

Taxonomic revision of the African stingless bees (Apoidea: Apidae: Apinae: Meliponini)

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All African stingless bees (Meliponini) are social. Their workers either collect pollen and nectar from flowers or, in *Cleptotrigona* Moure, rob pollen and nectar from other stingless bees. There are six genera of African stingless bees, *Cleptotrigona*, *Dactylurina* Cockerell, *Meliponula* Cockerell, *Plebeina* Moure, *Hypotrigona* Cockerell and *Liotrigona* Moure, comprising 19 species. Three new species are described, eight new combinations proposed and 30 names relegated to synonymy. The species in the above genera are revised, and descriptions and identification keys are provided.

Key words: Africa, bees, *Cleptotrigona*, *Dactylurina*, *Hypotrigona*, *Liotrigona*, *Meliponula*, *Plebeina*, pollinator, social.

Stingless bees belong to the tribe Meliponini, and keeping these bees is known as meliponiculture, analogous to apiculture which refers to the keeping of honeybees. The centre of diversity for stingless bees is South America, where meliponiculture is practised extensively. In Africa meliponiculture is uncommon, and harvesting of meliponine honey is mostly destructive. Apiculture, on the other hand, is widely practised on the African continent and the honeybee is essentially the only species that is managed for pollination of crops. There is only one honeybee species in Africa, *Apis mellifera* Linnaeus, which has several subspecies.

Six genera of stingless bees, comprising 19 species, are known to occur in Africa. They are all social. In five of the genera (*Dactylurina* Cockerell, *Meliponula* Cockerell, *Plebeina* Moure, *Hypotrigona* Cockerell and *Liotrigona* Moure) workers collect pollen and nectar from flowers, and in one genus (*Cleptotrigona* Moure) they rob pollen and nectar from the nests of other stingless bees. The flower visitors are pollinators of natural vegetation and commercial crops. They also provide honey, which in some species has medicinal value. Meliponini occur mostly within the tropics, and their range does not extend into the Palaearctic region of Africa.

With the growing pressure on the environment and the associated loss of honeybees, the need exists for additional pollinator species to be used in agriculture to maintain resilience in food production and improvement of yield, especially in hot, dry areas where honeybees are less abundant. Many Meliponini could be utilised as surrogates for honeybees. Replacing destructive harvesting of

stingless bees with meliponiculture would provide honey for food and medicine, and enhance pollination of both commercial crops and indigenous plants. However, for such an endeavour to be successful it is essential to know the identity and geographic range of the bees involved.

No comprehensive account of stingless bees in Africa exists. The following revision provides descriptions of, and identification keys for, the African Meliponini. Three new species are described, eight new combinations proposed and 30 names relegated to synonymy. This revision probably does not include all of the Afrotropical species of stingless bees, and descriptions of most species are insufficient because of the absence of male specimens in museum collections. It has been found that revisionary studies stimulate interest, and much new information and material becomes available after the results of such studies have been published. Further collecting and testing of the keys are therefore encouraged.

Coordinates for localities referred to in the text are provided in a gazetteer and acronyms for material depositories are expounded in the acknowledgements. Illustrations of faces have black areas shaded and yellowish areas unshaded. Host plant family names are given in Appendix 1.

Key to the genera of workers of social African bees

1. Forewing with three submarginal cells; body more than 8 mm long; eyes hairy
..... *Apis*
- Forewing with no, one or two often indistinctly defined submarginal cells; body less

- than 7 mm in length; eyes bare 2
2. Hind tibia without a corbicula, outer surface convex *Cleptotrigona*
- Hind tibia with a corbicula, outer surface mostly concave or flat; surrounded by long hairs 3
3. Forewing with vein Rs visible 4
- Vein Rs not discernible 6
4. Outer surface of hind tibia strongly concave *Meliponula*
- Outer surface of hind tibia weakly concave to slightly convex 5
5. First metasomal segment broader than long; posterodistal part of hind tibia angulate *Plebeina*
- First metasomal segment longer than broad; posterodistal part of hind tibia rounded *Dactylurina*
6. Sub-horizontal region of propodeum shorter than sub-vertical (posterior) part; upper apical part of hind tibia forming a distinct angle *Liotrigona*
- Sub-horizontal region of propodeum a little longer than sub-vertical (posterior) part; upper apical part of hind tibia rounded *Hypotrigona*

***Cleptotrigona* Moure**

Lestrimelitta Friese, 1903: 361; Arnold 1947: 198, 210. Type species: *Trigona limao* Smith, by monotypy [not a synonym of *Cleptotrigona*, used by Arnold (1947) for the African parasitic stingless bees].

Lestrimelitta (*Cleptotrigona*) Moure, 1961: 219. Type species: *Lestrimelitta cubiceps* Friese, by original designation.

Cleptotrigona Moure: Wille 1979: 245–275; Michener 1990: 108, 132–133; Michener 2000: 791–792.

Cleptotrigona are robber stingless bees. They forage in nests of other stingless bees belonging to the genera *Hypotrigona* and probably *Liotrigona* (Michener 2000), and are not known to visit flowers. They resemble the American robber, *Lestrimelitta*, but this resemblance is due to convergence and not genality. Michener (2000) suggested a close relationship between *Cleptotrigona* and *Liotrigona*. The genus is endemic to Africa and has one valid species, *Cleptotrigona cubiceps* (Friese).

***Cleptotrigona cubiceps* (Friese), Figs 1, 2, 9**

Lestrimelitta (*Trigona*) *cubiceps* Friese, 1912: 169 (worker lectotype MHUB).

Lestrimelitta cubiceps Friese: Araujo 1955b: 25–26; 1958: 203–211; Araujo & Kerr 1959: 224; Darchen 1971a: 403.

Cleptotrigona cubiceps (Friese): Wille 1983: 50, 61; Pauly 1998: 11; Michener 1990: 100, 105, 130, 132–133; 2000: 787, 792.

Trigona curriei Cockerell, 1917: 123 (worker holotype USNM); 1919: 210; 1934a: 55. **Syn.n.**

Lestrimelitta (*Cleptotrigona*) *curriei* (Cockerell): Moure 1961: 220.

Cleptotrigona curriei (Cockerell): Michener 1990: 105, 133.

Three syntypes of *Lestrimelitta cubiceps* and the holotype of *Trigona curriei* have been studied. They differ in the presence of a few long, pallid hairs on the scutum of *T. curriei*, which seems insufficient to recognise a distinct species. One syntype of *L. cubiceps* is designated here as the lectotype to establish the identity of this species. This bee is easy to identify. It is a very small, dark brown, stingless bee, without a corbicula, with a relatively large, shiny head and with black, velvety vestiture on the scutum.

Diagnosis

Worker. Measurements (all lengths): head 1.3 mm; scutum 0.8 mm; forewing 3.2 mm, body 3.5–4.0 mm. Integument dark brown, often with a reddish tinge, to black; appendages sometimes paler and ventral surfaces of tarsi sometimes yellow. Lower half of face, mesopleuron, propodeum, metasoma and legs mostly glabrous. Vestiture largely short on head and mesosoma, black and velvety; long hairs mostly pale. Head large (1.5 times as long as scutum, twice as long as eye, in lateral view, and gena 1.5 times as wide as eye); frons long (clypeus length about one-fifth face length) and clypeus length about one-third its width; mandible shorter anteriorly, with one or two anterior teeth, and one large posterior tooth (Fig. 1); propodeum angulately divided; forewing with two closed cells, without closed submarginal cell, and vein Rs distinct (Fig. 2); corbicula and penicillum absent, hind tibia a little swollen and with outer distal region glabrous.

Male. Unknown.

Distribution and hosts (Fig. 9)

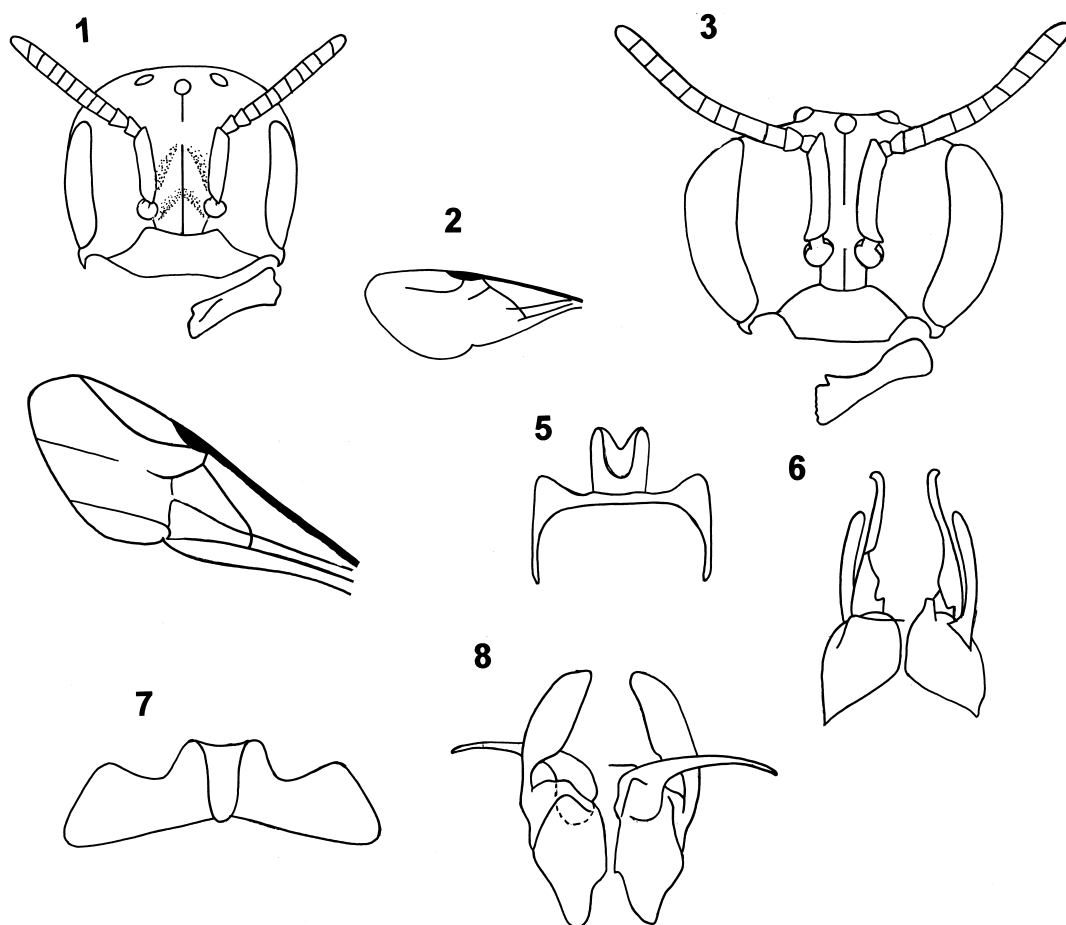
Cleptotrigona cubiceps is widely dispersed, apparently occurring wherever its host occurs, yet rarely collected compared with the abundant records of the apparent host genus. It cleptoparasitises *Hypotrigona* and probably *Liotrigona* (Michener 2000).

Material examined

Type material. *Trigona cubiceps*, worker lectotype, 2 worker paralectotypes: 'D O-Africa Amani 1912, *Lestrimelitta cubiceps* Fr. 1912 det Friese', MHUB.

Trigona curriei, worker holotype: 'Mt Coffee Liberia, Apr. 1897, R P Currie Collector, Type No. 23169', USNM.

Additional material. Tanzania: Liwale, 1953 (6



Figs 1–8. 1–2: *Cleptotrigona cubiceps*, worker; 1: face and mandible; 2: forewing. 3–6: *Dactylurina staudingeri*; 3: worker face and mandible; 4: worker forewing; 5: male S8; 6: male genitalia. 7–8: *D. schmidtii*, male; 7: S8; 8: genitalia.

workers NHML); Amani, 1912 (8 workers MHUB). Democratic Republic of Congo: Kando, 25.ix.1947, G F de Witte (3 workers MRAC); Rwindi, 23.viii–24.xi.1934, G F de Witte (2 workers MRAC). South Africa: Lapalala, 1100 m, 20.vii.1988, B K H Wissenbacher (1 worker SANC).

***Dactylurina* Cockerell**

Trigona (*Dactylurina*) Cockerell, 1934a: 47, 56, 62. Type species: *Trigona staudingeri* Gribodo, by original designation.

Dactylurina Cockerell, 1934a: 47; Moure 1961: 225–226; Michener 1990: 138; Camargo & Menezes Pedro 1992: 514; Lobreau-Callen et al. 1994: 134–135, 140; Michener 2000: 70, 781–783, 786, 788, 790, 792, 792, 799–800, 803, 806.

Unlike other African stingless bees, this genus

builds a vertical comb, surrounded by batumen, in exposed nests on trees (Michener 2000). The genus has two species, *D. staudingeri* (Gribodo) and *D. schmidtii* (Stadelmann). These bees are easy to identify. The genus has a laterally compressed metasoma and a partly convex corbicula. The species have different facial vestiture, as described in Table 1.

Diagnosis

Worker. Small (5.0–7.0 mm long), slender, black bees; frons not elongate (clypeus length about one-quarter face length); clypeus 2.5 times wider than long; mandible with a small, anterior subapical tooth and a broad apical tooth; metasoma laterally compressed (T1 longer than

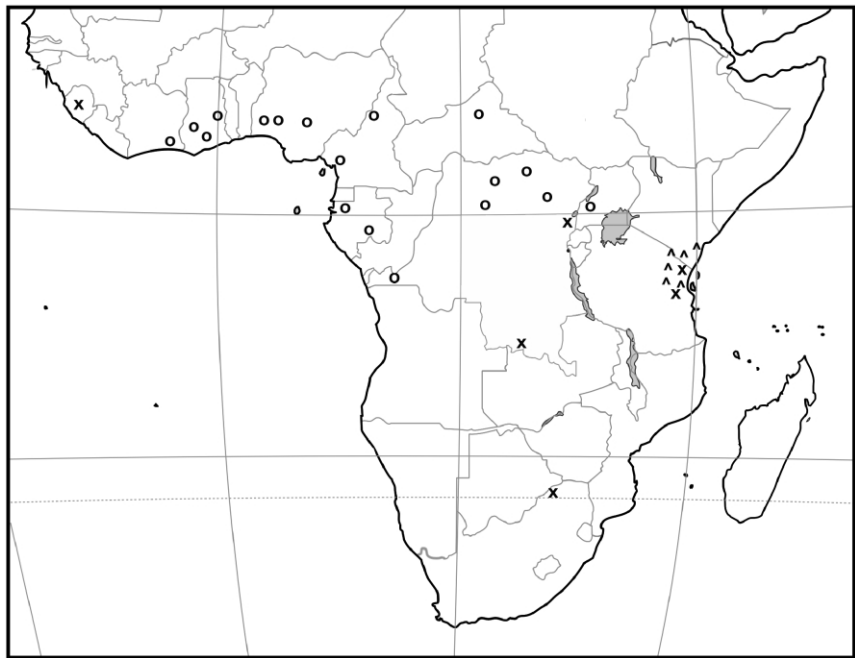


Fig. 9. Sub-Saharan Africa. Distribution of *Cleptotrigona cubiceps* (x), *Dactylurina staudingeri* (o) and *D. schmidtii* (^).

broad) and relatively long (over three times scutum length); forewing without closed submarginal cell (first submarginal crossvein incomplete), vein Rs distinct (Fig. 4); legs long (hind tibia more than twice as long as scutum); hind tibia with maximum width about one-third length; proximal region of corbicula convex, and distal region gently concave.

Male. Closely resembles worker, except that it has 11 flagellomeres, seven exposed terga and hind tibia not corbiculate, but with its maximum width one-third of its length.

Dactylurina staudingeri (Gribodo), Figs 3–6, 9
Trigona staudingeri Gribodo, 1893: 265–266 (10 worker syntypes MCSN); Friese 1909a: 444–445, 450, 453–454; Strand 1912b: 311; Friese 1914: 294; Strand 1914: 67; Cockerell 1919: 209; Cockerell 1937a: 12; Smith 1854a: 67–69.

Trigona (Dactylurina) staudingeri Gribodo: Cockerell 1934a: 47, 56, 62; Darchen 1966: 37–45; Darchen & Pain 1966: 25–35.
Dactylurina staudingeri (Gribodo): Moure 1961: 225–226; Skaife 1979: 245; Medler 1980: 483; Anderson et al. 1983: 7; Michener 1990: 120, 138; Camargo & Menezes Pedro 1992: 514; Lobreau-Callen et al. 1994: 135, 140.
Trigona dolichogaster Kohl, 1894: 280 (worker holotype, depository unknown); Friese 1909a: 453–454; Strand 1912a: 144.
Melipona (Tetragona) dolichogaster (Kohl): Vachal 1903: 360.

Trigona staudingeri was described from 10 worker specimens in MCSN. This material was studied by Moure (1961) and adequately redescribed, but he did not state whether he saw the holotype of *Trigona dolichogaster*, which he synonymised with *D. staudingeri*.

This species differs from the generic description only in the characters listed in Table 1.

Table 1. Diagnostic features of *Dactylurina staudingeri* and *D. schmidtii*.

Character	<i>D. staudingeri</i>	<i>D. schmidtii</i>
Worker, face	Lower half with moderately dense, weakly plumose vestiture, and upper region naked or sparsely clothed with white vestiture.	Completely and densely clothed with strongly plumose, white vestiture.
Male genitalia	Gonostyli narrow (Fig. 6).	Gonostyli wide (Fig. 8)
Distribution	Central and West Africa (Fig. 9).	East Africa (Fig. 9).

Distribution and host plants (Fig. 9)

This species is known from Angola, Cameroon, Democratic Republic of Congo, Equatorial Guinea, Gabon, Ghana, Ivory Coast, Liberia, Nigeria, Sierra Leone, Tanzania, Togo and Uganda. It has been collected on the flowers of the following plants: *Acalypha* sp., *Ageratum conyzoides*, *Ageratum* sp., *Amaranthus hybridus*, *Antigonon leptopus*, Araliaceae, *Artocarpus altilis* var. *semifera*, Asteraceae, *Boerhavia erecta*, *Borreria* sp., *Borreria verticillata*, *Brassica sinensis*, *Caesalpinia pulcherrima*, *Cajanus cajan*, *Celosia* sp., *Cissus* sp., *Citrus sinensis*, *Clerodendrum* sp., *Cocos nucifera*, *Cogniauxia podolaena*, *Combretum platypterum*, *Combretum splendens*, *Commelina benghalensis*, *Crinum jagus*, *Crotalaria* sp., *Cyperus* sp., *Dacryodes edulis*, *Dichostemma glaucescens*, *Digitaria* sp., *Elephantopus mollis*, *Emilia coccinea*, *Eucalyptus robusta*, Euphorbiaceae, *Euphorbia pulcherrima*, *Genipa clusiifolia*, *Haronga madagascariensis*, *Hibiscus sabdariffa*, *Hymenocallis* sp., *Indigofera* sp., *Ipomea* sp., *Jatropha multifida*, *Kyllinga* sp., *Lagerstroemia indica*, *Leptoderris* sp., *Leucaena leucocephala*, *Loranthus* sp., *Mangifera indica*, *Milletia* sp., *Ocimum* sp., *Oryza sativa*, *Pachyra aquatica*, Papilionaceae, *Paspalum* sp., *Passiflora edulis*, *Passiflora nitida*, *Polygonum lanigerum*, *Sansevieria laurentii*, *Sesamum* sp., *Sida acuta*, *Solenostemon* sp., *Spondias mombin*, *Stachytarpheta* sp., *Stachytarpheta angustifolia*, *Talinum portulacifolium*, *Tephrosia vogelii*, *Urena lobata* and *Zea mays*.

Material examined

Sierra Leone: Kamakwie, 24.iv.1912, J J Simpson (1 worker NHML); Njala, 24.vii.1926, E Hargreaves (2 workers NHML). Ivory Coast: Adiopodoume, xii.1956, P Dessart (1 worker MRAC). Ghana: Mampong, 27.vii.1979, P Room (1 worker NHML). Togo: Misahohe, Smend (1 worker MHUB); Bismarckburg, 22.ix–1.x.1892, L Conradt (12 workers MHUB, NHML). Nigeria: Fashola, xi.1974, J T Medler (1 worker SEMK); Ibadan, 10.ii.1987 (2 workers UMAN), Ile-Ife, 20.vi.1969, J T Medler (1 worker NHML); Dekina, i.1911, J W Scott-Macfie (1 worker NHML); Oshogbo, 2.iii.1910, J J Simpson (1 worker NHML). Cameroon: Kumba, 6.x.1949, H Oldroyd (1 worker NHML). Central African Republic: Floris National Park, 4.iii.1984, J M Fay (1 worker

SEMC). Equatorial Guinea: Uelleburg, G Tessmann (6 workers MHUB); Benito, 1–5.ix.1906, G Tessmann (3 workers MHUB). Gabon: Pana, 29.i.1986, Pauly (1 worker PC). Democratic Republic of Congo: Ituri, 17.vii.1937, J Ghesquiere (3 workers MRAC); Bambesa, 1.x.1934, J V Leroy (1 worker MRAC); Paulis, xi.1947, P L G Benoit (1 worker MRAC); Itimbiri, 1930, J van den Branden (1 worker MRAC); Bokuma, iii.1952, R P Lootens (7 workers MRAC); Gandajika, 21.viii.1970 (2 workers MRAC); Thysville, i.1953, J Sion (1 worker MRAC). Uganda: Ruwenzori, Bundibugyo, 22.viii–3.ix.1952, D S Fletcher (1 worker NHML).

Dactylurina schmidtii (Stadelmann), Figs 7–9

Melipona schmidtii Stadelmann, 1895: 622; 1898: 21 (worker holotype MHUB).

Trigona schmidtii (Stadelmann): Fries 1909a: 444, 454; 1909b: 166.

Dactylurina schmidtii (Stadelmann): Moure 1961: 226; Michener 1990: 105, 120, 135, 137–138.

The holotype of *Melipona schmidtii* has been studied. This species differs from the generic description only in the characters in Table 1.

Distribution (Fig. 9)

This species is only known from Kenya and Tanzania.

Material examined

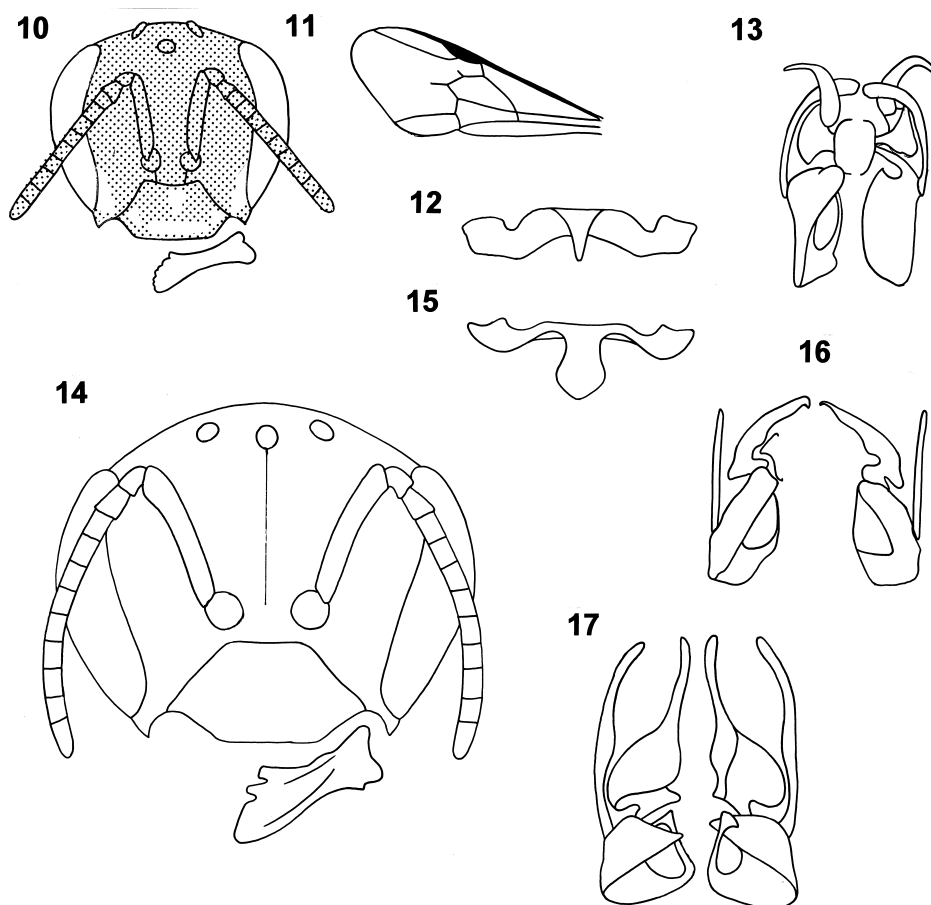
Type material. worker holotype: 'Sansibar C W Schmidt, Type, *Melipona schmidtii* Stadelmann', MHUB.

Additional material. Kenya: Rabai, viii.1930, van Someren (1 worker NHML); Mombasa, iv.1928, van Someren (1 worker NHML). Tanzania: Liwale, 1953 (1 worker NHML); Pande, 28.xi.1905, S Schroeder (1 worker MHUB); Kilimanjaro, 4000 m, 27.i.1906, S G Schroeder (4 workers MHUB); Amboni, 27.xi.1905, S V Schroeder (2 workers MHUB); Morongoro, 19.x.1956, W E Kerr, (3 workers 1♂ SANC); Dar-es-Salaam, Speyer (1 worker MHUB); Tanga, 11.vi.1985, G G M Schulten, (2 workers UMAN); Amani, 9.iii.1963, M T Gillies (1 worker SEMK); Usambara East, F Fischer (1 worker MHUB); Usambara, Bondei District, ii–iii.1980, C W Schmidt (1 worker MHUB); Kilosa, 19.x.1956 (1 worker SEMK).

Plebeina Moure

Plebeina Moure, 1961: 228. Type species: *Melipona denoiti* Vachal, by original designation; Michener 1990: 137–138; 2000: 70, 783, 786, 791, 794, 798–799.

This genus comprises one variable species.



Figs 10–17. 10–13: *Plebeina hildebrandti*; 10: worker face and mandible; 11: worker forewing; 12: male S8; 13: male genitalia. 14–16: *Meliponula bocandei*; 14: worker face and mandible; 15: male S8; 16: male genitalia. 17: *M. ferruginea*, male genitalia.

***Plebeina hildebrandti* (Fries) comb.n.,**

Figs 10–13, 18

Trigona hildebrandti Fries, 1900: 384 (worker holotype MHUB); 1909a: 444–445, 452; Strand 1912a: 144.

Melipona (Trigona) denoiti Vachal, 1903: 360 (5 worker syntypes MRAC). **Syn.n.**

Trigona denoiti (Vachal): Fries 1909a: 444, 458; Meade-Waldo 1913: 497; Cockerell 1920: 292; 1932: 173; 1934a: 48–49; Smith 1854a: 63–68; Skaife 1979: 244–246.

Trigona (Plebeina) denoiti (Vachal): Fletcher & Crewe 1981a: 183–195; 1981b: 197.

Meliplebeia denoiti (Vachal): Wille 1983: 50, 51.

Plebeina denoiti (Vachal): Moure 1961: 228–229; Michener 1990: 105, 135–138; 2000: 788, 798–799.

Trigona denoiti katagensis Cockerell, 1934a: 48–49 (worker holotype, NHML, 5 workers paratypes MRAC); 1936: 554. **Syn.n.**

Plebeina denoiti katagensis (Cockerell): Michener 1990: 138.

Trigona clypeata Fries, 1909a: 444–445, 452–453 (worker lectotype MHUB); Cockerell 1910: 245–246; Fries 1912: 169–170; Meade-Waldo 1913: 497 syn. of *M.*

denoiti; Fries 1915: 267; 1916: 451; Cockerell 1919: 211; 1920: 292; 1934a: 47–48; 1934b: 448–449; 1936: 554. **Syn.n.**

Trigona denoiti var. *clypeata* Fries: Cockerell 1920: 292.

Plebeina clypeata (Fries): Moure 1961: 229.

Trigona zebra Strand, 1911a: 158; (worker lectotype MHUB); 1911b: 163; 1912a: 144; Cockerell 1919: 211.

Trigona clypeata var. *zebra* Strand: Fries 1912: 169–170; 1916: 451; Cockerell 1920: 292 syn. of *M. denoiti*.

Plebeina zebra (Fries) [!]: Moure 1961: 229.

The type series of *Melipona denoiti* has not been studied, although those of *Trigona hildebrandti*, *Trigona clypeata* and *Trigona zebra* have been examined. The specific epithet *zebra* was attributed to Fries by Strand (1911a), but Fries's description appeared only in 1912. Meade-Waldo (1913) synonymised *denoiti* and *clypeata*, whereas Cockerell (1920) considered *zebra* to be a synonym of *denoiti*. I here synonymise *katagensis* with *hildebrandti*, after examination of

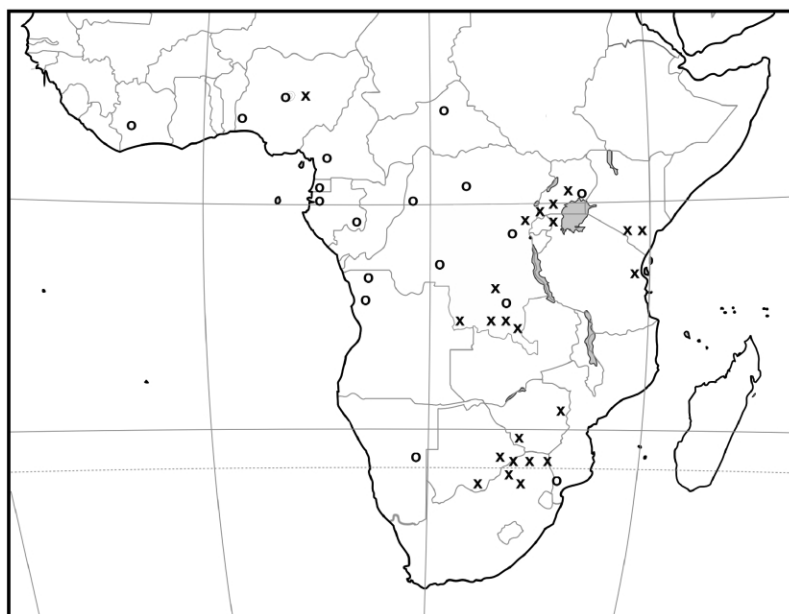


Fig. 18. Sub-Saharan Africa. Distribution of *Plebeina hildebrandti* (x) and *Meliponula bocandei* (o).

the type material.

This species nests in cavities in terrestrial termite nests. *Plebeina* superficially resembles *Meliponula* (*Meliplebeia*), but the latter are mostly bigger than *P. hildebrandti*. *Meliponula* (*Meliplebeia*) *lendliana* is of similar size as *P. hildebrandti*, but can easily be separated from the latter by the extent and definite edges of yellow maculation on the face, and the presence of yellow on the scutellum and tibiae. The shape of the posterior distal corner of the hind tibia is the most useful diagnostic feature for separating *Plebeina* and *Meliponula* (*Meliplebeia*).

Diagnosis

Worker. Lengths: head 1.4–2.0 mm; scutum 1.0–1.6 mm; forewing 3.8–5.1 mm; body 3.3–5.2 mm. Colour: vestiture white; integument of head and mesosoma completely black or brownish, with variable pale yellow maculation, usually on ventral and mediolongitudinal regions of clypeus and pronotal lobes, sometimes also on supraclypeus and lower paraocular area, and edges of yellow areas generally ill-defined; metasoma black to orange. Frons not elongate (clypeus length about one-quarter face length, and half clypeus width, cf. Fig. 10). Mandible with one broad tooth (Fig. 10). Legs short (hind tibia 1.3 times scutum length). Metasoma triangular in

cross-section and relatively short (less than twice scutum length). Forewing with marginal cell, and usually submarginal cell closed (anterior region of first submarginal cross vein faintly visible or absent); vein Rs distinct (Fig. 11). Hind tibia with corbicula flattish, glabrous and posterior region gently concave, distal posterior corner angulate.

Male. Closely resembles worker, except for 11 flagellomeres, no corbicula (hind tibia sparsely hirsute) and seven exposed terga. Metasomal sternum 7 and genitalia as in Figs 12–13.

Distribution and host plant (Fig. 18)

P. hildebrandti is known from many widely separated localities in central, east and southern Africa. Nigeria is the farthest west that it has been recorded. It has been collected on the flowers of *Acacia mellifera* and *Spirostachys africana*.

Material examined

Type material. *Trigona hildebrandti*, 2 worker syntypes: 'Sansibar S Hildebrandt', MHUB.

Trigona clypeata, 12 syntypes: 'Kalahari Kooa L. Schultze', MHUB, SEMK, SAMC.

Trigona zebra, 1 worker syntype: 'Kenya Ikutha', MHUB.

Trigona zebra, 7 worker syntypes: 'Kenya Kibwezi 06', MHUB.

Trigona denoiti katagensis, 6 worker paratypes:

'Elizabethville Dembody Kindones 21.v.1923 M Bequaert', MRAC; 'Elizabethville Kimi-lolo Riv. 3.vii.1920 M Bequaert', MRAC; 'Katanga Dilolo 27.vii.1931 J Ogilvie', MRAC; 'Katanga Lundu vi.1924 Ch Seydel', MRAC; 'Kapiri ix.1912 Miss Agric.', MRAC; 'Katanga, Tenke, 30.vii–9.viii.1931, J Ogilvie', NHML.

Additional material. Equatorial Guinea: Nkolentangen, xi.1907–v.1908, G Tessmann (1♂ MHUB). Democratic Republic of Congo: Katanga, Bianco, 8–11.viii.1931, J Ogilvie (1 worker MRAC); Kando, 15.viii–10.x.1953, R P Th De Caters (1 worker MRAC); Kanonga, 13–27.ix.1947, G F de Witte (1 worker MRAC). Rwanda: Gabiro, 28.iv.1968, E Verriest (1 worker MRAC); Kigali, 16.xii.1979, H R Feijen (2 workers UMAN); Nyanaza, Kinazi, 5–8.i.1953, P Basilewsky (1 worker MRAC). Uganda: Masaka, 22.vi.1987, G G M Schulten (1 worker UMAN); Kampala, 25.xi.1987, G.G.M. Schulten (3 workers UMAN). Kenya: Mpala Ranch, 5.iv.2000, B Gemmill, on *Acacia mellifera* (4 worker NMKE). Zimbabwe: Battery Spruit, 19.v.1932, J Ogilvie (1 worker MRAC); Matopo Hills, 17–30.iv.1932, A Mackie (6 workers MRAC). Botswana: Stockpoort 60 N, 3.i.1985 (3 workers SANC); Serowe, 6.i.1978, H R Feijen (1 worker UMAN); Gaborone, 14.i.1970, H R Feijen (1 worker UMAN). South Africa: Ben Alberts Nature Reserve, 24–28.xi.1980, C Eardley (1 worker SANC); Roodeplaat, 17.iii.1993, K Immelman (1 worker SANC); Lapalala, 1100 m, 10–11.i.1991, R G Oberprieler (1 worker SANC); Duiwelskloof, 12–14.i.1987, C Eardley (4 workers SANC); Skukuza, 19.i.1984, C Eardley (5 workers SANC); Blyderivier Nature Reserve, 25–26.x.1984, C Eardley (3 workers SANC); 14–19 km W Alldays; 14.iii.1980 C Eardley (8 workers SANC); Louis Trichardt, 4.iv.1932, J Ogilvie (1 worker MRAC); Ofcalaco, farm Carpe Diem, 30–31.ix.1994, C Eardley, M Mansell (39 workers SANC); Ryfontein Farm, 15 km SE Tzaneen, 20–23.vii.1992, C Eardley, M Stiller (12 workers SANC); Pienaarsrivier, v.1946, H Freen (23 workers SANC); Soutpan, near Pretoria, xi–xii.1985, C Eardley (34 workers SANC); D'Nyala Nature Reserve, 10–14.xi.1986, 19.xii.1987, C Eardley (200 workers SANC).

Meliponula Cockerell

Meliponula has three subgenera (Michener 2000). *Meliponula (Meliponula)* is monotypic, *Meliponula (Axestotrigona)* comprises two species

and *Meliponula (Meliplebeia)* has five species. A key to the subgenera is provided by Michener (2000).

Meliponula (Meliponula) Cockerell

Trigona (Meliponula) Cockerell, 1934a: 47. Type species: *Melipona bocandei* Spinola, by original designation.

Meliponula Cockerell: Wille 1979: 245–275; 1983: 42.

Meliponula (Meliponula) Cockerell: Michener 1990: 134–137; 2000: 70, 780, 783, 785, 788, 794–795.

Meliponula (Axestotrigona) Moure

Axestotrigona Moure, 1961: 237. Type species: *Melipona ferruginea* Lepeletier, by original designation.

Meliponula (Axestotrigona) Cockerell: Michener 1990: 134–135; 2000: 70, 794.

Meliponula (Meliplebeia) Moure

Meliplebeia Moure, 1961: 186, 189, 217, 229–232. Type species: *Trigona beccarii* Gribodo, by original designation.

Meliponula (Meliplebeia) Moure: Wille 1979: 250; Michener 1990: 135–136; 2000: 70, 785, 787–788, 794–785.

Plebeia Moure, 1961: 226. Type species: *Trigona lendliana* Friese, by original designation.

Apotrigona Moure, 1961: 233. Type species: *Trigona nebulata* Smith, by original designation.

Key to the species of Meliponula

1. Mesosomal dorsum completely black 2
- Mesosomal dorsum with white, orange or yellow maculations 4
2. Face black, metasomal dorsum completely black or red and black banded *Meliponula (Axestotrigona) ferruginea*.
- Face with yellow maculation 3
3. Large bee (about 7 mm long); epistomal suture bordered by yellow; ventral margin of clypeus usually narrowly yellow; metasoma black . . . *Meliponula (Axestotrigona) cameroonensis*
- Medium-sized bee (about 5 mm long); clypeus, supraclypeus and lower paracocular area mostly yellow; metasoma reddish . . *Meliponula (Meliplebeia) nebulata*
4. Face and scutum black; axilla and scutellum orange *Meliponula (Meliponula) bocandei*.
- Face with white or yellow maculations; scutum, scutellum and axilla variable 5
5. Legs with yellow maculation 7
- Legs completely black 6
6. Vestiture on vertex and scutum black, legs completely black *Meliponula (Meliplebeia) ogouensis*
- Vestiture on vertex and scutum white, legs black with trochanters yellowish *Meliponula (Meliplebeia) roubiki*
7. Antenna and scutum partly yellow *Meliponula (Meliplebeia) beccarii*

- Antenna and scutum completely black . . . 8
- 8. Entire scutum with white, very short, dense, simple vestiture, together with sparse, long, weakly plumose hairs and sparse, very densely plumose hairs (resembling tufts of hair)
 - *Meliponula (Meliplebeia) griswoldorum*
- Scutum with very short, simple, dense, blackish vestiture and a few very densely plumose (without long white weakly plumose hairs)
 - *Meliponula (Meliplebeia) lendliana*

***Meliponula (Meliponula) bocandei* (Spinola),**

Figs 14–16, 18

Melipona bocandei Spinola, 1853: 94 (worker holotype MIZT); Vachal 1903: 359.

Trigona bocandei (Spinola): Friese 1909a: 444–447; Strand 1912a: 144; Alfken 1924: 252; Cockerell 1937a: 12.

Trigona (Meliponula) bocandei (Spinola): Cockerell 1934a: 46–47, 56–57; Araujo 1955b: 23–24; 1958: 203.

Meliponula bocandei (Spinola): Moure 1961: 182, 189, 217, 235–237; Medler 1980: 483.

Meliponula (Meliponula) bocandei (Spinola): Michener 1990: 96, 101, 103, 105, 134–135, 137.

Trigona tomentosa Friese, 1900: 383 (worker lectotype NHMV); 1909a: 444–447; Strand 1911a: 159, 1911b: 163; 1912a: 144; Cockerell 1932: 173; 1933: 27; Strand 1921: 106.

Meliponula tomentosa (Friese): Moure 1961: 237.

Melipona chrysura Cockerell, 1918: 162 (male holotype NHML); 1934a: 46, 56.

Meliponula chrysura (Cockerell): Moure 1961: 235–237.

This subgenus is monotypic. Moure (1961) synonymised *tomentosa* and *chrysura* with *Meliponula bocandei*. The type material of *tomentosa* (MHUB) was studied, but not that of *bocandei* and *chrysura*.

This species is easy to identify as it is the only large stingless bee with orange vestiture, a largely black face, yellowish-orange scutellum and spoon-shaped hind tibia.

Diagnosis

Worker. Lengths: head 2.6 mm; scutum 1.9 mm; forewing 6.6 mm; body 7.0 mm. Colour of integument: head black and reddish-black, sometimes with yellow on ventral margin of clypeus and adjacent to epistomal suture; mesosoma black and reddish-black, except dorsal region of pronotum, pronotal lobe, axilla and scutellum orangish-yellow, metasomal terga generally with anterior regions blackish and posterior regions orange (black and orange areas weakly demarcated), and metasomal ventre black. Vestiture orange. Frons not elongate (clypeus length about one-third face length, and half clypeus width, Fig. 14); mandible with a large outer tooth and

two pointed inner teeth (Fig. 14); scutellum extended strongly backwards beyond metanotum, to about posterior extreme of propodeum; propodeum weakly curved; forewing similar to *M. hildebrandti* (cf. Fig. 11); hind tibia spoon-shaped and with posterodistal corner rounded; corbicula concave, round and confined to distal half of hind tibia.

Male. Similar to worker, except scutum 2.5 mm long; mandible much smaller and with two small teeth; hind tibia without a corbicula and narrow; S8 and genitalia as illustrated (Figs 15, 16).

Distribution and host plants (Fig. 18)

This species appears to occur through most of tropical Africa. It was collected on flowers of *Asystasia gangetica*, *Averrhoa carambola*, *Borreria verticillata*, *Cassia* sp., *Crotalaria* sp., *Cyperus* sp., *Dacryodes edulis*, *Duparquetia orchidacea*, *Elephantopus mollis*, *Gouania longipetala*, *Haronga madagascariensis*, *Leucaena leucocephala*, *Mangifera indica*, *Millettia* sp., *Mimosa pudica*, *Otomeria guineensis*, *Psidium guajava*, *Sesamum* sp., *Stachytarpheta angustifolia*, *Urena lobata* and *Vernonia conferta*.

Material examined

Type material. *Trigona tomentosa*, 6 worker paralectotypes 'Kamerun Jaunde stat. 800 m Zenker S', MHUB; 1 worker paralectotype 'Belg. Kongo Libenge Ubangi District H Schubotz leg. 25.x.1910', MHUB.

Additional material. Ivory Coast: Daloa, viii.1961, J Decelle (2 workers MRAC). Nigeria: Ibadan (IITA), 16.xi.1978, 10.ii.1987, 28.v.1987, 30.i.1988, G G H Schulten (27 workers UMAN). Central African Republic: Floris National Park, 24.ii.1983, J M Fay (1 worker SEMC). Equatorial Guinea: Uelleburg, G Tessmann (1 worker MHUB); Nkolentangen, G Tessmann (1 worker MHUB). Gabon: Franceville, La Lope Reserve, 60 km S, 12.i.1993, D Roubik, on *Millettia* sp. (1 worker SEMK); Kougoulu, 12.iv.1985, A Pauly (1 worker PC). Democratic Republic of Congo: Eala, iii.1932, H J Bredo (3 workers MRAC); Basoko, iv.1948, P L G Benoit (1 worker MRAC); Sankuru, Mwene Ditu, 24.xi.1952, Seydel (1 worker MRAC); Kamusanga, Lufira, Mt Sombwe, 750 m, 12.vii.1949, G F de Witte (13 workers MRAC); Trangi, Kivu, x.1956, N L H Krauss (2 workers SEMK). Kenya: Kakamega Forest, 24.iii.1988, H R Feijen (1 worker UMAN). Angola: Dande,

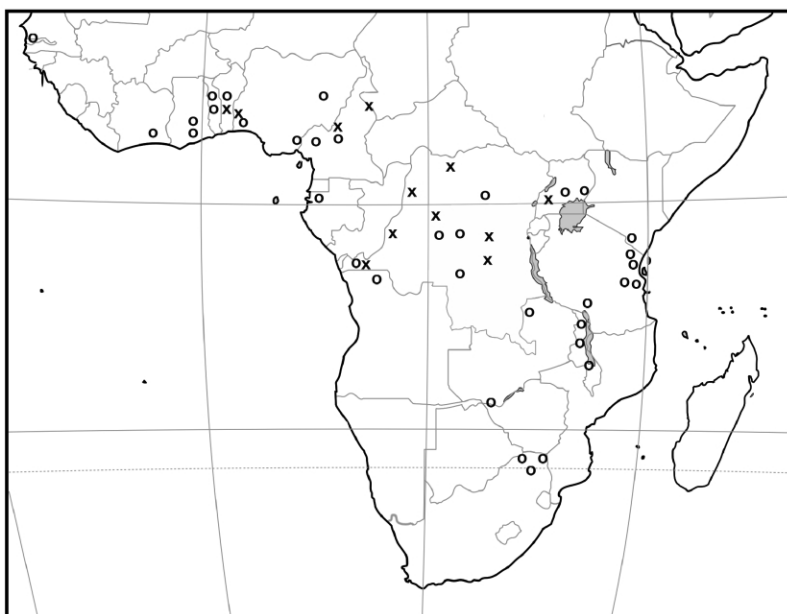


Fig. 19. Sub-Saharan Africa. Distribution of *Meliponula ferruginea* (o) and *M. cameroonensis* (x).

10.xii.1957, vii.1960, V de P Araujo (32 workers 11♂ TMSA, SEMK); Bolongongo, 23.x.1965, Giraudet (1 worker MRAC). Botswana: Maun 30 km N, vi.1981, B Clause (7 workers SANC, SEMC). Mozambique: Maputo, 28.x.1956, W E Kerr (1 worker SEMK).

Meliponula (*Axestotrigona*) *ferruginea*

(Lepeletier) **comb.n.**, Figs 17, 19

Melipona (*Trigona*) *ferruginea* Lepeletier, 1841: 428 (worker lectotype MIZT).

Trigona erythra Schletterer, 1891: 2 (worker lectotype NHMV); Friese 1909a: 444–445, 449–452; Hedicke 1931: 37–38; Cockerell 1933: 27; 1934a: 49–51; Darchen 1971b: 414–418; 1981: 54–56. **Syn.n.**

Melipona (*Trigona*) *erythra* (Schletterer): Vachal 1903: 359.

Axestotrigona erythra (Schletterer): Moure 1961: 238, 239.

Trigona (*Axestotrigona*) *erythra* Schletterer: Medler 1980: 483.

Melipona (*Axestotrigona*) *erythra* (Schletterer): Michener 1990: 134–135.

Trigona erythra erythra Schletterer: Cockerell 1934a: 49–51.

Meliponula (*Axestotrigona*) *erythra* (Schletterer): Michener 1990: 96, 101, 105, 134–135.

Melipona togoensis Stadelmann, 1895: 620 (worker lectotype NHMV).

Melipona (*Trigona*) *togoensis* Stadelmann: Vachal 1903: 359.

Trigona togoensis (Stadelmann): Friese 1909a: 443–446, 450, 454 syn.; 1909b: 166; Strand 1911a: 158; 1911b: 163; 1912b: 311–312; Friese 1912: 170; Strand 1914: 67; Cockerell 1919: 211; Strand 1921: 106; Hedicke 1931: 37–38; Cockerell 1932: 173; 1933: 27; 1937a: 12.

Axestotrigona togoensis (Stadelmann): Moure 1961: 239.

Meliponula (*Axestotrigona*) *togoensis* (Stadelmann): Pauly 1998: 12, 51, 53, 58, 60.

Trigona erythra var. *togoensis* (Stadelmann): Smith 1854:

65–66, 69.

Trigona erythra togoensis (Stadelmann): Cockerell 1934a: 49–51; Araujo 1955b: 24; 1958: 203.

Trigona langhofferi Friese, 1900: 383 (male lectotype NHMV); 1909a: 444–445, 450.

Axestotrigona langhofferi (Friese): Moure 1961: 239.

Trigona buschirii Friese, 1900: 384 (male lectotype NHMV); 1909a: 444–445, 448–449; Cockerell 1934a: 51. **Syn.n.**

Axestotrigona buschirii (Friese): Moure 1961: 239.

Trigona quagga Strand, 1911b: 163 (worker holotype MHUB); Cockerell 1919: 211; 1934a: 48–49. **Syn.n.**

Axestotrigona quagga (Strand): Moure 1961: 239.

Trigona junodi nomen nudum: Friese, 1909b: 162; 1912: 170.

Trigona junodi Cockerell, 1932: 174 (worker syntypes SEMK, SAMC); 1934a: 49; Friese 1941: 104; Darchen 1971b: 414–416. **Syn.n.**

Trigona togoensis junodi Cockerell: Cockerell 1919: 210.

Meliponiden junodi (Cockerell): Friese 1941: 96, 104.

Axestotrigona junodi (Cockerell): Moure 1961: 239.

Trigona tescorum Cockerell, 1910: 245–246 (worker holotype NHML); 1932: 174. **Syn.n.**

Trigona erythra tescorum Cockerell: Cockerell 1936: 554.

Axestotrigona tescorum (Cockerell): Moure 1961: 239.

Trigona erythra var. *testaceichelis* Strand, 1911c: 124 (worker holotype MHUB). **Syn.n.**

Axestotrigona ferruginea gambiensis Moure, 1961: 239–240 (worker holotype NHML). **Syn.n.**

Axestotrigona dudgeoni Moure, 1961: 240–241 (worker NHML). **Syn.n.**

Trigona oyani Darchen, 1971b: 407–420 (worker holotype NHML). **Syn.n.**

Meliponula (*Axestotrigona*) *oyani* (Darchen): Pauly 1998: 11, 53, 60.

Trigona (*Axestotrigona*) *erythra* var. *gabonensis* nomen nudum: Darchen 1969: 152, 173.

Melipona (*Trigona*) *ferruginea* Lepeletier was described from Brazil (Dalla Torre 1896). Later it was made the type species of the Afrotropical

subgenus *Axestotrigona* by Moure (1961), who mentioned that one of the two syntypes has a lectotype label. This is considered to be the lectotype designation for *Melipona* (*Trigona*) *ferruginea* Lepeletier. Moure (1961) also stated that he identified the lectotype in Cockerell's (1934a) key as *Trigona erythra* in the broad sense. The lectotype has been studied and is synonymous with *Trigona erythra*.

The type material of *Trigona erythra*, *Melipona togoensis*, *Trigona langhofferi*, *Trigona quagga*, *Trigona tescorum* and *Axestotrigona dudgeoni* has not been studied. They are not in their original depositories. The remaining type specimens were studied. Hedicke (1931) synonymised *erythra* and *togoensis*, and Friese (1909a) suggested that *langhofferi* is synonymous with *erythra* and *togoensis*. The other new synonymies are based on the descriptions and identified material. Original description of *Trigona junodi* and *Trigona* (*Axestotrigona*) *erythra* var. *gabonensis* were not located, but *junodi* was later described by Cockerell (1932) in a key to species.

This bee is either completely black or black with a red metasoma. With the naked eye the black appears grey because of the white vestiture. It differs from *M. cameroonensis* in that it is medium-sized and the vestiture is white.

Diagnosis

Worker. Lengths: Head 1.9–2.1 mm; scutum 1.4–1.6 mm; forewing 5.4–6.0 mm; body 5.1–5.9 mm. Colour: integument ranging from completely black to mostly black with variable amounts of reddish on mandible, legs and metasoma. Vestiture on head and mesosoma mostly short and white, vertex and scutellum with long black hair; legs orange to black; metasoma black dorsally and white ventrally and posteriorly. Frons not elongate (clypeal length about one-quarter face length, and half clypeal width, Fig. 10); mandible with large outer tooth and two pointed inner teeth (cf. Fig. 14); scutellum extended backwards to about posterior margin of metanotum; propodeum distinctly curved; forewing similar to *M. hildebrandti* (Fig. 11); hind tibia with posterodistal corner rounded and corbicula concave, oval and occupying two-thirds of distal half of hind tibia.

Male. Similar to worker, except scutum 1.8 mm long; vestiture on legs mostly pallid; mandible much smaller, with two smaller teeth; hind tibia

without a corbicula and narrow; S8 resembles that of *M. hildebrandti* and genitalia as illustrated (Fig. 17).

Distribution and host plants (Fig. 19)

This species appears to occur throughout tropical Africa, and has been collected on the flowers of *Ageratum conyzoides*, *Amaranthus hybridus*, *Antigonon leptopus*, *Asystasia gangetica*, *Borreria verticillata*, *Citrus aurantifolia*, *Citrus* sp., *Coffea*, *Cyperus* sp., *Dacryodes edulis*, day lilies, *Elephantopus mollis*, *Eucalyptus robusta*, *Genipa clusiifolia*, *Gouania longipetala*, *Haronga madagascariensis*, *Ipomea involucrete*, *Leucaena leucocephala*, *Mangifera indica*, *Manihot utilissima*, *Nauclea latifolia*, *Passiflora edulis*, *Polygonum lanigerum*, *Psidium guajava*, *Sesamum* sp., *Solenostemon* sp., *Triumfetta eriophlebia*, *Urena lobata*, *Vismia rubescens* and *Zea mays*.

Material examined

Type material. *Melipona* (*Trigona*) *ferruginea*, worker lectotype: '*Trigona ferruginea* Lep. J S Moure 58', MIZT.

Trigona junodi, worker syntypes: 'D O -Africa Amani 1912', MHUB; 'Shilouvane N Transvaal L (Junod)', SEMK, SAMC.

Trigona buschirii, worker lectotype and worker paralectotype: 'Acra W-Africa' and 'Exped.: Herzog Adolf Friedrich z Mecklenburg Central Africa Ituri I.08', MHUB.

Trigona erythra var. *testaceichelis*, worker holotype: 'Kamerun Tinto Gesundheitsamt', MHUB.

Axestotrigona ferruginea gambiensis, worker paratype: 'Gambia 16.4.11 J J Simpson 1911–250', NHML.

Trigona oyani, worker holotype and 1 worker paratype: 'Mis Biol P P G Makokou Gabon, R J Darchen Col. 27.2.1967 det.', NHML.

Additional material. Gambia: Banjuls, 5.ii.1987, G G M Schulten (2 workers UMAN). Ivory Coast: Amanikro, v–vi.1961, J Decelle (1 worker MRAC). Togo: Misahohe, 1895, E Baumann (1 worker MHUB); Regundes Plateau, Mt Agou, 5.ii.1995, G G M Schulten (1 worker UMAN); Bismarckburg, 2–3.x.1892, L Conradt (4 workers MHUB); Danalo, 22.v.1984, (1 worker UMAN); Kaode, 5.vi.1984 (1 worker UMAN). Gabon: Pana, 9 km N Bona, 29.i.1986, A Pauly (1 worker PC); Medouneu, 12.xii.1985, A Pauly (1 worker PC); Ntoun, 8.x.1984, A Pauly (1 worker PC). Nigeria: Ibadan

(IITA), 28.v.1987, G G M Schulten (1 worker UMAN). Cameroon: Lolodorf, L Conradt (4 workers MHUB); Rei Buba, 3–7.vi.1909, S G Riegenbach (1 worker MHUB); Bibundi, 6.xi.1904, G Tessmann (1 worker MHUB). Equatorial Guinea: Makome, S G Tessmann (1 worker MHUB). Democratic Republic of Congo: Boma, 28.viii.1913, Styczynski (2 workers MRAC); Dika, iii.1925, H Schouteden (2 workers MRAC); Gorges de la Pelenge, 10–14.vi.1947, G F de Witte (24 workers MRAC); Station Gandajika, 1957, P de Francquen (1 worker MRAC); Yangambi, 1940, (1 worker MRAC); Bitshumbi, 10–14.i.1936, H Damas (1 worker MRAC). Uganda: West Mengo, Entebbe, 10–11.iv.1983, G G M Schulten (8 workers UMAN). Kenya: Kakamega, Rondo Retreat, 29.xii.1999, B Gemmill, on day lilies (3 workers SANC); Embu, 15.v.1987, G G M Schulten (5 workers UMAN). Tanzania: Morogoro, 1963, D Ananias (1 worker UMAN); Marangu, 10.vi.1970, 1.vii.1970, H R Feijen (2 workers UMAN); Kilimanjaro, i.1906, G Schroeder (6 workers MHUB); Mkulumuri, Amani, xii.1905, G Schroeder (5 workers MHUB); Zanzibar, S Hildebrandt (1 worker MHUB); Langenburg, 19–30.iii.1898, S Fullerborn (1 worker MHUB); West Usambara, Mombo Kwei, ix.1906, F G Vosseler (1 worker MHUB); Bomole, 28.x.1905, G Schroeder (1 worker MHUB). Angola: Dande, vii.1960, V de P Araujo (22 workers TMSA). Malawi: Wiedhafen, 31.xi.1898, S Fullerborn (1 worker MHUB); Ntchisi Forest, 21.viii.1974, H R Feijen (2 workers UMAN). Zomba, Mlunguzi Estate, 14.iv.1974, H R Feijen (2 workers UMAN). Zambia: Luambe Camp, Luangwa Valley, 28.viii.1972, H R Feijen (3 workers UMAN). Zimbabwe: Victoria Falls, 23.xi.1995, M Kuhlmann (1 worker KC). South Africa: Pafuri, 23–29.i.1984, C Eardley (11 workers SANC); Ingwe Motel, Wylliespoort, 24.xi.1992, M W Mansell (8 workers SANC); Modjadji Nature Reserve, 13–14.i.1987, C Eardley (1 worker SANC); Shilouvane, Junod (2 workers MHUB); Carpe Diem Farm, 8–9.ix.1993, C Eardley, M Mansell (18 workers SANC); Ryfontein Farm, 15 km S E Tzaneen, 20–23.vii.1992, C Eardley, M Stiller (19 workers SANC).

Meliponula (Axestotrigona) cameroonensis

(Fries) **comb.n.**, Fig. 19

Trigona cameroonensis Fries, 1900: 383 (worker lectotype and 7 paralectotypes, MHUB); 1909a: 444, 448–449; Strand 1912a: 144; Meade-Waldo 1913: 497; Cockerell 1933: 27; 1934a: 51; 1937a: 12.

Melipona (Trigona) cearina Vachal, 1903: 359 (2 worker syntypes, MNHN). **Syn.n.**

Trigona cearina (Vachal): Fries 1909a: 444, 458; Strand 1912a: 144; Meade-Waldo 1913: 497 syn.

Meliponula (Axestotrigona) cearina (Vachal). Pauly 1998: 11, 63.

The type material of *M. cameroonensis* was studied. To have a single type locality and type specimen a lectotype has been designated. A syntype of *Meliponula cearina* was studied and it is conspecific with *M. cameroonensis*, as stated by Meade-Waldo (1913). This species is easy to identify because it is large, and with the naked eye appears completely blue-black. It does have a little yellow near the epistomal suture and on the ventral margin of the clypeus.

Diagnosis

Worker. Lengths: head 2.5 mm; scutum 1.8 mm; forewing 7.4 mm; body 7.1 mm. Integument virtually completely black, reddish-black in a few places and with a little yellow near epistomal suture and on ventral margin of clypeus. Vestiture black with white tomentum on face and side of mesosoma, especially side of propodeum. Frons not elongate (clypeus length less than one-quarter face length, and less than one-half clypeus width, Fig. 10); mandible with a large outer tooth and two pointed inner teeth (Fig. 14); scutellum extended a little backwards, beyond metanotum but not beyond propodeum; propodeum distinctly curved; Forewing similar to *M. hildebrandti* (Fig. 11); hind tibia with posterodistal corner rounded and corbicula concave, oval and occupying two-thirds of distal half of hind tibia.

Male. Unknown.

One specimen in STRI does not have a white tomentum on the face and side of mesosoma. It may be a new species, but has not been described as such because the pubescence is not in pristine condition.

Distribution and host plant (Fig. 19)

Meliponula cameroonensis is apparently confined to Central and West Africa. It has been collected feeding on flowers of *Cajanus cajan*.

Material examined

Type material. *Trigona cameroonensis*, worker lectotype and 7 paralectotypes: 'W Africa Togo', 'N Kamerun Joh:Albrechtshohe, 26.ii–3.iii.96, L Conradt S', 'N Kamerun Joh:Albrechtshohe, iii.96, L Conradt S' and 'N Kamerun Joh:Albrechtshohe,

i.96, L Conradt S', MHUB.

Melipona cearina, worker syntype: 'Bouyssou N'Doro X–XI.98, *cearina* female Vach., holotype, Museum Paris Coll. J Vachal 1911', MNHN.

Additional material. Nigeria: Ibadan (IITA), 30.i.1988, G G H Schulten (5 workers UMAN). Gabon: Okondja, 31.i.1987, A Pauly (1 worker MRAC). Congo: Brazzaville, 1907, E Rouraud, A Weiss (1 worker MRAC). Democratic Republic of Congo: Bokuma, 8.x.1951, P Lootens (1 worker MRAC); Bambesa, iv.1939, J Vrydagh (1 worker MRAC); Bassin Lukuga, iv–vii.1934, H De Saeger (3 workers MRAC); Eala, v.1932, A Corbisier (3 workers MRAC); Yakoma, 5–17.ii.1932, H J Bredo (5 workers MRAC); Wombali, 1913, P Vanderijst (1 worker MRAC); Dele, Rungu, vi.1938, J Ghesquiere (1 worker MRAC); Haut-Uele, Abimva, 19–22.vi.1925, H Schouteden (1 worker MRAC).

The type material of the following four species was not studied and their identity is uncertain.

***Meliponula (Axestotrigona) simpsoni* Moure
comb.n.**

Axestotrigona simpsoni Moure, 1961: 241–242 (worker holotype, NHML, damaged beyond recognition).

***Meliponula (Axestotrigona) sawadogoi*
Darchen comb.n.**

Trigona (Axestotrigona) sawadogoi Darchen, 1970: 140–145, 147 (material depository unknown) [only nest described, therefore an invalid name]; 1971b: 420.

***Meliponula (Axestotrigona) richardsi* Darchen
comb.n.**

Trigona (Axestotrigona) richardsi Darchen, 1981: 54–56 (type details and depository unknown).

***Meliponula (Axestotrigona) eburnensis*
Darchen comb.n.**

Trigona (Axestotrigona) eburnensis Darchen, 1970: 146–149 (material depository unknown) [only nest described, therefore an invalid name].

***Meliponula (Meliplebeia) beccarii* Friese,
Figs 20–23, 25**

Trigona beccarii Gribodo, 1879: 340 (worker syntypes, MCSN); Fox 1896: 559; Friese 1909a: 444–446; 1909b: 162; Strand 1911b: 164; Friese 1912: 170; 1916: 451; Cockerell 1919: 209; Alfken 1924: 252; Cockerell 1935: 1; Smith 1854: 66–69.

Trigona beccarii [!]¹ Gribodo: Friese 1941: 104.

Trigona (Meliponula) beccarii Gribodo: Cockerell 1934a: 57–61; Araujo 1963: 227.

Melipona beccarii (Gribodo): Stadelmann 1898: 21; Guiglia 1940: 297.

Meliponiden beccarii (Gribodo): Friese 1941: 96.

Trigona (Meliplebeia) beccarii Gribodo: Pooley & Michener 1969: 423, 428–430.

Meliponula (Meliplebeia) beccarii (Gribodo): Michener 1990: 96, 101, 105, 134–137.

Meliplebeia beccarii (Gribodo): Moure 1961: 229, 231–232; Araujo 1963: 132.

Melipona africana Stadelmann, 1895: 622 (worker holotype, MHUB); 1898: 21. **Syn.n.**

Trigona africana (Stadelmann): Friese 1909a: 444–446, 454; Strand 1911a: 158–159; 1911b: 164; 1912a: 144; 1912b: 311–312; Cockerell 1937b: 312.

Trigona (Meliponula) africana (Stadelmann): Cockerell 1934a: 59.

Trigona (Meliponula) africana africana (Stadelmann): Cockerell 1934a: 60.

Meliplebeia africana (Stadelmann): Moure 1961: 231–232.

Trigona topiorum Cockerell, 1910: 246 (2 worker syntypes, type depository unknown); 1932: 173; 1934a: 58–60 syn.

Meliplebeia topiorum (Cockerell): Moure 1961: 231.

Trigona africana var. *bibundicola* Strand, 1912b: 311–312 (worker holotype, MHUB); Cockerell 1934a: 58–60.

Syn. n.

Trigona beccarii var. *albofasciata* Friese, 1916: 422, 451 (worker lectotype, MHUB); Cockerell 1934a: 61. **Syn.n.**

Trigona (Meliponula) albofasciata (Friese): Cockerell 1934a: 61.

Trigona albofasciata Friese: Cockerell 1936a: 27.

Meliplebeia albofasciata (Friese): Moure 1961: 231.

Trigona beccarii jombenensis Cockerell, 1917: 123 (worker holotype, USNM); 1919: 209. **Syn.n.**

Trigona (Meliponula) africana jombenensis Cockerell: Cockerell 1934a: 61.

Trigona africana jombenensis Cockerell: Cockerell 1937b: 312.

Meliplebeia beccarii jombenensis (Cockerell): Moure 1961: 232.

Trigona (Meliponula) africana neavei Cockerell, 1934a: 60 (worker holotype, NHML). **Syn.n.**

Meliplebeia beccarii neavei (Cockerell): Moure 1961: 232.

Trigona (Meliponula) africana rhodesica Cockerell 1934a: 60–61 (worker holotype, NHML); 1936: 554–555. **Syn.n.**

Meliplebeia tanganyikae rhodesica (Cockerell): Moure 1961: 232.

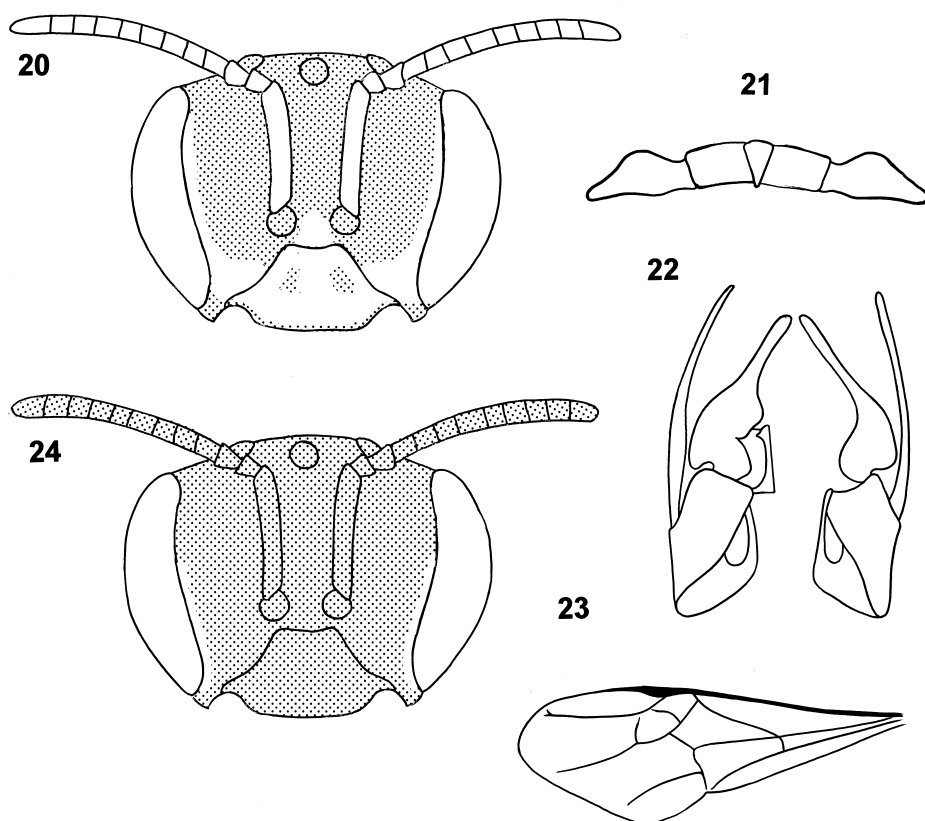
Trigona (Meliplebeia) beccarii rhodesica Cockerell: Pooley & Michener 1969: 428.

Trigona (Meliponula) africana medionigra Cockerell, 1934a: 59–60 (worker holotype, NHML). **Syn.n.**

Meliplebeia tanganyikae medionigra (Cockerell): Moure 1961: 232; Araujo 1963: 130–141.

Trigona (Meliplebeia) tanganyikae medionigra Cockerell: Pooley & Michener 1969: 429.

The type material of *Trigona beccarii jombenensis* and *Trigona topiorum* has not been studied. Those of *Trigona beccarii*, *Trigona africana*, *Trigona africana* var. *bibundicola*, *Trigona beccarii* var. *albofasciata*, *Trigona (Meliponula) africana neavei*, *Trigona (Meliponula) africana rhodesica* and *Trigona (Meliponula) africana medionigra* have been examined. *Trigona topiorum* was synonymised with *bibundicola* by Cockerell (1934a). *Trigona beccarii jombenensis* clearly lies within the colour variation of *Trigona beccarii* and is therefore synonymised with this species. Only one syntype of *Trigona beccarii* var. *albofasciata* was located in MHUB and it is here designated as the lectotype to ensure that the identity of this species is linked to one type specimen. *Melipona africana*, *Trigona africana* var. *bibundicola*, *Trigona beccarii* var. *albofasciata*, *Trigona*



Figs 20–24. 20–23: *Meliponula beccarii*; 20: worker face; 21: male S8; 22: male genitalia; 23: worker forewing. 24: *M. ogouensis*, worker face.

africana neavei, *Trigona africana rhodesica* and *Trigona africana medionigra* are here synonymised with *M. beccarii*.

Diagnosis

Worker. Lengths: Head 2.0–2.1 mm; scutum 1.7–1.8 mm; forewing 5.6–6.1 mm; body 5.8–6.6 mm. Colour: integument black with reddish distal tarsal segments and variable, often extensive, yellow maculation on clypeus, supraclypeus, paraocular areas, antenna (maximum yellow markings illustrated in Fig. 20), mandible, dorsal region of pronotum, pronotal lobe, mesepisternum behind pronotal lobe, broad band on lateral margin of scutum, axillae, most of scutellum (antero-median region black); dorsoproximal region of fore tibia; sometimes middle and hind tibiae; dorsolateral region of propodeum; anterolateral regions of terga I–II, and anterior regions of terga II–V. Vestiture very pale yellow, and orange on ventral surfaces of tarsi. Frons not elongate

(clypeus length about 0.3 times face length, and half clypeus width, Fig. 20); mandible with a broad outer tooth and a small inner tooth (Fig. 3); scutellum extended a little backwards, reaching backwards less than propodeum; propodeum distinctly curved. Forewing with marginal cell, and usually submarginal cell, closed (anterior region of first submarginal cross vein faintly visible or absent); vein Rs distinct, but not quite reaching wing margin (Fig. 23). Hind tibia with posterodistal corner rounded and corbicula, shallowly concave, oval and occupying two-thirds of distal half of hind tibia; surface of corbicula glabrous.

Male. Similar to worker, except scutum 2.1 mm long; mandible much smaller and with two small teeth; hind tibia narrow, without a corbicula; S8 and genitalia as illustrated (Figs 21, 22).

Distribution (Fig. 25)

This species appears to occur throughout tropical Africa.

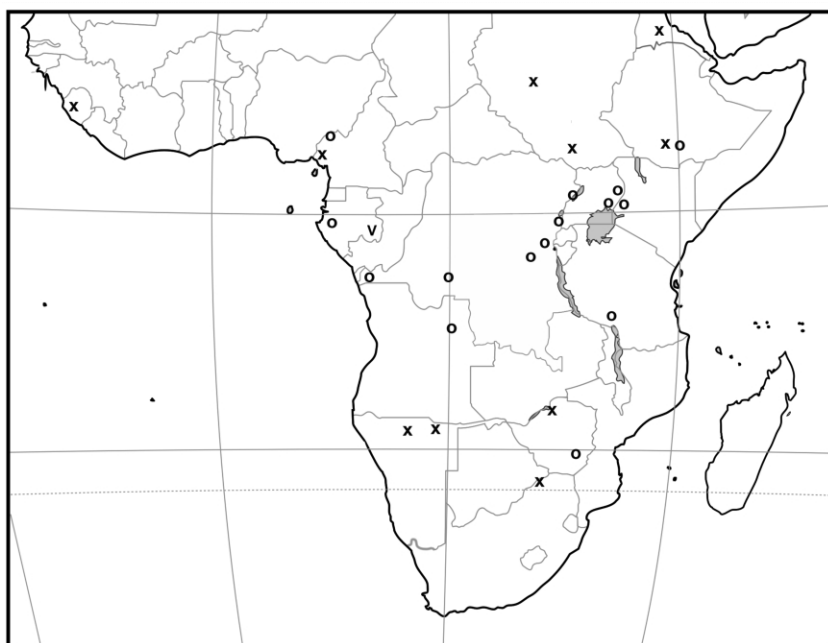


Fig. 25. Sub-Saharan Africa. Distribution of *Meliponula beccarii* (x), *M. ogouensis* (o) and *M. roubiki* (v).

Material examined

Type material. *Trigona beccarii*, worker syntype: 'Bogos. 1870 Keren O Beccari', NHML.

Trigona africana bibundicola, worker holotype: 'Kamerun Bibundi 16–30.ix.04 G Tessmann S G', MHUB.

Trigona beccarii albofasciata, worker lectotype: 'Deutsch-SW-Afr. Otjikoto (20 km W Tsumeb) 16.vi.1911, Hamb. Dtsch-sw. afr. Studienr. 1911 W Michaelsen leg.', MHUB.

Melipona africana, worker holotype: 'Sansibar C W Schmidt', MHUB.

Trigona africana neavei, *Trigona africana rhodesica* and *Trigona africana medionigra*, worker holotypes: details on specimens not recorded during examination.

Additional material. Eritrea: 08, Kristensen (1 worker labelled as holotype of subspecies of *Trigona beccarii*, MHUB). Guinea: V Homeyer (1 worker MHUB). Democratic Republic of Congo: Katanga, Lundu, vi.1924, C Seydel (1 worker MRAC). Tanzania: Amani, 1912 (3 workers MHUB). Malawi: Vipiya, 4.iii.1972, G G M Schulten (1 worker UMAN). Zimbabwe: Rekomitjie Research Station, 10.x.1973, R J Phelps (2 workers SANC). Namibia: Rundu 50 km W, 13.i.1985 (1 worker SANC); Namutoni, 28.xii.1974, H Empey (5 workers SANC). South Africa: Alldays

14–19 km W, 14.iii.1990, C Eardley (8 workers SANC).

Meliponula (Meliplebeia) ogouensis Vachal, Figs 24, 25

Melipona (Trigona) ogouensis Vachal, 1903: 359 (2 worker syntypes, MNHN).

Trigona ogouensis (Vachal): Friese 1909a: 444, 446–447.

Meliplebeia ogouensis (Vachal): Moure 1961: 231.

Meliponula (Meliplebeia) ogouensis (Vachal): Pauly 1998: 12.

Trigona africana var. *tanganyikae* Strand, 1911a: 158–159; 1912b: 312 (worker holotype, MHUB). **Syn.n.**

Trigona (Meliponula) var. *tanganyikae* Strand: Cockerell 1934a: 57.

Meliplebeia tanganyikae (Strand): Moure 1961: 232.

Meliplebeia africana tanganyikae (Strand): Moure 1961: 232.

Trigona tanganyikae Strand: Pooley & Michener 1969: 423, 428–429.

Trigona faecivora Strand, 1911b: 164–165 (6 worker paratypes, MHUB); 1912a: 144; Cockerell 1937b: 312.

Trigona (Meliponula) faecivora Strand: Cockerell 1934a: 57.

Meliplebeia faecivora (Strand): Moure 1961: 232.

Melipona alinderi Alfken, 1929: 475 (3 worker syntypes, MHUB); 1932: 54–55. **Syn.n.**

Trigona (Meliponula) alinderi (Alfken): Cockerell 1934a: 57–58; 1937b: 312.

Meliplebeia alinderi (Alfken): Moure 1961: 232.

Melipona alinderi var. *nigrita* Alfken, 1932: 54–55 (worker holotype, MHUB). **Syn.n.**

Trigona (Meliponula) alinderi var. *nigrita* (Alfken): Cockerell 1934a: 57.

Melipona alinderi mimica Alfken, 1932: 55 (worker holotype, MHUB). **Syn.n.**

Trigona (Meliponula) alinderi var. *mimica* (Alfken): Cockerell 1934a: 57–58.

Trigona alinderi mimica (Alfken): Cockerell 1937b: 312.

Meliplebeia alinderi mimica (Alfken): Moure 1961: 232.

Trigona beccarii var. *nigrifacies*, Friese, 1912: 170 (5 worker syntypes, type depository unknown). **Syn.n.**

Trigona beccarii nigrifacies Friese: Cockerell 1919: 209; 1937b: 312.

The type material of all these 'species' has been studied, except for that of *Trigona beccarii* var. *nigrifacies* that could not be located. *Trigona africana* var. *tanganyikae*, *Melipona alinderi*, *Melipona alinderi* var. *nigrita*, *Melipona alinderi mimica* and *Trigona beccarii* var. *nigrifacies* are here synonymised with *M. ogouensis*.

Diagnosis

Worker. Similar to *M. beccarii* except as follows: integument with yellow maculation confined to narrow lateral bands on paraocular area (Fig. 24) (face often completely black) and scutum, entire axillae and most of scutellum; vestiture on head and legs black, mesosoma dorsum black or orange.

Male. Unknown.

Distribution and host plant (Fig. 25)

This species apparently occurs throughout most of sub-Saharan Africa, except West Africa. It has been collected on flowers of day lilies.

Material examined

Type material. *Melipona ogouensis*, 1 worker syntype: 'Bouyssou N'Doro X-XI 98, *Ogouensis* worker Vach., holotype, Museum Paris Coll. J Vachal 1911', MNHN.

Trigona faecivora, 6 worker paratypes: 'Exped.: Herzog Adolf Friedrich z.Mecklenburg, N.Ruanda Galago See 11.07'; Exped.: Herzog Adolf Friedrich z.Mecklenburg, N.Ruanda, Vulk Karisinsbi, Bumbus Urwold 2500 m 11.07', MHUB.

Trigona africana var. *tanganyikae*, holotype worker: 'S Tanzanyika-S S Ufipa 10-12.ii.99 Msamwia Fromm S G', MHUB.

Melipona alinderi, 3 worker syntypes: 'Brit. Ost Afrika Mount Elgon 2900 m 12.4.1925', MHUB.

Melipona alinderi mimica, worker holotype: 'Brit. Ost Afrika Mount Elgon 12 Apr. 1925 Alinder leg.', MHUB.

Melipona alinderi var. *nigrita*, worker holotype and 1 worker paratype: 'Abyssinia Djem-Djem Forest, circa 8000 ft. 22-23.ix.1926 H Scott', MHUB, NHML.

Additional material. Cameroon: Nsop, 18.vii.1981, G G M Schulten (4 workers UMAN). Gabon: Ngounie, Dyanga 9 km E, 27.i.1986, A Pauly (1 worker MRAC). Democratic Republic of

Congo: Ruwenzori, Kalonga 2050 m, 7-10.viii.1932, L Burgeon (2 workers MRAC); Kivu, Ngesho, 8.viii.1935, H Damas (2 workers MRAC); Kivu, Nzombe (Amont) 2000 m, 1952, Froidebise (1 worker MRAC); Tshibinda, xii.1917, C Seydel (1 worker MRAC); Tshibinda, 21-27.viii.1931, J Ogilvie (2 workers MHUB); Albert National Park, Lac Gando, 6-8.iii.1935, G F de Witte (3 workers MRAC). Rwanda: Lusinga, 1760 m, 22.iii.1947, G F de Witte (1 worker MRAC); Lundu, vi.1924, C Seydel (1 worker MRAC); Astrida, Bukavu, 90 km Concade, 24.xii.1956, G Marlier (3 workers MRAC); Astrida, Bukavu, 90 km Cascade, 24.xii.1956, G Marlier (1 worker MRAC). Kenya: Mount Elgon, east slope, 3.ii.1971, J H and M Lourens (1 worker UMAN); Kakamega Forest, Rondo Retreat, B Gemmill, on day lilies (2 workers GC). Tanzania: S W Ruanda, 2700 m, Urwald, 6.i.1911, H Meyer (1 worker MHUB). Malawi: Vipiya, 4.iii.1972, G G M Schulten (1 worker UMAN). Angola: Dundo, v 1948, A de Barros Mechado (1 worker MRAC).

Meliponula (Meliplebeia) roubiki sp.n., Fig. 25

Diagnosis

Worker. Similar to *M. beccarii* except as follows: integument with yellow maculation on parocular area occupying most of lower half, reaching laterally well above antennal sockets; lateral and posterior margins of mesosomal dorsum with narrow yellow band (posteromedian region of scutellum yellow); legs black to blackish, except trochanters fellow; metasoma reddish to red anteriorly and blackish posteriorly, sometimes banded; vestiture on head and scutum white, scutellum yellow; hind tibia with posterodistal corner angulate.

Male. Unknown.

Distribution (Fig. 25)

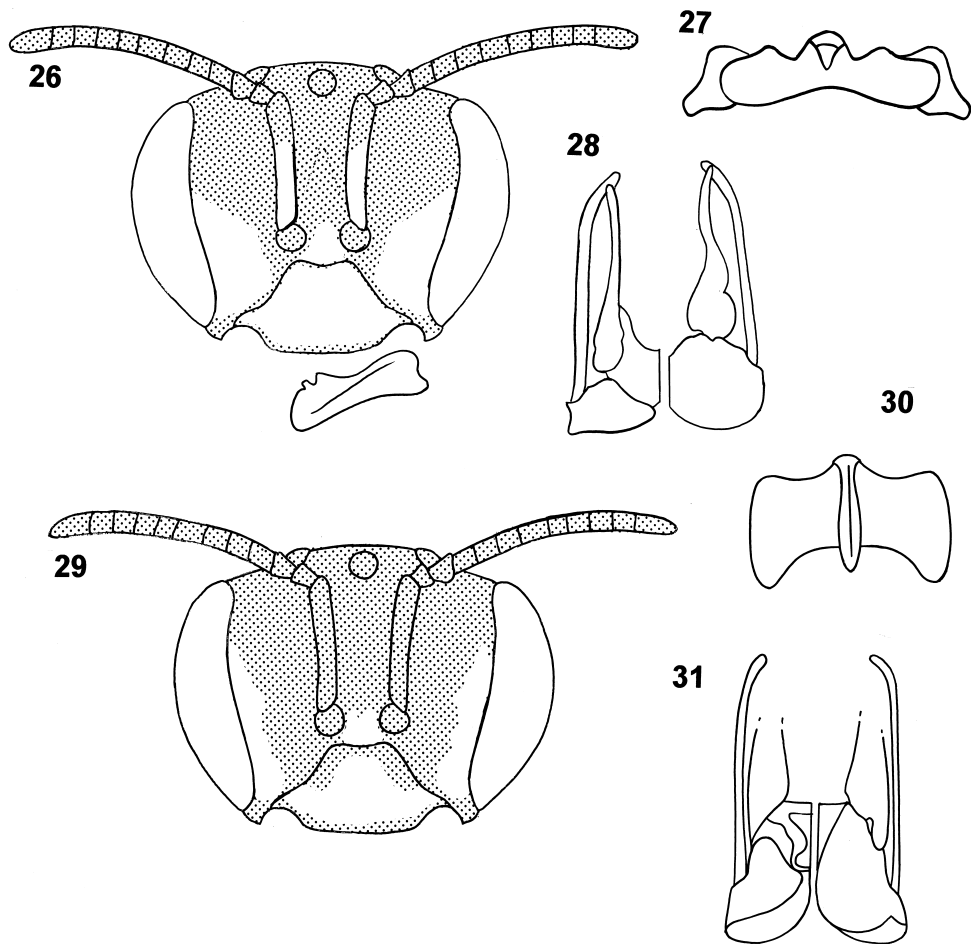
This species is known only from the type series collected in Gabon.

Etymology

This species was recognized as being new by Dave Roubik and is named for him.

Material examined

Type material. 42 workers, holotype and 41 paratypes, Gabon: Franceville Hwy. La Lope Reserve 12/I/93 sugar water D Roubik col (holotype and two paratypes, STRI; 1 paratype, SANC).



Figs 26–31. 26–28: *Meliponula nebulata*; 26: worker face and mandible; 27: male S8; 28: male genitalia. 29–31: *M. lendliana*; 29: worker face and mandible; 30: male S8; 31: male genitalia.

***Meliponula (Meliplebeia) nebulata* (Smith),**

Figs 26–28, 32

Trigona nebulata Smith, 1854b: 414 (worker holotype, NMHL); Friese 1909a: 444–445, 448–449; Strand 1911b: 163; 1912b: 311; 1914: 67; Cockerell 1919: 211; Strand 1921: 106; Hedicke 1931: 38; Cockerell 1934a: 51–53; Darchen 1969: 153–187.

Melipona (Trigona) nebulata (Smith): Vachal 1903: 360.

Melipona nebulata (Smith): Benoist 1944: 13.

Apotrigona nebulata (Smith): Moure 1961: 233–235; Pauly 1998: 51, 56.

Trigona (Apotrigona) nebulata Smith: Medler 1980: 483.

Meliponula (Meliplebeia) nebulata (Smith): Michener 1990: 105, 135–136.

Trigona nebulata nebulata Smith: Cockerell 1934a: 51–52.

Trigona conradti Friese, 1900: 383 (20 worker syntypes, MHUB); 1909a: 444–445, 448; Cockerell 1910: 246; Strand 1910: 41; 1912b: 311; 1914: 67; Friese 1914: 294; Hedicke 1931: 38 syn.

Trigona nebulata conradti Friese: Cockerell 1934a: 51–52.

Trigona nebulata var. *delimbata* Strand, 1914: 67 (5 worker syntypes, type depository unknown); Cockerell 1934a: 51–52. **Syn.n.**

Trigona nebulata abrassarti Cockerell, 1934a: 52–53 (2 worker syntypes, MRAC); Darchen 1969: 152; 1971b: 420. **Syn.n.**

Trigona abrassarti Cockerell: Darchen 1971b: 420.

Trigona nebulata infusata Cockerell, 1934a: 52–53 (worker syntypes, depository unknown). **Syn.n.**

Trigona nebulata komiensis Cockerell, 1934a: 52–53 (worker syntypes, MRAC); Darchen 1969: 151. **Syn.n.**

Trigona (Apotrigona) nebulata komiensis Cockerell: Darchen 1970: 140–141.

The type material has been studied, except for *Trigona nebulata* var. *delimbata* and *Trigona nebulata infusata*. Based on their original descriptions, I have synonymised them with *Meliponula nebulata*. *Trigona conradti* was considered to be a variety of *nebulata* by Friese (1909a) and Hedicke (1931) synonymised these two names. The one syntype of *abrassarti* that was studied is here designated as the lectotype to link the identity to the one specimen studied.

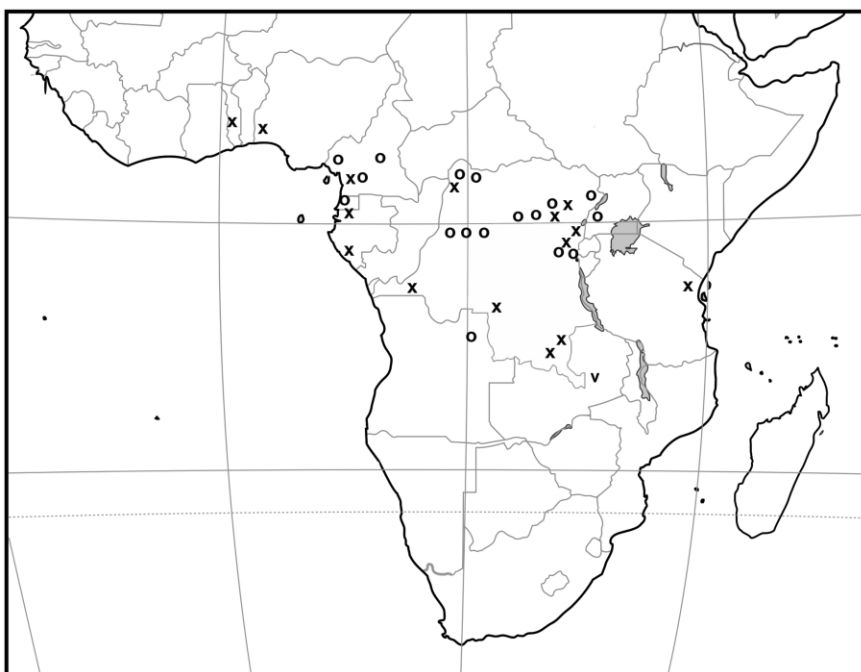


Fig. 32. Sub-Saharan Africa. Distribution of *Meliponula nebulata* (○), *M. lendiana* (x) and *M. griswoldorum* (v).

Diagnosis

Worker. Similar to *M. beccarii* except as follows: integument with yellow on almost entire clypeus, supraclypeus, labrum, most of mandible, lower paraocular area (reaching a little above antennal sockets adjacent to inner eye margin), anterior surface of antennal scape (Fig. 26); mesosoma completely black to black with yellow markings on pronotal lobe, mesepisternum behind pronotal lobe and lateral margin of scutum; metasoma largely reddish, not distinctly banded. Long vestiture on vertex, scutum and metasomal dorsum black, legs black, short vestiture orangish; metasoma reddish-orange on dorsum and pale orange on sides and venter.

Male. Similar to worker except for sex-limited characters, and S8 and genitalia as illustrated (Figs 27, 28).

Distribution and host plants (Fig. 32)

Trigona nebulata is apparently occurs in Central and West Africa. It has been collected on flowers of *Borreria verticillata*, *Dacryodes edulis*, *Elephantopus mollis*, *Haronga madagascariensis*, *Ipomea* sp., *Passiflora edulis*, *Sesamum* sp., *Urena lobata* and *Vernonia conferta*.

Material examined

Type material. *Trigona nebulata*, worker holotype: 'Type, B.M. TYPE HYM. 17B 1104, *Trigona nebulata* Type Sm., *nebulata* type Sm., 5/x/07, West Africa', NMHL.

Trigona nebulata conradti: 20 worker syntypes: 'Kamerun v.14 Duala v. Rothkirch'; 'Nkamerun Johann Albrechshohe L Conradt S6', MHUB.

Trigona nebulata abressarti, worker syntype: 'Musée du Congo Sankuru 1910 Dr Abrassart', MRAC.

Trigona nebulata komiensis, worker holotype and paratype: 'Sankuru, Komi, 30.iii. 1930, J Ghesquiere', MRAC.

Additional material. Cameroon: Nkolbisson, ix.1968, L G Segers (1 worker MRAC); Metet, T D A Cockerell (1 worker MHUB); Lolodorf, L Conradt (3 workers MHUB); Bipindi, x–xii.1898, S Zenker (1 worker MHUB); Victoria, 3.xii.1890, S Preuss (1 worker MHUB). Equatorial Guinea: Benito, 1–15.viii.1906, G Tessmann (2 workers MHUB); Rio Muni, Bata, 1963, G Sabater (5 workers MRAC). Democratic Republic of Congo: Uele, Nepoko, A Henrion (4 workers MRAC); Ruwenzori, N W Beni, i.1908 (4 workers MHUB); Eala, iv and x. 1933, J Ghesquiere (2 workers MRAC); Sankuru, Komi, 30.i. 1930, 23.iii.1930, J Ghes-

quiere (2 workers MRAC); Sankuru, Mwene Ditu, 25.xi.1952, C Seydel (4 workers MRAC); Equateur, Flandria, 19.iii.1932, R P Hulstaert (1 worker MHUB); Equateur, Boende, 13.ii.1926, R P Hulstaert (2 workers MRAC); Haut-Uele, Paulis, vii.1947, P L G Benoist (1 worker MRAC); Uele, Bambesa, iv and x.1933 (2 workers MRAC); Uele, Bayenga, Wamba, 810 m, 10.viii.1956, R Castelain (1 worker MHUB); Tshuapa, Bokuma, ii–iii.1954, R P Lootens (1 worker MRAC); Tshuapa, Mbele, 1954, R P Hulstaert (2 workers MRAC); Bambili, Rodhain (1 worker MHUB); Tshuapa, Ikela, viii.1956, R P Lootens (1 worker MHUB); Kilo, Mongwalu, vii.1938, Scheitz (1 worker MHUB); Yangambi, 7.xi.1957, P Dessart (1 worker MHUB); Costermansville, viii.1949, H Bomans (1 worker MHUB).

***Meliponula (Meliplebeia) lendliana* (Friese),**
Figs 29–32

Trigona lendliana Friese, 1900: 383 (worker lectotype, MHUB); 1909a: 444–445, 452; 1909b: 166; Cockerell 1919: 210; 1934a: 53.

Melipona (Trigona) lendliana (Friese): Vachal 1903: 360.

Plebeilla lendliana (Friese): Araujo 1958: 203; 1963: 130–141.

Trigona (Meliplebeia) lendliana Friese: Medler 1980: 483.

Meliplebeia lendliana (Friese): Wille 1983: 50.

Meliponula (Meliplebeia) lendliana (Friese): Michener 1990: 96, 105, 135–136.

Four syntypes from different localities were studied and one is designated here as the lectotype because this establishes the type locality and links the identity to a single specimen.

Diagnosis

Worker. Lengths: Head 1.4–1.5 mm; scutum 1.1–1.2 mm; forewing 3.9–4.0 mm; body 4.1–5.2 mm. Colour: integument black with reddish distal tarsal segments and yellow maculation on clypeus, except dorsolateral regions, supra-clypeus, outer margin of paraocular areas, from malar area to upper extreme of supra-antennal triangle, labrum and most of mandible (Fig. 29), pronotal lobe, lateral and posterior regions of scutellum (yellow notched with black postero-medially) and outer proximal ends of tibiae. Vestiture mostly pallid; scutum with very short, simple, dense, blackish vestiture and few very densely plumose, white hairs (resembling tufts of hair) anteriorly (without long white or densely plumose hairs on remainder of scutum); mesepisternum with many densely plumose (tuft-like) hairs. Frons not elongate (clypeus length about one-third face length, and less than half clypeus

width, Fig. 29); mandible with one broad tooth, and distal margin slightly undulated on inner half (cf. Fig. 26); scutellum extended a little backwards; propodeum strongly curved, and metanotum not reaching posterior extreme of propodeum; Forewing similar to that of *M. beccarii* (Fig. 23). Hind tibia with posterodistal corner rounded and corbicula concave, oval and occupying two-thirds of distal half of hind tibia; surface of corbicula reticulate.

Male. Similar to worker, except mandible much smaller and with two small teeth, outer tooth larger and pointed; hind tibia without a corbicula and narrow; S8 and genitalia as illustrated (Figs 30, 31).

Distribution and host plants (Fig. 32)

This species appears to occur only in the equatorial regions of Africa. It has been recorded on flowers of *Borreria verticillata*, *Cissus* cf. *producta*, *Dacryodes edulis*, *Gouania longipetala*, *Haronga madagascariensis* and *Mangifera indica*.

Material examined

Type material. *Trigona lendliana*, worker lectotype and paralectotype: 'D O-Africa Amani 1907, Vosseler'; 'S O Kamerun, Lolodorf L Conradt S', MHUB.

Additional material. Togo: Bismarckburg, 20.vii–29.ix.1890, Ruttner (1 worker MHUB). Nigeria: Ile-Ife, 9.iv.1971, J T Medler (1 worker MRAC). Gabon: Kougouleu, 16.viii.1985, A Pauly, (1 worker PC); Gamba, Ogoe Maritime, 25 m, ix.1901 and i, iv–v.2002, Syssou, Ngoma, Moussavou, Mikissa, Basset (3 workers 2♂ SAN). Democratic Republic of Congo: N'Zului Lac Kivu, 1500 m, 11–29.viii.1957, C Donis (2 workers MRAC); Rutshuru, xii.1937, J Ghesquiere (5 workers MRAC); Lac Kivu, Ruabungu, 17.x.1935, H Damas (2 workers MRAC); Rumangabo, Mt Gabiro, 11.iv.1945, G F de Witte (2 workers MRAC); Bombi, Butahu, 1180 m, 29.iii.1957, P Vanschuytbroeck (6 workers MRAC); Mt Ruwenzori, River Lusilobe, Mt Kyanyamu, 29.ix.1955, P Vanschuytbroeck (8 workers MRAC); Mt Ruwenzori, Mt Degio, 2200 m, 19.viii.1954, P Vanschuytbroeck, H Synave (8 workers MRAC); Mt Ruwenzori, River Kakalari, Bombi, 1725 m, 10.vi.1954, P Vanschuytbroeck, H Synave (3 workers MRAC); Mt Ruwenzori, River Lusilobe, Bomboka, Kyandoire, 15.x.1952, P Vanschuytbroeck, J Kekenbosch (2 workers

Table 2. Diagnostic characters of *Hypotrigona* and *Liotrigona*.

Character	<i>Hypotrigona</i>	<i>Liotrigona</i>
Scutum, dorsal view	Densely punctate, not shiny (Fig. 44)	Sparsely punctate, glabrous
Scutellum, dorsal view	Conceals metanotum	Metanotum exposed
Propodeum, lateral view	Subhorizontal part longer than subvertical region (Fig. 33)	Subhorizontal part shorter than subvertical part (Fig. 38)
Worker hind tibia: posterodistal corner	Rounded	Angulate
Worker hind tibia: distal end	At most slightly concave	Distinctly concave
Worker hind tibia: corbicula	Less than half as long as hind tibia	More than half as long as hind tibia
Worker hind tibia: median width	Slightly more than one-third length	Distinctly less than one-third length
Male genitalia	S8 narrow, gonocoxite short and wide (Figs 35–37)	S8 wide medially, gonocoxite long and narrow (Figs 39–40)

MRAC); Mt Ruwenzori, Kiurama, 2100 m, 26.x.1953, P Vanschuytbroeck, V Hendrick (8 workers MRAC); Mt Ruwenzori, Kalonge, 2150 m, River Nyamwamba, 18.vi.1957, P Vanschuytbroeck (1 worker MRAC); Ituri, La Moto Madyu, L Burgeon (1 worker MRAC); Katanga: Kakungwe, 27.v.1924, C Seydel (1 worker MRAC); Congo da Lemba, x.1913: R Mayne (1 worker MRAC); Kilo, Abetti, (1 worker MRAC); Bumba, xii.1930–i.1941, H de Saeger (1 worker MRAC). Kenya: Kakamega Forest, 5.xii.1982, T and R Griswold (7 workers BLCU).

***Meliponula (Meliplebeia) griswoldorum* sp.n.,**
Fig. 32

Diagnosis

Worker. As in *Meliponula lendliana* except vestiture on mesosomal scutum: white; entire scutum with very short, dense, simple vestiture, together with sparse, long, weakly plumose hairs and sparse very densely plumose hairs, resembling tufts of hair.

Male. Unknown.

Distribution (Fig. 32)

This species is only known from near Chipata, Zambia.

Etymology

This species is named for Terry and Rhonda Griswold who collected the type material, and recognised by Terry as being new to science.

Material examined

Type material. worker holotype and 29 worker

paratypes: 'Zambia, 20 km SE Chipata 10–xi–82 TL/RT Griswold' (holotype BLCU, 29 paratypes BLCU, SANC).

The identity of the following species is uncertain.

***Meliponula (Meliplebeia) gambiana* Moure**
comb.n.

Meliplebeia gambiana Moure, 1961: 232–233 (worker holotype, type depository unknown).

***Hypotrigona* Cockerell**

Trigona (Hypotrigona) Cockerell, 1934a: 47. Type species *Trigona gribodoi* Magretti, by original designation.

Hypotrigona Cockerell: Moure 1961: 220–223; Darchen 1977: 33–59.

Hypotrigona closely resembles *Liotrigona* in that they are both very small (2.2–3.1 mm long). Moure (1961) described some clear differences between these two genera and Table 2 will help to separate them.

The species of *Hypotrigona* are very difficult to separate. The only conclusive works are those of Guiglia (1955), in which *H. gribodoi* and *H. braunsi* are discussed, Michener (1959), in which *H. braunsi* and *H. araujo* are described and Moure (1961), where all the species are separated on lengths and ratios. Michener (1959) had biological information to justify the separation of *H. braunsi* and *H. araujo*. I cannot separate the workers of *H. gribodoi* and *H. braunsi*. In *H. ruspolii* an imaginary line between the proximal hind edge and the posterodistal angle is distinctly posterior to the midline and in the other species it is more or less in the middle of the hind tibia. Guiglia's (1955) illustration of the hind tibia of *H. gribodoi* resembles *H. ruspolii* with regard to the position of this imaginary line. This is apparently an artifact of the

position of the hind tibia, because she studied the type material and when I measured the hind tibia of the type material of *H. gribodoi* I found it to resemble *H. braunsi*. I have not studied the types of *H. braunsi* because it was adequately described by Guiglia (1955) and Michener (1959). There are possibly sibling species of *Hypotrigona* that have not yet been recognised. Material is being collected for molecular analysis.

Diagnosis

Worker. Lengths: Head 0.9–1.1 mm; scutum 0.6–0.7 mm; forewing 2.1–2.8 mm; body 2.2–2.9 mm. Colour, integument black with reddish to yellow mandible, antenna and distal tarsal segments, and sometimes metasoma yellowish. Vestiture white and very sparse; mainly on lower region of face, mesopleuron, scutellum and legs (in *H. penna* strongly pinnate vestiture on face and scutal vestiture is diagnostic, Fig. 45). Scutum very densely punctate, with areas between punctures less than puncture diameter (Fig. 44). Frons not elongate (clypeus length about one-fifth face length, and less than half clypeus width, Fig. 10); mandible with a broad outer and a small inner tooth; scutellum extended backwards and obscures metanotum when viewed from above; propodeum obtusely curved, subhorizontal region longer than subvertical region (Fig. 33); hind tibia with posterodistal corner rounded; corbicula poorly defined, occupying about distal half of hind tibia; its surface glabrous; worker hind tibia with median width slightly more than one-third length.

Male. Similar to worker, except mandible much smaller and with two small teeth, outer tooth larger; hind tibia without a corbicula and narrow; S8 and genitalia as illustrated (Figs 35–37).

Hypotrigona gribodoi (Magretti), Figs 33–36,

41

Trigona gribodoi Magretti, 1884: 630 (worker holotype, MCSN); 1898: 28; Friese 1909a: 444–445, 455–457; Strand 1911a: 158; 1911b: 163; Friese 1921: 1101; Cockerell 1910: 246; 1919: 210.

Trigona (Hypotrigona) gribodoi Magretti: Cockerell 1934a: 47, 54–55, 62; Bassindale 1954: 49–62; Araujo 1955a: 108; 1955b: 25; 1956: 10; 1958: 203; Araujo & Kerr 1959: 224 [misidentification = *H. braunsi*]; Michener 1959: 1; Pooley & Michener 1969: 423–428.

Hypotrigona gribodoi (Magretti): Moure 1961: 221; Michener 1990: 129–133.

Trigona braunsii Kohl, 1894: 280–281 (worker type, depositary unknown).

Melipona (Trigona) braunsi [! (Kohl): Vachal 1903: 360.

Trigona braunsi [! (Kohl): Friese 1909a: 444, 451, 455–457;

Strand 1911a: 158; Friese 1916: 451; Cockerell 1919: 210; Friese 1921: 1101; Alfken 1924: 253; Cockerell 1932: 174; 1934a: 55; Prins 1978: 857; Pooley & Michener 1969: 423–424.

Melipona braunsi [! (Kohl): Loveridge 1923: 1019.

Trigona (Hypotrigona) gribodoi Magretti [misidentification]: Araujo 1955a: 108; 1955b: 25; 1956: 10; 1958: 203; Araujo & Kerr 1959: 224.

Trigona (Hypotrigona) braunsi [! (Kohl): Araujo & Kerr 1959: 224–227; Michener 1959: 2–5; Medler 1980: 483.

Hypotrigona braunsi [! (Kohl): Moure 1961: 221; Sommeijer 1984: 173; Sommeijer et al. 1984: 200 syn; Michener 1990: 129.

There are no apparent differences between *gribodoi* and *braunsi* and the synonymy of Sommeijer et al. (1984) is therefore concurred. They were both described in 1884, and although the name *braunsi* (spelt with one 'i') appears more often in the literature, *gribodoi* is the preferred choice because of the spelling discrepancy in *braunsi*. Araujo & Kerr (1959) recognised two different forms of *H. braunsi*, and *H. braunsi* sensu stricto was given the Portuguese name 'cassusso'. The other was later described as *H. araujo* (Michener 1959).

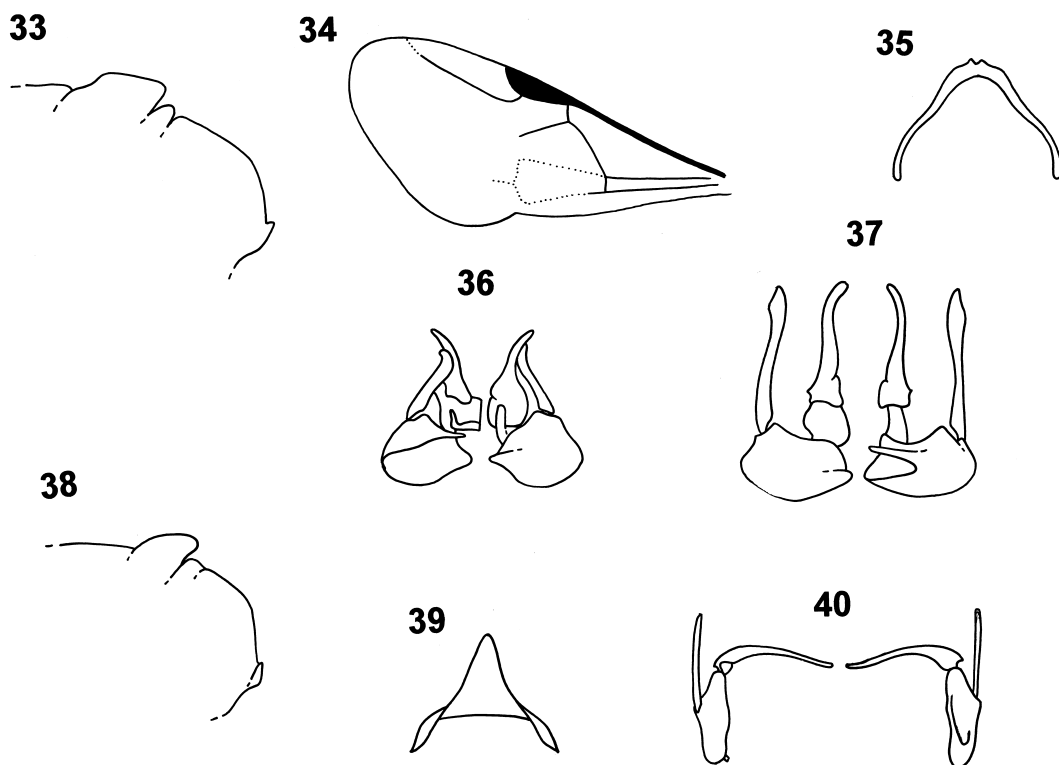
Diagnosis

Worker. Mandible and labrum, legs and metasoma black to orangish yellow; posterior margins of hind tibia and basitarsus often yellow; scutum dull to slightly shiny in and between punctures; vestiture on vertex and scutum weakly plumose; notaulus inconspicuous; forewing with marginal cell nearly closed, vein Rs distinct, but not quite reaching wing margin (Fig. 34); a line, on hind femur, from proximal posterior margin to posterodistal angle separates posterior half of hind tibia; posterodistal end of hind femur with a distinct angle, and dense tuft of hair encompassing angular area.

Male. Similar to worker, except sex-limited characters. Hind tibia without a scopa; S8 bifid and short apically (Fig. 35); genitalia short and wide and gonostylus short (Fig. 36).

Distribution and host plants (Fig. 41)

This species apparently occurs throughout tropical Africa. It has been collected on flowers of *Acacia senegalensis*, *Acacia tortilis*, *Ageratum conyzoides*, *Antigonon leptopus*, *Aspilia africana*, *Averrhoa carambola*, *Borreria* sp., *Borreria verticillata*, *Cissus* sp., *Cissus oreophila*, *Cissus producta*, *Crudia klaineri*, *Dacryodes edulis*, *Dialium soyauxii*, *Dichostemma glaucescens*, *Elephantopus mollis*, *Eucalyptus robusta*, *Ficus umbellatus*, *Gouania longipetala*, *Haronga*



Figs 33–40. 33–36: *Hypotrigona gribodoi*; 33: worker scutellum, metanotum and propodeum, profile; 34: worker forewing; 35: male S8; 36: male genitalia. 37: *H. ruspolii*, male genitalia. 38–40: *Liotrigona bottegoi*; 38: worker scutellum, metanotum and propodeum, profile; 39: male S8; 40: male genitalia.

madagascariensis, *Indigofera* sp., *Mangifera indica*, *Mikania cordata*, *Pancratium trianthemum*, *Psidium guajava*, *Psychotria* sp., *Solenostemon* sp., *Spirostachys africana*, *Stachytarpheta angustifolia*, *Tetraberlinia bifoliolata*, *Vernonia conferta*, *Zea mays*. Nests in *Ficus umbellatus*, *Heeria insignis*, *Pseudocadia zambesiaca* and *Spirostachys africana*.

Material examined

Type material. Worker holotype of *Trigona gribodoi*, 'Coll.e P Magretti, Keren, 21.iv.83', MCSN.

Additional material. São Tome: Principe Island, 28.xii.1932, W H T Tams (3 workers NHML); Bioko: Santa Isabel, 27.iii.1904 (1 worker NHML). Sierra Leone: Njala, 17.ii.1933, H Hargreaves (1 worker NHML). Liberia: Maylatwelli, 27.x, (1 worker NHML). Senegal: Louga, 18.v.1983, J W Everts (1 worker NHML). Ghana: Gold Coast, Dodowah, iii.1920, J W Scott-Macfie (5 workers NHML); Achimota, iii.1959, on *Pancratium*

trianthemum (2 workers NHML). Nigeria: Lagos, H Strachan (3 workers NHML); Yola, 1909, J M Dalziel (3 workers NHML); Patti Lokoja, vi.1906, G C Dungeon (1 worker NHML). Cameroon: Victoria, 22.xii.1921, L H Booth (2 workers NHML); Kumba, 24.x.1949, H Oldroyd (1 worker NHML). Gambia: Fajara, 19.xi.1983, K M Guichard (1 worker NHML). Uganda: Bwamba, Hakitengya, ii–iii.1949, W H R Lumsden (2 workers 3♂ NHML); Ruwenzori Range, Bundibugyo, 115 m, 22.viii–3.ix.1952, D S Fletcher (1 worker NHML); Ruwenzori Range, Semliki forest, 880 m, 22.viii–3.ix.1952, D S Fletcher (1 worker NHML); Ruwenzori Range, Namwamba Valley, 3100 m, xii.1934–i.1935 (1 worker NHML); Lodwar, xi.1934 (3 workers NHML); Kampala, 20.x.1929, H Hargreaves (1 worker NHML); Mormojr district, Moroto, 11.x.1952, B Verdcourt (2 workers NHML). Democratic Republic of Congo: Rutshuru, xii.1937, J Ghesquiere (1♂ MRAC); Katanga, Sapwe, 1935, Richard (1♂ MRAC); Thysville i.1953, J Sion (4♂ MRAC); Tshuapa, Bokuma,

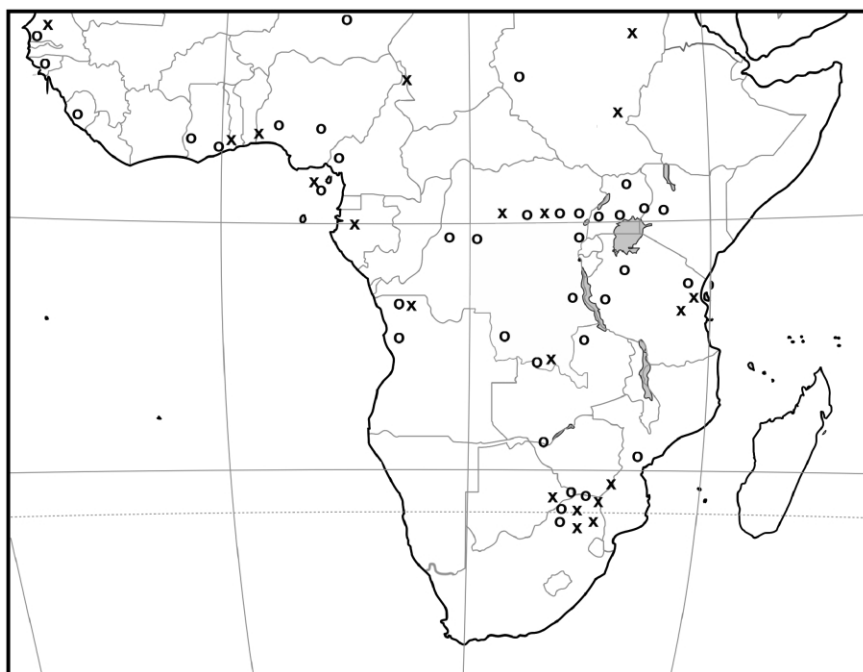


Fig. 41. Sub-Saharan Africa. Distribution of *Hypotrigona gribodoi* (x) and *H. ruspolii* (o).

iii.1954, R P Lootens (1♂ MRAC); Ruwenzori, Tete de Source river Indray, Samliki 1 840 m, 9.xi.1956, P Vanschuytbroeck (5♂ MRAC); Coquihatville, 1958, B N Goie (1 worker MRAC); Yamngambi, x.1956, N L H Crause (1 worker NHML); Albertville, ix.1931, J Ogilvie (1 worker NHML); Dilolo, 24–27.vii.1931, A Mackie (1 worker NHML); Stanleyville (1 worker NHML). Sudan: Darfur, iii–iv.1921, H Lynes (2 workers NHML). Kenya: Kakamega Forest, 20.xii.1970, A E Stubbs (1 worker NHML); Mombasa 4.iv.1960, J E Mellor (1 worker NHML). Tanzania: Nzega, iv.1932, W V Harris (1 worker 1♂ NHML); Sagala Swamp, x.1947 (2 workers NHML). Zambia: Mid-Luangwa Valley, 23–31.viii.1910, S A Neave (2 workers 2♂ NHML). Zimbabwe: Victoria Falls, ix.1931, J Ogilvie, (3 workers NHML). Mozambique: Upper Buzi River, 25.ix.1905, A K Marshall (1 workers NHML). Angola: Dande, vii.1960, V de P Araujo (24 workers TMSA); Bruco, 2.iii.1972 (8 workers NHML); Salazar, 9–15.iii.1972 (1 worker NHML); 20 km SW Luanda, 25.viii.1949, G R Gradwell, D Snow (3 workers NHML). South Africa: Mogol Nature Reserve, 27–29.ii.1984, C Eardley (94 workers 17♂ SANC); Messina Nature Reserve, 7.iii.1990, C Eardley (50 workers SANC); Altydroog Farm, C Eardley (24 workers 2♂ SANC);

Boekenhoutsloof, 17.xi.1984, C Eardley (9♂ SANC).

***Hypotrigona araujo* (Michener), Fig. 42**

Trigona (*Hypotrigona*) *gribodoi* Magretti: Araujo 1955b: 24–25.

Trigona (*Hypotrigona*) *araujo* Michener, 1959: 2–5 (worker holotype, AMNH).

Hypotrigona araujo (Michener): Moure 1961: 221–222; Michener 1990: 129.

The type material was not studied. This species was identified from Michener's (1959) excellent description. Of the two different forms of *H. braunsi* recognised by Araujo & Kerr (1959), the form given the Portuguese vernacular name 'landula' was described as *H. araujo* by (Michener 1959).

Diagnosis

Worker. Mandible and labrum, legs and metasoma black to orangish-yellow; posterior margins of hind tibia and basitarsus often yellow; scutum dull to slightly shiny in and between punctures; vestiture on vertex and scutum weakly plumose; natoulus inconspicuous; an imaginary line, on hind femur, from proximal posterior margin to posterodistal angle separates posterior half of hind tibia; posterodistal end of hind femur with a distinct angle, and with posterodistal dense tuft of hair

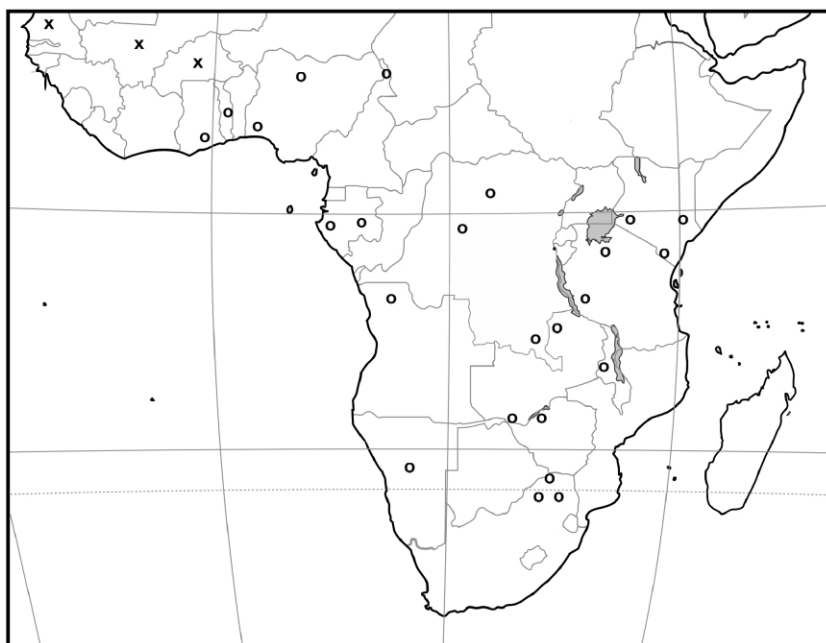


Fig. 42. Sub-Saharan Africa. Distribution of *Hypotrigona araujo* (o) and *H. penna* (x).

posterior to angle.

Male. S8 similar to *H. gribodoi* (cf. Figs 35, 36).

Distribution and host plants (Fig. 42)

This species appears to occur throughout tropical Africa, and was collected on flowers of *Monopetalanthus le-testui* and *Oleander* sp.

Material examined

Ghana: Accra (1 worker MHUB). Togo: Danalo, 22.v.1984 (1 worker UMAN). Nigeria: Zaria, 3.xi.1965, J N Lyall, on *Oleander* (8♂ NHML); Ibadan (IITA), 18.ii.1935, F D Golding (2 workers NHML). Cameroon: Tsad See Kontodea, 17.iii.1909, S G Riegenbach (8 workers MHUB). Gabon: Ogooue-Maritime, Rabi, 24.ix.1994, J J Wiernga, on *Monopetalanthus le-testui* (2 workers UMAN); Ogooue-Lolo, 30 km E Lastoursville, 16.x.1994, J J Wiernga (2 workers UMAN). Democratic Republic of Congo: Tshuapa, Bokuma, iii.1954, R P Lootens (9 workers MRAC); Basoko, 16.iii.1948, P L G Benoit (3 workers MRAC); Lulua, Katanga, iv–ix.1958, J Allaer (3 workers MRAC); Katanga, Sapwe, 1935, Richard (4 workers MRAC). Kenya: Diani, Mombasa, x–xi.1951, E Pinhey (3♂ NMKE); Nairobi, Karura Forest, 13.xii.1970, A E Shubbs (1 worker NHML); Taita (Voi), vi.1996, J Ville (1 worker NMKE). Tanzania:

Nzega, iv.1932, W V Harris (1♂ NHML); Liwale, 615 m, 1953 (2 workers 1♂ NHML). Angola: Dande, vii.1960, V de P Araujo (16 workers TMSA). Zambia: Mid-Luangwa Valley, 23–31.viii.1910, S A Neave (1♂ NHML). Malawi: Salima, Fish Eagle Inn, 19.viii.1974, H R Feijen (8 workers UMAN). Zimbabwe: Victoria Falls, xii.1914 (1♂ UMAN). South Africa: Mogol Nature Reserve, 27–29.ii.1984, C Eardley (67 workers SANC); Langjan Nature Reserve, 10.iii.1990, C Eardley (15 workers SANC); O T K Reserve, near Loskop Dam, 9–11.xii.1985, C Eardley (23 workers SANC); Sandrivierspoort, 42 km NE Nylstroom, 2.iii.1984, C Eardley (3 workers SANC). Namibia: Okahandja, 19–29.iii.1928 R E Turner (1♂ NHML).

Hypotrigona ruspolii (Magretti), Figs 37, 41, 44

Trigona ruspolii Magretti, 1898: 27–28 (2 worker syntypes, MHUB); Friese 1909a: 444, 457; Strand 1912a: 143; Friese 1915: 276; Alfken 1924: 253.

Trigona (Hypotrigona) ruspolii Magretti: Medler 1980: 483.

Hypotrigona ruspolii (Magretti): Moure 1961: 221.

Trigona magretti Friese, 1900: 384 (worker syntypes, MHUB); 1909a: 444, 457–458; Cockerell 1919: 210; Friese 1921: 1101; Alfken 1924: 253; Cockerell 1934a: 55; Darchen 1971a: 403.

Hypotrigona magretti (Friese): Moure 1961: 221; Michener 1990: 129–133.

Trigona (Hypotrigona) magretti Friese: Medler 1980: 483.

Melipona (Trigona) bouyssoui Vachal, 1903: 360 (11 worker 1 male syntype, MRAC). **Syn.n.**

Trigona bouyssoui (Vachal): Friese 1909a: 444, 458; Alfken 1924: 253.

Table 3. Diagnostic characters of the African species of *Hypotrigona*.

Character	<i>H. gribodoi</i>	<i>H. araujo</i>	<i>H. penna</i>	<i>H. ruspolii</i>
Head and scutal vestiture	Weakly pinnate	Weakly pinnate	Very strongly pinnate	Weakly pinnate
Scutal punctation	Slightly shiny	Slightly shiny	Slightly shiny	Moderately shiny
Scutum, notaulus	Usually indistinct	Usually indistinct	Usually indistinct	Usually conspicuous
Worker, width hind tibia	Wide	Wide	Wide	Narrow
Worker, hind tibia posterolateral end	Pubescent tuft on angle	Pubescence proximal to angle	Pubescent tuft on angle	Pubescent tuft on angle
Male genitalia	Gonostylus short (Fig. 36)	Gonostylus short (Fig. 36)	Unknown	Gonostylus long (Fig. 37)

The type material has been studied and *ruspolii*, *magretti* and *bouyssoui* are synonyms. One worker syntype of *Melipona bouyssoui* is here designated as the lectotype to fix the identity to one specimen because the entire type series has not been studied and several of the studied specimens are in poor condition. This species can be identified from the characters listed in Tables 2 and 3.

Diagnosis

Worker. Mandible and labrum yellow, legs and metasoma sometimes yellow; scutum moderately shiny between punctures (Fig. 44); notaulus usually conspicuous; vestiture on vertex and scutum weakly plumose; an imaginary line on hind femur between proximal posterior margin to posterodistal angle separates posterior third of hind tibia; posterodistal end of hind femur gently curved, with no apparent angle, and with posterodistal pubescent tuft on this curvature.

Male. Similar to *H. gribodoi*, except gonostylus long (Fig. 37).

Distribution and host plant (Fig 41)

This species occurs throughout tropical Africa. Nests have been found in *Ficus umbellatus* (Pooley & Michener 1969).

Material examined

Type material. *Trigona ruspolii*, 2 worker syntypes: 've6 ii, E Ruspoli 1892–92, Type, *Trigona ruspolii* Magr. Male 1909 Friese det.', 'Daua, E Ruspoli 1892–92, Type, *Trigona ruspolii* Magr. Male 1909 H Friese', MHUB.

Trigona magretti, worker syntype: 'Accra Africa, *Trigona magretti* 1900 Friese det., Type', MHUB.

Melipona bouyssoui, worker lectotype and 3 worker paralectotypes: 'Bouyssou Mouny pr.98, Museum Paris Coll. J Vachal 1911', MNHN.

Additional material. Sudan: Khartoum, i.iv.1912, H H King (1 worker NHML). Ethiopia: Gambeila, ii.1948, K M Guichard. São Tome: Santa Isabela, 1904 (1 worker NHML). Senegal: Velingara, 15.v.1983, J W Everts (2 workers UMAN). Cameroon: Tsad See, Kontodea, 17.iii.1909, S G Riggerbach (21 workers MHUB). Gabon: Ogooué-Maritime, Rabi, 24.ix.1994, 40 m, J J Wieringa (2 workers MANU). Nigeria: Lagos, 1898, H Strachan (1 worker MHUB). Democratic Republic of Congo: Barumbu, 3.xi.1913, Bequaert (1 worker MRAC); Katanga, Kafungwi, 17.v.1924, C Seydel (1 worker

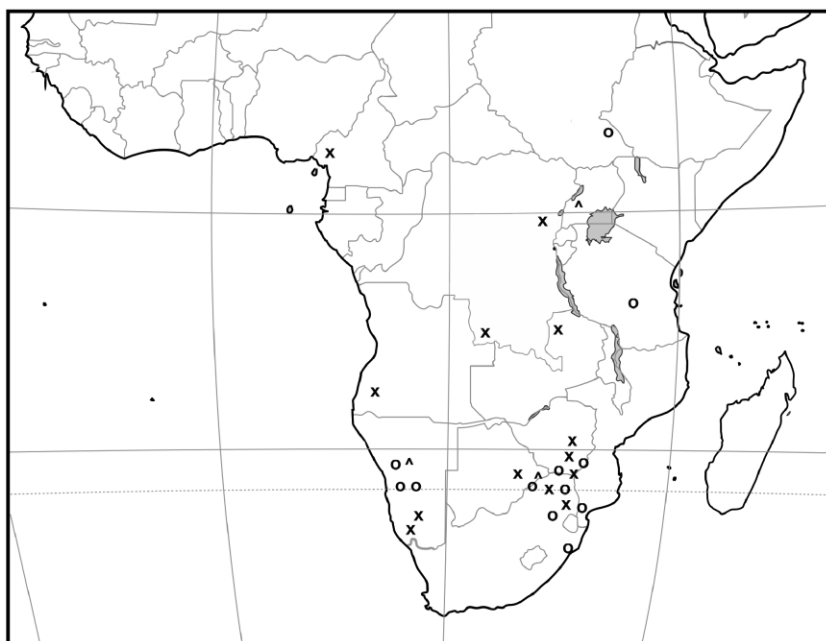


Fig. 43. Sub-Saharan Africa. Distribution of *Liotrigona bottegoi* (o) and *L. parvula* (x).

MRAC); Uele, Kulu, 1928, Vandenbranden (1 worker MRAC). Tanzania: Liwale, 1953, 615 m (1 worker NHML); Zanzibar, near Masi Moja, 20.viii–11.ix.1924, H J Snell (1 worker NHML). Angola: Dande, vii.1960, V de P Araujo (1 worker TMSA). Zimbabwe: Lundi River, 2–5.iii.1964, Vari, Van Son (3 workers TMSA). South Africa: Pafuri, 25–29.i.1984, C Eardley (11 workers SANC); near Mashipenge, 26.i.1984, C Eardley (2 workers SANC); Loskop Dam Nature Reserve, 12–13.xii.1985, C Eardley (14 workers SANC); Ellisras, 7.x.1961, H Empey (4 workers SANC); Wylliespoort,

31.i.1984, C Eardley (7 workers SANC); Komati-poort, 3.vi.1969, N W Strydom (2 workers SANC).

Hypotrigona penna sp.n., Figs 42, 45

Diagnosis

Worker. Mandible and labrum, legs and metasoma black to orangish-yellow; posterior margins of hind tibia and basitarsus often yellow; scutum dull to slightly shiny in and between punctures; vestiture on vertex and scutum very strongly

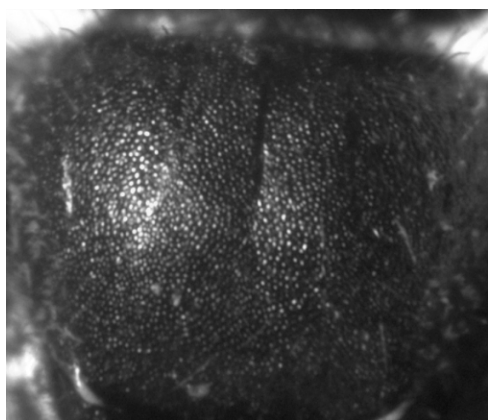


Fig. 44. *Hypotrigona ruspolii*, worker scutum, dorsal view.

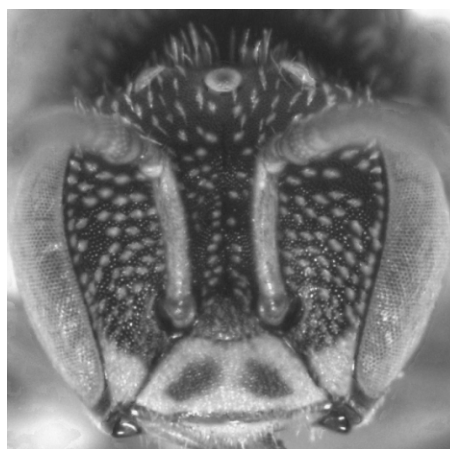


Fig. 45. *Hypotrigona penna*, worker face.

Table 4. Diagnostic characters of the African species of *Liotrigona*.

Character	<i>L. bottegoi</i>	<i>L. parvula</i>
Scutum, punctation	Moderately dense	Sparse
Scutum, sculpture	Reticulate	Glabrous
Hind tibia, posterodistal spine	Distal end weakly S-shaped	Distal end strongly S-shaped
Metosoma	Usually blackish	Often yellowish
Hind tibia and tarsus	Usually blackish	Usually yellowish

plumose, appearing as conspicuous tufts of hair (Fig. 45); natoulus inconspicuous, an imaginary line, on hind femur, from proximal posterior margin to posterodistal angle separates posterior half of hind tibia; posterodistal end of hind femur with a distinct angle, and posterodistal dense tuft of hair encompassing angular area.

Male. Unknown.

Distribution (Fig. 42)

This species is confined to West Africa.

Etymology

The name describes the plumose vestiture on the vertex and scutum.

Material examined

Type material (8 workers). Mali: Mourdiah, 25–31.viii.1986, M Matthews (holotype and 1 paratype, NHML). Niger: Niamey, 1.i.1978, G Popov (1 paratype NHML); Senegal: Velingara, 15.vi.1983, J W Everts (5 paratypes NHML).

Hypotrigona pothieri nomen nudum

Hypotrigona pothieri nomen nudum: Lobreau-Callen et. al. 1990: 69–83, 1994: 134.

Liotrigona Moure

Liotrigona Moure, 1961: 184, 189, 218, 223–225. Type species *Trigona bottegoi* Magretti, by original designation. Michener 2000: 70, 780, 783, 785, 790, 792–793.

There are two sub-Saharan species of *Liotrigona*. As with *Hypotrigona* there are possibly sibling species that cannot be easily recognised by morphology alone. Material is being collected for molecular analysis. *Hypotrigona* resembles *Liotrigona* most closely because they are very small. The differences between these two were well described by Moure (1961) and a diagnosis is provided in Table 4.

Diagnosis

Worker. Lengths: Head 0.8–0.9 mm; scutum

0.5–0.6 mm; forewing 1.4–1.9 mm; body 2.1–4.2 mm. Colour: integument black with reddish mandible, antenna and distal tarsal segments. Vestiture white and very sparse; mainly on lower region of face, mesopleuron, scutellum and legs. Scutum sparsely punctate, with punctures much more than a puncture diameter apart. Frons not elongate (clypeus length about one-quarter face length, and one-half clypeus width, Fig. 10); mandible with one broad tooth, and distal margin slightly undulated on inner half; scutellum extended a little backwards, not obscuring meta-notum when viewed from above; propodeum strongly curved, subhorizontal region a little shorter than subvertical region; hind tibia with posterodistal corner angulate; corbicula poorly defined, occupying little more than distal half of hind tibia; surface glabrous.

Male. Similar to worker, except mandible smaller; hind tibia without a corbicula and narrow; S8 wide and pointed posteriomedially (Fig. 39) and gonocoxite long and narrow (Fig. 40).

Liotrigona bottegoi (Magretti), Figs 38–40, 43

Trigona bottegoi Magretti, 1895: 156 (worker lectotype, MCSN); Friese 1909a: 444, 455–456; 1915: 276; 1921: 1101; Strand 1912a: 144; Cockerell 1919: 210; 1935: 1; 1936: 554; Darchen 1971a: 406

Trigona (Hypotrigona) bottegoi Magretti: Cockerell 1934a: 55, 62.

Trigona bottogoi [!] Magretti: Pooley & Michener 1969: 423.

Trigona (Liotrigona) bottegoi Magretti: Medler 1980: 483.

Liotrigona bottegoi (Magretti): Moure 1961: 223–225; Michener 1990: 132.

The type material of *L. bottegoi* was collected in Ethiopia and has been studied.

Diagnosis

Worker. Scutum moderately punctate, with reticulate sculpture, and simultaneously shiny; posterodistal end of hind tibia not S-shaped when tilted with distal end furthest from eye.

Male. Similar to worker except for sex-limited character, S8 and genitalia as in Figs 39,40.

Distribution and host plants (Fig. 43)

This species appears to only occur in West, Central, East and southern Africa. It was collected on flowers of *Annona muricata*, *Azela africana*, *Allophyllus africanus*, *Borassus aethiopicum*, *Bridelia ferruginea*, *Caesalpinia pulcherrima*, *Carica papaya*, *Cassia javanica*, *Cassia siamea*, *Citrus aurantium*, *Crossopteryx febrifuga*, *Cussonia barteri*, *Entada mannii*, *Eucalyptus* sp., *Euphorbia* sp., *Ixora* sp., *Luffa* sp., *Lippia* sp., *Mangifera indica*, *Psidium guajava*, *Piliostigma thonningii*, *Paullinea pinnata*, *Terminalia glaucescens* and *Zea mays*.

Material examined

Type material. Lectotype: 'Coll. P Magretti Arussi Galla V. Bottego, *Trigona bottegoi* Magrt., Typus', MCSN.

Additional material. Chad: Boum Kabie, Moya Chari, 6.iv.1966, J C Hitchcock (1 worker NHML). Uganda: W Buganda, Kawanda Research Station, 6.iii.1970, C N McNutt (1 worker NHML). Tanzania: Iringa, 4.viii.1971, H Feijen (2 workers UMAN); Liwale, 1953, (1 worker 1♂ NHML). Malawi: Mponela, 8.viii.1949, M H Breese (1 worker UMAN). Mozambique: Inhaca Island, G H Walker (4 workers SANC). Zimbabwe: Lundi, 3–5.iii.1964, Van Son, Vari (2 workers TMSA). South Africa: Altydroog farm, 8.iii.1990, C Eardley (5 workers SANC); Loskop Dam Nature Reserve, 12–13.xii.1985, C Eardley (5 workers SANC); Ryfontein farm, near Tzaneen, 20–23.vii.1992, C Eardley, M Stiller (11 workers SANC); Mogol Nature Reserve, 27–29.ii.1984, C Eardley (82 workers 2♂ SANC); 14–29 km W Alldays, 14.iii.1990, C Eardley (9 workers SANC); Eshowe, v.1943, G D Riquebourg (3 workers SANC). Namibia: Okahandja, 19–29.iii.1928, R E Turner (1 worker 2♂ NHML); Vredokoppies, Etosha Nature Park, J Irish, E Marais (15 workers SANC); Ameib Game Reserve, 22.ii.1988, G D Butler (5 workers SANC); Kuiseb River Pass, 22.iii.1983, C Eardley (5 workers SANC).

***Liotrigona parvula* Darchen Fig. 43**

Liotrigona parvula Darchen, 1971a: 403–406 (worker holotype, NHML).

Trigona parvula (Darchen): Lobreau-Callen et al. 1994: 134–143.

Diagnosis

Worker. Similar to *L. bottegoi* except as follows: scutum very sparsely punctate and smooth and shiny; posterodistal end of hind femur strongly

S-shaped when tilted with distal end furthest from eye.

Male. Similar to worker except sex-linked characters, which resemble that of *L. bottegoi*.

Distribution and host plants (Fig. 43)

This species occurs in West, Central and southern Africa. Collected on flowers of *Andropogon* spp., *Annona senegalensis*, *Antidesma membranaceae*, *Borassus aethiopicum*, *Bridelia ferruginea*, *Cochlospermum planchonii*, *Combretum* sp., *Crossopteryx febrifuga*, *Crossopteryx* sp., *Cussonia barteri*, *Dalbergiella welwitschii*, *Dracaena perrotteti*, *Elaeis guineense*, *Entada mannii*, *Hyparrhenia* spp., *Imperata cylindrica*, *Lippia* sp., *Loudetia simplex*, *Panicum phragmitoides*, *Phoenix reclinata*, *Piliostigma thonningii*, *Terminalia glaucescens* and *Vitex doniana*.

Material examined

Type material. *Trigona parvula*, worker paratype: 'Lamto C d Ivoire, R J Darchen Col. 14/11/62 Det.', NHML. Bruco, 26.ii–2.iii.1972 (worker paratype NHML).

Additional material. Liberia: Vdinjama, vii.1959, D L Lewis (5♂ NHML). Cameroon: Victoria, 6.i.1932, M Steele (1 worker NHML). Democratic Republic of Congo: Elizabethville, 11.ix.1931, J Ogilvie (1♂, NHML); Rwindi, 1000 m, 20–24.xi.1934, G F de Witte (1♂, MRAC). Zambia: Luwumbu Valley, Upper Luangwa, 770–1080 m, S A Neave (1 worker NHML). Zimbabwe: Makumbi Mission, iv.1975, A Watsham (1 worker NHML); Lundi, 13–16.iii.1964, Vari, Van Son (21 workers TMSA). Botswana: Swaneng Hill, 9.vii.1984, P Forchammer (16 workers SANC). South Africa: Messina Nature Reserve, 7.iii.1990, C Eardley (9 workers SANC); Blyderivierspoort Dam, Nature Reserve, 25–26.x.1984, C Eardley (25 workers SANC); D'Nyala Nature Reserve, 8–12.xii.1989, C Eardley (8 workers SANC); Langjan Nature Reserve, 10–20.i.1980, C Eardley (3 workers SANC); Skukuza, 19.i.1984, C Eardley (1 worker SANC). Namibia: near Orange River, x.1974, R Watmough (8 workers SANC); Windhoek, 14.xii.1933, J Ogilvie (1 worker NHML).

Species of uncertain identity***Trigona armata* Magretti**

Trigona armata Magretti, 1895: 153, 154–156 (male holotype, MCSN); Friese 1909a: 444, 447; Strand 1912a: 144; Friese 1915: 276.

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Appendix 1

Host plant families and genera (familial placement of genera mostly from <http://www.ecoport.org>)

Acanthaceae: <i>Asystasia</i>	<i>Piliostigma</i> , <i>Pseudocadia</i> , <i>Tephrosia</i> , <i>Tetraberlinia</i>
Amaranthaceae: <i>Amaranthus</i> , <i>Celosia</i> , <i>Pancratium</i>	Lamiaceae: <i>Ocimum</i> , <i>Solenostemon</i>
Anacardiaceae: <i>Heeria</i> , <i>Mangifera</i> , <i>Spondias</i>	Liliaceae: <i>Crinum</i> , <i>Dracaena</i> , <i>Hymenocallis</i> , day lilies
Annonaceae: <i>Annona</i>	Loranthaceae: <i>Loranthus</i>
Araliaceae: <i>Cussonia</i>	Lythraceae: <i>Lagerstroemia</i>
Arecaceae: <i>Borassus</i> , <i>Elaeis</i> , <i>Cocos</i> , <i>Phoenix</i>	Malvaceae: <i>Hibiscus</i> , <i>Sida</i> , <i>Urena</i>
Asteraceae: <i>Ageratum</i> , <i>Aspilia</i> , <i>Elephantopus</i> , <i>Emilia</i> , <i>Mikania</i> , <i>Vernonia</i>	Moraceae: <i>Artocarpus</i> , <i>Ficus</i> , <i>Pachyra</i>
Bixaceae: <i>Cochlospermum</i>	Myrtaceae: <i>Eucalyptus</i> , <i>Psidium</i>
Brassicaceae: <i>Brassica</i>	Nyctaginaceae: <i>Boerhavia</i>
Burseraceae: <i>Dacryodes</i>	Orchidaceae: <i>Duparquetia</i>
Caricaceae: <i>Carica</i>	Oxalidaceae: <i>Averrhoa</i>
Clusiaceae: <i>Vismia</i>	Passifloraceae: <i>Passiflora</i>
Combretaceae: <i>Combretum</i> , <i>Terminalia</i>	Pedaliaceae: <i>Sesamum</i>
Commelinaceae: <i>Commelina</i>	Poaceae: <i>Andropogon</i> , <i>Digitaria</i> , <i>Hyparrhenia</i> , <i>Imperata</i> , <i>Loudetia</i> , <i>Oryza</i> , <i>Panicum</i> , <i>Paspalum</i> , <i>Zea</i>
Convolvulaceae: <i>Ipomea</i>	Polygonaceae: <i>Antigonon</i> , <i>Polygonum</i>
Cucurbitaceae: <i>Cogniauxia</i> , <i>Luffa</i>	Portulacaceae: <i>Crotalaria</i> , <i>Talinum</i>
Cyperaceae: <i>Cyperus</i> , <i>Kyllinga</i>	Rhamnaceae: <i>Gouania</i>
Davalliaceae: <i>Oleander</i>	Rubiaceae: <i>Borreria</i> , <i>Coffea</i> , <i>Crossopteryx</i> , <i>Genipa</i> , <i>Ixora</i> , <i>Nauclea</i> , <i>Otomeria</i> , <i>Psychotria</i>
Dracaenaceae: <i>Sansevieria</i>	Rutaceae: <i>Citrus</i> , <i>Haronga</i>
Euphorbiaceae: <i>Acalypha</i> , <i>Antidesma</i> , <i>Bridelia</i> , <i>Dalbergiella</i> , <i>Dichostemma</i> , <i>Euphorbia</i> , <i>Jatropha</i> , <i>Manihot</i> , <i>Spirostachys</i>	Sapindaceae: <i>Allophyllus</i> , <i>Paullinea</i>
Fabaceae: <i>Acacia</i> , <i>Afzelia</i> , <i>Caesalpinia</i> , <i>Cajanus</i> , <i>Cassia</i> , <i>Crudia</i> , <i>Dialium</i> , <i>Entada</i> , <i>Indigofera</i> , <i>Leptoderris</i> , <i>Leucaena</i> , <i>Milletia</i> , <i>Mimosa</i> , <i>Monopetalanthus</i> ,	Tiliaceae: <i>Triumfetta</i>
	Verbenaceae: <i>Clerodendrum</i> , <i>Lippia</i> , <i>Stachytarpheta</i> , <i>Vitex</i>
	Vitaceae: <i>Cissus</i>

Gazetteer

Angola		Rei Buba	08.40 N 14.11 E
Bolongongo	08.28 S 15.15 E	Victoria	04.01 N 09.12 E
Bruco	15.07 S 13.11 E	Central African Republic	
Dande	06.06 S 15.06 E	Floris National Park	08.28 N 21.15 E
Dundo	09.48 S 14.41 E	Chad	
Luanda, 20 km SW	08.49 S 13.15 E	Boum Kabie, Moyen Chari	12.32 N 17.18 E
Salazar	09.18 S 14.55 E	Congo	
Botswana		Brazzaville	04.16 S 15.17 E
Gaborone	24.40 S 25.55 E	Democratic Republic of Congo	
Maun, 30 km N	19.45 S 23.14 E	Albert National Park	± 02.00 N 31.00 E
Serowe	22.23 S 26.43 E	Albertville	05.56 S 29.12 E
Stockpoort, 60 N	2327AC	Bambesa	03.28 N 25.43 E
Swaneng Hill	22.25 S 26.44 E	Bambili	03.39 N 26.07 E
Cameroon		Barumbu	01.14 N 23.31 E
Bibundi	04.13 N 08.59 E	Basoko	01.14 N 23.36 E
Bipindi	03.05 N 10.25 E	Bassin Lukuga	05.40 S 26.55 E
Duala	04.30 N 09.42 E	Bayenga, Wamba	03.55 S 20.19 E
Jaunde	03.52 N 11.31 E	Biano	10.13 S 26.04 E
Kontodea	± 13.00 N 14.20 E	Boende	00.44 S 19.12 E
Kumba	04.38 N 09.25 E	Bokuma	00.40 S 21.01 E
Lolodorf	03.14 N 10.44 E	Boma	04.29 S 14.03 E
Metet	03.00 N 12.01 E	Bombi, Butahu	03.13 N 18.44 E
Nkolbisson	04.00 N 12.00 E	Bumba	06.37 S 21.47 E
Nsop	06.22 N 10.52 E	Coquilhatville (= Mbandaka)	00.40 N 18.16 E

Costermansville	02.30 S 28.00 E	E Lastoursville	
Dele	01.32 N 30.16 E	Ogooui-Maritime, Rabi	01.53 S 09.50 E
Dika	02.11 N 21.38 E	Okondja	00.41 S 13.47 E
Dilolo	10.28 S 22.28 E	Pana, 9 km N Bona	01.41 S 12.39 E
Eala	00.04 N 18.17 E	Rabi	01.53 S 09.50 E
Elizabethville	11.40 S 27.28 E		
Flandria	00.20 S 20.00 E	Gambia	
Gandajika	06.45 S 23.57 E	Banjuls	13.28 N 16.39 W
Itimbiri	02.02 N 22.44 E	Fajara	13.28 N 16.42 W
Ituri	01.40 N 27.01 E		
Kakungwe	01.29 S 28.40 E	Ghana	
Kando	10.50 S 25.44 E	Accra	05.33 N 00.13 W
Kanonga	06.03 S 25.36 E	Achimota	05.37 N 00.14 W
Katanga	± 11.30 S 27.30 E	Dodowah	05.33 N 00.13 W
Kilo	01.48 N 30.14 E	Mampong	07.04 N 01.24 W
Kivu, Ruabungu	02.30 S 28.00 E	Guinea	09.31 N 13.43 W
Komi	03.29 S 23.19 E		
Kulu	03.28 N 23.39 E	Ivory Coast	
Lemba	05.12 S 15.34 E	Adiopodoume	05.20 N 04.07 W
Lufira, Mt Sombwe	08.16 S 26.27 E	Amanikro	07.41 N 04.21 W
Mwene Ditu	10.42 S 23.19 E	Daloa	06.53 N 06.27 W
Ngesho	01.17 S 29.07 E		
Paulis	02.46 N 27.37 E	Kenya	
Pelenge	02.46 S 22.37 E	Ikutha	02.04 S 38.11 E
Rumangabo	01.20 S 29.21 E	Kakamega Forest	00.17 N 34.45 E
Rutshuru	01.11 S 29.26 E	Kibwezi	02.25 S 37.58 E
Ruwensori, N W Beni	00.23 N 27.00 E	Mombasa/Mombasa Diani	04.30 S 39.40 E
Ruwenzori, Kalonga	09.10 S 27.25 E	Mount Elgon	01.07 N 34.44 E
Ruwenzori, Mount	02.33 N 22.09 E	Mpala	00.15 N 36.53 E
Rwindi	00.38 S 29.22 E	Nairobi, Karura Forest	01.17 S 36.49 E
Sankuru	04.17 S 20.25 E	Rabai	03.58 S 39.37 E
Sapwe	10.57 S 28.10 E	Taita (Voi)	03.23 S 38.34 E
Stanleyville	25.10 E 00.30 N		
Thysville	05.15 S 14.52 E	Liberia	
Tshibinda	05.52 S 21.20 E	Maylatwelli, Mt Coffee, Vdinjama	08.00 N 12.00 W
Tshuapa, Ikela	00.46 S 21.53 E		
Tshuapa, Mbele	04.12 N 19.43 E	Malawi	
Uele, Nepoko	01.40 N 27.01 E	Mponela	13.31 S 33.43 E
Wamba	00.16 N 21.54 E	Ntchisi Forest	13.22 S 34.00 E
Wombali	03.16 S 17.20 E	Salima, Fish Eagle Inn	13.47 S 34.26 E
Yakoma	04.05 N 22.27 E	Vipiya	11.30 S 33.30 E
Yangambi	00.47 N 24.28 E	Wiedhafen	10.28 S 34.35 E
		Zomba	15.23 S 35.20 E
Equatorial Guinea		Mali	
Bata	01.52 N 09.46 E	Mourdiah	14.28 N 07.28 W
Benito	01.35 N 09.37 E		
Makome	± 01.30 N 10.30 E	Mozambique	
Nkolentangen	± 09.30 N 10.30 E	Inhaca Island	26.01 S 32.58 E
Uelleburg	01.52 N 09.46 E	Maputo	25.58 S 32.34 E
Eritrea	15.20 N 38.56 E	Upper Buzi River	19.53 S 34.36 E
Ethiopia		Namibia	
Arussi Galla	07.30 N 39.30 E	Ameib Game Reserve	21.45 S 15.38 E
Djem-Djem Forestcirca 8000 ft	± 06.00 N 40.00 E	Kuiseb River Pass	23.17 S 15.46 E
Gambeila	08.18 N 34.37 E	Namutoni	18.48 S 16.58 E
		Okahandja	21.59 S 16.52 E
Gabon		Orange River near	28.17 S 16.55 E
Franceville, La Lope Reserve, 60 km S	01.38 S 13.35 E	Otjikoto, 20 km W Tsumeb	20.00 S 17.05 E
Gamba, Ogoue Maritime, 25 m	02.42 S 10.01 E	Rundu, 50 km W	18.25 S 19.30 E
Kougouleu	00.22 N 09.55 E	Vredekoppies, Etosha National Park	19.20 S 16.54 E
Medouneu	00.57 N 10.47 E	Windhoek	22.34 S 17.06 E
Ngounie, Dyanga 9 km E	00.37 S 10.18 E		
Ntoun	00.49 N 10.29 E	Niger	
Ogooue-Lolo, 30 km	00.42 S 12.59 E	Niamey	13.40 N 01.47 E

Nigeria

Fashola	07.54 N 03.47 E
Dekina	07.42 N 07.01 E
Ibadan (IITA)	07.23 N 03.54 E
Ile-Ife	07.28 N 04.34 E
Lagos	06.27 N 03.23 E
Lokoja	07.48 N 06.44 E
Oshogbo	07.46 N 04.34 E
Yola	11.40 N 07.59 E
Zaria	11.40 N 07.42 E

Rwanda

Astrida, Bukavu	02.36 S 29.44 E
Gabiro	02.25 S 29.02 E
Kigali	01.57 S 30.03 E
Lundu	05.16 S 12.49 E
Lusinga	20.19 S 30.30 E
Nyanza, Kinazi	02.30 S 29.30 E
Tshibinda	07.15 S 20.54 E

São Tome

Principe Island	01.39 N 07.25 E
Santa Isabel	03.30 N 08.45 E

Senegal

Louga	15.37 N 16.13 W
Velingara	15.35 N 16.15 W

Sierra Leone

Kamakwie	09.30 N 12.14 W
Njala	18.00 N 10.50 W

South Africa

Alldays, 14–19 km W	22.44 S 28.57 E
Altydroog Farm, near Beit Bridge	22.11 S 29.53 E
Ben Alberts Nature Reserve	24.37 S 27.23 E
Blyderivierspoortdam Nature Reserve	24.32 S 30.47 E
Boekenhoutskloof	25.31 S 28.29 E
Carpe Diem Farm, near Ofcalaco	24.06 S 30.24 E
D'Nyala Nature Reserve	23.45 S 27.49 E
Duiwelskloof	23.42 S 30.06 E
Ellisras	23.40 S 27.44 E
Eshowe	28.54 S 31.28 E
Ingwe Motel, Wylliespoort	22.58 S 29.56 E
Komatipoort	25.26 S 31.57 E
Langjan Nature Reserve	22.52 S 29.14 E
Lapalala	23.53 S 28.20 E
Loskop Dam Nature Reserve	25.25 S 29.20 E
Loskop Dam, O T K Reserve	25.27 S 29.24 E
Louis Trichardt	23.03 S 29.54 E
Mashipenge, near	22.35 S 31.01 E
Messina Nature Reserve	22.23 S 30.03 E
Modjadji Nature Reserve	23.38 S 30.20 E
Mogol Nature Reserve	23.58 S 27.45 E
Pafuri	22.26 S 31.12 E
Pienaarsrivier	25.12 S 28.17 E
Rooddeplaas, near Pretoria	25.36 S 28.21 E
Ryfontein Farm, 15 km SE Tzaneen	23.54 S 29.45 E
Sandrivierspoort	24.24 S 28.07 E
Shilouvane	24.06 S 30.24 E
Skukuza	24.59 S 31.55 E

Soutpan, near Pretoria	25.24 S 28.05 E
Wylliespoort	22.58 S 29.57 E

Sudan

Darfur	13.00 N 25.00 E
Khartoum	15.36 N 32.32 E

Tanzania

Amani	05.06 S 38.38 E
Amboni	05.03 S 39.03 E
Bomole	05.06 S 38.37 E
Dar-es-Salaam	05.15 S 38.50 E
Iringa	07.46 S 35.42 E
Kilimanjaro	03.04 S 37.22 E
Kilosa	06.50 S 36.59 E
Langenburg	± 09.00 S 34.10 E
Liwale	07.07 S 37.32 E
Marangu	03.17 S 37.31 E
Morongoro	06.49 S 37.40 E
Nzega	03.38 S 33.57 E
Pande	05.03 S 38.56 E
Ruanda	08.59 S 33.04 E
Sagala Swamp	05.13 S 31.06 E
Tanga	05.04 S 39.06 E
Usambara, East	04.25 S 38.10 E
Usambara, West	04.53 S 38.17 E
Zanzibar	06.10 S 39.11 E

Togo

Bismarckburg	08.11 N 00.41 E
Danalo	09.08 N 01.01 E
Kaode	09.06 N 01.20 E
Misahohe	06.57 N 00.35 E
Regundes Plateau, Mt Agou	09.01 N 00.50 E

Uganda

W Buganda, Kawanda Research Station	00.50 N 31.55 E
Bwamba, Hakitengya	00.44 N 30.03 E
Kampala	00.19 N 02.35 E
Lodwar	03.22 N 33.39 E
Masaka	00.20 S 31.44 E
Mormojr district, Moroto	02.32 N 34.39 E
Ruwenzori Range, Bundibugyo	00.42 N 30.04 E
Ruwenzori Range, Namwamba Valley	00.23 N 29.54 E
West Mengo, Entebbe	00.04 N 32.28 E

Zambia

Chipata	12.51 S 30.45 E
Luambe Camp, Luangwa Valley	09.38 S 29.32 E
Luwumbu Valley, Upper Luangwa	11.06 S 32.53 E
Mid-Luangwa Valley	09.38 S 29.32 E

Zimbabwe

Battery Spruit	18.56 S 32.31 E
Lundi River	21.18 S 32.24 E
Makumbi Mission	19.16 S 31.33 E
Matopo Hills	20.37 S 28.30 E
Rekomitjie Research Station	16.08 S 29.24 E
Victoria Falls	17.55 S 25.51 E