

Revision of the southern African genus *Frankenbergerius* Balthasar with description of new taxa (Coleoptera: Scarabaeidae: Scarabaeinae)

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Abstract

The southern African genus *Frankenbergerius* Balthasar is revised. Two new species, *F. opacus* sp. n. and *F. nitidus* sp. n. (South Africa, Western Cape), and one new subspecies, *F. armatus tuberculatus* ssp. n. (South Africa, Mpumalanga), are described. *F. imitativus* (Péringuey) is considered a junior synonym of *F. forcipatus* (Harold). A key to the species and notes on biology are given.

Keywords: *Coleoptera*, *Frankenbergerius*, *key to species*, *new species*, *new synonymy*, *Scarabaeidae*, *South Africa*

Introduction

Southern Africa has a rich Scarabaeinae fauna with many groups retaining ancient Gondwanaland affiliations and relict distribution on the subcontinent (Halffter and Matthews 1966; Cambefort 1991; Davis 1997). In the Scarabaeinae, two “old” Gondwanaland tribes are recognized, the Canthonini and the Dichotomiini (Cambefort 1991), however the latter is probably polyphyletic (Génier 1996; Montreuil 1998). The major deterrent to phylogenetic, biogeographic, ecological studies of the group is the lack of taxonomic data. While the African taxa of Canthonini are relatively well known (Howden and Scholtz 1987; Scholtz and Howden 1987a, 1987b; Davis et al. 1999), many of the nominal genera currently placed in the Dichotomiini are still in need of taxonomic treatment. One of these poorly known groups is the genus *Frankenbergerius* Balthasar which was long considered a junior synonym of *Coptorhina* Hope.

The generic name *Frankenbergerius* was proposed by Balthasar (1938, p 212) for one species, *F. mirabilis* Balthasar, described in the same paper from “Columbien, Chiriguana”. The genus was, however, inadequately described from apparently mislabelled material and one year later Paulian (1939, p 37) remarked that the description of *F. mirabilis* belongs to

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the African species *Coptorhina armata* (Boheman, 1857). Janssens (1939, p 31) followed Paulian and listed *Frankenbergerius* as a junior synonym of *Coptorhina*.

Ferreira (1954, p7) erected a new genus, *Pseudocoptorhina* (type species *C. armata* (Boheman)), to accommodate five species previously placed in *Coptorhina* and a new one, *P. gomesi*, which differ from other *Coptorhina* in having triangular metepisterna and a bifurcated spur on the anterior tibiae in males. In a later publication, Ferreira (1972, p 359) restored *Frankenbergerius* as a valid name since she recognized that *Frankenbergerius* and *Pseudocoptorhina* are based on the same type species and therefore the latter is a junior synonym of the former.

According to the original description the types of *F. mirabilis* were deposited in the author's collection, most of which is now housed in the National Museum of Natural History, Prague, although the older specimens may be deposited elsewhere (S. Bílý, personal communication). We were unable to trace the types. Since there is no evidence that *F. mirabilis* does occur in South America and because no statement in the original description of this species contradicts with characters of *C. armata*, we follow Paulian (1939) and Ferreira (1972) and consider *Frankenbergerius* a valid name for the taxon in question.

The genus differs from *Coptorhina* in a number of characters apart from those indicated by Ferreira (see below) and generic rank of this group is well supported. Both genera share a number of apomorphies with *Delopleurus* Erichson and *Sarophorus* Erichson; *Frankenbergerius* is a putative sister group to the clade *Coptorhina*+*Delopleurus*.

The genus currently comprises seven species. Two new species and one new subspecies are described below; *F. imitativus* (Péringuey) is placed in synonymy. Although the peculiar shape of the clypeus can readily distinguish some of the species, others are still poorly described and inadequately keyed. Most of the species have not been illustrated, nor have their aedeagi been described or figured.

Material and methods

Little material was available to past researchers because representatives of the genus were very rare in collections. However, currently large numbers of specimens of some species are available for study in South Africa, most of which were collected over the past few decades by the staff of the Transvaal Museum, Pretoria (TMSA), chiefly by means of pitfall trapping. Other institutions from which material was borrowed for this study are: Albany Museum, Grahamstown (AMSA), The Natural History Museum, London (BMNH), Durban Museum, Durban (DMSA), Institut Royal des Sciences Naturelles de Belgique, Brussels (IRSNB), Musée Royal de l'Afrique Centrale, Tervuren (MRAC), Muséum National d'Histoire Naturelle, Paris (MNHN), National Collection of Insects, Plant Protection Research Institute, Pretoria (SANC), National Museum, Bloemfontein (BMSA), Naturhistoriska Riksmuseet, Stockholm (NHRS), South African Museum, Cape Town (SAMC), and University of Pretoria Insect Collection, Pretoria (UPSA).

The distribution maps were generated with ArcView GIS 3.0 software (ESRI, Inc.). Coordinates were taken from the specimens' labels, if available, otherwise from the Alexandria Digital Gazetteer (<http://fat-albert.alexandria.ucsb.edu:8827/gazetteer/>).

Aedeagi were prepared according to the common technique used in entomological research and photographed in glycerol. Scanning electron micrographs were taken with a JEOL 840 electron microscope from uncoated specimens at low accelerating voltage (Figures 9, 10) and from the specimens coated with gold (Figures 25, 26). Outline figures are not to scale. Authors' comments are in square brackets.

Frankenbergerius Balthasar

Frankenbergerius Balthasar, 1938. Type species: *F. mirabilis* Balthasar 1938, p 212, by monotypy; Paulian 1939, p 37 (as synonym of *Coptorhina*); Janssens 1939, p 31 (as synonym of *Coptorhina*); Ferreira 1972, p 359.

Pseudocoptorhina Ferreira 1954, p 7; synonymy by Ferreira 1972, p 359.

Diagnosis

Males with less-developed clypeal processes and females of some species of *Frankenbergerius*, especially *F. barratti* (Waterhouse) with smooth elytra, are similar to species of *Coptorhina*. The two genera can immediately be distinguished, however, by the shape of the metepisternon. That of *Frankenbergerius* is triangular, widest in its anterior part, with slightly convex epipleural margin (Figure 1), while *Coptorhina*'s is somewhat rectangular, widest in its hind part, with secondary suture and very convex epipleural margin (Figure 2). Elytra of *Frankenbergerius* are not fused along sutural margins, as opposed to *Coptorhina*, and have complex sculpture in most species. The two genera differ strongly in secondary sexual characters. In *Coptorhina*, sexual dimorphism is very weak; males differ from females in having the last abdominal sternite slightly convex. In *Frankenbergerius*, sexes can easily be separated by the shape of the spur of the anterior tibiae, which is simple, acute in females and bifurcated in males. Males of some species also differ from females in having curious horn-like clypeal processes. However, the size of these horns, similar to other head processes in different groups of scarab beetles, is subject to much variation among individuals.

Description

Small to medium-sized beetles (length 4.5–16 mm, width 3.1–16 mm). Colour monotonous black to dark brown, sometimes anterior part of clypeus, legs or elytra slightly paler. Head and pronotum densely punctate and pubescent (except for *F. barratti*), in some species most of pronotum rugose. Each puncture, except for those of elytral striae, bears a short yellowish seta. Setae sometimes abraded on disc of pronotum and head.

Clypeus deeply sinuate in middle, angulate to dentate at sides in females and with more or less developed horns in males of most species. In some species anterior angles of clypeus with short carina directed proximally. Genae rectangular to rounded. Frontoclypeal suture interrupted on disc. Eyes small, the dorsal part slit-shaped, ventral part sub-rectangular. Distance between eye and gula approximately two times the width of eye in ventral view. Gula with longitudinal groove.

Pronotum more or less parallel-sided, wider than long. Anterior margin and base not bordered in most species; lateral margins bordered.

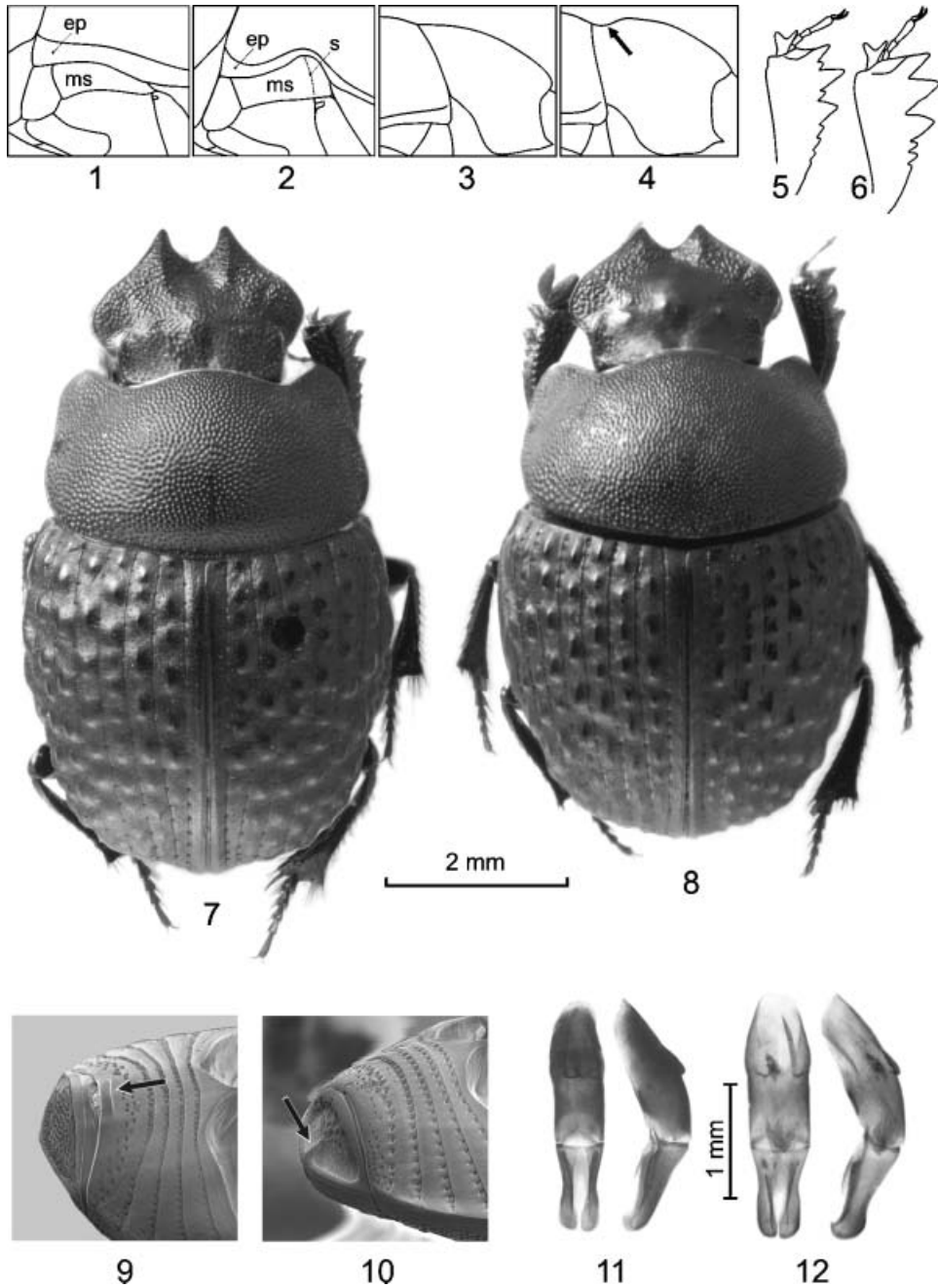
Elytra not fused, with humeral umbones, sinuate laterally near base. Elytral intervals flat to convex in apical part, with tubercles in most species. Scutellum not visible from above. Wings fully developed.

Anterior tibiae have three outer teeth with smaller intermediate teeth between (except for *F. nanus*, *F. opacus* sp. n., and *F. nitidus* sp. n.). Outer margins of middle and posterior tibiae without transverse keels, serrate.

Pygidium punctate on disc, bordered; with small longitudinal keel in *F. opacus* sp. n.

Parameres symmetrical, their apices strongly to feebly sclerotized, without setae. Armature of internal sac of aedeagus is similar in most species.

The immature stages are unknown.



Figures 1–12. *Frankenbergerius* spp. (1) *Frankenbergerius* sp. (2) *Coptorhina* sp. (3, 6, 8, 9, 11) *F. nanus*. (4, 7, 10, 12) *F. opacus* sp. n., holotype. (5) *F. gomesi*. (1, 2) Scheme of thoracic pleurites. ms, metepisternon; s, secondary suture; ep, epipleuron. (3, 4) Pronoptum in lateral view. (5, 6) Anterior tibia of ♂. (7, 8) Habitus of ♂; (9, 10) abdomen. (11, 12) aedeagus in dorsal and lateral view.

Diagnostic characters

The most important diagnostic character of *Frankenbergerius* species is the sculpture of the dorsal surface of the body and especially the elytra. The shape of the parameres is species-specific but in some individuals the character may be ambiguous. The shape of the clypeus in males is distinctive for some species (except for *F. nanus*, *F. opacus* sp. n., and *F. nitidus* sp. n.) in which clypeal processes are strongly developed.

Biology

Little is known of *Frankenbergerius* biology although inferences can be made from information recorded with museum specimens. The beetles have been collected most frequently in dense vegetation in association with litter and decomposing plant matter. Several records imply a close association with mushrooms. As opposed to *Coptorhina*, which has been studied in more detail and is known to be an obligatory basidial mushroom eater (Tribe 1976), *Frankenbergerius* presumably retained a more ancestral life style with no strict preference to mushrooms but rather to any rotten plant matter. The largest series of the beetles (*F. armatus*, 31 specimens) was collected in Silaka Forest Reserve (Eastern Cape Province) in rotten *Cussonia* fruit.

Frankenbergerius specimens have been collected by means of pitfall traps baited with different types of bait (banana, meat, and faeces) but this does not necessarily imply that the specimens were attracted to the baits. Very long trap exposures (up to 68 days) suggest that the beetles might be captured occasionally along with other litter dwellers. The only indication that *Frankenbergerius* specimens might be attracted to dung is one specimen of the rare species *F. nanus* collected near Darling (Western Cape Province) in a pitfall trap with fresh cattle dung which was exposed for 24 h. However, in some 15 months of trapping in the area (10 traps on three occasions per month), this was the only *Frankenbergerius* specimen recorded, so this was probably a chance trapping (A. Davis, personal communication). No specimens have been collected in dung pads, nor are there direct indications that specimens are attracted to carrion.

Mycetophagy has been hypothesized to be the ancestral feeding type of the Scarabaeinae, with a change to dung in most taxa evolving much later (Scholtz and Chown 1995). However, feeding on the higher fungi, the mushrooms, is more likely to be a later change from humus or dung to a more nutritious substance. In the lineage to which the genus *Frankenbergerius* belongs, the genera *Coptorhina* and *Delopleurus*, the obligatory mushroom eaters, represent the most derived taxa with the greatest number of apomorphies, while the genus *Sarophorus* Erichson, which feeds on dung, humus, and carrion, largely retained plesiomorphic character states (Frolov and Scholtz, 2003).

Nesting behaviour of *Frankenbergerius* has not been studied but it can be assumed that it is similar to related taxa. *Coptorhina* specimens have been observed feeding on mushrooms with two types of fruit-body. In the case of "puff-ball" mushrooms the adults burrow into the fruit-body, detach pieces and drag them into their burrows. In "parasol" mushrooms, the beetles climb the stalk and detach pieces of the gills, which they then drag into their burrows. Brood balls are constructed from the macerated pieces, eggs are laid and the balls coated with soil. Because males of some species of *Frankenbergerius* have long clypeal horns, they are probably unable to burrow into a fresh mushroom or detach pieces of it and probably do not take part in brood ball construction. Field observations are needed to clarify the genus' nesting behaviour.

Frankenbergerius specimens are apparently not attracted to light and are presumably day-fliers.

Key to *Frankenbergerius* species

- 1 Disc of pronotum densely punctate. Body smaller (4.5–10 mm) 2
- Disc of pronotum smooth. Body larger (8.5–16 mm) *F. barratti* (Waterhouse)

- 2 Anterior tibiae with smaller teeth between major outer teeth (Figure 5). Anterior margin of pronotum usually distinctly sinuate (very feebly or not sinuate in *F. gomesi*). Eastern Cape, KwaZulu-Natal, Mpumalanga, Northern provinces 3
- Anterior tibiae without distinct teeth between major outer teeth (Figure 6). Anterior margin of pronotum not sinuate. Western Cape Province. 5

- 3 Elytral interval 8 with long carina occupying more than basal half of elytron. Length 4.0–7.3 mm *F. gomesi* (Ferreira)
- Elytral interval 8 with a row of cariniform tubercles or with two carinae widely separated in the middle of elytron. 4

- 4 Elytral intervals 2–7 with smaller to indistinct tubercles (Figure 28). Apices of parameres widened in lateral view (Figure 37). Length 8.0–10.2 mm. *F. forcipatus* (Harold)
- Elytral intervals laterad of 1st or 2nd usually with distinct tubercles (Figures 21, 22). Apices of parameres not widened in lateral view (Figures 23, 24). Length 4.6–11.0 mm *F. armatus* (Boheman)

- 5 Pygidium without longitudinal carina in basal part. Disc of meso- and metasternum and dorsal surface of femora smooth to finely punctate. Base of pronotum not concave in lateral view (Figure 3) 6
- Pygidium with small longitudinal carina in basal part (Figure 10). Disc of meso- and metasternum and dorsal surface of femora densely punctate. Base of pronotum slightly concave in lateral view (Figure 4). Length 5.8–7.1 mm *F. opacus* sp. n.

- 6 Last abdominal sternite with transverse convexity near pygidium (Figure 9). Elytral intervals matt with shiny, elongated tubercles (Figure 8). Length 5.5–6.5 mm *F. nanus* (Péringuey)
- Last abdominal sternite flat. Elytral intervals shiny with round to elongated tubercles (Figure 13). Length 7.5 mm *F. nitidus* sp. n.

Frankenbergerius barratti (Waterhouse)

(Figures 29–32, 38, 43)

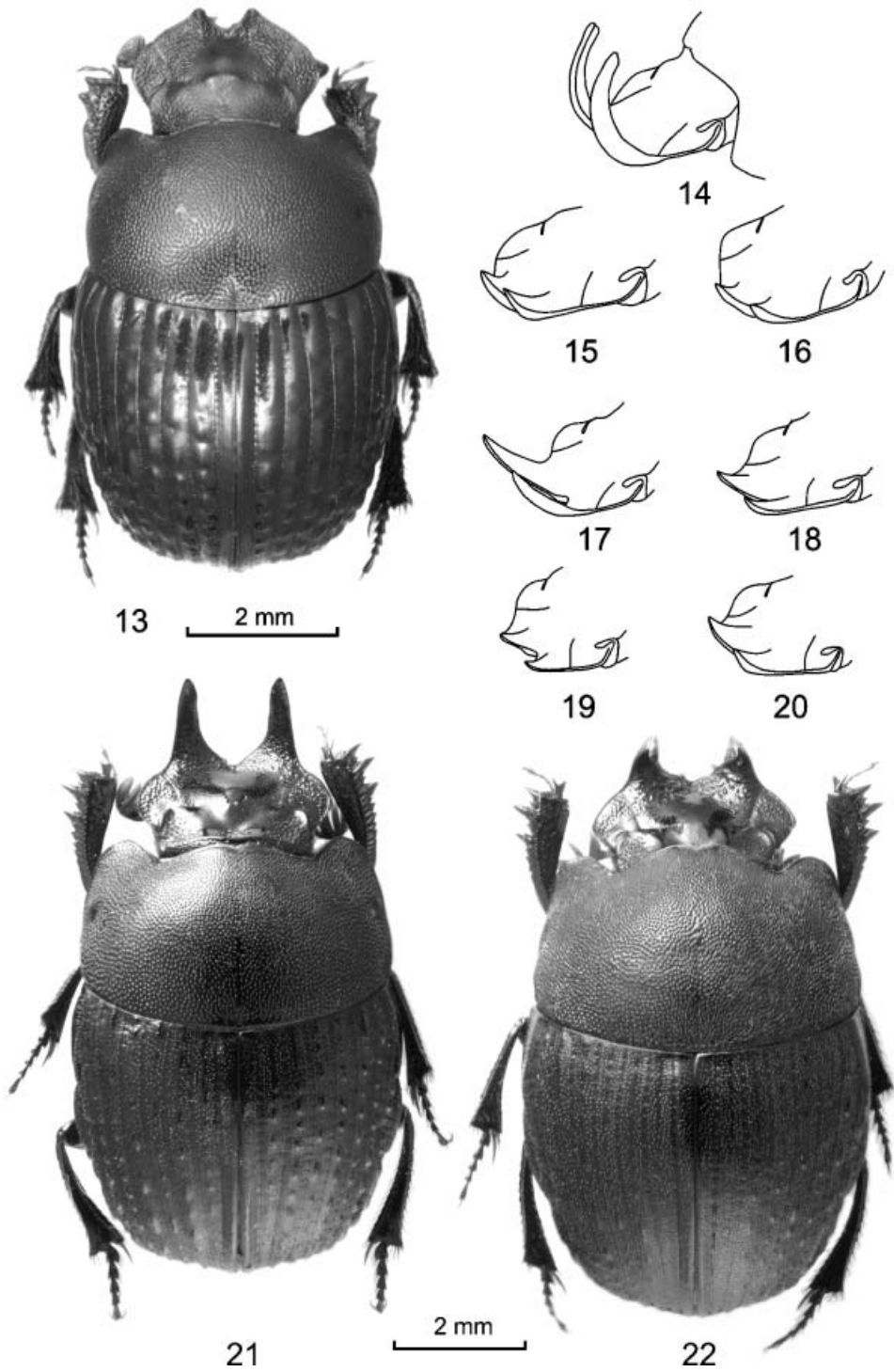
Coptorhina barratti Waterhouse 1876, p 22; Péringuey 1901, p 278, 293.

Pseudocoptorhina barratti (Waterhouse): Ferreira 1954, p 8.

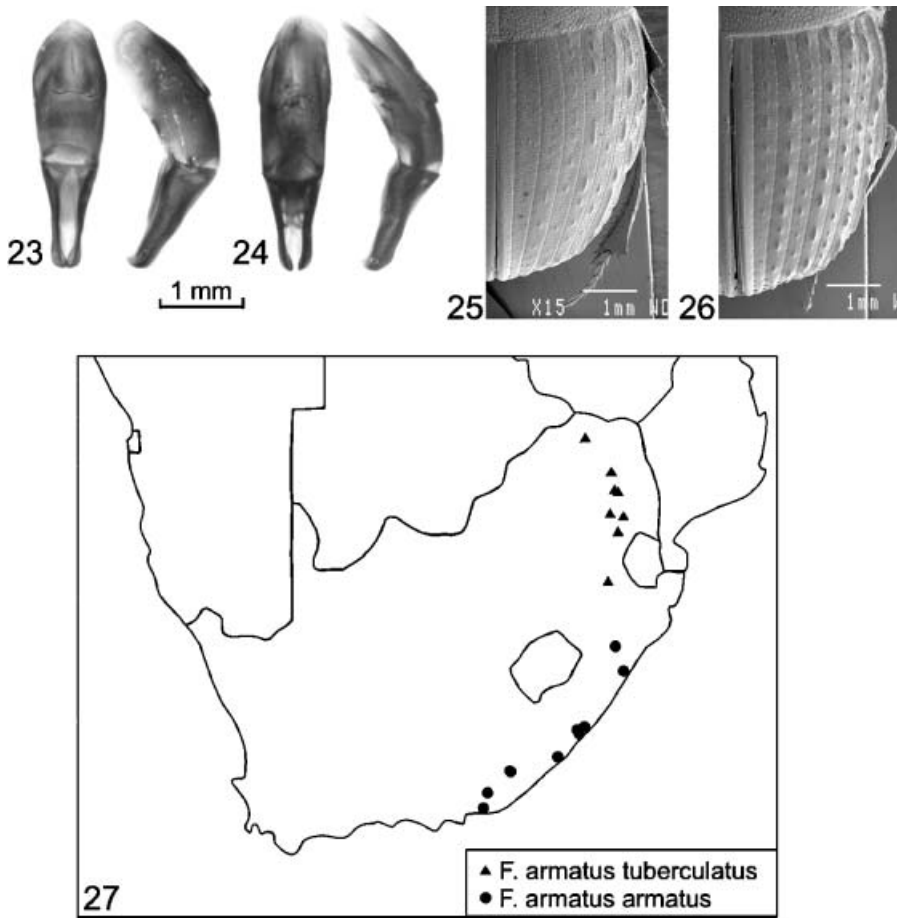
Frankenbergerius barratti (Waterhouse): Ferreira 1972, p 360, 363.

Diagnosis

This species can easily be separated by its large size (8.5–16 mm) and almost smooth upper side of body. Males usually have long and slender clypeal horns (Figure 30).



Figures 13–22. *Frankenbergerius* spp. (13) *F. nitidus* sp. n., holotype. (14–16, 22) *F. armatus armatus*. (17–21) *F. armatus tuberculatus* ssp. n. (13, 21, 22) Habitus (13, ♀; 21, 22 ♂; 21, holotype). (14–20) Head (14, 15, 17–19, ♂; 16, 20, ♀).



Figures 23–27. *Frankenbergerius armatus*. (23, 25) *F. armatus armatus*. (24, 26) *F. armatus tuberculatus* ssp. n. (23, 24) Aedeagus in dorsal and lateral view. (25, 26) Elytron. (27) Distribution map of *F. armatus*.

Description

Black, shiny beetle (Figure 29). Body length of males 8.5–16 mm, width 7.5–13 mm, of females 8.6–15 mm and 6.7–11 mm. Dorsal surface without visible setae.

Head. Clypeus of males with two long, acute horns curved upwards; horns 1–0.5 times the length of the head (Figures 30, 31). In females, clypeus with protruding anterior angles separated by deep sinuation (Figure 32). Genae right-angled, finely bordered. Genal sutures distinct. Lateral margin of clypeus distinctly sinuate near genal suture in males but without sinuation in females. Frontal suture obsolete. Head densely punctate except for disc which is smooth and slightly convex. Eyes small, almost completely divided by canthus, dorsal parts slit-shaped.

Pronotum. Pronotum with subparallel sides, two times wider than long. Anterior margin sinuate medially, anterior angles slightly sinuate laterally. Disc smooth, anterior and lateral parts densely punctate (puncture separated by one to two puncture diameters).

Elytra. Striae distinct, punctate (punctures separated by three to four puncture diameters). Intervals slightly convex, smooth, without tubercles.

Underside. Pygidium with deep border, its disc densely punctate. Abdominal and thoracic sternites coarsely punctate except for disc of metasternum.

Legs. Anterior tibiae with smaller teeth between major outer teeth in most specimens. Intermediate teeth can be obsolete in older individuals. Spur of anterior tibia bifurcated in males and simple, acute in females.

Aedeagus. Parameres with acute apices in lateral view (Figure 36).

Variability. Shape and length of clypeal processes in males vary (Figures 30, 31) otherwise variation among examined specimens is very slight. Females differ from males in not having bifurcated spur of anterior tibiae and in the shape of the clypeus (Figure 32).

Distribution

This rare species is known from a few localities in South Africa and Lesotho (Figure 43).

Type material examined

Holotype: ♂ with labels “Type”, “Transvaal”, and “Coptorhina Barratti, C. Waterh. Type” (BMNH).

Additional material examined

Mpumalanga: Uitsoek, Grootkloof Indigenous Forest, 25°15'S, 30°33'E, 15 December 1986, pitfall traps, 1♂, S. Endrödy-Younga leg. (TMSA); Road Barbeton to Bulembu near Swaziland border [25°55'S, 31°10'E], 20 January 2000, 1♀ (TMSA). Gauteng: Pretoria [25°45'S, 28°10'E], 1♀ (BMNH). KwaZulu-Natal: Durban [29°50'S, 31°01'E], 1♂ (BMNH); Farm Boschberg, 50 km N of Ladysmith 28°12'S, 29°48'E, 9–11 January 2001, A. Davis leg., 1♀ (UPSA). Lesotho: Maleata [not traced], March 1944, H. K. Munro leg., 3♂ and 1♀ (TMSA), 3♂ and 2♀ (BMNH). “Transvaal”, 1♂, (BMNH), 1♂ and 1♀ (IRSNB).

***Frankenbergerius gomesi* (Ferreira)**

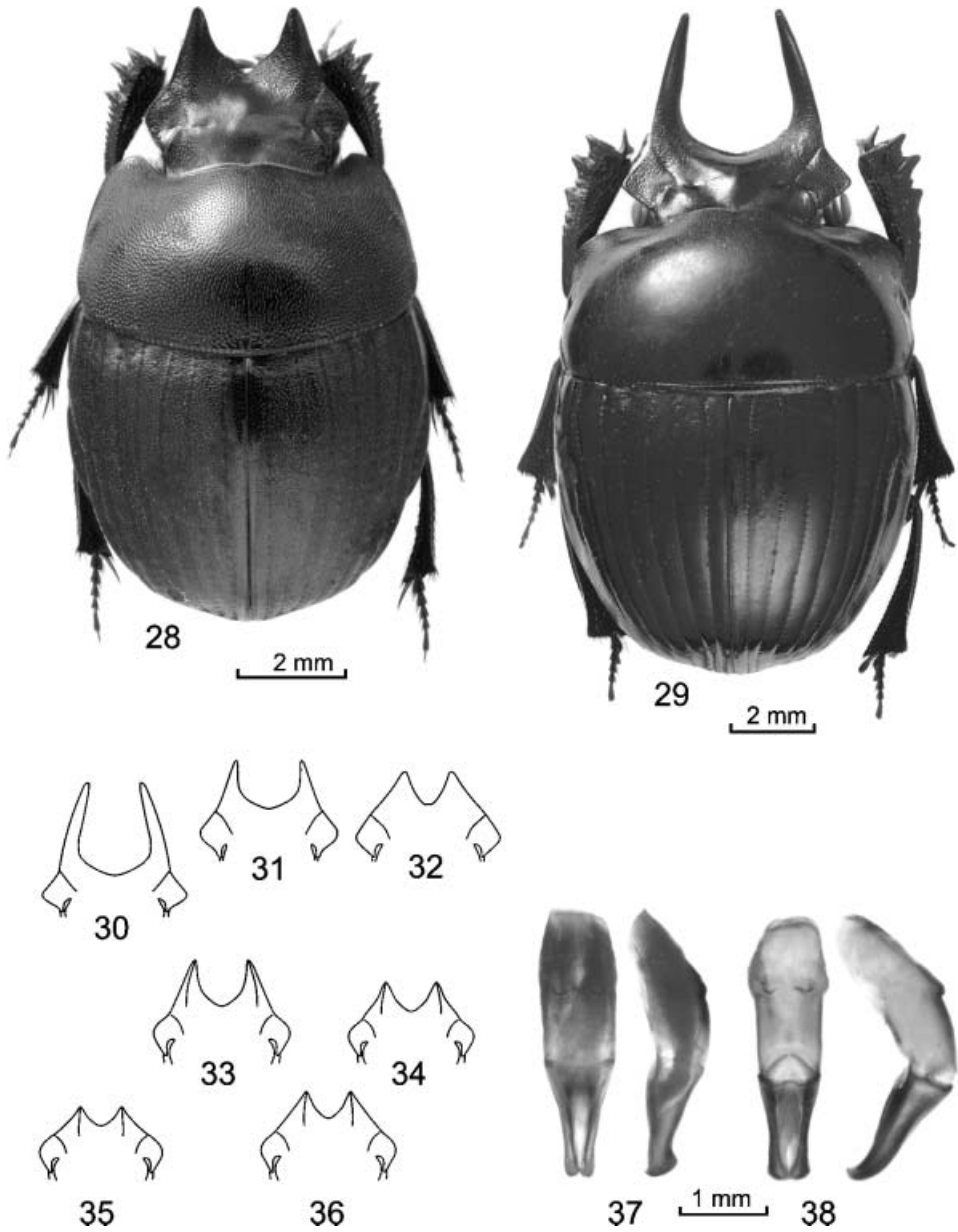
(Figures 39–43)

Pseudocoptorhina gomesi Ferreira 1954, p 10.

Frankenbergerius gomesi (Ferreira): Ferreira 1972, p 362.

Diagnosis

This species can be distinguished by elytral interval 8 with a long carina occupying two-thirds of the length of the elytron and by its small body size.

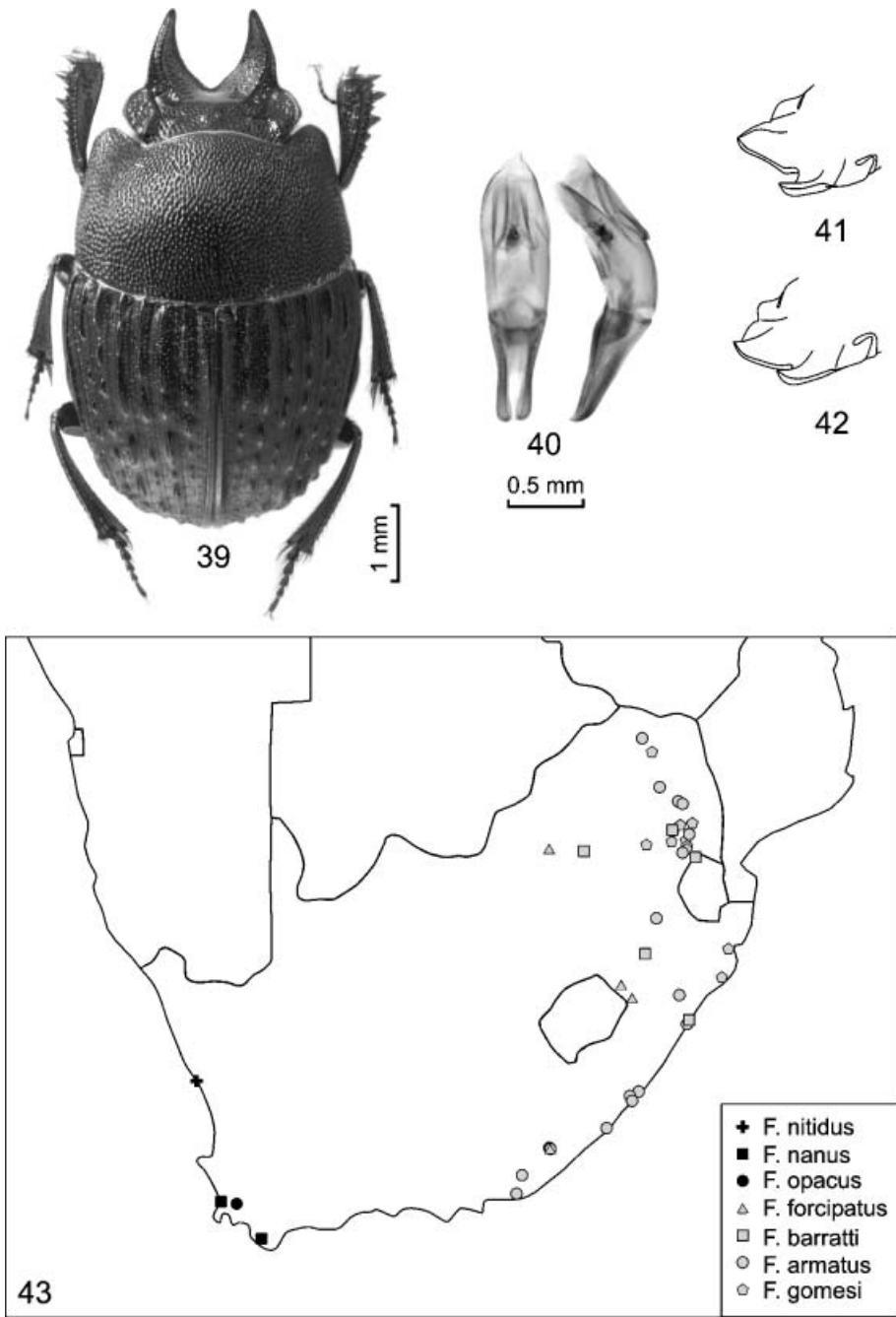


Figures 28–38. *Frankenbergerius* spp. (28, 33–37) *F. forcipatus*. (29–32, 38) *F. barratti*. (28, 29) Habitus of ♂. (30–36) Head (30, 31, 33–35, ♂; 32, 36, ♀). (37, 38) Aedeagus in dorsal and lateral view.

Description

Black to dark brown, shiny beetle (Figure 39). Body length of males 4.6–7.2 mm, width 2.5–3.2 mm, of females 4–7.3 mm and 2.4–3.9 mm. Dorsal surface with minute setae which may be abraded on most surfaces.

Head. Clypeus with two horn-like processes; processes slightly longer in males (Figures 41, 42). Genae obtuse, finely bordered. Genal sutures distinct. Lateral margin of clypeus with



Figures 39–43. *Frankenbergerius* spp. (39–42) *F. gomesi*. (39) Habitus of ♂. (40) Aedeagus in dorsal and lateral view. (41, 42) Head of ♂ and ♀, respectively. (43) Distribution map of *Frankenbergerius*.

deep sinuation near genal suture. Frontal suture obsolete medially. Dorsal surface of horn-like processes granular, rest of head densely punctate except for middle area of clypeus which is smooth. Eyes small, almost completely divided by canthus, their dorsal parts slit-shaped.

Pronotum. Pronotum narrower in anterior part, 1.6 times wider than long. Anterior margin not sinuate medially, or with minute unclear sinuation. Lateral margins and anterior angles finely bordered, anterior margin and base not bordered. Surface coarsely punctate with more or less elongated punctures.

Elytra. Striae distinct, punctate (punctures separated by three to four puncture diameters). Intervals indistinctly punctate on disc, with elongated tubercles. Interval 8 with long carina occupying two-thirds of elytron.

Underside. Pygidium with deep border, its disc densely punctate. Abdominal and thoracic sternites coarsely punctate except for disc of metasternum.

Legs. Anterior tibiae with smaller teeth between major outer teeth in most specimens. Spur of anterior tibia bifurcated in males and simple, acute in females.

Aedeagus. Parameres with angulate apices in lateral view (Figure 40).

Variability. Except for body size, the specimens examined show very little variation. Females differ from males in not having bifurcated spur of anterior tibiae and clypeus with somewhat shorter processes with smaller sinuation between (Figures 41, 42).

Distribution

This species is known from a number of localities in Limpopo, Mpumalanga, and KwaZulu-Natal provinces.

Type material examined

Holotype: ♂ with labels “Uitzicht, Zoutpansberg [Soutpansberg], Nov[ember] 1924, Heske [leg.]” and “Holotypus *Pseudocoptorhina gomesi* sp. n. M.C. Ferreira 1954” (TMSA).

Additional material examined

Mpumalanga: Nelspruit Nature Reserve, 25°29'S, 30°55'E, 18 December 1986, dry valley, pitfall traps, 53 days, 4♂ and 5♀; rivulent valley, pitfall traps, 4♂ and 2♀; litter, riverine bush, 2♂ and 1♀; Koppie, 2♂ and 3♀; 9 February 1987, dry valley, pitfall traps, 58 days, 13♂ and 24♀; rivulent valley, 3♂ and 1♀; 25 October 1986, rivulent valley, pitfall traps, 34 days, 1♂ and 3♀; dry valley, pitfall traps, 34 days, 4♂ and 1♀; 29 November 1986, dry valley, pitfall traps, 19 days, 5♂ and 7♀, S. Endrödy-Younga leg. (TMSA). 18 km S of Nelspruit, 25°37'S, 30°58'E, 10 February 1987, pitfall traps, 57 days, 2♂, S. Endrödy-Younga leg. (TMSA). 16 km N of Barbeton, 25°42'S, 30°57'E, 24 October 1986, pitfall traps, 31 days, 1♀; 30 November 1986, pitfall traps, 53 days, 1♀; pitfall traps, 57 days, 1♂ and 2♀, S. Endrödy-Younga leg. (TMSA). 17 km NNW of Barbeton, 25°36'S, 29°53'E, 10 November 1980, 1♂, S. Endrödy-Younga leg. (TMSA). Nelspruit, botanical garden, 25°31'S, 30°32'E, 24 January 1981, pitfall traps, 44 days, 8♂ and 8♀; 6 December 1980, pitfall traps, 45 days, 3♂ and 3♀, S. Endrödy-Younga leg. (TMSA). Nelspruit, January 1939, 1♀ (SAMC). Road between Sabie and Sudwala Caves [25°05'S, 30°40'E], 25 January 1996, fungi in eucalyptus forest next to road, 1♂, I. Pajor leg. (SANC). Hazyview,

25°04'S, 31°07'E, 27 January 1996, forest litter, 3♀ (TMSA). White River Distr., Farm Lichtfontein [25°19'S, 31°01'E], 28 December 1992, 2♂, R. Müller leg. (TMSA). KwaZulu-Natal: Hluhluwe Game Reserve, 28°05'S, 32°04'E, 18 January 1992, intercept trap, open biotope, 2♀; 20 January 1992, fungous trunk and litter, 1♂, S. Endrödy-Younga leg. (TMSA). Empangeni [28°45'S, 31°55'E], October 1976, 1♀; November 1976, 1♀; December 1976, 1♀, P. E. Reavel leg. (TMSA).

***Frankenbergerius forcipatus* (Harold)**

(Figures 28, 33–37)

Coptorhina forcipata Harold 1881, p 149; Péringuey 1908, p 627; Janssens 1939, p 32, 36.

Pseudocoptorhina forcipata (Harold): Ferreira 1954, p 9.

Frankenbergerius forcipatus (Harold): Ferreira 1972, p 360, 363.

Coptorhina imitativa Péringuey 1901, p 288; Janssens 1939, p 32, 36; Ferreira 1954, p 10 (as *Pseudocoptorhina*); Ferreira 1972, p 362, 363 (as *Frankenbergerius*); **syn. n.**

Diagnosis

This species is similar to *F. armatus* but can be separated from it by having elytral intervals 1–4 smooth or with only traces of tubercles. It also differs in the shape of the parameres (Figure 37).

Description

Black to dark brown, shiny beetle (Figure 28). Body length of males 8.1–10.2 mm, width 5.5–6.1 mm, of females 8–9.5 mm and 5.4–6 mm. Dorsal surface with fine setae.

Head. Clypeus with two horn-like processes; processes sometimes longer in males (Figures 33–36). Genae obtuse, finely bordered. Genal sutures distinct. Lateral margin of clypeus slightly sinuate near genal suture or without sinuation. Frontal suture obsolete medially. Dorsal surface of horn-like processes granular, other part of head densely punctate except for middle area of clypeus which is smooth. Eyes small, almost completely divided by canthus, their dorsal parts slit-shaped.

Pronotum. Pronotum narrower in anterior part, 1.8 times wider than length. Anterior margin not sinuate medially, or with minute unclear sinuation. Lateral margins and anterior angles finely bordered, anterior margin and base not bordered. Punctures separated by a puncture diameter on disc, becoming denser and somewhat elongated laterally.

Elytra. Striae distinct, punctate (punctures separated by three to four puncture diameters). Intervals 1 and 2 without tubercles; intervals 3–7 with small tubercles; interval 8 with long keel interrupted at middle of elytron; interval 9 with smaller keel situated in the middle of elytron.

Underside. Pygidium with deep border, its disc densely punctate. Abdominal and thoracic sternites coarsely punctate except for disc of meso- and metasternum.

Legs. Anterior tibiae with smaller teeth between major outer teeth in most specimens. Spur of anterior tibia bifurcated in males and simple, acute in females.

Aedeagus. Parameres with widened apices in lateral view (Figure 37).

Variability. Except for body size there is some variation in the length of the clypeal processes in males (Figures 33–35). Females can be separated by acute, not bifurcated spur of anterior tibiae and in most cases by shorter clypeal processes (Figure 36).

Distribution

This species is known from a few distant localities in Magaliesberg (Northwest Province), southern Drakensberg and Ciskei (Eastern Cape Province) (Figure 43).

Type material examined

F. forcipatus: holotype ♂ with labels “Cap.” and “forcipata type Harold” (MNHN). *F. imitativus*: holotype ♂ with labels “Coptorhina imitativa type [18]97” and “474” (SAMC).

Additional material examined

Northwest Province: Rustenburg [25°40'S, 27°15'E], 14 January 1895, 1♀ (SANC). KwaZulu-Natal Province: Drakensberg, Cathedral Peak, forest, 28°56'S, 29°12'E, 13 March 1976, pitfall traps, 7 days, 1♂ and 2♀; 15 March 1976, pitfall traps, 5 days, 3♀, S. Endrödy-Younga leg. (TMSA). Giant's Castle [29°14'S, 29°29'E], December 1979, 1♂, C. Scholtz leg. (UPSA). Eastern Cape Province: Pirie Bush 2♂ [?Pirie Forest, 27°14'E, 32°45'S] (BMNH). “Promontorium Bonae Spei, Transvaal”, 2♂ (BMNH).

Remark

C. forcipata was unknown to Péringuey when he described *C. imitativa* and his later record of the former species (Péringuey 1908, p 627) is based on its original description. Examination of the type specimens of the two nominal species shows no noticeable differences in the punctuation of the pronotum nor sculpture of the elytra, contrary to the characters given in the keys by Janssens (1939, p 32) and Ferreira (1954, p 8, 9).

***Frankenbergerius armatus* (Boheman)**

(Figures 14–27)

Epirhinus armatus Boheman 1857, p 200.

Coptorhina armata (Boheman): Harold 1872, p 205; Péringuey 1901, p 288, 294; Janssens 1939, p 32, 36.

Frankenbergerius armatus (Boheman): Ferreira 1972, p 362.

Coptorhina granulifera Harold 1871, p 112; synonymy by Harold 1872, p 205.

Frankenbergerius mirabilis Balthasar 1938, p 212; synonymy by Paulian 1939, p 37 (as *Coptorhina*).

Diagnosis

This species is most similar to *F. forcipatus* but can be separated by its smaller size, by having elytral intervals 2–4 with more distinct tubercles and by the parameres narrower in lateral view (Figures 23, 24).

Polymorphism

In the examined material, there are two distinct forms of males: one with clypeal horns curved upwards and slightly backwards (Figures 14, 22) with somewhat truncate apices, and another form with acute horns curved upwards but not backwards (Figures 17, 21). An additional, although minor difference, is the less tuberculate elytra in the first form (Figures 25, 26). The form with truncate apices of clypeal horns was collected in the Eastern Cape and KwaZulu-Natal provinces and the other one in Mpumalanga and Northern Province (Figure 27).

The distinctness of the form with acute clypeal horns from “typical” *F. armatus* was apparently recognized by M. Ferreira; one such specimen in the TMSA bears the label “Type ♂ *Pseudocoptorhina armata* var. *tuberculata* nov. M.G. Ferreira 1954”. However, the name was not published.

Because of the allopatric distribution and distinct morphological differences between males with well-developed horns we treat these two forms as subspecies. The absence of noticeable differences in paramere shape and ambiguous differences in elytral sculpture (characters that are normally distinctive for other *Frankenbergerius* species) prevent us from assigning them specific rank. However, if further research shows reproductive isolation or sympatric distribution, their rank should be reconsidered.

Remark

Harold (1871, p 112) described *C. granulifera* from Port Natal [Durban]. Later he transferred *E. armatus* to *Coptorhina* and wrote that *C. granulifera* belongs to this species (Harold 1872, p 205). We did not have the opportunity to examine the type of *C. granulifera*, however, the collection locality suggests that it is the nominotypical subspecies of *F. armatus*, to which the type of *C. granulifera* belongs.

***Frankenbergerius armatus armatus* (Boheman)**

(Figures 14–16, 22, 23, 25, 27)

Diagnosis

This subspecies differs from *F. armatus tuberculatus* by the clypeal horns of males that are curved upwards and backwards and truncate at the apices.

Description

Male (Figure 22). Dorsal surface of pronotum, elytra and head with small yellowish setae. Most of setae may be abraded; in most specimens setae absent on disc of head and pronotum.

Head. Clypeus in some individuals with horns curved upwards and slightly backwards (Figure 14) with somewhat truncate apices. Genae obtuse, finely bordered. Genal sutures visible as fine lines. Lateral margin of clypeus not, or very feebly, sinuate near genal suture. Frontal suture broadly interrupted at middle. Area behind genae slightly concave, coarsely punctate with big adjoining punctures, with distinct margins. Genae and anterior part of

clypeus densely punctate; margins of punctures indistinct. Very anterior part of clypeus with sculpture nearly rugose. Disc of head with minute, feebly visible punctuation. Inner (dorsal) surface of clypeal horns finely granular, outer (ventral) surface smooth. Anterior margin of clypeus flattened, deeply sinuate at middle, slightly rugose.

Pronotum. Anterior angles rounded. Lateral margins with fine border, hind and anterior angles and anterior margin with wider border. Border of anterior margin widened and sinuate at middle. Base not bordered. Hind angles obtuse. Dorsal surface densely and coarsely punctate; punctures separated by 0.2–0.3 times their diameters on disc, becoming denser laterally.

Elytra. Striae fine on disc becoming slightly wider and deeper apically, shiny, punctate (punctures separated by three to four puncture diameters). Intervals flat on disc, feebly convex in apical part, smooth to slightly shagreened and punctate (punctures separated by 1.5 to two puncture diameters). Intervals 2–7 with longitudinal tubercles, less developed than those in *F. armatus tuberculatus*. Interval 8 with long keel interrupted at middle of elytron. Interval 9 with smaller keel situated at about middle of elytron. Keels, especially hind part of keel on interval 8, serrate in most individuals.

Underside. Pygidium with deep border, its disc densely punctate. Abdominal and thoracic sternites coarsely punctate except for disc of meso- and metasternum.

Legs. Anterior tibiae with smaller teeth between major outer teeth in most specimens. Spur of anterior tibia bifurcated in males and simple, acute in females.

Aedeagus. Similar to *F. armatus tuberculatus* (Figure 23).

Variability. Body length of males 4.6–8.2 mm, width 3.5–5.2 mm, of females 6.2–8.3 mm and 3.9–5.0 mm. Colour of body from black to dark brown. Length of clypeal processes varies, some males have shorter clypeal processes (Figure 15). Females can be separated by acute, not bifurcated spur of anterior tibiae and, in some cases, by shorter clypeal processes (Figure 16).

Distribution

The subspecies is distributed in Eastern Cape and KwaZulu-Natal provinces up to 29°S in the north (Figure 27).

Type material examined

Lectotype (here designated): ♂ with labels “Caffraria”, “J. Wahlb[erg]”, “armata Boh.”, and “3636 E92” (NHRS). Paralectotypes: ♂ with labels “Caffraria”, “J. Wahlb”, “Type”, “armatus Bhm.”, “Typus”, “157 54”, “3632 E92”; 3♀ with labels “Caffraria”, “J. Wahlb” and catalogue numbers “3633 E92”, “3634 E92”, and “3635 E92” (NHRS).

In the original description, Boheman (1857, p 200) did not designate the holotype nor did he indicate the number of specimens examined. However, the size range provided (length 7.5–8.0 mm, width 5.0–5.2 mm) suggests that a few specimens were studied. The five specimens collected by Wahlberg fit these measurements well and might have all been

examined by Boheman. One of these specimens bears a label “typus”, but it has less-developed clypeal horns (and its left horn is broken) to class it unequivocally as the subspecies *armatus*. The locality label “Caffraria” suggests that this specimen could have been collected in the natural habitat of either of the two subspecies. To ensure stability of the nomenclature, another male specimen which has the explicit features of *F. armatus armatus* is here designated as the lectotype.

Additional material examined

KwaZulu-Natal Province: Durban [29°50'S, 31°01'E], 4♂? and 6♀, (BMNH), 4♂ and 3♀ (IRSNB). uMvoti [29°09'S, 30°45'E], 1♂, H. Fry leg. (SAMC). Eastern Cape Province: Ntsubane Forest, 31°27'S, 29°44'E, 25 November 1988, pitfall traps, 14 days, 8♂ and 12♀; fungi and forest litter, 1♀; fungous tree trunks, 1♀; 26 November 1988, pitfall traps, 14 days, 1♀ and 2♂; 1 December 1988, forest litter, 1♀, S. Endrödy-Younga leg. (TMSA). Dwesa Forest Reserve, 32°17'S, 28°50'E, 26 February 1985, pitfall traps, 7 days, 12♀ and 9♂; grass-netting, day, 1♀ and 1♂; 27 February 1985, sifting, indigenous forest litter, 2♂; 11 December 1979, sifting, forest litter, 2♂ and 3♀; 12 December 1979, owl pellet, 1♀; 17 December 1979, 1♂, S. Endrödy-Younga leg. (TMSA). Silaka Forest Reserve, 31°33'S, 29°30'E, 24 November 1987, pitfall traps, 8 days, 1♂; indigenous forest litter, 1♂ and 1♀; 24 November 1988, rotten *Cussonia* fruit, 14♂ and 17♀; 24 November 1988, ground traps, 8 day, 4♂ and 2♀, S. Endrödy-Younga leg. (TMSA). Amatole, Isidenge Forest Station, 32°41'S, 27°15'E, 16 November 1987, *Quercus* forest litter, 19♂ and 5♀; *Quercus* and *Eucalyptus* forest, fungi, 6♂ and 7♀; 14 November 1987, indigenous forest litter, 1♀; 12 November 87, dead *Quercus* bark, 3♂; 18 November 1987, *Pinus* forest litter, 1♂, S. Endrödy-Younga leg. (TMSA). Alexandria Forest Station, 33°44'S, 26°23'E, 5 December 1987, pitfall traps with banana bait, 2 days, 3♀; 6 December 1987, indigenous forest litter, 1♀, S. Endrödy-Younga leg. (TMSA). Grahamstown [33°18'S, 26°32'E], February 1978, 1♂ and 1♀, C. Scholtz leg. (UPSA). Port Saint John's [31°38'S, 29°32'E], November 1923, 1♂ and 1♀ (BMNH).

There are two series of this subspecies in TMSA with doubtful locality data: 6♂ and 3♀ from Nelshoogte, Knuckles rocks forest, 25°47'S, 30°50'E, 24 October 1986, S. Endrödy-Younga leg., and 11♂ and 15♀ with the label “Probably Uitsoek”. They were apparently mislabelled and the former series probably originated from Dwesa Forest Reserve (Ruth Müller, personal communication).

***Frankenbergerius armatus tuberculatus* ssp. n.**

(Figures 17–21, 24, 26, 27)

Diagnosis

This subspecies differs from the nominotypical one chiefly by the shape of the clypeal horns in males: the horns curve upwards, with acute apices (Figures 17, 21).

Description

Holotype: ♂ (Figure 21). Body length 9.5 mm, width 5.5 mm. Dorsal surface of pronotum, elytra and head with minute setae.

Head. Clypeus with two horns slightly curved upwards; horns acute at apices. Genae obtuse, finely bordered. Genal sutures visible as fine lines. Lateral margin of clypeus not or very feebly sinuate near genal suture. Frontal suture broadly interrupted at middle. Area behind genae slightly concave, coarsely punctate with big adjoining punctures with distinct margins. Genae and anterior part of clypeus densely punctate; margins of punctures indistinct. Very anterior part of clypeus sculpture nearly rugose. Disc of head with minute, feebly visible punctuation. Inner (dorsal) surface of clypeal horns finely granular; outer (ventral) surface smooth. Anterior margin of clypeus flattened, deeply sinuate at middle, slightly rugose.

Pronotum. Anterior angles rounded. Lateral margins with fine border, hind and anterior angles and anterior margin with wider border. Border of anterior margin widened and sinuate at middle. Base not bordered. Hind angles obtuse. Dorsal surface densely and coarsely punctate; punctures separated by 0.2–0.3 times their diameters on disc, becoming denser laterally.

Elytra. Striae fine, becoming slightly wider and deeper apically, shiny, punctate (punctures separated by three to four puncture diameters). Intervals flat on disc, feebly convex in apical part, smooth to slightly shagreened and punctate (punctures separated by 1.5 to two puncture diameters). Intervals 2–7 with longitudinal tubercles more developed than those in *F. armatus armatus*. Interval 8 with long keel interrupted at middle of elytron. Interval 9 with smaller keel situated at about middle of elytron. Keels, especially hind part of keel on interval 8, serrate in most individuals.

Underside. Pygidium with deep border, disc densely punctate. Abdominal and thoracic sternites coarsely punctate except for disc of meso- and metasternum.

Legs. Anterior tibiae with smaller teeth between major outer teeth in most specimens. Spur of anterior tibia bifurcated in males and simple, acute in females.

Aedeagus. Similar to *F. armatus armatus* (Figure 17).

Paratypes: body length of males 7.0–11.0 mm, width 4.1–5.2 mm, of females 6.3–8.6 mm and 4.0–5.1 mm. Colour of body from black to dark brown. In most specimens, disc of head and pronotum without setae. Length of clypeal horns varies in males (Figures 18, 19). Females can be separated by acute, not bifurcated spur of anterior tibiae and by shorter clypeal processes in some cases (Figure 20).

Distribution

This subspecies is distributed in Mpumalanga and Limpopo provinces. The southernmost known locality is Wakkerstroom in southern Mpumalanga (Figure 27).

Type material

Limpopo Province: Entabeni Forest Station [23°00'S, 30°14'E], November 1931, 3♀, G. van Son leg. (TMSA). Malta [24°10'S, 30°14'E], 1 February 1927, 1♀ (TMSA); Uitzicht [23°19'S, 30°01'E], Soutpansberg Distr., November 1924, 1♂ and 1♀ (IRSNB); Brak River [22°36'S, 29°44'E], October 1927, 1♂ (TMSA). Mpumalanga: Nelshoogte, Knuckles Rocks Forest, 25°47'S, 30°50'E, 24 October 1986, intercept traps, 41 day, 6♂ 3♀, S. Endrödy-Younga leg. (TMSA). Wakkerstroom [27°21'S, 30°08'E], January 1925,

1♀, G. van Dam leg. (TMSA). Uitsoek, 25°15'S, 30°34'E, 7 February 1987, high altitude grassveld, pitfall traps, 61 days, 9♂ and 7♀; 5 December 1986, Grootkloof indigenous forest, 25°15'S, 30°33'E, pitfall traps, 53 days, 5♂ and 6♀, S. Endrödy-Younga leg. (TMSA). Nelshoogte, 11 February 1987, Knuckles grassveld, Agaricaceae fungus, 1♂; pitfall traps, 58 days, 2♂ and 4♀; 4 December 1986, Knuckles Rocks Forest, pitfall traps, 68 days, 2♂; 8 April 1987, Knuckles grassveld, grass-netting, 1♀, S. Endrödy-Younga leg. (TMSA). Berlin, 24°32'S, 30°44'E, 4 February 1987, pitfall traps, 41 days, 1♂? and 1♀, S. Endrödy-Younga leg. (TMSA). Mariepskop, 24°35'S, 30°50'E, 2 May 1981, pitfall traps, 5 days, 1♂, S. Endrödy-Younga leg. (TMSA). Road Barbeton to Bulembu near Swaziland border [25°55'S, 31°10'E], 20 January 2000, 1♂ and 1♀ (TMSA). White River Distr., farm Lichtfontein [25°19'S, 31°01'E], 28 December 1992, 1♂, R. Müller leg. (TMSA).

***Frankenbergerius opacus* sp. n.**

(Figures 4, 7, 10, 12, 43)

Diagnosis

This species is similar to *F. nanus* and *F. nitidus* sp. n. but can be separated from them by the concave base of the pronotum, small longitudinal keel on the pygidium, and the shape of the parameres.

Description

Holotype: ♂ (Figure 7). Body black, shiny, length 7.0 mm, width 4.1 mm. Dorsal surface with minute setae.

Head. Clypeus with anterior angles dentiform, separated by deep sinuation. Genae rounded, finely bordered. Genal sutures almost indistinct. Lateral margins of clypeus not sinuate near genal suture. Frontal suture indistinct on disc. Genae and anterior part of clypeus densely punctate, almost rugose; disc more sparsely punctate, margins of punctures indistinct.

Pronotum. Anterior and hind angles rounded. Lateral and anterior margins bordered, base not bordered. Border of anterior margin widened at middle, without sinuation. Dorsal surface densely and coarsely punctate; punctures almost adjacent. Base of pronotum concave (Figure 4).

Elytra. Striae distinct, punctate (punctures as wide as striae, separated by four to five puncture diameters on disc); striae 9 and 10 widely separated, with deeper and larger punctures medially. Intervals matt, impunctate, with rounded to elongated shiny tubercles.

Underside. Pygidium with strong border and small longitudinal keel, its disc deeply depressed and densely punctate (Figure 10). Mesosternum coarsely punctate; metasternum smooth on disc, otherwise punctate as mesosternum.

Legs. Anterior legs with three outer teeth with indistinct teeth between. Anterior tibial spur bifurcated.

Aedeagus. Parameres with widely rounded apices (Figure 12).

Paratypes: body length varies in males from 5.8 mm to 7.1 mm, width from 4.0 mm to 3.6 mm, in females 7.5–6.1 mm and 4.6–3.9 mm, otherwise variation among specimens is very weak.

Distribution

The only recorded locality for this species is Stellenbosch (Western Cape Province) (Figure 43).

Type material

Holotype: ♂ with labels “Stellenbosch [33°56'S, 18°51'E] 24.5.22 Ch. K. Brain”, “*Coptorhina* sp. Not in B.M. Det. G.E. Bryant”, and “Pres. by Com. Inst. Ent. (BMNH) 1949–114” (BMNH). Paratypes: 2♂ and 3♀ with the same data but without identification label by Bryant (BMNH). One ♂ paratype lacks right elytron.

Additional material examined

One ♂ from unknown locality with handwritten label “33” (SANC).

***Frankenbergerius nanus* (Péringuey)**

(Figures 3, 6, 8, 9, 11, 43)

Coptorhina nana Péringuey 1888, p 95; 1901, p 288, 293; Janssens 1939, p 32, 36.

Frankenbergerius nanus (Péringuey): Ferreira 1972, p 362, 364.

Diagnosis

This species is similar to *F. opacus* sp. n. and *F. nitidus* sp. n. but can be separated from them by having distinct transverse convexity on the last abdominal sternite. From the former it can also be separated by the pronotum having a flat base, and from the latter by matt elytral intervals.

Description

Body black to dark brown, matt, elytra with shiny tubercles (Figure 8). Body length of males 5.8–6.2 mm, width 3.1–3.8 mm, of females 5.5–6.5 mm and 3.6–4.1 mm. Dorsal surface of pronotum with minute setae.

Head. Clypeus with anterior angles dentiform with deep sinuation between. Genae rounded, finely bordered. Genal sutures visible as fine lines. Lateral margins of clypeus very feebly sinuate near genal suture. Frontal suture indistinct. Genae and anterior part of clypeus densely punctate, almost rugose. Disc of head with minute, feebly visible punctures.

Pronotum. Anterior angles rounded. Lateral and anterior margins bordered, base not bordered. Border of anterior margin widened at middle, without sinuation. Hind angles

rounded. Dorsal surface densely and coarsely punctate; punctures separated by 0.2–0.3 times their diameters on disc, becoming denser laterally. Base not concave (Figure 3).

Elytra. Striae distinct, punctate (punctures as wide as striae, separated by three to four puncture diameters); striae 9 and 10 very close, with deeper and larger punctures. Intervals matt, impunctate, with elongated tubercles.

Underside. Pygidium with strong border, disc densely punctate. Disc of meso- and metasternum smooth. Last abdominal sternite with distinct transverse convexity (Figure 9).

Legs. Anterior legs with three outer teeth without smaller teeth between. Spur of anterior tibia bifurcated in males and simple, acute in females.

Aedeagus. Parameres with slightly sclerotized apices narrower in lateral view than in *F. opacus* sp. n. (Figure 11).

Variability. Except for body size variation indicated above, the specimens examined are very similar.

Distribution

This species is known from a few localities in the vicinity of Cape Town (Figure 43).

Type material examined

Syntype, ♂: Constantia [Cape Town], September 1885, Péringuey leg. (SAMC).

Additional material examined

Western Cape Province: Cape Town, June 1892, Péringuey leg., 3♀ (SANC) and 2♂ and 4♀ (SAMC); Pearly Beach, Bredasdorp [34°45'S, 19°30'E], 1♂ (SAMC); Groote Post farm, near Darling, 33°36'S, 18°25'E, 19 September 1988, pitfall trap with cow dung, 1♂, A. Davis leg. (UPSA).

***Frankenbergerius nitidus* sp. n.**

(Figures 13, 43)

Diagnosis

This species is similar to *F. nanus* and *F. opacus* sp. n. but can be separated from the former by having the last abdominal sternite flat, without a transverse convexity, and by shiny elytral intervals with rounded to elongated tubercles. From *F. opacus* n. sp. it differs in having the base of the pronotum flat, very close elytral striae 9 and 10, and pygidium without longitudinal keel in basal part.

Description

Holotype: ♀ (Figure 13). Body black, shiny, length 7.5 mm, width 4.5 mm. Dorsal surface without setae.

Head. Clypeus with anterior angles dentiform with deep sinuation between. Genae rounded, finely bordered. Genal sutures visible as fine lines. Lateral margins of clypeus very feebly sinuate near genal suture. Frontal suture indistinct. Genae and anterior part of clypeus densely punctate, almost rugose. Disc of head with minute, feebly visible punctures.

Pronotum. Anterior angles rounded. Lateral and anterior margins bordered. Border of anterior margin widened at middle, without distinct sinuation. Base not bordered. Hind angles rounded. Dorsal surface densely and coarsely punctate; punctures separated by 0.2–0.3 times their diameters on disc, becoming denser laterally.

Elytra. Striae distinct, punctate (punctures as wide as striae, separated by three to four puncture diameters); striae 9 and 10 very close, with deeper and larger punctures. Intervals shiny, impunctate, with rounded to elongated tubercles.

Underside. Pygidium with strong border, its disc densely punctate. Disc of metasternum and mesosternum smooth.

Legs. Anterior legs with three outer teeth without smaller teeth between. Anterior tibial spur acute and curved outwards.

Male. Unknown.

Distribution

This species is known from one locality in Namaqualand (Northern Cape Province) (Figure 43).

Type material

Holotype: ♀, RSA, Northern Cape Province, Hoekbaai, 31°11'S, 17°47'E, 28 August 1979, white mesembr. [Mesembryanthemaceae] flow[er], Endrödy-Younga leg. (TMSA).

The specimen was collected on a flower most probably by chance since no species of related taxa are known to be associated with flowers.

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