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The oldest representatives of the aphid family Ellinaphididae and phylogenetic relationships within the family

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ABSTRACT

The paper presents the descriptions of new aphid taxa from Late Jurassic/Early Cretaceous locality of Khotont (Mongolia). Two new genera *Secusellinaphis* gen. nov., *Vetellinaphis* gen. nov. and three new species of the family Ellinaphididae are described. The newly described species are: *Secusellinaphis khotontensis* sp. nov., *Vetellinaphis cracens* sp. nov. and *Vetellinaphis longalata* sp. nov. These are the oldest representatives of the family. Phylogenetic relationships within Ellinaphididae, the position of the family with respect to the Palaeoaphididae and evolutionary aspects of the new genera are discussed.

1. Introduction

Khotont (Hotont), which is known mainly for the fossils of insects and crustaceans, is located on the northern slope of Ukha Atszarga in the central part of Mongolia. This deposit originates from a lake which was located in a mid-latitude climate zone and the subtropical Euro-Chinese region (Chumakov, 2004). The lake was surrounded by semi-arid forests and mountains of volcanic origin (Ponomarenko, 2013). Perhaps its ecosystem was similar to today's oligotrophic mountain lakes with clean and cold water, rich in oxygen, characterized by low nutrient content and low primary production (Sinichenkova and Zherikhin, 1996).

The age of the lacustrine sediments of Khotont is defined as "disputed". Some researchers consider it as the Upper Jurassic deposit but others classify it rather as the Lower Cretaceous. Two thousand of fossil insects have been collected there representing 14 orders (Rasnitsyn and Zherikhin, 2002). The most numerous are the flies (Diptera), which constitute the half of the insect collection. The second most frequently represented order are the Hemiptera and among them 147 imprints have been identified as aphids (Ponomarenko, 2013). So far only three genera have been described: *Pterotella* Wegierek, 1991 (from the family Genaphididae), *Khotontaphis* Shaposhnikov and Wegierek, 1989 (from the Oviparosiphidae) and *Primpalaeoaphis* Żyła and Wegierek, 2013 (from the Palaeoaphididae) (Heie and Wegierek, 2011; Żyła and Wegierek, 2013). Part of the undescribed material comprises representatives of the extinct Cretaceous aphid family Ellinaphididae.

The family Ellinaphididae includes 11 genera and 39 species (Kania and Wegierek, 2008, 2013). Most of them have been described from Baissa (Lower Cretaceous, Transbaikalia, Russia), only one genus *Caudaphis* Zhang, Zhang, Hou and Ma, 1989 comes from the Lower Cretaceous of China (Shandong, Laiyang Basin, Tuanwang) (Heie and Wegierek, 2011). Recent studies have shown that this family was also present in the Early Cretaceous in Mongolia (Bon-Tsagaan deposit) (Kania and Wegierek, 2013).

The present paper describes two new genera and three new species of the family Ellinaphididae, which are the oldest representatives of this family.

2. Material and methods

The analyzed material consisted of 12 specimens of fossil aphids borrowed from the collection of Institute of Paleontology, Russian Academy of Sciences in Moscow. The fossils were preserved in the form of two imprints – the "obverse" and the "reverse". The material was analyzed using typical methods for paleoentomological research (Rasnitsyn, 2002). Specimens were photographed using the stereoscopic microscope Nikon SMZ1500 and polarized light microscope Nikon Eclipse-E600. In order to facilitate

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0195-6671/

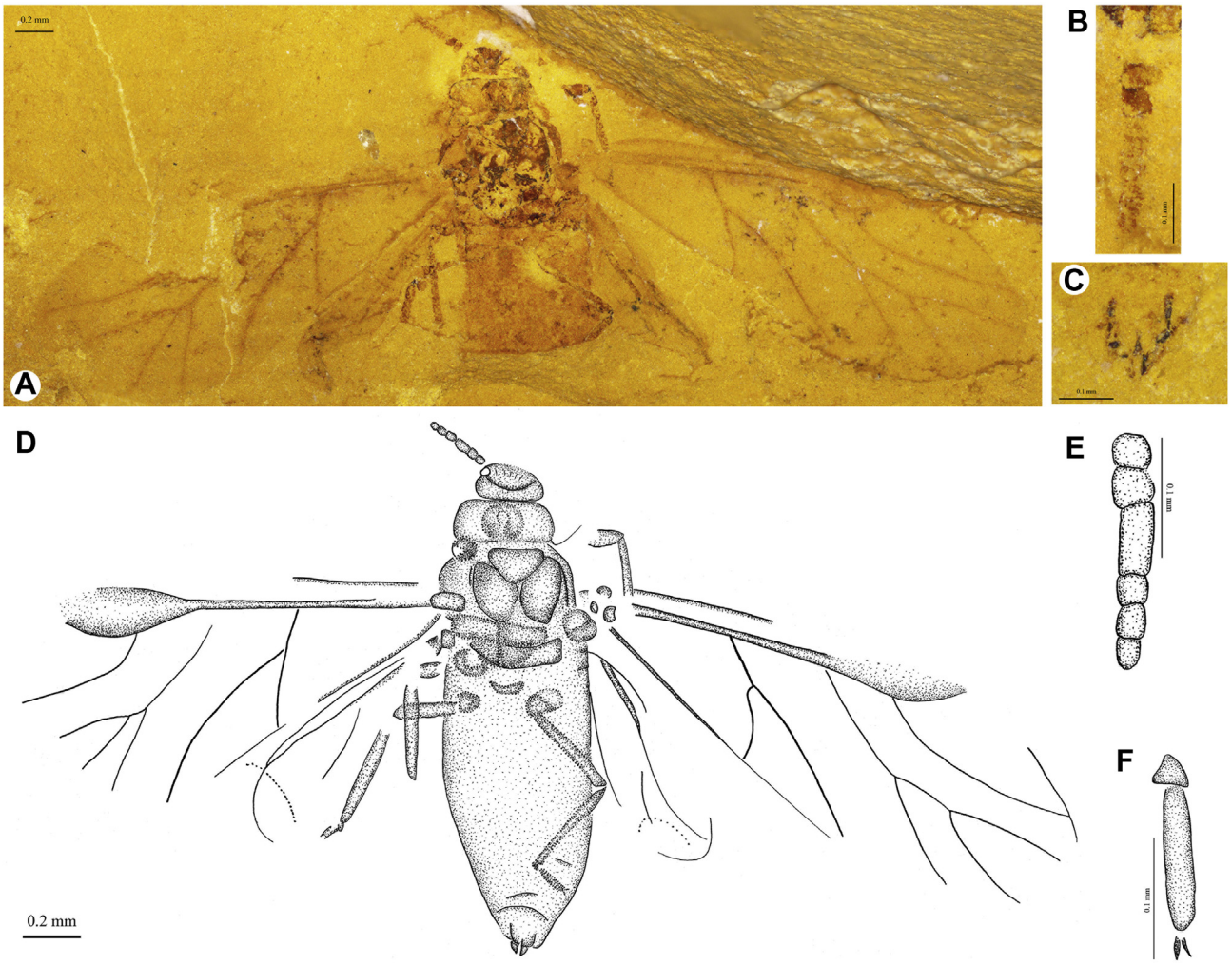

Fig. 1. *Secusellinaphis khotontensis* sp. nov., 4307/193±, holotype; A. dorsal view; B, E. right antenna; C. apical part of abdomen; D. reconstruction (dorsal view); F. hind tarsus.

understanding of the morphology of selected parts of the body, they were photographed using a scanning electron microscope Philips XL 30 TMP ESEM (with a secondary electron detector). Photographs and measurements were made in the NIS-Elements program. The figures are based on the combined drawings of reverse and obverse imprints, while the photographs represent only one imprint. All measurements are given in mm.

The method used for phylogenetic analysis was maximum parsimony (MP). The character matrix was constructed using Mesquite ver. 2.71 (Maddison and Maddison, 2009). The matrix includes 42 characters scored for nineteen taxa. Unknown character states were coded with "?" and inapplicable with "–". The analyses were conducted in TNT 1.1 software (Goloboff et al., 2008) using the "traditional search" option to find the most parsimonious trees. All character states were treated as unordered and equally weighted. Trees were viewed and analyzed using WinClada ver. 1.00.08 (Nixon, 2002).

3. Results

3.1. Systematic paleontology

Order Hemiptera Linnaeus, 1758
Suborder Sternorrhyncha Amyot and Serville, 1843
Infraorder Aphidomorpha Becker-Migdisova and Aizenberg, 1962
Superfamily Palaeoaphidoidea Richards, 1966
Family Palaeoaphididae Richards, 1966 sensu Kania and Wegierek, 2008

Subfamily Ellinaphidinae Kania and Wegierek, 2008 sensu Kania and Wegierek, 2008
Type genus Ellinaphis Shaposhnikov, 1979

Genus *Secusellinaphis* gen. nov.
Type species *Secusellinaphis khotontensis* sp. nov.; by present designation and monotypy.
Etymology: From the Latin *secus* – differently and *Ellinaphis* – type genus to the family. Gender: feminine.
Diagnosis: Contrary to the other genera from the family, the antennae consist of 6 segments.

Species *Secusellinaphis khotontensis* sp. nov.
Fig. 1
Etymology: The name is derived from the Khotont locality.
Holotype: **No. 4307/193±** (alate female); ***Paratypes:*** **No. 4307/185±, No. 4307/190±**
Type locality: Khotont (Hotont), Mongolia
Stratigraphic horizon: Upper Jurassic/Lower Cretaceous
Diagnosis: As for the genus.

Description: Length of body 1.63–2.56 (Fig. 1A, D). Length of head (0.12–0.18), more than half of its width (0.21–0.29). Lateral sutures