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Notes on types of Australian *Chartocerus* Motschulsky (Hymenoptera: Signiphoridae)

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ABSTRACT

Type specimens of 11 species of *Chartocerus* (Hymenoptera: Signiphoridae) from Australia described by A.A. Girault, in the collection of the Queensland Museum, and one species described by W.H. Ashmead, in the United States Museum of Natural History, are redescribed and illustrated. Lectotypes are designated for *Chartocerus australiensis* (Girault) and *Chartocerus hebes* (Girault).

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Australasia; type material;
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Introduction

Chartocerus Motschulsky, 1859 is the second largest genus in the family Signiphoridae, currently with 36 species (Noyes 2019, plus three species described by Schmidt et al. 2019). Most species for which the hosts are known are associated with mealybugs (Hemiptera: Pseudococcidae) and other sternorrhynchous Hemiptera such as scale insects. They are usually assumed to be hyperparasitoids (Rosen et al. 1992), and their presence is often discussed in the context of biological control programmes (e.g. Moore and Cross 1992; Goergen and Neuenschwander 1994; Triapitsyn et al. 2018). Unlike other signiphorid genera, most species of *Chartocerus* are not known primarily from the Neotropics, but from the Old World and Australia.

Several Australian species of *Chartocerus* were described by A.A. Girault in the early twentieth century. Many details about Girault's life which affected his work are given by Bouček (1988) and Dahms (1978), and Girault's privately printed papers were re-published as a compilation by Gordh et al. (1978), which also contains a biography. Some of the species treated here, described in the 1910s, when he was first appointed as assistant entomologist at the Queensland Department of Agriculture and Stock, were described in considerable detail, especially for the time. However, as Girault moved away from regular publishers and started to print his own papers privately, his descriptions began to appear as short diagnoses. This is not a rare situation, especially in insect taxonomy; however, Girault's type material is also often in poor condition due to the poor quality of slide preparations and multiple curatorial

issues, many of them associated with his precarious economic conditions at the time. These factors combined make these species particularly difficult to identify; unsurprisingly, most have been recorded only from their type localities. Dahms (1978, 1983, 1984, 1986) catalogued all the Girault types deposited at the Queensland Museum, which helped to clear up many of the curatorial problems created by specimen identifiers and labelling, among others. All the species treated here were transferred to *Chartocerus* by Woolley (1988).

Considering the complicated history of this material, we take the opportunity of this festschrift to publish images and notes on the type material of Australian *Chartocerus*, most of which were studied and photographed by JBW during his visit to the Queensland Museum in 1979, accompanied by John LaSalle, when they were both PhD students studying under Gordon Gordh (Gordon was conducting research on Girault's types of Australian Encyrtidae in the Queensland Museum at the time). John LaSalle's advocacy of delivering information from natural history collections to foster knowledge of biodiversity is recognised worldwide, particularly in his work associated with the Atlas of Living Australia (e.g. LaSalle et al. 2009, 2016; Mantle et al. 2012; Balke et al. 2013), and thus we dedicate this work as a contribution to honour his academic legacy.

Materials and methods

Photomicroscopy and digitisation

All specimens examined were slide-mounted in Canada balsam by Girault. Images of all species except *Chartocerus australiensis* were taken in the Queensland Museum with a Wild M20 compound microscope equipped with a phototube, 35 mm film camera and eyepiece reticle, generally using bright field microscopy. Black-and-white images were taken on Kodak Panatomic X film, and colour images were taken on Kodak Ektachrome Professional 160T slide film. All film images were scanned using a Kodak Coolscan slide scanner at 800 dpi. Images of *C. australiensis* were taken at Texas A&M University using an Olympus BH2 compound microscope equipped with DIC and a Zeiss MRc5 Axiocam digital camera. All images were processed in Adobe Lightroom Classic to enhance visible details, and plates were laid out and annotated in Adobe InDesign.

High-resolution versions of the type photographs are deposited at the Zenodo (2019) digital repository (www.zenodo.org), and the DOI for each set is provided under the species headings. We created and provide ZooBank LSID (zoobank.org) (Pyle and Michael 2008) and Encyclopaedia of Life (www.eol.org) (Parr et al. 2014) entries for each species, in hopes that these aggregators will continue to link and serve as a hub to digitised copies of the relevant literature, images, other databases and catalogues in the future.

Descriptions

Notes on the conditions of the specimens are provided under the 'Type material' heading; note that the literature citations listed under each specific heading have been limited to those referring to the type material and original description. Terminology in the descriptions largely follows Woolley (1988), Heraty et al. (2013) and the Hymenoptera Anatomy Ontology (Yoder et al. 2010) for general morphology, and Harris (1979) for microsculpture.

Measurements are based on ratios taken directly from the slides by JBW at the Queensland Museum, or from examination by ADM of the digital images using ImageJ (<https://imagej.nih.gov>) measurement tools (Rasband 2018).

The following museum abbreviations are used: **DEAP**, Department of Agriculture, Perth, WA, Australia; **SAM**, South Australian Museum, Adelaide, SA, Australia; **QM**, Queensland Museum, South Brisbane, QLD, Australia; **USNM**, National Museum of Natural History, Washington, DC, USA.

Results

Chartocerus australiensis Ashmead, 1900

urn:lsid:zoobank.org:act:7C9C7FB7-7B69-4477-9F7B-9AC18FB66A2A

EOL taxon ID: 847913

(Figure 1; DOI:10.5281/zenodo.3893692)

Ashmead (1900, p. 410), as *Signiphora australiensis* (original description).

Girault (1913a): notes on type material, descriptive notes, host record, distribution record.

Girault (1915): notes (republished from 1913a).

Type material. **LECTOTYPE female [here designated]:** USNM Type No. 4771, mounted in balsam. ‘Signiphora | australiensis Ash. | ♀ Type no. | 4771. USNM | Australia. | Koebele. 12.’ The original description does not provide further information. **PARALECTOTYPE** females: two specimens on same slide with same label data. Girault (1913a) redescribed the type material, having remounted the specimens on slides. The slide locality label is in Girault’s handwriting. One of the three females is damaged, embedded in resin that leaked outside of the coverslip. The head is detached from one of the other females (but it bears a complete antenna), and it is next to the third female. We here designate the female with detached head as lectotype, and the slide has been labelled accordingly.

Description. Females. Length (pronotum to apex of epiproct): 0.5–0.8 mm (n = 3). Body predominantly dark, originally described as black with metallic tones, scutellum ‘with a bluish tinge’ and mesonotum ‘with a bronzy tinge’. It is perceptible in the type slide that the scutellum is slightly darker than most of the mesoscutum, metanotum and medial area of propodeum. Head dark, as in pronotum and most of metasoma, antennal clava and anelli lighter than pedicel and scape. Legs tan, lateroposterior part of protibia and mesotibia lighter, tarsi white. Fore wings infuscated, darker patch extending from base to apex of stigmal vein, lighter infuscation on apex, and two hyaline patches: one at basal-posterior area, and one posterior to stigma vein, slightly curved towards base of wing. Head sculpture punctate and longitudinally striate, more conspicuous punctations along outer margin of antennal scrobes and inner margins of eyes, 1.3× as wide as high. Antennal scrobes well defined, extending through 3/4 of height of head. Other sulci absent. Eyes large, glabrous, about 2/3 of head height. Antenna with 4 anelli (1:1:1:1.2), clava 5× as long as wide, scape about 3/4 length of clava; pedicel about 1/3 length of clava. Pronotum through metanotum striate or striate to reticulate, fainter in scutellum and metanotum; pronotum barely visible dorsally in the specimen; mesoscutum about 3.5×

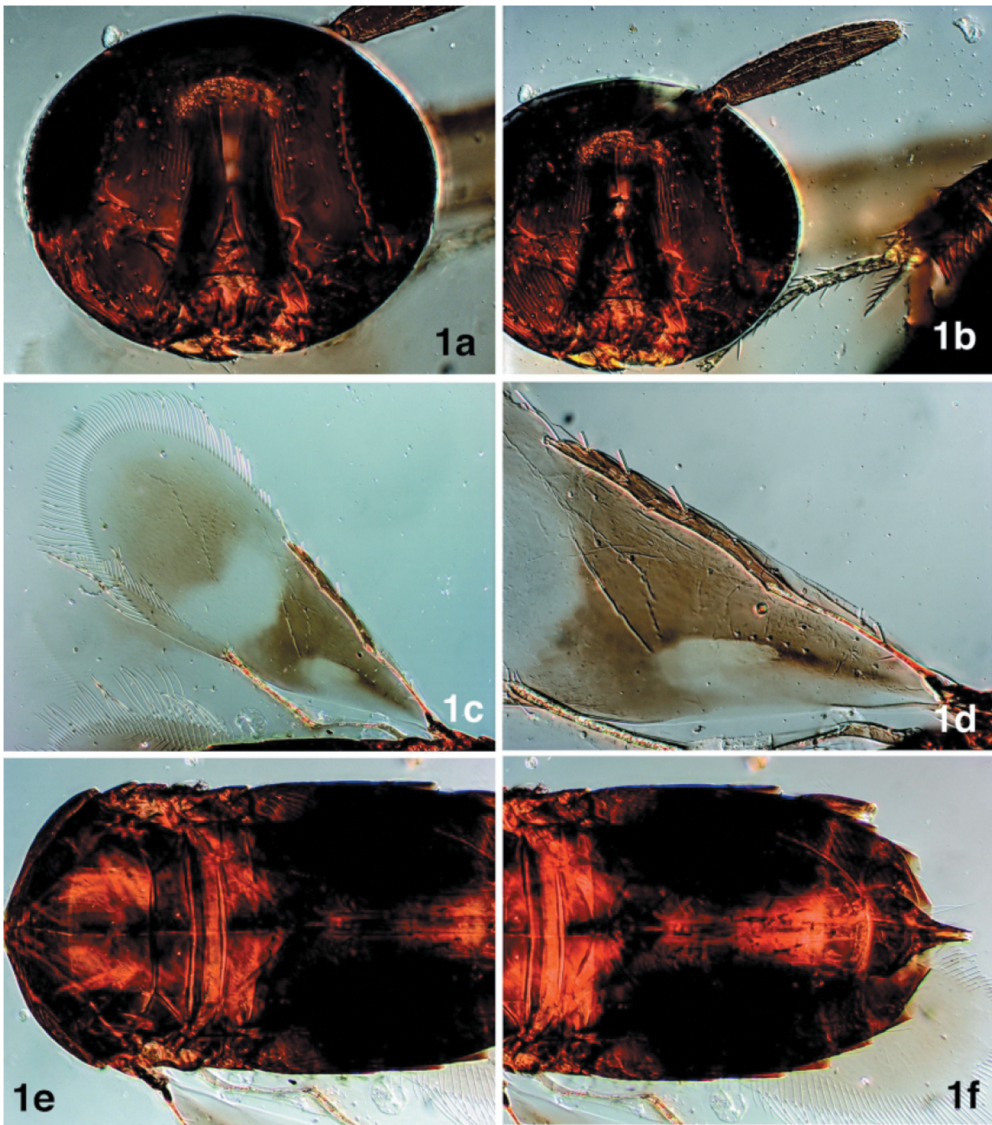


Figure 1. *Chartocerus australiensis* (Ashmead), holotype ♀, USNM Type 4771. (a) head; (b) antenna, mesobasitarsus and mesotibial spur; (c) fore wing; (d) fore wing venation; (e) mesosoma; (f) metasoma.

longer than scutellum, with about 13–15 small setae, most closer to medial-posterior area, scutellum with 7 setae aligned in parallel with posterior margin plus 1 larger seta on top of each axilla; internally marked axillae project anteriorly from scutellum to about $\frac{1}{2}$ of mesoscutum; metanotum about $\frac{2}{3}$ length of scutellum; medial triangle of propodeum finely reticulate. Protibia about $\frac{2}{3}$ of length of mesotibia. Mesofemur with 3 large apical spines; mesobasitarsus a little more than $\frac{1}{3}$ length of mesotibia, mesotibial spur about $\frac{2}{3}$ of length of basitarsus; metatibia as long as mesotibia. Apex of medial sclerite of propodeum curved, reaching posterior margin of propodeal segment. Propodeal

segment reaches but does not overlap the area between the lobes of Mt1. Fore wings about 2.5× as long as wide; longest setae of marginal fringe about ¼ of wing width; discal seta absent, 1 seta in submarginal vein; seta M1 absent; 5 small setae in basal area. Hind wings 4× as long as wide, longest setae of marginal fringe about ½ maximum width of wing; discal seta present; 2 setae on base of marginal vein. Mt1 bilobed, with slightly curved connection between the two lobes. Imbricate sculpture evident on tergites. Plates of ovipositor almost reach base of gaster.

Biology. In the original description, Ashmead mentions an unidentified ‘rhynchotan’ (i.e. Hemiptera) as host. Girault (1913a) reported on another slide (USNM: not located) ‘Acanthococcid on *Eucalyptus*’ from Koebele material collected in New South Wales.

***Chartocerus australicus* Girault, 1913**

urn:lsid:zoobank.org:act:BE035C57-4B1D-4D49-97EF-C4154DFCB0B0

EOL taxon ID: 847848

(Figure 2; DOI:10.5281/zenodo.3894025)

Girault (1913a, p. 226), as *Signiphora australica* (original description).

Dahms (1983, p. 91): notes on type material.

Type material. Holotype male, QM Hy 773 (T773; T4412), under cracked resin and coverslip, along with a specimen of *Aphelinoidea howardi* Gir. Transcription of labels as in Dahms (1983): ‘From window of a workmen’s quarters. Sugar farm, Nelson [= Gordonvale], N.Q. XII.21.1911’, ‘*Signiphora australica* Girault, ♂ Type, Hy/773 4412, 4412’, and on the reverse of the slide, ‘Queensland Museum. TYPE, Hy/773 S’. Dahms (1983) lists two other slides at the QM, one topotypical, with the date of 4 December 1911 (paratype, male) and the other without locality information, on the same slide as the type of *C. australiensis orbiculatus*. The original description refers only to the two males from Nelson (‘in xylol-balsam, December 4 and 21, 1911’) and indicates Hy 773 as the type. Dahms (1983) also states that T4412 was a duplicate QM accession number for this specimen and had been cancelled.

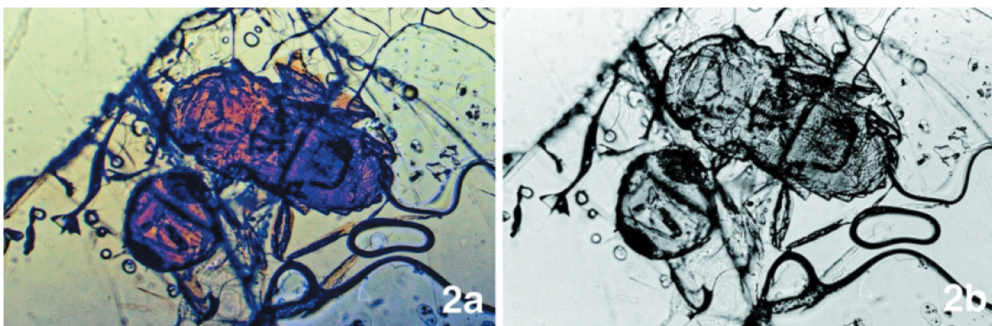


Figure 2. *Chartocerus australicus* (Girault), holotype ♂, Queensland Museum Type HY 773. (a) colour image; (b) black-and-white image.

Description. Male. Length (pronotum to apex of epiproct): 0.6 mm. Body brown; metasoma and propodeum darker than head and mesosoma; antennae, genae and clypeus slightly lighter than surrounding areas. Head approximately round in frontal view, antennal scrobes evident, clava 7× as long as wide, 3 anelli (2:2:1), pedicel 2.5× as long as wide, scape 4× as long as wide, clava 2.5× length of scape. Many structures cannot be observed. Pronotum about 8× as wide as long. The other sclerites were crushed; margins are not discernible. The wings are not visible. Median propodeal sclerite seems to be coarsely reticulated like the remainder of the metasoma. Mt1 visibly bilobed.

***Chartocerus australiensis orbiculatus* Girault, 1915**

urn:lsid:zoobank.org:act:E1B6555A-B559-41F5-BACE-26F20E018452

(Figure 3; DOI:10.5281/zenodo.3893660)

Girault (1915, p. 68), as *Signiphora australiensis orbiculata* (original description).

Dahms (1983, p. 92, 111): notes on type material.

Type material. Holotype male, QM Hy 2965 (T2965). The label, in Girault's handwriting, indicates: 'Type | Hy/2965 | A.A. Girault || Signiphora | australica Gir. || (red label) 4409 | Signiphora | australiensis | orbiculata | Gir. ♀'. The description indicates the locality as Gordonvale (Cairns), North Queensland, but this locality information is not provided in the slide labels. Dahms (1983, p. 92) describes the slide which contains the holotype as 'slide #3' in his discussion of *C. australicus*: '2 coverslip fragments; the one closest to "TYPE" label contains ♀ *Signiphora australiensis orbiculata* Girault; the other fragment contains a ♀ *Signiphora australica*, head, wings and some legs separated'. The female indication in the label is a lapsus (holotype is a male). Dahms (1983) states that T4409 is the QM number for the holotype.

Description. Male. Length (pronotum to apex of epiproct): 2.2 mm. Body brown; legs slightly lighter, tarsi of mid leg and hind leg white, and apical tarsomere of hind leg tan. Fore wings infuscated, interrupted by a median hyaline band; the anterior part of the infuscation extending from the base to the stigmal vein is slightly darker than the posterior. Head (crushed in the specimen; some structures not clearly visible), scape wide (approximately 3× as long as wide, pedicel 2× as long as wide, anelli not visible, clava fairly short and wide (4× as long as wide). Mesoscutum about 2× as long as scutellum, with 12 setae: 8 setae in posterior margin of scutellum plus 1 on top of each axilla. Mesotibia $\frac{1}{2}$ length of metatibia, mesobasitarsus about $\frac{1}{2}$ length of mesotibia, mesotibial spur slightly shorter than basitarsus, with 5 teeth. Mesofemur with 3 spines. Fore wings 3× as long as wide, marginal setae about $\frac{1}{3}$ of maximum wing width, 1 seta in submarginal vein. Hind wing 4× as long as wide, marginal fringe about $\frac{1}{2}$ width of wing, 1 seta in marginal vein. Mt1 bilobed, with a transverse area separating the two lobes.

Remarks. This name was made available at the subspecies level. Girault (1915) defined this subspecies based on differences of the wing infuscation. The distal portion of the wing is faintly infuscated as in *C. australiensis australiensis*.

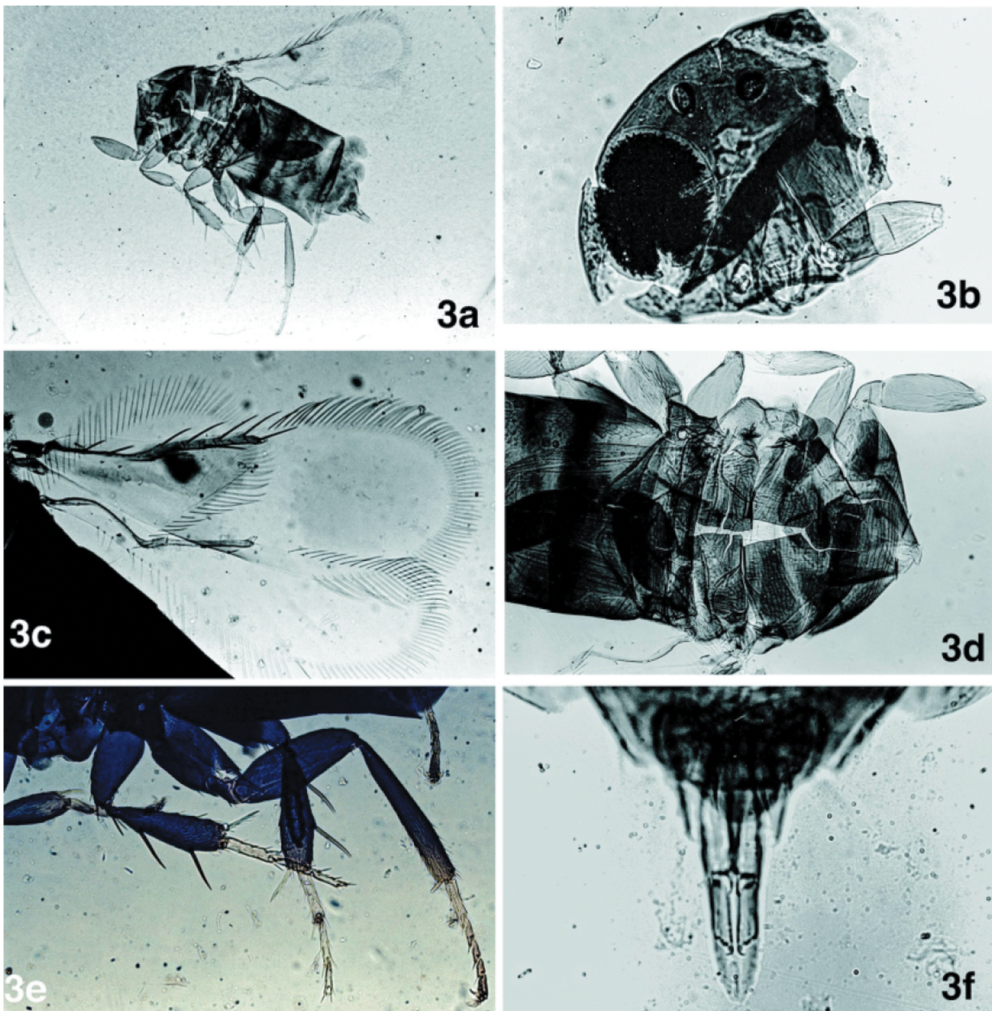


Figure 3. *Chartocerus australiensis orbiculatus* (Girault), holotype ♂, Queensland Museum Type HY 2965. (a) habitus; (b) head; (c) fore and hind wings; (d) mesosoma; (e) legs; (f) genitalia.

***Chartocerus beethoveni* Girault, 1915**

[urn:lsid:zoobank.org:act:B94D903A-6262-4516-A95B-FDB8C9D0C032](https://zoobank.org/act:B94D903A-6262-4516-A95B-FDB8C9D0C032)

EOL taxon ID: 847846

(Figure 4; DOI:10.5281/zenodo.3893696)

Girault (1915, p. 71), as *Signiphora beethoveni* (original description).

Dahms (1983, p. 119): notes on type material.

Type material. Holotype female, QM Hy 2969 (T2969, T4418), QMB, Chindera, New South Wales, 9 May 1914, A.P. Dodd, 'sweeping forest on sand-ridges near coast'. Partially crushed; medially broken. On the same slide there are parts of *Tetracnemoidea secunda* (Girault, 1915) (as *Arhopoideus secundus* Gir.). A separate label indicates 'Signiphora beethoveni Gir. | ♀ type | 4418'. Described from Chindera, New South Wales,

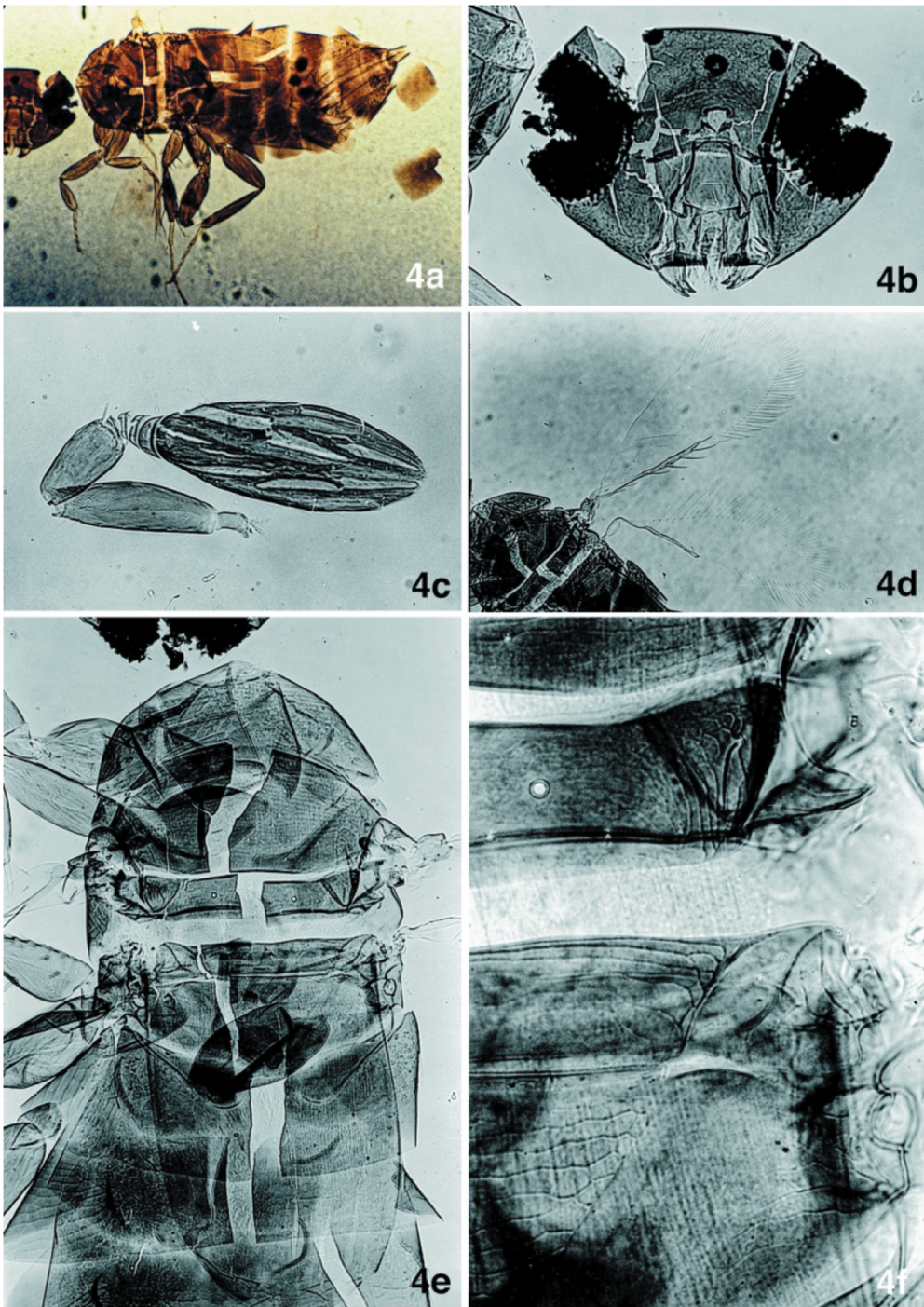


Figure 4. *Chartocerus beethoveni* (Girault), holotype ♀, Queensland Museum Type Hy 2969. (a) habitus; (b) head; (c) antenna; (d) fore and hind wings; (e) mesosoma; (f) mesoscutellum, metascutum and propodeum.

9 May 1914, A.P. Dodd, 'sweeping forest on sand-ridges near coast'. It is unambiguous that T2969 refers to the *S. beethoveni* specimen as it is cited in the original description. Dahms (1983) states that T4418 was a duplicate QM accession number for this specimen and had been cancelled.

Description. Female. Length (pronotum to apex of epiproct): 1.15 mm. Head and body appear uniformly light brown; head (frontovertex) slightly darker; fore legs and tarsi of all legs lighter brown to almost transparent. The wings are faded, mostly hyaline, but were described as with an infuscated band medially under the marginal vein. Head with frontovertex finely transversely striate, punctations typical of most *Chartocerus* not visible. Antennal scrobes well delimited. The morphology of the antenna is very distinctive, similar to that described for males of *C. kerrichi*: clava wide, ellipsoid, 3× longer than maximum width; 4 anelli (4:2:2:1), pedicel 2× as long as wide, scape 4× as long as wide and about $\frac{3}{4}$ of length of clava. Pronotum, mesoscutum, scutellum and metanotum transversally striate to finely, faintly reticulate; axillae reticulate, medial area of propodeum reticulate at lateral margins to striate medially, with cells 2–3× wider than long. Mesoscutum about 3.5× length of scutellum. Fore wing 3× as long as wide, marginal fringe slightly longer than $\frac{1}{2}$ of maximum width of wing, 2 setae in submarginal vein, M1 lacking, 5 small setae in basal area of wing, 1 wing in costal cell. Mesotibia 2× as long as protibia; metatibia only slightly longer than protibia, mesofemur with 3 spines, mesobasitarsus about $\frac{1}{2}$ length of mid tibia and mesotibial spur about same length of basitarsus, with 5 teeth. Mt1 bilobed.

***Chartocerus corvinus* Girault, 1913**

urn:lsid:zoobank.org:act:F8E2494C-599C-4BC9-BCF1-08255B0A2082

EOL taxon ID: 847843

(Figure 5; DOI:10.5281/zenodo.3893699)

Girault (1913a, p. 225), as *Signiphora corvina* (original description).

Dahms (1983, p. 198; 1984, p. 698, 701; 1986, p. 409, 568): notes on type material.

Type material. Holotype female, QM Hy 772, same slide as type of *Gonatocerus huxleyi* Girault and other specimens identified as *Signiphora australiensis*, *Abbella subflava*, *Ufens piceipes* and *Aphelinoidea howardii*, 'from a window in a granary and barn on a wheat farm at Roma, Queensland, 6 October 1911'. The accession number Hy 772 is not indicated on the slide; number 4407 is indicated on a red label. According to Dahms (1983), this female is in fact the holotype: 'QM: Slide – 1 cracked, complete coverslip (partly missing over 1 specimen) containing the Holotype = (head separated) of *Signiphora corvina* and other specimens as per labels "*Gonatocerus huxleyi* Girault, ♀ Type 1040. From windows of a granary, Roma, Q., 6 October 1911 AAG 3691, 3691" [...]''. An arrow was added by JBW to indicate the holotype. Dahms (1983) states that number T4407 was a duplicate QM accession number for this type and had been cancelled. T3691 refers to the *Gonatocerus* specimen.

Description. Female. Length about 1.2 mm. Body dark, femora and tibia slightly lighter, protibia especially light distally. Tarsi of all legs lighter than the rest of the legs. The basal

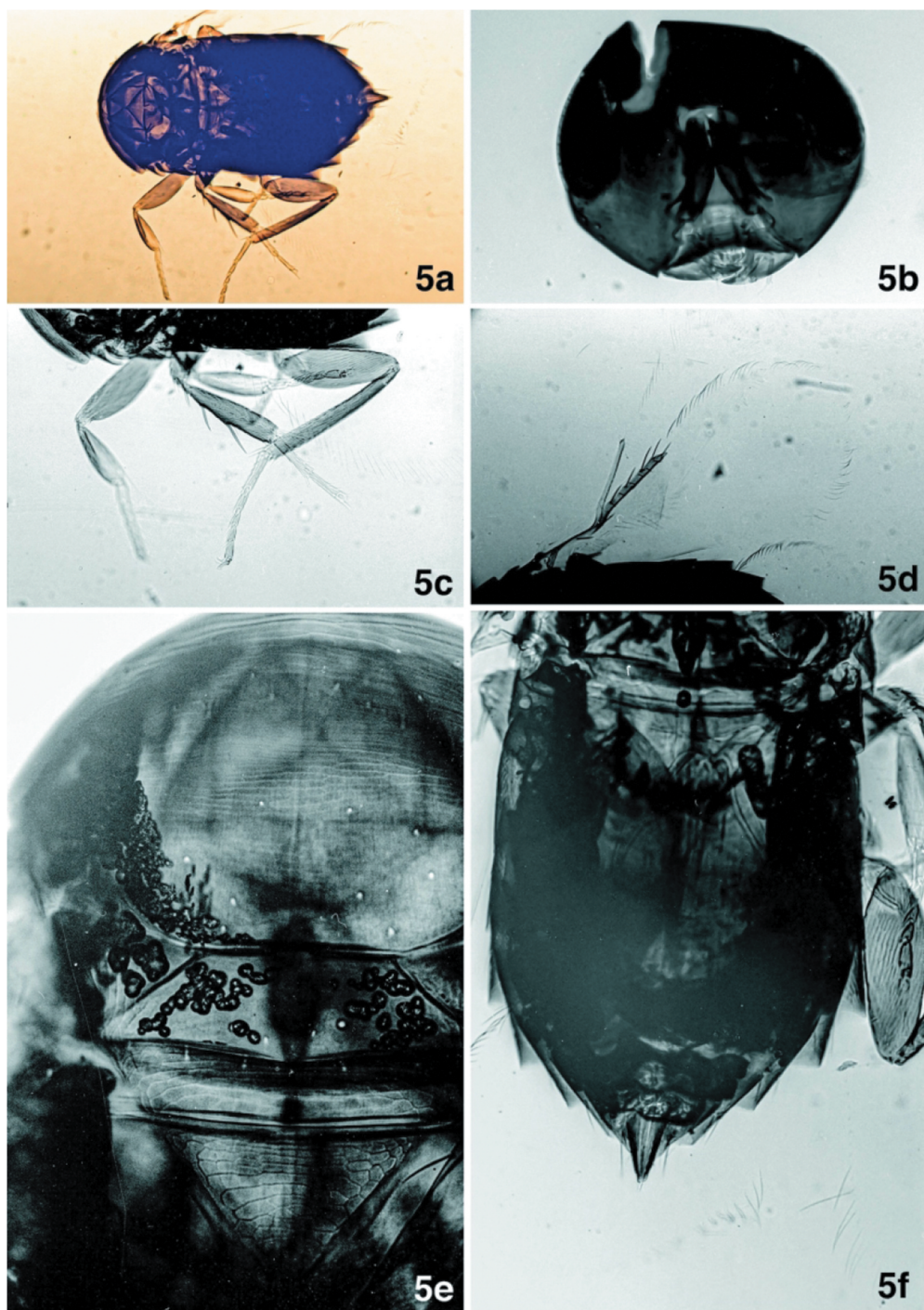


Figure 5. *Chartocerus corvinus* (Girault), holotype ♀, Queensland Museum Type Hy 772. (a) body and legs; (b) head; (c) legs; (d) fore and hind wings; (e) mesosoma; (f) metasoma.

infuscation of the fore wing extends in the anterior-basal portion of the wing to the stigmal vein. Head round in frontal view, genae reticulate, punctations lateral to antennal scrobes; interantennal area seems lighter than clypeus and genae. Eyes relatively small, about 1/3 height of head. Antennal scape about 5× as long as wide, pedicel and ring segments cannot be observed, club about 2.6× as long as wide. Mesoscutum transversally striate; scutellum, metanotum and basal part of medial propodeal sclerite striate to reticulate towards margins. Mesoscutum at least 2× length of scutellum. It is not possible to count the setae on the mesosomal terga. Fore wing very broad, at the broadest part about ½ length of wing. The wing vein reaches about half of the distance to the apex. Marginal fringe very short, not more than 1/8 of wing width, 2 setae on submarginal vein, M1 missing (M6 is broken in this type but the socket is visible). Hind wing also wide towards the apex, about 3.5× as long as wide, marginal fringe 1/5 of wing width, with discal seta. Mesobasitarsus less than ½ length of mesotibia; mesotibial spur slightly shorter than basitarsus and with 4 teeth. Mesofemur with 2 visible spines.

***Chartocerus delicatus* Girault, 1933**

urn:lsid:zoobank.org:act:C9E2E3E9-6AD8-41E0-8AE2-4A8B7438EF0E

EOL taxon ID: 848109

(Figure 6; DOI:10.5281/zenodo.3893702)

Girault (1933, p. 2), as *Matricia* (sic) *delicata* (original description).

Dahms (1983, p. 216): notes on type material.

Type material. Holotype female, QM T8736; partially broken, the head and one antenna removed. Dahms (1983) mentions the slide was cracked and mended with paper, and that it contains the female holotype together with several other insects. The label data reads: 'Matritia delicata Girault, Type ♀ || On adhesive bracts of *Passiflora* [sic], Taringa, 26 November 1928 | Ent. Div. Dep. Ag. & Stk., Qld.' The original description mentions only 'Taringa, No. 26, 1928'. Dahms (1983) provides some more information from Girault's unpublished manuscript: 'One female found upon the adhesive bracts of *Passiflora* [= *Passiflora*] *foetida* in my home garden was the type.'

Description. Female. Length 0.74 mm. Body light brown; legs and tarsi yellowish or light brown, syntergum and ovipositor sheath seem slightly darker than the rest of the body. Wing infuscation seems to cover the entire wing; it suggests a medial hyaline area, but the infuscation only gets lighter close to the end of the stigmal vein, and then also noticeably infuscated at the apex of the wing, with another small hyaline area on the anterior portion. Head roughly rounded in frontal view; punctate sculpturing. Pronotum, mesoscutum, scutellum and metanotum transversely striate; axillae reticulate, medial area of propodeum reticulate. Mesoscutum with about 14 small setae arranged somewhat symmetrically in posterior half of mesoscutum. Scutellum with 9–10 fine setae in posterior margin of scutellum and 1 on top of each axilla. Protibia about 2/3 of length of mesotibia; mesotibia about 2/3 of length of metatibia; mesobasitarsus less than half of length of mesotibia, mesotibial spur with 5 teeth. Fore wing with 2 setae on submarginal vein, lacking M1, as described above for other Australian species of *Chartocerus*. Hind wing 6.5×

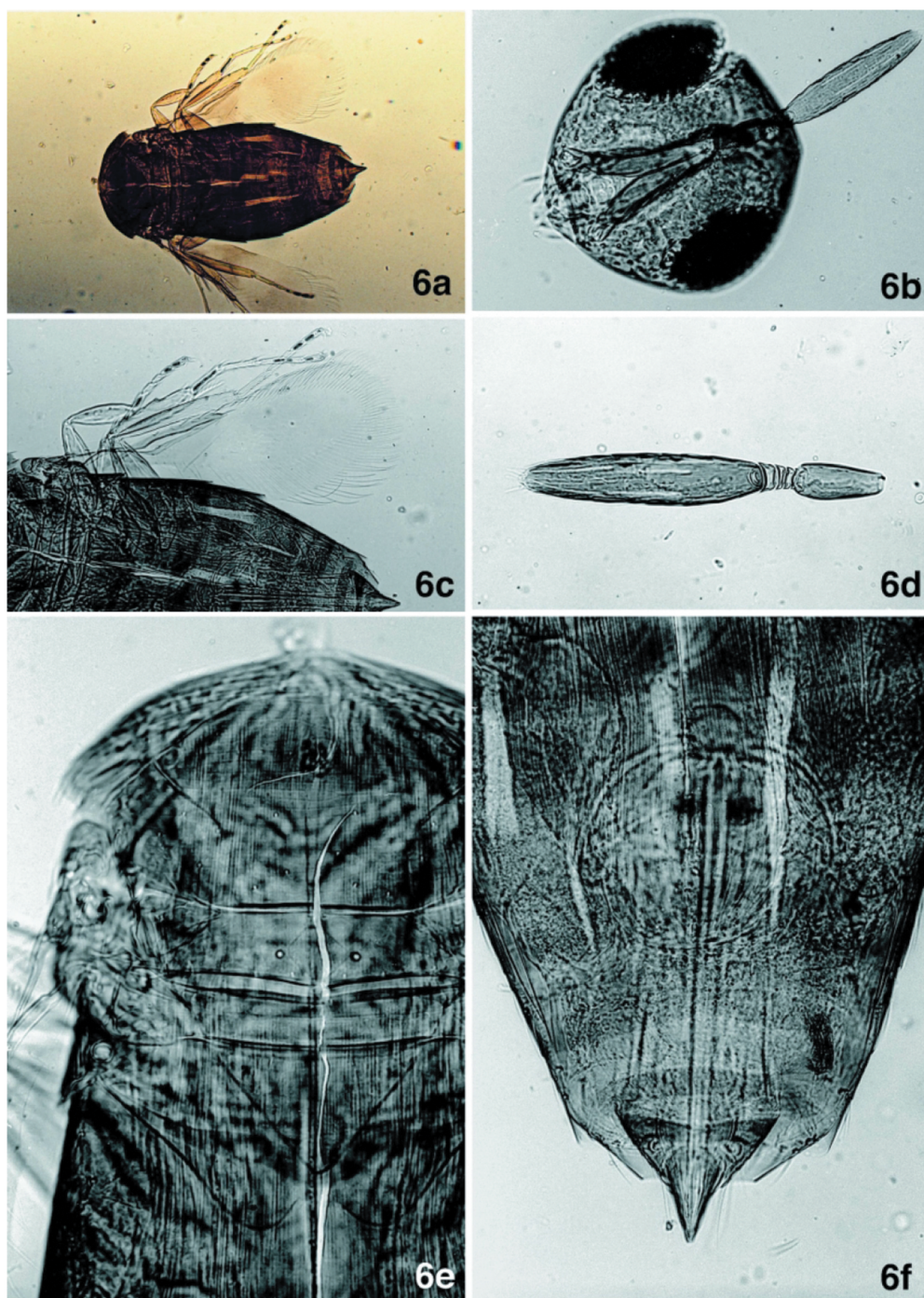


Figure 6. *Chartocerus delicatus* (Girault), holotype ♀, Queensland Museum Type HY 8786. (a) habitus; (b) head and antenna; (c) antenna; (d) fore and hind wings; (e) mesosoma; (f) metasoma.

as long as wide, marginal fringe a little less than $\frac{1}{2}$ width of wing. Mt1 bilobed, although faintly visible.

Remarks. Girault (1933) mentions it differs from *C. australicus* by shorter marginal fringe in wings, and metafemur infuscated only apically, which might have been an oversight, since several other species of *Chartocerus* present such a pattern.

***Chartocerus funeralis* Girault, 1913**

urn:lsid:zoobank.org:act:56888B8B-F5B3-47FF-8E1B-02BC10624260

EOL taxon ID: 848103

(Figure 7; DOI:10.5281/zenodo.3893731)

Girault (1913a, p. 224), as *Signiphora funeralis* (original description).

Dahms (1984, p. 582, 634; 1986, p. 568): notes on type material.

Type material. Holotype female, QM Hy 771 (T4410). Dahms (1984) describes one slide with a coverslip fragment with the holotype of *S. funeralis*, complete, along with other chalcidoids (identified as *Anagrus armatus*, *Abbella subflavella* and the holotype of *Pseudogramma fasciatipenne* Gir.) (label: 'From windows of empty dwellings, Herberton, N.Q., XII.28.1911, Hy 771 | 3484, 4410, 3484'), and a second slide (not type material) with a fragment containing a male *S. funeralis* partially dissected (head, antenna and one leg) (label: 'Signiphora funeralis Gir. | Indooroopilly | window | VII.5.1933') and a separate coverslip with a specimen of *Chartocerus hebes* (as *M. hebes*). Dahms (1984) states that T4410 was a duplicate QM accession number for the type specimen and had been cancelled. T3484 refers to the specimen of *Abbella subflavella*.

Description. Female. Length 0.74 mm. The holotype has faded to a yellowish tone, but it was originally described as being dark like the other species of *Chartocerus*, with metallic tinge on the head and mesoscutum. Fore wing infuscated except for a small basal area, posteriorly. Head with punctations scattered on face and genae. Scape about 4.5× as long as wide, pedicel 2× as long as wide, ring segments in ratios of 6:4:2:1, resembling *C. kerrichi*, clava 5× as long as wide. Mesoscutum a little more than 3.5× length of scutellum, with scattered small setae; scutellum with 6 faint setae along posterior margin. Fore wing almost 3× as long as wide, marginal fringe roughly $\frac{1}{2}$ width of the wing. Mesobasitarsus less than $\frac{1}{2}$ length of mesotibia, mesotibial spur about $\frac{1}{3}$ of the basitarsus. Mt1 bilobed, the two lobes separated smoothly by a concave curve; propodeal sclerite projecting posteriorly gradually.

***Chartocerus hebes* Girault, 1929**

urn:lsid:zoobank.org:act:B7FBF276-AEC1-4F17-85CD-BA04AED6564E

EOL taxon ID: 848102

(Figure 8; DOI:10.5281/zenodo.3893739)

Girault (1929), as *Matritia hebes* (original description).

Dahms (1984, p. 682): notes on type material.

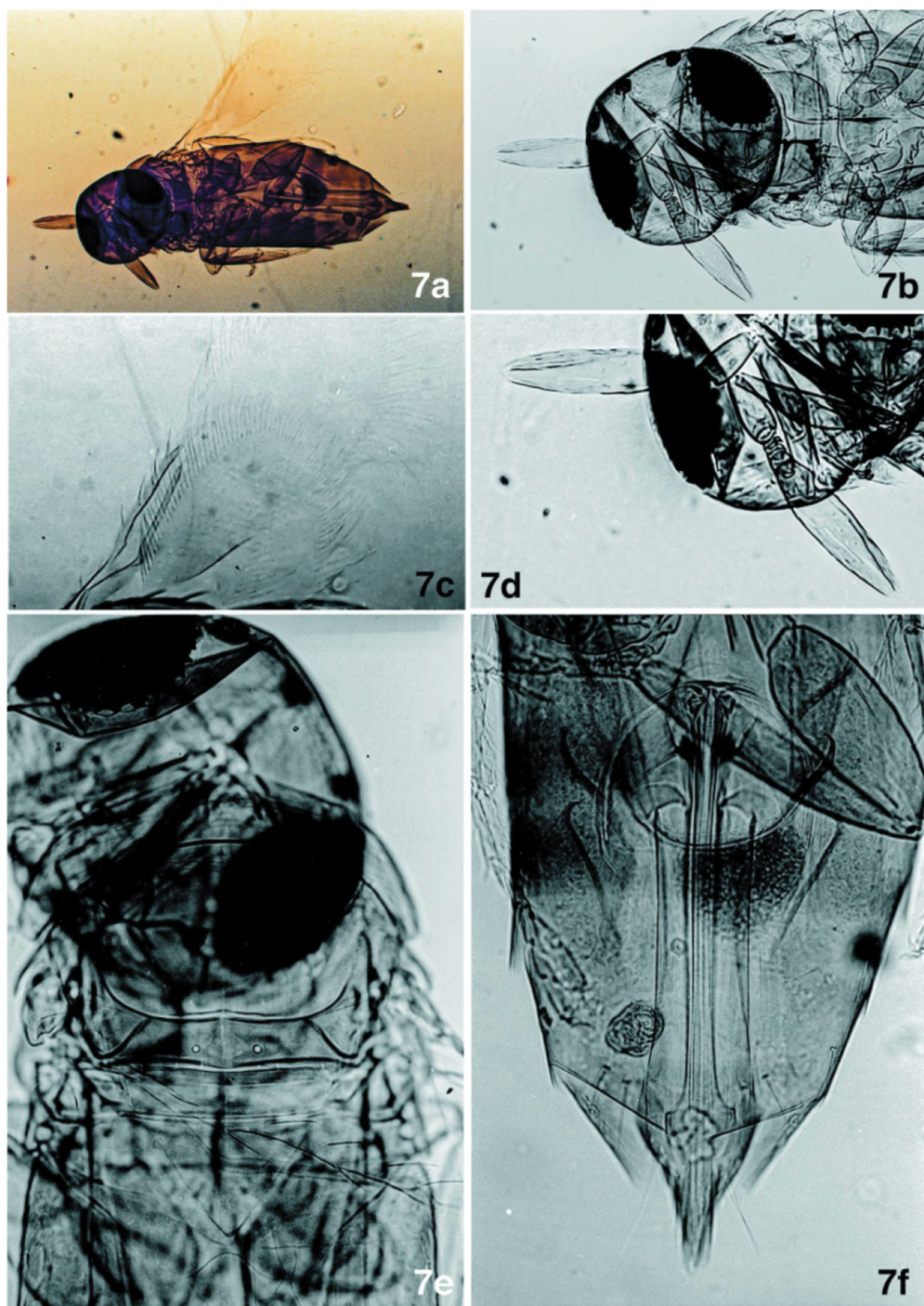


Figure 7. *Chartocerus funeralis* (Girault), holotype ♀, Queensland Museum Type Hy 771. (a) habitus; (b) head and antennae; (c) fore and hind wings; (d) antenna; (e) head and mesosoma; (f) metasoma.

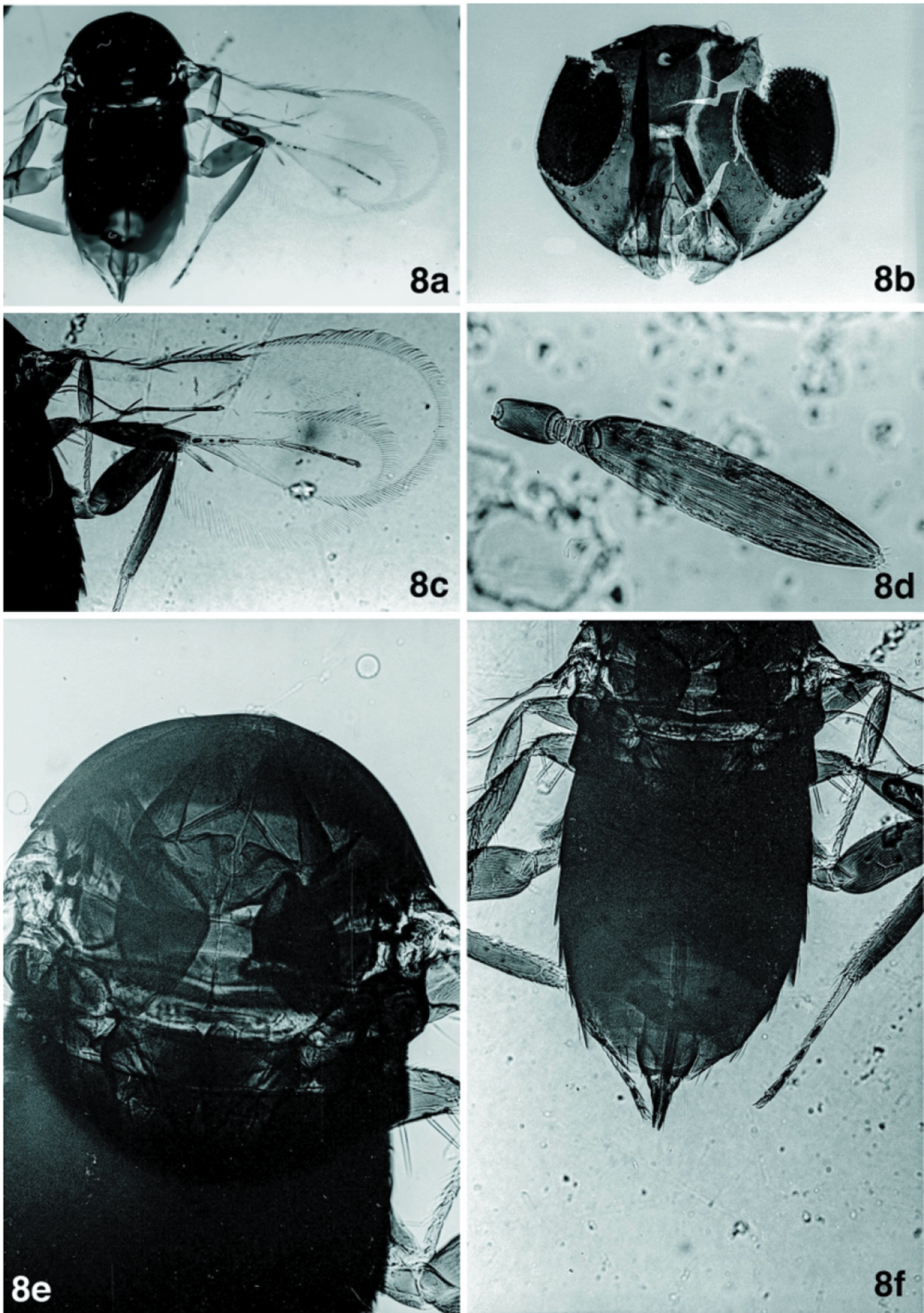


Figure 8. *Chartocerus hebes* (Girault), Lectotype ♀, Queensland Museum Type HY 235. (a) habitus; (b) head; (c) fore and hind wings; (d) part of antenna; (e) mesosoma; (f) metasoma.

Type material. **LECTOTYPE female [here designated]:** QM T4416, slide, with 1 female ('Hy.235 | *Matritia hebes* Girault | also wing ♀ cotype | Ent. Div. Dep. Ag. & Stk., Qld. 4416'). **PARALECTOTYPES:** 5 females.

In the original description, Girault mentions 'three females from spider eggs in a leaf-nest, Tasmania' (Girault 1929, p. 311), but based on the labels and the fact the QM specimens are also labelled as 'cotypes', Dahms (1984) indicated the type series was actually composed of six specimens, considered syntypes. He reported on material at two institutions: 1 slide at SAM containing 3 females (Label: 'TYPE | *Matritia hebes* Girault | type ♀ S. Aus. Mus. Ent. Div. Dep. Ag. & Stk., Qld. '), plus 1 card and 1 slide labelled as cotypes at QM. The card contains 2 females and a glue spot where a third specimen (likely the slide one) was attached, labelled 'Tasmania || From eggs of spider in leaf nest || 4416 || *Matritia hebes* Girault | Cotype ♀'s | T246546 (left), T246547 (center)', and the data from the QM material matches the original description. The slide-mounted female at QM (T4416) is here designated as lectotype, and the slide has been labelled accordingly.

Description. Female. Body dark, legs also dark, but posterior part of fore leg and apical part of metatibia lighter, tarsi yellowish. Wing infuscation differs from other species of *Chartocerus* because the apical part is darker than the basal part, with darkened areas extending below the stigmal vein. Head round in frontal view with deep punctations along inner margin of eyes, scattered on face and genae. Scape about 3× as long as wide, pedicel about 2× as long as wide, ring segments in ratios of 4:2:2:1, clava about 5× as long as wide. Scutellum about 1/3 of length of scutum. Fore wing with 2 setae on submarginal vein, 1 costal seta, 6 setae on marginal vein. Basitarsus of mid leg about 1/3 of length of mid leg. The propodeum and Mt1 were not cleared well enough in this preparation to be visualised; the same applies to the setation of the mesoscutum and scutellum.

***Chartocerus reticulatus* Girault, 1913**

urn:lsid:zoobank.org:act:95891FF8-CBB9-49CA-9FDF-5E28A3E68281

EOL taxon ID: 13795738

(Figure 9; DOI:10.5281/zenodo.3893745)

Girault (1913b, p. 166), as *Signiphora reticulata* (original description).

Dahms (1986, p. 474): notes on type material; note on placement as *Matritia* (Girault unpublished notes).

Type material. Holotype female, QM Hy 1281 (T4408), on a slide that also contains a coverslip fragment with the type of *Australaphycus albivoiductus* Gir., labelled 'Queensland Museum. TYPE | Hy/1281 | ♀ || *Australaphycus albivoiductus* Gir., Type ♀ || *Signiphora reticulata* Girault, ♀ type. Sweeping, forest, Ayr, Q., 6 Apr., 1912 | 4408.'" The specimen had the head removed, broken in many pieces, but the remainder of the body is preserved, one fore leg missing. Dahms (1986) describes three slides located at QM, one with the holotype and two with multiple individuals from Mackay [Queensland], labelled as *Signiphora Matritia reticulata* (Girault) (not type material) and all with heads and other parts dissected; he also states that the number T4408 was a duplicate QM accession number for the holotype and had been cancelled.

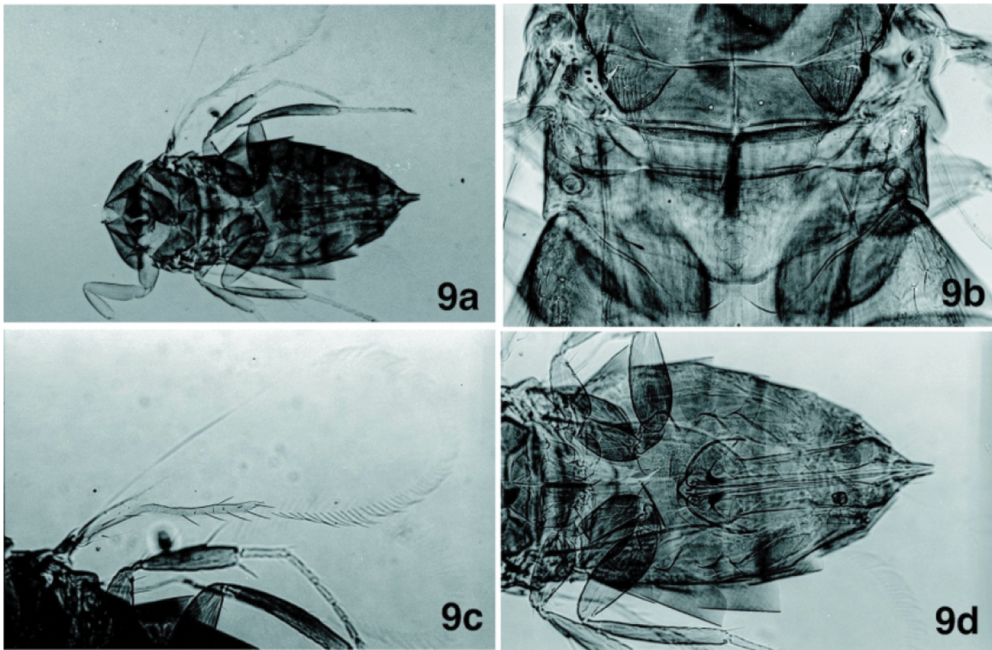


Figure 9. *Chartocerus reticulatus* (Girault), holotype ♀, Queensland Museum Type Hy 1281. (a) habitus; (b) mesosoma; (c) fore wing, mid and hind legs; (d) metasoma.

Description. Female. Length 0.96 mm. Body dark brown, legs lighter, golden brown, tarsi of mid leg yellowish. Wings hyaline. Head with somewhat equally spaced punctations, and striae close to antennal scape. Scape 3–3.5× as long as wide, medially wider than in extremities, pedicel 2× as long as wide, 4 anelli (1:3:3:5), clava 6–7× as long as wide. Mesoscutum about 2× as wide as long, scutellum 1/3 of length of mesoscutum. Mesotibia about 2× length of protibia; hind tibia 1.25× length of mesotibia. Mesobasitarsus a little more than 1/3 of length of mesotibia; mesotibial spur ½ length of basitarsus and with 3 teeth visible. Mesofemur with 2 spines. Fore wing 3× as long as wide, setae not larger than 1/8 of width of wing. The wing infuscation is not discernible.

Chartocerus ruskini Girault, 1921

urn:lsid:zoobank.org:act:ED82C36C-9356-4A7F-AC82-C5E0103EAD62

EOL taxon ID: 847839

(Figure 10; DOI:10.5281/zenodo.3893747)

Girault (1921, p. 188), as *Signiphora ruskini* (original description).

Dahms (1986, p. 491): notes on type material.

Type material. Holotype female, QM T4406, on a slide in bad condition, labelled: '*Lathromeroidea nigrella* ♂,♀, *Anaphoidea linnaei* 2 ♀'s, *Signiphora ruskini* Gir. Type. ♀ 4406 | (red label) 4406). There are several coverslip fragments with several other damaged specimens, some of which do not appear to be listed on the label. The slide does not have

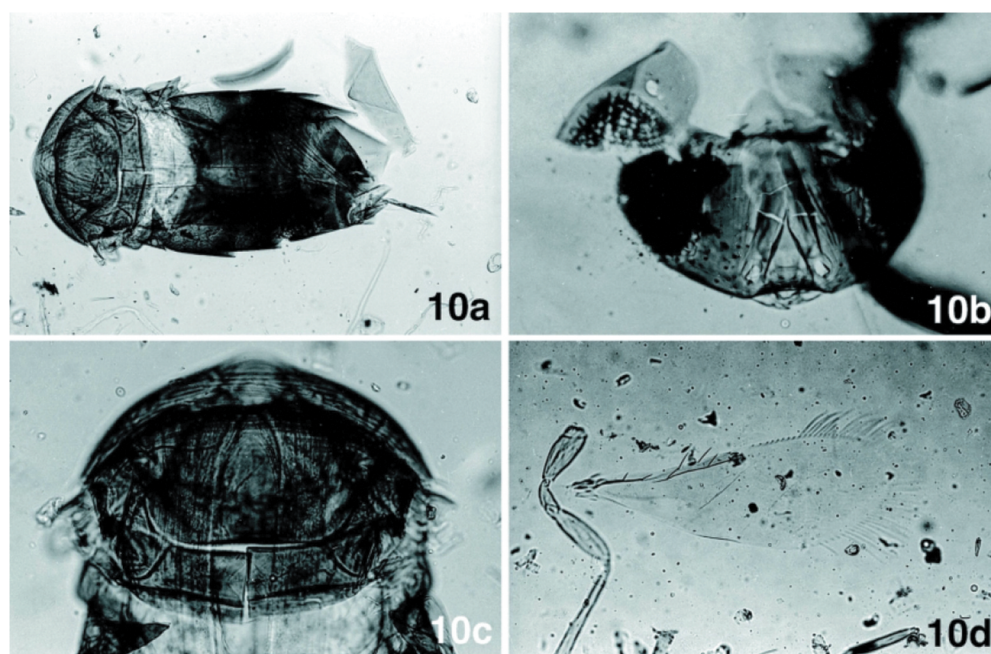


Figure 10. *Chartocerus ruskini* (Girault), holotype ♀, Queensland Museum Type Hy 4406. (a) habitus; (b) head; (c) mesosoma; (d) fore wing and hind leg.

date information, but in the original description, Girault indicates 'Nelson, forest, 6 March 1919'. The propodeal sclerite was dissected; head, legs, wings and antennae were also separated. The head is broken and partially under a corner of the coverslip that is cracked.

Description. Female. Length ~0.6 mm. Body mostly brown; scutellum, mesoscutum and pronotum slightly lighter than metasoma (the propodeum was dissected, so it appears lighter); the legs were removed, but were described as orange. Fore wing infuscation darker from base to under seta M4; remainder of wing lightly infuscated except for a hyaline basal area posteriorly and the very apex. Face striate, frontovortex with punctations more evident. Scutellum a little less than $\frac{1}{2}$ length of mesoscutum. The fore wing setation seems to be similar to other *Chartocerus* but is slightly obscured. Fore wing 2.7× as long as wide, marginal fringe as long as slightly less than $\frac{1}{2}$ maximum wing width. Mt1 bilobed.

***Chartocerus thusanoides* Girault, 1915**

[urn:lsid:zoobank.org:act:7158060D-5DCC-41FB-8D23-1A4A790FF251](https://zoobank.org/act:7158060D-5DCC-41FB-8D23-1A4A790FF251)

EOL taxon ID: 847837

(Figure 11; DOI:10.5281/zenodo.3893753)

Girault (1915, p. 71), as *Signiphora thusanoides* (original description).

Dahms (1986, p. 588): notes on type material.

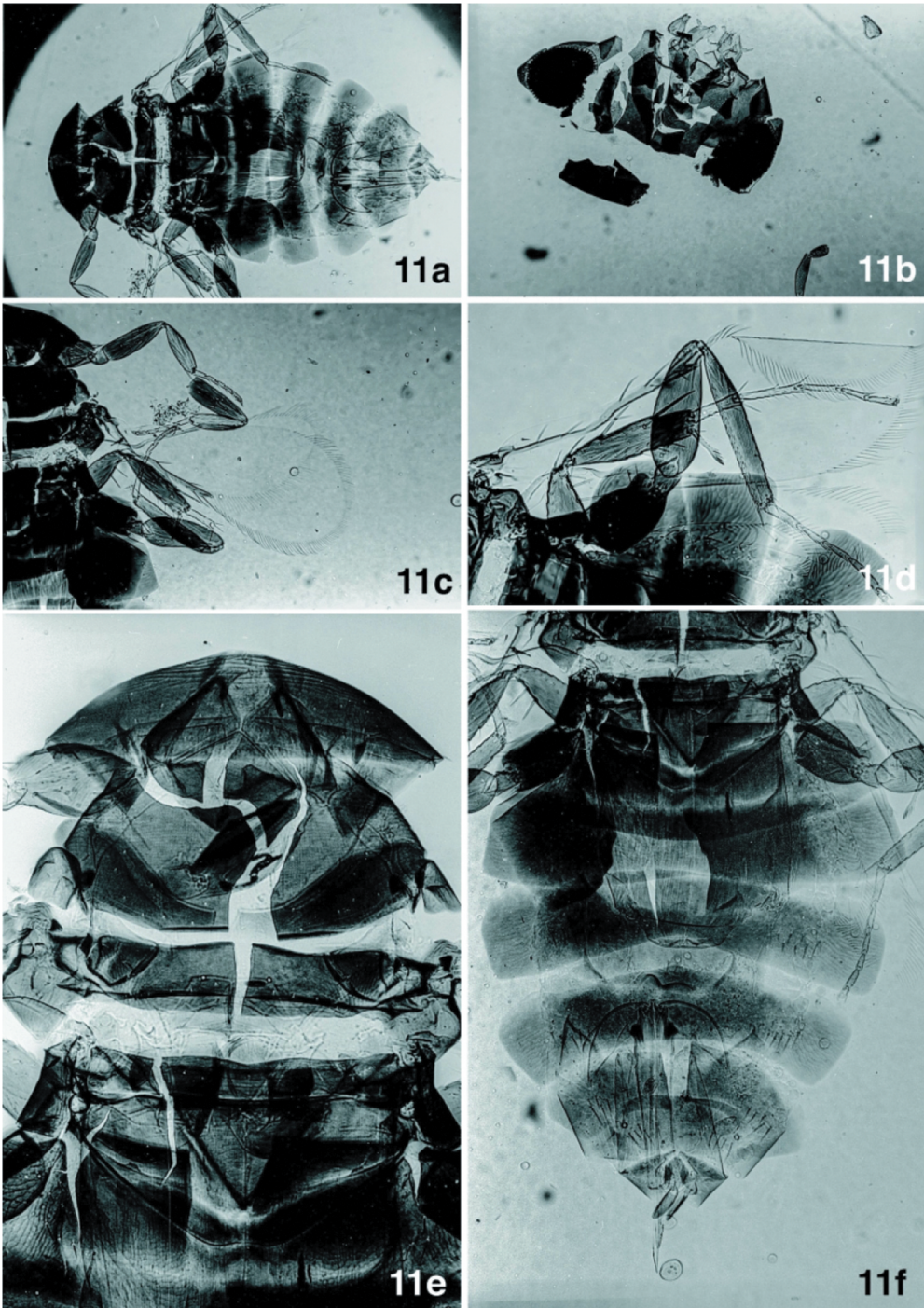


Figure 11. *Chartocerus thusanoides* (Girault), holotype ♀, Queensland Museum Type Hy 4415. (a) body; (b) fragments of head; (c) wings and legs; (d) wings and legs; (e) mesosoma and base of metasoma; (f) metasoma.

Remarks. Holotype female, QM Hy 2968 (T2968), on a slide in bad condition with two coverslip fragments, labelled 'TYPE || 4415 || (fading) Signiphora thusanoides Gir. ♀ type || Holotype *Signiphora thusanoides*, Gir. Det. J. B. Woolley "79"'. The specimen was crushed, with the mesosoma broken in half, but otherwise most structures are observable; the head is broken in several pieces. The other coverslip fragment contains another ♀ but there is no indication of identification. Dahms (1986) states that number T4415 was a duplicate QM accession number for this type and had been cancelled. The number QM Hy 2968 is given in the original description.

Description. Female. Length about 1.4 mm. Body mostly brown, legs lighter, with apical tarsomeres of metatibia tan; posterior face of mesotibia yellowish white. The head capsule was completely crushed; some punctations are visible on the fragments of the genae. Scape 4× as long as wide, pedicel a little less than 2× as long as wide, 4 anelli (2:3:4:7). Clava about 4× as long as wide. Pronotum about 5× as wide as long, mesoscutum 2.5× longer than scutellum. Fore wing wide, 2.3× as long as wide. Hind wing about 3× as long as wide, marginal fringe about ¼ of width of mesotibia. Mt1 slightly bilobed, the two lobes very close to each other, giving Mt1 the same trapezoid appearance as propodeum. Ovipositor short, the outer plates not reaching ½ length of the metasoma.

Types not examined

Chartocerus gratus (Girault, 1932), described as *Matritia gratia* (Girault 1932) was not examined. Dahms (1984) notes that the syntypes are in Perth (DEAP) and that the type series is a single slide containing 10 damaged syntypes of both sexes. We have not been able to examine this material. Girault's (1932) original description states 'From *hebes*. Wing 1 sans cross-band. Middle tibial spur all pale; hind fringe wing 2 ½ widest. Western Australia, on *Dactylopius*, L.J. Newman'.

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No potential conflict of interest was reported by the authors.

References

- Ashmead WH. 1900. On the genera of the chalcid-flies belonging to the subfamily Encyrtinae. *Proc US Natl Mus.* 22:323–412. doi:10.5479/si.00963801.22-1202.323.
- Balke M, Schmidt S, Hausmann A, Toussaint EFA, Bergsten J, Buffington M, Häuser CL, Kroupa A, Hagedorn G, Riedel A, et al. 2013. Biodiversity into your hands - A call for a virtual global natural history 'metacollection'. *Front Zool.* 10:55. doi:10.1186/1742-9994-10-55.
- Bouček Z. 1988. Australasian Chalcidoidea (Hymenoptera). A biosystematic revision of genera of fourteen families, with a reclassification of species. Wallingford (Oxon): CAB International/Cambrian News; p. 832.
- Dahms EC. 1978. A checklist of the types of Australian Hymenoptera described by Alexandre Arsene Girault: I. Introduction, acknowledgments, biography, bibliography and localities. *Mem Queensland Mus.* 19:127–190.
- Dahms EC. 1983. A checklist of the types of Australian Hymenoptera described by Alexandre Arsene Girault: II. Preamble and Chalcidoidea species A-E with advisory notes. *Mem Queensland Mus.* 21:1–255.
- Dahms EC. 1984. A checklist of the types of Australian Hymenoptera described by Alexandre Arsene Girault: III. Chalcidoidea species F-M with advisory notes. *Mem Queensland Mus.* 21:579–842.
- Dahms EC. 1986. A checklist of the types of Australian Hymenoptera described by Alexandre Arsene Girault: IV. Chalcidoidea species N-Z and Genera with advisory notes plus addenda and corrigenda. *Mem Queensland Mus.* 22:319–739.
- Girault AA. 1913a. A systematic monograph of the chalcidoid Hymenoptera of the subfamily Signiphorinae. *Proc US Natl Mus.* 45:189–233. doi:10.5479/si.00963801.1977.189.
- Girault AA. 1913b. A new *Signiphora* from Queensland, Australia (Hym.). *Entomol News.* 24:166–167.
- Girault AA. 1915. Australian Hymenoptera Chalcidoidea – VII. The family Encyrtidae with descriptions of new genera and species. *Mem Queensland Mus.* 4:1–184.
- Girault AA. 1921. Miscellaneous species of Chalcid-flies from Australia (Hymenoptera, Chalcididae). *Insecutor Inscitiae Menstruus.* 9:186–191.
- Girault AA. 1929. Notes on, and descriptions of, chalcid wasps in the South Australian Museum. Concluding paper. *Trans R Soc South Aust.* 53:309–346.
- Girault AA. 1932. New lower Hymenoptera from Australia and India. Brisbane: Private publication; p. 6.
- Girault AA. 1933. Some beauties inhabitant not of the boudoirs of commerce but of natures bosom - new insects. Brisbane: Private publication; p. 2.
- Goergen G, Neuenschwander P. 1994. *Chartocerus hyalipennis* (Hayat) (Hym.: Signiphoridae), a gregarious hyperparasitoid on mealybugs (Hom.: Pseudococcidae): biology and host range in West Africa. *Mit der Schweizerischen Entomologischen Ges.* 67(3–4):297–308.
- Gordh G, Menke A, Hall J, Dahms EC. 1978. The privately printed papers of A.A. Girault. *Mem Am Entomol Inst (Gainesville).* 28:1–400.
- Harris RA. 1979. A glossary of surface sculpturing. Sacramento (CA): California Department of Food and Agriculture, Division of Plant Industry, Laboratory Services.
- Heraty JM, Burks RA, Cruaud A, Gibson GAP, Liljeblad J, Munro J, Rasplus J-Y, Delvare G, Janšta P, Gumovsky A, et al. 2013. A phylogenetic analysis of the megadiverse Chalcidoidea (Hymenoptera). *Cladistics.* 29:466–542. doi:10.1111/cla.12006.
- LaSalle J, Wheeler Q, Jackway P, Winterton S, Hobern D, Lovell D. 2009. Accelerating taxonomic discovery through automated character extraction. *Zootaxa.* 2217:43–55. doi:10.11646/zootaxa.2217.1.3.
- LaSalle J, Williams KJ, Moritz C. 2016. Biodiversity analysis in the digital era. *Philos Trans R Soc London B Biol Sci.* 371:20150337. doi:10.1098/rstb.2015.0337.

- Mantle BL, LaSalle J, Fisher N. 2012. Whole-drawer imaging for digital management and curation of a large entomological collection. *ZooKeys*. 209:147–163. doi:10.3897/zookeys.209.3169.
- Moore D, Cross AE. 1992. Competition between two primary parasitoids, *Gyranusoidea tebygi* Noyes and *Anagyrus mangicola* Noyes, attacking the mealybug *Rastrococcus invadens* Williams and the influence of a hyperparasitoid *Chartocerus hyalipennis* Hayat. *Biocontrol Sci Technol*. 2 (3):225–234. doi:10.1080/09583159209355236.
- Motschulsky V. 1859. Insectes utiles et nuisibles. *Études Entomologiques*. 8:169–174.
- Noyes JS. 2019. Universal Chalcidoidea Database. The Natural History Museum; [accessed 2019 Mar 6]. <http://www.nhm.ac.uk/research-curation/research/projects/chalcidoidea/>.
- Parr CS, Wilson N, Leary P, Schulz KS, Hammock JA, Hammock JA, Hammock J, Goddard A, Rice J, Studer M, et al. 2014. The encyclopedia of life v2: providing global access to knowledge about life on earth. *Biodivers Data J*. 2:e1079. doi:10.3897/BDJ.2.e1079.
- Pyle RL, Michael E. 2008. ZooBank: developing a nomenclatural tool for unifying 250 years of biological information. *Zootaxa*. 1950:39–50. doi:10.11646/zootaxa.1950.1.6.
- Rasband WS. 2018. ImageJ 1.5. U. S. Bethesda (Maryland): National Institutes of Health; [accessed 2019 Oct]. <https://imagej.nih.gov/ij/>.
- Rosen D, Argov Y, Woolley JB. 1992. Biological and taxonomic studies of (Hymenoptera: Signiphoridae), a hyperparasite of mealybugs. *J Hymenoptera Res*. 1:241–253.
- Schmidt S, Hamid H, Ubaidillah R, Ward S, Polaszek A. 2019. A review of the Indonesian species of the family Signiphoridae (Hymenoptera, Chalcidoidea), with description of three new species. *ZooKeys*. 897:29–47. doi:10.3897/zookeys.897.38148.
- Triapitsyn SV, Aguirre MB, Logarzo GA, Hight SD, Ciomperlik MA, Rugman-Jones PF, Verle-Rodrigues JC. 2018. Complex of primary and secondary parasitoids (Hymenoptera: Encyrtidae and Signiphoridae) of *Hypogeococcus* spp. mealybugs (Hemiptera: Pseudococcidae) in the New World. *Florida Entomol*. 101(3):411–434. doi:10.1653/024.101.0320.
- Woolley JB. 1988. Phylogeny and classification of the Signiphoridae (Hymenoptera: Chalcidoidea). *Syst Entomol*. 13:465–501. doi:10.1111/j.1365-3113.1988.tb00256.x.
- Yoder MJ, Miko I, Seltmann K, Bertone M, Deans A. 2010. A gross anatomy ontology for Hymenoptera. *PLoS One*. 5:e15991. doi:10.1371/journal.pone.0015991.
- Zenodo. 2019. OpenAire Europe/CERN, Switzerland. [accessed 2019 Oct]. <https://zenodo.org/>.