ANNALES ZOOLOGICI (Warszawa), 2006, 56(1): 175-180

FOSSIL MAYFLY COLLECTIONS OF THE MUSEUM FÜR NATURKUNDE, HUMBOLDT UNIVERSITY BERLIN. I. *ELECTROLETUS SOLDANI* GEN. AND SP. NOV. (EPHEMEROPTERA: AMELETIDAE) FROM THE EOCENE BALTIC AMBER

Roman J. Godunko[1*] and Christian Neumann[2]

[1*]*State Museum of Natural History, National Academy of Sciences of Ukraine, Teatral'na str. 18, 79008 L'viv, Ukraine; e-mail: godunko@museum.lviv.net; godunko@seznam.cz*
[2]*Institut für Paläontologie, Museum für Naturkunde, Humboldt-Universität zu Berlin, Invalidenstrasse 43, 10115 Berlin, Germany; e-mail: christian.neumann@museum.hu-berlin.de*

Abstract.— *Electroletus soldani* **gen**. and **sp. nov**. from Eocene Baltic amber is described and illustrated. The presence of an elongate lateroparapsidal suture of the mesonotum, sublateroscutum and submedioscutum of the mesonotum with traces of the pigmented area, a backwards-stretched medially mesonotal suture, the dissimilar claws and a 5-segmented paracercus undoubtedly define the systematic position of *Electroletus* gen. nov. within the family Ameletidae McCafferty, 1991. The new genus differs from other genera of Ameletidae by combination of the following characters: pterostigmatic area of fore wings with 11–12 simple, not anastomosed veins; cubital field of fore wings with one pair of intercalaries; tarsi of middle and hind legs are longer than tibiae; tarsal segment I of all legs is the longest; styliger plate with median protuberance. Type specimen belongs to W. Simon's collection, which is hosted in the Museum für Naturkunde, Institute of Palaeontology, Humboldt University, Berlin.

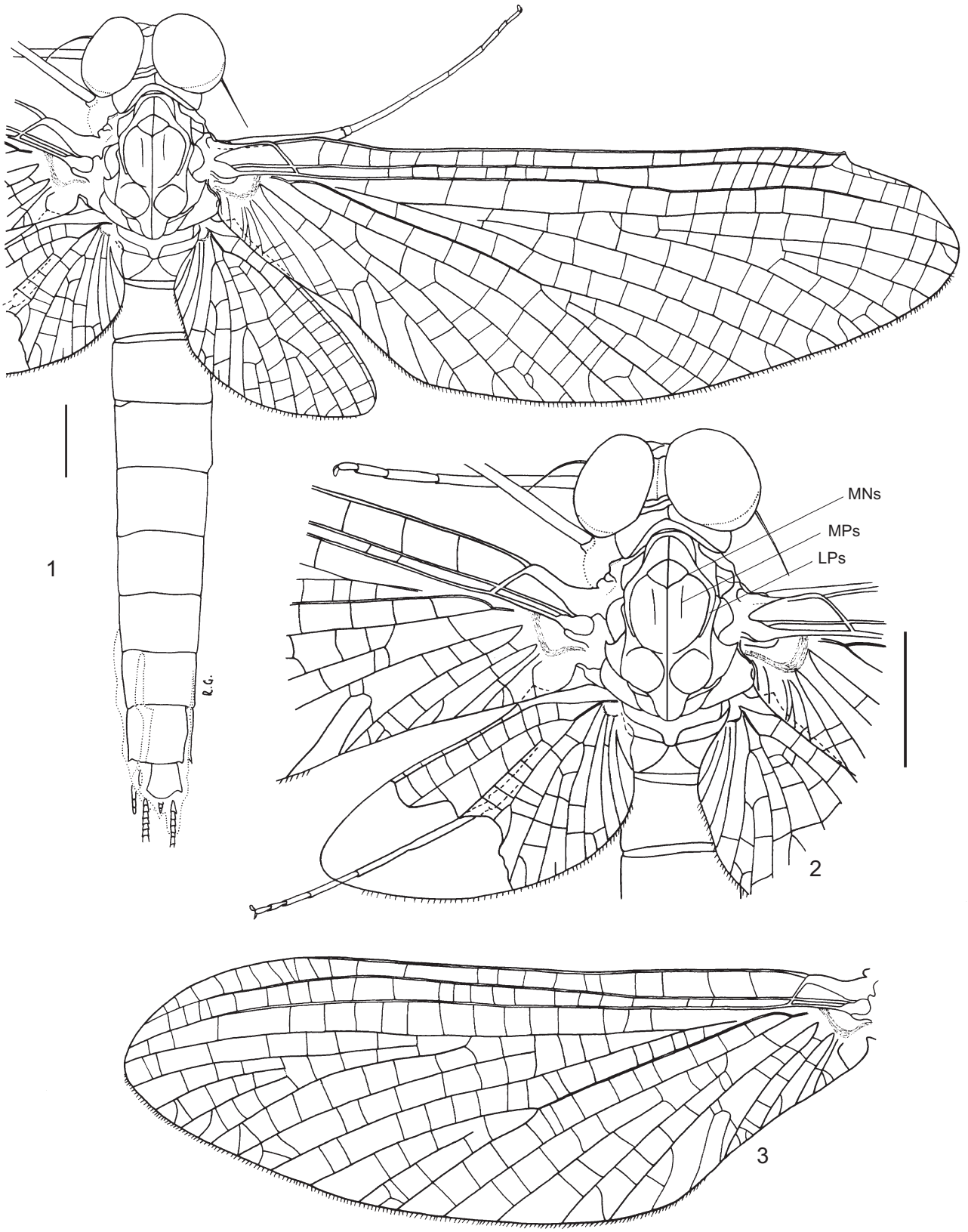
Key words.— Ephemeroptera, Ameletidae, *Electroletus*, *Electroletus soldani*, Eocene, Baltic amber.

Introduction

The family Ameletidae McCafferty, 1991 includes two genera. The genus *Ameletus* Eaton, 1865 includes about 50 species distributed in the Holarctic and in the Oriental Region. The genera *Chimura* Navás, 1915 and *Paleoameletus* Lestage, 1940, which were described in the first half of the last century, are the generic synonyms of the genus *Ameletus* (Edmunds and Traver 1954a, Edmunds 1960). The second genus of the family, that is *Metreletus* Demoulin, 1951, includes a single recent species – *M. balcanicus* Ulmer, 1920 distributed in Europe (Belgium, Bulgaria, Czech Republic, France, Germany, Hungary, Poland and Slovakia).

In 2003, studying the collection of fossil mayflies at the Institute of Systematics and Evolution of Animals, Polish Academy of Sciences (Kraków, Poland) in Eocene Baltic amber, we have found a female imago of the genus *Ameletus*. Its mesothorax is characterised by the presence of a membranous area between anepimeron and katepimeron (apomorphy of Ameletidae). The wing venation of this specimen resembles the plesiomorphic condition within *Ameletus*. Kluge (2004: 81) was the first, who reported about that find, having attributed the specimen to the genus *Ameletus*. Up to date, it is the single reliable fossil specimen of the family Ameletidae.

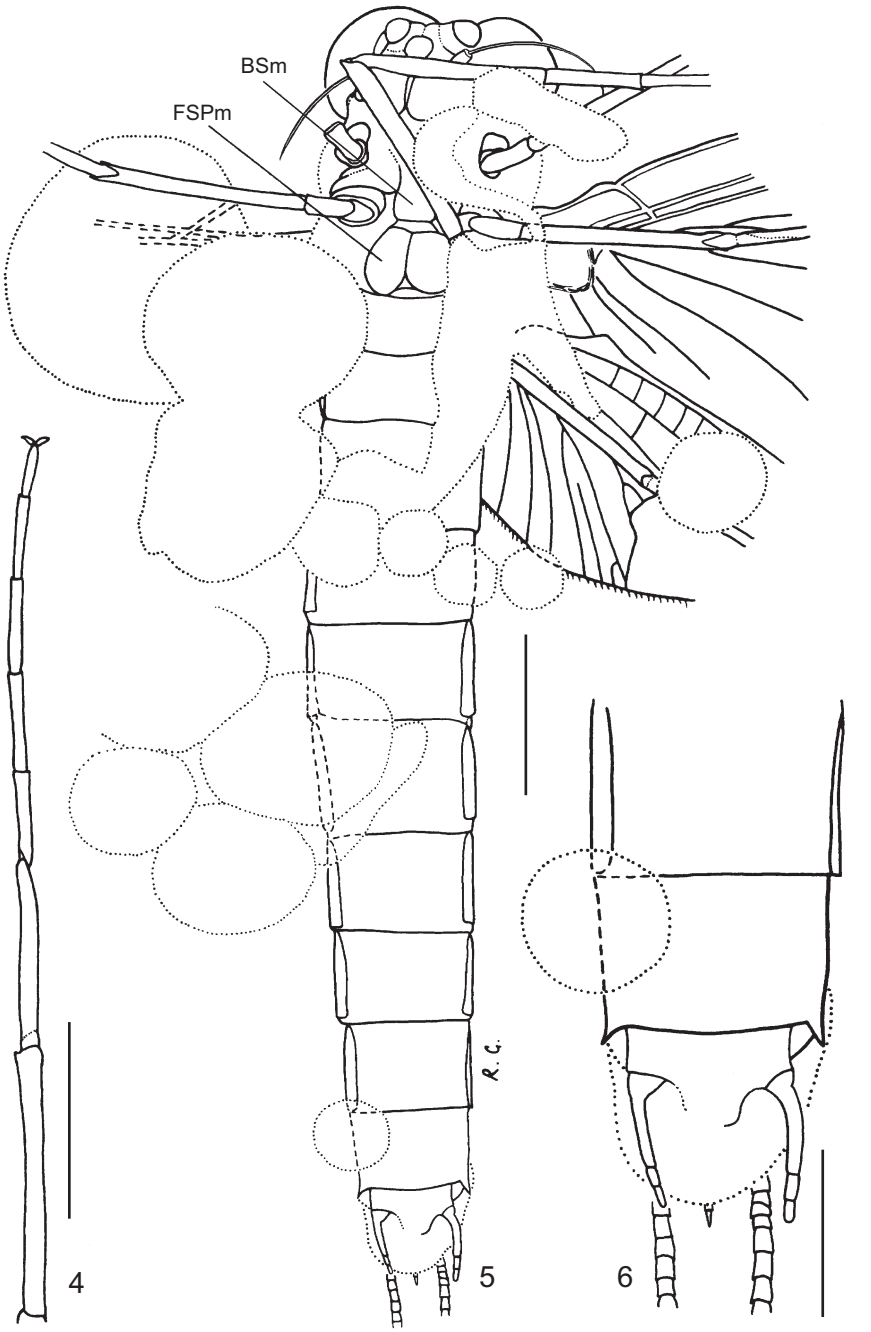
The male subimago, which is described in the present paper as *Electroletus soldani* sp. nov., has been found by the authors in the amber collection of W. Simon, preserved at the Museum für Naturkunde, Institute of Palaeontology, Humboldt University, Berlin. The specimen was apparently overlooked by Demoulin (1968),



Figures 1–3. *Electroletus soldani* sp. nov., holotype, inventory number MB.I 2244, W. Simon's amber collection of the Institute of Palaeontology, Humboldt University, Berlin, male subimago. (1) Body in dorsal view, (2) head, thorax and part of abdomen in dorsal view (MNs – mesonotal suture, MPs – medio-parapsidal suture, LPs – lateroparapsidal suture), (3) left fore wing in dorsal view. Scale bars = 1mm.

Table 1. Morphometrics of holotype of male subimago of *Electroletus soldani* sp. nov. from Eocene Baltic amber.

Characters	(mm)
Length of body	8.76
Length of right fore leg	5.19
Length of femur	1.53
Length of tibia	1.13
Length of tarsus	2.53
Segment I	0.56
Segment II	0.56
Segment III	0.55
Segment IV	0.50
Segment V	0.33
Length of left fore leg	4.78
Length of femur	1.57
Length of tibia	1.18
Length of tarsus	2.03
Segment I	0.52
Segment II	0.58
Segment III	0.40
Segment IV	0.25
Segment V	0.20
Length of right middle leg	3.90
Length of femur	1.33
Length of tibia	0.88
Length of tarsus	1.69
Segment I	0.53
Segment II	0.45
Segment III	0.35
Segment IV	0.18
Segment V	0.18
Length of left middle leg	3.88
Length of femur	1.33
Length of tibia	0.85
Length of tarsus	1.70
Segment I	0.55
Segment II	0.45
Segment III	0.34
Segment IV	0.18
Segment V	0.18
Length of right hind leg	3.35
Length of femur	1.13
Length of tibia	0.75
Length of tarsus	1.47
Segment I	0.45
Segment II	0.41
Segment III	0.25
Segment IV	0.18
Segment V	0.18
Length of left hind leg	3.38
Length of femur	1.13
Length of tibia	0.78
Length of tarsus	1.47
Segment I	0.45
Segment II	0.43
Segment III	0.25
Segment IV	0.18
Segment V	0.16
Length of right fore wing	8.40
Length of left fore wing	8.38
Length of right hind wing	2.83
Length of left hind wing	2.84
Hind/Fore wings length ratio	0.34
Length of cerci	7.84–7.88



Figures 4–6. *Electroletus soldani* sp. nov., holotype, inventory number MB.I 2244, W. Simon's amber collection of the Institute of Palaeontology, Humboldt University, Berlin, male subimago. (4) Left fore leg, (5) body in ventral view (BSm – basisternum of mesothorax, FSPm – furcasternal protuberance of mesothorax), scale bars = 1 mm, (6) tip of abdomen in ventral view, scale bar = 0.5 mm.

the first specialist who has investigated 14 fossil mayflies from that collection. He described nine new species and one new genus, namely *Baltameletus oligocaenicus* Demoulin, 1968 (type species of the monotypic genus *Baltameletus* Demoulin, 1968), *Siphlonurus*? *dubiosus* Demoulin, 1968 (family Siphlonuridae Banks, 1900) *Siphloplecton jaegeri* Demoulin, 1968 (family Metretopodidae Traver, 1935), *Cinygma baltica* Demoulin, 1968, *Heptagenia atypica* Demoulin, 1968, *H. gleissi* Demoulin, 1968, *H. senex* Demoulin, 1968, *Rhithrogena sepulta* Demoulin,

1968 (family Heptageniidae Needham, 1901) and *Ephemerella* (*Timpanoga*?) *viscata* Demoulin, 1968 (family Ephemerellidae Klapálek, 1909). He assigned two specimens to *Siphloplecton macrops* (Pictet, 1856), and designated one of them (the female imago) as allotype (Demoulin 1968: 249, Fig. 15). Another two specimens he illustrated and described as *Paraleptophlebia prisca* (Pictet, 1956) (Demoulin 1968: 263–265, Figs 31, 32), and one male imago as *Rhithrogena* sp. (Demoulin 1968: 261, Fig. 28).

This paper deals with the description and illustration of the male subimago of *Electroletus soldani* gen. et sp. nov. from the Eocene Baltic amber, belonging to the family Ameletidae. A combination of distinguishing characters, separating *Electroletus* gen. nov. from the other two genera of Ameletidae is given.

The morphological terminology follows Edmunds and Traver (1954b), Kluge (1994, 2004).

Taxonomy

Ameletidae McCafferty, 1991

Electroletus gen. nov.

Type species. *Electroletus soldani* sp. nov., by present designation.

Diagnosis. Male subimago. *Electroletus* gen. nov. is distinguished from all other genera of Ameletidae by the combination of the following features: pterostigmatic area of fore wings with 11–12 simple, not anastomosed veins; cubital field of fore wings with one pair of intercalaries; middle and hind tarsi longer than tibiae; first tarsal segment of middle and hind legs is the longest; styliger plate with median protuberance.

Etymology. The generic name of *Electroletus* gen. nov. is derived from "electron" – the Greek word for amber, and "letus" – typical generic ending of family Ameletidae. The gender is masculine.

Electroletus soldani sp. nov.
(Figs 1–9)

Diagnosis. The same as for the genus *Electroletus* gen. nov.

Description. Male subimago (Figs 1–9).

Measurements. See Table 1.

Colour of body light yellow to yellowish-brown. Head light brown. Eyes not contiguous. Antennae longer than head (Figs 1–2).

Thorax yellowish-brown. Mesonotal suture in anterior part of mesonotum is strongly stretched backwards medially, not transverse (Fig. 2). Lateroparapsidal suture is elongate. Submedioscutum and sublateroscutum with traces of pigmented area (Fig. 9). Lateral sides of thorax hardly visible. Epimeron of mesothorax invisible. Anterial paracoxal suture is present and complete. Median impression of furcasternum of mesothorax is absent, furcasternal protuberances are contiguous. Prosternum structure invisible (Fig. 2).

Wings opaque. Longitudinal veins of fore wings yellowish to yellowish-grey. Transversal veins whitish-grey, hardly visible. Pterostigmatic area of fore wings with 11–12 simple cross veins. Cubital field with a pair of intercalaries connected by transversal veins with CuA and CuP (Figs 1–3). Hind wings well developed with distinct costal projection pointed apically, as long as 0.34 of fore wings length (0.35–0.40 for whole Ameletidae by Kluge (2004)) (Figs 1–2).

Legs light, yellow to yellowish-grey. Fore legs lighter than middle and hind legs. Tarsi of middle and hind legs are longer than tibiae (Figs 1–2). Middle and hind legs with vestige of patella-tibial suture. All tarsi 5-segmented. Measurements of tarsal segments are in Table 1. The length of tarsal segments of the right and left fore legs is different probably due to post mortem change (Figs 2, 4, 5). First tarsal segment of middle and hind legs is the longest, fused with tibia (Figs 1–2). All claws are dissimilar, with one pointed and one blunt claw.

Abdominal segments yellow colour, terga slightly darker than sterna. Styliger plate with median protuberance. Penis lobes and a fragment of styliger protuberance are invisible. Forceps with two distal segments (Figs 5–6). Paracercus 5-segmented only. Cerci light, yellowish coloured, completely preserved.

Relationships. The presence of an elongate lateroparapsidal suture of the mesonotum, sublateroscutum and submedioscutum of the mesonotum with traces of a pigmented area, the medially backwards-stretched mesonotal suture, the dissimilar claws and the 5-segmented paracercus clearly define the systematic position of *Electroletus* gen. nov. within the family Ameletidae (see Kluge 2004: 80–81, Kluge et al. 1995: 111). The structure of the lateral sides of thorax in the specimen studied is hardly visible, what prevents from ascertaining the availability of membranous area between anepimeron and katepimeron of the mesothorax (apomorphy of Ameletidae) (see Kluge 2004: 81, Fig. 21C, Kluge et al. 1995: 111, Fig. 18).

By the presence of one pair of intercalaries in the cubital field of fore wings the fossil *Electroletus* gen. nov. is close to the extant genus *Metreletus*, which is characterised by the availability of one or two intercalaries (non-unique apomorphy) (Demoulin 1951: 19, Figs 1a, 1e, 11a, c, d, 1952: 4, Fig. 4, Ujhelyi 1960: 203, Fig. 5, Studemann et al. 1988: 315, Fig. 52a).

The genus *Ameletus* markedly differs from the above mentioned two genera by the structure of the cubital field of fore wings, in which the lack of intercalaries and the presence of 4–8 occasionally forked veins stretching

Figures 7–8. *Electroletus soldani* sp. nov., holotype, inventory number MB.I 2244, W. Simon's amber collection of the Institute of Palaeontology, Humboldt University, Berlin, male subimago. (7) body in dorsal view, (8) body in ventral view. Without scale.

from CuA to basitornal margin of the wing are observed (Kluge 2004: 82, Fig. 7C).

Electroletus gen. nov. can be distinguished from the other genera of Ameletidae by the following characters: the presence of only simple 11–12 cross veins in pterostigmatic area of fore wings, in contrast to forked veins of pterostigmatic area in *Ameletus* (Figs 1, 3, Studemann et al. 1988: 315, Fig. 51); the presence of a median protuberance of styliger plate, in contrast to the deep median incision of the styliger plate in *Ameletus* and *Metreletus* (Figs 5–6, Ujhelyi 1961: 201, Fig. 1, Studemann et al. 1988: 310–311, Figs 41–43, 48, 49). The structure of middle and hind legs in *Electroletus* gen. nov., that is, tarsi longer than tibia and the longest first tarsal segment, also clearly separate it from the genera *Ameletus* and *Metreletus* (see Demoulin 1951: 15, Ujhelyi 1961: 202–203, Fig. 6, Studemann et al. 1988: 35–316, Figs 50c, f).

Type. Holotype: male subimago in Eocene Baltic amber with well preserved body, well visible from the dorsal side. Lateral sides and some fragments of the dorsal side are hardly visible. The holotype is preserved in W. Simon's amber collection of the Institute of Palaeontology, Humboldt University, Berlin. The specimen is originally labeled as "Pseudoneuroptera. Ephemera". Inventory number MB.I 2244.

Etymology. The new species is named in honor of our friend Professor Tomáš Soldán.

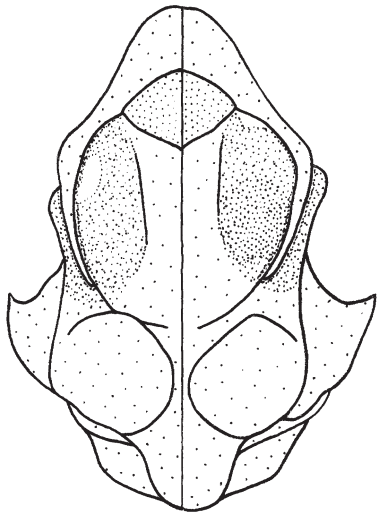


Figure 9. *Electroletus soldani* sp. nov., holotype, inventory number MB.I 2244, W. Simon's amber collection of the Institute of Palaeontology, Humboldt University, Berlin, male subimago. Thorax in dorsal view. The traces of pigmented area on submedioscutum and sublateroscutum are marked. Without scale

Acknowledgements

We would like to thank Prof. N. Ju. Kluge (St. Petersburg University) for consultation and help with literature. The authors are grateful to Iryna B. Konovalova (State Museum of Natural History NAS Ukraine, L'viv) for help with the English version of the paper.

The investigation of the material in the Institute of Palaeontology, Humboldt University, Berlin was financially supported by a grant from the Deutscher Akademischer Austausch Dienst (DAAD). The study of *Ameletus* sp. at the Institute of Systematics and Evolution of Animals, Polish Academy of Sciences (Kraków, Poland) was supported by the Kasa J. Mianowski (Warszawa, Poland) and grant of the Presidium of National Academy of Sciences of Ukraine.

References

Edmunds, G. F., Jr. 1960. Two generic synonyms in the Siphlonuridae (Ephemeroptera). Bulletin of the Brooklyn Entomological Society, 55: 24.

Edmunds, G. F., Jr., and J. R. Traver. 1954a. An outline of a reclassification of the Ephemeroptera. Proceedings of the Entomological Society of Washington, 56: 236–240.

Edmunds, G. F., Jr. and J. R. Traver. 1954b. The flight mechanics and evolution of the wings of Ephemeroptera, with notes on the archetype insect wing. Journal of Washington Academy of Sciences, 44: 390–400.

Demoulin, G. 1951. A propos de *Metretopus goetghebueri* Lestage 1938, et des Metretopodidæ (Insectes Ephéméroptères). Bulletin Institut Royal des Sciences Naturelles de Belgique, 27(49): 1–11.

Demoulin, G. 1952. Sur les affinities siphlonuridiennes du génre *Metreletus* Demoulin 1938 (Insectes Ephéméroptères). Bulletin Institut Royal des Sciences Naturelles de Belgique, 28(31): 1–11.

Demoulin, G. 1968. Deuxième contribution à la connaissance des Ephéméroptère de l'amber oligocène de la Baltique. Deutsche Entomologische Zeitschrift, 15(1–3): 233–276.

Kluge, N. J. 1994. Pterothorax structure of mayflies (Ephemeroptera) and its use in systematics. Bulletin de la Société Entomologique de France, 99(1): 41–61.

Kluge, N. J. 2004. The Phylogenetic System of Ephemeroptera. Kluwer Academic Publishers, Dordrecht. 456 pp.

Kluge, N. J., Studemann D., Landolt P. and T. Gonser. 1995. A reclassification of Siphlonuroidae (Ephemeroptera). Bulletin de la Société Entomologique Suisse, 68: 103–132.

Studemann, D., Landolt, P. and I. Tomka. 1988. Morphology and taxonomy of imagines and eggs of Central and Northern European Siphlonuridae (Ephemeroptera). Bulletin de la Société Entomologique Suisse, 61: 303–328.

Újhelyi, S. 1960. *Metreletus hungaricus* sp. n., eine neue Eintagsfliege (Ephemeroptera) aus Ungarn. Acta Zoologica Academiae Scientiarum Hungaricae, 6: 199–209.

Received: March 3, 2005
Accepted: August 8, 2005