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**A NEW SCALE INSECT GENUS HAVING FEATURES IN PARALLEL WITH
UNASPIS (STERNORRHYNCHA: COCCOIDEA: DIASPIDIDAE)**

By SADAO TAKAGI

Abstract

TAKAGI, S., 2024. A new scale insect genus having features in parallel with *Unaspis* (Sternorrhyncha: Coccoidea: Diaspididae). *Ins. matsum. n. s.* 80: 161–172, 5 figs.

Parunaspis beilschmiediae, n.g., n.sp., occurring in the Malay Peninsula on *Beilschmiedia*, and *Unaspis makilingena*, n.sp., occurring in Luzón Island on *Antidesma*, are described. The former has main taxonomic features in parallel with the latter (or the species of *Unaspis* as a whole), probably owing to adaptation to their similar modes of life.

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Scientific paper for the project 'Systematic and Ecological Surveys on Some Plant-parasitic Microarthropods in Southeast Asia'

INTRODUCTION

In this paper are described two Diaspidine species having main taxonomic features in parallel with each other. The view is adopted, however, that their resemblance should be attributed to their adaptation to similar modes of life.

DESCRIPTIONS

Parunaspis, n.g.

[para+*Unaspis*]

Nominifer [type-species]: *Parunaspis beilschmiediae*, n.sp.

Adult female having features generally as in the species of *Unaspis*, but different from the latter in having a pair of long stiff marginal setae between the median trullae. [These setae, occurring ventrally, probably belong to the ninth abdominal segment. In *Unaspis* species the corresponding setae are fine and generally short. As compared with them, the setae in *Parunaspis* are distinctly thicker, with the apex sharply pointed]. First-instar nymph with 6-segmented antennae. [In *Unaspis*, with 5-segmented antennae].

Parunaspis beilschmiediae, n. sp.

Material examined. Collected on Bukit Nanas, City of Kuala Lumpur, Malaya, Malaysia, on *Beilschmiedia* sp. (Lauraceae), 23.VIII.1990 (Sample 1), 27.X.1991 (Sample 2). Females and males occurring on leaves, and exclusively on the undersurface, females mainly along the veins. Female test brownish gray, without a distinct median ridge; male test with waxy cover not carinate. Nominifer [holotype specimen]: adult female, immature individual, from Sample 1, deposited in the collection of the Entomology Section, Forest Research Institute of Malaysia. Descriptions of wax organs in the adult female below are mainly based on immature individuals.

Adult female (Figs. 1, 2, 3A), Body elongated; when fully grown, derm wholly sclerotized and body appearing to be composed of two distinct parts, cephalothorax and abdomen; cephalothorax longer than abdomen, nearly oblong, vertical margin broadly rounded or nearly flat, sometimes even concaved medially; abdomen with segments I-III well lobed laterally; pygidium broad. Antennal tubercles conical, situated on head margin, projecting anteriorly, with a curved fleshy seta subbasally on lateral side. Both pairs of spiracles with disc pores, these being arranged in a flat arch in front of each spiracle, tending to make a double row in lateral part of the arch, some 8-18 disc pores associated with anterior and 4-8 with posterior spiracle. Prosoma with microducts strewn on ventral surface within body margin. Metathorax with microducts strewn within body margin on both surfaces and, on ventral surface, also more internally; a few ducts occurring within body margin a little thicker than microducts scattered around them [these thicker ducts are interpreted as diminished macroducts, not as enlarged microducts].

A sclerotized submarginal dorsal boss on abd I and also on III. Anal opening situated about centre of pygidium, superimposed on vulvar opening. Perivulvar disc pores absent.

Trullae [pygidial lobes] well represented in 3 pairs. Median trullae much larger than lateral ones, elongated and divergent; serrate on gently curved mesal margin, apex rounded, followed by a short serrate outer margin; bases of these trullae separated from each other by a good space, derm in this space being sclerotized [possibly on ventral

surface alone], with a pair of long stiff setae. Second and third trullae bilobulate, with the lobules similar in shape and size, obscurely serrate, bluntly pointed apically. Pygidial margin of abd IV and V finely serrate. Abd II and III with a small triangular sclerotized process on or within posterolateral margin of segmental lobe. Marginal gland spines slender; 1 on each of pygidial segments abd V-VIII. Prepygidial gland spines on abd I-IV, elongate except for several ones occurring on ventral surface of abd I antero-submarginally; these shorter gland spines accompanied with microducts scattered anteriorly, some 5-11 on abd I, 4-6 on II, 2-6 on III, 1-3 on IV.

Marginal macroducts 1 on abd VII, 2 on VI, V, and IV, each opening in a marginal prominence except for the one occurring between bases of inner and outer lobules of third trulla. Dorsal macroducts concentrated on pygidial segments abd IV-VII: some 22-31 macroducts occurring on lateral half of pygidium in a pattern which suggests that they are arranged principally in segmental rows on abd IV-VII, the row on VII, composed of 4-6 macroducts, being perpendicular along midline of body, and the other rows more or less oblique and disordered in arrangement. Dorsal macroducts of prepygidial abdomen occurring on lateral lobes of segments, gradually reducing in size on anterior segments.

First-instar nymph (Fig. 3, E) with 6-segmented antennae. *Second-instar female* (Fig. 3, B) with trullae similar to those in adult female, and with marginal macroducts on abd V-VIII.

Second-instar male (Fig 4). Body broadly obovate, with abundant macroducts dorsally and mainly on abdomen; with ventral macroducts mainly on thoracic segments. Marginal processes well represented on abdomen; median and second trullae as in female; a set of 3 platelike processes tending to be serrate apically and accompanied with a gland spine laterally on each of abd III-VI. Antennal tubercle conical. Anterior spiracle accompanied with several disc pores in a loose transverse row anteriorly, and with several conical gland spines posteriorly; posterior spiracle without disc pores; with a group of conical gland spines posterolaterally.

Remarks. It seems to me that this species is similar to *Unaspis rousseti* Balachowsky (1957), which was described from Bangkok, Thailand, as occurring on *Mangifera indica* leaves. The illustration of the pygidial apex, his Fig 9 (p. 30), shows a pair of enlarged median trullae with a pair of elongated marginal setae between their bases, but these setae are shown to be very fine. If these setae are, in reality, stiffened and the first-instar nymph has 6-segmented antennae, *U. rousseti* should represent a second species of *Parunaspis* as understood here. This is, however, no more than a possibility. Another species which has enlarged median trullae as in *Parunaspis* but is retainable in *Unaspis* is given below.

Unaspis makilingena, n.sp., Mud Spring form

Material examined. Collected in the grounds of the University of the Philippines at Los Baños, Laguna, Luzón: at Mud Spring, foot of Mt. Makiling, an inactive volcano, on leaves of a small tree of *Antidesma pentandrum*, Euphorbiaceae, 4.VIII.1993. The host tree was growing on the side of a small hole on the ground, from which volcanic steam was jetting out, so that the scale insect material was collected in the midst of blowing steam. The steam was not so hot as to make my collection difficult. It was, however, almost unbelievable to me that scale insects of any stage could survive this unusual condition and grow there normally. In fact, mounted specimens are in general not good in condition, especially those of the second-instar male are poor. I, therefore, designate the examined form 'the Mud Spring form', though the expected normal form is unknown

in the present study. Females and males occurring on both surfaces of leaves; on the upper surface, gathering on midribs and other veins; on the lower surface, gathering along veins. Female test brownish; male test with waxy cover tricarinate. Nominifer [holotype]: adult female, deposited in the collection of the University of the Philippines at Los Baños.

Adult female (Fig. 5, A-D). Body elongated, fusiform; when fully grown, cephalothorax much longer than abdomen, narrowing anteriorly, and sclerotized except along posterior margin of metathorax. Antennae represented by small triangular tubercles. Anterior spiracles each with several (some 3-5) disc pores laterally; posterior spiracles without disc pores, accompanied by a few triangular gland spines posteriorly. Head and pro- and mesothoracic region with microducts very few within the body margin on ventral surface. Metathorax with some microducts between body margin and posterior spiracle.

Trullae [pygidial lobes] in 3 pairs. Median trullae much larger than the others, elongated and divergent, forming a large notch at apex of pygidium; serrate on mesal margins, rounded apically; basally separated from each other by a good space, which is somewhat sclerotized [on ventral side alone?], provided with a pair of ventral marginal setae, which are short and weak, thus are similar to the other ventral setae on pygidial segments. Second and third trullae bilobulate; outer lobule somewhat smaller than the inner, but well represented in the second trullae, represented by a small triangular process in the third. Marginal macroducts well represented on abd IV-VII. Some 8-14 dorsal macroducts on lateral half of pygidial dorsum, a few (1 or 2) of them on abd VII. Lateral macroducts on metathorax and abd I-III, becoming smaller on anterior segments. A few gland spines marginally on abd I-IV; a few conical gland spines posteriorly to posterior spiracle.

Firsst-instar nymph (Fig. 5, F) with 5-segmented antennae. *Second-instar female* (Fig. 5, E) with enlarged median trullae and a pair of small marginal setae between their bases.

Second-instar male [neither detailed description nor exact figure could be prepared owing to poor conditions of the mounted individuals. Some observable features, however, show differences between this species and *P. beilschmiediae*, so that notes are given here to those differences]. *Marginal processes of abdomen including those corresponding to trullae* are all small, membranous and more or less serrate or fimbriate. *Macroducts* occurring mainly on abdominal dorsum, but apparently fewer than in *P. beilschmiediae*. *Some gland spines occurring on abdominal base* are elongated to form tubules [rather than spines], which are swollen basally and truncated apically.

DISCUSSION

Parunaspis and *Unaspis*

When the artifact *Phenacaspis* was critically revised, it was shown that it had been composed of leaf-associated forms of *Chionaspis* on one hand and of species which should belong to *Pseudaulacaspis* on the other hand, and that these genera could be constantly distinguishable from each other by the antennae in the first instar 6-segmented in *Chionaspis* and 5-segmented in *Pseudaulacaspis*; it was also shown that in the stage of adult female, the median trullae were provided with a pair of distinct marginal setae between their bases in the species of *Pseudaulacaspis*, while without such setae in the species of *Chionaspis* (Takagi and Kawai, 1967). Needless to say, these characters

are adopted simply as useful signs, apart from their biological, especially adaptive, significance. *Chionaspis* and *Pseudaulacaspis* thus revised and recomposed are large genera, having their own biological properties respectively. In the recent exhaustive treatment of the higher taxa within the Diaspididae (Normark and others, 2019), *Chionaspis* and *Pseudaulacaspis* are shown to be not particularly closely related with each other.

In the present study, I have failed to find any evidence to support the view that *Parunaspis* and *Unaspis* are closely related to each other. Above all, the different numbers of the antennal segments in the first nymphal stage may suggest the possibility of a remote relationship between them. What I would like to say in the present state of study is that *Parunaspis* and *Unaspis* are, in spite of the supposed remote relationship, provided with main features in parallel in their adult females as a result of adaptation to similar modes of life and especially to similar manners of test formation. In short, they may represent an example of parallelism in evolution.

According to certain authors (1962): 'The pygidium, with its attendant appendages, probably acts as a paint brush which the insect uses to apply the secretions from the highly glandular pygidial region.' If this explanation is correct, the appendages should be dorsal in position (though their main parts are usually produced beyond the pygidial margin), but in reality they appear to be grown on the ventral surface. Throughout my SEM observations on various diaspidids I had hold of my conviction that the main function of sclerotized trullae together with other sclerotized marginal structures is to clean the plant surface of the setting spot of the female insect and that the function of glanduliferous spines and plates is to arrange with wax filaments the floor of the spot for oviposition.

The most important rôle of diaspidid tests, however, may be the maintenance of stable environmental conditions under its cover, especially concerning moisture, for deposited eggs and neonatal nymphs. Broader tests may be more effective in this respect, and in fact it seems that forming a circular test is a common evolutionary trend in various groups within the family.

Matsuda (1927) made a detailed observation on the test-formation of an Aspidiotine scale insect. His work well shows how laborious for the insect the construction of a circular test is.

It seems that, in contrast with such an elaborate test-construction, the adult female bodies supply moulds for the tests in some *Unaspis* and *Unaspis*-featured scale insects. The elongate-ovate body with a pair of longitudinal rows of dorsal macroducts set close together nearly medially on the seventh abdominal segment in *U. acuminata* and some other species of *Unaspis* appear to correspond with their elongate female test with a median longitudinal ridge. This correspondence strengthens the supposition that in *Unaspis*-type scale insects the female tests are formed mainly by back-and-forth movements of the abdomen, representing an effective way in test-formation.

The consideration above suggests that *Unaspis*-type scales represent a successful group. In fact, not a few species of *Unaspis* including undescribed ones are in my collection from Malaysia and the Philippines. This may suggest the success of the *Unaspis*-type scales as well as the abundance of scale insect taxa in eastern tropical Asia (Indochina and east of the peninsula), where the scale-insect fauna remains unknown for a large geographical extent including the biogeographical region Wallacea.

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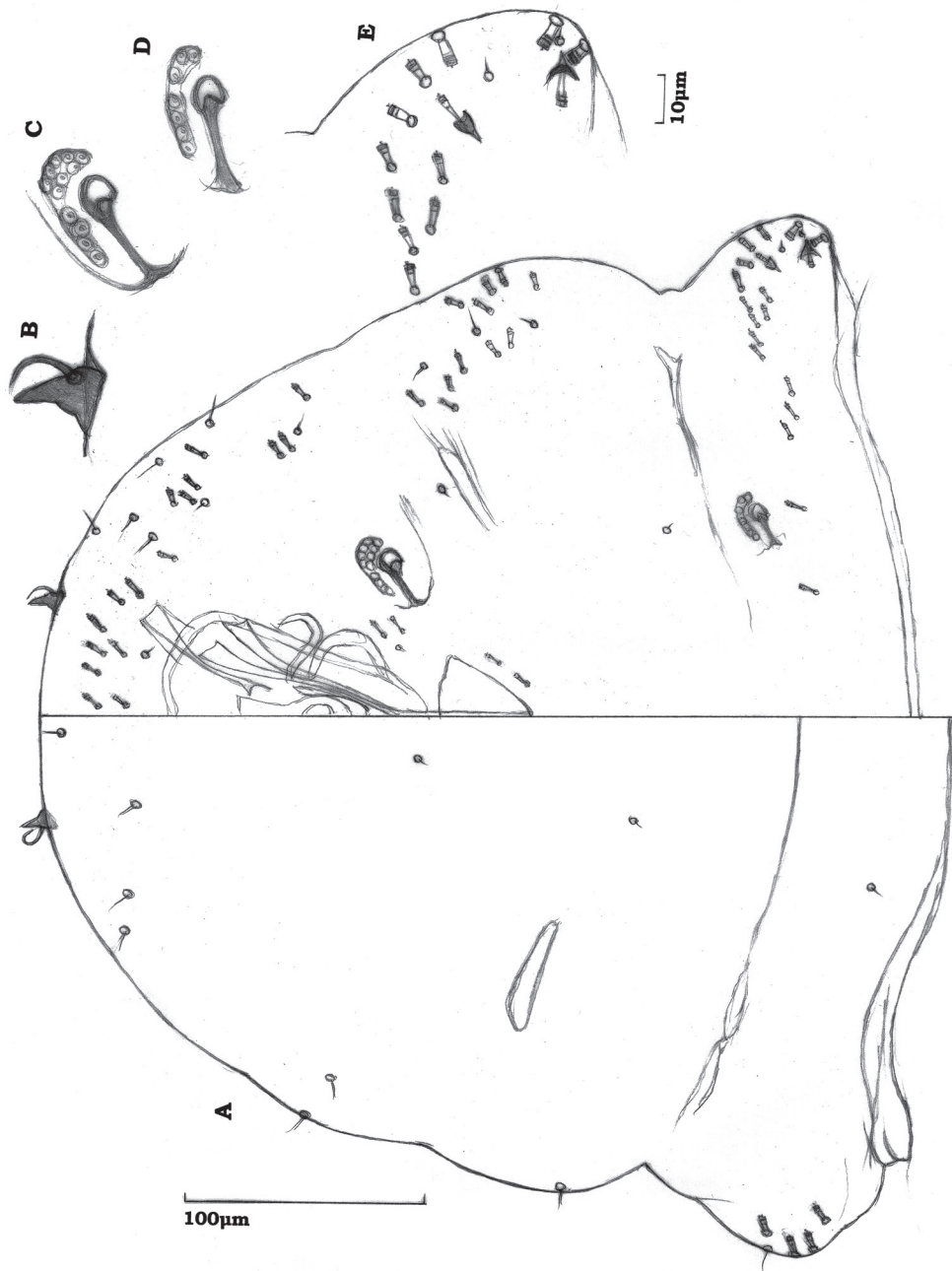


Fig. 1. *Parunaspis beilschmiediae*, n.sp., adult female. A, cephalothorax; B, antenna; C, anterior spiracle; D, posterior spiracle; E, metathorax: lateral lobe, ventral surface. Scale bars: 100µm, for A; 10µm, for B-E.

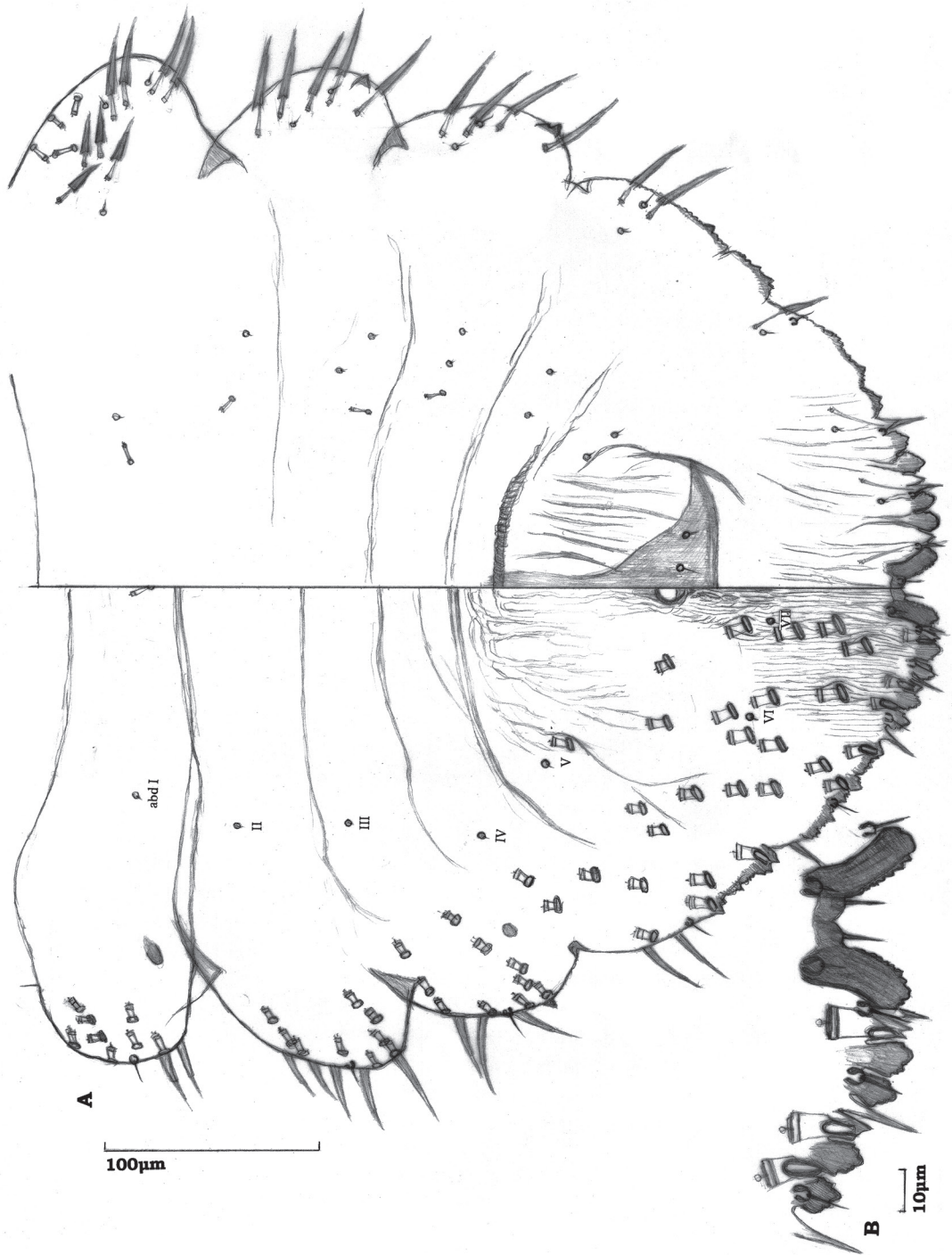


Fig. 2. *Parunaspis beilschmiediae*, n.sp., adult female. A, abdomen; B, trullae. Scale bars: 100µm, for A; 10µm, for B.

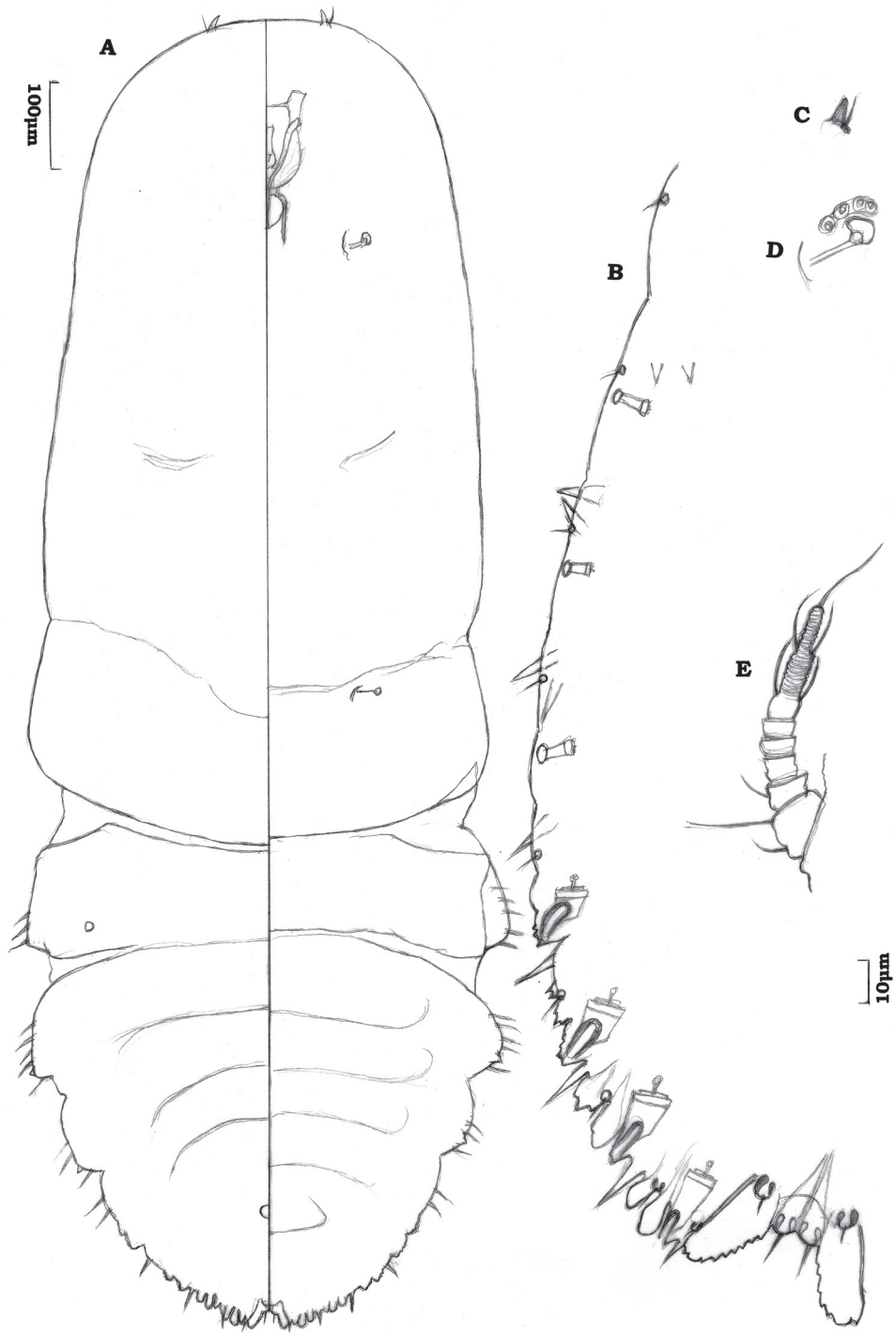


Fig. 3. *Parunaspis beilschmiediae*, n.sp. A, fullgrown adult female, outline of body. B-D, second-instar female; B, abdomen, body margin, dorsal surface; C, antenna; D, anterior spiracle; E, first-instar female, antenna. Scale bars: 100µm, for A; 10µm, for B-E.

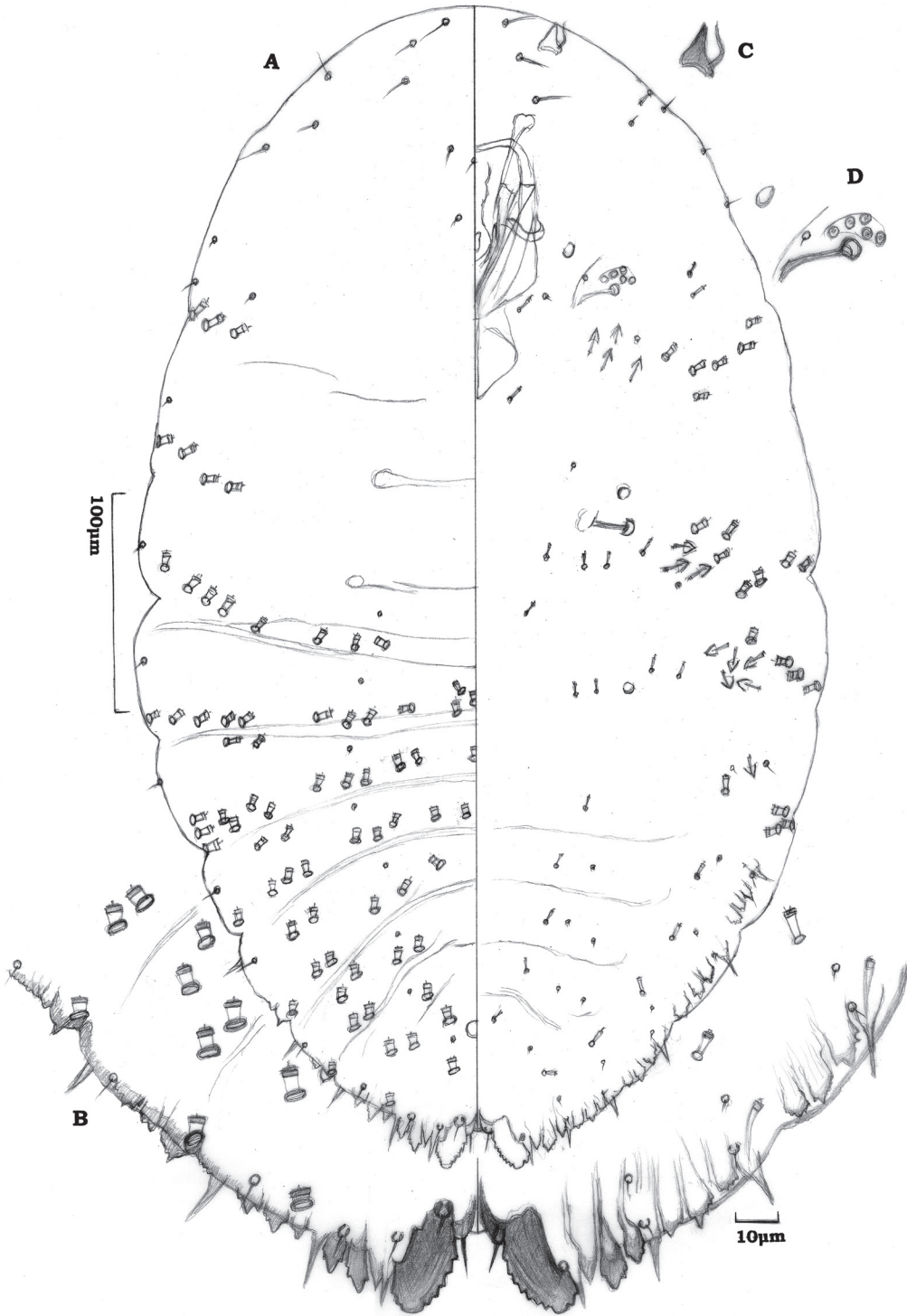


Fig. 4. *Parunaspis beilschmiediae*, n.sp., second-instar male. A, body; B, pygidial margin; C, antenna; D, anterior spiracle, with vestigial fore leg. Scale bars: 100µm for A; 10µm for B-D.

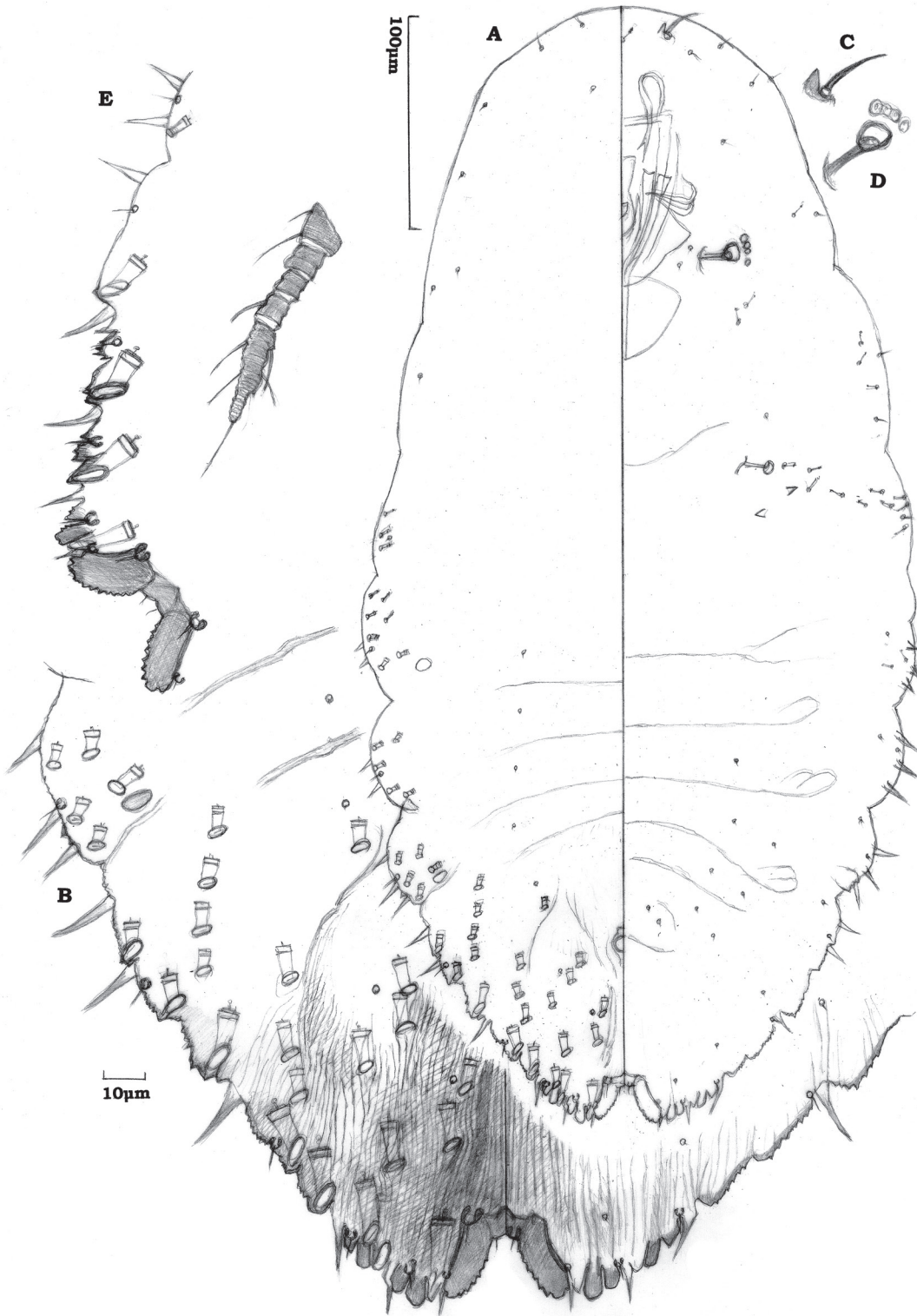


Fig. 5. *Unaspis makilingena*, n.sp. A-D, adult female, A, body; B, pygidium; C, antenna; D, anterior spiracle. E, second-instar female, pygidial margin, dorsal surface. F, first-instar female, antenna. Scale bars: 100µm, for A; 10µm, for B-F.

CORRECTIONS

Insecta matsumurana, *New Series* 79, 2023.

p. 68, Table 2. Correct 'PL-2' to 'PLP-2'.

p. 84, Table 1, 3rd column. Correct '58-70,0-90 [18]' to '58-70.0-90 [18]'.