



Revision of the Afrotropical genus *Fernandea* Melichar, 1912 (Hemiptera: Fulgoromorpha: Dictyopharidae), with description of a new species from Equatorial Guinea

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Abstract

The Afrotropical planthopper genus *Fernandea* Melichar, 1912 (Hemiptera: Fulgoromorpha: Dictyopharidae: Dictyopharinae: Orthopagini) is revised to include two species: *F. conradti* Melichar, 1912 (the type species), with material studied from Cameroon, Equatorial Guinea (Bioko island) and Togo, and *F. latifemorata* **sp. nov.**, described as new from mainland Equatorial Guinea. A lectotype is designated and a redescription is provided for *F. conradti* together with habitus photographs and detailed illustrations of the male and female terminalia which are published for the first time.

Key words: taxonomy, planthoppers, Dictyopharinae, Afrotropical region

Introduction

Dictyopharidae, a family of planthoppers (Hemiptera: Fulgoromorpha) predominantly feeding on dicots and closely related to lanternflies (Fulgoridae), contains some 740 described species in 169 genera distributed worldwide, with the greatest diversity in tropical and subtropical regions (Urban & Cryan 2009; Song *et al.* 2014, 2016a; Bourgoin 2016). A monograph by Melichar (1912) represents a historical groundwork for the systematics of the group. The largest subfamily Dictyopharinae currently includes 14 tribes, one of which is Orthopagini containing 20 genera and more than 50 species from the Oriental, Afrotropical, eastern Palaearctic and Australasian regions (Emeljanov 2011; Song *et al.* 2014, 2016b). Some of Orthopagini taxa are known from historical descriptions only which lack details needed to unambiguously diagnose the species and assess the phylogenetic relationships among the genera. A number of partial revisions, descriptions or redescriptions have been published recently as successive steps to make up for this state (Liang & Song 2006; Song & Liang 2006a,b, 2007, 2011, 2012a,b; Emeljanov 2008, 2011; Song *et al.* 2012, 2014, 2016b).

One of still little known dictyopharid genera is *Fernandea* Melichar, 1912 based on a single species, *Fernandea conradti* Melichar, 1912, originally described from the island of Bioko, Equatorial Guinea, in western Africa (Melichar 1912) and later recorded also from the Democratic Republic of Congo (Fennah 1958) and Guinea (Lallemand 1958). Along with most other dictyopharid genera, it was traditionally placed in the tribe Dictyopharini (Melichar 1912; Metcalf 1946). Recently, *Fernandea* was assigned to Orthopagini by Emeljanov (2011). Since Melichar's (1912) original description, no further taxonomic work has been published on this monotypic genus.

While revising and identifying dictyopharid material from collections of several institutions, we found additional specimens of *Fernandea* including another species from mainland Equatorial Guinea which we describe here as a new one, along with a detailed redescription of *F. conradti* based on the type material and a study of the male and female genitalia which we describe and illustrate for the first time. As a result, *Fernandea* is revised to include two species, *F. conradti* and *F. latifemorata* **sp. nov.**

Material and methods

The specimens studied in the course of this work are deposited in the Museum für Naturkunde, Berlin, Germany (MFNB), the Moravian Museum, Brno, Czech Republic (MMBC), and the Museum and Institute of Zoology, Polish Academy of Sciences, Warsaw, Poland (MZPW).

The post-abdomina of the specimens used for dissections were cleared in 10% KOH at room temperature for ca. 6–12 hours, rinsed in distilled H₂O and then transferred to 10% glycerol for examination. Observations were conducted under a stereomicroscope, measurements and photography under a Leica Z16 APO A stereomicroscope equipped with a Leica DFC495 microscope camera and Leica Application Suite 3.7.0 in MFNB. Some final images were compiled from multiple photographs using CombineZM image stacking software and improved with the Adobe Photoshop CS5.

The morphological terminology and measurements used in this study follow Song *et al.* (2016a, b) for most characters, Bourgoïn (1993) for the female genitalia, and Bourgoïn *et al.* (2015) for the forewing.

Taxonomy

Genus *Fernandea* Melichar, 1912

Fernandea Melichar, 1912: 53; Schmidt 1915: 349; Metcalf 1946: 48.

Type species. *Fernandea conradti* Melichar, 1912; by original designation.

Diagnosis. *Fernandea* can be distinguished by the following combination of characters: body ovoid, dorsally convex; head without distinct cephalic process; vertex narrow, with basal width much narrower than transverse diameter of eyes, lateral carinae strongly ridged and foliaceous, and median carina absent; frons with intermediate carinae gradually divergent ventrad and approaching beneath middle of eyes; frontoclypeal suture nearly straight; mesonotum with carinae very weak, lateral carinae nearly straight and abruptly incurved apically; forewings short, only slightly extending beyond abdomen apex, convex, coriaceous but translucent, veins with short setae, venation strongly reticulate with dense dendroid secondary veinlets among longitudinal veins on the whole surface, pterostigmal area absent; hindwings with anal area reduced, without secondary fold; legs elongate; fore coxae and femora greatly flattened, dilated, and foliaceous laterally, hind tibiae with seven apical spines; gonostyles with upper process dorsoventrally compressed; and male and female segment X with apical dorsal margin deeply excavated, so anal style not reaching beyond apical ventral margin of segment X.

Description. Body ovoid, dorsally convex (Fig. 1). Head short, not produced in a distinct cephalic process. Vertex (Figs 3A, 5A) with basal width much narrower than transverse diameter of eyes; lateral carinae strongly ridged, foliaceous, and parallel between eyes, jointed with lateral carinae of frons in perfect arc in profile (Figs 3B, 5B); anterior margin angularly convex but more or less grooved centrally, just beyond anterior margin of eyes (Figs 3A, 5A); posterior margin ridged and broadly concave; disc of vertex swollen at half length, medially furrowed, and median carina absent. Frons (Figs 3C, 5C) slightly inflated and bulbous at apex, distinctly beyond apex of vertex; frons narrowest at apex, broadest at frontoclypeal suture; intermediate carinae not sharp, gradually divergent ventrad and approaching beneath middle of eyes; median carina distinctly ridged and complete. Frontoclypeal suture nearly straight. Postclypeus and anteclypeus convex medially, with distinct median carina. Rostrum long, extending nearly to middle of hind femora. Eyes very large and semiglobose, postocular swelling developed transversely. Antennae with scape very small; pedicel large and subglobose, with more than 50 distinct sensory plaque organs distributed over entire surface; flagellum long, setuliform.

Pronotum (Figs 3A, 5A) relatively large and broad, anterior central margin angularly convex, lateral marginal areas straight and sloping with two longitudinal carinae on each side between eyes and tegulae, lower lateral carinae convex and visible in dorsal view (Figs 3A, 5A); posterior margin nearly straight; disc flat, median carina weakly ridged, with a lateral pit on each side. Mesonotum (Figs 3A, 5A) broad, short and flat, carinae very weak, lateral carinae nearly straight and abruptly incurved apically.

Forewings (Fig. 2C) “brachypterous” in size, which corresponds to “koeliopterous” by Metcalf (1950) or “submacropterous” by Emeljanov (e.g. 2011). They are relatively short, slightly extending beyond abdomen apex,

convex, coriaceous but translucent; veins with short setae. Venation patterns variable in left/right wing; ScP+R, MP, and CuA bifurcated near basal 1/3, and branching successively accessory veins for several times; MP distinctly bifurcated posterior to CuA; venation strongly reticulate, dense dendroid secondary veinlets among longitudinal veins on the whole wings, including clavus; number of apical cells between R and CuA more than 25; pterostigmal area absent. Hindwings (Fig. 2C) well-developed, but anal area reduced, without secondary fold; venation pattern also variable in left/right wing; numerous veinlets among longitudinal veins.

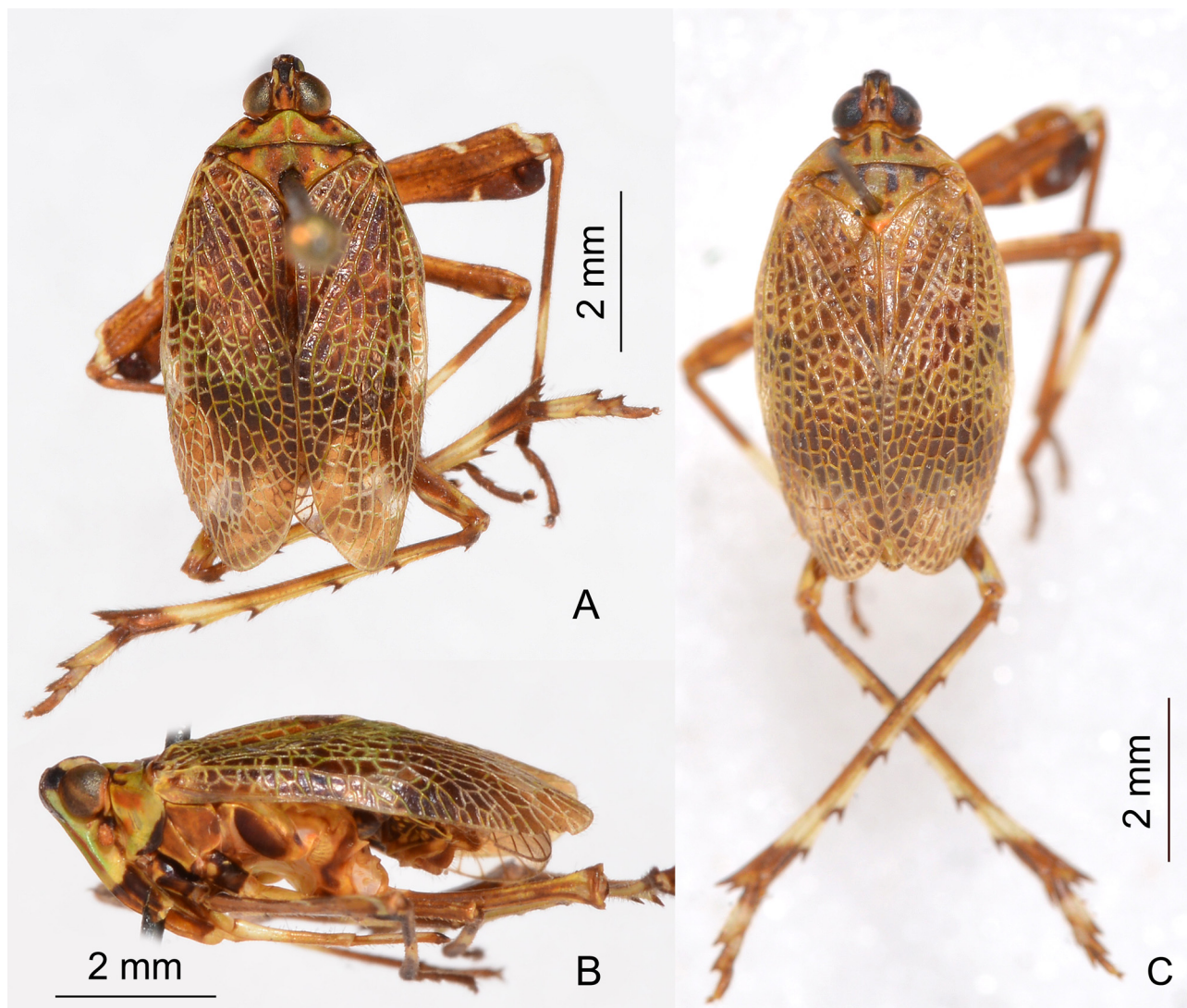


FIGURE 1. Habitus of *Fernandea* species. A. *F. conradti*, lectotype, female, dorsal view; B. *F. conradti*, lectotype, female, lateral view; C. *F. latifemorata* sp. nov., holotype, male, dorsal view.

Legs elongate; fore coxae (Fig. 5C) short, lateral carina strongly flattened and foliaceous; fore femora (Fig. 2A, B) elongate, greatly flattened, dilated, and foliaceous laterally, subapical part with a large depression on the inner side ventrally, bulging dorsally; middle femora elongate, slightly flattened and dilated; hind tibiae with 5–6 lateral spines and seven apical spines; hind tarsomeres I with ten and tarsomeres II with eight apical spines, respectively; apical spines of tarsomeres with long setae instead of platellae.

Abdomen with pregenital segments short and broad, without distinct median and intermediate carinae dorsally. Tergites III–VI with a large depression near lateral margin on each side. Sternites III–VI tuberculate (trace of sensory pits), with 6–10 tubercles on each side.

Male terminalia. Pygofer with dorsal margin slightly excavated to accommodate segment X, dorso-lateral margins angularly produced posteriorly in dorsal view (Figs 3D, 5D). Gonostyles (Figs 3E, 5E) symmetrical, expanding towards apex, broadest apically, apex straight; upper process acute apically in profile (Figs 3E, 5E), but actually compressed dorsoventrally in caudal view (Fig. 5G). Aedeagus (Figs 3G–I, 5H–J) with a pair of

endosomal processes: membranous, distinctly inflated, apically acute, and directed dorsally (Figs 3H, 5H); phallobase sclerotized and pigmented at base and laterally, with paired membranous and inflated lobes. Segment X (Figs 3D, 5D) large and oval in dorsal view, apical dorsal margin deeply excavated to accommodate anal style; anal style large and elongate, but not extending beyond the apical ventral margin of segment X.

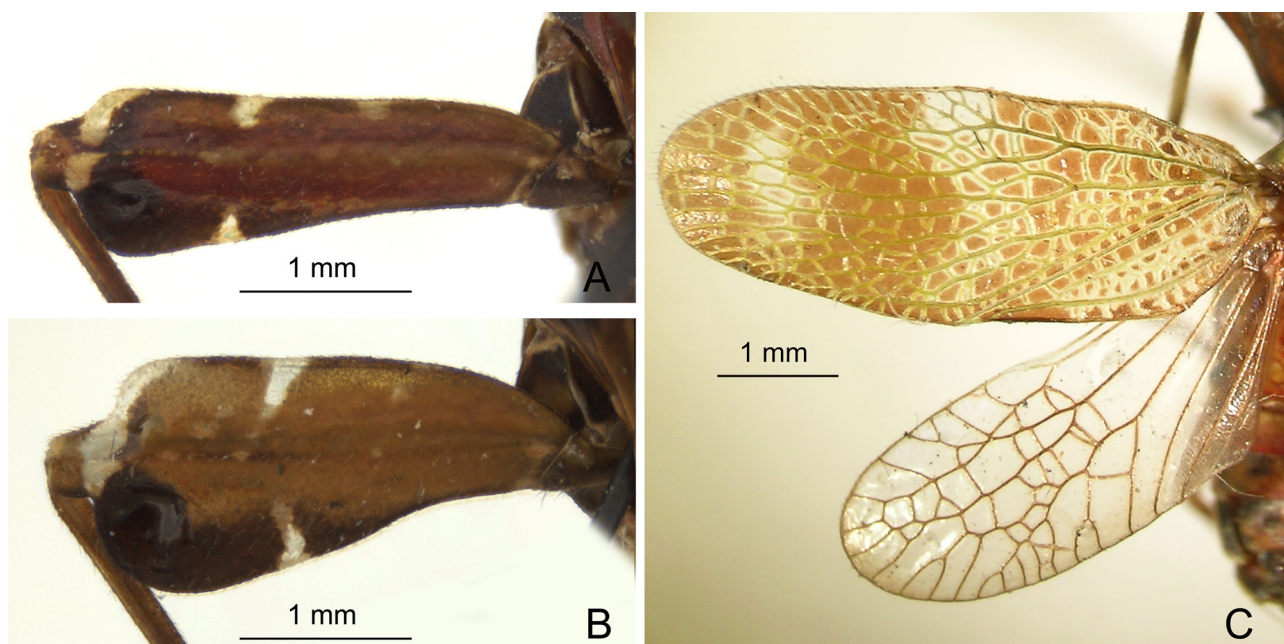


FIGURE 2. *Fernandea* spp., fore femora. A. *F. conradti*; B. *F. latifemorata* sp. nov.; C. Forewing and hindwing of *F. conradti*.

Female terminalia (Fig. 4A, B). Gonocoxae VIII with two membranous and flattened endogonocoxal processes (Gxp) on endogonocoxal lobe: Gxp1 large and elongate, with a long sclerotized plate in it; Gxp2 smaller and shorter. Gonapophyses VIII (first valvulae) with anterior connective lamina large and sclerotized, with seven teeth of varying sizes and shapes in lateral view (Fig. 4C). Gonapophyses IX (second valvulae) with posterior connective lamina triangular, symmetrical in ventral view (Fig. 4D), fused with the intergonocoxal plate (iGxp) at base; iGxp extended cephalad into genital cavity, forming wall of gonospiculum. Gonoplares (third valvulae) with two lobes homologous; lateral lobe large and moderately sclerotized, with long setae at apex; the posterior lobe membranous, containing long sclerotized plate (Fig. 4E). Segment X large and broad in dorsal view (Fig. 4F), apical dorsal margin deeply excavated to accommodate anal style; anal style large and elongate, but not extending beyond the apical ventral margin of segment X. Female ectodermal genital ducts ditrysian: oviporus opening exteriorly from posterior vagina and surrounded by gonapophyses VIII and IX, and copulaporus opening anterior to gonapophyses VIII between abdominal sternites VII and VIII. Bursa copulatrix (Fig. 4A) superficially membranous, regularly gridded, without sclerotized ornamentations. A pair of large digitiform glands (Fig. 4A) branched at anterior extremity of the anterior vagina on each side of the spermatheca. Spermatheca (Fig. 4A) divided clearly into five parts: orificium receptaculi, ductus receptaculi, diverticulum ductus, pars intermedialis, and glandula apicalis.

Diversity and distribution. *Fernandea* comprises two species which are endemic to the Guineo-Congolian region of western Africa.

Remarks. *Fernandea* is similar to *Macronaso* Synave, 1960, but can be distinguished from the latter by the head without distinct cephalic process, and the fore coxae and femora greatly flattened, dilated, and foliaceous laterally.

Fernandea and *Macronaso* are unique among African Orthopagini in sharing the following characters: body habitus ovoid, dorsally convex, forewings relatively short, only slightly extending beyond abdomen apex, convex and coriaceous, with dense dendroid secondary veins among longitudinal veins on the whole surface; hindwings with anal area reduced, without secondary fold. As modifications of the forewing size and venation are frequent among planthoppers and convergences have been documented in many unrelated groups (Gnezdilov 2013; Bourgoin *et al.* 2015), the taxonomic status and a possible sister-group relationship of the two genera needs to be further confirmed by a phylogenetic analysis for the World Orthopagini.

Key to species of *Fernandea* Melichar

1. Fore femora relatively narrow (Fig. 2A); phallobase with dorsolateral lobes longer and incurved dorsad (Fig. 3G-I), apex with numerous small and short spines. *F. conradti* Melichar, 1912
- Fore femora much broader (Fig. 2B); phallobase with dorsolateral lobes short, directed posteriad, apex without spines (Fig. 5H-J). *F. latifemorata* sp. nov.

Fernandea conradti Melichar, 1912

(Figs 1A, B, 2A, C, 3, 4)

Fernandea conradti Melichar, 1912: 53, Pl. 2, Figs 18, 19; Schmidt 1915: 349; Metcalf 1946: 48; Fennah 1958: 55; Lallemand 1958: 224.

Redescription. Body length (from apex of head to tip of forewings): ♂ 7.5 mm, ♀ 7.7–7.9 mm; head length (from apex to base of eyes): ♂ 0.9 mm, ♀ 0.9–1.0 mm; head width (including eyes): ♂ 1.3 mm, ♀ 1.3–1.4 mm; vertex width: ♂ 0.4 mm, ♀ 0.4 mm; forewing length: ♂ 5.6 mm, ♀ 6.0–6.4 mm.

General color brownish ochraceous marked with pale green, reddish ochraceous, and black in dorsal habitus. Head pale green to brownish ochraceous, a pair of small spots on vertex between eyes, vertex midline, head apex, preocular field and a small spot between antenna and eye all blackish brown. Frons with lateral and median carinae pale green, broad area between carinae reddish ochraceous. Clypeus dark brown, narrow transverse fascia at base greenish yellow. Pronotum redish ochraceous, median and intermediate carinae, lateral marginal areas, and paranotal lobes widely yellowish green, areas behind eyes narrowly and lateral margins of paranotal lobes more widely blackish brown. Mesonotum redish ochraceous, broad median and lateral carinae, and lateral marginal areas yellowish green, a pair of small spots near lateral marginal areas blackish brown. Forewings with membrane coriaceous but translucent, mostly brown, a small oval patch subapically and a small streak at costal margin medially hyaline, venation pale green; hind wings hyaline, venation dull ochraceous. Thorax beneath fuscous. Legs pale to dark brown; fore femora fuscous, apex and a pair of triangular spots on lateral margins in distal third bright white to pale green, subapical depression on the inner ventral surface and corresponding bulge on dorsal surface blackish brown; hind tibiae yellowish green, with base and apex including lateral and apical spines fuscous. Abdomen dorsally testaceous mixed with fuscous, a broad central stripe and a lateral stripe on each side dark brown; ventrally piceous, with numerous yellowish spots around sensory pits.

Male terminalia with pygofer narrow and elongate, slightly wider ventrally than dorsally (about 1.5:1); posterior margin distinctly convex subapically in lateral view (Fig. 3E). Aedeagus (Fig. 3G–I) large and robust, with a pair of long endosomal processes curved in middle and directed dorsad, apex acute and pigmented; phallobase sclerotized and pigmented at base and laterally, the remainder membranous, with large and inflated lobes: one pair of dorsolateral lobes cylindrical, incurved dorsad, apex with numerous small and short spines; the other pair of ventral lobes tapering and directed dorsad. Segment X large and broad in dorsal view (Fig. 3D), ratio of length to width near middle about 1.3:1.

Female terminalia (Fig. 4A–F) as in generic description.

Type material examined. Lectotype ♀, here designated, [EQUATORIAL GUINEA]: Fernando Po [= Bioko], Sa. Isabel [= Malabo] V.; *F. conradti* [Melichar's handwriting], det. Melichar.; Typus [dark red label]; *Fernandea* ♀ *conradti* sp. n., L. Melichar, 1912, Syntypus, P. Lauterer det. 1991 [Lauterer's handwriting]; Syn- typus [bright red label]; Collectio Dr. L. Melichar, Moravské museum Brno; Invent. č. 4944/Ent., Mor. muzeum, Brno; Lectotype ♀, *Fernandea conradti* Melichar, 1912, desig. Z.S. Song, I. Malenovský & A.P. Liang, 2015 [newly added yellow label] (MMBC).

Paralectotype, here designated, [EQUATORIAL GUINEA]: 1♀, Fernando Po [Bioko], Conradt; *Fernandea conradti* M. [Melichar's handwriting]; type [red label]; Paralectotype ♀, *Fernandea conradti* Melichar, 1912, desig. Z.S. Song, I. Malenovský & A.P. Liang, 2015 [newly added yellow label] (MZPW).

Other material examined. [CAMEROON]: 1♂, Kamerun, Conradt; Coll. Kraatz; Transcriptio, *Fernandea* ♂ *conradti* Melichar, L. Melichar det. 1912 [Lauterer's handwriting]; Collectio Dr. L. Melichar, Moravské museum Brno; Není členem typo- vé série [= the specimen is not part of the type series; Lauterer's handwriting], P. Lauterer 1991 (MMBC); 1♀, Kamerun, Conradt; Typus [dark red label]; *F. conradti* [Melichar's handwriting] det.

Melichar.; Transcriptio *Fernandea* ♀ *conradti* Melichar, L. Melichar det. 1912 [Lauterer's handwriting]; Collectio Dr. L. Melichar, Moravské museum Brno; Není členem typové série [= the specimen is not part of the type series; Lauterer's handwriting], P. Lauterer 1991 (MMBC); 1♀, Kamerun, Jaun de-Stat., 800 m, Zenker (MFNB); 1♀, Kamerun, Victoria, Preuss (MFNB). [TOGO]: 1♀, Togo, Bismarckburg, L. Conradt (MFNB); 1♀, Togo, Misahdhe, 1894, E. Baumann; *Fernandea conradti* Melichar, H. Synave det. [Synave's handwriting] (MFNB).

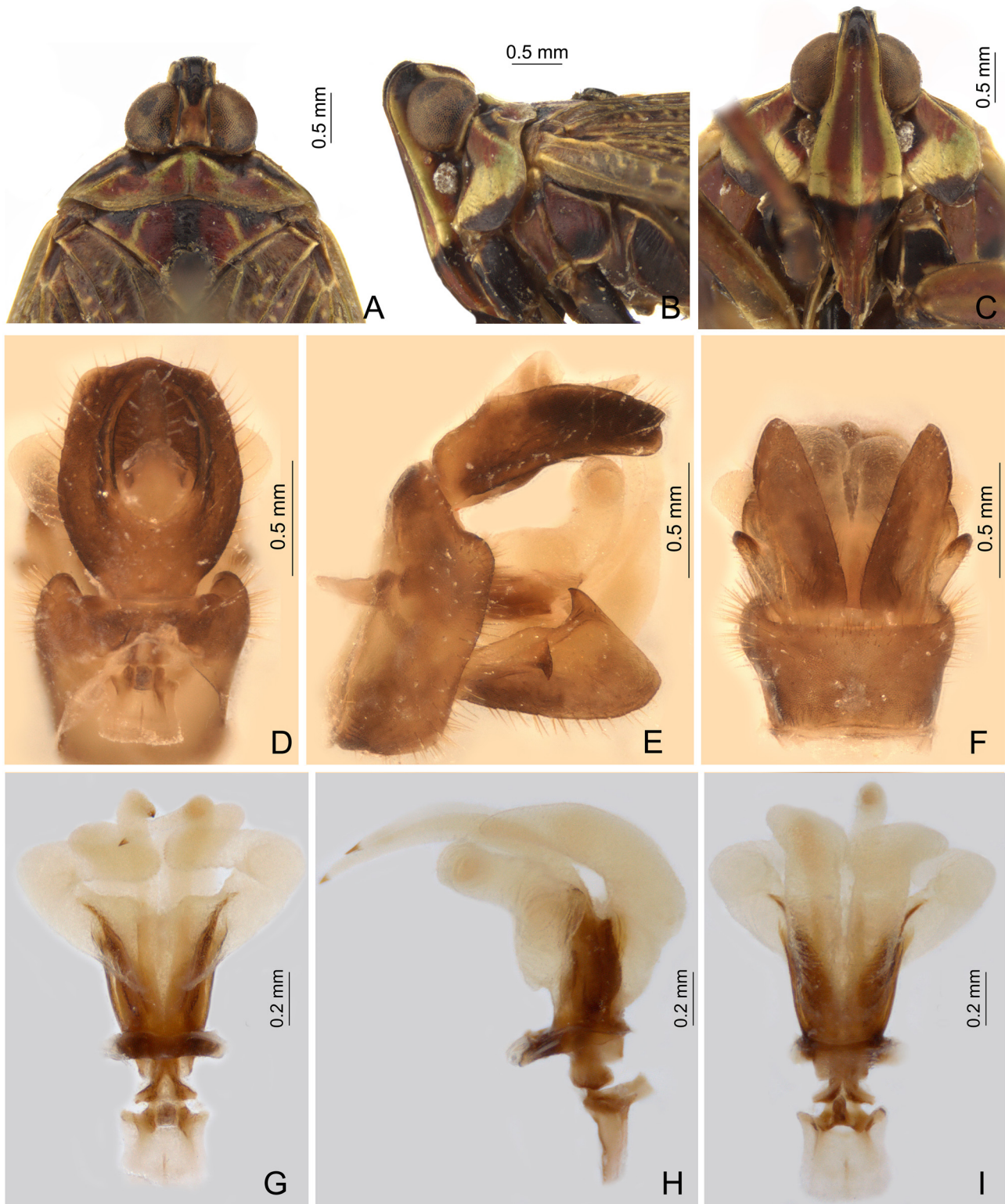


FIGURE 3. *Fernandea conradti*. A. Head, pronotum and mesonotum, dorsal view; B. Head and pronotum, lateral view; C. Head and pronotum, ventral view; D. Segment X and pygofer, dorsal view; E. Pygofer, gonostyles, and segment X, lateral view; F. Pygofer and gonostyles, ventral view; G. Aedeagus, dorsal view; H. Aedeagus, lateral view; I. Aedeagus, ventral view.

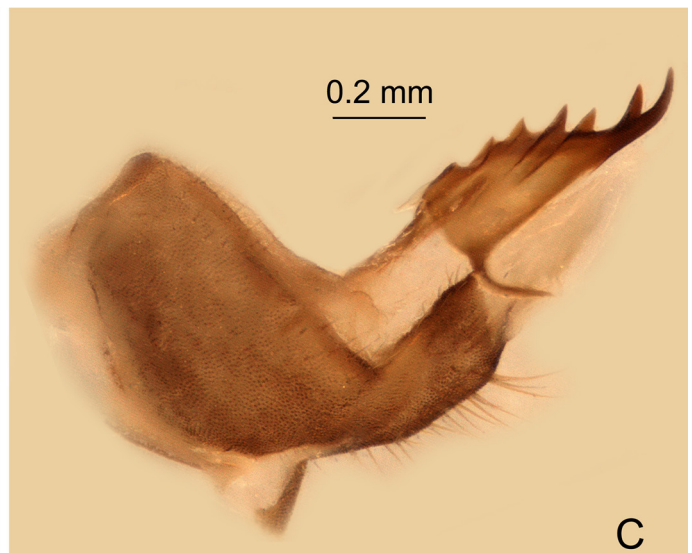
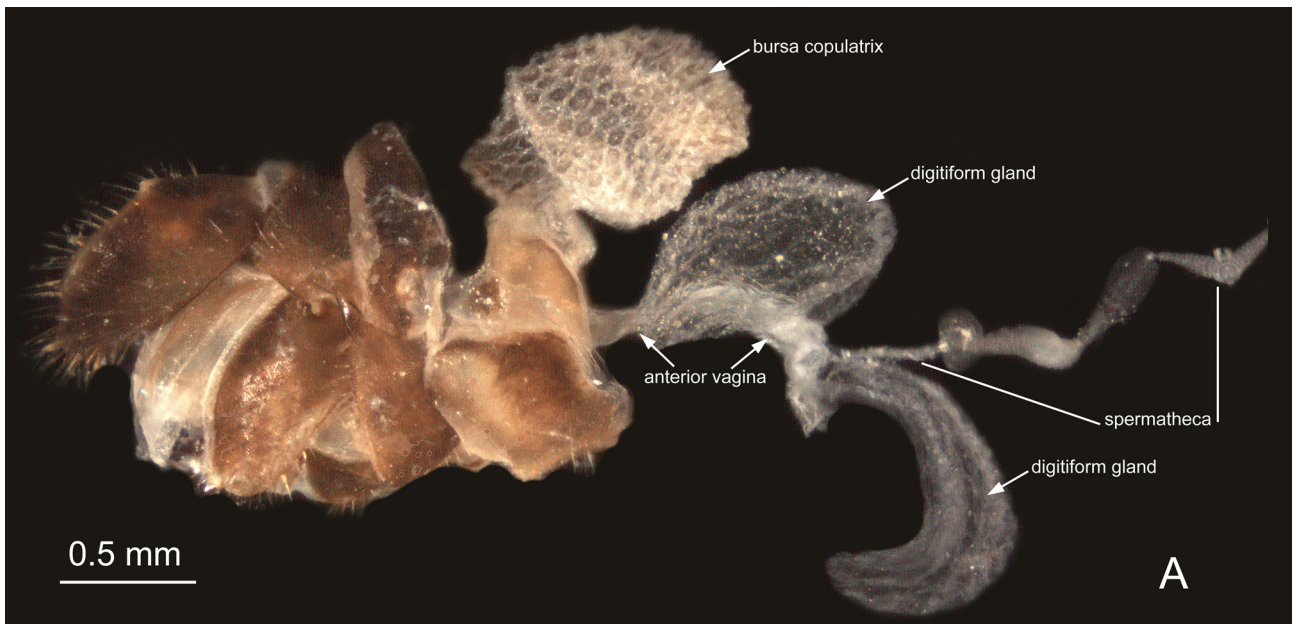


FIGURE 4. *Fernandea conradti*. A. Female terminalia and ectodermal genital ducts, lateral view; B. Female genitalia, ventral view; C. Gonapophysis VIII, dorsolateral view; D. Gonapophysis IX, ventral view; E. Gonoplace, lateral view; F. Female segment X, dorsal view.

Distribution. Material has been revised from Cameroon, Equatorial Guinea and Togo. The species was also recorded for the Democratic Republic of the Congo (Fennah 1958) and Guinea (Lallemand 1958).

Remarks. In the original description, Melichar (1912) mentions two specimens from Fernando Po (= Bioko island), collected by H. Conradt and deposited in his personal collection as the type series. We found one female specimen with the corresponding label data in Melichar's personal collection in MMBC and the other one female in MZPW which agrees with the note published by Schmidt (1915). According to Article 74 of ICZN (1999) we designate the specimen from MMBC as a lectotype for *F. conradti* to stabilize the nomenclature in the genus.

Two additional specimens (one male and one female) collected by Conradt in Cameroon and deposited in Melichar personal collection in MMBC obviously belong to *F. conradti*; both bear Melichar original identification labels though they were not mentioned in his monograph and are not part of the type series (cf. Melichar 1912). We have described and illustrated the male terminalia based on the male specimen from Cameroon.

***Fernandea latifemorata* sp. nov.**

(Figs 1C, 2B, 5)

Diagnosis. The new species can be distinguished from *F. conradti* by the broader fore femora and the aedeagus with shorter and smaller dorsolateral lobes of the phallobase.

Description (♂ only). Body length (from apex of head to tip of forewings): 7.1 mm; head length (from apex to base of eyes): 0.9 mm; head width (including eyes): 1.3 mm; vertex width: 0.4 mm; forewing length: 5.5 mm.

Coloration largely identical to *F. conradti*, but pronotum and mesonotum much paler, less reddish ochraceous, with a pair of longitudinal dark brown streaks along median carina, respectively (Fig. 1C, 5A).

Male terminalia with pygofer narrow and elongate, ventrally slightly wider than dorsally (about 1.5:1); posterior margin distinctly convex subapically in lateral view (Fig. 5E). Aedeagus (Fig. 5H–I) large and robust, with a pair of long endosomal processes curved in middle and directed dorsad, apex acute and pigmented; phallobase with membranous and inflated lobes: one pair of dorsolateral lobes short and broad, directed posteriad, apex without spines; the other pair of ventral lobes tapering and directed posteriad, apex with numerous small and short spines. Segment X large and relatively elongate in dorsal view (Fig. 5D), ratio of length to width near middle about 1.7:1.

Material examined. Holotype: ♂, [EQUATORIAL GUINEA]: Span. Guinea, Nkolentangan, 7.XI–8.V, G. Teßmann (MFNB).

Etymology. The specific epithet is an adjective derived from the Latin words *latus* (= wide, broad) and *femur* (= thigh). The new species is named for its greatly flattened, dilated, and foliaceous fore femora.

Distribution. Equatorial Guinea.

Remarks. The holotype was evidently collected during the expedition by German ethnologist, explorer and collector Günter Tessmann (1884–1969) to the Fang people which took place in 1907–1909. According to Tessmann (1913), the base camp of Nkolentangan was located near “Alén”, lying probably inside or close to what is today the Monte Alén National Park in mainland Equatorial Guinea (central coordinates 1°31'48"N, 10°6'36"E), an area covered with primary rainforest over an altitudinal range of 300–1250 m.

Acknowledgments

We are grateful to Jürgen Deckert, Peter Schönefeld (both MFNB), and Tomasz Huflejt (MZPW) for access to collections under their care and loan of specimens. The work on which this paper is based was supported by the grants from the National Natural Science Foundation of China (no. 31572297, to Z.S.S; nos. 31561163003, 31572298, and 31372249, to A.P.L), the Key Laboratory of the Zoological Systematics and Evolution of the Chinese Academy of Sciences (no. O529YX5105), and the Ministry of Culture of the Czech Republic as part of long-term conceptual development programme for research institutions granted to the Moravian Museum, Brno (no. MK000094862). Institutional support from the Department of Botany and Zoology, Masaryk University, Brno to I.M. at the stage of writing of the paper is greatly acknowledged as well.

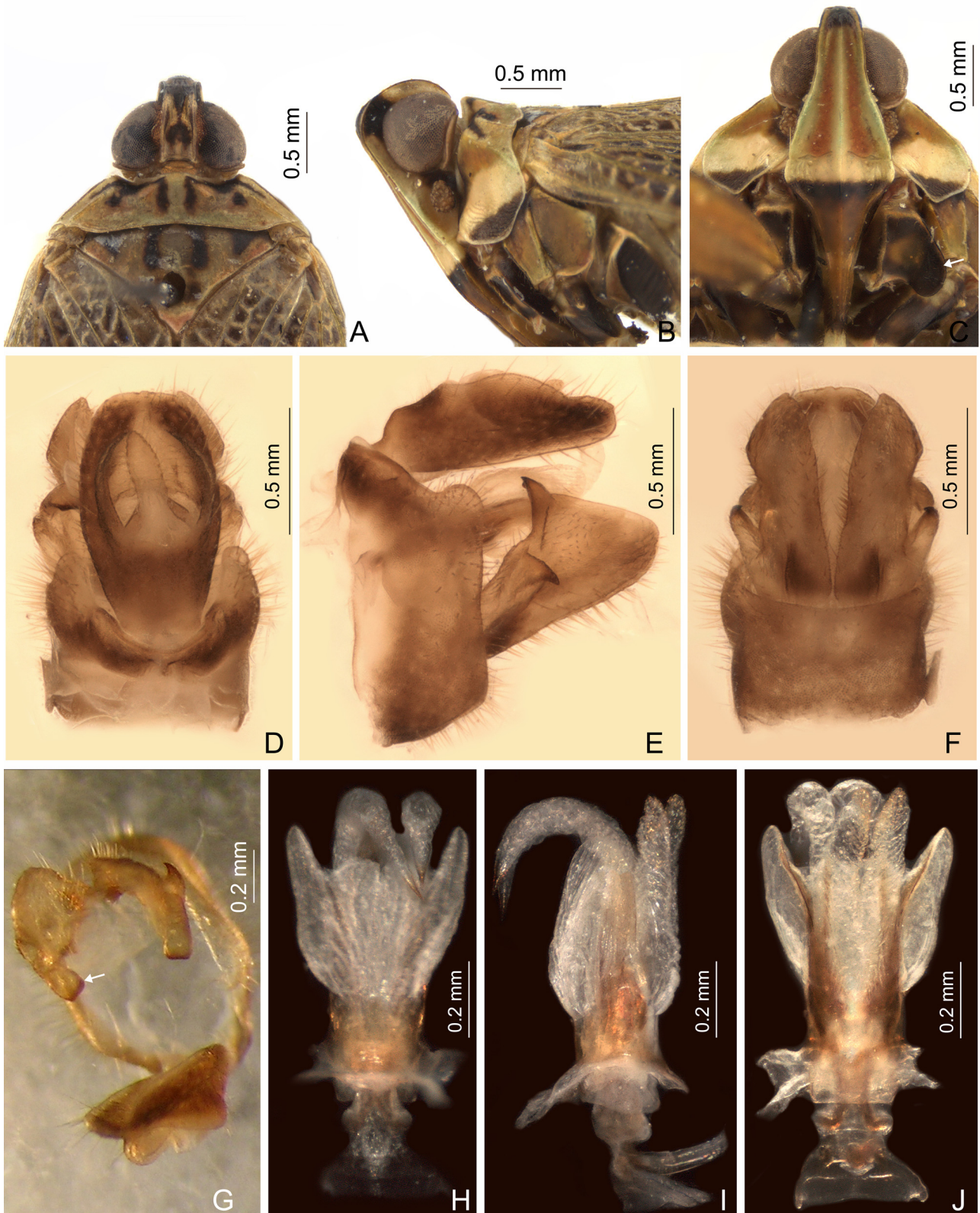


FIGURE 5. *Fernandea latifemorata* sp. nov. A. Head, pronotum and mesonotum, dorsal view; B. Head and pronotum, lateral view; C. Head and pronotum, ventral view (white arrow showing fore coxa); D. Segment X and pygofer, dorsal view; E. Pygofer, gonostyles, and segment X, lateral view; F. Pygofer and gonostyles, ventral view; G. Gonostyle, caudal view (white arrow showing dorsoventrally compressed upper process); H. Aedeagus, dorsal view; I. Aedeagus, lateral view; J. Aedeagus, ventral view.

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