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Author: Kirk-Spriggs, Ashley H.

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A revision of Afrotropical Quasimodo flies (Diptera: Schizophora; Curtonotidae). Part III – the Malagasy species of *Curtonotum* Macquart, with descriptions of six new species

Ashley H. Kirk-Spriggs

Department of Entomology, National Museum, P.O. Box 266, Bloemfontein, 9300 South Africa, and Department of Zoology & Entomology, Rhodes University, Grahamstown, 6140 South Africa; ashley.kirk-spriggs@nasmus.co.za

ABSTRACT

The Madagascan fauna of the genus *Curtonotum* Macquart, 1844 is reviewed. Type material of the seven species described by Tsacas in 1974 (*C. balachowskyi*, *C. boeny*, *C. keiseri*, *C. pauliani*, *C. sakalava*, *C. sternithrix* and *C. stuckenbergi*) was studied and additional material of five of these is noted, substantially increasing their known distributions. Six of the seven species described by Tsacas are endemic to Madagascar; unpublished records indicate, however, that *C. pauliani*, occurs in Namibia and South Africa on the African continental mainland. Six additional endemic species are described as new: *C. coronaeformis* sp. n., *C. gladiiformis* sp. n., *C. griveaudi* sp. n., *C. irwini* sp. n., *C. parkeri* sp. n., and *C. rinhatinana* sp. n. The head and thorax, frons, wing, sixth sternite and hypandrium of the male of the 13 species are illustrated for the first time, as well as the highly diagnostic male phallus, both laterally and dorsally at the junction of the basiphallus and distiphallus. A key to species based on male characters is provided, and species distributions are mapped and interpreted. The biogeographical significance of the Madagascan species is discussed. An annotated checklist of Madagascan Curtonotidae is presented, and co-ordinates used to plot maps and a list of vegetation types in which species occur are provided.

KEY WORDS: Curtonotidae, *Curtonotum*, Madagascar, identification key, new species, revision, taxonomy, biogeography.

INTRODUCTION

Four genera of Curtonotidae are currently known worldwide, i.e., *Axinota* van der Wulp, 1886, *Cyrtona s.l.* Séguy, 1938, *Tigrisomyia* Kirk-Spriggs, 2010 and *Curtonotum* Macquart, 1844, all of which occur in the continental Afrotropical Region; *Tigrisomyia* exclusively so. *Curtonotum* is the most speciose genus and is found in all zoogeographical regions of the world except Australasia/Oceania and Antarctica, although Klymko and Marshall (2011) point out that *Curtonotum* in its current broad sense is paraphyletic with respect to *Axinota*, and suggest restricting the name *Curtonotum* to a monophyletic New World group. Two genera are known to occur on Madagascar, *Axinota*, represented by a single species, *A. kyphosis* Kirk-Spriggs, 2010, of supposed Oriental origin and *Curtonotum* (Appendix I). Notably, the genus *Cyrtona s.l.*, which is extremely species-rich in the continental Afrotropical Region, is apparently absent.

The *Curtonotum* fauna of Madagascar has remained a neglected group and nothing is currently known of their biology and immature stages. Species in the continental Afrotropical Region are known to roost in the burrows of small mammals, hollow trees and overhangs of riverbeds, *etc*. (e.g., Kirk-Spriggs 2008*b*; Meier *et al.* 1997; Tsacas 1977) and, at least in the case of species occurring in xeric regions, are known to develop as scavengers in the damaged egg pods of locusts and grasshoppers (Orthoptera) (Greathead 1958; Kirk-Spriggs 2008*b*; Meier *et al.* 1997). A more complete review of the known biology of the genus will be presented in Part IV of this revision.

Specimens of *C. balachowskyi* Tsacas from Madagascar are subject to infestations of the entomophagous fungus *Laboulbenia curtonoti* Rossi & Kirk-Spriggs (Ascomycota), a species with an elongated rhizoid which penetrates the host's cuticle (Rossi & Kirk-Spriggs 2011). An infestation of a different, undescribed Laboulbeniales species was also observed on a specimen of *C. sakalava* Tsacas during the course of this study, but occurred in insufficient numbers to facilitate description.

In a first attempt to deal with the taxonomy of the Madagascan species of the genus, Tsacas (1974) described and named seven endemic species and identified, but did not name, five apparent others. Tsacas' study was, however, based on only 38 specimens. These were collected by Renaud Paulian (1913–2003), then Deputy Director of the Institut Scientifique de Madagascar, and colleagues from 1956 to 1960. This was supplemented with material sampled by Raymond Decary (1891–1973) in 1922, and Alfred "Fred" Jakob Keiser-Jenny (1895–1969) and his wife collected from May to October 1958. The study also included specimens collected by Brian Roy Stuckenberg (1930–2009), during his second Madagascan expedition from November 1957 to April 1958.

All specimens studied by Tsacas (1974), including all types, were borrowed for study from the respective institutions. A few additional specimens came to light in material loaned from Tel Aviv University, Israel, Zoologische Staatssammlung, München, Germany, and the KwaZulu-Natal Museum, Pietermaritzburg, South Africa, but by far the most substantial number of specimens now available for study result from Michael E. Irwin's extensive Arthropod Survey of Madagascar's Protected Areas (1998–2009), deposited in the California Academy of Sciences, San Francisco, USA.

Tsacas (1974) illustrated the spermathecae of five named and two unnamed Madagascan species, but did not describe these structures or assess their variability. Kirk-Spriggs (2008*a*), however, assessed intra- and inter-specific variability in spermathecal form of three continental Afrotropical species in the *Curtonotum cuthbertsoni* complex (*sensu* Tsacas 1977), with obclavate spermathecae and concluded that variability was too great to allow specific differentiation. For this reason (with the notable exceptions of *C. sternithrix*, which has dark rings around the sockets of all thoracic setae, and *C. sakalava*, which is unique in having the lateral maculae of the abdominal tergites developed into a continuous band in both sexes), only the males can be identified with certainty and then only following detailed examination of the male terminalia.

As noted above, Tsacas (1974) identified, but did not name, five "species" from Madagascar (*Curtonotum* sp. cf. *balachowskyi* n. sp. species a, *C.* cf. *balachowskyi* n. sp. species b, *C.* sp. cf. *pauliani*, n. sp. species c, *Curtonotum* sp. d, and *Curtonotum* sp. e), only the first of which is represented by a male and can be reliably determined. Close examination of the male terminalia of this specimen, in direct comparison to the types, reveals its conspecificity with *C. balachowskyi*. As these specimens were not formally named they have no bearing in nomenclature and the remaining female specimens must be regarded as indeterminate *Curtonotum* spp.

Earlier parts of this revision deal with the genus *Axinota* (Kirk-Spriggs 2010*a*) and the East African endemic genus *Tigrisomyia* (Kirk-Spriggs 2010*b*). Part IV will consider the species of *Curtonotum* occurring in the continental part of the Afrotropical Region and will include a more thorough account of species complexes and group associations.

MATERIAL AND METHODS

Preparation of spirit-preserved specimens

Material resulting from the Arthropod Survey of Madagascar's Protected Areas (1998–2009) and other material loaned from the California Academy of Sciences was sampled using Malaise traps and was initially preserved in 96 % ethanol. Only part of the material resulting from this extensive survey was available for study as numerous samples remain unsorted. These specimens were prepared in the following manner: specimens were placed on dry tissue paper to absorb excess alcohol and were then placed in vials of 2-ethoxy ethanol and left to stand overnight. The 2-ethoxy ethanol was then decanted and replaced with ethyl acetate, and again left overnight. Specimens were then removed and air-dried on tissue paper before being glued to card points using *Seccotine* and having the appropriate labels added. Ex-alcohol specimens are bleached to some extent and many have been rubbed or have setation missing; colours of dry-pinned specimens can be expected to be brighter.

Dissection

All male specimens included in this study were dissected. Abdomens were removed with watchmaker's forceps and macerated in 10 % potassium hydroxide in a heated block before being transferred to 70 % ethanol with a few drops of glacial acetic acid in an excavated glass block. Following dissection, abdomens and male terminalia were stored in a micro-vial with glycerol pinned beneath each specimen. The cork-bunged glass genitalia vials used by L. Tsacas, many of which had dried up or deteriorated, were all replaced and a label was appended to each specimen stating "Genitalia vial replaced A.H. Kirk-Spriggs [2006–2008]".

Preparation of figures and images

Figures of the head, thorax and frons (Figs 1–26), were prepared from images captured with a ®Leica EZ4HD stereo microscope with built-in digital camera. These were photographed using a ring light and dome (Kerr *et al.* 2008) in a range of focal planes and were digitized using ®Combine ZP Image Stacking Software.

Wings were detached and placed between two glass slides. Images (Figs 27–35, 37–39) were captured with a ®Leica Wild M3Z binocular microscope with ®Nikon E5400 digital camera attached. Fig. 36 was prepared using the ®Leica EZ4HD microscope.

Male terminalia were mounted laterally or dorsally, in a blob of heated and then cooled glycerine jelly. Figures of these structures (Figs 40–91) were prepared using a ®Leica Wild M3Z binocular microscope with a *camera lucida* attachment. Images were enlarged and traced, and details added by hand in pen and ink by constant referral to the specimen. Scale bars were added using a 0.5 mm graticule slide.

Measurements

Measurements were taken with a graticule eye piece on a ®Leica Wild M3Z binocular microscope, calibrated with a 0.5 mm graticule slide.

As the descriptions and redescriptions are based on the holotype in most cases, measurements are provided for the holotype only. In some cases overall lengths of series of specimens were taken prior to dissection and in such cases a range of lengths is provided. In some cases overall lengths could not be provided as specimens were dissected beforehand. In such cases the measurements provided by Tsacas (1974) are included (where applicable), or combined length of the head and thorax and thorax and scutellum alone are provided. Tsacas did not specify how his measurements were made, but overall length measurements appear to have included the wings (i.e., measured from the head to the tips of the wings), rather than the combined lengths of the head, thorax and abdomen, so are larger by comparison with the measurements provided here.

Overall length was measured from the anteriormost point of the frons to the tip of the abdomen (viewed laterally). Length of head and thorax combined was measured from the anteriormost point of the frons to the scutoscutellar suture (viewed dorsally).

Length of thorax and scutellum combined was measured from the anterior margin of the mesonotum (immediately posterior to head) to the anterior tip of the scutellum (viewed dorsally).

The eye height/length ratio was measured from the most ventral to the most dorsal point of the eye and through the eye medially (viewed laterally).

Genal height was measured immediately below the ventromedial part of the eye (viewed laterally).

Frons length represents the distance between the ventral margin (immediately above the point of antennal insertion), to the posterior ocelli (viewed dorsally). Frons width represents the distance between the lateral margins of the frons, measured at the midpoint between the posterior ocelli and the ventral margin of the frons.

Length of the wing was measured from the humeral crossvein (Fig. 27, *h*) to the apex of the second radial vein (Fig. 27, R_{4+5}).

Descriptions

A full redescription is provided for *C. balachowskyi* Tsacas, the most widely distributed species of the genus in Madagascar. Redescriptions and descriptions of other species are compared to this and differences and additional characters noted only. A full description or redescription of the male terminalia is provided in all cases.

Distribution maps

Each set of specimen locality co-ordinates listed in Appendix II was obtained in one of two ways: (a) original co-ordinates provided on data labels, later converted to decimal co-ordinates; or (b) obtained from Internet geo-referencing websites powered by Google Earth™.

Distribution maps were prepared by converting the list of geographic co-ordinates indicating the point location of specimen records into a spatial data layer in ArcMap 9.3. The specimen location layer was overlaid on the *Vegetation Map of Madagascar* by Moat and Smith (2007). Plotted points are based on material examined as part of the systematic revision only, i.e., all represent confirmed identifications.

Vegetation types cited in the text follow Moat and Smith (2007), as listed in Appendix II, biomes follow Yoder and Nowak (2006) (Fig. 105), biogeographical zones Boumans *et al*. (2007) and Wilmé *et al*. (2006) (Fig. 106) and bioclimatic zones Cornet (1974) and Schatz (2000) (Fig. 107).

Labels

Type label data are quoted exactly as they appear. A division slash (/) denotes the commencement of a new line, two division slashes (//) data on a further label. Significant supplementary or qualifying information is presented in square brackets when considered necessary. Information on label colour, *etc*. is only provided for type material. All labels are printed on white card unless otherwise stated. Specimens with the head missing are labelled as such, e.g., "Head missing 2008". Adult morphology follows Cumming and Wood (2009) and for the male terminalia Marshall *et al*. (2010).

Institutional codens

A list of institutional codens used in the text is provided below, with the names of respective curators and collection managers noted in parenthesis.

BMSA – National Museum, Bloemfontein, South Africa.
CAS – California Academy of Sciences, San Francisco, USA (N. Penny, C. Griswold). CAS specimens have collection codes with the prefix 'MA-' or 'MG-'.
FBUB – Biological Collection, Universität Bielefeld, Bielefeld, Germany (M. von Tschirnhaus).
MNHN – Muséum national d'Histoire naturelle, Paris, France (Ch. Daugeron).
NHMB – Naturhistorisches Museum, Basel, Switzerland (D. Burckhardt, I. Zücher).
NMSA – KwaZulu-Natal Museum, Pietermaritzburg, South Africa (M. Mostovski, R. Miller, P. Birkett).
TAU – Tel Aviv University, Tel Aviv, Israel (A. Freidberg).
ZSM – Zoologische Staatssammlung, München [= Munich], Germany (M. Kotrba, B. Stock, some *via* Michael von Tschirnhaus (FBUB)).

Abbreviations used in the text, on figures and in figure legends

A_1+CuA_2 – first anal vein (fold); A_2 – second anal vein (fold); AT – allotype; *bp* – basiphallus; *C* – costa; *ce* – cercus; cua_1 – cubital cell; CuA_1 – cubital vein; *dm* – discal medial cell; *dm–cu* – discal medial-cubital crossvein; *dp* – distiphallus; *ea* – ejaculatory apodeme; *ep* – epandrium; *h* – humeral crossvein; HT – holotype; *hy* – hypandrium; *m* – medial cell; *M* – medial vein; m – metres above sea level; N-T – non-type/s; *pg* – postgonite; *ph* – phallapodeme; PT – paratype/s; r_1 – first radial cell; r_{2+3} – second radial cell; R_{2+3} – second radial vein; r_{4+5} – third radial cell; R_{4+5} – third radial vein; *r–m* – radial-medial crossvein; *Sc* – subcosta; *ss* – surstylus.

TAXONOMY

Genus *Curtonotum* Macquart, 1844

Refer to Appendix I for synonymy.

Key to males of Malagasy species of *Curtonotum*
(Examination of the male terminalia is required in all cases.)

1 Wing membrane deep brown infuscate throughout (Figs 27–29); distiphallus either with narrow, ventrally-directed, lateral spine and two smaller basal spines (Figs 61, 62, indicated with arrows), or with patch of finger-like spinules basally and tuft of hairs submedially (Fig. 60) 2
– Wing membrane only faintly brown infuscate, sometimes marginally darker in r_1 and anterior half of r_{2+3} and/or in region of *dm–cu* crossvein only (Figs 30–39); distiphallus lacking ventrally-directed spines or other spinular modifications (if spines present, then these forming anterior margin of basiphallus) 4

2 Three strong postpronotal setae; all setae on mesonotum and thoracic pleura with distinct dark brown ring around each socket (Fig. 3); extensively developed lateral maculae and medial fascia of abdominal tergites black; sternites 4 and 5 modified, with comb of long, regular spinules on anterior margin, sternite 6 with deep V-shaped apical excision (Fig. 86); distiphallus with patch of finger-like spinules basally and tuft of hairs submedially (Fig. 60) .... **sternithrix** Tsacas

– Two strong postpronotal setae; all setae on mesonotum and thoracic pleura without distinct dark brown ring around each socket (Figs 1, 2); extensively developed lateral maculae and medial fascia of abdominal tergites brown; sternites 4 and 5 unmodified, sternite 6 dove-tailed (Figs 79, 80); distiphallus with conspicuous, ventrally-directed, long, lateral spine and two smaller spines (Figs 61, 62, indicated with arrows) 3

3 Frons (Fig. 14) pale brown, with conspicuous deep brown vittae reaching ventral margin; *dm–cu* crossvein angle and curvature as illustrated (Fig. 27); phallus weakly sclerotised at lateral margins of basiphallus (viewed dorsally) (Fig. 61); prominent ventrally-directed spine on distiphallus narrow, smaller spines positioned in basolateral region (Fig. 61) .... **keiseri** Tsacas

– Frons (Fig. 15) pale yellow, slightly darker posteriorly and medial to orbital plates (if frons slightly darker, vittae never strong or reaching ventral margin); *dm–cu* crossvein angle and curvature as illustrated (Fig. 28); phallus heavily-sclerotised at lateral margins of basiphallus (viewed dorsally) (Fig. 62); prominent ventrally-directed spine on distiphallus broad, smaller spines positioned in left and right lateral regions (Fig. 62) .... **stuckenbergi** Tsacas

4 Epandrium (viewed laterally) with oblique semicircular excavation along ventro-apical margin, ventral lobe forming a blunt point, from which two very strong, long black setae originate (Figs 46, 47); anterior margin of basiphallus with finger- or spine-like ventromedial projection (Figs 49, 50, 52, 53).................................. 5

– Epandrium (viewed laterally) evenly-rounded or straight at ventroapical margin, with extensive group of irregular, long setae along ventral margin (Figs 40, 41, 48, 64–66, 73, 76); anterior margin of basiphallus without finger- or spine-like ventromedial projection 6

5 Frons pale dirty yellow, faintly darker towards vertex and between orbital plates, both vittae inconspicuous (Fig. 23); sternite 6 with dense setulae (Fig. 88); surstylus short, wide basally (Fig. 46); *dm–cu* crossvein angle and curvature as illustrated (Fig. 36); basiphallus evenly rounded basally, with conspicuous internal bulge in basal fifth (Fig. 49); distiphallus with medial finger-like, slightly curved, ventrally-directed projection (Figs 49, 52) .... **boeny** Tsacas

– Frons pale brown to dark brown, forming conspicuous vittae, reaching ventral margin (Fig. 24); sternite 6 with sparse setulae (Fig. 89); surstylus long, narrow basally (Fig. 47); *dm–cu* crossvein angle and curvature as illustrated (Fig. 37); basiphallus straight in basal third, with slight internal bulge at midlength (Fig. 50); distiphallus with medial spine-like, ventrally-directed projection (Figs 50, 53) .... **griveaudi** sp. n.

6 Phallus highly modified; basiphallus (Fig. 74) grossly expanded, forming extensive, extremely wide, sclerotised, half moon-shaped plate, strongly concave on

left side, with large, heavily sclerotised sperm pump (Figs 74a, 74b), possibly inserted in left concavity; *dm–cu* crossvein angle and curvature as in Fig. 35 .... **rinhatinana** sp. n.
– Phallus not highly modified; basiphallus not grossly expanded, narrow (Figs 42, 43, 51, 67–69, 77); sperm pump absent; *dm–cu* crossvein angle and curvature not as in Fig. 35)..7

7 Hypandrium short, with broad-based subangulate-truncate dorsobasal lobe (Figs 48, 76); sternite 6 as illustrated (Figs 90, 91); basal section of distiphallus either with a conspicuous, short, dorsomedial keel (Figs 77, 78), or with conspicuous, short dorsomedial spine (Figs 51, 54)...8
– Hypandrium long, with broad-based rounded or subtriangular dorsobasal lobe (Figs 40, 41, 64–66); sternite 6 as illustrated (Figs 81–85); distiphallus lacking a keel or short, dorsomedial spine 9

8 Very small species, wing length *ca* 1.6 mm; frons (Fig. 26) markedly wider at vertex than at ventral margin; ocellar triangle large, extending *ca* one third length of frons; lateral margins of tergites 2–4 collectively forming an unbroken facia (at low magnification); *dm–cu* crossvein angle and curvature as in Fig. 39; distiphallus with conspicuous, short, dorsomedial keel (Figs 77, 78)............. **sakalava** Tsacas
– Larger species, wing length *ca* 3.2 mm; frons (Fig. 25) subparallel-sided; ocellar triangle small, extending *ca* one-fifth length of frons; lateral margins of tergites 2–4 with well-separated, subelliptical macula basally; *dm–cu* crossvein angle and curvature as in Fig. 38; distiphallus with short, dorsomedial spine (Figs 51, 54) (Madagascar, Namibia and South Africa)..................................... **pauliani** Tsacas

9 Sternite 6 broader than long, subquadrate (Figs 84, 85), either with very short setulae, only marginally longer at apical margin (Fig. 84), or with extremely long setulae at apical margin (Fig. 85); basiphallus in apical region, either with distinct raised, angulate fold on left margin (Fig. 44), or with two spines, one medial and one submedial (Fig. 45) 10
– Sternite 6 narrower in basal *ca* third, expanded laterally, with V-shaped or U-shaped apical excision, with moderately strong setulae at apical margin (Figs 81–83); basiphallus (in apical region) either with left lateral margin developed into a long, curved, ventrally-directed spine and smaller medial spine (Fig. 70), or with distinct raised keel and spinose area laterally on distiphallus (Figs 71, 72) 11

10 Frons (Fig. 20) subparallel-sided, pale dirty yellow, faintly darker towards vertex and between orbital plates, otherwise two vittae inconspicuous; *dm–cu* crossvein angle and curvature as illustrated (Fig. 33); basiphallus (Fig. 44) with right lateral margin evenly rounded, with slightly raised margin, forming even projection apically, left lateral margin with distinct, angulate, raised fold .... **balachowskyi** Tsacas
– Frons (Fig. 21) markedly wider at vertex than at ventral margin, pale brown, darker brown towards vertex and between orbital plates, forming conspicuous vittae that reach ventral margin; *dm–cu* crossvein angle and curvature as illustrated (Fig. 34); basiphallus (Fig. 45) with right lateral margin evenly rounded and flat, developed into a bluntly pointed ventromedial spine, with much smaller spine basolaterally .... **gladiiformis** sp. n.

11 Basiphallus moderately narrow in apical third (viewed dorsally), with left lateral margin developed into a long, curved, ventrally-directed spine and smaller medial spine (Fig. 70); *dm–cu* crossvein angle and curvature as illustrated (Fig. 30) ....**irwini** sp. n.
– Basiphallus laterally expanded in apical third (viewed dorsally) (Figs 71, 72), with distinct raised keel in left apical region and spinose area on lateral margin of distiphallus; *dm–cu* crossvein angle and curvature not as Fig. 30............................12

12 Distiphallus (Fig. 71) with sclerotised area subdivided medially, with thin ventrally directed spine in membranous window, right lateral section with three short, dark-tipped spines (viewed dorsolaterally; not visible on Fig. 71); *dm–cu* crossvein angle and curvature as illustrated (Fig. 31)...................................... **parkeri** sp. n.
– Distiphallus (Fig. 72) with basolateral, upturned, sclerotised, crown-like projection, this subtriangular (viewed laterally) (Fig. 69); *dm–cu* crossvein angle and curvature as illustrated (Fig. 32) ....**coronaeformis** sp. n.

Curtonotum balachowskyi Tsacas, 1974

Figs 7, 20, 33, 40, 42, 44, 84, 98

Curtonotum balachowskyi: Tsacas 1974: 710; figs 4a–d (p. 711); fig. 8f (p. 718). Type locality: "Madagascar: Mananjary".
Curtonotum sp. cf. *balachowskyi* n. sp. species b (*sensu* Tsacas 1974: 712).

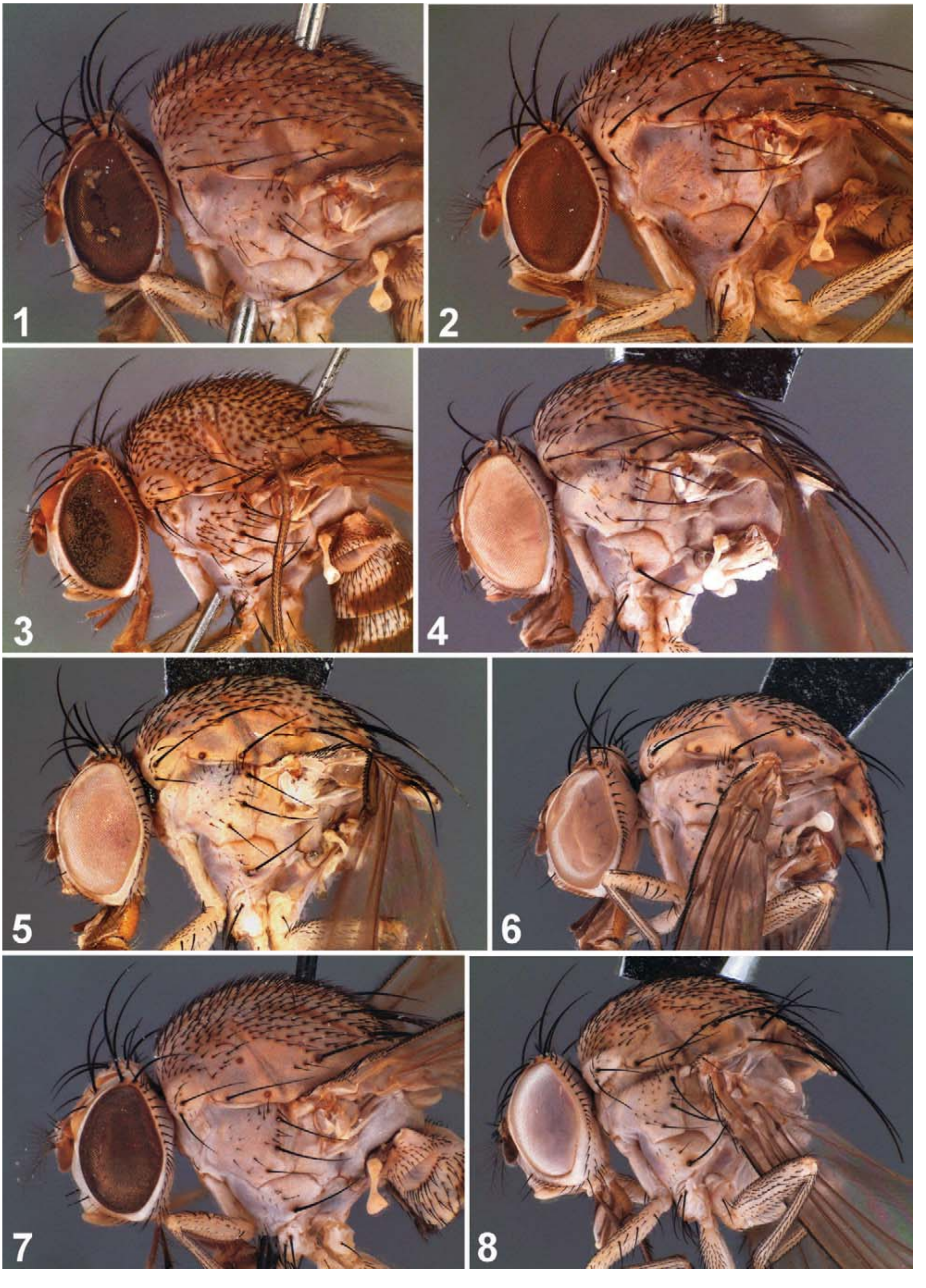
Differential diagnosis: This species differs from other species occurring on Madagascar in having the medial lobes of the hypandrium (viewed dorsally), parallel-sided, with a narrow medial membranous area clothed in tiny spinules. Interpretaton of its relationships to other species occurring in the Afrotropical Region must await the outsome of phylogenetic study.

Redescription:

Male (primarily based on field-pinned HT).

Measurements: Overall length 2.8–4.8 mm (n = 47, N-T); length of head and thorax combined 2.8 mm; length of thorax and scutellum combined 2.9 mm; wing 4 mm long.

Head (Figs 7, 20). Compound eye probably green-brown iridescent in living examples, in profile gently and evenly rounded anteriorly, slightly triangularly produced posteriorly, eye height/length ratio: 12:7 (HT); frons (Fig. 20) subparallel-sided, slightly wider than long, frons length/width ratio: 7:85 (HT), very slightly wider at vertex than at ventral margin, ground colour pale dirty yellow, faintly darker towards vertex and between orbital plates, otherwise both vittae inconspicuous, surface with a few minute pale to dark brown setulae, positioned at medial margin of orbital plates; orbital plates and ocellar triangle silver-grey pruinose; ocelli clear grey with 4 or 5 minute dark setulae arranged in two closely-approximated regular rows between posterior ocelli; orbital plates extending from vertex of head to 0.9 length of frons, slightly indented at lateral margin between posterior and anterior orbital setae; lateral margins with narrow silver pruinose fascia (adjacent to eye margin), widest at antennal insertions; posterior orbital seta moderately strong, slightly outcurved, shorter than outer vertical seta, with tiny proclinate medial orbital seta inserted anteromedially to socket of posterior orbital seta; anterior orbital seta moderately strong, *ca* half length of ocellar setae; ocellar setae finer, almost reaching ventral margin of frons; outer vertical seta shorter than inner;



Figs 1–8. Head and thorax (lateral view) of *Curtonotum* spp., males: (1) *C. keiseri*, PT, Mtge. D'Ambre, NHMB; (2) *C. stuckenbergi*, HT, Ambohitantely, NMHN; (3) *C. sternithrix*, HT, Antanambe, MNHN; (4) *C. irwini* sp. n., PT, Zombitse National Park, CAS; (5) *C. parkeri* sp. n., PT, same, CAS; (6) *C. coronaeformis* sp. n., PT, near Isalo National Park, CAS; (7) *C. balachowskyi*, HT, Fia Mananjary, MNHN; (8) *C. gladiiformis* sp. n., HT, Fianarantsoa, CAS. Not to scale.

postocellar setae strong, cruciate, slightly shorter than outer vertical seta; antennal scape and pedicel dirty pale brown, silver-grey pruinose, flagellomere 1 concolourous with pedicel basally, darkened apically, silver-grey pruinose as in face, longer than wide, apex bluntly-pointed, arista with 9–11 long dorsal branches and 3 or 4 ventral branches in addition to terminal fork; lunule and face uniform silver-grey pruinose throughout, face with broad silver fascia (adjacent to eye margin), facial carina developed as a low ridge, extending half length of face, pre-epistomal line indented; clypeus brown, especially laterally; 1 pair fairly strong vibrissae inserted on posterior lateral margin and 10 much finer setae bordering genal groove; occiput yellow to grey pruinose with moderately strong, black postocular setae; gena narrow, eye height/genal height ratio: 12:1 (HT), silver pruinose, abruptly dirty brown beyond basal angle; palpus black-brown, brown microtrichose.

Thorax (Fig. 7). Mesonotum moderately convex, very slightly flattened behind head, with multiple rows of regular, short, black, overlapping setulae; silver-grey pruinose, with four parallel chestnut-brown pruinose vittae on dorsal surface, 2 median vittae extending from anterior margin to region of anterior dorsocentral seta socket, 2 lateral vittae shorter, extending from ⅔ length to region of posterior dorsocentral seta socket, 2 pairs of dorsocentral setae, posterior long and strong (shorter than lateral scutellar seta), anterior shorter and finer (shorter and finer than medial scutellar seta); 1 pair acrostichal setae shorter than anterior dorsocentral seta; presutural seta moderately strong, reclinate, as long and strong as posterior notopleural seta; 2 notopleural setae the anterior slightly longer than posterior; 1 strong, reclinate supra-alar seta slightly exceeding length of posterior dorsocentral seta; 2 reclinate postalar seta moderately strong, same size as acrostichal setae; postpronotum dirty yellow-grey pruinose, with 2 strong postpronotal setae, the more dorsal longer and reclinate, the more ventral shorter and proclinate, with 10–12 finer black-brown setulae; anepisternum silver-grey pruinose with 3 moderately strong anepisternal setae, the dorsal and medial reclinate, stronger and of equal length, the more ventral shorter, slightly dorsally-directed, surface with 18 fine setulae scattered across surface, some larger and arranged in two groups of 3; anepimeron, laterotergite and meron silver-grey pruinose, glabrous; katepisternum silver-grey pruinose, with 2 katepisternal setae, the more ventral strong, slightly dorsally-directed, the more dorsal much smaller and finer, *ca* 0.2 length of ventral katepisternal setae, surface with 16 short, fine setulae at base and along posterior margin.

Scutellum. Silver-grey pruinose as in mesonotum, with faint medial brown pruinose vitta basally (under some lights); anterior 0.8 clothed in black, irregular, overlapping setulae; 2 pairs of strong scutellar setae, 1 weak basal scutellar setula and 1 weak intermediate scutellar setula, the latter inserted closer to lateral than medial scutellar setae (0.8 distance between medial and lateral scutellar setae).

Legs. Fore coxa silver-yellow pruinose with two moderately strong, brown, ventrally-directed preapical setae and comb of finer setulae medially, with 8–10 brown setulae on anterior surface; mid and hind coxa yellow-grey pruinose, mid coxa with 2 very strong, lateral, ventrally-directed, black setae and comb of finer setae medially and 3 brown setulae; hind coxa with 1 weaker lateral black seta and 1 brown setula; femora, tibia and tarsi uniform dirty yellow; all tibiae with preapical seta; fore tibia with 4 strong setae on lateral margin, the second basal seta shorter than other three, with ctenidium of 10–12 short, sharp, black spinules, separated from each other by one or more basal spinule widths.

Wing (Fig. 33). Long, relatively narrow, tip evenly-rounded, veins chestnut-brown, membrane very faintly infuscate brown throughout, very slightly darker in r_1 and anterior half of r_{2+3} and in region of *dm–cu* crossvein; costa with prominent costal spines in basal 0.8 from costal break; R_{4+5} slightly anteriorly-produced in basal third, R_{2+3} and R_{4+5} subparallel, r_{2+3} expanded apically; *dm–cu* crossvein slightly obliquely angled posteriorly, evenly curved medially; cua_1 relatively long and narrow; A_1+CuA_2 and A_2 manifested as a fold only; A_2 extending half length of cua_1; haltere dirty yellow.

Abdomen. Ground colour of tergites 1–5 yellow-grey pruinose, clothed in relatively long black, overlapping setulae, arranged in regular rows, those at apical margins longer and stronger; tergite 1 simple, devoid of maculae; tergite 2 with oblique, subrectangular brown-black pruinose dorsolateral macula on either side only; tergites 3–5 with narrow, V-shaped concolourous median fascia and well-separated and reduced concolourous T-shaped dorsolateral macula, lateral margin of tergites 2–5 with subelliptical concolourous macula in basal half; sternite 4, quadrate, sternite 5 rectangular, subparallel-sided, 0.25× longer than sternite 4, both unmodified, with brown setulae arranged in irregular rows, those along apical margins slightly longer and stronger; sternite 6 (Fig. 84) subquadrate (may appear narrower in undissected specimens), narrowed in basal 0.4, with shallow, broad, subtriangular excision apically, with faint brown maculae medially and fascia laterally, merging apically, clothed in short black irregular brown setulae in apical ⅔, those at apical margin longer and more prominent.

Terminalia (Figs 40, 42, 44). Hypandrium (Fig. 40, *hy*) long, with broad-based rounded-truncate dorsobasal lobe, posterior bridge dorsally and ventrally produced (rounded to slightly angulate in profile); hypandrial arms narrow basally, expanded apically (viewed laterally), with 2 setulae proximal to postgonite, the more lateral ventrally directed, the medial ventromedially directed (obscured by epandrium on Fig. 40), sclerotised area of medial lobes (viewed dorsally), parallel-sided, medial membranous area narrow, clothed in tiny spinules, separated in basal half, slightly overlapping in apical half; postgonite (Fig. 40, *pg*) long, thin and straight, with slight undulating anterior margin; epandrium (Fig. 40, *ep*) slightly broader dorsally than ventrally (viewed laterally), evenly-rounded on dorsal margin, posterior margin slightly angled, ventral margin with extensive row of long, regular to irregular, apically-directed setae; cercus (Fig. 40, *ce*) not prominent, longest setae as long as medium setae on ventral margin of epandrium; surstylus (Fig. 40, *ss*) long, widest basally, slightly curved in apical ⅔; phallus (as in Figs 42, *ph*, *bp*, *dp*; 44, *bp*, *dp*) C-shaped, moderately sclerotised, brown; phallapodeme (Fig. 42, *ph*), fused to basiphallus, subtriangular (viewed laterally), with basal margin developed into two short, flat projections in basal 0.4, bifurcated at point of connection with hypandrium; ejaculatory apodeme (Fig. 42, *ea*) free, duct inserted at junction of phallapodeme and basiphallus; basiphallus (Fig. 42, *bp*) narrow and regular for most of its length, with very slight internal bulge at point of first bend in basal three-fifths; apical section (Fig. 44, *bp*) broad, right lateral margin evenly rounded with slightly raised margin, forming even projection apically, left lateral margin with distinct raised fold; distiphallus (Figs 42, 44, *dp*) long, scimitar-like (viewed laterally), narrow (viewed dorsally).

Variation: The even projection on the right anterior margin of the basiphallus is somewhat variable in shape and angle in some specimens, other terminalia characters are consistent, however, and this is here regarded as intraspecific variation only.

Holotype (examined): ♂ MADAGASCAR: "MADAGASCAR Fia / Mananjary / 11.VIII.[19]58.F.KEISER [pink paper] // HOLOTYPE [red card] // CURTONOTUM / *balachowskyi* / ♂ holotype n.sp. / L. TSACAS DET. 1974 [printed & handwritten] // MUSÉUM PARIS // *Curtonotum* / *balachowskyi* ♂ / Tsacas, 1974 / A.H. Kirk-Spriggs *vidit* 2008" (MNHN). In excellent condition; re-staged on new poly mount; dissected, abdomen and terminalia in micro-vial pinned beneath specimen.

Paratypes (all labelled: "*Curtonotum* / *balachowskyi* ♂ [or ♀] / Tsacas, 1974 / A.H. Kirk-Spriggs *vidit* 2008"): MADAGASCAR: 1♀ same data as holotype except: "// PARATYPE [printed; red card] // CURTONOTUM / *balachowskyi* n.sp. / ♂ paratype / L. TSACAS DET. 1974 [printed & handwritten]"; 1♀ same except: "// CURTONOTUM / *balachowskyi* n.sp. / ♀ paratype / L. TSACAS DET. 1974 [printed & handwritten]" (both NHMB); 1♀ same except: "6.VIII.[19]58 // ALLOTYPE [printed; red card] // CURTONOTUM / *balachowskyi* / ♀ allotype n.sp. / L. TSACAS DET. 1974 [printed & handwritten]"; 1♂, "Ambila / [?Sunaibo - illegible] [handwritten] // VIII.[19]52 / (R.P.) [= R. Paulian] [handwritten] // INSTITUT / SCIENTIFIQUE / MADAGASCAR [pale grey card] // PARATYPE [red card] // CURTONOTUM / *balachowskyi* / ♂ paratype n.sp. / L. TSACAS DET. 1974 [printed & handwritten] // MUSÉUM PARIS" [head detached, glued to data label] (both MNHN); 1♂, "MADAGASCAR Tam. / Tamatave / 23.X.[19]58 F.KEISER [pink paper] // PARATYPE [red card] // CURTONOTUM / *balachowskyi* / ♂ paratype n.sp. / L. TSACAS DET. 1974 [printed & handwritten]" (NHMB).

Other material examined (all labelled: "*Curtonotum balachowskyi* Tsacas, 1974 ♂ det. A.H. Kirk-Spriggs 2010"): MADAGASCAR: *d'Analalava Prov.*: 1♂ Maromandia, R. Decary 1922, "*Curtonotum* sp. cf. *balachowskyi* n. sp. espece b, L. Tsacas det. 1974" (MNHN): *Fianarantsoa Prov.*: 1♂ near Isalo National Park, at stream east of Interpretive Center, 22°37.60'S:45°21.49'E, 13–19.i.2002, 750 m, M.E. Irwin & R. Harin'Hala, Malaise trap in open area (MA-02-11A-11); 1♂ near Isalo National Park, in dry wash east of Interpretive Center, 22°37.60'S:45°21.49'E, 12–22.vi.2002, 885 m, M.E. Irwin & R. Harin'Hala, Malaise trap in open area (MA-02-11B-32); 4♂ 50 km S of Farafangana, Mahabo Mananivo, Ampitavananima Forest, 23°7.79'S:47°43.02'E, 13–20.i. 2007, 34 m, M.E. Irwin, F. Parker & R. Harin'Hala, Malaise trap low altitude littoral rainforest (MG-35-01); same except: 1♂ 20–26.i.2007 (MG-35-02); 1♂ 26.i–4.ii.2007 (MG-35-03); 1♂ 4–10.ii.2007 (MG-35-04); 1♂ 10–17.ii.2007 (MG-35-05); 1♂ 17–24.iii.2007 (MG-35-10); 1♂ 24–31.iii.2007 (MG-35-11); 2♂ 14–21.v.2007 (MG-35-18); 5♂ 21–25.v.2007 (MG-35-19); 1♂ 29.v–2.vi.2007 (MG-35-20); 1♂ 2–10.vi.2007 (MG-35-21); 1♂ 10–15.vi.2007 (MG-35-22); 2♂ 15.vi–1.vii.2007 (MG-35-23); 5♂ 14–19.vii.2007 (MG-35-26); 2♂ 3–11.viii.2007 (MG-35-30); 3♂ 11–27.viii.2007 (MG-35-31); 2♂ 27.viii–6.ix.2007 (MG-35-32); 1♂ 6–13.ix.2007 (MG-35-33); 6♂ 13–20.ix.2007 (MG-35-34). *Tuléar Prov.*: 1♂ Zombitse National Park, near national road, 22°50.43'S:44°43.87'E, 26.xi–2.xii.2001, 825 m, R. Harin'Hala, Malaise trap, deciduous spiny forest (MA-02-13B-04); 1♂ Beza Mahafaly Reserve, Parcelle I near research station, 23°41.19'S:44°35.46'E, 15.x–10.xi.2001, 165 m, M.E. Irwin, F.D. Parker & R. Harin'Hala, Malaise trap in dry deciduous forest (MA-02-14A-01); 2♂ Mikea Forest, 97 ft, 22°54.22'S:43°28.53'E, 6–16.xii.2001, Malaise trap, deciduous dry forest, R. Harin'Hala & M.E. Irwin (MG-18A-05); same except: 2♂ 16–26.xii.2001 (MG-18A-06); 1♂ 26.xi–27.xii.2001 (MG-18A-07); 1♂ 27.xii.2001–6.i.2002 (MG-18A-08); 1♂ 19.ii–1.iii.2002 (MG-18A-14); 1♂ 8–18.iii.2002 (MG-18A-16); 2♂ 18–29.iv.2002 (MG-18A-20); 1♂ 9–19.v.2002 (MG-18A-22); 1♂ 22.vi–2.vii.2002 (MG-18A-26); 1♂ 2–13.vii.2002 (MG-18A-27); 1♂ 23.vii–6.viii.2002 (MG-18A-29); 1♂ 19.viii–3.ix.2002 (MG-18A-31); 3♂ 29.vi–6.vii.2003 (MA-02-18A-60); 2♂ 6–17.vii.2003 (MA-02-18A-61); 2♂ 17–27.vii.2003 (MA-02-18A-62); 5♂ 27.vii–3.viii.2003 (MA-02-18A-63); 2♂ Mikea Forest, 22°54.80'S:43°23.93'E, 20–27.xi.2001, 120 ft, R. Harin'Hala & M.E. Irwin, Malaise trap, spiny forest (MG-18B-03); same except: 3♂ 6–16.xii.2001 (MG-18B-05); 1♂ 16–26.xii.2001 (MG-18B-06); 1♂ 6–16.i.2002 (MG-18B-09); 1♂ 16–17.i.2002 (MG-18B-10); 1♂ 28.iii–8.iv.2002 (MG-18B-18); 1♂ 18–29.iv.2002 (MG-18B-20); 1♂ 29.iv–9.v.2002 (MG-18B-21); 1♂ 19–29.v.2002 (MG-18B-23); 1♂ 19.viii–3.ix.2002 (MG-18B-31); 1♂ Beroboka village 45 km NE Morondava, 19°58.65'S:44°39.92'E, 26–30.x.2007, 420 ft, M.E. Irwin & R. Harin'Hala, Malaise trap, Antsarongaza gallery forest (MG-45B-06); same except: 1♂ 6–13.xi.2007 (MG-45B-08) (all CAS). *Mgjunga Prov*.: 1♂ Ampijoroa National Park, 160 km N of MGevatanana on RN 04, 16°19.16'S:46°48.80'E, 2–9.vii.2003, 140 ft, M.E. Irwin & R. Harin'Hala, Malaise trap, deciduous forest (MG-25-05); same except: 1♂ 10–17.viii.2003 (MG-25-10) (all CAS); 1♂ 7–14.ix.2003 (MA-25-14) [in spirit], BMSA(DNA)#0042 (BMSA); 1♂ 2–9.xi.2003 (MG-25-22); 1♂ 9–20.xi.2003 (MG-25-23); 3♂ 30.xi–8.xii.2003 (MG-25-25); 1♂ 16–27.x.2004 (MG-25-34); 1♂ 21.i–7.ii.2005 (MG-25-42); 3♂ 17–19.ii.2005 (MG-25-43). *Antananarivo Prov*.: 1♂ Ambohitantely, 46 km NE of Ankazobe, 18°11.88'S:47°16.89'E, 28.xii.2003–10.i.2004, 2300 ft, R. Harin'Hala & M.E. Irwin, Malaise trap, forêt sclerophylle (MG-27-12); 6♂ same except: 10–20.i.2004 (MG-27-13); 1♂ same except: 1–12.ii.2004 (MG-

27-15). *Majunga Prov*.: 2♂ Ambovomamy Belambo, 20 km NW of Port Berger, 15°27.07'S:47°36.80'E, 4–14.i.2007, 33 m, R. Harin'Hala, M.E. Irwin & F. Parker, Malaise, secondary growth on white sand (MG-33-01); same except: 3♂ 21–22.i.2007 (MG-33-03); 1♂ 22–27.i.2007 (MG-33-04); 1♂ 7–13.ii.2007 (MG-33-07); 1♂ 13–18.ii.2007 (MG-33-08) (all CAS); 1♂ 18–25.ii.2007 (MG-33-09) [in spirit], BMSA(DNA)#0044 (BMSA); 1♂ 3–10.iii.2007 (MG-33-11); 1♂ 10–18.iii.2007 (MG-33-12); 1♂ 18–26.iii.2007 (MG-33-13); 1♂ 6–12.iv.2007 (MG-33-16); 9♂ Besalampy District, Marofototra dry forest, 17 km W of Besalampy, 16°43.30'S:44°25.42'E, 24.ix–1.x.2007, 170 ft, M.E. Irwin & R. Harin'Hala, Malaise trap, dry wash in forest (MG-42A-01); 1♂ Besalampy District, Marofototra palm forest 17 km W of Besalampy, 16°43.30'S:44°25.42'E, 1–8.x.2007, 35 ft, M.E. Irwin & R. Harin'Hala, Malaise trap, palm trees on sand (MG-42B-02); same except: 6♂ 8–15.x.2007 (MG-42B-03); 13♂ 15–22.x.2007 (MG-42B-04) [1 head missing]; 6♂ 22–29.x.2007 (MG-42B-05); 2♂ 29.x–5.xi.2007 (MG-42B-06); 5♂ 2–12.xi.2007 (MG-42B-07); 9♂ 12–19.xi.2007 (MG-42B-08); 9♂ 19–26.xi.2007 (MG-42B-09); 5♂ 26.xi–3.xii.2007 (MG-42B-10); 9♂ 3–10.xii.2007 (MG-42B-11); 8♂ 10–17.xii.2007 (MG-42B-12); 5♂ 17–24.xii.2007, (MG-42B-13); 4♂ Maintirano District, Asondrodava dry forest, 15 km N of Maintirano, 17°57.92'S:44°2.13'E, 27.ix–8.x.2007, 200 ft, M.E. Irwin & R. Harin'Hala, Malaise trap in dry forest (MG-43A-01); same except: 4♂ 8–15.x.2007 (MG-43A-02); 5♂ 22–29.x.2007 [1 with wing detached and glued to point] (MG-43A-04); 1♂ 29.x–5.xi.2007 (MG-43A-05); 2♂ 5–12.xi.2007 (MG-43A-06); 4♂ 12–17.xi.2007 (MG-43A-07); 1♂ 17.xi–3.xii.2007 (MG-43A-08); 2♂ 3–10.xii.2007 (MG-43A-09); 6♂ 10–17.xii.2007 (MG-43A-10); 26♂ 17–24.xii.2007 (MG-43A-11); 5♂ 24–31.xii.2007 (MG-43A-12); 18♂ 31.xii.2007–7.i.2008 (MG-43A-13); 23♂ 7–14.i.2008 (MG-43A-14); 18♂ 14–21.i.2008 (MG-43A-15); 27♂ 21–28.i.2008 (MG-43A-16); 28♂ 28.i–4.ii.2008 (MG-43A-17); 23♂ Maintirano District, Asondrodava dry forest 15 km N of Maintirano, 17°57.92'S:44°2.13'E, 27.ix–8.x.2007, 200 ft, M.E. Irwin & R. Harin'Hala, Malaise trap, dry forest at dune (MG-43B-01); same except: 7♂ 8–15.x.2007 (MG-43B-02); 12♂ 15–22.x.2007 (MG-43B-03) [1 head missing]; 11♂ 22–29.x.2007 (MG-43B-04); 5♂ 29.x–5.xi.2007 (MG-43B-05); 1♂ 5–12.xi.2007 (MG-43B-06); 3♂ 12–17.xi.2007 (MG-43B-07) (all CAS); 1♂ 10–17.xii.2007 (MG-43B-11) [in spirit], BMSA(DNA)#0053 (BMSA); 3♂ 17–24.xii.2007 (MG-43B-12); 5♂ 24–31.xii.2007 (MG-43B-13); 4♂ 31.xii.2007–7.i.2008 (MG-43B-14) (all CAS); 1♂ 14–21.i.2008 (MG-43B-16) [in spirit], BMSA(DNA)#0055 (BMSA); 2♂ 21–28.i.2008 (MG-43B-17). *Toamasina Prov*.: 1♂ Mobot site, Analalava, 7 km SW of Foulpointe, 17°42'32"S:49°27'29"E, 15–21.ix.2007, 80 ft, M.E. Irwin & R. Harin'Hala, Malaise trap, low altitude dense humid forest (MG-37A-01) (CAS).

Distribution (Fig. 98): The most widely distributed species of the genus in Madagascar, distributed in six vegetation types (Appendix II), in the Dry Deciduous Forest, Central Highlands and Evergreen Rainforest biomes. Occurring in nine biogeographical zones and all bioclimatic zones (Figs 105–107; Tables 1–3).

Curtonotum boeny Tsacas, 1974

Figs 10, 23, 36, 46, 49, 52, 88, 101

Curtonotum boeny: Tsacas 1974: 712; figs 5a–9 (p. 713), fig. 8c (p. 718). Type locality: "Madagascar: Ambato-Boeny".

Differential diagnosis: This species is closely related to *C. griveaudi* sp. n., differing in the colour of the frons and antennae, the shape of the wing and the shape of the male terminalia. Both share the peculiar subtriangular form of the epandrium with the lateral setation reduced to two long and strong setae originating from the blunt point formed by the ventral margin. *Curtonotum boeny* differs from *C. griveaudi* sp. n., however, in having the hypandrial arm narrowed apically, the surstylus shorter and wider basally, the presence and position of the conspicuous internal bulge on the phallus and the apical shape of the basiphallus, with the more pronounced finger-like medial projection. The ranges of the two species overlap, but it is not known whether they occur sympatrically.

Redescription:

Male (primarily based on field-pinned HT).

As redescribed for *C. balachowskyi*, differing in the following respects:

Measurements: Overall length 3.2–4.5 mm (n = 6, N-T); length of head and thorax combined 2.1 mm; length of thorax and scutellum combined 1.95 mm; wing length 3.2 mm (HT).

Head (Figs 10, 23). Eye prominent, eye height/length ratio: 9:5 (HT); frons (Fig. 23), slightly wider than long, frons length/width ratio: 50:55 (HT), markedly wider at vertex than at ventral margin; arista with 8 long dorsal branches and 3 ventral branches in addition to terminal fork; face with narrow silver fascia (adjacent to eye margin); 1 pair of weak vibrissae inserted on posterior lateral margin and 10 much finer setae bordering genal groove; occiput grey pruinose throughout; gena narrow, eye height/genal height ratio: 9:1 (HT), silver pruinose, slightly dirty yellow beyond basal angle; palpus brown.

Thorax (Fig. 10). Mesonotum with two narrow, weakly-defined, parallel, medial chestnut-brown pruinose vittae on dorsal surface, extending from anterior margin to region of anterior dorsocentral seta socket; anterior dorsocentral seta much shorter and finer than medial scutellar seta; reclinate supra-alar seta, slightly shorter than posterior dorsocentral seta; thoracic pleurae silver-grey, yellow pruinose in their centres; postpronotum silver-grey pruinose, with 8–10 fine black-brown setulae; anepisternum silver-grey pruinose, with yellow pruinose patches medially, with 19–20 fine setulae, the 5 larger grouped together at posterodorsal margin; katepisternum with dorsal katepisternal seta *ca* 0.3 length of ventral katepisternal seta, with 18 short, fine setulae at base and along posterior margin.

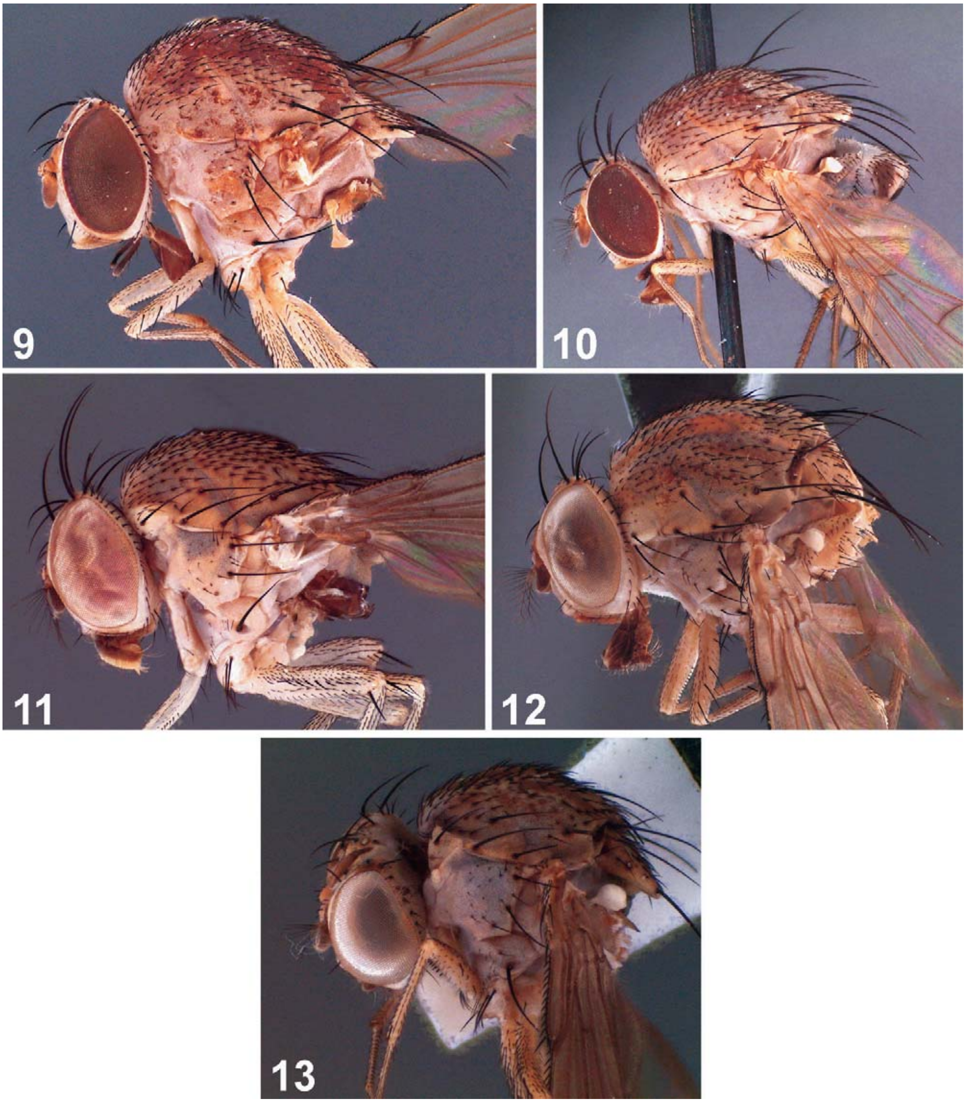
Scutellum. As in mesonotum; two pairs of strong scutellar setae, 1 weak basal scutellar setula and 1 weak intermediate scutellar setula, the latter inserted equidistant between lateral and medial scutellar setae.

Legs. Fore coxa with 8–10 brown setulae on anterior surface; hind coxa with lateral black seta; fore tibia with ctenidium of 8 short spinules.

Wing (as in Fig. 36). Veins brown, membrane hyaline with very faint brown infuscation, slightly darker in region of *dm–cu* crossvein; *dm–cu* crossvein obliquely angled.

Abdomen. Tergite 1 simple, devoid of maculae; tergite 2 with oblique, subovoid brown-black pruinose dorsolateral macula on either side only; tergites 3–5 with large broad, V-shaped concolourous median fascia and large concolourous T-shaped dorsolateral maculae, these close to, but not fully merging with, median fascia; lateral margin of tergites 2–5 with subelliptical concolourous macula in basal half; sternite 4 quadrate, weakly sclerotised; sternite 5 slightly longer than sternite 4, lateral margins rounded, with oblong brown macula on either side, both unmodified, with sparse brown setulae arranged in irregular rows, those along apical margins of sternite 5 slightly longer and stronger; sternite 6 (Fig. 88) subquadrate (may appear narrower than Fig. 88 in undissected specimens), slightly expanded medially, with moderately deep, subtriangular excision apically, brown in apical 0.8, clothed in closely-packed, long, curved, overlapping brown setulae in apical 0.8.

Terminalia (Figs 46, 49, 52). Hypandrium (Fig. 46, *hy*) rather flattened and long, with broad-based, rounded-truncate dorsobasal lobe, posterior bridge dorsally and ventrally produced (subtriangular in profile); hypandrial arms of even width (viewed laterally), with 2 setulae proximal to postgonite, the more lateral ventrally directed, the medial ventromedially directed (obscured by epandrium on Fig. 46), sclerotised area of medial lobes (viewed dorsally), with slightly rounded margins, not overlapping (not convex); postgonite (Fig. 46, *pg*) long, thin and straight; epandrium (Fig. 46, *ep*) subtriangular (in lateral view), with deep, oblique excavation along ventral margin, ventral lobe forming a blunt point from which two very strong, long setae originate; cercus (Fig. 46, *ce*) not prominent, longest setae as long as medium setae on dorsal margin of epandrium; surstylus (Fig. 46, *ss*) long, widest basally, slightly curved in apical ⅔; phallus (as in Figs 49, *ph*, *bp*, *dp*; 52, *bp*, *dp*) C-shaped, moderately sclerotised, brown;



Figs 9–13. Head and thorax (lateral view) of *Curtonotum* spp., males: (9) *C. rinhatinana* sp. n., HT, Ankarafantsika, CAS; (10) *C. boeny*, HT, Ambato-Boeni, MNHN; (11) *C. griveaudi* sp. n., HT, Asondrodava dry forest, CAS; (12) *C. pauliani*, N-T, Tsingy National Park, CAS; (13) *C. sakalava*, N-T, Berenty Special Reserve, CAS. Not to scale.

phallapodeme (Fig. 49, *ph*) fused to basiphallus, subtriangular (viewed laterally), with basal margin developed into two flat, broad, subtriangular projections in basal 0.4, bifurcated at point of connection with hypandrium; ejaculatory apodeme (Fig. 49, *ea*) free, duct inserted at junction of phallapodeme and basiphallus; basiphallus (Fig. 49, *bp*) broader in basal half, slightly narrowed in apical half, with large, conspicuous internal bulge at point of first bend in basal fifth; apical section (Fig. 52, *bp*) moderately broad, right lateral margin with raised keel, projecting medially as long, finger-like projection; distiphallus (Figs 49, 52, *dp*) long, with slight curve at midlength, very narrow (viewed laterally and dorsally).

Variation: The frons appears slightly darker in ex-alcohol specimens.

Holotype (examined): ♂ MADAGASCAR: "MADAGASCAR Maj. / Ambato-Boeni / 23.VI.[19]58 F. KEISER [pink paper] // HOLOTYPE [red card] // CURTONOTUM / *boeny* n.sp. / Holotype ♂ / L. TSACAS DET. 1973 [printed & handwritten] // MUSÉUM PARIS // *Curtonotum* / *boeny* ♂ / Tsacas, 1974 / A.H. Kirk-Spriggs *vidit* 2008" (MNHN). In excellent condition; pinned and double-mounted on card triangle; right wing detached and glued to point; dissected, abdomen and terminalia in micro-vial pinned beneath specimen.

Paratypes (all labelled: "*Curtonotum* / *boeny* ♀ / Tsacas, 1974 / A.H. Kirk-Spriggs *vidit* 2008–2010"): MADAGASCAR: 1♀ same labels as holotype, except: "// ALLOTYPE [red card] // CURTONOTUM / *boeny* n.sp. / Allotype ♀ / L. TSACAS DET. 1973 [printed & handwritten]" [left wing detached and glued to card] (MNHN); 2♀ same except: "// PARATYPE [red card] // CURTONOTUM / *boeny* n.sp. / Paratype ♀ / L. TSACAS DET. 1973 [printed & handwritten]" (NHMB).

Notes: Tsacas (1974: 713) cited the date of collection of the type series as "23.v.58", but the labels actually read "23.VI.58". He further noted that the holotype and 1 paratype were deposited in MNHN and that the allotype and 1 paratype were deposited in NHMB. In truth, the holotype and allotype are deposited in MNHN and 2 paratypes in NHMB.

Other material examined (all labelled: "*Curtonotum* / *boeny* ♂ [or ♀] / Tsacas, 1974 / det. A.H. Kirk-Spriggs 2010"): MADAGASCAR: *Mahajanga Prov*.: 4♂ Parc National Tsingy de Memaraha, 3.4 km 93° E Bekopaka, Tombeau Vazimba, 19°08'31"S:44°49'41"E, 50 m, 6–10.xi.2001, leg. [B.] Fisher, [C.] Griswold *et al*., tropical dry forest, Malaise trap (MAD49), BLF4233 (CAS).

Distribution (Fig. 101): Occurring in the Wooded Grassland-Bushland and Western Dry Forest vegetation types, in the Dry Deciduous Forest biome. In the North West and West biogeographical zones and Dry bioclimatic zone (Figs 105–107; Tables 1–3; Appendix II).

Curtonotum coronaeformis sp. n.

Figs 6, 19, 32, 66, 69, 72, 83, 97

Etymology: From Latin *corona* (crown) and *formis* (in the form of), and refers to the crown-like lateral extension of the distiphallus of this species.

Differential diagnosis: This species is closely related to *C. parkeri* sp. n.; the shape, maculae and setation of abdominal sternites 4 and 5 are virtually identical, the apical region of the basiphallus is markedly expanded in both species, with very similar left and right raised keels and both share the raised and spinose right sclerotised area of the basiphallus. In *C. coronaeformis* sp. n., however, the basiphallus is less markedly narrowed medially and less expanded in the apical third, and the raised and spinose right sclerotised area of the distiphallus is conspicuously developed, with a series of regular to irregular spines. The two species occur sympatrically.

Description:

Male (primarily based on ex spirit-preserved HT).

As redescribed for *C. balachowskyi*, differing in the following respects:

Measurements: Overall length unknown; length of head and thorax combined 2.9 mm; length of thorax and scutellum combined 2.4 mm; wing length 3.7 mm.

Head (Figs 6, 19). Compound eye prominent, probably green-brown iridescent in living examples, eye height/length ratio: 10:7 (HT); frons (Fig. 19), slightly wider than long, frons length/width ratio: 5:6 (HT), markedly wider at vertex than at ventral margin, ground colour pale yellow to pale brown, darker brown towards vertex and between orbital plates forming conspicuous vittae that reach ventral margin; orbital plates and ocellar triangle golden-grey pruinose; orbital plates extending from vertex of head to *ca* 0.8 length of frons, margins regular; antennal scape and pedicel dirty pale brown, silver-grey pruinose, flagellomere 1 very long, *ca* 2.5× longer than wide, apex evenly-rounded, yellow basally, darkened apically, yellow-grey pruinose, arista with 8 or 9 long dorsal branches and 3 ventral branches in addition to terminal fork; lunule and face silver-grey pruinose, yellow pruinose beneath flagellomere 1; gena narrow, eye height/genal height ratio: 10:1 (HT), silver pruinose throughout; palpus pale brown.

Thorax (Fig. 6). Mesonotum as described for *C. boeny*; acrostichal setae, much shorter than anterior dorsocentral seta; supra-alar seta, slightly shorter than posterior dorsocentral seta; postalar setae longer and stronger than acrostichal setae; postpronotum yellow-grey pruinose, with 6 finer black-brown setulae; anepisternum silver-grey pruinose, with yellow pruinose patches medially, surface with 18 fine setulae, some larger and arranged in 2 groups of 3 and 4; katepisternum silver-grey to silver-yellow pruinose, with 13 short, fine setulae at base and along posterior margin.

Scutellum. As in mesonotum, with very faint medial brown pruinose vitta basally (under some lights), slightly paler yellow pruinose at posterior margin; weak intermediate scutellar setula inserted at 0.8 distance between medial and lateral scutellar setulae.

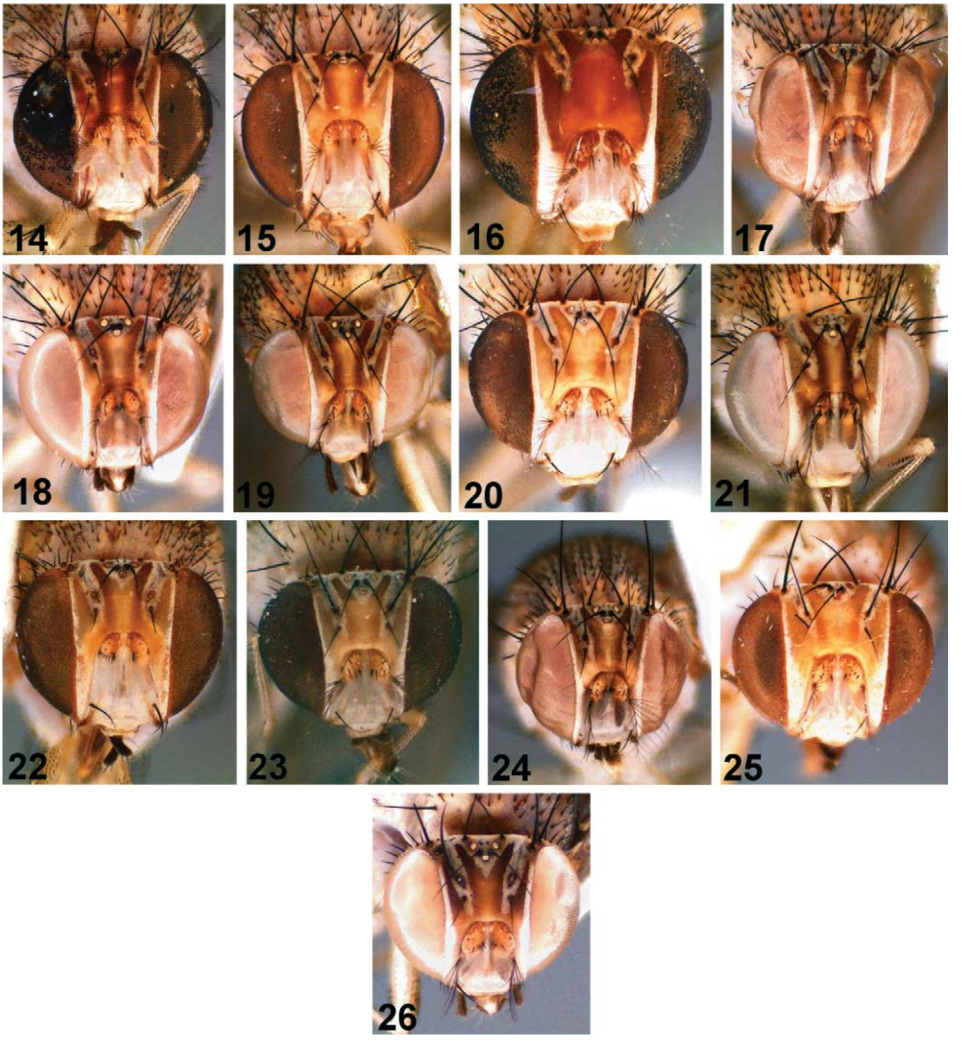
Legs. Fore coxa with 22 brown setulae on anterior surface; fore tibia with ctenidium of 10 or 11 short, sharp black spinules.

Wing (as in Fig. 32). Veins chestnut-brown, membrane very faintly infuscate brown throughout, very slightly darker in r_1 and in region of *dm–cu* crossvein; *dm–cu* crossvein oblique, in shape of uninterrupted arc.

Abdomen. Tergites 3–5 with broad V-shaped, median fascia adjoining and slightly merging with large, concolourous T-shaped dorsolateral maculae; lateral margin of tergites 2–5 with subelliptical concolourous macula in basal half to ⅔; sternite 4 with posterior and lateral margins evenly rounded, apical margin straight; sternite 5 rectangular, similarly shaped to sternite 4, slightly longer and wider medially, with 2 small ovoid basomedial maculae, sternites 4 and 5 unmodified, with long, dense, brown setulae arranged in irregular rows, those along lateral margins longer and stronger; sternite 6 (Fig. 83) narrowed basally, evenly rounded laterally (may appear narrower than Fig. 83 in undissected specimens), with broad, deep apical excision and brown maculae medially and fascia laterally, merging apically, clothed in long, black, irregular, medially-directed, brown setulae in apical 0.8, those at apical margin longer and more prominent.

Terminalia (Figs 66, 69, 72). Hypandrium (Fig. 66, *hy*) long, with broad-based rounded-truncate dorsobasal lobe, posterior bridge dorsally and ventrally produced

(rounded to slightly angulate in profile); hypandrial arms constricted in apical ⅔ (viewed laterally), with 2 setulae proximal to postgonite, the more lateral ventrally directed, the medial ventromedially directed (obscured by epandrium on Fig. 66), sclerotised area of medial lobes (viewed dorsally), with margins evenly rounded, convex, closely abutting, not overlapping; postgonite (Fig. 66, *pg*) long, thin, spindle-like; epandrium (Fig. 66, *ep*) broad (viewed laterally), evenly-rounded on dorsal margin, posterior



Figs 14–26. Frons (dorsal view) of *Curtonotum* spp., males: (14) *C. keiseri*, PT, Mtge. D'Ambre, NHMB; (15) *C. stuckenbergi*, HT, Ambohitantely, NMHN; (16) *C. sternithrix*, HT, Antanambe, MNHN; (17) *C. irwini* sp. n., HT, Zombitse National Park, CAS; (18) *C. parkeri* sp. n., HT, same, CAS; (19) *C. coronaeformis* sp. n., HT, Fianarantsoa, CAS; (20) *C. balachowskyi*, HT, Fia Mananjary, MNHN; (21) *C. gladiiformis* sp. n., HT, Fianarantsoa, CAS; (22) *C. rinhatinana* sp. n., HT, Ankarafantsika, CAS; (23) *C. boeny*, HT, Ambato-Boeni, MNHN; (24) *C. griveaudi* sp. n., HT, Asondrodava dry forest, CAS; (25) *C. pauliani*, N-T, Ankarafantsika, CAS; (26) *C. sakalava*, N-T, Andohahela National Park, CAS. Not to scale.

margin slightly angled, ventral margin with extensive row of long, regular to irregular, apically-directed setae; cercus (Fig. 66, *ce*) not prominent, longest setae longer than setae on dorsal margin of epandrium; surstylus (Fig. 66, *ss*) long and narrow, slightly curved in apical ⅔; phallus (as in Figs 69, *ph*, *bp*, *dp*, 72, *bp*, *dp*) C-shaped, moderately sclerotised, brown; phallapodeme (Fig. 69, *ph*) fused to basiphallus, subtriangular (viewed laterally), with basal margin developed into two flat, narrow, rounded projections in basal 0.4, bifurcated at point of connection with hypandrium; ejaculatory apodeme (Fig. 69, *ea*) free, duct inserted at junction of phallapodeme and basiphallus; basiphallus (Fig. 69, *bp*) broad basally, narrowed just beyond midlength; apical section (Fig. 72, *bp*) expanded and broad, right lateral margin with ventral projection, left margin with distinct raised keel; distiphallus (Figs 69, 72, *dp*) long, narrow and curved, with extensive broad membranous section, basolaterally with upturned, sclerotised, crown-like projection (subtriangular viewed laterally).

Variation: The size and number of teeth and smaller serrations at the margin of the upturned, sclerotised, crown-like projection of the distiphallus are variable. This is here interpreted as intraspecific variation only, since other terminalia characters are constant.

Holotype ♂ "MADAGASCAR: Province / Fianarantsoa, near Isalo / National Park, in dry wash / east of Interpretive Center / 22°37.60'S, 45°21.49'E / 23.ii–5.iii.2002, 885 m / M.E. Irwin & R. Harin'Hala / Malaise trap in open area / MA-02-11B-57 // HOLOTYPE ♂ / *Curtonotum* / *coronaeformis* sp. n. / A.H. Kirk-Spriggs 2010 [red card]" (CAS). In good condition; card-pointed; dissected, abdomen and terminalia in micro-vial pinned beneath specimen.

Paratypes (all labelled: "PARATYPE ♂ / *Curtonotum* / *coronaeformis* sp. n. / A.H. Kirk-Spriggs 2010 [blue card]"): 3♂ same data as holotype, except (1 labelled: "BMSA(DNA)#0049") [1 right wing detached and glued to card]; same except: 1♂ "12–22.vi.2002, MA-02-11B-32"; 1♂ "6–14.xii.2002, MA-02-11B-49" (all CAS).

Distribution (Fig. 97): Apparently confined to the Wooded Grassland-Bushland vegetation type, in the Central Highlands biome. In the Central biogeographical zone and Subarid bioclimatic zone (Figs 105–107; Tables 1–3; Appendix II).

Curtonotum gladiiformis sp. n.

Figs 8, 21, 34, 41, 43, 45, 85, 99

Etymology: From Latin *gladius* (sword) and *formis* (in the form of), and refers to the sword-like shape of the distiphallus of this species.

Differential diagnosis: This species is probably most closely related to *C. balachowskyi* Tsacas. Both share the similarly-shaped scimitar-like distiphallus, with the incurved basal area (viewed laterally) and the subquadrate sternite 6, with a very shallow apical excision. *Curtonotum gladiiformis* differs from *C. balachowskyi*, however, in having the lateral margin of the apical border of the basiphallus developed into a medial and submedial spine, as opposed to *C. balachowskyi*, in which the right lateral border forms a distinct, angulate fold, and in having the setae on sternite 6 much longer on the apical margin.

Description:

Male (primarily based on ex spirit-preserved HT).

As redescribed for *C. balachowskyi*, differing in the following respects:

Measurements: Overall length unknown; length of head and thorax combined 2.9 mm; length of thorax and scutellum combined 2.6 mm (HT); wing 4.4 mm long ($n = 1$, PT).

Head (Figs 8, 21). Eye prominent, eye height/length ratio: 11:7 (HT); frons (Fig. 21), slightly wider than long, frons length/width ratio: 7:8 (HT), ground colour pale brown, darker brown towards vertex and between orbital plates forming conspicuous vittae that reach ventral margin; orbital plates and ocellar triangle golden-grey pruinose; ocelli clear brown; orbital plates extending from vertex of head to 0.8 length of frons, lateral margins with narrow silver pruinose fascia (adjacent to eye margin), slightly wider at antennal insertions; posterior orbital seta moderately strong, slightly longer than outer vertical seta; antennal scape and pedicel brown-grey pruinose, flagellomere 1 yellow pruinose basally, pitchy brown, grey pruinose apically, arista with 8 or 9 long dorsal branches and 3 or 4 ventral branches in addition to terminal fork; lunula yellow-grey pruinose; face with narrow silver fascia (adjacent to eye margin); occiput grey pruinose; gena narrow, eye height/genal height ratio: 10:1 (HT), silver pruinose throughout, very slightly darker beyond basal angle; palpus pale brown, brown microtrichose.

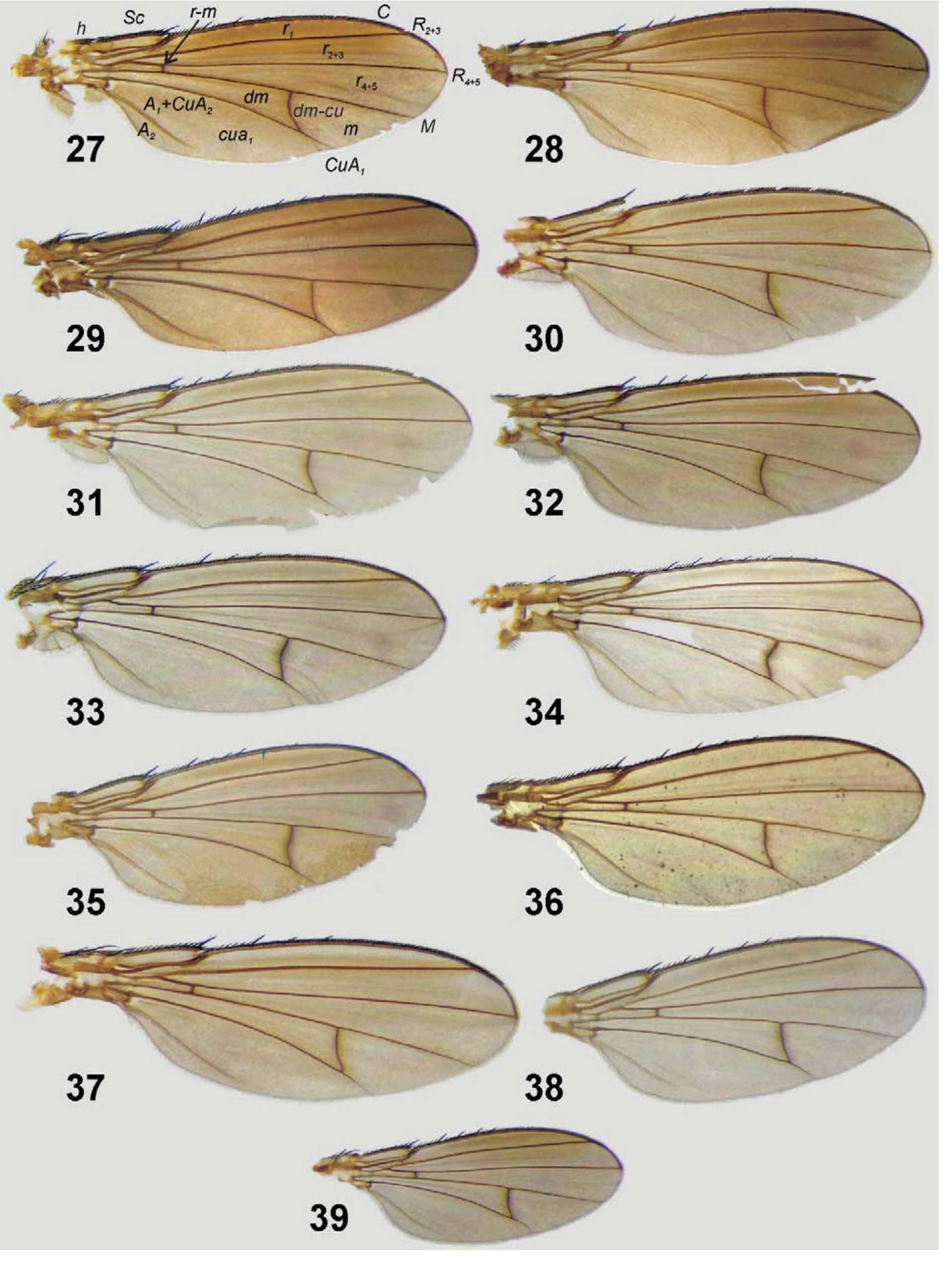
Thorax (Fig. 8). Mesonotum as described for *C. boeny*; presutural seta (missing on holotype and paratypes); anterior notopleural seta markedly longer than posterior; supra-alar seta shorter than posterior dorsocentral seta; postalar setae longer and stronger than acrostichal setae; postpronotum silver-yellow pruinose, with 11 finer black-brown setulae; anepisternum silver-grey pruinose, silver-yellow pruinose medially, surface with 24 fine setulae, some larger and arranged in 2 groups of 3; anepimeron, laterotergite and meron silver-grey to yellow-grey pruinose; katepisternum silver-grey to yellow-grey pruinose with darker grey macula in anterior half, dorsal katepisternal setae *ca* 0.4 length of ventral katepisternal setae, with 11 short, fine setulae at base and along posterior margin.

Scutellum. As in mesonotum, slightly paler yellow pruinose at posterior margin; weaker intermediate scutellar setula inserted at 0.8 distance between medial and lateral scutellar setulae.

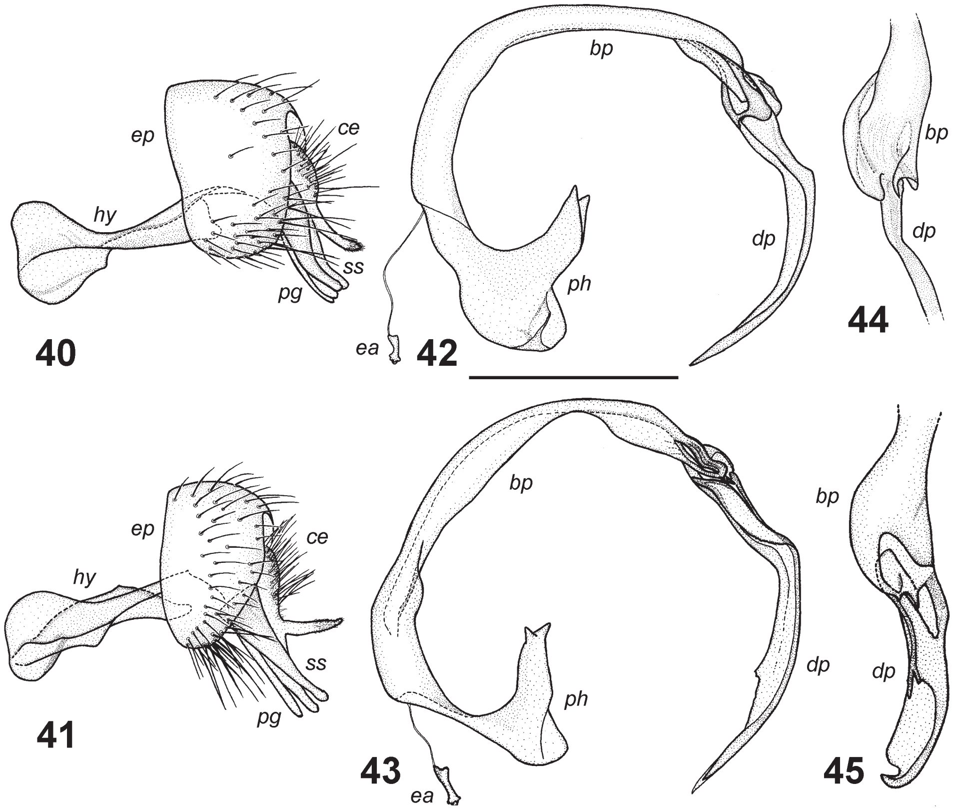
Legs. Fore coxa with 9 brown setulae on anterior surface; mid coxa with 8 brown setulae; fore tibia with ctenidium of 12 spinules.

Wing (as in Fig. 34). Broad basally, tip evenly rounded, veins chestnut-brown, membrane very faintly infuscate brown throughout, very slightly darker in region of *dm–cu* crossvein; *dm–cu* crossvein evenly arched; haltere dirty white.

Abdomen. Tergite 1 simple, devoid of maculae; tergite 2 with oblique, subrectangular brown-black pruinose dorsolateral macula on either side and faint medial fascia; tergites 3–5 with broad, V-shaped concolourous median fasciae and well separated and extensive concolourous T-shaped dorsolateral macula, these close, but not merging with medial fascia, lateral margin of tergites 2–5 with subquadrate concolourous macula in basal ⅔; sternite 4, weakly sclerotised, quadrate, sides evenly narrowing to straight apical margin; sternite 5 similar, but wider and longer, both unmodified, with long, brown, sparse setulae arranged in irregular rows, lateral setulae longer and stronger; sternite 6 (Fig. 85) much broader than long (may appear narrower than Fig. 85 in undissected specimens), with very shallow apical excision and faint, transverse, brown maculae apically, clothed in extremely long, sparse, black, irregular setulae, especially along apical margin.



Figs 27–39. Wing of *Curtonotum* spp., males, unless otherwise stated: (27) *C*. *keiseri*, N-T, Joffreville, TAU; (28) *C*. *stuckenbergi*, ♀ AT, Ambohitantely, NMSA; (29) *C*. *sternithrix*, PT, Manambato, NMSA; (30) *C*. *irwini* sp. n., PT, Zombitse National Park, CAS; (31) *C*. *parkeri* sp. n., HT, same, CAS; (32) *C*. *coronaeformis* sp. n., PT, near Isalo National Park, CAS; (33) *C*. *balachowskyi*, N-T, Asondrodava dry forest, CAS; (34) *C*. *gladiiformis* sp. n., PT, near Isalo National Park, CAS; (35) *C*. *rinhatinana* sp. n., HT, Ankarafantsika, CAS; (36) *C*. *boeny*, ♀ PT, Ambata-Boeni, MNHN; (37) *C*. *griveaudi* sp. n., N-T, Sambava Beach, TAU; (38) *C*. *pauliani*, N-T, Tsingy National Park, CAS; (39) *C*. *sakalava*, N-T, Berenty Special Reserve, CAS. Not to scale.



Figs 40–45. Male terminalia of *Curtonotum* spp.: (40, 41) hypandrium and epandrium, lateral view: (40) *C. balachowskyi*, N-T, Fianarantsoa, CAS; (41) *C. gladiiformis* sp. n., PT, same, CAS; (42, 43) phallus, right lateral view: (42) *C. balachowskyi*, HT, Mananjary, MNHN; (43) *C. gladiiformis*, HT, Fianarantsoa, CAS; (44, 45) basiphallus and distiphallus junction, dorsal view: (44) *C. balachowskyi*; (45) *C. gladiiformis*. Scale bar = 0.5 mm.

Terminalia (Figs 41, 43, 45). Hypandrium (Fig. 41, *hy*) long, with broad-based rounded-truncate dorsobasal lobe, posterior bridge dorsally and ventrally produced (rounded to slightly angulate in profile); hypandrial arm constricted medially (viewed laterally), with 2 setulae proximal to postgonite, the more lateral strong, ventrally-directed, the medial much smaller and weaker (or absent) (obscured by epandrium on Fig. 41), sclerotised area of medial lobes (viewed dorsally), with margins evenly rounded, convex medially, closely abutting, not overlapping; postgonite (Fig. 41, *pg*) long, thin and straight, with slight undulating anterior margin; epandrium (Fig. 41, *ep*) broader dorsally than ventrally (viewed laterally), evenly rounded on dorsal margin, posterior margin slightly angled, ventral margin with extensive row of long, regular to irregular, ventrally-directed setae; cercus (Fig. 41, *ce*) not prominent, longest setae longer than dorsal setae of epandrium; surstylus (Fig. 41, *ss*) long, widest basally, slightly curved in apical ⅔; phallus (as in Figs 43, *ph*, *bp*, *dp*; 45, *bp*, *dp*) C-shaped, very large, moderately sclerotised, brown; phallapodeme (Fig. 43, *ph*) fused to basiphallus, subtriangular (viewed laterally), with basal margin developed into two flat, narrow, subtriangular projections in basal 0.4, bifurcated at point of connection with hypandrium; ejaculatory apodeme

(Fig. 43, *ea*) free, duct inserted at junction of phallapodeme and basiphallus; basiphallus (Fig. 43, *bp*) broad in basal region, with conspicuous internal bulge, then narrowed, moderately constricted in *ca* apical ⅔ (viewed dorsally); apical section (Fig. 45, *bp*) broad, right lateral margin evenly rounded and flat, developed into a bluntly-pointed ventromedial spine, with much smaller spine basolaterally; distiphallus (Figs 43, 45, *dp*) moderately sclerotised, extremely long, sword-like, with conspicuous curved indentation in basal third (viewed laterally), sclerotised area subdivided basally, with triangular window.

Variation: In the two PT the basiphallus is not as markedly constricted in the apical ⅔ as in Fig. 43 and this may be the result of slight distortion in phallus of the HT.

Holotype: ♂ "MADAGASCAR: Province / Fianarantsoa, near Isalo / National Park, in dry wash / east of Interpretive Center / 22°37.60'S, 45°21.49'E / 28.iii–9.iv.2003, 885 m / M.E. Irwin & R. Harin'Hala / Malaise trap in open area / MA-02-11B-60 // HOLOTYPE ♂ / *Curtonotum* / *gladiiformis* sp. n. / A.H. Kirk-Spriggs 2010 [red card]" (CAS). In good condition, some head setae missing; card-pointed; dissected, abdomen and terminalia in micro-vial pinned beneath specimen.

Paratypes (all labelled: "PARATYPE ♂ / *Curtonotum* / *gladiiformis* sp. n. / A.H. Kirk-Spriggs 2010 [blue card]"): 1♂ same data as holotype, except: "3–10.ii.2002, MA-02-11B-14" [right wing detached and glued to card]; 1♂ "6–14.xii.2002, MA-02-11B-49 // BMSA(DNA)#0050" (both CAS).

Distribution (Fig. 99): Apparently confined to the Wooded Grassland-Bushland vegetation type, in the Central Highlands biome. In the Central biogeographical zone and Subarid bioclimatic zone (Figs 105–107; Tables 1–3; Appendix II).

Curtonotum griveaudi sp. n.

Figs 11, 24, 37, 47, 50, 53, 89, 102

Etymology: The species is named in honour of Paul Elexis Jacques Griveaud (1907–1980), in recognition of his contribution to Madagascan entomology.

Differential diagnosis: This species is closely related to *C. boeny*, differing in the colour of the frons and antennae, the shape of the wing and the shape of the male terminalia. Both share the peculiar subtriangular form of the epandrium, with the lateral setation reduced to two long, strong setae originating from the blunt point formed by the ventral margin. *Curtonotum griveaudi* sp. n. differs from *C. boeny*, however, in having the hypandrial arm much broader apically and the surstylus considerably longer and narrower basally. The species further differ in the presence and position of the low internal bulge of the phallus, with the basal section of the phallus quite straight, and the apical shape of the basiphallus, with its reduced lateral keel and short, spine-like ventromedial projection. The ranges of the two species overlap, but it is not known whether they occur sympatrically.

Description:

Male (primarily based on ex spirit-preserved HT).

As redescribed for *C. balachowskyi*, differing in the following respects:
Measurements: Overall length unknown; length of head and thorax combined 2.2 mm; length of thorax and scutellum combined 2.2 mm (HT); wing length 3.5 mm (n = 1, N-T).

Head (Figs 11, 24). Eye prominent, eye height/length ratio: 10:6 (HT); frons (Fig. 24), markedly wider at vertex than at ventral margin, frons length/width ratio: 1:5 (HT), ground colour pale brown to dark brown, darker brown towards vertex and between orbital plates forming conspicuous vittae that reach ventral margin; ocellar triangle golden-grey pruinose, ocelli clear brown; orbital plates extending from vertex of head to 0.8 length of frons, markedly wider at socket of posterior orbital seta; lateral margins with narrow silver pruinose fascia (adjacent to eye margin), slightly wider at antennal insertions; posterior orbital seta moderately strong, slightly longer than outer vertical seta; antennal scape and pedicel brown-grey pruinose, flagellomere 1 yellow pruinose basally, pitchy brown, grey pruinose apically, arista with 10 long dorsal branches and 4 ventral branches in addition to terminal fork; lunule brown, face with narrow silver fascia (adjacent to eye margin); occiput grey pruinose; gena narrow, eye height/genal height ratio: 10:1 (HT), silver pruinose throughout, very slightly darker beyond basal angle; palpus pale brown, brown microtrichose.

Thorax (Fig. 11). Mesonotum as described for *C. boeny*; anterior dorsocentral setae much shorter and finer than medial scutellar seta; postalar setae moderately strong, slightly longer and stronger than acrostichal setae; postpronotum silver-grey pruinose, with 7 or 8 finer black-brown setulae; anepisternum silver-grey pruinose, with yellow pruinose patches medially, surface with 28 fine setulae, some larger and arranged in 2 groups of 3 and 4; anepimeron, laterotergite and meron silver-grey to yellow pruinose; katepisternum silver-grey to yellow pruinose, with dorsal katepisternal setae *ca* 0.2 length of ventral katepisternal setae, with 18 short, fine setulae at base and along posterior margin.

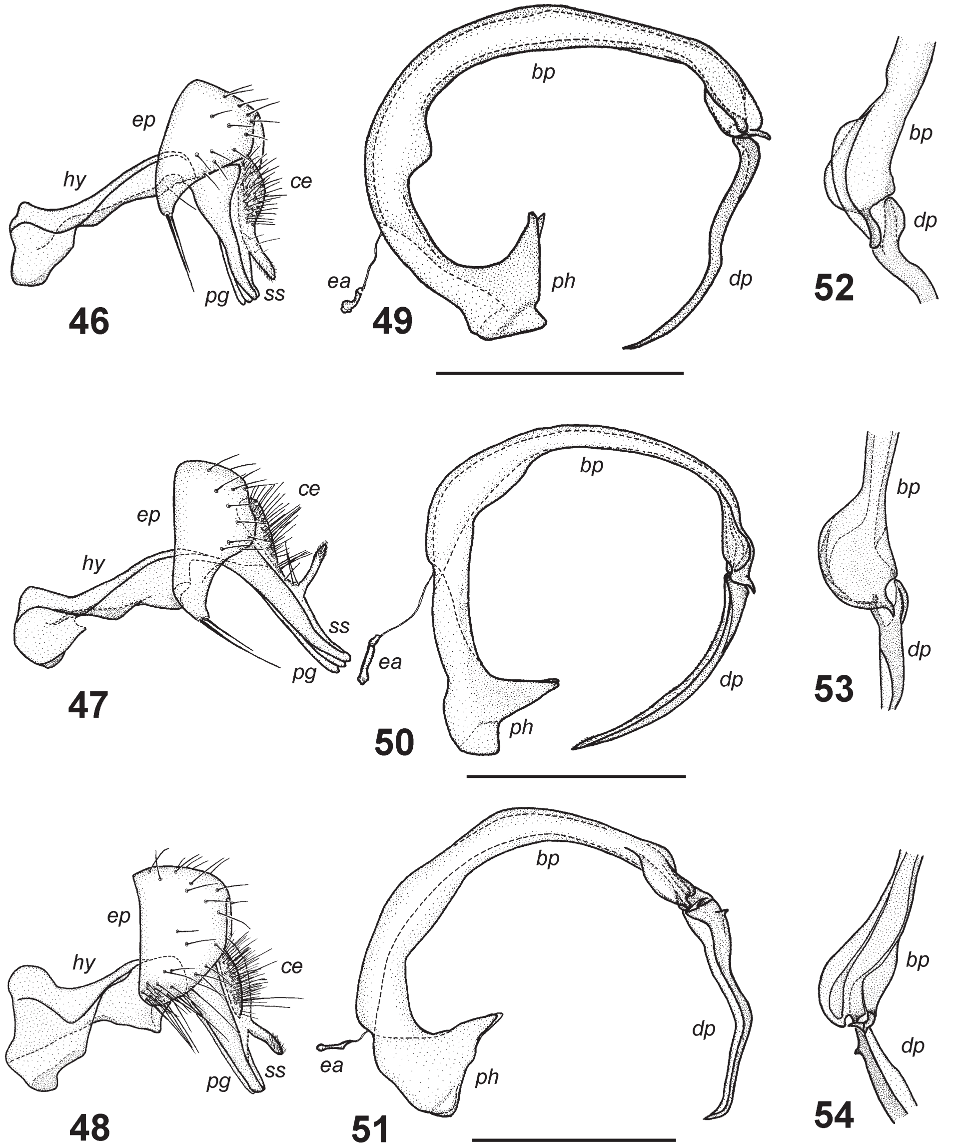
Scutellum. As in mesonotum, with very faint medial brown pruinose vitta basally (under some lights), slightly paler yellow pruinose at posterior margin; weak intermediate scutellar setula inserted closer to lateral than medial scutellar setae.

Legs. Fore coxa with 18 brown setulae on anterior surface; mid coxa with 16 brown setulae; fore tibia with ctenidium of 10 spinules.

Wing (as in Fig. 37). Veins brown, membrane hyaline with very faint brown infuscation, very slightly darker in posterior half of r_1 and anterior half of r_{2+3} and in region of *dm–cu* crossvein; *dm–cu* crossvein strongly, obliquely angled in even arc.

Abdomen. Tergite 1 simple, devoid of maculae; tergite 2 with oblique, subovoid brown-black pruinose dorsolateral macula on either side only; tergites 3–5 with large, broad V-shaped median fascia and large concolourous T-shaped dorsolateral macula, these close or adjoining, but not fully merging with median fascia; lateral margin of tergites 2–5 with subelliptical concolourous macula in basal half; sternite 4, long, rectangular, weakly sclerotised; sternite 5 same length as sternite 4, lateral margins curved, with oblong brown macula on either side, both unmodified, with very sparse brown setulae arranged in irregular rows, those along lateral margins of sternite 5 slightly longer and stronger; sternite 6 (Fig. 89) rather broad apically, narrow basally (may appear narrower than Fig. 89 in undissected specimens), with moderately shallow, subtriangular excision apically, brown in apical 0.8, clothed in sparse, long, straight, overlapping brown setulae in apical 0.8.

Terminalia (Figs 47, 50, 53). Hypandrium (Fig. 47, *hy*) long, with broad-based rounded-truncate dorsobasal lobe, posterior bridge dorsally and ventrally produced (subtriangular in profile); hypandrial arms expanded apically, with sclerotised ventrally-directed arc (viewed laterally), setulae absent, sclerotised area of medial lobes (viewed dorsally), with slightly rounded margins, not overlapping (not convex); postgonite (Fig. 47, *pg*) long, thin and straight; epandrium (Fig. 47, *ep*) subtriangular (in lateral view), with deep, oblique semicircular excavation along ventral margin, ventral lobe forming a blunt point, from which two very strong, long setae originate; cercus (Fig. 47, *ce*) not prominent, longest setae as long as medium setae on dorsal mar-



Figs 46–54. Male terminalia of *Curtonotum* spp.: (46–48) hypandrium and epandrium, lateral view: (46) *C. boeny*, N-T, E. Bekopaka, CAS; (47) *C. griveaudi* sp. n., PT, Asondrodava, CAS; (48) *C. pauliani*, N-T, E. Bekopaka, CAS; (49–51) phallus, right lateral view: (49) *C. boeny*; (50) *C. griveaudi*; (51) *C. pauliani*; (52–54) basiphallus and distiphallus junction, dorsal view: (52) *C. boeny*; (53) *C. griveaudi*, PT, Mahafaly Reserve, CAS; (54) *C. pauliani*. Scale bars = 0.5 mm.

gin of epandrium; surstylus (Fig. 47, *ss*) drawn out, very long and narrow, slightly wider basally and curved in apical 0.8; phallus (as in Figs 50, *ph*, *bp*, *dp*, 53, *bp*, *dp*) C-shaped, weakly sclerotised, pale brown; phallapodeme (Fig. 50, *ph*) fused to basiphallus, subtriangular (viewed laterally), with basal margin developed into two flat, broad, subtriangular projections in basal 0.4, bifurcated at point of connection with hypandrium; ejaculatory apodeme (Fig. 50, *ea*) free, duct inserted at junction of phallapodeme and basiphallus; basiphallus (Fig. 50, *bp*) broad and straight in basal half, broadest at first bend, with slight internal bulge, then markedly narrowed (narrowest at second bend); apical section (Fig. 53, *bp*) very broad, right margin laterally expanded and evenly rounded, with slightly raised margin, left lateral margin with distinct raised fold, projecting medially as short, spine-like ventromedial projection; distiphallus (Figs 50, 53, *dp*) long, evenly curved, scimitar-like (viewed laterally), narrow (viewed dorsally).

Variation: The frons is darker in some specimens, almost chestnut-brown; even in specimens with a paler brown frons the two longitudinal brown vittae are strikingly apparent.

Holotype: ♂ "Madagascar: Majunga / Prov., Maintirano District / Asondrodava dry forest / 15km N of Maintirano / 17°57.92'S 44°2.13'E / 24–31.xii.2007, 200 ft / M.E. Irwin & R. Harin'Hala / Malaise trap, dry forest / at dune, MG-43B-13 // HOLOTYPE ♂ / *Curtonotum* / *griveaudi* sp. n. / A.H. Kirk-Spriggs 2011 [red card]" (CAS). In good condition, right foreleg missing; card-pointed; dissected, abdomen and terminalia in micro-vial pinned beneath specimen.

Paratypes (all labelled: "PARATYPE ♂ [or ♀] / *Curtonotum* / *griveaudi* sp. n. / A.H. Kirk-Spriggs 2011 [blue card]"): 1♂ "Madagascar: Tuléar / Province, Mikea Forest, / NW of Manombo / 22°54.22'S, 43°28.53'E / 6–17.vii.2003, 30 m / M.E. Irwin & R. Harin'Hala / Malaise trap in deciduous / dry forest / MA-02-18A-61"; 1♂ "Madagascar: Province / Fianarantsoa, near Isalo / National Park, in dry wash / east of Interpretive Center / 22°37.60'S:45°21.49'E / 6–14.xii.2002, 885 m / M.E. Irwin & R. Harin'Hala / Malaise trap in open area / MA-02-11B-49"; 1♂ "Madagascar: Tuléar / Province, Beza Mahafaly / Reserve, Parcelle I near / research station / 23°41.19'S:44°35.46'E / 9–20.ix.2002, 165 m / R. Harin'Hala, Malaise / trap in dry deciduous forest / MA-02-14A-35 // BMSA(DNA)#0047" (all CAS); 1♂ 2♀ "Madagascar NE, Sambava Beach, 14.iv.1991, A. Freidberg & Fini Kaplan" [♂ with phallus missing from vial; left wing detached and glued to card] (all TAU).

Other material examined (labelled: "*Curtonotum* / *griveaudi* ♂ / sp. n. / A.H. Kirk-Spriggs 2011"): MADAGASCAR: *Majunga Prov.*: 1♂ Maintirano District, Asondrodava dry forest 15 km N of Maintirano, 17°57.92'S:44°2.13'E, 10–17.xii.2007, 200 ft, M.E. Irwin & R. Harin'Hala, Malaise trap, dry forest at dune (MG-43B-11) [in spirit], BMSA(DNA)#0054 (BMSA).

Distribution (Fig. 102): Occurs in the Wooded Grassland-Bushland and South Western Dry Spiny Forest-Thicket vegetation types, in the Arid Spiny Bush, Central Highlands and Dry Deciduous Forest biomes. In the West and South biogeographical zones and Dry and Subarid bioclimatic zones (Figs 105–107; Tables 1–3; Appendix II).

Curtonotum irwini sp. n.

Figs 4, 17, 30, 64, 67, 70, 81, 95

Etymology: The species is named in honour of Michael Edward Irwin, in recognition of his contribution to our knowledge of Madagascan Diptera.

Differential diagnosis: This species is probably most closely related to *C. parkeri* sp. n. and *C. coronaeformis* sp. n. All share the extensively-developed sclerotised area of the distiphallus and sternite 6 is very similar in all three species. It differs from *C. parkeri* and *C. coronaeformis*, however, in lacking a raised lateral, spinose ridge on the distiphallus and in having the right lateral margin of the basiphallus developed into a long, curved, ventrally-directed spine, with smaller spine medially.

Description:

Male (primarily based on ex spirit-preserved HT).

As redescribed for *C. balachowskyi*, differing in the following respects:

Measurements: Overall length 3.85–4.55 mm (n = 8, PT); length of head and thorax combined 2.5 mm; length of thorax and scutellum combined 2.3 mm (HT); wing length 3.2 mm (n = 1, PT).

Head (Figs 4, 17). As described for *C. gladiiformis* sp. n., except: eye height/length ratio: 12:8 (HT); frons (Fig. 17), frons length/width ratio: 6:7 (HT); posterior orbital seta moderately strong, slightly shorter than outer vertical seta; arista with 9 or 10 long dorsal branches and 4–6 ventral branches in addition to terminal fork; gena narrow, eye height/genal height ratio: 12:1 (HT), silver pruinose, slightly darker beyond basal angle; palpus pale brown.

Thorax (Fig. 4). Mesonotum as described for *C. boeny*, except: presutural seta moderately strong, shorter and weaker than posterior notopleural seta; postpronotum with 7 finer black-brown setulae; anepisternum silver-grey pruinose, with silver-yellow pruinose areas, surface with 18 fine setulae, some larger and arranged in 2 groups of 3 and 2; anepimeron, laterotergite and meron silver-grey to silver-yellow pruinose; katepisternum silver-grey to silver-yellow pruinose, with darker macula in anterior half, with dorsal katepisternal setae *ca* 0.3 length of ventral katepisternal setae, with 18 short, fine setulae at base and along posterior margin.

Scutellum. As described for *C. gladiiformis* sp. n.

Legs. Fore coxa with 13 brown setulae on anterior surface; mid coxa with 7 brown setulae; fore tibia with ctenidium of 14 spinules.

Wing (as in Fig. 30). Veins chestnut-brown, membrane very faintly infuscate brown throughout, very slightly darker in region of *dm–cu* crossvein; *dm–cu* crossvein acutely angled with interrupted arc; haltere dirty white.

Abdomen. Tergite 1 simple, devoid of maculae; tergite 2 with oblique, subovoid brown-black pruinose dorsolateral macula on either side only; tergites 3–5 with large broad, V-shaped concolourous median fascia and large concolourous T-shaped dorsolateral macula, these close or adjoining, but not fully merging with median fascia; lateral margin of tergites 2–5 with subelliptical concolourous macula in basal half; sternites 4–5, as described for *C. coronaeformis* sp. n.; sternite 6 (Fig. 81), narrowed basally, evenly rounded laterally (may appear narrower than Fig. 81 in undissected specimens), with broad, shallow apical excision and brown maculae medially and fascia laterally, merging apically, clothed in long, black, irregular, apically-directed, brown setulae in apical half, those at apical margin much longer and more prominent.

Terminalia (Figs 64, 67, 70). Hypandrium (Fig. 64, *hy*) long, with broad-based rounded-truncate dorsobasal lobe, posterior bridge dorsally and ventrally produced (rounded to slightly angulate in profile); hypandrial arm constricted apically (viewed laterally), with 2 setulae proximal to postgonite, the more lateral strong, ventrally directed, the medial much smaller and weaker (obscured by epandrium on Fig. 64), sclerotised area of medial lobes (viewed dorsally), with margins evenly rounded, convex medially, closely abutting, not overlapping; postgonite (obscured by surstylus on Fig. 64) long, thin and straight, with slight undulating anterior margin; epandrium (Fig.

64, *ep*) broader dorsally than ventrally (viewed laterally), evenly rounded on dorsal margin, posterior margin slightly angled, ventral margin with extensive row of long, regular to irregular, apically-directed setae; cercus (Fig. 64, *ce*) not prominent, longest setae as long as setae on dorsal margin of epandrium; surstylus (Fig. 64, *ss*) long, widest basally, slightly curved in apical ⅔; phallus (as in Figs 67, *ph*, *bp*, *dp*, 70, *bp*, *dp*) C-shaped, heavily sclerotised, brown; phallapodeme (Fig. 67, *ph*) fused to basiphallus, subtriangular (viewed laterally), with basal margin developed into two flat, narrow, subtriangular projections in basal 0.4, bifurcated at point of connection with hypandrium; ejaculatory apodeme (Fig. 67, *ea*) free, duct inserted at junction of phallapodeme and basiphallus; basiphallus (Fig. 67, *bp*) broad in *ca* basal half, with slight internal bulge at midlength, then markedly narrowed, strongly constricted in *ca* apical ⅔ (viewed dorsally); apical section (Fig. 70, *bp*) moderately broad, right lateral margin evenly rounded, left lateral margin developed into long, curved ventrally-directed spine, with smaller spine medially; distiphallus (Figs 67, 70, *dp*) broad basally, sclerotised area extensive, abruptly narrowed towards apex, basal section with membranous window, apical section narrow and spindle-like.

Variation: The length of the larger, curved ventrally-directed spine of the distiphallus is variable in some specimens. Other terminalia characters are constant and this is here interpreted as intraspecific variation only.

Holotype: ♂ “MADAGASCAR: Tuléar Province / Zombitse National Park / near ANGAP office, 840 m / 22°53.19’S:44°41.53’E / 28.ii–6.iii.2002 / California Acad of Sciences / R. Harin’Hala, Malaise trap / deciduous spiny forest / MA-02-13A-18 // HOLOTYPE ♂ / *Curtonotum* / *irwini* sp. n. / A.H. Kirk-Spriggs 2010 [red card]” (CAS). In fair condition, wings slightly tattered and mesonotum rubbed; card-pointed; dissected, abdomen and terminalia in micro-vial pinned beneath specimen.

Paratypes (all labelled: “PARATYPE ♂ / *Curtonotum* / *irwini* sp. n. / A.H. Kirk-Spriggs 2010 [blue card]”): MADAGASCAR: same data as holotype, except: 2♂ “15.x–9.xi.2001, MA-02-13A-01”; 12♂ “9–19.xi.2001, MA-02-13A-02”; 3♂ “19–26.xi.2001, MA-02-13A-03”; 3♂ “26.xi–2.xii.2001, MA-02-13A-04”; 6♂ “2–7.xii.2001, MA-02-13A-05”; 1♂ “7–14.xii.2001, MA-02-13A-06”; 5♂ “14–16.xii.2001, MA-02-13A-07”; 2♂ “16–22.xii.2001, MA-02-13A-08”; 1♂ “22–29.xii.2001, MA-02-13A-09”; 8♂ “29.xii.2001–5.i.2002, MA-02-13A-10”; 4♂ “5–12.i.2002, MA-02-13A-11”; 1♂ “19–26.i.2002, MA-02-13A-13”; 5♂ “5–14.ii.2002, MA-02-13A-15”; 12♂ “14–21.ii.2002, MA-02-13A-16”; 7♂ same data as holotype; 1♂ “6–13.iii.2002, MA-02-13A-19”; 1♂ “13–20.iii.2002, MA-02-13A-20”; 9♂ “27.iii–3.iv.2002, MA-02-13A-22”; 3♂ “3–11.iv.2002, MA-02-13A-23”; 2♂ “11–16.iv.2002, MA-02-13A-24”; 2♂ “16–23.iv.2002, MA-02-13A-25”; 2♂ “23.iv–1.v.2002, MA-02-13A-26”; 3♂ “1–9.v.2002, MA-02-13A-27”; 4♂ “9–19.v.2002, MA-02-13A-28”; 3♂ “19–27.v.2002, MA-02-13A-29”; 2♂ “27.v–4.vi.2002, MA-02-13A-30”; 5♂ “4–12.vi.2002, MA-02-13A-31”; 1♂ “12–23.vi.2002, MA-02-13A-32”; 4♂ “3–13.vii.2002, MA-02-13A-34”; 1♂ “13–25.vii.2002, MA-02-13A-35”; 3♂ “8–19.viii.2002, MA-02-13A-37”; 4♂ “19.viii–3.ix.2002, MA-02-13A-38”; 1♂ “13–24.ix.2002, MA-02-13A-40”; 2♂ “24.ix–5.x.2002, MA-02-13A-41”; 1♂ “5–31.x.2002, MA-02-13A-42”; 1♂ “31.x–16.xi.2002, MA-02-13A-43”; 2♂ “4–20.i.2003, MA-02-13A-47”; 4♂ “MADAGASCAR: Tuléar / Prov., Zombitse National / Park, near national road / 22°50.43’S, 44°43.87’E / 15.x–9.xi.2001, 825 m / R. Harin’Hala, Malaise / trap, deciduous spiny forest / MA-02-13B-01”; same except: 1♂ “9–19.xi.2001, MA-02-13B-02”; 1♂ “19–26.xi.2001, MA-02-13B-03”; 2♂ “26.xi–2.xii.2001, MA-02-13B-04”; 2♂ “7–14.xii.2001, MA-02-13B-06”; 7♂ “14–16.xii.2001, MA-02-13B-07”; 2♂ “22–29.xii.2001, MA-02-13B-09”; 7♂ “29.xii–5.i.2002, MA-02-13B-10”; 1♂ “5–12.i.2002, MA-02-13B-11”; 3♂ “26.i–5.ii.2002, MA-02-13B-14”; 1♂ “5–14.ii.2002, MA-02-13B-15”; 4♂ “14–21.ii.2002, MA-02-13B-16”; 3♂ “28.ii–6.iii.2002, MA-02-13B-18”; 3♂ “6–13.iii.2002, MA-02-13B-19”; 3♂ “13–20.iii.2002, MA-02-13B-20”; 2♂ “20–27.iii.2002, MA-02-13B-21”; 1♂ “27.iii–3.iv.2002, MA-02-13B-22”; 1♂ “16–23.iv.2002, MA-02-13B-25”; 1♂ “19–27.v.2002, MA-02-13B-29”; 2♂ “27–13.vii.2002, MA-02-13B-30”; 2♂ “13–25.vii.2002, MA-02-13B-31”; 1♂ “25.vii–1.viii.2002, MA-02-13B-32”; 1♂ “1–14.viii.2002, MA-02-13B-33”; 5♂ “14–25.viii.2002, MA-02-13B-34 [1 with right wing detached and glued to card]”; 4♂ “25.viii–3.ix.2002, MA-02-13B-35”; 1♂ “MADAGASCAR: Tuléar / Province, Beza Mahafaly / Reserve, Parcelle I near / research station / 23°41.19’S, 44°35.46’E / 15.x–10.xi.2001, 165 m / M.E. Irwin, F.D. Parker & / R. Harin’Hala, Malaise

/ trap in dry deciduous forest / MA-02-14A-01"; same except: 2♂ "28.xi–4.xii.2001, MA-02-14A-04"; 2♂ "4–11.xii.2001, MA-02-14A-05"; 2♂ "11–18.xii.2001, MA-02-14A-06"; 2♂ "18–25.xii.2001, MA-02-14A-07"; 1♂ "25.xii.2001–2.i.2002, MA-02-14A-08"; 3♂ "2–9.i.2002, MA-02-14A-09"; 1♂ "16–18.i.2002, MA-02-14A-11"; 1♂ "25.i–1.ii.2002, MA-02-14A-13"; 2♂ "8–15.ii.2002, MA-02-14A-15"; 1♂ "22.ii–1.iii.2002, MA-02-14A-17"; 2♂ "1–7.iii.2002, MA-02-14A-18"; 1♂ "14–22.iii.2002, MA-02-14A-20"; 1♂ "28.vi–7.vii.2002, MA-02-14A-28"; 1♂ "18–28.vii.2002, MA-02-14A-30"; 1♂ "28.vii–9.viii.2002, MA-02-14A-31"; 1♂ "9–16.viii.2002, MA-02-14A-32"; 1♂ "16–28.viii.2002, MA-02-14A-33"; 2♂ "9–20.ix.2002, MA-02-14A-35"; 3♂ "20.ix–5.x.2002, MA-02-14A-36"; 1♂ "MADAGASCAR: Tuléar / Province, Beza Mahafaly / Reserve, Parcelle II near / Bellevue, 23°41.39'S, 44°34.53'E / 15.x–10.xi.2001, 180 m / M.E. Irwin, F.D. Parker & / R. Harin'Hala, Malaise trap / in spiny forest / MA-02-14B-01"; same except: 1♂ "4–11.xii.2001, MA-02-14B-05"; 1♂ "MADAGASCAR: Majunga / Ampijoroa National Park / 160 km N of Maevatanana / on RN 04 / 16°19.16'S, 46°48.80'E / 30.xi–8.xii.2003, 43 m / M.E. Irwin & R. Harin'Hala / Malaise trap in deciduous / Forest / MA-25-25"; 1♂ "MADAGASCAR: Tuléar Province / Sous Prefecture Fort Dauphin / Andohaeala National Park / Ihazofotsy Parcelle III, 190 ft / 24°49.85'S, 46°32.17'E / 11–22.vi.2003 / Malaise trap, dry/spiny forest / M.E. Irwin, F. Parker & R. Harin'Hala / MG-21-22" (all CAS).

Other material examined (all labelled: "*Curtonotum irwini* sp. n. det. A.H. Kirk-Spriggs 2010"): MADAGASCAR: *Tuléar Prov.*: 1♂ Zombitse National Park, near ANGAP office, 22°53.19'S:44°41.53'E, 21–28.ii.2002, 840 m, R. Harin'Hala, Malaise trap, deciduous spiny forest (MA-02-13A-17) [in spirit], BMSA(DNA)#0018; 1♂ same except: [in spirit], BMSA(DNA)#0019; 1♂ Beza Mahafaly Reserve, Parcelle I near research station, 23°41.19'S:44°35.46'E, 19.v–8.vi.2002, 165 m, R. Harin'Hala, Malaise trap in dry deciduous forest (MA-02-14A-25) [in spirit], BMSA(DNA)#0059. *Majunga Prov.*: 1♂ Ampijoroa National Park 160 km N of Maevatanana on RN 04, 16°19.16'S:46°48.80'E, 8–17.xii.2003, 43 m, M.E. Irwin & R. Harin'Hala, Malaise trap in deciduous forest (MA-25-26) [in spirit], BMSA(DNA)#0058 (all BMSA).

Distribution (Fig. 95): Occurring in the Western Dry Forest, South Western Dry Spiny Forest-Thicket, Wooded Grassland-Bushland and Western Sub-humid Forest vegetation types, in the Arid Spiny Bush and Dry Deciduous Forest biomes. In the Central and South biogeographical zones and Dry and Subarid bioclimatic zones (Figs 105–107; Tables 1–3; Appendix II).

Curtonotum keiseri Tsacas, 1974

Figs 1, 14, 27, 55, 58, 61, 79, 92

Curtonotum keiseri: Tsacas 1974: 706, 707 (figs 2e–f). Type locality: "Madagascar, Joffreville".

Differential diagnosis: This species is closely related to *C. stuckenbergi* Tsacas, differing in the colour of the frons (brown with distinct vittae in *C. keiseri* and yellow with indistinct vittae in *C. stuckenbergi*) the colour of flagellomere 1 and the shape of the male terminalia. Both share the deep brown, infuscate wing membrane, the dove-tailed sternite 6, and the straight, ventrally-directed, lateral spine and two smaller spines on the distiphallus. *Curtonotum keiseri* differ from *C. stuckenbergi*, however, in the angle and degree of curvature of the *dm–cu* crossvein of the wing, in the lateral margins of the phallus being only moderately sclerotised, and in the smaller spines of the distiphallus positioned in the basolateral region, rather than the left and right lateral regions. The ranges of the two species do not overlap, and they occur allopatrically.

Redescription:

Male (primarily based on field-pinned HT and PT).

As redescribed for *C. balachowskyi*, differing in the following respects:
Measurements: Total length 5 mm; length of head and thorax combined 3 mm; length of thorax and scutellum combined 3 mm (n = 1, PT); wing length 3.8 mm (n = 1, N-T).

Head (Figs 1, 14). As described for *C. gladiiformis* sp. n., except: eye height/length ratio: 13:8 (n = 1, PT); frons (Fig. 14), frons length/width ratio: 6:7 (n = 1, PT), orbital plates extending 0.9 length of frons; posterior orbital seta moderately strong, slightly shorter than outer vertical seta; flagellomere 1 yellow pruinose basally and along posterior margin, dark grey pruinose centrally and on anterior margin, arista with 10 or 11 long dorsal branches and 4 ventral branches in addition to terminal fork; gena narrow, eye height/genal height ratio: 12:1 (HT), silver pruinose, slightly darker beyond basal angle; vibrissae strongly developed; palpus pale brown.

Thorax (Fig. 1). Mesonotum with 2 median vittae wide, 2 lateral vittae shorter, clearly defined; supra-alar seta, *ca* twice length of posterior dorsocentral seta; postalar setae, moderately strong, slightly exceeding length of acrostichal setae; postpronotum with 13 finer, black-brown setulae; anepisternum surface with 33 fine setulae, some larger and arranged in 2 groups of 3 and 5; anepimeron, laterotergite and meron silver-grey to yellow-grey pruinose; katepisternum silver-grey to yellow-grey pruinose, dorsal katepisternal seta *ca* 0.3 length of ventral katepisternal seta, with 18 short, fine setulae at base and along posterior margin.

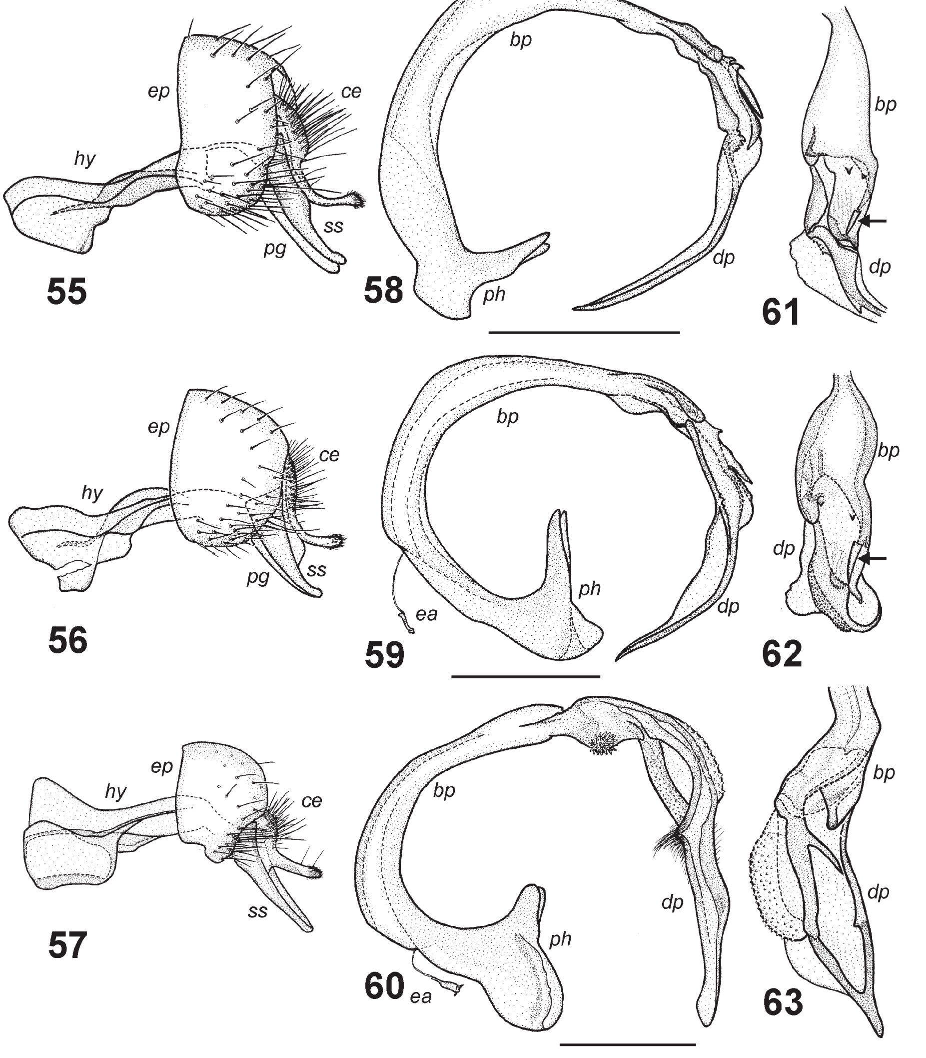
Scutellum. As described for *C. gladiiformis* sp. n.

Legs. Fore coxa with 13 brown setulae on anterior surface; mid coxa with 6 brown setulae; fore tibia with ctenidium of 12–14 short, sharp, black spinules.

Wing (as in Fig. 27). Long and broad, tip evenly-rounded, veins chestnut-brown, membrane deep-brown infuscate throughout, darker in r_1 and anterior half of r_{2+3} and in region of *dm–cu* crossvein; *dm–cu* crossvein with even arc dorsally; haltere dirty yellow.

Abdomen. Tergite 1 with oblique, small, subrectangular brown-black pruinose dorsolateral macula on either side and narrow medial facia; tergite 2 with larger subrectangular brown-black maculae and similar medial facia; tergites 3–5 with very wide, V-shaped concolourous median fascia and large concolourous T-shaped dorsolateral macula, these fully merging with medial fascia in anterior third, lateral margin of tergites 2–5 with subelliptical, large, concolourous macula in basal half; sternites 4–5 as described for *C. coronaeformis* sp. n.; sternite 6 (Fig. 79) dove-tailed (may appear narrower than Fig. 79 in undissected specimens), narrowed in basal third, with deep triangular excision apically, apical lobes evenly rounded, with dark brown maculae laterally, clothed in short, black, irregular, brown setulae in apical ⅔, those at lateral and apical margins longer and more prominent.

Terminalia (Figs 55, 58, 61). Hypandrium (Fig. 55, *hy*) long, with broad-based rounded-truncate dorsobasal lobe, posterior bridge dorsally and ventrally produced (subtriangular to slightly angulate in profile); hypandrial arm constricted medially (viewed laterally), with 2 parallel setulae proximal to postgonite, of similar length (obscured by epandrium on Fig. 55), sclerotised area of medial lobes (viewed dorsally), with margins evenly rounded, convex medially, closely abutting, overlapping; postgonite (Fig. 55, *pg*) long, thin and straight, with slight undulating anterior margin; epandrium (Fig. 55, *ep*) slightly broader dorsally than ventrally (viewed laterally), evenly rounded on dorsal margin, posterior margin slightly angled, ventral margin with extensive row of long, regular to irregular, apically-directed setae; cercus (Fig. 55, *ce*) not prominent, longest setae longer than setae on dorsal margin of epandrium; surstylus (Fig. 55, *ss*) long, widest basally, slightly curved in apical ⅔; phallus (as in Figs 58, *ph*, *bp*, *dp*, 61, *bp*, *dp*) C-shaped, moderately sclerotised, brown; phallapodeme (Fig. 58, *ph*) fused to basiphallus, subtriangular (viewed laterally), with basal margin developed into two flat, broad, subtriangular projections in basal fifth, bifurcated at point of connection with hypandrium; ejaculatory apodeme (Fig. 58, *ea*) free, duct inserted at junction of phallapodeme and basiphallus (missing from specimens illustrated in Fig. 58); ba-



Figs 55−63. Male terminalia of *Curtonotum* spp.: (55−57) hypandrium and epandrium, lateral view: (55) *C. keiseri*, N-T, Ambohitra, TAU; (56) *C. stuckenbergi*, HT, Ambohitantely, NMHN; (57) *C. sternithrix*, PT, Manambato, MNHN; (58−60) phallus, right lateral view: (58) *C. keiseri*, ejaculatory apodeme missing; (59) *C. stuckenbergi*; (60) *C. sternithrix*; (61−63) basiphallus and distiphallus junction, dorsal view: (61) *C. keiseri*, ventrally-directed lateral spine indicated with arrow; (62) *C. stuckenbergi*, ventrally-directed lateral spine indicated with arrow; (63) *C. sternithrix*. Scale bars = 0.5 mm.

siphallus (Fig. 58, *bp*) broad basally and in region of first bend, then narrowed to apex, markedly narrowed in apical third (viewed dorsally); apical section (Figs 58, 61, *bp*) broad basally, sclerotised area extensive, abruptly narrowed towards apex, basal section with membranous window, with one narrow, but strong, straight, ventrally directed lateral spine (arrowed on Fig. 61) and two smaller spines, positioned in basolateral region, left margin of sclerotised area with irregular row of small tubules.

Variation: Insufficient material is available to assess variability.

Holotype (examined): ♂ MADAGASCAR: "MADAGASCAR.D.-S. / Joffreville / 25.V.[19]58 F. KEISER [pink paper] // HOLOTYPE [red card] // CURTONOTUM / *keiseri* n.sp. / Holotype / L. TSACAS DET. 1973 [printed & handwritten] // BM [handwritten] // MUSÉUM PARIS // *Curtonotum* / *keiseri* ♂ / Tsacas, 1974 / A.H. Kirk-Spriggs *vidit* 2006" [head missing] (MNHN). In poor condition, head and all legs except left fore femur, fore tibia, left hind femur and hind tibia missing; direct-pinned; dissected, abdomen and terminalia in micro-vial pinned beneath specimen.

Paratype: ♂ "MADAGASCAR.D.-S. / Mtge. D'Ambre [= Montagne d'Ambre] / 24.V.[19]58 F.KEISER [pink paper] // PARATYPE [red card] // CURTONOTUM / *keiseri* n.sp. / paratype / L. TSACAS DET. 1973 [printed & handwritten] // *Curtonotum* / *keiseri* ♂ / Tsacas, 1974 / A.H. Kirk-Spriggs *vidit* 2008" (NHMB).

Other material examined (labelled: "*Curtonotum keiseri* Tsacas, 1974 ♂ det. A.H. Kirk-Spriggs 2011"): MADAGASCAR: 1♂ Madagascar N., Ambohitra, Joffreville, 800 m, 9–12.iv.1991, A. Freidberg & Fini Kaplan [left wing detached and glued to card] (TAU).

Distribution (Fig. 92): Apparently confined to the Humid Forest vegetation type in the Evergreen Rainforest biome. In the North biogeographical zone and Dry bioclimatic zone (Figs 105–107; Tables 1–3; Appendix II).

Curtonotum parkeri sp. n.

Figs 5, 18, 31, 65, 68, 71, 82, 96

Etymology: The species is named in honour of Frank Parker, in recognition of his contribution to our knowledge of Madagascan Hymenoptera.

Differential diagnosis: This species is closely related to *C. coronaeformis* sp. n.; the shape, maculae and setation of abdominal sternites 4 and 5 are virtually identical, the apical region of the basiphallus is markedly expanded in both species, with very similar left and right raised keels, and both share the raised and spinose right sclerotised area of the basiphallus. In *C. parkeri* sp. n., however, the basiphallus is more markedly narrower medially and expanded in the apical third, and the raised and spinose right sclerotised area of the distiphallus is less conspicuously developed, with three short, dark-tipped spinules. The two species occur sympatrically.

Description:

Male (primarily based on ex spirit-preserved HT).

As redescribed for *C. balachowskyi*, differing in the following respects:

Measurements: Overall length 3.65–4.4 mm (n = 4, PT); length of head and thorax combined 2.8 mm; length of thorax and scutellum combined 2.3 mm; wing length 4.1 mm (HT).

Head (Figs 5, 18). As described for *C. gladiiformis* sp. n., except: eye height/length ratio: 10:6 (HT); frons (Fig. 18), frons length/width ratio: 5:6 (HT), arista with 7 or 8 long dorsal branches and 3 or 4 ventral branches in addition to terminal fork; gena narrow, eye height/genal height ratio: 12:1 (HT), silver pruinose, slightly darker beyond basal angle; palpus pale brown.

Thorax (Fig. 5). Mesonotum as described for *C. boeny*; presutural seta moderately strong, shorter than posterior notopleural seta; supra-alar seta twice as long as posterior dorsocentral seta; postalar setae longer and stronger than acrostichal setae; postpronotum with 6 finer black-brown setulae; anepisternum silver-grey pruinose, with silver-yellow pruinose areas, surface with 20 fine setulae, some larger and arranged in 2 groups of 3 and 4; anepimeron, laterotergite and meron silver-grey to silver-yellow pruinose; katepisternum silver-grey to silver-yellow pruinose, with darker macula in anterior half, dorsal katepisternal seta fine, *ca* 0.3 length of ventral katepisternal seta, with 16 short, fine setulae at base and along posterior margin.

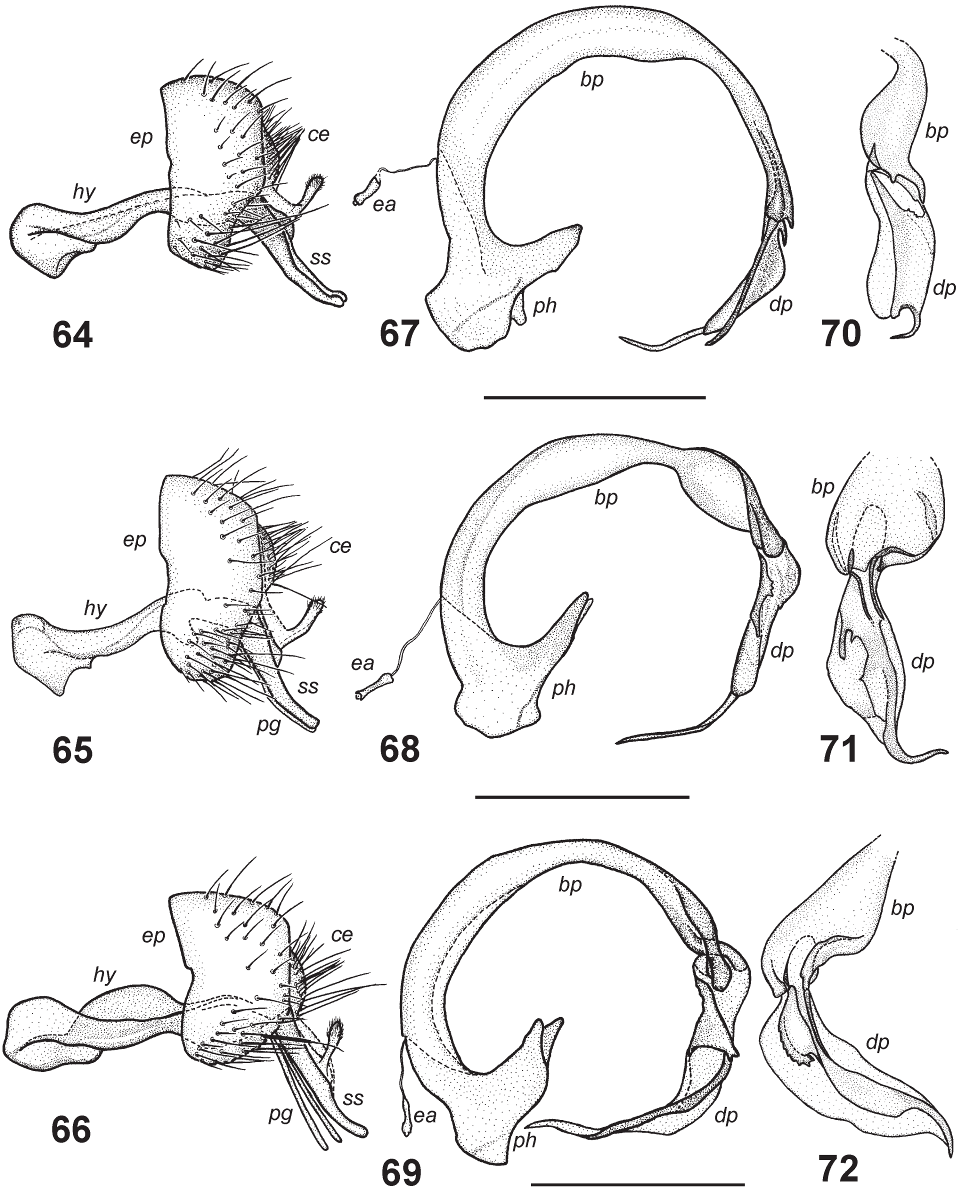
Scutellum. As described for *C. gladiiformis* sp. n.

Legs. Fore coxa with 14 brown setulae on anterior surface; mid coxa with 7 brown setulae; fore tibia with ctenidium of 13 spinules.

Wing (as in Fig. 31). Veins chestnut-brown, membrane very faintly infuscate brown throughout, very slightly darker in region of *dm–cu* crossvein; *dm–cu* crossvein with even arc; haltere dirty white.

Abdomen. Tergite 1 simple, devoid of maculae; tergite 2 with oblique, subovoid brown-black pruinose dorsolateral macula on either side only; tergites 3–5 with large, broad, V-shaped, concolourous median fascia and large, concolourous T-shaped dorsolateral macula, these close or adjoining, but not fully merging with median fascia; lateral margin of tergites 2–5 with subelliptical, concolourous macula in basal half; sternites 4 and 5 as described for *C. coronaeformis* sp. n.; sternite 6 (Fig. 82) markedly expanded laterally (may appear narrower than Fig. 82 in undissected specimens), narrowed basally with shallow, broad, subtriangular excision apically, with dark brown maculae medially, clothed in long, dense, irregular brown setulae, those at apical margin longer and more prominent.

Terminalia (Figs 65, 68, 71). Hypandrium (Fig. 65, *hy*) long, with broad-based rounded-truncate dorsobasal lobe, posterior bridge dorsally and ventrally produced (subtriangular to slightly angulate in profile); hypandrial arm constricted apically (viewed laterally), with 2 setulae proximal to postgonite, the more lateral strong, ventrally directed, the medial much smaller and weaker (obscured by epandrium on Fig. 65), sclerotised area of medial lobes (viewed dorsally), with margins evenly rounded, convex medially, closely abutting, overlapping; postgonite long, thin and straight, with slight undulating anterior margin; epandrium (Fig. 65, *ep*) slightly broader dorsally than ventrally (viewed laterally), evenly rounded on dorsal margin, posterior margin slightly angled, ventral margin with extensive row of long regular to irregular, apically-directed setae; cercus (Fig. 65, *ce*) not prominent, longest setae longer than medium setae on dorsal margin of epandrium; surstylus (Fig. 65, *ss*) long, widest basally, slightly curved in apical ⅔; phallus (as in Figs 68, *ph*, *bp*, *dp*, 71, *bp*, *dp*) C-shaped, strongly sclerotised, brown; phallapodeme (Fig. 68, *ph*) fused to basiphallus, subtriangular (viewed laterally), with basal margin developed into two flat, narrow, subtriangular projections in basal 0.4, bifurcated at point of connection with hypandrium; ejaculatory apodeme (Fig. 68, *ea*) free, duct inserted at junction of phallapodeme and basiphallus; basiphallus (Fig. 68, *bp*) broad in basal third, with slight internal bulge at first bend, very markedly narrowed in apical ⅔ (viewed dorsally); apical section (Fig. 71, *bp*) extremely broad, right lateral margin evenly rounded with semicircular raised margin, left lateral margin with distinct raised keel; distiphallus (Figs 68, 71, *dp*) broad basally, sclerotised area extensive, divided medially, with thin ventrally-directed spine in membranous window, right lateral section with three short, dark-tipped spines (viewed dorsolaterally), apical section narrow, bent and spindle-like.



Figs 64–72. Male terminalia of *Curtonotum* spp.: (64–66) hypandrium and epandrium, lateral view: (64) *C. irwini* sp. n., HT, Zombitse National Park, CAS; (65) *C. parkeri* sp. n., PT, same, CAS; (66) *C. coronaeformis* sp. n., HT, Fianarantsoa, CAS; (67–69) phallus, right lateral view: (67) *C. irwini*; (68) *C. parkeri*; (69) *C. coronaeformis*; (70–72) basiphallus and distiphallus junction, dorsal view: (70) *C. irwini*; (71) *C. parkeri*; (72) *C. coronaeformis*. Scale bars = 0.5 mm.

Variation: No significant variation is noted.

Holotype: ♂ "MADAGASCAR: Tuléar Province / Zombitse National Park / near ANGAP office, 840 m / 22°53.19'S, 44°41.53'E / 28.ii–6.iii.2002 / California Acad of Sciences / R. Harin'Hala, Malaise trap / deciduous spiny forest / MA-02-13A-18 // HOLOTYPE ♂ / *Curtonotum* / *parkeri* sp. n. / A.H. Kirk-Spriggs 2010 [red card]" (CAS). In good condition, some setation of head missing; card-pointed; right wing detached and glued to card; dissected, abdomen and terminalia in micro-vial pinned beneath specimen.

Paratypes (all labelled: "PARATYPE ♂ / *Curtonotum* / *parkeri* sp. n. / A.H. Kirk-Spriggs 2010 [blue card]"): MADAGASCAR: 3♂ same data as holotype (CAS); same except: 3♂ "29.xii.2001–5.i.2002, MA-02-13A-10"; 1♂ "26.i–5.ii.2002, MA-02-13A-14"; 4♂ "14–21.ii.2002, MA-02-13A-16"; 3♂ "27. iii–3.iv.2002, MA-02-13A-22"; 1♂ "1–9.v.2002, MA-02-13A-27"; 1♂ "MADAGASCAR: Tuléar / Prov., Zombitse National / Park, near national road / 22°50.43'S, 44°43.87'E / 20–27.iii.2002, 825 m / R. Harin'Hala, Malaise / trap, deciduous spiny forest / MA-02-13B-21"; 2♂ "MADAGASCAR: Province / Fianarantsoa, radio tower / 22 km SW of Ilakaka, near / Fianarantsoa/Tuléar border / 22°46.75'S, 45°1.50'E / 27.ii–6.iii.2002, 1100 m / M.E. Irwin & R. Harin'Hala / Malaise in Uapacca forest / MA-02-12-10"; 1♂ "MADAGASCAR: Tuléar / Province, Andohahela Nat'l / Park, Tsimelahy, Parcelle II / 24°56.21'S, 46°37.60'E / 6–16.i.2003, 180 m / M.E. Irwin, F. Parker & / R. Harin'Hala, Malaise trap / in transitional forest / MA-02-20-12"; 1♂ "MADAGASCAR: Province / Fianarantsoa, near Isalo / National Park, in dry wash / east of Interpretive Center / 22°37.60'S, 45°21.49'E / 10–17.ii.2002, 885 m / M.E. Irwin & R. Harin'Hala / Malaise trap in open area / MA-02-11B-15"; same except: 1♂ "22–30.vi.2002, MA-02-11B-33"; 1♂ "4–13.v.2002, MA-02-11B-27"; 1♂ "6–14.xii.2002, MA-02-11B-49"; 1♂ "2–12.ii.2003, MA-02-11B-55"; 1♂ "MADAGASCAR: Tuléar / Province, Beza Mahafaly / Reserve, Parcelle I near / research station / 23°41.19'S, 44°35.46'E / 7–18.vii.2002, 165 m / R. Harin'Hala, Malaise / trap in dry deciduous forest / MA-02-14A-29" (all CAS).

Other material examined (all labelled "*Curtonotum parkeri* sp. n. det. A.H. Kirk-Spriggs 2010"): MADAGASCAR: *Fianarantsoa Prov*.: 1♂ near Isalo National Park, in dry wash east of Interpretive Center, 22°37.60'S:45°21.49'E, 9–17.xi.2001, 885 m, M.E. Irwin & R. Harin'Hala, Malaise trap in open area (MA-02-11B-02) [in spirit], BMSA(DNA)#0017; 1♂ same except: 14–22.vi.2003 (MA-02-11B-67) [in spirit], BMSA(DNA)#0061; 1♂ radio tower, 22 km SW of Ilakaka near Fianarantsoa/Tuléar border, 22°46.75'S:45°1.50'E, 27.ii–6.iii.2002, 1100 m, M.E. Irwin & R. Harin'Hala, Malaise in Uapacca forest (MA-02-12-10) [in spirit], BMSA(DNA)#0041; 1♂ same except: 16–27.ii.2002 (MA-02-12-09) [in spirit], BMSA(DNA)#0060 (all BMSA).

Distribution (Fig. 96): Occurring in Tapia Forest and Wooded Grassland-Bushland vegetation types in the Central Highlands, Evergreen Rainforest and Dry Deciduous Forest biomes. In the South and South East biogeographical zones and Subarid bioclimatic zone (Figs 105–107; Tables 1–3; Appendix II).

Curtonotum pauliani Tsacas, 1974

Figs 12, 25, 38, 48, 51, 54, 90, 103

Curtonotum pauliani: Tsacas, 1974: 715; figs 7a–d (p. 716), fig. 8b (p. 718). Type locality: [Madagascar] "Nosy Mitsio".

Differential diagnosis: This species is most closely related to *C. cuthbertsoni* and to a complex of seven, as yet undescribed species, all occurring in the continental Afrotropical Region. All possess one or more basomedial spines on the dorsal margin of the distiphallus. The Madagascan species, *C. sakalava* Tsacas, which has a conspicuous basomedial keel on the distiphallus, shares the similarly-shaped hypandrium, with the broad-based, wide and angulate dorsobasal lobe and broad hypandrial arms, and this species is here tentatively ascribed to the same complex, pending a detailed phylogenetic analysis.

Redescription:

Male (primarily based on ex-alcohol N-T).

As redescribed for *C. balachowskyi*, differing in the following respects:

Measurements: Overall length 3.1–4.1 mm (n = 13, N-T); length of head and thorax combined 2.3 mm; length of thorax and scutellum combined 2.15 mm; wing length 3.2 mm (n = 1, N-T).

Head (Figs 12, 25). Eye height/length ratio: 9:6 (n = 1, N-T); frons (Fig. 25), subparallel-sided, slightly wider than long, frons length/width ratio: 5:7 (n = 1, N-T), ground colour pale dirty yellow, with paler yellow demarcated ventral border, faintly darker towards vertex and between orbital plates, otherwise both vittae inconspicuous, not reaching ventral border; ocelli clear grey (brown in some specimens); orbital plates short, extending from vertex of head to *ca* 0.7 length of frons; posterior orbital seta moderately strong, marginally longer than outer vertical seta; postocellar setae markedly shorter than outer vertical seta; flagellomere 1 yellow pruinose basally, darker in apical half, slightly silver-grey pruinose, just over *ca* twice as long as wide, apex bluntly rounded, arista with 3–5 dorsal and 3 or 4 ventral branches in addition to terminal fork; vibrissae weak; gena narrow, eye height/genal height ratio: 9:1 (n = 1, N-T); palpus brown, brown microtrichose.

Thorax (Fig. 12). Mesonotum with 2 conspicuous, broad, reddish brown median vittae and 2 lateral, shorter vittae; posterior dorsocentral setae longer and stronger than medial scutellar seta; presutural seta slightly longer and weaker than posterior notopleural seta; anterior notopleural setae longer than posterior; postpronotum silver-grey pruinose, with 9–12 finer black-brown setulae; anepisternum silver-grey pruinose with yellow-grey patch medially, with 15 fine setulae, some larger and arranged in 2 groups of 4; katepisternum silver-grey to silver-yellow pruinose, with darker macula in anterior half, dorsal katepisternal seta, *ca* 0.4 length of ventral katepisternal seta, with 12 short, fine setulae at base and along posterior margin.

Scutellum. Silver-grey pruinose, as in mesonotum, with faint medial brown pruinose vitta basally (under some lights); intermediate scutellar setula (if present) inserted equidistant between lateral and medial scutellar setae.

Legs. Fore coxa with 15 brown setulae on anterior surface; fore tibia with 4 strong setae on lateral margin, the second basal seta of similar length to other three, with ctenidium of 13 short, sharp black spinules.

Wing (as in Fig. 38). Short, broad basally, tip evenly-rounded, veins chestnut-brown, membrane very faintly infuscate brown throughout, marginally darker in r_1 and anterior half of r_{2+3} and in region of *dm–cu* crossvein; *dm–cu* crossvein slightly obliquely angled posteriorly, quite straight; cua_1 relatively short and broad; r_{2+3} markedly expanded apically; haltere dirty white.

Abdomen. Tergite 2 with oblique, subrectangular brown-black pruinose dorsolateral macula on either side only; tergites 3–5 with very narrow, V-shaped concolourous median fascia and well separated and greatly reduced concolourous T-shaped dorsolateral macula, lateral margin of tergites 2–5 with subelliptical concolourous macula in basal third; sternite 4, quadrate with evenly-rounded apical margin; sternite 5 rectangular, subparallel-sided, with straight apical margin, *ca* one-third longer than sternite 4, both unmodified, with spare, brown setulae arranged in irregular rows, those along lateral margins slightly longer and stronger; sternite 6 (Fig. 90) subquadrate (may appear narrower than Fig. 90 in undissected specimens), subparallel-sided, with shallow, broad, excision apically, with faint brown maculae laterally, clothed in short to long, irregular brown setulae in apical half, laterally and at apical margin longer and more prominent.

Terminalia (Figs 48, 51, 54). Hypandrium (Fig. 48, *hy*) short, with broad-based sub-angulate-truncate dorsobasal lobe, posterior bridge markedly dorsally and ventrally produced (angulate in profile); hypandrial arms very broad, slightly narrower basally, than apically (viewed laterally), ventrally developed into blunt point apically, with 2 equally strong setulae proximal to postgonite, both ventromedially-directed (obscured by epandrium on Fig. 48), sclerotised area of medial lobes (viewed dorsally), straight basally, well-separated for ⅔ of their length, abutting in apical third; postgonite (Fig. 48, *pg*) short and broad in basal ⅔, narrowed to apex; epandrium (Fig. 48, *ep*) slightly broader dorsally than ventrally (viewed laterally), evenly-rounded on dorsal margin, posterior margin slightly angled, ventral margin with extensive row of long regular to irregular, ventrally-directed setae; cercus (Fig. 48, *ce*) slightly prominent, longest setae as long as medium setae on ventral margin of epandrium; surstylus (Fig. 48, *ss*) short, wide and straight; phallus (as in Figs 51, *ph*, *bp*, *dp*, 54, *bp*, *dp*) C-shaped, weakly sclerotised; phallapodeme (Fig. 51, *ph*) fused to basiphallus, subtriangular (viewed laterally), with basal margin developed into two moderately flat, subtriangular projections in basal 0.4, bifurcated at point of connection with hypandrium; ejaculatory apodeme (Fig. 51, *ea*) free, duct inserted at junction of phallapodeme and basiphallus; basiphallus (Fig. 51, *bp*) broad basally and at midlength, otherwise uniform; apical section (Fig. 54, *bp*) fairly broad, right lateral margin evenly rounded with latromedial raised keel, left margin straight, developed into tiny, recurved spine; distiphallus (Figs 51, 54, *dp*) long and narrow, curved in medial and apical regions (viewed laterally), basal section with conspicuous, short dorsomedial spine.

Variation: The external characters of this species are more variable than in other species occurring on Madagascar; especially the relative lengths of the setation. Very slight differences also occur in the degree of development of the small basal spine between the basiphallus and distiphallus, otherwise the male terminalia appear consistent and such variation is here regarded as intraspecific.

Holotype (examined): ♂ MADAGASCAR: "Madagascar Nord-Ouest / Nosy Mitsio / 13–14.I.[19]60 / R. Paulian // INSTITUT / SCIENTIFIQUE / MADAGASCAR [pale grey card] // HOLOTYPE [red card] // CURTONOTUM / *pauliani* / Holotype ♂ n.sp. / L. TSACAS DET. 1973 [printed & handwritten] // MUSÉUM PARIS // *Curtonotum* / *pauliani* ♂ / Tsacas, 1974 / A.H. Kirk-Spriggs *vidit* 2006" [head missing] (MNHN). In fair condition, head, right fore leg, left fore tarsus and hind leg missing; re-staged on nu-poly mount; dissected, abdomen and terminalia in micro-vial pinned beneath specimen.

Paratypes (all labelled: "PARATYPE [red card] // CURTONOTUM / *pauliani* / n.sp. / L. TSACAS DET. 1973 [printed & handwritten] // *Curtonotum* / *pauliani* ♂ [or ♀] / Tsacas, 1974 / A.H. Kirk-Spriggs *vidit* 2006"): MADAGASCAR: 1♀ same labels as holotype, except: "ALLOTYPE [red card] // CURTONOTUM / *pauliani* / n.sp. / L. TSACAS DET. 1973 [printed & handwritten]" [wing detached, glued to card]; 2♂ same labels as holotype [1 head missing]; 1♀ same labels as holotype, except: "EXEMP. / DESS. [printed; orange card]"; 1♀ same labels as holotype, except: "ouile gameha / ma tres large / Anomalié ♀ [handwritten]"; 1♂ "Madagascar Nord-Ouest / dct. Majunga / forêt Ankarafantsitka [= Ankarafantsika] 120m / XII-[19]59 / Raharizonina // INSTITUT / SCIENTIFIQUE / MADAGASCAR [pale grey card] // MUSÉUM PARIS" [head missing]; 1♂ "MUSEUM PARIS / MADAGASCAR / PROV. D'ANALALAVA / MAROMANDIA / R. DECARY 1922 [grey card] // PARATYPE [red card] // Specimen / missing from mount / 2006"; 1♂ 1♀ same labels, except: "Pr A18 / ♂ [handwritten] [head missing]" (all MNHN).

Other material examined (all labelled: "*Curtonotum pauliani* Tsacas, 1974 ♂ det. A.H. Kirk-Spriggs 2008–2011"): MADAGASCAR: *Mahajanga Prov*.: 2♂ Madagascar, Ankarafantsika (Forest Reserve), near Marovoay, 1.xii.1959, E.S. Ross [1 labelled: "*Curtonotum pauliani* Tsacas, L. Tsacas det. 1976"; 1 with right wing detached and glued to point]; 13♂ Parc National Tsingy de Memaraha, 3.4 km 93°

E Bekopaka, Tombeau Vazimba, 19°08'31"S:44°49'41"E, 50 m, 6–10.xi.2001, leg. [B.] Fisher, [C.] Griswold *et al*., tropical dry forest, Malaise trap (MAD49), BLF4233 [1 with right wing detached and glued to card] (all CAS); 1♂ Besalampy District, Marofototra palm forest 17 km W of Besalampy, 16°43.30'S:44°25.42'E, 3–10.xii.2007, 35 ft, M.E. Irwin & R. Harin'Hala, Malaise trap, palm trees on sand (MG-42B-11) [in spirit], BMSA(DNA)#0062; 1♂ same except: BMSA(DNA)#0063 (both BMSA); 1♂ same except: 10–17.xii.2007 (MG-42B-12); 2♂ same except: 17–24.xii.2007 (MG-42B-13) (all CAS); 1♂ Ampijoroa National Park, 160 km N of Maevatanana on RN 04, 16°19.16'S:46°48.80'E, 30.xi–8.xii.2003, 43 m, M.E. Irwin & R. Harin'Hala, Malaise trap in deciduous forest (MA-25-25) [in spirit], BMSA(DNA)#0043 (BMSA).

Distribution: The only non-endemic species, occurring in Madagascar, Namibia and South Africa (Kirk-Spriggs in prep.) and probably represents a relatively recent introduction onto Madagascar. Its occurrence in the Sambirano bioclimatic zone may indicate recent introduction *via* the circulation system of the Indian monsoon. In Madagascar (Fig. 103) occurring in the Western Dry Forest and Wooded Grassland-Bushland vegetation types in the Sambirano Rainforest, Dry Deciduous Forest and Evergreen Rainforest biomes. In the Sambirano, North East, North West and West biogeographical zones and Dry and Humid bioclimatic zones (Figs 105–107; Tables 1–3; Appendix II).

Curtonotum rinhatinana sp. n.

Figs 9, 22, 35, 73, 74, 74a, 74b, 75, 87, 100

Etymology: The specific epithet is a combination of the names Rinha and Tina Harin' Hala, in recognition of their contribution to Malagasy dipterology.

Differential diagnosis: Although similar in external characters to other species of the genus occurring in Madagascar (inasmuch as the poor condition of the unique holotype allows comparison), the bizarre structure of the basiphallus and the presence of what is here interpreted as a sclerotised sperm pump, may preclude any direct association. This is the only know species worldwide to possess such a structure and this may be an ancient species, that has been retained as a relict on Madagascar. Associations with other species (if they exist), must await a detailed phylogenetic analysis.

Description:

Male (based on unique field-pinned HT).

As redescribed for *C. balachowskyi*, differing in the following respects:
Measurements: Overall length unknown; length of head and thorax combined 2.7 mm; length of thorax and scutellum combined 2.6 mm; wing length 4.1 mm.

Head (Figs 9, 22). Eye height/length ratio: 11:7 (HT); frons (Fig. 22), subparallel-sided, slightly wider than long, frons length/width ratio: 6:8 (HT), slightly wider at vertex than at ventral margin, ground colour pale dirty yellow, vittae conspicuous, reaching ventral margin; orbital plates and ocellar triangle silver-grey pruinose, ocelli clear brown; orbital plates extending from vertex of head to 0.8 length of frons; lateral margins with very narrow silver pruinose fascia (adjacent to eye margin), widest at midlength of face (posterior and anterior orbital setae, postocellar and vertical setae missing on unique HT and cannot be described); ocellar setae short, only extending *ca* 0.7 length of frons; antennal scape and pedicel dirty pale brown, silver-grey pruinose, flagellomere 1 concolourous with pedicel, darkened in apical ⅔, especially along anterior margin, slightly silver-grey pruinose, 2.5× as long as wide, apex evenly-rounded (right flagellomere 1 and left arista missing from HT and arista cannot be described); lunule brown, shiny; face uniform silver-grey pruinose throughout, with very narrow silver fascia (adjacent to eye margin), region between this fascia and ptilinal fissure yellow-silver pruinose, facial carina developed as a prominent ridge, extending ⅔ length of face, vibrissae strong; occiput grey pruinose; gena narrow, eye height/genal height ratio: 11:1 (HT), silver pruinose, abruptly dirty brown beyond basal angle; palpus thin, black, brown basally, brown microtrichose.

Thorax (Fig. 22). Mesonotum (badly rubbed on unique HT), as described for *C. boeny*, except: acrostichal setae slightly shorter than anterior dorsocentral seta (presutural and notopleural setae missing on HT and cannot be described); postalar setae, moderately strong, longer than acrostichal setae; postpronotum (postpronotal setae missing on HT, but socket size indicates two present), with 8 finer, black-brown setulae; anepisternum silver-grey pruinose, with yellow pruinose patch in centre, with 3 moderately strong anepisternal setae (the more ventral missing on HT, but size of socket indicates this to be smaller and finer than dorsal and medial setae), with 20 fine setulae, some larger and arranged in 2 groups of 3 and 2; katepisternum with ventral katepisternal seta strong, the more dorsal much smaller and finer, *ca* 0.3 length of ventral katepisternal setae, surface with 15 short, fine setulae at base and along posterior margin.

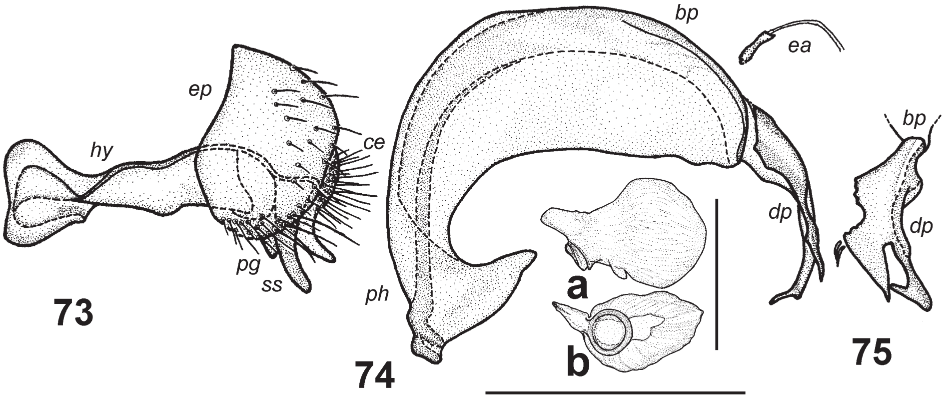
Scutellum. Uniform, golden-silver-grey pruinose (medial vitta not discernable on HT, basomedial area rubbed); weak intermediate scutellar setula inserted 0.8 distance between medial and lateral scutellar setae.

Legs. Fore coxa with 8 diminutive brown setulae on anterior surface; mid coxa with 2 very strong, lateral, ventrally-directed black setae, 1 very strong medial seta and 5 brown setulae; fore tibia with 4 strong setae on lateral margin, the second basal seta of similar length to other three, with ctenidium of 9 or 10 short, sharp, black spinules, separated from each other by one or more basal spinule widths.

Wing (as in Fig. 35). Relatively short and very broad, tip slightly angularly rounded; veins chestnut-brown, membrane very faintly infuscate brown throughout, very slightly darker in medial region of r_1 and in region of *dm–cu* crossvein; *dm–cu* crossvein subvertical, with indentation in basal half; haltere pale yellow.

Abdomen (Tergites 1–2 damaged on macerated abdomen of HT): Ground colour of tergites unknown; tergites 3–5 with narrow, V-shaped concolourous median fascia and well separated and greatly reduced concolourous T-shaped dorsolateral macula, apparently not merging with fascia, lateral margin of tergites 2–5 with subelliptical concolourous macula in basal half; sternite 4, quadrate, evenly rounded laterally, with straight apical margin; sternite 5 rectangular, evenly-rounded at sides, slightly less that twice length of sternite 4, with faint lateral macula, both unmodified, with sparse brown setulae arranged in irregular rows, those along lateral and apical margins of sternite 4 slightly longer and stronger; sternite 6 (Fig. 87) subquadrate (may appear narrower than Fig. 87 in undissected specimens), narrowed basally, evenly rounded laterally, with very shallow, broad excision apically, with indistinct medial macula and fascia laterally, clothed in short, brown, regular setulae in apical ⅔, those at apical margin spare, longer and more prominent.

Terminalia (Figs 73, 74, 75). Hypandrium (Fig. 73, *hy*) long, with broad-based rounded-truncate dorsobasal lobe, posterior bridge dorsally and ventrally produced



Figs 73–75. Male terminalia of *Curtonotum rinhatinana* sp. n., HT, Ankarafantsika, CAS: (73) hypandrium and epandrium, lateral view; (74) phallus, right lateral view, ejaculatory apodeme detached during dissection, but probably normally inserted at junction of phallapodeme and basiaphallus; (74a) sperm pump, lateral view; (74b) sperm pump, ? ventral view; (75) basiphallus and distiphallus junction, dorsal view. Scale bars = 0.5 mm.

(rounded to slightly angulate in profile); hypandrial arms narrow basally, expanded apically (viewed laterally), with 2 setulae proximal to postgonite, the more lateral ventrally directed, the medial ventromedially directed (obscured by epandrium on Fig. 73), sclerotised area of medial lobes (viewed dorsally), parallel-sided, well separated; postgonite (Fig. 73, *pg*) very short, relatively broad, with slight undulating anterior margin; epandrium (Fig. 73, *ep*) slightly broader dorsally than ventrally (viewed laterally), evenly rounded on dorsal margin, posterior margin angled, ventral margin with row of long regular to irregular, apically-directed setae; cercus (Fig. 73, *ce*) not prominent, longest setae longer than setae on dorsal margin of epandrium; surstylus (Fig. 73, *ss*) very short, widest basally, slightly curved in apical half; phallus (as in Figs 74, *ph*, *bp*, *dp*, 75, *bp*, *dp*) highly modified, heavily sclerotised, brown, especially along anterior margin; phallapodeme (Fig. 74, *ph*) fused to basiphallus, subtriangular and flat, with heavily-sclerotised region basally (viewed laterally); ejaculatory apodeme detached during dissection (Fig. 75, *ea*) but free, with duct probably inserted at junction of phallapodeme and basiphallus; basiphallus (Fig. 74, *bp*) grossly expanded, forming extensive, extremely wide, sclerotised, half-moon-shaped plate, strongly concave on left side, arm of basiphallus discernable through plate cuticle for basal half and apical ⅔; distiphallus (Figs 74, 75, *dp*) extremely short, with relatively broad, sclerotised basal section (viewed laterally, Fig. 75, *dp*), right margin indented laterally, with crenulated margin, right lateral margin with membrane with short forked process (may have become detached from lateral margin during dissection), blade ending in acute point, left margin with black-brown sclerotised, apically recurved bar, with curved, downwardly-directed process at point of bend; sperm pump (Figs 74a, 74b) heavily sclerotised, brown, with rugose surface, capsulate, ovoid, with apical extension and distinct sclerotised lip around apical opening (this became detached during dissection and its position in relation to the rest of the terminalia complex cannot be accessed).

Variation: Insufficient material is available to assess variability.

Holotype: ♂ "MADAGASCAR: / Ankarafantsika / (Forest Reserve) / near Marovoay / XII-1-1959 // E. S. Ross / Collector // HOLOTYPE ♂ / *Curtonotum* / *rinhatinana* sp. n. / A.H. Kirk-Spriggs 2010 [red card]" (CAS). In fair condition, mesonotum rubbed, some head setation missing and tarsi damaged; one wing detached and glued to card; card-pointed; dissected, abdomen and terminalia in micro-vial pinned beneath specimen.

Distribution (Fig. 100): Apparently confined to the Western Dry Forest vegetation type in the Dry Deciduous Forest biome. In the North West biogeographical zone and Dry bioclimatic zone (Figs 105–107; Tables 1–3; Appendix II).

Curtonotum sakalava Tsacas, 1974

Figs 13, 26, 39, 76–78, 91, 104

Curtonotum sakalava: Tsacas, 1974: 713; figs 6a–d (p. 714). Type locality: "Madagascar: Quest, Morondava".

Differential diagnosis: This is the smallest described species of the genus worldwide. It is probably not closely related to other species occurring on Madagascar, but shares some genitalic features in common with *C. cuthbertsoni* and to a complex of seven as yet undescribed species occurring in the continental Afrotropical Region. The degree of development of the maculae on the abdominal tergites and the strong basomedial keel of the distiphallus, however, may preclude its direct association with this group.

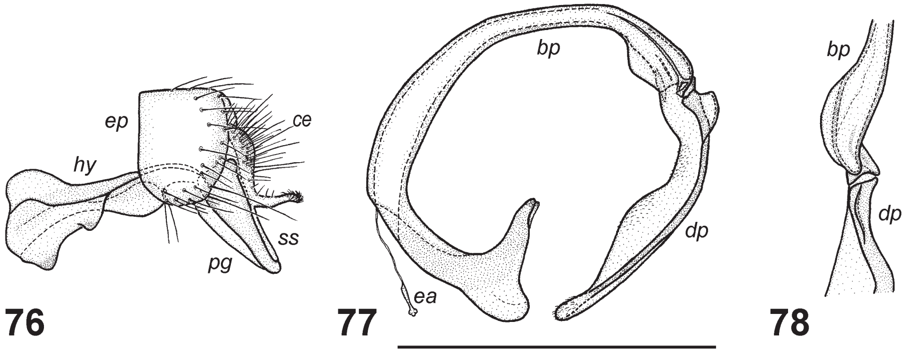
Redescription:

Male (primarily based on ex-alcohol N-T).

As redescribed for *C. balachowskyi*, differing in the following respects:
Measurements: Overall length 1.9–3.5 mm (n = 42, N-T); length of head and thorax combined 1.8 mm; length of thorax and scutellum combined 1.6 mm; wing length 2.3 mm (n = 1, N-T).

Head (Figs 13, 26). Eye prominent, eye height/length ratio: 8:5 (n = 1, N-T); frons (Fig. 26), slightly wider than long, frons length/width ratio: 40:45 (n = 1, N-T), markedly wider at vertex than at ventral margin, ground colour pale dirty yellow, dark brown towards vertex and between orbital plates, vittae interrupted at point of ocellar triangle, not reaching ventral margin; orbital plates and ocellar triangle golden-grey pruinose; orbital plates wide, extending from vertex of head to 0.9 length of frons; ocellar triangle large, extending third length of frons; posterior orbital seta longer than outer vertical seta; anterior orbital seta shorter than half length of ocellar setae; postocellar setae shorter than outer vertical seta; flagellomere 1 yellow basally and along anterior margin, darker medially, silver-grey pruinose, 2.5× as long as wide, arista with 6 or 7 long dorsal branches and 3 or 4 ventral branches in addition to terminal fork; facial carina slightly yellow pruinose, developed as a low ridge, extending ⅔ length of face, clypeus black, much narrower than face; vibrissae moderately strong, and 10 very small, brown setae bordering genal groove; occiput golden-grey pruinose; gena narrow, eye height/genal height ratio: 8:50 (n = 1, N-T), silver pruinose, abruptly golden-brown beyond basal angle; palpus black-brown.

Thorax (Fig. 26). Mesonotum golden-grey pruinose, with 2 median conspicuous, broad, brown pruinose vittae and 2 lateral, shorter vittae; posterior dorsocentral setae same length as lateral scutellar seta; postalar setae slightly longer than acrostichal setae; postpronotum golden-grey pruinose, with 4 finer black-brown setulae; anepisternum



Figs 76–78. *Curtonotum sakalava*, male terminalia: (76) hypandrium and epandrium, lateral view, N-T, Berenty Special Reserve, CAS; (77) phallus, right lateral view, HT, Morondava, MNHN; (78) basiphallus and distiphallus junction, dorsal view. Scale bar = 0.5 mm.

silver-grey pruinose, with 12 fine setulae, some larger and arranged in 2 groups of 3; katepisternum silver-grey pruinose, yellow-grey pruinose anteriorly, ventral katepisternal seta finer, *ca* 0.2 length of ventral katepisternal setae, surface with 12 short, fine setulae at base and along posterior margin.

Scutellum. Uniform, golden-grey pruinose throughout; intermediate scutellar setula inserted three-fifths distance between medial and lateral scutellar setae.

Legs. Fore coxa with 9 brown setulae; mid and hind coxa silver-yellow pruinose, mid coxa with 3 brown setulae; hind coxa with 2 brown setula; fore tibia usually with 4 strong setae on lateral margin, the second basal seta of similar length to other three, with ctenidium of 7–9 short, sharp black spinules.

Wing (as in Fig. 39). Short, broad basally, tip evenly-rounded, veins chestnut-brown, membrane very faintly infuscate brown throughout, marginally darker in r_1 and anterior half of r_{2+3} and in region of *dm–cu* crossvein; *dm–cu* crossvein obliquely angled posteriorly, with slight curvature at midlength; haltere dirty yellow.

Abdomen. Tergite 2 with oblique, subrectangular brown-black pruinose dorsolateral macula on either side and small, medial macula in apical third; tergites 3–5 with narrow, V-shaped concolourous median fascia and broad, concolourous T-shaped dorsolateral macula, these separated from medial facia; lateral margin of tergites 2–3 with extensive concolourous macula for full length of tergite, tergite 4 with macula extending half length of tergite (collectively forming an unbroken facia, viewed at low magnification); sternite 4, quadrate, with straight apical margin; sternite 5 rectangular, evenly rounded at sides, third longer than sternite 4, both with sparse, brown setulae, those along lateral margins slightly very longer and stronger; sternite 6 (Fig. 91) subquadrate (may appear narrower than Fig. 91 in undissected specimens), with shallow, broad excision apically, with faint brown maculae laterally, clothed in short, irregular, brown setulae, those at apical margin longer and more prominent.

Terminalia (Figs 76–78). Hypandrium (Fig. 76, *hy*) short, with broad-based subangulate-truncate dorsobasal lobe, posterior bridge markedly dorsally and ventrally produced (angulate in profile); hypandrial arms broad, slightly narrower basally, than apically (viewed laterally), with 2 equally strong setulae proximal to postgonite, both ventromedially-directed, sclerotised area of medial lobes (viewed dorsally), straight basally, well-separated for ⅔ of their length, abutting in apical third; postgonite (Fig. 76, *pg*) short and broad in basal ⅔, narrowed to apex; epandrium (Fig. 76, *ep*) slightly broader dorsally than ventrally (viewed laterally), flat on dorsal margin, posterior margin straight, ventral margin with extensive row of long, regular to irregular, apically-directed setae; cercus (Fig. 76, *ce*) slightly produced, longest setae as long as longest setae on ventral margin of epandrium; surstylus (Fig. 76, *ss*) short, wide and straight; phallus (as in Figs 76, *ph*, *bp*, *dp*, 77, *bp*, *dp*) C-shaped, weakly sclerotised; phallapodeme (Fig. 77, *ph*) fused to basiphallus, subtriangular (viewed laterally), with basal margin developed into two flat, narrow, flat projections in basal 0.4, bifurcated at point of connection with hypandrium; ejaculatory apodeme (Fig. 77, *ea*) free, duct inserted at junction of phallapodeme and basiphallus; basiphallus (Fig. 77, *bp*) slightly broader basally, then narrow and regular for most of its lengths; apical section (Fig. 78, *bp*) moderately broad, right lateral margin evenly rounded with slightly raised keel, left lateral margin even; distiphallus (Figs 77, 78, *dp*) long, narrow and evenly curved (viewed laterally), basal section with conspicuous, short dorsomedial keel.

Female. Similar to male, except in the following respects: overall length 1.9–2.9 (*n* = 17, N-T); frons very slightly wider, abdomen longer.

Variation: The frons is more extensively brown between the orbital plates in some specimens, with the vittae more conspicuous. Fore tibia with 3 strong, lateral setae, rather than 4, in some specimens.

Holotype (examined): ♂ MADAGASCAR: "Morondava / fôret sud / de Befasy / I-[19]56 R.P. [= R. Paulian] // INSTITUT / SCIENTIFIQUE / MADAGASCAR [pale grey card] // HOLOTYPE [red card] // CURTONOTUM / *sakalava* / Holotype n.sp. / L. TSACAS DET. 1974 [printed & handwritten] // MUSÉUM PARIS // *Curtonotum* / *sakalava* Tsacas, 1974 ♂ / A.H. Kirk-Spriggs *vidit* 2006 // Specimen / missing from mount / 2006" (MNHN). The specimen is entirely missing from the mount, but the abdomen and terminalia are stored in vial beneath the specimen.

Other material examined (all labelled: "*Curtonotum sakalava* Tsacas, 1974 ♂ [or ♀] det. A.H. Kirk-Spriggs 2008–2010"): MADAGASCAR: *Tuléar Prov*.: 2♂ 2♀ SW coast N of Tuléar (= Toliara), hotel area "Mora Mora", 14.ii.1984, M. von Tschirnhaus, dry forest near sand beach (X1179) (ZSM); 1♂ Mahafaly Plateau, 6.2 km 74° NE of Itampolo, 24°39'13"S:43°59'48"E, 21–25.ii. 2002, 80 m, spiny forest thicket, Malaise trap, [B.] Fisher, [C.] Griswold *et al*. (MAD29), BLF5759; 1♂ Forêt de Mahavelo, Isantoria River, 24°45'30"S:46°09'26"E, 28.i–1.ii.2002, 110 m, spiny forest thicket, Malaise trap, [B.] Fisher, [C.] Griswold *et al*. (MAD48), BLF5237; 1♀, Sous Prefecture Fort Dauphin, Andohahela National Park, Ihazofotsy Parcelle III, 24°49.85'S:46°32.17'E, 21.x–2.xii.2002, 190 ft, Malaise trap, dry/spiny forest, M.E. Irwin, F. Parker & R. Harin'Hala (MG-02-21-01C); same except: 1♂ 1♀ 12–16.xii.2002 (MG-21-03); 2♀ 15–26.i.2003 (MG-21-04); 1♂ 2♀ 15–26.i.2003 (MG-21-07); 1♂ 18–29.iii.2003 (MG-21-13); 1♀ 21–28.iv.2003 (MG-21-16); 1♀ 28.iv–6.v.2003 (MG-21-17); 1♂ 6–13.v.2003 (MG-21-18); 1♀ 3–11.vi.2003 (MG-21-21); 2♂ 1♀ 29.vi–6.vii.2003 (MG-21-24); 1♂ 1♀ 24.viii–3.ix.2003 (MG-21-30); 2♂ 23–30.xi.2003 (MG-21-39); 3♂ 7–19.xii.2003 (MG-21-42); 4♂ 3–14.i.2004 (MG-21-44); 1♂ Sous Prefecture Fort Dauphin, 74 km S of Tsihombe, 120 ft, Cap Ste Marie Special Reserve, 25°35.36'S:45°09.78'E, 8–18.x.2003, Malaise trap, spiny bush, R. Harin'Hala & M.E. Irwin (MG-23-44); 1♂ Mikea Forest, 22°54.22'S:43°28.53'E, 19.viii–3.ix.2002, 97 ft, Malaise trap, deciduous dry forest, R. Harin'Hala & M.E. Irwin (MG-18A-31); same except: 1♀ 27.vii–3.viii.2003 (MA-02-18A-63); 1♀ 12–23.xi.2003 (MA-02-18A-74); 1♂ Mikea Forest, 22°54.80'S:43°23.93'E, 28.iii–8.iv.2002, 120 ft, Malaise trap, spiny forest, R. Harin'Hala & M.E. Irwin (MG-18B-18); 1♂ Zombitse National Park, near ANGAP office, 22°53.19'S:44°41.53'E, 28.ii–6.iii.2002, 840 m, R. Harin'Hala, Malaise trap, deciduous spiny forest (MA-02-13A-18); same except: 1♀ 19–27.v.2002 (MA-02-13A-29); 1♂ 19.viii–3.ix.2002 (MA-02-13A-38); 1♀ 5–31.x.2002 (MA-02-13A-42); 1♀ 28.ii–10.iii.2003 (MA-02-13A-51); 1♂ Zombitse National Park, near national road, 22°50.43'S:44°43.87'E, 5–12.i.2002, 825 m, R. Harin'Hala, Malaise trap, deciduous spiny forest (MA-02-13B-11); same except: 1♂ 20–27.iii.2002 (MA-02-13B-21); 1♂ 2♀ Beza Mahafaly Reserve, Parcelle I near research station, 23°41.19'S:44°35.46'E, 15.x–10.xi.2001, 165 m, M.E. Irwin, F.D. Parker & R. Harin'Hala, Malaise trap in dry deciduous forest (MA-02-14A-01); same except: 2♂ 10–21.xi.2001 (MA-02-14A-02); 1♂ 1♀ 21–28.xi.2001, R. Harin'Hala (MA-02-14A-03); 1♂ 21–28.xi.2001

(MA-02-14A-04); 5♂ 3♀ 4–11.xii.2001 (MA-02-14A-05); 4♂ 11–18.xii.2001 (MA-02-14A-06); 1♂ 1♀ 18–25.xii.2001 (MA-02-14A-07); 2♂ 25.xii.2001–2.i.2002 (MA-02-14A-08); 1♂ 2–9.i.2002 (MA-02-14A-09); 4♂ 2♀ 16–18.i.2002 (MA-02-14A-11); 3♂ 1♀ 18–25.i.2002 (MA-02-14A-12); 3♂ 3♀ 8–15.ii.2002 (MA-02-14A-15); 3♂ 1♀ 15–22.ii.2002 (MA-02-14A-16); 1♂ 1♀ 22.ii–1.iii.2002 (MA-02-14A-17) (all CAS); 2♂ 1–7.iii.2002 (MA-02-14A-18) [in spirit], (BMSA(DNA)#0020 & BMSA(DNA)#0021) (BMSA); 1♀ 7–14.iii.2002 (MA-02-14A-19); 2♂ 22–29.iii.2002 (MA-02-14A-21); 1♂ 29.iii–10.iv.2002 (MA-02-14A-22); 2♂ 10–29.iv.2002 (MA-02-14A-23); 2♂ 29.iv–19.v.2002 (MA-02-14A-24); 1♀ 19.v–8.vi.2002 (MA-02-14A-25); 1♂ 8–18.vi.2002 (MA-02-14A-26); 2♂ 28.vi–7.vii.2002 (MA-02-14A-28); 3♂ 7–18.vii.2002 (MA-02-14A-29) [1 head missing]; 3♂ 1♀ 18–28.vii.2002 (MA-02-14A-30); 1♂ 1♀ 28.vii–9.viii.2002 (MA-02-14A-31); 3♂ 9–16.viii.2002 (MA-02-14A-32) [1 head missing]; 2♂ 1♀ 16–28.viii.2002 (MA-02-14A-33); 5♂ 1♀ 28.viii–9.ix.2002 (MA-02-14A-34); 6♂ 2♀ 9–20.ix.2002 (MA-02-14A-35); 3♂ 1♀ 20.ix–5.x.2002 (MA-02-14A-36); 1♀ 5–20.x.2002 (MA-02-14A-37); 1♀ 20–28.x.2002 (MA-02-14A-38); 5♂ 10–22.xi.2002 (MA-02-14A-40); 1♀ 22.xi–2.xii.2002 (MA-02-14A-41); 4♂ 1♀ 2–12.xii.2002 (MA-02-14A-42); 3♀ 12–17.xii.2002 (MA-02-14A-43); 1♀ 17–20.xii.2002 (MA-02-14A-44); 1♂ 1♀ 20–24.xii.2002 (MA-02-14A-45); 2♂ 24.xii.2002–2.i.2003 (MA-02-14A-46); 2♂ 2♀ 9–23.i.2003 (MA-02-14A-48); 1♂ 1♀ 23.i–4.ii.2003 (MA-02-14A-49); 2♂ 1♀ 4–6.ii.2003 (MA-02-14A-50); 3♂ 2–13.iii.2003 (MA-02-14A-52); 1♂ 23.iii–2.iv.2003 (MA-02-14A-54); 1♂ 1♀ 21–29.iv.2003 (MA-02-14A-57); 1♂ 1♀ 29.iv–7.v.2003 (MA-02-14A-58); 1♀ 1–15.vi.2003 (MA-02-14A-62); 2♀ Beza Mahafaly Reserve, Parcelle II near Bellevue, 23°41.39'S:44°34.53'E, 15.x–10.xi.2001, 180 m, M.E. Irwin, F.D. Parker & R. Harin'Hala, Malaise trap, in spiny forest (MA-02-14B-01); same except: 2♂ 28.xi–4.xii.2001 (MA-02-14B-04); 1♂ 11–18.xii.2001 (MA-02-14B-06); 1♀ 18–25.xii.2001 (MA-02-14B-07); 1♂ 2♀ 25.xii.2001–2.i.2002 (MA-02-14B-08); 1♂ 2–9.i.2002 (MA-02-14B-09); 1♂ 16–18.i.2002 (MA-02-14B-11); 1♀ 18–25.i.2002 (MA-02-14B-12); 1♂ Andohahela National Park, Tsimelahy, Parcelle II, 24°56.21'S:46°37.60'E, 4–11.xi.2002, 180 m, M.E. Irwin, F. Parker & R. Harin'Hala, Malaise trap, in transitional forest (MA-02-20-03); same except: 1♀ 26.xi–2.xii.2002 (MA-02-20-06); 1♀ 2–9.xii.2002 (MA-02-20-07); 5♂ 2♀ 17–27.xii.2002 (MA-02-20-10); 9♂ 4♀ 6–16.i.2003 (MA-02-20-12); 4♂ 3♀ 16–26.i.2003 (MA-02-20-13); 1♂ 1♀ 26.i–5.ii.2003 (MA-02-20-14); 1♀ 5–15.ii.2003 (MA-02-20-15); 2♂ 2♀ 15–26.ii.2003 (MA-02-20-16); 5♂ 4♂ 26.ii–8.iii.2003 (MA-02-20-17); 7♂ 8–18.iii.2003 (MA-02-20-18); 3♂ 5♀ 18–28.iii.2003 (MA-02-20-19); 1♀ 28.iii–8.iv.2003 (MA-02-20-20); 1♀ 29.vi–10.vii.2003 (MA-02-20-31); 1♂ 10–20.vii.2003 (MA-02-20-32); 1♂ 17–24.viii.2003 (MA-02-20-36); 1♂ 24–31.viii.2003 (MA-02-20-37); 1♂ 1♀ 31.viii–10.ix.2003 (MA-02-20-38); 1♂ 10–21.ix.2003 (MA-02-20-39); 1♂ 21.ix–1.x.2003 (MA-02-20-40); 1♂ 1♀ 30.x–9.xi.2003 (MA-02-20-44); 2♂ 3♀ 30.xi–11.xii.2003 (MA-02-20-47); 1♀ 11–21.xii.2003 (MA-02-20-48); 1♂ 3♀ 23.xii.2003–5.i.2004 (MA-02-20-50); 1♀ 15–28.i.2004 (MA-02-20-52); 1♂ 28.i–12.ii.2004 (MA-02-20-53); 1♂ 12–23.ii.2004 (MA-02-20-54); 2♂ 1♀ 23.ii–6.iii.2004 (MA-02-20-55); 1♂ Andohahela National Park, Ihazofotsy Parcelle III, 24°49.85'S:46°32.17'E, 2–12.xii.2002, 80 m, M.E. Irwin, F. Parker & R. Harin'Hala, Malaise trap, in dry spiny forest (MA-02-21-02); same except: 2♂ 26.xii.2002–5.i.2003 (MA-02-21-05); 1♀ 5–15.i.2003 (MA-02-21-06); 1♂ 26.i–3.ii.2003 (MA-02-21-08); 2♂ 29.iii–10.iv.2003 (MA-02-21-14); 2♂ 1♀ 10–21.iv.2003 (MA-02-21-15); 3♂ 7–17.xii.2003 (MA-02-21-41); 1♀ 17–19.xii.2003 (MA-02-21-42); 2♀ 19.xii.2003–3.i.2004 (MA-02-21-43); 1♂ 3–14.i.2004 (MA-02-21-44); 1♂ 14.ii–1.iii.2004 (MA-02-21-47); 3♂ 2–11.iv.2004 (MA-02-21-49); 3♂ 2♂ Sous Prefecture Fort Dauphin, 58 km SW of Fort Dauphin, 8 km NW of Amboasary, Berenty Special Reserve, 25°00.40'S:46°18.20'E, 14–24.iv.2003, 280 ft, Malaise trap, gallery forest, M.E. Irwin & R. Harin'Hala (MG-22-22); same except: 2♂ 25.v–4.vi.2003 (MG-22-26); 1♂ 7–22.viii.2004 (MG-22-54); 5♀ Berenty Special Reserve, 8 km NW Amboasary, 25°00.40'S:46°18.20'E, 25–26.x.2002, 85 m, M.E. Irwin, F. Parker & R. Harin'Hala, Malaise trap, gallery forest (MA-02-22-01) [1 with right wing detached and glued to card]; same except: 1♂ 6♀ 26.x–2.xi.2002 (MA-02-22-02); 3♂ 6♀ 2–9.xi.2002 (MA-02-22-03); 1♂ 2♀ 9–16.xi.2002 (MA-02-22-04); 5♂ 2♀ 16–23.xi.2002 (MA-02-22-05) [1♂ head missing]; 4♂ 2♀ 23–30.xi.2002 (MA-02-22-06); 3♂ 2♀ 30.xi–7.xii.2002 (MA-02-22-07); 3♂ 3♀ 7–14.xii.2002 (MA-02-22-08); 1♂ 2♀ 16–27.xii.2002 (MA-02-22-10); 5♂ 6♀ 27.xii.2002–7.i.2003 (MA-02-22-11); 2♂ 6♀ 7–17.i.2003 (MA-02-22-12); 2♂ 1♀ 17–26.i.2003 (MA-02-22-13); 3♂ 26.i–5.ii.2003 (MA-02-22-14); 2♀ 5–15.ii.2003 (MA-02-22-15); 2♂ 5♀ 15–25.ii.2003 (MA-02-22-16); 1♀ 25.ii–7.iii.2003 (MA-02-22-17); 1♂ 2♀ 17–24.iii.2003 (MA-02-22-19); 1♂ 1♀ 24.iii–3.iv.2003 (MA-02-22-20); 1♀ 25.v–4.vi.2003 (MA-02-22-26); 1♂ 8–15.xi.2003 (MA-02-22-29); 1♀ 22–30.xi.2003 (MA-02-22-31); 1♀ 4–15.ii.2004 (MA-02-22-39); 2♂ 30.iv–14.v.2004 (MA-02-22-46); 7♂ Berenty Special Reserve, 85 m, 8 km SW of Fort Dauphin, 8 km NW of Amboasary, 25.ii–7.iii.2003, 25°00.40'S:46°18.20'E, M.E. Irwin, F. Parker & R. Harin'Hala, Malaise trap gallery forest (MA-02-22-17); same except: 4♂ 5–15.ii.2003 (MA-02-22-15); 3♀ Berenty Special Reserve, 8 km NW Amboasary, 25°01.26'S:46°18.33'E, 10–19.vi.2003, 35 m, M.E, Irwin, F. Parker & R. Harin'Hala, Malaise trap, spiny forest (MA-02-22A-01); same except: 1♂ 5♀ 8–15.xi.2003 (MA-02-22A-02); 5♂ 5♀ 15–22.xi.2003 (MA-02-22A-03); 2♂ 2♀ 22–30.xi.2003 (MA-02-22A-04); 2♂ 30.xi–7.xii.2003 (MA-02-22A-05); 1♂ 1♀ 14–21.xii.2003 (MA-02-22A-07); 2♂ 21.xii.2003–1.i.2004 (MA-02-22A-08); 1♂ 2–13.i.2004 (MA-02-22A-09); 1♂ 1♀ 13–23.i.2004 (MA-02-22A-10); 1♂ 23.i–4.

ii.2004 (MA-02-22A-11); 1♂ 15–28.ii.2004 (MA-02-22A-13); 1♀ 28.ii–24.iii.2004 (MA-02-22A-14); 1♂ 24.iii–4.iv.2004 (MA-02-22A-15); 2♂ 1♀ 4–15.iv.2004 (MA-02-22A-16); 1♀ 15–29.iv.2004 (MA-02-22A-17); 1♀ 11–23.vi.2004 (MA-02-22A-19); 1♀ 4–18.vii.2004 (MA-02-22A-20); 1♂ 1♀ 4–18.vii.2004 (MA-02-22A-21); 4♂ 2♀ 18–31.vii.2004 (MA-02-22A-22); 1♂ 31.vii–15.viii.2004 (MA-02-22A-23); 1♀ 15–29.viii.2004 (MA-02-22A-24); 2♂ 1♀ 8–21.ix.2004 (MA-02-22A-26); 1♂ 21.ix–7.x.2004 (MA-02-22A-27) (all CAS); 3♀ District of Morondava, Beroboka village, 45 km NE of Morondava, 19°58.65'S: 4°39.98'E, 30.x–6.xi.2007, Antsaronganjaza dry forest (MG-45A-07); same except: 1♂ 6–14.xii.2007 (MG-45A-12) (all CAS); 1♂ Beroboka village 45 km NE Morondava, 19°58.65'S:44°39.92'E, 30.xi–6. xii.2007, 420 ft, M.E. Irwin & R. Harin'Hala, Malaise trap, Antsarongaza gallery forest (MG-45B-11) [in spirit], BMSA(DNA)#0056 (BMSA). *Fianarantsoa Prov*.: 1♂ near Isalo National Park, at stream east of Interpretive Center, 22°37.60'S:45°21.49'E, 4–13.v.2002, 750 m, M.E. Irwin & R. Harin'Hala, Malaise trap in open area (MA-02-11A-27); same except: 1♀ 27.v–4.vi.2002 (MA-02-11A-30); 1♀ 10–25.vii.2002 (MA-02-11A-35); 1♀ 22–29.xi.2002 (MA-02-11A-47); 1♂ 17–28.iii.2003 (MA-02-11A-58); 1♂ 28.iii–9. iv.2003 (MA-02-11A-59); 1♀ near Isalo National Park, in dry wash east of Interpretive Center, 22°37.60'S:45°21.49'E, 15.x–9.xi.2001, 885 m, M.E. Irwin, F.D. Parker & R. Harin'Hala, Malaise trap (MA-02-11B-01); same except: 1♀ 16–21.xii.2001 (MA-02-11B-07); 1♀ 21–29.xii.2001 (MA-02-11B-08); 2♂ 13–19.i.2002 (MA-02-11B-11); 1♂ 3–10.ii.2002 (MA-02-11B-14); 1♀ 17–24.ii.2002 (MA-02-11B-16); 1♀ 30.iii–7.iv.2002 (MA-02-11B-22); 1♀ 7–15.iv.2002 (MA-02-11B-23); 1♂ 4–13.v.2002 (MA-02-11B-27); 1♀ 13–20.v.2002 (MA-02-11B-28); 1♀ 20–27.v.2002 (MA-02-11B-29); 1♀ 25.vii–9.viii.2002 (MA-02-11B-36); 1♀ 23.viii–7.ix.2002 (MA-02-11B-38); 1♂ 22.ix–3.x.2002 (MA-02-11B-40); 1♂ 14–22.xii.2002 (MA-02-11B-50); 1♀ 28.iii–9.iv.2003 (MA-02-11B-60). *Majunga Prov*.: 1♂ Ampijoroa National Park, 160 km N of Maevatanana on RN 04, 16°19.16'S:46°48.80'E, 9–20.xi.2003, 43 m, M.E. Irwin & R. Harin'Hala, Malaise trap in deciduous forest (MA-25-23) [in spirit], BMSA(DNA)#0057 (BMSA); same except: 1♂ 19–26.x.2003 (MA-25-20) (CAS).

Distribution (Fig. 104): Widely distributed in five vegetation types (Appendix II), in the Dry Spiny Bush and Dry Deciduous Forest biomes. In the North West, West and South biogeographical zones and Dry and Subarid bioclimatic zones (Figs 105–107; Tables 1–3).

Curtonotum sternithrix Tsacas, 1974

Figs 3, 16, 29, 57, 60, 63, 86, 94

Curtonotum sternithrix: Tsacas, 1974: 708; figs 3a–e (p. 709), fig. 8e (p. 718). Type locality: "Madagascar Est, Antanambe".

Differential diagnosis: Not closely related to any other species occurring on Madagascar. It exhibits a number of distinctive features, including the presence of three, rather than two, strong humeral setae, and is the only Afrotropical species described to date with conspicuous brown rings around the sockets of the thoracic setae. The abdominal sternites and phallus are highly modified and distinctive. Interpretation of its relationship to other species on the continental Afrotropical Region must await the outcome of a detailed phylogenetic analysis.

Redescription:

Male (primarily based on field-pinned HT and PT).

As redescribed for *C. balachowskyi*, differing in the following respects:
Measurements: Overall length 5.6 mm; length of head and thorax combined 3.8 mm; length of thorax and scutellum combined 3.1 mm; wing length 4.6 mm.

Head (Figs 3, 16). Eye height/length ratio: 15:9 (HT); frons (Fig. 16), markedly produced (Fig. 3), parallel-sided, frons length/width ratio: 18:21 (HT), ground colour uniform dark brown, faintly paler medially and in region of ventral margin, lacking any trace of vittae, surface with a few minute pale to dark brown setulae; orbital plates and ocellar triangle golden-silver-grey pruinose, orbital plates and ocellar triangle extremely short, the former extending less than half length of frons, lateral margins with moderately wide, sharply-contrasting, silver pruinose fascia (adjacent to eye margin), widest at antennal insertions; anterior orbital seta strong, *ca* two-third length of ocellar setae; ocellar setae short, only reaching *ca* ⅔ length of frons; flagellomere 1 brown, silver-grey pruinose, yellow-brown basally, moderately short, *ca* twice as long as wide, apex squarely rounded, arista with 11 or 12 long dorsal branches and 3 or 4 ventral branches in addition to terminal fork; lunule and face uniform silver pruinose throughout, face with extremely broad silver fascia (adjacent to eye margin), not contrasting markedly with face, facial carina developed as a prominent ridge; 1 pair of moderately weak vibrissae; occiput with strong, black postocular setae; gena wide, eye height/genal height ratio: 1:10 (HT), silver pruinose, abruptly dirty brown beyond basal angle; palpus narrow, yellow-brown, black microtrichose.

Thorax (Fig. 3). All setae on thorax with prominent dark red ring around each socket, markedly so on mesonotum; mesonotum brown, silver-grey pruinose, with two poorly defined narrow chestnut-brown pruinose vittae; anterior dorsocentral seta much shorter and finer (ca. half length of medial scutellar seta); presutural seta moderately strong, longer and stronger than posterior notopleural seta; postalar setae shorter and finer than acrostichal setae; postpronotum with 3 strong postpronotal setae, the more dorsal longer and reclinate, the medial and ventral shorter and proclinate, with 12–14 finer setulae; anepisternum with more ventral anepisternal setae reclinate, surface with 34 moderately long setulae, those between anepisternal setae longer; ventral katepisternal seta very long and strong, dorsal strong, over half length of ventral, with 22 short, fine setulae at base and along posterior margin.

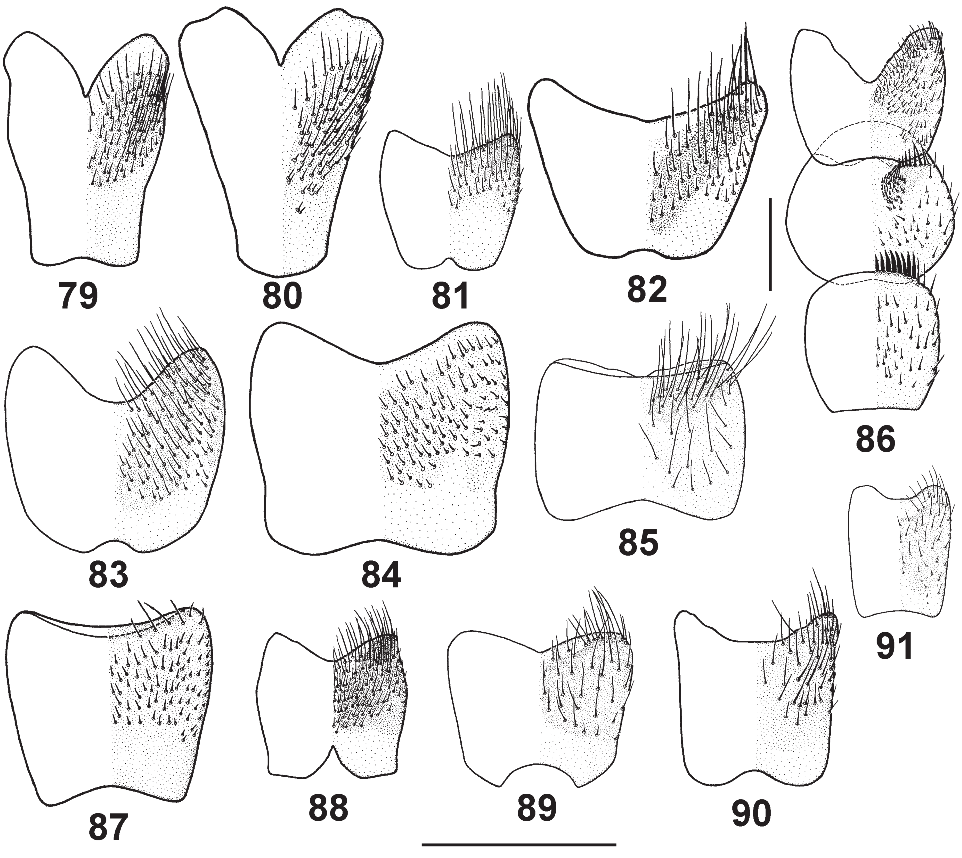
Scutellum. Golden-brown pruinose, darker than mesonotum, without medial brown pruinose vitta basally, apical margin yellow pruinose; 1 weak basal scutellar setula and 2 weak intermediate scutellar setula, the more medial inserted at 0.8 distance between medial and lateral scutellar setae.

Legs. Fore coxa with 21 brown setulae; femora, tibia and tarsi slightly reddish yellow; tibia darker reddish apically; fore tibia with 4 strong setae on lateral margin, the second basal seta same length as first basal, with ctenidium of 10–13 long, sharp black spinules, separated from each other by two or more basal spinule widths.

Wing (as in Fig. 29). Long and narrow, especially cua_1 and *m* cells, tip evenly-rounded, veins chestnut-brown, membrane deep infuscate brown throughout, darker in r_1 and anterior half of r_{2+3} and in region of *dm–cu* crossvein; *dm–cu* crossvein subvertical, with slight curvature posteriorly; haltere dirty yellow.

Abdomen. Ground colour of tergites 1–5 reddish yellow to grey pruinose, silver pruinose laterally and at apical margins of tergites; tergite 1 with small, oblique black-brown macula laterally and concolourous medial fascia, these merging slightly at apical margin; tergites 2–5 with extremely broad V-shaped, black median fascia and extensive, concolourous, T-shaped dorsolateral macula, all extensively merging with medial fascia; lateral margin of tergites 2–5 with large, subrectangular, concolourous macula in basal half to ⅔; sternite 4 (Fig. 86), modified, quadrate, evenly rounded apically and laterally, with comb of 16 long, thick, black-brown spinules on apical margin, surface with spare irregular brown setae; sternite 5 (Fig. 86), modified, ovoid, grossly expanded laterally, with raised submedial area in apical ⅔, bearing batch of short regular spines arranged in an arc, each side with comb of eight long, thick, black-brown, apically-directed spines, spinose region with faint brown macula, surface with short setae arranged in irregular rows; sternite 6 (Fig. 86) narrow at base, laterally expanded (may appear narrower than Fig. 86 in undissected specimens), with deep and broad, V-shaped excision apically, with faint brown maculae medially and fascia laterally, merging apically, clothed in very short, irregular black-brown setulae for most of length, those at apical margin slightly longer and more prominent.

Terminalia (Figs 57, 60, 63). Hypandrium (Fig. 57, *hy*) long, with broad-based rounded-angulate dorsobasal lobes; posterior bridge dorsally and ventrally produced (angulate in profile); hypandrial arms broad basally, narrowed apically (viewed laterally), with 2 setulae proximal to postgonite, the more lateral ventrally directed, the medial ventromedially directed (obscured by epandrium on Fig. 57), sclerotised area of medial lobes (viewed dorsally), narrow basally and apically, medially expanded and semicircular, here slightly overlapping (not convex); postgonite (obscured by surstylus



Figs 79–91. Sternites 6 (79–85, 87–91) and 4–6 (86) of *Curtonotum* spp. males: (79) *C. keiseri*, N-T, Ambohitra, TAU; (80) *C. stuckenbergi*, HT, Ambohitantely, NMHN; (81) *C. irwini* sp. n., PT, Zombitse National Park, CAS; (82) *C. parkeri* sp. n., PT, same, CAS; (83) *C. coronaeformis* sp. n., PT, Fianarantsoa, CAS; (84) *C. balachowskyi*, N-T, same, CAS; (85) *C. gladiiformis* sp. n., N-T, same, CAS; (86) *C. sternithrix*, PT, Manambato, MNHN; (87) *C. rinhatinana* sp. n., HT, Ankarafantsika, CAS; (88) *C. boeny*, N-T, E. Bekopaka, CAS; (89) *C. griveaudi* sp. n., PT, Mahafaly Reserve, CAS; (90) *C. pauliani*, N-T, E. Bekopaka, CAS; (91) *C. sakalava*, N-T, Berenty Special Reserve, CAS. Scale bars = 0.5 mm.

on Fig. 57) long, thin and straight, with slight undulating anterior margin; epandrium (Fig. 57, *ep*) diminutive in proportion to hypandrium, slightly longer than broad (viewed laterally), evenly-rounded on dorsal margin, ventral margin markedly indented, here glabrous, with extensive row of long regular to irregular, apically-directed setae along ventroapical margin; cercus (Fig. 57, *ce*) not prominent, longest setae not exceeding longest setae at ventroapical margin of epandrium; surstylus (Fig. 57, *ss*) very long and narrow, widest basally, slightly curved in apical ⅔; phallus (as in Figs 60, *ph*, *bp*, *dp*, 63, *bp*, *dp*) C-shaped, strongly sclerotised, brown; phallapodeme (Fig. 60, *ph*) fused to basiphallus, basal portion produced and rounded (viewed laterally), with basal margin developed into two extensive, very broad, flat projections in basal ⅔, bifurcated, broad and dovetailed at point of connection with hypandrium; ejaculatory apodeme (Fig. 60, *ea*) free, duct inserted at junction of phallapodeme and basiphallus; basiphallus (Fig. 60, *bp*) wide in basal half, expanded at junction of basiphallus and distiphallus, here with extensive mat of long, translucent, finger-like, overlapping spinules that continue on basoventral surface of distiphallus; apical section (Fig. 63, *bp*) broad, right lateral margin divided, forming even projection apically; distiphallus (Figs 60, 63, *dp*) extremely long and broad, with extensive membranous area, left lateral margin with membranous fold, clothed in short wart-like spinules, sclerotised area subdivided basally and medially with extensive membranous window, and conspicuous tuft of hairs submedially (viewed laterally).

Variation: Insufficient material is available to assess variability.

Holotype (examined): ♂ MADAGASCAR: "Madagascar Est / Antanambe 8m / 1.IV.[19]58 / B. Stuckenberg // HOLOTYPE [red card] // CURTONOTUM / *sternithrix* / Holotype ♂ n.sp. / L. TSACAS DET. 1973 [printed & handwritten] // MUSÉUM PARIS // *Curtonotum* / *sternithrix* ♂ / Tsacas, 1974 / A.H. Kirk-Spriggs *vidit* 2008" (MNHN). In excellent condition, left wing detached and glued to mount; re-staged on nu-poly mount; not dissected.

Paratypes (all labelled: "*Curtonotum* / *sternithrix* ♂ [or ♀] / Tsacas, 1974 / A.H. Kirk-Spriggs *vidit* 2008"): MADAGASCAR: 1♀ "Manambato / (Anove) // INSTITUT / SCIENTIFIQUE / MADAGASCAR [pale grey card] // COM. INST. ENT. / COLL. NO14644 // ALLOTYPE [red card] // CURTONOTUM / *sternithrix* / Allotype ♀ n.sp. / L. TSACAS DET. 1973 [printed & handwritten] // MUSÉUM PARIS" [left wing detached and glued to card] (MNHN). 1♂ "Manambato / (Anove) // INSTITUT / SCIENTIFIQUE / MADAGASCAR [pale grey card] // PARATYPE [red card] // CURTONOTUM / *sternithrix* / paratype ♂ n.sp. / L. TSACAS DET. 1973 [printed & handwritten] // à renvoyer à / Stuckenberg à le / place du le Holotype / unique ici L. Tsacas 1975" (NMSA).

Distribution (Fig. 94): Occurring in Plateau Grassland-Wooded Grassland Mosaic and Degraded Humid Forest vegetation types, in the Evergreen Rainforest biome. In the Northern Central East and South East biogeographical zones and Humid bioclimatic zone (Figs 105–107; Tables 1–3; Appendix II). Stuckenberg's specimen label refers to site 28 in his unpublished report of his second Madagascan Expedition (1957–1958) (Kirk-Spriggs in press). The entry for 1 April 1958 reads: "(28) ANTANAMBE – night stop and some collecting."

Curtonotum stuckenbergi Tsacas, 1974

Figs 2, 15, 28, 56, 59, 62, 80, 93

Curtonotum stuckenbergi: Tsacas, 1974: 705; figs 2a–d (p. 707), fig. 8g (p. 718). Type locality: "Madagascar, Ambohitantely".

Differential diagnosis: This species is closely related to *C. keiseri*, differing in the colour of the frons (yellow with indistinct vittae in *C. stuckenbergi* and brown with distinct vittae in *C. keiseri*), the colour of flagellomere 1, and in the shape of the male terminalia. Both share the deep brown, infuscate wing membrane, the dove-tailed sternite 6, and straight, ventrally-directed lateral spine and two smaller spines on the distiphallus. *Curtonotum stuckenbergi* differs from *C. keiseri*, however, in the angle and degree of curvature of the *dm–cu* crossvein of the wing, in having the lateral margins of the phallus heavily-sclerotised and the smaller spines of the distiphallus positioned in the left and right lateral regions, rather than basolaterally. The ranges of the two species do not overlap, and they occur allopatrically.

Redescription:

Male (primarily based on field-pinned HT and PT).

As redescribed for *C. balachowskyi*, differing in the following respects:
Measurements: Overall length 8 mm (Tsacas 1974: 706); length of head and thorax combined 2.9 mm; length of thorax and scutellum combined 3.5 mm (HT); wing length 5.7 mm ($n = 1$, PT).

Head (Figs 2, 15). Eye height/length ratio: 12:8 (HT); frons (Fig. 15), frons length/width ratio: 7:8 (HT), orbital plates extending 0.8 length of frons; posterior orbital seta moderately strong, slightly shorter than outer vertical seta; flagellomere 1 yellow pruinose basally, otherwise grey pruinose throughout, arista with 7 or 8 long dorsal branches and 3 ventral branches in addition to terminal fork; gena narrow, eye height/genal height ratio: 12:1 (HT), silver pruinose, slightly darker beyond basal angle; vibrissae weakly developed; palpus pale brown.

Thorax (Fig. 2). Mesonotum with the 2 median vittae narrow, 2 lateral vittae shorter, clearly defined; supra-alar seta, *ca* twice length of posterior dorsocentral seta; postalar setae, moderately strong, slightly exceeding length of acrostichal setae; postpronotum with 11 finer black-brown setulae; anepisternum with 15 fine setulae, some larger and arranged in 2 groups of 2 and 3; anepimeron, laterotergite and meron silver-grey to yellow-grey pruinose; katepisternum silver-grey to yellow-grey pruinose, dorsal katepisternal seta very fine and short, *ca* 0.1 length of ventral katepisternal seta, with 13 short, fine setulae at base and along posterior margin.

Scutellum. As described for *C. gladiiformis* sp. n.

Legs. Fore coxa with 8 brown setulae on anterior surface; mid coxa with 8 brown setulae; fore tibia with ctenidium of 12 short, sharp black spinules.

Wing (as in Fig. 28). Long, broad, tip evenly rounded, veins chestnut-brown, membrane deep brown infuscate throughout, darker in r_1 and anterior half of r_{2+3} and in region of *dm–cu* crossvein; *dm–cu* crossvein obliquely angled and moderately straight; haltere dirty yellow.

Abdomen. Abdominal tergites as described for *C. keiseri*; sternites 4–5 as described for *C. coronaeformis* sp. n.; sternite 6 (Fig. 80) dove-tailed (may appear narrower than Fig. 80 in undissected specimens), markedly narrowed basally, widened laterally, with deep triangular excision apically, apical lobes squarely rounded, with dark brown maculae laterally, clothed in short, irregular brown setulae in apical ⅔, those at lateral and apical margins longer and more prominent.

Terminalia (Figs 56, 59, 62). Hypandrium (Fig. 56, *hy*) long, with broad-based rounded-truncate dorsobasal lobe, posterior bridge dorsally and ventrally produced

(subtriangular to slightly angulate in profile); hypandrial arm constricted medially (viewed laterally), with 2 parallel setulae proximal to postgonite of similar length (obscured by epandrium on Fig. 56), sclerotised area of medial lobes (viewed dorsally), with margins evenly rounded, convex medially, closely abutting, overlapping; postgonite (Fig. 56, *pg*) long, thin and straight, with slight undulating anterior margin; epandrium (Fig. 56, *ep*) slightly broader dorsally than ventrally (viewed laterally), evenly rounded on dorsal margin, posterior margin slightly angled, ventral margin with extensive row of long regular to irregular, apically-directed setae; cercus (Fig. 56, *ce*) not prominent, longest setae longer than setae on dorsal margin of epandrium; surstylus (Fig. 56, *ss*) moderately short, widest basally, slightly curved in apical ⅔; phallus (as in Figs 59, *ph*, *bp*, *dp*, 62, *bp*, *dp*) C-shaped, heavily sclerotised, especially lateral margins of apical section of basiphallus (viewed dorsally), dark brown; phallapodeme (Fig. 59, *ph*) fused to basiphallus, subtriangular (viewed laterally), with basal margin developed into two large, flat and broad, subtriangular projections in basal ⅔, widely bifurcated at point of connection with hypandrium; ejaculatory apodeme (Fig. 59, *ea*) free, duct inserted at junction of phallapodeme and basiphallus; basiphallus (Fig. 59, *bp*) broad basally and in region of first bend, then narrowed to apex, markedly narrowed in apical third (viewed dorsally); apical section (Figs 59, 62, *bp*) very broad basally, with evenly-rounded lateral margins, sclerotised area extensive, abruptly narrowed towards apex, basal section with large membranous window, with one very strong, thick, straight, ventrally-directed lateral spine (indicated with arrow on Fig. 62) and two smaller spines, positioned in left and right basolateral regions, membranous lateral extension with extensive series of small tubules.

Variation: Insufficient material is available to assess variability.

Holotype (examined): ♂ MADAGASCAR: "Madagascar Centre / Ambohitantely 1600m / dct Ankazobe / B. Stuckenberg // 6.i.[19]58 [type-written; white paper] // HOLOTYPE [red card] // CURTONOTUM / *stuckenbergi* / Holotype n.sp. / L. TSACAS DET. 1973 [printed & handwritten] // MUSÉUM PARIS // *Curtonotum* ♂ / *stuckenbergi* Tsacas, 1974 / A.H. Kirk-Spriggs *vidit* 2008" (MNHN). In excellent condition; re-staged on nu-poly mount; dissected, abdomen and terminalia in microvial pinned beneath specimen.

Paratype (labelled: "*Curtonotum* ♂ / *stuckenbergi* Tsacas, 1974 / A.H. Kirk-Spriggs *vidit* 2008"): MADAGASCAR: 1♀ "MADAGASCAR Tan. / Ambohitantely / 10.VI.[19]58 F.KEISER [pink paper] // ALLOTYPE [red card] // CURTONOTUM / *stuckenbergi* / Allotype n.sp. / L. TSACAS DET. 1973 [printed & handwritten]" [left right wing detached and glued to card] (NHMB).

Note: Tsacas (1974: 706) notes "10-v-1958" as the date of capture of the allotype ♀; in truth the label reads "10.VI.58."

Distribution (Fig. 93): Apparently confined to the Humid Forest vegetation type in the Central Highlands biome. In the Central biogeographical zone and Subhumid bioclimatic zone (Figs 105–107; Tables 1–3; Appendix II). The description of this species is based on two specimens collected at the same locality; one by Brian Stuckenberg in January and one by "Fred" Keiser in June 1958. "Ambohitantely" as listed on Stuckenberg's specimen labels refers to site 7 in his unpublished report of his second Madagascan Expedition (1957–1958) (Kirk-Spriggs in press). The entry for 6 January 1958 reads: "(7) AMBOHITANTELY FOREST, ANKAZOBE DIST. – by car, approx. 120 kms. N.-W. of Tananarive, a residual patch of forest in savannah country of fair relief. Numerous small patches of forest in the vicinity suggest that the whole area was once forested and has recently been denuded. A number of peculiar species taken."

DISCUSSION

Vicariance versus *dispersal hypotheses*

Two causal factors have been suggested to explain the origins of Madagascar's unique biota: Gondwanan vicariance and Cenozoic "sweepstake" dispersal (e.g., Cox 1998; Heads 2009; Trewick 2000; Yoder & Nowak 2006).

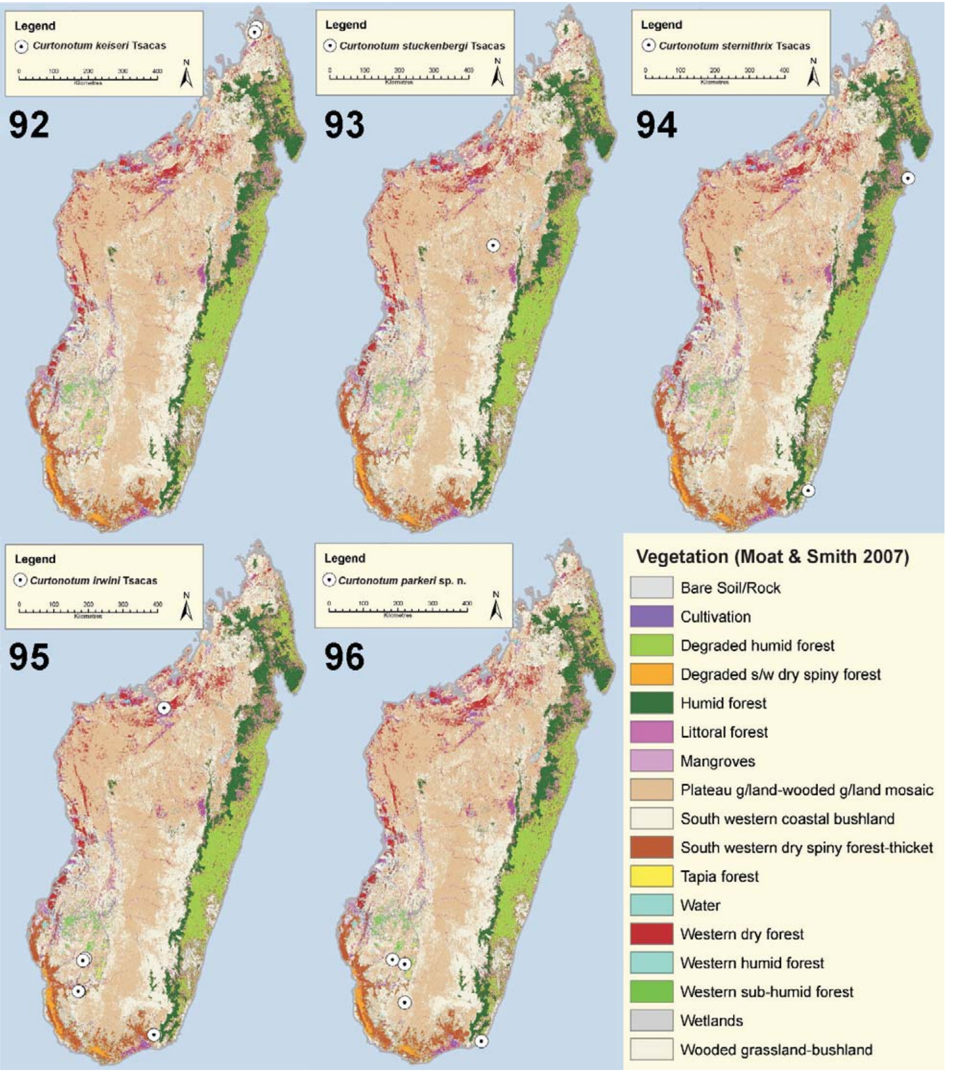
The Schizophora in general were absent from the Cretaceous, those that were present being ancient taxa (Platypezoidea, Phoridae *sensu lato* and stem groups) (e.g., Grimaldi & Engel 2005; Wiegmann *et al*. 2011). The presence of ancient and stem-group members of the families Camillidae, Drosophilidae and Diastatidae *sensu lato* (incl. Campichoetidae) in Baltic amber (e.g., Hennig 1965; Tschirnhaus & Hoffeins 2009), indicate that the divergence of ephydroid families probably occurred during the early Paleogene. The vast radiation of acalyprates in general probably took place in the Eocene (e.g., Hennig 1965) and modern genera evolved by the Early Miocene (Arillo & Ortuño 2005). The recent discovery of verified fossil inclusions of Curtonotidae in Miocene amber from the Dominican Republic (Grimaldi & Kirk-Spriggs, in prep.), formed in a single sedimentary basin, during the early Miocene through early Middle Miocene (Iturralde-Vincent & McPhee 1996), now provides a minimum age for the Curtonotidae in the fossil record. The Curtonotidae are, therefore, far too recent in geological terms to be considered as Gondwanan relicts and only the second of the above-mentioned hypotheses need be considered here.

Cenozoic "sweepstake" dispersal represents transoceanic distribution of African founder individuals from 65.5 Mya to the present (Yoder & Nowak 2006; Vences *et al*. 2009). Rafting or flight remains the predominant explanation for such dispersal events. In a recent study using palaeogeographic reconstructions and palaeo-oceanographic modelling, Ali and Huber (2010) concluded that strong surface currents flowed from north-east Mozambique and Tanzania eastwards towards Madagascar during the Palaeogene, and concord perfectly with conditions favourable for "sweepstake" dispersal of founder individuals from continental Africa. They conclude, therefore, that rafting (at least in the case of small mammals), may have been the dominant means of transoceanic dispersal during the Cenozoic era, but that this was not apparent after the early Miocene when oceanic currents had evolved to their current configuration.

In the case of the Insecta and some other invertebrate groups, it has been suggested that aerial dispersal (termed "Anemochore dispersal" in some of the literature), may be as plausible an explanation for founder individual dispersal, and there is much indirect evidence for dispersal among the Pacific islands (e.g. Kirk-Spriggs 2010*a*; Kirk-Spriggs & McGregor 2009, for review). Kirk-Spriggs (2010*a*) further suggested that the occurrence of the curtonotid *Axinota kyphosis* on Madagascar (a species of presumed Oriental origin), may have resulted from founder individual transoceanic dispersal via the circulation system of the Indian monsoon.

In a review of published phylogenetic studies of various floral and faunal groups occurring on Madagascar (i.e., plants, invertebrates, vertebrates and birds), Yoder and Nowak (2006) concluded that there are numerous endemic clades of Malagasy taxa whose closest sister group relationships are to African taxa, and that there appears to be an overwhelming indication of Cenozoic dispersal. They found that nearly half the plants, invertebrates and vertebrates included in these studies exhibit sister group relationships to African taxa, indicating that the majority of lineages ancestral to Malagasy endemics had their relatives or ancestors in Africa. Although this study has been superseded by other studies on similar themes, the general conclusions stated here remain apparent.

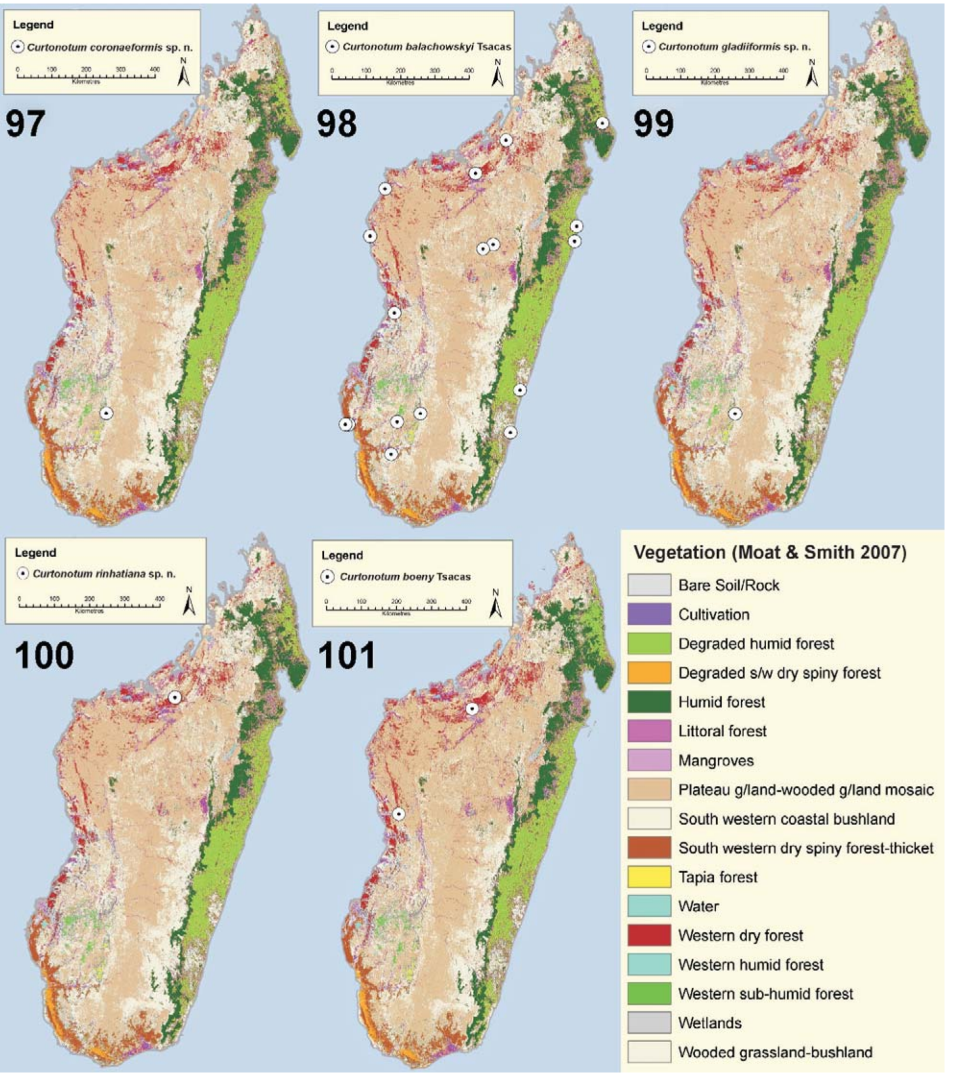
In a review of the Diptera on Madagascar, Irwin *et al*. (2003) noted, that endemism among the Diptera is extremely high on Madagascar, with 80 % of species being endemic to the island. In the case of the genus *Curtonotum*, partly revised here, 25 species (of which 13 are undescribed) occur in the continental Afrotropical Region, representing 65 % of the regional fauna, while 13 species (of those 6 newly-described) occur on Madagascar, representing 35 % of the Afrotropical fauna as a whole (Kirk-Spriggs in



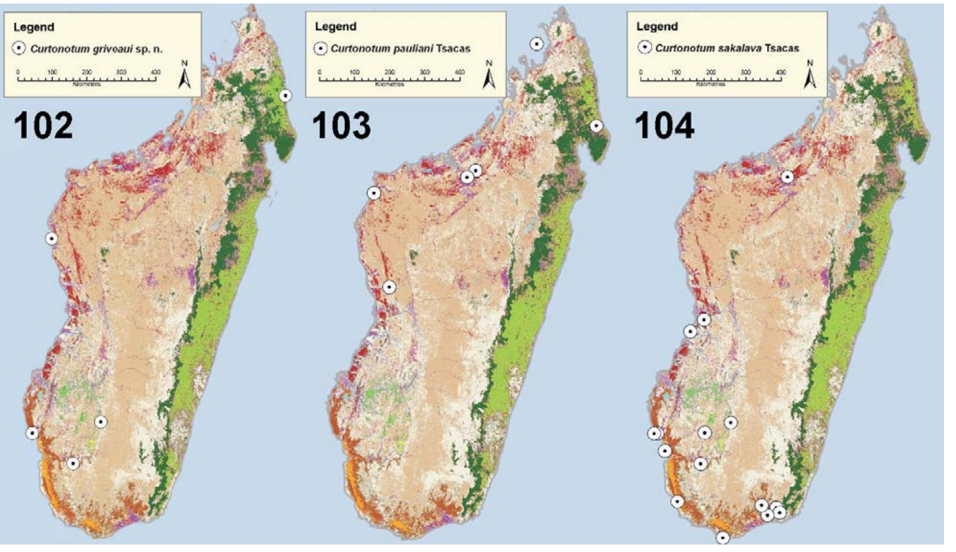
Figs 92–96. Distribution of Malagasy *Curtonotom* spp.: (92) *C. keiseri*; (93) *C. stuckenbergi*; (94) *C. sternithrix*; (95) *C. irwini* sp. n.; (96) *C. parkeri* sp. n.

prep.). Only one species, *C. pauliani*, known from unpublished records from Namibia and South Africa, occurs both on Madagascar and the mainland Afrotropical Region (Kirk-Spriggs in prep.). It should be borne in mind, however, that the continental Afrotropical fauna of the genus is far better sampled and represented in collections than it is for Madagascar, and additional dedicated sampling on the island is sure to reveal further undescribed species.

Even prior to his 1977 study of the continental Afrotropical species of the genus, Tsacas (1974), suggested that the seven described Malagasy species of *Curtonotum* were derived from continental Africa and noted the close affinities of *C. pauliani* (Ma-



Figs 97–101. Distribution of Malagasy *Curtonotom* spp.: (97) *C. coronaeformis* sp. n.; (98) *C. balachowskyi*; (99) *C. gladiiformis* sp. n.; (100) *C. rinhatinana* sp. n.; (101) *C. boeny*.



Figs 102–104. Distribution of Malagasy *Curtonotom* spp.: (102) *C. griveaudi* sp. n.; (103) *C. pauliani*; (104) *C. sakalava*. See Figs 92–101 for vegetation key.

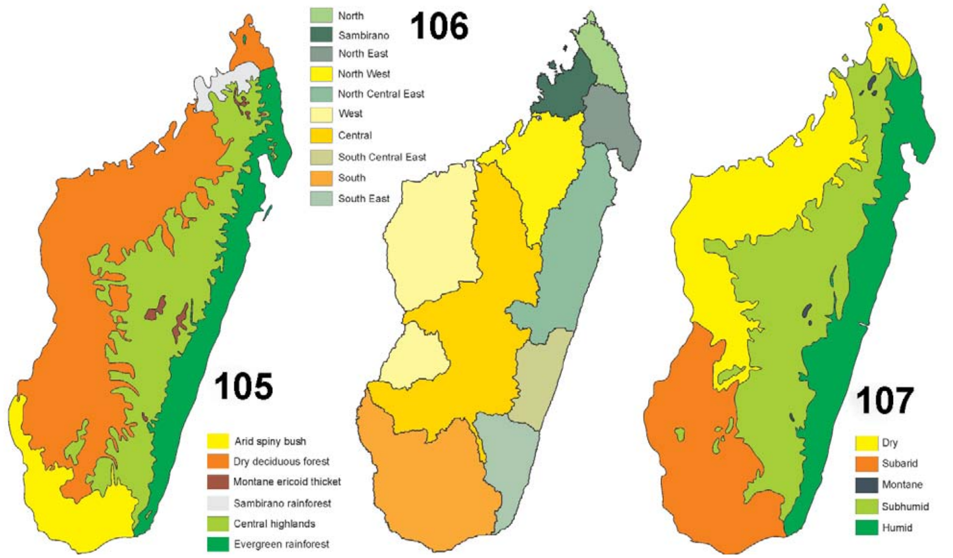
dagascar) to *C. cuthbertsoni* Duda, 1935 and *C. quinquevittatum* Curran, 1933 (both continental Afrotropical species), these three species being so similar externally that only the shape of the phallus allowed specific differentiation. In a later study, Kirk-Spriggs (2010*a*) intimated that the Malagasy *Curtonotum* faunal lineage may be derived from more than one dispersal event.

Madagascar's biomes and other interpretations

Climatic and biotic disparities that are evident within Madagascar led to various proposals to subdivide the island into discrete subunits that correspond broadly to its major biomes. These have been defined by bioclimatic factors (e.g., Schatz 2000), vegetation and elevation (e.g., Humbert 1955; Koechlin 1972), or by faunal composition (e.g., Angel 1942; Vences *et al*. 2009). Three such interpretations are discussed here: the biomes of Madagascar, after Yoder and Nowak (2006) (Fig. 105), biogeographic zonation, following Boumans *et al*. (2007) and partly Wilmé *et al*. (2006), after Glaw and Vences (2007: 13) (Fig. 106), and bioclimatic zonation, following Cornet (1974) and Schatz (2000), after Glaw and Vences (2007: 13) (Fig. 107).

Modern practice divides Madagascar into six distinct biomes (Fig. 105), as briefly outlined below. The major biomes exhibit sharp borders, even in the lowlands, and display a remarkable east-west trend in precipitation, from tropical humid to subarid bioclimatic extremes (Fig. 107) (Vences *et al*. 2009).

Evergreen Rainforest. Humidity transported by the eastern trade winds precipitates on the eastern slopes of the eastern mountain chains, which creates a marked rainfall gradient from the tropical humid north-east and east to the subarid south-west of the island (Vences *et al*. 2009). Evergreen lowland rainforest cloaks the east coast of the island, extending *ca* 100 km inland up the eastern mountains (Yoder & Nowak 2006). These forests receive 2500–4000 mm precipitation per year, with a significant dry



Figs 105–107. (105) The biomes of Madagascar (after Yoder & Nowak 2006); (106) biogeographic zonation of Madagascar, following Boumans *et al*. (2007) and partly Wilmé *et al*. (2006) (after Glaw & Vences 2007); (107) bioclimatic zonation of Madagascar, following Cornet (1974) and Schatz (2000) (after Glaw & Vences 2007).

season at lower elevations and a shorter one at higher elevations. Hence these slopes support broadleaf Evergreen Rainforest (Wells 2003).

Central Highlands. At elevations of 800 m and extending well into the interior of the island, the rainforest gives way to the Central Highlands, dominated by moist montane forest (Yoder & Nowak 2006).

Montane Ericoid Thicket. At higher elevations, above 2000 m, the moist montane forests of the Central Highlands are replaced by high elevation thickets, dominated by ericoid (Ericaceae) shrubs (Yoder & Nowak 2006). Three major massifs occur in the north, central and south, that reach elevations of up to 2900 m (Vences *et al*. 2009, fig. 1; Wilmé *et al*. 2006).

Dry Deciduous Forest (or Central Grasslands). In the western half of Madagascar, below elevations of 800 m, montane forest shifts to Dry Deciduous Forest, dominated by sclerophyllous trees and shrubs, as this area falls within the rain shadow created by the eastern mountains. Deforestation and heavy grazing have impacted heavily on the Central Highlands and Dry Deciduous Forest biomes and today the central parts of the island consists largely of degraded and depauperate grasslands, although some areas protected from fires, such as the wet floors of deep-sided gullies, retain some forest remnants (Yoder & Nowak 2006; Wells 2003). Minute Humid Forest relicts are also harboured on isolated massifs within the drier regions of the island (Vences *et al*. 2009).

Arid Spiny Bush (or Southern Spiny Bush). The arid south-west extension of the deciduous forests become extremely arid, as the influence of the 30° latitude subtropical arid belt become apparent (Yoder & Nowak 2006). This part of Madagascar receives less than 300 mm of rain per year in its driest parts and the streams are ephemeral. It is covered with highly xerophytic "spiny bush" that includes the endemic botanical family Didiereaceae and many other endemic succulents, baobabs and other plants and this biome includes most of Madagascar's endemic flora (Wells 2003).

Sambirano Rainforest. In the extreme north-west of Madagascar around Ambanja and the Sambirano River valley, a region of deciduous forest receives heavy seasonal rainfall that results from the Indian monsoonal circulation. This seasonal influx of precipitation produced a rainforest distinct biome known as Sambirano, which is geographically and biologically distinct from the eastern rainforest (Yoder & Nowak 2006).

Distribution and biome associations of the Malagasy Curtonotum *fauna*

The distributions of the Malagasy species of *Curtonotum* are tabulated according to the three interpretations of biome-related subunits noted above (Figs 105–107) (Tables 1–3).

Table 1 interprets the biome concept of Yoder and Nowak (2006) (Fig. 105). If these data are examined, it can be seen that the Dry Deciduous Forest biome has the most species represented (8), followed by the Central Highlands (7; five of which occur in isolated biome remnants in the south-west). The Evergreen Rainforest has five species (one of which occurs in the isolated forest remnant to the far north of the island), and the Arid Spiny Bush has four species. Only one species is recorded from the Sambirano Rainforest and none from the Montane Ericoid Thicket. Seven of the 13 species occur in a single biome, one in two, four in three and one in four.

Table 2 interprets biogeographic zonation, following Boumans *et al*. (2007) and partly Wilmé *et al*. (2006), after Glaw and Vences (2007: 13) (Fig. 106). According to this concept seven species occur in the South (two of which occur at the borderline between two zones), six in the Central zone, five in the West and three each in the North East and South East. The North, Sambirano and South Central East have one species each. One species occurs in eight zones, one in four, two in three, four in two and five species in one alone.

Table 3 interprets bioclimatic zonation, following Cornet (1974) and Schatz (2000), after Glaw and Vences (2007: 13) (Fig. 107). From these data it is apparent that the greater number of species occur in the Subhumid zone (eight; five of which occur in remnant fragments of the zone), followed by the Dry (eight), the Humid (six; one fragmented), and the Subarid (five). No species are recorded from the Montane and six of the 13 recorded species occur in more than one zone.

Collectively, these interpretations indicate that biome exclusiveness is largely inconclusive for many *Curtonotum* spp. and that the biome-restricted patterns that are glaringly apparent in some other floral and faunal groups are considerably less marked for species of the genus.

The distribution of the 13 species occurring on Madagascar (illustrated in Figs 92–104), can be briefly summarised as follows: two species, *C. sternithrix* and *C. keiseri* are restricted to the Evergreen Rainforest biome; *C. sternithrix* to the main eastern rainforest and *C. keiseri* exclusively to Parc National de la Montagne d'Ambre, a volcanic massif (maximum elevation 1475 m), covered in montane forest that rises from the surrounding dry areas. The sister species of *C. keiseri*, namely *C. stuckenbergi*, is restricted to the Central Highlands biome, in Ambohitantely Forest Reserve, which lies at elevations between 1300 and 1650 m. Two species, *C. coronaeformis* sp. n.

TABLE 1

Distribution of the Malagasy species of *Curtonotum* according to biome types. Biome classification follows Yoder and Nowak (2006) (Fig. 105).
Coding: (+) presence, (–) absence, (*) remnant fragment of main biome type.

Species	Biome classification						No. of biomes
	Arid Spiny Bush	**Dry Deciduous Forest**	**Montane Ericoid Thicket**	**Sambirano Rainforest**	**Central Highlands**	**Evergreen Rainforest**	
C. balachowskyi	+	+	–	–	+	+	**4**
C. boeny	–	+	–	–	–	–	**1**
C. coronaeformis sp. n.	–	–	–	–	+*	–	**1**
C. gladiiformis sp. n.	–	–	–	–	+*	–	**1**
C. griveaudi sp. n.	+	+	–	–	+*	–	**3**
C. irwini sp. n.	+	+	–	–	–	–	**2**
C. keiseri	–	–	–	–	–	+*	**1**
C. parkeri sp. n.	–	+	–	–	+*	+	**3**
C. pauliani	–	+	–	+	–	+	**3**
C. rinhatinana sp. n.	–	+	–	–	–	–	**1**
C. sakalava	+	+	–	–	+*	–	**3**
C. sternithrix	–	–	–	–	–	+	**1**
C. stuckenbergi	–	–	–	–	+	–	**1**

TABLE 2

Distribution of the Malagasy species of *Curtonotum* by biogeographic zone. Biogeographic zones follow Boumans *et al*. (2007) and partly Wilmé *et al*. (2006) (after Glaw & Vences 2007: 13) (Fig. 106). Coding: (+) presence, (–) absence, (*) borderline between two zones.

Species	Biogeographic zones										
	North	**Sambirano**	**North East**	**North West**	**North Central East**	**West**	**Central**	**South Central East**	**South**	**South East**	**No. of zones**
C. balachowskyi	–	–	+	+	+	+	+	+	+	+	**8**
C. boeny	–	–	–	–	–	+	+	–	–	–	**2**
C. coronaeformis sp. n.	–	–	–	–	–	–	–	–	+*	–	**1**
C. gladiiformis sp. n.	–	–	–	–	–	–	–	–	+*	–	**1**
C. griveaudi sp. n.	–	–	+	–	–	+	–	–	+	–	**3**
C. irwini sp. n.	–	–	–	–	–	–	+	–	+	–	**2**
C. keiseri	+	–	–	–	–	–	–	–	–	–	**1**
C. parkeri sp. n.	–	–	–	–	–	–	–	–	+	+*	**2**
C. pauliani	–	+	+	–	–	+	+	–	–	–	**4**
C. rinhatinana sp. n.	–	–	–	+*	–	–	–	–	–	–	**1**
C. sakalava	–	–	–	–	–	+	+	–	+	–	**3**
C. sternithrix	–	–	–	–	+	–	–	–	–	+	**2**
C. stuckenbergi	–	–	–	–	–	–	+	–	–	–	**1**

TABLE 3

Distribution of the Malagasy species of *Curtonotum* by bioclimatic zone. Bioclimatic zones follow Cornet (1974) and Schatz (2000) (after Glaw & Vences 2007: 13) (Fig. 107). Coding: (+) presence, (–) absence, (*) remnant fragment of main bioclimatic zone.

Species	Bioclimatic zones					No. of zones
	Dry	**Subarid**	**Montane**	**Subhumid**	**Humid**	
C. balachowskyi	+	+	–	+	+	**4**
C. boeny	+	–	–	–	–	**1**
C. coronaeformis sp. n.	–	–	–	+*	–	**1**
C. gladiiformis sp. n.	–	–	–	+*	–	**1**
C. griveaudi sp. n.	+	+	–	+*	+	**4**
C. irwini sp. n.	+	+	–	–	–	**2**
C. keiseri	–	–	–	–	+*	**1**
C. parkeri sp. n.	–	+	–	+*	+	**3**
C. pauliani	+	–	–	+	+	**3**
C. rinhatinana sp. n.	+	–	–	–	–	**1**
C. sakalava	+	+	–	+*	–	**3**
C. sternithrix	–	–	–	–	+	**1**
C. stuckenbergi	–	–	–	+	–	**1**
Total no. of species	**7**	**5**	**0**	**8 (5*)**	**6 (1*)**	

and *C. gladiiformis* sp. n., are apparently restricted to the Central Highlands biome fragment in the south-central region of Madagascar, both being only recorded from Fianarantsoa, near Parc National de la Isalo. *Curtonotum coronaeformis* sp. n., and its sister species *C. parkeri* sp. n., occur sympatrically, with *C. parkeri* sp. n. restricted to the south of the island. *Curtonotum rinhatinana* sp. n. is restricted to the Dry Deciduous Forests at Ankarafantsika National Park in the north-west of Madagascar, which forms a mosaic of dense, Dry Deciduous Forest. Two species, *C. sakalava* and *C. irwini* sp. n., although occurring in more than one biome type, are predominantly associated with the Arid Spiny Bush and the Dry and Subarid bioclimatic zones. *Curtonotum boeny* is restricted to the Dry Deciduous Forest biome, recorded from two localities: Ambato-Boeni and Parc National Tsingy de Memaraha. Its sister species, *C. griveaudi* sp. n., is much more widely distributed, occurring in the north-east, west and south-west of the island. *Curtonotum pauliani* occurs mainly in the north-east of Madagascar and is the only species of the genus recorded as occurring in the Sambirano Rainforest biome. Lastly, *C. balachowskyi* is widely distributed in Madagascar and occurs in four of Madagascar's biome types.

Vences *et al*. (2009) noted that radiations of Malagasy lineages resulted in a wealth of microendemics restricted to small ranges within the landmass of Madagascar and that species formation may have been influenced by bioclimatic disparities between the arid west and humid east (see also Dewer & Richard 2007). Populations of widespread species adapted to humid conditions remain isolated in Humid Forest relicts in predominantly dry areas during periods of cool and dry climate and, over time, diverge to become separate species without adapting to different climatic conditions. This may explain the microendemic species of *Curtonotum* (noted above) that are apparently restricted to specific isolated, afforested mountains and/or to biome fragments in the dryer western and northern regions of Madagascar (Vences *et al*. 2009). The previous assumption that deforestation of the Central Highlands and Dry Deciduous Forest biomes and subsequent forest fragmentation is wholly anthropogenic is a myth. This is evidenced by pre-anthropogenic charcoal and fossil data that demonstrate Pleistocene oscillation in the extent of these biomes and their associated vegetation cover (Bond *et al*. 2008; Burney *et al*. 2003; Vences *et al*. 2009).

Lineages of the Malagasy *Curtonotum* fauna will become more apparent once the combined morphological and molecular phylogeny of the Curtonotidae as a whole is published in Part IV of this revision, and Bayesian divergence dates are established for some of the African and Madagascan clades.

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APPENDIX I

Annotated checklist of Curtonotidae of Madagascar. Type localities are cited as they appear on the original type specimen labels. A list of institutional codens is provided in the "Material and methods" section. Information is provided on deposition of holotypes and synonymy.

Genus ***AXINOTA*** van der Wulp, 1886

***AXINOTA*:** van der Wulp 1886: cviii. Type-species: *Axinota pictiventris* van der Wulp, 1886, by original designation ("gen. n, sp. n.").

APSINOTA van der Wulp, 1887: 178 [footnote]. Unjustified emendation of *Axinota*.

THAUMASTOPHILA Hendel, 1914: 112. Type-species: *Thaumastophila hyalipennis* Hendel, 1914: 113, by original designation.

ANASEIOMYIA Malloch, 1930: 328. Type-species: *Anaseiomyia uniformis* Malloch, 1930: 329, by original designation.

kyphosis Kirk-Spriggs, 2010*a*: 115. Type-locality: "Madagascar: 10 km W von Sakaraha" (HT, ZSM). Afrotropical: Madagascar.
= *Apsinota* sp. *sensu* Tsacas (1974: 717). "Madagascar, Prov. d'Analalava, Maromandia" (PT, MNHN).

Genus ***CURTONOTUM*** Macquart, 1844

CURTONOTUM: Macquart 1844: 350 (193). Type-species: *Musca gibba* Fabricius, 1805 [preoccupied], by original designation. [The name of the type-species is a junior primary homonym preoccupied by *Musca gibba* Müller, 1776: 175 and *M. gibba* Rossi, 1794: 73. *Curtonotum taeniatum* Hendel, 1913: 629 was accepted as the replacement name by Thompson and Pont (1993)].

CYRTONOTUM Agassiz, 1846: 108. Unjustified emendation of *Curtonotum* Macquart, 1844.

DIPLOCENTRA Loew, 1862: 13. [Unnecessary] new replacement name for *Curtonotum* Macquart, 1844.

SELIACANTHA Bezzi, 1895: 66. *Nomen nudum*, attributed to Rondani and proposed in synonymy (with *Diplocentra* Loew, 1862). Name from a collection label. Also Bezzi (1902: 192).

SELIDACANTHA Bezzi, 1895: 66. *Nomen nudum*, proposed as an emendation of the likewise unavailable *Seliacantha* Bezzi, 1895: 66. Also Bezzi (1902: 192).

balachowskyi Tsacas, 1974: 710. Type locality: "Madagascar, Mananjary" (HT, MNHN). Afrotropical: Madagascar.
= *Curtonotum* sp. cf. *balachowskyi* n. sp. species b (*sensu* Tsacas 1974: 712).

boeny Tsacas, 1974: 712. Type locality: "Madagascar, Ambato-Boeny" (HT, MNHN). Afrotropical: Madagascar.

coronaeformis sp. n. Type locality: "Madagascar, Fianarantsoa, near Isalo National Park" (HT, CAS). Afrotropical: Madagascar.

gladiiformis sp. n. Type locality: "Madagascar, Fianarantsoa, near Isalo National Park" (HT, CAS). Afrotropical: Madagascar.

griveaudi sp. n. Type locality: "Madagascar, Asondrodava dry forest, 15 km N of Maintirano" (HT, CAS). Afrotropical: Madagascar.

irwini sp. n. Type locality: "Madagascar: Zombitse National Park" (HT, CAS). Afrotropical: Madagascar.

keiseri Tsacas, 1974: 706. Type locality: "Madagascar, Joffreville" (HT, MNHN). Afrotropical: Madagascar.

parkeri sp. n. Type locality: "Madagascar: Zombitse National Park" (HT, CAS). Afrotropical: Madagascar.

pauliani Tsacas, 1974: 715. Type locality: [Madagascar] "Nosy Mitsio" (HT, MNHN). Afrotropical: Madagascar, Namibia and South Africa.

rinhatinana sp. n. Type locality: "Madagascar: Ankarafantsika Forest Reserve" (HT, CAS). Afrotropical: Madagascar.

sakalava Tsacas, 1974: 713. Type locality: "Madagascar Quest, Morondava" (HT, MNHN). Afrotropical: Madagascar.

sternithrix Tsacas, 1974: 708. Type locality: "Madagascar Est, Antanambe" (HT, MNHN). Afrotropical: Madagascar.

stuckenbergi Tsacas, 1974: 705. Type locality: "Madagascar, Ambohitantely" (HT, MNHN). Afrotropical: Madagascar.

APPENDIX II

Geographical co-ordinates used to map distributions plotted on Figs 92–104, based on material examined in this study and listed in the material examined sections. Vegetation types listed follow Moat and Smith (2007).

Species	Locality	Latitude	Longitude	Vegetation type
C. balachowskyi	Ambila	-22.000000	47.966667	Degraded Humid Forest
C. balachowskyi	50 km S of Farafangana, Mahabo Mananivo, Ampitavananima Forest	-23.116667	47.716667	Wooded Grassland–Bushland
C. balachowskyi	Ambohitantely, 46 km NE of Ankazobe	-18.183333	47.266667	Plateau Grassland–Wooded Grassland Mosaic
C. balachowskyi	Ambovomamy Belambo, 20 km NW of Port Berger	-15.450000	47.600000	Wooded Grassland–Bushland
C. balachowskyi	Ampijoroa National Park	-16.316667	46.800000	Western Dry Forest
C. balachowskyi	Beza Mahafaly Reserve, Parcelle I near research station	-23.683333	44.583333	South Western Dry Spiny Forest–Thicket
C. balachowskyi	Mananjary	-18.300000	47.000000	Plateau Grassland–Wooded Grassland Mosaic
C. balachowskyi	Mikea Forest (1)	-22.900000	43.466667	South Western Dry Spiny Forest–Thicket
C. balachowskyi	Mikea Forest (2)	-22.900000	43.383333	Coastal Buffer
C. balachowskyi	near Isalo National Park, at stream east of Interpretive Center	-22.616667	45.350000	Wooded Grassland–Bushland
C. balachowskyi	Tamatave	-18.100000	49.400000	Degraded Humid Forest
C. balachowskyi	Beroboka village 45 km NE Morondava	-19.977500	44.665333	Wooded Grassland–Bushland
C. balachowskyi	Asondrodava dry forest, 15 km N of Maintirano	-17.965333	44.035500	Wooded Grassland–Bushland
C. balachowskyi	Marofototra dry forest, 17 km W of Besalampy	-16.721667	44.423667	Western Dry Forest
C. balachowskyi	Analalava, 7 km SW of Foulpointe	-17.705333	49.454833	Degraded Humid Forest
C. balachowskyi	Maromandia	-15.000000	50.133333	Wooded Grassland–Bushland
C. balachowskyi	Zombitse National Park, near national road	-22.833333	44.740833	Plateau Grassland–Wooded Grassland Mosaic
C. boeny	Ambato-Boeni	-16.450000	46.750000	Wooded Grassland–Bushland
C. boeny	Parc National Tsingy de Memaraha	-19.133333	44.816667	Western Dry Forest
C. coronaeformis sp. n.	near Isalo National Park	-22.626667	45.358167	Wooded Grassland–Bushland
C. gladiiformis sp. n.	near Isalo National Park	-22.626667	45.358167	Wooded Grassland–Bushland
C. griveaudi sp. n.	near Isalo National Park	-22.626667	45.358167	Wooded Grassland–Bushland

APPENDIX II *(continued)*

Geographical co-ordinates used to map distributions plotted on Figs 92–104, based on material examined in this study and listed in the material examined sections. Vegetation types listed follow Moat and Smith (2007).

Species	**Locality**	**Latitude**	**Longitude**	**Vegetation type**
C. griveaudi sp. n.	Asondrodava dry forest, 15 km N of Maintirano	-17.965333	44.035500	Wooded Grassland-Bushland
C. griveaudi sp. n.	Beza Mahafaly Reserve, Parcelle I	-23.686500	44.591000	South Western Dry Spiny Forest–Thicket
C. griveaudi sp. n.	Mikea Forest, NW of Manombo	-22.903667	43.475500	South Western Dry Spiny Forest–Thicket
C. griveaudi sp. n.	Sambava Beach	-14.266667	50.166667	Plateau Grassland–Wooded Grassland Mosaic
C. irwini sp. n.	Zombitse National Park, near national road	-22.833333	44.740833	Plateau Grassland–Wooded Grassland Mosaic
C. irwini sp. n.	Ampijoroa National Park, 160 km N of Maevatanana on RN 04	-16.316667	46.800000	Western Dry Forest
C. irwini sp. n.	Beza Mahafaly Reserve, Parcelle I near research station	-23.683333	44.583333	South Western Dry Spiny Forest-Thicket
C. irwini sp. n.	Sous Prefecture Fort Dauphin Andohaeala, National Park Ihazofotsy Parcelle III	-24.816667	46.533333	South Western Dry Spiny Forest-Thicket
C. irwini sp. n.	Beza Mahafaly Reserve, Parcelle II near Bellevue	-23.683333	44.566667	Wooded Grassland-Bushland
C. irwini sp. n.	Zombitse National Park, near ANGAP office	-22.883333	44.683333	Western Sub-humid Forest
C. keiseri	Joffreville	-12.483333	49.200000	Humid Forest
C. keiseri	Montagne d'Ambre	-12.616667	49.150000	Humid Forest
C. parkeri sp. n.	near Isalo National Park, in dry wash east of Interpretive Center	-23.000000	45.000000	Tapia Forest
C. parkeri sp. n.	Zombitse National Park, near national road	-23.000000	45.000000	Tapia Forest
C. parkeri sp. n.	Andohahela National Park, Tsimelahy, Parcelle II	-25.000000	47.000000	Wooded Grassland-Bushland
C. parkeri sp. n.	Radio tower, 22 km SW of Ilakaka, nr. Fianarantsoa/Tulear border	-23.000000	45.000000	Tapia Forest
C. parkeri sp. n.	Beza Mahafaly Reserve, Parcelle I	-24.000000	45.000000	Wooded Grassland–Bushland
C. parkeri sp. n.	Zombitse National Park, near ANGAP office	-23.000000	45.000000	Tapia Forest
C. pauliani	Ankarafantsika	-16.150000	47.033333	Western Dry Forest
C. pauliani	Maromandia	-15.000000	50.133333	Wooded Grassland–Bushland

APPENDIX II *(continued)*

Geographical co-ordinates used to map distributions plotted on Figs 92–104, based on material examined in this study and listed in the material examined sections. Vegetation types listed follow Moat and Smith (2007).

Species	Locality	Latitude	Longitude	Vegetation type
C. pauliani	Ampijoroa National Park, 160 km N of Maevatanana on RN 04	-16.319333	46.813333	Western Dry Forest
C. pauliani	Marofototra palm forest, 17 km W of Besalampy	-16.721667	44.423667	Western Dry Forest
C. pauliani	Nosy Mitsio	-12.900000	48.600000	Wooded Grassland–Bushland
C. pauliani	Parc National Tsingy de Memaraha	-19.133333	44.816667	Western Dry Forest
C. rinhatinana sp. n.	Ankarafantsika Forest Reserve	-16.150000	47.033333	Western Dry Forest
C. sakalava	Andohahela National Park (1)	-24.816667	46.533333	South Western Dry Spiny Forest–Thicket
C. sakalava	near Isalo National Park	-22.626667	45.358167	Wooded Grassland–Bushland
C. sakalava	Andohahela National Park (2)	-24.933333	46.616667	South Western Dry Spiny Forest–Thicket
C. sakalava	Berenty Special Reserve	-25.000000	46.300000	Mangroves
C. sakalava	Beza Mahafaly Reserve	-23.683333	44.583333	South Western Dry Spiny Forest–Thicket
C. sakalava	Cap Ste Marie Special Reserve	-25.583333	45.150000	South Western Dry Spiny Forest–Thicket
C. sakalava	Forêt de Mahavelo	-24.750000	46.150000	South Western Dry Spiny Forest–Thicket
C. sakalava	Mahafaly Plateau	-24.650000	43.983333	South Western Dry Spiny Forest–Thicket
C. sakalava	Mikea Forest (1)	-22.900000	43.466667	South Western Dry Spiny Forest–Thicket
C. sakalava	Mikea Forest (2)	-22.900000	43.383333	Plateau Grassland–Wooded Grassland Mosaic
C. sakalava	Morondava	-20.284722	44.317500	Plateau Grassland–Wooded Grassland Mosaic
C. sakalava	N of Tuléar (= Toliara)	-23.350000	43.666667	Plateau Grassland–Wooded Grassland Mosaic
C. sakalava	Ampijoroa National Park	-16.319333	46.813333	Western Dry Forest
C. sakalava	Beroboka village, 45 km NE Morondava	-19.977500	44.665333	Wooded Grassland–Bushland
C. sakalava	Beroboka village	-19.977500	44.666333	Wooded Grassland–Bushland
C. sakalava	Zombitse National Park	-22.883333	44.683333	Western Sub-humid Forest
C. sternithrix	Antanambe	-16.430000	49.850000	Degraded Humid Forest
C. sternithrix	Manambato	-24.516700	47.266700	Plateau Grassland–Wooded Grassland Mosaic
C. stuckenbergi	Ambohitantely	-18.166667	47.283333	Humid Forest