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**Whiteflies of Belize (Hemiptera: Aleyrodidae)
Part 2—a review of the subfamily Aleyrodinae Westwood**

JON H. MARTIN



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Whiteflies of Belize (Hemiptera: Aleyrodidae) Part 2—a review of the subfamily Aleyrodinae Westwood

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Abstract

A field survey of Sternorrhyncha (Hemiptera) in Belize, principally conducted within the Chiquibul Forest Reserve (CFR), has revealed almost 200 species of whiteflies, all but 40 of them belonging to the subfamily Aleyrodinae. Provided here is an illustrated account of described Belize species of Aleyrodidae-Aleyrodinae. This account proposes three new generic synonymies, three new specific synonymies, nine ten combinations, one revalidated species and provides descriptions of three new genera and 12 new species. Two appendices are provided: a check list, which includes species remaining undescribed, and the associated host-plant genera or families (when known) of all putative species; and a summary of taxonomic changes proposed here. Line drawings and/or photographs of slide-mounted puparia are provided for all described species, and photographs alone are provided for a few of the more distinctive species that remain undescribed.

Key words: Whiteflies, Aleyrodinae, review, Belize, neotropical, check list, illustrations, host-plants

Introduction

The Aleyrodidae comprises a single family within the Sternorrhyncha, one of three suborders of the Hemiptera, and includes around 1,500 currently valid species and subspecies names. This communication is the conclusion of a two-part systematic account of this family in the Central American country of Belize. The study material is the result of an extensive survey conducted within the Chiquibul Forest Reserve (CFR), Cayo District, whilst the author was based at Las Cuevas Research Station. The first part of this study (Martin, 2004) provided an account of the subfamily Aleurodicinae in Belize, and included an introduction to general whitefly biology and natural history, a review of literature relevant to taxonomic studies of both of the two whitefly subfamilies in the New World, details of the methodologies involved, and protocols for the field collection and laboratory preparation of whitefly specimens. The reader is therefore referred to Part 1 for all of these general topics.

In its two parts this is the most detailed account, to date, of Central American Aleyrodidae and is particularly timely in view of the increases in distribution of several species, as discussed below.

Terminology and scope

All descriptions and discussions here concern the puparium (fourth-instar nymph), unless otherwise stated. Figure A (p. 5) depicts a stylised aleyrodine puparium, with the major morphological features annotated. Puparial descriptions and discussions presented here generally follow the terminology discussed by Russell (1943) and employed by Martin

(1987, 1999) and by Gill (1990). For each genus of Aleyrodinae in Belize, the author's interpretation of its diagnostic characters is given. In the individual species accounts, the quoted geographical distributions are attributable to Mound & Halsey (1978), supplemented by material currently present in the collection of The Natural History Museum, London (BMNH). As in part 1, host plant genera and family names follow the system of Balick *et al.* (2000). Once again, the opportunity has been taken to propose here all whitefly nomenclatural changes suggested as a result of this study, even if involving taxa not recorded from Belize.

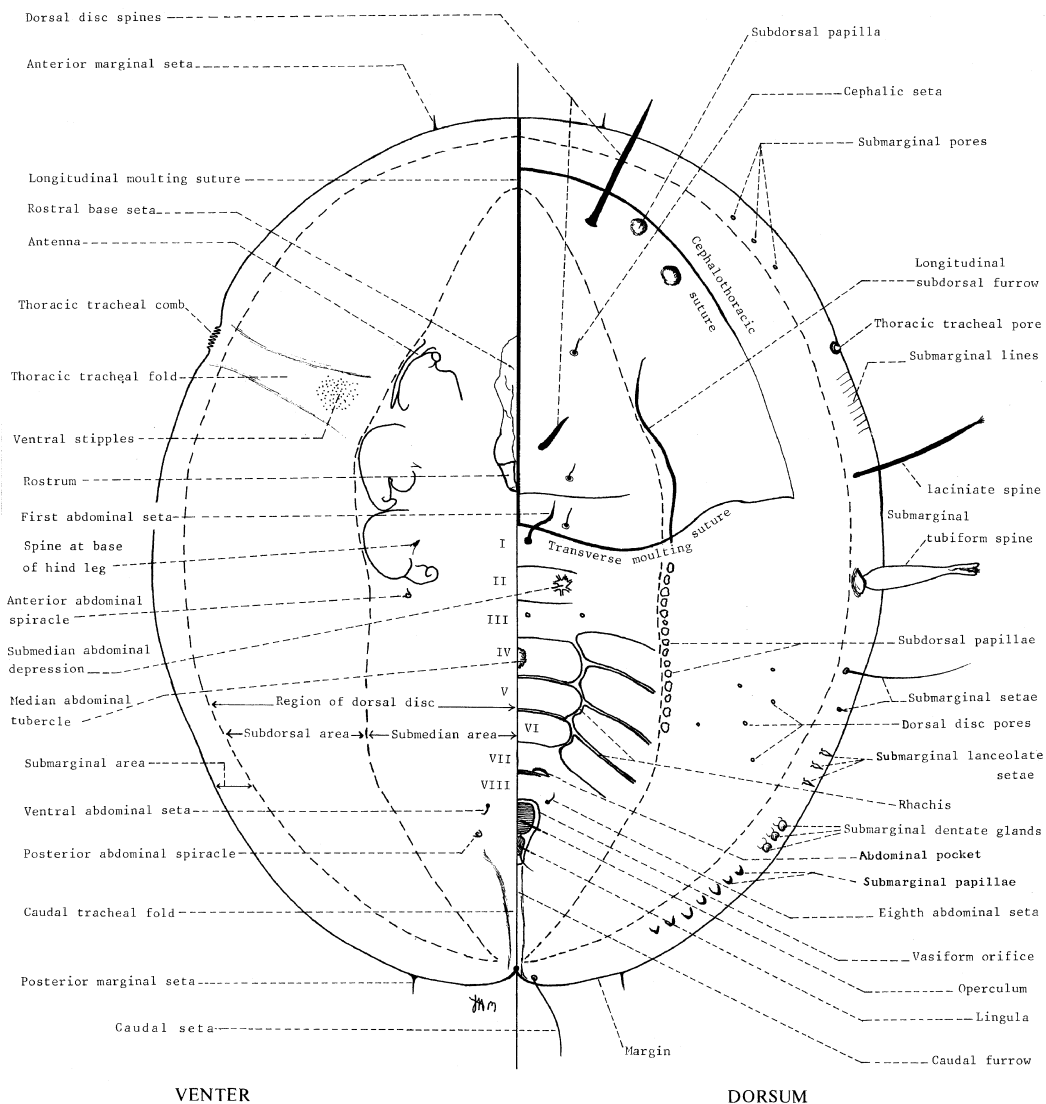


FIGURE A. Stylised Aleyrodinae puparium, annotated with anatomical terminology used in descriptions and discussion (modified after Martin, 1987).

The scope of this second part of the study of Belize whiteflies is somewhat different from that of part 1. For the Aleurodicinae, as complete an account as possible was prepared, with only a few uncertain specimens of *Paraleyrodes* species remaining undescribed. The Aleyrodinae present different challenges, not only because the subfamily is represented by four times as many putative species in Belize. Although a puparial key was provided to all Neotropical genera of the Aleurodicinae, in part 1, the manifold uncertainties over generic definitions and placements within the Aleyrodinae have rendered the provision of a similar key to aleyrodine genera impractical.

Species encountered in Belize as established agricultural pests are likely to be identifiable by use of the illustrated key provided by Martin (1987).

All described Belize aleyrodine species are illustrated in this account, with at least a whole-puparium line drawing or photograph of a slide-mounted specimen, and many species are provided with both. Species newly described here also feature supplementary drawings of particular puparial features. Notable adult characters are also discussed and illustrated for a small number of species.

With available resources not permitting a more detailed study, many species necessarily remain undescribed. A photographic image of a slide-mounted specimen is provided here to facilitate future recognition of a few of the species remaining undescribed, thus allowing specialists and non-specialists rapidly to compare images with unrecognised neotropical specimens. However, such small images are not provided for species unlikely thus to be readily recognisable (particularly those within assemblages of very similar species of *Aleurotrachelus*, *Tetraleurodes*, *Aleuropleurocelus* or *Dialeurodes sensu lato*), but very brief notes on many undetermined species are given in Appendix 1.

In the descriptions of new species the most complete available host plant data are presented, and hosts are also discussed in the comments on several others. Synoptic information on host plant genera and/or family determinations have been included in the check list (Appendix 1) where available. With the exception of species colonising grasses (which do appear to be specialist feeders), most species are considered unlikely to have great host specificity, even if only one host is currently known.

For easy reference, Appendix 2 provides a concise list of the taxonomic changes proposed in the course of this work.

Neotropical Aleyrodinae extending into the Old World

There is a recognised phenomenon of whitefly species escaping the confines of the neotropics, often causing problems for quarantine and agricultural organisations in areas of new introduction. This was discussed in Part 1 of this account, with specific examples from the subfamily Aleurodicinae treated in detail.

However, other recent escapees from the neotropics are members of the Aleyrodinae. *Tetraleurodes acaciae* (Quaintance) (see p. 51) is now known to occur in the Pacific, the Philippines and Hong Kong, colonising a number of fabaceous [leguminous] plants. *Aleurotrachelus atratus* Hempel is a palm-feeding species now present in Samoa, the Comoro archipelago, São Tomé, the Canary Islands and the southern USA [although it has not yet been collected in Belize, it is likely to be present]. The Araceae-feeding *Crenidorsum aroidophagus* Martin & Aguiar (see p. 38) now affects ornamental aroids in Madeira, Fiji and Hawaii, and has been found under glass in France and Germany. Most recently, the avocado-feeding *Tetraleurodes perseae* Nakahara, described from California and Central America in 1995, was discovered in Israel and Lebanon in 2002 [it possibly occurs in Belize—see discussion of *T. confusa* Nakahara, p. 52]. *Aleuroplatus perseaphagus* Martin *et al.* (1996) was described from the island of Madeira, where it had become naturalised, but its similarity to *A. vinsonioides* (Cockerell) (see p. 19), together with museum material from Costa Rica and Venezuela, reveal it to be another neotropical introduction. An example of the potential threat from other New World whiteflies concerns *Aleuroplatus biluminiporus* Martin & Malumphy (2002), thriving on bay trees (*Laurus nobilis*, Lauraceae) in plantations in Colombia, having transferred from local, possibly also lauraceous, hosts: bay is a Mediterranean native, yet fresh Colombian-grown leaves are imported back into Europe for the condiments industry, sometimes carrying these whiteflies. Voucher specimens from most of these introduced populations are present in the BMNH collection, but to date only *T. acaciae* and *C. aroidophagus* have been recorded in Belize with certainty.

Specimen depositories

BMNH—The Natural History Museum, London SW7 5BD, UK

CDEA—California Department of Agriculture, Sacramento, USA

FDA—Florida Department of Agriculture & Consumer Services, Gainesville, USA

MZUSP—Museu de Zoologia da Universidade de São Paulo, Brazil

UCD—R.M.Bohart Museum of Entomology, University of California, Davis, USA

USNM—US Department of Agriculture, Beltsville, Maryland, USA (custodians of the Sternorrhyncha collections of the United States National Museum of Natural History, Washington DC)

Subfamily ALEYRODINAE Westwood, 1840: 435, 442–443

DIAGNOSIS. Puparia with lingula much smaller than in Aleurodicinae, with 2 setae (e.g. Figs 7, 11, 17, 29), with no discernible setae, or with lingula obscured by operculum (Figs 13–16, 18, 19); puparial legs without claws (e.g. Figs A, 22, 23, 31, 48); never with compound or agglomerate pores on puparial dorsum.

Genera and species of Aleyrodinae present in Belize**ALEUROCANTHUS** Quaintance & Baker

Aleurocanthus Quaintance & Baker, 1914: 102. Type species *Aleurodes spinifera* Quaintance, 1903: 63–64, by original designation.

DIAGNOSIS AND COMMENTS. As interpreted here, *Aleurocanthus* comprises species with the following combination of characters: puparia are usually dark, often with rather sparse marginal wax secretion; exuviae of earlier instars often remain attached, in a stack above the puparium; margin regularly toothed, not deflexed; dorsum bearing stout glandular spines, usually with both a submarginal row and a dorsal disc array (Figs 39–40) [these spines not to be confused with robust setae as shown in fig. 41]; sometimes with drops of secreted fluid present at the spine apices; cephalic, eighth abdominal and caudal setae present; first abdominal setae present but usually thickened, sometimes similar to glandular spines; operculum usually obscures lingula; often dimorphic, with male puparia much smaller than those of females.

Aleurocanthus is a palaeotropical genus, currently including over 70 described species. Only one species, *A. woglumi* Ashby occurs in Belize. Martin (1985) placed *A. husaini* Corbett (1939) as a junior synonym of *A. woglumi*, based upon descriptive data. However, puparial specimens examined subsequently have revealed this synonymy to be erroneous, and *A. husaini* is here considered to be a valid species (**stat. rev.**).

***Aleurocanthus woglumi* Ashby**

(Figs 39–40, 82)

Aleurocanthus woglumi Ashby, 1915: 321–322. Lectotype, Jamaica (designated by Martin, 1999: 31).

DISTRIBUTION. Widely distributed in most warmer parts of the world.

COMMENTS. *A. woglumi* is often known as the citrus blackfly because of the black puparia, combined with the dark bodies and dusky wings of the adults. Although this species was described from Jamaica, it is almost certain that *A. woglumi* is a native of the Oriental or Austro-oriental Region, and it is currently the only member of this important genus known in Central America.

ALEUROCERUS Bondar

Aleurocerus Bondar, 1923: 156. Type species *Aleurocerus luxuriosus*, by original designation.
Uraleyrodes Sampson & Drews, 1941: 180. Type species *Uraleyrodes ceriferus*, by monotypy.
[Synonymised by Mound & Halsey, 1978: 27.]

DIAGNOSIS AND COMMENTS. As interpreted here, *Aleurocerus* comprises species with the following combination of puparial characters: vasiform orifice wider than long, lingula obscured by operculum, orifice itself borne on a striking bifid, horned, process (Fig. 38); cuticle dark brown to black; living puparia usually gregarious, secreting coarse, raphia-like, ribbons of secretion, with exuviae of earlier stages often stacked above the puparium; submargin separated from the dorsal disc by a pronounced furrow; abdominal segments submedially rhachisform; margin coarsely toothed.

Aleurocerus is a well-defined genus, occurring only in the Neotropical Region (but occasionally intercepted by quarantine authorities elsewhere—see *A. palmae*, below). Russell (1986) provided an account of *Aleurocerus*, including an annotated puparial drawing and a key to the ten known species. In Belize, three species have been found, all of them already described (see below).

In BMNH there are several samples of puparia (from Costa Rica, Panamá and Trinidad) where the vasiform orifice terminates in a pronounced single horn, and these are considered to belong to a distinct genus that is closely allied to *Aleurocerus*.

***Aleurocerus ceriferus* (Sampson & Drews)**

(Fig. 83)

Uraleyrodes ceriferus Sampson & Drews, 1941: 180–181. Syntypes, Mexico.

Aleurocerus ceriferus (Sampson & Drews) Mound & Halsey, 1978: 27.

Aleurocerus cerifer (Sampson & Drews) Russell, 1986: 151. Unjustified emendation.

DISTRIBUTION. Neotropical Region: Belize, Costa Rica, Honduras, Mexico, Panamá.

COMMENTS. This species is readily distinguishable from the other species of *Aleurocerus* by virtue of its characteristically notched marginal teeth. *A. ceriferus* in Belize clearly favours species of *Piper* as its host plants. The author also found this species to be extremely common in Panamá, where it colonised several host plant families.

***Aleurocerus chiclensis* Russell**

(Fig. 84)

Aleurocerus chiclensis Russell, 1986: 154–157. Holotype, Mexico.

DISTRIBUTION. Neotropical Region: Belize, Mexico.

COMMENTS. The fine characters used by Russell (1986), in her key to species of *Aleurocerus*, are needed to define *A. chiclensis*.

***Aleurocerus palmae* Russell**

(Fig. 85)

Aleurocerus palmae Russell, 1986: 172–175. Holotype, Mexico [intercepted at Dallas, Texas].

DISTRIBUTION. Neotropical Region: Belize, Guatemala, Honduras, Mexico; Palaearctic Region: [Madeira—see below].

COMMENTS. Russell (1986) described this species from approximately 2000 puparia intercepted in the USA, from Honduras, Guatemala and Mexico, all from imported palm leaves. In Belize, *A. palmae* has also been collected from broad-leaved hosts, as well as from palms.

Material of *A. palmae* has been intercepted in Madeira twice, in 1994 and 1996, on unidentified palm foliage of unknown origin, imported via the Netherlands: it appears not to have become established on the island (Antonio Aguiar, pers.comm.).

ALEUROCYBOTUS Quaintance & Baker

Aleurocybotus Quaintance & Baker, 1914: 101. Type species *Aleurodes graminicola* Quaintance, 1899b: 89–90, by original designation.

DIAGNOSIS AND COMMENTS. Adults are the most reliable stage for generic diagnosis: antennal segment VII bears a pair of long apical filaments in males (Fig. 1), and a single such filament in females (Fig. 2); each foot, in both sexes, has a single smooth true claw and a more fleshy claw-shaped appendage which bears minute spinules (Figs 5–6)—this appendage may be the modified paronychium which is not otherwise evident (Russell, 2000). Major puparial characters include: body elongate, margin finely toothed and not modified at thoracic tracheal openings (Fig. 8); cuticle pale but often brownish medially; longitudinal and transverse moulting sutures reach puparial margin; antennal bases located anterolateral to fore legs; submedian abdominal depressions present, often pronounced; vasiform orifice cordate to triangular, lingula exposed but included in the orifice (Fig. 7). Members of this genus have been recorded feeding only on grasses.

Bink-Moenen (1983) had opined that Old World and New World species included within *Aleurocybotus* were likely to represent different genera. Russell (2000) concurred and proposed a new genus, *Vasdavidius*, to accommodate the five Old World species formerly included in *Aleurocybotus*, following studies that clarified the unusual adult characters discussed above. Species now included in *Aleurocybotus* are only known from the New World. One new species from Belize, whose puparia unusually produce copious woolly secretions, is here described.

Aleurocybotus cereus sp. nov.

(Figs 1–8, 86)

PUPARIUM (Figs 7–8, 86). *Habitus*. The immature stages of this species occur singly or in aggregations under the blades of the host grass, smaller groups most usually occurring near the blade's base. A dense and finely flocculent white secretion completely obscures the insects themselves, and there is little indication of ant-attendance. Whitefly-infested blades were found only in deep shade. *Margin*. Outline elongate-oval, often slightly asymmetric, 0.57–0.78 mm long, 0.27–0.39 mm wide, generally widest at metathorax/abdominal segment I (n=15). Margin often appearing irregular but crenulate when viewed in relief (Fig. 8), around 16–18 rounded teeth occupying 0.1 mm of lateral margin, not modified at tracheal openings. *Dorsum*. Longitudinal moulting suture reaches puparial margin; transverse moulting sutures also reaching margin posterior to meso-metathoracic division, allowing cephalothoracic plates to detach as adult emerges (Fig. 86). Submedian/subdorsal area of dorsal disc smooth to slightly uneven, with abdominal segmentation and meso-metathoracic division well marked, but remainder of cephalothoracic divisions hardly evident (Fig. 8); abdominal segment VII not significantly reduced in length medially; submedian abdominal depressions rather subtly indicated. Entire submarginal zone obviously glandular in nature, punctuated by subcircular glands (Fig. 7) and darker inter-glandular divisions, the whole zone appearing reticulate (Fig. 86). Vasiform orifice (Fig. 7) rounded-cordate, internally smooth, inset from puparial margin by approximately its own length; operculum laterally-rounded trapezoidal, occupying a little over half of vasiform orifice, its posterior margin finely setose and with a pair of fine setae; lingula head only slightly expanded, rounded, bearing a single pair of posteriorly-directed setae and included within vasiform orifice. Caudal furrow little-defined. *Chaetotaxy*. Anterior and posterior marginal setae present, hair-like, a little shorter than dorsal setae. Normal dorsal disc chaetotaxy comprises single submedian pairs of cephalic and eighth abdominal setae, single subdorsal pairs of pro-, meso- and metathoracic (Fig. 8), and first abdominal setae; pair of submarginally-placed caudal setae, plus two pairs of submarginal setae placed anterior to caudal setae and lateral/posterolateral to vasiform orifice (Fig. 7); occasionally subdorsum of abdominal segment V or VI with a seta on one or both sides of body; eighth abdominal setae placed opposite anterior edge of operculum (Fig. 7); all dorsal setae similar to each other, long and fine, the shortest pair usually the eighth abdominals which are about as long as the vasiform orifice. *Pores*. A small number of rather large simple pores present, inconsistently paired on either side of puparium—usually 1 lateral to the submedian abdominal depression on each of segments I and III–VIII, 1–2 on each side of each thoracic segment, and 2–3 on each side of cephalic segment; the simple pores not evidently of the geminate pore/porette type. *Venter*. Cuticle smooth, diaphanous. Ventral abdominal setae very fine, underlying vasiform orifice. Legs bisegmental and with apical adhesion pads directed anteriorly on the fore legs, and posteriorly on the middle and hind legs (Fig. 86) which also each have one or two minute

basal setae. Antennal bases anterolateral to fore legs. Slightly sexually dimorphic, with puparial antennae of females reaching middle of middle legs, and those of males reaching base of hind legs. Tracheal folds absent.

ADULT (Fig 1–6.). Adult females were observed feeding solitarily, each within an annulus of mealy wax, somewhat reminiscent of species of *Paraleyrodes* (Aleurodicinae). A small number of adults were also reared from puparia in culture. These display the curious generic characteristic of having only one smooth tarsal claw on each leg, the other “claw” being a more fleshy and minutely spinulose structure (Figs 5–6), possibly the modified paronychium (Russell, 2000). Further, the antennae of males end in two long filaments, usually fused together (Fig. 1), while those of females have a similar but single filament (Fig. 2). These claw and antennal characters are diagnostic for adults of *Aleurocybotus*, species of which only occur in the New World. Other major characters include: antennal segment II approximately 3X segment I; body length 1.08–1.18 mm (male, n=4) and 1.21–1.30 mm (female, n=5), females with 7 antennal segments, males with 6 or 7 recognisable segments (some fusion seems common), abdomen of female with two pairs of ventral wax plates (Fig. 3) but of male with four pairs (Fig. 4); abdominal dorsum of female with a broad band of thick-rimmed simple pores on each of abdominal segments II–VII (Fig. 3), such pores absent in males. Males with aedeagus simple, curved upward and apically acute (Fig. 4).

MATERIAL EXAMINED. Holotype puparium, BELIZE, CFR, site of Millionario camp, on *Lasiacis ?rugelii* (Poaceae), 24.vi.2002 (J.H.Martin #7707) (BMNH). Paratypes (all Martin coll.): 85 puparia, 1 third-instar larva, 15 first-instar larvae, 4 adult males, 15 adult females, same data as holotype (BMNH, USNM); 1 puparium, 1 adult female, same host and locality, 26.iii.2003 (BMNH); 34 puparia, 22 third-instar larvae, 2 second-instar larvae, 5 first-instar larvae, same host and locality, 03.vi.2004; 4 puparia, CFR, San Pastor track, on *Lasiacis* sp. (possibly a different species), 22.iii.2003 (BMNH); numerous puparia and larvae dry on leaves, same host and locality as holotype (BMNH).

ETYMOLOGY. The species name is the latin *cereus* (meaning waxen), alluding to the large amount of secreted wax in the immature stages.

COMMENTS. The immature stages of *A. cereus* are rendered highly visible because of the white-coloured and rather fibrous nature of their secretions. In complete contrast, those of all species of *Aleurocybotus* previously described, including those Old World species transferred to the new genus *Vasdavidius* by Russell (2000), only secrete limited amounts of clear or translucent material, frequently rendering them very cryptic when feeding. Certainly, therefore, the absence of visible secretions in a colony of *Aleurocybotus* should indicate that it cannot be *cereus*.

See also COMMENTS on *Aleurotulus laneus*, here described (p. 26).

ALEUROGLANDULUS Bondar

Aleuroglandulus Bondar, 1923: 121. Type species *Aleuroglandulus subtilis*, by monotypy.

DIAGNOSIS AND COMMENTS. As interpreted here, *Aleuroglandulus* comprises species with the following combination of puparial characters: usually prothorax, and often also abdominal segment III, with a glandular area on each side of body (Figs 35, 37, 89), the glands variably defined but usually at least staining more darkly than remainder of puparium; thoracic and caudal tracheal combs present, the teeth much differentiated from remainder of margin but margin not indented; vasiform orifice subcordate, lingula exposed but mostly included within orifice boundary, lingula head lobulate; a distinct caudal furrow leading from vasiform orifice to posterior puparial margin (Figs 28, 29, 36).

Russell (1944) revised this genus, describing three new species. The present study leads the author to the conclusion that two of Russell's species should be regarded as junior synonyms of the type species, *A. subtilis* Bondar, but that one colony found in Belize represents a new species which is here described. With these changes to a previously revised genus, an alternative key to species is provided, below.

Key to puparia of species of *Aleuroglandulus*

1. Vasiform orifice inset almost twice its length from posterior margin of puparium; prothoracic glands indiscernible (Fig 28)..... *striatus* Sampson & Drews
- Vasiform orifice inset only by its own length or less from posterior margin of puparium (Figs 29, 36); prothoracic glands well-defined (Fig 35, 37) or at least staining differentially2
2. Prothoracic glandular areas not well defined, but smoothly convex in unmounted specimens, and staining more readily than remaining cuticle when slide-mounted (Fig. 87). Leg bases each with a pronounced basal spine (Fig. 31)..... *inanis* **sp. nov.**
- Prothoracic glandular areas well defined (Figs 35, 37, 89), often pigmented brownish. Leg bases each with either a stout spine or a fine seta..... 3
3. With glands absent from abdominal segment III (as in fig. 37), **and also** with only a fine seta at base of each leg..... *magnus* Russell
- Glands usually present on abdominal segment III (Fig. 35), but may be much reduced or absent. A stout spine present at base of each leg (as in fig. 31)..... *subtilis* Bondar

***Aleuroglandulus inanis* sp. nov.**

(Figs 29–32, 87, 139)

PUPARIUM. *Habitus*. Feeding on lower surfaces of leaf, numerous but evenly distributed,

not associated with major veins. Rather cryptic, yellowish in appearance, secretions from glandular areas not mealy but appear to be hygroscopic, with many individuals shiny-wet in humid conditions (Fig. 139). In unmounted dried material, cephalic glandular areas visible as shiny, shallow humps. Rims of operculum and vasiform orifice, and head of lingula, brownish. *Margin*. Outline broadly ovoid, somewhat narrowed caudally, flattened between caudal setae, widest opposite transverse moulting sutures; clear sexual size dimorphism, 1.13–1.27 mm long, 0.88–0.95 mm wide (female) and 1.00–1.08 mm long, 0.76–0.81 mm wide (male) (n=50). Anterior and posterior marginal setae present, minute. Margin smooth to irregular, without teeth excepting the thoracic tracheal combs of up to five irregularly-defined rounded teeth, and caudal tracheal combs of 10+ better-defined small rounded teeth. *Dorsum*. Longitudinal moulting suture reaches puparial margin; transverse moulting sutures turning apically anteriad, terminating in subdorsum opposite ends of pronounced, straight meso-metathoracic suture. Remaining cephalothoracic segmentation in form of oblique folds, not suture-like; abdominal segmental divisions terminate in subdorsum, segment III/IV somewhat more pronounced than remainder; abdominal segment VII not reduced medially; submedian abdominal depressions distinct. Cephalic and abdominal segment III glandular areas stain more darkly than remainder of cuticle (Fig. 87), but are not otherwise differentiated in slide-mounted specimens (but see *habitus* description, above); cephalic glandular areas overlie whole of forelegs and antennae, and abut the cephalic/prothoracic and pro-mesothoracic folds, but those on abdominal segment III are much smaller and abut only the segment III/IV suture. Vasiform orifice (Fig. 29) rounded-triangular, inset from puparial margin by less than its own length (Fig. 87) and situated on a rounded-heptagonal raised area which also incorporates a shallow caudal furrow; when floor of orifice is visible, it is punctuated as shown (Fig. 30). Operculum subcircular, occupying basal two-thirds of vasiform orifice; lingula head (Fig. 29) spinulose, occasionally overlapping posterior margin of vasiform orifice, with three pairs of pronounced lateral lobes and a pair of apical setae; lingular setae extend beyond vasiform orifice, almost to puparial margin. *Chaetotaxy*. Anterior and posterior marginal setae present, very fine, but often lost during slide preparation. Single pairs of short, fine cephalic (Fig. 32), first abdominal and eighth abdominal setae present, the latter placed adjacent to anterior corners of vasiform orifice and much shorter than operculum (Fig. 29–30); caudal setae stout, placed marginally at either end of caudal tracheal comb, attaining length of vasiform orifice. *Pores*. A small number of distinct and rather large pore/porette geminate pairs (Fig. 32) present on dorsal disc, five on each side in cephalothorax, one adjacent to each submedian abdominal depression on abdominal segments III & IV, one adjacent to each distal end of intersegmental sutures V–VII, and one a little further mesad on segments V & VII. *Venter*. Ventral abdominal setae long and fine, similar in length to vasiform orifice. Legs normal, each with a fine adhesion pad and each also with a single stout thorn-like spine (Fig. 31). [Foreleg spine sometimes superficially appears to be associated with antennal base, and hind leg spine is usually smaller than those on fore and

middle legs.] Antennal bases anterior to fore legs; antennae very short and apically pointed (Fig. 31). Thoracic tracheal folds marked as a pair of parallel lines running mesad from thoracic marginal combs, but unpatterned.

MATERIAL EXAMINED. Holotype puparium, BELIZE, CFR, on *Carica* sp. (Caricaceae), 05.iii.1996 (J.H.Martin #6746) (BMNH). Paratypes: 55 puparia, 5 third-instar larvae, 1 second-instar larva, same data as holotype (BMNH, USNM).

ETYMOLOGY. The specific epithet is the latin word *inanis* (meaning ghostly or insubstantial), reflecting the characteristics of the paired prothoracic and 3rd abdominal glands.

COMMENTS. *A. inanis* differs from the other described *Aleuroglandulus* species in the following combination of characters: glandular areas shiny but otherwise indicated on prepared specimens only by differential staining; with the vasiform orifice inset from the puparial margin by less than its own length; the presence of leg-base spines. These characters are constant throughout the substantial type sample.

***Aleuroglandulus striatus* Sampson & Drews**
(Figs 28, 88)

Aleuroglandulus striatus Sampson & Drews, 1941: 157–159. Syntypes, Mexico.

DISTRIBUTION. Neotropical Region: Belize, Costa Rica, Guatemala, Honduras, Mexico.

COMMENTS. See key to species, above, for distinguishing characters. The author has only encountered *A. striatus* in very small numbers, usually widely scattered. Even with dorsal glandular areas inevident, this species exhibits all other generic characters.

***Aleuroglandulus subtilis* Bondar**
(Figs 35–37, 89)

Aleuroglandulus subtilis Bondar, 1923: 121–122. Syntypes, Brazil.

Aleuroglandulus emmae Russell, 1944: 5. Holotype, Mexico. **Syn. nov.**

Aleuroglandulus malangae Russell, 1944: 5. Holotype, Cuba. **Syn. nov.**

DISTRIBUTION. Neotropical Region: Belize, Brazil, Costa Rica, Cuba, Dominican Republic, Ecuador, Mexico, Nicaragua, Panamá; Nearctic Region: USA (Florida).

COMMENTS. Russell (1944) described three new species of *Aleuroglandulus*—*A. emmae*, *A. magnus* and *A. malangae*—each from very small numbers of specimens. *A. emmae* and *A. magnus* were described from seven and six specimens, respectively, taken from herbarium specimens or from quarantine interceptions, with even these small sample

sizes representing two separate collections (*A. magnus*) and four collections (*A. emmae*). Although Russell said of the type sample of *A. malangae* “the insects [puparia] were abundant on the leaves submitted”, the description was prepared from only eight slide-mounted individuals. Such small samples, especially where these represent several individual collections, do not allow an assessment of variability in such notoriously fluid characters as the sizes of glandular patches or the precise numbers of teeth in tracheal combs. Study of material in BMNH indicates that all specimens possessing the combination of leg-base spines, vasiform orifice inset from puparial margin by less than its own length, and well-defined prothoracic glands should be regarded as conspecific. Two large slide-mounted samples (Costa Rica, on *Colocasia* cultivar, n=50+; Belize, on *Schizolobium parahybum*, n=35) clearly indicate that the thoracic tracheal combs are highly variable within colonies. In contrast, two very small samples (Panamá, on *Erythrina fusca*, n=5 and unidentified host, n=2) demonstrate that the glands on abdominal segment III can vary from quite large to entirely absent within an individual colony, and the thoracic tracheal teeth from distinct-acute to hardly discernible. For these reasons, the decision has been taken to propose *A. emmae* and *A. malangae* as junior synonyms of *A. subtilis*.

ALEUROPARADOXUS Quaintance & Baker

Aleuoparadoxus Quaintance & Baker, 1914: 105. Type species *Aleyrodes iridescens* Bemis, 1904: 487–489 by monotypy.

DIAGNOSIS AND COMMENTS. As interpreted here, *Aleuoparadoxus* comprises species with puparia (Figs 19–21, 90–93) that display the following combination of characters: puparia ovoid to slightly wider than long; cuticle usually dark brown to black and with little evident secreted wax; margin crenulate, modified at thoracic tracheal openings; dorsal papillae present, usually with a submarginal row and others present on dorsal disc, the papillae variably developed but usually some rather flat, plate-like; transverse moulting sutures reach submargin; median lengths of abdominal segments VI & VII similar; each cephalic seta situated at lateral apex of a shallow, thumb-shaped ridge; vasiform orifice cordate, fully occupied by operculum, lingula head lobulate but covered by operculum; with a short caudal furrow, defined by a pair of variably developed caudal ridges which terminate at the pair of caudal setae; ventrally, tracheal folds well defined and legs lined mesally by a band of blunt spinules.

Russell (1947) revised this New World genus, comprising ten described species, assigning the genus to the tribe Trialeurodini. Russell noted the propensity for puparia of *Aleuoparadoxus* species to develop readily on both leaf surfaces, and she further noted that morphological differences were not evident between upper and lower-surface individuals. Five species are known from Belize, three of them described and two that

remain undescribed. No colonies have been discovered in Belize, all specimens having been found singly.

***Aleuoparadoxus rhodae* Russell**

(Figs 20, 90)

Aleuoparadoxus rhodae Russell, 1947: 20–22. Holotype, Mexico.

DISTRIBUTION. Neotropical Region: Belize, Mexico.

COMMENTS. This species is represented from Belize by a single puparium (Fig. 90), part of an eight-species whitefly sample collected from its myrtaceous tree host, probably a species of *Eugenia*.

***Aleuoparadoxus sapotae* Russell**

(Figs 19, 91)

Aleuoparadoxus sapotae Russell, 1947: 25–28. Holotype, Belize [“British Honduras”].

DISTRIBUTION. Neotropical Region: Belize.

COMMENTS. *A. sapotae* is the only species of the subfamily Aleyrodinae to have been described from Belize prior to the present study: its type locality was mistakenly quoted as being in [the Republic of] Honduras by Mound & Halsey (1978). It was described from a single specimen (Fig. 91). One species found in CFR during the present study (*Aleuoparadoxus* sp.1, fig. 92, Appendix 1) belongs to the *A. sapotae*-group, as defined by Russell, but exhibits several differences—notably its indistinct submarginal papillae, fewer subdorsal cephalic modified papillae, and a pronounced pale double eyespot on each side of the cephalic region. A further member of the *A. sapotae*-group is represented in BMNH by material from Costa Rica and Panamá.

***Aleuoparadoxus truncatus* Russell**

(Figs 21, 93)

Aleuoparadoxus truncatus Russell, 1947: 30–33. Holotype, Honduras.

DISTRIBUTION. Neotropical Region: Belize, Honduras, Mexico.

COMMENTS. This species is represented from Belize by only three solitary specimens. *Aleuoparadoxus* sp. 2 (Appendix 1), represented by two specimens, is similar to *A. truncatus*, but differs in its narrower submargin and more rounded vasiform orifice.

ALEUROPLATUS Quaintance & Baker

Aleuroplatus Quaintance & Baker, 1914: 98. Type species *Aleurodes quercusaquaticae* Quaintance, 1900: 35–36, by original designation.

DIAGNOSIS AND COMMENTS. As interpreted here, *Aleuroplatus* comprises species with the following combination of characters: cuticle usually black or brownish, occasionally pale; margin regularly crenulate, the marginal outline and/or teeth modified at caudal and thoracic tracheal openings to form an indentation or a “comb” which may be very marked or quite subtle; submargin not differentiated from dorsal disc by a fold or furrow; transverse moulting sutures not reaching puparial margin; vasiform orifice subcircular to subcordate, operculum occupying most of orifice and obscuring lingula; first abdominal setae absent; dorsal surface usually very flat, abdominal rhachis usually absent; venter often heavily sculptured, caudal and thoracic tracheal folds often marked.

Although the type species was described from the New World (Florida), *Aleuroplatus* currently accommodates a disparate worldwide assemblage of around 80 described species: these species include a great range of characteristics, and not all of them answer the rather loose diagnosis given here. Certainly, *Aleuroplatus* is a polyphyletic assemblage and is in much need of revision.

In Belize, only two described species have been identified (see below). However, 14 other taxa have been placed in *Aleuroplatus*, with varying degrees of certainty, from material amassed during this study (see Appendix 1).

***Aleuroplatus cococolus* Quaintance & Baker**

(Fig. 94)

Aleuroplatus cococolus Quaintance & Baker, 1917: 385–386. Syntypes, Trinidad.

DISTRIBUTION. Neotropical Region: Belize, Brazil, Costa Rica, Cuba, Nicaragua, Panamá, Trinidad.

COMMENTS. The puparia of this species secrete clear, glassy, material around and over themselves: when alive they have a shiny, “laquered” appearance, with a narrow line of opaque wax issuing from each of the three tracheal openings at the puparial margin. *A. cococolus* is very common in Central America, but the puparia have not been observed in aggregations. The puparia of some samples display detail variations that may be specific differences and *Aleuroplatus* spp 11 and 13 from Belize (Appendix 1), in particular, are morphologically very similar to *A. cococolus*.

***Aleuroplatus vinsonioides* (Cockerell)**
(Figs 95, 140)

Aleurodes vinsonioides Cockerell, 1898: 225–226. Syntypes, Mexico.
Aleuroplatus vinsonioides (Cockerell) Quaintance & Baker, 1914: 98.

DISTRIBUTION. Neotropical Region: Belize, Costa Rica, Cuba, Guyana, Jamaica, Mexico, Panamá.

COMMENTS. This species is most distinctive in life, each black puparium secreting a fringe of sulphur-yellow wax rays, and a median tuft of yellow wax (Fig. 140). The puparia are usually found in small groups under the leaves of lauraceous hosts. The puparial cuticle is hard and brittle, and requires a substantial degree of bleaching for slide examination, with the result that good slide preparations are few.

ALEUROPLEUROCELUS Drews & Sampson

Aleuropleurocelus Drews & Sampson, 1956: 282. Type species *Aleuropleurocelus laingi* by original designation.

DIAGNOSIS AND COMMENTS. As interpreted here, *Aleuropleurocelus* comprises species with the following combination of characters: venter smaller than dorsum, resulting in deflexion of dorsum (Fig 133–134), with morphological margin being ventrally located and usually crenulate [this character is also seen in species of *Aleurovitreus* **gen. nov.**, figures 22–23, *q.v.*]; puparia black; vasiform orifice slightly elevated (sometimes appears to be surrounded by a sclerotised ring) and variously shaped, but smooth internally and fully occupied by operculum; lingula concealed by operculum; transverse moulting sutures usually reach beyond apparent margin, onto deflexed part of morphological dorsum; cephalic setae present or absent, but first abdominal setae always absent.

Drews & Sampson (1956, 1958) considered that their new genus, *Aleuropleurocelus*, should accommodate New World species which have black puparia with the dorsal surface deflexed to meet a smaller venter. They stated that this genus differed from the Old World genus *Tetralicia* Harrison (1917) through the latter having its true (ventrally located) margin smooth or irregular, its operculum not fully occupying the vasiform orifice and the vasiform orifice being toothed internally. However, *Tetralicia* then only included the type species, *T. ericae* Harrison and, as more species have become available for study in both hemispheres, this suite of separation characters has become unreliable. However, Old and New World assemblages of whitefly species have often proved to be generically separate (see comments on *Aleurocybotus*, p. 10), and therefore *Aleuropleurocelus* and *Tetralicia* are both retained pending further clarification of their respective diagnostic characters.

Puparia of *Aleurotrachelus cecropiae* Bondar (1923) in BMNH, (probably syntypes, see Martin, 2004:56), have their morphological margin substantially deflexed and are characteristically tiny, and the opportunity is therefore taken here to transfer this species to *Aleuropleurocelus* (**comb. nov.**).

Slides of *Aleurodes abnormis* Quaintance (1900) in BMNH (ex-USNM) had been labelled as "*Tetralicia*" *abnormis*, but Quaintance & Baker (1914) had transferred this species to *Tetraleurodes*. As far as the author is aware, the combination *Tetralicia abnormis* has never been published. However, examination of these puparia reveals the morphological true margin to be significantly deflexed, and this species is here transferred to *Aleuropleurocelus* **comb. nov.** The uncertain relationship between *Aleuropleurocelus* and *Tetralicia* is discussed two paragraphs above.

There are presently ten described species included in *Aleuropleurocelus* but, in Belize, ten undescribed species are considered to belong to this genus (see Appendix 1). Each of the Belize *Aleuropleurocelus* species is represented only by a small numbers of specimens, and none warrants description here, although two are illustrated to show generic characters (Figs 133–134).

ALEUROTHRIXUS Quaintance & Baker

Aleurothrixus Quaintance & Baker, 1914: 103–104. Type species *Aleurodes howardi* Quaintance 1907: 91–94, by original designation, a junior synonym of *Aleurodes floccosa* Maskell, 1896: 432–433 [synonymised by Costa Lima, 1942: 425].

Hempelia Sampson & Drews, 1941: 166. Type species *Hempelia chivelensis*, by original designation and monotypy. **Syn. nov.**

DIAGNOSIS AND COMMENTS. As interpreted here, *Aleurothrixus* comprises species with the following combination of characters: dorsal disc almost completely separated from wide submarginal area by an often complex, sometimes disjunct fold (Figs 13–15); cephalic setal pair absent but metathoracic, eighth abdominal and caudal submedian setal pairs present, often long and fine; submargin with seven pairs of rather spine-like, often minute, setae in cephalothorax and anterior part of abdomen; abdominal rhachis present (Figs 13, 15, 96, 97) or absent (Figs 14, 135); vasiform orifice at least as wide as long (often transversely-elliptical), sometimes elevated and prone to distortion when slide-mounted, usually fully occupied by operculum; margin with coarse teeth, each with a basal gland (giving rise to the common historical description of the margin having "a double row of teeth"); marginal teeth not, or very slightly, modified at caudal and thoracic tracheal openings; cuticle pale or with variable degree of dark pigmentation.

Sampson & Drews (1941) described a new genus, *Hempelia*, to accommodate their new species *H. chivelensis*, using the characters of the vasiform orifice to distinguish *Hempelia* from *Tetraleurodes*. However, the glandular marginal teeth, seven pairs of submarginal setae in the anterior half of the body, the broad vasiform orifice and the

definition of a particularly broad submarginal area (Fig. 13) are all characters of the genus *Aleurothrixus*, even though the puparia of most *Aleurothrixus* species have pale cuticle in contrast to the black puparia of *H. chivelensis*. However, some *Aleurothrixus* species have been described with the dorsal disc dark, and even the normally-pale *A. floccosus*-group is known to have populations with the dorsal disc darkly pigmented (Martin, 1999: 51). *Hempelia* is therefore considered a junior synonym of *Aleurothrixus*. Puparia in BMNH of *Aleurotrachelus myrtifolii* Bondar (1923) (probably syntypes, see Martin, 2004:56) are clearly congeners of *H. chivelensis*, and the species is therefore here transferred to *Aleurothrixus* (**comb. nov.**).

There are presently 20 described species accommodated within *Aleurothrixus*, but *A. antidesmae* Takahashi (1933) (described from Taiwan) and a small number of similar Asian species, currently included in this genus, are clearly not congeneric with the New World assemblage and may require a new genus to accommodate them.

Three described species of *Aleurothrixus* have now been recorded from Belize, along with three additional species which are probably undescribed. Belize *Aleurothrixus* species 1 and 2 are briefly discussed in the comments on *A. myrtacei* and *A. chivelensis* respectively, below. *Aleurothrixus* species 3 has characteristically dagger-shaped eighth abdominal and caudal setae, as depicted for *A. aguiari* Costa Lima (1942), but the nature of the marginal tooth-base glands is quite different.

***Aleurothrixus chivelensis* (Sampson & Drews) comb. nov.**

(Fig. 13)

Hempelia chivelensis Sampson & Drews, 1941: 166. Syntypes, Mexico.

DISTRIBUTION. Neotropical Region: Belize, Mexico.

COMMENTS. As discussed in the generic diagnosis, above, the puparial characteristics of this species agree with the generic definition of *Aleurothrixus*, as interpreted here, leading to the decision to propose *Hempelia* as a junior synonym of *Aleurothrixus*. Puparia usually develop in distinct aggregations, which is a characteristic often observed in other species of *Aleurothrixus*.

Aleurothrixus sp. 2 (Fig. 135, see Appendix 1), represented in BMNH by material from both Belize and Nicaragua, is similar to *A. chivelensis* but the marginal teeth are coarser and the vasiform orifice is surrounded by figure of characteristic shape.

***Aleurothrixus floccosus* (Maskell)**

(Figs 15, 96)

Aleurodes floccosa Maskell, 1896: 432–433. Lectotype, Jamaica (designated by Martin, 1999: 50). *Aleurothrixus floccosus* (Maskell) Quaintance & Baker, 1914: 103.

DISTRIBUTION. Neotropical Region—widely distributed; Nearctic Region—Florida; Palearctic Region—Mediterranean basin, Macaronesia, Japan (Okinawa); Ethiopian Region—widely distributed; Oriental Region—India; Austro-Oriental Region—Philippines, Singapore; Pacific Region—Galapagos Is, Tahiti; Malagasian Region—Mauritius, Réunion.

COMMENTS. *A. floccosus*, often known as the woolly whitefly, is a native of the Neotropical Region, first described from Jamaican material sent to Maskell in New Zealand. The woolly whitefly has been present in the Mediterranean basin, the Macaronesian islands and in Africa for many years but has more recently been found in eastern and south-eastern Asia (Singapore, 1994; Philippines, 1996; Okinawa, 1998—vouchers in BMNH), and is also present in the Malagasian Region and in the Pacific: it is a species which has been slowly extending its range for many years, and has been the cause of economic problems in several parts of the world. There is variation in puparial cuticular pigmentation between populations (Martin, 1999: 51), and it is possible that there are several races of this pest species.

***Aleurothrixus myrtacei* Bondar**

(Figs 14, 97)

Aleurothrixus myrtacei Bondar, 1923: 176. Syntypes, Brazil.

DISTRIBUTION. Neotropical Region: Barbados, Belize, Brazil, Guadeloupe.

COMMENTS. *A. myrtacei* has puparia with finer marginal teeth and shorter submedian setae than in *A. floccosus*, but it shares the characteristic gregarious habit of the immature stages, which are usually found in discreet, crowded, groups. Two Brazilian puparia in BMNH (which are probably syntypes, see Martin, 2004:56), have their eighth abdominal and caudal setae shorter and stouter than those of Belize specimens; however, specimens in BMNH from guava in Barbados have these setal pairs intermediate in form and this is considered to be intraspecific variation.

Aleurothrixus sp 1 (see Appendix 1) closely resembles *A. myrtacei*, differing only in the very dark puparial cuticle. *A. myrtacei* may exhibit variation in the degree of puparial pigmentation, as seen in some populations of *A. floccosus* (see discussion of *A. floccosus*, above).

ALEUROTRACHELUS Quaintance & Baker

Aleurotrachelus Quaintance & Baker, 1914: 103. Type species *Aleurodes tracheifer* Quaintance, 1900: 38–39, by original designation.

Luederwaltiana Hempel, 1922: 1185–1186. Type species *Luederwaltiana eriosemae* by original designation and monotypy **syn. nov.**

DIAGNOSIS AND COMMENTS. As interpreted here, *Aleurotrachelus* comprises species whose puparia (Figs 16, 17, 98–100, 141) share the following combination of characters: margin regularly toothed, the teeth not, or hardly, modified at caudal and thoracic tracheal openings at margin, but the teeth have glands at their bases, often appearing double-ranked as a result (Fig. 17, enlarged detail); dorsal disc loosely defined by a pair of longitudinal cephalothoracic folds, usually overlying the legs and often extending into abdomen; shallow rhachis present, often without lateral arms; cephalic setae usually absent, metathoracic, eighth abdominal and caudal submedian setae present; first abdominal setae absent in New World species; subdorsum without setae, but submargin sometimes with tiny setae whose bases are almost indistinguishable from row of submarginal pores; vasiform orifice subcircular to subcordate, situated on posterior end of rhachis, usually longer than wide, operculum occupies most of the orifice; lingula often rather large and may be either excluded (Fig. 17, enlarged detail) or folded into vasiform orifice; puparia of most species with cuticle dark brown to black, but some species with pale puparia.

Examination of puparial type material of *Luederwaltiana eriosemae* Hempel (1922), kindly loaned by MZUSP, revealed it to be clearly congeneric with the type species of *Aleurotrachelus*, *A. tracheifer* (Quaintance), whereas numbers of other species currently placed in *Aleurotrachelus* are unlikely to be congeners (see below). The specimens on the examined Hempel syntype slide of *L. eriosemae* were poorly cleared, and the mountant is imperfect, but there are 15 specimens present and, between them, all the major characters are visible, leading to the conclusion that *Luederwaltiana* is a junior synonym of *Aleurotrachelus*, with *L. eriosemae* transferred to *Aleurotrachelus* **comb. nov.**

This genus has always been very flexibly interpreted, with the result that *Aleurotrachelus* is now one of the largest assemblages of whitefly species, is certainly polyphyletic, and is in great need of revision. There are currently over 85 described species included, but it is certain that many of these (especially in the Old World) will prove not to be congeners. With some of the species discovered in Belize, perhaps the greatest difficulty has been in deciding which are better placed in *Aleurotrachelus*, rather than *Aleurothrixus* or *Aleurotulus* (*q.v.*). Inevitably, *Aleurotrachelus* has been used here to receive several species of rather doubtful identity.

The particularly imprecise definition of *Aleurotrachelus sensu lato* has resulted in 13 species from Belize being assigned to the genus, only three of them described.

Aleurotrachelus socialis Bondar

(Fig. 98)

Aleurotrachelus socialis Bondar, 1923: 145–146. Syntypes, Brazil.

DISTRIBUTION. Neotropical Region: Belize, Brazil, Colombia, Costa Rica, Ecuador, Guyana, Panamá.

COMMENTS. Although described from *Cecropia* sp. (Moraceae), *A. socialis* is the

name applied to the species now particularly known as a pest of yuca crops (cassava, *Manihot* varieties, Euphorbiaceae) in Central and South America. The shape of the vasiform orifice varies somewhat between samples: the orifice is a little wider than long in the “typical” cassava form (Fig. 98), but almost square in outline in other cassava samples and on other hosts. However, the characteristic castellate marginal teeth, small dorsal patches of tiny spinules, and rather stout eighth abdominal setae that are longer than the caudal setae are constant characters. The puparia of *A. socialis* are very similar to those of the palm-feeding *A. atratus* Hempel, but the puparia of *A. atratus* are larger and the vasiform orifice is more cordate than in *A. socialis*.

Although no samples have been seen from cassava in Belize, the vasiform orifice in puparia from other hosts (see Appendix 2) varies from the wider “typical” cassava form to the more square form and this species is tentatively here recorded as occurring in Belize.

***Aleurotrachelus tracheifer* (Quaintance)**

(Figs 16, 99, 141)

Aleurodes tracheifer Quaintance, 1900: 38–39. Syntypes, Mexico.

Aleurotrachelus tracheifer (Quaintance) Quaintance & Baker, 1914: 103.

DISTRIBUTION. Neotropical Region: Belize, Mexico, Panamá.

COMMENTS. Puparia of this species usually occur in small clusters under leaves, and their secretions are delicate and distinctive (Fig. 141). The puparial cuticle is dark brown, but bleaching is rarely necessary. *A. tracheifer* is one of the few *Aleurotrachelus* species whose puparia possess a pair of cephalic submedian setae.

***Aleurotrachelus trachoides* (Back)**

(Figs 17, 100)

Aleurodes trachoides Back, 1912: 151–153. Syntypes, Cuba.

Aleurotrachelus trachoides (Back) Quaintance & Baker, 1914: 103.

DISTRIBUTION. Neotropical Region: widely distributed; Ethiopian Region: Gambia (see below); Pacific Region: widely distributed.

COMMENTS. *A. trachoides* is a native of the Neotropical Region, but had become established in Tahiti by the 1930s (BMNH). It has become more widespread across the Pacific since the late 1970s, and is now also in Hawaii (late 1990s) and Guam (2003). A recent quarantine interception in England, on plant material from Gambia, indicates possible establishment in the Ethiopian Region (Malumphy, 2005). *A. trachoides* has been called the solanum whitefly by some people, and it does seem to favour hosts in the

Solanaceae, but it also feeds on several other plants, including aroids (Araceae), frangipanni (Apocynaceae) and Convolvulaceae.

Belize *Aleurotrachelus* species 2 (Appendix 1) closely resembles *A. trachoides*, apparently differing only in the puparial lingula being less broad and less posteriorly notched. In Belize species 4, the characters of the lingula and submargin strongly resemble *A. trachoides*, but the marginal teeth are strongly castellate and not markedly paler than the dorsal disc as they are in *A. trachoides*.

ALEUROTULUS Quaintance & Baker

Aleurotulus Quaintance & Baker, 1914: 101–102. Type species *Aleurodes nephrolepidis* Quaintance, 1900: 29–30, by original designation.

DIAGNOSIS AND COMMENTS. As interpreted here, *Aleurotulus* comprises species whose puparia (Figs 9–11, 42, 101–104) display the following combination of characters: margin regularly toothed, the teeth either simple or each with a gland at its base; if margin modified at tracheal openings then as combs of modified teeth; submargin not differentiated from remainder of dorsal disc; single submedian pairs of metathoracic, eighth abdominal and caudal setae present, cephalic and mesothoracic pairs present or absent; submargin bearing seven pairs of tiny setae in cephalothorax (Fig. 10) and anterior part of abdomen [character shared with species of *Aleurothrixus*]; abdomen with or without a rhachis; vasiform orifice ovoid to cordate, mostly occupied by operculum; lingula head large, usually extending beyond boundary of vasiform orifice (Fig. 11), but sometimes folded vertically into posterior part of orifice; puparial cuticle pale or brown, but not requiring bleaching.

Only six described species are included in this genus. In Belize *Aleurotulus* is represented by one described species (*A. mundururu* Bondar), one that is here described (*A. laneus* **sp. nov.**), and one species that remains undescribed, all species belonging to a group that share the presence of posterolaterally-directed arms extending from the median abdominal rhachis, and characteristically deep oblique cephalothoracic folds. However, members of the *A. mundururu*-group may later prove not to be congeners of the type species of *Aleurotulus*, *A. nephrolepidis* (Quaintance): *A. nephrolepidis* lacks the abdominal rhachis, deep cephalothoracic folding and marginal tooth-base glands. The whole generic grouping of *Aleurothrixus*, *Aleurotulus* and *Aleurotrachelus* will require a range of techniques to allow its complete reappraisal.

Aleurotulus laneus sp. nov.

(Figs 9–12, 101)

PUPARIUM. *Habitus*. Puparia developing in small aggregations under leaf blades. Each individual secreting dense tangle of fine, translucent, filaments from dorsal surface, and marginal fringe of more-opaque wax rays. *Margin*. Outline ovoid, 0.90–1.05 mm long, 0.54–0.65 mm wide, generally widest at abdominal segment II/III (n=10). Margin regularly crenulate, 10–11 teeth occupying 0.1 mm, teeth not modified at thoracic tracheal openings. *Dorsum*. In outer submargin, each marginal tooth with a distinct basal gland, narrower than tooth (Fig. 10–11), ovoid and slightly longer than wide; a pair of subtle folds extending mesad from base of each tooth, between tooth-base glands, folds longer and more robust at posterior end of puparium. Longitudinal moulting suture reaching puparial margin, its middle one-third part distinctly keeled; transverse moulting sutures terminating in subdorsum, opposite median part of abdominal segment I, but their confluence with the longitudinal suture is so far anterior as to be almost contiguous with suture-like meso-metathoracic division. Dorsal disc with cuticle generally rather smooth; cephalic region defined by pair of oblique subdorsal folds; median part of abdomen raised to form rhachis (Fig. 101), with very finely spinulose cuticle; lateral to rhachis, 4 major pairs of folds are directed posteriad at an acute angle to median line of puparium; anterior to these folds a much shorter pair of folds is confluent with raised part of segment I; abdominal segment VII not reduced in length medially. Vasiform orifice (Fig. 11) cordate, slightly elevated, about as long as wide, but fringed posteriorly by a finely rugose “skirt”, giving orifice an apparently trapezoidal outline at lower magnifications, orifice inset from puparial margin by slightly more than its own length; operculum rounded-hexagonal, almost fully occupying vasiform orifice; lingula with head little wider than shaft, globose, surface finely spinulose and bearing 2 apical setae, usually just lingular head extending beyond boundary of vasiform orifice. Pockets (submedian abdominal segment VII/VIII boundary) hardly evident. *Chaetotaxy*. Posterior marginal setae present, hair-like; anterior marginal setae not always evident but then shorter than posterior pair. Submedian setal pairs (Fig. 9) as follows: cephalic, robust, thickened, often curved, 70 µm in holotype; metathoracic, thickened but long and rather ribbon-like, 140 µm in holotype; eighth abdominal, extremely broad, dagger-like, apically acute or occasionally bifid (80 µm, with one bifid, in holotype, fig. 11); caudal, very long and fine, 150 µm in holotype. Outer submargin, between longitudinal moulting suture and a point opposite median part of abdominal segment II, with 7 pairs of tiny setae (the anteriormost 6 pairs depicted in Fig. 10), these difficult to see if margin down-curved. *Pores*. Dorsal disc provided with pore/porette geminate pairs, themselves fairly regularly paired on each side of body, one or two pairs on each segment of rhachis; outer subdorsum with uneven row of pore/porettes (approximately 17 on each side of puparium in holotype); one tiny porette present immediately mesal to some marginal tooth-base glands (Fig. 10), and slightly further

mesad is a row of slightly larger pores (but these pores and porettes not apparently geminate), approximately one pore or porette to each 4–6 tooth-base glands. *Venter*. Ventral abdominal setae long, fine, similar to posterior marginal pair, underlying mid-point between vasiform orifice and pockets. Each leg with one minute basal spine, often more difficult to see on front legs. Antennal bases anteromesal to fore legs, antennae smooth-sided, slightly acute apically and shorter than front legs. Tracheal folds absent.

ADULT FEMALE (Fig. 12). Body 1.2–1.3 mm long (n=6). Antennae 0.35 mm long, 7-segmented, segment II 3X segment I in length; segments III, V, VI & VII each with an elongate uncinula (terminology of Bink-Moenen, 1983), rather thickly seta-like, but that on segment VI much shorter and finer than remainder (Fig. 12); segment III with two, segments V & VII each with one, protuberant subapical sensorium (possibly equivalent to the lachneait of Bink-Moenen's terminology); segment VII terminating in a process similar in length to remainder of segment. Abdomen with 2 pairs of large ventral wax plates, each about 0.18 mm wide. Wings with venation typical for Aleyrodinae, each with only a simple main vein; fore wings elongate-oval, 2.75 times longer than wide. Vasiform orifice subcircular to ovoid; lingula acute apically, without an obvious pair of apical setae. One tarsal claw clearly larger and thicker than the other on each leg; tarsal paronychium acute-spatulate when viewed laterally, but appearing like a third claw when viewed vertically. [Adult male unknown.]

MATERIAL EXAMINED. Holotype puparium, BELIZE, CFR, on *Lasiacis* sp. (Poaceae), 22.iii.2003 (J.H.Martin #7782) (BMNH). Paratypes: 89 puparia, 29 third-instar larvae, exuviae of 6 second-instar and 2 first-instar larvae, 6 adult females, same data as holotype, or same host and locality, 22.iii.2003, 28.iii.2003 & 05.iv.2003 (Martin) (BMNH, USNM); dry puparial material on leaf blades, same data as holotype (BMNH).

ETYMOLOGY. The species name is the latin *laneus* (meaning woolly), describing the fine, filamentous tangle secreted by each puparium.

COMMENTS. *A. laneus* is clearly a member of the *A. mundururu*-group, differing from *A. mundururu* Bondar principally in possession of a pair of cephalic setae which are similar to broad, dagger-like, eighth abdominal setae (*A. mundururu* has no cephalic setae, and its eighth abdominal setae are long and fine, hair-like), and in the marginal tooth-base glands being longer than wide, more uneven in size than they are in *A. mundururu*.

Aleurotulus laneus shares its host in the CFR with *Aleurocybotus cereus*. The puparia of both species are obscured by flocculent secretions and appear quite similar prior to slide-mounting, but are unmistakable when examined microscopically. The adult females of the two species have very different antennal segments (Figs 12, 2 respectively) and microscopic recognition of adults alone should be possible. Adult males of *Aleurotulus laneus* have not been seen, but are also likely to be easily distinguished from those of *Aleurocybotus cereus*. Also sharing the same grass host is *Trialeurodes abdita* (q.v.).

***Aleurotulus mundururu* Bondar**

(Figs 42, 102–104)

Aleurotulus mundururu Bondar, 1923: 131–132. Syntypes, Brazil.

DISTRIBUTION. Neotropical Region: Belize, Brazil, Costa Rica, Ecuador, Guyana, Trinidad.

COMMENTS. *A. mundururu* is one of a group of species with a distinct abdominal rhachis with lateral arms that are angled acutely posteriad, with very characteristic oblique cephalothoracic folds, a keeled longitudinal moulting suture, and with the meso-metathoracic division much thickened submedially, intersecting the longitudinal moulting suture close to its confluence with the transverse moulting sutures (Fig. 42). *A. mundururu* does not possess a pair of cephalic setae; the metathoracic, eighth abdominal and caudal setal pairs are long and hair-like; the glands at the bases of the marginal teeth are even-sized, each narrower than one tooth-base and not longer than wide. *A. laneus* (described above) is also a member of this group, differing from *A. mundururu* primarily in the possession of a pair of cephalic setae (Fig. 9), in the thickened nature of the cephalic and eighth abdominal setal pairs, and the nature of the marginal tooth-base glands.

Some puparia of *A. mundururu* possess a series of apparent short folds, perpendicular to the puparial margin, leading mesad from the marginal tooth bases and effectively defining the submarginal zone (Figs 103–104). However, post-emergence pupal cases do not display this character (Fig. 102), and it appears to be an artifact of the developing adult insect inside the puparium.

In addition to *A. mundururu* and *A. laneus*, one further member of the *A. mundururu*-group (Appendix 1) has been collected in Belize, and also in Nicaragua. The puparia of this species secrete distinct peripheral wax “stars”, and there are other taxonomic differences.

***ALEUROVITREUS* gen. nov.**Type species *Aleyrodes insignis* Bondar, 1923: 127–128.

DIAGNOSIS—PUPARIUM (Figs 22, 23, 105–108, 142). Without evident waxy secretions, individuals scattered singly under leaves, generally cryptic whilst feeding and silvery, glassy, in appearance when adults or parasitoids have emerged (Fig. 142). Cuticle often entirely pale, but some species with brownish patches variably developed on some or all individuals (Figs 105–107). Morphological margin always deflexed ventrally, such that the contact footprint of the puparium on the leaf surface is smaller than the overall body size, with regular rounded crenulations that are not usually clearly modified at the tracheal openings. Dorsal chaetotaxy typically comprising paired submedian cephalic, meso- and

metathoracic, eighth abdominal and caudal setae: sometimes with both thoracic pairs reduced to little more than their tubercular bases and set close to the meso–metathoracic intersegmental fold, but cephalic pairs only rarely wanting. Vasiform orifice cordate, internally smooth, variably elevated posteriorly, fully occupied by the operculum. Abdominal segment VII not significantly reduced in length medially. With geminate pore/porettes regularly distributed over dorsum. Transverse moulting sutures closely approach apparent puparial margin (the actual edge of the puparium).

ETYMOLOGY. The generic name derives from the latin adjective *vitreus* (meaning glassy), reflecting the distinctly glassy appearance of empty pupal cases of members of this genus.

COMMENTS. The puparia of *Aleurovitreus* are similar to those of *Aleuropleurocelus* Drews & Sampson, the major difference being the opaquely black cuticle in *Aleuropleurocelus*. However, the puparial cuticle of *Aleurovitreus* species is also much smoother and finer than in species of *Aleuropleurocelus*, the venter being especially much less robust.

Most material in the BMNH collection was collected in Central America, but a few specimens from Brazil and Venezuela indicate a wide distribution in South America too. Species from Belize, that are considered to belong to *Aleurovitreus*, display marked variation in the degree of marginal deflexion, from a narrow and regular band (Fig. 108) to a very broad and irregular zone (Fig. 22). Nine species of *Aleurovitreus* have been collected in Belize, including the type species, *A. insignis* (Bondar); one new species is here described and seven remain undescribed.

***Aleurovitreus insignis* (Bondar) comb. nov.**

(Figs 22, 107)

Aleyrodes insignis Bondar, 1923: 127–128. Syntypes, Brazil.

DISTRIBUTION. Neotropical Region: Belize, Brazil, Costa Rica, Venezuela.

REDESCRIPTION—PUPARIUM. *Habitus.* Usually widely scattered on the undersides of leaves, with no evident waxy secretion and thus very cryptic when still feeding, but colourless-glassy when empty. *Margin.* Outline oval, 0.54–0.75 mm long, 0.36–0.52 mm wide, generally widest opposite transverse moulting sutures (n=20). Apparent margin smooth, but morphological margin deflexed ventrally, with 15–18 rounded crenulations per 0.1mm, precise appearance dependent on presentation to the field of view, not modified at thoracic tracheal openings. *Dorsum.* Dorsal disc generally smooth, with a patch of brown pigmentation centred on confluence of longitudinal and transverse moulting sutures, and other patches variably present between cephalic setae, at extremities of transverse moulting sutures and anterior to vasiform orifice (Fig. 107). Longitudinal moulting suture reaches round ventrally to the deflexed morphological

margin, appearing crimped along its middle one-third, but hardly keeled; transverse moulting sutures terminate in outer subdorsum. Meso-metathoracic division pronounced and marked into subdorsum, other cephalothoracic segmentation indistinct, abdominal segmentation distinct only medially, segment VII not significantly reduced medially; submedian abdominal and cephalothoracic depressions distinct, subcircular to ovoid. Individuals of some samples with variably developed submedian tubercles on abdominal segments I–IV or V, probably environmentally induced. Vasiform orifice cordate, smooth, about as wide as long, situated on an elevation and inset about its own length from posterior puparial margin; operculum completely occupying vasiform orifice, obscuring lingula head. *Chaetotaxy*. Single submedian pairs of cephalic, meso- and metathoracic, eighth abdominal and caudal setae present, usually all long and stout, with the cephalic pair normally longest and sometimes overlapping puparial margin, eighth abdominal setae placed anterior and slightly lateral to vasiform orifice. Two pairs of fine, straight thoracic submarginal setae present, physically just on the dorsal surface in most examined specimens, usually much shorter than submedian setae but puparia of one Brazilian sample in BMNH with only the caudal setae longer than the thoracic submarginal pairs. Anterior and posterior marginal setae present, fine and hair-like, arising from crenulations of morphological margin. *Pores*. Geminate pore/porettes sparse, one on each side of submedian part of each abdominal segment except VI, one on each side of subdorsum of abdominal segments III–VIII, and typically up to 3 on each side of each cephalothoracic segment. In addition to the geminate pore/porettes, a small subdorsal group of thick-rimmed bright pores is present in prothorax, often within an apparent circular shallowly raised area, typically 3 or 4 pores in each group; an outer submarginal group of 2–3 pores of the same type present on each side of abdominal segment IV, and 1–2 on each side of segment V. *Venter*. Smooth, diaphanous. Ventral abdominal setae very fine, bases close to median line, underlying anterior edge of vasiform orifice. Legs smooth, bisegmental, the adhesion padded apices directed mesad, middle and hind legs sometimes each with a minute basal seta just visible. Antennae similar in length to distal segments of fore legs, their bases anteromesal to fore legs. Thoracic and caudal tracheal folds absent. Submedian thoracic adhesive sacs absent.

MATERIAL EXAMINED. 4 syntype puparia, BRAZIL, Bahia, on *Persea gratissima* (Bondar) (MZUSP); BELIZE, numerous puparia, Las Cuevas Research Station, on *Persea americana*, 1994–2002 (Martin) (BMNH, USNM); 18 puparia, BRAZIL, São Paulo, Campinas, on *Persea americana*, v.1983 (Lourencao) (BMNH); 1 puparium, COSTA RICA, Heredia Province, 15km N of Puerto Viejo, on ?*Persea* sp., 04.ii.1983 (Martin) (BMNH); 1 puparium, VENEZUELA, Aragua, La Candelaria, on *Persea americana*, 01.iii.1982 (Arnal/Debrot) (BMNH).

COMMENTS. This species is probably common on avocado trees throughout Central and South America, given the disjunct distribution of the countries from which it has been collected. The widely scattered individual puparia, combined with pale cuticle, very small

size and lack of waxy secretions, lead to its being overlooked unless actively sought. Material collected in Belize, Costa Rica and Venezuela has been compared with syntypes kindly made available for study by MZUSP, confirming the determination. It is felt that a redescription of this species is needed because inadequacies in the original description, combined with the poor original illustration, have been responsible for it remaining wrongly placed in *Aleyrodes* until now.

***Aleurovitreus risor* sp. nov.**

(Figs 23, 105–106)

PUPARIUM. *Habitus.* Individuals mostly feeding solitarily, scattered under leaves, amongst rather long leaf hairs. Without visible secretions, shiny. Brownish pigmentation, when present (see *Dorsum*), clearly visible with a hand lens (Fig. 105). *Margin.* Outline oval but often distorted by presence of adjacent leaf hairs, slightly flattened caudally and more acute anteriorly, 0.65–0.72 mm long, 0.43–0.53 mm wide, generally widest opposite transverse moulting sutures (n=16). Morphological margin ventrally deflexed, often rather uneven in mounted specimens, degree of dorsal overhang greatest anteriorly, with 14–16 rounded crenulations per 0.1 mm, not modified at thoracic tracheal openings. Apparent margin smooth. *Dorsum.* Cuticle varies from entirely pale, to possession of a brownish ovoid subdorsal patch on either side of abdominal segments II–V/VI along with a cephalic patch of similar pigmentation, between cephalic setae and apparent puparial margin. Longitudinal moulting suture reaches round ventrally to deflexed morphological margin, rather uneven in proximal half but not keeled; transverse moulting sutures terminate slightly anterior to confluence of longitudinal and transverse moulting sutures, in outer subdorsum. Meso–metathoracic division pronounced, transverse and straight; other cephalothoracic segmentation fainter, angled slightly anteriorly; abdominal segmentation distinct into subdorsum, segment VII not reduced medially; a pair of straight, parallel longitudinal folds define submedian area of abdomen between transverse moulting sutures and vasiform orifice, submedian abdominal depressions somewhat indicated at intersections of these folds with abdominal intersegmental divisions, but cephalothoracic depressions absent. Dorsal disc generally smooth, but subdorsum with a pattern of highly irregular reticulations, with which the intersegmental divisions coalesce distally. Vasiform orifice cordate, smooth internally, inset from apparent margin by about 1.5 times its own length; operculum similar, fully occupying orifice and obscuring lingula head which can just be seen to possess a pair of apical setae. *Chaetotaxy.* Anterior and posterior marginal setae arising from crenulations of morphological margin, fine. Cephalic and eighth abdominal setae stout, hair-like, over twice length of vasiform orifice in most specimens; caudal setae similar but usually somewhat shorter, placed right on apparent margin; meso- and metathoracic setae only represented by vestigial bases, set submedially and close to

meso-metathoracic division. *Pores*. Geminate pore/porettes placed as shown in figure 23: cephalic—3 subdorsal pairs (within pigmented area when that is present), 1 submedian pair posterior to each cephalic seta, 1 submedian pair close to cephalic/prothoracic division; thoracic pairs—typically 2 or 3 pairs on each segment; abdominal pairs—I, III, V, VII & VIII each with a submedian pair just lateral to longitudinal submedian folds, III–VII each with a subdorsal pair, a small number of others placed in outer subdorsum where segmentation not defined. *Venter*. Smooth, readily imprinting with pattern of leaf stomata. Ventral abdominal setae fine, about length of vasiform orifice, their bases almost underlying bases of eighth abdominal setae. Legs smooth, bisegmental, the adhesion padded apices directed mesad; middle and hind legs each with a minute setal base, but seta so small as to be hardly evident. Antennae similar in length to distal segments of fore legs, their bases anteromesal to fore legs. Thoracic tracheal folds only subtly marked, but a narrow band of stipples present between anterior abdominal spiracles and fore legs, skirting legs laterally. A pair of pronounced adhesive sacs present mesal to juxtaposition of fore and middle legs.

MATERIAL EXAMINED. Holotype puparium, BELIZE, CFR, on *Piper* sp. (Piperaceae), 22.vi.2002 (J.H.Martin #7703) (BMNH). Paratypes: 48 puparia, same data as holotype (BMNH, USNM). Other material: dried leaf material with attached puparia, from type sample (BMNH).

ETYMOLOGY. The specific epithet is the latin word *risor* (meaning a laugher or mocker), describing the curious face-like image presented by more darkly pigmented puparia when viewed in the reversed position, with the posterior apex of the puparium uppermost (Fig. 105).

COMMENTS. *A. risor* is one of a suite of four *Piper*-feeding species found in the CFR, all of them with a pair of longitudinal, parallel folds defining the submedian part of the puparial abdomen, with the meso- and metathoracic dorsal setae reduced to little more than their submedially placed bases close to the meso–metathoracic division, and with a pronounced pair of submedian thoracic adhesive sacs. In the other three species, the deflexed part of the morphological dorsum varies from very narrow and evenly folded (Figs 108) to extremely wide (such that the venter is only half the overall puparial width); in one species the geminate pore/porettes are borne on small tubercles.

***BEMISIA* Quaintance & Baker**

Bemisia Quaintance & Baker, 1914: 99–100. Type species *Aleurodes inconspicua* Quaintance, 1900: 28–29, by original designation. [synonymised with *Aleurodes tabaci* Gennadius, 1889: 1–3 by Russell, 1957: 122.]

DIAGNOSIS AND COMMENTS. As interpreted here, *Bemisia* comprises species with puparia (Figs 24, 25–27, 109) which display the following combination of characters:

cuticle usually completely pale, occasionally with brownish pigmentation; margin irregularly crenulate, often modified at caudal and/or thoracic tracheal openings at margin to form ill-defined combs of fine teeth, with margin often shallowly emarginate at these points; transverse moulting sutures not reaching margin; vasiform orifice acute-triangular, sometimes laterally emarginate, usually leading into a pronounced caudal furrow; operculum occupying basal half of orifice; head of lingula typically elongate-triangular, finely spinulose, bearing a pair of stout apical setae (Fig. 27, expanded detail), lingula always exposed but included within confines of vasiform orifice; chaetotaxy and presence of dorsal sculpturing and tubercles may be highly variable within species, depending on physical characteristics of leaves of host plants (Mound, 1963); ventrally, caudal and thoracic tracheal folds marked, usually finely stippled.

Bemisia is probably the whitefly genus best known to general and agricultural entomologists. This is because of the notoriety of one species in particular, *B. tabaci* (Gennadius), a pest of many agricultural crops and vector of plant virus diseases. This is discussed further in the account of *B. tabaci*, below. The genus currently includes just over 40 species, and is known from all geographical regions of the world. There is still speculation about the geographical origin of the genus.

Mound (1963) demonstrated experimentally that puparia of *B. tabaci* display great phenotypic variation, apparently dependent on the physical characteristics of leaf surfaces. Phenotypic variation of the puparial stage appears to be a generic trait, and caution needs to be exercised before visible morphological differences are regarded as being more than intraspecific variation. However, it is felt that some puparial characters of one taxon found in Belize are sufficiently constant to warrant its description as a new species, below. A few other specimens from Belize are not assigned to species with any certainty.

One Belize species (undetermined genus #2, species 1, figure 136), from *Lonchocarpus rugosus* (Fabaceae: Papilionoideae), has puparia somewhat resembling those of *Bemisia* species, but the nature of the moulting sutures, medially unreduced abdominal segment VII, curious dorsal tuberculate glands, lingula with basal lobes, and lack of submarginal setae all preclude inclusion in *Bemisia*, and its generic position is not certain: a single specimen from *Lonchocarpus atropurpureus* appears to be congeneric with it (see Appendix 1).

***Bemisia centroamericana* sp. nov.**

(Figs 24, 109)

PUPARIUM. *Habitus.* Feeding puparia and earlier stages extremely cryptic when alive, appearing silvery when dried out or subsequent to emergence of adults. No waxy secretions evident. *Margin.* Outline ovoid, often very irregular owing to development amongst leaf pubescence, 0.75–0.92 mm long, 0.48–0.68 mm wide, generally widest at

metathorax/ abdominal segment I when outline unmodified (n=20). Margin irregular, not toothed, sometimes modified at thoracic tracheal openings in form of a few irregular, rounded and thickened crenulations, more distinctly so modified at caudal tracheal opening. Overall puparial outline often heavily indented as body expands around leaf hairs. *Dorsum*. Entire dorsum punctuated by complex pattern or rather irregular short furrows/folds, these generally perpendicular to edge of puparium submarginally, but mostly running nearly concentric with curvature of puparial margin in subdorsum (Fig. 109), and in submedian area furrowing has no dominant direction; Pro-/meso- and meso-/metathoracic segmental divisions marked by longer furrows that cut across complex dorsal furrowing, and abdominal segmentation similarly marked submedially. Longitudinal moulting suture reaching puparial margin, but very faintly marked; transverse moulting sutures terminating in subdorsum, hardly discernible beyond puparial legs. Abdominal segment VII much reduced medially, only 7 segments readily recognisable, pockets only indicated by a pair of short thickenings on anterior edge of segment VIII. With single pairs of large, digitiform, seta-bearing processes as follows: cephalic subdorsal, anterior-prothoracic submedian, mesothoracic subdorsal, 1st abdominal submedian, 4th abdominal subdorsal; additionally with a similar, non-seta-bearing submedian pair on mesothorax (almost contiguous on each side of longitudinal moulting suture), and abdominal segments I-III or I-IV each with a single tubercle on median line, those on segments I & II most similar to the almost-median mesothoracic pair; less well defined tubercles variably present lateral to abdominal segmentation, in extreme inner subdorsum. Vasiform orifice elongate-triangular, its sides emarginate, a few folds leading mesad from internal walls of orifice, orifice inset from posterior puparial margin by at least its own length, with a narrow caudal furrow that widens to flank the orifice on both sides; operculum cordate, occupying less than half length of vasiform orifice; lingula head ovoid, finely spinulose, included within boundaries of vasiform orifice, bearing a pair of apical setae. *Chaetotaxy*. Anterior and posterior marginal setae present, hair-like, posterior pair slightly longer than anterior pair. Each digitiform seta-bearing process (see above) with a very stout seta, maximally 0.22 mm long in holotype; caudal setae similar but not borne on digitiform processes; 8th abdominal setae minute, located at anterior end of narrow furrow that borders vasiform orifice; 4 pairs of minute subdorsal setae present on each side of body, between abdominal segments V and VIII, and usually at least 4 pairs of similarly tiny setae present in cephalothoracic submargin, but resolving these setae is difficult and there do not appear to be such setal pairs present on anterior abdominal segments. *Pores*. Dorsum with scattered geminate pore/porettes with 2 on each side of submedian area of most segments and, particularly, 2 on each side between median tubercle and digitiform seta-bearing tubercle on abdominal segment I. *Venter*. Ventral abdominal setae underlying vasiform orifice, very fine and hair-like, a little longer than posterior marginal setae. Middle and hind legs sometimes each with a minute basal seta discernible. Antennal bases mesal to, and antennal length similar to, fore legs. Caudal and thoracic tracheal folds marked as bands of tiny spinules, spinule band of thoracic fold skirting middle legs .

MATERIAL EXAMINED. Holotype puparium, BELIZE, CFR, Las Cuevas Research Station clearing, on *Bocconia frutescens* (Papaveraceae), 13.ii.1996 (J.H.Martin #6653) (BMNH). Paratypes: BELIZE (all CFR, Martin)—25 puparia, 2 third-instar larvae, same data as holotype (BMNH); 68 puparia, 6 third-instar larvae, 14 adult males, 15 adult females, many dry puparia on leaves, same host and locality, 06.xi.1994, 02.xii.1994, ii.1995, 17.ii.1996 (BMNH, USNM); many dry puparia, Puente Natural, on *Bocconia frutescens*, 09.vi.2002, 02.iv.2003; 11 puparia, 1 third-instar larva, 1 ?second-instar larva, Las Cuevas, on ?Asteraceae, 24.iii.2003; 1 puparium, Monkey Tail track, on Asteraceae (possibly *Lasiantha* sp.), 22.vi.2002; 1 puparium, San Pastor track, on unidentified vine, 14.ii.1996 (all BMNH); EL SALVADOR—1 puparium (intercepted at Houston, Texas), on *Origanum vulgare* (Lamiaceae), 30.xi.1993 (Johnson, 034556TX, 93-12850); HONDURAS—2 puparia, Tegucigalpa, on *Poinsettia* sp. (Euphorbiaceae), 24.viii.1959 (Dysart H-2); MEXICO—2 puparia (intercepted at El Paso, Texas), on unknown plant, 15.iii.1977 (Vigil, 007538, 77-6623); 3 puparia, Empalme, Sonora (intercepted at Nogales, Arizona), on *Psidium guajava* (Myrtaceae), 04.iv.1949 (Darnell, 68891, 49-5156); 2 puparia, Mexico D.F. (intercepted at San Antonio, Texas), on *Ficus* “coria” [?carica] (Moraceae), 27.vi.1956 (Wallis, 2212); 1 puparium, Mexico D.F. (intercepted at San Antonio, Texas), on “fig leaf” [*Ficus*, Moraceae], 27.vi.1956 (Wallis 2215, 56-7759); 2 puparia, Cadereyta (intercepted at Laredo, Texas, on unstated host, 18.xi.1957 (Watt, 58121, 57-17340) (all non-Belize paratypes in USNM).

Tentatively identified material, not given paratype status: 1 puparium, BELIZE, CFR, Monkey Tail track, on *Manihot esculentus* (Euphorbiaceae), 01.iii.1996 (Martin) (BMNH); USA, California, 1 puparium, Monterrey, on *Serjania* sp. (Sapindaceae), no date (Q[ua]intance] 8799) (USNM); ex-MEXICO, 7 puparia (intercepted at El Paso, Texas), on *Calocarpum* sp. [= *Pouteria*, Sapotaceae], 04.iii.1987 (Galvin, 030910, 87-3145); 7 puparia (intercepted at Los Angeles, California), on *Hibiscus* sp. (Malvaceae), 01.iv.1978 (Waite, 21047, 78-4653) (all USNM).

ETYMOLOGY. This species is so named because all known material has been collected in, or been intercepted from, Central American countries.

COMMENTS. The robust, digitiform tubercles from which arise the similarly robust cephalic, anterior-prothoracic, mesothoracic, first abdominal and fourth abdominal subdorsal setal pairs, contrasting with the minute eighth abdominal setae, are the main characters that typify *B. centroamericana*. Although the great majority of examined specimens have been collected from *Bocconia frutescens*, the other specimens here designated as paratypes exhibit the same major characteristics. Given the propensity for species of *Bemisia* to exhibit puparial variation, it is to be expected that some variation will occur amongst populations of *B. centroamericana*: the material tentatively identified as *B. centroamericana*, listed above, varies in the degree of development of digitiform seta-bearing tubercles, but the nature of variation within this species is yet to be investigated.

Morphologically *B. centroamericana* clearly belongs to the broad group of *B. afer* (Priesner & Hosny), as currently understood, its vasiform orifice with emarginate sides and inset from the posterior margin of the puparium by at least its own length, these vasiform orifice characteristics combined with the presence of two submedian geminate pore/porettes on each side of abdominal segment I, between the median tubercle and the first abdominal seta-bearing tubercle. In *B. tabaci sensu lato* the vasiform orifice is straight-sided and inset from margin by less than its own length, and only a single geminate pore/porette is present mesad of the first abdominal seta on each side of abdominal segment I.

Given the frequency with which *B. centroamericana* has been intercepted at US quarantine stations, hitherto always from Central American countries, and the number of host plants recorded, it appears likely that *B. centroamericana* will prove to be a common and widespread species, at least within the isthmus. To judge from the sparse populations observed on *Bocconia* in 2003, the very abundant populations encountered during earlier field visits to CFR may have been an unusual and periodic event because this species is almost certainly native.

A few specimens from Belize (*Bemisia* sp. 1, see Appendix 1) have more dorsal tubercles than in any specimens identified as *B. centroamericana*, but none are digitiform and the puparia bear few, or no, enlarged dorsal setae: their vasiform characteristics more closely match those of *B. centroamericana* and *B. afer* (Priesner & Hosny) than *B. tuberculata* (Bondar).

***Bemisia tabaci* (Gennadius)**

(Figs 25–27)

Aleurodes tabaci Gennadius, 1889: 1–3. Lectotype, Greece (designated by Martin, 1999: 59–60).

Bemisia tabaci (Gennadius) Takahashi, 1936: 110.

Bemisia argentifolii Bellows & Perring, in Bellows *et al.*, 1994: 196. Holotype, California. [Synonymised by De Barro *et al.*, 2005: 201.]

DISTRIBUTION. Cosmopolitan in all warmer parts of the world.

COMMENTS. *B. tabaci*, variously known under the common names tobacco, cotton or sweet potato whitefly, is much the most investigated of whitefly species because of the many problems it causes in worldwide agriculture. Cock (1986) published a survey of the literature on *B. tabaci*, with 829 entries, and an update followed (Cock, 1993). Many other communications have been published subsequently, most commonly on molecular investigations (see below) and on aspects of plant virus transmission.

B. tabaci has been regarded as a morphologically variable single species, with an exceptionally wide range of host plants, following the demonstration of the phenomenon of puparial plasticity (Figs 25–27) by Mound (1963). However, more recent investigations have shown many field-collected populations (“biotypes”) to have small host plant ranges,

with some behaving as though monophagous. Indeed, Mound had found the transfer of populations from one host to another to be a great obstacle during his experimental work on host-induced morphological variation. Several such population biotypes have been recognised for some years, but the development of new techniques for the study of cytology and molecular sequencing has led to many more being recognised. A situation of great complexity, controversy and nomenclatural confusion has now arisen, and this was compounded when “biotype B” was eventually given its own species name, *B. argentifolii* Bellows & Perring (in Bellows *et al.*, 1994), and its own common name, “silverleaf whitefly” (from the visible feeding damage caused to squash plants). However, the other recognised biotypes were not treated in this way, with many workers agreeing that the naming of *B. argentifolii* was premature. De Barro *et al.* (2005) have declared *B. argentifolii* to be a race of *B. tabaci* and, thus, its junior synonym but much controversy remains.

The characters for distinguishing *B. tabaci sensu lato* from the *B. afer/B. centroamericana*-group are discussed under *B. centroamericana*, above.

Throughout this study, only a single sample of *B. tabaci* was discovered, feeding on a small euphorbiaceous herb, by the side of the CFR access road.

CRENIDORSUM Russell

Crenidorsum Russell, 1945: 55–57. Type species *Crenidorsum tuberculatum*, by original designation.

DIAGNOSIS AND COMMENTS. As interpreted here, *Crenidorsum* comprises species whose puparia (Figs 44, 110) display the following combination of characters: puparia flat; margin distinctly and regularly toothed, usually not modified at tracheal openings at margin, the teeth with or without basal glands; submargin not separated from dorsal disc by a fold concentric with curve of margin; a pair of longitudinal subdorsal folds present in cephalothorax and anterior abdomen, these folds approximately overlying legs and may be lined by scallop-like patterning; first abdominal setae absent; cephalic, meso- and metathoracic submedian setal pairs variably present; abdominal segment VII not, or very slightly, reduced medially; caudal furrow absent; vasiform orifice almost fully occupied by operculum, lingula usually included within orifice by virtue of folding but extends beyond orifice if unfolded; ventrally, thoracic tracheal folds absent or little evident; cuticle brown or pale.

Crenidorsum comprises species similar in several respects to *Aleurotrachelus* and *Aleurotulus*, but the combination of characters listed above define *Crenidorsum* relatively well, even though any future studies are likely to result in redefinition of the *Aleurotrachelus* group. Described by Russell (1945) to accommodate 12 new neotropical species, *Crenidorsum* now includes 21 described species, eight of them from the Old World. Future appraisal of this genus may show the Old and New World species not to be congeners.

In Belize, seven species of *Crenidorsum* have been collected, only one of them described, but all of these species are only represented by very small numbers of specimens. A further, eighth, species from Belize is tentatively included in *Crenidorsum*, despite the dorsal disc being almost completely separated from the submargin by a fold, because the outer edge of this fold is lined by scallop-like markings which are very common in species of *Crenidorsum*.

***Crenidorsum aroidephagus* Martin & Aguiar**

(Figs 44, 110)

Crenidorsum aroidephagus Martin & Aguiar, in Martin *et al.*, 2001: 3–7. Holotype, Madeira.

DISTRIBUTION. Neotropical Region: Belize, Brazil, Costa Rica, Panamá; Palaearctic Region: Madeira, [France, Germany—under glass]; Pacific Region: Fiji, Hawaii.

COMMENTS. In Belize, the highly cryptic, non-waxy, puparia of this species occur sparsely under the leaves of its aroid hosts, and are difficult to find. However, in areas of new introduction larger populations are normal until brought under control. This species seems likely to extend its range still further, resulting from the popular trade in ornamental aroids (such as *Monstera* and *Philodendron*), the Araceae being its only known host family at present.

***DIALEURODES* Cockerell**

Aleyrodes (*Dialeurodes*) Cockerell, 1902: 283. Type species *Aleyrodes citri* Riley & Howard, 1893: 219–222, by original designation. [Synonymised with *Aleyrodes citri* Ashmead, 1885: 704 by Quaintance & Baker, 1917: 408.]

Dialeurodes Cockerell; as full genus, Quaintance & Baker, 1914: 97.

DIAGNOSIS AND COMMENTS. As interpreted here, *Dialeurodes sensu lato* comprises species with the following combination of characters: outline usually oval or slightly elongate, the margin may be rather flat or insinuate thoracically; tracheal openings at margin usually marked by invaginated pores which may sometimes be shallow; margin smooth or slightly crenulate; submargin not separated from dorsal disc; cephalic, eighth abdominal and caudal setae present, first abdominal setae present or absent; subdorsum (or occasionally submargin) with setae, typically about 12–14 pairs, some or all of which are usually tiny and may be difficult to resolve; transverse moulting sutures not reaching margin; abdominal segment VII not, or little, reduced in length medially; vasiform orifice small in proportion to puparium, usually subcircular or broadly elliptical, fully occupied by operculum; lingula usually covered by operculum but sometimes protruding beyond posterior edge of orifice, often structurally complex but not lobulate; caudal furrow

variably marked; ventrally, caudal and thoracic tracheal folds marked and usually punctuated by stippling; cuticle usually pale, sometimes variously pigmented.

Two preliminary cladistic appraisals of members of the broad *Dialeurodes*-group were conducted by Jensen (1999, 2001). His results have indicated that a cladistic approach to puparial systematics is practicable, clearly indicating discrete groupings within this assemblage. Jensen (2001) provided clear means of distinguishing *Dialeurodes* from *Massilieurodes* Goux and from *Singhiella* Sampson, but there remain very many taxa (both described and undescribed) that have not been examined in this kind of detail, and *Dialeurodes* is in great need of reappraisal. *Dialeurodes sensu lato* is much the most speciose of whitefly genera. It currently comprises a worldwide assemblage of around 120 described species, after taking into account those species recently transferred to *Massilieurodes* and *Singhiella* by Jensen. Inevitably many species still included are not congeneric with the type species, *D. citri* (Ashmead).

In most geographical areas where whitefly inventory studies have been conducted, a significant number of species are assignable to *Dialeurodes sensu lato*. In Belize, only one described species has been identified, and that has here been transferred into *Dialeurodes* from *Aleuroplatus*. A further 12 species are here placed within this group, many very tentatively, including some that may later prove to be more appropriately placed in other described or new genera. Indeed, as this manuscript was about to go to press, Lima & Racca-Filho (2005) described their new genus, *Peracchius*: two Belizean species are regarded as belonging to *Peracchius*, explaining sequence numbers missing from the list of species of *Dialeurodes sensu lato*. in Appendix 1.

***Dialeurodes denticulatus* (Bondar) comb. nov.**

(Figs 41, 111)

Aleuroplatus denticulatus Bondar, 1923: 113–115. Syntypes, Brazil.

Dialeurodes michoacanensis Sampson & Drews, 1941: 165–166. Syntypes, Mexico. **Syn. nov.**

DISTRIBUTION. Neotropical Region: Belize, Brazil, Costa Rica, Guatemala, Mexico, Nicaragua, Panamá.

COMMENTS. Although type material of *D. michoacanensis* has not been examined, its original description and illustration closely match Brazilian puparia of *Aleuroplatus denticulatus* Bondar in BMNH (probably syntypes, Martin, 2004: 560); they also share their host plant genus, *Ficus*, and are therefore considered synonymous. Also, examination of Bondar's material of *A. denticulatus* indicates that this species should be transferred to *Dialeurodes*.

Jensen (1999) recognised what he termed the *D. michoacanensis* species-group, with *D. michoacanensis* Sampson & Drews and *D. egregissima* S.& D. sharing the unusual presence of a ventral band of spinules between the puparial mouthparts and antennae.

However, the puparium of *D. egregissima* has its transverse and longitudinal moulting sutures with their distal extremities joined by a cephalothoracic suture (see figure A, p. 5), forming a pair of plates which are lost when the adult insect emerges; this character has been regarded as having generic significance (e.g. the Asian genus, *Cockerelliella* Sundararaj & David, 1992), and yet the moulting sutures of *D. denticulatus* are typical for *Dialeurodes*. Until the relative importance of this character is investigated in more detail *D. egregissima*, and a similar species from Belize (species 8, Appendix 1), are here retained within *Dialeurodes sensu lato*.

A number of puparia collected from avocado (*Persea americana*), in both Belize and Nicaragua, share the following characters with *D. denticulatus* collected from species of *Ficus*: ventral spinule band present between antennae, the same chaetotaxy with capitate dorsal setae, and a cluster of a few tiny pale tubercles present at mesal margin of each thoracic and caudal tracheal marginal indentation. The dorsal surfaces of puparia from avocado are more coarsely tuberculate than in most specimens from *Ficus* species, but the submedian zone is delineated in the same way. It is considered most likely that the avocado specimens are a variant of *D. denticulatus*, especially given that there is also a degree of variation shown in the degree of roughening of the dorsal puparial surfaces of specimens collected from different species of *Ficus*.

DIALEUROLONGA Dozier

Dialeurodes (Dialeurolonga) Dozier, 1928: 1001. Type species *Dialeurodes (Dialeurolonga) elongata*, by original designation and monotypy.

Dialeurolonga Dozier; as full genus, Takahashi, 1951: 354.

DIAGNOSIS AND COMMENTS. As interpreted here, *Dialeurolonga* comprises species with the following combination of characters: with internally toothed tracheal pores (sometimes indented so shallowly as to resemble tiny invaginated combs) at tracheal openings at margin; vasiform orifice cordate, usually rather elongate, operculum not fully occupying orifice; lingula head usually distinctly lobulate, at least partially exposed but included within vasiform orifice; sometimes with submarginal tubercles (which are lacking in the similar genus, *Dialeurodes*); ventrally, thoracic and/or caudal fold stippled, often characteristically marked by transverse lines of tiny tubercles or spinules.

Dialeurolonga was originally proposed as a subgenus of *Dialeurodes*. Although it was raised to full generic status by Takahashi (1951), it remains a genus somewhat unsatisfactorily defined, with the characters above being a synopsis of the author's current understanding. However Jensen's (1999, 2001) cladistic studies of *Dialeurodes sensu lato* indicate the complexity of the whole *Dialeurodes* group.

Most of the 48 described *Dialeurolonga* species are from the Ethiopian, Malagasian and Oriental Regions, but species from South East Asia, Australia and the Pacific Region

have also been assigned to the genus, with varying degrees of doubt. A single species from Belize is here described and is considered to be morphologically close to several species from the Old World tropics. There is also material from Costa Rica and Panamá (BMNH) tentatively placed in *Dialeurolonga*.

***Dialeurolonga guettardae* sp. nov.**

(Figs 45–48, 112)

PUPARIUM. *Habitus.* When feeding, the immature stages are cryptic, with no noticeable waxy secretions; puparia have always been found as widely scattered individuals, never occurring in colonies. *Margin.* Outline elongate-oval, 0.87–1.22 mm long, 0.51–0.73 mm wide, generally widest at abdominal segment I (n=11). Margin rather irregular, appearing somewhat crenulate when there is slight downcurling of the margin. Margin is modified at thoracic tracheal openings as indented, toothed pores; the thoracic pores with a thickened “C”-shaped boundary and one or two rounded internal teeth (Fig. 46); caudal pore similar, but its rim less thickened and with 1–3 rounded internal teeth (Fig. 45). *Dorsum.* Longitudinal moulting suture faint but reaching puparial margin; transverse moulting sutures terminating subdorsally, over hind legs. Dorsal disc with pro-meso-, meso-metathoracic and abdominal segmentation distinct into subdorsum; abdominal segment VII a little shorter than segment VI medially. Submedian abdominal depressions only subtly indicated. Dorsum punctuated by fine black punctae, fainter in submargin and outer subdorsum but coarser and more crowded in median areas of thorax and anterior abdominal segments. Variably developed, pore-associated papillae (Fig. 112) present (see *pores*)—1–2 subdorsal ranks, sometimes one rank defining the submedian area (but otherwise only the pores visible), and a row of small and faint papillae (or only the pores themselves) effectively defining the submargin; abdominal segments I–VI each with a pronounced rounded median tubercle. Vasiform orifice (Fig. 45) cordate, about as long as wide, inset from posterior puparial margin by about twice its own length, slightly corrugate internally, with a narrow posterior notch; operculum similar in shape, occupying about three-quarters of vasiform orifice; lingula head (Fig. 47) with 3–4 small lobules on apex, otherwise smooth-sided, surface finely spinulose, with a pair of apical setae, included within vasiform orifice but mostly covered by operculum (Fig. 45). Caudal furrow present, narrow and bordered by a pair of longitudinal ridges. *Chaetotaxy.* Dorsal setae restricted to single submedian pairs of cephalic, first abdominal, eighth abdominal and caudal setae, stout and usually shorter than vasiform orifice; caudal setae placed slightly anterior to tracheal pore, at the ends of the caudal furrow ridges; anterior and posterior marginal setae present, similar to dorsal setae but longer, up to length of vasiform orifice. *Pores.* Each submedian/subdorsal papilla with an associated tiny geminate pore/porette pair, or sometimes the pores are without significant papillae; other fine pores

difficult to distinguish from dorsal sculpture. *Venter*. Ventral abdominal setae very fine, underlying and similar in length to vasiform orifice. Middle and hind legs (Fig. 48) each basally with a stout spine and two fine setae, all of similar length; fore legs each with a smaller basal spine only; each leg with an apical adhesion pad. Antennal bases anteromesal to fore legs, antennae only as long as fore legs and usually overlapping them. Thoracic tracheal folds marked as unsculptured furrows only; caudal tracheal folds finely spinulose.

MATERIAL EXAMINED. Holotype puparium, BELIZE, CFR, Las Cuevas—Millionario road, on *Guettarda combesi* (Rubiaceae), 05.vi.2002 (J.H.Martin #7640) (BMNH). Paratypes: 11 puparia, same data as holotype (BMNH); 7 puparia, same host and locality, 11.ii.1996; 15 puparia, Guacamallo Bridge—Millionario road, same host, 25.ii.1996 (Martin) (BMNH, USNM).

ETYMOLOGY. This species is named after its only known host plant, the small rubiaceous tree *Guettarda combesi*, commonly called “glassy wood” in Belize.

COMMENTS. See generic comments, above. No adults of *D. guettardae* have been seen.

***DISIPHON* Russell**

Disiphon Russell, 1993: 463–464. Type species *Asterochiton dubienus* Bondar, 1923: 179–180, by original designation and monotypy.

DIAGNOSIS AND COMMENTS. As interpreted here, *Disiphon* comprises species with the following combination of characters: cuticle pale; glands present on dorsal disc, of two distinctly different shapes (Figs 33, 113); with a weak submedian abdominal rhachis; longitudinal moulting suture keeled (Fig. 34); confluence of longitudinal and transverse moulting sutures almost contiguous with meso-/metathoracic suture; median lengths of abdominal segments VI and VII similar; submedian pairs of cephalic, meso- & metathoracic, eighth abdominal and caudal setae present; vasiform orifice subcircular to cordate, operculum obscuring lingula; caudal furrow absent.

The puparia of *Disiphon* somewhat resemble those of *Siphoninus* Silvestri (1915), but *Siphoninus* puparia possess submedian first abdominal setae but no thoracic setae, have the longitudinal moulting suture unkeeled, and their dorsal disc glands are only in the form of elongate siphons. More similar are a very few African species currently placed in the genus *Cohicaleyodes* Bink-Moenen (1983), notably *C. blanzyi* (Cohic), which was originally described in *Siphoninus*, and an undescribed species recently collected from coffee in Uganda.

In Belize, only one species of *Disiphon* has been collected, and is here described.

***Disiphon russellae* sp. nov.**

(Figs 33–34, 113)

PUPARIUM. *Habitus.* Immature stages feed lined along major leaf veins under leaves, each with cephalic margin abutting the vein. Cryptic when feeding, with no visible secretions (even from the siphons). Post-emergence, the pupal case is glassy and much distorted. Eye spots of developing adults clearly visible prior to emergence. A few individuals with a median cephalic patch of brownish cuticle. *Margin.* Outline broadly oval, subtly acute anteriorly and with caudal tracheal teeth slightly protuberant, 0.96–1.14 mm long, 0.70–0.88 mm wide, generally widest at abdominal segment II/III (n=25). Margin regularly crenate, 11–13 apically rounded teeth per 100 μm , the teeth slightly larger in vicinity of tracheal openings, but not in the form of a significantly differentiated comb. *Dorsum.* Longitudinal moulting suture reaches puparial margin, with a pronounced keel occupying the middle third of its length (Fig. 34); transverse moulting sutures form an inverted “V” (Fig. 113), before curving anteriorly and terminating in subdorsum. Meso-metathoracic suture pronounced, straight, only visible submedially, intersecting the confluence of longitudinal and transverse moulting sutures; cephalic/prothoracic junction in the form of oblique folds, mirroring the inverted “V” of the transverse moulting sutures to form an “X”-shaped feature; abdominal segmentation clearly marked only submedially, rhachisform, with a subtle radial arm extending towards base of each elongate siphon; abdominal segment VII not significantly reduced medially. Vasiform orifice (Fig. 33) subcircular, its floor characteristically patterned as shown, the whole structure located on a triangular extension of the abdominal rhachis; operculum trapezoidal, occupying about two-thirds of orifice, almost obscuring the lingula; head of the lingula can just be seen to be spinulose and bisetose apically. Caudal furrow absent. *Chaetotaxy.* Anterior and posterior marginal setae present, fine. Single pairs of cephalic and eighth abdominal setae 55–85 μm , stout, acute; meso- and metathoracic pairs somewhat shorter; caudal setae similar but longer, 120–170 μm . Mesal to marginal tooth-base folds, extending anteriorly from abdominal segment III, is an uneven line of tiny setae and spine-like structures that may be setal bases, with usually 10 discernible as setae on each side of puparium. *Pores & glands.* Siphon-like glands of two types present (Fig. 113): one cephalic and three abdominal pairs of the elongate type present in outer subdorsum, expanded but rounded apically, up to 220 μm long, the apical pore leading to a channel which is clearly visible near siphons apex, and a tiny dark porette visible adjacent to the pore; the short, thimble-shaped type represented by one subdorsal and one submedian cephalic pair, two subdorsal thoracic pairs, and four subdorsal and one submedian abdominal pairs, each with a central pore/glandular channel and an offset porette (as also seen apically on the elongate siphons). Faintly marked pore/porette pairs present in a row mesad of submarginal tiny setae, and scattered over dorsal disc; a slightly more pronounced pairing on each side of rhachis on abdominal segments II–V & VII. *Venter.* Ventral abdominal setae fine, similar

in length to vasiform orifice. Legs normal, each with an apical adhesion pad. Each middle and hind leg with a single tiny basal seta. Antennal bases antero-mesal to, and antennae similar in length to, forelegs. Rows of very fine submedian spinules present abdominally. Thoracic and caudal tracheal folds not marked.

MATERIAL EXAMINED. Holotype puparium, BELIZE, CFR, on *Piper* sp. (Piperaceae), 06.xi.1994 (J.H.Martin #6462) (BMNH). Paratypes: 33 puparia, 1 third-instar larva, 16 adult females, same data as holotype (BMNH); 41 puparia, 8 third-instar larvae, same locality, on unidentified seedlings of Lauraceae, 18.xi.1994, 22.xi.1994, 30.xi.1994 (Martin) (BMNH, USNM); 6 puparia, same locality, on *Chiococca ?alba* (Rubiaceae), 01.vi.2004 (Martin); 9 puparia, same locality, on *Nectandra ?colorata* (Lauraceae), 09.vi.2004 (Martin) (BMNH).

ETYMOLOGY. Named for Louise M. Russell, who recognised and described the unique combination of characters that define the genus *Disiphon*, contributed to the study of Sternorrhyncha for over 50 years, and who celebrated her centenary as this manuscript neared completion.

COMMENTS. *D. russellae* differs from the only other described species, *D. dubienus* (Bondar), in possessing many fewer siphon-like glands, and in the elongate type being very much longer than in *D. dubienus*.

PARALEUROLOBUS Sampson & Drews

Paraleurolobus Sampson & Drews, 1941: 168–169. Type species *Paraleurolobus imbricatus*, by original designation and monotypy.

DIAGNOSIS AND COMMENTS. As interpreted here, *Paraleurolobus* comprises species with the following combination of characters: puparia very flat; margin with regular teeth, these subtly modified at thoracic and caudal tracheal openings; very broad submargin separated from dorsal disc by a complete furrow, concentric with curvature of margin; submedian pairs of cephalic, meso- & metathoracic, eighth abdominal and caudal setae present, the caudal pair placed close to subdorsal furrow; first abdominal setae absent; vasiform orifice subcircular to cordate, operculum obscuring lingula; caudal furrow absent; cuticle black, sometimes requiring bleaching, or bicoloured.

In Belize, *Paraleurolobus* is represented by *P. chamaedoreae* Russell (see below) and three undescribed species.

***Paraleurolobus chamaedoreae* Russell**

(Figs 43, 114)

Paraleurolobus chamaedoreae Russell, 1994: 540–546. Holotype, Mexico (intercepted at San Antonio, Texas).

DISTRIBUTION. Neotropical Region: Belize, Costa Rica, Mexico, Nicaragua.

COMMENTS. Russell (1994) described this species from several quarantine interceptions in USA from Mexico, all involving cut palm foliage from *Chamaedorea* species, known as xate (pronounced sha-té) in the floristry industry. Only a single puparium has been collected in Belize, from a member of the Moraceae; there are also in BMNH three field-collected samples from Costa Rica, and two samples from Nicaragua, all of them collected from dicotyledonous hosts. Figure 43 shows principal characters, while figure 114 reveals its intricate cuticular folding.

***PERACCHIUS* Lima & Racca-Filho**

Peracchius Lima & Racca-Filho, 2005: 40. Type species *Peracchius durantae*, by original designation and monotypy.

DIAGNOSIS AND COMMENTS. The major diagnostic characters for *Peracchius* are as follows: puparia elongate spindle-shaped, acute posteriorly, acute or indented (Fig. 137) anteriorly; always with a pair of acute and stout subapical setae at each end of puparium (Figs 137–138); anterior and posterior marginal setae considerable distances away from puparial apices, but unusually long; margin modified at thoracic and caudal tracheal openings; caudal furrow present; operculum obscuring lingula, filling vasiform orifice; with normal pair of 8th abdominal setae close to vasiform orifice, and a second 8th abdominal pair posterior to vasiform orifice; typically with a pair of setae on each of abdominal segments I, III–VII, pro-, meso- and metathorax these most or all capitate; cephalic region with submedian setal pair (the normal “cephalic setae”) and at least two other pairs which are usually capitate; transverse moulting sutures reaching, or almost reaching puparial margin; many segments usually with tubercles in submedian zone, either along median line or bordering submedian zone; ventral tracheal folds marked, sometimes only subtly; legs well separated from each other.

Only five puparia from Belize belong to this genus, three identified here as belonging to the type species, *P. durantae*, and two that represent an undescribed species.

In addition to the Brazilian specimens of *P. durantae*, and the Belizean material, there are samples of puparia in BMNH that belong to *Peracchius* from Costa Rica, Guyana, Panamá and Tobago indicating a wide distribution for this genus.

***Peracchius durantae* Lima & Racca-Filho**

(Figs 137–138)

Peracchius durantae Lima & Racca-Filho, 2005: 40. Holotype, Brazil.

DISTRIBUTION. Neotropical Region Belize, Brazil.

COMMENTS. The description of this species was published as this manuscript was about to be submitted. Three puparia from the CFR, initially identified as members of the *Dialeurodes* group, were found to belong to *P. durantae*, but no host data are available. As described by Lima & Racca-Filho, the Belize puparia were also found feeding contiguous with major leaf veins.

SINGHIELLA* SampsonSinghiella* Sampson, 1943: 211. Type species *Trialeurodes bicolor* Singh, 1931: 50–52, by original designation and monotypy.

DIAGNOSIS AND COMMENTS. Jensen (2001) has redefined *Singhiella* as comprising species from the *Dialeurodes*-group with the following combination of characters: some or all dorsal pores situated on rounded papillae (which may be very shallow); outer edges of legs without ornamentation; front and middle legs not contiguous; usually with three or more pairs of dorsal pores on abdominal segment I; often with minute basal spinules on antennae.

As redefined by Jensen, *Singhiella* now comprises 29 described species. All of these were described from the palaeotropics, except for *S. citrifolii* (Morgan) which is the only species known from Belize, and whose origins are discussed below.

***Singhiella citrifolii* (Morgan)**

(Figs 18, 115)

Aleyrodes citrifolii Morgan, 1893: 70–74. Syntypes, USA (Louisiana).*Dialeurodes citrifolii* (Morgan) Quaintance & Baker, 1914: 97.*Singhiella citrifolii* (Morgan) Jensen, 2001: 307

DISTRIBUTION. Neotropical Region—Argentina, Brazil and widely distributed in the Caribbean, Central and northern South America; Nearctic Region—Bermuda, USA (Alabama, California, Colorado, Florida, Kentucky, Louisiana, Maryland, Mississippi, Missouri, North Carolina, Pennsylvania, Texas—some records almost certainly from under glass); Palaearctic Region—Japan, Lebanon, Madeira, Morocco; Oriental Region—China, Hong Kong, India, Vietnam; Austro-Oriental Region: Malaysia, Singapore; Pacific Region—Caroline Is, Hawaii, Marianas, Western Samoa.

COMMENTS. Jensen (2001) considered *S. citrifolii* to be probably an Asian native, along with all of the other species included in *Singhiella*. This species has had economic impact on citrus crops in the neotropics for many years, but it only seems to have developed an economic profile in the Oriental and Austro-oriental Regions since the 1990s (observations on material present in BMNH collection). It is to be expected that the USNM would have heavy New World representation in its collection. However, an early presence of *S. citrifolii* in Asia would be expected to be reflected in the BMNH collection, which it is not. Whatever its true origins, *S. citrifolii* is a common pest of citrus crops, and appears still to be expanding its range. At the time of writing, it is now also established in parts of the Pacific and Palaearctic Regions.

TEGMALEURODES gen. nov.

Type species *Tegmaleurodes lentus* sp. nov.

DIAGNOSIS—PUPARIUM. Where untreated puparia are available for study, they have no visible waxy secretions. However, during preparation for slide-mounting it becomes apparent that all puparia are protected by a tough covering, or “carapace”, that is resistant to all known chemical regimes for removal of puparial secretions: this covering often appears irregularly reticulate on slide-mounted specimens (Fig. 116), when it has not been mechanically removed. Individuals of some species develop in aggregations under leaves and are generally very cryptic, whereas puparia of some other species seen in Belize are more sparsely distributed (even if very numerous) and rusty-reddish in colour. Cuticle often entirely pale, but some species with dusky pigmentation, particularly submedially. Puparial margin clearly, but variously, modified at the tracheal openings. Longitudinal moulting suture reaching puparial margin; transverse moulting sutures usually almost reaching margin, sometimes much curved anteriorly. Dorsal chaetotaxy (when discernible) typically maximally comprises paired submedian cephalic, first and eighth abdominal and caudal setae. Vasiform orifice cordate, not elevated posteriorly, mostly occupied by the operculum, but lingula often partly exposed and detail frequently visible through operculum. Segmentation often hardly evident medially, whether dorsal cover is present or absent. Geminate pore/porettes sometimes visible, sparsely distributed over dorsum.

ETYMOLOGY. The generic name derives from the latin noun *tegmen* (meaning a cover, covering or shield) describing the tough material secreted by the puparia.

COMMENTS. There are several whitefly species from the Neotropical Region whose puparia are protected by a tough carapace of secretion, not readily apparent when specimens are *in situ* on leaves but which frustrates efforts to prepare individuals for examination on slides. Amongst the better-known of such species are the members of the *Trialeurodes floridensis* species-group, as defined by Russell (1948)—see p. 57 and figure 128. It is instructive to quote Russell (1948:18), defining the *Tr. floridensis*-group: “Dorsal

layer of wax pitted and striated, tough and leathery, adhering to derm, usually present even after insects have gone through chemicals used in mounting procedure and, though transparent, tending to obscure characters.” Species regarded as belonging to *Tegmaleurodes* share with the *Trialeurodes floridensis*-group such characters as the reduced dorsal chaetotaxy, delicate ventral (and sometimes also dorsal) cuticle, and occasional presence of leg-base spines, as well as the robust nature of the dorsal secretions. However, the shape of the vasiform orifice, almost filled by the lingula, combined with highly modified tracheal openings at the puparial margin, are characters more reminiscent of *Dialeurodes sensu lato* (into which group several *Tegmaleurodes* species had been tentatively placed, as unidentified species), but the tough dorsal covering and usually-reduced dorsal chaetotaxy preclude inclusion anywhere in the *Dialeurodes*-group, even in its broadest sense. The complete absence of submarginal glandular papillae, the relatively large puparial size, the usually-reduced dorsal chaetotaxy and the tough dorsal secretions combine to suggest that a new genus is required to accommodate such species.

Several neotropical taxa in the collection of BMNH, not belonging to *Trialeurodes* (see above paragraph), have the characteristic presence of a tough dermal covering (or have its former presence noted on slide labels). Many of these taxa loosely agree with the definition of *Tegmaleurodes*, but more detailed studies are quite likely to refine the definition, perhaps requiring further genera to be established. Resulting from this study, seven putative species from Belize have been placed in *Tegmaleurodes* (see Appendix 1).

Study of original descriptions of *Aleuroplatus integellus* Bondar (1923) and *Aleuroplatus crustatus* Bondar (1928), kindly translated for the author by Antonio Aguiar, revealed conflicting descriptive information. Bondar stated that puparia of *A. crustatus* were observed to distort and fall from leaves as the secretions desiccated; in contrast, puparia of *A. integellus* were stated not to secrete visible wax although being otherwise similar to those of *A. crustatus*. However, there are specimens in BMNH that closely answer the description and illustration of *A. integellus*, and these do possess the characteristic tough secreted covering. Bondar seems rarely to have treated his specimens before immersing them in slide-mountant (personal observations), and puparia of *A. integellus* would almost certainly have been highly cryptic when still attached to leaves very likely leading to Bondar’s failure to observe evident secretion. The author therefore considers that *Aleuroplatus integellus* Bondar (1923) and *Aleuroplatus crustatus* Bondar (1928) should both be transferred into *Tegmaleurodes*, both **comb. nov.**

***Tegmaleurodes lentus* sp. nov.**

(Figs 49–52, 116)

PUPARIUM. *Habitus*. Puparia developing in loose aggregations under leaves, cryptic

when still feeding, cuticle of each puparium having a slightly “soapy” appearance. Each thoracic and caudal tracheal fold visible through body as a straight white line; submedian zone delineated by an ovoid ridge. When slide-mounted, dorsum is seen to be covered by a carapace of tough secretion (see generic description and discussion, above), leaving only the vasiform orifice exposed. *Margin*. Outline broadly ovoid, much indented at thoracic and caudal openings, 1.41–1.50 mm long, 1.24–1.30 mm wide, generally widest at abdominal segment II (n=12) (Fig. 49); one specimen 1.25 long, 1.02 mm, possibly indicative of sexual dimorphism. Margin with extremely shallow crenulations, 8–9 per 0.1 mm of margin, margin modified at thoracic tracheal openings as deep invaginations, with the enclosed “pore” bearing several rounded teeth (Fig. 50); each thoracic pore with a few tiny tubercles closely adjacent. *Dorsum*. Longitudinal moulting suture reaches puparial margin; transverse moulting sutures almost reach puparial margin, but are unusually curved forwards to almost coincide with thoracic tracheal pores (Figs 49, 116). Dorsal disc with all segmentation indistinct, except that pockets on abdominal VII/VIII boundary are quite evident when dorsal secretions have been removed. When secretions intact, submedian zone and anterior boundary of thoracic area are clearly marked as thickened secretion (Fig. 116); with secretions removed all specimens have delicate cuticle torn, but subdorsal zone finely patterned with indistinct reticulations. Vasiform orifice (Fig. 51) broadly cordate, approximately 60 µm long, about as long as wide, not elevated, inset from caudal tracheal pore by about 3 times its own length; operculum similarly shaped, almost filling orifice; lingula head usually hidden by operculum but discernibly broad and lobulate, with a pair of apical setae. *Chaetotaxy*. Anterior and posterior marginal setae not evident on any specimen. Tiny setae, each shorter than operculum, present in single cephalic, first and eighth abdominal pairs; eighth abdominal setae located opposite widest part of vasiform orifice (Fig. 51); no evidence of a pair of caudal setae can be found. *Pores*. When dorsal secretions have been removed, dorsal disc can be seen to possess sparsely distributed geminate pore/porettes. *Venter*. Ventral abdominal setae similar to eighth abdominal dorsal setae, their bases slightly antero-lateral to vasiform orifice. Each leg base with a pronounced, thorn-like, spine and 1–3 minute setae; antennal bases anterior to fore legs but antenna and leg almost exactly superimposed when viewed on slides (Fig. 52). Tracheal folds only evident in some slide-mounted specimens, despite being clearly visible when specimens still attached to leaves.

MATERIAL EXAMINED. Holotype puparium, BELIZE, CFR, Las Cuevas vicinity, on *Pouteria reticulata* (Sapotaceae), 25.iii.2003 (J.H.Martin #7805) (BMNH). Paratypes (all same locality, Martin coll.): 11 puparia on slides (plus many more dry, attached to leaves), same data as holotype (BMNH, USNM); 8 puparia (plus many more dry, attached to leaves), on Lauraceae, 05.xi.1994 (BMNH); 25 puparia (plus many more dry, attached to leaves), on undetermined woody broad-leaf host, 03.vi.2002 (BMNH, USNM); 3 puparia, on *Manilkara zapota* (Sapotaceae), 20.iii.2003 (BMNH); 6 puparia, on undetermined woody broad-leaf host, 05.vi.2002 (BMNH).

ETYMOLOGY. The chosen specific name is the latin word *lentus* (variously meaning tough, flexible or tenacious), any one of which interpretations well describes the chemical-resistant puparial secretions.

COMMENTS. Very unusually, the holotype puparium has been selected from amongst specimens that were macerated and dehydrated, but without any attempt being made to remove secretions, either mechanically or chemically. Without exception, warming puparia in chloral-phenol led to gross distortion of the specimens, as a result of uneven expansion of the secreted carapace. Further, mechanical removal of the tough dermal covering almost always caused damage to the dorsal cuticle, which is apparently more delicate than in most whitefly taxa. The holotype of *T. lentus* thus has the advantages of undistorted outline (Fig. 116), ventral characters generally easily visible, and undamaged cuticle; these advantages are balanced by difficulty in visually resolving most of the chaetotaxy, cuticular pores and other fine details.

TETRALEURODES Cockerell

Aleyrodes (Tetraleurodes) Cockerell 1902: 283. Type species *Aleyrodes (Tetraleurodes) perileuca* Cockerell, 1902, by original designation.

Tetraleurodes Cockerell; as full genus, Quaintance & Baker: 1914: 107–108.

Mexicaleyrodes Sampson & Drews, 1941: 166–167. Type species *Mexicaleyrodes contigua* by monotypy **syn. nov.**

DIAGNOSIS AND COMMENTS. As interpreted here, *Tetraleurodes* comprises species (Figs 53–59, 117–124) with the following combination of characters: cuticle dark brown to black (at least in New World species), usually requiring bleaching for examination on slides; margin regularly toothed, usually with tooth-base glands, teeth not modified at thoracic tracheal openings at margin; submargin (which is often almost vertical in its natural position) separated from dorsal disc by a distinct margin-concentric fold; submargin sculptured by fine ridges/furrows running mesad from margin; longitudinal moulting suture reaches margin or submarginal fold; transverse moulting sutures may terminate at, before, or beyond submarginal fold; abdominal segment VII not, or slightly, reduced medially; eighth abdominal and caudal setae present; variable combinations of submedian cephalic and thoracic setae present; first abdominal setae absent; vasiform orifice subcordate, usually elevated posterolaterally, fully occupied by operculum which obscures lingula; caudal furrow absent. In life, puparia often secrete peripheral white wax but without such secretion dorsally.

Tetraleurodes is a large and polyphyletic assemblage of species, with 66 available species names indicated in the index of the BMNH collection. Although the type species was described from the USA, the 20 species included by Quaintance & Baker (1914) were from five geographical regions and it now includes taxa from almost worldwide. *Tetraleurodes* is somewhat better defined than *Aleurotrachelus*, which was also originally proposed to accommodate New World species.

Nakahara (1995) reviewed species of *Tetraleurodes*, predominantly those occurring in the USA, covering several of the species here recorded from Belize. From the results of the present study, *Tetraleurodes* is the most speciose genus in Belize, with seven described and 17 undescribed species examined. One undescribed species from avocado (*Persea*, Lauraceae) is illustrated (Fig. 124).

***Tetraleurodes acaciae* (Quaintance)**

(Figs 56, 117)

Aleurodes acaciae Quaintance, 1900: 19–20. Lectotype, Mexico (designated by Nakahara, 1995: 110).

Tetraleurodes acaciae (Quaintance) Quaintance & Baker, 1914: 108.

DISTRIBUTION. Neotropical Region: Colombia, Venezuela, and widely distributed in the Caribbean and Central America; Nearctic Region: USA (Arizona, California, Florida, Texas); Oriental Region: Hong Kong; Austro-oriental Region: Philippines; Pacific Region: Fiji.

COMMENTS. *T. acaciae* is one of a suite of similar species defined by the presence of a submarginal row of rounded tubercles that stand proud of the puparial surface when seen in relief (Fig. 117). *T. acaciae* is the only member of this group seen from Belize, from where it is represented only by a few individuals that occurred singly. Members of the *T. acaciae*-group have principally been recorded feeding on fabaceous (legume) hosts (Nakahara, 1995), and the few specimens from Belize were also taken from fabaceous hosts.

***Tetraleurodes chivela* Nakahara**

(Figs 59, 118)

Tetraleurodes chivela Nakahara, 1995: 123–125. Holotype, Mexico.

DISTRIBUTION. Neotropical Region: Belize, Mexico.

COMMENTS. This species was described from only four Mexican specimens, two of them intercepted by the United States quarantine service. In Belize it is represented from three samples only, each comprising very small numbers of puparia.

***Tetraleurodes confusa* Nakahara**

(Figs 57, 119)

Tetraleurodes confusa Nakahara, 1995: 125–127. Holotype, USA (Florida).

DISTRIBUTION. Neotropical Region: Belize, Puerto Rico; Nearctic Region: USA (Florida, Mississippi).

COMMENTS. Most of the material upon which the description was based was field-collected in Florida, where it is evidently very common. In Belize, it is represented by a small number of specimens taken from avocado. The minute differences used to differentiate *T. confusa* from *T. perseae* (which was described by Nakahara in the same 1995 paper, and see p. 7 here) may prove to be intraspecific variation, especially when the occurrence of both nominal species on avocado is taken into account.

***Tetraleurodes fici* Quaintance & Baker**

(Figs 54, 120)

Tetraleurodes fici Quaintance & Baker, A.C., in Baker, J.M., 1937: 616–617. Syntypes, Mexico.

DISTRIBUTION. Neotropical Region: Bahamas, Belize, Colombia, Costa Rica, Cuba, Guatemala, Jamaica, Mexico, Nicaragua, Trinidad, Venezuela; Nearctic Region: USA (Florida).

COMMENTS. Several samples of *T. fici* were collected in Belize, but almost all comprised single specimens. The puparia are usually shining-black, with a broad peripheral fringe of pure white wax.

***Tetraleurodes mori* (Quaintance)**

(Figs 53, 121)

Aleurodes mori Quaintance, 1899a: 1–4. Syntypes, Jamaica, USA (Florida).

Tetraleurodes mori (Quaintance) Quaintance & Baker, 1914: 108.

DISTRIBUTION. Neotropical Region: Belize, Costa Rica, Jamaica, Mexico, Nicaragua, Panamá. Nearctic Region: USA (widely distributed).

COMMENTS. This species is very common and widely distributed in the USA, but is also found widely in Central America. In Belize, it is represented by several samples but only by slightly over 20 specimens in total. The cluster of pores on each side of abdominal segment IV is an important recognition character.

***Tetraleurodes pringlei* Quaintance & Baker**

(Figs 58, 122)

Tetraleurodes pringlei Quaintance & Baker, A.C., in Baker, J.M., 1937: 617–618. holotype, Mexico.

DISTRIBUTION. Neotropical Region: Belize, Mexico.

COMMENTS. Nakahara (1995) only had the holotype (whose status he discussed) and two quarantine-intercepted specimens available for study in connection with his account of *T. pringlei*. In Belize, it is only represented by five puparia.

***Tetraleurodes quadratus* Sampson & Drews**

(Figs 55, 123)

Tetraleurodes quadratus Sampson & Drews, 1941: 176–177. Syntypes, Mexico.

DISTRIBUTION. Neotropical Region: Belize, Costa Rica, Mexico, Nicaragua, Panamá, Trinidad.

COMMENTS. *T. quadratus* was described from an unstated number of puparia from Mexico, and is represented from Belize by only four individuals.

TRIALEURODES Cockerell

Aleyrodes (*Trialeurodes*) Cockerell, 1902: 283. Type species *Aleyrodes pergandei* Quaintance, 1900: 31–32, by original designation.

Trialeurodes Cockerell; as full genus Quaintance & Baker, 1915: xi.

DIAGNOSIS AND COMMENTS. As interpreted here, *Trialeurodes* comprises species (Fig 60–74, 125–132) with the following combination of characters: Submargin with glandular papillae, which may be acute, broadly conical or rounded, and which sometimes also occur on the dorsal disc; abdominal segment VII much reduced in length medially; vasiform orifice cordate, posteriorly well-defined, not usually fully occupied by operculum; lingula at least partly covered by operculum, although remaining visible, included within orifice, with characteristic lobulate head; puparial cuticle usually pale, often very fragile once adults have emerged; margin with shallow and rather irregular crenulations, sometimes a little modified at thoracic tracheal openings at margin to form combs of teeth; ventrally, leg base spines or setae present but variably developed, tracheal folds absent.

Trialeurodes is a predominantly New World genus and is much better defined than many others. It currently includes about 60 species, worldwide. Russell (1948) revised the Nearctic species, dividing them between six species-groups. *Trialeurodes* species discovered in Belize are mostly members of the *T. floridensis* (Quaintance)-group, but the *T. variabilis* (Quaintance)-group and *T. vaporariorum* (Westwood)-group are also represented. Three distinctive species are here described, none of them appearing to belong to one of Russell's North American species-groups. There are probably at least 15 species represented amongst study material from Belize but the nature of intraspecific

variation, particularly within the *T. floridensis*-group (see below), is insufficiently understood for certainty.

***Trialeurodes abdita* sp. nov.**

(Figs 61, 125)

PUPARIUM. *Habitus.* Appearance of empty pupal cases silvery and difficult to see because of sparse secretions; under a hand lens a fine secreted filament can be seen to issue from each submarginal papilla, to form a translucent peripheral fringe (Fig. 125); dorsum without evident secretion. *Margin.* Outline elongate-oval, 0.81–1.07 mm long, 0.38–0.48 mm wide, about 2.00–2.50 times longer than wide, generally widest opposite transverse moulting sutures (n=15). Margin with shallow and very irregular-sized crenulations, 12–15 per 0.1mm of lateral margin, sometimes very slightly modified at thoracic and/or caudal tracheal openings. *Dorsum.* Longitudinal moulting suture reaches puparial margin; transverse moulting sutures terminate in submargin in pupal cases vacated by adults. Dorsal disc with abdominal segmentation rather indistinct and only marked into subdorsum, with cephalothoracic divisions even less marked. Abdominal segment VII about half length of segment VI medially. Submedian abdominal depressions not evident. Submargin with row of pronounced papillae, all acute and most longer than wide, each less than one papilla-width from its adjacent neighbour, occasionally a very small number occurring mesal to main row (Fig. 61); papillae uneven in size, largest twice length of smallest and similar in length to lingula head; laterally several small papillae alternate with each large papilla, but most papillae larger at anterior and posterior ends of pupal case; holotype bearing 96 papillae (48 on cephalothorax and 48 on abdomen) on one side of pupal case. Cuticle of dorsal disc generally smooth but often densely punctuated by granular “mottling” which is more evident in “quickmounted” pupal cases not treated chemically (Fig. 125). Vasiform orifice elongate-cordate, longer than wide, less sharply defined at its posterior apex which is slightly notched, with a small tubercle at anterior end of this notch; vasiform orifice fluted internally, inset from posterior puparial margin by a little over its own length; operculum laterally-rounded trapezoidal, occupying basal half of vasiform orifice, without evident posterior marginal setae; lingula head completely exposed beyond operculum but included in vasiform orifice, with 3 pairs of lateral lobes and pair of apical setae. Caudal furrow hardly evident. *Chaetotaxy.* Anterior marginal setae not seen in small study sample; posterior marginals fine, hair-like, about half length of caudal setae. Single pairs of cephalic, first and eighth abdominal and caudal setae present, all longer than posterior marginals but similar in size to each other, similar to length of vasiform orifice (Fig. 61); first abdominal setae situated near segment I/II division, eighth abdominal setae situated lateral to anterior edge of operculum, caudal setae situated between posteriormost pair of papillae. *Pores.* Immediately mesal to row of submarginal papillae is a row of unevenly-spaced tiny dark pores, fewer in number than

papillae (Fig. 61, expanded detail). Small dorsal disc pores present, apparently not geminate, irregularly positioned with usually 1–2 on each side of abdominal submedian area and a few more distributed across subdorsum and submargin, and similarly distributed on cephalothorax. *Venter*. Ventral abdominal setae long and fine, similar to posterior marginal setae, rather close to median line and underlying vasiform orifice and operculum. Legs normal, each with an apical pad and a stout basal spine, sometimes a second (smaller) spine and a tiny seta also present basally (but see comments, below). Antennal bases situated slightly anterior to fore legs, antennae similar in length to fore legs and often overlapping them. Tracheal folds not marked. Ventral cuticle extremely fragile—see comments, below.

MATERIAL EXAMINED. Holotype post-emergence pupal case, BELIZE, CFR, San Pastor trackside, on *Lasiacis* sp. (Poaceae), 29 v.2004 (J.H.Martin #7937) (BMNH). Paratypes: 19 post-emergence pupal cases or damaged puparia, same data as holotype (BMNH).

ETYMOLOGY. The specific epithet is the latin adjective *abdita* (meaning concealed or secret), reflecting the discovery of specimens only on grass leaves deep in a thicket, close to the ground.

COMMENTS. The puparia of *T. abdita* secrete no evident waxy material on the dorsal surface, but on two chemically-untreated individuals the fine peripheral wax filaments are clearly visible (Fig. 125), one filament issuing from each submarginal papilla. This species is represented by only one small sample, mainly comprising post-emergence pupal cases. Despite very careful removal from the blades of their host grass, most of their ventral surfaces are damaged and incomplete, with the middle pair of legs being the feature lost most often. The specimen selected as holotype has one side of the dorsal cephalothorax missing, but the chaetotaxy is otherwise complete, and all legs are present on one side, allowing most features to be observed satisfactorily. On the same slide, one paratype specimen has legs that are more complete than in the holotype, but has suffered substantial loss of setae.

This species does not appear to belong to any of the species groupings defined for the North American *Trialeurodes* species by Russell (1948). *T. abdita* is perhaps closest to the *T. vaporariorum* group, with fragile pale cuticle, wax secretions only evident peripherally and abdominal segment VII well defined medially: however, the presence of stout spines at the bases of the puparial legs precludes inclusion in this group, as do the particularly acute submarginal papillae. The combination of acute papillae and stout leg-base spines is reminiscent of the Old World *T. ricini* (Misra)-group, but puparia of members of the *T. ricini*-group secrete a tough, gelatinous dorsal carapace that resists chemical de-waxing.

T. abdita shares its host plant in Belize with *Aleurocybotus cereus* and *Aleurotulus laneus*, both described above, but its puparial secretions are very fine and almost invisible, in contrast to the flocculent secretions of the other two species.

***Trialeurodes cryptus* sp. nov.**

(Figs 60, 126)

PUPARIUM. *Habitus* Puparia scattered under the leaves of the host, extremely difficult to see, their clear, gelatinous dorsal secretions not visible except microscopically. *Margin*. Outline elongate, but precise shape variable between individuals, owing to leaf hairs modifying growth; 0.61–0.74 mm long, 0.25–0.32 mm wide, 2.17–2.48 times longer than wide (n=12). Margin smooth to irregular, but fine folds extending a short distance mesad lend an appearance of marginal teeth at some points; margin is modified at thoracic tracheal openings as small combs of 3 teeth, with a sclerotic crescent behind (mesal to) the teeth; caudal tracheal opening is modified as a comb of different form. *Dorsum*. Longitudinal moulting suture reaches puparial margin, thickened and crimped along its middle two-thirds (Fig. 60); transverse moulting sutures terminate in submargin. Segmentation rather faintly marked. Dorsal disc with maximally about 8 pairs of submarginal papillae, apically acute: these comprise 2–3 pairs on anterior part of the cephalic region, 1–2 pairs posterior to vasiform orifice and 2–3 pairs between these extremities. Additionally there are rounded dorsal disc tubercles, always with one medially on abdominal segment VIII anterior to vasiform orifice; presence of other tubercles is highly variable but most extremely there is one medially on every abdominal segment, with a submedian row to each side of the median line, and also a subdorsal row, the submedian and subdorsal rows extending onto the cephalothorax. Abdominal segment VII greatly reduced medially, but pockets do not overlap segment VI. Vasiform orifice ovoid, almost smooth internally but with a small circular pit near its posterior extremity; operculum rather cordate, without posterior setae, occupying about three-quarters of the orifice, covering all but the extreme apex of the lobulate-headed lingula which has an apical pair of tiny setae. *Chaetotaxy*. Anterior and posterior marginal setae present, very fine, especially the anterior pair. Single pairs of cephalic, first and eighth abdominal and caudal setae present, robust and acute, similar in length to operculum (Fig. 60). *Pores*. Dorsum with scattered simple pores and porettes, but few are in evidently geminate pairings. *Venter*. Cuticle very delicate, diaphanous. Ventral abdominal setae similar to posterior marginal setae, very fine. Legs rather poorly developed, but each with an evident apical pad, and each with 1 or 2 minute basal setae just discernible under highest magnification. Antennal bases anterolateral to fore legs, the antennae very short, hardly reaching bases of middle legs. Tracheal folds not marked.

MATERIAL EXAMINED. Holotype puparium, BELIZE, CFR, Grano de Oro track, on ?Bombacaceae, 22.xi.1994 (J.H.Martin #6487) (BMNH). Paratypes: 27 puparia, 1 third-instar larva, 2 third-instar/puparial intermoult, same data as holotype (BMNH, USNM).

ETYMOLOGY. The specific name alludes both to the difficulty in resolving many fine characters, because of the tenacity of the dorsal secretions, and to the extreme crypsis of the feeding stages on leaf surfaces.

COMMENTS. Few of the puparia of the type sample have benefitted from direct examination of the cuticular surface, such was the difficulty in removal of the tough dorsal carapace of secretion (see comments on *Tegmaleurodes*, p. 47–48). It is clear, however, that *T. cryptus* does not fall within one of the species-groups of *Trialeurodes* proposed by Russell (1948). Despite the similarities of the dorsal secretions, the much smaller number and different form of the submarginal papillae, combined with the pronounced tracheal combs, places this species distantly from the *T. floridensis*-group. No other known species of *Trialeurodes* is likely to be confused with *T. cryptus*.

***Trialeurodes floridensis* (Quaintance)**

(Figs 65, 73–74, 127–128)

Aleurodes floridensis, Quaintance, 1900: 26–27. Syntypes, USA (Florida).

Trialeurodes floridensis (Quaintance) Quaintance & Baker, 1915: xi.

DISTRIBUTION. Neotropical Region: Venezuela, and widely distributed across the Caribbean and Central America; Nearctic Region: southern USA.

COMMENTS. Russell (1948) divided the North American species of *Trialeurodes* into six discrete groups. The *T. floridensis*-group still comprises the eight species, four of them newly described, treated by Russell. The group is recognised by the presence of a single, even, outer submarginal ring of close-set papillae, each with a pore at its base, a tough gelatinous puparial covering (Fig. 128) that is resistant to all preparation chemicals (see comments on *Tegmaleurodes*, p. 48), and leg-bases with only minute setae (Fig. 74).

In Belize, it is considered that the group is represented by *T. floridensis* and *T. vitrinellus* (Cockerell) (*q.v.*), as well as several forms that are probably undescribed species within this group. Species of *Trialeurodes* are known to exhibit environmentally-induced puparial variation, and precise species definition within the Belizean *T. floridensis*-group will require further studies. Provisionally, there appear to be at least four unidentified species in this group, *Trialeurodes* spp 1, 4, 5 and 6 on the check list (Appendix 1). Several samples, all them slightly differing from each other, most closely resemble *T. intermedia* Russell (being devoid of dorsal disc tubercles), and are grouped under *Trialeurodes* sp.1 in Appendix 1. Belize *Trialeurodes* species 4, 5 & 6 are more distinctive, typical of the *T. floridensis*-group, but do not appear to belong to described species.

***Trialeurodes paucipapilla* sp. nov.**

(Figs 62–64, 129)

PUPARIUM. *Habitus*. Appearance in life not noted. *Margin*. Outline ovoid, 0.90–1.02 mm

long, 0.60–0.72 mm wide, generally widest opposite transverse moulting sutures (n=15). Margin with shallow crenulations, 16–19 per 0.1mm of lateral margin, modified at each thoracic tracheal opening as a smooth section of thickened cuticle (Fig. 64), and caudally as a pair of such thickenings (Fig. 63). *Dorsum*. Longitudinal moulting suture often rather indistinct, but reaches puparial margin; transverse moulting sutures terminate just distal to hind legs. Dorsal disc with all segmentation distinct into subdorsum, with the exception of the ill-defined cephalic/prothoracic division. Abdominal segment VII about half length of segment VI medially. Submedian abdominal depressions evident. Submargin with small papillae, all acute and much longer than wide, about 12 µm long, most specimens with 6 on one side and only 5 on the other (that closest to longitudinal moulting suture often wanting on one side of the puparium, Fig. 64). Submedian cuticle generally smooth, subdorsal/submarginal cuticle densely punctuated by shallow tubercular “cobble” (Fig. 129). Vasiform orifice (Fig. 63) triangular, longer than wide, rather poorly defined at its posterior apex, fluted internally, inset from posterior puparial margin by a little over its own length; operculum laterally-rounded trapezoidal, occupying slightly more than basal half of vasiform orifice, without evident posterior marginal setae; lingula head completely exposed beyond operculum, with 5 pronounced lobes, rather acute, only its apical setae extending beyond vasiform orifice. Caudal furrow faintly indicated, narrow. *Chaetotaxy*. Anterior and posterior marginal setae present, fine, hair-like. Single pairs of cephalic, first and eighth abdominal and caudal setae present, all shorter than marginal setae, very fine; eighth abdominal setae laterally placed very close to base of vasiform orifice, caudal setae almost contiguous with posteriormost pair of papillae (Fig. 63). *Pores*. Exceptionally sparsely provided with dorsal disc pores, not geminate, apparently no more than two on each side of dorsal disc on each abdominal segment, and similarly scarce on cephalothorax. Submargin with a row of pores smaller than those on dorsal disc, this row interspersed with the papillae, around 18 on each side of body in holotype. *Venter*. Ventral abdominal setae long and very fine, but rather close to median line and underlying vasiform orifice and operculum. All legs rather reminiscent of those of third-instar larvae, each with an apical pad, and only hind legs directed mesad apically (Fig. 62). A minute basal seta just discernible on each leg. Antennae placed anterolateral to fore legs, very short, with an apical pointed process, reaching only to pro–mesothoracic intersegmental division. Tracheal folds not marked.

MATERIAL EXAMINED. Holotype puparium, BELIZE, CFR, Las Cuevas, on *Coccoloba ?belizensis* (Polygonaceae), 04.vi.2002 (J.H.Martin #7631) (BMNH). Paratypes: 22 puparia, same data as holotype (BMNH; USNM); 8 puparia, CFR, same host, 13.ii.1996, 04.iii.1996, 06.vi.2002 (Martin) (BMNH) .

ETYMOLOGY. The specific epithet is based on the latin noun *paucitas* (meaning paucity), in connection with the small number of physically tiny submarginal papillae in this species.

COMMENTS. The puparia of this species secrete no evident waxy material and, probably consequently, the puparial dorsum has few pores. Whilst the presence of papillae, lobulate lingula, and medially-reduced abdominal segment VII all strongly indicate inclusion in *Trialeurodes*, the shape of the vasiform orifice and lingula are nevertheless atypical. Certainly, *T. paucipapilla* is not a member of any of Russell's (1948) Nearctic groupings of *Trialeurodes* species, nor does it closely resemble any other known species, described or otherwise.

***Trialeurodes similis* Russell**

(Figs 68, 130)

Trialeurodes similis Russell, 1948: 31. Holotype, USA (Florida).

DISTRIBUTION. Neotropical Region: Belize, Mexico; Nearctic Region: USA (Florida).

COMMENTS. *T. similis* is a member of the *variabilis*-group of Russell (1948). In Belize, it is currently only known from a single colony on *Waltheria indica* (Sterculiaceae), a roadside herb with densely tomentose leaves.

***Trialeurodes vaporariorum* (Westwood)**

(Figs 67, 70–72)

Aleurodes vaporariorum Westwood, 1856: 852. Syntypes, England.

Trialeurodes vaporariorum (Westwood) Quaintance & Baker, 1915: xi.

DISTRIBUTION. Cosmopolitan, but less common in Oriental and Austro-Oriental Regions, and usually found under glass in cooler temperate regions.

COMMENTS. *T. vaporariorum* has long been known as a worldwide pest, particularly of herbaceous crops under glass. This has led to its often-used common name, the glasshouse whitefly. It was assumed by Westwood (almost certainly correctly) to be a New World native, with the descriptive material suspected of having been imported to England from Mexico. The *T. vaporariorum*-group is one of Russell's (1948) North American species assemblages.

Although less notorious than the *Bemisia tabaci*-group, *T. vaporariorum* is nonetheless a serious and widespread pest that causes significant economic damage, especially amongst covered vegetable and foliage crops. This is reflected in a large literature on aspects of this species. Despite being a New World native, there are occasional damaging local population explosions in the region: a recent example involved the near-death of a hedge of *Lantana camara* on a university campus in Quito, Ecuador in 2005 (personal observations, material in BMNH).

***Trialeurodes variabilis* (Quaintance)**

(Figs 69, 131)

Aleurodes variabilis Quaintance, 1900: 39–41. Syntypes, USA (Florida).*Trialeurodes variabilis* (Quaintance) Quaintance & Baker, 1915: xi.

DISTRIBUTION. Neotropical Region: Belize, Brazil, Ecuador, and widely distributed across the Caribbean and Central America; Nearctic Region: USA (Florida).

COMMENTS. *T. variabilis* is a species with exceptionally small puparia in which the papillae are almost, or even entirely, wanting. Although six genera of plant hosts (each in a different family) were recorded by Mound & Halsey (1978), material in BMNH clearly indicates that *Carica papaya* is a favoured host plant for this species.

***Trialeurodes vitrinellus* (Cockerell)**

(Figs 66, 132)

Aleyrodes (*Trialeurodes*) *vitrinellus* Cockerell, 1903: 241. Syntypes, Mexico.*Trialeurodes vitrinellus* (Cockerell) Quaintance & Baker, 1915: xi.

DISTRIBUTION. Neotropical Region: Belize, Mexico.

COMMENTS. In her account of North American *Trialeurodes* Russell (1948) illustrated and described *T. vitrinellus* with shallow dorsal tubercles loosely defining the submedian area of the thorax and abdomen, with further tubercles on the median line of several abdominal segments. However, specimens determined by Russell and present in BMNH have no dorsal disc tubercles at all, better answering the description of her new species, *T. intermedia*. It is considered that puparia from *Psidium guajava* in the CFR, possessing tubercles as described above, belong to *T. vitrinellus*, one of the *T. floridensis* group of species (*q.v.*).

TRIALEUROLONGA gen. nov.Type species *Trialeurolonga trifida* **sp. nov.**

DIAGNOSIS - PUPARIUM (Figs 75–81). Large puparia, with pale cuticle, not feeding gregariously. Margin finely crenulate, modified at tracheal openings. Submargin with glandular papillae. Dorsal chaetotaxy limited to paired submedian cephalothoracic, first and eighth abdominal and caudal setae. Longitudinal and transverse moulting sutures reaching, or almost reaching, puparial margin, cephalothoracic plates often lost in post-emergence pupal cases. Vasiform orifice at least as wide as long, operculum obscuring

lingular characters. Abdominal segment VII not significantly reduced in length medially. With geminate pore/porettes regularly distributed over dorsum. Ventral cuticle diaphanous, tracheal folds marked but not sculptured.

ETYMOLOGY. The chosen generic name reflects the combination of puparial characters that suggest affinities with both *Trialeurodes* and *Dialeurolonga*.

COMMENTS. The presence of a submarginal row of glandular papillae is a character that is shared by species of *Trialeurodes* and many species of *Dialeurolonga*. However, the structure of these papillae in the type species of *Trialeurolonga* (see below) differs from those in *Trialeurodes* and *Dialeurolonga*. The nature of the modification of the puparial margin at the tracheal openings, the transverse moulting sutures reaching the puparial margin, and the unreduced median length of abdominal segment VII are characters shared with *Dialeurolonga* but not with *Trialeurodes*. However, the rather faintly-marked and unsculptured ventral tracheal folds are more typical for *Trialeurodes* than *Dialeurolonga*, but the general size and shape of the puparia would be unusual in *Trialeurodes* but more typical in *Dialeurolonga*. The form of the vasiform orifice, with the operculum completely obscuring the lingular characters, is not seen in either *Trialeurodes* or *Dialeurolonga*. The nature of the submarginal papillae, along with the obscured lingula, modified margin at the tracheal openings, and long and closely-adjacent caudal setae suggest affinities with the Australasian/Pacific genus *Orchamoplatus* (Russell, 1958).

Only one species from Belize appears to belong to this new genus, and is described below. Its suite of characters do not appear to match those of any neotropical genera described to date.

***Trialeurolonga trifida* sp. nov.**

(Figs 75–81)

PUPARIUM. *Habitus*. Cuticle entirely pale. Individuals scattered under leaves, not gregarious, without evident waxy secretions except for a very fine transparent marginal fringe of waxy filaments; yellowish or cryptic whilst feeding and silvery, glassy, in appearance when adults or parasitoids have emerged. *Margin*. Outline 1.48–1.61 mm long, 1.10–1.22 mm wide, generally widest at abdominal segment II/III (n=20). Margin very finely crenulate (Figs 79–81), about 17–20 rounded teeth per 0.1 mm of margin; margin modified at each thoracic (Figs 80–81) and caudal tracheal opening with a dorsally-placed elongate lobe with a broader lobe to either side, often with a smaller intermediate lobe indicated on each side, this structure overlying a distinct notch formed between two enlarged marginal crenulations. *Dorsum*. Longitudinal moulting suture reaches puparial margin; transverse moulting sutures almost reaching, and perpendicular to, margin (Fig. 75). Submargin with a single row of numerous small, glandular papillae (responsible for secreting marginal waxy fringe, described above). Each submarginal papilla comprises a

pair of moderately acute upper (dorsal) prongs, underlain ventrally by a single more sharply acute point that is visible between the upper prongs (Figs 79–80). About 4–6 marginal crenulations present between each pair of papillae, 67 and 71 papillae on each side in holotype. Dorsal disc subtly corrugate/reticulate. Pro–meso- and meso–metathoracic divisions, and abdominal segmentation distinct submedially; paired submedian abdominal depressions (segments I–VII) distinct, subcircular, with two similar pairs on metathorax and another pair on pro–mesothoracic boundary. A small group of (usually 4) tiny dark, rounded, tubercles antero-mesal to cephalic setae, with a few similar ones often distributed between cephalic setae and longitudinal moulting suture (Fig. 75); anteromesal to each cephalic seta is a “septate” ovoid structure slightly closer to longitudinal moulting suture. Abdominal segment VII not reduced in length medially, pockets hardly evident. Vasiform orifice (Fig. 78) inset from posterior puparial margin by 3–4 times its own length, almost subcircular, about as wide as long, its inner rim thickened except anteriorly, fluted on inner sides, and with a pair of ovoid cells and a transverse short fold posteriorly, length of orifice 50 μm in holotype; operculum similar in shape to, but somewhat smaller than, vasiform orifice, covering and completely obscuring lingula. A narrow caudal furrow somewhat indicated between a pair of roughened ridges leading from either side of vasiform orifice to caudal setae. *Chaetotaxy*. Anterior and posterior marginal setae present, hair-like, 24 μm and 40 μm long respectively in holotype. Single pairs of cephalic, first and eighth abdominal setae present, straight and rather fine, similar to each other and up to 40 μm long in holotype. Pair of caudal setae much longer than other submedian setae, 120 μm long in holotype, their bases located just submarginally and marking distal extremities of caudal ridges. *Pores*. Dorsal disc with fairly evenly-distributed geminate pore/porettes, each segment with one submedian pair and another pair marking submedian/subdorsal boundary, with a few more pairs in subdorsum. Each submarginal papilla with a distinct pore at its base. *Venter*. Ventral abdominal setae similar to posterior marginals, their bases anterior to vasiform orifice. Middle and hind legs each with the usual pair of tiny basal setae, the hind legs each additionally with two even more minute, accessory, setae; where discernible, fore legs also appear to possess minute setae similar to the accessory setae of hind legs. Antennal bases anterior to, similar in length to, and overlain by fore legs, antennal apices unusually acute and slender (Fig. 77). Thoracic and caudal tracheal folds each only marked by a pair of boundary lines, the folds unpunctuated (Fig. 81).

MATERIAL EXAMINED. Holotype puparium, BELIZE, CFR, Monkey Tail track, on *Chiococca ?alba* (Rubiaceae), 01.vi.2004 (J.H.Martin #7967) (BMNH). Paratypes: 9 puparia, same data as holotype (BMNH); 18 puparia (2 dry on leaf tissue), 8 third-instar larvae, 1 third-instar/puparium intermoult, CFR, Puente Natural, on *Amyris* sp. (Rutaceae), 02.iv.2003 (Martin) (BMNH, USNM); 1 incomplete puparial dorsum, CFR, Las Cuevas, on undetermined host, 02.vi.2002 (Martin) (BMNH).

ETYMOLOGY. The specific name is the latin *trifida* (meaning three-forked), reflecting the nature of each of the submarginal papillae.

COMMENTS. The affinities of this new species, within its monobasic genus, are discussed under the generic comments, above.

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Appendix 1— check list of the Aleyrodidae-Aleyrodinae of Belize, with known host genera or families in Belize

- many records concern host plants for which identification was not possible, and these are omitted
- many of the undescribed / undetermined whitefly species are here placed in genera with caution, and future studies may result in alternative placements
- for synonymies see species accounts in main text of the paper

whitefly species	host genus and/or family	comments
<i>Aleurocanthus woglumi</i> Ashby	<i>Citrus</i> (Rutaceae)	collected elsewhere in Belize, not CFR
<i>Aleurocerus ceriferus</i> (Sampson & Drews)	<i>Brosimum</i> (Moraceae) <i>Drypetes</i> (Euphorbiaceae) <i>Piper</i> (Piperaceae)	
<i>Aleurocerus chiclensis</i> Russell	? <i>Eugenia</i> (Myrtaceae) <i>Manilkara</i> (Sapotaceae) <i>Protium</i> (Burseraceae)	
<i>Aleurocerus palmae</i> Russell	<i>Chamaedorea</i> (Arecaceae) <i>Desmoncus</i> (Arecaceae) <i>Pouteria</i> (Sapotaceae)	
<i>Aleurocybotus cereus</i> sp. nov.	<i>Lasiacis</i> (Poaceae)	
<i>Aleuroglandulus inanis</i> sp. nov.	<i>Carica</i> (Caricaceae)	
<i>Aleuroglandulus striatus</i> Sampson & Drews	<i>Casearia</i> (Flacourtiaceae) <i>Coccoloba</i> (Polygonaceae) <i>Laetia</i> (Flacourtiaceae) ? <i>Trichilia</i> (Meliaceae)	
<i>Aleuroglandulus subtilis</i> Bondar	<i>Erythrina</i> (Fabaceae, Papilionoideae) <i>Schizolobium</i> (Fabaceae, Caesalpinioideae) Arecaceae Fabaceae	
<i>Aleuoparadoxus rhodae</i> Russell	? <i>Eugenia</i> (Myrtaceae)	
<i>Aleuoparadoxus sapotae</i> Russell	<i>Manilkara</i> [“ <i>Achras</i> ”] (Sapotaceae)	holotype (USNM) is the only known specimen, not from CFR
<i>Aleuoparadoxus truncatus</i> Russell	? <i>Eugenia</i> (Myrtaceae) <i>Lonchocarpus</i> (Fabaceae, Papilionoideae)	
<i>Aleuoparadoxus</i> sp. 1	<i>Laetia</i> (Flacourtiaceae) ? <i>Lonchocarpus</i> (Fabaceae, Papilionoideae) <i>Pimenta</i> (Myrtaceae)	<i>sapotae</i> -group, figure 92

.....continued

whitefly species	host genus and/or family	comments
<i>Aleuoparadoxus</i> sp. 2	<i>Pimenta</i> (Myrtaceae)	near <i>truncatus</i>
<i>Aleuroplatus cococolus</i> Quaintance & Baker	<i>Brosimum</i> (Moraceae) <i>Calophyllum</i> (Clusiaceae) <i>Coccoloba</i> (Polygonaceae) <i>?Eugenia</i> (Myrtaceae) <i>Guettarda</i> (Rubiaceae) <i>Pimenta</i> (Myrtaceae) <i>Psidium</i> (Myrtaceae) <i>Strychnos</i> (Loganiaceae) <i>Terminalia</i> (Combretaceae) Asteraceae <i>?Rutaceae</i>	
<i>Aleuroplatus vinsonioides</i> (Cockerell)	<i>Nectandra</i> (Lauraceae) Lauraceae	
<i>Aleuroplatus</i> sp. 1		
<i>Aleuroplatus</i> sp. 2	<i>Monstera</i> (Araceae)	
<i>Aleuroplatus</i> sp. 3	<i>Coccoloba</i> (Polygonaceae) Moraceae	yellow wax fringe & tuft.
<i>Aleuroplatus</i> sp. 4	<i>Miconia</i> (Melastomataceae) Melastomataceae	
<i>Aleuroplatus</i> sp. 5	<i>Lasianthaea</i> (Asteraceae) Asteraceae	
<i>Aleuroplatus</i> sp. 6	<i>Persea</i> (Lauraceae)	<i>biluminiporus</i> Martin & Malumphy / <i>perseaphagus</i> Martin <i>et al.</i> -group
<i>Aleuroplatus</i> sp. 7	<i>Guettarda</i> (Rubiaceae) <i>Pimenta</i> (Myrtaceae) <i>?Rutaceae</i>	glassy wax secretion
<i>Aleuroplatus</i> sp. 8	<i>Guettarda</i> (Rubiaceae) <i>?Trichilia</i> (Meliaceae)	
<i>Aleuroplatus</i> sp. 9	<i>Calophyllum</i> (Clusiaceae) <i>Pimenta</i> (Myrtaceae) Araceae	
<i>Aleuroplatus</i> sp. 10	<i>Casearia</i> (Flacourtiaceae)	
<i>Aleuroplatus</i> sp. 11	<i>Lonchocarpus</i> (Fabaceae, Papilionoideae)	<i>cococolus</i> -group, glassy wax secretion
<i>Aleuroplatus</i> sp. 12	<i>Coccoloba</i> (Polygonaceae)	
<i>Aleuroplatus</i> sp. 13		<i>cococolus</i> -group
<i>Aleuroplatus</i> sp. 14	<i>Casearia</i> (Flacourtiaceae) <i>Coccoloba</i> (Polygonaceae) <i>Ouratea</i> (Ochnaceae)	yellow wax fringe & tuft, but not sp. 3?

.....continued

whitefly species	host genus and/or family	comments
<i>Aleuropleurocelus</i> sp. 1	?Euphorbiaceae	
<i>Aleuropleurocelus</i> sp. 2	<i>Monstera</i> (Araceae) Araceae, vine Arecaceae ?Rubiaceae	
<i>Aleuropleurocelus</i> sp. 3	Arecaceae	
<i>Aleuropleurocelus</i> sp. 4	? <i>Trichilia</i> (Meliaceae)	
<i>Aleuropleurocelus</i> sp. 5	? <i>Vitex</i> (Verbenaceae) Asteraceae	cf. <i>oblanceolatus</i> Sampson & Drews
<i>Aleuropleurocelus</i> sp. 6	<i>Acalypha</i> (Euphorbiaceae)	
<i>Aleuropleurocelus</i> sp. 7	?Rubiaceae	
<i>Aleuropleurocelus</i> sp. 8	<i>Lasianthaea</i> (Asteraceae)	cf. <i>oblanceolatus</i>
<i>Aleuropleurocelus</i> sp. 9	<i>Laetia</i> (Flacourtiaceae)	
<i>Aleuropleurocelus</i> sp. 10	<i>Psychotria</i> (Rubiaceae)	puparium covered by tiny bifid spines
<i>Aleurothrixus chivelensis</i> (Sampson & Drews)	<i>Persea</i> (Lauraceae)	
<i>Aleurothrixus floccosus</i> (Maskell)	<i>Psidium</i> (Myrtaceae) <i>Zanthoxylum</i> (Rutaceae)	
<i>Aleurothrixus myrtacei</i> Bondar	<i>Pimenta</i> (Myrtaceae) ?Rubiaceae	
<i>Aleurothrixus</i> sp. 1	? <i>Chiococca</i> (Rubiaceae)	cf. dark form of <i>myrtacei</i> ?
<i>Aleurothrixus</i> sp. 2	?Hippocrataceae	black puparia, figure 135.
<i>Aleurothrixus</i> sp. 3	<i>Diospyros</i> (Ebenaceae) ? <i>Lonchocarpus</i> (Fabaceae, Papilionoideae)	
<i>Aleurotrachelus socialis</i> Bondar	<i>Calophyllum</i> (Clusiaceae) <i>Coccoloba</i> (Polygonaceae) <i>Persea</i> (Lauraceae) <i>Pimenta</i> (Myrtaceae) <i>Piper</i> (Piperaceae) ? <i>Tetracera</i> (Dilleniaceae) ?Bignoniaceae, vine ?Lauraceae	degree of variability uncertain, see comments
<i>Aleurotrachelus tracheifer</i> (Quaintance)	<i>Coccoloba</i> (Polygonaceae) ? <i>Eugenia</i> (Myrtaceae) <i>Protium</i> (Burseraceae) <i>Strychnos</i> (Loganiaceae) Moraceae	
<i>Aleurotrachelus trachoides</i> (Back)	Solanaceae	

.....continued

whitefly species	host genus and/or family	comments
<i>Aleurotrachelus</i> sp. 1		
<i>Aleurotrachelus</i> sp. 2	<i>Peperomia</i> (Piperaceae) <i>Piper</i> (Piperaceae) Arecaceae	<i>trachoides</i> -group but smaller lingula head
<i>Aleurotrachelus</i> sp. 3	<i>Deherainia</i> (Theophrastaceae) <i>Guettarda</i> (Rubiaceae) <i>Pimenta</i> (Myrtaceae) <i>Psidium</i> (Myrtaceae) <i>Trichilia</i> (Meliaceae) Bignoniaceae, vine Sapindaceae, vine	? variable single species
<i>Aleurotrachelus</i> sp. 4	<i>Inga</i> (Fabaceae, Mimosoideae)	dark castellate marginal teeth, <i>trachoides</i> -type lin- gula
<i>Aleurotrachelus</i> sp. 5	<i>Calophyllum</i> (Clusiaceae)	pale puparia, long wavy sub- marginal hair-like setae
<i>Aleurotrachelus</i> sp. 6	<i>Brosimum</i> (Moraceae) <i>Malmea</i> (Annonaceae) <i>Protium</i> (Burseraceae) <i>Serjania</i> / <i>Paullinia</i> (Sapindaceae) <i>Tetracera</i> / <i>Davilla</i> (Dilleniaceae) <i>Zanthoxylum</i> (Rutaceae)	single variable species?
<i>Aleurotrachelus</i> sp. 7	<i>Pimenta</i> (Myrtaceae)	
<i>Aleurotrachelus</i> sp. 8		pale puparia, vasiform ori- fice elevated & pigmented
<i>Aleurotrachelus</i> sp. 9	<i>Bunchosia</i> (Malpighiaceae)	
<i>Aleurotrachelus</i> sp. 10	<i>Protium</i> (Burseraceae)	<i>trachoides</i> -group
<i>Aleurotulus laneus</i> sp. nov.	<i>Lasiacis</i> (Poaceae)	
<i>Aleurotulus mundururu</i> Bondar	? <i>Strychnos</i> (Loganiaceae)	
<i>Aleurotulus</i> sp. 1		<i>mundururu</i> -group, coarser marginal teeth, cephalic setae present
<i>Aleurovitreus</i> gen. nov. <i>insignis</i> (Bondar)	<i>Persea</i> (Lauraceae)	
<i>Aleurovitreus risor</i> sp. nov.	<i>Piper</i> (Piperaceae)	
<i>Aleurovitreus</i> sp. 1	<i>Ficus</i> (Moraceae)	near <i>risor</i> , larger vasiform orifice
<i>Aleurovitreus</i> sp. 2	<i>Piper</i> (Piperaceae)	<i>risor</i> -group, margin much more deflexed

.....continued

whitefly species	host genus and/or family	comments
<i>Aleurovitreus</i> sp. 3	<i>Piper</i> (Piperaceae)	<i>risor</i> -group, dorsal papillae, margin narrowly deflexed
<i>Aleurovitreus</i> sp. 4	<i>Piper</i> (Piperaceae)	<i>risor</i> -group, smooth, narrowly deflexed, figure 108
<i>Aleurovitreus</i> sp. 5		
<i>Aleurovitreus</i> sp. 6	<i>Trophis</i> (Moraceae) ?Rubiaceae	resembles <i>Asialeyrodes</i> in some characters
<i>Aleurovitreus</i> sp. 7		
<i>Bemisia centroamericana</i> sp. nov.	<i>Bocconia</i> (Papaveraceae) ?Lasianthaea (Asteraceae) Asteraceae	
<i>Bemisia tabaci</i> (Gennadius)	?Euphorbiaceae, herb	
<i>Bemisia</i> sp. 1	<i>Erythrina</i> (Fabaceae, Papilionoideae) ?Eugenia (Myrtaceae) <i>Zanthoxylum</i> (Rutaceae)	<i>afer</i> (Priesner & Hosny) / <i>berbericola</i> (Cockerell)-group
<i>Crenidorsum aroidephagus</i> Martin & Aguiar	<i>Monstera</i> (Araceae) Araceae	
<i>Crenidorsum</i> sp. 1	<i>Pouteria</i> (Sapotaceae) ?Apocynaceae ?Lauraceae	
<i>Crenidorsum</i> sp. 2	Melastomataceae	
<i>Crenidorsum</i> sp. 3	<i>Terminalia</i> (Combretaceae)	
<i>Crenidorsum</i> sp. 4	<i>Ilex</i> (Aquifoliaceae) ?Euphorbiaceae ?Lauraceae	
<i>Crenidorsum</i> sp. 5	<i>Miconia</i> (Melastomataceae) <i>Protium</i> (Bursleraceae)	cf. <i>differens</i> Russell
<i>Crenidorsum</i> sp. 6	?Eugenia (Myrtaceae)	
<i>Crenidorsum</i> sp. 7		
<i>Dialeurodes denticulatus</i> (Bondar)	<i>Brosimum</i> / <i>Pseudolmedia</i> (Moraceae) <i>Ficus</i> (Moraceae) <i>Persea</i> (Lauraceae) Moraceae	see comments concerning <i>Persea</i> record, p. 40
<i>Dialeurodes sens lat.</i> sp. 1	<i>Malmea</i> (Annonaceae) <i>Oxandra</i> (Annonaceae) ?Pouteria (Sapotaceae)	dorsal disc darkly pigmented
<i>Dialeurodes sens lat.</i> sp. 2	?Lauraceae	<i>egregissima</i> Sampson & Drews-group, see discussion on pp. 39–40

.....continued

whitefly species	host genus and/or family	comments
<i>Dialeurodes sens lat.</i> sp. 3	<i>Brosimum</i> (Moraceae) <i>Calophyllum</i> (Clusiaceae)	
<i>Dialeurodes sens lat.</i> sp. 4	<i>Arrabidaea</i> (Bignoniaceae)	
<i>Dialeurodes sens lat.</i> sp. 6	<i>Protium</i> (Burseraceae)	
<i>Dialeurodes sens lat.</i> sp. 7	<i>Brosimum</i> (Moraceae)	
<i>Dialeurodes sens lat.</i> sp. 8	<i>Heliconia</i> (Heliconiaceae)	<i>egregissima</i> -group, see discussion on p. 39–40
<i>Dialeurodes sens lat.</i> sp. 9	<i>Arrabidaea</i> (Bignoniaceae) Bignoniaceae, vines	
<i>Dialeurodes sens lat.</i> sp. 10		
<i>Dialeurodes sens lat.</i> sp. 11	? <i>Eugenia</i> (Myrtaceae)	reddish-cryptic in life, vasi-form orifice with glandular surround
<i>Dialeurodes sens lat.</i> sp. 12		cf. <i>navarroi</i> Bondar, false submarginal fold, deep tracheal pores
<i>Dialeurodes sens lat.</i> sp. 14	<i>Brosimum</i> (Moraceae)	<i>egregissima</i> -group, see discussion on p. 39–40
<i>Dialeurolonga guettardae</i> sp. nov.	<i>Guettarda</i> (Rubiaceae)	
<i>Disiphon russellae</i> sp. nov.	<i>Chiococca</i> (Rubiaceae) <i>Nectandra</i> (Lauraceae) <i>Piper</i> (Piperaceae) Lauraceae	
<i>Paraleurolobus chamaedoreae</i> Russell	Moraceae	
<i>Paraleurolobus</i> sp. 1	<i>Calophyllum</i> (Clusiaceae)	only dorsal disc darkly pigmented
<i>Paraleurolobus</i> sp. 2	<i>Calophyllum</i> (Clusiaceae)	
<i>Paraleurolobus</i> sp. 3		
<i>Peracchius durantae</i> Lima & Racca-Filho		
<i>Peracchius</i> sp. 1	<i>Nectandra</i> (Lauraceae) ?Lauraceae	
<i>Singhiella citrifolii</i> (Morgan)	<i>Citrus</i> (Rutaceae)	collected elsewhere in Belize, not in CFR
<i>Tegmaleurodes lentus</i> gen. & sp. nov.	<i>Manilkara</i> (Sapotaceae) <i>Pouteria</i> (Sapotaceae) Lauraceae	

.....continued

whitefly species	host genus and/or family	comments
<i>Tegmaleurodes</i> sp. 1		near <i>integellus</i> (Bondar), 8 th abdominal setae posterior to vasiform orifice
<i>Tegmaleurodes</i> sp. 2	<i>Pimenta</i> (Myrtaceae)	very large puparia, 8 th abdominal setae posterior to vasiform orifice
<i>Tegmaleurodes</i> sp. 3	?Myrtaceae	
<i>Tegmaleurodes</i> sp. 4	? <i>Lonchocarpus</i> (Fabaceae, Papilionoideae)	
<i>Tegmaleurodes</i> sp. 5	? <i>Eugenia</i> (Myrtaceae)	near sp. 2 but 8 th abdominal setae conventionally placed
<i>Tegmaleurodes</i> sp. 6	<i>Pouteria</i> (Sapotaceae) Lauraceae Lauraceae / Moraceae	? <i>platicus</i> (Bondar)-group
<i>Tetraleurodes acaciae</i> (Quaintance)	<i>Bauhinia</i> (Fabaceae, Caesalpinioideae) <i>Cassia</i> (Fabaceae, Caesalpinioideae) <i>Inga</i> (Fabaceae, Mimosoideae) Fabaceae	
<i>Tetraleurodes chivela</i> Nakahara	? <i>Eugenia</i> (Myrtaceae)	
<i>Tetraleurodes confusa</i> Nakahara	<i>Persea</i> (Lauraceae)	see discussion of <i>confusa</i> / <i>perseeae</i> -group, p. 52
<i>Tetraleurodes fici</i> Quaintance & Baker	<i>Ficus</i> (Moraceae) <i>Pimenta</i> (Myrtaceae) <i>Urera</i> (Urticaceae)	
<i>Tetraleurodes mori</i> (Quaintance)	? <i>Eugenia</i> (Myrtaceae) <i>Psidium</i> (Myrtaceae) <i>Stizophyllum</i> (Bignoniaceae) Asteraceae Sapindaceae, vine	
<i>Tetraleurodes pringlei</i> Quaintance & Baker		
<i>Tetraleurodes quadratus</i> Sampson & Drews	<i>Brosimum</i> (Moraceae) <i>Pimenta</i> (Myrtaceae)	
<i>Tetraleurodes</i> sp. 1	<i>Coccoloba</i> (Polygonaceae) Moraceae	near <i>quadratus</i>
<i>Tetraleurodes</i> sp. 2	?Lauraceae	
<i>Tetraleurodes</i> sp. 3	<i>Chiococca</i> (Rubiaceae) <i>Crossopetalum</i> (Celastraceae)	cf. <i>fici</i> but vasiform orifice acutely elevated
<i>Tetraleurodes</i> sp. 4	<i>Brosimum</i> (Moraceae)	
<i>Tetraleurodes</i> sp. 5	Marantaceae	

.....continued

whitefly species	host genus and/or family	comments
<i>Tetraleurodes</i> sp. 6	<i>Dendropanax</i> / <i>Oreopanax</i> (Araliaceae)	tall puparia, entire dorsum detaches
<i>Tetraleurodes</i> sp. 7		unusually large posterior notch in vasiform orifice
<i>Tetraleurodes</i> sp. 8	<i>Persea</i> (Lauraceae)	figure 124
<i>Tetraleurodes</i> sp. 9	<i>Piper</i> (Piperaceae)	cf. <i>Aleurovitreus</i> but margin not deflexed, pale puparia
<i>Tetraleurodes</i> sp. 10		cf. spp 5, 14
<i>Tetraleurodes</i> sp. 11	<i>Strychnos</i> (Loganiaceae) <i>?Trophis</i> (Moraceae)	cf. <i>Paraleurolobus</i> ?
<i>Tetraleurodes</i> sp. 12	<i>Lonchocarpus</i> (Fabaceae, Papilionoideae)	very convex puparia. Upper surfaces of leaves
<i>Tetraleurodes</i> sp. 13	<i>Pimenta</i> (Myrtaceae)	cf. <i>Aleuropleurocelus</i> , nature of margin uncertain
<i>Tetraleurodes</i> sp. 14	<i>Calophyllum</i> (Clusiaceae)	castellate marginal teeth
<i>Tetraleurodes</i> sp. 15	<i>Brosimum</i> / <i>Pseudolmedia</i> (Moraceae)	
<i>Tetraleurodes</i> sp. 16	<i>?Eugenia</i> (Myrtaceae)	8 th abdominal setae almost on puparial median line, anterior to vasiform orifice
<i>Tetraleurodes</i> sp. 17	<i>Protium</i> (Bursaceae)	with <i>Aleurolobus</i> -type sub-marginal setae
<i>Trialeurodes abdita</i> sp. nov.	<i>Lasiacis</i> (Poaceae)	
<i>Trialeurodes cryptus</i> sp. nov.	?Bombacaceae	
<i>Trialeurodes floridensis</i> (Quaintance)	<i>Guettarda</i> (Rubiaceae) <i>Persea</i> (Lauraceae)	several other Belize species in this group—see undetermined species listed below
<i>Trialeurodes paucipapilla</i> sp. nov.	<i>Coccoloba</i> (Polygonaceae)	
<i>Trialeurodes similis</i> Russell	<i>Waltheria</i> (Sterculiaceae)	
<i>Trialeurodes vaporariorum</i> (Westwood)	? <i>Ageratum</i> (Asteraceae) Asteraceae ?Lamiaceae	
<i>Trialeurodes variabilis</i> (Quaintance)	<i>Carica</i> (Caricaceae)	
<i>Trialeurodes vitrinellus</i> (Cockerell)	<i>Psidium</i> (Myrtaceae)	

.....continued

whitefly species	host genus and/or family	comments
<i>Trialeurodes</i> sp. 1	<i>Calophyllum</i> (Clusiaceae) <i>Deherainia</i> (Theophrastaceae) ?Eugenia (Myrtaceae) <i>Strychnos</i> (Loganiaceae) Bignoniaceae, vine ?Lauraceae Lauraceae / Moraceae	<i>floridensis</i> species-group (cf. <i>intermedia</i> Russell), small variations between samples, but only single sp?
<i>Trialeurodes</i> sp. 2		elongate, with carapace, vasiform orifice notched, papillae only apical
<i>Trialeurodes</i> sp. 3	<i>Brosimum</i> (Moraceae)	cf. sp. 2 but vasiform orifice rounded, papillae normally distributed
<i>Trialeurodes</i> sp. 4		? <i>floridensis</i> species-group
<i>Trialeurodes</i> sp. 5	<i>Lasianthaea</i> (Asteraceae)	<i>floridensis</i> species-group
<i>Trialeurodes</i> sp. 6	<i>Psidium</i> (Myrtaceae) ?Vitex (Verbenaceae)	<i>floridensis</i> species-group
<i>Trialeurodes</i> sp. 7	<i>Stizophyllum</i> (Bignoniaceae)	thorn-like papillae of two sizes, ?? species-group
<i>Trialeurolonga trifida</i> gen. & sp. nov.	<i>Amyris</i> (Rutaceae) <i>Chiococca</i> (Rubiaceae)	
*****	*****	*****
?genus #1, sp. 1	Moraceae	cf. <i>Pseudaleurolobus</i> , black, dorsal disc defined
?genus #2, sp. 1	<i>Lonchocarpus</i> (Fabaceae, Papilionoideae)	lingula semi-lobulate, moulting sutures reach to margin, figure 136
?genus #2, sp. 2	<i>Lonchocarpus</i> (Fabaceae, Papilionoideae)	
?genus #3, sp. 1		excluded lingula, long submarginal setae, tracheal combs
?genus #4, sp. 1	<i>Protium</i> (Burseraceae)	cf. <i>Asialeyrodes</i> but with tracheal combs

Appendix 2—summary of taxonomic changes proposed in this work**New combinations**

Aleuroplatus crustatus Bondar (1928), transferred to *Tegmaleurodes*
Aleuroplatus denticulatus Bondar (1923), transferred to *Dialeurodes*
Aleuroplatus integellus Bondar (1923), transferred to *Tegmaleurodes*
Aleurotrachelus cecropiae Bondar (1923), transferred to *Aleuropleurocelus*
Aleurotrachelus myrtifolii Bondar (1923), transferred to *Aleurothrixus*
Aleyrodes insignis Bondar (1923), transferred to *Aleurovitreus*
Hempelia chivelensis Sampson & Drews (1941), transferred to *Aleurothrixus*
Luederwaltiana eriosemæ Hempel (1923), transferred to *Aleurotrachelus*
Mexicaleyrodes contigua Sampson & Drews (1941), transferred to *Tetraleurodes*
Tetraleurodes abnormis (Quaintance, 1900), transferred to *Aleuropleurocelus*

New generic synonyms

Hempelia Sampson & Drews (1941) becomes a junior synonym of *Aleurothrixus*
Quaintance & Baker (1914)
Luederwaltiana Hempel (1922) becomes a junior synonym of *Aleurotrachelus* Quaintance
& Baker (1914)
Mexicaleyrodes Sampson & Drews (1941) becomes a junior synonym of *Tetraleurodes*
Cockerell (1902)

New specific synonyms

Aleuroglandulus emmae Russell (1944) becomes a junior synonym of *A. subtilis* Bondar
(1923)
Aleuroglandulus malangae Russell (1944) becomes a junior synonym of *A. subtilis*
Bondar (1923)
Dialeurodes michoacanensis Sampson & Drews (1941) becomes a junior synonym of *D.*
denticulatus (Bondar, 1923)

New genera

Aleurovitreus, type species *Aleyrodes insignis* Bondar (1923)
Tegmaleurodes, type species *Tegmaleurodes lentus* **sp. nov.**
Trialeurolonga, type species *Trialeurolonga trifida* **sp. nov.**

New species

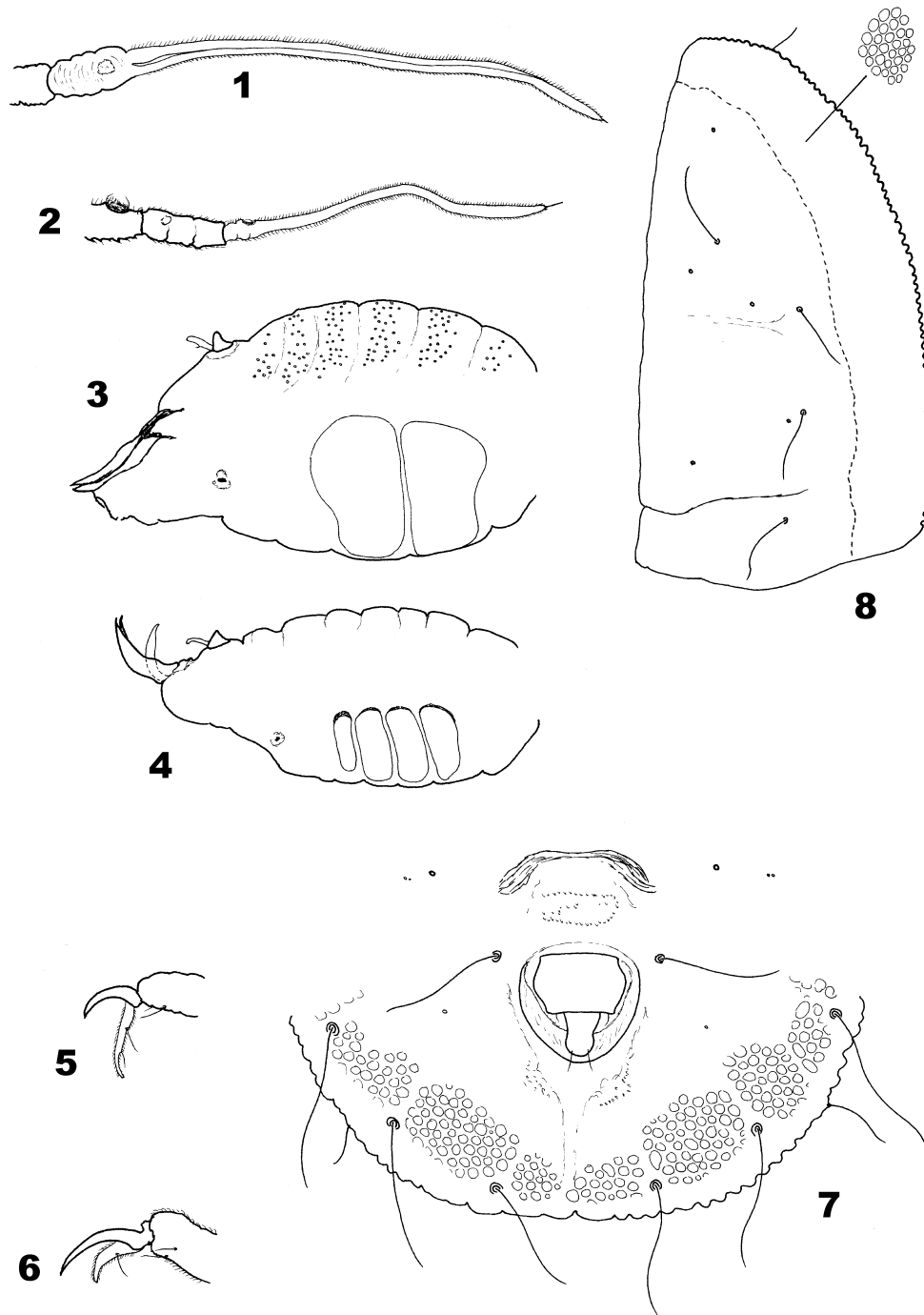
ZOOTAXA

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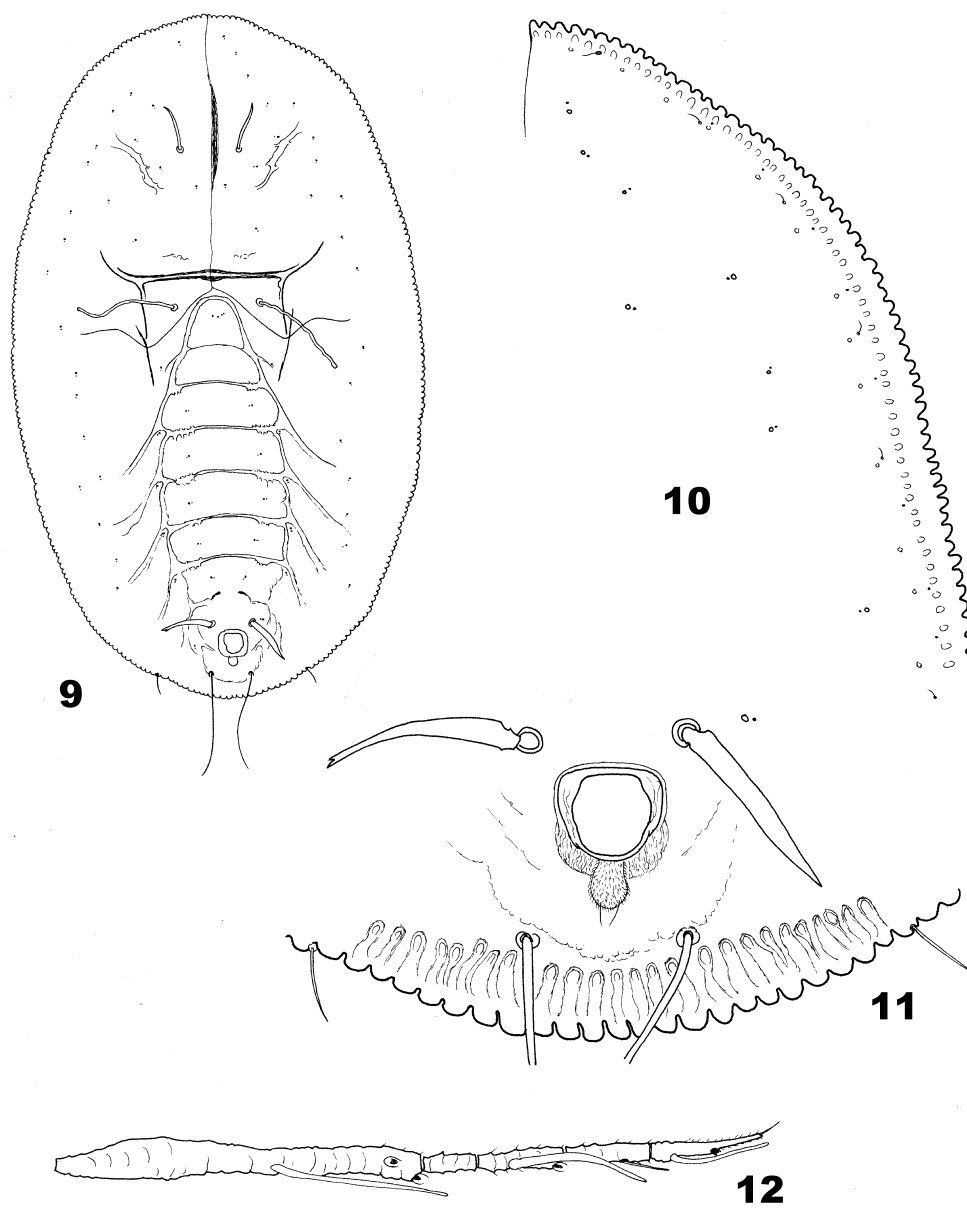
Aleurocybotus cereus
Aleuroglandulus inanis
Aleurotulus laneus
Aleurovitreus risor
Bemisia centroamericana
Dialeurolonga guettardae
Disiphon russellae
Tegmaleurodes lentus
Trialeurodes abdita
Trialeurodes cryptus
Trialeurodes paucipapilla
Trialeurolonga trifida

Revised status

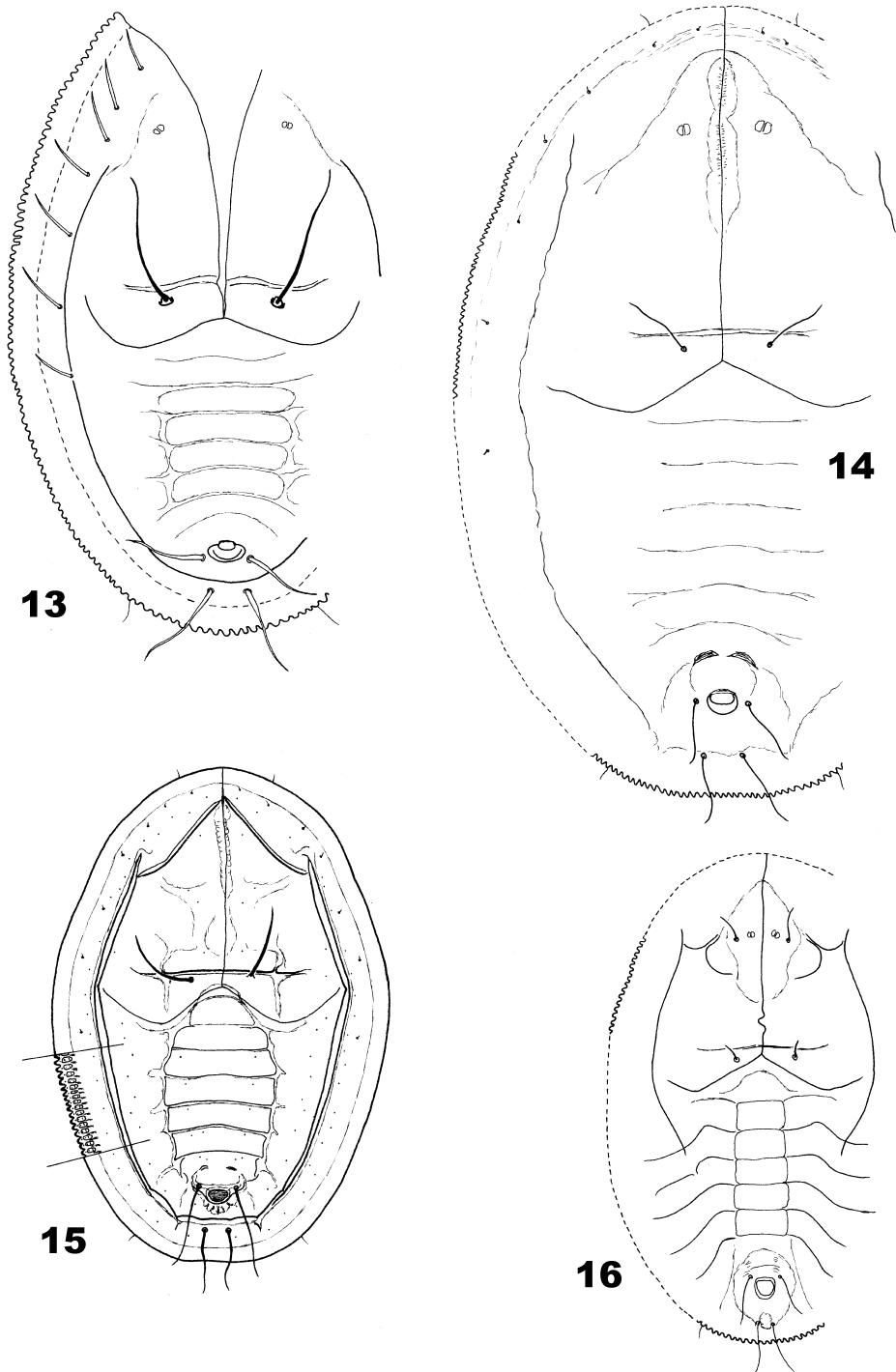
Aleurocanthus husaini Corbett (1939) regarded as a valid species, here removed from synonymy with *A. woglumi* Ashby (1915).



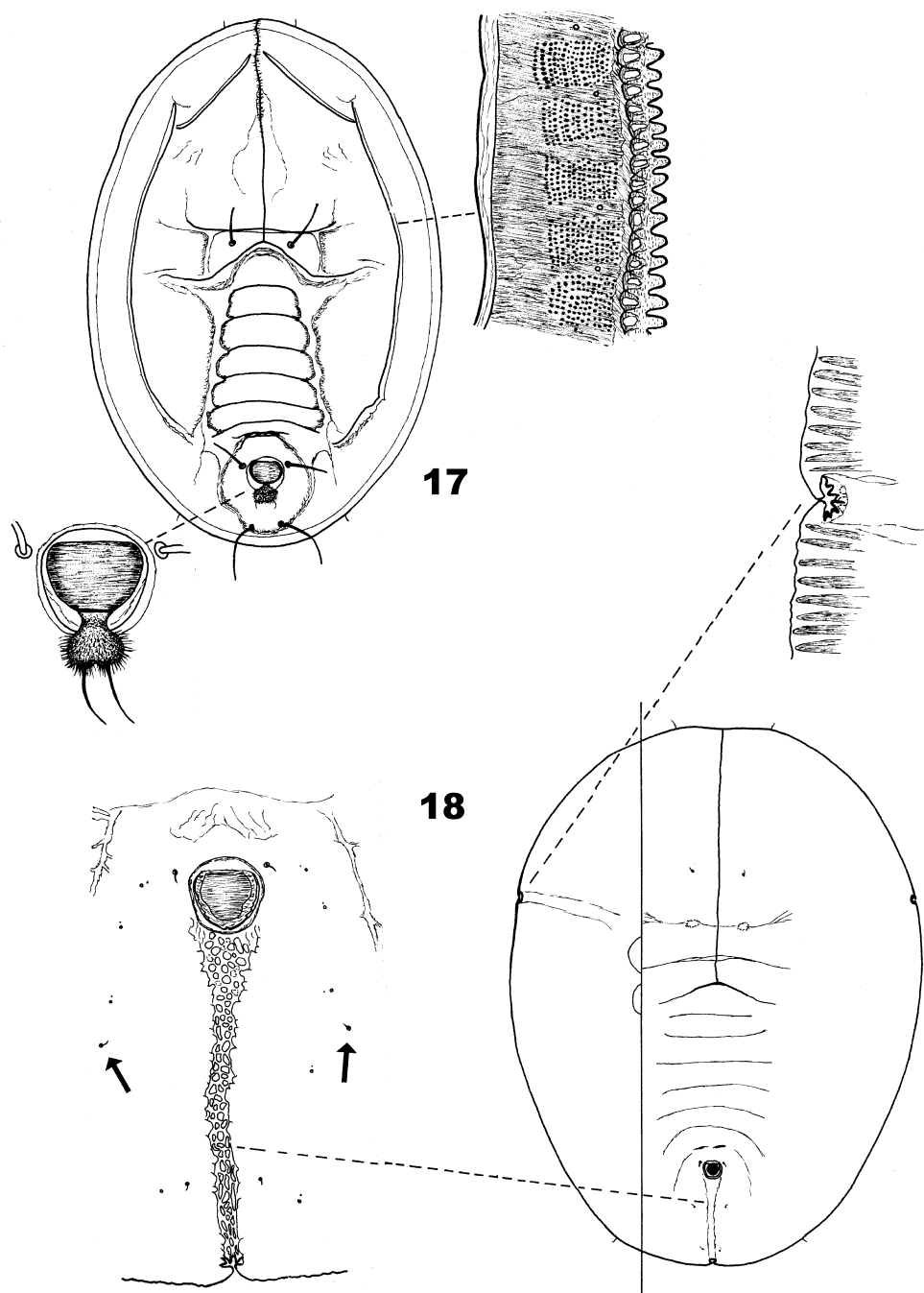
FIGURES 1–8. *Aleurocybotus cereus* sp. nov. 1, adult male, antennal apex; 2, adult female, antennal apex; 3, adult female, abdomen, lateral; 4, adult male, abdomen, lateral; 5, adult male, single claw and claw-like ?paronychium; 6, adult female, single claw and claw-like ?paronychium; 7, puparium, posterior dorsal detail (see Fig. 86 for photograph); 8, puparium, cephalothoracic plate with inner margin of glandular zone indicated by dashed line, and one glandular cluster shown.



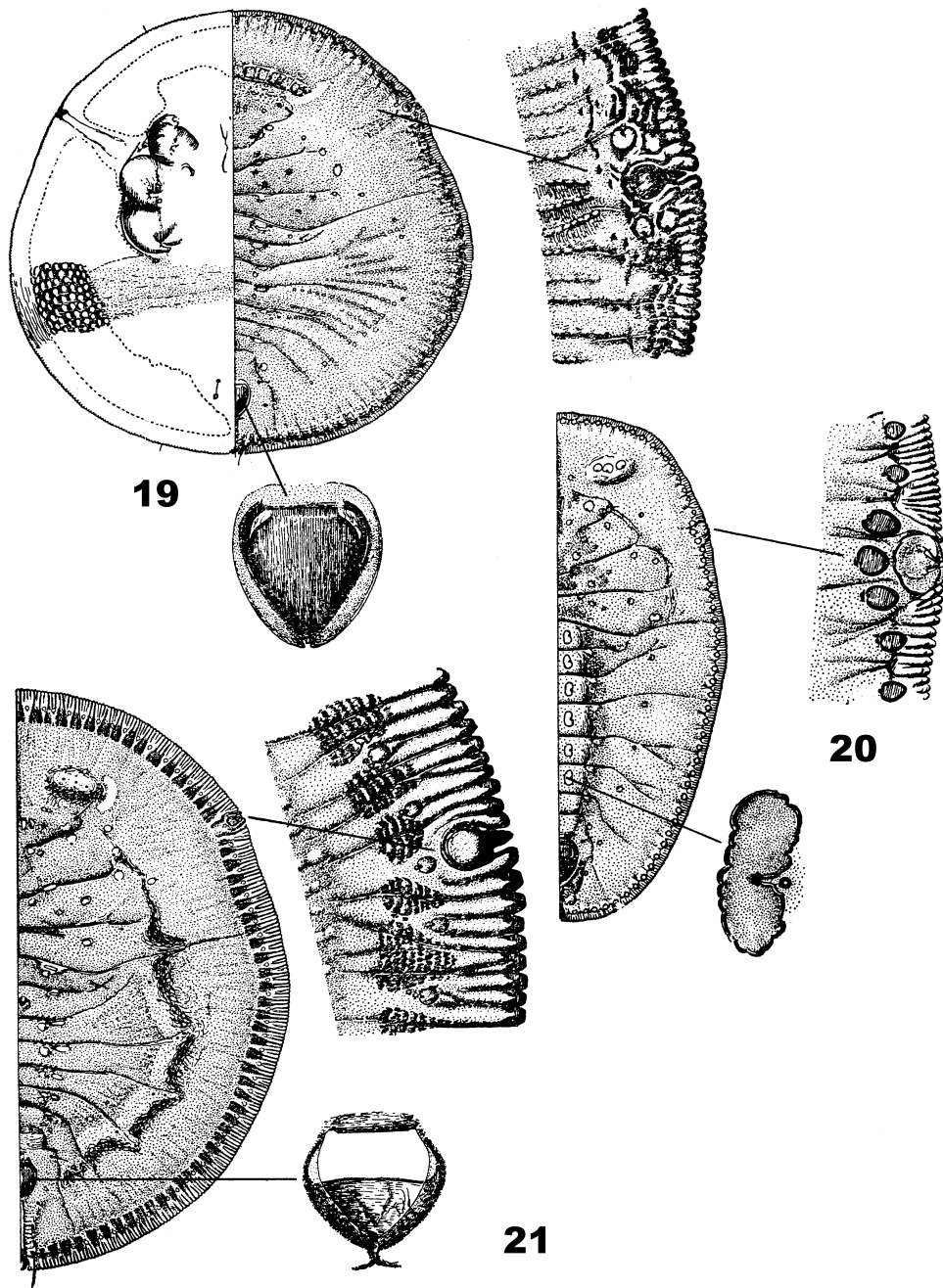
FIGURES 9–12. *Aleurotulus laneus* sp. nov. 9, puparium, dorsum (see Fig. 101 for photograph); 10, puparium, cephalothoracic margin and submarginal dorsal detail; 11, puparium, posterior dorsal detail; 12, adult female, antenna, apical flagellar segments.



FIGURES 13–16. 13–15, *Aleurothrix* spp. 13, *A. chivelensis* (Sampson & Drews), vacated pupal case, dorsal, simplified drawing; 14, *A. myrtacei* Bondar, puparium, dorsum, simplified drawing (see Fig. 97 for photograph); 15, *A. floccosus* (Maskell), puparium, dorsum (see Fig. 96 for photograph); 16, *Aleurotrachelus tracheifer* (Quaintance), puparium, dorsum, simplified drawing (see Figs 99, 141 for photographs).



FIGURES 17–18. 17, *Aleurotrachelus trachoides* (Back), puparium, dorsum, with enlarged detail of margin & submargin, and vasiform orifice (see Fig. 100 for photograph); 18, *Singhiella citrifolii* (Morgan), puparium, simplified drawing with enlarged detail of thoracic tracheal pore area, and vasiform orifice & caudal furrow with displaced submarginal setal pair 15 (of Jensen, 2001) arrowed (see Fig. 115 for photograph).



FIGURES 19–21. *Aleuoparadoxus* spp, puparia (after Russell, 1947). 19, *A. sapotae* Russell with enlarged detail of thoracic tracheal pore area, and vasiform orifice (see Fig. 91 for photograph); 20, *A. rhodae* Russell with enlarged detail of thoracic tracheal pore area, and submedian abdominal gland (see Fig. 90 for photograph); 21, *A. truncatus* Russell with enlarged detail of thoracic tracheal pore area, and vasiform orifice (see Fig. 93 for photograph).

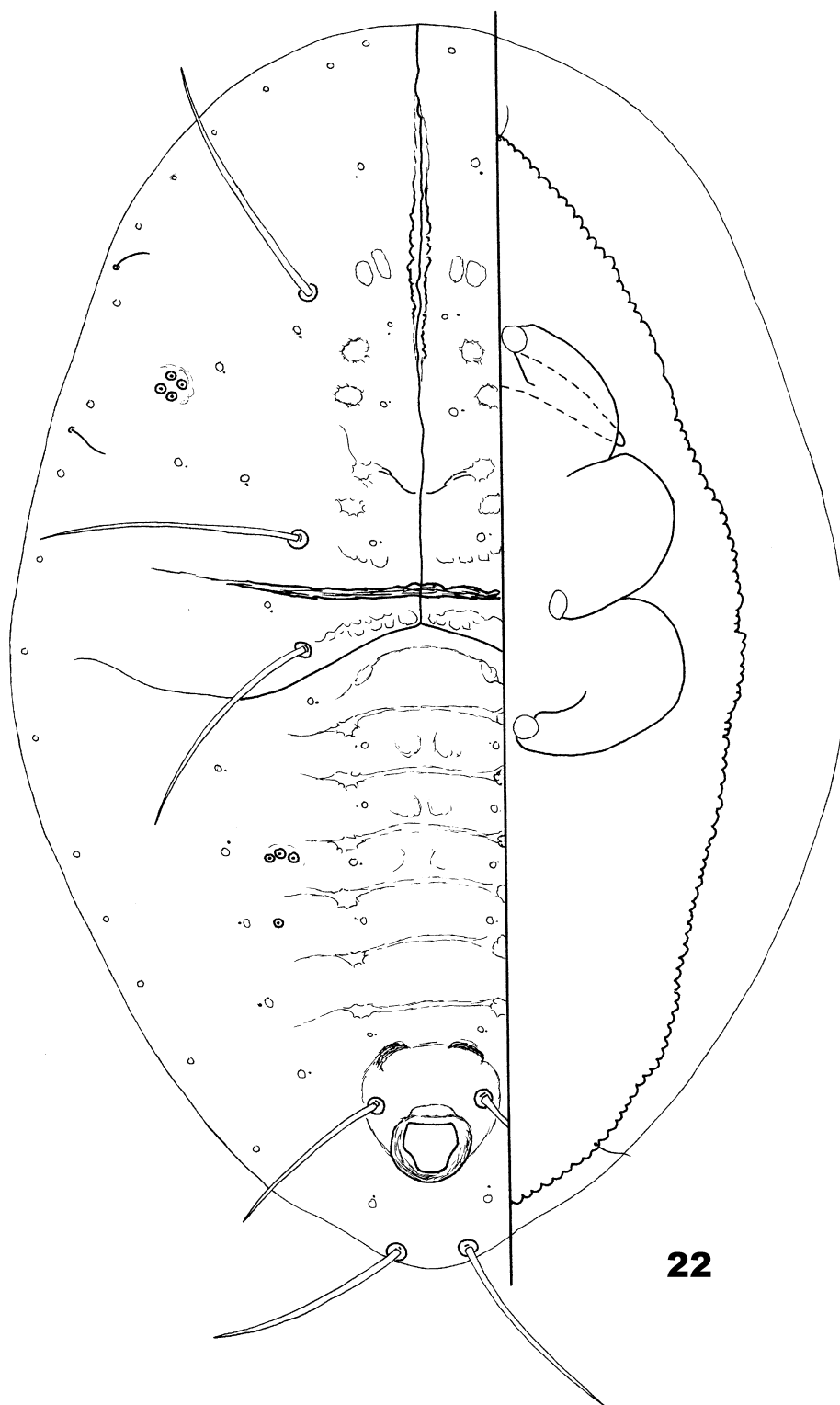


FIGURE 22. *Aleurovitreus* **gen. nov.** *insignis* (Bondar), puparium from *Persea americana* ex-Belize, used in preparation of redescription (see Fig. 107 for photograph).

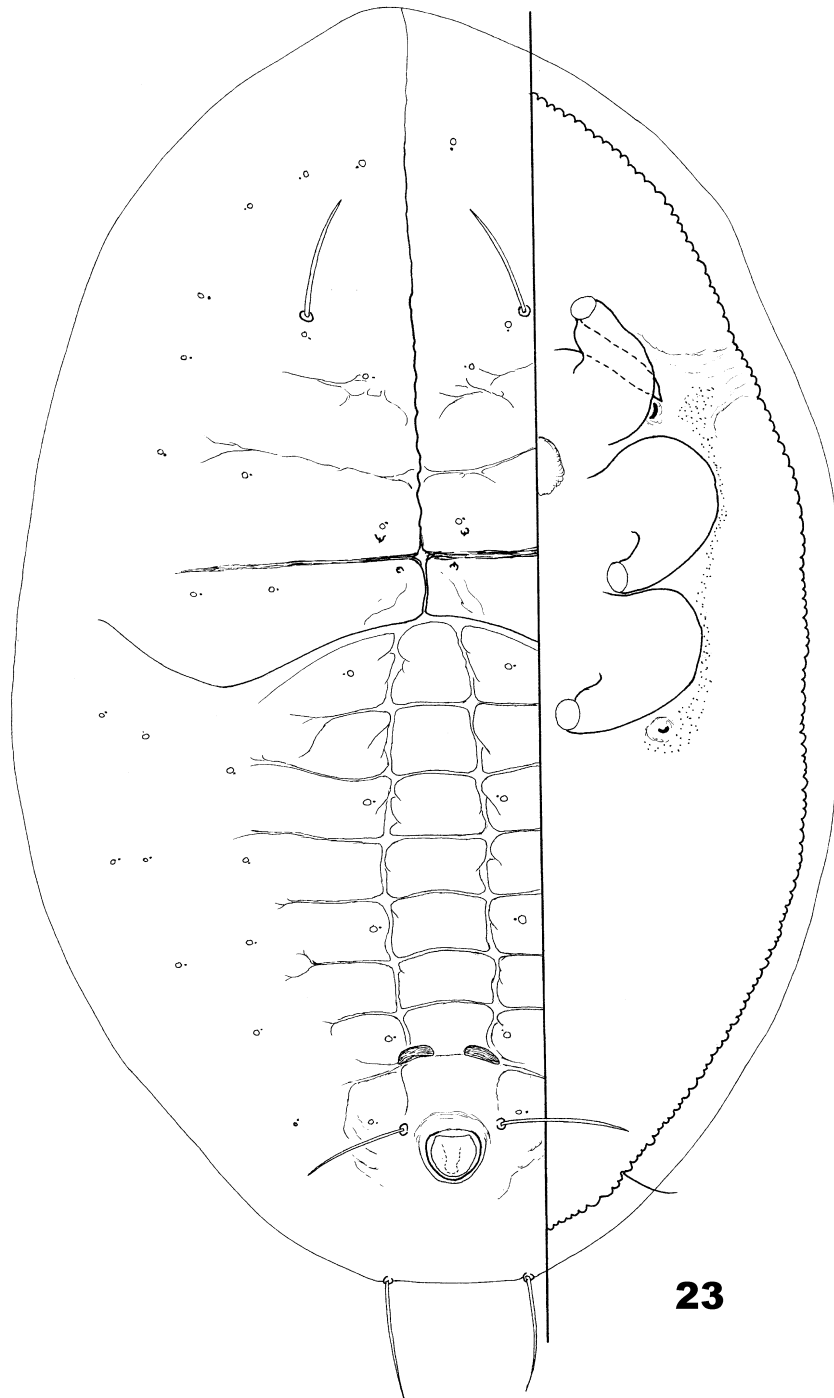
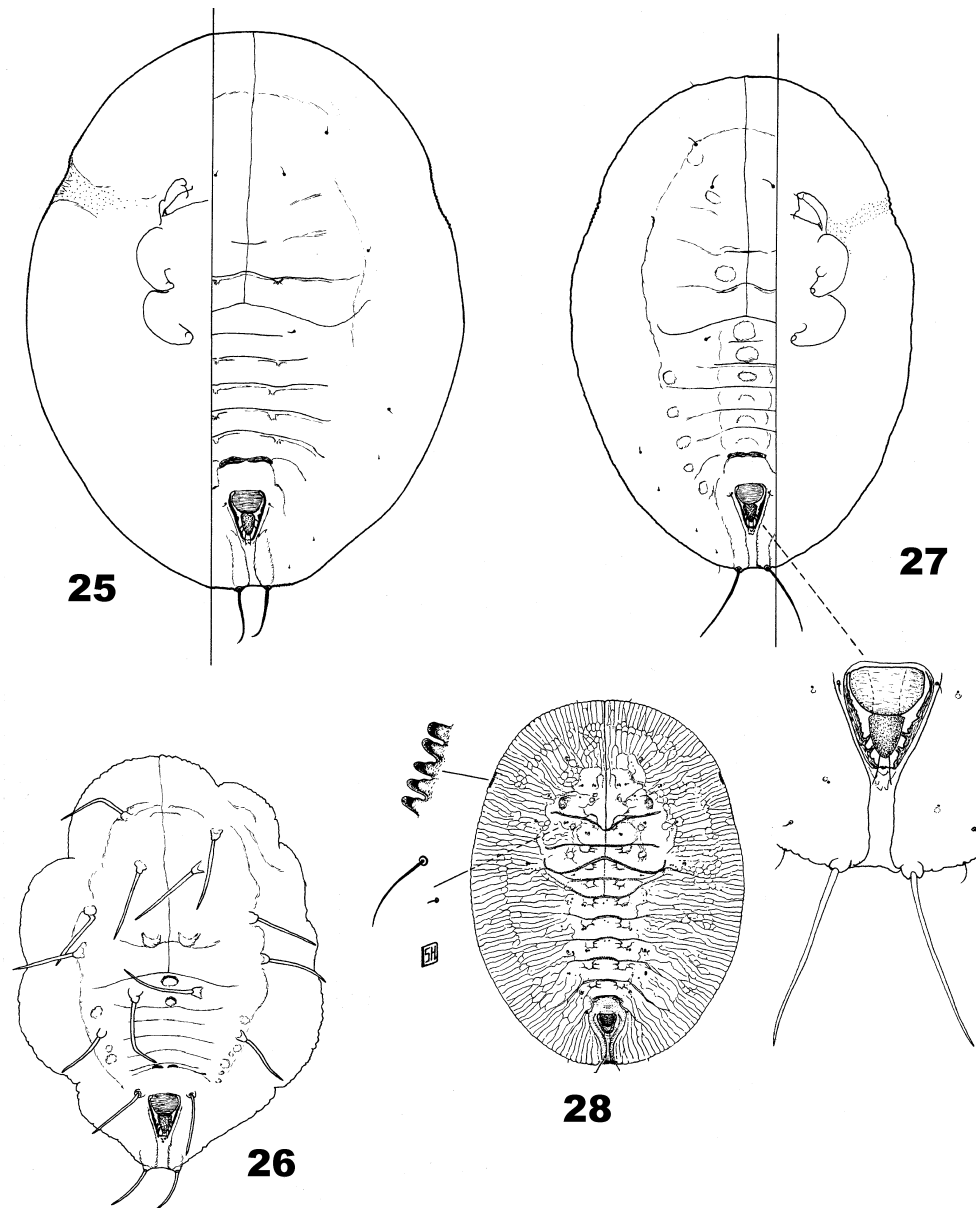


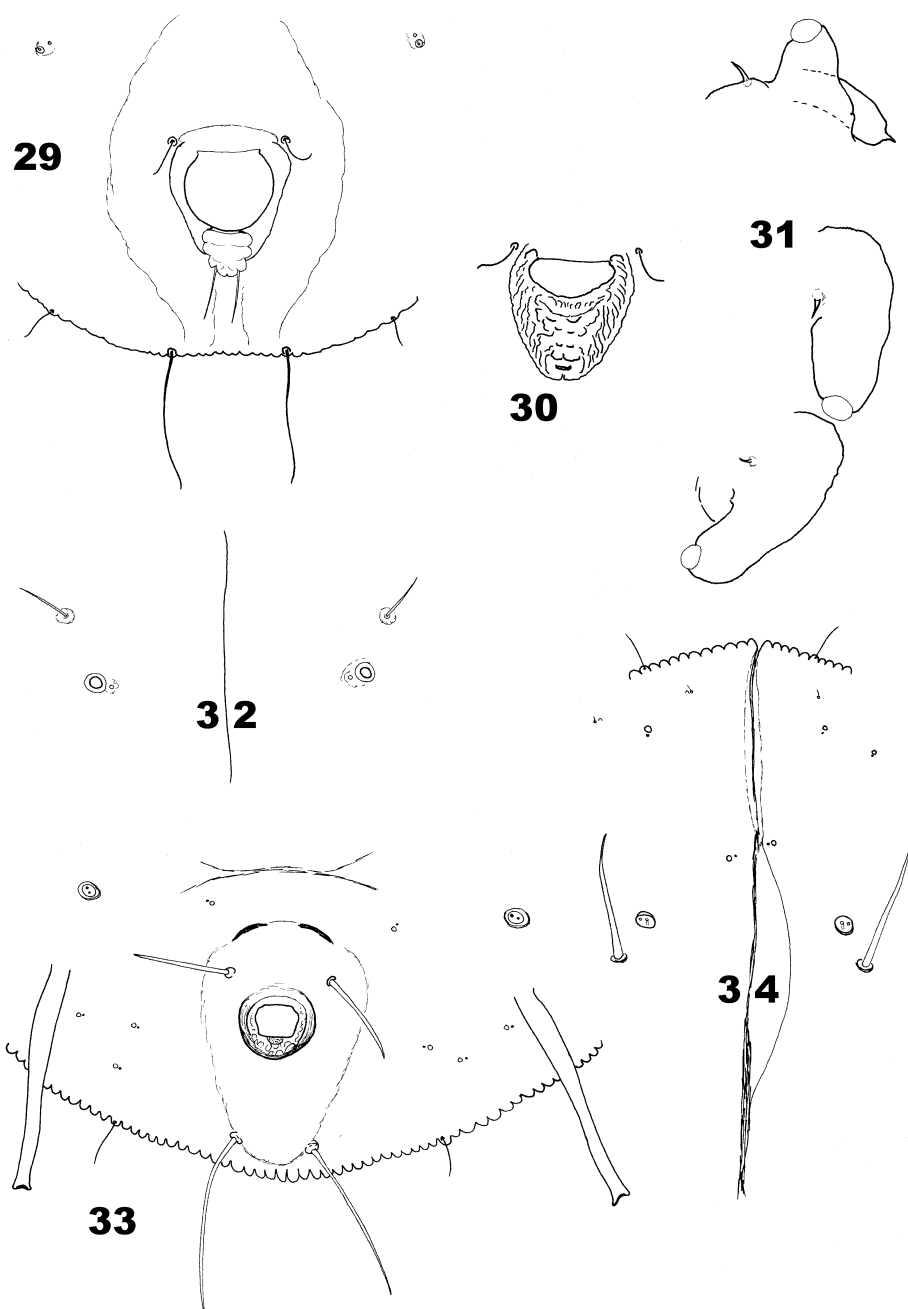
FIGURE 23. *Aleurovitreus risor* gen. & sp. nov., holotype puparium (see Figs 105-106 for photographs).



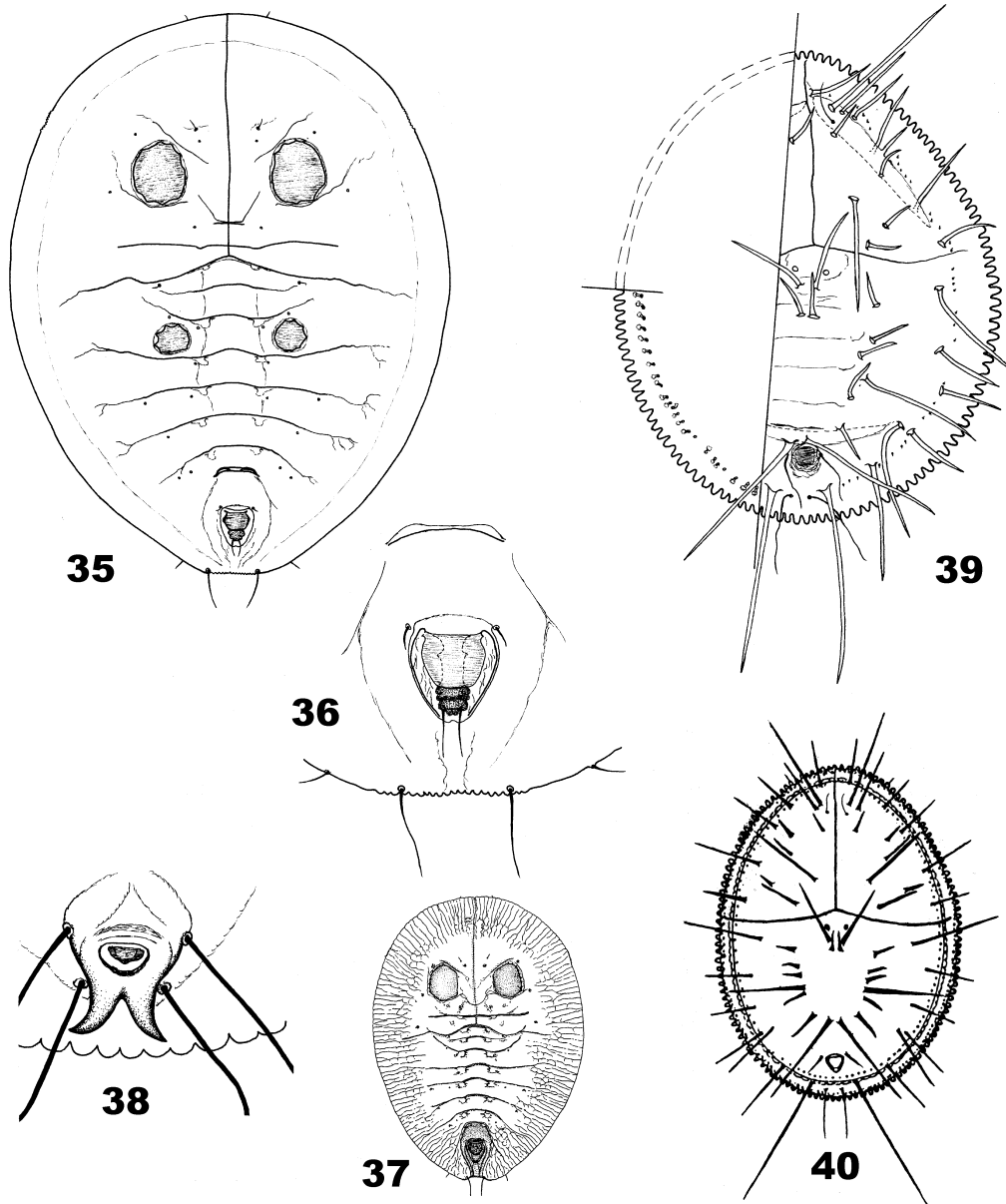
FIGURE 24. *Bemisia centroamericana* sp. nov., puparium, dorsum (see Fig. 109 for photograph).



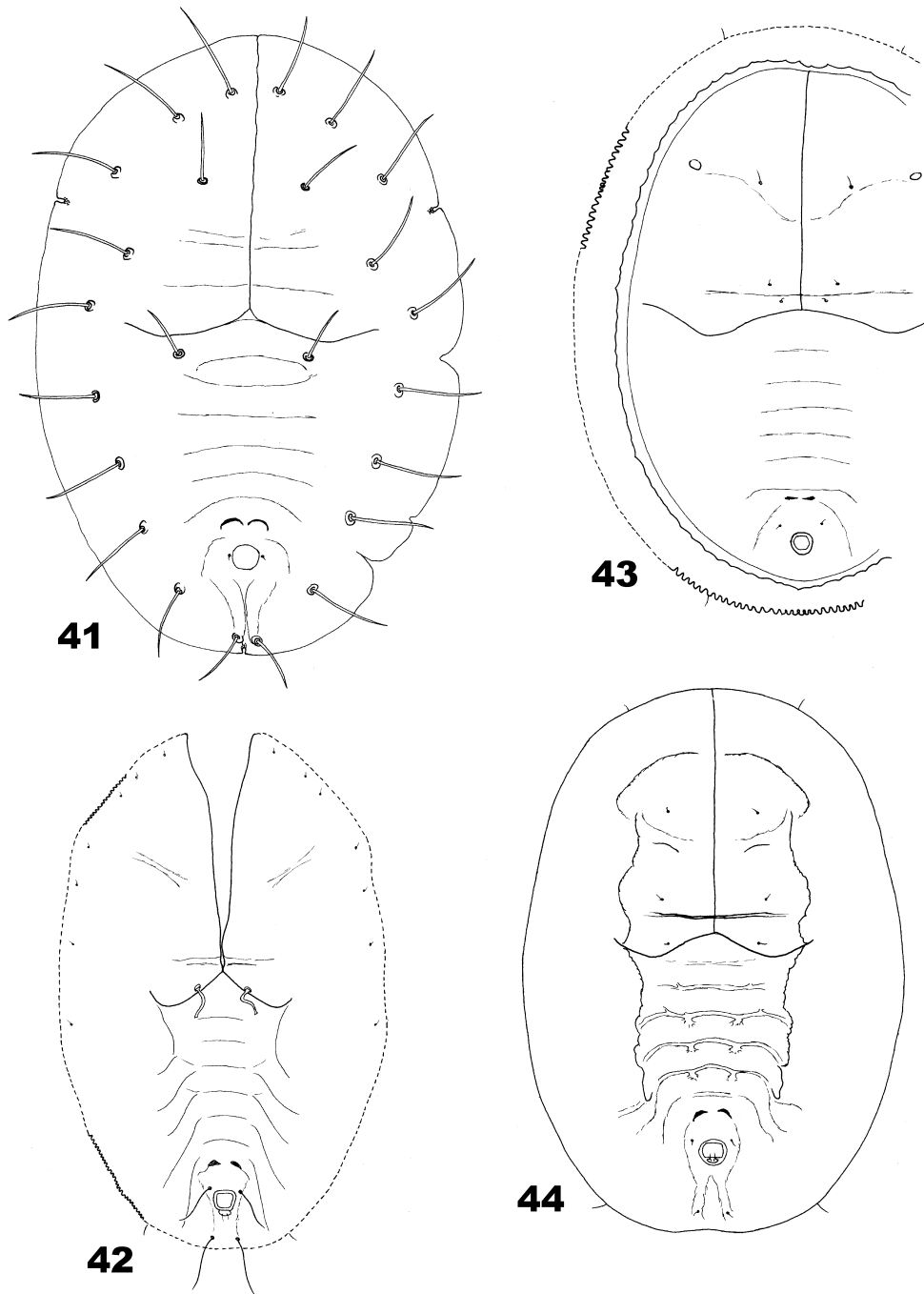
FIGURES 25–28. 25–27, *Bemisia tabaci* (Gennadius), puparia, demonstrating variation within the species, 27 with enlarged detail of vasiform orifice and caudal setae; 28, *Aleuroglandulus striatus* Sampson & Drews, puparium (after Russell, 1944), with enlarged detail of thoracic tracheal comb, and setae at base of middle leg (see Fig. 88 for photograph).



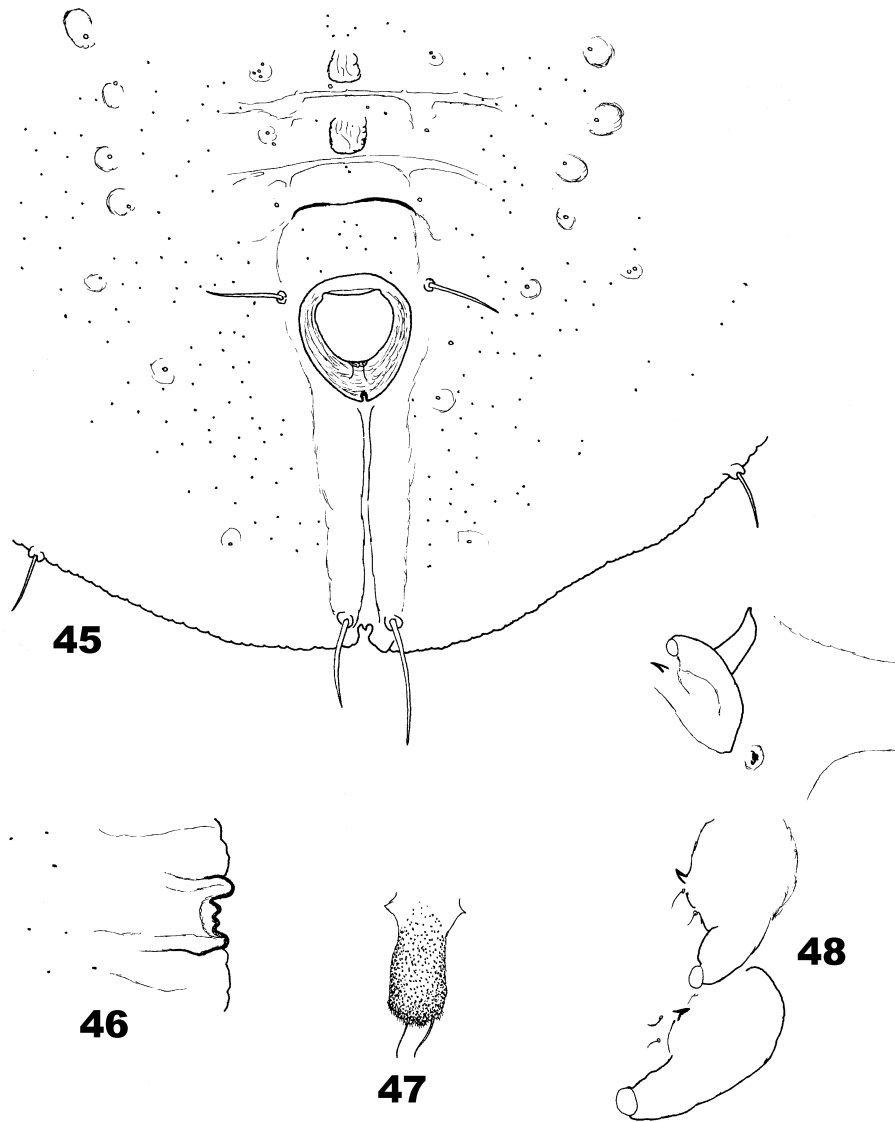
FIGURES 29–34. 29–32, *Aleuroglandulus inanis* **sp. nov.**, puparium (see Figs 87, 139 for photographs). 29, posterior dorsal detail; 30, detail of floor of vasiform orifice; 31, legs and leg-base spines; 32, cephalic setae and geminate pore/porette pairs. 33–34, *Disiphon russellae* **sp. nov.**, puparium (see Fig. 113 for photograph). 33, posterior dorsal detail, showing both types of dorsal siphon-glands; 34, longitudinal moulting suture, cephalic setae, short-type of siphon-glands and geminate pore/porettes.



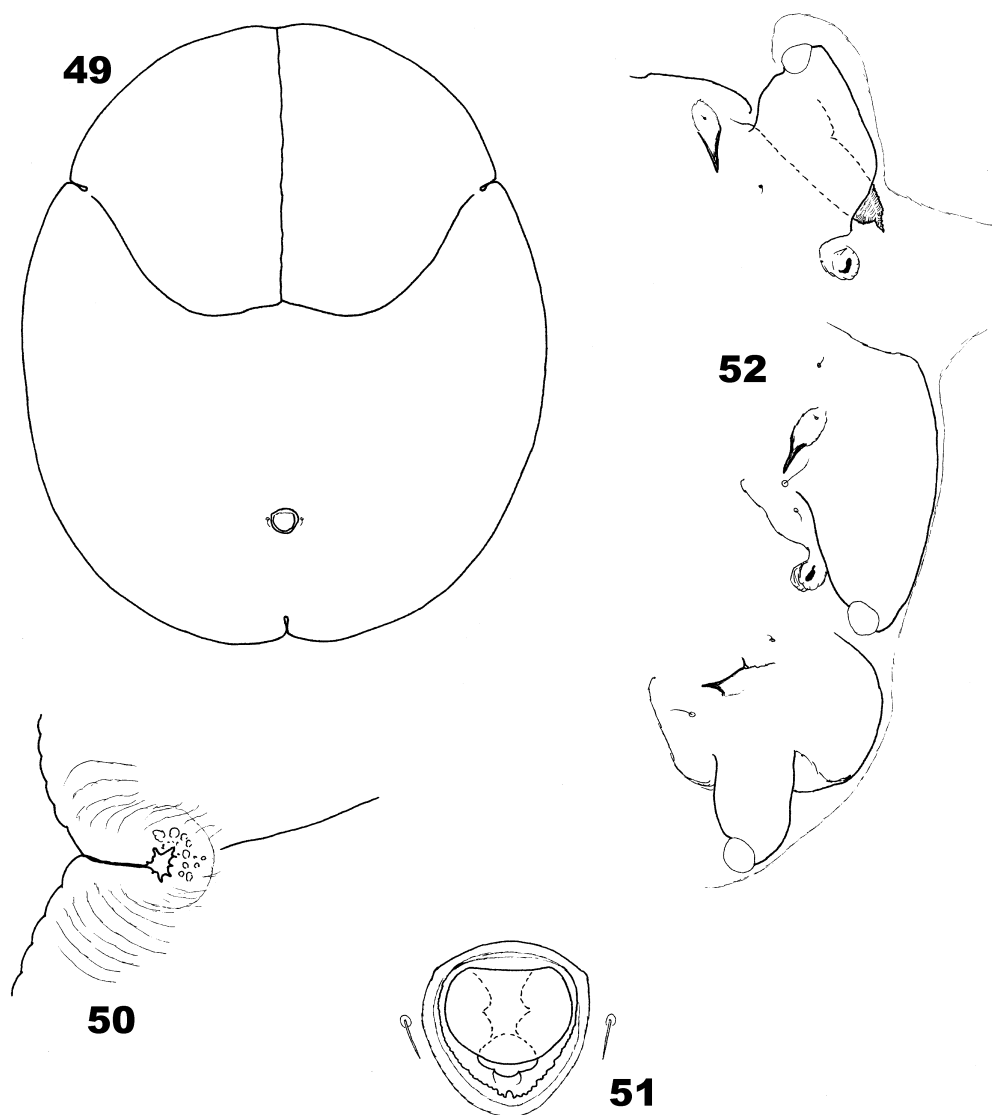
FIGURES 35–40. 35–37, *Aleuroglandulus subtilis* Bondar, puparium (see Fig. 89 for photograph). 35–36, specimen from *Colocasia* ex-Costa Rica [*A. malangae* Russell *sensu* Russell, 1944]; 37, puparium (after Russell, 1944). 38, *Aleurocerus* sp., puparium, transverse-ovoid vasiform orifice located on vertically-directed bifid process (see Figs 83–85 for photographs). 39–40, *Aleurocanthus woglumi* Ashby, puparium (see Fig. 82 for photograph), 39 drawn from specimen, 40 stylised.



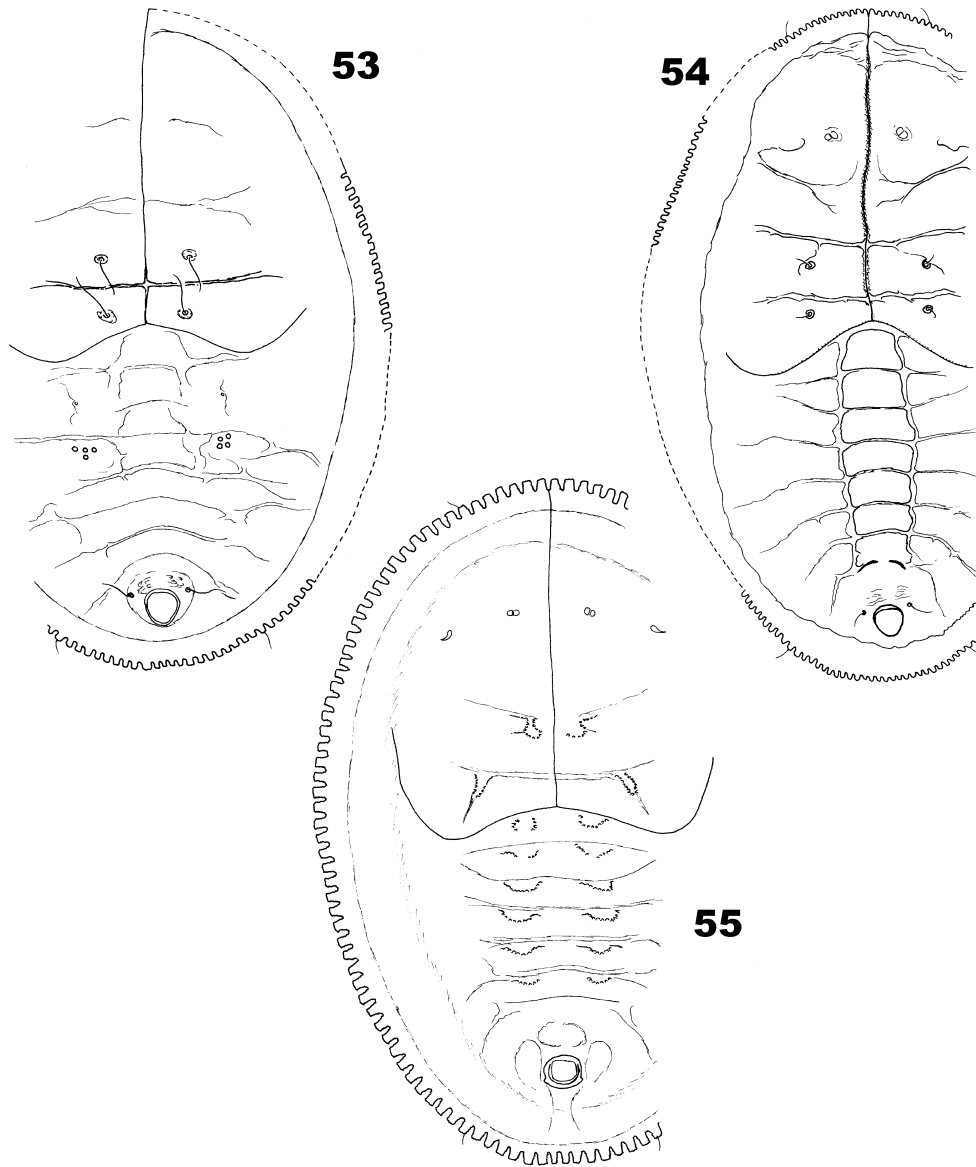
FIGURES 41–44, puparia, dorsal surfaces, simplified drawings. 41, *Dialeurodes denticulatus* (Bondar) (see Fig. 111 for photograph); 42, *Aleurotulus mundururu* Bondar, vacated pupal case (see Figs 102–104 for photographs); 43, *Paraleurolobus chamaedoreae* Russell (see Fig. 114 for photograph); 44, *Crenidorsum aroidephagus* Martin & Aguiar (see Fig. 110 for photograph).



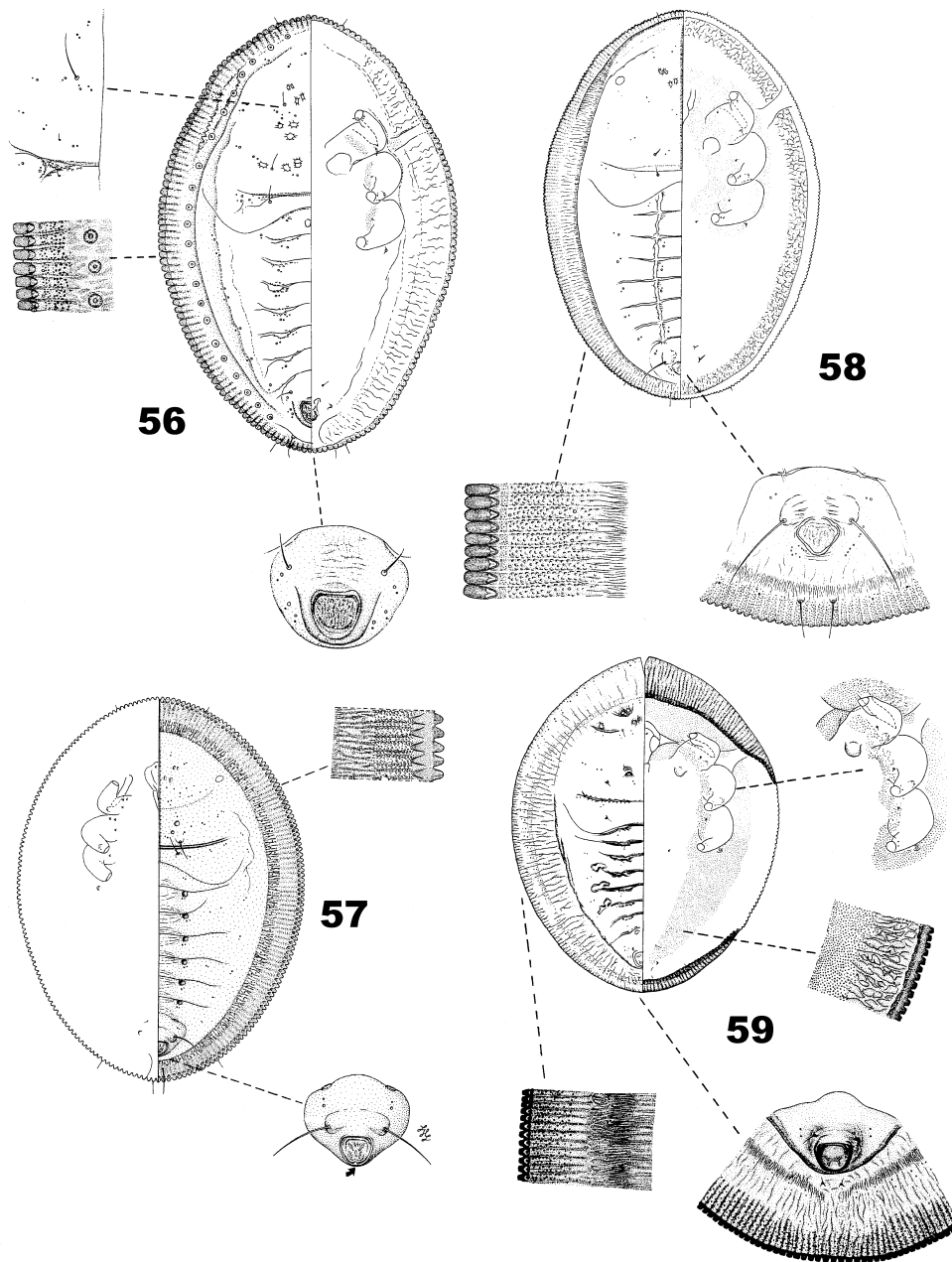
FIGURES 45–48, *Dialeurolonga guettardae* **sp. nov.**, puparium (see Fig. 112 for photograph). 45, posterior dorsal detail; 46, thoracic tracheal opening at margin; 47, lingula, 48, legs and leg-base spines.



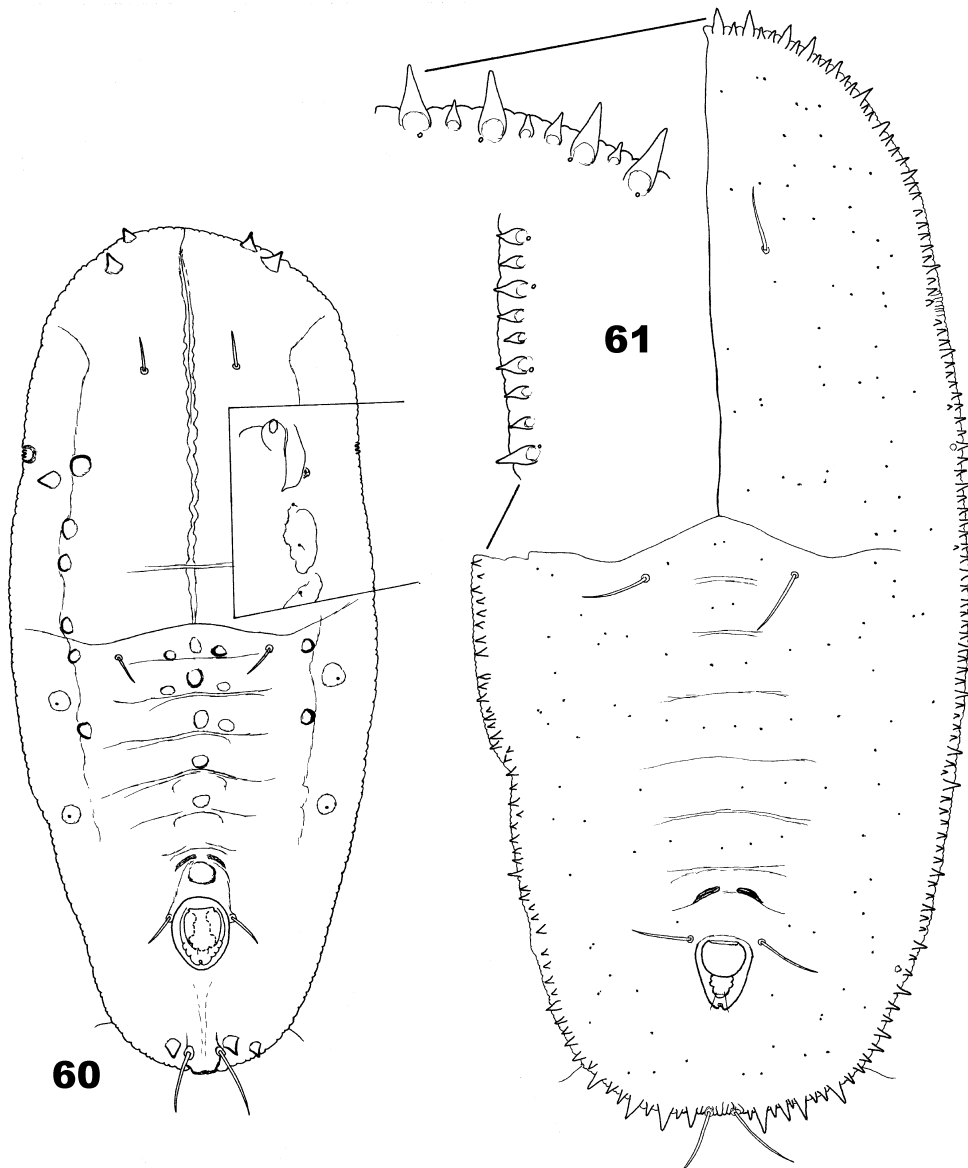
FIGURES 49–52, *Tegmaleurodes lentus* gen. & sp. nov, puparium (see Fig. 116 for photograph). 49, simplified outline of unmacerated specimen, with moulting sutures and vasiform orifice; 50, thoracic tracheal pore; 51, vasiform orifice; 52, legs and stout leg-base spines.



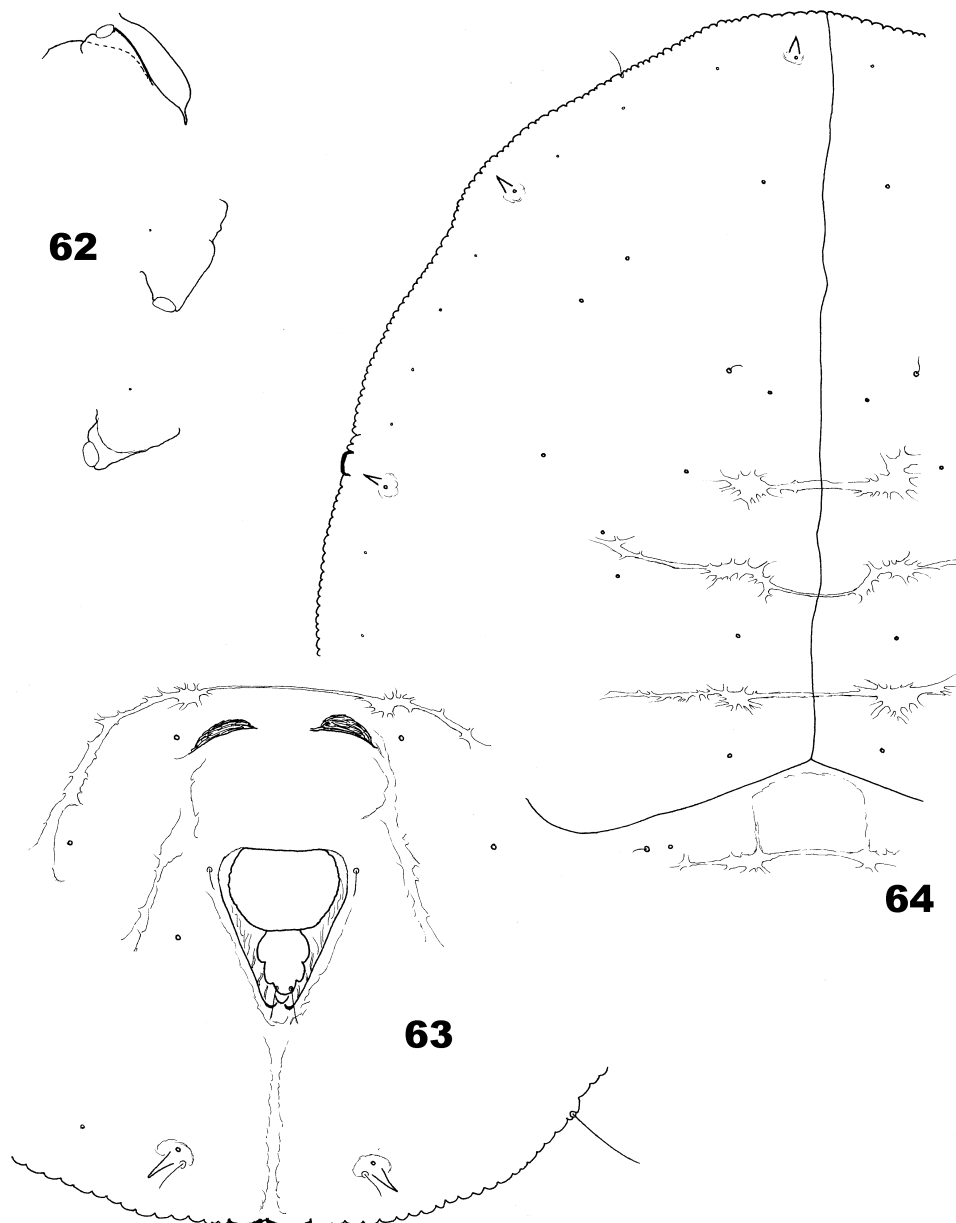
FIGURES 53–55, *Tetraleurodes* spp, puparia, dorsal surfaces, simplified drawings. 53, *T. mori* (Quaintance) (see Fig. 121 for photograph); 54, *T. fici* Quaintance & Baker (see Fig. 120 for photograph); 55, *T. quadratus* Sampson & Drews (see Fig. 123 for photograph).



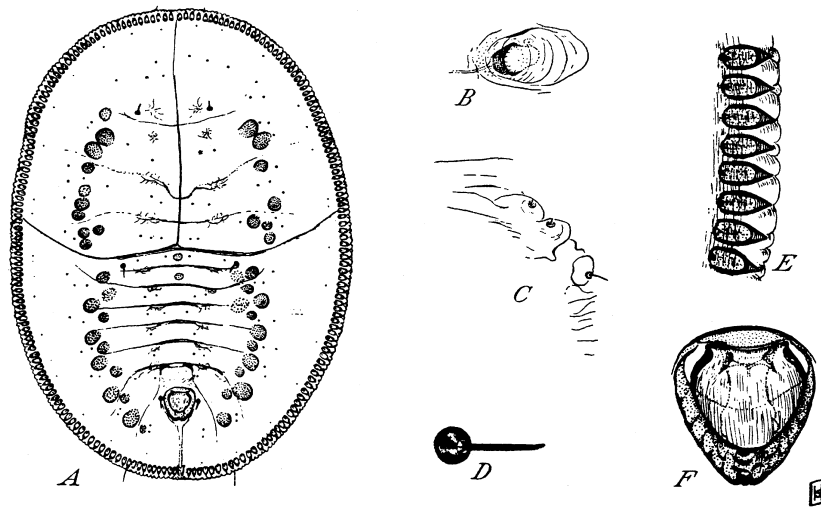
FIGURES 56–59, *Tetraleurodes* spp, puparia (drawings modified after Nakahara, 1995). 56, *T. acaciae* (Quaintance), with enlarged detail of cephalic seta, margin & submargin, and vasiform orifice (see Fig. 117 for photograph); 57, group of *T. confusa* Nakahara/*T. perseae* Nakahara—puparium of *confusa* and vasiform orifice of *perseae* (see Fig. 119 for photograph); 58, *T. pringlei* Nakahara, with enlarged detail of margin & submargin, and vasiform orifice (see Fig. 122 for photograph); 59, *T. chivela* Nakahara, with enlarged detail of legs, margin & ventral submargin, margin & dorsal submargin, and vasiform orifice (see Fig. 118 for photograph).



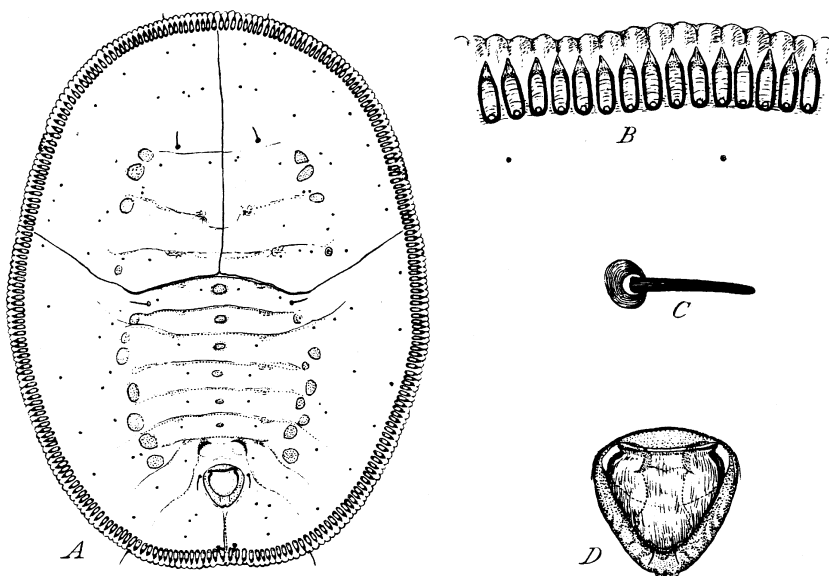
FIGURES 60–61, *Trialeurodes* spp, puparia. 60, *T. cryptus* **sp. nov.** (see Fig. 126 for photograph); 61, *T. abdita* **sp. nov.**, dorsum only, with enlarged detail of submarginal papillae (see Fig. 125 for photograph).



FIGURES 62–64, *Trialeurodes paucipapilla* **sp. nov.**, puparium (see Fig. 129 for photograph). 62, legs; 63, posterior dorsal detail & vasiform orifice; 64, cephalothoracic plate.

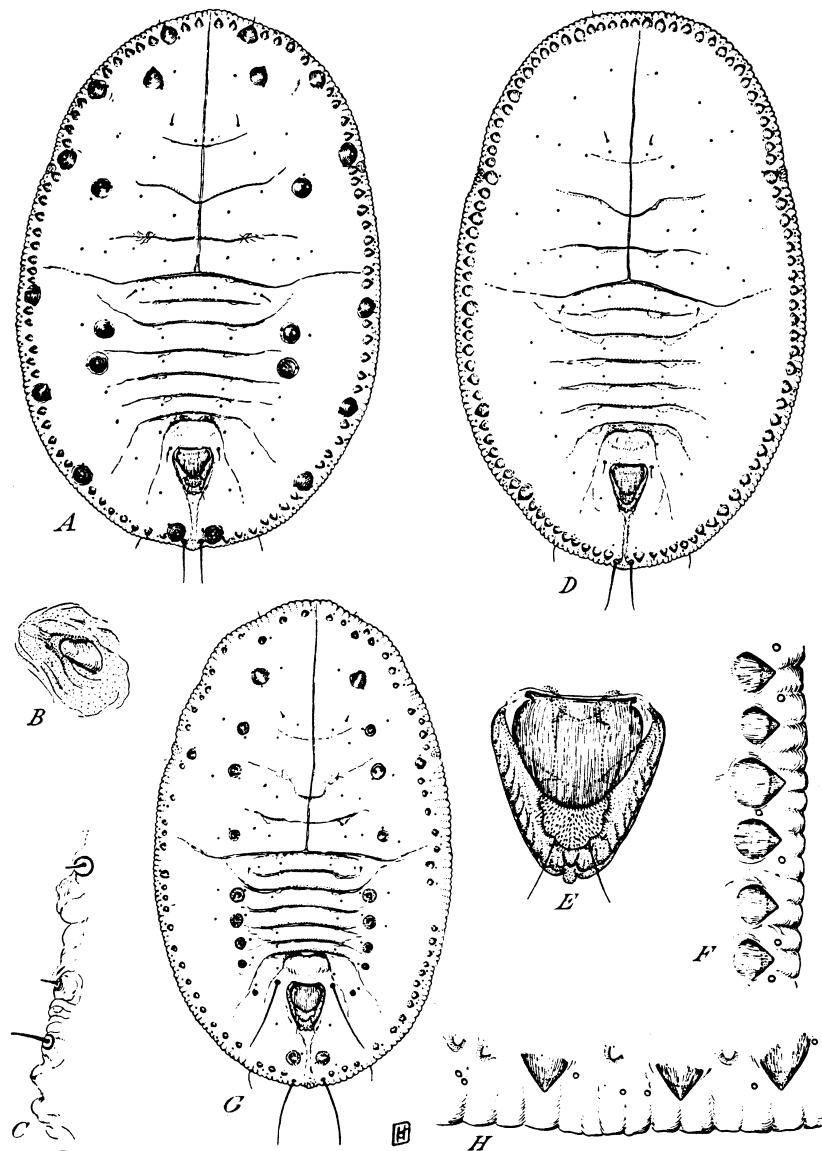


65 *Trialeurodes floridensis*: A, Outline; B, thoracic spiracle; C, part of inner basal area of middle leg; D, first abdominal seta; E, section of margin and submargin; F, vasiform orifice.



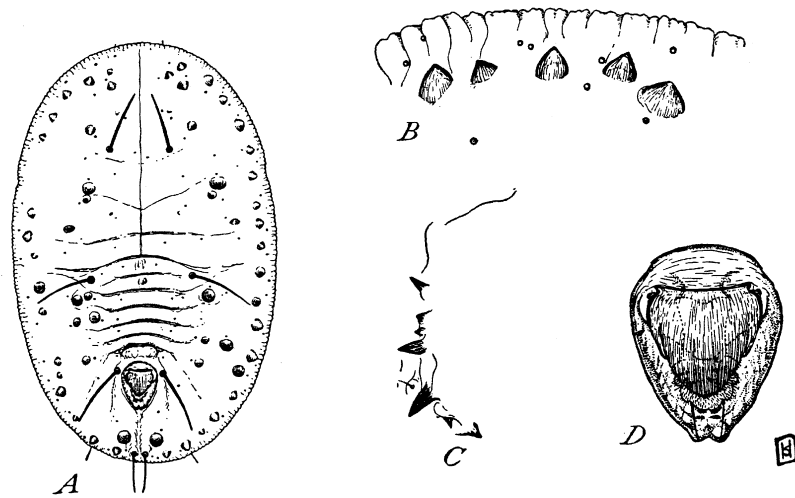
66 *Trialeurodes vitrinellus*: A, Outline; B, section of margin and submargin, showing submarginal setal bases; C, first abdominal seta; D, vasiform orifice.

FIGURES 65–66, *Trialeurodes floridensis* species-group, puparia and captions, after Russell (1948). 65, *T. floridensis* (Quaintance) (see Figs 127–128 for photographs); 66, *T. vitrinellus* (Cockerell) (see Fig. 132 for photograph).

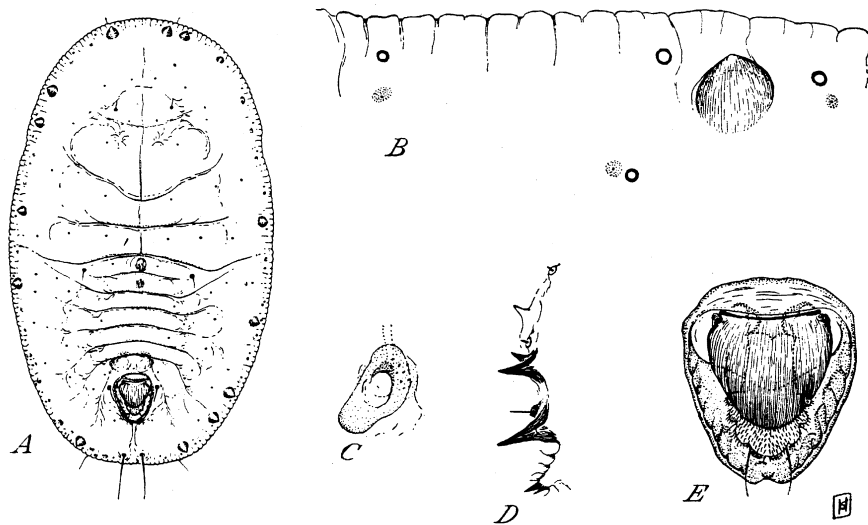


67 *Trialeurodes vaporariorum*: A, Outline, specimen from moderately hairy leaf; B, same, thoracic spiracle; C, same, part of inner basal area of middle leg; D, outline of specimen from smooth leaf; E, same, vasiform orifice; F, same, section of margin and submargin; G, outline of specimen from very hairy leaf; H, section of margin and submargin of a specimen from a smooth, tough leaf showing degenerate papillae and greater width of marginal crenulations.

FIGURE 67. *Trialeurodes vaporariorum* (Westwood), puparium and captions, after Russell (1948).

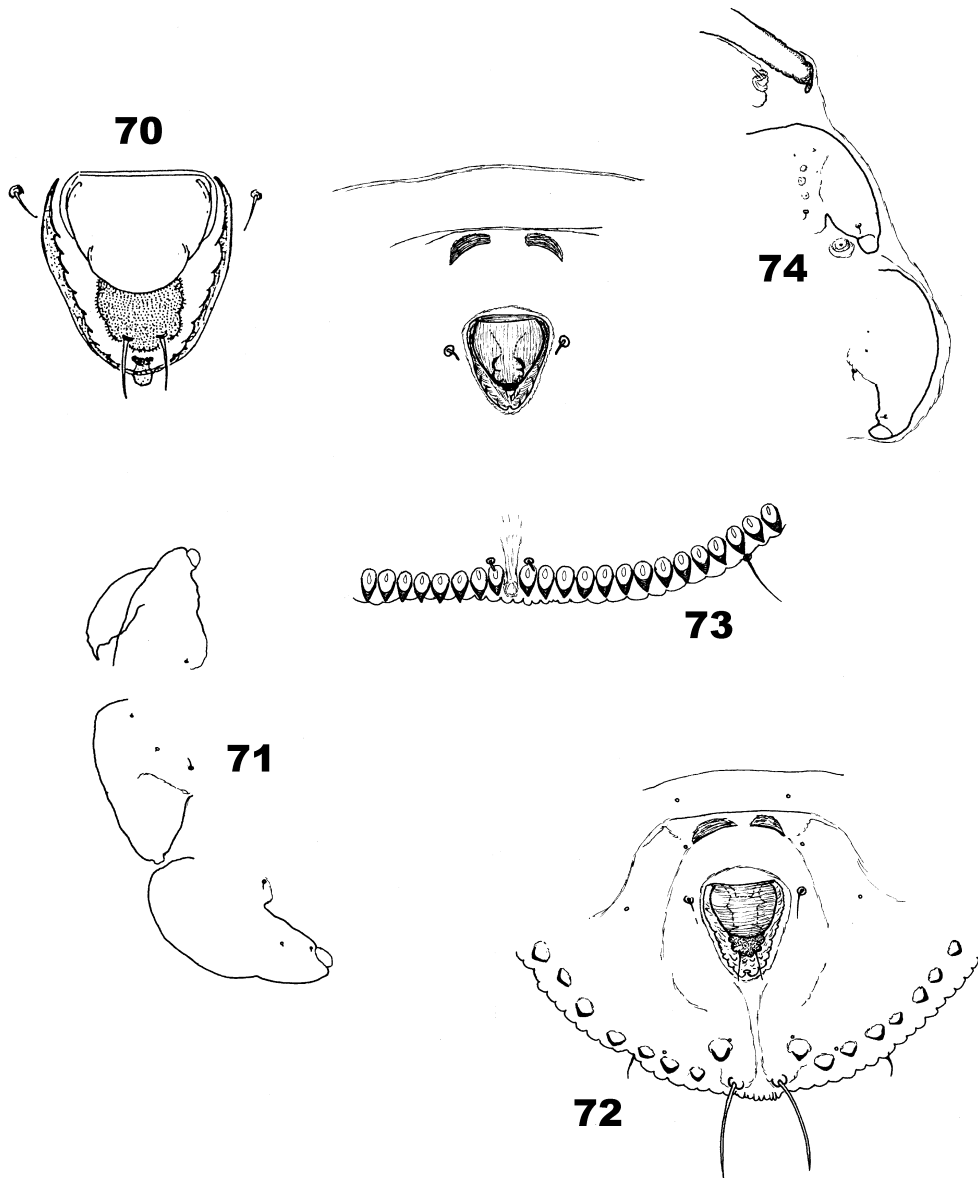


68 *Trialeurodes similis*: A, Outline; B, section of margin and submargin; C, part of inner basal area of middle leg; D, vasiform orifice.

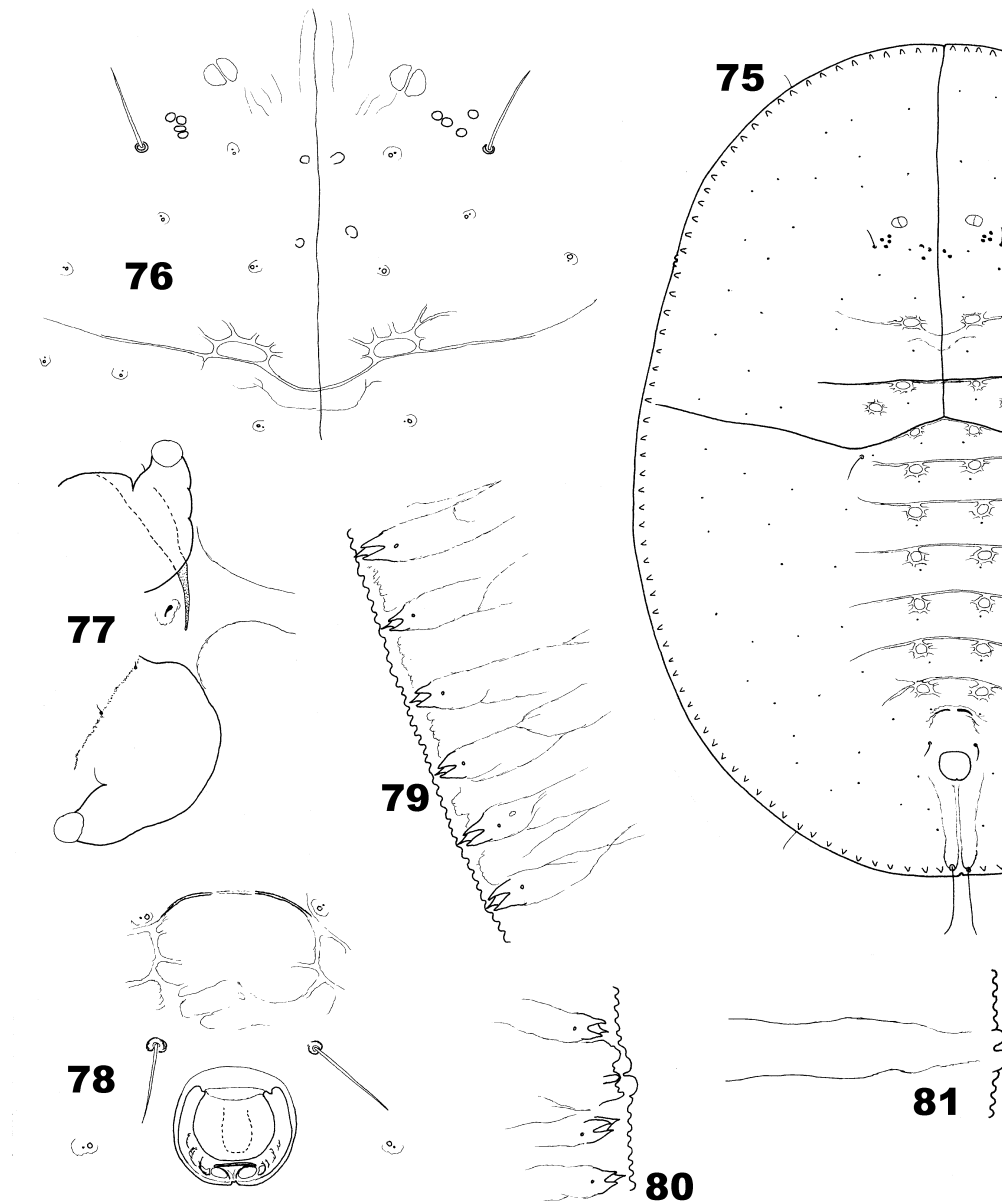


69 *Trialeurodes variabilis*: A, Outline; B, section of margin and submargin; C, thoracic spiracle; D, part of inner basal area of middle leg; E, vasiform orifice.

FIGURES 68–69, *Trialeurodes* species, puparia and captions, after Russell (1948). 68, *T. similis* Russell (see Fig. 130 for photograph); 69, *T. variabilis* (Quaintance) (see Fig. 131 for photograph).



FIGURES 70–74, *Trialeurodes* species, puparia. 70, *T. vaporariorum* (Westwood), vasiform orifice; 71, *T. vaporariorum*, legs and antenna; 72, *T. vaporariorum*, posterior dorsal detail; 73, *T. floridensis* (Quaintance), posterior dorsal detail; 74, *T. floridensis*, legs and antenna.



FIGURES 75–81, *Trialeurolonga trifida* gen. & sp. nov. puparium. 75, puparial dorsum; 76, cephalothoracic setae and vicinity; 77, antenna, pro- and mesothoracic legs; 78, vasiform orifice; 79, submarginal detail, abdomen; 80, thoracic tracheal opening at margin, dorsal; 81, thoracic tracheal opening at margin, ventral.