

Two new species from Kenya in the physogastric termitophilous genus *Termitoderus* Mateu 1966 (Coleoptera Scarabaeidae Aphodiinae)

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Two new species from Kenya are added to a remarkable Afrotropical genus of physogastric scarabs: *Termitoderus ultimus* and *T. sandsi*. They live in the fungus gardens of different termite species of the genus *Odontotermes* Holmgren 1912. The genus *Termitoderus* Mateu 1966 is briefly discussed in the context of termitophilous laparostict Scarabaeoidea in general, and the four known species are keyed.

KEY WORDS: Coleoptera, Scarabaeidae, *Termitoderus*, *Odontotermes*, Kenya, key, new species, termitophiles, physogastry.

INTRODUCTION

Some of the more obscure groups of scarabs integrated in termite societies are physogastric: they develop a greatly expanded abdomen, with extended membranes and modified sclerites. As is well known, a multitude of termite guests are more or less physogastric, prime examples being found in the beetle family Staphylinidae, so thoroughly studied by KISTNER (1979, 1982) and others over the past decades. Usually this physogastry is a complex postimaginal phenomenon, thought to be related to the development of reproductive and/or glandular systems; the glands are assumed to produce chemical messengers serving the acceptance of the inquiline by their termite hosts.

Among termitophilous Scarabaeoidea, physogastry is rare, being limited to two laparostict lineages: (a) some phylogenetically basic forms in the subfamily Ceratocanthinae, i.e. certain genera in the Neotropical tribes Scarabatermitini and Ivieolini (HOWDEN & GILL 2000, OCAMPO & BALLERIO 2006); and (b) one Afrotropical genus in the more derived subfamily Aphodiinae, viz. *Termitoderus* Mateu 1966, placed in its own monogeneric tribe Termit-

toderini (TANGELDER & KRIKKEN 1982, HOWDEN & GILL 1993). *Termitoderus* is the subject of this paper. For a recent overview detailing the position of these taxa, see also SMITH (2006).

The total morphological spectrum of termitophilous laparostict scarabs is very diverse, ranging from generalized forms with supposedly mycangial structures in the aphodiine tribe Eupariini (many are found with leaf-cutting ants of the tribe Attini, STEBNICKA 1999, 2007), via numerous trichome-bearing groups (KISTNER 1982, TANGELDER & KRIKKEN 1982), to the extremely evolved taxa, including the physogastric forms treated here, and various blind, flightless groups (like Termitotroginae, KRIKKEN in press). The pantropical Ceratocanthinae (list in OCAMPO & BALLERIO 2006) comprise, apart from the physogastric forms and other oddities, several “simpler” loricate termitophiles, which are capable of complete conglobation (Ceratocanthini); the majority of these conglobate ceratocanthine taxa may not be obligatory inquilines.

Termitoderus were found in termite colonies in arid zones of savanna/steppe vegetation, the termites all belonging to the Afro-Oriental genus *Odontotermes* Holmgren 1912. The first species to be described was *T. grassei* Mateu 1966, type of the genus, from the Ennedi Plateau in northeastern Chad. TANGELDER & KRIKKEN (1982), in a taxonomic study of the equally termitophilous sister group of *Termitoderus*, the Corythoderini, implied their awareness of two more species, without formally describing them. Later, HOWDEN & GILL (1993) described a second *Termitoderus* species from Angola and Namibia. In the present paper the two species from northwestern Kenya alluded to in our 1982 study are described in full for the first time, and a key to the four species now known is given. Termitoderines may be more widespread in sub-Saharan Africa than suggested by the few records now available; considering the distribution of their host genus *Odontotermes*, we anticipate more records from areas between and beyond the regions mentioned.

The new species were both taken from termite fungus combs in a single locality in the Turkana region, one of them apparently together with a species of the unrelated blind, flightless scarab genus *Termitotrox* Reichensperger 1915 (to be described by KRIKKEN in press). Details on the structure of the fungus combs are not available. The two *Termitoderus* species appear to have different *Odontotermes* species as hosts.

Apart from their inclination to physogastry and the inherent changes in thoracic, elytral and abdominal structures, the termitoderines are characterized by an essentially subdeltoid pattern of convexities and depressions on the pronotal disc, plus additional costae and basolateral trichomes, presumably all functioning in the communication with their termite hosts. The mentum of *Termitoderus* is small, anteriorly rounded, and the labial palpi appear completely vestigial, suggesting special trophic (possibly trophallactic) relationships. The legs of *Termitoderus* are extremely slender, as in the related Corythoderini, and very unlike the plump femora, tibiae and tarsi of their colony companions in the Termitotroginae — thus suggesting different modes of life, perhaps different micro-niches, in the termite environment. Notice particularly the unusually long first segment on the meso- and metatarsi of *Termitoderus*. Adults have been seen to freely move around among

their hosts (MATEU 1966). The hind wings could be functional, but possibly only before the onset of physogastry (MATEU 1966, however, reported his specimen to be apterous). Immature stages are unknown.

The Kenyan species are jointly distinguishable from the other two by sharing a much more pronounced subdeltoid set of sulci on their pronotum, including a complete, long median sulcus and a pair of anteriorly convergent paradiscal sulci. The differences between the two species are considerable (see last couplet of Key to *Termitoderus* species, and diagnostic remarks under Descriptions), in such a way that, in spite of their pronotal similarities, they cannot be considered directly related.

TECHNICAL REMARKS

The pronotal sulci (grooves) are termed (from midline laterad): median, paradiscal, sublateral, and lateral sulcus; plus (transverse) basal sulcus. The pronotal convexities are termed (from midline laterad): discal (cushions), sublateral, lateral, and marginal (longitudinal) costa; plus (transverse) basal area or costa, which has fully sclerotized lateral (more or less acuminate) trichomatal projections. The basolateral trichomes are positioned in and around the posterolateral confluence of the pronotal sulci. The elytral striae are hard to homologize due to fusion and obliteration, and here they are counted from the scutellum/suture to the lateral border just as is.

In the descriptions the prefix *micro-* means that the feature concerned is distinct only at magnifications of at least $\times 40$.

For the scales (magnifications) of the pictures, consult the detailed measurements of the various body parts, given at the end of the holotype descriptions. The measurements are ± 0.05 mm on account of variation in positioning and other factors.

Termitoderines are very fragile and rare in collections, and consequently we have refrained from dissecting (and sexing) or otherwise tampering with the specimens studied; according to HOWDEN & GILL (1993) sexual dimorphism in *Termitoderus* is very limited. For proper anatomical work more material is needed.

Termitologists and mycologists are urged to look out for termitoderines and other scarab inquilines when examining colonies of Macrotermitinae. Samples for morphological and molecular phylogenetic studies are welcome, and so are samples of the host, as the taxonomy of the genus *Odontotermes* is notoriously poorly resolved.

BMNH: The Natural History Museum, London; RMNH: National Museum of Natural History Naturalis, Leiden.

KEY TO *TERMITODERUS* SPECIES

- 1 Set of three sulci on pronotal disc limited, median sulcus not extending forward beyond middle of disc, paradiscal sulci not extending to apicomedian surface..... 2
- Set of three sulci on pronotal disc all reaching apicomedian surface (figs 5, 10), paradiscal sulci evenly arcuate from base to near apex of median sulcus. 3
- 2 Posterior end of lateral costa of pronotum not narrowed, bent outward near trichome. Clypeal apex widely bisinuate. Length 4.1-5.2 mm. Southwestern Africa. *T. kistneri* Howden & Gill 1993

- Posterior end of lateral costa of pronotum narrowed, hooked downward near trichome. Clypeal apex narrowly emarginate, sides rounded. Length ca 4.5 mm. Chad. *T. grassei* Mateu 1966
- 3 Elytral striae indistinct and impressed only at base, effaced over most of elytral length; elytral margin sharply ridged in front (forming gutter adjacent to and behind pronounced humeral tubercle). Clypeus, and pronotal and elytral sides shining. Clypeal border widely, evenly rounded (Fig. 9). Generally pale brown to yellow-brown, elytra darker; smaller, narrower species. Length ca 3.5 mm. Kenya. *T. sandsi* n. sp.
- Elytral striae distinct and impressed on at least basal half of elytral length; elytral margin not sharply ridged, no humeral tubercle. Clypeus, and pronotal and elytral sides matt. Clypeal border widely bisinuate (Fig. 4). Generally medium to dark brown; larger, broader species. Length ca 4 mm. Kenya. *T. ultimus* n. sp.

DESCRIPTIONS

Termitoderus ultimus n. sp. (Figs 1-6, 12-13)

Holotype. Total length ca 4 mm. Colour generally medium to dark brown, shining, some parts microreticulate, matt; several parts more or less transparent. Setae pale-yellow, mostly erect, short ones numerous, inconspicuous; very long setae (possibly including special sensillae) much sparser.

Clypeus very widely bisinuate in front, clypeogenal transition at border scarcely interrupted, outline there very slightly concave; border from genal tips forward completely, finely marginate, clypeopleuron medially distinct but narrow; clypeal surface matt, microreticulate, with numerous fine erect microsetae, their micropunctures widely separated; clypeofrontal transition transversely impressed, distinct. Frons slightly convex, midline shallowly depressed; setae as on clypeus, but less numerous. Genae with distinct, subangular lateral tip, which is shortly rounded; surface matt. Eyes large (in full-face view), maximum number of facet rows from genal canthus to frons 12-14; bordering genal canthus in front of eye with short impression.

Pronotum with complete median, paradiscal, sublateral and lateral sulci, all deep and well defined; apical border immarginate. Discal pronotal cushions very shining, with some micropunctures bearing long erect seta and with numerous larger, superficial (matt) microreticulate punctures without setae. Median and paradiscal sulci narrow, median sulcus reaching apical margin, paradiscal sulci widely arcuate to apicomedian surface; basal sulcus very slightly curved on either side of base of median sulcus. Sublateral costa anteriorly broad along paradiscal sulcus, surface as discal cushions; lateral costa matt, broad in front, gradually narrowed caudad; marginal costa matt, strongly, evenly convex, sides evenly rounded in dorsal view (immarginate); basal area broad, laterally narrowing into pointed trichomatal projection; surface of basal costa shining, with matt punctures as on disc; basal border straight in dorsal view, steeply declivous to elytral base, immarginate. Basolateral trichome well developed under and around trichomatal projection



Figs 1-11. — *Termitoderus* habitus and upper side, holotypes. *T. ultimus* (Figs 1-6) and *sand-si* (Figs 7-11). Fig. 1, habitus, lateral view; Figs 2, 7, forebody, oblique; Figs 3, 8, forebody, lateral; Figs 4, 9, head, full-face; Figs 5, 10, forebody, dorsal; Figs 6, 11, elytron, dorsal.

and curled extension from caudal end of lateral costa. Scutellum virtually flat, elongate semi-elliptic in outline.

Elytra transversely convex, surrounding meso- and metathorax and anterior part of physogastric abdomen; distal margin rounded, hyaline, flap-like; apicosutural section of elytra shortly rounded; basal margin depressed under pronotal base; lateral border very widely rounded, lacking epipleuron. Elytral striae impunctate, sulcate-striate over about half elytral length, discal striae effaced to apex; striae arranged as follows: striae 1-2 distinct, separately reaching base, 3-4 joined at base, 5-6 joined at base, 7 ending at base between raised, anteriorly protuberant interstriae, 8-9 jointly ending at humeral base. Elytral interstriae more or less microreticulate on basal half, lateral ones distinctly, entirely matt (strongly microreticulate); interstriae which reach base costiform to protuberant in front; sparse long, erect setae in micropunctures. Humerus protuberant from very broad, anteriorly narrowed marginal interstria, but not standing out as separate tubercle. Alae present.

Antennae yellow, with 8 distinct segments, including 3-lamellate club, club segments roughly 4 times longer than wide (their distal side tomentous, and with numerous fine setae). Mentum rounded in front, base with distinct anteriorly pointed tubercle; labial palpi reduced; maxillary palpi well developed. Preprosternum tectiform, unmodified; postprosternum unmodified; propectoral sides matt, abundantly setose. Mesosternal disc shining, sides matt; unmodified. Metasternal disc shining, sides matt; unmodified. Abdomen swollen, membranous, tan; distal three abdominal segments distinct, remainder shrivelled under elytra and against thorax; pygidial and anal sclerites brownish, distinct, but without notable features.

Protibia slender, more or less parallel-sided, with two acuminate external denticles; apico-internal spine short. Protarsus inserted in apico-internal cavity; protarsal segment 1 strongly thickened distad, with microsetae, segments 1 and 5 each longer than segments 2-4 combined, small simply sickle-shaped claws present, as on other tarsi. Meso- and metatibiae complanate, thin, more or less parallel-sided, their apex scarcely thickened, with pair of apico-internal spurs (very short on mesotibia) and some spines on apico-external point; mesotibia without torsion; numerous fine setae present. Meso- and metatarsal segments 1 very long, thin, complanate, apex acuminate superiorly; metatibial apex with pair of spurs, approximate proportions longer spur // tarsal segments 1-5: 23//69/6/4/5/20. All femora very long and slender, more or less parallel-sided, arched upward, numerous fine setae present. Meso- and metacoxae showing elongate, yellowish (possibly glandular) structure shining through.

Measurements in mm. Maximum width of head 1.25. Median length of pronotum 1.25, maximum width 1.53. Sutural length of elytra up to transverse axis along apices 2.00, maximum width combined 1.75.

Variation. Total length ca 4 mm (difficult to give exactly in these physogastric specimens). Paratype very similar to holotype.

Type-material. Holotype (BMNH) and paratype (RMNH), unsexed, with the following label data: N Kenya: S Turkana District: Lokori, on Kerio River, vii/1969, W.A. Sands, in fungus combs of termite *Odontotermes latericius* (Haviland 1898). Our type labels added.

Diagnostic remarks. *T. ultimus* makes a plump impression compared to *sandsi*; body and legs (apart from physogastric abdomen) largely medium to dark brown, with clypeus and pronotal and elytral sides distinctly matt (microreticulate). Pronotal sulci all deep, well defined, and subdeltoid discal set complete. Basal edge of pronotum straight in dorsal view. Head broad, more or less *Aphodius*-like; anterior margin widely bisinuate, genae projecting, subangular; frons moderately convex. Legs slender, but more robust than in *sandsi*; mesotibiae not showing torsion, tibial apices not remarkably thickened. Mentum with distinct tubercle at base; preprosternum simply tectiform. Elytral striae distinctly impressed over much of their length, lateral margin convex and slightly protuberant in front only, not distinctly tuberculate and ridged.

Remarks. The pronotum pictured in TANGELDER & KRIKKE (1982: fig. 14) belongs to this species. The host termite is not mentioned for Kenya in WANYONYI et al. (1984, nor for Ethiopia, COWIE et al. 1990), and may thus be a new record.

Etymology. This species is named *ultimus* because of its apparently very complete pattern of elytral sulci.

***Termitoderus sandsi* n. sp. (Figs 7-11, 14-15)**

Holotype. Total length ca 3.5 mm. Colour generally brown, shining, forebody and legs light brown; several parts more or less transparent. Setae pale-yellow, mostly erect, short ones numerous, inconspicuous; very long setae (possibly including special sensillae) much sparser.

Clypeus evenly widely rounded, clypeogenal transition uninterrupted; clypeal and genal borders immarginate; clypeopleuron poorly pronounced; head surface shining, with numerous fine erect microsetae, their micropunctures widely separated; clypeofrontal transition marked only by base of frontal convexity. Frons strongly, evenly convex; setae as on clypeus. Genae with short, subangular lateral tip, surface poorly separated from clypeal surface by slight convexity. Eyes moderately large (in full-face view), facets fine, indistinct.

Pronotum with virtually complete median, paradiscal, sublateral and lateral sulci, all deep and distinct; apical border immarginate. Discal pronotal cushions very shining, with numerous micropunctures bearing long seta. Median sulcus reaching apical margin, but less sharply defined rostrad, paradiscal sulci broad, widely arcuate to apicomedian surface; basal sulcus deep, slightly curved around steeply declivous discal cushions. Sublateral costa anteriorly broadened along paradiscal sulcus, posteriorly sharply narrowed to infuscated tip with trichomatal tuft of hairs; surface as discal cushions; lateral costa broad in front, gradually narrowed caudad to infuscated tip with tuft of trichomatal hairs; marginal costa shining, strongly, evenly convex, sides evenly rounded (immarginate); basal area broad, strongly raised, medially distinctly depressed, basal edge in dorsal view widely convex on



Figs 12-15. — *Termitoderus* legs, holotypes. *T. ultimus* (Figs 12-13) and *sandsi* (Figs 14-15). Figs 12, 14; protibia, Figs 13, 15, hind leg, with surrounding caudal parts.

either side, immarginate, steeply declivous to elytral base; laterally narrowing into trichomatal projection; surface of basal costa as on disc. Basolateral trichome well developed under and around trichomatal projection and curled extension from caudal end of lateral costa; below this basolateral trichomatal projection is another projection with trichomatal hairs. Scutellum virtually flat, elongate semi-elliptic in outline.

Elytra transversely convex, surrounding meso- and metathorax and anterior part of physogastric abdomen; distal, flap-like margin fully rounded from apicosutural section to elytral sides, hyaline; basal margin depressed under pronotal base; lateral border very widely rounded, lacking distinct epipleuron. Elytral discal striae largely effaced, only short sulci at base present; (strial) sulci arranged as follows: 1-4 shallow, distinct at base only, (lateral) 5-7 shallow, but extended further caudad, gradually effaced; 7 is here the marginal one, extending from humeral tubercle caudad. Elytral surface generally shining, with sparse, long, erect setae in micropunctures. Humerus with separate, almost club-shaped tubercle, anterior section of margin distinctly ridged (nearly canaliculate). Alae present.

Antennae yellow, with 8 distinct segments, including 3-lamellate club, club segments roughly 4 times longer than wide (their distal side tomentous, and with numerous fine setae). Mentum rounded in front, base unmodified; labial palpi reduced; maxillary palpi well developed. Preprosternum tectiform, slightly protuberant; postprosternum unmodified; propectoral sides shiny, slightly concave under marginal costa, abundantly setose. Meso- and metasternal surfaces shining, unmodified. Abdomen swollen, membranous, dorsal side largely white; sternites distinct, light brown; pygidium ditto; apex from anus with globular, membranous white bulge.

Protibia slender, more or less parallel-sided, with two acuminate external denticles; apico-internal spine short. Protarsus inserted in apico-internal cavity; protarsal segment 1 moderately thickened distad, with microsetae, segments 1 and 5 each about as long as segments 2-4 combined, small simply sickle-shaped claws present, as on other tarsi. Meso- and metatibiae complanate, very thin, more or less parallel-sided, their apex thickened, with pair

of apico-internal spurs (very short on mesotibia) and some spines on apico-external point; mesotibia with slight torsion; numerous fine setae present. Meso- and metatarsal segments 1 very long, very thin, their apex thickened and acuminate superiorly; metatibial apex with pair of spurs, approximate proportions longer spur // tarsal segments 1-5: 17//60/7/7/7/18. All femora very long and slender, more or less parallel-sided, slightly arched upward, numerous fine setae present.

Measurements in mm. Maximum width of head 0.98. Median length of pronotum 0.93, maximum width 1.20. Sutural length of elytra up to transverse axis between apices 1.88, maximum width combined 1.25.

Type-material. Holotype (BMNH), unsexed, with the following label data: N Kenya: S Turkana District: Lokori, on Kerio River, vii/1969, W.A. Sands, in fungus combs of the termite *Odontotermes mediocris* (Sjöstedt 1911). Our holotype label added.

Diagnostic remarks. The general impression of *T. sandsi* is of a smaller, more slender species than *ultimus*; forebody and legs largely light brown to yellowish, elytra darker; clypeus as well as pronotal and elytral sides shining, similar to other dermal surfaces. Pronotal sulci deep, subdeltoid discal set complete, median sulcus in front shallower or at least less well defined than in *ultimus*. Basal edge of pronotum in dorsal view with convex curve on either side of median impression. Head broad, edge from genal tips evenly rounded to (non-emarginate) apex; frons distinctly convex. Legs slender, more so compared to *ultimus*; meso- and metatibiae very thin, razor-sharp, their apices thickened; mesotibiae showing slight but distinct torsion; apex of equally thin mesotarsal segment 1 distinctly thickened, metatarsal segment 1 less so. Mentum without tubercle; preprosternum broadly protuberant. Elytral striae only impressed at base and laterally, striation effaced on disc; lateral elytral margin ridged for a short distance, caudad from distinct humeral tubercle.

Etymology. This species is dedicated to the collector, W. (Bill) A. Sands, distinguished termitologist (see, for instance, his 1998 book on African and Middle East termites).

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