis ampliata*
- Sides of pygophore smooth and distally convergent ..... *Galeatus spinifrons*
- 18. Endosoma with plate-like sclerites and one pair of sclerotized appendages ..... *Cysteochila* spp.
- Endosoma with plate-like sclerites and more than 2 pairs of sclerotized appendages ..... 19
- 19. Endosomal appendages, at least one pair, furnished with tiny denticles ..... 20
- Basal 2 pairs of endosomal appendages strongly protruded in the shape of a large canine-tooth respectively ..... *Uhlerites* spp.
- 20. Pygophore as wide as long or a little wider, parameres not strongly sinuate and without any denticles at the apex ..... 21
- Pygophore very long, parameres very thick, strongly sinuate and with conical protuberances at the apex ..... 22
- 21. Sclerotized structures on endosomal wall usually of 3 kinds ..... *Stephanitis* spp.
- Sclerotized structures on endosomal wall of 4 kinds ..... *S. nashi* group
- 22. b - endosomal appendages elongate ..... *S. ambigua*
- b - endosomal appendages not elongate ..... *Tingis populi*

# 1. *Cantacader lethierryi* Scott, 1874

(Pl. 1-1, Pl. 5-1, Pl. 9-1)

Pygophore comparatively small, slightly wider than long in median line of ventral wall. Posterior rim distinctly protruded behind to form a caudal lobe, of which

posterior margin is truncate and bears several hairs, and quite distinguished from that of the species in Tinginae. Lateral margins gently inflated at the basal portion, proximal margin almost entire. Ventral wall strongly inflated but dorsal wall gently rounded.

Parameres stout and twice bent so as to be distinguishable in 3 portions. Each portion very thick but main middle portion somewhat thicker than the other. On inner margin furnished with several simple hairs but outer side with several small rod-like hairs at regular intervals and the other surfaces with some fine hairs.

Phallus relatively large, basal plate thick, ductifer large, rectangular and composed of 2 parts. Dorsal plate very broad and semiannular. Middle portion of phallosome short, partially sclerotized in 2 plates. Apical tubular portion long, and the distal half somewhat narrowed and cleft longitudinally so as to form 2 narrow valvular processes, in dorsal view. Endosomal wall, corresponding to bulbous portion, between basal and dorsal plates, furnished evenly with numerous, sclerotized minute protuberances.

## 2. *Agramma nexillis* (Drake, 1948)

(Pl. 1-2, Pl. 5-2, Pl. 9-2)

Pygophore slightly wider than long. Posterior rim broadly but shortly protruded, trapezoidal in shape, with the distal side narrow and slightly sinuate. Lateral margins gently inflated at the middle. Proximal margin of dorsal wall archedly excavated, but of ventral wall almost flat but narrowly concave at the middle.

Parameres strongly curved, somewhat curved, caudal portion bent at right angle to main median portion. Main median portion comparatively thick, slightly curved, and the outer side gently inflated, with some fine hairs. Caudal portion slender and almost hairless.

Phallus simple, basal plate also small. Dorsal plate entirely annular but middle portion broad. Tubular portion of phallosome slender, slightly curved, apically tapered, roundly terminated and not well differentiated from middle portion.

## 3. *Dictyla formosa* (Drake, 1923)

(Pl. 1-3, Pl. 5-3, Pl. 9-3)

Pygophore nearly square. Posterior rim broadly protruded backwards to form a trapezoid in outline, and its distal side straight. Lateral margins almost straight but slightly inflated somewhat before middle. Proximal margin of dorsal wall archedly excavated at the middle, and the margin of ventral wall gently concave.

Parameres gradually tapered and roundly curved towards apex, indistinguishable between caudal and main portions, and the inner and outer margins furnished with several fine hairs. Proximal stalk and main portions extremely black or strongly sclerotized but gradually discolored to the apex, and caudal portion colorless or weakly sclerotized.

Phallus with a basal plate nearly rectangularly curved. Dorsal plate comparatively large and very distinct in form — apparently U-shaped but the middle part broadly extended dorsobasally.

Middle portion of phallotheca very short, tubular portion short but longer than the former. Endosomal wall, occupying within tubular portion with  $\alpha$ -endosomal sclerite which is very distinct and well sclerotized. Endosomal diverticula large, each diverticulum with one long sclerotized plate which is densely striped with very fine oblique lines.

#### 4. *Acalypta sauteri* Drake, 1942

(Pl. 1-4, Pl. 5-4, Pl. 9-4)

Pygophore wider than the length of ventral wall in median line. Posterior rim strongly, roundly protruded. Lateral margins markedly narrowed at the distal fifth. Distal portion rather strongly pressed dorsoventrally and sharply pointed posteriorly in profile. Ventral wall with one very large, transparent window, its basal margin just reaching the proximal margin of the ventral wall. Both proximal margins of dorsal and ventral walls archedly concave.

Parameres extremely slender, gradually tapered and broadly curved towards apex. Main median portion furnished with several hairs on its inner and outer margins, caudal portion comparatively long and slender.

Phallus large. Basal plate large and characteristic in shape, each apodeme with a distinct protuberance. Dorsal plate broad and V-shaped. Middle portion of phallotheca short and partially sclerotized in 2 curved plates; tubular portion slender, about twice as long as the length of middle portion. Endosomal sclerite as long as the outer thecal portion, and the distal portion of endosoma abruptly narrowed.

#### 5. *Derephysia foliacea* (Fallén, 1807)

(Pl. 1-5, Pl. 5-5, Pl. 9-5)

Pygophore nearly square but somewhat wider than the length of ventral wall. Posterior rim broadly but shortly protruded, nearly rectangular and notched in middle of the distal side. Apical portion of lateral sides moderately inflated. Ventral surface with a very large transparent window of ampulla-shape, but the basal margin of the window not reaching the proximal margin of the ventral wall. Proximal margin of dorsal wall strongly excavated in parabolic curve, but that of ventral wall nearly entire.

Parameres long, gradually tapered and broadly curved towards apices. Caudal portion slender and curved. Inner and outer margins with several fine hairs.

Phallus comparatively large, basal plate thick, ductifer square and surrounded by another sclerotized band. Dorsal plate V-shaped. Middle portion of phallotheca short, partially sclerotized in 2 curved plates; tubular portion very long, twice as long as the middle portion and less sclerotized.

#### 6. *Baeochila occasa* (Drake, 1942)

(Pl. 1-6, Pl. 5-6, Pl. 9-6)

Pygophore slightly wider than long. Posterior rim broadly and trapezoidally

protruded, but its distal side slightly notched in middle. Lateral margins moderately inflated at the middle and proximal margin of dorsal wall fairly excavated, but that of ventral wall nearly entire.

Parameres with main portion possessing a conspicuous protuberance and several hairs on inner margin and being roundly inflated on outer side. Caudal portion of the inner margin except apical part slightly sinuated. Dorsal surface furnished evenly with many fine hairs.

Phallus very weak, with a basal plate simple, dorsal plate of phallotheca semianular and comparatively broad. Middle portion of phallotheca short, tubular portion long, both portions not so sclerotized as in dorsal plate. Endosomal wall indistinguishable, without any remarkable sclerotized structure.

#### 7. *Eteoneus yasumatsui* Takeya, 1962

(Pl. 1-7, Pl. 5-7, Pl. 10-7)

Pygophore small, a little wider than the length of ventral wall. Posterior rim broadly and trapezoidally protruded, its distal side approximately straight, as wide as the length of dorsal wall in median line, and with many fine hairs. Lateral margins nearly straight. Proximal margin of dorsal wall strongly excavated triangularly, but the margin of ventral wall approximately entire.

Parameres simple, with a main portion very thick and the outer margin evenly rounded and furnished with several fairly long hairs at regular intervals. And the other surfaces evenly with many fine hairs.

Phallus simple, basal plate well sclerotized, dorsal plate of phallotheca semianularly sclerotized, and the middle part strongly extended dorsobasally and extremely broad. Middle portion of phallotheca very simple and tubular portion slightly sclerotized and tapered distally. Bulbous portion large and containing moderate endosomal diverticula. Endosomal wall, occupying within tubular portion, with a fairly sclerotized plate-like patch.

#### 8. *Copium japonicum* Esaki, 1931

(Pl. 1-8, Pl. 5-8, Pl. 10-8)

Pygophore slightly wider than long. Posterior rim broadly but shortly and trapezoidally protruded, its distal side straight and as wide as the length of trapezoidal protuberance. Sides slightly inflated at the middle. Proximal margin of dorsal wall excavated in a small triangular form, but the margin of ventral wall slightly rounded at the middle. Entire surface except basal portion of dorsal and ventral walls and dorsal surface of posterior trapezoidal portion, densely covered with fine hairs.

Parameres short, side of middle portion strongly inflated, and furnished with several fairly long hairs. The other surfaces with fine hairs sparsely. Caudal portion short.

Phallus comparatively small, basal plate round and basal foramen nearly circular. Dorsal plate of phallotheca semiannular and narrow but middle portion extended dorsobasally to form a stalk. Middle portion of phallotheca short and partially

sclerotized in 2 narrow plates and tubular portion extremely slender, about twice as long as middle portion and sclerotized in 2 curved plates. Endosomal wall, occupied within the basal part of tubular portion, with a slender  $\alpha$ -endosomal sclerite, which is about half the length of the tubular portion of phallotheca.

9. *Leptoypha wuorentausi* (Lindberg, 1927)

(Pl. 1-9, Pl. 5-9, Pl. 10-9)

Pygophore nearly as wide as long. Posterior rim broadly but shortly protruded, nearly rectangular but distal corners gently rounded, and the distal side slightly notched at the middle. Distal portion of lateral sides roundly inflated. Proximal margin of dorsal wall strongly excavated triangularly, but that of ventral wall nearly entire.

Parameres semicircularly curved; main median portion comparatively thick, carinate along inner margin, provided with several hairs on inner side, a fairly long hairs on outer side and many fine hairs on dorsal surface; outer side of caudal portion also with fine hairs in a row.

Phallus comparatively small, with a basal plate nearly square in outline. Dorsal plate of phallotheca very broad and nearly V-shaped, middle portion of theca short, partially sclerotized in 2 small plates and tubular portion comparatively long.

10. *Leptoypha capitata* (Jakovlev, 1876)

(Pl. 1-10, Pl. 5-10, Pl. 10-10)

Pygophore nearly as wide as long. Posterior rim protruded and parabolic in outline. Distal portion of the sides fairly inflated. Dorsal wall blackish or well sclerotized but proximal region apparently pale or feebly sclerotized. Proximal margin of dorsal wall narrowly excavated in tectiform, and a little more elongated than in ventral wall. Proximal margin of ventral wall sinuated and middle portion fairly convex. Ventral wall somewhat paler than dorsal side, and with a large transparent window in middle portion.

Parameres stream-line shaped; main median portion thick, and the inner side somewhat flat, with one median longitudinal carina, and many fine hairs, and the other surfaces also with fine hairs sparsely. Caudal portion short, archedly curved.

Phallus simple, basal plate simple, each apodeme with a distinct conical protuberance. Dorsal plate of phallotheca semiannular, broad and well sclerotized. Middle portion short and slightly sclerotized in 2 narrow plates. Tubular portion long, also not so well sclerotized as in dorsal plate. Endosomal wall, occupying within tubular portion, sclerotized in semitubular shape, its distal portion extremely tapered to a triangular tip.

11. *Idiocysta* sp.

(Pl. 1-11, Pl. 5-11, Pl. 10-11)

Pygophore wider than long, posterior rim gently protruded with the distal end



sinuate in the middle. Distal portion of the sides gently inflated. Proximal margin of dorsal wall archedly concave, but the margin of ventral wall entire.

Parameres very slender, extremely curved. Main portion with 2 low protuberances on inner margin and furnished with several long hairs on outer margin. Inner side and ventral surface with fine hairs.

Phallus moderate in size; basal plate simple and basal foramen nearly circular. Dorsal plate of phallosome typically V-shaped and very narrow. Middle portion of phallosome fairly long, partially sclerotized in 2 plates and tubular portion comparatively long. Endosomal wall, occupying within tubular portion, of the theca with a small  $\alpha$ -endosomal sclerite.

## 12. *Cochlochila lewisi* (Scott, 1880)

(Pl. 2-12, Pl. 5-12, Pl. 10-12)

Pygophore wider than long. Posterior rim protruded, nearly trapezoidal and the distal side as wide as the length of the trapezoidal projection. Sides gently inflated and with fine tubercles.

Parameres roundly curved and gradually tapered towards apex, and main median portion indistinguishable from caudal portion, and the inner margin of the main and caudal portions curved semicircularly. Main and caudal portions furnished evenly with stout hairs.

Phallus with a basal plate thin; dorsal plate of phallosome U-shaped but the middle part strongly extended dorsobasally. Middle portion of theca short, partially sclerotized in 2 narrow plates, and the tubular portion of theca about twice as long as middle portion. Endosomal wall, occupying within the tubular portion, with a distinct  $\alpha$ -endosomal sclerite, the wall corresponding to the middle portion, bearing a small transverse sclerite near middle.

## 13. *Galeatus spinifrons* (Fallén, 1896)

(Pl. 2-13, Pl. 6-13, Pl. 11-13)

Pygophore shaped like a chestnut in outline, wider than long. Posterior rim fairly trapezoidally projected posteriorly, and furnished with fine hairs. Sides gently convergent distally. Ventral surface with a long transparent window. Proximal margin of dorsal wall a little concave, but that of ventral wall broadly excavated.

Parameres slender and strongly curved, gradually tapered towards apex, with the boundary between main portion and caudal portion indistinguishable. Inner margin furnished with many fine hairs but outer margin of the main portion with fairly long hairs.

Phallus with a basal plate stout. Dorsal plate of phallosome semiannular and middle part extended dorsobasally, middle portion of phallosome short and partially sclerotized in 2 narrow plates and tubular portion long and weakly sclerotized. Endosomal wall, occupying within the apical tubular portion of theca, with a transverse  $\alpha$ -endosomal sclerite.

14. *Uhlerites debile* (Uhler, 1896)

(Pl. 2-14, Pl. 6-14, Pl. 11-14)

Pygophore about as long as wide. Posterior rim broadly but shortly and trapezoidally protruded, its distal side straight and as wide as the length of dorsal wall in median line. Proximal margin of dorsal wall triangularly excavated, but the margin of ventral wall entire.

Pygophoric tube somewhat dorsoventral, and the thickness less than the width,  $3331\ \mu$ ;  $500\ \mu$ .

Parameres very simple, thickened basally and gradually narrowed to a pointed apex, the boundary between main and caudal portions indistinguishable, and broadly curved so that the inner curvature about semicircular. Along the inner semicircular margin with many fine hairs in 2 rows, but outer side of the main portion with several hairs at regular intervals, but outer side of the caudal portion lacking the similar hairs, and the other areas of parameres with very fine hairs sparsely.

Phallus with a basal plate simple. Dorsal plate of phallotheca semiannular and the middle portion extended dorsobasally. Middle portion of phallotheca partially sclerotized in 2 curved plates and the tubular portion of theca long and also sclerotized. Endosomal wall with a small transverse sclerite and 2 pairs of extremely distinct appendages, which are fairly large, long canine-tooth shaped and projected distally. Proximal pair of the appendages superficially arisen at middle of tubular portion, and touched with each other at their bases. Another pair superficially originated at lateral proximal ends of middle portion of phallotheca, and the pair separated from each other and situated on the sides of endosome. Inner base of the latter appendages armed with some tiny denticles.

15. *Uhlerites latius* Takeya, 1931

(Pl. 2-15, Pl. 6-15, Pl. 11-15)

Pygophore nearly rectangular in outline, about as wide as long. Posterior rim shortly and broadly protruded backwards to form a trapezoidal expansion, its distal side nearly straight and wider than the length of dorsal wall in median line. Lateral margins of pygophore slightly inflated at distal half, proximal margin of dorsal wall fairly excavated triangularly, but that of ventral wall slightly prolonged. Suspensory arms and apical half of pygophoric tube furnished with fine hairs.

Parameres similar but slightly smaller than those of *U. debile*.

Phallus distinct; middle portion of phallotheca long, partially sclerotized in 2 narrow plates; tubular portion of theca long and sclerotized in 2 broad plates. Endosomal wall with 2 pairs of characteristic appendages. Proximal pair superficially arisen at base of tubular portion and 3 small denticular processes attached to respective base of the pair. Distal pair superficially arisen at lateral bases of both sclerites of middle portion of phallotheca and either of the pair deeply bifurcated or divided into 2 spinous processes.

16. *Tingis populi* Takeya, 1932

(Pl. 2-16, Pl. 6-16, Pl. 13-23)

Pygophore strange, large, distinctly longer than wide. Posterior rim shortly protruded but very characteristic in form—posterolateral corners of the posterior expansion strongly projected, and the margin between the corners concavely sinuate. Lateral margins moderately inflated at the middle. Proximal margin of dorsal wall extremely excavated, but that of ventral wall strongly protruded and broadly arched.

Parameres also characteristic, of a shoe form in profile. Basal stalk portion very broad, and inner side of main median portion slightly inflated, but the outer side of the portion swollen hemispherically at basal part of the outer side, and the rest of the outer side furnished with several stout bristles. Caudal portion comparatively thick, and with a characteristic small conical projection at its inner side of subapical point.

Phallus comparatively small. Basal plate thin. Dorsal plate of phallotheca semiannular, stalked at base and nearly Y-shaped. Middle portion of phallotheca partially sclerotized in 2 curved plates, and the tubular portion of theca long and semitubularly sclerotized.

Endosomal wall with a semitubular *a*-sclerite and 2 pairs of appendages. The former sclerite occupied within tubular portion. The inner pair of the latter large, corresponding to the *b*-endosomal sclerotized appendages, globular, armed with many tiny denticles which are closed to each other; but the outer pair, corresponding to the *c*-endosomal sclerotized appendages, small and simply pointed at apex.

17. *Tingis ampliata* (Herrich-Schäffer, 1839)

(Pl. 2-17, Pl. 6-17, Pl. 11-16)

Pygophore nearly polygonal, slightly wider than long. Posterior rim gently protruded and the distal side somewhat concave at middle. Sides somewhat protrudent slightly posterior to the middle. Proximal margin of dorsal wall strongly, sharply excavated, but the margin of ventral wall almost entire. In dried state, ventral surface with a transverse sulcus, with appearance of a washbasin in sectional line, and furnished with many fine hairs.

Parameres simple and comparatively small. Inner margin of main portion slightly inflated and furnished with fairly long hairs, but outer side with very long hairs, and the other surfaces also with fine hairs. Caudal portion narrow and evenly curved.

Phallus comparatively large; basal plate thin; dorsal plate of phallotheca semiannular and middle part extremely broad. Bulbous portion large and contains large endosomal diverticula. Middle portion of phallotheca very short, and partially sclerotized in 2 curved plates, and tubular portion very long and somewhat tapered near apex.

Endosomal wall, corresponding to the tubular portion, with a distinct sclerite, which is as long as middle portion of the theca. In some specimens, endosomal wall of diverticula furnished with many transverse and zigzag stripes.

18. *Tingis comosa* (Takeya, 1931)

(Pl. 2-18, Pl. 6-18, Pl. 11-17)

Pygophore approximately hexagonal in outline. Posterior rim broadly but shortly protruded in a trapezoidal shape and furnished with many fine hairs. Sides roundly inflated at distal halves. Proximal margin of dorsal wall slightly but sharply excavated at the middle, and with narrow membranous collar. Proximal margin of ventral wall broadly but smoothly excavated.

Parameres simple, inner side of main portion furnished with fine hairs, but the outer side with long hairs, and caudal portion comparatively short and gently curved.

Phallus with basal plate comparatively thin, the lateral arms twisted. Dorsal plate of phallotheca typically V-shaped, middle portion of theca short and partially sclerotized in 2 small plates, and the tubular portion of theca long. Endosomal wall occupying within apical tubular portion of phallotheca, bearing a semitubular sclerite, which is about half as long as the tubular portion. Endosomal diverticula large, each armed with a band of prickles, the band annularly curved and composed of many sclerotized slender prickles.

19. *Physatocheila orientis* Drake, 1942

(Pl. 2-19, Pl. 6-19, Pl. 12-18)

Pygophore comparatively large and polygonal. Posterior rim protruded in a trapezoidal shape, its distal side gently concave. Lateral margins moderately inflated at about middle. Proximal margin of dorsal wall strongly excavated triangularly and with a membranous collar, but the margin of ventral wall almost entire. Ventral surface except proximal portion, furnished with many fine hairs and with a transparent window, which is bell-shaped in outline.

Parameres large, inner curvature nearly semicircular. Inner margin furnished with fine hairs, but outer side of main portion with fairly long hairs at regular intervals. Caudal portion extremely slender.

Phallus with basal plate somewhat transverse and thick. Dorsal plate of phallotheca semiannular and the middle part broad. Middle portion of theca short and partially sclerotized in 2 broad plates. Tubular portion of theca long and semitubularly sclerotized, but basally narrowed in profile. Endosomal wall occupied within the tubular portion of theca, with 2 curved sclerotized plates which are tapered distally and ampullaceous form in outline.

Endosomal wall, corresponding to basal half of tubular portion of the theca with one more small semitubular sclerite, which is nearly as long as half of the tubular portion. Bulbous portion of endosome, corresponding underneath to dorsal plate, with one pair of very distinct sinuous bars.

20. *Cysteocheila vota* Drake, 1948

(Pl. 3-20, Pl. 6-20, Pl. 12-19)

Pygophore except a posterior expansion, nearly square. Posterior rim broadly

but shortly protruded in a trapezoidal shape, its distal side slightly concave at the middle and furnished with fine hairs. Distal portion of lateral sides slightly inflated. Proximal margin of dorsal wall sharply excavated, but that of ventral wall almost entire. Surface of distal half of dorsal wall furnished with many minute circular spots.

Parameres gradually and broadly curved in a semicircle and smoothly rounded. Inner side of main portion somewhat swollen. Inner side of the curve furnished with several fine hairs, but outer side with fairly long and curved hairs.

Phallus with a basal plate nearly square, and lateral arms twisted. Dorsal plate of phallotheca semiannular and V-shaped in dorsal view. Middle portion of phallotheca slightly sclerotized in 2 narrow plates, and the tubular portion of theca long and semitubularly sclerotized.

Endosomal wall, occupied within tubular portion, with a curved plate-like sclerite. Endosome, corresponding to the middle portion, with one pair of large bulges, which are armed with minute extremely sclerotized denticles.

## 21. *Cysteochoila salicorum* (Baba, 1925)

(Pl. 3-21, Pl. 6-21, Pl. 12-20)

Pygophore nearly pentagonal and posterior rim protruded in a trapezoidal shape, its posterolateral corners rounded and the distal side gently concave at the middle. Distal portion of the sides broadly inflated. Proximal margin of dorsal wall slightly but sharply excavated at middle, but the margin of ventral wall almost entire. Ventral surface with a small transparent window at distal area.

Parameres comparatively thick, inner and outer margins furnished with short bristles, and caudal portion distinguishable from main portion and gradually tapered to the apex.

Phallus comparatively large. Basal plate thick. Apodeme small and with one hemispherical protuberance. Dorsal plate of phallotheca semiannular. Middle portion of theca partially sclerotized in 2 narrow plates. Tubular portion of theca long.

Endosomal wall, occupied within tubular portion of phallotheca, with semitubularly sclerotized short vesica, which is half as long as the tubular portion of the theca, and the inside of vesica bears also one pair of elongate plate-like sclerites. Endosomal wall, corresponding to the proximal side of the middle portion of the phallotheca, furnished with one pair of special bulges, from which a few conspicuous sclerotized structures are grown out—a main process shaped like a long canine-tooth, a sharp prickle-shaped thorn and many minute conical tubercles on each bulge, the main process situated on each center and the prickle on inner edge of respective bulge.

## 22. *Cysteochoila consueta* Drake, 1948

(Pl. 3-22, Pl. 6-22, Pl. 12-21)

Pygophore nearly pentagonal. Posterior rim broadly but shortly protruded, trape-

zoidal in form and its distal side furnished with many fine hairs. Distal portion of the sides fairly inflated. Proximal margin of dorsal wall excavated triangularly and with a membranous collar, but the margin of ventral wall almost entire.

Parameres very simple. Inner margin of main portion furnished with several fine hairs, but outer side with some fairly long hairs, and caudal portion evenly curved.

Phallus small. Dorsal plate of phallotheca simply semiannular. Middle portion of phallotheca short, but apical tubular portion slender.

Endosomal wall, occupying within base of the tubular portion, with a small sclerite. Endosomal wall corresponding to dorsal plate, with a pair of bulgeous appendages, which are strongly pointed at apex and claw-like. But in the other specimens, these bulges not so sharply pointed as a claw, and only simply tubercular.

### 23. *Cysteocheila fieberi* (Scott, 1874)

(Pl. 3-23, Pl. 6-23, Pl. 12-22)

Pygophore nearly hexagonal. Posterior rim broadly but shortly protruded in a trapezoidal shape, but its distal side slightly concave at the middle. Apical portion of the sides gently inflated. Ventral surface with a transparent window, which is shaped like a snow-man in outline. Proximal margin of dorsal wall sharply excavated and with a narrow membranous collar, but the margin of ventral wall broadly and smoothly excavated.

Parameres small, middle portion extremely inflated, but caudal portion comparatively long and slender. Inner margin and outer side furnished with several hairs.

Phallus with a basal plate comparatively small. Dorsal plate of phallotheca semiannular and middle part a little extended basally and nearly V-shaped. Middle portion of theca short and the tubular portion of theca slender. Endosomal wall, occupied within base of the tubular portion, with a small sclerite and the wall, corresponding to dorsal wall, with one pair of sclerotized bulges, which are shaped like a pip of apple.

### 4. Male genitalia II (*Stephanitis*)

A key to species of the genus *Stephanitis* by pygophore and genital organs.

1. Proximal margin of dorsal wall of pygophore excavated trapezoidally, endosomal appendages more than 4 pairs ..... 2
- Proximal margin of dorsal wall of pygophore excavated archedly or triangularly, endosomal appendages less than 3 pairs ..... 3
2. Pygophore as wide as long, and larger ..... *S. nashi*
- Pygophore longer than wide, and smaller ..... *S. nashi suigensis*
3. Distal side of posterior expansion of pygophore concave, and both posterior corners triangularly protruded ..... 4

- Distal side of posterior expansion of pygophore straight, both posterior corners gently rounded ..... 6
- 4. Distal side of posterior expansion of pygophore comparatively wide, and the sides of pygophore remarkably inflated somewhat posterior to the middle ..... *S. ambigua*
- Distal side of posterior expansion of pygophore comparatively narrow, the sides of pygophore smoothly inflated at distal portion ..... 5
- 5. Pygophore comparatively long. Endosoma lacks *b*- and *c*-appendages ..... *S. subfasciata*
- Pygophore rather short. Endosoma, *b*- and *c*-appendages specialized in shape and without denticles ..... *S. esakii*
- 6. Pygophore square or nearly rectangular ..... 7
- Sides of pygophore inflated distally ..... 10
- 7. Pygophore typically square. *b*-appendages distinctly elongate, with denticles on their distal portion. *c*-appendages spindle-shaped, not armed with denticles, and bifurcated deeply ..... *S. typica*
- Pygophore nearly rectangular. *b*-appendages short, with denticles, *c*-appendages slender and arising from both outer sides of endosoma ..... 8
- 8. *a*-sclerite not so conspicuous in comparison with the latter 2 species, *b*-appendages globose ..... *S. exigua*
- *a*-sclerite distinctly large, *b*-appendages slightly elongate ..... 9
- 9. *b*-appendages comparatively large and armed with many denticles ..... *S. aperta*
- *b*-appendages comparatively small, very weak, with only 4 pairs of tiny denticles ..... *S. fasciicarina*
- 10. *b*-endosomal appendages lacking ..... *S. veridica*
- Endosomal appendages of 3 kinds ..... 11
- 11. *c*-appendages not curved but shaped like a brush ..... *S. pyrioides*
- *c*-appendages curved and proximal stalk distinguishable from distal flap portion ..... 12
- 12. Proximal margin of ventral wall of pygophore not so protruded triangularly... *S. svensoni*
- Proximal margin of ventral wall projected triangularly ..... 13
- 13. *b*-appendages much smaller than *a*-sclerites. Basal stalk of *c*-appendages feebly sclerotized, and flap portion short but broadly rounded ..... *S. yasumatsui*
- *b*-appendages larger or approximately equal to *a*-sclerites. Basal stalk of *c*-appendages strongly sclerotized and flap portion elongate ..... 14
- 14. Distal side of posterior expansion of pygophore rather concave ..... 15
- Distal side of posterior expansion of pygophore approximately straight ..... 18
- 15. *b*-appendages somewhat long and pointed at apex ..... *S. miyamotoi*
- *b*-appendages comparatively thick. Basal portion of *c*-appendages strongly sclerotized ..... 16
- 16. *b*-appendages smaller than *a*-sclerite ..... 17
- *b*-appendages nearly equal to *a*-sclerite. Parameres extremely stout and outer side of middle portion strongly inflated triangularly ..... *S. takeyai*
- 17. Parameres thicker ..... *S. oberti*
- Parameres thinner ..... *S. watanabei*
- 18. Pygophore, parameres and phallus generally larger ..... *S. drakei*
- Male genital organs comparatively smaller ..... 19

19. *b*-appendages larger than *a*-sclerite ..... *S. hikosana*  
 - *b*-appendages smaller than *a*-sclerite ..... *S. hasegawai*

# 1. *Stephanitis nashi nashi* Esaki et Takeya, 1931

(Pl. 3-24, Pl. 6-24, Pl. 13-24)

Pygophore nearly square in outline, and as long as wide. Posterior rim broadly but shortly protruded in a trapezoidal shape and the distal side straight, and much wider than the length of dorsal wall in median line. Sides gently inflated at the anterior third. Proximal margin of dorsal wall distinctly excavated trapezoidally, but proximal margin of ventral wall gently protruded in a triangular projection. Anterior area of ventral surface with a transparent window, which is comparatively small and longitudinal.

Parameres strongly or almost rectangularly curved. Inner side of the main portion furnished with many fairly long hairs, but the caudal portion with fine hairs in one row. Main portion on outer margin with several long hairs, on middle area of dorsal surface with several such hairs, but on ventral surface sparsely with fine hairs.

Phallus comparatively small, with a basal plate simple. Dorsal plate of phallotheca semiannular and almost V-shaped. Middle portion of phallotheca comparatively short and partially sclerotized in one pair of curved plates. Apical tubular portion of phallotheca broad, transparent and membranous. Endosoma, occupying within the tubular portion, with lateral walls thickened and forming 2 long semitubular parts, and the wall at apices of the parts well sclerotized and forming one pair of sclerites, which are *a*-sclerites. Endosomal wall, distal to *a*-sclerite or superficially behind dorsal plate (seen through phallothecal wall), armed with 3 pairs of very interesting structures, *b*- and *c*-appendages strongly transformed, median pair long and shaped like a cucumber, and the appendages at proximal portion with several tiny slender appendages, and on outer side with another pair of short appendages, which are small and armed with tiny denticles, and corresponding to the *c*-appendages. The *d*-appendages globose, situated at the sides of endosoma, and armed with tiny denticles.

# 2. *Stephanitis nashi suigensis* Saito, 1933

(Pl. 3-25, Pl. 6-25, Pl. 13-25)

Structure of pygophore similar to those of *S. nashi nashi*, but pygophore smaller, and comparatively longer than wide.

Parameres similar to those of the nominate subspecies but apparently smaller.

Phallus small. Basal plate simple and apodeme very small and with one protuberance and shaped like a hat. Middle portion of phallotheca partially sclerotized in 2 curved plates. Tubular portion of phallotheca long, transparent and membranous. Thickened endosomal wall, within the tubular portion, slightly tapered distally and somewhat sclerotized. Endosomal wall at the distal portion of the thickening, with a nearly rectangular sclerite, and at the part corresponding to middle portion of



phallosome with 3 pairs of appendages resembled those of the former subspecies, but all appendages armed with denticles.

### 3. *Stephanitis ambigua* Horváth, 1912

(Pl. 3-26, Pl. 7-26, Pl. 13-26)

Pygophore longer than wide. Posterior rim protruded so as to form a wide but short posterior expansion, its distal side archedly concave and both posterolateral corners triangularly pointed, and with fine hairs. Lateral margins fairly inflated at a little posterior to the middle. Proximal margin of dorsal wall strongly excavated somewhat angularly, but the margin of ventral wall extremely protruded in a triangular projection.

Parameres strongly or almost rectangularly curved, inner side of the main portion nearly straight, outer side of the portion extremely and angularly inflated. Caudal portion comparatively thick, tapered distally, and the apex inwardly with 2 tiny conical protuberances. Various hairs regularly situated just like the *Stephanitis* type, that is described in the preceding species, and may be regarded as a general character in most of the species of the genus *Stephanitis*.

Phallus comparatively small, with a basal plate simple. Dorsal plate of phallosome semiannular and extremely extended basally at middle. Middle portion of phallosome partially sclerotized in 2 curved plates. Tubular portion of phallosome as long as middle portion, and not so sclerotized. Endosomal wall continued to phallosomal mouth, semitubularly sclerotized and convergent towards the mouth. Endosomal wall at distal end of the above mentioned sclerites with one square sclerite, which is weakly sclerotized and sometimes inconspicuous, and at the corresponding part to base of middle portion of phallosome, armed with 2 pairs of sclerotized appendages — Inner pair, corresponding to the *b*-sclerotized appendages, very long and shaped like a cucumber and the inner-side armed with many tiny denticles, and the pair arisen from bases of the outer pair and reaching the level of the ends of lateral arms of dorsal plate. Outer pair, corresponding to the *c*-sclerotized appendages, small and shaped like a chestnut, but sometimes very lean and sharply pointed at apices in balsam mounted specimens.

Of this species, the pygophore, parameres and *b*- and *c*-endosomal appendages are somewhat similar to those of *Tingis populi*. And it is probable that the *c*-appendages of this species indicate the prototype.

### 4. *Stephanitis subfasciata* Horváth, 1912

(Pl. 3-27, Pl. 7-27, Pl. 13-27)

Pygophore longer than wide. Posterior rim narrowly distally protruded and the apex fairly excavated in middle. Distal portion of the sides broadly inflated. Proximal margin of dorsal wall strongly excavated archedly, but the margin of ventral wall extremely protruded in a triangular projection. The basal opening comparatively narrow and rhombic.

Parameres nearly stream-lined. Inner side of main portion slightly inflated, but the outer side extremely and roundly inflated. Caudal portion comparatively small.

Various hairs regularly situated as in the other species of this group.

Phallus comparatively large, basal plate square, apodemes with 3 small conical protuberances. Dorsal plate Y-shaped. Middle portion of phallotheca partially sclerotized in 2 curved plates. Tubular portion of phallotheca long. Endosomal wall with *a*-sclerite, which is conspicuously sclerotized, but lacking *b*- and *c*-appendages.

#### 5. *Stephanitis esakii* Takeya, 1931

(Pl. 3-28, Pl. 7-28, Pl. 13-28)

Pygophore nearly as wide as long. Posterior rim narrowly distally protruded, moderately long, and the distal side fairly concave in middle. Distal portion of the sides gradually rounded. Proximal margin of dorsal wall gently excavated but the margin of ventral wall slightly rounded, and basal opening extremely narrow.

Parameres smoothly curved and nearly stream-lined. Inner-side of main portion slightly inflated, outer-side of the portion extremely inflated, and furnished with some very long hairs in a row. Distal part of dorsal surface with many fairly long hairs, but ventral surface evenly with many fine hairs. Caudal portion comparatively thick, slightly bent itself, and sharply pointed at apex.

Phallus small, basal plate simple, apodemes with 3 small protuberances. Dorsal plate semiannular and extended at middle. Middle portion of phallotheca partially sclerotized in 2 curved plates. Tubular portion of phallotheca slender, also partially sclerotized. Endosomal wall with 2 pairs of characteristic appendages—the proximal pair shaped like a sweet potato in outline, and sharply pointed at apex and strongly sclerotized just like a prickly shape. Near each base of the appendages attached a very minute sclerotized spot. The 2nd pair reddish, shaped like a potato, and situated in median portion of endosome. On endosomal diverticula observed some irregularly sclerotized spots.

#### 6. *Stephanitis typica* (Distant, 1903)

(Pl. 3-29, Pl. 7-29, Pl. 14-29)

Pygophore typically square but 4 corners slightly truncate equally, in dorsal view. Posterior rim shortly protruded and the distal side very wide and straight. Lateral margins also straight. Proximal margin of dorsal wall slightly concave, but the margin of ventral wall nearly straight but a little convex at middle.

Parameres thick, inner margin of main portion nearly straight, but outer-side of the portion strongly inflated in a triangular form in profile, caudal portion strongly curved at base. Various hairs regularly situated as in the other species of this group.

Phallus with a basal plate simple and thin. Dorsal plate semiannular and extremely extended at the middle. Middle portion of phallotheca partially sclerotized in 2 curved plates. Tubular portion of phallotheca long, also semitubularly sclerotized. The *a*-sclerite very small and dumbbell-shaped. Endosomal wall, corresponding to base of tubular portion, with 2 pairs of appendages, which are thought to be trans-

formed from *b*- and *c*-appendages. The inner pair, corresponding to the *b*-appendages, very long, armed with many slender, tiny denticles on the apical halves, and the outer pair, corresponding to the *c*-appendages, spindle-shaped in outline and deeply bifurcated, and projected obliquely sideways. Two endosomal diverticula within the large bulbous portion of phallotheca.

#### 7. *Stephanitis exigua* Horváth, 1912

(Pl. 3-30, Pl. 7-30, Pl. 14-30)

Pygophore small and nearly square. Posterior rim broadly but shortly and protruded and the distal side somewhat concave. Lateral margins slightly inflated at distal halves. Proximal margin of dorsal wall more or less excavated, but the margin of ventral wall smooth. Ventral surface with a large transparent window, which is pear-shaped in outline.

Parameres with inner side of main portion slightly inflated and outer side of the portion strongly inflated. Caudal portion comparatively short. Stiff or fine hairs regularly situated as in the other species of this group.

Phallus relatively large, basal plate thick and the arms extremely twisted. Dorsal plate semiannular and extremely extended at middle. Middle portion of phallotheca short, partially sclerotized in 2 small plates. Tubular portion of phallotheca comparatively long, also semitubularly sclerotized. Endosomal wall, occupied within the apical portion of phallotheca, semitubularly sclerotized and tapered distally.

Endosomal wall, corresponding to basal part of the apical portion of phallotheca, with *a*-sclerite and *b*-pair of appendages. The latter globose and armed with many tiny denticles, and closed to each other at base. The *c*-appendages very slender and arisen from the sides of endosoma, and with many tiny denticles.

#### 8. *Stephanitis aperta* Horváth, 1912

(Pl. 3-31-a, Pl. 4-31-b, Pl. 7-31, Pl. 14-31)

Pygophore nearly square. Posterior expansion short and both posterolateral corners smoothly rounded. Distal portion of lateral sides slightly inflated. Proximal margin of dorsal wall fairly excavated archedly, but the margin of ventral wall smoothly rounded. Ventral surface bearing a transparent window in the middle.

Parameres with inner margin of main portion approximately straight but little inflated at middle, and outer side of the portion strongly but roundly inflated. Caudal portion narrow. Stiff or fine hairs regularly situated as in the other species of this group.

Phallus with a basal plate simple. Dorsal plate semiannular and strongly extended at the middle. Middle portion of phallotheca short and partially sclerotized in 2 curved plates. Apical tubular portion of theca broad.

Endosomal wall, occupying within the tubular portion of theca, also sclerotized in 2 semitubular plates and tapered distally, and with *a*-sclerite and one pair of *b*-appendages. The former extremely stiffened in a large transverse plate, the latter somewhat elongated and bud-shaped, contiguous with each other and finely

denticled. The *c*-appendages very slender, originated from outer sides of the *b*-pair, distally reaching the level of ends of lateral arms of dorsal plate, and armed with denticles.

#### 9. *Stephanitis fasciicarina* Takeya, 1931

(Pl. 4-32, Pl. 7-32, Pl. 14-32)

Pygophore small, nearly square. Posterior rim broadly but shortly protruded and the distal side nearly straight. Sides nearly straight but slightly concave at the middle. Proximal margin of dorsal wall fairly excavated archedly, but the margin of ventral wall smooth.

Parameres generally stream-lined. Inner margin of main portion nearly straight and furnished with many slender hairs, outer side of the portion extremely, roundly inflated and with several long hairs. Caudal portion narrow and with several fine hairs on the inner margin.

Phallus with a basal plate thin. Dorsal plate relatively thick and semiannular, and extended at middle. Middle portion of phallotheca partially sclerotized in 2 small plates. Tubular portion long, also sclerotized in 2 curved plates. Endosomal wall, occupying within the tubular portion, with *a*-sclerite and *b*-appendages. The former distinctly sclerotized in 2 conspicuous plates but partially continuous to each other at the median line, and the latter very small, bud-shaped, and armed with several tiny denticles. The *c*-appendages slender, armed with many tiny denticles, with the apices extending to the level of the ends of lateral arms of dorsal plate.

#### 10. *Stephanitis veridica* Drake, 1948

(Pl. 4-33, Pl. 7-33, Pl. 14-33)

Pygophore nearly square in dorsal view and as wide as long. Distal halves of lateral sides fairly inflated. Posterior expansion very short, posterolateral corners smoothly rounded, and a little concave at the middle of the margin.

Proximal margin of dorsal wall moderately excavated, but the margin of ventral wall roundly protruded. Ventral surface with a transparent window, which is shaped like a lemon-fruit in outline. Both posterolateral areas of the ventral surface furnished with many fine hairs, but the other areas bald.

Parameres large, inner side of main portion gently inflated and furnished with many long, stout bristles, and outer side of the portion strongly inflated but tapered towards apex, and with long bristles. Dorsal surface of the main portion with several long hairs on apical area, the ventral surface except outer side, with many fine hairs, and the caudal portion comparatively short and with fine hairs on the inner side.

Phallus with a basal plate simple. Dorsal plate thick, and nearly V-shaped. Tubular portion of phallotheca semitubularly sclerotized. Within the tubular portion of theca, endosomal wall semitubularly sclerotized. Endosomal wall with *a*-sclerite and one pair of appendages at the base of the tubular portion. The former small and transverse, but the latter long, globular and curved, and with many tiny denticles on keeled portions.

11. *Stephanitis svensoni* Drake, 1948

(Pl. 4-34, Pl. 8-35, Pl. 15-34)

Pygophore somewhat wider than long. Posterior expansion very short and its distal side smoothly concave at the middle, and furnished with fine hairs on middle point only. Distal halves of the sides extremely inflated. Proximal margin of dorsal wall strongly excavated triangularly, but the margin of ventral wall gently protruded and slightly sinuate.

Parameres large with the shape and hairs similar to those of *S. veridica*, but the size distinctly larger than the latter.

Phallus small, basal plate thin and distal arms strongly twisted. Dorsal plate semiannular and the middle portion very broad and nearly U-shaped. Middle portion of phallotheca partially sclerotized in 2 curved plates. Tubular portion of theca long. Endosomal wall, occupying in tubular and middle portions, with *a*-sclerite, *b*- and *c*-appendages. The *b*-appendages large, globose and armed with tiny denticles and shaped like a strawberry. The *c*-appendages long, curved, and divided into 2 parts—the basal stalk portion strongly sclerotized and curved so as to surround *b*-appendages and the distal flap portion also bent, projected obliquely sideways and armed with tiny denticles.

12. *Stephanitis pyrioides* (Scott, 1874)

(Pl. 4-35, Pl. 7-34, Pl. 15-35)

Pygophore small. Distal margin somewhat concave at the middle. Sides posteriorly, gently inflated. Proximal margin of dorsal wall strongly excavated triangularly, but the margin of ventral wall strongly protruded triangularly, and the basal opening rhombic in dorsal view and with a narrow membranous collar.

Parameres nearly, rectangularly curved. Inner margin of main portion nearly straight, but a little inflated at the middle. Caudal portion comparatively short, inner margin finely sinuated at the basal part, and the apex sharply curved and pointed as a minute hook. Stiff or fine hairs regulary situated as in the other species of this group.

Phallus with a basal plate simple. Dorsal plate semiannular and extremely extended at the middle. Middle portion of phallotheca partially sclerotized in 2 curved plates. Tubular portion of theca slightly sclerotized. Endosomal wall, occupying with in tubular and middle portions, with *a*-sclerite and 2 pairs of appendages. The *a*-sclerite simple, but the latter 2 pairs armed with tiny denticles. The *b*-pair globose but the outer appendages very large, shaped like a brush, and arisen from the sides.

13. *Stephanitis yasumatsui* Takeya, 1951

(Pl. 4-36, Pl. 8-36, Pl. 15-36)

Pygophore nearly as wide as long. Posterior expansion very short and the posterior side straight and wide. Sides extremely inflated at the distal halves. Prox-

imal margin of dorsal wall gently excavated, but the margin of ventral wall extremely protruded.

Parameres apparently distinguishable into 3 portions, especially caudal portion short and narrow. Stiff or fine hairs regularly situated as in the other species of this group.

Phallus with a basal plate thick and lateral arms twisted. Dorsal plate semianular, strongly extended at the middle and nearly V-shaped. Middle portion of phallosome short and partially sclerotized in 2 curved plates. Tubular portion of phallosome semitubularly sclerotized. Within the tubular portion occupied endosomal vesica, which is tapered towards phallosomal mouth and ampullaceous. The *a*-sclerite conspicuous, *b*-appendages very small and armed with very minute conical prickles, *c*-appendages comparatively large and shaped like a keel petal of the papilionaceous flower of garden pea, with a rounded margin finely serrated and with the stalk portion not so sclerotized as in *S. takeyai* group. Endosomal diverticula large and ejaculatory duct extremely thick.

#### 14. *Stephanitis miyamotoi* Takeya, 1963

(Pl. 4-37, Pl. 8-37, Pl. 15-37)

Pygophore nearly square in outline, slightly longer than wide. Posterior expansion short, and the distal side slightly concave at the middle. Distal portion of lateral sides gently inflated. Proximal margin of dorsal wall strongly excavated, but the margin of ventral wall gently protruded in an obtuse triangle.

Parameres large, divided into 3 portions. Inner side of the main portion smoothly inflated and furnished with several long and extremely stiff bristles and some short bristles, and outer side of the portion very much inflated and with several long hairs, which are slender than those on the inner side, dorsal surface with several long bristles on the apical area, but ventral surface evenly with many fine hairs. Caudal portion strongly bent from the main portion, but slightly curved and with fine hairs on the inner side in 2 rows.

Phallus thin, basal plate transverse. Dorsal plate semiannular and well extended at the middle and nearly V-shaped. Middle portion of phallosome partially sclerotized in 2 semitubular plates. Tubular portion of phallosome long, and distally tapered and ampullaceous. Endosomal wall, within tubular portion of phallosome with the *a*-sclerite, *b*- and *c*-appendages. The *a*-sclerite small, *b*-appendages globose and elongated, shaped like a long bud, and armed with tiny denticles. The *c*-appendages somewhat large, with the basal portion archedly curved so as to surround the middle pair, with the distal lobe projected obliquely sideward, external keel portion distinctly sclerotized but with the inner margin finely serrated. The above description is based on a teneral specimen.

#### 15. *Stephanitis watanabei* Takeya, 1963

(Pl. 4-38, Pl. 8-38, Pl. 15-38)

Pygophore nearly as wide as long. Posterior expansion short and the distal side smoothly concave at the middle. Distal halves of lateral sides well inflated. Prox-

imal margin of dorsal wall archedly excavated, but that of ventral wall broadly protruded.

Parameres similar to those of *S. miyamotoi*, with various hairs also regularly situated as in the other species of this group.

Phallus also similar to that of *S. miyamotoi*, but the sclerotized structures generally thicker than those of the latter, and different in more thickened and larger *b*- and *c*-appendages.

#### 16. *Stephanitis oberti* (Kolenati, 1856)

(Pl. 4-39, Pl. 8-39, Pl. 16-39)

Pygophore, parameres and phallus much the same as those of *S. watanabei*, and with some resemblance to *S. miyamotoi*. But the parameres more thickened, distal lobes of *c*-appendages narrower than the latter species and overlapped with each other at the middle, and the shapes of *b*- and *c*-appendages a little differed from *S. miyamotoi*.

It is supposed that this species is more closely allied to *S. watanabei* than to *S. miyamotoi*.

#### 17. *Stephanitis takeyai* Drake et Maa, 1953

(Pl. 4-40, Pl. 8-40, Pl. 16-40)

Pygophore slightly longer than wide. Structures of pygophore similar to those of *S. oberti*, but generally larger than in the latter species.

Parameres unique, stalk portion very small, main portion extremely stout and thick, inner margin of main portion well inflated and furnished with long setaceous bristles, the outer margin strongly protruded and sinuated in a mountain form, and with several long hairs. Caudal portion shaped like a process, and with several fine hairs on the inner margin.

Phallus with a basal plate, dorsal plate and middle and tubular portions of phallosome similar to those of *S. oberti*. The *a*-sclerite simple, but *b*- and *c*-appendages distinct, *b*-pair globose, armed with tiny denticles, of a strawberry type. The *c*-pair large, with a basal stalk portion extremely sclerotized and curved so as to surround the former pair and with the distal lobe projected obliquely sideward and finely serrated at outer edge.

#### 18. *Stephanitis hasegawai* Takaya, 1963

(Pl. 4-41, Pl. 8-41, Pl. 16-41)

Pygophore nearly as wide as long. Posterior expansion short and the distal side almost straight but a little bent at the middle. Distal and proximal margins of dorsal wall strongly excavated triangularly, but proximal margin of ventral wall gently protruded in a triangular projection. Ventral surface with a transparent window.

Parameres with the inner side of main portion gently inflated, outer side of the

portion extremely inflated and the margin slightly sinuated. Stiff or fine hairs regularly situated as in the other species of this group.

Phallus comparatively small, basal plate simple, dorsal plate V-shaped. Middle and tubular portions of phallothecae slightly sclerotized.

Endosomal wall with *a*-sclerite and *b*- and *c*-appendages, *b*-pair comparatively small and armed with tiny denticles, but *c*-pair large, well sclerotized on basal stalk portion and curved so as to surround the *b*-pair, distal lobe curved, projected obliquely sideways and overlapped that of the opposite side at the middle, and outer margin of the lobes finely wrinkled.

#### 19. *Stephanitis hikosana* Drake, 1948

(Pl. 5-42, Pl. 8-42, Pl. 16-42)

Pygophore as wide as long. Posterior expansion very short but wide and the distal side nearly straight. The other structure of pygophore similar to those of *S. hasegawai*.

Parameres also similar to those of *S. hasegawai*, but slightly larger, and outer margin of main portion partially straight.

Phallus with a basal plate simple, dorsal plate of phallotheca, thick and Y-shaped. Endosomal wall, occupying within tubular portion of phallotheca, sclerotized semitubularly and the sclerotized part tapered towards phallothecal mouth. Endosomal wall at the base of semitubular sclerotization with *a*-sclerite and *b*- and *c*-appendages. *b*-pair comparatively small, shaped like a bud and armed with many tiny denticles, and *c*-pair large, basal stalk portion small, and distal flap portion broad and finely serrated along the outer rounded margin.

#### 20. *Stephanitis drakei* Takeya, 1963

(Pl. 5-43, Pl. 8-43, Pl. 16-43)

Pygophore large, posterior expansion short but wide, and the distal side slightly and smoothly bent. Sides strongly inflated distally. Proximal margin of dorsal wall triangularly excavated, but proximal margin of ventral wall strongly protruded into a triangular projection, and so proximal opening of pygophore rhombic in dorsal view.

Parameres generally resembled those of *S. hikosana* but apparently larger.

Phallus moderately developed, basal plate stout but simple. Dorsal plate of phallotheca thick and semiannular but middle portion extended basally. Middle portion of phallotheca partially sclerotized in 2 curved plates, tubular portion of phallotheca long, tapered distally and sclerotized semitubularly. Within the tubular portion of theca endosomal wall fairly sclerotized in 2 slender plates, and the wall near proximal ends of the slender plates with *a*-sclerite. The *b*-appendages small but elongate and armed with fine denticles, and *c*-appendages simple, with a proximal stalk short, curved and surrounding the former *b*-pair, and distal flap portion also small, tapered apically, projected obliquely laterally and slightly wrinkled along the rounded margins.



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## IX. Explanation of Plates

## Plate 1. Pygophores (1-11)

1. *Cantacader lethierryi*  
a: dorsal view. b: caudal view.
2. *Agramma nexilis*
3. *Dictyla formosa*
4. *Acalypta sauteri*  
a: dorsal view. b: ventral view.  
c: lateral view.
5. *Derephysia foliacea*  
a: dorsal view. b: ventral view.
6. *Baeochila occasa*
7. *Eteoneus yasumatsui*
8. *Copium japonicum*
9. *Leptoypha wuorentausi*
10. *Leptoypha capitata*  
a: dorsal view in dried state. b:  
dorsal view in alcohol. c: ventral  
view in dried state. d: ventral view  
in alcohol.
11. *Idiocysta* sp.  
a: dorsal view in dried state. b:  
ventral view in dried state. c:  
dorsal view in alcohol.

## Plate 2. Pygophores (12-19)

12. *Cochlochila lewisi*
13. *Galeatus spinifrons*  
a: dorsal view. b: ventral view.
14. *Uhlerites debile*  
a: dorsal view. b: caudal view.
15. *Uhlerites latius*
16. *Tingis (Tingis) populi*
17. *Tingis (Tingis) ampliata*  
a, b, d: dorsal view. b, c: in dried  
states. c: ventral view.
18. *Tingis (Tingis) comosa*  
a: dorsal view. b: ventral view.
19. *Physatocheila orientis*  
a: dorsal view. b: ventral view.

## Plate 3. Pygophores (20-31a)

20. *Cysteocheila vota*
21. *Cysteocheila salicorum*
22. *Cysteocheila consueta*  
a: dorsal view. b: distal view.

23. *Cysteocheila feberi*  
a: dorsal view. b: ventral view.
24. *Stephanitis nashi nashi*  
a: dorsal view. b: ventral view.
25. *Stephanitis nashi suigensis*  
a: dorsal view. b: ventral view.
26. *Stephanitis ambigua*
27. *Stephanitis subfasciata*
28. *Stephanitis esakii*  
a: dorsal view. b & c: dried state.  
c: ventral view.
29. *Stephanitis typica*
30. *Stephanitis exigua*  
a: dorsal view. b: ventral view.
- 31a. *Stephanitis aperta*  
a: dorsal view.

## Plate 4. Pygophores (31b-41)

- 31b. *Stephanitis aperta*  
b: ventral view.
32. *Stephanitis fasciatarina*
33. *Stephanitis veridica*  
a, c: dorsal view. b, d: ventral  
view. a, b: dried state. c, d: in al-  
cohol.
34. *Stephanitis svensoni*
35. *Stephanitis pyrioides*
36. *Stephanitis yasumatsui*  
a: dried state. b: in alcohol.
37. *Stephanitis miyamotoi*
38. *Stephanitis watanabei*
39. *Stephanitis oberti*
40. *Stephanitis takeyai*
41. *Stephanitis hasegawai*  
a: dorsal view. b: ventral view.

Plate 5. Pygophores (42, 43) and Para-  
meres (1-12)

42. *Stephanitis hikosana*  
a: dorsal view. b: ventral view.
43. *Stephanitis drakei*  
a, b: dorsal view. b, c: dried state.  
c: ventral view.

## Parameres (1-15)

- a: dorsal view. b: ventral view.

1. *Cantacader lethierryi*
2. *Agramma nexilis*
3. *Dictyla formosa*
4. *Acalypta sauteri*
5. *Derephysia foliacea*
6. *Baeochila occasa*
7. *Eteoneus yasumatsui*
8. *Copium japonicum*
9. *Leptoypha wuorentausi*
10. *Leptoypha capitata*
11. *Idiocysta* sp.
12. *Cochlochila lewisi*

Plate 6. Parameres (13-25)

13. *Galeatus spinifrons*
14. *Uhlerites debile*
15. *Uhlerites latius*
16. *Tingis (Tingis) populi*
17. *Tingis (Tingis) ampliata*
18. *Tingis (Tingis) comosa*
19. *Physatocheila orientis*
20. *Cysteocheila vota*
21. *Cysteocheila salicorum*
22. *Cysteocheila consueta*
23. *Cysteocheila fieberi*
24. *Stephanitis nashi nashi*
25. *Stephanitis nashi suigensis*

Plate 7. Parameres (26-34)

26. *Stephanitis ambigua*
27. *Stephanitis subfasciata*
28. *Stephanitis esakii*
29. *Stephanitis typica*
30. *Stephanitis exigua*
31. *Stephanitis aperta*
32. *Stephanitis fasciicarina*
33. *Stephanitis veridica*
34. *Stephanitis pyrioides*

Plate 8. Parameres (35-43)

35. *Stephanitis svensoni*
36. *Stephanitis yasumatsui*
37. *Stephanitis miyamotoi*
38. *Stephanitis watanabei*
39. *Stephanitis oberti*
40. *Stephanitis takeyai*
41. *Stephanitis hasegawai*
42. *Stephanitis hikosana*

43. *Stephanitis drakei*

Plate 9. Phalli (1-6)

1. *Cantacader lethierryi*
2. *Agramma nexilis*
3. *Dictyla formosa*
4. *Acalypta sauteri*
5. *Derephysia foliacea*
6. *Baeochila occasa*

Plate 10. Phalli (7-12)

7. *Eteoneus yasumatsui*
8. *Copium japonicum*
9. *Leptoypha wuorentausi*
10. *Leptoypha capitata*
11. *Idiocysta* sp.
12. *Cochlochila lewisi*

Plate 11. Phalli (13-17)

13. *Galeatus spinifrons*
14. *Uhlerites debile*
15. *Uhlerites latius*
16. *Tingis (Tingis) ampliata*
17. *Tingis (Tingis) comosa*

Plate 12. Phalli (18-22)

18. *Physatocheila orientis*
19. *Cysteocheila vota*
20. *Cysteocheila salicorum*
21. *Cysteocheila consueta*
22. *Cysteocheila fieberi*

Plate 13. Phalli (23-28)

23. *Tingis (Tingis) populi*
24. *Stephanitis nashi nashi*
25. *Stephanitis nashi suigensis*
26. *Stephanitis ambigua*
27. *Stephanitis subfasciata*
28. *Stephanitis esakii*

Plate 14. Phalli (29-33)

29. *Stephanitis typica*
30. *Stephanitis exigua*
31. *Stephanitis aperta*
32. *Stephanitis fasciicarina*
33. *Stephanitis veridica*

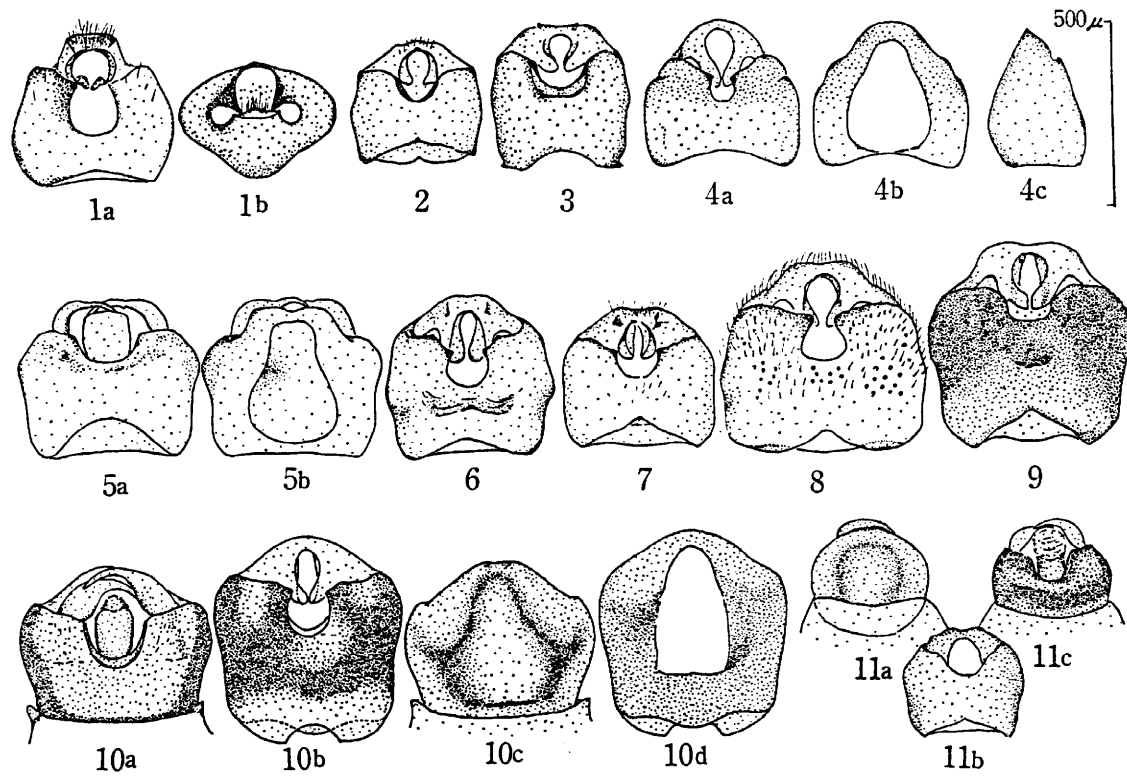
Plate 15. Phalli (34-38)

34. *Stephanitis svensoni*

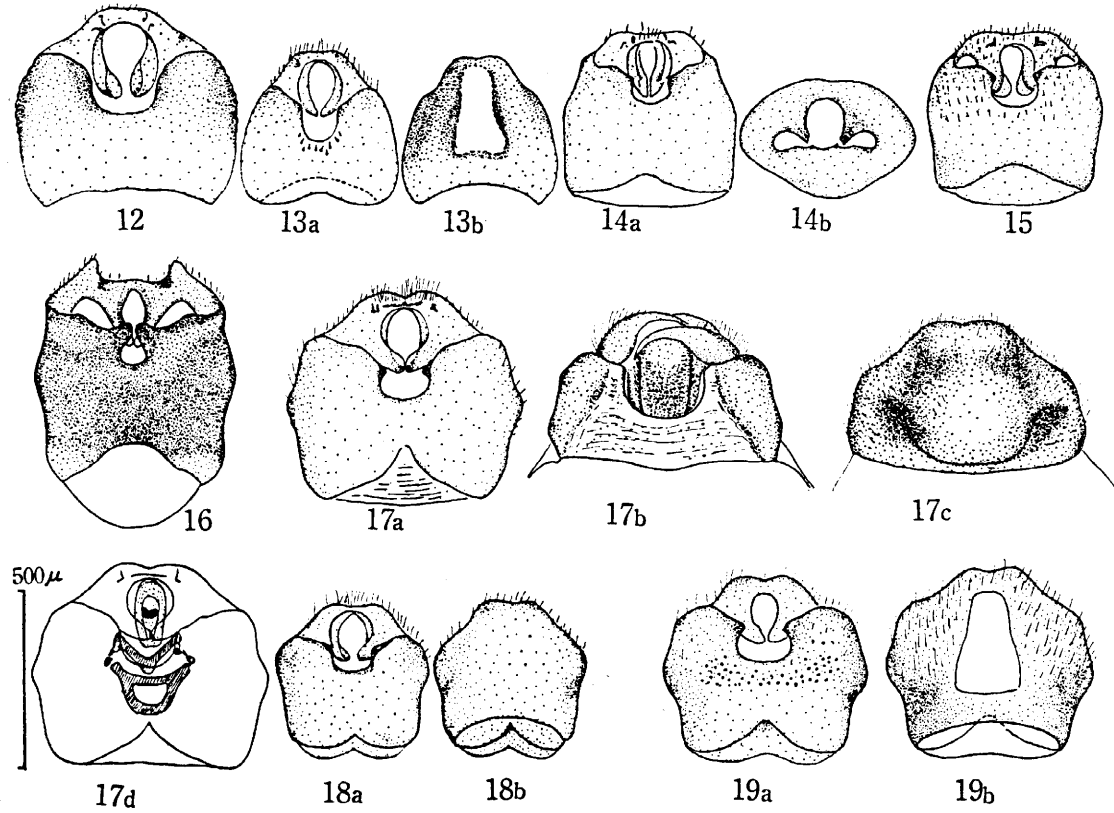
- 35. *Stephanitis pyrioides*
- 36. *Stephanitis yasumatsui*
- 37. *Stephanitis miyamotoi*
- 38. *Stephanitis watanabei*

Plate 16. Phalli (39-43)

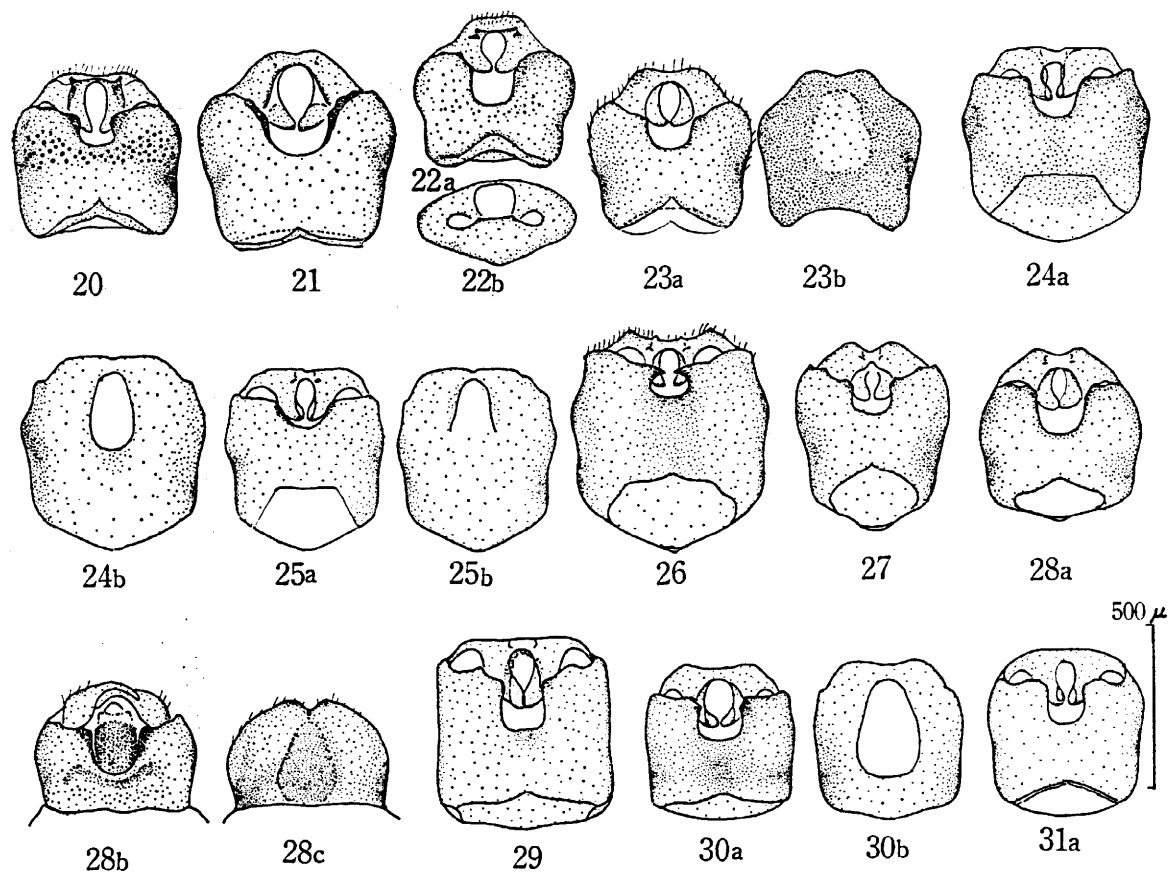
- 39. *Stephanitis oberti*
- 40. *Stephanitis takeyai*
- 41. *Stephanitis hasegawai*
- 42. *Stephanitis hikosana*
- 43. *Stephanitis drakei*



Male genitalia of the East Asiatic Tingidae

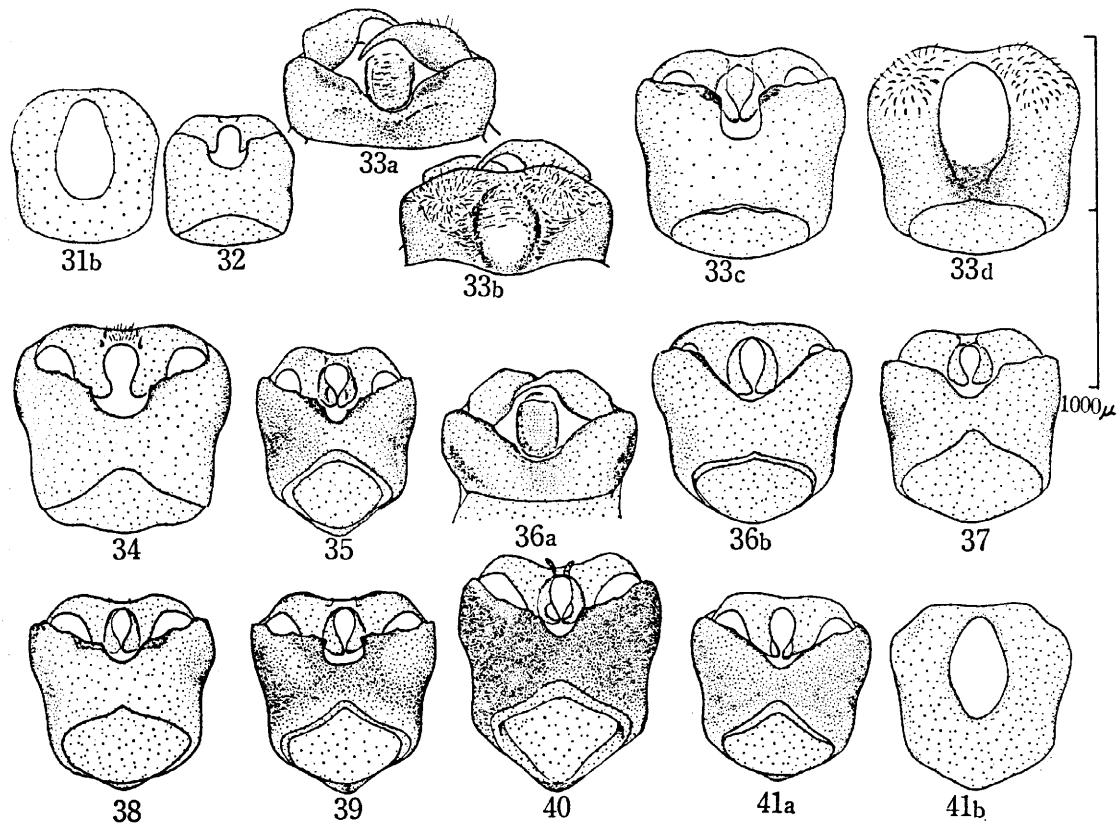


Male genitalia of the East Asiatic Tingidae

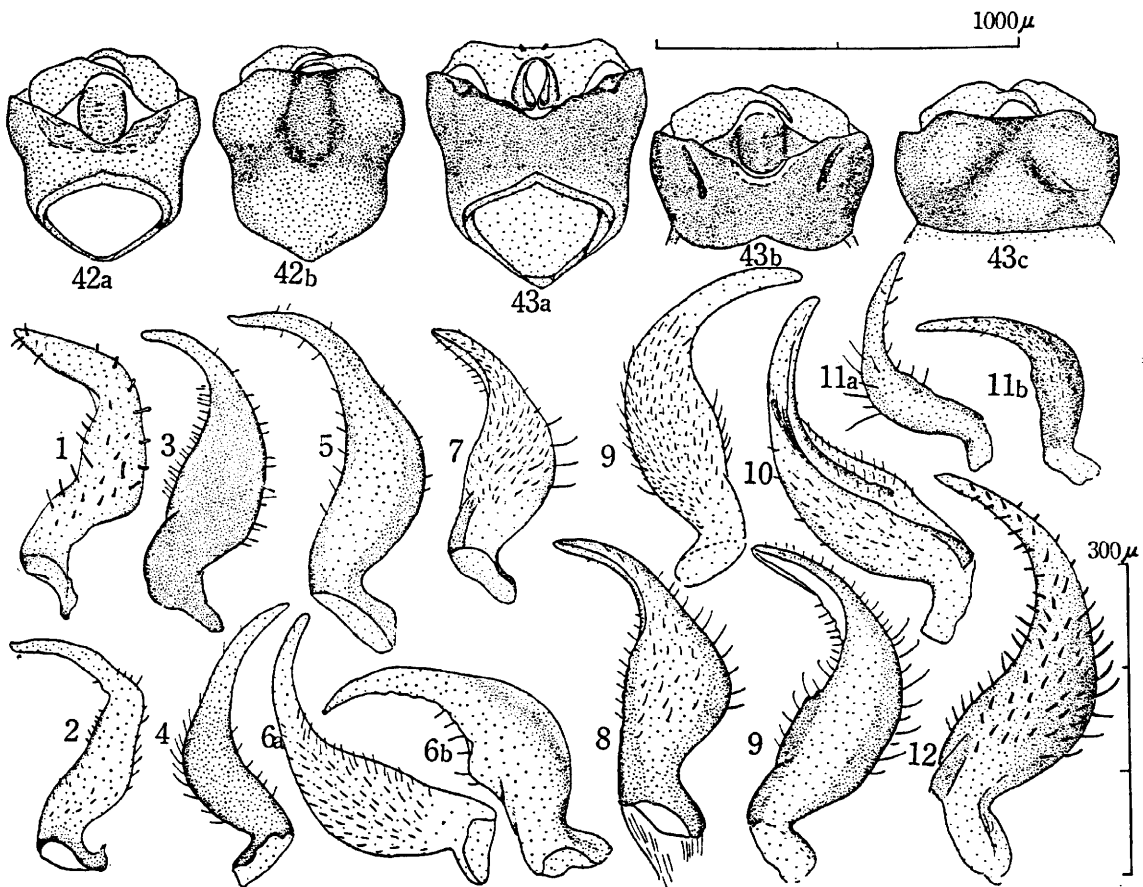


Male genitalia of the East Asiatic Tingidae

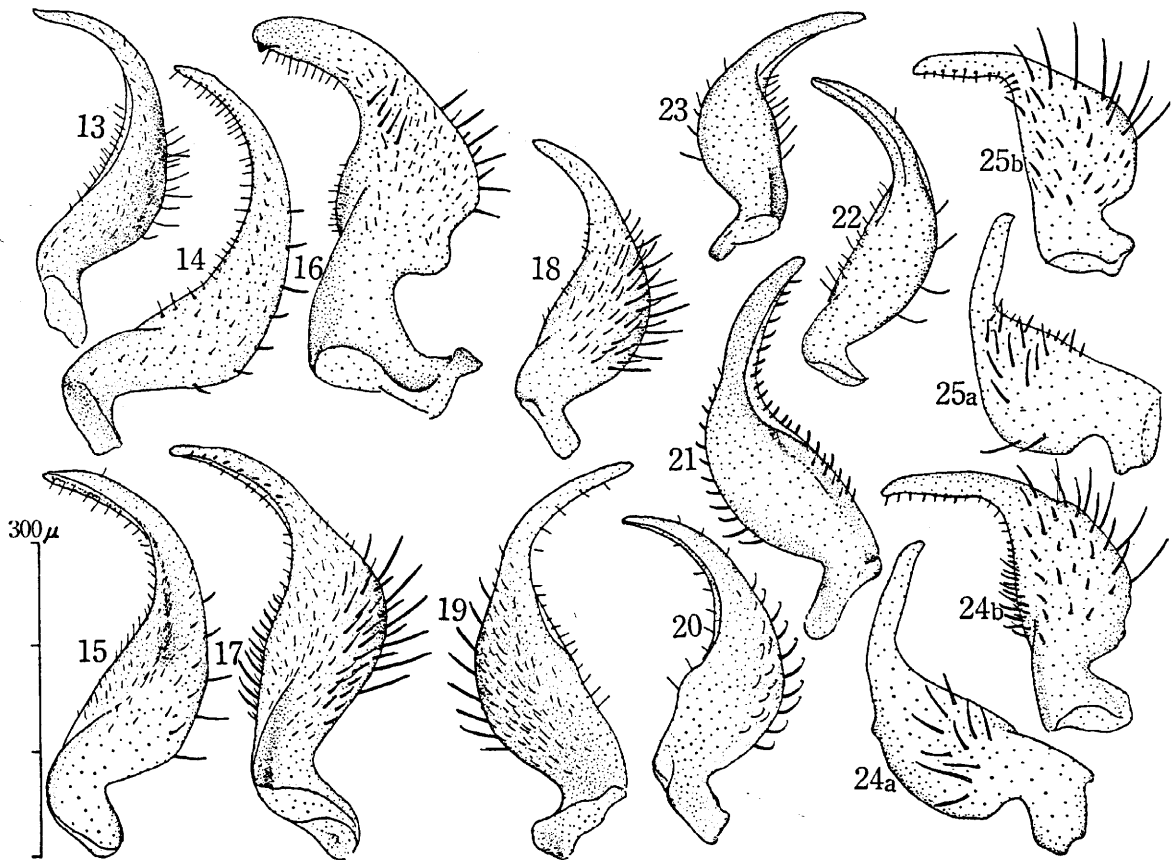




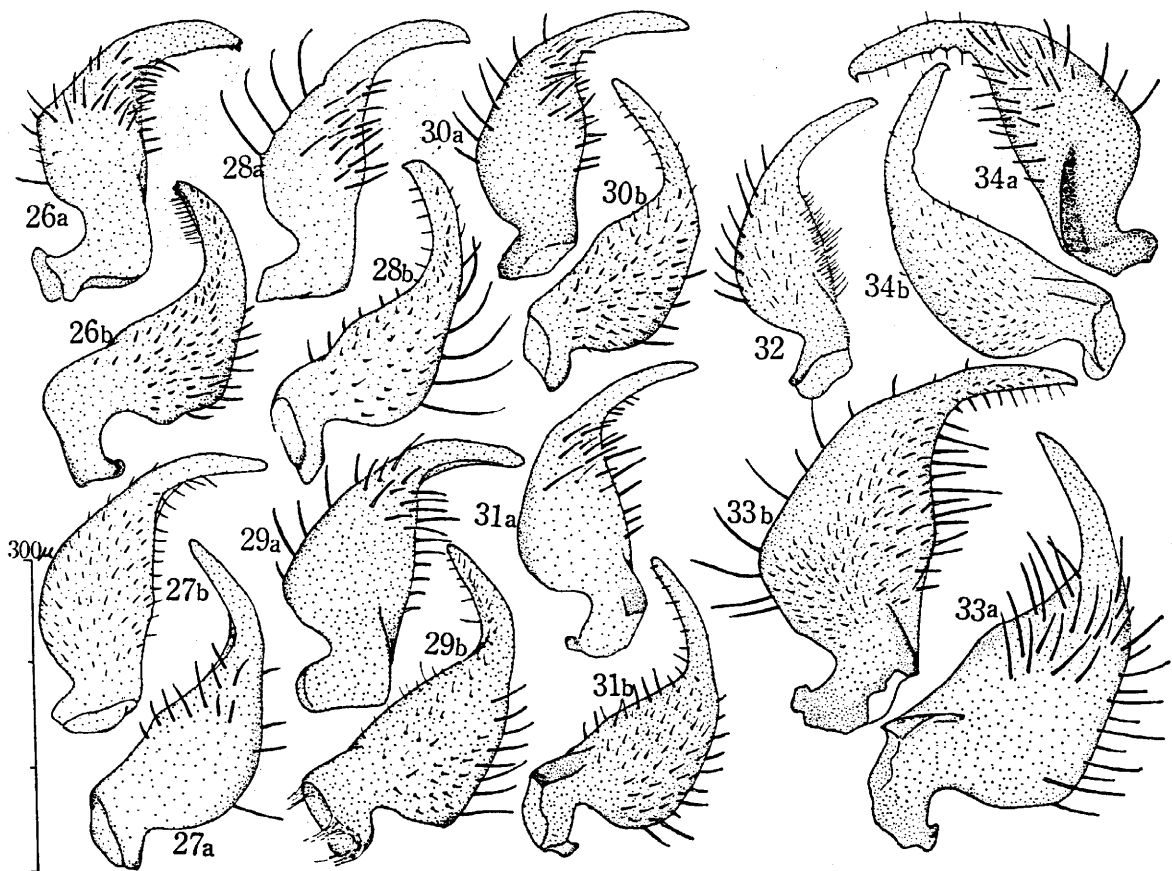
Male genitalia of the East Asiatic Tingidae



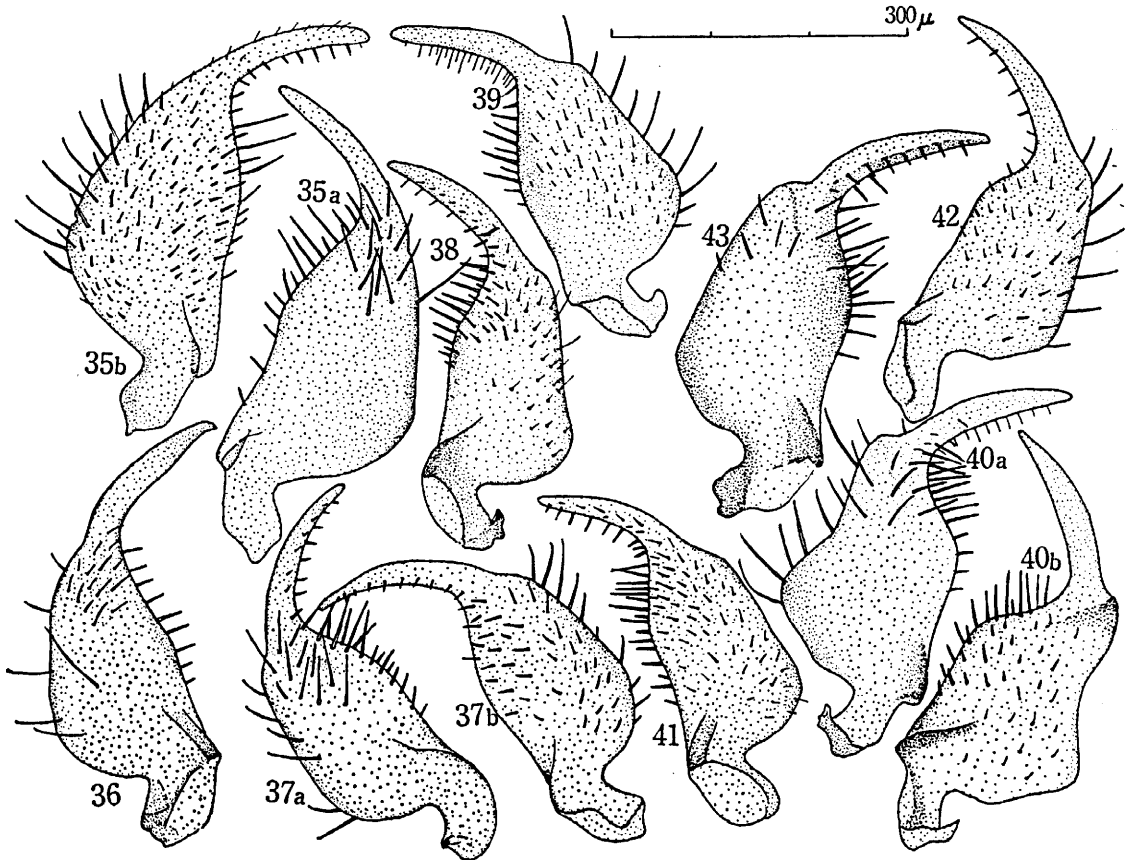
Male genitalia of the East Asiatic Tingidae



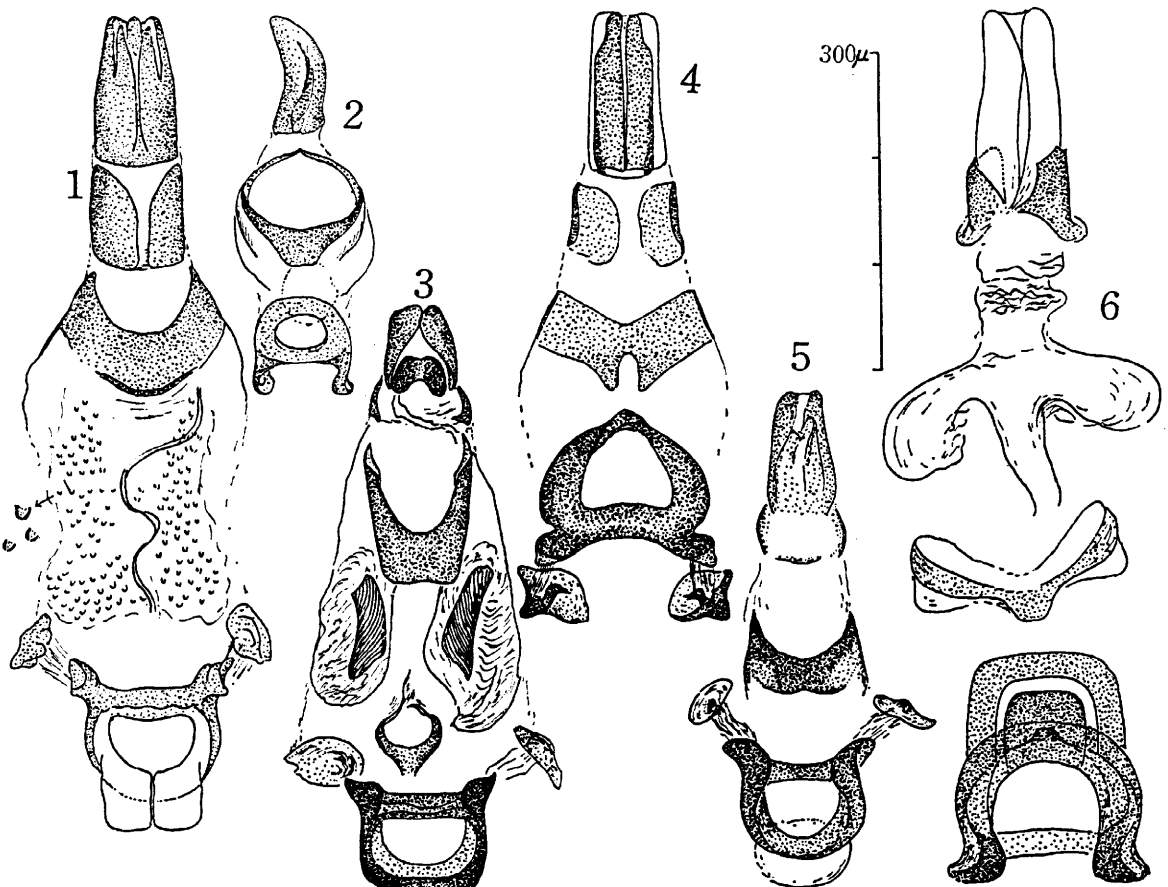
Male genitalia of the East Asiatic Tingidae



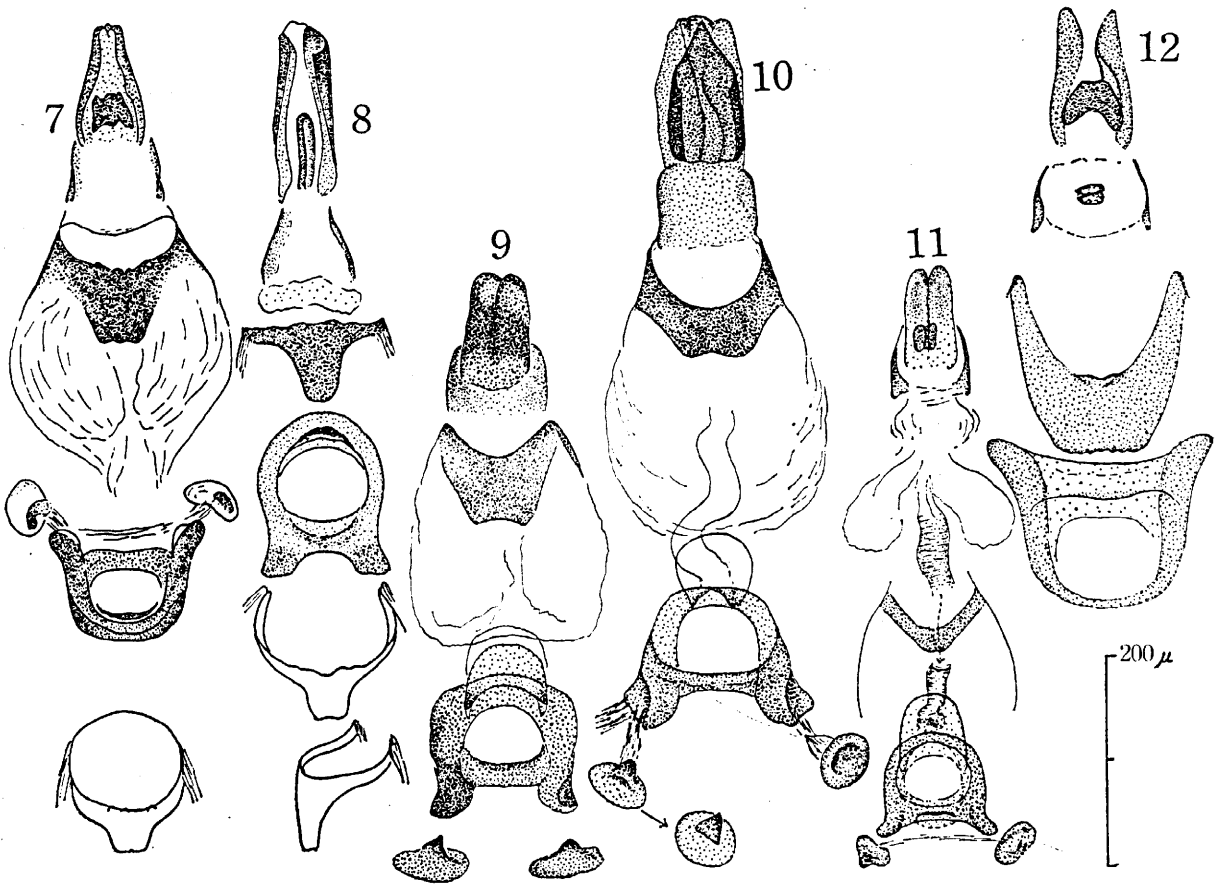
Male genitalia of the East Asiatic Tingidae



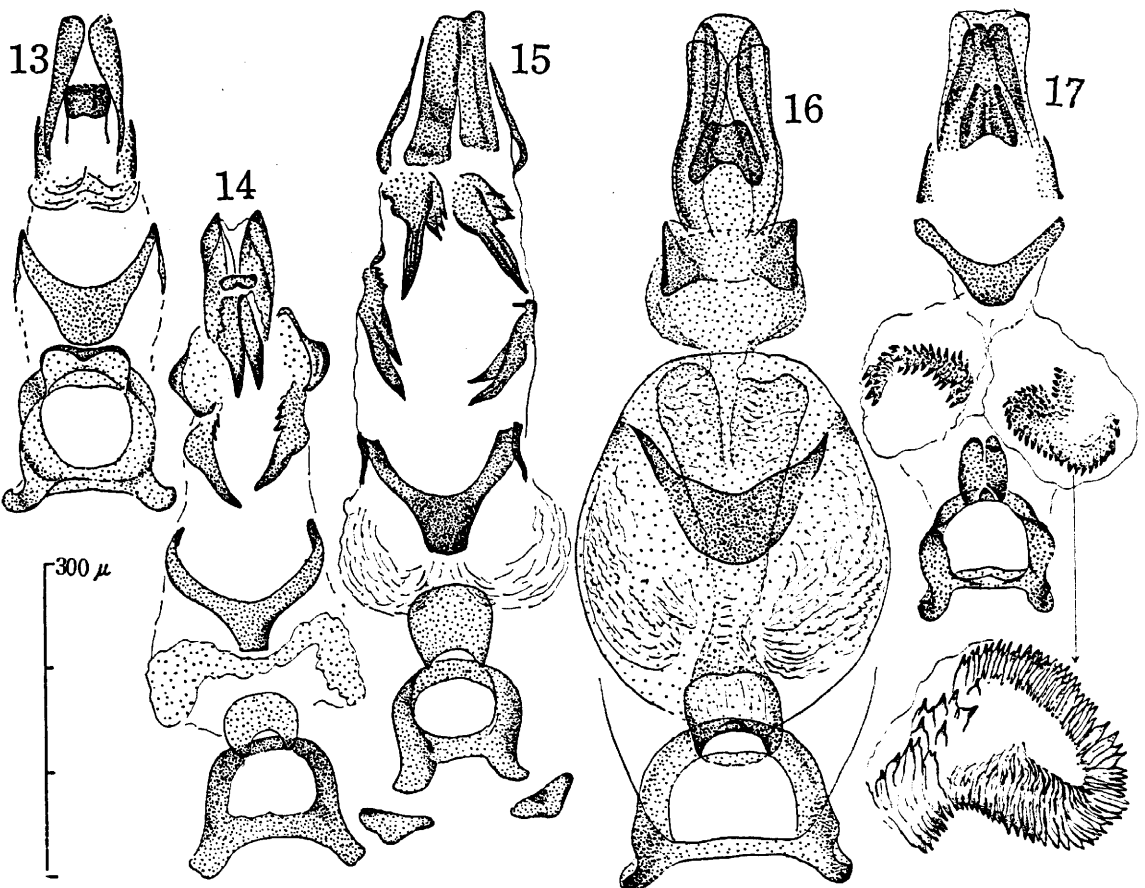
Male genitalia of the East Asiatic Tingidae



Male genitalia of the East Asiatic Tingidae

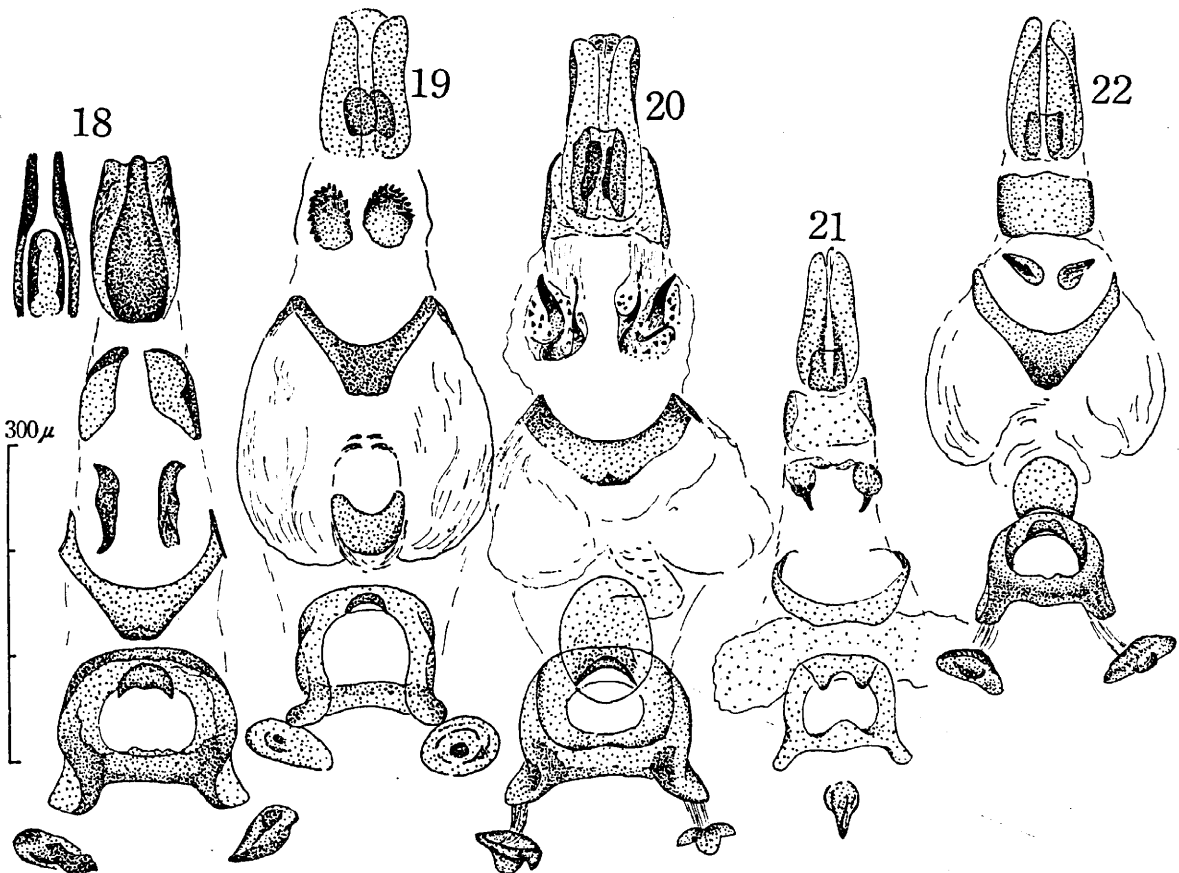


Male genitalia of the East Asiatic Tingidae

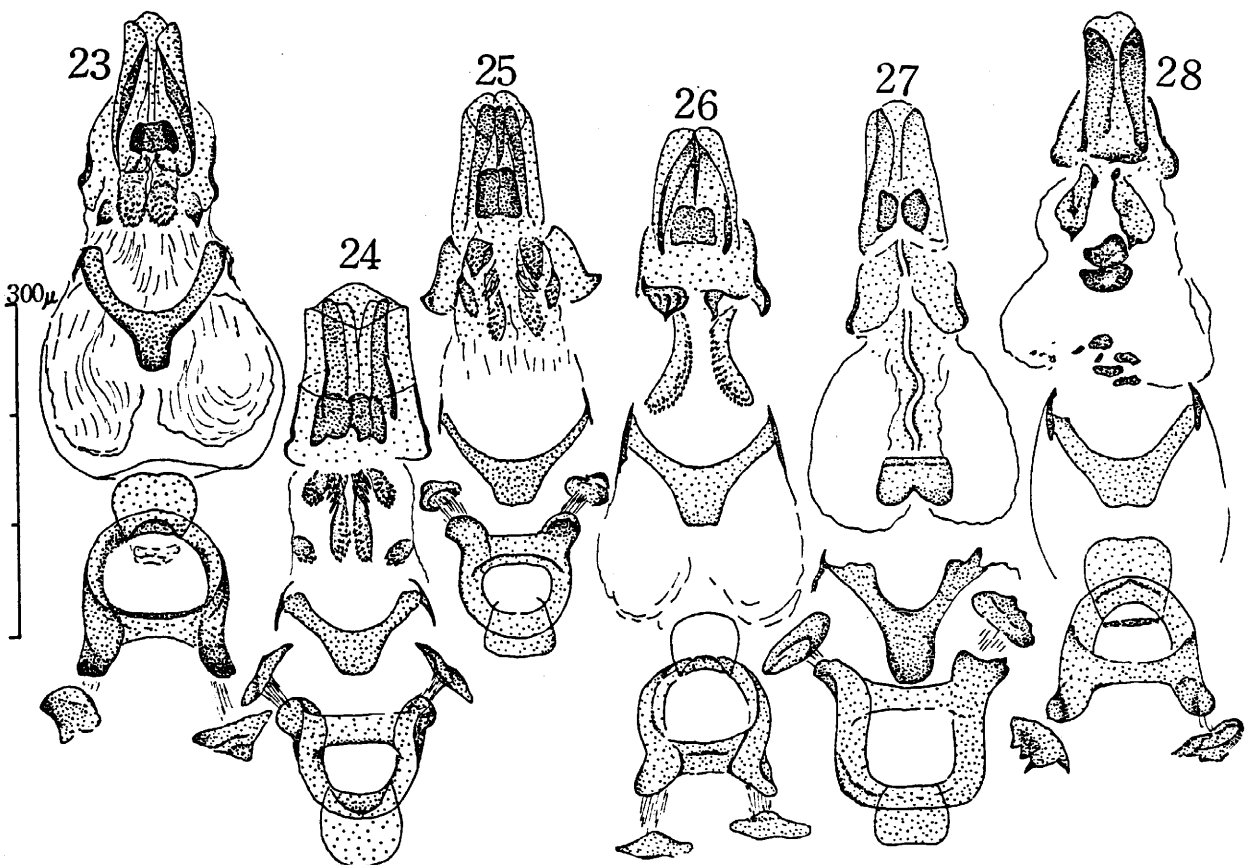


Male genitalia of the East Asiatic Tingidae

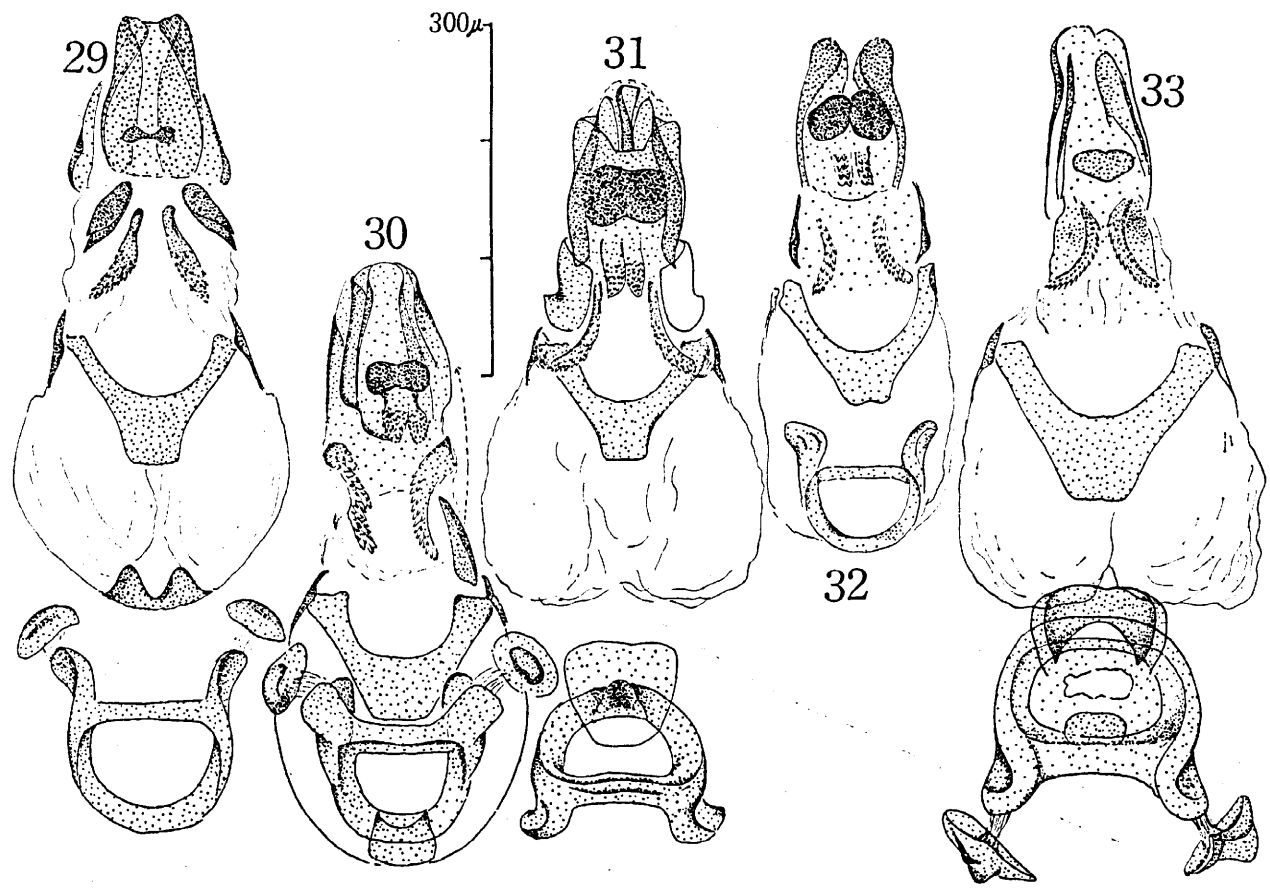




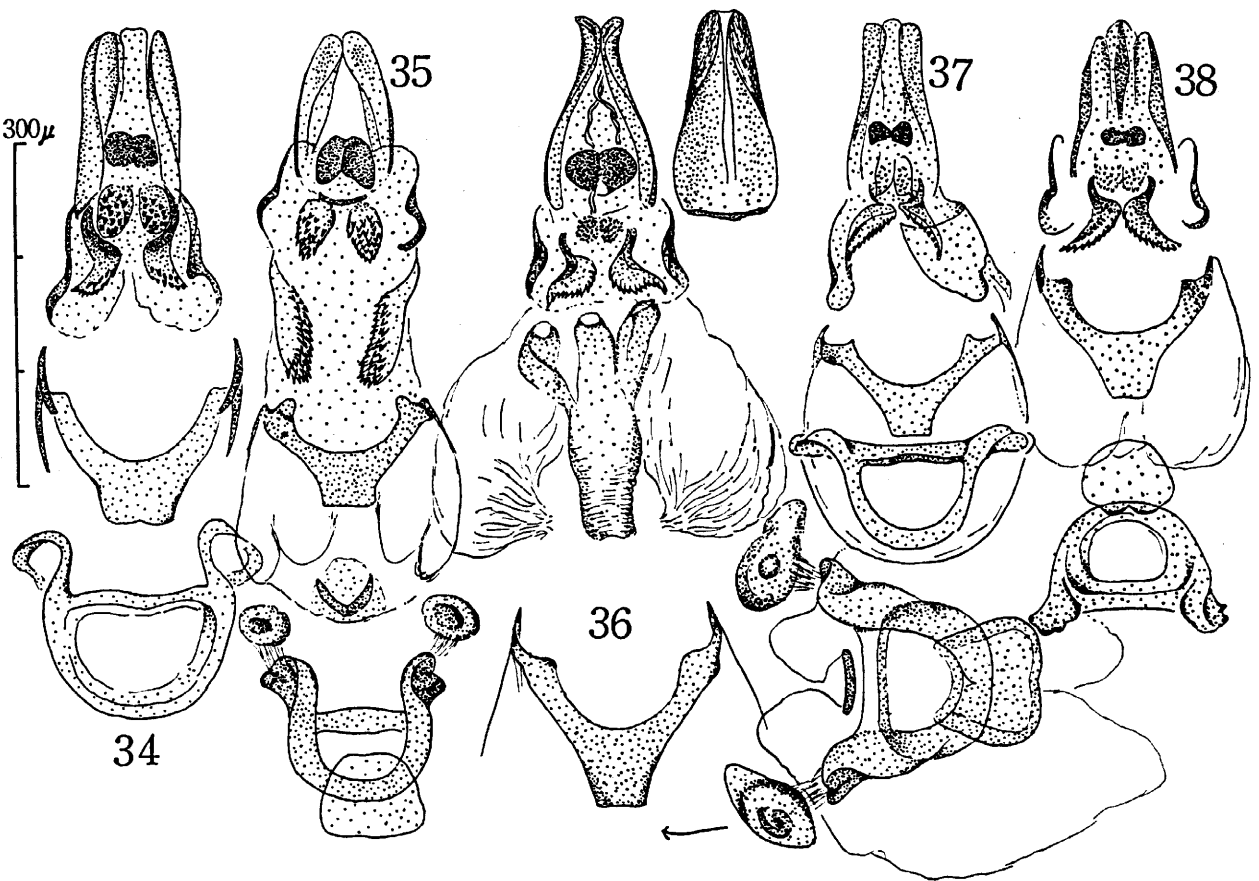
Male genitalia of the East Asiatic Tingidae



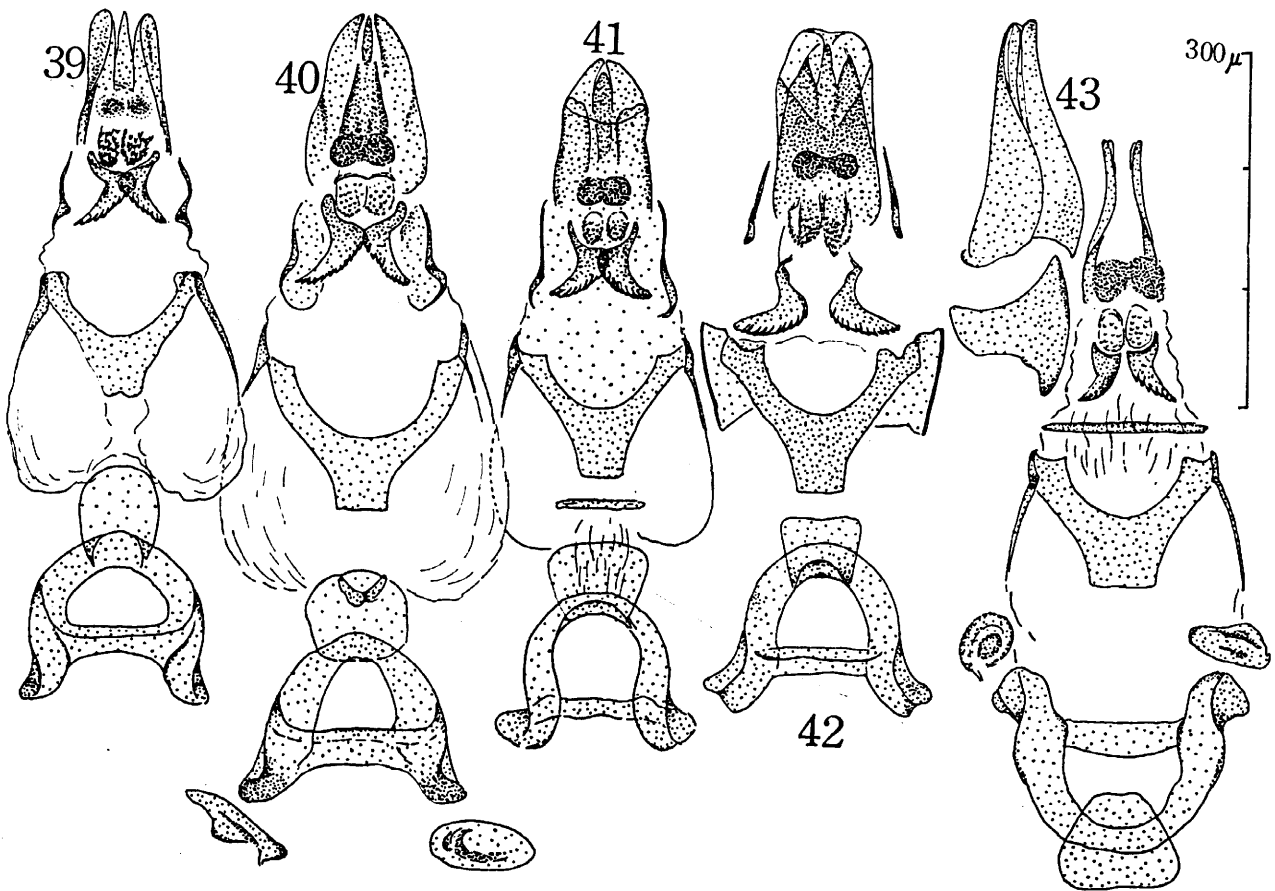
Male genitalia of the East Asiatic Tingidae



Male genitalia of the East Asiatic Tingidae



Male genitalia of the East Asiatic Tingidae



Male genitalia of the East Asiatic Tingidae