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New Blattoptera from Early Cretaceous of Santana Formation (Araripe Basin, NE Brazil) and a review of *Arariplebatta* Mendes, 2000

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ABSTRACT. *Arariplebatta* Mendes is here reviewed taking into account its previous diagnosis in Portuguese, the proposal of a new species, *A. cesi*, and an emended diagnosis of *Blattulopsis beckeri* Mendes. To include the genus and the new related forms the new family Araripeblattidae is presented and *Elisama americana* Vršanský is considered a synonym of *Araripeblatta brevis* Mendes. Those Blattoptera came from the same laminated limestones from the basal part of Santana Formation, Ceará State, Northeast Brazil, Late Aptian in age, where the original samples were collected.

Key words: Blattopera, *Araripeblatta*, Araripeblattidae n. fam., Santana Formation, Lower Cretaceous, Brazil.

RESUMO. NOVOS BLATTOPTERA NO CRETÁCEO INFERIOR DA FORMAÇÃO SANTANA (BACIA DO ARARIPE, NE DO BRASIL) E A REVISÃO DE *ARARIPLEBATTA MENDES*, 2000. O gênero *Araripeblatta* Mendes é aqui revisado considerando-se sua diagnose original em português, a atribuição de uma nova espécie, *A. cesi*, e os novos elementos propostos para a diagnose de *Blattulopsis beckeri* Mendes. Para incluir o gênero e as novas formas relacionadas uma nova família é apresentada, Araripeblattidae, e *Elisama americana* Vršanský, é entendida como sinonímia de *Araripeblatta brevis* Mendes. Essas formas de Blattoptera provêm dos mesmos níveis de calcário laminado das previamente descritas, correspondentes à parte basal da Formação Santana (Membro Crato), Bacia do Araripe, estado do Ceará, com idade Neoaptiano.

Palavras-chave: Blattopera, *Araripeblatta*, Araripeblattidae n. fam., Formação Santana, Cretáceo Inferior, Brasil.

INTRODUCTION

The Blattoptera are an ancient group of insects which dominate the Late Carboniferous, which became rare during the Triassic and greatly diversified again in Jurassic and Cretaceous times (Schneider, 1983; Vršanský, 2002; Grimaldi and Engel, 2005). Like other Dictyoptera, their phylogenetic relationships remain controversially discussed in regard of some discrepancies between the stratigraphic record and the proposed phylogeny (Grimaldi, 2001). Following the recent molecular studies of Lo *et al.* (2002) the living roaches are a paraphyletic group of insects.

The blattopteran fauna from Santana Formation was firstly investigated by Pinto and Purper, (1986), Pinto (1989), and in the following by Marcio Mendes, who has produced ten short communications in scientific meetings, apart from his master and doctoral thesis about the Araripe Basin blattopterans. The material described by Mendes (2000) was housed at Guarulhos University (São Paulo, Brazil) and quite all were collected by the senior author of the present contribution. The single

comprehensive publication (Mendes, 2000) was written in Portuguese, including the diagnostic features, contrary the rules of the International Code of Zoological Nomenclature, which was one of the motives to the study presented here.

The Santana fossil insects, including Blattoptera forms, were also focused in foreign researchers, especially in the 1990s, based on samples stored in collections outside Brazil. In resulting publications new forms were described, sometimes ignoring the Brazilian contributions.

In this work, fossil specimens of Blattoptera from a small collection of the Paleontological Laboratory from Centro de Ensino Superior de Juiz de Fora (CES-JF), Minas Gerais State, Brazil, are reviewed in the light of the foregoing commentaries.

The quarry location and the geological setting of Araripe Basin are shown in Figure 1, and the stratigraphic data follow the conceptions from Ponte and Ponte Filho (1996), and Assine (2007).

The methodology and terms of the insect descriptions are that presented in Martins-Neto *et al.* (2005).

SYSTEMATIC PALEONTOLOGY

Order Blattoptera Brunner, 1882

Araripeblattidae fam. nov.

Type genus. *Araripeblatta* Mendes, 2000 here designated.

Diagnosis. Small-sized blattopteran with tegmen length around 9 mm. Females with recurrent ovipositor. Contact points of first R branch with the anterior wing border of MA origin (oMa), and contact of CuP with the posterior wing border are arranged in one line slightly transverse to the wing long axis. M and R fused close to the tegmen base. Paired small spines on the left fore tibia (in ventral view), and not paired long spines in the right fore tibia (in ventral view).

Discussion. Araripeblattidae n. fam. differs from Blattulidae Vischniakova (1982), the closest family, by having RA, oMA, and CuP transversely aligned. In Blattulidae tegmen, the secondary branches of RP and MA are restricted to the apical area, above the middle of the apex. A line between the contact of RA with the anterior wing border and the point of contact of CuP with the posterior wing border are nearly perpendicular arranged to the wing long axis. The point of M bifurcation (oMA) is situated slightly backward of this line (lcm=aml< oMA, see Martins-Neto *et al.*, 2005).

Araripeblatta Mendes, 2000

Type species. *Araripeblatta brevis* Mendes, 2000

Emended diagnosis. Apart the family characteristics, anal field occupying around 1/3 of the tegmen length and 80% of the tegmen width.

Araripeblatta brevis Mendes, 2000
(Figures 3A-B)

Synonym. *Elisama americana* Vršanský 2002, fig. 11, 21–26, 30.

Emended diagnosis. Apart the generic diagnosis, tegmen 9 mm long and 2.7 mm wide.

Holotypus. A female specimen, housed at the Laboratory of Geosciences, Guarulhos University, Guarulhos, Brazil, collection number UnG/1T-20 (Figure 3A).

Paratypus. A female specimen, housed at the same Institution, collection number UnG/1T-21 (Figure 3B).

DISCUSSION

Araripeblatta was firstly proposed by Mendes (2000), based on a single and relatively complete specimen, preserved in ventral view. Vršanský (2002) created a new species (*E. americana*) of the genus *Elisama* Giebel 1856, based on fragmentary material from the Santana Formation, housed at the American Museum (USA, AMNH XX; stated this way by Vršanský, 2002, probably due to a lapse). He ignored or omitted the description of *A. brevis* Mendes (2000), although both type specimens are identical in the preserved characteristics. In his summary of Blattoptera remains from Araripe Basin, Bechly (2007) refers the work of Mendes (2000) but does not mention *Araripeblatta brevis* neither other published blattopterans from there. Obviously based on

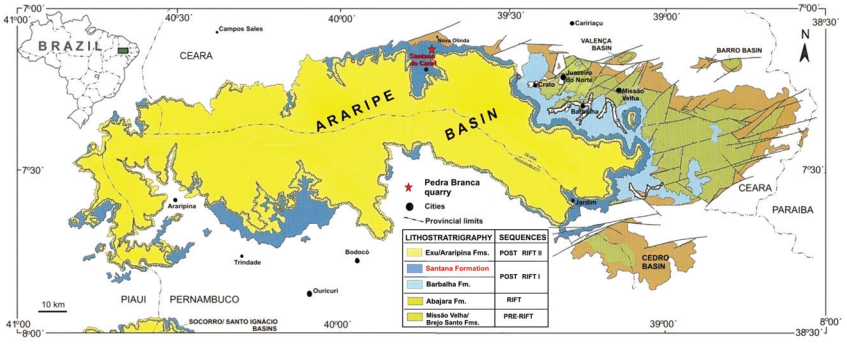

Figure 1. Geological and stratigraphical setting of Araripe Basin (modified from Assine, 2007), and Pedra Branca Mine location, where it is exposed the calcareous beds.

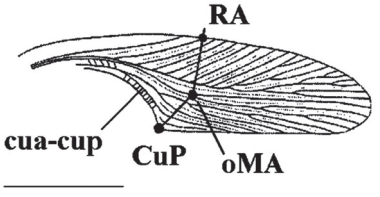

Figure 2. *Blattullopsis popovi* Pinto (Blattullidae), modified from Pinto (1990). Abbreviations: **cua-cup**, cross veins between CuP and CuA; **CuP**, posterior cubitus; **oMA**, origin of anterior Media; **RA**, anterior Radius. Scale bar: 5 mm.

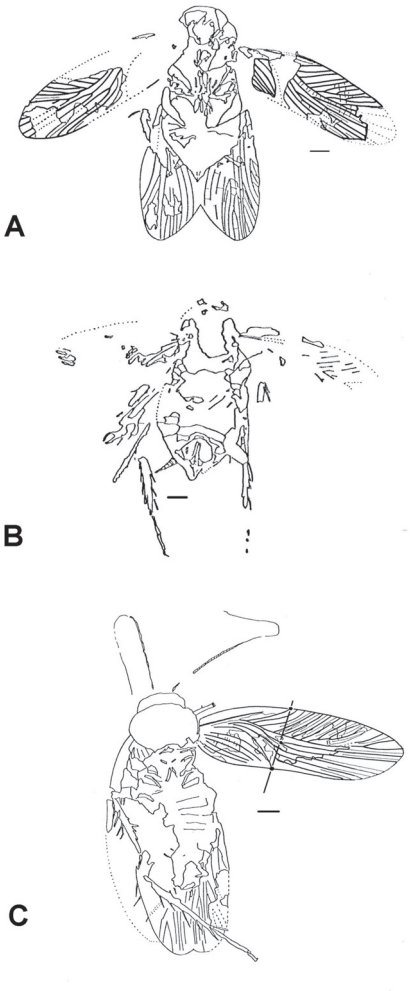

Figure 3. A-B. *Araripeblatta brevis* Mendes, 2000, holotype and paratypus, respectively, redrawn from Mendes (2000); **C.** *Araripeblatta beckeri* n. comb., redrawn from Mendes (2000). Scale bar: 1 mm.

Vršanský (2002), Bechly (2007) figured a specimen as *Elisama* Giebel 1856 (Figure 11.23f). Nevertheless, the figured specimen exhibits the same morphology of *Araripeblatta brevis,* and it is clearly not related to *Elisama*, a Blattulidae with species known from European Jurassic and Jurassic/Cretaceous transition in Asia (Wang *et al.*, 2007). *Elisama americana* is here considered a junior synonym of *Araripeblatta brevis.*

Araripeblatta beckeri n. comb.
(Figure 3C)

Mendes (2000) has erected *Blattulopsis beckeri* Mendes (2000) for a distinct specimen from Santana Formation (UnG/1T-025, housed at Guarulhos University), considering it as Blattulidae. This specimen coincides perfectly with *Araripeblatta* as well as with the new family here proposed, leading to the proposition of the new combination. Common feature is a virtual straight line, arranged slightly transverse to long axis of the wing, which connects the point where the RA (first R branch) ends, at the anterior wing border, with the point of oMA, as well as with the point where the CuP ends, at the posterior wing border. Those aspects lead to the proposition of the new combination.

A. beckeri n. comb. has a slightly longer tegmen (10 mm) and exhibits intercalary veins (plesiomorphic), also present in both *A. brevis* and *A. cesae.* For otherwise, both *A. brevis* and *A. beckeri* have not the area between CuP and the first anal vein filled by cross veins. Another interesting fact to note is the confirmation that the left forelegs (in ventral view) have relatively small paired spines in all of the three *Araripeblatta* species, as well as the right foreleg exhibiting longer and not paired spines (see Figures 3B-C).

Araripeblatta cesae n. sp
(Figures 4, 5)

Etymology. Latinized from CES, Centro de Ensino Superior de Juiz de Fora (CES/JF), Minas Gerais, Brazil.
Holotypus. CES-JF – I – 001, housed at Centro de Ensino Superior de Juiz e Fora, CES/JF.
Diagnosis. Area between CuP and the first anal vein filled by numerous and perpendicular cross veins; CuP with a distal secondary branch relatively parallel to both Medial ones and the anal margin.
Type locality. Pedra Branca Mine, on the road that connects Nova Olinda and Santana do Cariri municipalities, 4 km far from the first city, Ceará State, Brazil.
Stratigraphy. Upper part of Crato Member, Santana Formation.
Age. Late Aptian.
Description. Forelegs armed with spaced paired short spines at the left fore tibia, and longer ones, not spaced on the right one (at right in Figure 4A). Tegmen strongly sclerotinized, ornamented secondary veins consisting of small homogeneous granules (see detail in Figures 4B-C and 5A-B), 8.83 mm long and 2.91 mm wide. Basal width as narrow as apical one. Distal end of RA (first branch of R) close to the tegmen mid length. Ten RP secondary branches, the last four dichotomous, and the last one reaching the apical area. M origin close to the tegmen base, MA simple, parallel to RP; MP distally dichotomous.

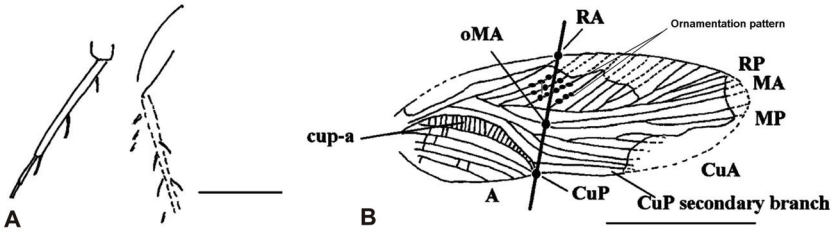

Figure 4. *Araripeblatta cesi* n. sp. (holotype). A. Fore and hind legs; B. Right tegmen. Abbreviations: **A**, anal vein; **CuA**, anterior cubitus; CunP, posterior cubitus; MnA, anterior media; **MP**, posterior media; **oMA**, Ma origin; **RA**, anterior radius; **RP**, posterior radius. Scale bars: A, 2.5 mm; B, 5 mm.

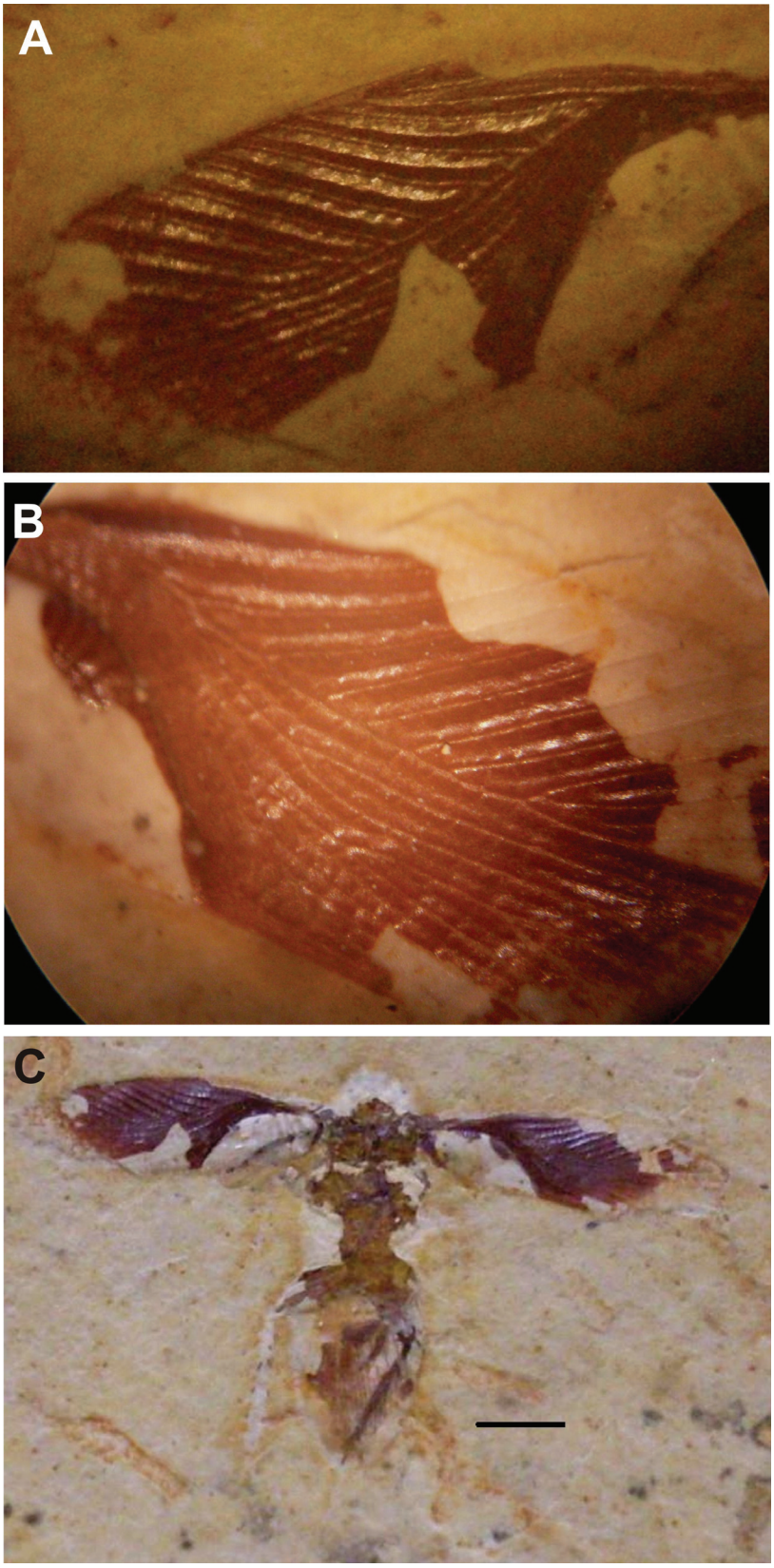

Figure 5. *Araripeblatta cesi* n. sp., holotype. **A.** Detail of the left tegmen; **B.** Right tegmen. **C.** Habitus; Scale bar: 3 mm.

CuA five-branched, originating from the Sc+R+M basal trunk, close to the tegmen base. CuP strongly curved, reaching the anal area at 1/3 of the tegmen length. A virtual connection of the point where the RA (first R branch) ends, at the anterior wing border, with the point of oMA, as well as with the point where the CuP ends, at the posterior wing border, which forms a straight line arranged slightly transverse to the wing long axis. Five parallel anal veins oblique to the anal margin. Space between CuP and the first anal vein filled by cross veins.

Discussion. *Araripeblatta cesae* n. sp. differs from the closest species, *Araripeblatta brevis* Mendes, in having the area between CuP and the first anal vein filled by cross veins, and the secondary CuP branch parallel and close to the posterior wing margin.

CONCLUSION

Over the last years, the taxonomy of Blattoptera from the Lower Cretaceous of Santana Formation became increasingly confused. It happened due to descriptions of isolated samples, sometimes badly preserved, that were housed in foreign museums or in private collections. Furthermore, it is effected by the inadequate approaches of local researchers, who published the diagnoses of new taxa in Portuguese, contrary to the rules of the International Code of Zoological Nomenclature. Here it is aimed at a revision of so far published taxa from Santana Formation, and it is proposed a new taxon of family rank that joints some of the previously described genera and species. The Araripeblattidae n. fam. includes the genus *Araripeblatta* Mendes and, at least, three species. Some of the conspicuous characteristics of this blattopteran group are the small size, the presence of a recurrent ovipositor in females (plesiomorphic) and a not constant color pattern (none of the material here analyzed exhibits it).

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