



Genera of the leaf-feeding Dendrothripinae of the world (Thysanoptera, Thripidae), with new species from Australia and Sulawesi, Indonesia

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Abstract

Character states used in distinguishing taxa within the Thripidae subfamily Dendrothripinae are discussed, and a key presented to the 11 genera recognized worldwide. Comments on each of these genera are provided, together with keys to the species from Australia of *Dendrothrips*, *Ensiferothrips* and *Pseudodendrothrips*. From Australia are described, four new species of *Dendrothrips*, one of *Pseudodendrothrips*, and a remarkable new species of *Ensiferothrips* that has required a re-diagnosis of that genus. Another new species of *Ensiferothrips* is described from Sulawesi, thus greatly extending the known geographical range of this previously Australian genus.

Key words: new species, Australia, Sulawesi, Indonesia, Thripidae, Dendrothripinae

Introduction

Species of the subfamily Dendrothripinae all live and breed on green leaves, and the range of host-plants on which breeding is known ranges from ferns to fig trees. Several species of *Dendrothrips* are particularly associated with the family Oleaceae (Marullo 2003), species of *Pseudodendrothrips* are commonly associated with Moraceae, and the species of *Edissa* and *Petrothrips* live on Poaceae. The subfamily is found worldwide, but with individual genera having restricted distributions. *Leucothrips* and *Halmathrips* are the only genera with species native to the Americas, with the other nine genera all being from the Old World. The most species-rich genus, *Dendrothrips*, extends from northern Europe through the Palaeotropics to Japan and Australia, whereas *Asprothrips*, *Ensiferothrips* and *Pseudodendrothrips* are essentially southeast Asian to Australia. However, as with many other Thysanoptera, human trading patterns have distributed a few species widely around the world, including *Leucothrips nigripennis* on cultivated ferns (Mound 1999), *Asprothrips bimaculatus* in association with banana plantations (Michel & Ryckewaert 2014), and *Asprothrips seminigricornis* on various fruit trees (Mound & Wells 2015). Despite these associations with cultivated plants, only a few members of this subfamily have any economic impact. *Dendrothrips ornatus* sometimes causes leaf damage to garden hedges of *Ligustrum* in England. *Pseudodendrothrips mori* can be a minor pest on the leaves of *Morus* trees that are cultivated in Taiwan for the production of silkworms. Species of *Leucothrips* sometimes occur in large numbers on the leaves of their hosts, but only *piercei* on *Capsicum* in Argentina has been considered a serious pest (Zamar *et al.* 2014).

The Dendrothripinae is one of four subfamilies that are currently recognized in the Thripidae. In considering the phylogenetic relationships among these four, taxon sampling for molecular studies has been too limited to securely establish relationships. However, the available data suggests that although the three smaller subfamilies might each be monophyletic, this results in paraphyly of the large group, the Thripinae (Buckman *et al.* 2012). A similar conclusion concerning the monophyly of the Sericothripinae has been derived recently from morphological data (Lima & Mound 2016), but monophyly of the Dendrothripinae requires further testing.

The first purpose of this paper is to discuss the character states used in diagnosing taxa within this subfamily, and thus provide an identification key to the 11 genera recognized. The second purpose is to review the diversity of

this group in Australia. Despite intensive collecting in recent years most dendrothripines in Australia remain known from remarkably few specimens, a situation that possibly reflects a high level of host specificity. Four new species of *Dendrothrips* are described here from Australia, also one new species of *Ensiferothrips* that is so different from its congeners that it has required a generic re-diagnosis. A new species of *Ensiferothrips* is also described from Indonesia that is closely similar in structure to the most common of the Australian species in this genus, and thus greatly increases the known geographical range of the genus. As a result, this increases the number of described species of Dendrothripinae worldwide to 103, and full nomenclatural details for these are available in ThripsWiki (2016). Holotypes of the new species are deposited either in the Australian National Insect Collection, Canberra (ANIC) or the Natural History Museum, London (BMNH), with paratypes in the Queensland Primary Industries Insect Collection (QDPC), Brisbane.

Character states of Dendrothripinae

The members of this subfamily all share a remarkably long, narrow, lyre-shaped metathoracic furca, and the sculpture and chaetotaxy of the metanotum are also largely characteristic.

1. *Antennae*: Although essentially 8-segmented in this group, some species have segment VI divided by a partial or complete suture, thus producing a 9-segmented condition. In contrast, the species of *Edissa* and some species of *Dendrothrips* and *Leucothrips* have the terminal segments fused to give a 7-segmented condition. *Pseudodendrothrips alexei* shows a further variation, in that segment VI is subdivided, but morphological VII and VIII are fused, thus producing independently an 8-segmented condition. In most species, segment III is scarcely longer than wide, but is clearly more elongate in species of *Filicopsotrips*.

2. *Antennal sense cones*: On segments III and IV the sense cones are usually short and forked, with the two branches often transversely orientated and thus difficult to observe. In a few species these sense cones are simple. Segment VI bears a long sense cone on the outer margin, and in different species this arises close to the base of the segment or about half-way along its length.

3. *Ocellar setae*: Almost all species of dendrothripinae have three pairs of ocellar setae, and although these are generally small, the setae of pair III are greatly enlarged in a few species (e.g. *Ensiferothrips*). The position of pair III varies among genera from between the posterior ocelli (in *Filicopsotrips*) to clearly outside the anterolateral margins of the triangle (in *Dendrothrips*).

4. *Maxillary palps*: In species of *Asprothrips*, *Edissa*, *Parsiiothrips* and *Petrothrips* these are short and 3-segmented. In at least one undescribed *Halmathrips* species the palps are long and 3-segmented, and in *Dendrothrips oatleyi* from South Africa they are long and 4-segmented. However, in most other dendrothripines the palps are short and 2-segmented, with the distal segment sometimes constricted medially giving the impression of a third segment.

5. *Pronotum*: *Halmathrips* and *Leucothrips* species have a transverse groove medially across the pronotum (Fig. 4). A similar condition occurs in species of *Pseudodendrothrips*, and there is a faint indication laterally of a similar groove in *Filicopsotrips* species and *Ensiferothrips primus*. Posteromarginal and posteroangular setae are not elongate in most species, but are prominent in several species of *Dendrothrips*, and greatly enlarged in *D. aneckei* from South Africa as well as three species of *Ensiferothrips*.

6. *Metanotum*: The median pair of setae is small and arises about one third of the length of the sclerite from its anterior margin, and the sculpture is commonly longitudinally reticulate/striate.

7. *Metathoracic furca*: The two arms of the long, slender, lyre-shaped furca are close together, and extend to the mesothorax, although they are rather shorter in species of *Leucothrips*. In species of that genus the furca is thus rather more similar in shape to the broader U-shaped condition found among species of some Panchaetothripinae genera, including *Caliothrips* and *Retithrips* for which Bhatti (2006) proposed separate families. Bhatti illustrated (2006, Figs 2, 6) a transverse apodeme associated with the base of the furca that he called the “metafurcal plate”, and he stated this was present in all species in the Dendrothripinae. However, examination of all dendrothripines recorded from Australia, also more than 12 *Dendrothrips* species from other parts of the world, has found no evidence of such a transverse structure, except in species of *Pseudodendrothrips*. Certainly there is a complex of sclerotised structures associated with the metathoracic furcal invagination among dendrothripines. These presumably provide rigidity to the base of the unusually elongate furca, and thus limit distortion when the large muscles associated with jumping contract suddenly.

8. *Fore wing*: The anteromarginal cilia in *Dendrothrips* species arise ventrally and well-behind the apparent margin of the wing. Species in the other genera, including *Edissa*, *Ensiferothrips*, *Filicopsotrips* and *Petrothrips* have a less extreme condition but still with the cilia ventral and clearly posterior to the fore wing anterior margin, whereas in the smaller species of *Leucothrips* and *Pseudodendrothrips* the cilia are closer to the anterior margin. In *Dendrothrips* and *Parsiiothrips* species, the wing apex is curved and lacks terminal setae, whereas in species of the other genera there is a terminal seta (or cilium) that varies in length between species.

9. *Abdominal tergites*: In most species of this subfamily the paired median setae on the tergites are elongate with their bases close together, whereas in species of *Asprothrips*, *Edissa*, *Parsiiothrips* and *Petrothrips* these setae are small to minute and often wide apart.

10. *Surface sculpture*: The pattern of sculpture and reticulation on the pronotum and the lateral thirds of the tergites is usually species specific in *Dendrothrips*, but among the species of *Pseudodendrothrips* the pattern of sculpture is remarkably uniform.

11. *Sternal pore plates*: These have not been reported on males of any species in this subfamily.

Key to world genera of Dendrothripinae

[*based on description; *Projectothripoides* omitted as a nomen dubium]

1. Median tergal setal pair much shorter than distance between their bases (Figs 1, 2) 2
- Median tergal setal pair longer than the distance between their bases (Figs 6, 12) 5
2. Fore wing apex with 2 small stout setae; antennal segments III and IV with forked sense cones *Asprothrips*
- Fore wing apex without stout setae, but with long fine cilia; antennal segments III and IV with simple sense cones 3
3. Tarsi 1-segmented; antennae 7-segmented *Edissa*
- Tarsi 2-segmented; antennae 8-segmented 4
4. Pronotum with many small tubercles on anterior and lateral thirds; fore wing posteromarginal cilia straight **Parsiiothrips*
- Pronotum weakly reticulate without any small tubercles; fore wing posteromarginal cilia slightly wavy. **Petrothrips*
5. Hind tarsus more than half as long as hind tibia; Old World species *Pseudodendrothrips*
- Hind tarsus no more than one third as long as hind tibia 6
6. Pronotum with median transverse groove complete (Fig. 4); New World species 7
- Pronotum evenly sculptured, median transverse groove if present incomplete medially; Old World species 8
7. Body and wings pale, without pigmentation (but *nigripennis* with wings uniformly dark). *Leucothrips*
- Body and fore wings with various patterns of pigmentation *Halmathrips*
8. Fore wing apex rounded, without terminal seta *Dendrothrips*
- Fore wing apex sub-acute to acute, with a prominent terminal seta 9
9. Antennae 8-segmented; head with ocellar setae pair III minute, arising well outside ocellar triangle; pronotum with no long setae. *Iranodendrothrips*
- Antennae 9-segmented; ocellar setae pair III elongate, arising within or on anterior margins of triangle; pronotum with prominent posteroangular setae 10
10. Ocellar setae pair III arising between posterior ocelli (Fig 3); fore wing apex with 2 setae both less than 0.3 as long as width of wing; antennal segments III–IV with elongate apical neck, sense cones extending to at least one-third of the length of succeeding segment. *Filicopsotrips*
- Ocellar setae pair III arising on anterior margins of ocellar triangle (Figs 21, 26); fore wing apex with one long seta, as long as or longer than wing width; antennal segments III–IV without an apical neck, sense cones scarcely extending beyond base of succeeding segment. *Ensiferothrips*

***Asprothrips* Crawford**: Seven species are now known in this genus, all from southeast Asia. These range from *seminigricornis*, a white species with black antennal apices, to species with the body bicoloured or dark and the wings variously coloured. Two of the species have become widespread, presumably through the trade in horticultural produce. One of these, *bimaculatus*, was described from Martinique (Michel & Ryckewaert 2014) and subsequently recorded from China and Malaysia (Tong *et al.* 2016). The other, *seminigricornis*, was described from Australia but has been found widely around the world (Mound *et al.* 2016).

***Dendrothrips* Uzel**: As a result of the new species described below, this genus now includes 55 species, many of which are brightly coloured. At one time the genus was subdivided, depending on whether the pronotum bears prominent posteroangular setae or not, but there is a considerable range among the species in this character state. *D. anneckei* from South Africa is particularly unusual in having the pronotal posteromarginal setal pairs I and IV

elongate with broadly capitate apices, also ocellar setae pair III. These setae are thus similar in form to those of three of the species of *Ensiferothrips*, although the wing structure of *anneckeii* is typical of *Dendrothrips*. Four species have been described previously in this genus from Australia, and four new species are added below, but little is known about their biology. There is no host recorded for *glynn*, a species that remains known only from four females taken near Cairns, with one from Cooktown, and another from Townsville, also one female from near Taree on the New South Wales coast. This is one of a group of tropical species with the head reticulate that includes *latimaculatus* from southern Japan and *reticulatus* from New Caledonia. The second Australian species with a reticulate head, *williamsi*, has a very distinctive dark fore wing, and has been taken in good numbers from *Scolopia braunii* [Flacourtiaceae] at Taree in New South Wales, with two females collected from *Synoum glandulosum* [Meliaceae] at Mt Tamborine, in southeast Queensland. The ocellar triangle of *howei* is largely tuberculate with weak reticulation posterior to the triangle. This species is known only from Lord Howe Island where it has been taken commonly on *Trophis scandens* [Moraceae] and *Xylosma maideni* [Flacourtiaceae]. In Australia the only common member of this genus is *diaspora* that has been taken widely across the continent, from Tasmania across New South Wales and even at Millstream in Western Australia. It is particularly associated with *Notelaea* species [Oleaceae], and has been found commonly on Norfolk Island on *Nestegis apetala* [Oleaceae]. One of the new species described below is also known only from *Notelaea microcarpa*. The fore wing colour of *diaspora* is sexually dimorphic; males have the median dark area uniformly dark, whereas females have this dark area interrupted medially by a paler band.

Key to *Dendrothrips* species from Australia

1. Body and antennal segments I–II almost entirely white, female with head dark brown dorsally but white ventrally (Fig. 15) *viticola* sp.n.
- Body never white, at least antennal segment II and pterothorax brown, if abdomen pale then with small dark spots on tergites. 2
2. Head with ocellar region reticulate (Fig. 20) 3
- Head with ocellar region lacking distinct reticulation 4
3. Fore wing largely pale with three weak transverse darker markings *glynn*
- Fore wing extensively dark but with basal fifth sharply pale *williamsi*
4. Fore wing clavus uniformly brown (Fig. 8) 5
- Fore wing clavus mainly pale, with either base or apex brown 6
5. Antennal segment III almost as pale as IV and V; pronotal reticles delimited by pale, flange-like ridges (cf. Fig. 18) *diaspora*
- Antennal segment III dark brown, in contrast to yellow IV and V; pronotal reticles delimited by bold sculpture lines (Fig. 5) *julatteni* sp.n.
6. Clavus pale with base dark, fore wing uniformly deeply shaded with base sharply pale; pronotum transverse reticles with internal markings *howei*
- Clavus pale with only apex dark, fore wing not deeply shaded; pronotum without (or with weak) markings between lines of sculpture 7
7. Fore wing pale, with several small darker markings; ocellar triangle with finely tuberculate sculpture (Fig. 9); antennae 7-segmented, segments III–IV much paler than V–VI (Fig. 11) *notelaea* sp.n.
- Fore wing weakly but uniformly shaded with base slightly paler; ocellar triangle sculptured with weak irregular lines (Fig. 18); antennae 9-segmented, segments III–VI uniformly light brown (Fig. 16) *victoriae* sp.n.

Dendrothrips julatteni sp.n.

Female macroptera: Head, body and legs mainly light brown, pterothorax darkest, abdominal tergites pale medially, tarsi yellow; antennal segment I light brown, II–III dark brown, IV–V yellow, VI–IX light brown with VI paler at base; fore wing weakly shaded with 3 pale areas, sub-basally, medially and sub-apically, clavus uniformly dark.

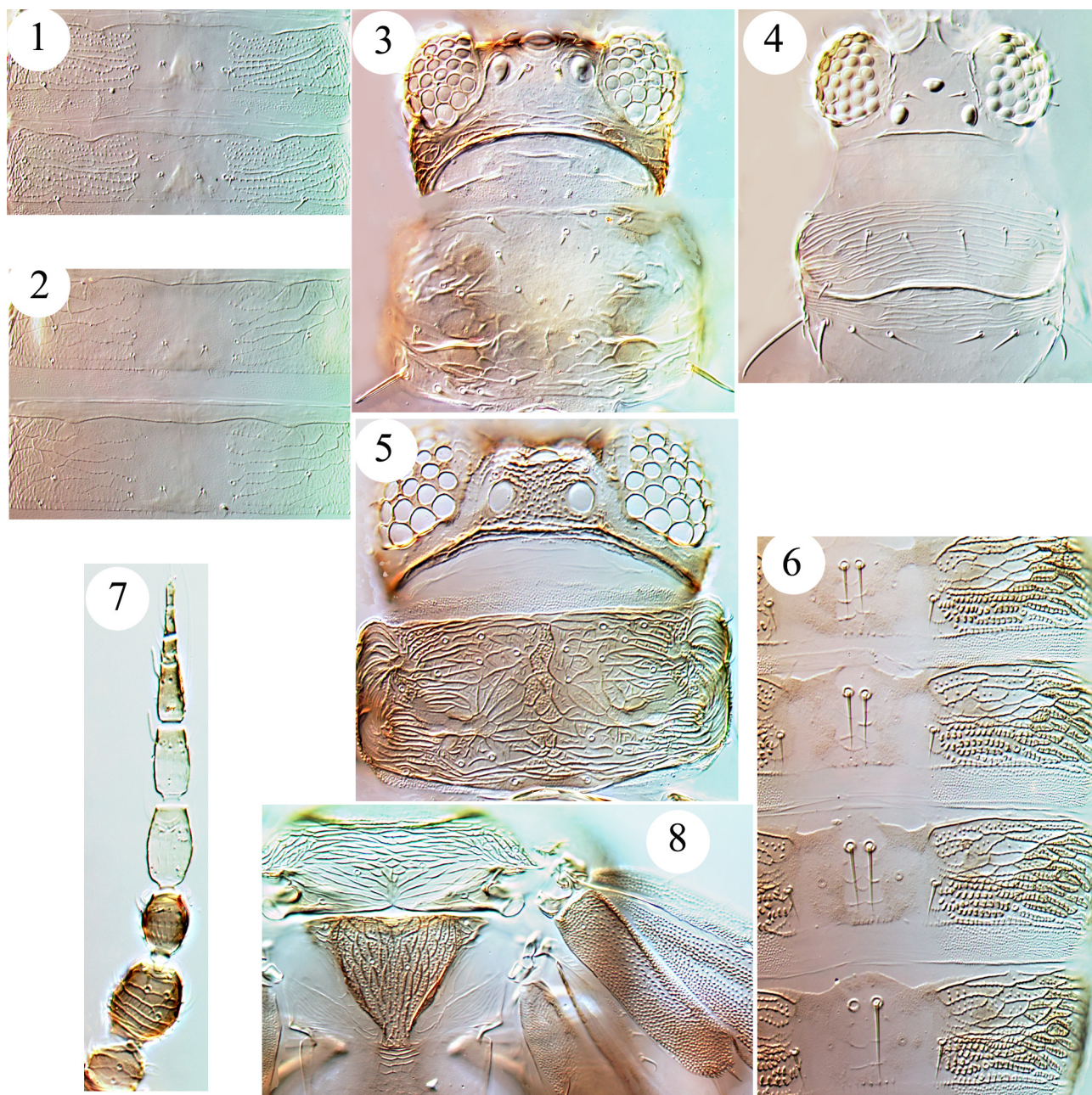
Head with ocellar triangle finely tuberculate (Fig. 5), with a few reticulate lines at posterior margin, ocellar setae III just outside ocellar triangle. Antennae 9-segmented (Fig. 7); sense cone on VI arising near base of segment but extending beyond apex of IX; sense cones on III and IV stoutly U-shaped. Pronotum with complex irregular sculpture and markings within the reticles (Fig. 5). Metanotum longitudinally reticulate with internal markings

(Fig. 8). Fore wing typical of genus, major setae scarcely longer than microtrichia, anteromarginal cilia arising ventrally well behind margin. Tergites II–VII strongly reticulate with complex short longitudinal sculpture lines on posterolateral areas (Fig. 6), VIII with long marginal comb, IX with many discal microtrichia.

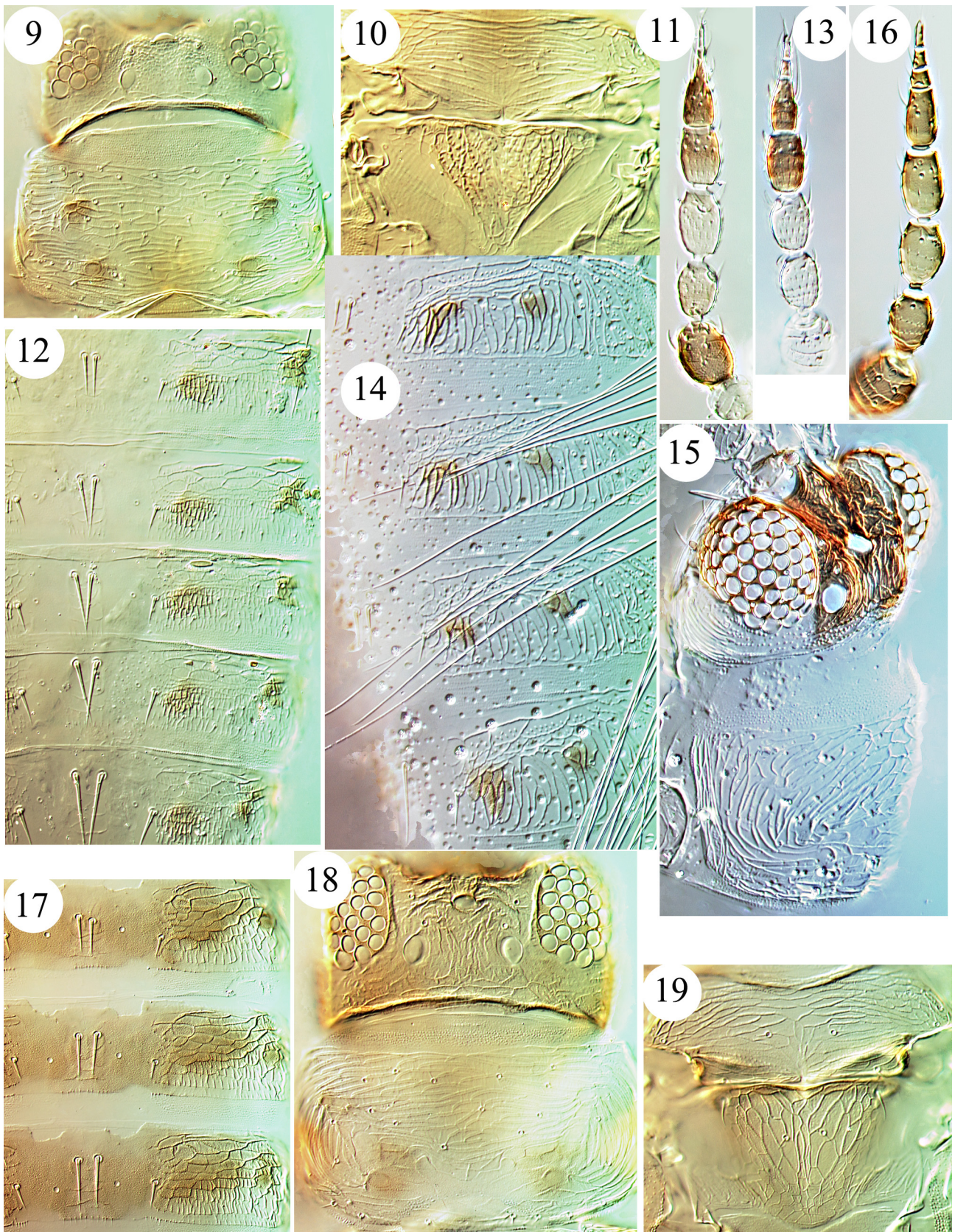
Measurements (holotype female in microns). Body length 1050. Head, length 50; width across eyes 160. Pronotum, length 80; width 175. Fore wing length 750. Antennal segments III–IX length 27, 30, 25, 20, 7, 12, 12.

Material studied. Holotype female, **Australia, Queensland, Julatten**, from *Arthropteris tenella* [Filicopsida], 6.viii.2004 (LAM4446), in ANIC.

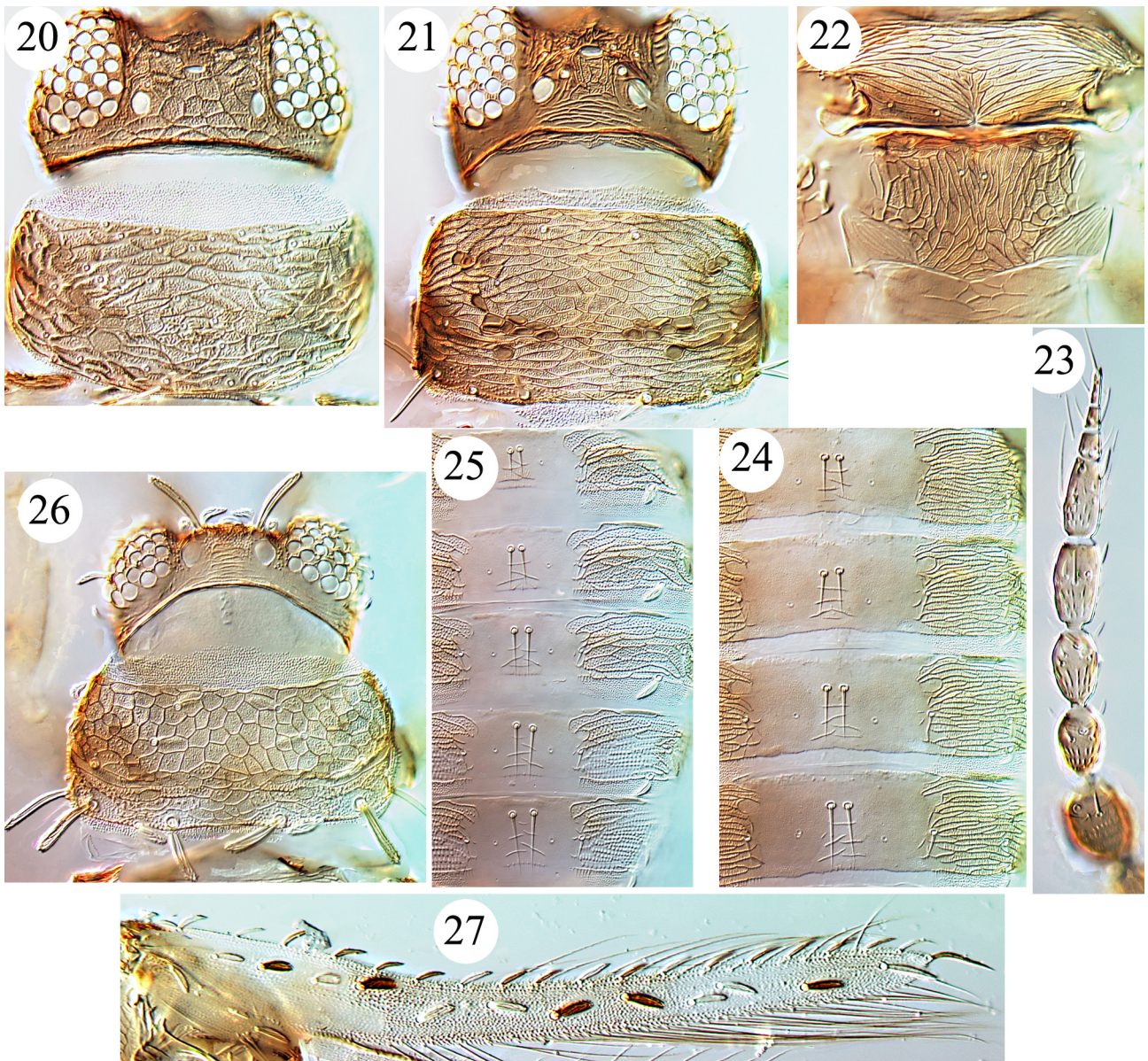
Comments. This species is unique within the genus in having antennal segment III as dark brown as segment II. It is also readily distinguished by the sculpture of the pronotum and metanotum.



FIGURES 1–8. Dendrothripinae. 1–2 tergites IV–V: (1) *Asprothrips bimaculatus*; (2) *Edissa steinerae*. 3–5 Head and pronotum: (3) *Filicopsothrips wellsae*; (4) *Leucothrips piercei*. 5–8 *Dendrothrips julatani*: (5) head and pronotum; (6) tergites IV–VII; (7) antenna; (8) metanotum and fore wing clavus.



FIGURES 9–19. Dendrothripinae. 9–12 *Dendrothrips notelaea*: (9) head and pronotum; (10) meso and metanotum; (11) antenna; (12) tergites III–VII. 13–15 *Dendrothrips viticola*: (13) antenna; (14) tergites III–VI; (15) head and pronotum. 16–19 *Dendrothrips victoriae*: (16) antenna; (17) tergites III–V; (18) head and pronotum; (19) meso and metanotum.



FIGURES 20–27. Dendrothripinae. (20) *Dendrothrips williamsi* head and pronotum. 21–24 *Ensiferothrips lamingtoni*: (21) head and pronotum; (22) meso and metanotum; (23) antenna; (24) tergites III–VI. 25–27 *Ensiferothrips wallacei*: (25) tergites III–VII; (26) head and pronotum; (27) fore wing.

***Dendrothrips notelaea* sp. n.**

Female macroptera: Head, body and legs mainly pale; pronotum, also tergites III–VII, with 2 pairs of brown spots on lateral thirds; tarsi and hind tibiae yellow; antennal segment I white, II dark brown, III–IV yellow, V yellow at base but distal segments brown; fore wing pale with two weakly shaded areas medially and sub-apically that do not form transverse bands, also a dark spot on posterior margin close to dark apex of clavus.

Head sculpture finely tuberculate (Fig. 9), with a few reticulate lines at posterior margin, ocellar setae III just outside ocellar triangle. Antennae 7-segmented (Fig. 11); sense cone on VI arising near apex of segment; sense cones on III and IV stoutly V-shaped. Pronotum with irregular transverse reticles of which the marginal ridges are flattened (Fig. 9), with no (or weak) markings within the reticles. Metanotal sculpture irregularly tuberculate/reticulate (Fig. 10). Fore wing typical of genus, major setae scarcely longer than microtrichia, anteromarginal cilia arising ventrally well behind margin. Tergites III–VII posterolaterally with short longitudinal sculpture lines (Fig. 12), VIII with short marginal comb, IX with many discal microtrichia on posterior third.

Measurements (holotype female in microns). Body length 950. Head, length 55; width across eyes 135. Pronotum, length 80; width 150. Fore wing length 650. Antennal segments III–VII length 30, 33, 25, 33, 10.

Material studied. Holotype female, **Australia, New South Wales**, 50km north of Narrabri, from *Notelaea microcarpa*, 15.vii.1968 (LAM 722), in ANIC.

Paratypes, 4 females taken with holotype; **Queensland**, Carnarvon Station, 3 females from leaf litter and tree bark spray, 14.x.2014, same locality, 1 female from *Melaleuca* leaves, 16.x.2014; Stanthorpe, 1 female from *Olea europaea*, 9.xi.2001; Brisbane, Moggill, 1 female in nursery, 8.xii.1997; Brisbane, Mt. Glorious, 1 female from *Cyathea*, 6.ix.2009.

Comments. This species shares a similar pronotal sculpture with *diaspora* and *victoriae*, as mentioned below under the latter species. The distal antennal segments are more foreshortened than in any other species of this genus from Australia, particularly in contrast to the condition found in *julatteni* and *victoriae*.

***Dendrothrips victoriae* sp.n.**

Female macroptera: Head, body and legs largely brown, but pronotum and mesonotum sharply pale, also tarsi and posterolateral areas of tergites II–VII; antennal segment II dark brown, segments I and III–IX uniformly light brown; fore wing uniformly lightly shaded except for anterior two-thirds at base, clavus pale with apex brown.

Head with irregular sculpture lines (Fig. 18), ocellar setae III minute on anterolateral margins of triangle. Antennae 9-segmented (Fig. 16); suture on VI not fully complete, sense cone arising on basal third of segment; sense cones on III and IV unusually small and slender. Pronotum with irregular transverse reticles of which the marginal ridges are flattened (Fig. 18), with no markings within the reticles. Metanotal reticulation longitudinal, median setae minute (Fig. 19). Fore wing typical of genus, major setae no longer than microtrichia, anteromarginal cilia arising ventrally well behind margin. Tergites III–VII posterolaterally with short longitudinal sculpture lines (Fig. 17), VIII with short marginal comb, IX with many discal microtrichia on posterior third.

Measurements (holotype female in microns). Body length 1250. Head, length 85; width across eyes 160. Pronotum, length 95; width 200. Fore wing length 850. Antennal segments III–IX length 33, 30, 30, 30, 7, 7, 12.

Material studied. Holotype female, **Australia, Victoria**, near Bendigo, from *Daviesia* sp. [Fabaceae], i.2014 (Renae Forbes), in ANIC.

Comments. The sculpture of the pronotum is similar to that of *notelaea* and *diaspora*, suggesting that these represent an Australian radiation within this genus, which is possibly in association with species of Oleaceae. This species is distinctive for the weak sculpture on the head and the almost uniformly light brown antennae and fore wing.

***Dendrothrips viticola* sp.n.**

Female macroptera: Body and legs white, head dark brown dorsally but white ventro-laterally (Fig. 15), tergites III–VII with 2 pairs of small dark spots laterally, VIII with a single pair; antennal segments I–IV white, V–VIII dark brown; fore wing light brown with 3 pale areas that do not extend to the posterior margin, sub-basally, medially and apically (but with extreme apex weakly shaded), clavus dark on distal half.

Head reticulate with tuberculate areas posterior to compound eyes (Fig. 15); ocellar setae III minute, on anterolateral margins of triangle. Antennae 8-segmented, sense cone on VI arising on distal half of segment and scarcely reaching antennal apex. Pronotum transversely reticulate, all setae minute. Metanotum with elongate reticulation. Tergites II–VIII with longitudinal reticulation (Fig. 14), setae S1 and S2 elongate, but remaining setae minute; VIII with posteromarginal comb weak, IX without discal microtrichia on posterior half.

Measurements (holotype female in microns). Body length 950. Head, length 70?; width across eyes 120? Pronotum, length 80; width 130? Fore wing length 630. Antennal segments III–VIII length 25, 25, 25, 20, 7, 10.

Male macroptera: Smaller and paler than female, head mainly white, tergites without dark spots; fore wing pale bands extend to posterior margin of wing.

Material studied. Holotype female, **Australia, Northern Territory**, Jabiru, Little Burdulba Creek, from *Vitex acuminata*, 22.xii.1996 (LAM3079), in ANIC.

Paratype: One male taken with holotype.

Comments. The holotype is badly damaged, with the head and pronotum rotated (thus some of the measurements are not precise), but the colour and sculpture of this female are unique in the genus. The only described *Dendrothrips* species that is at all similar is *vitex*; this was described from *Vitex zeyheri* at Pretoria, South Africa, but has also been seen from Selangor, Malaysia, on *Vitex negundo*. That species has similar tergal sculpture to *viticola*, but the head, fore wings and clavus are without any brown markings.

Edissa Faure: The two species placed in this genus apparently breed only on species of Poaceae and Cyperaceae. One has been collected in South Africa and Sudan, but the other from several sites in north eastern Australia between Cairns and the Torres Strait islands, and also in southern Japan and Thailand (Mound 1999).

Ensiferothrips Bianchi: Based originally on a single species, *primus*, from New Caledonia, this species is widespread in eastern Australia, and *secundus* was described subsequently from Lord Howe Island. Both of these are associated with the leaves of species of trees and shrubs in the family Moraceae. Two further species are described below, one from Australia but the other from much further north, in Sulawesi, Indonesia. The genus has previously been recognized from the large, expanded, grooved and dark setae on the head, pronotum and fore wings, although this character state occurs only in females with the setae of males being much more slender. At first sight, the females of the new Australian species described below are markedly different from the females of the other three available members of the genus, because they have slender major setae. However, the similarity of these setae to those of the known males of the other species precludes considering this Australian species as representing yet another genus. *Ensiferothrips* is thus considered to comprise those Dendrothripinae that have the following character states: ocellar setae pair III elongate; maxillary palps 2-segmented; antennae 9-segmented; pronotal posteromarginal setae pairs III and IV elongate; fore wing apex with a long seta.

Key to species of *Ensiferothrips*

1. Females with fore wing first vein bearing 4 or 5 large dark expanded setae bearing longitudinal ridges (Fig. 27); head with ocellar triangle tuberculate between ocellar setae pair III (Fig. 26); sternites with numerous small tubercles 2
- Females with fore wing first vein setae all pale; ocellar triangle reticulate; sternites reticulate. 3
2. Basal stem of fore wing first vein with 4 (rarely 5) setae, of which only the distal seta is large and dark, first vein thus with 4 large dark setae; sternite VII median setal pair closer to posterior margin than their length *primus*
- Basal stem of fore wing first vein with 4 setae (Fig. 27), of which setae II and IV are larger and darker than I and III, first vein thus with 5 large dark setae; sternite VII median setal pair further from posterior margin than their length. *wallacei* sp.n.
3. Female with pronotal and ocellar setae longitudinally grooved and slightly flattened; lateral areas of tergite IV transversely reticulate, posterior reticles with internal longitudinal striae; fore wing apical seta 2/3 as long as width of wing; sternite VII setae arising submarginally *secundus*
- Pronotal and ocellar setae setaceous, acute, without longitudinal ridges (Fig. 21); lateral areas of tergite IV transversely striate (Fig. 24); fore wing apical seta longer than wing width; sternite VII with all three setae arising at margin *lamingtoni* sp.n.

Ensiferothrips lamingtoni sp.n.

Female macroptera: Body and legs brown, tarsi yellow; antennal segments I–II brown, III weakly shaded, IV–IX brownish yellow; fore wing pale at base with two transverse dark bands, clavus pale with dark base.

Head reticulate, reticles of ocellar triangle with internal markings (Fig. 21), ocellar setae pair III arising on margins of triangle; frons with 2 pairs of stout setae near bases of antennae; maxillary palps small, 2-segmented. Antennae 9-segmented (Fig. 23), VI with complete division and long sense cone arising on basal third; sense cones on III and IV with arms transverse. Pronotum reticulate, reticles with internal markings except for paired groups of darker foveae (Fig. 21); posterior margin with 4 pairs of setae, outer pair IV longest. Mesonotal setae all small, metanotal median setae small and distant from anterior margin (Fig. 22), reticles elongate with internal markings. Fore wing first vein with 7–10 widely spaced setae, second vein with 2 setae, clavus with 2 veinal and one discal setae; anteromarginal cilia arising ventrally just behind anterior margin, costal setae finely pointed. Tergites with

lateral thirds closely striate (Fig. 24), VIII with long marginal comb; IX and X with band of discal microtrichia on posterior third. Sternites transversely reticulate, III–VII with 3 pairs of marginal setae, II with 2 pairs.

Measurements (holotype female in microns). Body length 1100. Head, length 60; width across eyes 150; ocellar setae pair III 30. Pronotum, length 100; width 180; posteromarginal setae I–IV 25, 15, 35, 50. Fore wing length 800; apical seta length 75. Antennal segments III–IX length 30, 28, 28, 30, 8, 5, 12.

Male: Not known.

Material studied: Holotype female, **Australia, Queensland**, O'Reillys, Lamington N.P., from leaves of *Quintinia sieberi* [Paracryphiaceae], 10.x.2006 (LAM 4941), in ANIC.

Paratypes: 8 females taken with holotype; 4 females same data except 9.x.2006; same locality: 2 females from *Pentaceras australis* flowers [Rutaceae], 10.x.2006, 2 females from tree lvs, 9.x.2006, 1 female from *Homalanthus nutans* [Euphorbiaceae], 10.x.2006, 2 females from yellow pan trap, x.2006.

Comments. The sculpture of the tergites and the chaetotaxy of the fore wing resembles that of *Leucothrips* species, but the pronotum lacks a median transverse groove. There is thus a gradient in body form from *lamingtoni* to the extremes of *primus* and *wallacei*, with *secundus* exhibiting intermediate conditions. The latter species remains known only from Lord Howe Island where it lives on *Trophis scandens* [Moraceae].

***Ensiferothrips wallacei* sp.n.**

Female macroptera: Body light brown, femora and tibiae bicoloured, tarsi yellow; fore wing first vein with 5 large, black major setae, costal setae and apical seta also dark; enlarged major setae on head and pronotum much paler. Head with numerous small tubercles (Fig. 26), transversely reticulate posterior to ocellar triangle; ocellar setae pair III with longitudinal ridges, pairs I and II clearly fringed. Pronotum reticulate (Fig. 26), posteromarginal setae pairs I, III and IV longitudinally ridged, much larger than pair II; discal setae flattened and fringed. Metanotal median setae flattened and fringed. Fore wing veinal setae longitudinally ridged and fringed, costal setae smaller but flattened and fringed (Fig. 27). Tergite lateral thirds transversely reticulate with many small tubercles (Fig. 25). Sternite VII with all 3 pairs of setae arising in front of margin.

Measurements (female holotype in microns). Body length 800. Head, length 60; width across eyes 130; ocellar setae III 35. Pronotum, length 75; width 150; posteromarginal setae III and IV 35. Fore wing length 500. Antennal segments III–IX length 25, 20, 20, 18, 7, 7, 12.

Material studied. Holotype female, **Indonesia, Sulawesi Utara**, Dumoga Bone N.P., 8.ii.1985, by insecticide fogging in lowland forest (BM 1985-10), in BMNH.

Paratypes: 3 females taken with holotype.

Comments. The structural similarity to the Australian species *primus* is remarkable (see Mound 1999). More than 100 specimens of *primus* have been studied (in ANIC), taken at various sites in eastern New South Wales and southeast Queensland, as well as Lord Howe Island, Norfolk Island and New Caledonia, and usually from the leaves of species of *Streblus* spp or *Trophis scandens* [Moraceae]. The fore wing chaetotaxy of these specimens has been found to be consistent, with only one large black seta on the basal stem of the fore wing first vein, in contrast to the two such setae in *wallacei*. Moreover, this new species was collected more than 3000 km north of the known range of *primus*.

***Filicopsotrips* Mound**: Only one species is placed in this genus, from New Caledonia, and it remains known only from the type specimens that were collected from a tree fern. This thrips has more slender antennae than most dendrothripines, except for some species of *Ensiferothrips*.

***Halmathrips* Hood**: As indicated by the key to genera, the five described species listed in this genus, all from the Mexican and Caribbean area, also an undescribed species from Brazil, are similar in structure to those placed in *Leucothrips*. The generic classification of Neotropical dendrothripines remains unclear. Two species described from southern Brazil are listed in *Pseudodendrothrips*, but they are more closely related to *Leucothrips* and *Halmathrips*.

Iranodendrothrips Alavi et al.: The only species described in this genus was collected in northeastern Iran on *Populus nigra* [Salicaceae]. However, a single male of a related species has been seen from Kenya, taken on *Catha edulis* [Celastraceae]. This male has the fore wing rather similar with two short apical setae, but the head and pterothorax have brown markings, pair IV of the pronotal posteroangular setae are about twice as long as pairs I–III (instead of being equally small), and the pronotum is distinctly reticulate.

Leucothrips Reuter: Of the five species placed in this genus, populations identified as *theobromae* have been studied from various places between Trinidad, Colombia and southern Mexico. However, at present *theobromae* can be distinguished from *furcatus* only by the presence of a small red pigmented area at the base of the antennae. These tiny species appear to have been dispersed in recent years across the Pacific (Mound *et al.* 2016), and *nigripennis* was dispersed around the world many years ago by the trade in cultivated ferns (Mound 1999).

Parsiiothrips Bhatti: The only species listed in this genus was described from a single female taken from a fern in northern India, and it remains known only from that description (Bhatti 1990).

Petrothrips Masumoto & Okajima: The only known species, from Japan, is similar in structure to the species of *Edissa*, and similarly was collected from grasses.

Projectothripoides Shumsher Singh: The only species placed in this genus, from India, remains unrecognizable, and Bhatti (1990) indicated that it is possibly not a dendrothripine.

Pseudodendrothrips Schmutz: There are now 19 species listed in this genus, and all of them seem to be associated with the leaves of Moraceae, particularly various species of *Morus* and *Ficus*. These thrips all have unusually elongate hind tarsi, and the sculpture on the abdominal tergites and also the metanotum is remarkably similar among the species. Two species were described from southern Brazil, *alboniger* and *fulvus*, and these should probably be placed in *Leucothrips* as they do not have elongate hind tarsi (Mound & Marullo 1996). Of the others, 16 are from tropical Asia, with *candidus* from Cape Verde Island in the Atlantic. In Australia, the record of *mori* continues to be doubtful (Mound 1999), as the available specimens are possibly unpigmented individuals of *darci*. Despite earlier confusion in the literature, there appear to be consistent differences in colour between *bhattii* and *darci*. The first is known only from Japan and has uniformly dark fore wings, with the anterior part of the head extensively brown but the pronotum uniformly pale. In contrast, *darci* has fore wings that are weakly and not quite uniformly shaded, the head is pale with only the interantennal projection dark (Fig. 28), and the pronotum has sublateral dark areas. A similar, but much darker form has been studied from Thailand on *Morus*, but specimens from *Morus* in India, identified as *bhattii*, cannot at present be distinguished from *darci*.

In Australia, specimens identified as *darci* have been studied from Queensland (Brisbane; Monto; Carnarvon; Redlynch), Northern Territory (Darwin; Humpty Doo; Bathurst Island), and Western Australia (Kununurra). This species has been taken occasionally from *Morus*, but is abundant on *Ficus virens* at Darwin and widespread on *Ficus coronata* in northern Australia. The reliance on slight differences in body colour to distinguish species of this genus may not be entirely satisfactory. For example, specimens are sometimes taken together with typical *darci* that lack dark markings on the head and pronotum, and have the fore wings pale. Some of these specimens are thus similar to *mori*, but others that have antennal segment II pale cannot be distinguished from the description of *candidus* from the Cape Verde islands.

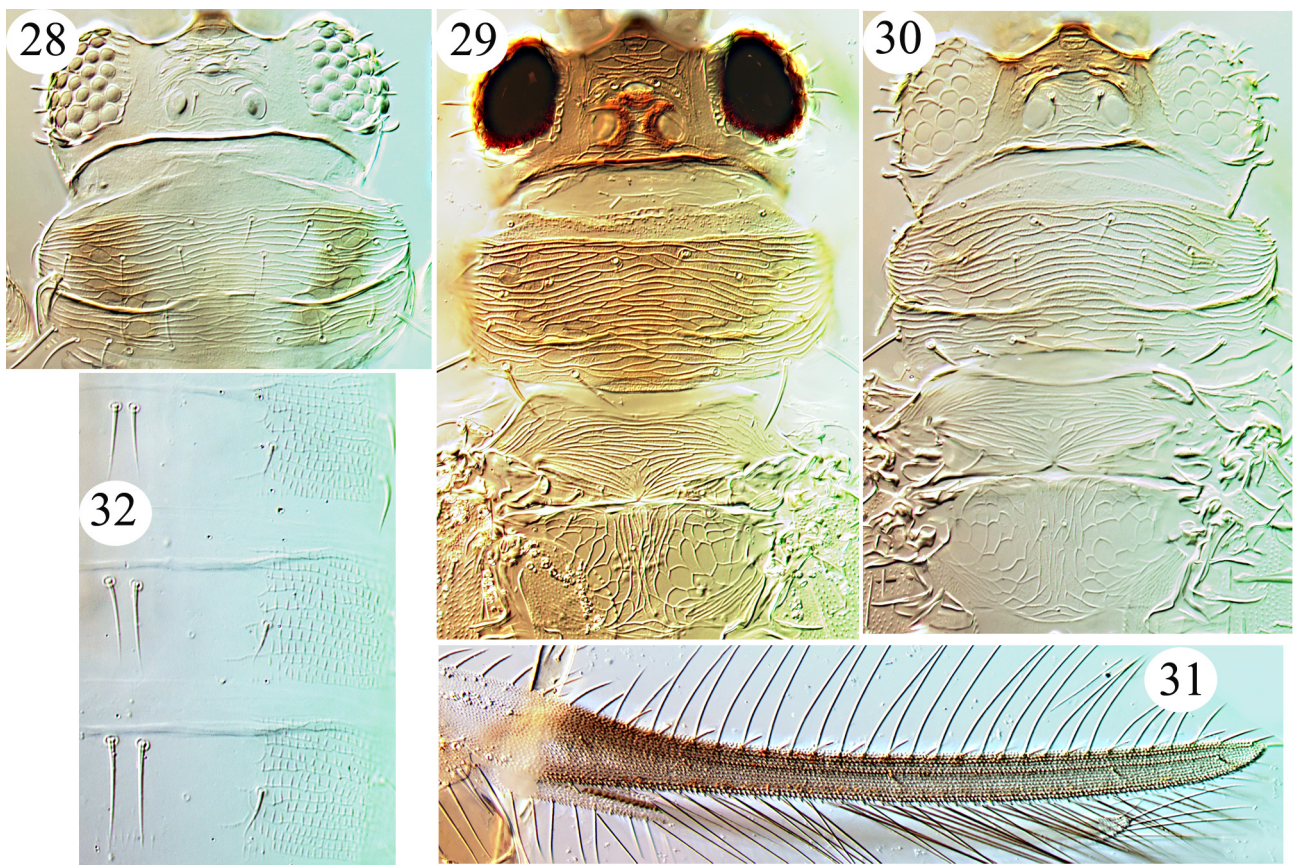
The antennal segmentation of species in this genus also caused some taxonomic confusion in earlier studies. The distal part of segment VI is commonly separated by a partial or complete suture, thus producing a 9-segmented condition. In contrast, the terminal antennal segments are fused in a few species, thus producing a 7-segmented condition. *P. alexei* is unusual in that segment VI is subdivided, but the terminal two segments are fused, thus producing an 8-segmented antenna (Mound & Tree 2007).

Key to *Pseudodendrothrips* species from Australia

1. Abdomen extensively brown. 2
- Abdomen uniformly white with no brown markings 3
2. Fore wing uniformly shaded, veinal setae acute; head with ocellar setae pair III stout and longitudinally grooved; antennae 8-segmented [Queensland] *alexei*
- Fore wing shaded with pale bands at base, sub-medially and apically, veinal setae short, stout and dark; ocellar setae III finely pointed; antennae 9-segmented [Lord Howe Island] *gillespiei*
3. Head and pronotum uniformly pale, with no brown areas *mori*
- Head and pronotum with brown areas 4
4. Head pale with only interantennal projection brown (Fig. 28); pronotum pale with paired sublateral dark markings; *darci*
- Head more extensively light brown (Figs 29, 30); pronotum light brown but without discrete brown markings; fore wings uniformly dark with basal fifth sharply pale and apical area variably paler *marissae* **sp.n.**

Pseudodendrothrips marissae sp.n.

Female macroptera: In life, sharply bicoloured, abdomen almost white but head and thorax often with extensive red internal pigment. Body and legs largely pale; head extensively brown dorsally and ventrally but paler laterally; pronotum evenly light brown but paler on posterior third; antennal segments I and II as dark brown as head, III–IX light brown with III palest; fore wing basal third or quarter white (also clavus) in sharp contrast to dark median area that is gradually paler toward the apex (Fig. 31).



FIGURES 28–32. Dendrothripinae. (28) *Pseudodendrothrips darci* head and pronotum. 29–32 *Pseudodendrothrips marissae*: (29) head and pronotum—paratype female in Hoyers Mountant; (30) head and pronotum—non-paratype female; (31) fore wing; (32) tergites IV–VI.

Structural details typical of genus; head weakly reticulate, ocellar setae III small arising just mesad of anterior margins of posterior ocelli (Fig. 30); compound eyes with about 7 weakly pigmented facets. Antennae 9-segmented, sense cones on III and IV elongate and U-shaped; VI with sense cone arising close to base, VII clearly

distinct from VI. Pronotum transversely reticulate, reticles with internal markings; posterior margin with 3 (sometimes 4) pairs of setae of which outer 2 pairs longest. Mesonotal setae small, metanotum typical of genus (Fig. 30). Fore wing with 7 veinal setae, clavus with 2 veinal and one discal setae; costal cilia arising almost at anterior margin; posteromarginal cilia straight. Hind tarsi very long, about 0.8 as long as hind tibiae. Tergites II–VIII lateral thirds with transverse rows of small longitudinal ridges (Fig. 32), median setal pair long and close together; VIII with long marginal comb; IX and X with band of discal microtrichia on posterior third. Sternites transversely reticulate, III–VII with 3 pairs of marginal setae, II with 2 pairs, setae on VII arising sub-marginally.

Measurements (female holotype in microns). Body length 900. Head, length 50; width across eyes 130; ocellar setae III 12?. Pronotum, length 65; width 140; posteroangular setae 30, 35. Fore wing length 600. Hind tibia 120; hind tarsus 100. Antennal segments III–IX length 27, 33, 30, 33, 10, 15, 15.

Male macroptera. Similar to female but smaller and paler, head brown on at least anterior half, pronotum scarcely brown; fore wing basal pale area shorter than in female.

Material studied. Holotype female, **Australia, New South Wales**, Lorient, Lansdowne (near Taree), from *Ficus coronata*, 13.iv.2002 (LAM 4134), in ANIC.

Paratypes: 2 females, 2 males taken with holotype; Queensland, Mt Glorious, Red Cedar Flat, 4 females, 3 males from *Ficus coronata*, 13.x.2006. Australian Capital Territory, Namadji, 1 male from *Poa* sp., 19.xi.2006.

Specimens excluded from type series: New South Wales, Redhead, SE of Taree, 10 females, 10 males from *Ficus fraseri*, 19.i.2001; Kiwarrak, 20km south of Taree, 1 female, 1 male from *Ficus rubiginosa*, 14.iv.2002; Queensland, Monto, 2 females from *Ficus coronata*, 27.iii.1995.

Comments. The dark fore wing with the basal fifth sharply pale distinguishes this species from its congeners in Australia. Moreover, the pronotum is more evenly brown in colour, rather than bearing discrete brown areas (Fig 29). The females excluded from the type series have the pronotum rather paler (Fig. 30), the fore wing more extensively pale distally, and the males with the body and wings almost uniformly pale. In common with all the *Pseudodendrothrips* known from Australia, the apex of the hind tibia in *marissae* bears a single stout seta, in contrast to the two such setae found in *aegyptiacus*, a pale bodied species that is widespread from eastern Mediterranean countries, including Egypt, Israel and Abu Dhabi, to southern Africa and the Canary Islands.

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