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Description of *Asiothrixus* gen. nov. (Hemiptera: Aleyrodidae) and two new species with diagnoses and a puparial key to species

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Abstract

A new Asian genus is diagnosed, *Asiothrixus*, with *Aleurothrixus antidesmae* Takahashi as type species, together with *Asiothrixus smilaceti* (Takahashi) **comb**. **nov**., *Asiothrixus silvestris* (Corbett) **comb**. **nov**., *Asiothrixus specialis* **sp**. **nov**. and *Asiothrixus unicus* **sp**. **nov**. Lectotypes are designated for both *A. antidesmae* and *A. smilaceti*. Characteristics of the new genus are discussed, and puparial diagnoses and illustrations for the species provided, together with a puparial key to species.

Key words: Aleyrodidae, *Aleurothrixus*, *Asiothrixus*, new genus, key

Introduction

In 2007 the whitefly fauna of the world comprised 1556 described species grouped in 161 genera (Martin & Mound, 2007). Since then Martin (2008) proposed two new genera, *Aleuroctarthrus* and *Palaealeurodicus* for the Old World species formerly placed in *Aleurodicus* Quaintance & Baker (Aleurodicinae), and synonymised the genus *Lecanoideus* Quaintance & Baker with *Aleurodicus* Douglas. Recently, Dubey *et al*. (2009) synonymised the genus *Lipaleyrodes* Takahashi with *Bemisia* Quaintance & Baker.

Quaintance & Baker (1914) described the genus *Aleurothrixus* for a New World species *Aleyrodes howardi* Quaintance which was later synonymised with *Aleurothrixus floccosus* (Maskell) by Costa Lima (1942). *Aleurothrixus* currently includes 20 species (Martin & Mound, 2007), all from the New World apart from three Asian species, plus *A. floccosus* that has invaded the Old World. Martin (1988, 1999) indicated the South East Asian species in *Aleurothrixus* were not congeneric with the New World species. Hence, a study was undertaken of these Old World species to appraise their generic position. Three previously described, and two new, Asian species are placed into a new genus *Asiothrixus*, and 17 New World species remain in *Aleurothrixus*.

The puparia of *Asiothrixus* resemble those of *Siphoninus* Silvestri, with most individual puparia possessing glandular dorsal siphons (Figs 3, 6, 15, 31), but differ in having wax secreting glands at the base of the marginal teeth (often erroneously referred to as double row of marginal teeth), in having only two pairs of siphons present (on abdominal segment II and III), and in having the lingula almost obscured by the operculum. In *Siphoninus*, the dorsal siphons are much more numerous, with often a medially-placed siphon present on abdominal segment II, the marginal teeth are without glandular bases and the lingula is exposed but included within the confines of the orifice. *Asiothrixus* differs from *Aleurocanthus* Quaintance & Baker in having marginal teeth with glandular bases, and in the absence of paired stout spines on the submargin and subdorsum surface. The bases of abdominal siphons in the new genus are "glandular" as seen in the species of *Aleurocanthus*, however, the siphon apex is broad and open, forming a concavity as in some *Aleurocanthus* species. For example, the dorsal spines in *Aleurocanthus imperialis* Cohic (1968) are apically expanded. It is possible that the apically widened glandular siphons or spines serve the purpose of secretion of liquid wax.

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Material and methods

The type puparia of *A. antidesmae* and *A. smilaceti* are from the Taiwan Agricultural Research Institute (TARI), Taiwan. The pupal cases of two new species, and some of the *A. antidesmae* were collected by J. H. Martin, Natural History Museum, London, UK. The discussion and key characteristics of *A. silvestris* are based on the information available in Corbett (1935), because no type material from that publication survives. Identified puparia of *Asiothrixus* species from National Taiwan University are included. Puparia and adults of *A. smilaceti* were field-collected, and laboratory-reared in Taiwan, and the emerged adults and empty puparia preserved in 95% ethanol. Puparia were mounted using the method suggested by Martin (1987). The terminology for external and internal morphological structures is that of Bink-Moenen (1983), Martin (1985), and Gill (1990). Micro-measurements and camera lucida drawings were made using an Olympus (Japan) BX 51 microscope located in the Department of Entomology, National Taiwan University, Taiwan. A slide of *A. smilaceti* will be deposited each in the collections of the Natural History Museum, London, U.K. and U. S. Department of Agriculture, Beltsville, Maryland, U.S.A. (Sternorrhyncha collections of the United States National Museum of Natural History, Washington D.C.).

Asiothrixus gen. nov.

Type species: *Aleurothrixus antidesmae* Takahashi.

Diagnosis. PUPARIA. pale white, usually with peripheral wax filaments around the margin. Margin crenulate, not modified at tracheal pore openings, marginal crenulations with wax secreting glands at base, appearing as double row of teeth. Submargin not demarcated from dorsal disc. Submedian area usually with scallop/crescent-shaped markings. Longitudinal moulting suture reaching margin, and transverse moulting suture reaching subdorsum. Submedian metathoracic setae absent. First abdominal setae absent. A combination of cephalic, eighth abdominal and caudal submedian setae present; second and third abdominal segments usually each with a pair of siphons, the siphons glandular in nature, enlarged, and appearing swollen, siphons not or with light demarcation near mid-length, their apical ends broad, trumpet-shaped, siphons sometimes absent from a few puparia of a colony or present only one side of the puparium; dorsal disc with simple pores associated with porettes, usually a row of large pores present along the bases of marginal glands; pores along the marginal glands without associated porettes. Sometimes, dorsal siphons or submarginal row of pores absent from puparium, but one of these characters always present; submargin usually with 2 pairs of setae on cephalothorax and 2–3 pairs on abdomen. The median length of the abdominal segment VII nearly equal to VI. Vasiform orifice elongate-subcircular, inner posterior wall with transverse ridges; operculum almost covering the orifice; lingula almost obscured; only tip may be visible. Ventrally, tracheal folds may be indicated by spinules, adhesive sacs and spiracles visible.

ETYMOLOGY: The genus name *Asio-* and *-thrixus* elicited from the geographical distribution of the species in Asian region, and the *–thrixus* means "thread-like" representing the marginal wax fringe which is present in the live puparia.

Remarks. The new genus differs from *Aleurothrixus* in the following combination of characters: submargin not separated from the dorsal disc, metathoracic setae absent, a row of submarginal pores present and/or the submedian area of second and third abdominal segments with siphons, the second, and third abdominal siphons are glandular at base and forming concavity at apex, and vasiform orifice elongate-subcircular. The species of *Aleurothrixus* have: the very wide submargin distinctly separated from the dorsal disc, metathoracic setae present, dorsal disc without siphons, and the vasiform orifice usually transversely-elliptical. The new genus differs from *Aleurotrachelus* Quaintance & Baker and *Cohicaleyrodes* Bink-Moenen in the absence of lateral longitudinal fold/markings on the submedian/subdorsal area of cephalothorax and abdomen. It also differs from *Dialeuropora* Quaintance and Baker by the presence of dorsal siphons and wax secreting glands at the base of submarginal teeth, and much smaller submarginal

pores. In *Dialeuropora* the submarginal pores are much larger and sometimes associated with small tubercles, and submarginal wax secreting glands are absent.

Key to puparia of *Asiothrixus* species

1. Caudal setae positioned halfway between vasiform orifice and puparial caudal margin; 15–16 pairs of submarginal pores present along wax secreting glands 2
-. Caudal setae submarginal, closer to wax secreting glands; 25–35 pairs of submarginal pores present in a row along submarginal wax secreting glands; if not, 6–8 pairs of minute pores, equal to dorsal pores, scattered (not in row) and located far from submarginal wax secreting glands 3
2. Dorsal siphons absent from abdominal segments II and III in most specimens (present in a few); abdominal segments rhachisform (Fig. 26); operculum almost as long as wide ..... *specialis* **sp. nov.**
-. Dorsal siphons present on abdominal segments II and III; abdominal segments not rhachisform; operculum distinctly longer than wide ..... *silvestris*
3. A longitudinal row of crescent-shaped scallops extending from prothorax to abdominal segment II on submedian area (Fig. 37); cephalic setae long, reaching beyond puparial margin; submarginal setae capitate .... *unicus* **sp. nov.**
-. Scallops absent from dorsum; cephalic setae small, not reaching beyond puparial margin; submarginal setae acute 4
4. Two pairs of submarginal setae present on cephalothorax and three pairs on abdomen; a row of large pores absent along the bases of submarginal wax secreting glands, 6–8 simple pores without associated porettes may be present on submargin (Fig. 13); siphons always present, basal and apical half of siphons never subequal in length; basal half much smaller and much glandular, almost rounded ..... *smilaceti*
-. Two pairs of submarginal setae each on cephalothorax and abdomen; a row of 25–35 pairs of large (usually larger than abdominal dorsal pores, 2.5 µm–7.5 µm in diameter width) pores arranged along the bases of marginal glands (Figs 1, 5, 7); siphons sometimes absent or variable in number, basal and apical half of siphons nearly subequal in length, basal half rarely reduced ..... *antidesmae*

Asiothrixus antidesmae (Takahashi) comb. nov.

(Figs 1–6, 7–9, Table 1)

Aleurothrixus antidesmae Takahashi, 1933: 13-14. Lectotype (here designated).

Material examined. Taiwan: Lectotype puparium, Kuraru, one puparium on slide, on *Antidesma* sp., 26.v.1932, R. Takahashi (TARI); paralectotypes, 27 puparia on one slide, data same as lectotype; 10 puparia on *Antidesma* sp., 25.v.1932, R. Takahashi (all TARI); other specimens: Nantou, Shueili, 5 puparia on *Smilax* sp., 29.ix.1995, K. C. Chou; Nantou, Wushe, 10 puparia on *Smilax* sp., 12.v.1994, K. C. Chou; Bingdong, Eluanbi, 18 puparia on unidentified plant, 19.iii.1996, K. C. Chou (all NTU); **Brunei**: Penanjong, coast, 6 puparia on slide, on *Dillenia* sp., 03.iii.1989, J. H. Martin 5431, B. M. 1989-89, 4 puparia on slide, data same as preceeding (Martin 5430); **Hawaiian Is**.: Maui, Wailuku, 14 puparia on *Calophyllum inophyllum*, 03.iii.1999, J. H. Martin 7201; **Palau Is**.: Koror, 14 puparia and one third instar on *Ixora* sp., 15.v.2005, K. Englberger (ENQ2005/333); **Indonesia, Sulawesi Utara**: Dumoga-Bone N. P., Toraut forest, near base camp, approx. 215 m. alt., 8 puparia on unidentified plant, 6.v.1985, J. H. Martin 4926; 12 puparia on ?Myrtaceae, 30.iii.1985, J. H. Martin 4767; **Singapore**: Botanic Gardens, Napier/Cluny Rds, 2 puparia on *Garcinia eugeniaefolia*, 29.xii.1996, J. H. Martin 6992; 11 puparia, one third instar on two slides, unidentified plant, 29.xii.1996, J. H. Martin 6993 (all NHM London).

Host plants. *Antidesma* sp. (Takahashi, 1933); ?Myrtaceae & indet. (Martin, 1988); *Anthurium andraeanum, Gardenia jasminoides, Gardenia* sp., *Morinda citrifolia, Ocimum* sp. (Evans, 2007); *Smilax* sp. (new record). *Calophyllum inophyllum, Dillenia* sp., *Garcinia eugeniaefolia, Ixora* sp. (all NHM) (new records).

Distribution. Taiwan (Takahashi, 1933); Sulawesi (Martin, 1988); Puerto Rico, Philippines, Thailand (Evans, 2007); Brunei, Guadeloupe, Hawaii Is., Palau, Singapore, W. Samoa (NHM London).

Remarks. The puparium of this species resembles *A. smilaceti* but differs from it by the presence of a row of 25–35 pairs of large pores along the bases of marginal glands; abdominal segments not medially rhachisform, and four pairs of submarginal setae (two pairs each on cephalothorax and abdomen). This is the only species of *Asiothrixus* known to occur in the New World. Martin observed puparial wax variation as follows: on *Garcinia eugeniaefolia* (Singapore) with translucent wax rays and median tuft; on *Dillenia* sp. (Brunei) with slightly mealy group; from Sulawesi with broad fringe and 20–30 median brown wax tufts and slightly white marginal wax.

TABLE 1. Puparial measurements for *Asiothrixus* species. (*A. silvestris* measurements are in Corbett, 1935).

Measurements (in µm)	*A. antidesmae**	*A. smilaceti*	*A. specialis* **sp. nov.**	*A. unicus* **sp. nov.**
Pupal case length (in mm)	0.77–0.88	0.81–0.95	0.78–0.96	0.67–0.81
Pupal case width (in mm)	0.47–0.61	0.56–0.67	0.51–0.61	0.37–0.50
Anterior marginal setae	8.7–27.5	25–30	25–35	27.5–32.5
Posterior marginal setae	31.5–38.7	30–40	30–42	27.5–35
Cephalic setae length	25–97	15–32.5	7.5–47.5	130–180
1st submarginal setae	10–33.7	5–15	35–42.5	6.25–10
2nd submarginal setae	15–37.5	7.5–20	6.5–40	7.5–10
3rd submarginal setae	17.5–37.5	7.5–20	25–50	7.5–12.5
4th submarginal setae	21.25–42.5	11.2–17.5	27.5–47.5	6.25–11.2
5th submarginal setae	Absent	5–16.2	Present/ Absent	7.5–12.5
2nd abdominal siphons	32.5–72.5	57.5–90	Absent	150–183.7
3rd abdominal siphons	30–182.5	70–90	Absent	152–175
8th abdominal setae length	62.5–77.5	27.5–50	32.5–52.5	77.5–82.5
Caudal setae length	13.75–82.5	22.5–55	8.1–52.5	85–120
Ventral setae length	6–30	11.2–27.5	20–25	15–20
Ventral setae apart	30–57.5	48.7–63.7	57.5–68.7	37.5
Vasiform orifice length	52.5–62.5	55–63.7	62.5–78.1	41.2–47.5
Vasiform orifice width	46.2–65	51.2–61.2	52.5–67.5	45–52.5
Operculum length	27.5–40	28.7–82.5	41.2–52.5	20.5–32.5
Operculum width	32.5–31.2	37.5–41.2	41.2–50	31.2–35
No. of crenulations in 0.1 mm	10–14	10–12	9–12	13–15
Length between vasiform orifice and caudal margin	42.5–65	40–60	62.5–77.5	42.5–65
No. of pairs of submarginal pores	25–35	6–8	15–16	23–30

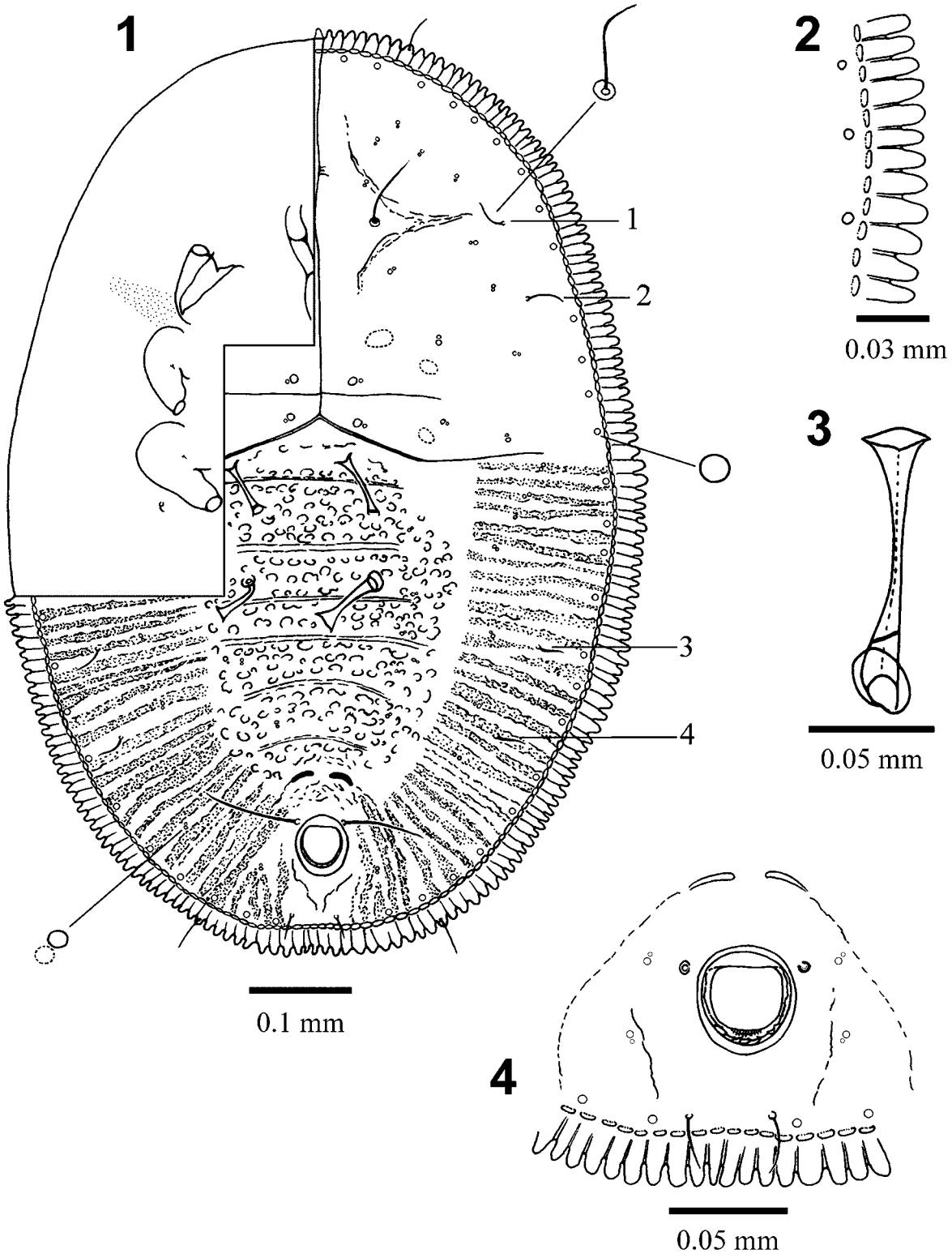
*In some puparia of a single colony, the siphons are absent on second and third abdominal segments.

***Asiothrixus smilaceti* (Takahashi) comb. nov.**
(Figs 10–12, 13–25, Table 1)

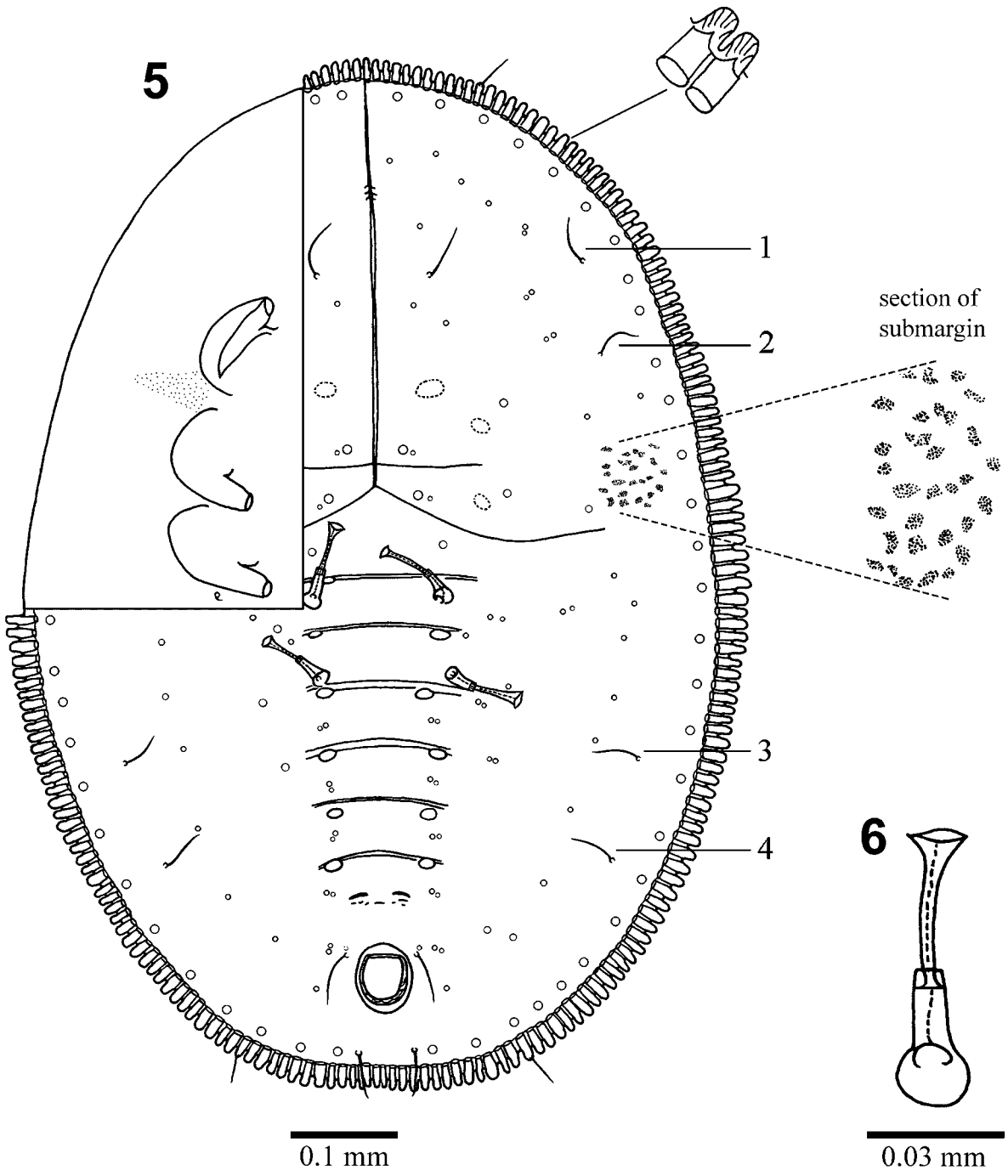
Aleurothrixus smilaceti Takahashi, 1934: 63-64. Lectotype (here designated).

Material examined. Taiwan: lectotype puparium of *Aleurothrixus smilaceti*, Hichiseisan, on *Smilax* sp., 23.ix.1933, R. Takahashi, clearly indicated on slide (TARI); paralectotypes, 8 complete and one broken puparium on same slide as lectotype; 18 puparia, on other slides (TARI); other specimens: **Taiwan**: Taipei, Yangmingshan, 34 puparia on *Smilax* sp., 27.i.1994, K. C. Chou; Nantou, Donpu, 22 puparia on *Smilax* sp., 18.vii.1996, K. C. Chou; 30 puparia on *Smilax* sp., 4.viii.1994, K. C. Chou; Nantou, Lien-Hua-Chih, 30

puparia on *Smilax* sp., 12.vii.1996, K. C. Chou; Kenting National Park, 9 puparia on *Smilax* sp., 4.iv.1986, C. C. Ko; Taitung, Chipen, 12 puparia on unidentified plant, 25.ii.1990, C. C. Ko (all NTU); Jianshi forest, 69 puparia, 1 ♀, 2 ♂ on 6 slides, on *Smilax* sp., 11.vi.2009, A. K. Dubey & Y. T. Shih (NTU 5382); 10 puparia, 2 ♀ on 2 slides, on *Smilax* sp., 11.vi.2009, A. K. Dubey & Y. T. Shih (several puparia in 95% alcohol) (NTU 5381).



FIGURES 1–4 *A. antidesmae*, lectotype puparium, Taiwan (TARI) (A1–A3 representing corresponding abdominal segments). 1, dorsal and ventral surface. 2, marginal teeth with glands at base. 3, dorsal siphon from abdominal segment. 4, posterior end of puparium and vasiform orifice.

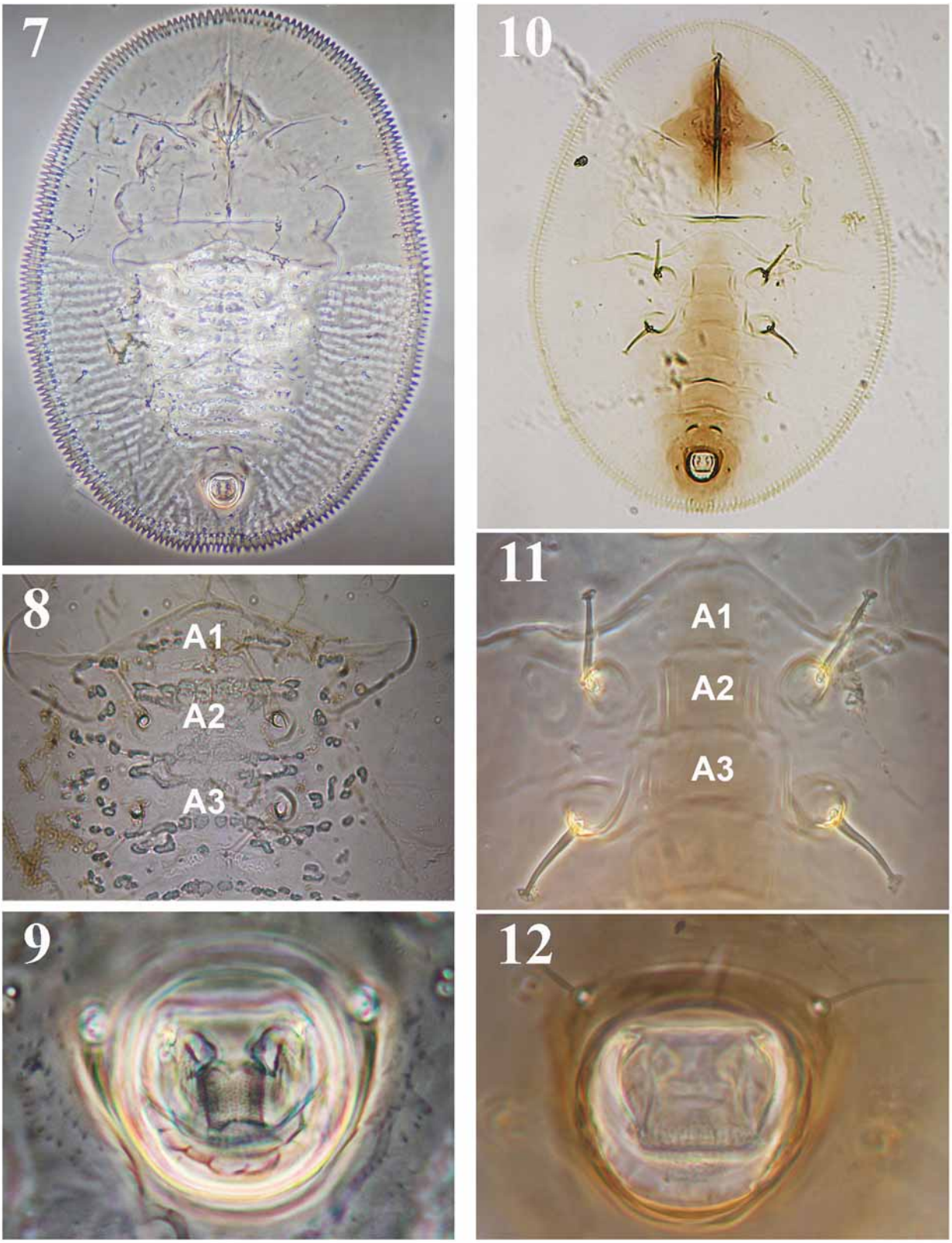


FIGURES 5–6 *A. antidesmae*, paralectotype puparium, Taiwan (TARI). 5, dorsal and ventral surface. 6, siphon from abdominal segment.

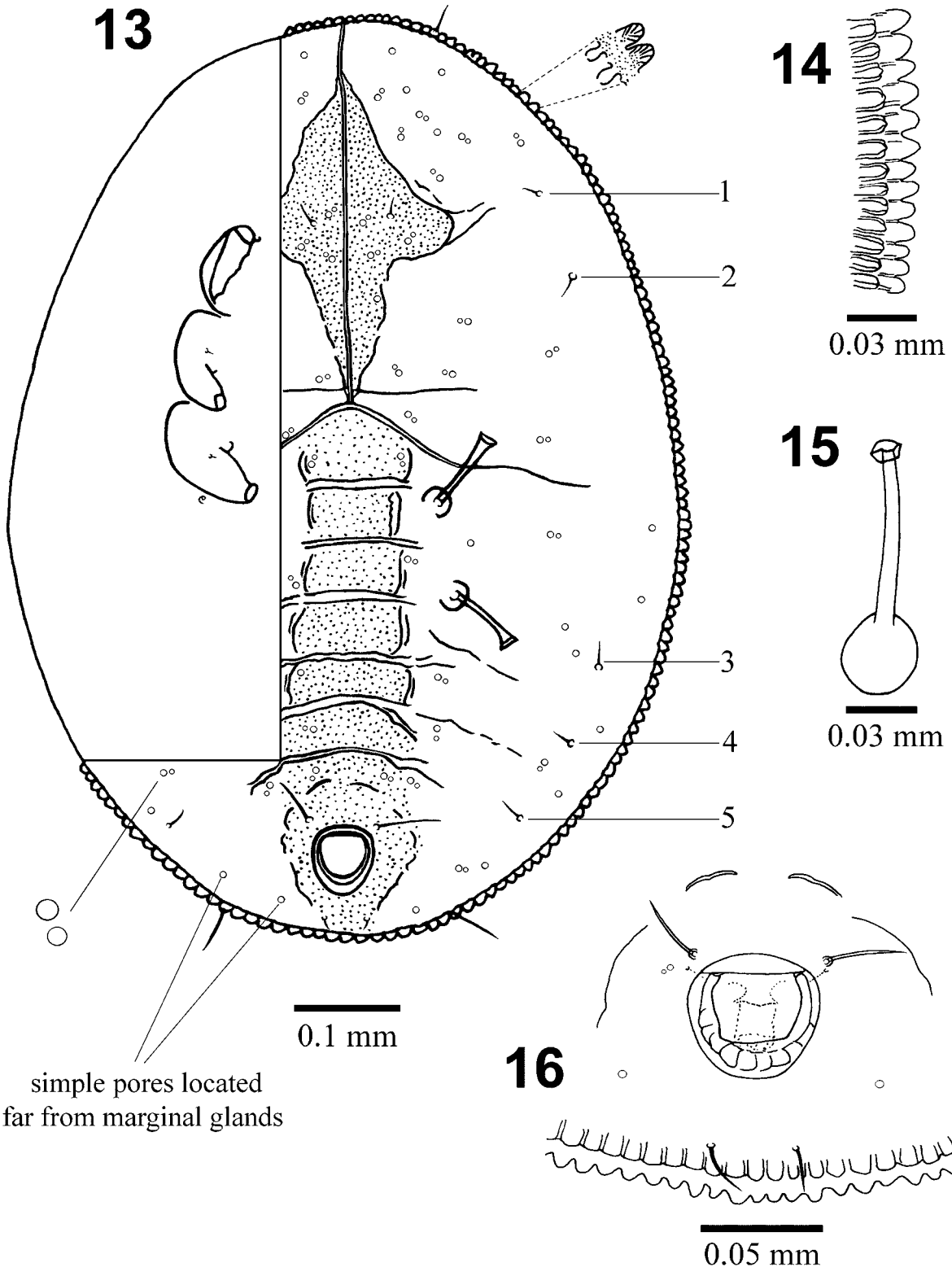
Host plants. *Smilax* sp. (Takahashi, 1934), *Smilax china* (Evans, 2007).

Distribution. Taiwan.

ADULT MALE (Figs 17–20). Antenna 7-segmented, segment III longest, 2 primary sensoria placed subapically, and 1 sensorial cone located in front of the middle, apex of the sensorial cone reaching beyond the apical end of segment III; segment VI and VII each with 1 sensorial cone; segment V and VII each with 1 primary sensoria; the upper and lower lobes of each compound eye are joined by 4 ommatidia; 4 pairs of abdominal wax plates, each assisted by 1 minute seta on outer side and 2 setae on inner side, 1 small circular marking in middle of each wax plate was visible. Genitalia: each clasper with subapical teeth and adhesive sac, apical spine present, the median dorsal surface with 5 setae; aedeagus pointed apically.



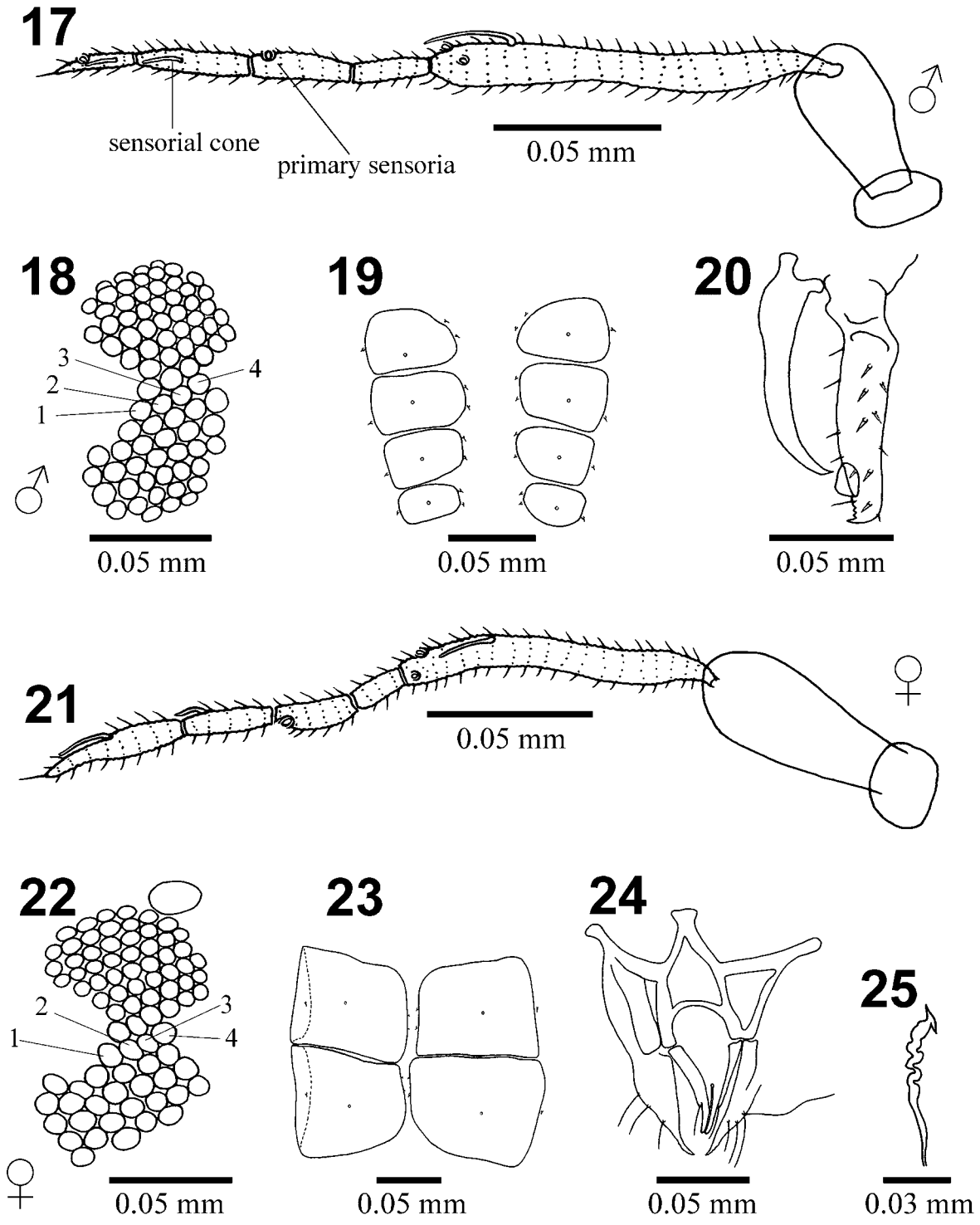
FIGURES 7–12 photomicrographs, *A. antidesmae* and *A. smilaceti*, lectotype puparium, Taiwan (TARI). 7, *A. antidesmae*, puparium, dorsal surface. 8, same, siphons on abdominal segments II and III. 9, same, vasiform orifice. 10, *A. smilaceti*, puparium, dorsal surface. 11, same, siphons on abdominal segments II and III. 12, same, vasiform orifice.



FIGURES 13–16 *A. smilaceti*, lectotype puparium, Taiwan (TARI). 13, dorsal and ventral surface. 14, marginal teeth with glands at base. 15, siphon from abdominal segment. 16, posterior end of puparium and vasiform orifice.

ADULT FEMALE (Figs 21–25). Antenna 7-segmented, segment III longest with 2 primary sensoria subapically and 1 sensorial cone, the apex of sensorial cone not reaching the tip of segment III; 1 sensorial cone each on segment VI and VII; 1 primary sensoria each on segment V and VII; the upper and lower lobes of each compound eye are joined by 4 ommatidia; 2 pairs of abdominal wax plates, each assisted with 1 seta

on outer side and 2 setae on inner side. Genitalia: paired gonopophysis with 3 pairs and unpaired gonopophysis with 1 pair of setae. Cement gland deeply constricted at three places.



FIGURES 17–25 *A. smilaceti*, adults, Taiwan (NTU). 17, antenna (male). 18, eye (male). 19, abdominal wax plates (male). 20, clasper and aedeagus. 21, antenna (female). 22, eye (female). 23, abdominal wax plates (female). 24, genitalia (female). 25, cement gland.

Remarks: This is a host specific species. The puparia are found in groups on the lower leaf surfaces, with transparent dorsum and marginal fringe of white wax, milky white in appearance. The puparium differs from that of *A. antidesmae* by the presence of rhachisform abdominal segments, shape of siphons and five pairs of

submarginal setae (two pairs on cephalothorax and three on abdomen), and by the absence of a row of large pores along the base of marginal glands. Pigmentation was absent on the submedian area of freshly mounted puparia.

***Asiothrixus specialis* sp. nov.**
(Figs 26–28, 33–35, Table 1)

PUPARIUM. Elliptical, broadest at transverse moulting suture region, gradually constricted toward posterior region. Margin dentate, each tooth with a wax secreting gland at base, deep incision between teeth, teeth not modified at tracheal pore openings.

Dorsum. Submargin not demarcated from dorsal disc. Cephalothorax with an oblique furrow. Submarginal area with a row of wide rimmed circular pores; submarginal pores located closer to the bases of marginal wax secreting glands. Longitudinal moulting suture reaching margin and transverse moulting suture reaching submedian area. Transverse moulting suture slightly turned anteriorly on submedian area. Abdominal segments I–VII rhachisform, each with a pair of pores and associated porettes on submedian area. Pores and associated porettes scattered on subdorsum. Glandular siphons absent on abdominal segments.

Vasiform orifice. Subcircular, posteriorly little narrow, inner posterior wall of the orifice with ridges; operculum covering 1/3rd of orifice. Lingula tip exposed, not extending beyond posterior wall of the orifice, with a pair of minute setae subapically. Pockets not contiguous.

Chaetotaxy. Anterior and posterior marginal setae present. First abdominal setae absent. Cephalic, eighth abdominal setae cephalolaterad of vasiform orifice and caudal setae present. Caudal setae placed on halfway between posterior end of vasiform orifice and puparial caudal end. Submargin with four pairs of pointed setae, two pairs each on cephalothorax and abdomen.

Venter. Adhesive pads at leg apices, adhesive sacs and spiracles visible. A pair of minute setae present at base of meso-, and metathoracic legs. Ventral setae positioned moderately below eighth abdominal setae. Stipples present at base of prothoracic legs, reaching submarginal area. Antennae reaching at base of prothoracic legs.

Distribution. Brunei (Borneo).

Host plant. Unidentified vine.

Material examined. Holotype, **Brunei**: Borneo, hilltop rain-forest, near Bukit Bedawan, 4°30'N, 114°48'E, 1 puparium of 6 puparia on one slide, on indet. vine., 30.iii.1989, J. H. Martin 5501, B. M. 1989-89 (NHM London).

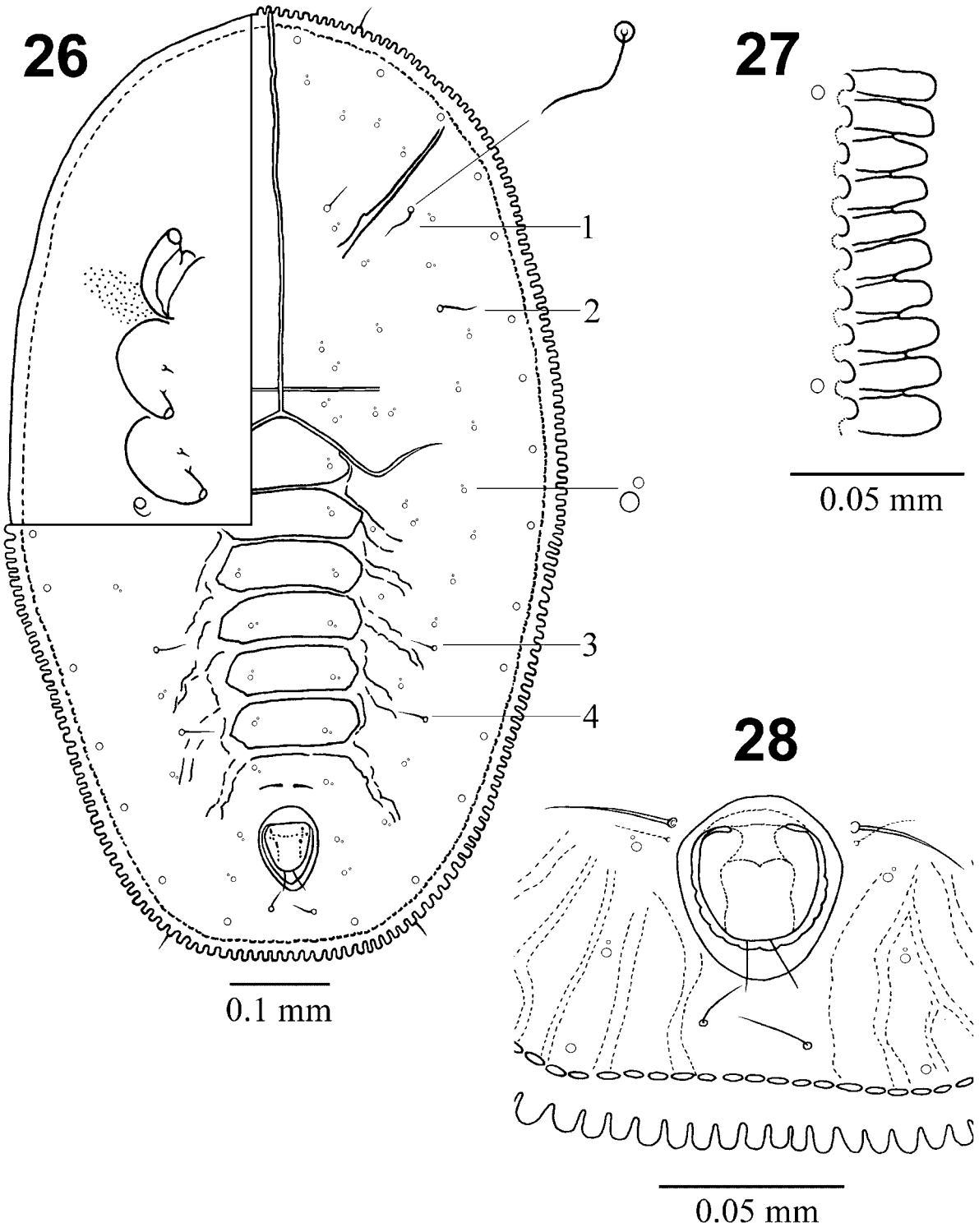
Paratypes. 5 puparia on slide with holotype; 15 puparia on two slides, data as for holotype (NHM London).

Etymology. The species name is derived from a Latin word "*specialis'* meaning 'special', 'alone' for emphasizing puparial morphology within the new genus.

Remarks. The puparia of this species can be distinguished from other species of the genus by the usual, but not constant, absence of dorsal siphons on the abdominal segments, and by the presence of rhachisform abdominal segments, slightly long and posteriorly narrow vasiform orifice. The puparia of this species resemble *A. silvestris* in shape and in number of submarginal pore pairs, but differ by the absence of siphons on abdominal segment II and III, and rhachisform abdominal segments.

***Asiothrixus unicus* sp. nov.**
(Figs 29–32, 36–39, Table 1)

PUPARIUM. Elliptical, broadest at abdominal segment II–III, narrower toward anterior half. Margin teethed, each tooth with a wax secreting gland at base; teeth not modified at tracheal pore openings.



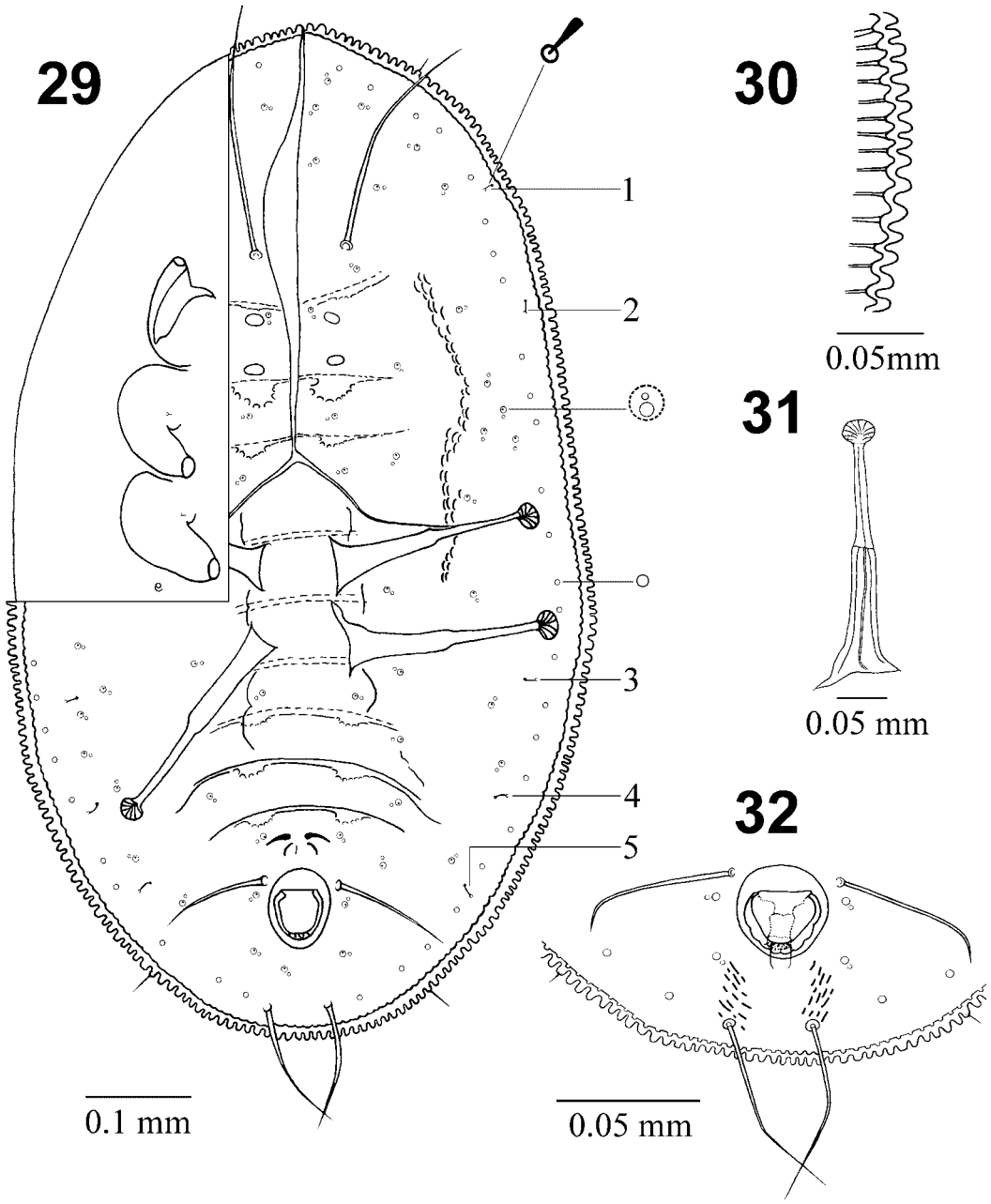
FIGURES 26–28 *A. specialis* **sp. nov.**, holotype puparium, UK (NHM). 26, dorsal and ventral surface. 27, margin. 28, posterior abdominal area.

Dorsum. Submargin not demarcated from dorsal disc. Longitudinal moulting suture reaching margin and transverse moulting suture reaching submedian area. Submargin with five pairs of capitate setae, two pairs on cephalothorax and three pairs on abdomen. Submarginal area with a row of minute circular pores, number of submarginal pores varies in left and right half of puparium; submarginal pores located far from marginal

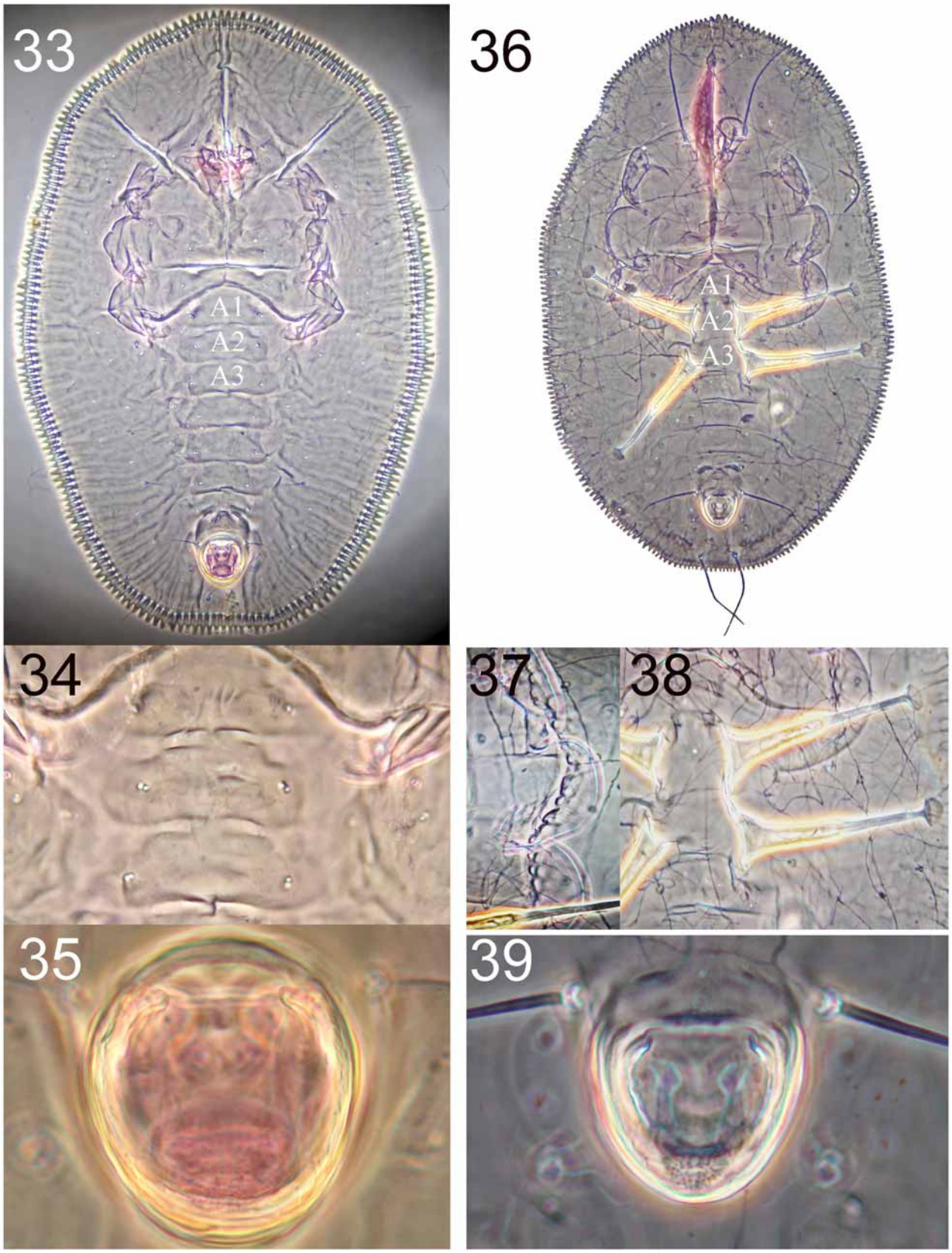
glands. A longitudinal row of crescent-shaped scallops present on submedian/subdorsal area, extending from cephalothorax to second abdominal segment. Abdominal segment VII not reduced medially. Abdominal segments suture I/II–III/IV weakly visible. A pair of glandular siphons present on abdominal segment II and III, each siphon narrowed toward anterior half and apically expanded with concave, nearly circular opening. Pockets not contiguous.

Vasiform orifice. Subcircular, inner posterior wall of the orifice with ridges; operculum covering 75% of orifice. Lingula tip exposed, not extending beyond posterior wall of the orifice, with a pair of setae subapically.

Chaetotaxy. Anterior and posterior marginal setae present. First abdominal setae absent. Cephalic, eighth abdominal and caudal setae present, eighth abdominal setae cephalolaterad of vasiform orifice. Cephalic setae three times longer than the length of vasiform orifice. Caudal setae submarginal, located in a row of submarginal pores.



FIGURES 29–32 *A. unicus* **sp. nov.**, holotype puparium, UK (NHM). 29, dorsal and ventral surface. 30, margin. 31, dorsal siphons. 32, posterior abdominal area.



FIGURES 33–39 photomicrographs, *A. specialis* **sp. nov.** and *A. unicus* **sp. nov.**, holotype puparium, UK (NHM) (A1–A3 representing corresponding abdominal segments). 33, *A. specialis*, puparium. 34, abdominal segments I–III. 35, same, vasiform orifice. 36, *A. unicus*, puparium. 37, scallop-shaped markings on submedian area. 38, siphons from abdominal segment. 39, vasiform orifice.

Venter. Adhesive pads at leg apices, adhesive sacs and spiracles visible. Spinules in thoracic tracheal folds absent. Antennae reaching at base of prothoracic legs. A pair of minute setae present at base of meso-, and metathoracic legs.

Distribution. Indonesia, Sulawesi.

Host plant. *Piper* sp. (Piperaceae).

Material examined. Holotype, **Indonesia, Sulawesi**: Dumoga-Bone N. P., Toraut forest, near base camp, approximately 215 m. alt., one puparium of 5 puparia on one slide, on *Piper* sp., 15.iii.1985, J. H. Martin 4679 (NHM London).

Paratypes. 4 puparia on slide with holotype; 3 puparia on slide, data as for holotype (NHM London).

Etymology. The species name is derived from a Latin word '*unicus*' meaning 'only', 'singular' or 'sole' for emphasizing peculiar morphologies of the puparium.

Remarks. The puparia of this species are distinguishable from other *Asiothrixus* species by the narrow elongate shape and by the presence of long cephalic setae, reaching beyond the puparial margin, capitate submarginal setae and scallop-shaped markings on submedian area. It differs from *A. smilaceti* in the shape of siphons on abdominal segments II and III (in *A. smilaceti*, the basal parts of siphons are much enlarged and rounded), capitate submarginal setae, long cephalic setae and scallop-shaped markings on submedian area.

Discussion

In defining *Aleurothrixus* Quaintance & Baker (1914: 103) stated that '…submarginal area not separated from dorsal disc; dorsum without papillae or pores, but bearing along median line a few pairs of long, spine-like hairs; ...", which statement does not match their own drawing. Martin (1999) re-diagnosed the genus as "dorsal disc almost completely separated from wide submarginal area by a rather, complex, disjunct fold, approximately concentric with puparial margin." Here we follow this generic diagnosis for *Aleurothrixus*, leading us to the conclusion that the Asian assemblage comprises a different genus entirely. Both *Aleurothrixus* and *Asiothrixus* have glands at the bases of the marginal teeth (a character commonly described in literature as a "double row of marginal teeth". Marginal teeth with basal glands are also present in species of *Aleurotrachelus* and *Aleuromarginatus* Corbett, but the new genus differs from the former in the absence of a pair of lateral longitudinal folds in the submedian area of the cephalothorax, and from *Aleuromarginatus* in the puparial shape, the structure of vasiform orifice, the presence of submedian siphons, and a much reduced chaetotaxy: also, the species of *Aleuromarginatus* feed exclusively on leguminous (Fabaceae) hosts.

Establishment of the new genus has led to three new name combinations as already discussed. The new combination, *Asiothrixus silvestris* (Corbett), is based solely on the description of this species provided by Corbett (1935).

The species of *Asiothrixus* may be distinguished by use of the key, but a few observations on variability follow. In life, *A. silvestris* was described as having no marginal secretion whereas *A. antidesmae* has many long waxy threads emanating from the whole margin (waxy threads also present in some of Takahashi's mounted puparia). In *A. antidesmae*, the microtubercles on the submedian area of the abdomen were absent in some of the examined specimens (Fig. 5), in some they were also present on the cephalothorax, and were entirely absent in others. It is most likely that the "microtubercles' in this species are solid wax deposition on the dorsum. However, the number of submarginal setae (two pairs each on cephalothorax and abdomen) was stable in *A. antidesmae*. In *A. antidesmae*, the siphons are somewhat variable, the variations observed amongst a single population collected by Takahashi on May 26, 1932. A more extreme variation is the absence of siphons in six of 13 puparia of *A. antidesmae* examined from Singapore (Martin, NHM), sometimes present only one side of the puparium; their lengths also varied within the population of the single colony; one third instar mounted with this population lacks abdominal siphons but submarginal glands were clearly visible. The dorsal pores on the submedian area were usually associated with minute porettes or placed alone, and size of submarginal pores varied greatly from 2.5 to 7.5 µm in diameter width. In *A. smilaceti*, the pore and porettes were closely placed or separated by 2–3 pore diameters. Martin (1988) referred to two colonies of puparia of

A. antidesmae-group being collected from Sulawesi, one of which was from *Piper* sp. (Piperaceae), and differing sufficiently to be distinct from *antidesmae* itself: these specimens are those here described as *Asiothrixus unicus*, the other Sulawesi group being determined as *A. antidesmae*.

Asiothrixus species are native to the Old World, and the pupal morphology discussed here distinguishes these species from *Aleurothrixus* species which are natives of the New World. *A. antidesmae* is invasive and has now been reported from Hawaii, Puerto Rico, Guadeloupe, Western Samoa and the Palau Islands (Evans, 2007; NHM London). Among the *Aleurothrixus* species, only *A. floccosus* is known to be invasive in the Old World tropics.

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