



## Reassessment of some of Kirkaldy's Australian species of Delphacini (Hemiptera: Delphacidae: Delphacinae)

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### Abstract

The following nomenclatural changes are provided for Australian Delphacini: *Queenslandicesa fennahi* **sp. nov.** (= *Thymalops anderida* sensu Fennah); *Yangdelphax jihyuetanica* **gen. et sp. nov.** (= *Hadeodelphax pluto* sensu Yang), with *Yangdelphax afurculus* (Guo & Liang) **comb. nov.**; *Gelastodelphax* Kirkaldy **stat. rev.**, with type species, *G. histrionica*, redescribed; *Nycheuma anderida* (Kirkaldy) **comb. nov.** (= *Dicranotropis cognata* Muir **syn. nov.**); *Delphax albotristriata* Kirkaldy (= *Delphax thyestes* Kirkaldy **syn. n.**); *Sardia* Melichar (= *Hadeodelphax* Kirkaldy **syn. rev.**) and *Sardia rostrata* Melichar (= *Hadeodelphax pluto* Kirkaldy **syn. rev.**) and *Hadeodelphax pluto pluto* Kirkaldy (= *Hadeodelphax pluto pallidior* Kirkaldy **syn. rev.**); *Delphax disonymos* Kirkaldy (= *Delphax hyas* Kirkaldy **syn. nov.**); *Delphax anemonias* Kirkaldy (= *Delphax pylaon* Kirkaldy **syn. nov.**). All species currently assigned to the genus *Matutinus* Distant, a junior homonym of *Matutinus* Macleay, are transferred to the new genus *Distantinus*. Lectotypes are designated for *Gelastodelphax histrionicus* Kirkaldy, *Hadeodelphax pluto* Kirkaldy, *Hadeodelphax pluto pallidior* Kirkaldy, *Delphax anemonias* Kirkaldy, *D. matanitu* Kirkaldy, *D. pylaon* Kirkaldy, *D. thyestes* Kirkaldy, *D. albotristriata* Kirkaldy, *D. hyas* Kirkaldy and *Dicranotropis anderida* Kirkaldy.

**Key words** Fulgoromorpha, planthopper, systematics, taxonomy.

### INTRODUCTION

The taxonomy of Australia's Delphacini was pioneered by Kirkaldy (1903, 1904, 1906, 1907a, 1910), who described several new species and genera. Kirkaldy's (1907a) uncertainty in the generic placement of some of his species was subsequently reflected in the transfer of many of his species to other genera as workers became more confident of the importance of characters of the male genitalia in defining species and generic limits (e.g. Muir 1917, 1923; Muir & Giffard 1924; Fennah 1965).

The dependence on characters of the male genitalia makes identification of female specimens difficult or impossible at the species level and often even the generic level. This poses significant problems when species originally described from females cannot be associated with males that are readily separable using characteristics of the genitalia but substantially similar in all other features. For example, 14 of the Australian species of Delphacidae described by Kirkaldy (1907a) were based either on females only, or lacked sufficient detail or illustration of the male to enable subsequent validation of

the species. Seven of these species have subsequently either been redescribed, synonymised or validated, usually by comparison with long series of specimens that exhibited sufficient intraspecific variation to account for the differences used by Kirkaldy (1907a) to separate them (Muir & Giffard 1924; Fennah 1965; Asche & Wilson 1990; Donaldson 1991). The remaining seven species, *Dicranotropis aristoxenis* Kirkaldy, *Anectopia igerna* Kirkaldy, *Haplodelphax naias* Kirkaldy, *Delphax thyestes* Kirkaldy, *Delphax hyas* Kirkaldy, *Delphax liemonias* Kirkaldy and *Delphax pylaon* Kirkaldy, have not been validated, although some have been transferred to other genera (see Bellis *et al.* 2014 for current combinations).

Compiling all of the holdings of Delphacini in Australian insect collections and examination of Australian material in the BPBM has provided an unprecedented assessment of the diversity of Delphacini present in Australia, including a number of species not previously reported (Bellis *et al.* 2014) and the existence of more than 30 undescribed species (G. Bellis & J. Donaldson unpubl. data 2015). Access to long series of specimens of the full range of species present additionally allows some interpretation of the identity of some of the species based thus far on only females, and this paper reports on the status of several of these and other species and genera described by Kirkaldy (1906, 1907a).

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## MATERIALS AND METHODS

Specimens of Australian species of Delphacini lodged in the BPBM were compared with material held in Australian insect collections and borrowed from other collections as required. Definitive diagnoses were made by dissection of male genitalia, clearing in 10%KOH for up to 12 h, then examination under a dissecting or compound microscope. Additionally, a suite of non-genital characters was scored for male and female specimens of these species.

Photographs were taken using a Leica DC300 digital camera using Leica DC Twain® version 5.1.10 software. Several photographs of each specimen were taken at differing focal planes, and these were montaged using Automontage Essentials® 5.020096 ES to produce a single image with all important parts of the specimen in focus. Images were taken at 2592 × 1944 resolution and saved in TIFF format.

### Depository abbreviations

AM, Australia Museum, Sydney, New South Wales, Australia; ASCU, Agricultural Scientific Collections Unit, Orange Agricultural Institute, Orange, New South Wales, Australia; BPBM, Bernice P. Bishop Museum, Honolulu, Hawaii, USA; NCHU, National Chung Hsing University, Taiwan; NQQIC, Northern Queensland Quarantine Insect Collection, Cairns, Queensland, Australia; NTEIC, Northern Territory Economic Insect Collection, Darwin, Northern Territory, Australia; NTQIC, Northern Territory Quarantine Insect Collection, Darwin, Northern Territory, Australia; QDPI, Queensland Department of Primary Industries & Fisheries, Brisbane, Queensland, Australia; UQIC, University of Queensland Insect Collection, Brisbane, Queensland, Australia – currently housed in the Queensland Museum (QM) but retained as a separate entity.

## TAXONOMY

*Gelastodelphax* Kirkaldy 1906: 411 **Type species.**  
*Gelastodelphax histrionicus* Kirkaldy 1906 by monotypy

**Diagnosis.** Head about as wide as pronotum, vertex longer than wide at base and longer than pronotum, fastigium rounded, weakly carinate. Frons at least twice as long as width at widest point, median carina weak, forking at base of frons and with arms converging basad of fork. Male genitalia with single median process present on anal segment, diaphragm sclerotised but lacking armature; suspensorium not Y-shaped. Pygophore with multiple medioventral processes. Aedeagus laterally compressed, bifurcate dorsally, with reflexed tag process dorsally near apex.

### *Gelastodelphax histrionicus* Kirkaldy

#### Figures 1–9

*Gelastodelphax histrionicus* Kirkaldy 1906: 411; 1907a: 146

**Type material examined.** Lectotype ♂ (here designated): ‘Sandhills, Bundaberg, Q, 04’. The specimen also bears a red

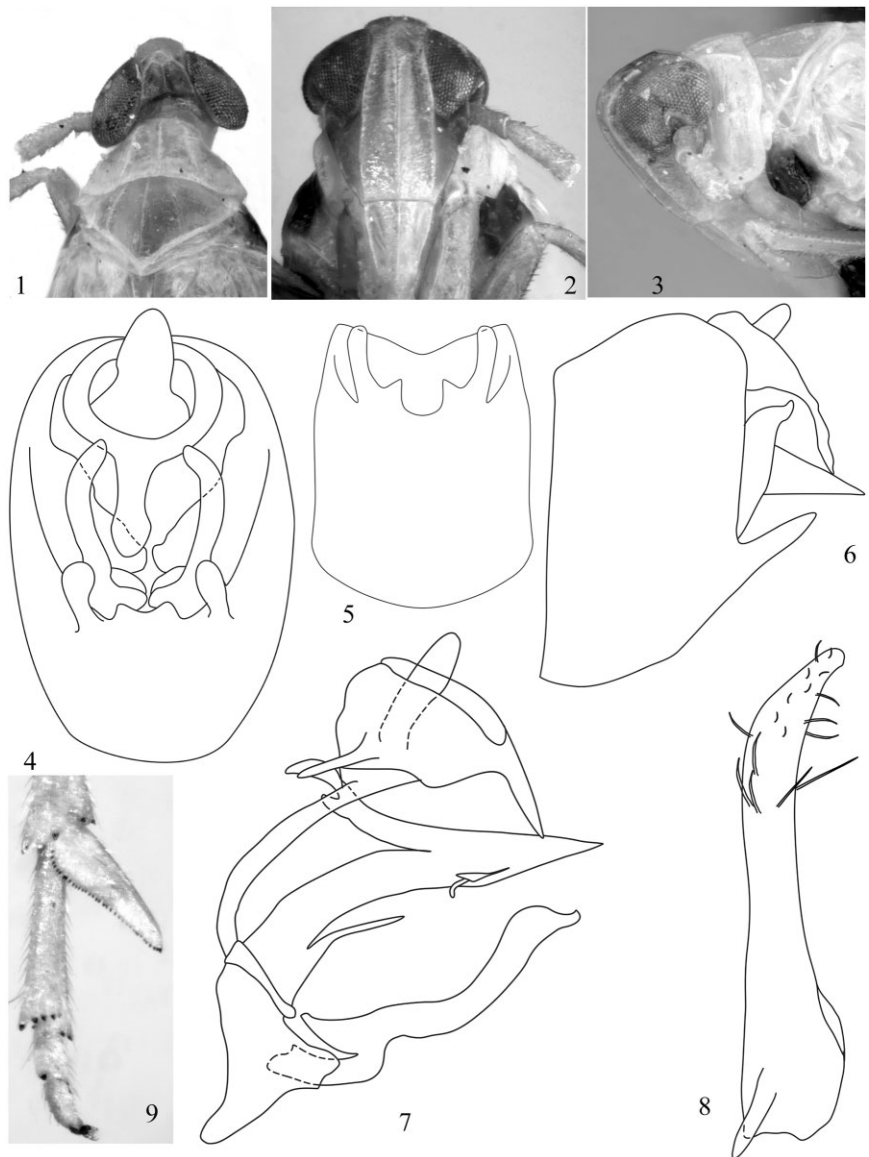
label with the following data: ‘Type of *histrionicus* Kirk, *gelastodelphax histrionicus*, 0116 Kirk’ (BPBM).

**Other material examined: Australia: Queensland.** 3 km of Mt Molloy, 30.Jan.1982, JF Donaldson, D-vac, 1 ♂, (QDPI).

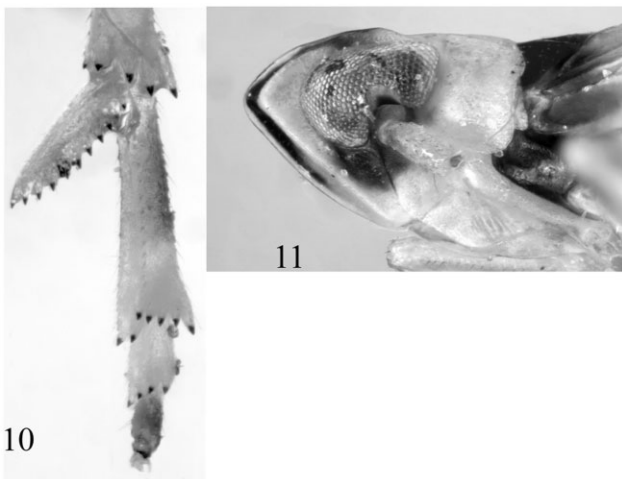
**Description.** Anterolateral carinae meeting before apex of vertex, basal compartment of vertex longer than wide and about as long as anterior compartment (Fig. 1). Frons about 2.6 times as long as width at widest point, widest at about 1/4 from apex (Fig. 2). Lateral margins of frons convex, widening apically, slightly flattened near ocelli. Antennae reaching apex of frons, segment I conical, about 2.1 times as long as wide, segment II about 2.9 times as long as wide and about 1.7 times as long as segment I. Ocelli and blemmata (fuscous spot surrounding the ocellus) present (Fig. 3). Apical rostrum segment about 2.9 times as long as wide. Pronotum lateral carinae slightly curved, reaching hind margin, parallel apically. Mesonotum medial and lateral carinae reaching hind margin. Hind tibial spur formula 5:7:4, calcar thin tectiform with 1 row of about 35 teeth and with apical spine (Fig. 9). Claval suture absent in brachypterous tegmen, Sc+R fork of brachypterous tegmen distad of Cu1 fork and basad to junction of anal veins and sutural margin of tegmen. Male pygophore with two long and two short medioventral processes (Figs 4,5). Aedeagus with reflexed dorsal tag, long narrow ventral process arising basally and smaller process subapically on right-hand side (Fig. 7).

**Notes.** Kirkaldy (1906) erected the genus *Gelastodelphax* for the single species *histrionicus* that was collected in Queensland; Fennah (1965), however, transferred *histrionicus* to *Eumetopina* based on examination of a female specimen from Bonang, Victoria. A female specimen in UQIC bears label data consistent with that reported by Fennah (1965) as well as a determination label ‘*Eumetopina* ?*histrionica* Kirk. Det RG Fennah’, and we regard this specimen as the one examined by Fennah (1965). This specimen has 11 teeth on the post-tibial spur (Fig. 10) and the vertex and the frons meet at a distinct angle (Fig. 11). The left post-tibial spur is missing from the specimen of *G. histrionicus* here designated as lectotype, and although the right post-tibial spur is partially obscured by glue, 28 teeth are still visible. The Mt Molloy male specimen has 35 teeth on both post-tibial spurs (Fig. 9), and in both this specimen and the lectotype the vertex rounds onto the frons (Fig. 3). These features indicate that the two male specimens are not conspecific with the female examined by Fennah (1965), and that the transfer of *G. histrionicus* into *Eumetopina* and subsequent sinking of *Gelastodelphax* under *Eumetopina* is based on a misidentification and is consequently invalid. We propose to resurrect the genus *Gelastodelphax*, which at present remains monotypic.

We have been unable to find any further specimens conspecific with the female examined by Fennah (1965) and are reluctant to describe this species or to place it into a genus until we have examined further material, particularly males.



**Figs 1–9.** *Gelastodelphax histrionica* Kirkaldy. (1) Head dorsum. (2) Face. (3) Head lateral. (4) Male pygophore, posterior view. (5) Male pygophore, ventral view. (6) Male pygophore, lateral view. (7) Male genitalia, lateral view. (8) Left paramere. (9) Post-tibial spur.



**Figs 10–11.** *Gelastodelphax histrionica sensu* Fennah 1965. (10) Post-tibial spur. (11) Head lateral.

Kirkaldy (1906) does not list the number of specimens of *G. histrionica* examined and only a single male specimen is lodged in the BPBM. The label data of this specimen are consistent with that cited by Kirkaldy (1906), and the specimen additionally bears a red holotype label that has been attributed to Muir (Medler 1987). We regard this specimen as part of the type series, but as other specimens may have comprised the series we hesitate to recognise it as the holotype and we therefore designate it as lectotype.

***Nycheuma* Fennah**

*Nycheuma Fennah* 1964: 145 **Type species.** *Dicranotropis dimorpha* Matsumura 1910: 37 by original designation

**Diagnosis.** The diagnosis provided by Hou and Chen (2014) is modified as follows. Head including eyes slightly wider than pronotum. Vertex quadrate, about 1.2 times wider at base than

submedial length. Frons median carina forked about level of ocelli with arms parallel basad of fork. Antennae surpassing the level of frontoclypeal suture. Pronotum lateral carinae not reaching hind margin. Pygofer ventral margin with 3 small medioventral processes in all species, except *N. endymion* which has only 1 and *N. menuis* which has none. Aedeagus with a long retrose process at apex and two smaller processes laterally.

***Nycheuma anderida* (Kirkaldy) comb. n.**

*Dicranotropis anderida* Kirkaldy 1907a: 133

*Delphacodes anderida*; Muir 1917: 335

*Dicranotropis cognata* Muir 1917: 317 **syn. n.**

*Nilaparvata greeni* Distant 1906: 473; Muir 1919: 7 (*misident.*)

*Dicranotropis cognata*; Fennah 1956: 111

*Nycheuma cognatum*; Fennah 1969: 37; 1971: 571; 1975: 89; Kuoh et al. 1983: 81; Yang 1989: 96; Hou & Chen 2014: 50.

*Thymalops anderida*; Fennah 1965: 20; Yang 1989: 90 (*misident.*)

*Queenslandicesa anderida*; Koçak & Kemal 2010: 129 (*misident.*)

**Type material examined.** *Dicranotropis anderida*: Lectotype ♀ (here designated) ‘Cairns Q. R, Austr. 7, 1904’ (BPBM); paralectotypes (here designated) ‘Cairns, Q., Austr. 8, 1904’ 2♀♀; ‘Brisbane, Q. Austr. 6, 1904’ 1♀; ‘Rewa, Fiji Muir 3 1906’, 1♀; ‘Cairns Q. R, Austr. 7, 1904’, 1♀ (all BPBM). The latter specimen also bears a red label with the following data: ‘Type of *anderida* Kirk.’ and a further label stating ‘*Nilaparvata lugens* (Stål); = not *lugens*! Asche det II.87’.

*Dicranotropis cognata*: Holotype ♂ ‘Brisbane, Q. Austr. 6, 1904’ (BPBM).

**Other material examined.** **Australia, Queensland:** Fish Hole Silver Plains, Cape York, 13.59°S 143.33°E, 17.Jul.1990, JF Grimshaw, at light, 2 macropterous ♂♂ (NQQIC); Millaroo, 18.Mar.1982, IR Kay, D-vac rice, headlands, 2 brachypterous ♂♂ (QDPI); Pinklands, 28.Feb.1973, JF Donaldson, at light, 1 macropterous ♂ (NTQIC); Pinklands, 19.Feb.1973, JF Donaldson, at light, 1 macropterous ♂ (NTQIC); Little Mitchell River nr Yalkula, 28.Mar.1976, ID Galloway, 1 brachypterous ♂ (QDPI); Beside Noah’s Ck, 15 km N Daintree R., 26.Mar.1976, ID Galloway, 1 brachypterous ♂ (QDPI); **Northern Territory:** Marrakai Ck. Lower Adelaide R, 17.Mar.1986, C Wilson, collected on *Mimosa pigra*, 1 macropterous ♂ (QDPI); **New South Wales:** Wallarah Ck, Bluehaven, 8 km NE of Wyong, 31.March 1986, GR Brown, at mercury vapour light, 1 macropterous ♂ (ASCU).

**Diagnosis.** This is the only species of *Nycheuma* with the following suite of characters: male pygophore with 3 separate

medioventral processes present, the middle one longest; lateral process on the right side of the aedeagus shorter and arising closer to the apex than process on the left side.

**Notes.** The series of six female specimens of *D. anderida* in BPBM bear data consistent with that cited by Kirkaldy (1907a), and we regard these as part of the type series. One of these specimens bears a red type label that has been attributed to Muir (Medler 1987), but the abdomen of this specimen is missing so an entire specimen with the same collection data is designated here as lectotype and the remaining specimens in the series as paralectotypes.

The new synonymy and new combination indicated above are based on comparison of the type series of *D. anderida* with the holotype and a series of other specimens of *N. cognatum* (Muir).

***Queenslandicesa* Koçak & Kemal**

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*Queenslandicesa* Koçak & Kemal 2010: 129. Replacement name for *Thymalops* Fennah 1965: 20 (junior homonym of *Thymalops* Iablokoff-Khnzorian 1962) **Type species.** *Queenslandicesa fennahi* Bellis & Donaldson (= *Dicranotropis anderida*: sensu Fennah 1965: 20) in accordance with ICZN Online Article 70.3.2

**Diagnosis.** The generic characters outlined by Fennah (1965) and Yang (1989) for *Thymalops* (= *Queenslandicesa*) are modified as follows. Head including eyes as wide as pronotum. Vertex as long submedially as wide at base, apex as wide as base, lateral margins slightly concave, apical margin transverse, submedian carinae not uniting at apex, nearly parallel, Y-shaped carinae moderately distinct, basal compartment wider at base than greatest length. Frons in midline about twice as long as wide, median carinae parallel prior to fork at level of ocelli. Rostrum surpassing mesotrochanters. Antennae surpassing frontoclypeal suture, segment I longer than wide and about half as long as segment II. Ocelli present, at least in macropters. Pronotum with lateral carinae not attaining hind margin. Spinal formula of hind leg 5-7-4. Post-tibial spur with about 20 teeth. Anal segment of male collar-shaped, lateroapical angles each produced into a small spinose process. Pygofer with single medioventral process present, in ventral view rounded apically, strongly incised evenly on both sides. Aedeagus compressed laterally, with reflexed tag at apex and with one or two teeth on left side. Suspensorium Y-shaped, arms about as long as stem. Diaphragm broad, membranous. Parameres simple, divergent.

***Queenslandicesa fennahi* sp. nov.**

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*Dicranotropis anderida*; Fennah 1965: 20; Yang 1989: 90 (misidentification) **Type material examined:** Holotype macropterous ♂: **Australia, Queensland:** ‘Beside Brisbane R. (Tennyson) ii.1977, ID Galloway, Malaise trap’, (QM). Paratypes: **Australia, Queensland:** Cow Bay N of Daintree R. At light, 15–27.Nov.1983, IC Cunningham, 1 ♂ (NTQIC); **Taiwan:** Taichung, 15.Oct.1985, CT Yang; BPBM Acc. 1990.094, 2 brachypterous ♂♂ (BPBM).

**Diagnosis.** The characters outlined by Fennah (1965) and Yang (1989) for *Thymalops anderida* are modified as follows. Postclypeus at base slightly wider than frons at apex, nearly as long as wide at base. Ocelli present in macropterous but absent in brachypterous specimens. Antennae reaching to level of middle of postclypeus, segment I about 1.5 times longer than wide and about half as long as segment II. Post-tibial spur with 15–22 teeth. Anal segment of male short, lateroapical angles produced into stout processes, directed caudad. Pygofer in posterior view with opening as wide as long. Aedeagus large, arched upward medially, with 2 large teeth on the left side, one medially, another subapically, and with a very long irregular flagellum on the right side. Parameres moderately long, inner margin nearly straight, outer margin slightly concave in apical third, basal angles each with a prominent process.

**Notes.** We have been unable to locate the specimen of *T. anderida* (Kirkaldy) examined by Fennah (1965: 20) but have compared the type series of *D. anderida* Kirkaldy, which are all female, with a series of male specimens conforming with Fennah’s description of *T. anderida*. While the specimens are very similar in features of the head, the type series of *D. anderida* have 29–35 (mean 31.4,  $n = 5$ ) spines on the post-tibial spur, while that of *T. anderida* sensu Fennah has 16–22 (mean 18.5,  $n = 8$ ), indicating that these specimens are not conspecific.

Fennah (1965) noted the presence of *Q. fennahi* (as *Thymalops anderida*) in Taiwan, and indeed Yang (1989) subsequently reported a long series of this species from Taiwan. As we have been unable to locate Fennah’s original specimen, we now designate one of the specimens examined herein as holotype of *Q. fennahi*. This species is named in honour of Ronald G. Fennah in recognition of his work on the taxonomy of the Delphacidae.

### ***Nilaparvata Distant***

*Nilaparvata Distant 1906: 473* **Type species.** *Nilaparvata greeni* Distant 1906: 473 (= *Delphax lugens* Stål) by original designation

*Hikona Matsumura 1935: 139; Okada (1977: 2)* **Type species.** *Hikona formosana* Matsumura 1935: 139

*Kalpa Distant 1906: 474; Muir and Giffard (1924: 16)* **Type species.** *Kalpa aculeata* Distant 1906: 474

**Diagnosis.** The generic characters outlined by Bartlett (2007) are modified as follows. Basitarsus bearing 1–3 teeth on the

proximal half of the ventral margin, males with parameres bifurcate; pygophore with genital diaphragm weak bearing poorly developed armature.

### ***Nilaparvata albotristriata* (Kirkaldy)**

#### **Figures 12–19**

*Delphax albotristriatus* Kirkaldy 1907a: 154

*Delphax thyestes* Kirkaldy 1907a: 152 *syn. n.*

*Nilaparvata albotristriata*; Metcalf 1943: 322

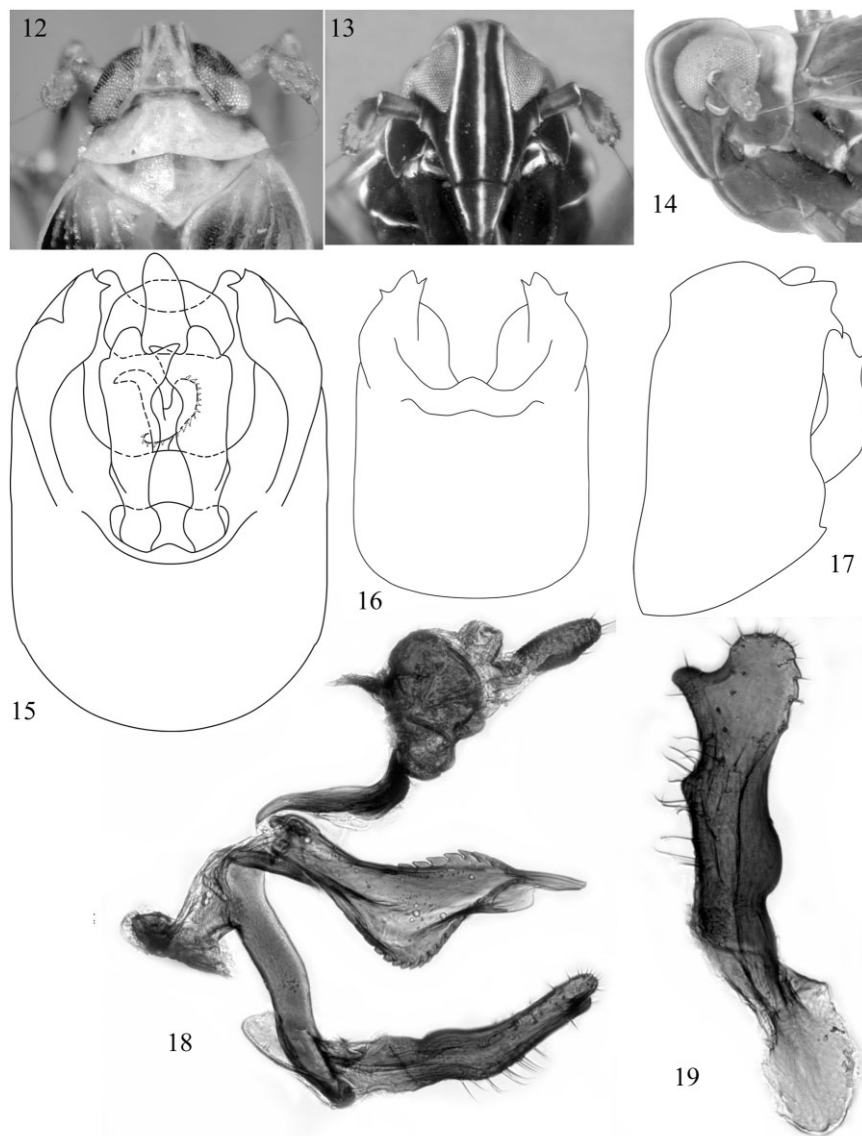
*Chloriona thyestes*; Metcalf 1943: 328

**Type material examined.** *Delphax albotristriatus*: Lectotype ♂ (here designated) ‘Brisbane, Q. Austr. 11–1904’ (BPBM); *Delphax thyestes*: Lectotype ♀ (here designated) ‘Bundaberg, Qld, Austr. 11–1904’ (BPBM).

**Other material examined.** **Australia: Northern Territory,** Garden Pt, Melville Is, 18.Jun.2003, GA Bellis, 1 ♀ (NTQIC); **Queensland,** Cairns, 18.May.2004, G Bellis, 1 ♂ (NTQIC); **New South Wales,** Pearl Beach, 30.Nov.1979, MJ Fletcher, 1 ♀ (ASCU); Frenchmans Ck 15.Nov.1969 T Weir, 2 ♂♂ (UQIC). **Guam,** Inarajan, 5.Jul.1956; RL Usinger Collector; on grass at beach; O.H. Sweeny collection; Bishop Museum; Acc. #1964.188, 1 ♀ (BPBM).

**Description.** Head about as wide as pronotum, vertex about as long as wide at base and more than 1.5 times longer than pronotum, apical margin truncate; anterolateral carinae meeting at apex of vertex, basal compartment of vertex longer than wide and about as long as anterior compartment (Fig. 12). Fastigium rounded, not carinate (Fig. 14). Frons about 2.6 times as long as width at widest point about 1/4 from apex; median carinae strong, forking in basal third of frons and with arms converging basad of fork (Fig. 13). Antennae not reaching apex of frons, segment I conical, about 1.7 times as long as wide, segment II about 2.3 times as long as wide and about 1.3 times as long as segment I. Ocelli present, blemmata absent. Apical rostrum segment about 4.8 times as long as wide. Pronotum lateral carinae slightly curved, not reaching hind margin, diverging apically. Mesonotum lateral carinae reaching hind margin, mesonotum medial carinae not reaching hind margin. Hind tibial spur formula 5:7:4, additionally a row of one to three spines present along the hind tibia; post-tibial spur flattened with 2 rows of teeth, 15–18 in total and with apical spine. Claval suture present in macropters but not brachypters, Sc+R fork of macropterous tegmen level with Cu1 fork and distad of junction of anal veins and sutural margin of tegmen.

Male with processes absent from anal segment (Fig. 15), a single, short medioventral pygophore process (Fig. 17); diaphragm symmetrical, lacking sclerotised armature. Suspensorium not Y-shaped. Aedeagus twisted with toothed flanges (Fig. 18).



**Figs 12–19.** *Nilaparvata albostrigata* (Kirkaldy). (12) Head dorsum. (13) Face. (14) Head lateral. (15) Male pygophore, posterior view. (16) Male pygophore, ventral view. (17) Male pygophore, lateral view. (18) Male genitalia, lateral view. (19) Left paramere.

**Notes.** The female of *Delphax thyesstes* (Kirkaldy) here designated as lectotype was compared with a series of male and female specimens of *N. albostrigata*, including the specimen here designated as lectotype, and all observable characters were found to be within the limits of *N. albostrigata*. Some sexual dimorphism is noticeable in the colouring of these specimens, and this may explain why Kirkaldy (1907a) described them as separate species. *Delphax thyesstes* has page precedence over *D. albostrigata*, but as there are no males in the type series of *D. thyesstes* it is preferable that *D. albostrigata* with a male lectotype here designated becomes the senior synonym.

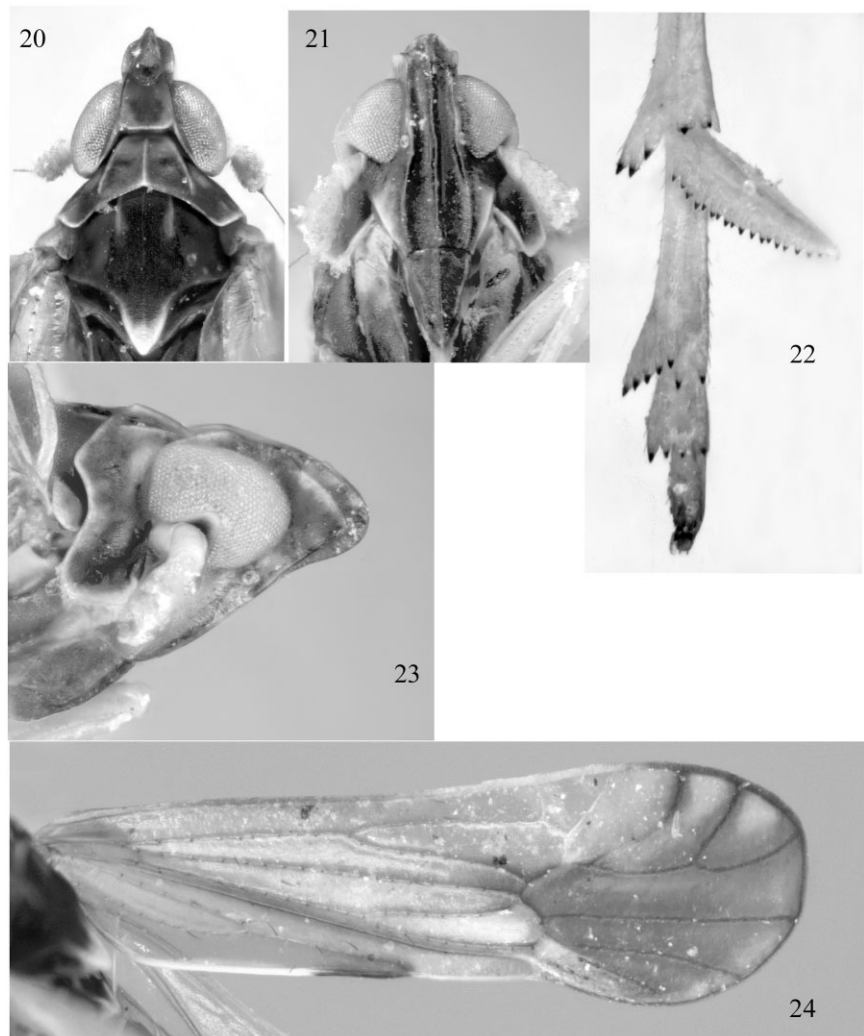
The two lectotypes, the female specimen of *D. thyesstes* and the male of *D. albostrigata* from BPBM, have label data consistent with the data cited by Kirkaldy (1907a), and both also bear a red type label that has been attributed to Muir (Medler 1987).

### ***Sardia Melichar***

*Sardia Melichar* 1903: 96 **Type species.** *Sardia rostrata* Melichar 1903: 96 by original designation

*Hadeodelphax* Kirkaldy 1906: 410; Kirkaldy 1907b: 302 **Type species.** *Hadeodelphax pluto* Kirkaldy 1906: 410 by original designation

**Diagnosis.** The generic characters outlined by Yang (1989) are modified as follows. Head including eyes narrower than pronotum. Vertex at least twice as long as wide, strongly produced in front of eyes, sides nearly parallel, apical margin acutely produced medially, submedian carinae uniting on vertex, basal compartment narrower at base than greatest length. Frons in midline about three times longer than wide. Rostrum reaching metatrochanters. Ocelli present. Pronotum



**Figs 20–24.** *Sardia rostrata* Melichar (*Hadeodelphax pluto* Kirkaldy lectotype male). (20) Head dorsum. (21) Face. (22) Apical spines of hind leg segments. (23) Head lateral. (24) Tegmen.

with lateral carinae attaining hind margin. Spinal formula of hind leg-5:7:4. Post-tibial spur with about 20 teeth.

Anal segment of male ring-like, in profile process arising from median portion. Aedeagus short and stout, tubular and lacking processes. Diaphragm narrow with dorsal margin produced dorsad. Parameres simple. Female without genital scale.

**Notes.** *Hadeodelphax* was synonymised with *Sardia* by Kirkaldy (1907b: 302) without comment. Yang (1989) subsequently resurrected *Hadeodelphax* and rejected the synonymy of the type species, *H. pluto* Kirkaldy, with *S. rostrata* Melichar. The specimen described by Yang (1989) is, however, not referable to *H. pluto* Kirkaldy (see notes below), and the resurrection of *Hadeodelphax* is consequently based on a misidentification. We therefore propose that *Hadeodelphax* is returned to synonymy with *Sardia*.

### ***Sardia rostrata* Melichar**

#### **Figures 20–24**

*Sardia rostrata* Melichar 1903: 96

*Hadeodelphax pluto* Kirkaldy 1906: 410 *syn. n.*

*Hadeodelphax pluto pallidior* Kirkaldy 1907a: 140 *syn. n.*

*Sardia pluto*; Kirkaldy 1907b: 302; Muir, 1917: 328

*Sardia rostrata*; Muir 1923: 257

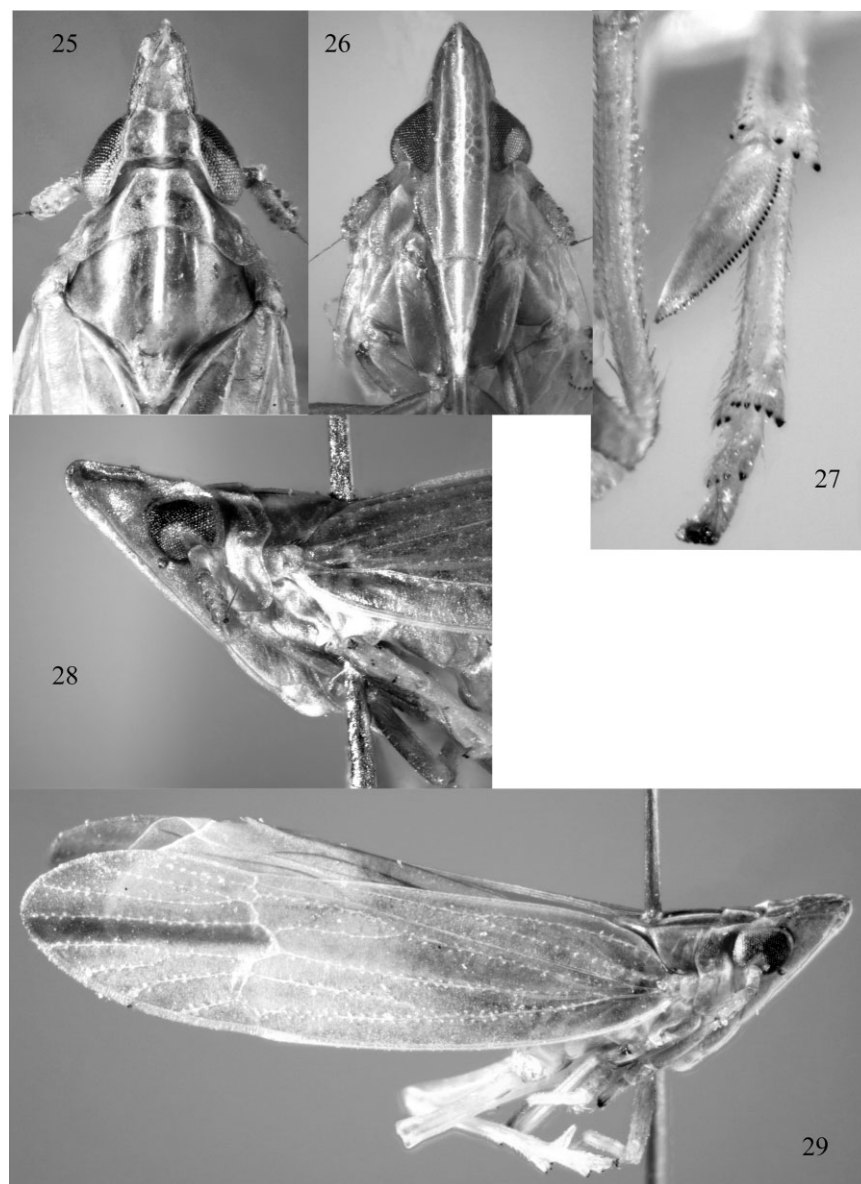
*Sardia rostrata pluto*; Fennah 1965: 44.

**Type material examined.** *H. pluto*: Lectotype ♂ (here designated) ‘Cairns, Q. Austr. 7.16.1904, Coll. Koebele’ (BPBM); Paralectotype ♂ (here designated), ‘Cairns, Qld. Australia. Aug.1904’ (BPBM);

*H. pluto pallidior*: Lectotype ♀ (here designated) labelled ‘*H. pluto pallidior*’ with collection label only bearing the number ‘2247’ (BPBM).

#### **Other material examined. Australia, Cocos (Keeling)**

**Islands:** Horsborough Is, 26.May.2000, G Bellis sweeping *Ishaemum mutica*, 3 ♀♀, 2 ♂♂ (NTQIC); **Western Australia:** Kimberley Dist, Great Northern Highway, 55 km N Hall’s Ck, 25.May.1999, Cassis & Silveira at light, 5 ♀♀, 2 ♂♂ (AM); Kununurra, Frank Wise Research Station, light trap/vac/s’cane, 24.May.2000, R Blanche & J Lloyd, 2 ♂♂ (NTQIC); **Northern Territory:** Gurrumurru, 24.Apr.2001, G



**Figs 25–29.** *Yangdelphax jihyuetanica* sp. nov. (25) Head dorsum. (26) Face. (27) Apical spines of apical leg segments. (28) Head lateral. (29) Habitus.

Bellis sweeping *Colocasia esculenta*, 4 ♀♀, 7 ♂♂ (NTQIC); **Queensland:** ‘Ecluctus’, Iron Range, 19.Jul.1997, G and A Daniels, 1 ♀ (UQIC); Brisbane, 9.Apr.1956, TE. Woodward, 1 ♀ (UQIC); **New South Wales:** Doyalson/Bluehaven, at MV light, 31.Mar.1986, GR Brown, 4 ♀♀, 2 ♂♂ (ASCU); Pearl Beach nr Woy Woy, 2.May.1987, at mercury vapour light, MJ Fletcher, JA MacDonald & DJ Scambler, 2 ♂♂ (ASCU); Dee Why Lagoon, 31.Mar.1962, DK McAlpine, 1 ♂ (AM).

**Diagnosis.** The diagnosis provided for *S. rostrata* by Yang (1989) is modified as follows. Anal segment of male with lateroapical angles widely separated, each produced medially into a long spinose ventrally directed process. Pygofer with laterodorsal angle not produced, in posterior view with opening as wide as long, lateral margins weakly defined, slightly convex. Aedeagus with apical third slightly narrowed, lacking processes but with 4–5 teeth on dorsal aspect near

apex. Gonopore terminal, on dorsal surface. Suspensorium deeply incised ventrally, straight dorsally. Diaphragm very narrow, dorsal margin produced dorsad, apical margin incised medially. Parameres simple, gently converging apically to pointed tips.

**Notes.** Both Muir (1923) and Fennah (1965) synonymised *S. pluto* with *S. rostrata*, but Yang (1989) resurrected *H. pluto* following examination of Taiwanese specimens that he considered differed from *S. rostrata*, although there is no evidence that he examined any of the type specimens of *H. pluto*. Comparison of the male here designated as lectotype, another male (the abdomen of which is now missing) here designated as paralectotype, and a female here designated as lectotype of *H. pluto pallidior*, with a specimen of *H. pluto* sensu Yang (1989) revealed that for the characters highlighted by Yang (1989), i.e. shape of tegmen (Figs 24,29), spinal formula of hind leg and number of calcar teeth (Figs 22,27), as well as



other characters such as the shape of the frons (Figs 21,26), vertex (Figs 20,25) and head in profile (Figs 23,28), the type specimens of both subspecies of *H. pluto* conform with *S. rostrata* and are very different to *H. pluto* sensu Yang (1989). On this basis we confirm earlier proposals that *H. pluto* and *Hadeodelphax* are junior synonyms of *S. rostrata* and *Sardia*, respectively.

Kirkaldy (1907a) described the subspecies *H. pluto pallidior* based solely on differences in colour and size from *H. pluto*. He noted that specimens of *H. pluto* are 'subject to natural decoloration', and indeed for several years the variation in colour served to separate this species from *S. rostrata*. Muir (1923) finally decided that the differences in colour and head length were not sufficient to separate these two species and placed *S. pluto* as a junior synonym of *S. rostrata*. No mention was made, however, either by Muir (1923) or anyone subsequently, on the status of the subspecies of *S. pluto*. Fennah (1965), apparently unaware of Muir's (1923) synonymisation of *S. pluto* with *S. rostrata*, placed *S. pluto* as a subspecies of *S. rostrata* but gave no reasons to support the existence of two or more subspecies. Like Muir (1923), Fennah (1965) did not propose any action for *S. pluto pallidior*. Examination of specimens from WA, NT, Qld, NSW and the Cocos (Keeling) Is reveals that the colour and size variations used to separate the subspecies of *S. rostrata* represent intraspecific variation and do not support the recognition of subspecies, and we propose that *H. pluto pallidior* is synonymised with *H. pluto pluto* (= *Sardia rostrata* Melichar).

The data cited by Kirkaldy (1906) for the type series of *H. pluto* are 'Queensland, Cairns (vii-Aug, Koebele's No. 2247)'. The BPBM has three specimens bearing either locality data or a collection number, which is consistent with that cited by Kirkaldy (1906, 1907a), and we regard these as part of the type series. Two of these specimens, a female labelled *H. pluto pallidior* and a male labelled *H. pluto*, whose abdomen is missing, bear a red holotype label that has been attributed to Muir (Medler 1987). The third specimen in the series is an entire male and this specimen is here designated lectotype. The remaining female and damaged male are here designated paralectotypes.

### ***Yangdelphax* gen. nov.**

<http://zoobank.org/urn:lsid:zoobank.org:act:BF7A4936-41F3-47B6-AF48-B3E5A52C3DBA>

**Type species.** *Yangdelphax jihyuetanica* sp. nov.

**Diagnosis.** The diagnosis provided by Yang (1989) for *Hadeodelphax* sensu Yang (1989) is modified as follows. Head including eyes narrower than pronotum. Vertex at least 1.5 times longer than width between eyes, strongly produced in front of eyes, sides converging to apex, apical margin acutely produced medially, submedian carinae uniting on vertex, Y-shaped carina distinct, basal compartment wider at base than greatest length. Frons in midline more than 3.5 times longer than wide, lateral carinae nearly straight. Rostrum reaching to

meso-trochanters. Ocelli present. Pronotum with lateral carinae attaining hind margin. Spinal formula of hind leg 5-8-4. Post-tibial spur with more than 30 teeth. Tegmina with anterior margin distinctly convex medially and acute at apex. Anal segment of male collar-shaped with a pair of processes. Aedeagus tubular. Suspensorium ring-like, stem very small. Diaphragm very narrow. Parameres short and broad. Female with genital scale.

**Etymology.** This genus is named after Dr Chung Tu Yang in recognition of his contributions to the taxonomy of Delphacidae in the Oriental region.

### **Included species**

*Yangdelphax afurculus* (Guo and Liang, in Guo *et al.* 2005: 162) **comb. n.**

### ***Yangdelphax jihyuetanica* sp. nov.**

<http://zoobank.org/urn:lsid:zoobank.org:act:6DDF54EE-E7A8-48BD-BBB9-4668F3667B7F>

### **Figures 25–29**

*Hadeodelphax pluto*; Yang 1989: 284 (*misidentification*)

**Type material.** Holotype ♂ (here designated), Taiwan, Jihyuetan, Nantou Hsein, 25.May.1985, SC Tsaur (NCHU). Paratypes: same data as holotype 2♀♀, 1♂, (NCHU).

**Diagnosis.** The diagnosis provided by Yang (1989) is modified as follows. Vertex about 1.8 times longer in middle line than width between eyes, basal compartment about 1.3 times wider at base than greatest length (Fig. 25). Vertex strongly extended in front of eyes, fastigium acutely rounded (Fig. 28). Frons about 4 times longer than wide, widest at level of ocelli, median carina simple, lateral carinae nearly parallel (Fig. 26). Postclypeus at base nearly as wide as frons at apex, distinctly longer than wide at base. Rostrum surpassing meso-trochanters. Antennae surpassing frontoclypeal suture, segment I about 2.4 times longer than wide and about 0.6 times length of segment II. Post-tibial spur with 32–36 teeth (Fig. 27).

Anal segment of male with long spinose process. Pygofer laterodorsal angle with small process submarginally, posterior margin slightly produced caudad above base of parameres. Aedeagus stout, tubular, apical third deeply incised, forming a spine-like process dorsally, lower portion narrow with several ventral teeth near apex. Orifice terminal. Suspensorium circular. Diaphragm narrow, dorsal margin triangularly produced, directed dorsad. Parameres slightly divergent, outer margin nearly straight, apical margin broad, slightly emarginate, inner margin apical half with lobe-like production, oblique. Female with genital scale rounded apically, obtusely angulate basally.

**Notes.** As pointed out by Yang (1989), *H. pluto* sensu Yang (1989) is not congeneric with *Sardia*. The designation of

*H. pluto* Kirkaldy as a junior synonym of *S. rostrata* consequently necessitates the erection of a new genus, *Yangdelphax*, to accommodate *H. jilhyuetanica* and its congener, *Hadeodelphax afurculus* Guo and Liang.

### **Syndelphax Fennah**

*Syndelphax Fennah 1963: 15 Type species. Delphax matanitu* Kirkaldy 1907a, synonym of *D. disonymos* Kirkaldy

**Diagnosis.** The generic characters provided by Yang (1989) are modified as follows. Vertex as long or slightly longer than wide at base, slightly narrower at apex than at base, submedian carinae uniting at apex. Frons in midline about twice as long as wide. Postclypeus wider at base than frons at apex. Rostrum surpassing mesotrochanters. Antennae cylindrical, segment I longer than wide, shorter than segment II. Ocelli present. Spinal formula of hind leg 5-7-4. Post-tibial spur with 12–25 teeth.

Anal segment of male ring-like or collar-shaped, lateroapical angles each produced into a spinose process. Pygofer in profile with laterodorsal angle moderately produced, in posterior view with opening wider than long, lacking medioventral process. Aedeagus tubular, simple or with a few teeth subapically: Suspensorium elongate oval, ring-like. Diaphragm narrow, produced dorsomedially in a rather long process. Parameres relatively long, flattened and distally subtruncate.

### **Syndelphax disonymos (Kirkaldy)**

*Delphax matanitu* Kirkaldy 1907a: 155

*Delphax disonymos* Kirkaldy 1907a: 156

*Delphax hyas* Kirkaldy 1907a: 156 *syn. n.*

*Delphacodes matanitu*; Muir 1917: 333; Muir 1929: 220; Fennah 1956: 122

*Delphacodes hyas*; Muir 1917: 333

*Syndelphax matanitu*; Fennah 1963: 15; Fennah 1965: 48

*Syndelphax disonymos*; Fennah 1975: 109; Yang 1989: 270

**Type material examined.** *Delphax matanitu* lectotype ♂ (here designated) 'Ba, Fiji, Muir, 1.1906' (BPBM); *Delphax hyas* lectotype ♀ (here designated) 'Cairns, Q, K, Australia, 8.1904', paralectotype ♀ (here designated) 'Cairns, Q, K, Australia, 8.1904', paralectotype ♂ (here designated) 'Cairns, Q, R, Australia, 7.1904' (all BPBM).

**Other material examined. Australia, Northern Territory:** Brigalow Farms, Katherine, 23.Mar.2000, Dvac maize crop, M Hoskins 1 ♂ (NTEIC); Coastal Plains Research Station, 4.Oct.1985, C Wilson, 2 ♀♀, 2 ♂♂ (NTQIC); **Queensland:** Innisfail, 9.Apr.2002, sweeping grasses and weeds, G Bellis, 4 ♀♀, 4 ♂♂ (NTQIC); Innisfail, 10.Apr.2002, sweeping

grasses and weeds, G Bellis, 10 ♀♀, 8 ♂♂ (NTQIC); Innisfail, 11.Apr.2002, sweeping grasses and weeds, G Bellis, 5 ♀♀, 4 ♂♂ (NTQIC); **New South Wales:** Doyalson/Bluehaven, at MV light, 31.March.1986, GR Brown 7 ♀♀, 1 ♂ (ASCU); Trangie, at light trap, 17–18.Mar.1984, MJ Fletcher 1 ♂ (ASCU).

**Diagnosis.** The diagnosis provided by Yang (1989) is modified as follows. Frons widest about level of ocelli. Postclypeus nearly as long as wide at base. Rostrum with apical segment shorter than subapical. Antennae reaching to level of middle of postclypeus, segment I about 1.4 times longer than wide and about half as long as segment II. Post-tibial spur with 16–24 (average 19) teeth.

Aedeagus without teeth, slightly narrowed at apical third, with tapering process at dorsoapical angle. Orifice terminal. Diaphragm with dorsal margin produced dorsad medially into a long process with caudally produced longitudinal median line, apex blunt. Parameres long and broad, moderately divergent, outer margin slightly sinuate, inner margin shallowly concave at basal two thirds, widest near apex, very shallowly concave medially at apex.

**Notes.** *Delphax matanitu* Kirkaldy, *Delphax disonymos* Kirkaldy and *Delphax hyas* Kirkaldy were described in the above order in the same publication (Kirkaldy 1907a). Fennah (1963) assigned *Delphax matanitu* Kirkaldy as the type species of *Syndelphax*, then subsequently (Fennah 1975) synonymised *D. matanitu* with *D. disonymos* without providing a reason for the precedence of *D. disonymos* and despite *D. matanitu* having page precedence over *D. disonymos*.

A female of *Delphax hyas* Kirkaldy, here designated as lectotype, as well as a male with the apex of the abdomen missing and an intact female, here both designated as paralectotype specimens of *Delphax hyas* Kirkaldy, were examined and all observable characters were found to be within the limits of *D. disonymos*.

Kirkaldy (1907a) listed Redlynch and Kuranda as syntype localities of *D. hyas* and July and August, respectively, as the month of collection from these sites. Three specimens in BPBM are labelled with these data and we regard these specimens as the syntype series. The apex of the abdomen of the single male specimen is missing and one of the females bears a red holotype label that has been attributed to Muir (Medler 1987); we select this female as the lectotype and the other two specimens as paralectotypes.

In his description of *D. matanitu*, Kirkaldy listed three localities in Fiji, indicating that there were at least three specimens in the type series. A male specimen in BPBM bearing data consistent with one of these specimens also bears a red holotype label that has been attributed to Muir (Medler 1987) and is designated here as lectotype.

### **Terthron Fennah**

*Terthron Fennah 1965: 55 Type species. Delphax anemonias* Kirkaldy 1907a by original designation

**Diagnosis.** The generic characters outlined by Yang (1989) are modified as follows. Head including eyes narrower than pronotum. Vertex as wide or wider at base than long submedially, as wide at base as at apex, lateral carinae straight or concave, apical margin transverse, submedian carinae uniting at apex, Y-shaped carina weak, basal compartment wider at base than greatest length. Frons in midline about twice its maximum width, lateral carinae shallowly convex, single median carina. Postclypeus at base wider than frons at apex. Rostrum surpassing meso-trochanters, but not attaining meta-trochanters. Antennae cylindrical, surpassing frontoclypeal suture. Ocelli present. Pronotum lateral carinae not attaining hind margin. Spinal formula of hind leg 5-7-4. Posttibial spur with about 20 teeth.

Anal segment of male short, ring-like, lateroapical angles widely separated, each produced into a long spinose process, in profile arising far below dorsal margin. Pygofer with opening as long as wide, lateral margins weakly defined, with or without medioventral process. Aedeagus laterally compressed, broad at base, ventral margin produced rod-like or triangularly. Suspensorium triangular oval or elongate with ventral ring-like. Diaphragm produced into a lobe, widening towards apex, dorsal margin slightly incised, surface beset with many granulations. Parameres widening towards truncate apex, inner margin sinuate.

### ***Terthron anemonias* (Kirkaldy)**

#### **Figures 30–37**

*Delphax anemonias* Kirkaldy 1907a: 159; Muir 1916: 385

*Delphax pylaon* Kirkaldy 1907a: 160 *syn. n.*

*Pissonotus pylaon*; Muir 1917: 325

*Terthron anemonias*; Fennah 1965: 51

*Terthron pylaon*; Bartlett and Deitz 2000: 146

**Type material examined.** *Delphax anemonias* lectotype ♂ (here designated) 'Cairns, Q. (K.) Austr. 8, 1904' (BPBM). *Delphax pylaon* lectotype ♂ (here designated) 'Cairns, Q. Austr. 7.1904', (BPBM)

**Other material examined.** **Australia, Northern Territory:** Yapilika, Melville Is, 18.Jun.2003, G Bellis 3 ♂♂ (NTQIC); Garden Pt, Melville Is, 18.Jun.2003, G Bellis 1 ♂ (NTQIC); Arafura Swamp nr Ramingining, 9.Jul.2003, G Bellis 3 ♂♂ (NTQIC); Mabuhay Farm, Coach Rd via Adelaide R, 24.Mar.2002, G Bellis 5 ♂♂ (NTQIC). **Queensland:** Innisfail, 13.April.2002, G Bellis 1 ♂ (NTQIC); Innisfail, 10.Apr.2002, G Bellis 1 ♀ (NTQIC); Mareeba, 7.Apr.2002, G Bellis 1 ♂ (NTQIC); Mareeba, Kennedy H'way, 8.Apr.2002, KL Anderson 1 ♂ (NTQIC).

**Description.** Head with apical margin truncate, anterolateral carinae meeting at apex of vertex; basal compartment of vertex about as long as anterior compartment. Vertex, pronotum and mesonotum

with a narrow white medial stripe (Fig. 30). Fastigium rounded, not carinate (Fig. 32). Frons about 2.2 times as long as width at widest point, widest at level of ocelli, with strong median carinae forking in basal third of frons, and with arms converging basad of fork (Fig. 31). Antennae reaching apex of frons, antennal segment II about 2.4 times as long as wide and about 2.1 times as long as segment I. Apical rostrum segment about 4 times as long as wide. Claval suture present in macropters, Sc+R fork of macropterous tegmen basad to both CuI fork and to the junction of anal veins and sutural margin of tegmen.

Male with one pair of processes present on anal segment (Fig. 33) and a single, small medioventral pygophore process (Fig. 35); diaphragm symmetrical with sclerotised armature; aedeagus bifurcate (Fig. 36).

**Notes.** The differences noted by Kirkaldy (1907a) to distinguish these two species refer mostly to colour and the colour variation seen in the series of specimens examined herein includes that expressed in the specimens here designated as lectotypes of their respective species. Similarly, while the lateral keels of the pronotum do differ slightly between the two lectotype specimens, this variation is not significant when a wider range of specimens are examined.

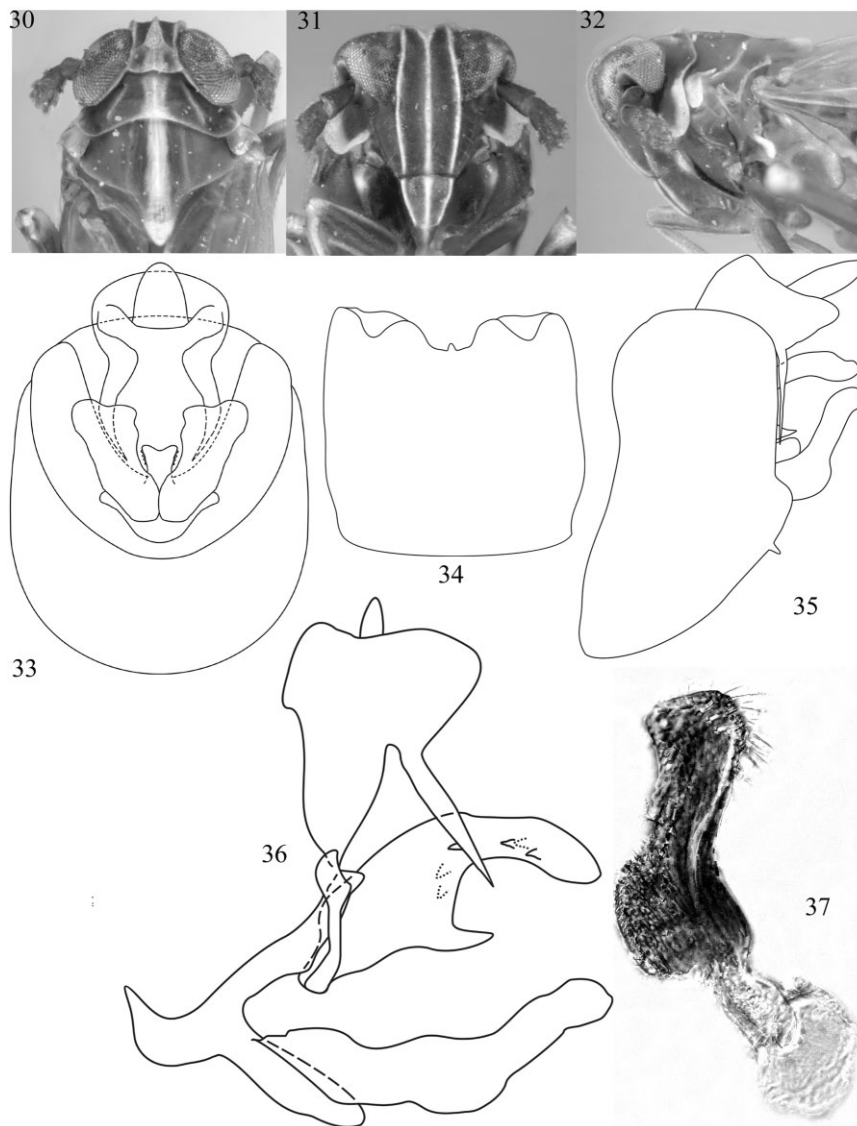
Kirkaldy (1907a) noted that male *D. pylaon* have no spines on the anal segment, but high magnification examination of the specimen here designated as lectotype and which appears to be the specimen illustrated by Kirkaldy (1907a) reveals that two ventral spines are in fact present but are recessed into the pygophore, possibly due to the drying process. Additionally, this specimen has a parasite, probably a strepsipteran, protruding from the side of its abdomen, and as parasitism is known to cause deformities in the genitalia of Delphacidae (Kathirithamby 2005) this may be the cause of the recessed anal segment projections in this specimen. All other observable characters of the lectotype of *D. pylaon* were found to be within the limits of that of *T. anemonias*, and we propose to synonymise this species with *T. anemonias*.

In his description of *D. anemonias*, Kirkaldy listed three localities, indicating that there were at least three specimens in the type series. A male specimen in BPBM bearing data consistent with one of these specimens also bears a red holotype label that has been attributed to Muir (Medler 1987) and is designated here as lectotype. Similarly, Kirkaldy listed two localities in the description of *D. pylaon* and a male in the BPBM bearing data consistent with one of these and with one of Muir's red holotype labels is designated here as lectotype.

### ***Distantinus* nom.nov.**

*Matutinus Distant* 1917: 278 (*junior homonym* of *Matutinus Macleay* 1838: 70) **Type species.** *Matutinus opulentus* Distant 1917 (= *Delphax lautipes* Stål) by original designation

**Notes.** The generic name *Matutinus* Distant is preoccupied by *Matutinus* Macleay and is consequently unavailable. As there are no junior synonyms of *Matutinus* Distant, a new name is proposed to accommodate those species currently assigned by



**Figs 30–37.** *Terthron anemonias* (Kirkaldy). (30) Head dorsum. (31) Face. (32) Head lateral. (33) Male pygophor, posterior view. (34) Male pygophore, ventral view. (35) Male pygophore, lateral view. (36) Male genitalia, lateral view. (37) Left paramere.

Bartlett *et al.* (2013) to *Matutinus* Distant. The new name is for William Lucas Distant (1845–1922), who first described the genus *Matutinus*, in recognition of his pioneering work in delphacid taxonomy.

**Included species**

- Distantinus achates* (Fennah 1972) **comb. n.**
- D. aculeatus* (Yang 1989) **comb. n.**
- D. amyclas* (Fennah 1972) **comb. n.**
- D. anacreon* (Fennah 1972) **comb. n.**
- D. andraemon* (Fennah 1972) **comb. n.**
- D. antares* (Fennah 1972) **comb. n.**
- D. apollo* (Fennah 1972) **comb. n.**
- D. artemis* (Fennah 1972) **comb. n.**
- D. baijis* (Kuoh 1980) **comb. n.**
- D. erebus* (Fennah 1972) **comb. n.**
- D. erinna* (Fennah 1972) **comb. n.**
- D. fuscipennis* (Muir 1919) **comb. n.**
- D. hylonome* (Fennah 1972) **comb. n.**

- D. hyperion* (Fennah 1972) **comb. n.**
- D. ion* (Fennah 1964) **comb. n.**
- D. iphias* (Fennah 1972) **comb. n.**
- D. lautipes* (Stål 1858) **comb. n.**
- D. ligea* (Fennah 1969) **comb. n.**
- D. melichari* (Kirkaldy 1906) **comb. n.**
- D. neovittacollis* (Muir 1926) **comb. n.**
- D. occiophale* (Asche 1988) **comb. n.**
- D. omphale* (Fennah 1972) **comb. n.**
- D. orestes* (Fennah 1972) **comb. n.**
- D. orion* (Fennah 1972) **comb. n.**
- D. putoni* (Costa 1888) **comb. n.**
- D. vitticollis* (Stål 1855) **comb. n.**
- D. yanchinus* (Kuoh 1980) **comb. n.**

**DISCUSSION**

Associating male and female specimens of Delphacini remains problematic. Some seldom used characters, for example the

number of teeth on the post-tibial spur, were found to vary between individuals but were within a consistent range for conspecific males and females and this proved useful in this study. While the morphology of female genitalia has been used to separate females of some species (e.g. Asche & Wilson 1989), this may not always help in associating specimens with identified males. The advent of molecular tools allows reliable association of male and female specimens of sexually dimorphic insects (e.g. Bellis *et al.* 2013), although difficulties obtaining useful DNA from old specimens using current technology precludes its use on Kirkaldy's type material. Recent improvements to the extraction and processing of DNA from old museum specimens (Hebert *et al.* 2013), however, suggest that technology may one day be able to provide positive confirmation of the identity of these historical specimens and confirm the associations proposed in this paper.

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## REFERENCES

- Asche M. 1988. Delphacidae from Cote d'Ivoire (Homoptera Fulgoroidea). *Revue Française d'Entomologie (Nouvelle Serie)* **10** (2), 151–231.
- Asche M & Wilson MR. 1989. The three taro planthoppers: species recognition in *Tarophagus* (Homoptera: Delphacidae). *Bulletin of Entomological Research* **79**, 285–298.
- Asche M & Wilson MR. 1990. The delphacid genus *Sogatella* and related groups: a revision with special reference to rice-associated species (Homoptera: Fulgoroidea). *Systematic Entomology* **15**, 1–42.
- Bartlett CR. 2007. A review of the planthopper genus *Nilaparvata* (Homoptera: Delphacidae) in the new world. *Entomological News* **118**, 49–66.
- Bartlett CR & Contributors. 2013 (and updates). *Delphacid planthoppers of North America*. [Accessed 26 Jun 2015.] Available from URL: <http://ag.udel.edu/enwc/research/delphacid/index.html>
- Bartlett CR & Deitz LL. 2000. Revision of the New World delphacid planthopper genus *Pissonotus* (Homoptera: Fulgoroidea). Thomas Say Publications in Entomology: Monographs, 234pp.
- Bellis GA, Dyce AL, Gopurenko D & Mitchell A. 2013. Revision of the *Immaculatus* group of *Culicoides* Latreille (Diptera: Ceratopogonidae) from the Australasian region with descriptions of two new species. *Zootaxa* **3680** (1), 15–37.
- Bellis GA, Donaldson JF, Quintao V, Rice A, Tenakanai D & Tran-Nguyen L. 2014. New records of Delphacini (Homoptera: Delphacidae: Delphacinae) from Australia Timor Leste and Papua New Guinea and an updated checklist of Delphacini from Australia. *Austral Entomology* **53** (2), 167–174.
- Costa A. 1888. Notizie ed osservazioni sulla Geo-Fauna Sarda. Memoria terza. Risultamento delle ricerche fatte in Sardegna nella estate del 1883. *Atti della Reale Accademia delle Scienze Fisiche e Matematiche. Napoli. (Ser. 2)* **1** (9), 1–64.
- Distant WL. 1906. Rhynchota. Heteroptera-Homoptera. *The Fauna of British India including Ceylon and Burma* **3**, 1–503.
- Distant WL. 1917. Rhynchota. Part ii: Suborder Homoptera. The Percy Sladen Trust Expedition to the Indian Ocean in 1905 under the leadership of Mr J. Stanley Gardiner M.A. *Transactions of the Linnaean Society of London Zoology* **17**, 273–322.
- Donaldson JF. 1991. Revision of the Australian Tropidocephalini (Homoptera: Delphacidae: Delphacinae). *Journal of the Australian Entomological Society* **30**, 325–332.
- Fennah RG. 1956. Homoptera: Fulgoroidea. *Bernice P. Bishop Museum Insects of Micronesia* **6** (3), 1–211.
- Fennah RG. 1963. New genera of Delphacidae (Homoptera Fulgoroidea). *Proceedings of the Royal Entomological Society London (B)* **32**, 15–16.
- Fennah RG. 1964. Delphacidae from Madagascar and the Mascarene Islands (Homoptera: Fulgoroidea). *Transactions of the Royal Entomological Society London* **116** (7), 131–150.
- Fennah RG. 1965. Delphacidae from Australia and New Zealand (Homoptera Fulgoroidea). *Bulletin of the British Museum (Natural History) Entomology* **17**, 1–59.
- Fennah RG. 1969. Fulgoroidea (Homoptera) from New Caledonia and the Loyalty Islands. *Pacific Insects Monographs* **21**, 1–116.
- Fennah RG. 1971. Homoptera Fulgoroidea Supplement. *Insects of Micronesia* **6**, 563–609.
- Fennah RG. 1972. A revision of the genus *Matutinus* Distant (Homoptera: Fulgoroidea: Delphacidae). *Bulletin of Entomological Research* **61**, 421–461.
- Fennah RG. 1975. Homoptera: Delphacidae from Ceylon. *Entomologica Scandinavica Supplementum* **4**, 79–136.
- Guo L-Z, Liang A-P & Tiang G-M. 2005. Four new species and a new record of Delphacidae (Homoptera) from China. *Oriental Insects* **39**, 161–174.
- Hebert PDN, deWaard JR, Zakharov EV *et al.* 2013. A DNA 'Barcode Blitz': rapid digitization and sequencing of a natural history collection. *PLoS ONE* **8** (7), e68535.
- Hou X-H & Chen X-S. 2014. Revision of the planthopper genus *Nycheuma* Fennah (Homoptera, Fulgoromorpha, Delphacidae). *ZooKeys* **462**, 47–57.
- Iablokoff-Khnzorian SM. 1962. Die Gattungstypen von Latreille. *Folia Entomologica Hungarica, Budapest (N.S)* **15**, 421–424.
- Kathirithamby J. 2005. Strepsiptera (Insecta) of Mexico – a review. *Vedalia* **12** (2), 103–118.
- Kirkaldy GW. 1903. Miscellanea Rhychotalia – No.7. *Entomologist* **36**, 179–181.
- Kirkaldy GW. 1904. Some new Oahuan (Hawaiian) Hemiptera. *Entomologist* **37**, 174–179.
- Kirkaldy GW. 1906. Leafhoppers and their natural enemies. Pt IX. Leafhoppers – Hemiptera. *Bulletin of the Hawaiian Sugar Planters Association Division of Entomology* **1**, 271–479.
- Kirkaldy GW. 1907a. Leafhoppers – supplement (Hemiptera). *Bulletin of the Hawaiian Sugar Planters Association Division of Entomology* **3**, 1–186.
- Kirkaldy GW. 1907b. Further remarks principally on some saccharicolous Fulgoroidea. *Annales de la Societe Entomologique de Belgique* **51**, 300–302.
- Kirkaldy GW. 1910. Hemiptera. *Fauna Hawaiiensis Supplement* **1910**, 531–599.
- Koçak AÖ & Kemal M. 2010. Some replacement names among the genus group names in various families of the order Homoptera. *Priamus* **12** (5), 128–130.
- Kuoh CL. 1980. Descriptions of five new species of Delphacidae (Homoptera). *Acta Entomologica Sinica* **23** (2), 195–201.
- Kuoh CL, Ding JH, Tian LX & Hwang CL. 1983. Economic insect fauna of China. Fasc. 27. Homoptera Delphacidae, Science Press, Beijing.
- Macleay WS. 1838. On the Brachyurous Decapod Crustacea. Brought from the Cape by Dr. Smith. In: A. Smith, Illustrations of the Zoology of South Africa: consisting chiefly of figures and descriptions of the

- objects of natural history collected during an expedition into the interior of South Africa in the years 1834, 1835 and 1836; fitted out by 'The Cape of Good Hope Association for Exploring Central Africa:' together with a summary of African Zoology and an inquiry into the geographical ranges of species in that quarter of the globe. Published under the Authority of the Lords Commissioners of Her Majesty's Treasury. Invertebratae, pls 2, 3 (ed. A Smith), pp. 53–71. Smith, Elder and Co., London.
- Matsumura S. 1910. Neue Cicadinen aus Europa und Mittelmeergebiet (Schluss). *Journal of the College of Sciences, Imperial University of Tokyo, Tokyo* **27** (18), 1–38.
- Matsumura S. 1935. Revision of *Stenocranus* Fieb. (Hom.) and its allied species in Japan-Empire. *Insecta Matsumurana* **9**, 125–140.
- Medler JT. 1987. Types of Flatidae (Homoptera) XI. Taxonomic notes on Kirkaldy types in the Bishop Museum with illustrations of the genitalia of male lectotypes. *Bishop Museum Occasional Papers* **27**, 115–125.
- Melichar L. 1903. Homopteren-Fauna von Ceylon. Verlag von Felix L. Dames. Berlin. pp: i–iv, 1–248pp.
- Metcalf ZP. 1943. General catalogue of the Homoptera. Fascicle IV Fulgoroidea. Part 3 Araeopidae (Delphacidae), North Carolina State College Raleigh, NC, USA, 552pp.
- Muir F. 1916. Additions to the known Philippine Delphacidae (Homoptera). *Philippine Journal of Science. Section D. General Biology, Ethnology and Anthropology* **11** (6), 369–385.
- Muir F. 1917. Homopterous notes. *Proceedings of the Hawaiian Entomological Society* **3**, 311–338.
- Muir F. 1919. Notes on the Delphacidae in the British Museum Collection. *Canadian Entomologist* **51**, 6–8.
- Muir F. 1923. Two species of Delphacidae (Homoptera) from Kermadec Archipelago. *Transactions of the New Zealand Institute* **54**, 257.
- Muir F. 1926. Contributions to our knowledge of South American Fulgoroidea (Homoptera). Part 1. The Family Delphacidae. *Bulletin of the Experiment Station of the Hawaiian Sugar Planters' Association. Entomological Series* **18**, 1–51.
- Muir F. 1929. New and little known African Delphacidae (Homoptera Fulgoroidea) in the collection of the British Museum. *Annals and Magazine of Natural History* **4** (Ser. 10), 186–222.
- Muir F & Giffard WM. 1924. Studies in North American Delphacidae. *Bulletin of the Hawaiian Sugar Planters Association Division of Entomology* **15**, 1–53.
- Okada T. 1977. Taxonomic characters for identification of the rice brown planthopper (*Nilaparvata lugens*) and its related species in the Asia and Pacific region. 'The Rice Brown Planthopper', Food and Fertilizer Technology Centre for the Asian and Pacific Region, 25pp.
- Stål C. 1855. Nya Hemiptera. *Öfversigt af Kongliga Svenska Vetenskaps-Akademiens Förhandlingar* **12**, 181–192.
- Stål C. 1858. Orthoptera och Hemiptera fran södra Afrika. *Öfversigt af Kongliga Svenska Vetenskaps-Akademiens Förhandlingar* **15**, 307–320. Stockholm.
- Yang CT. 1989. *Delphacidae of Taiwan (II) (Homoptera Fulgoroidea)*. NSC Special Publications No. 6, Taipei Taiwan, 334 pp.

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