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Cretaceous Gondwanian Cockroaches (Insecta: Blattaria)

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Vršanský, P. 2004. Cretaceous Gondwanian Cockroaches (Insecta: Blattaria). *Entomol. Probl.* 34(1–2): 49–54. – The dominant families in all studied Gondwanian sites are the extant families Mesoblattinidae (= Blattidae) and/or Blattellidae. Adults of a small species of Umenocoleidae with Polyphagoid affinities (plesiomorphies) are found in Lebanese amber (together with diverse immatures of a single species of Mesoblattinidae, and Blattulidae). The assemblage of the rich Santana Formation in Brazil is dominated by Blattellidae, with subdominant Blattulidae, and also Umenocoleidae. Impression fossils from Israel are a single adult Mesoblattinidae in the Barremian and two isolated wings, one of Mesoblattinidae and another of Blattellidae, in the Turonian. Polyphagidae are absent from the Cretaceous Gondwana. The radiation of modern Blattaria into Gondwana must have taken place after the Barremian.

Cretaceous Gondwanian sites appear to be less diverse than Laurasian ones, where the family, genus as well as species level diversity is considerably higher.

Based on roaches, the hypothesis of the relationship of the Israeli fauna to the Laurasian rather to Gondwanian sites (Dobruskina et al. 1997) is questioned, but the fauna of the Lebaneese amber is found related (with a sister species) to the undescribed fauna of the New Jersey amber.

New taxa described herein are *Gondwablatta abrahami* gen. et sp.nov. (Barremian); *Nymphoblatta azari* gen et sp.nov. (Hauterivian-Aptian); *Turoniblatta israelica* gen et sp.nov. and *Nehevblattella grofitica* gen. et sp.nov. (Turonian).

Key words: Cretaceous, Gondwana, Blattaria, fossil, amber, new genera, new species.

Introduction

The Jurrasic and/or Cretaceous continenetal continental Gondwanian fossil insects are rare, and the only significant site is the Santana Formation in Brazil (to be described elsewhere). Therefore the finds of Gondwanian fauna elements in the Cretaceous record of Israel and Lebanon (Dobruskina et al. 1997, Azar 1997) are important.

Notable is the low diversity of roaches in the known Gondwanian localities. There are only 7 species present in hundreds of specimens from the Santana Formation, with a single species of Mesoblattinidae (in comparison with more than 20 species in the Laurasian Bon Tsagaan and Baissa with at least 3 species of Mesoblattinidae).

There is an additional occurrence of the Cretaceous Gondwanian roaches in the Australian Koonwarra, where Blattulidae (a damaged fore wing) and unidentifiable (Mesoblattinidae) immatures are present.

The material presented here displays an immense diversification of modern-type Blattaria (with ootheca) and particularly modern Mesoblattinidae (Blattinae) and Blattellidae which evolved during the Lower Cretaceous (possibly in Siberia), and represent dominant families in most of the Cretaceous sites worldwide (Vršanský 1997–2003, Vršanský et al. 2002). The Umenocoleidae still have a significant position in the ecosystems, a group that later disappears from the fossil record. Notable is the absence of Polyphagidae in the Cretaceous Gondwana.

Material and Methods

Several hundred specimens were studied.

– The Turonian material come from the South Nehev Desert, Israel, on the left bank of the vadi Grofit, near its outfall to the Arava valley, in the uppermost member of the Ora Beds Formation.

– The Barremian fossil was collected in the wadi El-Maliah, Ras Abu Susche, in Samaria, Israel. Insects are found in the middle tuffite vulcanites of Taiasir, which present lake sediments of volcanic origin (Mimran 1972).

Material from Israel is temporarily kept in the Paleontological Institute (PIN), Moscow, to be returned to the Hebrew University, Jerusalem (HU).

– Santana material (kept at the American Museum of Natural History [AMNH], and Guelph University, Canada) originated approx. 45 km ENE of Juazeiro do Norte, near Nova Olinda settlement. Here, small quarries were excavated (Grimaldi 1990). The Crato member represents lacustrine deposits that apparently formed under increasingly arid climatic conditions. The lake was landlocked and fairly saline for much of its history, finally drying to produce a sequence of gypsiferous evaporites capped in most parts by a caliche layer (da Silva 1986) of an Aptian to Lower Albian age.

– Lebanese amber. One of the oldest known insectiferous fossil resins (retinites) is found in Jezzin (30 km east of Saida) and in other sites in Lebanon. Their age is

debatable, with the least dispersion of estimations being from the Hauterivian to Aptian (Early Cretaceous). Several thousands of inclusions have been collected there, representing 13 insect orders (dipterans and hymenopterans predominating), as well as 3 arachnid orders: spiders, mites and pseudoscorpions (SCHLEE & DIETRICH 1970; ZHERIKHIN 1978; AZAR 1997). Material is deposited in the AMNH, New York.

The pictures represent re-drawn photographs that were made using a ZEISS photographic device.

Results

Hauterivian-Aptian (Lebanese amber)

Blattoidea BRUES et MELANDER, 1932
Mesoblattinidae HANDLIRSCH, 1906
***Nymphoblatta* VRŠANSKÝ et GRIMALDI gen.nov.**

Type species. *Nymphoblatta azari* VRŠANSKÝ et GRIMALDI gen. et sp.nov.

Diagnosis. Medium-sized species. Antenna with numerous strong and long chaeta on each segment. Pronotum much wider than long, with pale margins. Cercus thin and long, with very strong and long sensilla chaetica (even in initial immature stages). Legs with strong spines.

Systematic remarks. The genus differs from *Nehevblattella* gen.nov. and *Archimesoblatta* VRŠANSKÝ, 2003 in having a body not as wide as required for such a type of forewing and from *Piniblattella* VRŠANSKÝ, 1997 in having a different and more narrow cercus (especially the first segment). (Both *Piniblattella* and *Gondwablatta* gen.nov. [related Mesoblattinidae] have a pale pronotal margin.) It differs from *Gondwablatta* in having a pronotum not as wide, and from *Praeblattella* VRŠANSKÝ, 2003 and *Mesoblattina* GEINITZ, 1880 in being more robust.

It is very probable that the genus is closely related to an undescribed genus from the Santana Formation.

Etymology. The genus name reflects the fact that the genus is based on nymphs and not on adults. Gender feminine.

***Nymphoblatta azari* VRŠANSKÝ et GRIMALDI gen. et sp.nov.** (Figs 4, 6)

Holotype. AMNH Lebaneese amber No. 91; Lower Cretaceous; presumably 3rd nymphal instar.

Additional material. AMNH no. 22, presumably 1st instar; both of the same origin as holotype.

Description. Figs 4, 6. Antenna about 1–1.5 times as long as the total roach length, sensilla as long as the width of the first antennal segments. Pronotum as wide as the first abdominal segment. Cerci multisegmented, sensillae numerous (at least 3 at each segment), as long as the cercal segments. Legs cursorial, heavily carinated. For measurements see below.

Remarks. Body size can be calculated indirectly. According to the relationship and roughly similar size of *Piniblattella vitimica* (VISHNIAKOVA, 1964), I infer a similar number of instars (6–7) in the present species. I adapted Dyar's rule (BEIER 1961) to the succeeding instars of *P. vitimica* (Abdominal segment 1 (A1) width: 0.96–1.28, 1.44–1.96, 2.00–2.40, 2.80–3.28, 3.90–4.09, 4.50–5.08, pronotal width: 0.83, 1.15, 1.66, 2.51, 3.16, 4.48) in VRŠANSKÝ (1997). When applied to the present species, these data indicate 1st instar for AMNH 22 (antenna: 1.79 mm; A1: 0.84 mm; pronotum: 0.72 mm; total length: 1.15 mm) and 3rd stadium for the holotype (antenna: about 3.2 mm; A1: 1.3 mm; pronotum: 1.0 mm; total length: 2.64 mm). This makes it possible to restore the size of all instars from 1st through 7th: for AMNH 77: 1.15, 2.10, 2.94, 4.11, 5.76, 8.06, 11.2; for holotype: 1.34, 1.88, 2.64, 3.60, 5.05, 7.07, 9.89. [1.88, 2.64, 3.60, 5.05, 7.07, 9.89, 13.8 if it is 2nd instar]. Thus, if we assume that the number of instars does not exceed 7, the species should be of average body length under 14 mm, and more likely 10 mm. Supposing only 6 instars, the maximum size is only 8 mm, holotype is also 3rd instar (the inference based on the fully developed cercus and legs), the average size is 8–10 mm. Therefore the total average size is presumed to be about 10 mm, similar to the most common Mesoblattinidae (*Praeblattella* species).

Etymology: species is named after Dr. Deny Azar, Lebanese palaeoentomologist.

Umenocoleoidea CHEN et TIAN, 1973
Umenocoleidae CHEN et TIAN, 1973
***Jantaropterix lebani* VRŠANSKÝ et GRIMALDI, 2003**

Unnamed roach: GRIMALDI 1996, p. 37.
Jantaropterix lebani VRŠANSKÝ et GRIMALDI, 2003: Fig. 79

This species, with polyphagoid affinities (plesiomorphies), closely related to *J. newjersey* from the Turonian of New Jersey, is present.

Polyphagoidea WALKER, 1868
Blattulidae VISHNIAKOVA, 1982

An undescribed species probably belonging to Elisama is present (Fig. 5) (total length 2.6 mm).

Barremian

Blattoidea
Mesoblattinidae
***Gondwablatta* gen.nov.**

Type species. *Gondwablatta abrahami* gen. et sp.nov.

Diagnosis. Large species with rich venation, distinct intercalaries and cross-veins. Sc branched in the forewing, RS differentiated, cerci strong and short. Pronotum very wide.

Systematic remarks. *Gondwablatta* differs from *Mesoblattina*, *Hispanoblatta* MARTÍNEZ-DELCLÓS, 1993, *Praeblattella* and *Turoniblatta* gen.nov. in having more

numerous venation (in all veinal systems), less differentiated RS and wing margins less parallel. It differs from *Archimesoblatta* (sister genus) in having more dense venation (plesiomorphy).

Etymology: after Gondwana. Gender feminine.

***Gondwablatta abrahami* gen. et sp.nov.** (Fig. 1)

Unnamed roach: Dobruskina et al., 1997, Pl. X, Fig. 6

Holotype. HU 38336; Hauterivian to Barremian of wadi El-Maliah, Ras Abu Susche, Samaria, Israel.

Description. Fig. 1. Branch number in forewing: Sc with 2–3 branches; R (+Rs) about 30 veins, M 15 or more; Cu with possibly up to 8 veins. Intercalaries distinct and coloured, as well as numerous cross-veins. Body and pronotum wide, (pronotum as wide as first abdominal segment). Cerci multisegmented.

Etymology. Species name is after collector, Mr. Abraham Shimron (Jerusalem).

Aptian-Lower Albian

Blattoidea
Blattellidae Karny, 1908

The Blattellidae is the dominant family in the Santana roach assemblage, representing about 60% of the cockroaches. Its abundance within the Blattaria may not be caused by the taphonomical advantages – the preservation in Santana is excellent and most of the material represents entire insects. The Forewings of the Blattellidae are of a medium rigidity. Two species (one undescribed) of two undescribed genera include:

(*Mesoblattina) limai* Pinto et Purper, 1986.

Pinto & Purper 1986: Plates I. and II.

Polyphagoidea
Blattulidae

Subdominant family in the Santana assemblage representing about 25% of cockroaches. Most of the preserved specimens represent entire insects. Two genera (*Elisama* Giebel, 1856 and undescribed one) present with one species each.

***Elisama americana* Vršanský, 2002**

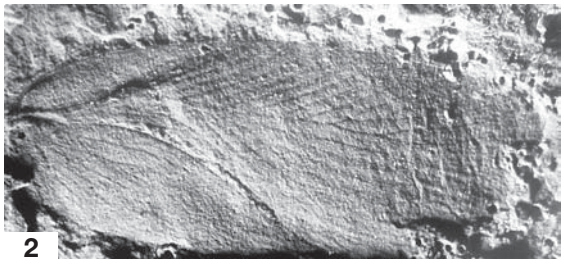
Vršanský 2002: figs 11, 21–26, 30.

Umenocoleidae
***Ponopterix axelrodi* Vršanský et Grimaldi, 1999**

Unnamed roach: Grimaldi 1990; *Ponopterix axelrodi* Vršanský et Grimaldi, 1999: Vršanský 1999, figs 5–11; Vršanský et al. 2002, fig. 376.

In the collecion of AMNH and Guelph University, the species is represented by 28 of about 220 roach specimens. This ratio may be overevaluated (collection is not representative because of affinities of collectors to esthetic specimens and thus to more rigid species). Nevertheless, *P. axelrodi* may represent up to 15% of all roaches found in Santana.

Fig. 1. *Gondwablatta abrahami* sp.nov. Holotype. HU 38336; Hauterivian to Barremian of vadi El-Maliah, Ras Abu Susche, Samaria, Israel.



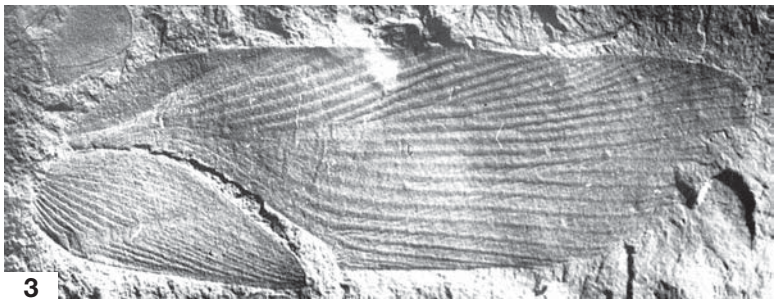


Fig. 2. *Nehevblattella grofitica* sp.nov. Holotype. HU 38333; Upper Cretaceous (Turonian) Ora Beds Formation of Nehev Desert in Israel.
Fig. 3. *Turoniblatta israelica* sp.nov. Holotype. HU 38332; Upper Cretaceous (Turonian) Ora Beds Formation of Nehev Desert in Israel.

Turonian

Blattoidea
Blattellidae
***Nehevblattella* gen.nov.**

Type species. *Nehevblattella grofitica* gen. et sp.nov.

Diagnosis. Small species. Wing rather wide (apomorphy), with venation reduced compared with other Cretaceous blattellids. Rs differentiated. Cu reduced to several veins, branched at the terminal fourth of their length. Clavus is extremely long, reaching almost the half of the wing length, A simple.

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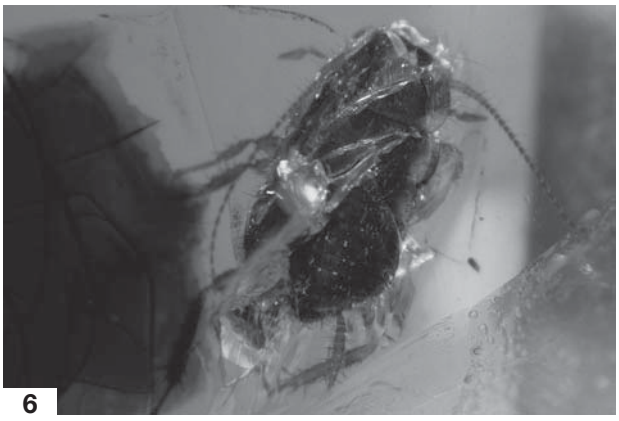

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Figs 4–6. 4, 6) Instars of *Nymphoblatta azari* VRŠANSKÝ et GRIMALDI sp.nov. (AMNH Lebanon Amber no. 22, 91 (Holotype); 5) undescribed Blattulidae. AMNH Lebanon amber no. 77.

Systematic remarks. Differs from *Piniblattella* in terminally branched R and generally wider wing, from other undescribed Cretaceous Blattellidae in having long clavus. It is related to an undescribed genus from the Santana Formation which also has a rather wide wing.

Etymology: after Nehev. Gender feminine.

***Nehevblattella grofitica* gen. et sp.nov.** (Figs 2, 7)

Unnamed roach: DOBRUSKINA et al., 1997, Fig. 2, Pl. X, Fig. 4.

Holotype. HU 38333; Upper Cretaceous (Turonian) Ora Beds Formation of Nehev Desert in Israel.

Description. Figs 2, 7. Total number of veins about 40: Sc1; R 19; M 9; Cu 3; A 8; Sc very short; Rs not differentiated, R with branches descending parallel to each other, 3 of them dichotomising; Cu free, with 2–3 veins. Clavus almost reaching wing midlength, with about 8 veins, A simple (possibly one or two of them dichotomised). No visible cross-veins or intercalaries. Wing length about 10 mm, width 4 mm.

Etymology: Species name is after vadi Grofit.

Mesoblattinidae
***Turoniblatta* gen.nov.**

Type species. *Turoniblatta israelica* gen. et sp.nov.

Diagnosis. Large cockroach (known species with wing about 22.5 mm long). Wing rather narrow, with Sc simple, R and A systems rich, R with several terminal veinlets (plesiomorphy), M reduced to several veins, Cu expanded, clavus of ordinary length, some anal veins branched.

Systematic remarks. Differing from *Gondwablatta, Archimesoblatta, Praeblattella* and *Hispanoblatta* in having long wing and short clavus with rich A (plesiomorphy).

Etymology: after the Turonian (Cretaceous). Gender feminine.

***Turoniblatta israelica* gen. et sp.nov.** (Figs 3, 8)

Unnamed roach: DOBRUSKINA et al., 1997, Fig. 1, Pl. X, Fig. 3.

Holotype. HU 38332; Upper Cretaceous (Turonian) Ora Beds Formation of Nehev Desert in Israel.

Description. Figs 3, 8. Forewing with total vein number about 50, Veins more or less parallel. Branch number: Sc 1, R (+Rs) 22, M 6, Cu 7, A 12. Dense venation restricted to R and A systems, R expanded, especially terminally, with additional branching there. M and Cu sparsely branched, mostly with simple branches (apomorphy). Forewing length 22.5 mm, width 4 mm.

Etymology: after Israel.

Conclusions

– Gondwanian Cretaceous roach assemblages are dominated by Mesoblattinidae (= Blattidae) and Blattelli-

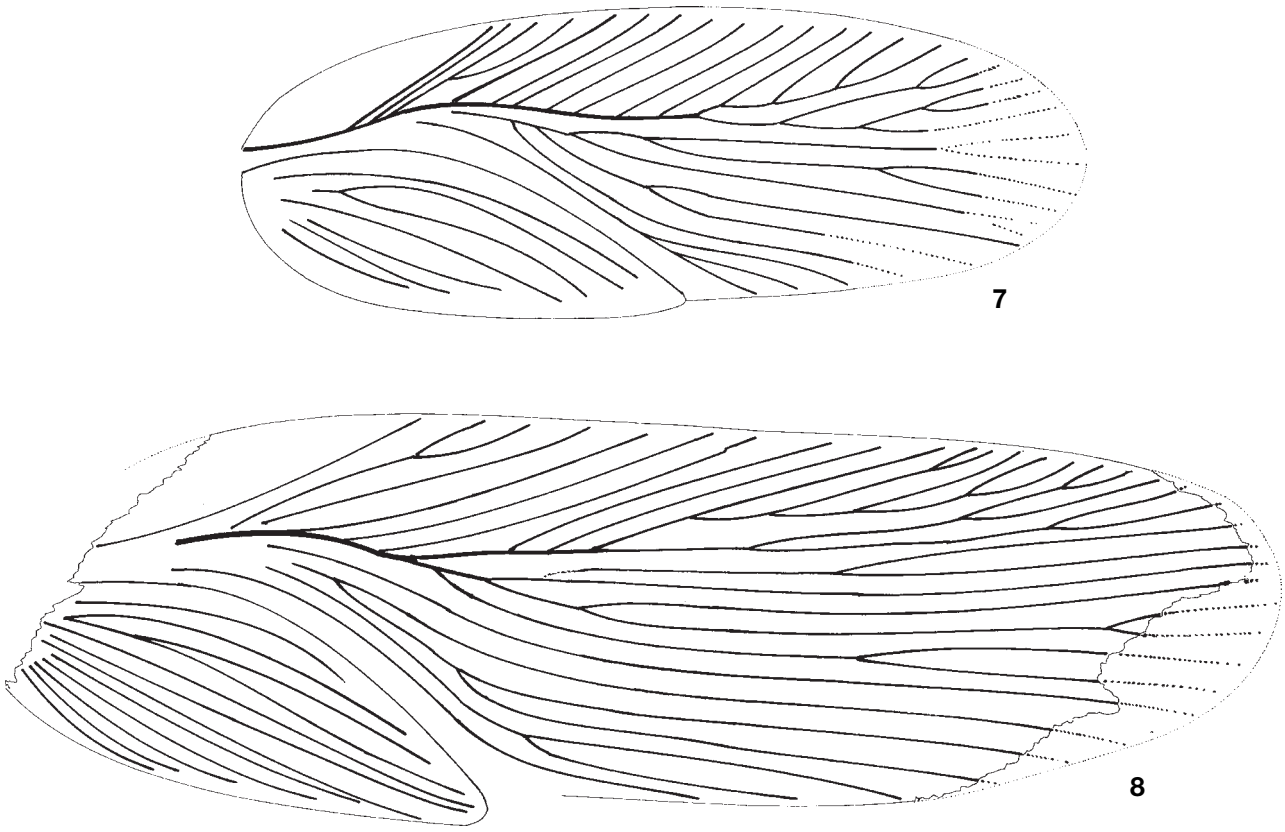

Fig. 7. *Nehevblattella grofitica* sp.nov. Holotype. HU 38333; Upper Cretaceous (Turonian) Ora Beds Formation of Nehev Desert in Israel. Fig. 8. *Turoniblatta israelica* sp.nov. Holotype. HU 38332; Upper Cretaceous (Turonian) Ora Beds Formation of Nehev Desert in Israel.

dae, with Blattulidae subdominant and Umenocoleidae (including species with polyphagoid affinities) not uncommon. Other families, including Polyphagidae are absent in the Cretaceous Gondwana.

– At species, genus and family level (within Blattaria), the Gondwanian sites are found less diverse than the Laurasian ones.

– The cenoses of Israel and Lebanon appear similar to the Gondwanian cenosis of the Santana formation (with two sister genera), but there is a common genus present in the Lebanese and New Jersey amber. No close relation among Israelian and Laurasian sites is found and therefore the hypothesis of Dobruskina et al. (1997) of the relationship of those cenoses is questioned.

– The Gondwanian sites (except Santana) contain Mesozoic Blattaria, indicating the modern cockroaches (Polyphagidae, Blattellidae) evolved in the Laurasia. Their radiation must have taken place after the Barremian.

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