

## New fossil Tipulidae from the volcano-sedimentary Latest Oligocene of Bes-Konak (Turkey)

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**ABSTRACT.** Three new species of *Tipula* from the Latest Oligocene of Bes-Konak (Turkey) are described, viz. *Tipula (Platytipula) anatolica* sp. n., *Tipula (Tipula) oligocenica* sp. n. and *Tipula (Trichotipula) paicheleri* sp. n. A morphological comparison with their closest recent and fossil relatives is provided.

**KEY WORDS:** Diptera, Tipulidae, Tipulinae, *Tipula*, Oligocene, morphology, taxonomy, new species.

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### INTRODUCTION

Thanks to the works of Dr Jean-Claude PAICHELER and his collecting efforts, it is possible to study the rich entomofauna of the Latest Oligocene volcano-sedimentary paleolake of Bes-Konak (Fig. 1) (PAICHELER 1978, 1988, PAICHELER et al. 1978, 2007). The fauna is especially well preserved, including a total collection of 3 784 fossil insects: 771 aquatic Heteroptera (Corixidae – *Notonecta* spp.: 20.4% of the specimens); relatively few aerial or terrestrial insects, though mainly Diptera (Bibionidae); less abundant Coleoptera, Hemiptera and Hymenoptera (Formicidae); and a few adult and larval Odonata. Among vertebrates, larvae of *Pelobates* sp. are also very numerous, with a few metamorphosed instars and adults of Ranidae (Anura) and Urodela (Trituridae). Numerous leaves, seeds and plant fragments indicative of a dense and diversified woodland environment (including forest ponds) and consisting of a large number of hygrophilous taxa such as *Myrica*, *Salix*

and *Zelkova*, plus some limnophytic taxa such as *Ceratophyllum*, *Typha* and *Zannichellia* (PAICHELER & BLANC 1981). Some shared insect taxa, especially Odonata, suggest an age very close to that of the latest Oligocene paleolake of Aix-en-Provence (NEL & PAICHELER 1994).



**Fig. 1.** The locality of fossil Tipulidae from the Latest Oligocene preserved in diatomite sediments, Gürçü-Dere Valley (40°35-38'N, 32°39-42'E, altitude 1200-1300 m according to WASSERSUG & WAKE (1995)), Anatolia, Turkey. A – *Tipula (Tipula) oligocenica* n. sp., holotype No. MNHN.F.A38732; B – *Tipula (Platytipula) anatolica* n. sp., holotype No. MNHN.F.A38734; C – *Tipula (Trichotipula) paicheleri* n. sp., holotype No. MNHN.F.A38735.

Tipulidae LATREILLE, 1802 are one of the oldest evolutionary lines among Diptera. The first direct ancestors of this group appeared in the Triassic, about 240 Ma (KRZEMIŃSKI 1992a, KRZEMIŃSKI et al. 1994, SHCHERBAKOV et al. 1995, KRZEMIŃSKI & KRZEMIŃSKA 2003, KRZEMIŃSKI & EVENHUIS 2000).

The oldest representative of the Tipulidae, *Tipula (s. lato) eva* KRZEMIŃSKI, 1992b, was described from the Upper Burneya depression, Khabarovsk Kray, Russia (Upper Cretaceous – probably Cenomanian).

The rapid radiation of the Tipulidae did not occur until the Mesozoic (EVENHUIS 1994). The numerous finds of fossil representatives of this group come from Europe, from where more than 60 species have been described by HEER (1849), NOVAK (1877), MEUNIER (1899, 1906, 1915, 1916), LOEW (1850), COCKERELL (1917, 1921), COCKERELL & HAINES (1921), HENRIKSEN (1922), ALEXANDER (1931), STATZ (1934, 1944), THEOBALD (1937), ZEUNER (1938), FREIWALD (1990), GENTILINI (1990) and KRZEMIŃSKI (2000), and from North America by SCUDDER (1890,1894), HANDLIRSCH (1910), ALEXANDER (1938), MELANDER (1949), LEWIS (1969, 1973) and WIGHTON (1980), who described over 30 species, mainly from the genus *Tipula* LINNAEUS, 1758.

From the Oligocene of Europe 10 species have been described in the genus *Tipula* NOVÁK (1877) from the present-day Czech Republic; MEUNIER (1915) and STATZ (1934, 1944) from Germany, and from France THEOBALD (1937).

This paper is dedicated to Professor Wiesław Krzemiński and Professor Ryszard Szadziwski, eminent specialists in fossil and recent Diptera.

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#### MATERIAL AND METHODS

The study is based on material from the collection Jean-Claude PAICHELER, collected in 1977-1980, which is deposited at the Laboratoire de Paléontologie, MNHN, Paris. The specimens (four imprints from Upper Oligocene sediments) were studied using a Nikon SMZ 1500 stereomicroscope. The microphotographs were taken with a Nikon DS-Fi1 camera equipped with a stereomicroscope. The drawings were made on the basis of specimens and photographs. The measurements of specimens were taken with NIS-Elements D 3.0 software.

#### SYSTEMATIC PALAEOLOGY

Order Diptera LINNAEUS, 1758

Family Tipulidae LATREILLE, 1802

Subfamily Tipulinae LATREILLE, 1802

**Genus *Tipula* LINNAEUS, 1758**

Type species: *Tipula oleracea* LINNAEUS, 1758; by subsequent designation of LATREILLE 1810: 442, 379.

**Subgenus *Tipula* LINNAEUS, 1758**

Type species: *Tipula oleracea* LINNAEUS, 1758; by subsequent designation of LATREILLE 1810: 442, 379.

***Tipula (Tipula) oligocenica* sp. n.**

(Fig. 2)

**Material**

Holotype No. MNHN.F.A38732, Paratype No. MNHN.F.A38733.

**Etymology**

Specific epithet after the geological period – the Oligocene.

**Diagnosis**

Sc ending opposite fork of Rs into  $R_{2+3+4}$  and  $R_5$ , Rs approximately one and half times longer than m-cu,  $R_2$  regular; d-cell pentagonal;  $M_4$  separating from  $M_{3+4}$  at 1/2 of d-cell, petiola shorter than upper edge of d-cell, length of petiola only 1/2 of upper edge of d-cell.

**Description**

Wing (Figs. 2A, B). Wing 3.83 mm wide (paratype 4.5 mm wide); venation comparatively well visible with not well visible basal part of wing; Sc ending opposite fork of Rs into  $R_{2+3+4}$  and  $R_5$ ; cross-vein r-r ( $R_2$ ) connecting  $R_1$  and  $R_3$ . Rs long, one and half times longer than cross-vein m-cu;  $R_4$  long, wavy,  $R_5$  evenly arched to apex of wing; d-cell short but wide;  $M_1$  and  $M_2$  connected into petiola which occurs between cell and fork of  $M_{1+2}$  into  $M_1$  and  $M_2$ ; cross-vein m-cu long, connected with  $M_{3+4}$  in their fork on  $M_3$  and  $M_4$ ; fork of  $M_{3+4}$  on  $M_3$  and  $M_4$  in 1/2 of d-cell; cell m-cu strongly narrowed at edge of wing;  $A_1$  separating near Cu;  $A_2$  long and straight.

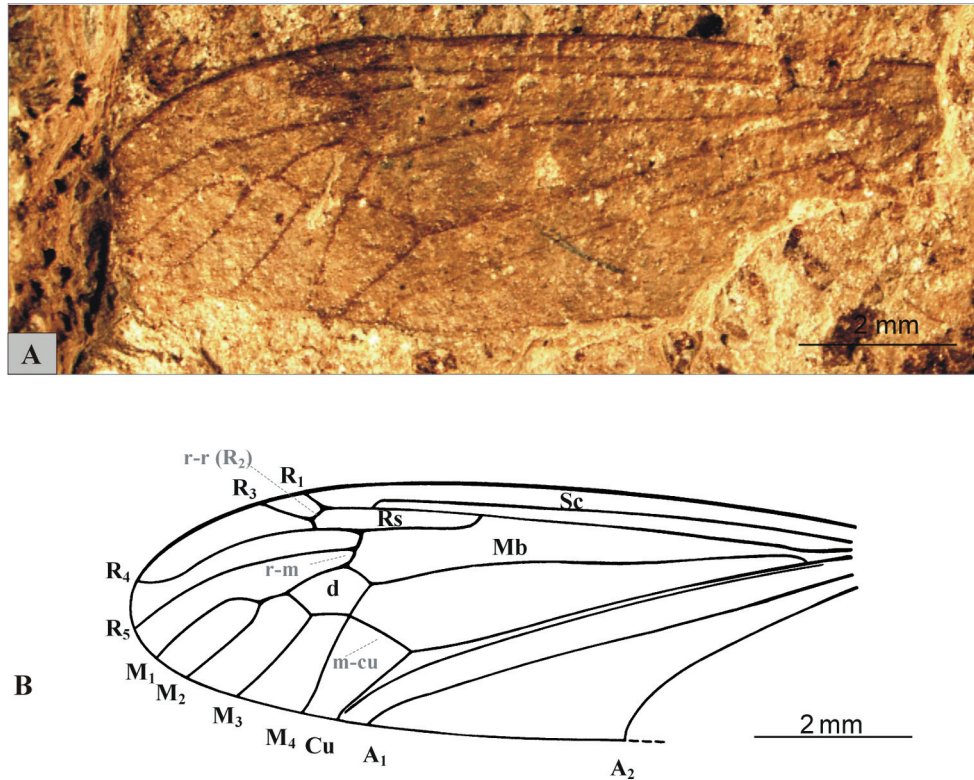
**Remarks**

Only the wing has been preserved.

The new species *Tipula oligocenica* sp. n. has features that characterize the subgenus *Tipula* LINNAEUS, 1758: wing usually with contrasting shady costal area, with a more or less pale area behind the shady area, radius (Rs) 1.5 to 2 times longer than m-cu,  $R_2$  regular; d-cell widely pentagonal;  $M_4$  separating from  $M_{3+4}$  at 1/2 of d-cell (SAVCHENKO 1961), allowing its placement in the subgenus *Tipula*. The classification is based on the wing venation because the specimen is not well preserved.

**Age and occurrence**

Upper Oligocene volcano-sedimentary paleolake of Bes-Konak, Turkey.



**Fig. 2.** *Tipula (Tipula) oligocenica* sp. n., holotype No. MNHN.F.A38732, wing venation: A – photograph, B – drawing (orig.).

#### **Subgenus *Platytipula* MATSUMURA, 1916**

Type species: *Tipula moiwana* MATSUMURA, 1916; by original designation.

#### ***Tipula (Platytipula) anatolica* sp. n.**

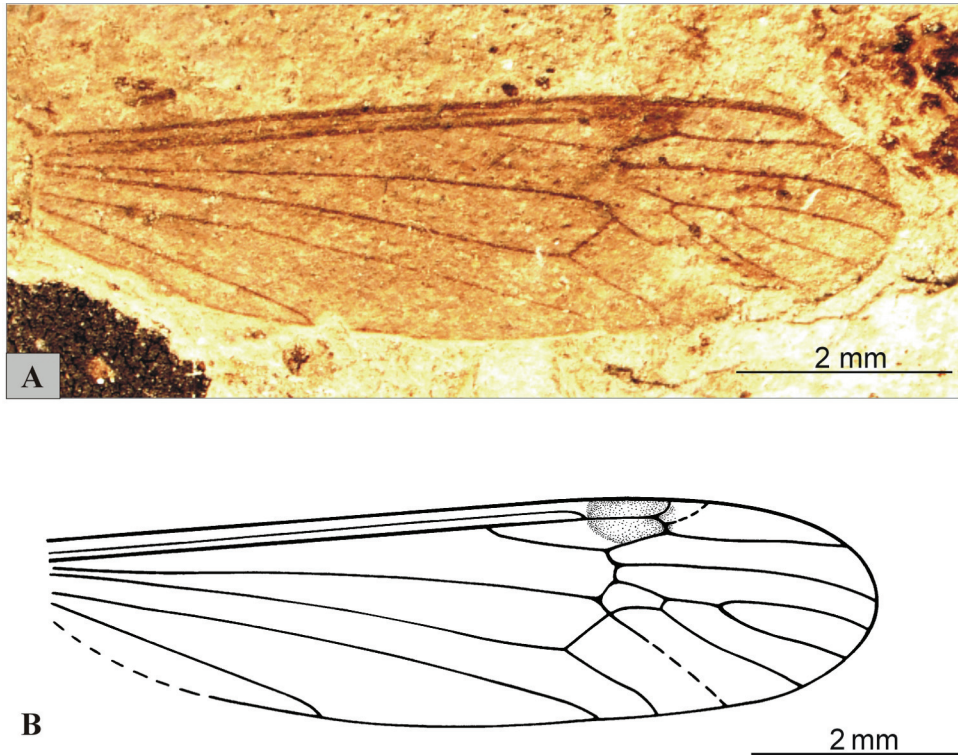
(Fig. 3)

#### **Material**

Holotype No. MNHN.F.A38734.

#### **Etymology**

The name is derived from Anatolia (Turkey).



**Fig. 3.** *Tipula (Platytipula) anatolica* sp. n., holotype No. MNHN.F.A38734, wing venation: A – photograph, B – drawing (orig.).

#### Diagnosis

Sc ending in 1/4 before bifurcation of radius (Rs) into R<sub>2+3+4</sub> and R<sub>5</sub>; Rs approximately twice as long as m-cu; R<sub>2</sub> regular; d-cell pentagonal; M<sub>4</sub> separating from M<sub>3+4</sub> before 1/2 of d-cell; petiola as long as upper edge of d-cell.

#### Description

Wing (Figs. 3A, B). Wing 7.49 mm long, 5.00 mm wide; wing venation comparatively well visible; pterostigma well distinct; basal part of wing not preserved; Sc ending before fork of Rs into R<sub>2+3+4</sub> and R<sub>5</sub>; vein R<sub>3</sub> not visible; R<sub>4</sub> long, slightly wavy, R<sub>5</sub> slightly evenly arched; d-cell very small and narrow; petiola as long as upper edge of d-cell; M<sub>1</sub> almost three times as long as petiola; cross-vein m-cu rather short and opposite fork of M<sub>3+4</sub> into M<sub>3</sub> and M<sub>4</sub>; lower edge of d-cell made by M<sub>3</sub> vein, three times longer than part made by M<sub>3+4</sub>; only basal part of M<sub>4</sub> visible; end of A<sub>1</sub> comparatively apart from distal part of Cu vein; A<sub>2</sub> rather long and straight.

**Remarks**

Only the wings are preserved.

The new species *Tipula anatolica* sp. n. has features that characterize the subgenus *Platytipula* MATSUMURA, 1916: radius (Rs) slightly longer than m-cu, R<sub>2</sub> regular; d-cell pentagonal; M<sub>4</sub> separating from M<sub>3+4</sub> before 1/2 of d-cell, m-cu slanting (SAVCHENKO 1961), allowing it to be classified in the subgenus *Platytipula*. The classification is based on the wing venation because the specimen is not well preserved.

**Age and occurrence**

Upper Oligocene volcano-sedimentary paleolake of Bes-Konak, Turkey.

**Subgenus *Trichotipula* ALEXANDER, 1915**

Type species: *Tipula oropezoides* JOHNSON, 1909, by original designation.

***Tipula (Trichotipula) paicheleri* sp. n.**

(Fig. 4)

**Material**

Holotype specimen MNHN.F.A38735.

**Etymology**

The specific name is dedicated to Dr Jean-Claude Paicheler, who found the specimen.

**Diagnosis**

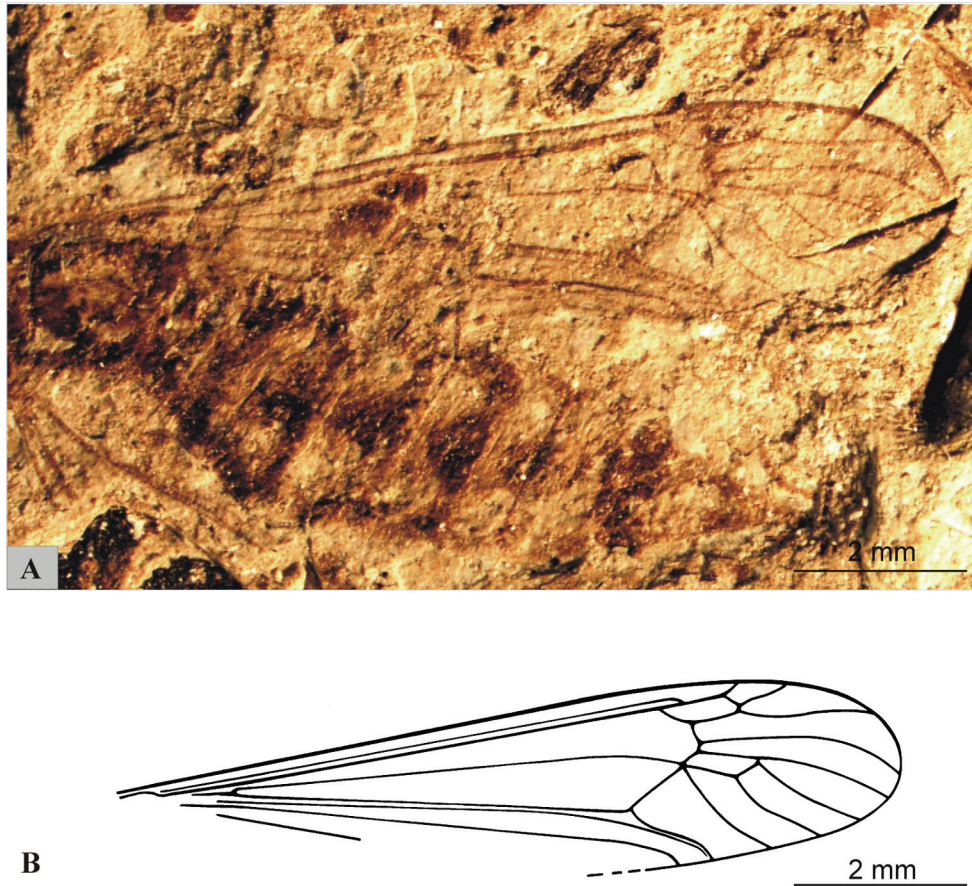
Sc ending in 1/2 bifurcation of radius (Rs) into R<sub>2+3+4</sub> and R<sub>5</sub>; Rs distinctly shorter than m-cu, 1/2 of m-cu; R<sub>2</sub> regular; d-cell tetragonal; M<sub>4</sub> separating from M<sub>3+4</sub> directly at d-cell base; M<sub>1</sub> and M<sub>2</sub> not connected in a common petiola.

**Description**

Body (Fig. 4A). 10.01 mm long; eyes huge, oval; wing slightly unshaped with basal and anal parts slightly visible.

Wing (Fig. 4A, B). Wing 9.27 mm long, 2.09 mm wide; vein Sc 5.5 mm long; R<sub>1</sub> ending before fork of R<sub>2+3+4</sub> on R<sub>2+3</sub> and R<sub>4</sub>; vein R<sub>5</sub> strongly cambered to hind edge of wing in 2/3 of its length; d-cell small and narrow; M<sub>1+2</sub> making edge of d-cell and forked at end of d-cell on M<sub>1</sub> and M<sub>2</sub>; M<sub>1</sub> and M<sub>2</sub> not connected in common petiola; M<sub>3</sub> strongly wavy; lower base of d-cell made only by vein M<sub>3</sub>; M<sub>4</sub> separating from M<sub>3+4</sub> directly at base of d-cell; m-cu long, straight, m-cu cell strongly narrowed from 2/3 and slightly wider at edge of wing; end of A<sub>1</sub> near distal part of Cu; only basal part of A<sub>2</sub> visible.

Ovipositor. Not very elongated.



**Fig. 4.** *Tipula (Trichotipula) paicheleri* sp. n., holotype No. MNHN.F.A38735: A – body, photograph, B – wing venation, drawing (orig.).

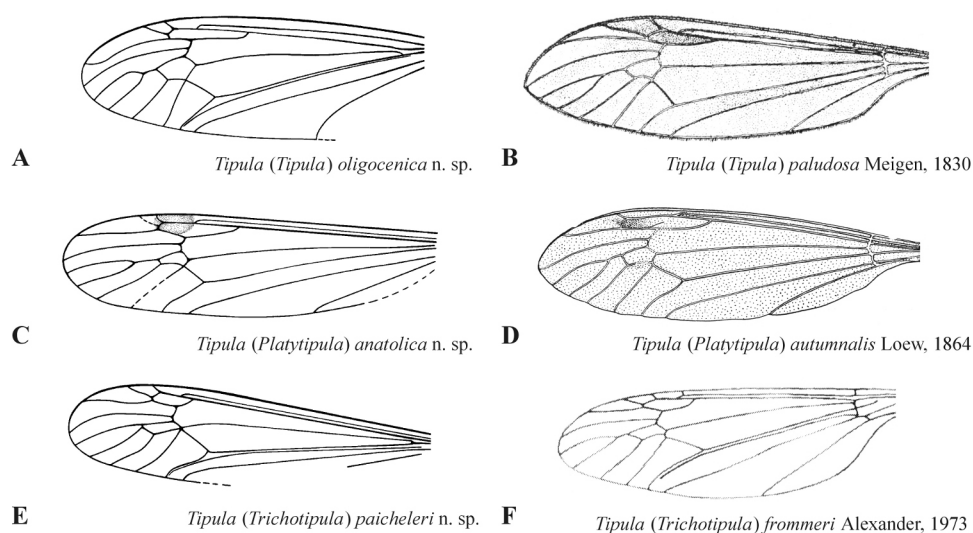
#### Remarks

The holotype is not well preserved; part of the head and eyes, antennae and the partially preserved rostrum; only the ventral view of thorax and abdomen visible; part of the right wing is visible.

The new species *Tipula paicheleri* n. sp. has features that characterize the subgenus *Trichotipula* ALEXANDER, 1915: wing venation with short radius (Rs), distinctly shorter than cross-vein m-cu, m-cu elongated, transverse,  $R_2$  regular,  $M_4$  separating from  $M_{3+4}$  directly at base of d-cell; m-cu cell strongly narrowed from 2/3 and slightly wider at edge of wing (SAVCHENKO 1961). The classification is based on the wing venation on account of the specimen not being well preserved.

**Age and occurrence**

Upper Oligocene volcano-sedimentary paleolake of Bes-Konak, Turkey.



**Fig. 5.** Wing venations of fossil and recent species: A, C, E – new Latest Oligocene species, B – recent representative of subgenus *Tipula* (after SAVCHENKO 1961), D – recent representative of subgenus *Platytipula* (after SAVCHENKO 1961), F – recent representative of subgenus *Trichotipula* (after ALEXANDER 1973).

**CONCLUSIONS**

Recent Tipulidae are mostly associated with moist and temperate forests, swamps, marshes and meadows, and can be found in high latitudes as well as at high altitudes. The immature stages of Tipulidae are semiaquatic to terrestrial and can be found in such places as moist leaf litter, moss, rotting logs, mud and sands along riverbanks, and are associated with decaying plant material. Though possessing functional mouthparts, the immature stages of recent Tipulidae have only rarely been observed feeding at flowers. The modern Tipulidae have a worldwide distribution and comprise approximately 4 000 species. About one hundred fossil representatives of eight genera have been described, based on imprints and inclusions in amber from different periods; some 70 of these are attributed to the genus *Tipula* (EVENHUIS 1994). The species newly described herein differ distinctly from other fossil species known from the Oligocene period. The fossil Tipulidae known from the Latest Oligocene of Aix-en-Provence (France) – *Tipula grandis* MEUNIER,

1916, *Tipula bouati* MEUNIER, 1915, and *Tipula cossmanni* MEUNIER, 1915 – differ distinctly from the newly described species.

The wing venations of our new species enable these to be classified into three different subgenera. These new species and recent species of the subgenera *Tipula*, *Platytipula* and *Trichotipula* show strong similarities in their wing venation (Fig. 5).

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