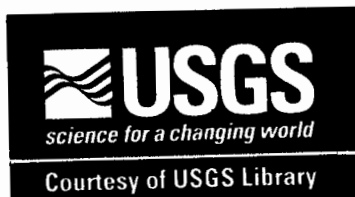


**CONTRIBUTION TO THE KNOWLEDGE OF THE AQUATIC
PALEOENTOMOFAUNA FROM SANTANA FORMATION (ARARIPE
BASIN, LOWER CRETACEOUS, NORTHEAST BRAZIL) WITH
DESCRIPTION OF NEW TAXA.**

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ABSTRACT: Although a hundred of known insect species from Santana Formation (Lower Cretaceous, Northeast Brazil) rather terrestrial, some groups remain undescribed or little known as is the case of relatives of the orders Coleoptera, Heteroptera, Phasmatoptera, Mecoptera and Megaloptera. The knowledge of the aquatic paleoentomofauna, so restrict when comparable with terrestrial specimens, is enlarged here with the description of a new genus and two new species of Ephemeroptera and a new taxa of Heteroptera (Belostomatidae) recently collected. Additionally the taxon *Conan barbarica* Martins-Neto, 1998, is reviewed and it is removed from Coleoptera, as firstly interpreted, to Odonata, and this peculiar giant nymph is compared with the other published ones of the same deposits.

Key Words: Santana Formation, Lower Cretaceous, Ephemeroptera, Odonata, Heteroptera.

RESUMO: Atualmente centenas de espécies de insetos são conhecidas para a Formação Santana (Cretáceo Inferior, Nordeste do Brasil). Alguns grupos terrestres permaneceram não descritos ou pouco conhecidos como é o caso de representantes das ordens Coleoptera, Heteroptera, Phasmatoptera, Mecoptera e Megaloptera. O conhecimento da paleoentomofauna aquática, muito restrito quando comparado com os espécimes terrestres, é aumentado aqui com a descrição de um novo gênero e duas novas espécies de Ephemeroptera e um novo taxa de Heteroptera (Belostomatidae) recentemente coletado. Adicionalmente, o taxon *Conan barbarica* Martins-Neto, 1998, após revisão, é removido de Coleoptera, como inicialmente interpretado, para Odonata, sendo essa ninfa gigante comparada com outras publicadas do mesmo depósito.

Palavras-chaves: Formação Santana, Cretaceo inferior, Ephemeroptera, Odonata, Heteroptera.

Introduction

During the last two decades the fossil insects of the Santana Formation comes special attention of the international paleontologist community due the excellent state of preservation and great diversity,

however unfortunately this also contributes to an increase in the interest of the private collectors. In this contribution are described new genus and species of recently collected material, all of which came from the yellowish laminated limestone of the Crato Member (lowest unit of Santana Formation)

outcrop at Nova Olinda City, Ceará State, Northeast Brazil (Araripe Basin). According with both stratigraphical and paleopalynological data, the age of this member is rather considered as Upper Aptian/Lower Albian, about 112 to 108 million years.

The terminology and classification used follows Popov (1996) and Martins-Neto (1996, 1998).

SISTEMATIC PALEONTOLOGY

HEMIPTERA

NEPOMORPHA Popov, 1968

BELOSTOMATIDAE Leach, 1815

BELOSTOMATINAE Leach, 1815

Neponymphes n. gen

Type species: *Neponymphes godoi* n. sp., designated here.

Etymology: From Nepomorpha Suborder.

Diagnosis

Nymph: compound eyes very large, occupying nearly the entire sides of the head in dorsal view, around 2/3 of head. Pronotum 3 mm in length and 1 mm in wide; scutellum 4 mm in length and 3 mm in wide.

Discussion

The known members of this family characteristically have are mid-sized. *Neponymphes* n. gen. differs from the genera of others subfamilies by having the abdominal projections of the respiratory tube not forming an air trap. In this exemplar have not air trap. There are not notice in the fossil record of genera exhibiting pronotum and scutellum as large as in this specimen, in this nymphal fase. The eyes stand out occupying a great part of the head, showing great importance for the survival of the nymph.

Neponymphes godoi n. sp

(Plate 1, Fig. A and B)

Etymology: In honor to the paleontologist Vinicius Moreno Godoi (FFCL:RP-USP).

Holotype: RGMT- T094 Martins-Neto Collection, housed in the Laboratório de Paleontologia of the Faculdade de Filosofia Ciências e Letras de Ribeirão Preto-USP.

Type locality: outcrop at Km 4 of the road Santana do Cariri-Nova Olinda, Ceará State, Northeast Brazil.

Type stratum: laminated limestone level, uppermost part of the Crato Member, lowest unit of the Santana Formation, Araripe Basin.

Age: Upper Aptian/Lower Albian, Lower Cretaceous.

Diagnosis

As for the genus. Body 12 mm in length, ovoid-like.

Description

Young individual preserved in dorsal view. Body ovoid-like. Eyes in spheric shape with 1 mm in diameter. Metepisterna extending back to cover the proximal abdomen sterna. Scutellum with 2 mm in length; pronotum with 1 mm long and 3 mm wide. Abdomen 8-segmented, the large one having 1 mm in width and 6 mm length. Left foreleg partially preserved with raptorial-like shape. Hind legs flattened and fringed; tarsi 2-segmented with one distal claw preserved; tibiae 5 mm long, femur at least 3 mm as preserved; tarsi 2 mm long and tarsal claw very narrow with 1 mm long.

Discussion

The first known record of this family came from West Europe, Lower Jurassic, Poland (Popov, 1996). The first true Belostomatinae was found in the Upper Jurassic sediments of west Germany, namely *Mesonepa* Handirslich (1906). From

cretaceous sediments as Mongolia and Spain also was recorded. The Belostomatidae is a worldwide family, distributed mainly at tropics.

ODONATOPTERA

ANISOPTERA Selys & Hagen, 1854

Family *incertae sedis* (Aeschinidiidae?)

Genus: *Conan* Martins-Neto, 1998

Type specie: *Conan barbarica* Martins-Neto, 1998, by original designation
(Plate 1, Fig.C and D)

Discussion

This specimen was originally described like a Coleoptera, Coptoclavidae, known from Cretaceous sediments from Mongolia and China. After review, was verified that the original interpretation needs to be reconsidered. Despite of the structural similarities with Coptoclavidae in this specimen is possible to see a small paracercus, typical for Odonatoptera. Additionally, *Conan barbarica* Martins-Neto (1998) is a big-sized nymph with 65 mm, quite twice larger, than the others known Coptoclavidae which have no more than 35 mm. Martins-Neto (1998) mentions that the meso and metathorax proportion, beyond of the more robust size remove your inclusion in any of the known coptoclavid genera. Bechly (1998), mentions one giant undescribed nymph, of the same deposits, possible an Anisoptera, suggesting similarities with *Nothomacromia sensibilis* Carle & Wigthorn (1990), of the Family Aeschinidiidae, found in the same outcrop. However, this former specimen is smaller, having lyre-like antennae, forcep-like paraprocts and spiniform epiproct. According to Bechly (1998) those characters are highly derived and unique and have been considered as synapomorphic for the group. In accordance with this, *Conan barbarica* is removed to Odonatoptera. The big size is uncommon characteristic for the most dragonflies, which

largest individuals belongs to the Family Aeschinidiidae. Possibly *Conan barbarica* is a aeschinidiidid, more compatible with your body size. *Conan barbarica* is maintained as a valid name by having sufficient morphological characters which distinguish it of all known described dragonflies.

EPHEMEROPTERA

SIPHLONURIDAE Ulmer, 1920

Genus *Costalimella* Martins-Neto, 1996

Type species: *Costalimella nordestina* Martins-Neto, 1996 by original designation.

Costalimella zucchini n. sp.
(Plate 2, Fig. E and F)

Etymology: In honor to entomologist Dr. Ronaldo Zucchi, Faculdade de Filosofia Ciências e Letras de Ribeirão Preto-USP, Brazil.

Holotype: RGMT- 2053 Martins-Neto Collection housed in the Laboratório de Paleontologia of the Faculdade de Filosofia Ciências e Letras de Ribeirão Preto-USP

Locus typicum, stratum typicum and age: as for *Neponymphes godoi* n. sp.

Diagnosis

Imago with a relatively narrow fore wing, with a triangular and fairly sharp tip, MA branching at the $\frac{3}{4}$ of wing length. Hind wing 9 mm in length and 5 mm wide.

Description

Both head and thorax poorly preserved. Hind wing 9 mm in length and 5 mm wide. Fore and hind wing partially superimposed Costal area relatively broad at base, narrowing toward the tip, filled up by numerous cross veins. ScP long, reaching the apical margin. RP origin near of the wing base, five- branched. MA 8 mm long, quite straight, forking at 6 mm of the base. Cu

forks at 1/3 from the posterior margin. Anal veins superimposed.

Discussion

The type species has a small size, about 6mm. *C. zucchii* n. sp. differs of the *C. nordestina* Martins-Neto, 1996 by having a greater size, almost twice larger and numerous intercalate veins. Jell & Duncan (in Martins-Neto, 1996) described various Siphonuridae from Koonwarra (Lower Cretaceous, Australia) although uncomparable with the Brazilian species.

Uncertain Family

Caririephemera n. gen

Etymology: From Cariri local municipality which the material came from of region of the outcrops.

Type specie: *Caririephemera marquesi* n. sp. designated here.

Diagnosis

Nymph with triangular head. Thorax with the pronotum as wide as long. Body robust, without gills, as preserved.

Description

Head poorly preserved 3 mm wide and 1 mm long. Thorax 5 mm length and width. The legs poorly preserved. Abdomen with 8 segments, the first one is five times broader than long, the last as long as wide. Gills absent. The color of the body was very well preserved showing a brown color.

Discussion

This nymph have a size above the average of the nymphs current.

Caririephemera marquesi
(Plate 2, Fig. G and H)

Etymology: In honor of the chronobiologist Dra. Miriam David Marques.

Holotype: RGMT-129 Martins-Neto collection housed in the housed Laboratório de Paleontologia of the Faculdade de Filosofia Ciências e Letras de Ribeirão Preto-USP.

Locus typicum, stratum typicum and age: as for *Neponymphes godoi* n. sp.

Diagnosis

As for the genus.

Description

As for the genus

Discussion

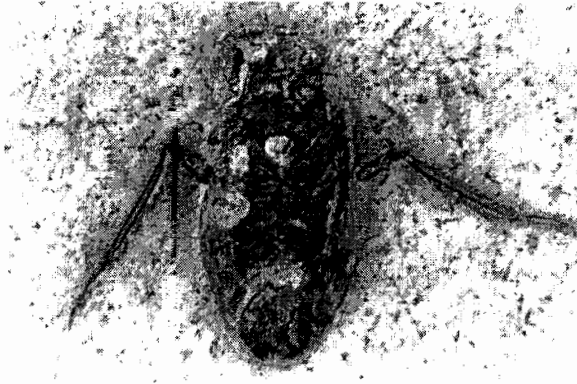
The absence of gill merit special attention because maybe this species hasn't. A sturdy body like this not would lose easily yours gills without to leave some signal like an insertion signal. The lack of gills could be a very important autapomorphy for this specimen virtually unknown for the Araripe paleontomofauna. This character is present just in Baetiscidae. However, other morphological aspects are unavailable for this moment, isn't possible a placing in any family.

Acknowledgements

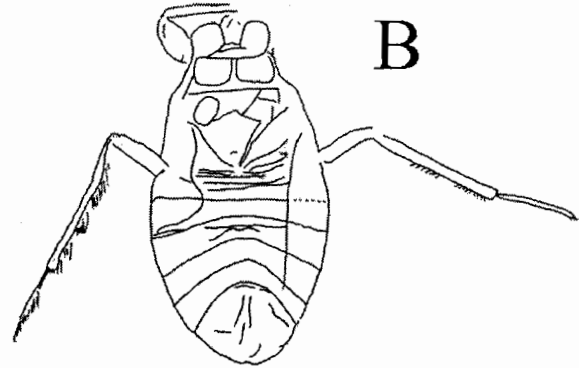
I am very grateful to Professor R. G. Martins-Neto for your supporting and commenting on the manuscript and drafts. Thanks to paleontologist Vinicius M. Godoi for your help on digitalization of the photos. This research was supported by CAPES and Entomology course of the Faculdade de Ciências e Letras de Ribeirão Preto-Universidade De São Paulo.

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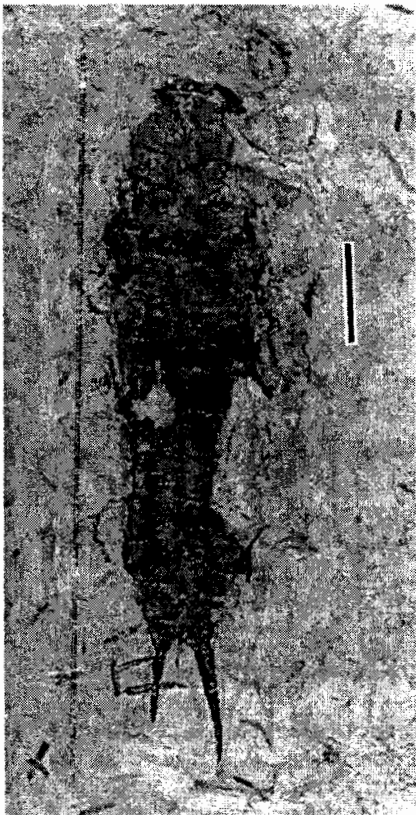
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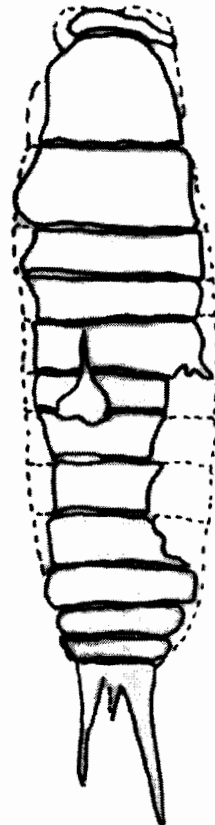
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B



C

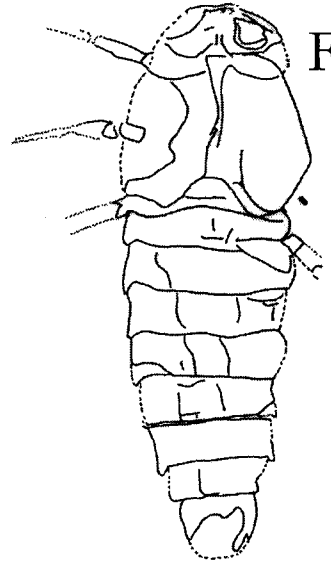


D

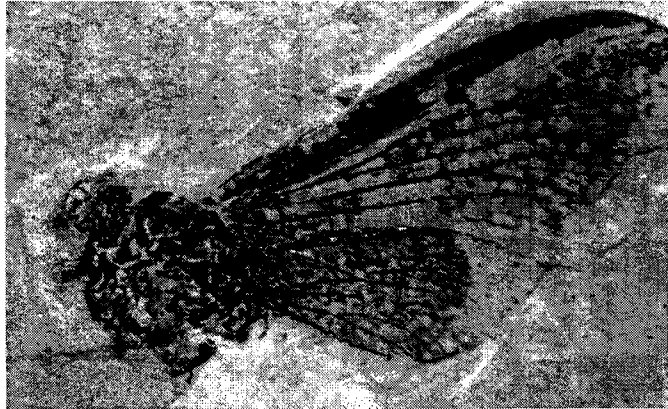
PLATE 1 - Aquatic paleoentomofauna from Santana Formation (Araripe basin, lower Cretaceous, northeast Brazil).
 A-B - *Neponymphes godoi* n. sp.; C-D - *Conan barbarica* Martins-Neto, 1998.



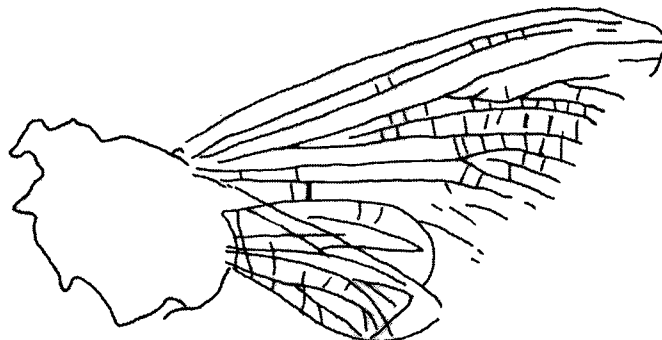
E



F



G



H

PLATE 2 - Aquatic paleoentomofauna from Santana Formation (Araripe basin, lower Cretaceous, northeast Brazil).
E-F - *Costalimella zuechii* n. sp.; G-H - *Caririephemera marquesi* n. sp.

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