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Description of a new genus and three new species of Metarbelidae (Lepidoptera: Cossoidea) from East and Central Africa, with notes on biogeography

Ingo Lehmann & Hossein Rajaei Sh.

* *Zoologisches Forschungsmuseum Alexander Koenig, Adenauerallee 160, D-53113 Bonn; E-mail: ingo5.lehmann@googlemail.com (corresponding author).*

Abstract. *Shimonia* gen. nov., a new genus of Metarbelidae (Lepidoptera: Cossoidea), is described from East and Central Africa (Afrotropical Region). It currently comprises four species, three of which are described as new: *S. timberlakei* sp. n., *S. oyiekeae* sp. n. and *S. fischeri* sp. n. The fourth species, *S. splendida* (Fletcher, 1968) is here transferred to the new genus from *Metarbela* Holland, 1893. Illustrations of adult morphology and notes on ecology and biogeography of these species are presented.

Keywords. Afrotropical Region, *fischeri* sp. n., forest refuge areas, new species, new genus, *oyiekeae* sp. n., revision, *Shimonia* gen .nov., *splendida*, taxonomy, *timberlakei* sp. n.

INTRODUCTION

Since Janse's monograph (1925) for South Africa and Gaede's (1929) publication, there has been no comprehensive treatment of Afrotropical Metarbelidae. Moreover, until the late nineties of the last century, it was not even clarified whether Metarbelidae deserved family rank (Holloway 1986; Schoorl 1990) or should be treated as a subfamily of Cossidae (Minet 1986, Edwards et al. 1998). Though no less than 202 species of Metarbelidae are recorded from the Afrotropics belonging to 16 genera (De Prins & De Prins 2012), this group has not received much attention. Only recently the diversity of the family came into focus again (Lehmann 1997, 2007, 2008a, 2008b, 2010a, 2010b, 2011).

Recent works using molecular methods placed Metarbelidae as one of the seven families of Cossoidea (Regier et al. 2009; Mutanen et al. 2010; van Nieukerken et al. 2011). On the other hand, Cossoidea were found to be a heterogeneous group not forming a monophylum. The position of Metarbelidae within the Cossoidea-Sesioidea assemblage still needs further support, though it appears that Metarbelidae could be closely related to Ratardidae, with which they share several morphological features, e.g., in having only one strong anal vein in the forewing as well as the ovipositor lobes shaped like an '8'(Holloway 1986; Edwards et al. 1998). The family ranges from mainland Africa and Madagascar across Arabia to Southeast Asia (Lehmann 2008b; De Prins & De Prins 2012) whilst some alleged New World 'Metarbelidae' (genus *Indarbela* Fletcher, 1922) belong to the Hypoptinae, a subfamily of the Cossidae (Edwards et al. 1998). Although the generic and species definitions within Metarbelidae are not yet definitive (Lehmann 2010a, b, 2011), ongoing studies suggest that this family comprises many more than 300 species, and hence about 50% more than previously estimated by Edwards et al. (1998).

Taking into consideration the ongoing deforestation, destruction of natural habitats, rapidly changing anthropogenic environment, and impossibility of field research in some regions of East and Central Africa, presumably a number of yet undescribed species could already be extinct in nature. Therefore the preserved historical collections serve as the major source for defining and revising the genera of Metarbelidae and for assembling taxonomic and faunistic data on this family. Additionally, they offer a chance to present data on habitats. Lepidoptera species are often associated with certain vegetation types or biotopes (Van Dyck 2011). A particular association of Metarbelidae to legume-dominated forests has been emphasized by Lehmann (2008a) based on 14 years of field work in southeast coastal Kenya (Lehmann & Kioko 2000, 2005). However, information on ecology, bionomics and habitats in Central Africa is scant and mostly scattered over many small and obscure publications. Furthermore, this information in regard to habitats is often separated from taxonomic papers and hence, requires integration. The biotopes of Central Africa were formed due to dramatic climate changes over millions of years (Leal 2004). There is a great similarity between upland floras of Central and Northeast Africa and past climate change caused the fragmentation of a once continuous forest belt, includ-

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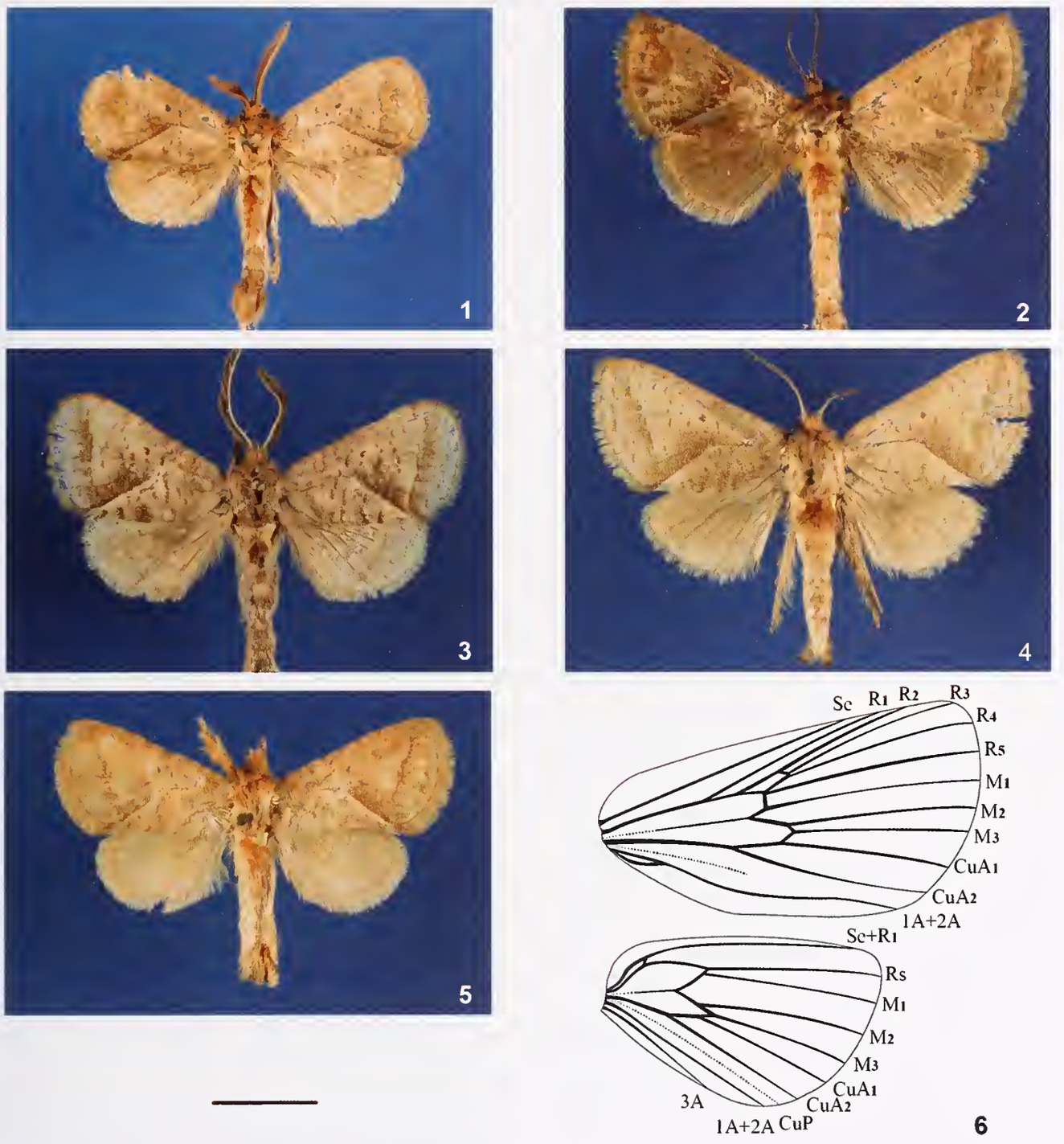


Figs 1–6. Adults and venation: **1.** *Shimonia timberlakei* **sp. n.**, holotype ♂, DRC, Eala; **2.** *S. timberlakei* **sp. n.**, paratype ♀, DRC, Eala; **3.** *S. splendida*, ♂, DRC, Isiro; **4.** *S. fischeri* **sp. n.**, holotype ♀, DRC, Katako-Kombe; **5.** *S. oyiekeae* **sp. n.**, holotype ♂, DRC, Lubumbashi; **6.** *Shimonia timberlakei* **sp. n.**, venation. Scale bar for figs 1–5: 10 mm.

ing montane forests, resulting in rain forest refuges (Hooker 1864, 1874; Lönnberg 1929). Subsequently, several authors developed a refuge concept for Africa. It proposes that modern biotas in the tropics originate partly from ecological islands that result from past cycles of forest fragmentation and subsequent expansion. The concept also includes the assumption that from the mid-Cretaceous to mid-Tertiary there is no evidence of major tectonic disturbances in Africa. Instead, the most important determinants of African biogeography were the northward drift of the continent and the central African uplift in mid-Tertiary, as well as periods of aridity alternating with wetter periods in the Pleistocene and Holocene (*e.g.*, van Zinderen Bakker & Clark 1962; Hamilton 1976; Diamond &

Hamilton 1980; Grubb 1982; Colyn et al. 1991; Maley 1991; Leal 2004). Therefore, referring to the above-mentioned refuge concept, it can be assumed that African forest-dependent species, such as Metarbelidae, survived and partly evolved isolated in these islands because these areas remained permanently forested during cool and dry climatic periods of the Pleistocene.

Here and in the frame work of the revision of the family Metarbelidae (by the first author) we describe a new genus and three new species based on morphological characters.

MATERIAL AND METHODS

The material examined here comes from the following collections: The Natural History Museum, London, U.K. (BMNH); the National Museums of Kenya, Nairobi (NMK); and the Royal Museum for Central Africa, Tervuren, Belgium (RMCA).

The specimens were photographed and compared with all described Metarbelidae, currently 202 published species.

For the process of maceration the abdomen was detached and macerated between one to three days in a glass tube containing a cold 10% solution of potassium hydroxide. After the maceration of the abdomen the genitalia were removed and transferred to distilled water for cleaning, drawing and spreading. Then the genitalia were flooded with isopropyl alcohol and remained as such for two hours before being mounted in Euparal. The genitalia slides were photographed using a digital sterco-microscope (ZEISS-SteREO: Discovery.V20), in addition specimens of several taxa examined were studied with a Scanning Electron Microscope (SEM, Hitachi S-2460N), both at ZFMK.

The terminology for external characters follows Janse (1925), Scoble (1995), Edwards et al. (1998), and for internal features, mainly the genitalia, Sibatani et al. (1954) and Klots (1970). The biogeographical names follow White (1983), Sayer et al. (1992) and Burgess et al. (2004).

Note: Democratic Republic of the Congo (DRC) has been under this name 1965 to 1971, and again since 1997; it was called the Republic of the Congo 1960 to 1964, and Republic of Zaïre 1971 to 1997.

TAXONOMIC REVIEW

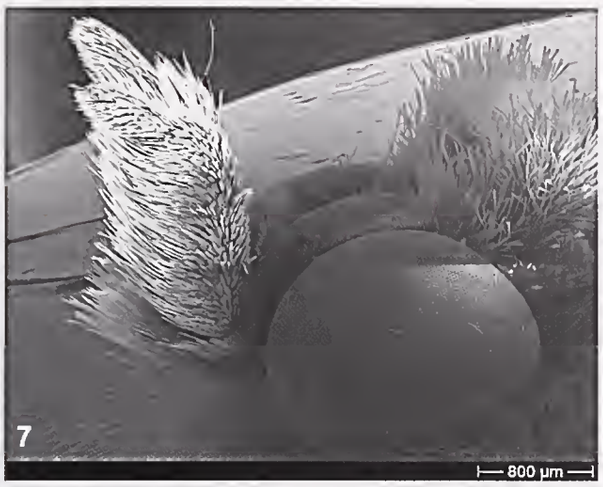
***Shimonia* gen. nov.**

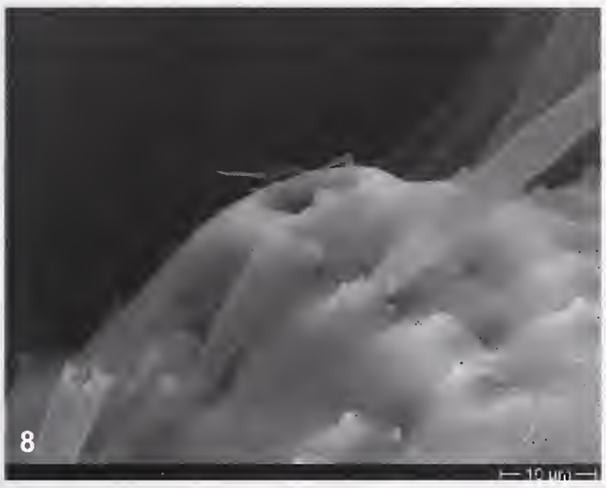
Type species: *Shimonia timberlakei* **sp. n.**

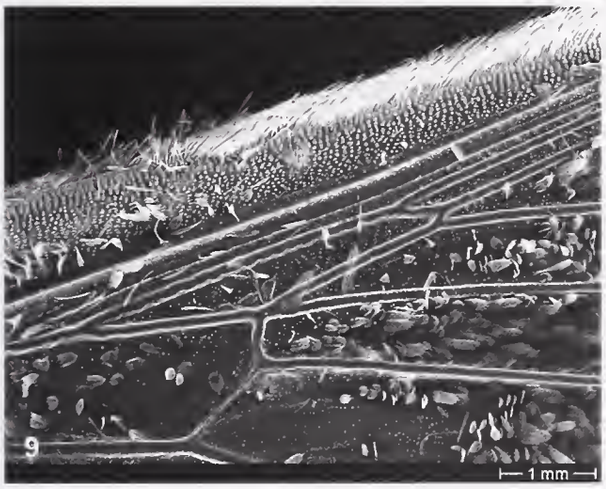
Diagnosis. *Shimonia* possesses typical metarbelid characters (Holloway 1986; Edwards et al. 1998; Lehmann 2008a) which are repeated here with some additions: Head rugulose, not retracted under the prothorax. Antennae bipectinate in males; bipectinate, unipectinate or filiform in females. Wings long, rather broad (in Cossidae wings longer, narrower, apically more strongly acute, in the also closely related Ratardidae both wings of almost equal size, round, butterfly-like), hindwings smaller than forewings; pattern weak, sometimes absent, often reticulate or transversely striated on a pale ground-colour. Frenulum and retinaculum usually absent; chaetosemata and tympanal organs always absent; epiphysis present or absent, if present it arises from about middle of fore-tibia; tibia and first tarsomere of hindleg not dilated (as in the Cossidae). Only a simple basal stem of vein M present in discal cell of both wings, therefore accessory cells absent (in Cossidae several basal branches of M present, forming accessory cells); vein CuP in forewing obsolete (but represented by a distinct fold which may be incomplete); one strong anal vein in the forewing (fused veins 1A+2A). Male genitalia: uncus beak-like or wide, tip often bifid or bilobed; gnathos arising near base of uncus, sometimes with medially separate or fused, drumstick-, hand- or lever-like appendages; socii very small or absent; valvae small, rather rounded, sometimes with thorn-like processes and/or modification to the sacculus; aedeagus tube-like. Female genitalia: shortly telescopic ovipositor with broad, rounded (8-shaped) or elliptic distal lobes; ductus and corpus bursae small, membranous ('reduced' *sensu* Holloway 1986); membrane between tergites 7 and 8 often expanded.

Shimonia is defined as a new genus based on the following putative morphological apomorphies (Figs 10–18): i) in the male genitalia, two narrow and very long thorn-like processes, usually of similar length, extend externally from the base of the valva, reaching beyond its distal edge; ii) segment 8 of female is setose, which is unusual among the other genera of Metarbelidae, with two large latero-ventral plates, ventrally connected by a narrow band. The combination of characters presented above does not occur elsewhere and demands the creation of a new genus.

The very long labial palpi, the long, narrow and well-developed tibial spurs and the rather large areole that sometimes has a short crossbar between R_3 and R_4 are treated here as plesiomorphic characters. These characters have been mentioned for "most primitive genera of Lepidoptera", e.g. *Cossodes* (Cossidae) (Turner 1918). Although other plesiomorphic characters of the latter genus are absent in *Shimonia*, for example simple antennae in both sexes, *Shimonia* is considered as probably one of the most basal or ancient metarbelid genera. Four Afrotropical species of this genus are recognized: *Shimonia timberlakei* **sp. nov.**, *S. splendida* (Fletcher, 1968), *S. fischeri* **sp. nov.** and *S. oyiekeae* **sp. nov.** *Shimonia splendida* is transferred from *Metarbela* Holland, 1893 to the new genus, based on the defining characters mentioned above.







Figs 7–9. Head and wing structure (SEM) of *Shimonia splendida*, ♀: **7.** Head, eyes and palpi (frons largely descaled); **8.** Fronto-clypeal projection (lateral view); **9.** Section of forewing with areolc.

Description. Regarding other genera of the Metarbelidae, the moths of the new genus are rather large, with a wingspan of 37–47 mm. *Head:* Rough-scaled; with a pair of small conical projections basally on frons in both sexes (Fig. 8); labial palpi long (the longest among the Metarbelidae, 1.5 times the diameter of eye,) (Fig. 7); antennae of male bipectinate; of female mainly unipectinate (cf. Lehmann 2008a), branches in the middle of the antenna apically bifid; flagellum and dorsal surface of branches densely scaled (this scaling appears to be absent in some females). *Thorax:* Densely covered with hair-like scales, without a collar ring; with a short crest on metathorax. Epiphysis of the foreleg present, hindlegs with two pairs of long and narrow tibial spurs (length at least 1.2 mm) in both sexes. Forewing upperside with simple, reticulate pattern (postmedial line and a straight line along vein CuA_2 always distinct), colours more or less brownish, not strongly contrasting (Figs 1–5). Scales of wing-margins long-stalked (stalks 3/4 of total length). Wing venation similar in both sexes (Fig. 6): in forewing 1A+2A forked at base; CuP obsolete, represented by a fold; CuA_2 originating from posterior margin of cell; CuA_1, M_3, and M_2 basally separated, initiating from or near posterior angle of cell; M_1 arising from about middle of discal vein, slightly closer to R_5 than to M_2; R_1 from anterior margin of discal cell; R_2, R_3, R_4 and R_5 separate, arising from the areole in both sexes or R_3 +R_4 originate from the same or nearly the same point, in the latter case there is a very short cross-bar; Sc more or less parallel to R_1. In hindwing CuA_2 from posterior margin of discal cell; CuA_1, M_3, and M_2 as in forewing, M_1 close to Rs from anterior angle of cell, separated or from the same point; a short cross-bar between cell and Sc (basal stem of R_1) usually present; discal cell of both wings with a short vein inside (stem of vein M). Retinaculum and frenulum absent. *Abdomen:* covered with dense hair-scales, abdominal tuft not longer than one-third of abdomen length.

Male genitalia. Saccus short, narrow, distally rounded; uncus large, flattened, very long and broad, setose on ventral surface; apically bilobed. Valva with two acuminate, very long, thorn-like appendices of similar length, arising externally from its base, bent at their tip; internal surface membranous, densely setose. Gnathos arms very broad basally, covered with many short, tooth-like structures medially; arms not fused, only connected by a narrow band on ventral side. Juxta with two acuminate lobes and a deep emargination dorsally. Phallus simple, vesica without cornuti (Figs 10, 12, 14).

Female abdominal structure and genitalia. Segment 8 sclerotized, loosely setose, setae often in groups of two or three; anterior margin of tergal area more or less emarginated. Latero-ventrally on segment 8 two large, rounded or triangular plates present, both connected ventrally by a sclerotized band. Ovipositor short, papillae analcs rounded or elliptic, covered with some short, rarely with long setae (Figs 16–18); ductus and corpus bursae small, thinly membranous, without distinct characters (not drawn).

Distribution. Species belonging to the new genus are found in Central and East Africa, extending its range from the arc formed by the Congo River in the West (DRC), eastwards into the Albertine Rift region (Uganda) and probably further East to western Kenya (Mount Elgon or close to it). Isiro (northeastern Congo Basin, DRC) is currently the most northern distribution limit, and the Katangan Copper Bow (southeastern DRC) the most southern limit (Fig. 19).

Ecology. *Shimonia* species appear to be forest species that are associated with lowland, submontane or montane rainforests and dense wet woodlands with an average annual rainfall of at least 1200 mm. The species of this genus may be linked to the following vegetation types: "Guineo-Congolian swamp forest and riparian forest"; "Mixed moist semi-evergreen Guineo-Congolian rainforest" including patches of "Single-dominant moist evergreen and semi-evergreen Guineo-Congolian rainforest", "Afromontane rainforest", "Zambezian dry evergreen forest" surrounded by wetter types of "Zambezian miombo woodland" *sensu* White (1983). Different plant communities in the biotopes of *Shimonia* share a common feature: woody legumes are dominants or co-dominants both in the rainforest types as well as in the 'miombo'.

Etymology. New genus is named after Shimoni Lehmann, the son of the senior author, who accompanied his father several times on excursions to Africa/Kenya and has always shown great interest in his studies. The gender of the new genus is feminine.

KEY TO THE SPECIES OF *SHIMONIA*, BASED ON MALE AND FEMALE GENITALIA

1a. Male (male of *fischeri* unknown) 2
1b. Female (female of *oyiekeae* unknown) 4
2a. Male genitalia with very broad, triangular bases of thorn-like external processes of valva ..... *oyiekeae* **sp. nov.**
2b. Male genitalia with narrow bases of thorn-like processes of valva 3
3a. Sacculus of valva bearing an additional, short process ..... *splendida*
3b. Sacculus of valva without such process ..... *timberlakei* **sp. nov.**
4a. Ventral part of segment 8 gradually narrowed to a slender connection, anterior apophyses about twice as long as posterior apophyses ..... *fischeri* **sp. nov.**
4b. Ventral part of segment 8 forming a broad sclerotized band; anterior apophyses as long as posterior apophyses or slightly longer 5
5a. Latero-ventral sclerotized plate on segment 8 oval ..... *timberlakei* **sp. nov.**
5b. Latero-ventral sclerotized plate on segment 8 elongate triangular ..... *splendida*

1. *Shimouia timberlakei* sp. n.

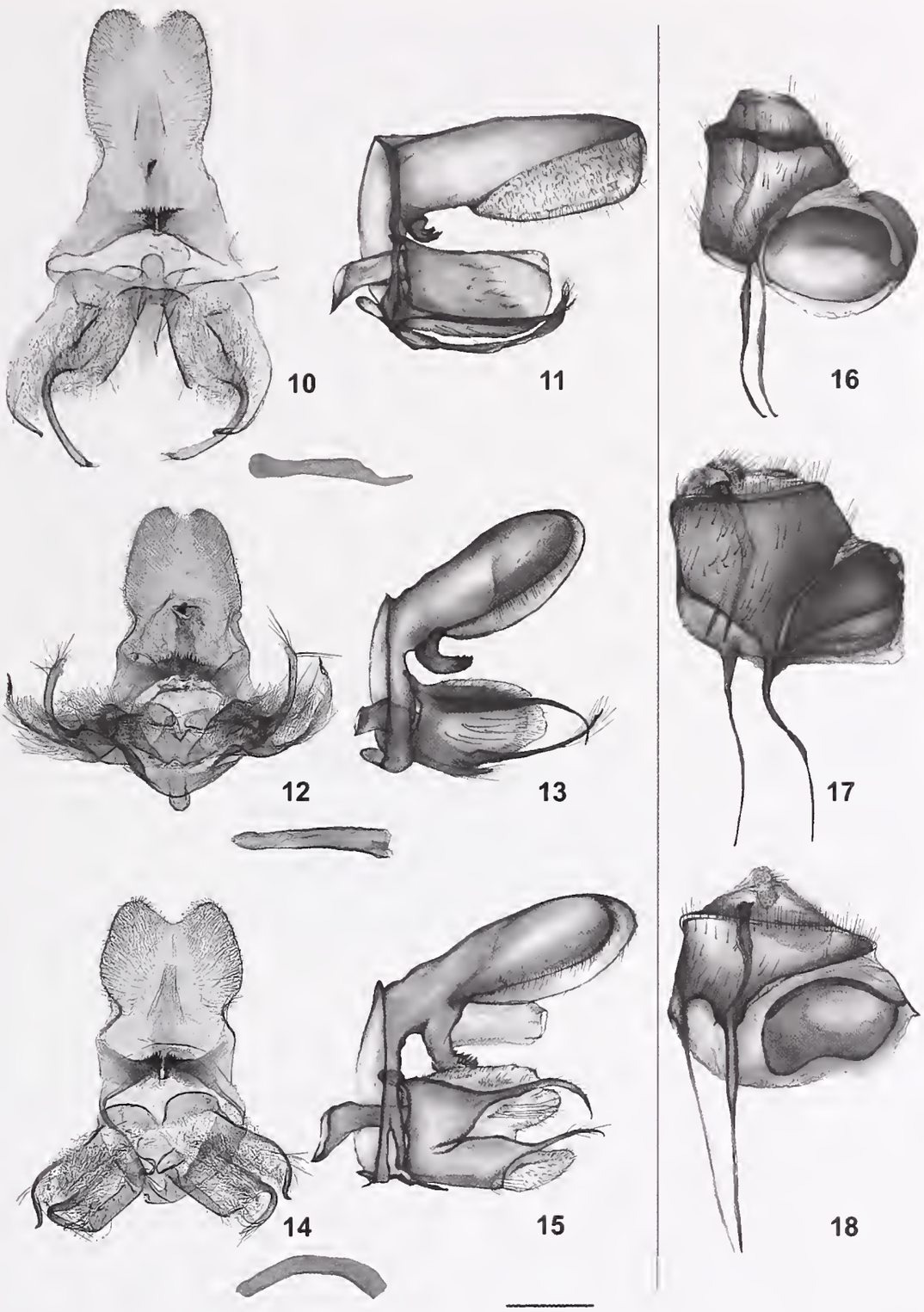
Figs 1, 2, 10, 11, 16

Material examined. *Holotype* ♂, Belgian Congo, Équateur Province, Eala, 19 June 1935, J. Ghesquière leg., [label] number 616, genitalia slide number 31/072010 I. Lehmann (RMCA). *Paratype* ♀, same locality and date, J. Ghesquière leg., number 616, genitalia slide number 12/072010 I. Lehmann (RMCA).

Description. Forewing length in male 16.0 mm (wingspan 38 mm), in female 19.0 mm (wingspan 41 mm); antenna-wing ratio 0.69:1 in male, 0.58:1 in female. *Head*: light-ochre, scales glossy, eyes olive with small black spots; antennae coloured as head; branches of antennae 7 times width of shaft in males, 1.5 times in females, covered with minute scales dorsally; tip of antennae with long, strongly bent scales; labial palpi light-ochre, tips pointed. *Thorax*: Patagia and tegulae light-ochre, glossy. Hind-femora, -tibiae and -tarsi light-ochre, glossy, with two pairs of tibial spurs, medial pair shorter. Forewing light-ochre, glossy; with a small, rounded, sepia cell-spot and a small patch of olive-ochre distally; several faded lines of olive running from costa to CuA_2; subterminal line broad, olive with a patch of olive-ochre in its distal half; CuA_2 marked olive anteriorly, light ochre posteriorly; ciliae of wing margins long, 1.5 mm, light-ochre. Underside of forewing rough-scaled, of a lighter ochre than above, glossy. Hindwing upperside with ground-colour as in forewings, but almost patternless, glossy; underside as in forewing. Wing venation see Fig. 6. *Abdomen*: Mainly light-ochre, glossy.

Male genitalia (Figs 10, 11). Uncus large (2,5 times the length of the tegumen), ventrally setose, roundly bilobed distally, rather rectangular in lateral view; gnathos short, very broad basally, distally bent and strongly dentate; arms not completely fused at middle, only connected by a narrow band caudally; valva almost rectangular, but distally smoothly rounded, setose at internal surface, ventral margin with long setae, with two very long thorn-like processes externally, the latter with acuminate and setose tips, their median sector with a few scattered short and long setae; tegumen basally fused with vinculum, the latter forming a firm and very narrow ring. Saccus short, finger-shaped, gently rounded caudally. Phallus short, about as long as valva, straight, narrowest in middle, bilobed with a deep cleft distally.

Female abdomen and genitalia (Fig. 16). Papillae anales broad, shaped like an '8' in posterior view, almost without setae. Segment 8 long, covered with long scattered se-



Figs 10–18. Male and female genitalia. **10, 11.** *Shimonia timberlakei* **sp. n.**, holotype ♂; **12, 13.** *S. splendida*, ♂; **14, 15.** *S. oyiekeae* **sp. n.**, holotype ♂; **16.** *Shimonia timberlakei* **sp. n.**, paratype, ♀; **17.** *S. splendida*, ♀; **18.** *S. fischeri* **sp. n.**, holotype, ♀. **10, 12, 14.** ventral view; **11, 13, 15.** lateral view (males); **16, 17, 18.** lateral view (females; ductus and corpus bursae omitted). Scale bar: 1mm.

tae often arranged in groups of three; anterior margin dorsally only with a shallow emargination; latero-ventrally with two large, rounded, sclerotized plates, connected by a band ventrally. Posterior apophyses slightly sinuate, almost as long as anterior ones.

Diagnosis. The very large, setose, sclerotized uncus (2.5 times length of tegumen) is unique in the genus. The female genitalia share the oval latero-ventral plates with those of *S. fischeri* **sp. n.**, but these plates are rather kidney-shaped in *fischeri*, the ventral band connecting both

plates is much narrower in the latter, the deep, semi-circular emargination of the anterior margin of the tergal plate present in *S. fischeri* is only shallowly emarginated in *S. timberlakei*. The apophyses are almost equal in length, while in *fischeri* the anterior apophyses are almost twice as long as the posterior apophyses (compare fig. 18).

Distribution. *S. timberlakei* **sp. n.** is currently known only from Eala, DRC. Eala (altitude 328 m) has no dry season and its average annual rainfall is about 2070 mm.

Etymology. The species is named after the editor of *Flora Zambesiaca,* Jonathan Timberlake (Royal Botanic Gardens Kew, U.K.) to honor his attention to conservation issues of *Acacia* and *Brachystegia* and for his kind provision of important unpublished information on various habitats in Zambia, Zimbabwe and Mozambique to the first author.

2. *Shimonia splendida* (Fletcher, 1968), **comb. nov.**
Figs 3, 7–9, 12, 13, 17
Metarbela splendida Fletcher, 1968: 329

Material examined. Holotype ♂, Uganda, Bundibugyo District, Rwenzori Range, Bwamba Pass, 6.500 feet, December 1934-January 1935, F.W. Edwards leg. (BMNH). *Additional specimens:* 1 ♂, Belgian Congo [Democratic Republic of the Congo], Uele District, Paulis [Isiro], 15 February 1959, Dr. M. Fontaine leg., genitalia slide number 04/072010 I. Lehmann (RMCA); 1 ♀, Belgian Congo [Democratic Republic of the Congo], Uele District, same locality, 09 February 1960, Dr. M. Fontaine leg., genitalia slide number 05/122010 I. Lehmann (RMCA).

Original description of *Metarbela splendida* Fletcher, 1968 (p. 329):
"Male 47mm: Vestiture pale ochre, weakly suffused with drab. Fore wing ochre, patterned with broken, transverse striae of grey ochre, surrounded by cinnamon brown irroration; pattern dense anterior of vein *Culb* and at three-fifths inner margin; vein *Culb* edged posteriorly with parallel area of clean and sharply defined ground colour. Hindwing pale ochre, very lightly irrorate with drab. Distinct in the genus by reason of its pattern and its very large size, being one and one-half times greater in wingspan than any known species".

Additional re-description. Forewing length in male and female 20.0 mm (wingspan 45 mm); antenna-wing ratio in male 0.70:1 (antenna broken in female specimen). *Head*: Greyish-ochre, with cream-coloured scales around eyes and base of antennae; eyes brown; antennae very long, with pure white scales dorsally on shaft; length of antennal branches 7 times width of shaft, densely covered with pale olive scales dorsally, tips with long scales, strongly bent backwards (towards proximal part of antenna), all branches ventrally setose (setae arranged in pairs up to base of branch); female antennae unipectinate; flagellum with ochreous scales; branches 1.5 times width of shaft, flat. Labial palpi longer than diameter of eye (Fig. 7), olive ventrally and laterally, sepia dorsally; tips narrow. *Thorax*: Patagia and tegulae greyish-ochre, scales with grey tips; a crest of cream mixed with greyish-ochre on metathorax. Hindleg-femora, -tibiae and -tarsi cream-coloured, glossy; two pairs of tibial spurs present, medial spurs at middle of tibia, about 1.6 mm long, apical spurs about 1.5 mm long, reaching over the first tarsomere; distance between medial and apical spurs about 2.5 mm. Forewing upperside pale greyish-ochre; a narrow terminal and broad subterminal line of dark olive stretching from apex to near tornus; a small rounded discal spot of sepia present in cell; several faded lines of olive running from costa to dorsum; a broad, dark olive band anterior along CuA_2, a pale line posterior to it; ciliae of wing margin long, ca. 1.5 mm; underside cream, glossy. Hindwing upperside pale greyish-ochre, with a faded reticulated pattern of strong olive, glossy; underside and cilia shaded as in forewing. Wing venation very similar to that of *S. timberlakei*. *Abdomen* coloured like upperside of wings.

Male genitalia (Figs 12, 13). Uncus smaller than in the previous species (around 1,5 times the length of the tegumen) ,ventrally setose, with short and long setae, roundly bilobed distally. Gnathos bent hook-like in lateral view, distally dentate; arms medially not fused, only connected by a narrow band caudally. Valva bearing two widely separated, very long thorn-like processes with acuminate tips, the ventral process covered with long setae distally; valva setose at internal surface; outer surface ventrally and medially covered with long sparse setae; sacculus with a weakly sclerotized setose extension. Tegumen basally fused with vinculum, the latter forming a firm ring; saccus short, rounded caudally. Phallus slightly longer than valva, slighlty sinuate, narrowing towards apex, the latter bilobed, with a deep cleft.

Female abdomen and genitalia (Fig. 17). Papillae anales shaped like an '8'; segment 8 covered with long, rather scattered setae, often arranged in groups of three; tergal region broad, with a gently rounded emargination anteriorly, narrower ventrally; latero-ventral sclerotised plates narrowly triangular, ventrally connected by a broad band. Posterior apophyses broader at base, slightly angled medially, a little shorter than anterior apophyses which are gently sinuate and slightly longer than length of segment 8.

Diagnosis. The male of *S. splendida* is structurally unique in the genus because of its pronounced saccular process.

Fig. 19. Type localities of species of *Shimonia* **gen. nov.** (indicated by black spots and bold fonts).

The female of *S. splendida* can be easily distinguished from its congeners by the triangular shape of the latero-ventral sclerotized plates on segment 8 which in *S. timberlakei* **sp. n.** and in *S. fischeri* **sp. n.** are roundish or oval. Papillae anales are densely covered with long and short setae (long setae are absent in the other two species).

Distribution. *Shimonia splendida* is currently known from the northeastern region of DRC (Isiro) and western Uganda (Rwenzori Mountains). Isiro (formerly called Paulis; 02°46'N, 27°36'E; altitude 750 m; average annual rainfall 1530–1600 mm) is a town *about* 50 km north of the large Ituri Forest in northeastern DRC (Haut-Uele Province). Bwamba Pass (average annual rainfall 2200–3000 mm; collecting site at the altitude of 1981 m) is located in the Rwenzori Mountains. It is the old trail between Fort Portal and Bundibugyo (T. Davenport, pers. comm.).

3. *Shimonia fischeri* sp. n.
Figs 4, 18

Material examined. Holotype ♀, Belgian Congo [Democratic Republic of the Congo], Sankuru, Katako-Kombe, 23 June 1952, Dr. M. Fontaine leg., genitalia slide number 26/092010 I. Lehmann (RMCA).

Description. Female forewing length 21.0 mm (wingspan 45 mm); antenna-wing ratio 0.52:1. *Head*: Ochre around eyes and base of antennae; eyes brown with small black patches; antennae denscly scaled olive on dorsal sidc of the shaft as well as on branches; lcngth of branchcs of antennae 1.5 times width of shaft; tips with long scales, only slightly bent backwards, covered with scattered hairs ventrally; labial palpi longer than diameter of eyc, light-ochre ventrally and laterally, slightly darker dorsally. *Thorax*: Patagia and tegulae light ochre, glossy. Hindleg-femo-

ra, -tibiae and -tarsi ochre; medial spurs at half of tibia 2.0 mm long, apical spurs ca. 1.5 mm long, covering first tarsomere; distance between medial and apical spurs about 2.5 mm. Forewing upperside light ochre, with many short striae; terminal line reduced to striae; a broad subterminal line of dark olive stretching from apex to CuA_2; a small rounded discal spot of dark ochre present in cell; several faded lines of olive running from costa to dorsum, two broader lines below CuA_2, the latter marked dark olive but cream on posterior edge; ciliae of wing margins long, ca. 1.5 mm, ochre; underside ochre, glossy. Hindwing upperside light ochre, glossy; underside and cilia as in forewing. *Abdomen* largely ochre.

Male. Unknown.

Female abdomen and genitalia (Fig. 18) Sclerotized plates of segment 8 covered with many setae, arranged in a row on posterior margin and in pairs on its surface, broad dorsally, with a deep semicircular emargination anteriorly, gradually narrowed to small ventral connection, latero-ventral plates bean-shaped, with shallow rounded emargination on its anterior margin and ventrally connected by a narrow band. Anterior apophyses broad in basal third, ca. 2 times as long as posterior apophyses which are gently sinuate, about as long as segment 8.

Diagnosis. *Shimonia fischeri* **sp. n.** superficially resembles *S. splendida*. However, the ground colour of *S. fischeri* is a lighter ochre; moreover, *S. fischeri* has a very short cross-bar from R_3 to R_4 and vein R_5 is originating from the middle of the posterior vein of the areole in the forewing, a unique feature in the genus. The long setae on segment 8 are often arranged in groups of two (groups of three in *splendida*). Only few setae occur on the papillae anales (more densely setose in *splendida*). The sclerotized tergal plate of segment 8 is distinctly broader than the narrow sternal plate, and the latero-ventral plates are ovate (triangular in *splendida*) and ventrally connected by a band. *S. oyiekeae* is also similar in the ground colour (differences see next species).

Distribution. *Shimonia fischeri* **sp. n.** is known from the southeastern region of the Congo Basin (Katako-Kombe, province Kasaï-Oriental, southeast DRC). Katako-Kombe is located at an altitude of 570 m, average annual rainfall 1700–1900 mm.

Etymology. The species is named after the botanist Professor Dr. Eberhard Fischer (University of Koblenz-Landau, Germany) to honour his attention to conservation issues of the plants of Nyungwe National Park (Rwanda) and of the orchids of Rwanda.

4. *Shimonia oyiekeae* sp. n.
Figs 5, 14, 15

Material examined. *Holotype* ♂, Belgian Congo [Democratic Republic of the Congo], Katanga, Elisabethville [Lubumbashi], 19 Sept 1952, Ch. Seydel leg., genitalia slide number 03/072010 I. Lehmann (RMCA). *Paratype* ♂, Republic of the Congo [Democratic Republic of the Congo], Katanga, Kolwezi, August.1964, number 47, V. Allard leg., genitalia slide number 16/022011 I. Lehmann (NMK).

Description. Forewing length 15.0 mm (wingspan 37.0 mm); antennae broken. *Head*: cream around eyes and base of antennae, eyes olive with small black spots; antennae bipectinate, branches 5 times width of shaft, tips with long scales; shaft and branches densely covered with pale ochre scales dorsally, distance between branches at base equal to the width of the branch, all branches strongly bent towards apex of antenna; labial palpi longer than diameter of eye, light-ochre dorsally, with long hair-like scales ventrally. *Thorax*: patagia and tegulae light-ochre with cream tips, glossy. Femora, tibiae and tarsi of hindlegs cream with two pairs of tibial spurs, medial pair 1.9 mm long, apical pair 1.5 mm long, covering first tarsomere, the distance between spur pairs about 2.6 mm. Forewing: upperside light-ochre; costal margin with patches of dark ochre; a small discal spot of dark ochre in the centre of median cell; an oblique and slightly waved subterminal line of dark ocher from costa to the end of CuA_2; ciliae of wing margins long, 1.5 mm, cream, glossy. Underside cream, glossy. Wing venation very similar to *S. timberlakei* (Fig. 6). Hindwing: upperside cream-ochreous, glossy; cilia long, 1.8 mm; underside as in forewing. *Abdomen*: largely light-ochre.

Male genitalia (Figs 14, 15). Uncus broad, almost as long as tegumen (ventral view), ventral surface setose, with short and long setae; the two thorn-like setose appendices of valva arising from large plates; arms of gnathos slightly bent dorsally, dentate distally, connected by a narrow band caudally. Saccus finger-like, small, rounded caudally; basal part of tegumen and vinculum forming a firm ring, vinculum divided by a long narrow cleft ventrally; phallus slightly longer than valva, curved, tapering towards apex, bilobed and with a deep cleft apically.

Female. Unknown.

Diagnosis. *S. oyiekeae* differs from its congeners by distinctly smaller wing size. Also the superficially similar female of *S. fischeri* is much too large in relation to the *oyiekeae* male as to be considered as possibly conspecific (moreover, both taxa do not occur sympatrically). In the male genitalia two characters easily separate this species

from its congeners: i) the two thorn-like appendices of the valva arise from broad basal plates which cover about the half of its surface; ii) membranous distal parts of valva deeply bilobed.

Distribution. *Shimonia oyiekeae* **sp. n.** is known from Lubumbashi and Kolwezi (Katangan Copper Bow, DRC). Lubumbashi (formerly called Elisabethville; altitude 1210–1298 m; average annual rainfall 1270 mm) and Kolwezi (altitude 1448 m; average annual rainfall 1200 mm) are located in the southeastern DRC (Katanga Province).

Etymology. The species is named after Dr Helida Achieng Oyieke (NMK, Nairobi) to honour her valuable contribution to many research programmes, to the studies of the first author in Kenya as well as her successful collection management at the NMK.

DISCUSSION

Most of the Afromontane rain forests are under severe pressure and survive only in protected or rugged, inaccessible areas. A major threat to these forests is their fragmentation due to the establishment of small farms (Bowie & Blom 2004). *Shimonia splendida* is probably under a severe threat in its montane habitat. This is also the case with *S. oyiekeae* **sp. n.** due to enormous habitat destruction in the *"Katangan Copper Bow"* sensu François (1973). This area stretches in a broad zone from Kolwezi in the West to Lubumbashi in the East (400 km × 70 km) and is about 250 km southwest from the southern end of the Albertine Rift region. Extraction of heavy metals started a long time ago in Katanga and in the adjacent Zambian *"Copperbelt"* sensu François (1973). Copper metallurgy has been reported as already existing during the 14th century (De Plaen et al. 1982). Today, a unique copper-cobalt flora with a high endemism occurs in these areas (Leteinturier et al. 1999; Malaisse et al. 1999). This copper-cobalt flora might be of less importance for Metarbelidae since the latter are more dependent on the original wet 'miombo'. Many Metarbelidae species probably no longer exist. For example, in the Copperbelt 51% or 391,400 ha of its 'miombo' was deforested between 1937 and 1983 (Lees 1962; Chidumayo 1987). The conservation of species of *Shimonia* East of the arc formed by the Congo River is less of a problem as still large relatively stable or intact swamp forest as well as lowland rain forest blocks remain (Burgess et al. 2004).

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