Two new non-biting midges from the Early Cretaceous Lebanese amber (Diptera: Chironomidae)

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Abstract. Two chironomid flies, Ziadeus kamili n. gen., n. sp. and Paicheleria magnifica n. gen., n. sp., respectively attributed to the recent subfamilies Tanypodinae and Prodiamesinae, are described from the Early Cretaceous Lebanese amber. Although very old, this non-biting midge fauna was very diverse with no less than 11 genera and species. However, it was also strongly different from the recent faunas for the complete absence of the Chironominae, that is today the dominant subfamily. The development of the modern chironomid fauna occurred during the Late Cretaceous and/or the Early Paleogene, but when and how?


Keywords: Insecta, Diptera, Chironomidae, Tanypodinae, Prodiamesinae, Lebanese amber, Early Cretaceous.

If the fossil record of the non-biting midges goes as far as the Late Triassic and Early Jurassic (Ansorge 1999; Krzeminski & Jarzembowski 1999), our knowledge on the Mesozoic history of this family is still patchy because many of the so far described taxa are based on poor material (Veltz et al. 2007), and because the available fossils in different Cretaceous amber are still waiting their descriptions. The chironomid fauna from the Lebanese amber is one of the most diverse and best known dating from the Lower Cretaceous, with no less than nine genera and species, belonging to the extinct subfamily Aenneinae Ansorge 1999 (with some reserve?), and the recent subfamilies Tanypodinae Skuse 1889, Orthocladiinae Kieffer 1911, and Prodiamesinae Sæther 1976 (Veltz et al. 2007; Azar et al. 2008). These authors also demonstrated that all the fossils that were currently attributed to the recent subfamily Podonominae Thiennemann & Edwards 1937 are either incertae sedis or Tanypodinae. Thus the Podonominae is now unrecorded before the Cenozoic, as for the very large recent subfamily Chironominae. The earliest records of the Chironominae are from the Early Eocene amber of France (Doitteau & Nel 2006). These are a minority among the Early Eocene non-biting midges, probably in relation to their absence or low representation in the Late Cretaceous. This subfamily was still under diversification during the Early Paleogene. Among the other recent subfamilies, only the Aphroteniinae Brundin 1966 is represented in the Mesozoic by Electrotenia Kalugina 1980, with one species E. brundini Kalugina 1980, based on adult male and female from the Late Cretaceous Taymir amber from North Siberia, and the Diamesinae Edwards 1929 represented by Cretodiamesa Kalugina 1976, with one C. taimyrica Kalugina 1976, and based on adult male and female from Late Cretaceous Taymir amber (Kalugina 1976, 1980).

We describe two new fossils from the Lebanese amber belonging respectively to the Tanypodinae and Prodiamesinae. These new fossils confirm that among the Cretaceous chironomid faunas, the Lebanese one is the most diverse. Nevertheless it remains strikingly different from a Late Cenozoic or recent fauna. Efforts are needed in future to determine when and in which way the modern chironomid fauna developed, during the Late Cretaceous and/or the Early Paleogene.

Material and methods
We follow the body and wing venation terminology of Sæther...
et al. (2000). In descriptions, characters are based on males when present; those proper to females being indicated. All the material is deposited in the Muséum National d'Histoire Naturelle de Paris, collection D. Azar.

Descriptions of new taxa

Family Chironomidae Newman 1834
Subfamily Tanypodinae Skuse 1889
Tribe Pentaneurini Hennig 1950 or Macropelopiini Zavrel 1929

Ziadeus n. gen.

Type species. Ziadeus kamili n. sp.

Etymology. Named after Kamil Ziadé, colleague of one of us (DA).

Diagnosis. Eyes bare; R$_{2+3}$ well separated from R$_1$ and R$_{4+5}$, apically divided into R$_2$ and R$_3$, with R$_2$ rather long and well distinct; costa produced beyond R$_{4+5}$ by distance less than length of cross-vein RM, ending slightly before M$_{1+2}$; anal point very long; inferior and superior volsella very broad; gonostylus apically very thin, as long as gonocoxite; hind tibial comb in one row; two tibial spurs on both mid and hind leg with lateral teeth, comb-like, similar to those of the recent genus Macropelopia Thienemann 1916, hind tibial spurs not flattened.

Ziadeus kamili n. sp. (Fig. 1–2)


Figure 1

Ziadeus kamili n. gen., n. sp., holotype 917A, male. A, photograph of general habitus; B, drawing of head (scale bar = 0.5 mm); C, drawing of wing (scale = 0.5 mm); D, photograph of male genitalia; E, drawing of male genitalia. dorsal and ventral views (scale bar = 0.5 mm).
**Etymology.** Named after Kamil Ziadé.

**Diagnosis.** As for the genus.

**Description.** Head 0.67 mm wide; ocelli absent; antenna 1.1 mm long, much longer than head, distinctly hairy, with flagellomeres 1–13 covered with long setae, scape broad and short, rounded, pedicel very short, 14 flagellomeres, 13th flagellomere very long, 0.5 mm long, 14th flagellomere regularly tapering from base to apical nipple, 2× as long as broad at base; eye bare with an apically expanded dorso-medial extension, with five rows of ommatidia at minimal width; mouthpart rather long in both male and female; part of mandibles visible from above as long as clypeus in both male and female; all palpal segments with numerous setae; clypeus with few dorsal setae; no visible postocular, frontal, inner vertical, and outer setae in male.

Postnotum setose, with a longitudinal median groove; surface of scutellum bare but with numerous long setae on posterior margin; scutal tubercle not visible; numerous supraalar, prealar, anterior acrostichal, and dorsocentral setae; postanepisternal setae absent.

Macropterous, wing 2.2 mm long, 0.65 mm wide, hyaline, covered with microtrichia and macrotrichia on main veins; anal vein An2 absent; radius with three branches R_{1}, R_{2-3}, and R_{4-5}; R_{2-3} well separated from R_{1} and R_{4-5}, R_{2-3} apically forked into R_{2} and R_{3}; R_{2} ending in R_{1}, R_{3} 0.2 mm long, ending in costa; costa ending just beyond insertion of last branch of radius.

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**Figure 2**

*Ziadus kamili* n. gen., n. sp., paratype 341B, female. **A,** photograph of genitalia; **B,** drawing of genitalia (scale bar = 0.1 mm); **C,** photograph of tibial spurs (arrow indicates the denticulations of tibial spur); **D,** photograph of tarsal setae (simple arrows indicate long dorsal setae; double head arrows indicate the series of short vertical setae); **E,** photograph of tarsal claws (scale bar = 0.05 mm).
Figure 3
*Paicheleria magnifica* **n. gen., n. sp.**, holotype specimen 221, male. **A**, photograph of general habitus; **B**, drawing of wing (scale bar = 0.5 mm); **C**, photograph of male genitalia; **D**, drawing of male genitalia (scale bar = 0.1 mm); **E**, drawing of labial palp (scale bar = 0.1 mm); **F**, photograph of mid tibial spur; **G**, photograph of tarsal claws.
produced by 0.06 mm, less than length of cross-vein RM, ending slightly before M 2+3; only M 2,3 and M 3,4 present; cross-vein MCu present; cubital fork 0.06 mm proximal to cross-vein MCu; cross-vein RM and MCu aligned.

Tibial spur formula 1–2–2, all with lateral teeth, comb-like, those of hind legs not flattened, state similar to Macropelopia (see Murray & Fittkau 1989: fig. 5.23E); two hind tibial spurs of nearly same length; fourth tarsomeres of all legs cylindrical, not cordiform; claw of middle legs simple as in front and hind legs, not pectinate; a hind tibial comb disposed in one row; a row of short setae all perpendicular to tarsal segment, on posterodistal side of each segment (Fig. 2D); a long, backward curved, and erected setae in proximal third or quarter of anterior side of each tarsal segment (Fig. 2D).

Abdomen covered with numerous long setae; gonostylus with a series of erected setae at base, gonostylus long, very broad at base and very long and thin at apex, 0.24 mm long, 0.06 mm wide at base, as long as gonocoxite (0.21 mm long, 0.2 mm wide), gonocoxite with numerous long setae; anal point very sharp and long (0.2 mm high); inferior and superior volsella broad; female cerci long and thin, 0.16 mm long, covered with short setae.

**Type locality and horizon.** Early Cretaceous, Hammana / Mdeyrij, Caza Baabda, Mouhafazat Jabal Loubnan (Mont Lebanon district), Lebanon.

**Discussion.** According to the keys to Nearctic genera of Oliver (1981) and to the key to Holarctic subfamilies of Oliver & Dillon (1989) and to Palaearctic subfamilies in Sæther et al. (2000), Ziadeus n. gen. falls in the subfamily Tanypodinae because of the following characters: macropterous, extending posterior to first abdominal segment; cross-vein MCu present; R 2,3 present, apically forked into R 2 and R 3; postnotum with longitudinal groove; wing covered with macrotrichia.

Ziadeus kamili can be attributed to the clade (Tanypodinae + Usumbaromyiinae) because it shows the main synapomorphy, i.e., “tibial spurs with lateral teeth, comb-like” (Sæther 2000). Affinities with the Usumbaromyiinae Andersen and Sæther, 1994 can be excluded because of the presence of vein MCu; tarsomere 4 elongate, not cordiform; claw of middle legs simple as in front and hind legs, not pectinate (Andersen & Sæther 1994). Nevertheless the female genitalia of Z. kamili differ from the present day Tanypodinae in the very long cerci, which would rather suggest Orthocladiinae or Telmatogotoninae (Sæther 1977).

According to the key to Nearctic tanypodine tribes and genera of Oliver (1981) and to Fittkau (1962), Ziadeus falls in the Pentaneurini or Macropelopiini because of the following characters: fourth tarsomeres cylindrical, not cordiform; cubital fork proximal to cross-vein MCu. The presence of postnotal setae suggests affinities with the Macropelopiini. The male genital structures of Ziadeus (especially the gonostylus) strongly differs from those of Tanypodinae already described from the Lebanese amber (Libanopelopia cretica Veltz et al. 2007, Cretapeloia salomea Veltz et al. 2007, and Wadelius libanicus Veltz et al. 2007). Lastly Ziadeus differs from Cretanene Azat et al. 2008 its pectinate tibial spurs.

**Subfamily Prodiamesinae Sæther 1976**

**Paicheleria n. gen.**

**Type species.** Paicheleria magnifica n. sp.

**Etymology.** Named after our friend and colleague Dr. Jean-Claude Paicheler, University of Reims, France.

**Diagnosis.** MCu present, in a basal position, at the distal two third between base of M and RM; R 2,3 present, simple; wing membrane without setae; FCu distal to MCu; bare eyes; male genitalia with very acute anal point, inferior volsella elongate with small basal gibbosity, narrow elongate gonostylus, spatulate at apex.

**Paicheleria magnifica n. sp. (Fig. 3)**

**Holotype.** 221 (male), paratype 623c (male), Azar coll., deposited in the Muséum National d’Histoire Naturelle, Paris.

**Etymology.** Named after the wonderful state of preservation of the holotype.

**Type locality and horizon.** Early Cretaceous, holotype and allotype are from Hammana / Mdeyrij, Caza Baabda, Mouhafazat Jabal Loubnan (Mont Lebanon district), Lebanon.

**Diagnosis.** As for the genus.

**Description.** Ocelli absent; antenna much longer than head, distinctly hairy, with flagellomeres 1–13 covered with long setae, scape broad and short, rounded, pedicel very short, 13 flagellomeres; eye bare, with a distinct dorso-medial extension; mouthpart lacking functional mandibles; palps long, with four visible palpal segments with numerous setae, last palpal segment being the narrowest and longest; postocular, frontal, inner vertical, and outer vertical setae not visible, maybe absent.

Postnotum, scutellum; scutum destroyed.

Macropterous, wing 1.37 mm long, 0.4 mm wide, hyaline; membrane without setae; anal vein An2 absent; radius with only three branches R 1, R 2,3, and R 4,5; R 1 rather long, 0.6 × times as long as R 4,5; R 4,5 simple, closely parallel to R 3; costa ending at apex of R 4,5; cross-vein MCu present, at two third between base of M and RM; fork of Cu nearly opposite RM; Cu1 weakly curved.

Tibial spur formula 1, 2, 2; tibial spurs simple but covered by small scales, curved; hind tibial comb present, disposed in one row of four long spines, only slightly shorter than the tibial spurs, tarsal claws with a strong preapical tooth.

Abdomen narrow; anal point very acute; inferior volsella elongate with small basal gibbosity; gonostylus curved, narrow, elongate, and spatulate at apex; gonocoxite longer than gonostylus, covered with long setae.

**Discussion.** Following the key to Holarctic subfamilies of Oliver & Dillon (1989) and to Palaearctic subfamilies in Sæther et al. (2000), Paicheleria n. gen. falls in the Prodiamesinae because of the following...
characters: macropterous; MCu present; R_{2,3} very weak, but simple; R_{4,5} and R_{2,3} closely approximate; wing membrane without setae; FCu well distal to MCu. Furthermore, Paicheleria has bare eyes, unlike in most recent Diamesinae.

Among the non-Holarctic subfamilies, affinities with the Aphroteniinae are excluded because Paicheleria has retained a MCu and a R_{2,3}. Usambaromyiinae have no MCu. The Chilenomyiinae have a MCu in a basal situation, but no R_{2,3}. Furthermore, their wings are densely hairy all over, unlike Paicheleria.

Within the Prodiamesinae, Paicheleria differs from all recent genera in its male genitalia and the much more basal position of MCu, midway between base of M and RM, and its R_{4,5} ending well basal of wing apex (Sæther 1989). Two Prodiamesinae are already described from the Lebanese amber, i.e. Libanodiamesa Veltz et al. 2007 and Cretadiamesa Veltz et al. 2007. Paicheleria differs from the former in its vein MCu in a distinctly more distal position, and from the latter in its male genitalia with strongly developed inferior volsella and longer and narrower gonostylus.

**Conclusion**

Our recent discoveries of several genera and species of Chironomidae (Azar et al. 2008; and Veltz et al. 2007) demonstrate the high diversity of this group during the Lower Cretaceous in the North-East Gondwana. The two additional genera and species of chironomid flies described herein from the Lebanese amber increase our knowledge about the biodiversity of this very peculiar group and could help in improving our understanding of its real relationships with its sister groups, i.e. Ceratopogonidae and Simuliidae.

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**References**


