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ANT NEST BEETLES OF THE CARNEGIE MUSEUM
(COLEOPTERA: CARABIDAE: PAUSSINAE: PAUSSINI)

PETER NAGEL

Institut für Natur-, Landschafts- und Umweltschutz (NLU)/Biogeographie
Universität Basel, Switzerland (Peter.Nagel@unibas.ch)

ABSTRACT

Paussini (Coleoptera: Carabidae: Paussinae) from the collections of the Carnegie Museum of Natural History were studied and identified. The species are mainly from Africa with one each from the Middle East and India. The collection consists of long series from different localities but is especially rich in specimens from Malawi with eight species recorded from there for the first time. The paper also presents first records for many other African countries. In the framework of a revisionary treatment of the *Paussus cucullatus* Group *sensu stricto*, type material of *Paussus semicucullatus* Wasmann, *Paussus pseudocucullatus* Nagel, and *Paussus conradti* Kolbe were studied. It is shown that *Paussus elizabethae* Péringuey, 1897, is a valid species and not a synonym of *P. conradti* Kolbe, 1896. *Paussus phyllocerus* Reichenasperger, 1925, is recognized as a new synonym of *Paussus excavatus* Westwood, 1833. Two species from Malawi are described as new to science: *Paussus buetikeri*, new species, and *Paussus rawlinsi*, new species. One key each is provided for ease of identification of species closely related to *P. cucullatus* Westwood and *Paussus manicamus* Péringuey, respectively. All available type specimens and many other species are shown in drawings.

KEY WORDS: Coleoptera, Carabidae, Paussini, Africa, faunistics, new species, first records, zoogeography, taxonomy, identification key

INTRODUCTION

Ant nest beetles are carabids with strong deviation from the ordinary ground beetle habitus. This is due to the myrmecophilous habits and habitus of the more derived taxa. The more comprehensive monophylum Paussinae comprises Metriini, Mystropomini, Ozaenini, Protopaussini, and Paussini (Di Giulio et al. 2003) to which the enigmatic Nototylini may also belong (Deuve 1994). The phylogenetic composition of Ozaenini has not yet been resolved unambiguously, yet its paraphyletic state and possible resolution have been dealt with recently (Ball and MacCleve 1990; Nagel 1997; Di Giulio et al. 2003). Only a few species appear to be abundant while the majority of species, especially of the true myrmecophiles, is rare. The number of species is estimated at 780, of which more than 560 are Paussini.

Recent treatments of ozaenines include Stork (1985), Ball and MacCleve (1990), Ball and Shpeley (1990), and Deuve (2001a, 2001b, 2004, 2005). Contributions to the phylogeny of paussines, including data on fossils and early ontogenetic stages, have been presented recently by Nagel (1997), Kaupp et al. (2000), Di Giulio et al. (2003), and Di Giulio and Moore (2004). The latest findings on fossils have been presented by Wappler (2003) (Eocene lake deposits from the Eifel, Germany) and Solórzano Kraemer (2006) (Mexican amber). Luna de Carvalho (1989) published a monographic treatment of Protopaussini and Paussini. Since then only two new extant species of Paussini *sensu stricto* have been described, both from West Africa (*Paussus krelli* Kaupp and Rödel, 1997; *P. mendesi* Luna de Carvalho, [2001]) and Lorenz (1998) designated a replacement name (*Paussus rougemontianus*). Catalogs include Erwin and Sims (1984), Stork (1986), Moore et al. (1987), Lorenz (1998, 2005), Bousquet (2002), and Nagel

(2003a). For *Paussus sensu lato*, Nagel (2003a) listed all names available at genus level according to the International Commission on Zoological Nomenclature (1999).

Luna de Carvalho (1966) included paussines of the Carnegie Museum available at that time. In the present paper specimens are treated that have been acquired more recently. This article adds to the knowledge of the Paussini by the description of new species and the treatment of some less known or misinterpreted species. It also includes keys to the identification of certain species groups. The material treated here is particularly interesting because it includes many specimens from Malawi, an African country that had not yet been intensely sampled for paussines.

MATERIAL STUDIED AND METHODS

Some time ago I received two lots of paussid beetles from the collection of the Carnegie Museum. This paper reports on my identification and study of those specimens. I confined the study to external structural characters, which are deemed sufficient in this context. In addition to specimens from Carnegie Museum, other material available to me was studied and presented in this paper as appropriate.

Repositories for studied material are abbreviated throughout as follows: **BSUB**, Biogeographische Sammlung der Universität Basel, Basel, Switzerland (Peter Nagel); **CMNH**, Carnegie Museum of Natural History, Pittsburgh, USA (Robert L. Davidson); **I.R.Sc.N.B.**, Institut Royal des Sciences naturelles de Belgique, Bruxelles, Belgium (Léon Baert); **MNHN**, Muséum national d'Histoire naturelle de Paris, Paris, France (Thierry Deuve); **NHMM**, Natuurhistorisch Museum Maastricht,

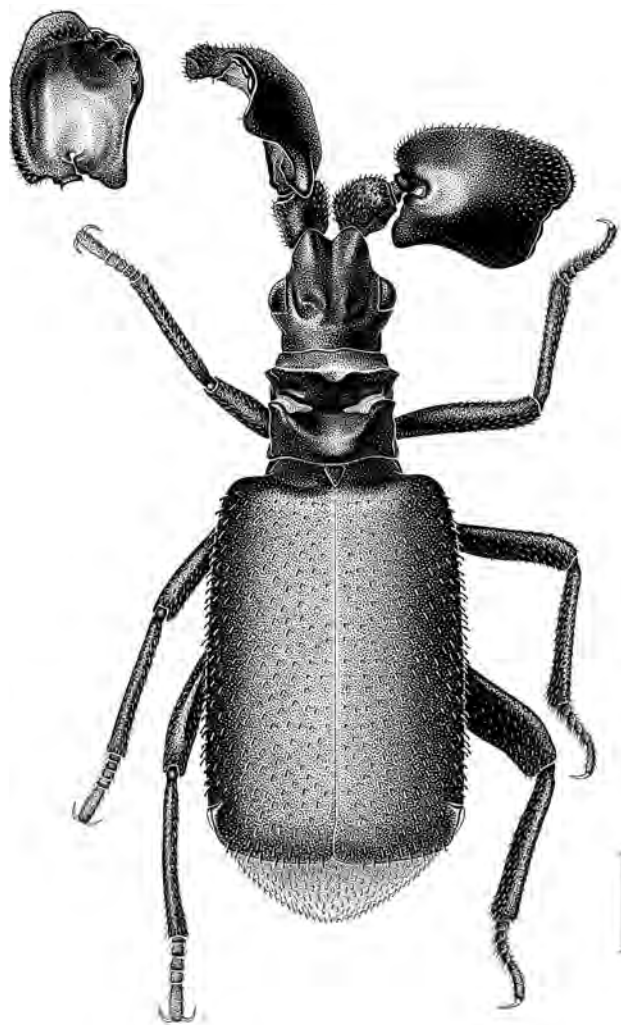


Fig. 1.—*Paussus buettikeri*, new species, ♂, holotype, habitus. Malawi. Inset shows left antennal club from below. Scale bar 1 mm. For explanation of display of appendages see Material Studied and Methods section of text.

Maastricht, The Netherlands (Fokeline Dingemans); **NHMB**, Naturhistorisches Museum Basel, Basel, Switzerland (Michel Brancucci, Eva Sprecher); **NHMW**, Naturhistorisches Museum Wien, Wien, Austria (Manfred Jäch); **ZFMK**, Zoologisches Forschungsinstitut und Museum Alexander Koenig, Bonn, Germany (Michael Schmitt); **ZMHUB**, Zoologisches Museum der Humboldt-Universität, Berlin, Germany (Manfred Uhlig); **ZSM**, Zoologische Staatssammlung München, München, Germany (Martin Baehr).

The classification is based on Nagel (2003a). The generic and subgeneric classification of the genus *Paussus sensu lato* by Darlington (1950), Luna de Carvalho (1989) or Lorenz (2005), or even those by Kolbe (e.g., 1933) or Wasmann (e.g., 1929), often appear contradictory to the knowledge of phylogenetic relationships within paussines

accumulated during the last fifteen to twenty years. Therefore, a very conservative classification is used until the phylogenetic relationship of species groups can be resolved at a more advanced stage.

The descriptions are accompanied by drawings, all of which follow the same principle. The appendages of the right side are shown at their broadest view while the left antenna and legs are shown at a distortion of 90 degrees, i.e., they are shown at their narrowest view. In contrast to traditional scientific drawings with appendages in a more natural position, this view may not please some aestheticians. I chose this type of display for ant nest beetles because of their often-flattened legs and three-dimensionally sculptured antennae. With this type of presentation the figures serve as a direct aid for identification.

SYSTEMATIC ZOOLOGY

Order Coleoptera

Family Carabidae

Subfamily Paussinae

Tribe Paussini Latreille, 1807

Subtribe Cerapterina Billberg, 1820

Genus *Cerapterus* Swederus, 1788

Most *Cerapterus* are difficult to distinguish and a modern revision based on recent technology such as the study of microsculpture of different surface parts by scanning electron microscopy or the internal sac of the aedeagus, to say nothing of DNA analyses, is wanting. It is therefore with reservation that I assign the specimens to a particular species.

Cerapterus laceratus Dohrn, 1891

Material Examined.—**BOTSWANA.** Gaborone, 21–27 Nov 1987, R.D. Ward, coll.; Robert D. Ward Collection, donated 1989; *Cerapterus smithi* Westw., det. R.L. Davidson; 1♂ [CMNH]. Gaborone, 22–28 Jan 1988, R.D. Ward, coll. Robert D. Ward Collection, donated 1989; 1♀ [CMNH].

SOUTH AFRICA. Transvaal, Sabie R., Paul Kruger Gate, Kruger N.P., 11–12 January 1992, Ward; 1♂ [CMNH].

Cerapterus longihamus Reichensperger, 1933

Material Examined.—**MALAWI.** Chitipa District, Jembya Reserve, 18 km SSE Chisenga, 10-08S, 33-27E, 1,870 m, 1–10 Jan 1989, J. Rawlins, S. Thompson, 3♂ [CMNH]. Same data but 21–31 Dec 1988, 2♂ [CMNH].

Cerapterus smithii MacLeay, 1838

Material Examined.—**MALAWI.** Lilongwe Dist., 4 km S Lilongwe, 2 February 1989, J. Rawlins, S. Thompson, 1♀ [CMNH].

SOUTH AFRICA. Transvaal, Eiland, H. Merensky Nature reserve, 25–26 Jan 1992, R. Ward; 1♂ [CMNH].

BOTSWANA. Tlokwen, 22–29 Feb 1988, R.D. Ward, coll. Robert D. Ward Collection, donated 1989; *Cerapterus smithi* Westw., det. Davidson; 1♂ [CMNH].

Subtribe Pentaplatarthrina Kolbe, 1927
Genus *Pentaplatarthrus* Westwood, 1833

***Pentaplatarthrus paussoides* Westwood, 1833**

The species is widespread in southern Africa and replaced by *P. gestroi* Kolbe, 1896, from central Zimbabwe northwards.

Material Examined.—BOTSWANA. Sebele, 1–7 March 1988, R.D. Ward, coll.; Robert D. Ward Collection, donated 1989; *Pentaplatarthrus paussoides* Westw., det. R. Davidson; 1♀ [CMNH].

Subtribe Platyrhopalina Jeannel, 1946
Genus *Platyrhopalopsis* Desneux, 1905

***Platyrhopalopsis melleii* (Westwood, 1833)**

This species has been recorded from “China borealis” (Dohrn 1886), “China” (Janssens 1953) and “Nordindien” or “Northern India” respectively (Wasmann 1904; Fowler 1912) (cf. Nagel 2003a) but all exactly traceable localities are situated in southern India.

Material Examined.—INDIA. Kerala, Quilon District, Thenmala, VI.1985, T.R.S. Nathan; 1 specimen [CMNH].

Subtribe Paussina Latreille, 1807
Genus *Paussus* Linné, 1775

***Paussus cochlearius* Westwood, 1838**

The extent of variation in several structural characters of this species is not clear. Therefore, records of *P. cochlearius* (described from “Africa Australi”) and the related species *P. fairmairei* Raffray, 1885 (Ethiopia), *P. tununguensis* Reichensperger, 1933 (Tanzania), *P. batillarius* Reichensperger, 1933 (Zaire), and *P. leechi* Luna de Carvalho, 1968 (Namibia) must be taken with care. The whole species complex is distributed from Mauretania to Ethiopia, from Tanzania including the island of Zanzibar (Unguja) through the Democratic Republic of the Congo (formerly Zaire) to South Africa and Namibia. Numerous specimens are only available from South Africa, while otherwise only few specimens from few localities are known. It is therefore with reservation that I assign the specimen to *P. cochlearius*. This species complex is not yet known from Malawi.

Material Examined.—MALAWI. Chitipa District, Jembya Reserve, 18 km SSE Chisenga, 10-08S, 33-27E, 1,870 m, 11–20 Dec 1988, J. Rawlins, S. Thompson; 1♀ [CMNH].

***Paussus buettikeri*, new species**
(Fig. 1)

Diagnosis.—This species cannot be confounded with any of the described paussines. The unique shape of the anten-

nal club especially characterizes it. In addition, the deep black color combined with the dark, thick, erect setae are not known from any other species. While blackish species are well represented in the fauna of the Oriental Region, such species are rare in the Afrotropical Region. The deep black color of the latter species is either restricted to the elytra (e.g., *Paussus aureofimbriatus* Wasmann, 1904) or the pubescence differs considerably as in *Paussus viator* Péringuey, 1896.

Description.—♂: Body length 5.9 mm from tip of head to tip of elytra; width across both elytra 2.4 mm.

Body black, except abdomen and pygidium pale brown with lateral part of first and second sternite blackish, tarsi dark brown, margins of coxae and subapical fold and narrow margins of elytra pale brown, trichomes of pronotal cleft very pale, margins of antennal clubs paler, central basal part of antennal clubs pale brown, this pale spot more extended below than above.

Body dull, except front and head above eyes slightly more glossy, legs (except basis of femora) and abdomen glossy; overall pubescence not conspicuous, above and beneath sparse, minute, yellowish scales, similar to dust particles; legs, first antennomere, palpi, outer margins of antennal clubs and pygidial disk with longer scattered yellowish setae; head and pronotum almost glabrous, few minute, scattered, appressed scales present; disk of antennal club glabrous, density of pubescence increasing towards margins, consisting of scattered small scales to thick setae; elytra with scattered thick, dark, blunt erect setae; meso- and metanotum similar to pronotum; abdomen with scattered, short, almost appressed scale-like setae; pygidium with scattered, broad, blunt setae, which are similarly short but erect, dense and in a row along margin.

Head with frons bilobed in front and triangularly impressed; vertex without openings, slightly vaulted, almost flat above and with one shallow lateral impression above each eye; first antennomere without clearly demarcated trichome, yet with yellowish, thick, short setae denser at upper inner angle.

Antennal club thin, hollow beneath, vaulted above; details of shape see Fig. 1; three very blunt teeth present at inner apical part, which are remnants of metameric structuring known from the *Paussus cucullatus* Group and allies; frontal margin marked by a distinct line; club surface almost smooth immediately around basal insertion, densely punctured on whole disk, with apical sensory field (Nagel 1979) restricted to protruding apical part bordering indentations; mouthparts with palpi adjacent, “closing” mouth from beneath.

Pronotum transversely divided by deep cleft with pale trichomes on both sides; pronotum as wide as head; frontal part bluntly keeled transversely, interrupted in middle.

Elytra conspicuously matte by dense, even microgranulation; series umbilicata barely discernible, consisting of three ocellate punctures with fine, erect, pale setae; elytral lateral margins indicated by blackish setae set in a row; hind wings fully developed.

Abdomen with fine microsculpture, glossy; pygidium with rectangular margin, no keel; pygidial disk with shallow, impressed central part.

Legs slender; fore tibiae narrow, diameter roundish oval; hind tibiae only slightly broader, compressed, diameter flat oval; legs coarsely punctured; tibial spurs absent; tarsi with yellow setae, appressed above, denser and sticking out below, without brush-like pad.

Aedeagus with apex of middle lobe oblique without indentation; both parameres glabrous.

Etymology.—It is a great pleasure for me to name this extraordinary beetle for Professor Dr. Dr.h.c. Wilhelm Büttiker, Magden, Switzerland, founding editor of the renowned series “Fauna of Arabia,” whose various contributions to Afrotropical and Arabian faunistics, medical entomology and nature conservation are invaluable.

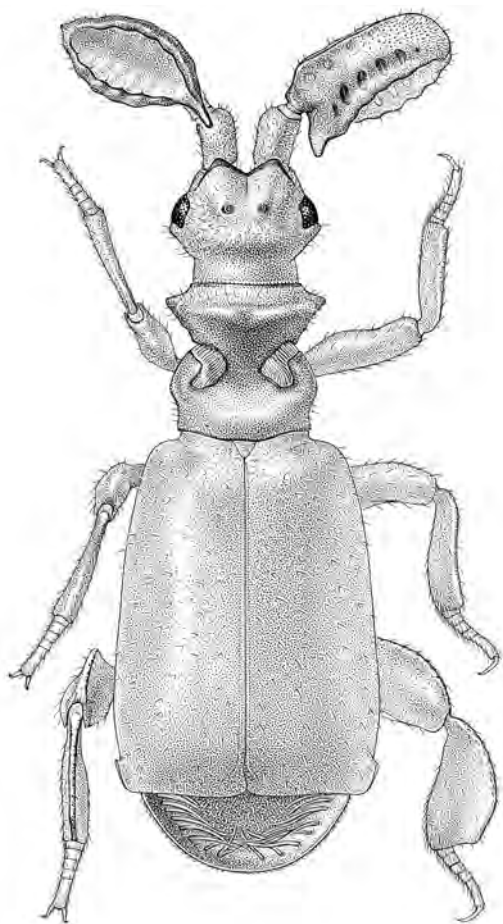


Fig. 2.—*Paussus conradti* Kolbe, ♀, holotype. Tanzania. Scale bar 1 mm.

Type Material.—Holotype, male. VERBATIM LABEL DATA: MALAWI. Chitipa District / Jembya Reserve, 10 km SSE / Chisenga. 10-08S, 33-27E / 1,870 m. 1-10 Jan 1989/J. Rawlins, S. Thompson [CMNH].

Discussion.—*Paussus upembanus* Janssens, 1951, is the only species with an antennal club of a certain yet still remote structural similarity. It is known from the Parc National de l'Upemba in the southeastern Democratic Republic of Congo (formerly Zaire) (Janssens 1951; Luna de Carvalho 1968, 1989). Both *P. buettikeri* and *P. upembanus* show a ribbon-like antennal club with the margins slightly and shortly bent inwards. In addition, the "ribbon" is twisted around the longitudinal axis in *P. upembanus* and the phylogenetically lower yet actually apical part bears five very long, thick bristles. Neither Janssens (1951) nor Luna de Carvalho (1968) indicates the sex of their specimens in hand. However, the considerable differences between *P. buettikeri* and *P. upembanus* are not at all in accordance with the known trends of sexual dimorphism in paussines. Among the differentiating characters in *P. upembanus* are the brown color, the transverse head, the simple, vaulted frontal part of the pronotum that is devoid of a transverse keel, and several large tufts of bris-

les at the distal part of the elytra.

I doubt a close phylogenetic relationship exists between these two species despite the vague structural similarity of the antennal club. This is based on the fact that in *P. upembanus* the metamorous apical margin with its five bristles is phylogenetically homologous to the lower part of the conchoid antennal club of the *P. cucullatus* Group. On the other hand, in *P. buettikeri*, the truncated marginal teeth are homologous with the upper part. In this latter species the lower part is completely atrophied.

Based on a purely phenotypic classification the new species would be ranked together with *P. upembanus* as a member of the subgenus *Strombipaussus* Luna de Carvalho, 1989. I propose to treat *P. buettikeri* as a species group of its own until more evidence for a particular phylogenetic relationship is available.

Paussus turcicus Frivaldszky von Frivald, 1835

This species has a wide range from Macedonia to Kyrgystan. The southernmost localities are found in Israel, Palestine and Jordan: Jerusalem, Hulda, Tel Aviv, Sasa (Luna de Carvalho and Chikatunov 1999), Nazareth (MNHN), Haifa (MNHN, NHMW), Amman (this record). These records from Amman are the first and only records from Jordan. They formed the basis for the listing of Jordan in Nagel (2003a). While *P. turcicus* is an exclusively Palearctic species, its sister species *P. tibialis* Westwood, 1841, is the vicariant from India (Bihar, Bengal) with known localities also in Pakistan (NHMB) and Nepal (Nagel Collection in BSUB). *P. tibialis* differs from *P. turcicus* by the regular presence of the black disk of the elytra (in *P. turcicus* this color variant exists occasionally) and the presence of a row of short, thick, erect bristles along the lateral elytral margin. Both species share the compression and enlargement of the hind legs as well as the short transverse slit-like opening at the vertex.

Material Examined.—JORDAN. Amman, (Abdoun), 26 Dec 1991, R.D. Ward; *Cochliopaussus turcicus* (Frivaldszky) det. R. Davidson, 5♂, 1♀ [CMNH]; Amman, (Abdoun), 1-5 Sept 1991, Robert D. Ward, 1♀ [CMNH]; Amman, (Abdoun), 24-31 Dec 1991, dark soil in field, R.D. Ward, 1♂ [CMNH].

Revisionary Notes on the *Paussus cucullatus* Group *sensu stricto*

The Carnegie material of this species group of small beetles (4 mm) could not have been classified with certainty without a more detailed treatment of all species traditionally included: *P. conradti* Kolbe, *P. cucullatus* Westwood, *P. elizabethae* Péringuey, *P. excavatus* Westwood, *P. phyllocerus* Reichensperger, *P. pseudocucullatus* Nagel, and *P. semicucullatus* Wasmann. By courtesy of the curators I received the holotype specimens of *P. conradti* and *P. semicucullatus*. Paratype specimens of *P. pseudocucullatus* are available to me at BSUB. This study revealed that

some confusion had been created by the early misinterpretation of *P. conradti*. It could also be detected that two Malawi specimens represent a new species.

***Paussus conradti* Kolbe, 1896**

(Fig. 2)

This species does not form part of the *P. cucullatus* Group *sensu stricto*. The main differences are the compressed yet not widened middle and fore tibiae, the obliquely cut anterior basal corner of the antennal club, the blunt transverse collar of the anterior pronotum and the fringe of bristles along the edge of the pygidium consisting of separate tufts. The elytral pubescence is simple and consists of widely scattered erect setae. This pubescence is much less dense than in *P. elizabethae* with the individual setae a little longer. The two frontal pores are small, entire, and level with the head surface, without bracket- or ear-like outer margin. They appear larger because of a broad circular border of black color. The body length from the clypeus to the apical part of the elytra is 4.0 mm. The male specimen lacks the right antenna and most tarsi. It is similar to the female holotype in all characters listed above. The eyes are slightly more vaulted in the male.

I do not find evidence that this species has ever been correctly recorded since its description. Obviously, Reichensperger misinterpreted *P. conradti* (see discussion below) and Luna de Carvalho (1963, 1967, 1989) adopted this view. On a visit to the Natural History Museum in Budapest in 1998 I verified that Luna de Carvalho's (1967) record of *P. conradti* from Tanzania, Moshi, refers to *P. elizabethae*. The specimen from Transvaal reported as *P. conradti* by Luna de Carvalho (1963) is also *P. elizabethae* as evident from the accompanying figure.

Material Examined.—TANZANIA. D.Ost-Afrika, Tanga bis Ngambo, 2.7.-11.7.91, Conradt S. ["S." meaning Sammler = collector, Uhlig i.l. 2005]; 65024; ♀; Type; *Paussus conradti* Kolbe * [new label]; *Paussus conradti* Kolbe, Holotypus, Nagel vidit 1993; *conradti* Kolbe* [large original label, originally fixed to the bottom of the box] [ZMHUB].

LOCALITY UNKNOWN. 12.XII.09 Holtz; *Paussus conradti* Kolbe [Kolbe's handwriting]; ♂ [ZMHUB].

***Paussus cucullatus* Westwood, 1850**

(Fig. 3, 10E)

This is one of the most abundant *Paussus* species in South Africa.

Material Examined.—BOTSWANA. Ngamiland Dist., Moremi Wildlife Res., North Gate, 19 10'S, 23 45'E, 28 Dec 1988, R. Ward, 2♂, 8♀ [CMNH].

***Paussus elizabethae* Péringuey, 1897, revised status**

(Fig. 4, 5, 10B, 10C, 11A)

Among the South African species similar to *P. cucullatus*,

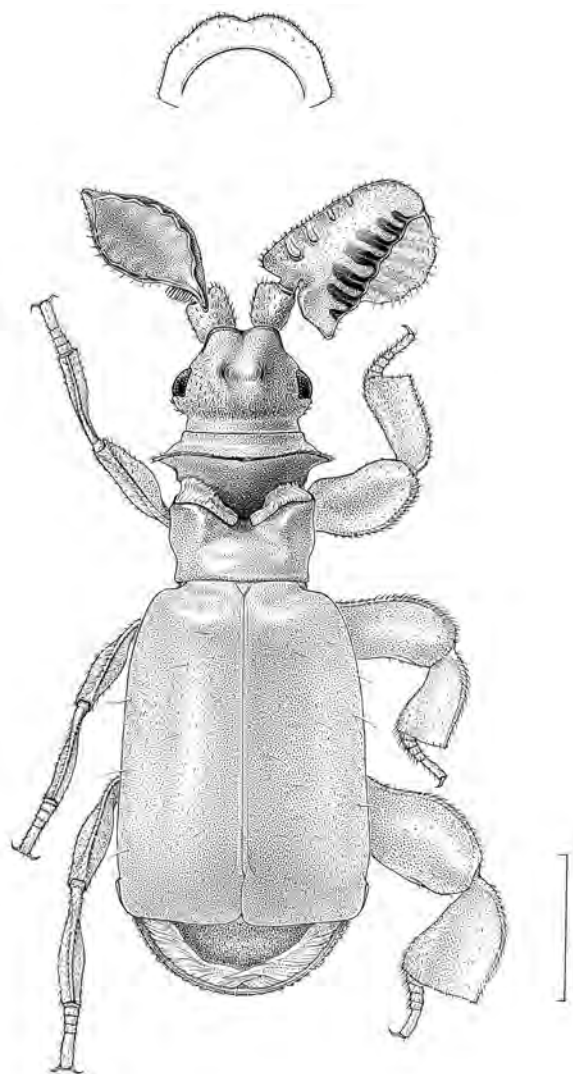


Fig. 3.—*Paussus cucullatus*, ♂, Zambia, Southern Province, Mandala dam, 16°30'S 26°55'E, near Mbabala, ca 30 km N of Choma, funnel trap, 14.-15.IX.1987, leg. T. Ertz, SEMG [Scientific Environmental Monitoring Group of the Regional Tsetse and Trypanosomiasis Control Programme, European Development Fund] [Nagel Collection in BSUB]. Inset shows pronotal collar in anterior view. Scale bar 1 mm.

P. elizabethae is immediately characterized by the elytral pubescence consisting of moderately dense erect setae. The two frontal pores are large, elevated and show a complete margin.

Reichensperger (1938b) established the synonymy between *P. elizabethae* and *P. conradti* because he classified specimens from Ukerewe Island in Lake Victoria and Ngerengere as *P. conradti* (see specimen from the same locality listed below). A short time before he had recorded a specimen from Nairobi as *P. conradti* (Reichensperger 1938a). In no case did he find differences to South African *P. elizabethae*. In a later publication, Reichensperger (1951) assigned a specimen from Katanga (Democratic

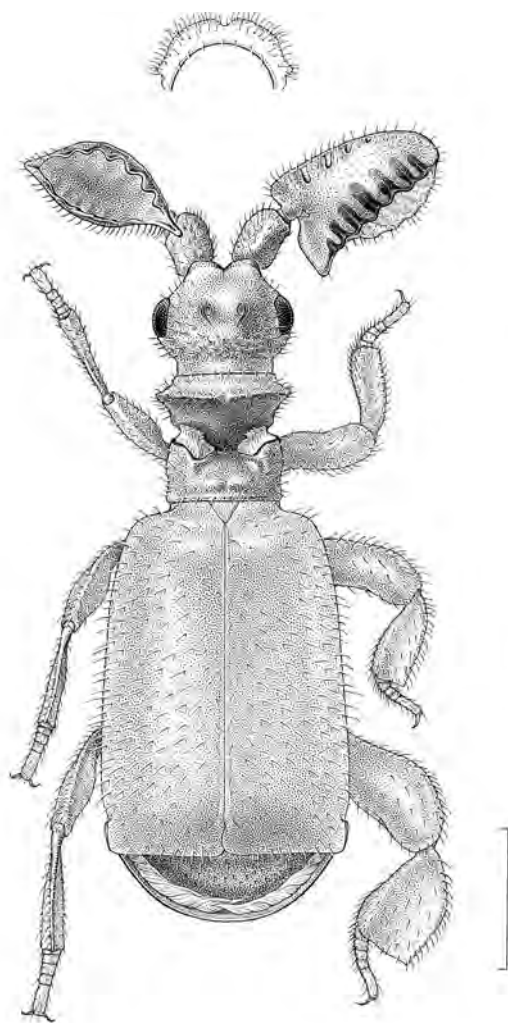


Fig. 4.—*Paussus elizabethae*, ♂. South Africa, Capland, Algoa Bay, Dr. H. Brauns, 25-7-97 [Nagel Collection in BSUB]. Inset shows pronotal collar in anterior view. Scale bar 1 mm.

Republic of the Congo, formerly Zaire) to the pair of synonyms. All these records refer to the well-described and drawn *P. elizabethae*. Reichensperger never saw the type specimen of *P. conradti* and Kolbe's original description is not precise enough to rule out such a misinterpretation. We have now studied and drawn the holotype of *P. conradti* (see above) and are thus able to confirm the uniqueness of both species. The synonymy of both names in the catalogs of Janssens (1953) and Lorenz (1998, 2005) and the monograph of Luna de Carvalho (1989) is incorrect.

In addition to the elytral pubescence, the following characters distinguish *P. elizabethae* from *P. cucullatus*: the former has the femora and tibiae less compressed and lamelliform, the head outline more circular, the head strongly wrinkled and equipped with setulae, the frontal pores oval and more exposed, and the pronotal collar less raised and not sharp-edged like a blade.

The specimens from Malawi differ slightly from the additional material listed below by their somewhat thicker and shorter elytral setae (Figs. 5, 10B) and the slightly broader pronotal collar compared to the width of head and posterior pronotum. The pronotal collar is particularly low in South African specimens (Fig. 4). The specimen from Lake Victoria has a smaller antennal club when compared to other females. I interpreted the differences in the Malawi specimens as possible species-specific characters when I studied them for the first time in 1996 and assigned the label "*Paussus* sp. n. aff. *elizabethae*." However, interpreted against the background of the currently known variability, none of these characters seems to justify the description of a new species. Yet, even if the Malawi specimens do, in fact, turn out to represent a separate species, it would be a new species in addition to the southern African *P. elizabethae* and the eastern African *P. conradti*.

Obviously, *P. elizabethae* is a widely distributed species, which is now known from Kenya, Tanzania, Malawi, Democratic Republic of the Congo (formerly Zaire, Katanga only), Zimbabwe, and South Africa. Here we record it for the first time from Malawi and Zimbabwe.

Material Examined.—**SOUTH AFRICA.** Algoa Bay, Capland, Dr. H. Brauns, 25 7 97; *P. cucullatus* Westw.; det. Reichensperger; 1♂ [Nagel Collection in BSUB].

ZIMBABWE. NW Zimbabwe, Zambezi Valley, Rukomechi, electric target [electrified flight intercept trap, field trials in the framework of studies on ecological side effects of tsetse fly control], 2.XII.86, sect. II, 1400–1800 hours, leg. S. Gussmann, 1♀ [Nagel Collection in BSUB]; Rukomechi, ring of targets, 10.I.1987, 1500–1800 h, leg. Gussmann; 1♀ [Nagel Collection in BSUB].

MALAWI. Chitipa District, Jembya Reserve, 18 km SSE Chisenga, 10-08S, 33-27E, 1,870 m, 1–10 Jan 1989, J. Rawlins, S. Thompson; *Paussus* sp.n. aff. *elizabethae*, Nagel det. 1996, 2♂, 1♀ [CMNH].

TANZANIA. Tang. Terr., Ukerewe I., Father Conrads; *P. conradti* Kolbe, det. Nagel 1984; 1♀ [Nagel Collection in BSUB] [1993 compared with holotype of *P. conradti* and dissimilarity stated].

Paussus excavatus Westwood, 1833 (Fig. 6)

Paussus phyllocerus Reichensperger, 1925. **New synonym.**

This species is very rare and the only records of *P. excavatus* since its description are those of Basilewsky (1968) and Nagel (2003b). I do not find any significant difference between the re-description and accompanying figures of *P. excavatus* by Westwood (1845) and the descriptions and figures of *P. phyllocerus* in Reichensperger (1925) and Luna de Carvalho (1963). These descriptions and our material leave little doubt that all belong to the same species.

This species is listed here and included in the following key because it is related to the *P. cucullatus* Group *sensu stricto* by its compressed and broad middle and fore tibiae. The width of the tibiae, especially the fore tibiae, is not as large as in *P. cucullatus* but resembles more the tibiae of *P. elizabethae*. *P. excavatus* has a body size of 4 mm (tip of

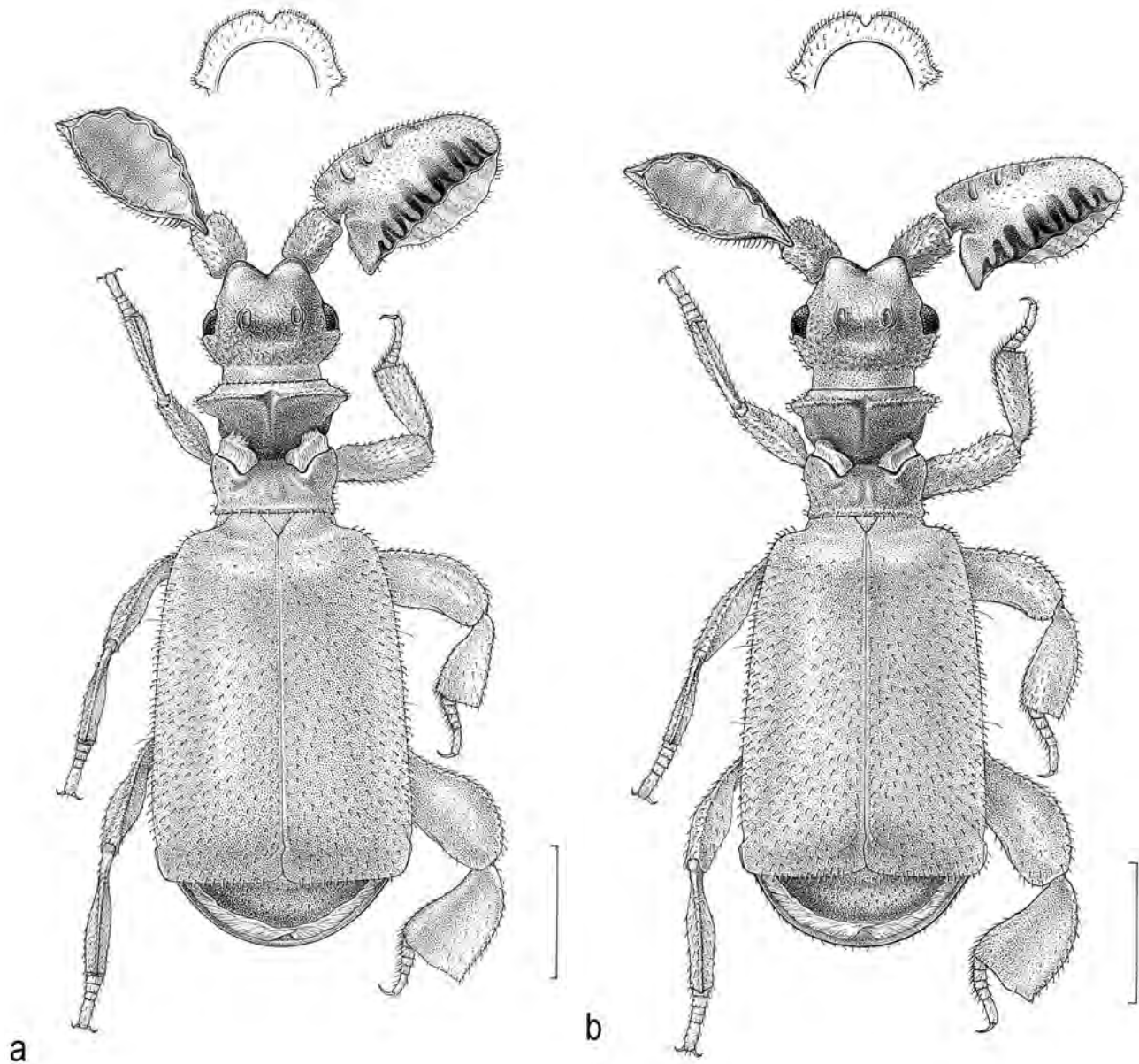


Fig. 5.—*Paussus elizabethae*. Malawi, Chitipa District, Jembya Reserve, 18 km SSE Chisenga, 10-08S, 33-27E, 1,870 mm, 1-10 Jan 1989, J. Rawlins, S. Thompson [CMNH]. A, ♀; B, ♂. Inset shows pronotal collar seen from the front. Scale bar 1 mm.

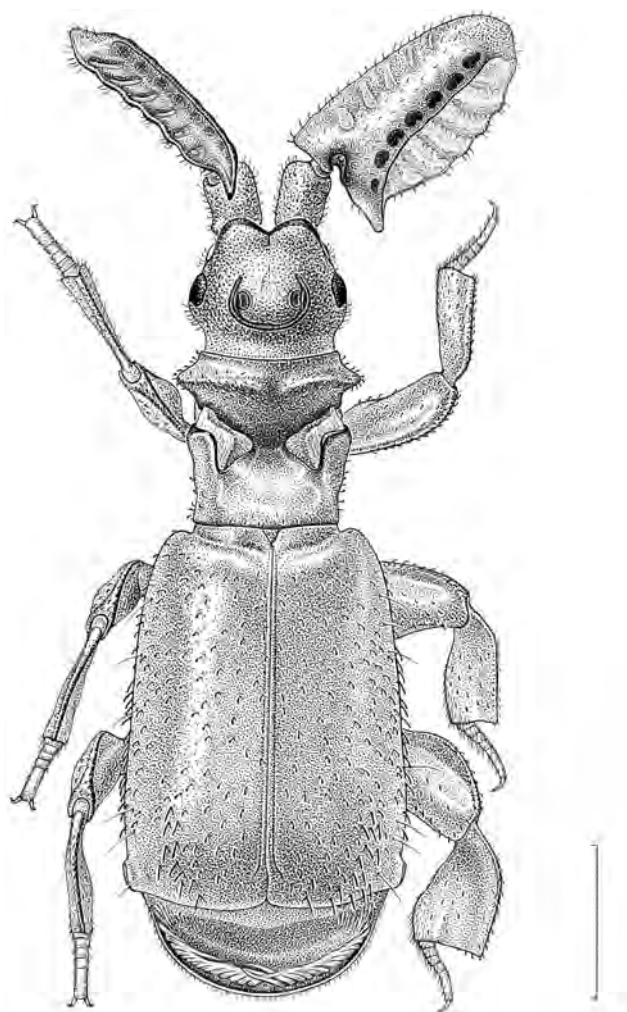


Fig. 6.—*Paussus excavatus*, ♀. S-Bénin, Forêt de la Lama, 06°57'N 02°10'E, ca 25 km SSW of Bohicon, 2001, Projet BioLama, CHR2 M XI [Nagel Collection in BSUB]. Scale bar 1 mm.

head to tip of elytra) and differs from the other species of this group by its long and flat antennal clubs and the conspicuous semicircular rear connection of the bracket-shaped exterior border of the frontal orifices. The outer basal tooth of the antennal club is protruding and pointed. It lacks the ventral subbasal trichome. The anterior pronotum is shaped as a very low and blunt transverse collar with a distinct yet truncated lateral tooth at each side. The elytral pubescence consists of scattered erect setae that are thicker and slightly shorter than in *P. elizabethae*.

P. excavatus has been recorded under this name from Senegal, Ivory Coast, and Bénin, under the name of *P. phyllocerus* from the Democratic Republic of the Congo (formerly Zaire, Provs. Haut Uélé, Equateur), and here we record it from Cameroon.

Material Examined.—BÉNIN. S-Bénin, Forêt de Lama, 06°57'N 02°10'E, ca 25 km SSW of Bohicon, 2001 Projet BioLama; CHR 2 M XI [= forest fallow invaded by *Chromolaena odorata*, Malaise trap],

Paussidae 1; 1♀ [Nagel Collection in BSUB]; same collecting data, but 2002–2003; DM I O 3 III [= Twin Malaise trap, baited with cut wood, June, 2002], AT BE-D [old stand of teak], Pau 5; 1♂ [Nagel Collection in BSUB]; same collecting data, but 2002–2003; Paussidae 3, C-FD3 B III [= control, window trap on tree trunk, dense semi-deciduous forest, June, 2002], 1♂ [Nagel Collection in BSUB].

CAMEROON. Tombel [South-West Cameroon, 04°45'N 09°40'E], Sept. 67; Muséum Paris, Camérout, B. deMiré; *Paussomorphus* ap. viator Péringuey; *Paussus exaratus* Westw., B. de Miré det. 1974; *Paussus excavatus* Westw., Nagel det. 1986; 1♂ [Nagel Collection in BSUB].

Paussus pseudocucullatus Nagel, 1983
(Fig. 7, 10D)

Other than the paratype specimens, the material listed below represents the only new records since the first description of this species. The species is now known from Angola, Zambia, and the Democratic Republic of Congo (formerly Zaire).

The specimen from Zambia differs from the other specimens by the interior margin of each frontal orifice being level with the exterior shell-shaped margin. In contrast to the structure in *P. semicucullatus* and as usual in *P. pseudocucullatus*, this exterior rim is high.

Material Examined.—DEMOCRATIC REPUBLIC OF CONGO. (formerly ZAIRE) Lusengi [= Mayumbe, Lusengi, Bas Congo, Zaire, L. Baert i.l. 1986], 31-V-25, A. Collart; [I.R. Sc. N.B.]. I.G.25.041, Coll. & det. J. Delève; *Paussus pseudocucullatus* Nagel, Nagel det. 1986; 1♂ [Nagel Collection in BSUB]; same data; 1♂ [Nagel Collection in BSUB]; same data; 4♂, 4♀ [I.R. Sc. N.B.]; same data, but 30-V-25; 4♂, 2♀, 4 ex. sex indet. [I.R. Sc. N.B.]; same data, but 9-IV-26; 3♂, 1♀ [I.R. Sc. N.B.]; same data but 2-VI-25; 2♂, 1♀ [I.R. Sc. N.B.] [partly with ants].

ZAMBIA. Lusaka, R.A. Beaver, Malaise trap, 24-5.X.79; 1♂ [Nagel Collection in BSUB].

ANGOLA. Camabatela, 910m, R.H. Braun, Paratypus, *Paussus pseudocucullatus* Nagel; 1♀, 2♂ [Nagel Collection in BSUB].

Paussus semicucullatus Wasmann, 1904
(Fig. 8A, 8B, 10F, 11B)

Wasmann (1904) states that Dr. Hans Brauns had detected the new species and that Brauns will describe it. He also cites "*Paussus semicucullatus* Brauns, n.sp.," similar to a previous publication (Wasmann 1898). However, no published description of this species by Brauns is known. In 1904 the species name is accompanied by a description of Wasmann. The name thus becomes available as *P. semicucullatus* Wasmann, 1904.

The holotype (Fig. 8A) is in perfect condition. It measures 3.7 mm from the tip of the head to the tip of the elytra. Similar to *P. pseudocucullatus* Nagel, 1983, the dull head contrasts with the shining surface of the pronotum, elytra and legs. The elytral pubescence is basically similar to *P. cucullatus* and *P. pseudocucullatus*. The appressed setae are still shorter and barely detectable in the holotype, while in the Rwanda specimens the elytral pubescence appears identical to the two aforementioned species. The transverse collar of the anterior pronotum in *P. semicucullatus* is

almost as sharp as, but significantly lower, than in *P. cucullatus*. In the original description, Wasmann (1904) stressed as a main character the boundary of the frontal depression that is delimited at its left and right side by the frontal orifices. He underlined that this area has a sharp edging all around except the frontal part ("im ganzen Umfange mit Ausnahme der vorderen Öffnung scharf erhaben gerandet" Wasmann, 1904, p.53). This character varies among the Rwanda specimens in hand. A distinct semicircular edging with an almost complete posterior edge exists in one specimen only. The edging in the other specimens is well shaped at both sides and distinctly bent towards the middle at its posterior part, yet not closing the area between the pores from behind (Fig. 8B, 11B). Even in the holotype the posterior edge is narrow and low although indicated by a thin black line. Such a rim-like structure, which connects the orifices at their rear part, is sometimes more or less clearly visible in specimens of *P. cucullatus* or *P. pseudocucullatus* and, therefore, not a good diagnostic character.

The main differences between *P. semicucullatus* on one hand and *P. cucullatus* and *P. pseudocucullatus* on the other, are the lower pronotal collar and the shape of the frontal orifices. The frontal openings are situated between the middle part of the eyes and far apart from each other, similar to *P. pseudocucullatus*. The exterior bracket-like protection of each orifice is much lower than in *P. pseudocucullatus*. The inner protuberance of each orifice is thus level with or slightly higher than the outer rim.

P. semicucullatus has been reported by Reichensperger (1925) from Zaire, Tongo Katanta, Manyema, 1918 (Dr. Gerard leg.). He emphasizes the weaker elytral pubescence when compared to *P. cucullatus* and the other description fits well to this species.

In a later publication, Reichensperger (1951) reported *P. semicucullatus* from Katanga and Kivu, leg. Leleup (Democratic Republic of the Congo, formerly Zaire). While comparing them with *P. cucullatus*, he mentioned their darker coloration, the more circular head, and the fine, scattered, appressed elytral pubescence with setae which look like dust particles ("Elytren...staubartig fein zerstreut anliegend behaart," Reichensperger, 1951:72). Many years ago, examples of these specimens from ZFMK were available to me and the presence of the lower pronotal collar was noted (Nagel 1983). Therefore, I suppose that these specimens are in fact *P. semicucullatus*, although an identity with *P. rawlini* cannot be excluded with certainty.

Luna de Carvalho (1989) classifies specimens from Zaire (now Democratic Republic of the Congo) and Rwanda as *P. semicucullatus*. The description of the edging of the frontal openings corresponds well with the structure in *P. semicucullatus*. There is, however, no mention of a lower pronotal collar, but similar to Reichensperger (1951) and Nagel (1983) the description

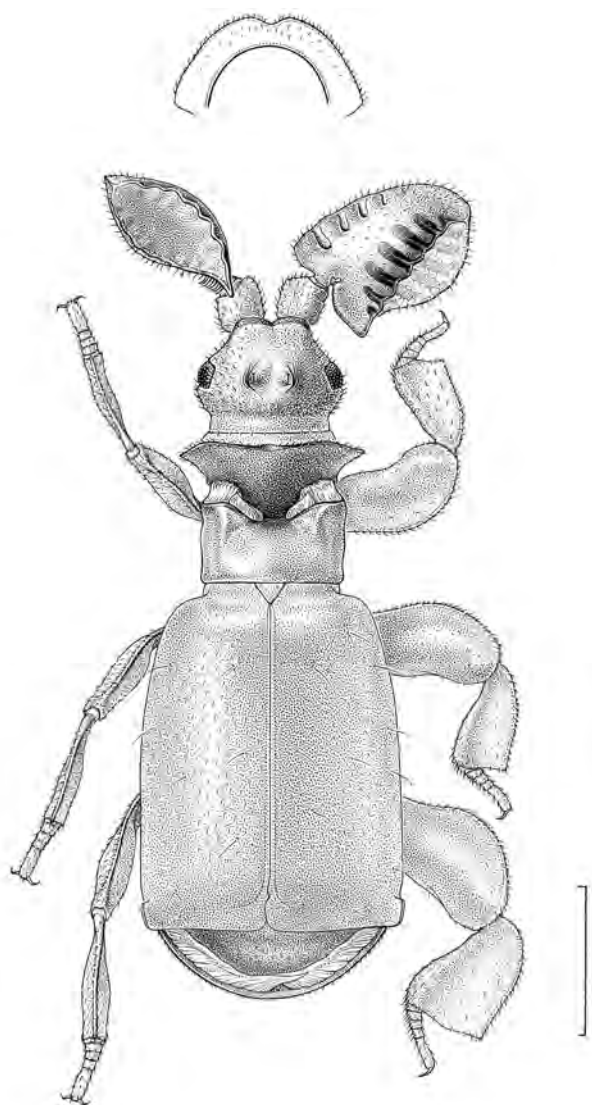


Fig. 7.—*Paussus pseudocucullatus*, ♂. Democratic Republic of the Congo (formerly Zaire), Lusengi, 31-V-25, A. Collart [Nagel Collection in BSUB]. Inset shows pronotal collar in anterior view. Scale bar 1 mm.

of the elytral pubescence ("glabre," "avec grosse ampliation, on note des fines soies courtes et couchées" [glabrous, at great magnification one recognizes thin, short, and appressed setae] Luna de Carvalho 1989, p. 510, 529) would leave some doubt as to which species the specimens belong. Most possibly the scattered fine erect setae had been rubbed off and Luna de Carvalho's interpretation is correct. In any case, an identity with *P. rawlini* seems unlikely due to the fact that in this new species the golden-yellow elytral setae are not thin but scaliform and individually discernible at a magnification of approximately 20×.

The specimen from Mohoro (ZMHUB) is similar to the holotype in that the scattered appressed setae of the

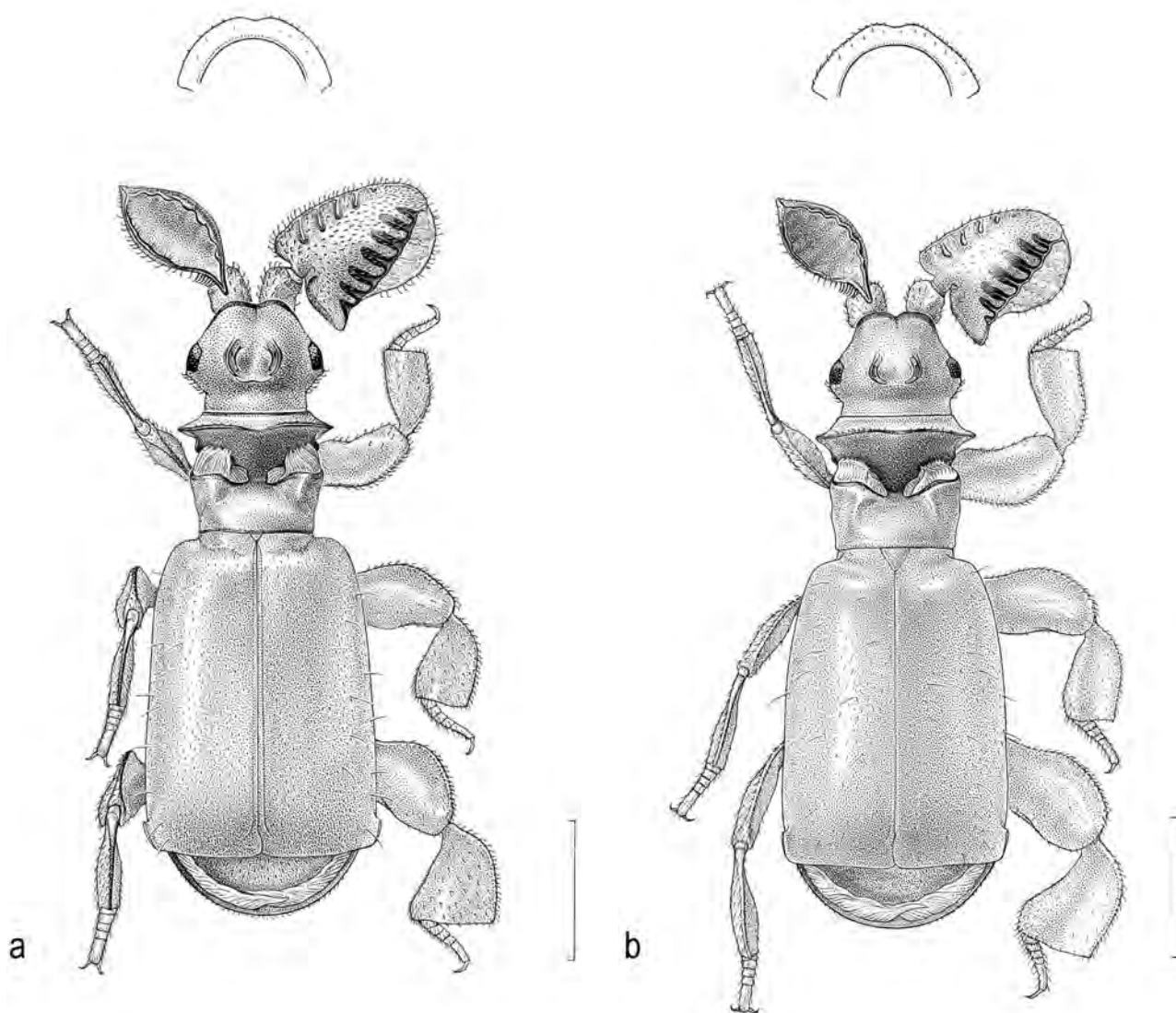


Fig. 8.—*Paussus semicucullatus* Wasmann. Inset shows pronotal collar in anterior view. A, ♀, holotype, South Africa; B, ♂, Rwanda, Cyangugu, Nyakabuye, 1984, leg. H. Mühle [Nagel Collection in BSUB]. Scale bars 1 mm.

elytra are extremely short and barely visible. There are only 2 to 3 long, thin erect setae left and the remains of two broken, erect setae.

The distribution of *P. semicucullatus* thus comprises South Africa, Tanzania, Rwanda and the Democratic Republic of Congo (Kivu, Katanga).

Material Examined.—**SOUTH AFRICA.** Port Elizabeth (Capkolonie); *P. semicucullatus* Brauns Type; b. *Pheidole punctulata*; Brauns Brief 21; 1♀; [holotype] [The same pin bears also a major and a minor worker of the *Pheidole* ant] [NHMM].

RWANDA. Cyangugu, Nyakabuye, 28.11.1984, leg. H. Mühle; 1♀ [Nagel Collection in BSUB]; same data but 30.3.1984; 1♂ [Nagel Collection in BSUB]; same data but 20.–25.10.1984; 2♂ [Nagel Collection in BSUB].

TANZANIA. Mohoro; 1♀ [ZMHUB].

Paussus rawlinsi, new species

(Figs. 9, 10A)

Diagnosis.—This species is similar to and closely related to *P. cucullatus* and its immediate allies yet clearly characterized by its particular pubescence. The most obvious distinguishing characters of *P. rawlinsi* are the simple elytral pubescence, the very short, flattened setulae of the elytral pubescence (Fig. 10A), and the protruding pores situated far apart from each other on the vertex. The differences to the most similar species are keyed out below.

Description of holotype.—♀; General appearance of *P. cucullatus*. Body length 4 mm from tip of head to tip of elytra.

Body light brown, shining, except head and front part of pronotum

(collar) matte; above and beneath with yellowish short pubescence, except posterior part of pronotum glossy and glabrous; pubescence appears like dust particles on elytra at 20× magnification; pubescence of equally short thick, scaliform bristles appressed and sparse on antennal clubs, scattered on head and pronotal collar and still denser and at an angle on elytra.

Head almost as long as broad (1.1 times broader), with upper margin of clypeus slightly incised in middle; vertex strongly vaulted, slightly impressed between openings; distance between two openings larger than distance between one opening and upper margin of eye; outer margin of each opening erect like a blinker or shell and double-lined on top, inner margin equally erect yet much narrower; frons and vertex matte with coarse punctation, each puncture bearing one appressed, short, scale-like bristle; depression between openings glabrous, no coarse punctation yet slightly shining due to rough microsculpture.

Antennal club with frontal, apical and rear outline roundish, barely longer than wide (1.2 times); ventral subbasal trichome of dense erect bristles clearly demarcated; upper surface smooth and glossy, basal tooth area less shining due to scattered minute punctures.

Pronotum 1.3 times broader than long, distinctly broader than head; transverse collar of frontal pronotum high, sharply keeled; frontal part of collar less shining due to shallow wrinkling; rear incline matte of dense micropunctures; posterior part of prothorax above and beneath glabrous, smooth and glossy with just a few setae at sides.

Elytra shining despite distinct yet shallow wrinkling; yellowish pubescence like dust particles at low magnification; bristles short, broad, scale-like, often split apically, thus forming a triangular scale (Fig. 10A); few thin erect setae of *series umbilicata* present.

Margin of pygidium similar to *P. cucullatus*, broad and equipped with very long and dense trichomes; disk equipped with scattered bristles slightly smaller than on elytra.

Femora and tibiae strongly flattened and broadened, equipped with pubescence similar to whole underside (except posterior prothorax); most bristles strongly split.

The paratype specimen differs by the fact that virtually all bristles of the general pubescence are split from their base and look like a minute bunch of setae (the degree of splitting may well depend on the type and intensity of preservative or solvent used for killing and preservation).

Etymology.—The species is named for its collector John E. Rawlins, Section of Invertebrate Zoology, Carnegie Museum of Natural History, who contributed profoundly to the current knowledge of the Malawian insect fauna and, in particular, to the Malawian paussine fauna.

Type Material.—Holotype, female. VERBATIM LABEL DATA: MALAWI: Chitipa District, Jembya Reserve, 18 km SSE Chisenga, 10-08S, 33-27E, 1,870 m, 1–10 Jan 1989, J. Rawlins, S. Thompson; *Paussus* sp. n. aff. *pseudocucullatus*, Nagel det 1996; ♀ [CMNH]; Paratype: same locality data, 1♀ [CMNH].

Key to Species of the *Paussus cucullatus* Group *sensu stricto*

This key includes all species closely allied to *P. cucullatus* and characterized by a body size of approximately 4.0 mm, two frontal orifices, distinctly compressed and widened middle tibiae, and strongly flattened and widened hind tibiae. The equally small species more closely related to *P. conradti*, such as a still undescribed species from Arabia (MNH), *P. rougemontianus* Lorenz (Syn.: *P. rougemonti* Luna de Carvalho) (with an almost closed antennal club) from Yemen, or the larger *P. cyathiger* Raffray from Ethiopia, differ from *P. cucullatus* and its allies in the shape of the legs (i.e., the middle and fore legs are not

widened or strongly compressed). These species with rather narrow middle and fore tibiae are excluded from the key.

In contrast, for example, to some species of the *P. thomsonii* or *P. laevifrons* Groups, sexual dimorphism is only weakly established in the species in the following key. In the females the eyes are slightly smaller and slightly less protruding, the antennal clubs are a little broader and the tibiae a little shorter and thus relatively broader (Figs. 5, 8). All these characters are in agreement with the general tendency of the derived Paussini, yet here scarcely recognizable.

Please note that all species display a few thin, long, erect setae of the *series umbilicata*, irrespective of the double or simple elytral pubescence.

1. Antennal club flat, long; semicircular double line embracing the frontal orifices at the rear; anterior pronotum without distinct transverse collar, bluntly rounded; antennal club without trace of ventral subbasal trichome (Fig. 6); Senegal to Democratic Republic of the Congo [formerly Zaire]).....
.....*P. excavatus* Westwood, 1833
- 1'. Antennal club inflated, short; rear area between frontal orifices never completely bordered with a distinct and double line, at most a simple edging or bulge present; anterior pronotum shaped as a transverse collar, low or high, obscure or blade-shaped and sharply edged; antennal club with ventral subbasal trichome present, even if very weak 2
- 2(1'). Elytral pubescence of two types: scattered, short, thin appressed setae, plus very scattered, long, very thin, erect setae (the latter indistinguishable from setae of the *series umbilicata*) (N.B.: both types of setae are of a similar light brown color as the elytra and, therefore, on brief examination the elytra may appear almost glabrous; the erect setae are often broken, rubbed off or stuck to the surface) (Figs. 10D–F); elytra strongly shining, smooth or with a shallow wave-like structure; all three pairs of legs strongly flattened and widened (Figs. 3, 7, 8); antennal club dorsally between the apical sensory field and the base strongly shining, smooth, glabrous (*P. cucullatus*, *P. pseudocucullatus*) or shining with scattered setulae (*P. semicucullatus*)..... 3
- 2'. Elytral pubescence simple (Figs. 10A–C); elytra shining or dull; fore legs compressed and widened (Fig. 9) or not widened (Figs. 4, 5); antennal club with scattered setulae dorsally between the apical sensory field and the base. 5
- 3(2). Collar of anterior pronotum low yet with a sharp edge (Fig. 8); antennal club dorsally between the apical sensory field and the base shining with scattered setulae; vertex with frontal pore area with posterior edging almost complete or indicated (Figs. 8, 11B); when

viewed from above, distance between exterior margins of pores at least as great as distance between outer margin of pores and inner margin of eye; exterior lateral margin of pores not or slightly protruding in a shell-like manner; dorsal surface of head with fine granulation, dull, without setulae sticking out (Fig. 11B) (South Africa, Tanzania, Rwanda, Democratic Republic of the Congo [formerly Zaire]) *P. semicucullatus* Wasmann, 1904

- 3'. Pronotal collar high and sharply edged (Figs. 3, 7); antennal club glabrous and strongly shining except for apical sensory field; vertex with posterior margin of frontal pore area never distinctly edged; when viewed from above, distance between exterior margins of pores at most as great as distance between outer margin of pores and inner margin of eye; pores exteriorly with or without distinct shell-like border; dorsal surface of head with very fine microsculpture, shining, mostly with setulae sticking out (pilosity similar to Fig. 11A) 4

- 4(3'). Head with paired pores almost level with frons, obliquely directed to the front, situated between the frontal parts of eyes when viewed from above (Fig. 3) (Southern Africa) *P. cucullatus* Westwood, 1850

- 4'. Head with pores exteriorly protected by raised shell-like costae, directed upwards, situated between the middle of the eyes when viewed from above (Fig. 7) (Zambia, Democratic Republic of the Congo [formerly Zaire], Angola) *P. pseudocucullatus* Nagel, 1983

- 5(2'). Elytra with a matte finish, rugose; evenly set with yellowish and rather long and thick, erect setae (Figs. 4, 5); these bristles are apically blunt and sometimes frayed (Figs. 10B,C); frontal pores oval, margin entire, not protected by costae or tubercles, situated on top of the vaulted head (Fig. 11A); antennal club with ventral sub-basal trichome very thin, composed of few, thick setae, different from all other species in this key; antennal club and pronotum distinctly longer than broad; head and pronotum approximately of equal width (Figs. 4, 5) (Kenya, Tanzania, Malawi, Democratic Republic of the Congo [formerly Zaire], Zimbabwe, South Africa) *P. elizabethae* Péringuey, 1897

- 5'. Elytra strongly shining, almost smooth, surface structure indicated by shallow, merging punctation; evenly set with very short, scaliform setulae that are broadly split at their ends (Figs. 9, 10A); frontal pores protected exteriorly by a shell-like costa, interiorly by an equally high cone; antennal club with ventral sub-basal trichome thick, compact, forming a dense pad similar to all other species in this key except *P. excavatus* and *P. elizabethae*; antennal club barely longer than broad, pronotum broader than long, distinctly broader than head (Fig. 9) (Malawi) *P. rawlinsi*, new species

Paussus viator Péringuey, 1896

I have seen specimens of this species from South Africa, Zimbabwe, Zambia, and Mozambique. Reichensperger (1938a: 86) reported it from Tanzania ("Kilimandjaro, versant sud-est, Kilema, 1440m"). This is the first record for Malawi.

Material Examined.—**MALAWI.** Chitipa District, Jembya Reserve, 18 km SSE Chisenga, 10-08S, 33-27E, 1,870 m, 5-10 Dec 1988, J. Rawlins, S. Thompson, 1♂ [CMNH]; same data but 11-20 Dec 1988, 2♂ [CMNH]; same data but 21-31 Dec 1988, 1♂ [CMNH]; same data but 1-10 Jan 1989, 3♂ [CMNH].

Paussus klugii Westwood, 1838

The range of this species comprises South Africa, Swaziland, Zimbabwe, Zambia, Angola, Democratic Republic of the Congo [formerly Zaire], Mozambique, Tanzania and South Kenya. To my knowledge it has not yet been reported from Botswana.

Material Examined.—**SOUTH AFRICA.** Transvaal, Pretoria District, Boekenhouts Kloof, 22-23 Feb 1992, Kalahari sands, Robert D. Ward, 1♂, 1♀ [CMNH].

BOTSWANA. Ngamiland Dist., Moremi Wildlife Res., North Gate, 19 10'S, 23 45'E, 28 Dec 1988, R. Ward, 1 specimen [CMNH].

Paussus bohemani Westwood, 1855

The species is known from Zimbabwe, South Africa, Botswana, Namibia and Angola.

Material Examined.—**BOTSWANA.** Maun, 26 Dec 1988, R.D. Ward, coll.; Robert D. Ward Collection, donated 1989, 1♂ [CMNH]; Savuti Ch., 27.IX.1970, BL Trap, N.S. Irving; Robert D. Ward Collection, donated 1989, 1♂ [CMNH]; Bakgatla, Sebele, 5.XI.68, MV Trap; Robert D. Ward Collection, donated 1989, 1 specimen [CMNH].

Paussus dohrnii Westwood, 1852

The species is known to occur in South Africa and Mozambique.

Material Examined.—**SOUTH AFRICA.** Transvaal, 15 km E Karino Station, Mpageni Pass, 1 Nov 1992, Robert Ward, 1♂ [CMNH].

Paussus massarti Reichensperger, 1933

Luna de Carvalho (1989) lists localities in the Democratic Republic of the Congo (formerly Zaire), Angola and Namibia. I saw one specimen from Zambia (ZSM). Here we report the species for the first time from Malawi.

Material Examined.—**MALAWI.** Chitipa District, Jembya Reserve, 18 km SSE Chisenga, 10-08S, 33-27E, 1,870 m, 5-10 Dec 1988, J. Rawlins, S. Thompson, 2♂ [CMNH]; same data but 11-20 Dec 1988, 2♂ [CMNH]; same data but 21-31 Dec 1988, 3♂ [CMNH]; same data but 1-10 Jan 1989, 1♂ [CMNH]; same data but 11-20 Jan 1989, 4♂ [CMNH]; same data but 21-24 Jan 1989, 1♂ [CMNH].

Paussus spinicoxis Westwood, 1850

This is the most frequently collected African paussine. It is widely distributed in eastern and southern Africa.

Material Examined.—BOTSWANA. Gaborone, 14–20 Nov 1987, R.D. Ward, coll., Robert D. Ward Collection, donated 1989, 1♀ [CMNH]; Notwane R., 21 km S of Gaborone, 5 March 1988, Ward/Stronkhorst, Robert D. Ward Collection, donated 1989, *Paussus spinicoxis* Westw., det. R. Davidson, 1♂ [CMNH].

ZIMBABWE. 20 km SW Harare, 29–31 Dec 198, leg. P. Cresswell; Robert D. Ward Collection, donated 1989; *Paussus spinicoxis* Westw., det. R. Davidson, 2♂ [CMNH].

TANZANIA. Nyamirembe, 8 Oct 1976, coll. R.W. Pemberton, Robert D. Ward Collection, donated 1989; *Paussus obsti*; 1♂ [CMNH].

Paussus canaliculatus Wasmann, 1919

Paussus rotundicollis Wasmann, 1922 (Nagel 1983)

This species is widely distributed from southern Africa to the Democratic Republic of the Congo (formerly Zaire).

Material Examined.—BOTSWANA. Bakgatla, Sebele, 18.X.1970, at light, N.S. Irving; Robert D. Ward Collection, donated 1989, 1♀ [CMNH].

Paussus damarinus Westwood, 1874

Widespread in southern Africa (South Africa, Botswana, Namibia, Angola, Zimbabwe, Mozambique, Tanzania) but not yet recorded from Zambia and Malawi. The Malawi specimens are a little smaller on average, especially when compared to the rather large South African specimens. Perhaps this is due to clinal variation.

Material Examined.—MALAWI. Chitipa District, Jembya Reserve, 18 km SSE Chisenga, 10-08S, 33-27E, 1,870 m, 11–20 Dec 1988, J. Rawlins, S. Thompson, 1♂ [CMNH]; same data but 21–31 Dec 1988, 2♂ [CMNH]; same data but 1–10 Jan 1989, 5♂ [CMNH]; same data but 11–20 Jan 1989, 3♂ [CMNH].

ZAMBIA. Wasa Kasanka Nat. Park, 12 34'S, 30 18'E, April 26 1992, C.H. Scholtz, 1♂ [CMNH].

Paussus curtisii Westwood, 1864

This species is abundant. The variation in shape of the tip of the antennal club has been shown by Nagel (1983). Luna de Carvalho (1989, p.711) clarified that Westwood's descriptions and figures (Westwood, 1864:190: "antennarum clava...3-denticulata"; 1874: plate 18, f. 11) are misleading because the female holotype is of the ordinary two-toothed form. Its range comprises southern Africa through Angola and Zaire to Rwanda and Kenya. It had not yet been recorded from Malawi.

Material Examined.—MALAWI. Chitipa District, Jembya Reserve, 18 km SSE Chisenga, 10-08S, 33-27E, 1,870 m, J. Rawlins, S. Thompson, 5♂ [CMNH].

BOTSWANA. Notwane R., 21 km S of Gaborone, 5 March 1988, Ward/Stronkhorst; Robert D. Ward Collection, donated 1989; *Paussus*

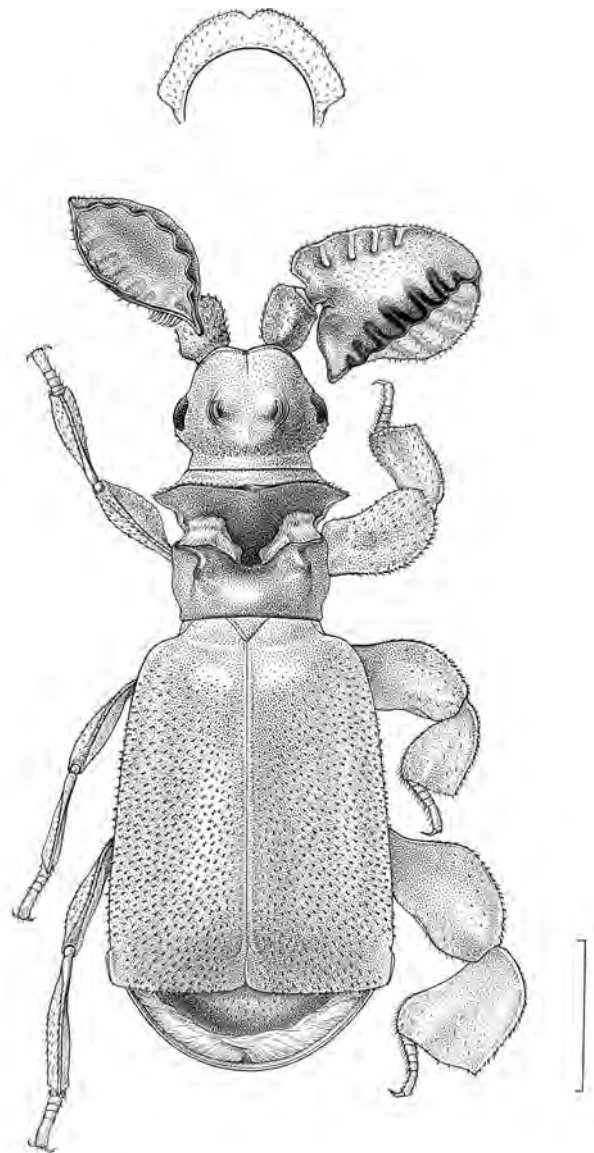


Fig. 9.—*Paussus rawlinsi*, new species, ♀ holotype, habitus. Malawi. Inset shows pronotal collar in anterior view. Scale bar 1mm.

curtisii Westw., det. R. Davidson, 1♂, 1♀ [CMNH].

SOUTH AFRICA. Transvaal, Warmbaths vicinity, 5 April 1992, Robert D. Ward, 6♂, 5♀ [CMNH].

Paussus cylindricornis Péringuey, 1885

The species is distributed in southern Africa and has already been recorded from Botswana. The differences to *P. telescopifer* Wasmann, 1922, from Tanzania include the lower vertex and the two round micro-trichomes near the apex of the pygidial disk in *P. cylindricornis* (cf. Nagel 1980a).

Material Examined.—BOTSWANA. Palapye Jct., 24–30 Dec 1989, Pete Cresswell, 1♂ [CMNH].

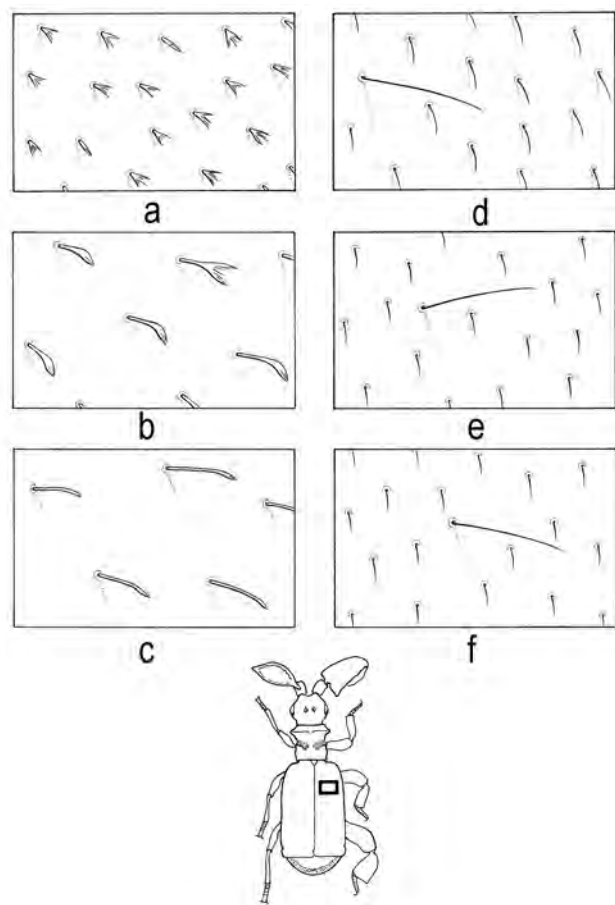


Fig. 10.—Elytral pubescence of *Paussus cucullatus* and allies. Inset shows section displayed from first third of right elytron. A, *P. rawlini*, new species; B, *P. elizabethae*, Malawi; C, *P. elizabethae*, South Africa (Capland); D, *P. pseudocucullatus*, Dem. Rep. Congo; E, *P. cucullatus*, Zambia; F, *P. semicucullatus*, Rwanda.

Paussus vanrooni Wasmann, 1922

The classification of the southern African pair of species *P. vanrooni* and *P. shuckardi* Westwood, 1838, has been discussed by Nagel (1983b) and Luna de Carvalho (1989).

Material Examined.—**BOTSWANA.** Palapye (Jct.), 9 July 1989, Pete Creswell, 1♂ [CMNH]; same data but 24–30 Dec 1989, 1♂ [CMNH]; same data but 27 Jan 1990, 1♂ [CMNH]; 4–8 Feb 1990, 8♂ [CMNH]; same data but Nov 1988, *leg.* P. Cresswell, Robert D. Ward Collection, 1♀ [CMNH]; same data but 7–15 Jan 1989, *Paussus vanrooni* Wasm., det. R. Davidson, 4♂ [CMNH]; Chobe River, 8 km W Kasane, 27–29 Dec. 1987, R.D. Ward, coll., Robert D. Ward Collection, 1♀ [CMNH]; Maun, 16 Dec 1988, R.D. Ward, coll., Robert D. Ward Collection, donated 1989, *Paussus vanrooni* Wasm., det. R. Davidson, 1♂ [CMNH]; Tlokwen, 22–29 Feb 1988, R.D. Ward, coll., Robert D. Ward Collection, donated 1989, *Paussus vanrooni* Wasm., det. R. Davidson, 1♂ [CMNH]; Gabarone, 1–5 Dec 1987, R.D. Ward, coll., Robert D. Ward Collection, donated 1989, *Paussus vanrooni* Wasm., det. R. Davidson, 1♂ [CMNH].

Paussus manicanus Péringuey, 1896

(Fig. 12)

This is the first record of *P. manicanus* from Malawi. The *P. manicanus* Group comprises *P. manicanus*, *P. planicollis* Raffray, 1885, and *P. vollenhovii* Westwood, 1874. The antennal club of females is slightly shorter and broader than that of males and its surface is smooth and glossy (in males weakly granulose yet still shining). In addition, in females the eyes are smaller and less protruding and the tibiae are slightly shorter and broader. The species are distinguished by the following main characters.

Material Examined.—**MALAWI.** Chitipa District, Jembya Reserve, 18 km SSE Chisenga, 10-08S, 33-27E, 1,870 m, 5–10 Dec 1988, J. Rawlins, S. Thompson, 9♂ [CMNH]; same data but 11–20 Dec 1988, 5♂ [CMNH]; same data but 21–31 Dec 1988, 40♂ [CMNH]; same data but 1–10 Jan 1989, 43♂ [CMNH]; same data but 11–20 Jan 1989, 8♂ [CMNH]; same data but 21–24 Jan 1989, 8♂ [CMNH].

Key to the *Paussus manicanus* Group

(Fig. 12–14)

1. Posterior margin of pygidium slightly elevated, forming a sharp, acute edge, equipped above with a thin band of short and dense setae that barely project beyond the margin, below with a row of widely separated, short, appressed setae; elytra with numerous punctures; body length (clypeus to tip of elytra) 6.5–8.0 mm (South Africa, Swaziland, Botswana, Namibia, Mozambique, Zimbabwe, Zambia, Angola, Tanzania, Malawi, SE Democratic Republic of the Congo [formerly Zaire]) ..
..... *P. manicanus* Péringuey (Fig. 12)
- 1'. Posterior margin of pygidium strongly elevated, forming an acute keel; posterior margin equipped above with a broad band of long setae that distinctly project beyond the margin, below with an irregular row of equally long, slightly sloping setae, which are set separate yet close; elytra with a few large, flat punctures concentrated mostly at basal-inner part; body length 6.5–8.2 mm 2
- 2(1'). Antennal club of male 2 times longer than broad; basal-inner part of elytra with a few large, flat punctures, and a few beyond middle, each bearing one thin, erect seta; body length 7.5–8.2 mm (Kenya, Somalia; Tanzania?, Angola?)
..... *P. vollenhovii* Westwood (Fig. 13)
- 2'. Antennal club of male narrower, at least 2.3 times longer than broad; elytral punctation denser, more extensive; fine pubescence evenly extended over almost the entire elytra (similar to *P. manicanus*); body length 6.5–7.0 mm (Tanzania, Kenya, Ethiopia, Eritrea)
..... *P. planicollis* Raffr. (Fig. 14)

Paussus woerdeni Ritsema, 1876

The two species *P. woerdeni* and *P. adinventus* Dohrn, 1888, are very similar. The criteria to separate them as well as the assignment of the synonyms *P. oculatus* Wasmann, 1922, and *P. vanhaelsti* Luna de Carvalho, 1976, differ between authors (Nagel 1977; Luna de Carvalho 1989). The present classification is based on the distinct pubescence of the elytra in *P. woerdeni*. The species complex is known from Uganda, Rwanda, Gabon, Democratic Republic of the Congo (formerly Zaire), Tanzania, Zambia, Angola. We report it here for the first time from Malawi.

Material Examined.—MALAWI. Chitipa District, Jembya Reserve, 18 km SSE Chisenga, 10-08S, 33-27E, 1,870 m, 1-10 Jan 1989, J. Rawlins, S. Thompson, 1♀ [CMNH]; same data but 11-20 Jan 1989, 1♀ [CMNH].

Paussus cf. *nageli* Luna de Carvalho, 1980
(Fig. 15)

This is the second record of *P. nageli*, which has been known only from the holotype from Chad. The *P. armatus* Group has been comprehensively revised by Nagel (1977). Luna de Carvalho (1980) gives additional information on this group, which he treated as *Katapaussus* Wasmann, 1929. Despite this background information it is with great reservation that I attribute the present specimen to this species.

It corresponds to the description and figure (Luna de Carvalho 1980, 1989) in the medially strongly constricted and deeply excavated pronotum and the long, inflated antennal club. It differs from the original description in the dorsal antennal subbasal trichome, which is equally minute but compact in the present specimen. It further differs by the straight (instead of slightly bent) antennal club and the presence of a vertical cone-shaped horn of similar size as in *P. thomsonii* Reiche, 1860, or *P. arabicus* Raffray, 1885. In the holotype of *P. nageli* the horn is much lower. Due to the narrower posterior part of the pronotum the anterior pronotum appears much wider than either *P. thomsonii* or *P. arabicus*.

The present specimen resembles *P. thomsonii* in the rather broad and parallel tibiae, the shape of the frontal horn and in the following structures of the antennal club. The club is straight, the fronto-basal angle is almost rectangular and the basal tooth is obtuse. It differs from *P. thomsonii* by its longer antennal club, the weak concave double curves of the basal posterior margin of the antennal club, and the distinctly more constricted and cleft pronotum. It differs from *P. arabicus* by the rather broad and parallel tibiae, more obtuse basal tooth of the antennal club and the rectangular fronto-basal angle of the club.

P. thomsonii has a circum-Saharan distribution, which comprises East Africa, Southwest Arabia, southern Israel, Egypt, Libya, Tunisia, Algeria, and Morocco. In addition, specimens from Mali have been attributed to this species

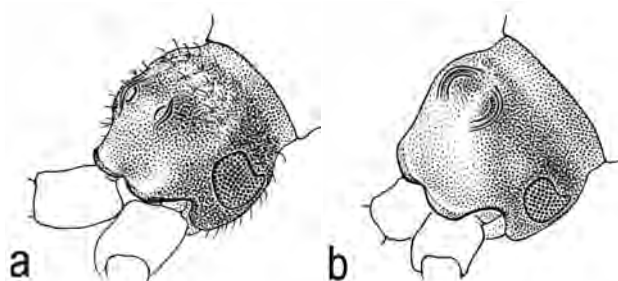


Fig. 11.—Oblique view of head. A, *P. elizabethae*, ♂, South Africa (Capland); B, *P. semicucullatus*, ♂, Rwanda.

(Nagel 1977). In 1997 I saw four *P. thomsonii*- or *P. nageli*-like specimens from Niger (Madaroumfa, Maradi, Mayayi) in the collection of the Laboratoire d'Entomologie, Centre de Recherche, Institut National de Recherches Agronomiques du Niger, Maradi, Niger, yet had no possibility of closer study or loan.

The present specimen has to be classified as *P. nageli* if the listed differences from the holotype are interpreted as interspecific variation. It could also be interpreted as a structurally distinct West African specimen of *P. thomsonii* due to clinal variation. Finally, it might represent a new species, closely allied to both *P. thomsonii* and *P. nageli*. The availability of just one single specimen does not allow a well-founded decision for any of the three possibilities.

Material Examined.—NIGER. Niamey, 28 Sept 1984, T.S. McNary, 1♂ [CMNH].

Paussus cornutus Chevrolat, 1832

The species is distributed from Senegal to Sudan and northern Uganda and inhabits mainly the Sudan savannah zone (see revision in Nagel 1977).

Material Examined.—NIGER. Niamey, 26 July 1984, T.S. McNary, 1♂ [CMNH].

Paussus rusticus Péringuey, 1885

A southern African species, which is not rare and is easy to recognize. The only species with which it may be confused is its sister species, *P. chappuisi* Reichensperger, 1938, a vicariant from Ethiopia, Kenya and northern Tanzania (see revision in Nagel, 1977).

Material Examined.—BOTSWANA. Maun, 26 Dec 1988, R.D. Ward, coll.; Robert D. Ward Collection, donated 1989, 1♂ [CMNH].

Paussus aenigma Reichensperger, 1954
(Fig. 16)

The specimen from northwestern Tanzania (Uha, listed below) was studied some years ago and sent back to Berlin and is, therefore, currently not available to me. The name

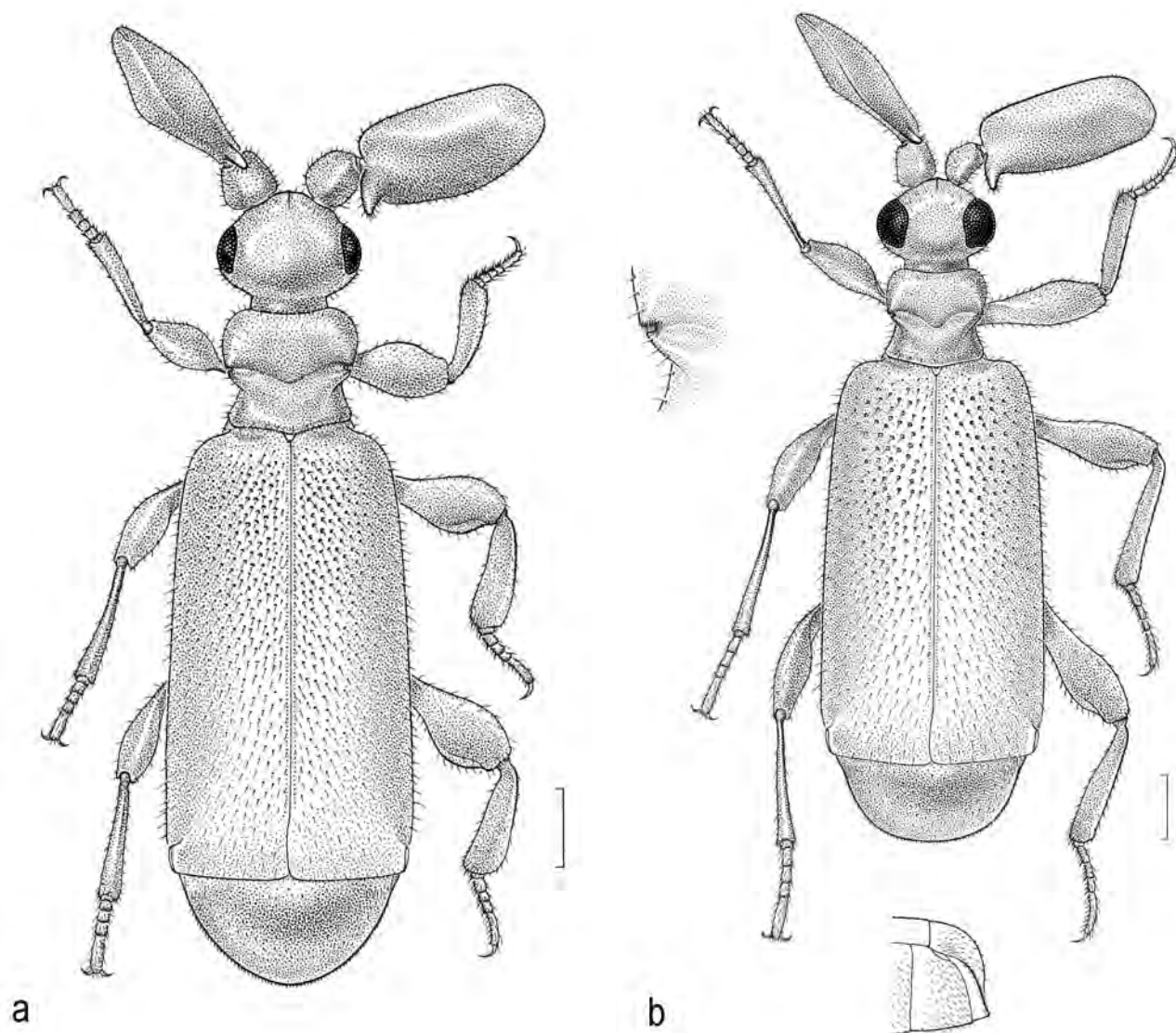


Fig. 12.—*Paussus manicatus*, A, ♀, South Africa, Transvaal, Nylsvley Nature Reserve, 24.39S 28.42E, XI.1980–II.1981, light trap, E. Grei [Nagel Collection in BSUB]; B, ♂, Malawi, Chitipa District, Jembya Reserve, 18 km SSE Chisenga, 10-08S, 33-27E, 1,870 m, 5–10 Dec 1988, J. Rawlins, S. Thompson [CMNH]. Upper inset shows middle section of lateral pronotum. Lower inset shows lateral view of pygidium. Scale bar 1 mm.

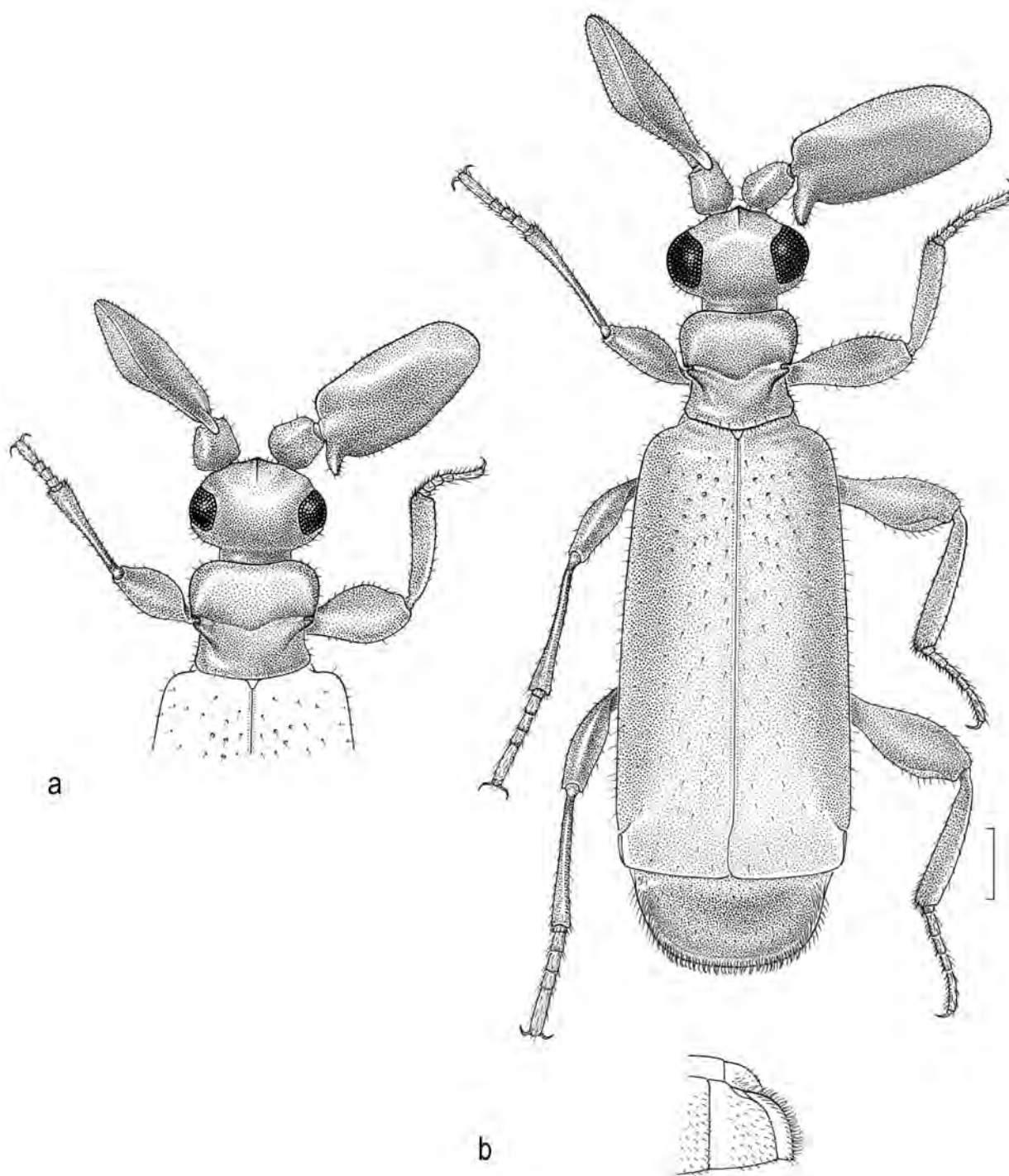


Fig. 13.—*Paussus vollenhovii*. A, ♀, Kenya, Sagala Hills, XI.95, Werner leg. [Nagel Collection in BSUB]; B, ♂, Kenya, Taita Hills, XII.1991, Werner leg. [Nagel Collection in BSUB]. Inset shows lateral view of pygidium. Scale bar 1 mm.

P. methneri Kolbe is attached to this specimen and is a *nomen nudum*, as it has not been published.

According to the original description (Reichensperger 1954) the holotype differs from both Burundi and Malawi specimens in the presence of a longitudinal keel of the vertex, the lack of pronotal lateral trichomes and the distinctly longer antennal clubs. Although Reichensperger (1954) did not note the sex of the holotype, it seems reasonable to interpret these differences as sexual dimorphism.

The Malawi specimen differs from the Burundi specimen in the acute margin of the pygidium, the round shape and slightly smaller size of the two lateral pygidial trichomes, the lower and medially projecting upper edge of the clypeus, and the slightly shorter antennal club. The holotype from Morogoro, southern Tanzania, is explicitly stated to have oval pygidial pad-like trichomes (Reichensperger, 1954).

With only two females in hand and just four specimens known altogether it does not seem reasonable to describe a new species on the basis of these weak characters. The species is thus known from Tanzania, Burundi and Malawi. To date, this species was known only from the holotype.

Material Examined.—**MALAWI.** Chitipa District, Jembya Reserve, 18 km SSE Chisenga, 10-08S, 33-27E, 1,870 m, 1-10 Jan 1989, J. Rawlins, S. Thompson, 1♀ [CMNH].

TANZANIA. Uha, X.12; Type; *Paussus methneri* n.sp. Kolbe; 1♀ [ZMHUB].

BURUNDI. Source du Nil, 2000 m, 15.III.1992, E. Arndt; 1♀ [Nagel Collection in BSUB].

Paussus cylindricollis Wasmann, 1922

The determination is based on Nagel (1980b). The species is known to occur in Ethiopia, Somalia, Kenya, Burundi, Tanzania, Angola, "Nyassa" (former name for Lake Malawi and neighboring regions).

Material Examined.—**ETHIOPIA.** Shewa Prov., Kolea Dairy Development, 2 km S Kolea, 1700m, 8 25'N, 39 02'E, 18-21 April 1995, Duane A. Schlitter; 4♂ [CMNH].

Genus *Hylotorus* Dalman, 1823

Hylotorus sebakuanus Péringuey, 1908

This is the first record for Botswana. The species is known from Zimbabwe and Zaire.

Material Examined.—**BOTSWANA.** Chobe Dis., Chobe Lodge, 8 km W Kasane, 30-31 Dec 1988, R.D. Ward; Robert D. Ward Collection, donated 1989; 1♂ [CMNH].

DISCUSSION

Many of the paussines described in this paper were collected at the edge of an isolated relict forest in northern Malawi, the Jembya Forest Reserve. An entomologist

(Dr. John E. Rawlins) and a botanist (Dr. Sue A. Thompson) from the Carnegie Museum of Natural History sampled vegetation and invertebrates at the site from 2 December 1988 to 25 January 1989. These paussine collections were associated with many specimens of both invertebrates and plants gathered by Rawlins and Thompson in collaboration with Vincent Nyrenda, staff entomologist of the Forest Research Institute of Malawi. More than 140,000 invertebrate specimens were taken, representative of all lineages encountered.

The following information has been kindly provided by John E. Rawlins. The Jembya Forest Reserve is on the northern slopes of the Nyika Plateau near the Zambian border (Chitipa District, 18 km SSE Chisenga, 10°08'S, 33°27'E) and consisted in 1988-1989 of a single patch of upland forest at 1,870 m elevation, reduced to less than 60 hectares from what was historically widespread forest by repeated seasonal burning of the surrounding scrublands. These fire-maintained savannas are characterized by thick grass, bracken fern, and scattered trees and small shrubs, especially fire-resistant species of *Protea* (Proteaceae). Termite mounds and ant nests were densely scattered over the savannah at Jembya Reserve.

Paussines from the Jembya Forest Reserve were captured almost entirely at sheets illuminated by mercury vapor lamps in the scrubland within 300 m of the forest edge. No specimens were collected within the forest itself, which was a diverse and dense growth of trees dominated by very large *Albizia* (Fabaceae: Mimosoideae) over an understory characterized by *Garcinia* (Hypericaceae) and other small trees. During December the weather was warm and relatively dry, but this ended abruptly on December 24 with a shift in wind direction and arrival of the cool monsoon that persisted throughout January. In contrast to many other insect species, paussines were active throughout this transition in temperature and precipitation, and were particularly abundant during the first week of January.

In general, most savannah paussines (mainly members of the *Paussus armatus*, *P. laevifrons*, and *P. spinicoxis* Groups) are attracted by light while strict forest species are found almost exclusively in pitfall traps or in ants' nests. There are exceptions to both such as *Paussus benoitii* Janssens that had never been attracted to light during three months at a savannah site in Cameroon but found in an ants' nest under stones just a few meters from the illuminated sheet (Nagel 1982). Perhaps *P. buettikeri* represents one of the forest species that accidentally had been sampled at light.

Most Malawi paussines treated in this paper are southern African species whose range extends to Tanzania. Malawi represents the northernmost known locality of the two species *P. massarti* and *P. damarinus*. Species such as *P. aenigma* or *P. cylindricollis* have a more eastern African distribution. The two new species and the eight first records for Malawi demonstrate the

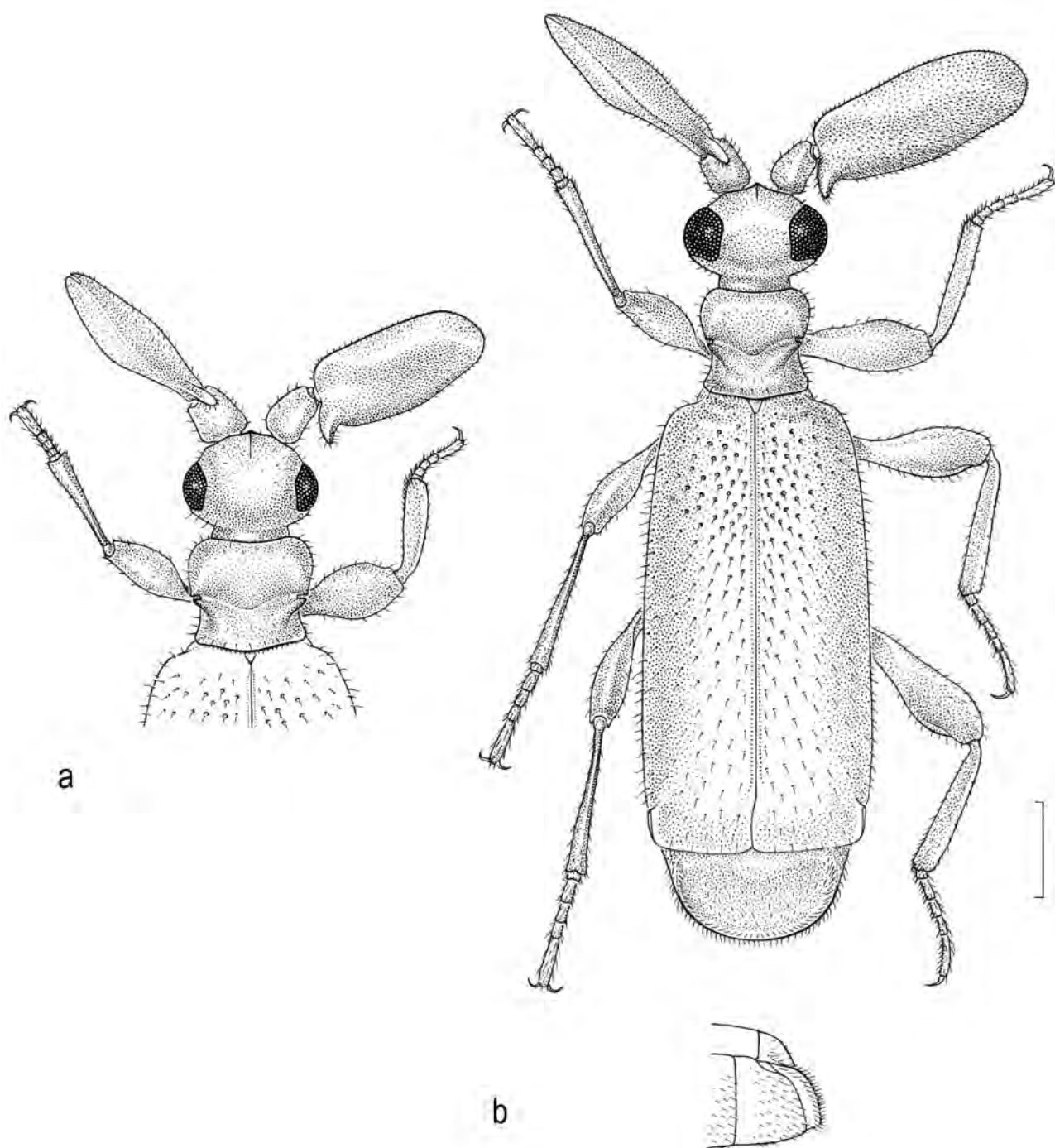


Fig. 14.—*Paussus planicollis*. Kenya, Kibwezi, Scheffler S.V. [Nagel Collection in BSUB], A, ♀; B, ♂, Inset shows lateral view of pygidium. Scale bar 1 mm.

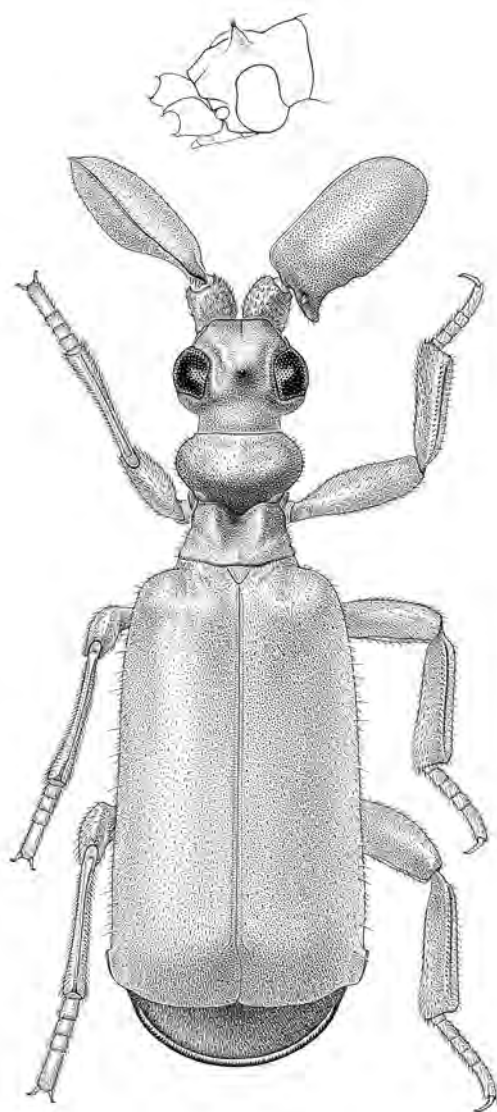


Fig. 15.—Presumed *Paussus nageli* Luna de Carvalho, ♂. Niger, Niamey, 28 Sept 1984, T.J. McNary [CMNH], see text. Scale bar 1 mm.

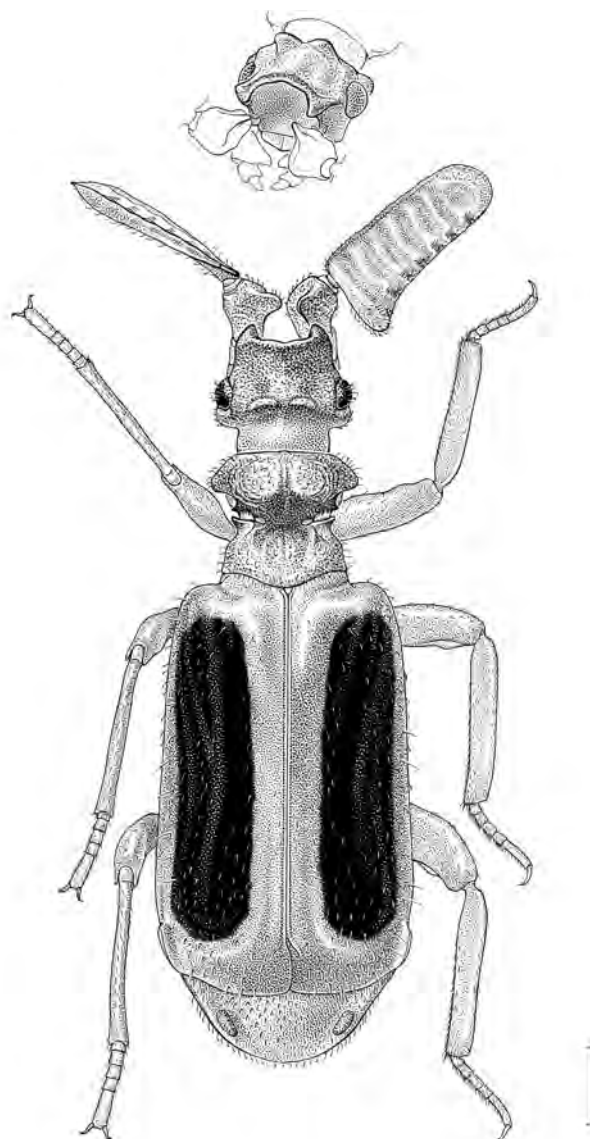


Fig. 16.—*Paussus aenigma* Reichensperger, ♀. Burundi, Source du Nil, 2000 m, 15.II.1992, leg. E. Arndt [Nagel Collection in BSUB]. Scale bar 1 mm.

successful activity of the collectors on one hand and, on the other, a hitherto insufficient knowledge of the paussine fauna of this country.

Because of the small country size and because most major ecoregions of Malawi extend well beyond the country's borders, endemic species would at most be expected from the higher altitudes of plateaus like Nyika in the North or Mulanje in the South (Burgess et al. 2004; Stuart et al. 1990). Although African paussine beetles have been recorded from altitudes above 2000m no truly montane grassland species are known. However, relics of miombo forest extending to higher altitudes or relics of high altitude dense mountain forests could well harbour paussines and endemic taxa cannot be excluded from the start.

In general for those groups of insects already studied, the fauna of Jembya Forest Reserve does not exhibit marked endemism and in general resembles the fauna of the Nyika Plateau to the south, or the Mughese and Willindi Forests to the northeast (Rawlins *in litteris*, 2005).

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curators of the scientific collections listed in the “material studied” section have always been very helpful. I gratefully acknowledge their kind cooperation.

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