

***Centuriarus* n. gen., a new genus of Eneopterinae crickets from Papua (Insecta, Orthoptera, Grylloidea)**

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Robillard T. 2011. — *Centuriarus* n. gen., a new genus of Eneopterinae crickets from Papua (Insecta, Orthoptera, Grylloidea). *Zoosystema* 33 (1): 49-60. DOI: 10.5252/z2011n1a2.

ABSTRACT

The present study describes *Centuriarus* n. gen., a new genus of Eneopterinae crickets from Papua Island (Papua New Guinea and Indonesia), which belongs to the Lebinthini tribe. The type species *Centuriarus centurio* (Brunner von Wattenwyl, 1898) n. comb., formerly *Eurepa centurio*, is redescribed and a lectotype is designated. Another *Eurepa* species, *Eurepa punctata* (Brunner von Wattenwyl, 1898), formerly *Piestodactylus punctatus*, is transferred to *Lebinthus* based on the original description and observation of one female syntype. Descriptions focus on general morphology, male and female genitalia, and forewing venation.

RÉSUMÉ

Centuriarus n. gen., un nouveau genre de grillons Eneopterinae (Insecta, Orthoptera, Grylloidea) de Papouasie.

La présente étude décrit *Centuriarus* n. gen., un nouveau genre de grillons Eneopterinae de Papouasie (Indonésie et Papouasie Nouvelle-Guinée), qui appartient à la tribu des Lebinthini. L'espèce type *Centuriarus centurio* (Brunner von Wattenwyl, 1898) n. comb., précédemment *Eurepa centurio*, est redécrite et un lectotype est désigné. Une autre espèce d'*Eurepa*, *Eurepa punctata* (Brunner von Wattenwyl, 1898), précédemment *Piestodactylus punctatus*, est transférée dans *Lebinthus* sur la base de la description originale et de l'observation d'un syntype femelle. Les descriptions se concentrent sur la morphologie générale, les genitalia mâles et femelles et la nervation des élytres.

KEYWORDS

Insecta,
Orthoptera,
Grylloidea,
Eneopterinae,
Lebinthini,
Lebinthus,
Indonesia,
Papua New Guinea,
new genus.

MOTS CLÉS

Insecta,
Orthoptera,
Grylloidea,
Eneopterinae,
Lebinthini,
Lebinthus,
Indonésie,
Papouasie
Nouvelle-Guinée,
genre nouveau.

INTRODUCTION

As shown by several recent studies, the cricket subfamily Eneopterinae (Grylloidea) is most diverse in the Western Pacific region (Desutter-Grandcolas & Robillard 2006; Otte 2007; Robillard 2009, 2010). But a closer look at the fragmentary knowledge from this region reveals that the greatest part of this diversity remains to be uncovered and/or described. This is particularly true for the fauna of Papua Island, which is barely known through a few species briefly described by Brunner von Wattenwyl (1898) and Chopard (1931). Most of eneopterine species from Papua belong to the tribe Lebinthini Robillard, 2004, which is predominant in the region (Robillard & Desutter-Grandcolas 2004a, 2006, 2008), but two species were erroneously placed in the genus *Eurepa* Walker, 1869 (tribe Eurepini), otherwise exclusively known from Australia (Otte & Alexander 1983).

One species, *Eurepa punctata* (Brunner von Wattenwyl, 1898) clearly belongs to *Lebinthus* Stål, 1877, according to the original description and the observation of a female specimen found in the collections of the Muséum national d'Histoire naturelle, Paris. *Eurepa centurio* (Brunner von Wattenwyl, 1898) is in a different situation as it appears to belong to a new genus related to the Lebinthini tribe.

In the present study I define the new genus *Centuriarius* n. gen. for *Eurepa centurio* and redescribe this species. Descriptions focus on genitalia and forewing venation in both sexes. A key of determination of Lebinthini genera is provided.

MATERIAL AND METHODS

MALE TEGMINAL VENATION

Male tegminal veins and cells (Fig. 1) are named after Desutter-Grandcolas (2003) for Ensifera, and Robillard & Desutter-Grandcolas (2004a) for the subfamily Eneopterinae more specifically.

MALE AND FEMALE GENITALIA

Male and female genitalia have been dissected in softened specimens by cutting the membranes between the paraprocts and the subgenital plate, or between the ovipositor and the subgenital plate

respectively; they have been cleaned with cold KOH and coloured using blue artist acrylic ink, and have been observed using a binocular microscope Leica MZ16 at magnifications up to 160, and then kept in glycerine in vials pinned under specimens. Male genitalia are named according to Desutter (1987), modified in Desutter-Grandcolas (2003) and Robillard & Desutter-Grandcolas (2004a). Dotted parts in figures correspond to membranous areas.

ABBREVIATIONS

General morphology

fa	fastigium;
FW	forewing;
I-1, I-3	first and third segments of fore leg tarsomere;
III-1, III-3	first and third segments of hind leg tarsomere.

Male genitalia

ec arc	ectophallic arc;
ec ap	ectophallic apodeme;
ec f	ectophallic fold;
en ap	endophallic apodeme;
en s	endophallic sclerite;
ps l	pseudepiphallal lophi;
ps p	pseudepiphallal paramere;
r	rami.

Tegminal venation

1A-4A	first to fourth anal veins;
CuA	anterior cubitus;
CuA2	second bifurcation of CuA;
CuP	posterior cubitus;
MA, MP	anterior, posterior media veins;
R	radial vein;
c1-3	first to third cells of C alignment;
d1 cell	first cell(s) of D alignment (mirror).

Measurements

FIIL	length of hind femora;
FIIW	width of hind femora;
FWL	forewing length;
FWW	forewing width (at the level of maximal width);
OL	ovipositor length;
PronL	pronotum length;
PronW	pronotum width;
TIIL	length of hind tibiae.

Institutions

MNHN	Muséum national d'Histoire naturelle, Paris;
NHMW	Naturhistorisches Museum, Vienna;
RMNH	Nationaal Natuurhistorisch Museum (formerly Rijksmuseum van Natuurlijke Historie), Leiden.

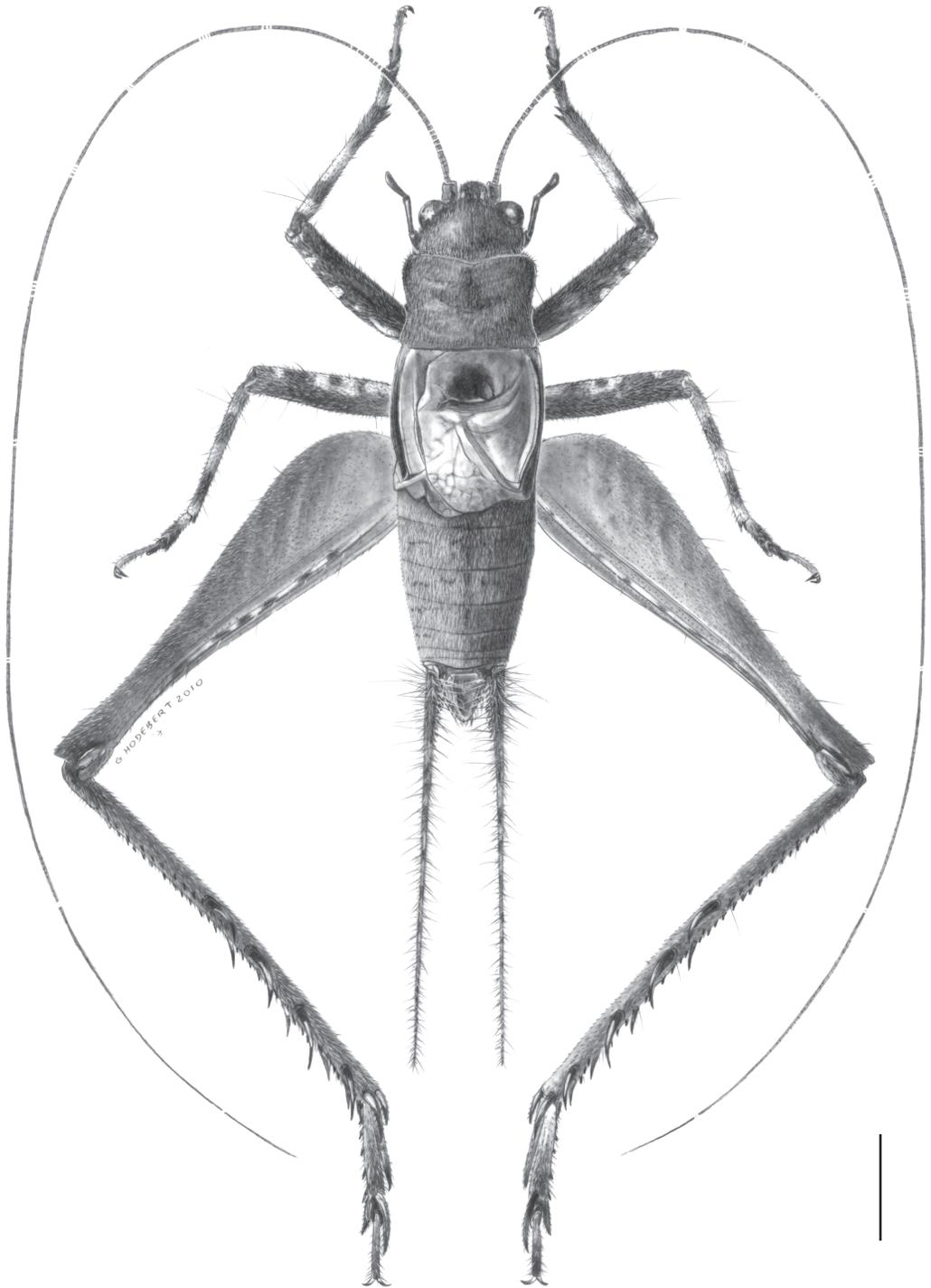


FIG. 1. — *Centurarius centurio* (Brunner von Wattenwyl, 1898) n. comb., ♂ lectotype (NHMW), habitus. Scale bar: 5 mm.

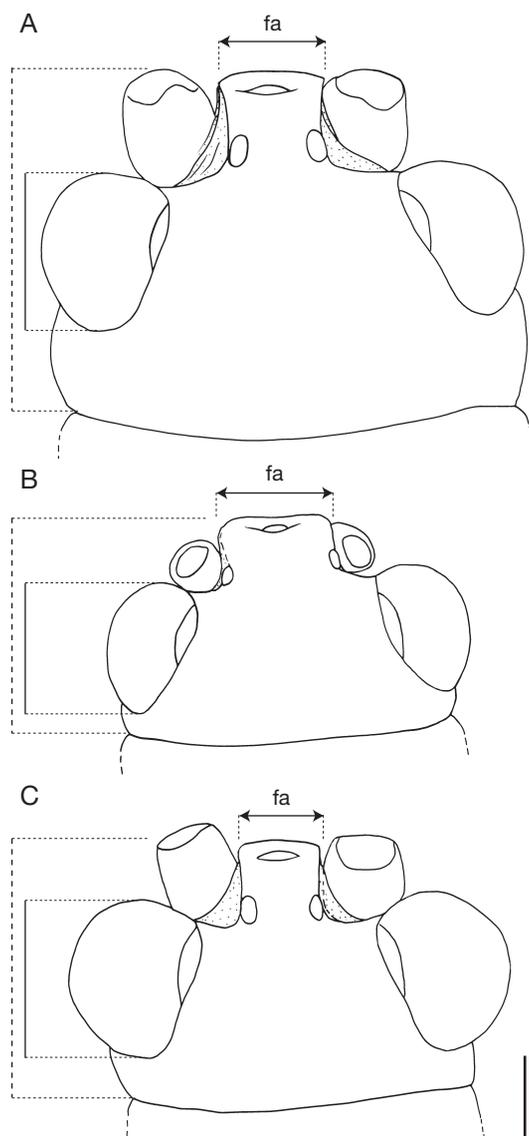


FIG. 2. — Shape and size comparisons of the head of *Centuriarus centurio* (Brunner von Wattenwyl, 1898) n. comb., (A), *Lebinthus leopoldi* Chopard, 1931 (B), and *Cardiodactylus novaeguineae* (Haan, 1842) (C), showing eye length (bold line), head length (large dotted line) and fastigium width (fa; horizontal arrow). Scale bar: 1 mm.

SYSTEMATICS

Subfamily ENEOPTERINAE Saussure, 1874
Tribe LEBINTHINI Robillard, 2004

Genus *Centuriarus* n. gen.

TYPE SPECIES. — *Piestodactylus centurio* Brunner von Wattenwyl, 1898, here designated.

ETYMOLOGY. — Genus named after the type species.

DIAGNOSIS. — Among Eneopterinae and Lebinthini genera, *Centuriarus* n. gen. is characterized by its large size and a mix of characters otherwise found in *Cardiodactylus* Saussure, 1878, *Lebinthus* and *Agnotecous* Saussure, 1878. It is more slender in shape than *Lebinthus* and *Agnotecous* but resembles these genera by microptery in both sexes (FW short and hind wings absent), with similar inward curve of male CuA as in *Lebinthus*. Despite microptery, male and female FW venations are more elaborate than in *Lebinthus* and *Agnotecous*, with a more differentiate mirror in males. Legs are long and fastigium is narrow as in *Cardiodactylus*, but eyes are smaller than in *Lebinthus* and *Agnotecous*. Male genitalia are characterized by the absence of a median process, which is always present in *Cardiodactylus* and in most *Agnotecous* species (except a few species in *yahoue* species group), but is lacking in most *Lebinthus* species; pseudepiphallallic parameres are bilobate and oriented perpendicularly to genitalia main axis. Contrary to all other Lebinthini species, the ovipositor in *Centuriarus* n. gen. is not denticulate on apex dorsal edge.

DESCRIPTION

Genus characterized by its large size even for the Lebinthini tribe (Fig. 1) and more slender shape than *Lebinthus* and *Agnotecous*. Eyes little prominent (Fig. 2), smaller than in other Lebinthini genera; fastigium as long as wide, slightly widened apically, not separated from vertex by a transverse depression nor furrowed longitudinally. Ocelli large, bulbous. Face higher than wide. Dorsal disk of pronotum slightly wider than long, its anterior margin indented, its posterior margin straight (Fig. 1). Legs long. Fore tibiae with 2 tympana; inner tympanum covered by a sclerotised expansion (Fig. 3A), its membrane visible along a small longitudinal slit only; outer tympanum ellipsoidal, transversally plicate (Fig. 3B). Fore tibiae with 2 inner and 1 outer apical spurs. Tibiae II with 2 inner and 2 outer spurs. Hindfemora filiform at apex. Hindtibiae serrulated on their whole length, furrowed longitudinally on their dorsal side and with 4 pairs of subapical spurs and 3 pairs of apical spurs; inner spurs long and curved, outer spurs short and straight. Tarsomeres III-1 with 2

dorso-apical spines and a row of spines on outer dorsal edge; no lateral outer spine. FWs short, not reaching abdomen midlength; hindwings absent. Cerci long and thin, longer than hind femora.

Male

Metanotal glands absent. Stridulum complete (Fig. 4): harp wide; mirror not rounded but differentiated from other cells of D alignment; d2 cell undifferentiated; stridulatory file with teeth both on the transverse and longitudinal parts of 1A; bump near 1A basis carrying extra stridulatory teeth (Fig. 5). CuP absent but claval fold visible along CuA. Diagonal faint, on top of a fold. CuA curved inward around the median fold, short and located on dorsum as in *Lebinthus* and *Agnotecous*. Apical field short but involving 3 cell alignments posterior to the mirror (alignments E-G). FW lateral field: R with several bifurcations in its posterior third; intermedian area dark brown. Subgenital plate clog-shaped, twice as long as sternite; inner side of subgenital plate with paired subapical swellings.

Male genitalia. (Fig. 6) Pseudepiphallus triangular, basal margin straight, posterior apex with paired membranous lophi, setose, and without a median process as in most other *Lebinthini* species. Rami straight, parallel and short. Ventral pseudepiphallic plate narrow and elongate. Pseudepiphallic parameres well sclerotised, with a dorsal lobe, a basal ventral lobe oriented anteriorly, and 2 distal ventral lobes parallel and perpendicular to the main genitalia axis. Ectophallic apodemes parallel and long. Ectophallic arc well sclerotised, straight. Ectophallic fold short, with a spatula-like sclerotisation. Lateral ectophallic expansions oriented anteriorly. Endophallic sclerite comprising a short median sclerotisation and 2 lateral arms, very long anteriorly, exceeding pseudepiphallic sclerite. Endophallic apodeme narrow, crest-like.

FEMALE

FWs (Fig. 7A) slightly overlapping, yellow brown, dorsal field with 7 strong longitudinal veins, 1A very strong and bifurcated at midlength; lateral field with 4 longitudinal veins, R without bifurcations. Ovipositor apex laterally flattened, lanceolate and smooth dorsally (Fig. 7B).

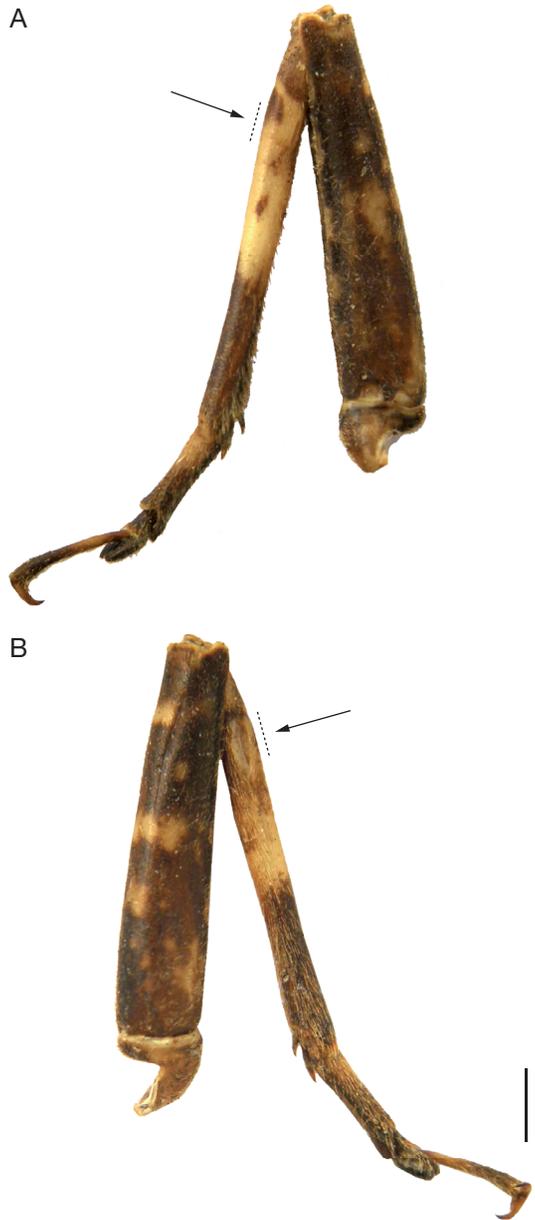


FIG. 3. — *Centuriarus centurio* (Brunner von Wattenwyl, 1898) n. comb. fore leg in inner (A) and outer (B) views. The tympana are indicated using black arrows and dotted lines. Scale bar: 1 mm.

Female genitalia (Fig. 7C-E). Copulatory papilla more similar in general shape to that of *Cardiodactylus* than to *Lebinthus* or *Agnotecous*; ovoid, with a basal sclerotised ring and ventral reliefs.

Centuriarus centurio

(Brunner von Wattenwyl, 1898) n. comb.

(Figs 1-7)

Piestodactylus centurio Brunner von Wattenwyl, 1898: 278.*Lebinthus centurio*—Chopard 1931: 21 (in the description of *Lebinthus flavipalpis* Chopard, 1931).*Eurepa centurio*—Chopard 1968: 356. —Otte 1994: 66. —Robillard & Desutter-Grandcolas 2004: 271-293 (> *Eurepini* tribe).

TYPE MATERIAL. — No type series is mentioned in the original description, but the author mentions “my collection”. One male specimen found in the collections of Vienna is suspected to be part of the type series according to labels and measurements; it is designated as lectotype: **Indonesia**. [Irian Jaya, Papua Island], Kaiser Wilhelm Ins., 1 ♂, 19.281 (NHMW).

TYPE LOCALITY. — Indonesia, Papua Island, no precise locality.

OTHER MATERIAL EXAMINED. — **Indonesia**. [Irian Jaya, Papua Island], Hollandia [Jayapura], 1911, Dr. P.N. von Kampen Ned. Nw [New] Guinea exp, 1 ♂, 2 ♀♀ (RMNH); 1 ♂ (MNHN-ENSIF 1772).

Papua New Guinea. Simbang, Huon Golf, 1898, Biro, identified *Eurepa centurio* Br. by L. Chopard, 1 ♀ (MNHN-ENSIF 1444).

DISTRIBUTION. — Papua Island.

DIAGNOSIS. — Very large species, with a contrasted colouration, yellow brown with a dark brown area on FW in both sexes.

HABITAT AND LIFE HISTORY TRAITS. — Unknown.

MEASUREMENTS. — See Table 1.

REDESCRIPTION

In addition to the features of the genus, colouration contrasted, mostly yellow brown with darker areas. Eyes red brown. Head dorsum homogeneously brown with a yellow brown area posterior to eyes (Fig. 1). Fastigium yellow brown. Scapes yellow brown with dark brown patterns, antennae dark brown with yellow rings. Cheeks dark brown except for a Y-shaped yellow pattern and a yellow spot below eyes. Face yellow brown with dark brown patterns on front head and below antennae. Mouthparts yellow or whitish, more or less

mottled with dark brown. Palpi yellow with one dark brown ring per segment. Pronotum: Dorsal disk brown to dark brown, diversely mottled with yellow brown, especially on posterior and lateral margins; lateral lobes dark brown. Legs: fore (Fig. 3) and median femora dark brown with yellow brown spots; tibiae, tarsomeres I-1 and tarsomeres I-3 dark brown with a yellow brown ring. Hind femora mostly dark brown mottled with yellow brown, homogeneously brown near the knees; hind tibiae almost homogeneous brown, with yellowish areas around bases of spurs; basis of tarsomeres III-1 yellow brown, distal part dark brown. Hind tibiae with 8-9 ($m = 8.3$, $n = 4$) inner and 11-13 ($m = 12.3$, $n = 4$) outer spines above spurs and 7-8 ($m = 7.8$, $n = 4$) inner and 8-10 ($m = 9$, $n = 4$) outer spines between spurs. Tarsomeres III-1 with 3-4 ($m = 3.7$, $n = 3$) spines on dorsal outer edges and 1 ($n = 3$) spine on outer side bases. Abdomen brown dorsally, sometimes with lateral whitish spots. Cerci yellow brown, mottled with dark brown at basis, then with dark brown rings in distal part.

Male

FW colouration (Figs 1; 4): cells and veins homogeneously yellow brown with several small dark brown spots and a large dark area anterior to 1A, including a portion of 2A and 3A; part of intermedian area and area between MA and R dark brown. FW venation (Fig. 4): harp triangular, with thin cuticular reliefs, crossed by one complete transverse vein. CuA quite weak. c1 cell not crossed by a transverse vein. D alignment and mirror (d1) well differentiated, but mirror not rounded. Stridulatory file (Fig. 5): 103 teeth on the transverse part of 1A, 21 teeth on the longitudinal part, and 6 teeth on the ventral bump near 1A basis (total = 130 teeth, $n = 1$). Lateral field: latero-dorsal angle made by MP; distal part of MP weak, fused to MA; R bifurcated three times in distal third; ventral part of lateral field with 4 extra longitudinal veins.

Male genitalia (Fig. 6). Pseudepiphallus profile almost flat; lophi very setose on ventral side, with lateral indentations on sclerotisation of dorsal side.

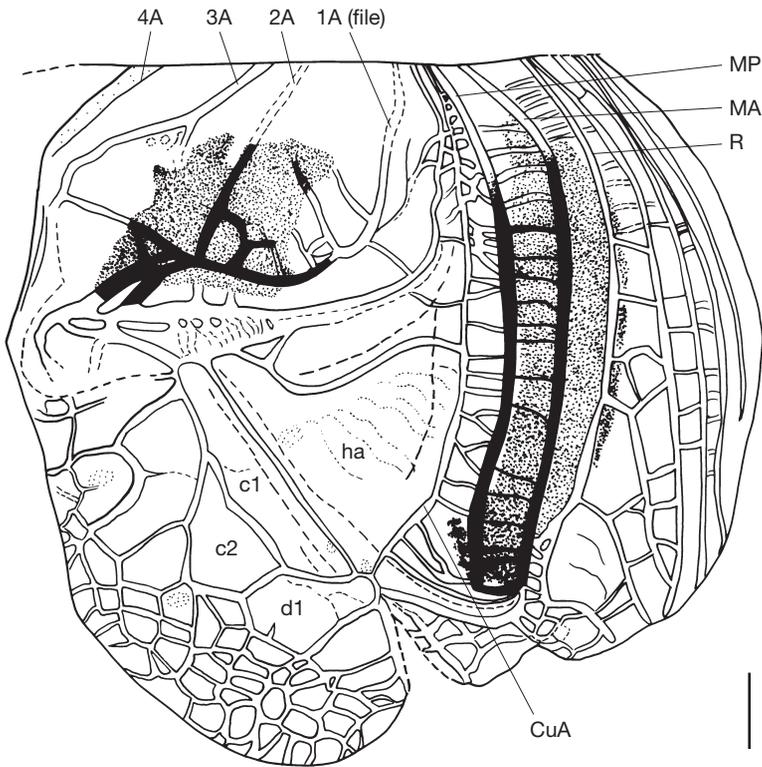


FIG. 4. — *Centuriarus centurio* (Brunner von Wattenwyl, 1898) n. comb. male, FW venation. Dense and spaced dotted areas represent respectively dark and whitish colouration patterns; strong dotted lines represent folds and reliefs. Abbreviations: see Material and methods. Scale bar: 1 mm.

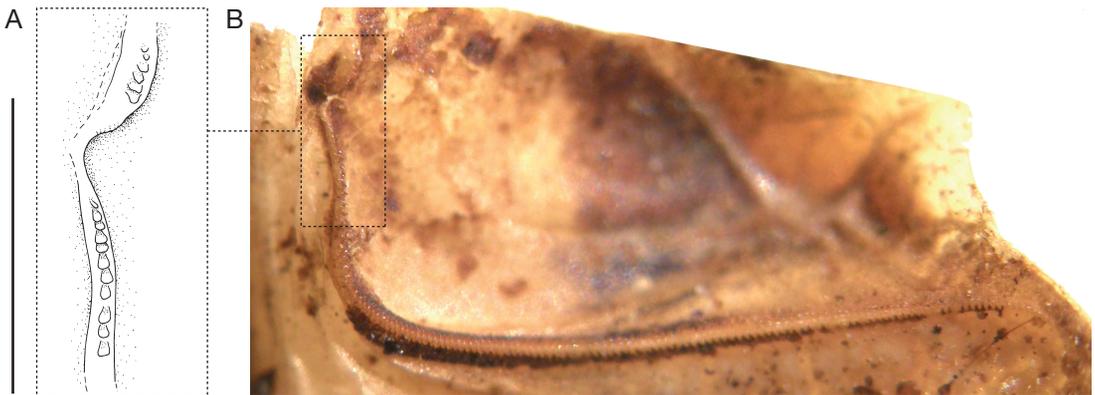


FIG. 5. — Anterior part of male FW of *Centuriarus centurio* (Brunner von Wattenwyl, 1898) n. comb. in ventral view (B), with a detailed view of the basal bump on the stridulatory file (A). Scale bar: A, 1 mm.

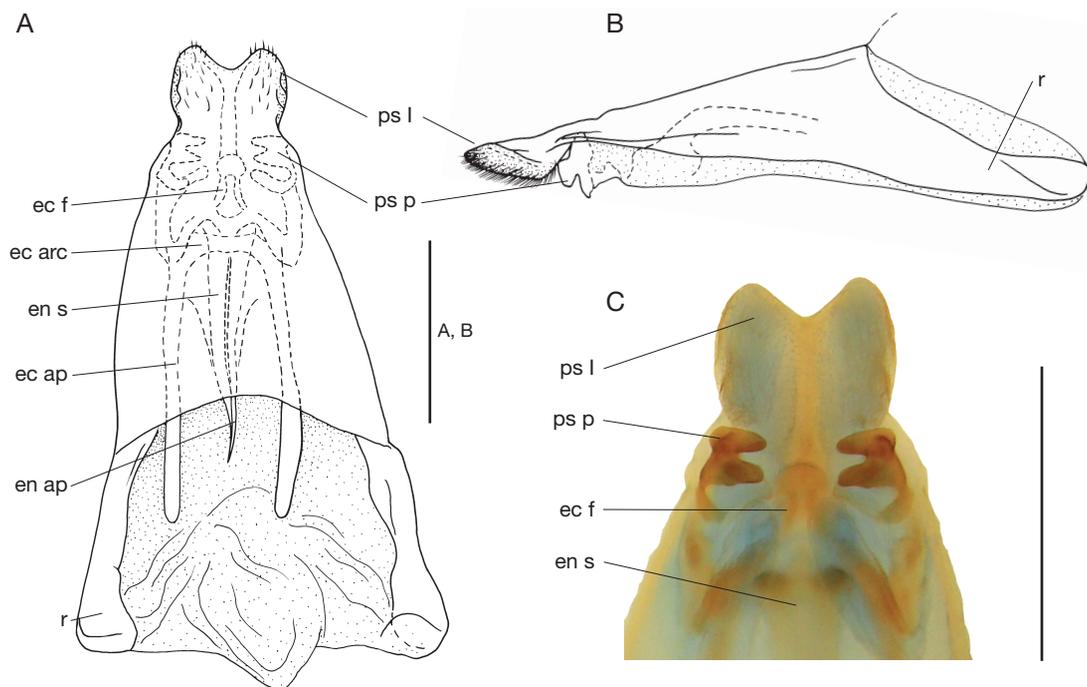


FIG. 6. — Male genitalia of *Centuriarus centurio* (Brunner von Wattenwyl, 1898) n. comb. in dorsal (A), lateral (B), and ventral (C) views. Abbreviations: see Material and methods. Scale bars: 1 mm.

TABLE 1. — Measurements (in mm) of *Centuriarus centurio* (Brunner von Wattenwyl, 1898) n. comb., mean values in brackets. Male measurements include the lectotype. Abbreviations: see Material and methods.

	PronL	PronW	FWL	FWW	FIIL	FIIW	TIIL	OL
♂ lectotype	4.9	6.9	8.3	6.2	25.3	6.1	24.5	—
♂♂ (n = 3)	4.6-4.9 (4.8)	6.1-6.9 (6.4)	7.2-8.3 (7.6)	5.7-6.2 (5.9)	22.5-25.4 (n = 2)	5.6-6.1 (n = 2)	22.9-24.5 (n = 2)	—
♀♀ (n = 3)	5.2-5.5 (5.3)	6.6-7 (6.7)	6.2-6.4 (6.3)	4.2-4.4 (4.3)	26-28.2 (n = 2)	6.4-6.8 (n = 2)	23.8-26.3 (20.8)	18.8-22 (20.8)

Female

FWs yellow brown to dark brown, including cells and veins, with a dark brown area including bases of veins 2A, 3A and 4A; dark brown spots near bifurcation of 1A; intermedian area and between MA and R dark brown except on posterior margin of FW (Fig. 7A). Longitudinal veins very strong, especially 1A, MA and MP; transverse veins weak. Ovipositor slightly shorter than hind femur (Table 1).

Female genitalia (Fig. 7C-E). Well sclerotised, with lateral undulations; ventral reliefs consist of a median triangular crest prolonged by the raised apex.

REMARK

The female specimen from Papua New Guinea is darker than those from Irian Jaya, but shows not significant differences in general patterns of colouration and FW venation.

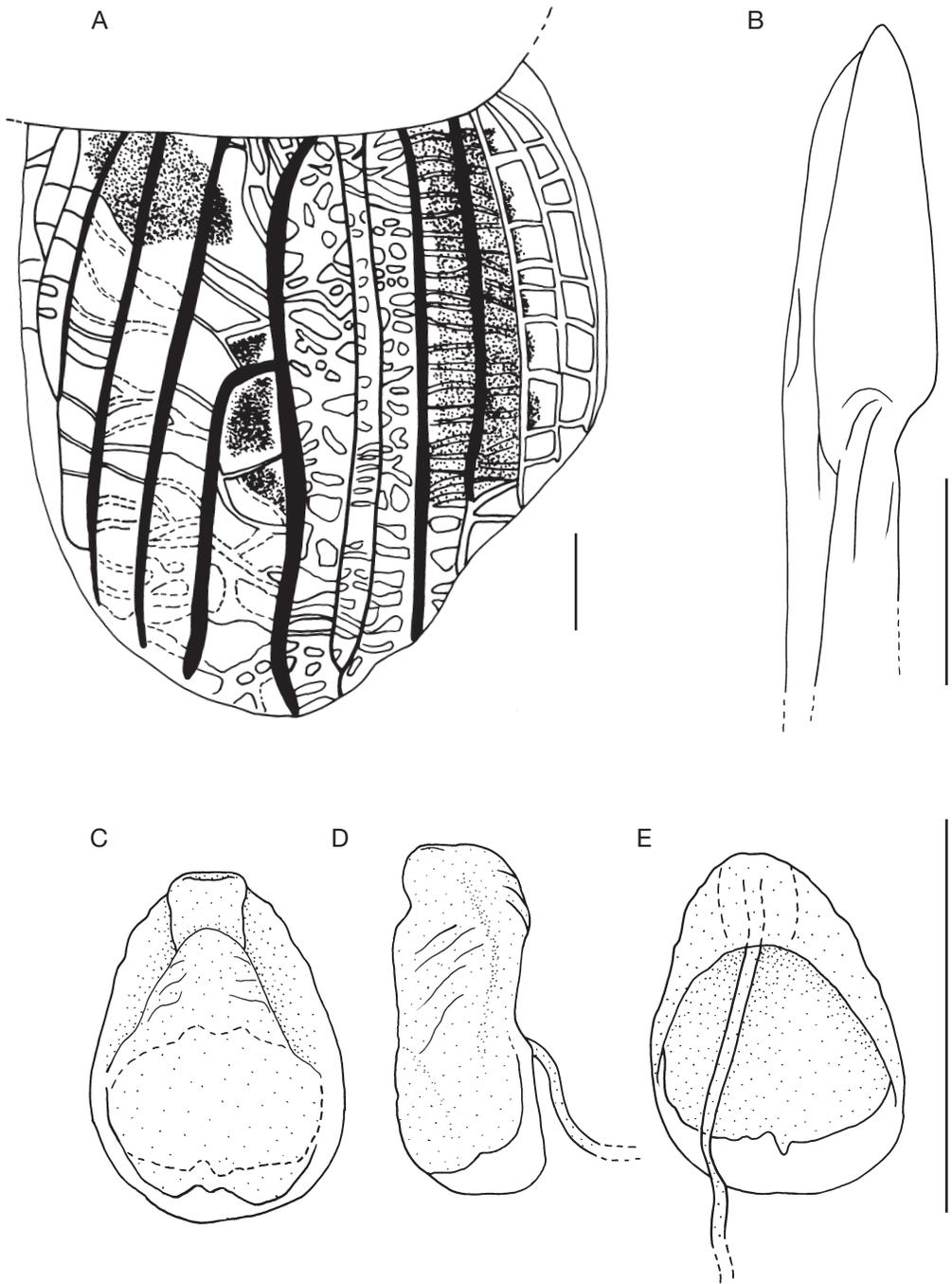


FIG. 7. — Female of *Centurarius centurio* (Brunner von Wattenwyl, 1898) n. comb.: FW venation (A), apex of ovipositor (B), and copulatory papilla in ventral (C), lateral (D) and dorsal (E) views. In FW venation, dense dotted areas represent dark colouration patterns; in copulatory papilla, dotted parts correspond to membranous areas. Scale bars: 1 mm.

Genus *Lebinthus* Stål, 1877*Lebinthus punctatus*

(Brunner von Wattenwyl, 1898) n. comb.

Piestodactylus punctatus Brunner von Wattenwyl, 1898: 278.*Eurepa punctata* – Chopard 1968: 356. — Otte 1994: 66. — Robillard & Desutter-Grandcolas 2004: 271-293 (> *Eurepini* tribe).

TYPE MATERIAL. — No type series is mentioned in the original description, but the author mentions “Patria: Halmahera (K.)”, which could correspond to specimens collected by W. Kukenthal. One female specimen found in the collections of MNHN is suspected to be part of the type series according to the labels and measurements.

Indonesia. [Maluku Utara province] Halmehera [Island], 1894, 1 ♀, W. Kukenthal (MNHN-ENSIF1448).

TYPE LOCALITY. — Indonesia, Halmahera Island, no precise locality.

DISTRIBUTION. — Halmahera Island.

REMARK

According to the original description and male and female habitus drawings made by Brunner von Wattenwyl (1898), *Piestodactylus punctatus* does not belong to the genus *Eurepa*, but to *Lebinthus*. This is confirmed by observations of the female type specimen examined here, which presents the following features of *Lebinthus*: FWs short, fastigium as wide as long, eyes large, ovipositor denticulate at apex.

KEY TO THE GENERA OF *LEBINTHINI* ROBILLARD, 2004

1. Long wings (reaching the tip of abdomen or longer) *Cardiodactylus*
— Short wings (not reaching abdomen mid length; Fig. 1) 2
2. Fastigium at least twice as wide as long (Fig. 2B), eyes large (Fig. 2B, C), ovipositor denticulate at apex 3
— Fastigium as wide as long, or narrower (Fig. 2A), eyes small (Fig. 2A), ovipositor not denticulate at apex (Fig. 7B) *Centuriarius* n. gen.
3. Male FWs with lateral field generally longer than dorsal field, distributed in New Caledonia *Agnotecous*
— Male FWs with lateral field shorter than dorsal field, not distributed in New Caledonia (Grande Terre) *Lebinthus*

DISCUSSION

Despite Chopard's (1931) annotation saying that *Piestodactylus centurio* belongs to *Lebinthus*, this species was later placed in the genus *Eurepa* under which *Piestodactylus* was synonymized (Chopard 1968), with no further examination. The first reason for this may be that no type specimens were clearly mentioned in the original description, preventing a direct comparison with newly described species of *Eurepa*. The other reason for this misplacement may be that there was barely new material originating from Papua Island since Brunner von Wattenwyl's 1898 paper, and therefore no analysis in depth of the cricket fauna of this diverse, yet largely unexplored territory.

The new genus *Centuriarius* n. gen. is characterized morphologically by features comprising size of eyes, female ovipositor not indented, basal bump on stridulatory file, and male genitalia with pseudepiphallic parameres transversally oriented. This character state is also observed in the genus *Xenogryllus* Bolivar, 1890 (pers. obs.). However, given its general morphology, FW venation and genitalia in both sexes, *Centuriarius* n. gen. clearly belongs to the *Lebinthini*, which include three other genera, *Lebinthus*, *Cardiodactylus* and *Agnotecous*.

It is difficult to hypothesize whether *Centuriarius* n. gen. is closer to *Cardiodactylus* or to *Lebinthus*. According to the short wings in both sexes and by venation characters shared with *Lebinthus*, as the

inward curve of CuA or the weak differentiation of the mirror, *Centuriarus* n. gen. would better be considered close to *Lebinthus*. This is supported by the structure of male genitalia, which lack the median process characterising *Cardiodactylus* and partly *Lebinthus* and *Agnotecous*.

However, striking features of *Centuriarus* n. gen. are more similar to *Cardiodactylus*, including shape of fastigium, slender general shape and leg length, although some of these characters could be associated with a particular biology shared by *Cardiodactylus* and *Centuriarus* n. gen. but not necessarily inherited from a common ancestor.

The inclusion of *Centuriarus* n. gen. in forthcoming analyses based on previous phylogenetic reconstruction of the subfamily Eneopterinae (Robillard & Desutter-Grandcolas 2004a, 2006; Robillard 2006) will uncover its relationships within the Lebinthini. New data acquisitions are however necessary, not only to include molecular data to the studies, but also to consider the acoustic signals of this new taxon. Its belonging to the Lebinthini is particularly interesting, as this tribe is characterized by original patterns of frequency spectra and high dominant frequencies (Robillard & Desutter-Grandcolas 2004b; Robillard *et al.* 2007; Robillard 2009, 2010). Whether *Centuriarus* n. gen. is a basal taxon within Lebinthini or an intermediary form between *Cardiodactylus* and (*Lebinthus-Agnotecous*) would help understanding the origin and patterns of evolution of the spectral innovations found in the tribe.

Acknowledgements

I thank Rob de Vries and Caroline Pepermans of the National Museum of Natural History, Leiden, The Netherlands, for help during the study in the Leiden collections, funded by a MNHN grant (PPF, "État et structure phylogénétique de la biodiversité actuelle et fossile", P. Janvier); and Ulrike Aspöck of the Naturhistorisches Museum, Vienna, Austria, for help during the study in the Vienna collections, funded by the SYNTHESYS European program (AT-TAF-3004). I also thank Gilbert Hodebert (MNHN) for the habitus drawing, Annemarie Ohler, Laure Desutter-Grandcolas and David Rentz for their critical reading and their suggestions on the manuscript.

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Submitted on 16 April 2010;
accepted on 9 September 2010.