



Title	NOTES ON THE BEESONIIDAE (HOMOPTERA : COCCOIDEA)
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Citation	Insecta matsumurana. New series : journal of the Faculty of Agriculture Hokkaido University, series entomology, 37, 27-41
Issue Date	1987-10
Doc URL	http://hdl.handle.net/2115/9840
Type	bulletin (article)
File Information	37_p27-41.pdf



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NOTES ON THE BEESONIIDAE
(HOMOPTERA : COCCOIDEA)

By SADAŌ TAKAGI

Research Trips for Agricultural and Forest Insects in the Subcontinent of India [Grants-in-Aid for Overseas Scientific Survey, Ministry of Education, Japanese Government, 1983, No. 58041001 ; 1984, No. 59043001], Scientific Report No. 28.

Scientific Results of the Hokkaidō University Expeditions to the Himalaya.

Abstract

TAKAGI, S. 1987. Notes on the Beesoniidae (Homoptera : Coccoidea). *Ins. matsum. n. s.* 37 : 27-41, 7 figs. (7 pls.).

Three species of the Beesoniidae occurring on fagaceous plants are treated. *Beesonia quercicola* and *B. albohirta*, both described from China, are regarded as synonyms of *Beesonia napiformis* (= *Xylococcus napiformis*), which is now known from Japan, Korea, China and Nepal. *B. brevipes*, n. sp., is described from Nepal. Another unnamed species, very close to *B. brevipes*, occurs in Japan. It is suggested that *Trichococcus* Kanda (nec Borchsenius), originally proposed for *Xylococcus napiformis*, is a good genus.

Addendum. Three forms of larvae of *Beesonia dipterocarpi* are treated. They are all referred to the first instar, and the presence of two forms in the first instar male is suggested. The first instar female is very similar to that of *B. napiformis*. The supposed distinctness of *Trichococcus* has, therefore, turned very doubtful.

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Contents. *Beesonia napiformis* — *B. brevipes*, n. sp. — *B. sp.* — *Beesonia* and *Trichococcus* — addendum : *B. dipterocarpi*.

The main purpose of this paper is to record three species of the Beesoniidae occurring on fagaceous plants. This family was erected by Ferris (1950) for *Beesonia dipterocarpi* and *Beesonia quercicola*. *B. dipterocarpi* was described by Green (1926, 1928) from Burma as a gall-maker on *Dipterocarpus* (Dipterocarpaceae). *B. quercicola* was described by Ferris (1950) from China as occurring on oaks (Fagaceae) and "in cracks and roughenings of the bark".

Xylococcus napiformis, described by Kuwana (1914) from Japan as occurring on *Quercus* (Fagaceae), is in reality a species of the Beesoniidae. A new genus, *Trichococcus*, was proposed for it by Kanda (1941) [*Trichococcus* Borchsenius, 1948, is a homonym]. In the course of the present study I have found that *X. napiformis* and *B. quercicola* are the same species. *Beesonia albohirta*, recently described from China, may also be identical with *X. napiformis*. Specimens of two other species, which are very close to *X. napiformis* and associated with fagaceous plants as well, have been examined. I am inclined to the opinion that these three species form their own genus, *Trichococcus* (see under "*Beesonia* and *Trichococcus*"). However, I tentatively include them in *Beesonia*, because our knowledge is still insufficient especially as to *B. dipterocarpi*.

Green (1926) mentioned "a slight resemblance" of the adult male of *B. dipterocarpi* to that of *Conchaspis*, and also "more affinity" to the Tachardiinae [= Kerriidae] in other stages. Ferris (1950) pointed out that the Beesoniidae "present the most remarkable morphological developments to be found anywhere in the Coccoidea." Koteja (1974), on the basis of his study on the mouth-parts, placed the Beesoniidae in the "Asterolecaniidae family group", which comprises *Callococcus*, the Asterolecaniidae and *Halimococcus* besides the Beesoniidae and comes close to the "Diaspididae family group" (the Diaspididae and the Phoenicococcidae). This view is especially interesting, because the ducts present in the Beesoniidae are shaped at the inner end like the geminate pore of the Asterolecaniidae and similar to macroducts found in the first instar (and rarely also in other instars) of the Diaspididae.

B. dipterocarpi is bisexual. Detailed study of male instars will contribute to the phylogenetic problem of this family.

RECORDS OF THE THREE SPECIES OCCURRING ON FAGACEAE

The three species occurring on fagaceous plants are represented by the female only, which passes three larval instars. The second and third instars live in hollow pits formed on twigs and branches, with the posterior end of the body exposed at the opening of the pit and secreting white waxy threads. In this respect they are similar to the intermediate stage of *Xylococcus*. However, in the three species of the Beesoniidae (and probably also *B. dipterocarpi*) the adult female remains within the skin of the third instar and is extremely simplified in structure.

Beesonia napiformis

Xylococcus napiformis Kuwana, 1914, Pomona Journal of Entomology and Zoology 6 (1) : 1 [Tôkyô, Japan, on "*Quercus serrata*" (= *Quercus acutissima*); "adult female" (= 3rd instar female), egg, and 1st instar].

Trichococcus napiformis : Kanda, 1941, Kontyû-Sekai (The Insect World) 54 (3) (No. 523) : 7 (71) [*Trichococcus* erected for *Xylococcus napiformis*; "adult female" (= 2nd instar female) and 1st

instar].

Beesonia quercicola Ferris, 1950, Microentomology 15 (1): 5 [Yunnan Province, China, on *Quercus acutissima* and *Q. schottkyana*; Canton, China, on an undetermined oak; 1st to 3rd instars and adult female], n. syn.

Trichococcus napiformis: Koteja, 1974, Zeszyty Naukowe Akademii Rolniczej w Krakowie 27 [labium; taxonomic position of the family Beesoniidae].

Trichococcus napiformis: Koteja and Liniowska, 1974, Przegląd Zoologiczny 18 (3): 365 [larva, 2nd instar, and "female" (=3rd instar)].

Trichococcus napiformis: Paik, 1978, Illustrated Flora and Fauna of Korea 22, Insecta (VI), p. 281 [Korea, on *Quercus acutissima*].

Beesonia napiformis: Kawai, 1980, Scale Insects of Japan in Colors, Tôkyô, p. 181 [Japan, on *Quercus acutissima* and *Q. glauca*].

Beesonia albohirta Hu and Li, 1986, Journal of Shandong Agricultural University 17 (4): 75 [Shandong Province, China, on *Quercus acutissima* and *Q. variabilis*; 1st instar], n. syn.

Material examined. Many specimens collected in Japan, some specimens collected in Nepal, and part of Ferris' material of *B. quercicola* were available for my study.

Japan. Tôkyô, on *Quercus acutissima* and *Q. glauca* (20-v-1965, 8-ix-1976). Kôhu, Yamanashi-ken, on *Q. acutissima* (13-vii-1966). Simoda, Idu Penins., on *Q. phillyraeoides* (4-x-1967). Makihara and Seto, Aichi-ken, on *Q. glauca* and *Q. acutissima* (24-ix-1976, 4-x-1976). Yunoyama Spa, Mie-ken, on *Q. paucidentata* (28-ix-1976). Unebi-yama, Nara-ken, on *Q. glauca* (10-xi-1971). Nati, Arahune Coast, and Kozagawa, Kii Penins., on *Q. sp.*, *Q. glauca* and *Q. phillyraeoides* (15-, 17-, 18-x-1972). Mimasaka, Okayama, and Kurasiki, Okayama-ken, on *Q. glauca*, *Q. acutissima*, and *Q. phillyraeoides* (9-viii-1964, 16-vi-1965, ix-1977). Motoyama, Kôti-ken, on *Q. glauca* (6-xi-1964). Isigaki Is., Ryûkyû, *Q. sp.* (27-x-1970).

China. Hot Spring, Kunming, Yunnan, on *Quercus acutissima* (29-iv-1949) [mounted from Ferris' material of *Beesonia quercicola*]. "Deng-wu-shan, Kwantung", on *Lithocarpus sp.* (13-iii) [1 mounted specimen of the 2nd instar from Ferris' collection].

Nepal. Nagarjun, nr. Kathmandu, ca. 1500 m, on *Castanopsis tribuloides* (12-, 14-x-1983). Sundarjal, nr. Kathmandu, 1800 m, on *Lithocarpus elegans* (23-x-1983).

First instar larvae were obtained from more than ten localities in Japan and the two localities in Nepal; five specimens of this instar were mounted from the type-material of *B. quercicola*. Other lots of material collected in Japan are all regarded as belonging to the present species on the basis of other larval instars, which are, however, often too heavily sclerotized to study. The second instar specimen from Deng-wu-shan probably belongs to the material collected by Ferris "from an undetermined oak at Deng-wushan, on the West River above Canton, China" and referred by him to *B. quercicola*.

All the instars of the female were described and illustrated by Ferris (1950, "*B. quercicola*") in detail, so that I can add little except to point out a few errors or inadequacies in his description and drawings. Hu and Li (1986, "*B. albohirta*") also gave a detailed description of the first instar. The following account is, therefore, supplementary to their works.

First instar (Figs. 1-3). Antenna with a small sclerotized tubercle (sensillum?) on the membrane between the 2nd and 3rd segments; this tubercle is situated on the posterior margin when the antenna is stretched laterally. In the hind leg, the tarsus is about 65-90 micra long and 2.4-3.4 times as long as the tibia. [Ferris stated that

the tarsus is about 4 times as long as the tibia ; in 3 specimens mounted from his material of *B. quercicola* the hind tarsus is about 65-70 micra long and 2.6-2.8 times as long as the tibia.]. Hu and Li pointed out the presence of "a sensory pore [sensillum] on proximal lateral margin" of the tarsus. Thoracic spiracles bearing a "large rosette-like pore" as described and illustrated by Ferris but with 5 loculi centrally as shown by Hu and Li [4 loculi are drawn by Ferris] ; this pore is thickly sclerotized, and often mounted sideways. Anus situated dorsally (becoming retracted into terminal end of body), small, placed in a quadrate, sclerotized plate, which bears 4 broad, flattened and blunt setae and 12 translucent (but obscure) spots ; there are a pair of similar but much smaller setae laterally to the plate, each seta arising from the centre of a small, triangular, sclerotized plate, which bears 3 translucent spots around the base of the seta [Ferris failed to show this anal plate-seta complex exactly]. There are 4 ducts on each side of body, occurring near margin ; these ducts are short and broad, with the inner end heavily sclerotized and 8-shaped ; they are regarded as belonging to the head and thoracic segments. Head and thorax with dorsal setae pointed, blunt, or a little swollen apically ; all setae may be pointed, or setae of different types may be present in various proportions. Abdomen dorsally with setae forming submedian and submarginal longitudinal rows, each row ending in a broad, flattened, and pointed seta near the anal plate-seta complex ; ventrally with a series of quite stout marginal setae, of which the antepenultimate one is falcate.

Second instar (Figs. 3 & 4). The anal setae are 6 [not 4 as shown by Ferris] ; broad, flattened, and apically pointed ; each seta with a ring of 7 pores around the base, the anal opening also with a ring of similar pores. Ducts (8-shaped at the inner end) occurring laterally in anterior part of body. Numerous 5-locular pores [interpreted as ducts by Ferris] scattered laterally in posterior part of body (posteriorly to the level of the spiracles). Spiracles with many 5-locular disc pores on the peritreme.

Third instar (Fig. 4). There are many ducts (which are 8-shaped at the inner end as in the preceding instars) strewn over the head. Terminal sclerotized region with many 5-locular pores [interpreted by Ferris as tubular ducts] on ventral to lateral surface. Spiracles with many 5-locular pores.

As described above, the first instar is somewhat variable in the tarsal length and the state of the dorsal setae occurring on the head and thorax. However, the material examined seems to form a continuous series. The specimens examined of *B. quercicola* cannot be distinguished from part of material collected in Japan.

Beesonia brevipes, n. sp.

Material examined. Langtang Valley, Bagmati, 2100 m, Nepal, on *Quercus glauca* (29-ix-1975). On the way from Sankranti to Sikkama, Kosi, 2400 m, Nepal, on *Quercus lamellosa* (16-xi-1983).

Many specimens of the first to third instars were mounted from material collected in the Langtang Valley. Nominiferous specimen [holotype] : first instar from the Langtang Valley (deposited in the collection of the Entomological Institute, Hokkaido University).

First instar (Figs. 5 & 6). Tarsus about 50-56 micra long and 2.0-2.2 times as long as tibia in hind leg. Dorsal setae of head and thorax hairy. Dorsal derm

without distinct circular patches (which are always seen in *B. napiformis*).

Otherwise similar to *B. napiformis* and agrees with the latter in the number of ducts, the anal plate-seta complex, the abdominal setae, etc.

Second instar (Figs. 6 & 7). Anal setae less protruding beyond terminal invagination of abdomen than in *B. napiformis*; not acuminate as in *B. napiformis*, but truncate apically, each making a figure of a narrow rectangle.

Third instar (Fig. 7). Ducts seemingly much fewer than in *B. napiformis*, though their exact numbers cannot be given.

Beesonia sp.

Material examined. Kisaradu and Kimitu, Tiba-ken, Japan, on *Castanopsis cuspidata* (14-x-, 9-xi-1975). (Second and 3rd instars represented by specimens in very poor condition).

This species seems to be distinct from *B. napiformis* in having shorter tarsi (hind tarsus about 49-56 micra long) in the first instar and truncate anal setae in the second instar. Dorsal derm with circular patches not well developed as in *B. napiformis*.

This species cannot be distinguished from *B. brevipes* in the tarsal length of the first instar. It shows slightly larger values of the tibiotarsal ratio (owing to the slightly shorter tibia; hind tarsus 2.3-2.6 times as long as tibia), in which, however, it almost overlaps with *B. brevipes*. In this respect and in the truncate anal setae of the second instar this species is apparently very close to *B. brevipes*. It differs from the latter in the setae occurring on the head and thorax: these setae are not hairy, but stiff and ending in a blunt or swollen apex as is often the case with *B. napiformis*.

This species will be better described and named on the basis of further material in good condition.

BEESONIA AND TRICHOCOCCUS

Green (1926, 1928) apparently misinterpreted instars in describing *Beesonia dipterocarpi*. His "2nd", "3rd", and "4th stage female" must be the first, second, and third instar, respectively. On this understanding his description and illustration suggest that *B. dipterocarpi* is similar to the three species occurring on oaks in the gross structure of the larval instars. Ferris (1950) presumed that "certain features not noted by Green are present in *dipterocarpi*."

One of the remarkable features common to the three species occurring on oaks is the anal plate-seta complex in the first instar. In *B. dipterocarpi* "the posterior extremity (2, c) exhibits six short, truncate, cylindrical setae, arranged in a circle round the anal orifice, each with a small circular cell on each side of its base" (Green 1928, p. 206, Fig. 2c). Then, in Green's species, the anal plate complex (the quadrate anal plate and triangular side plates) is absent; the truncate setae are six in number as in the three species, but arranged all in a circle, and there seems to be no size differentiation among them; there must be 12 small circular cells associated with the bases of the truncate setae (two cells are associated with the base of each seta), whereas in the three species the translucent spots present in the anal and side plates are 18 in total (12+3+3; three spots should be associated with each seta in the anal plate, too). So far as the state is really as shown by Green, *B. dipterocarpi* and the three species occurring on oaks are remarkably different in the anal area of

the first instar. This may be a good reason for recognizing *Trichococcus* as distinct from *Beesonia*.

Beesonia dipterocarpi occurs on *Dipterocarpus tuberculatus* in Burma, and the other species on oaks in Nepal, China, Korea and Japan. It is possible that this pattern of host association (Dipterocarpaceae and Fagaceae) will find examples in other groups of insects. In fact, closely related species of the leaf-mining microlepidopterous family Gracillariidae occur on oaks and dipterocarps in Japan, Nepal and Malaya (T. Kumata, pers. commun.). In eastern Asia, as well known, oaks dominate in the warm-temperate forest and the tropical lower montane forest, and dipterocarps in the tropical rain forest. From the viewpoint of the abundance of these plants as resources the pattern may be worthy of attention in studying evolution of phytophagous insects in eastern Asia. Oaks generally harbour many insects. According to Veevers-Carter (1984), "no animal life, . . . , actually counts on dipterocarp flowerings or fruitings for assistance in survival" owing to the presence of sterile years. On the other hand, there may be no reason against the supposition that many insects are associated with dipterocarp leaves or stems.

ACKNOWLEDGEMENTS

Through the courtesy of Mr. Robert Schuster, Curator of the Entomology Collection, University of California, Davis, I have had the opportunity to examine Ferris' material of *Beesonia quercicola*. Some specimens from Japan were collected by Mr. S. Kawai.

REFERENCES

- Green, E.E., 1926, Bulletin of Entomological Research 17: 55; 1928, ditto 19: 205.
—Veevers-Carter, W., 1984, Riches of the rain forest, Oxford University Press, xvi+103 pp., 12 pls.—Other references are given under the heading *Beesonia napiformis*.

ADDENDUM

Shortly after the manuscript of the paper had been submitted for publication, I received from Dr. D. J. Williams and Dr. Jennifer M. Cox five slides of larvae mounted from the material of *Beesonia dipterocarpi* collected in Burma on *Dipterocarpus tuberculatus*. These slides contain three forms of larvae, all with well-developed legs, as given below, and I think that they all belong to the first instar. Needless to say, this interpretation poses a new problem.

I am grateful to Dr. Williams and Dr. Cox for giving me the opportunity to examine this unusual insect.

Form A. Six specimens. Very similar to the 1st instar larva of *Beesonia napiformis*. Antennae nearly as in *B. napiformis*, but appearing 4-segmented owing to the presence of 4 sclerotized bands. Dorsum with sclerotized patches as in *B. napiformis*. Body setae nearly as in *B. napiformis*. Spiracles, tubular ducts, and anal area as in the 3 species occurring on oaks (the quadrate anal plate is clearly visible, though the triangular side plates are not, in 2 specimens). Hind tarsus about

55 micra long.

Form B. Nine specimens. Antennae nearly as in Form B. Dorsum without patches. Abdominal setae not thick. No tubular ducts. There are 6 short, truncate setae round the anal orifice, each seta with a pair of pores appressed to its base; these pores are larger than the base of the seta, encircling the latter [Green (1928) described and figured the anal area as of the "2nd stage female"]. Hind tarsus much shorter than in Form A, about 40 micra long.

Form C ["embryonic larva" (Green 1926)]. Twenty specimens. Antennae 3-segmented [basal segment overlooked by Green], the 2nd and 3rd segments nearly as described by Green ["basal" and "terminal joint"]. There is no well-defined "bilobed, more heavily chitinized area" on the thorax as drawn by Green; the prothorax is instead reticulate extensively over the dorsum; rudiments of reticulation on head, meso- and metathorax, and abdominal segments. Body setae only moderately thick. There are 4 tubular ducts on each side of the body as in Form A. There are 6 setae round the anal orifice as in Form B, but each seta is encircled by 3, occasionally 4, pores. Hind tarsus attaining about 100 micra in length.

Green called Form C the "embryonic larva", and interpreted Form A and B as the "2nd stage female" and "2nd stage male" (though he was confused in describing the "posterior extremity of 2nd stage female"). But Form C is too large (about 440 to 480 micra long in the specimens examined which appear teneral) to precede in instar Form B (about 305 to 340 micra long in the specimens examined which are teneral) and Form A (about 360 to 420 micra long). It may not be embryonic in reality. Green mistook the third instar female for the adult female, and this may be the reason why he thought Form C embryonic. (The adult female must remain within the skin of the third instar and deposit eggs within the latter as in the species occurring on oaks.)

Form A undoubtedly corresponds to the first instar larva of *B. napiformis* and the other species occurring on oaks, and in these species the male is unknown. Form A, therefore, is interpreted as the first instar female. When it is fully grown, its frontal area is "enormously distended" and contains "the early nymphal stage" (Green 1928). This was also observed in *B. napiformis* and *B. brevipes*, and Green's "early nymphal stage" should be the 2nd instar female. Form B and C, therefore, cannot be the second instar female, at least.

No larvae corresponding to Form B and C have been found in *B. napiformis* in spite of the abundant material examined and in the other two species occurring on oaks. This is explainable if these forms are male insects: the male simply does not occur in these species. Then, do Form B and C represent the first and second instar males?

Form B cannot be the second instar male, because, as stated above, it is much smaller than Form C (when compared in teneral condition). Form C cannot be the second instar male, either, because it was found in "embryonic" condition (that is, according to my interpretation, within the cast skin of the third instar female). It is the opinion here adopted that both Form B and C belong to the first instar male. Form C is, however, peculiar in the reticulate dorsum and with remarkably long legs. I am much inclined to believe that Form B is the "normal" form of the first instar male. What is, then, Form C?

B. dipterocarpi induces “large foliaceous galls”, and “a medium-sized gall may contain as many as a dozen fully developed females” (Green 1928). In the mode of life it differs remarkably from the species living on oaks. In short, it is more social. I think this affords a clue to the problem, but in the present state of our knowledge any further conjecture as to the form may not be well founded. We are still upon an insufficient basis of material and observation.

I once supposed that *Beesonia* and *Trichococcus* are distinguishable from each other in the characters of the anal area of the first instar. However, the anal area described and figured by Green (1928) as of the “2nd stage female” (=first instar female) of *B. dipterocarpi* is in reality that of Form B, the “normal” form of the first instar male as here interpreted. Now that the difference is deemed merely sexual, the supposed distinctness of *Trichococcus* has turned very doubtful (though I do not think that it is negated completely, because our knowledge as to the other instars of *B. dipterocarpi* is still meagre).

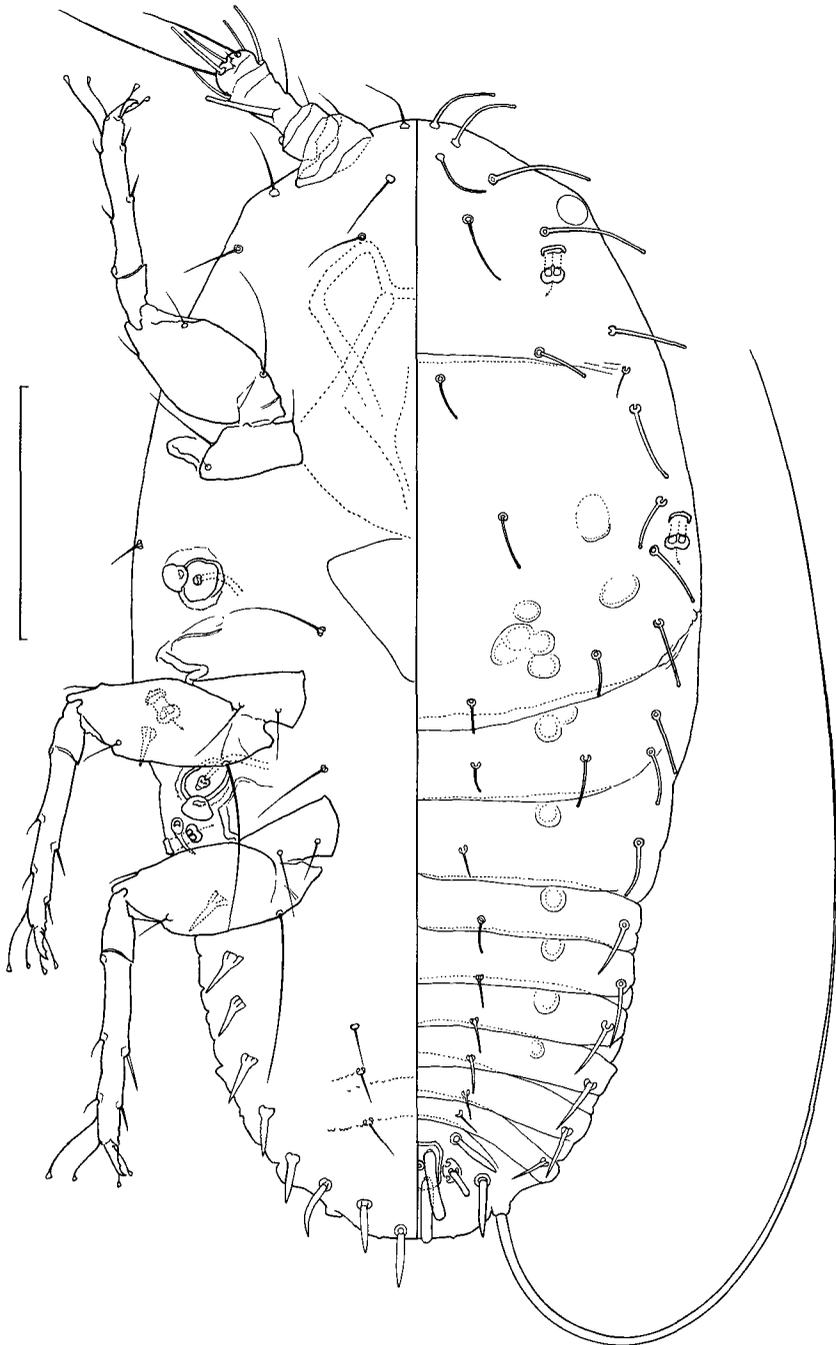


Fig. 1. *Beesonia napiformis*, 1st instar. Kôhu, Yamanashi-ken, Japan, on *Quercus acutissima*. Scale: 100 micra.

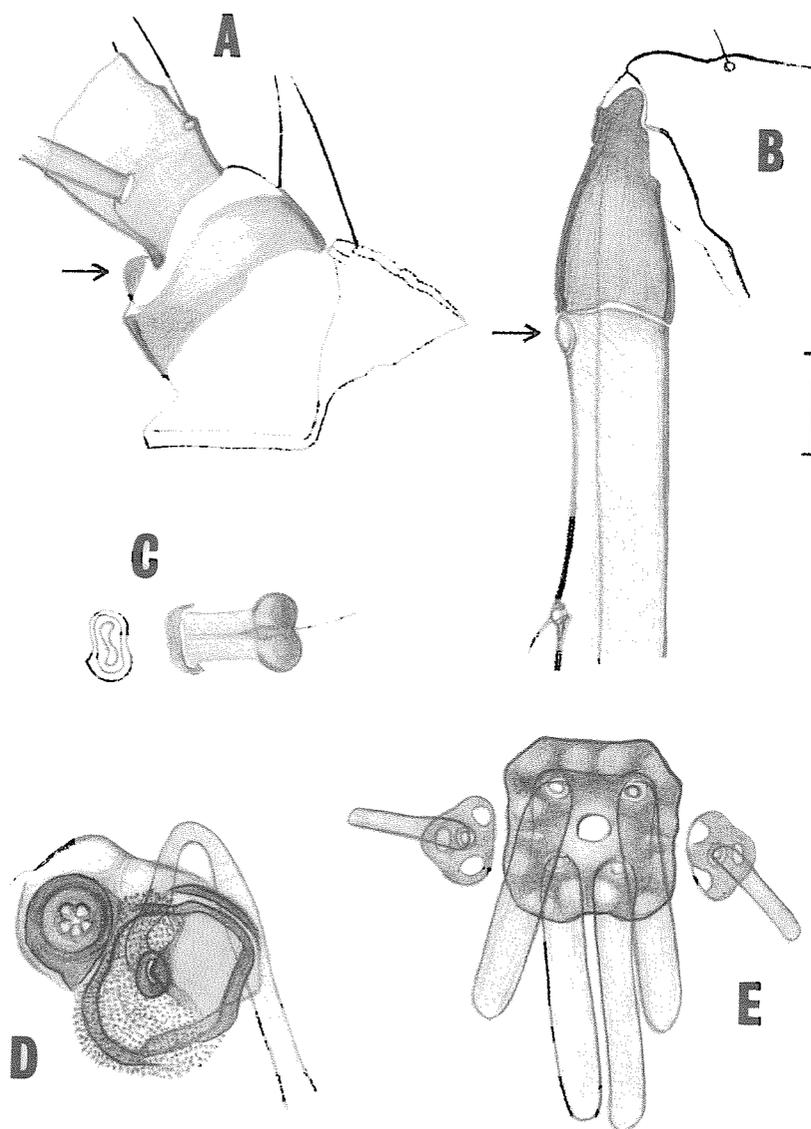


Fig. 2. *Beesonia napiformis*, 1st instar: 2nd antennal segment, showing "sensillum" [A], base of tarsus, showing "sensillum" [B], duct [C], anterior spiracle [D], and anal plate-seta complex [E]. Kôhu, Yamanashi-ken, Japan, on *Quercus acutissima*. Scale: 10 micra.

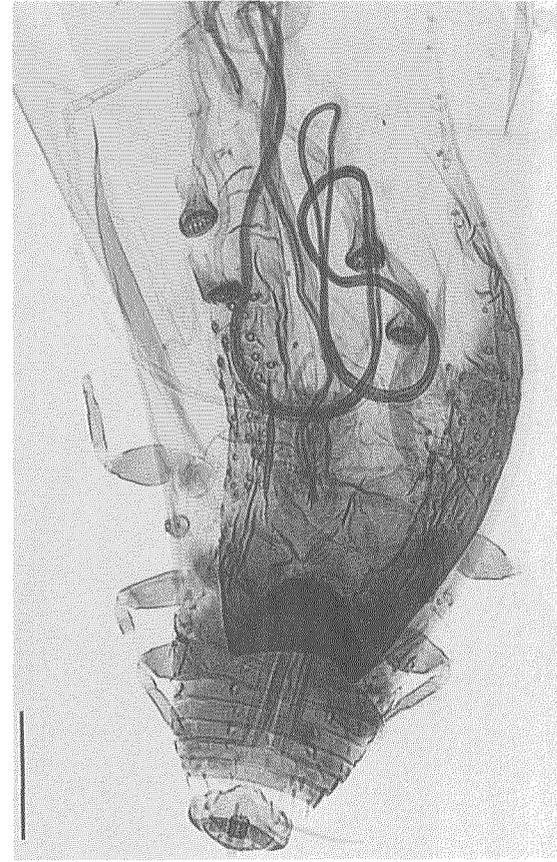
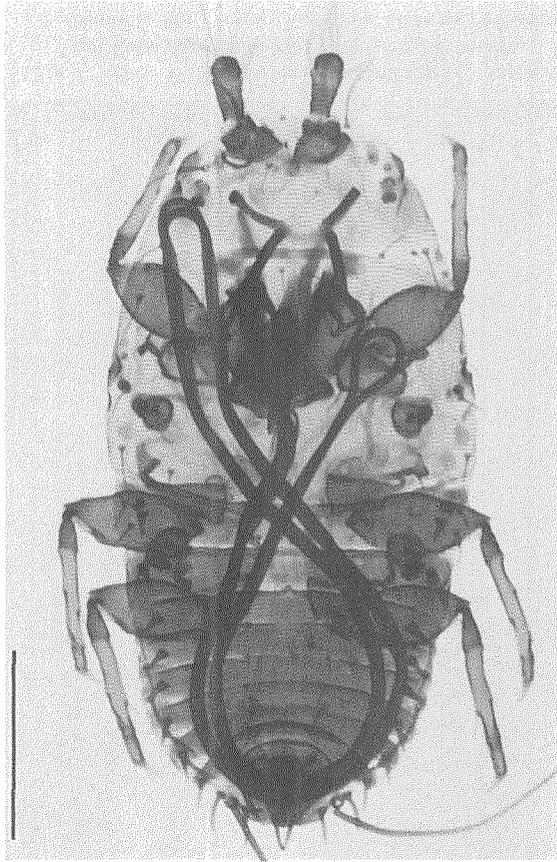


Fig. 3. *Beesonia napiformis*. First instar [left]. Kôhu, Yamanasi-ken, Japan, on *Quercus acutissima*. Scale: 100 micra.
Second instar in the skin of the 1st instar [right]. Motoyama, Kôti-ken, Japan, on *Quercus glauca*. Scale: 100 micra.

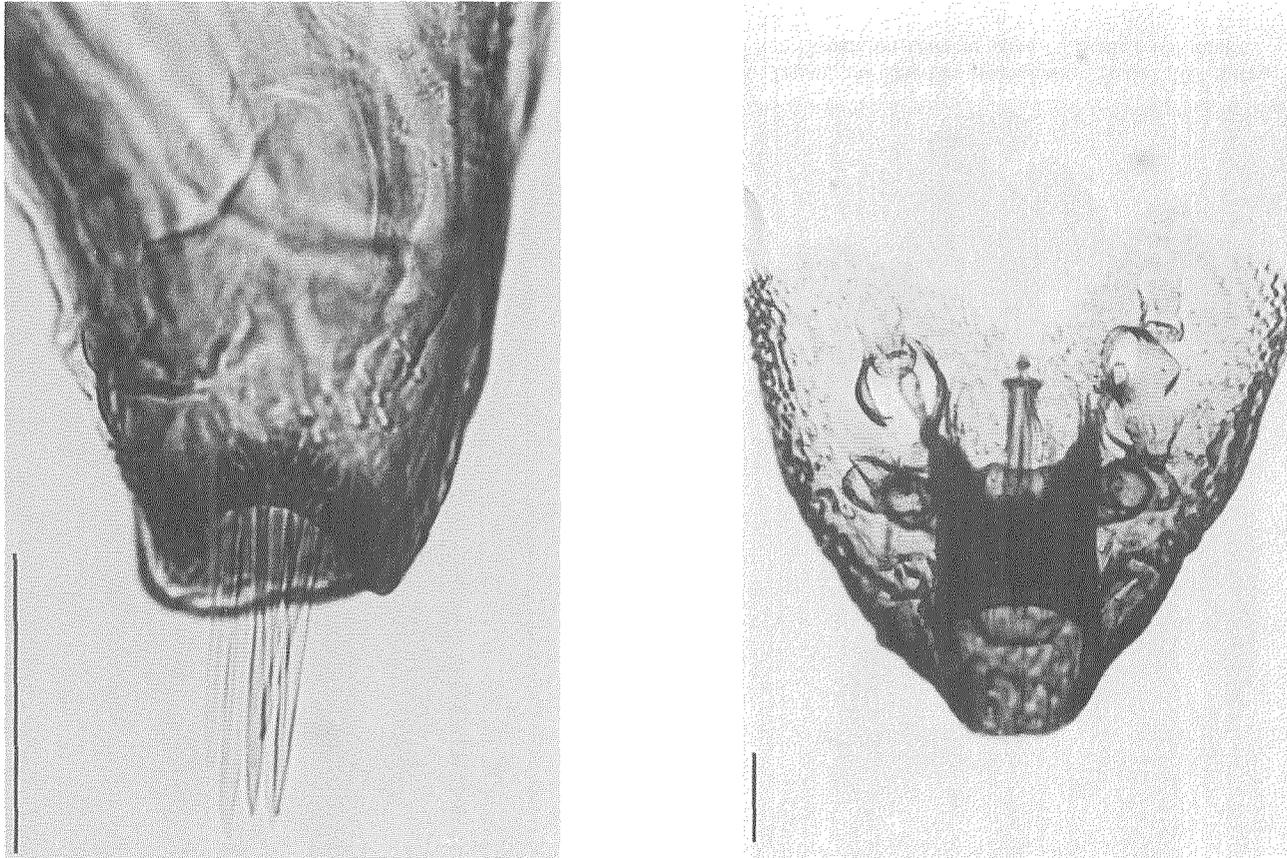


Fig. 4. *Beesonia napiformis*. Second instar: posterior extremity showing anal setae [left]. Yunoyama Spa, Mie-ken, Japan, on *Quercus paucidentata*. Scale: 100 micra. Third instar: posterior extremity focused on ventral surface [right]. Simoda, Idu Penins., Japan, on *Quercus phillyraeoides*. Scale: 100 micra.

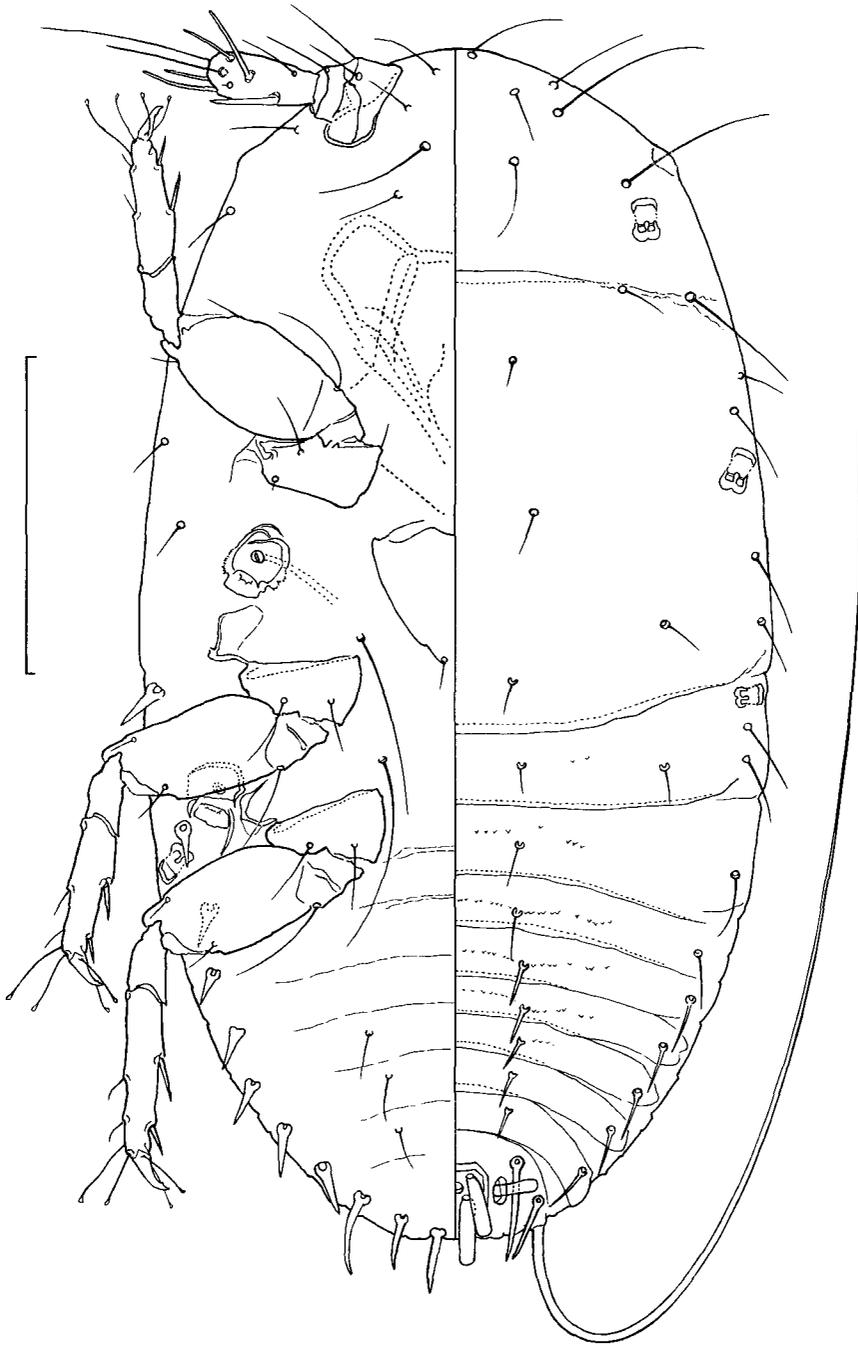


Fig. 5. *Beesonia brevipes*, n. sp., 1st instar. Langtang Valley, Nepal, on *Quercus glauca*.
Scale: 100 micra.

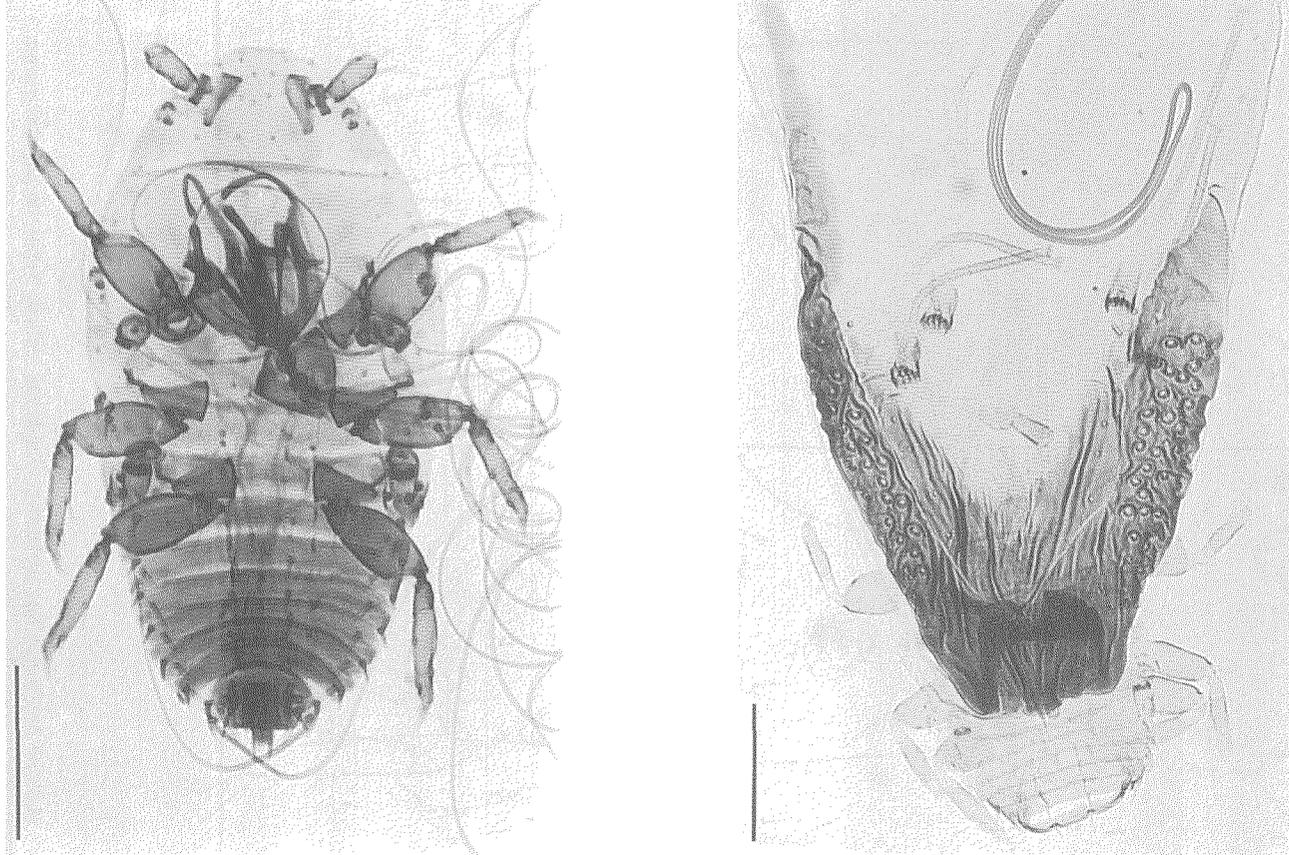


Fig. 6. *Beesonia brevipes*, n. sp., 1st instar [left] and 2nd instar in the skin of the 1st instar [right]. Langtang Valley, Nepal, on *Quercus glauca*. Scale: 100 micra.

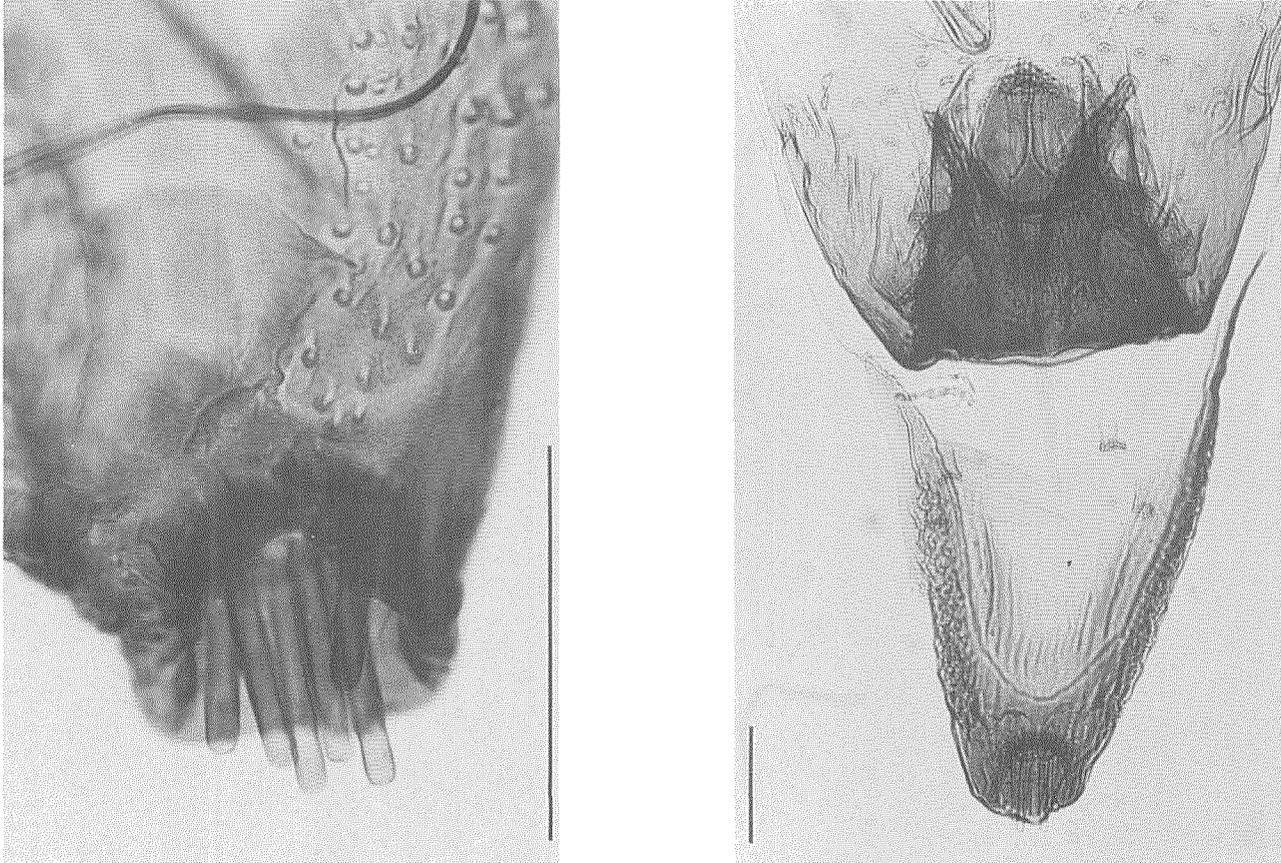


Fig. 7. *Beesonia brevipes*, n. sp., 2nd instar : posterior extremity showing anal setae [left] and 3rd instar in the skin of the 2nd instar : posterior extremity [right]. Langtang Valley, Nepal, on *Quercus glauca*. Scale: 100 micra.