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New mayfly genera from the Middle Triassic of Poland and their evolutionary and paleogeographic implications (Ephemeroptera: Litophlebiidae, Vogesonymphidae)

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Abstract

Two new mayfly genera and species from the Triassic deposits of the Pałęgi area (southeast Poland) are described. This is the first description of aquatic insects from the Pałęgi locality. *Triassolitophlebia pategica* **gen. et sp. nov.** (Litophlebiidae) is established on the basis of an isolated forewing. This is the first finding of this family in the Northern Hemisphere, known previously only from the Molteno Formation (South Africa). This is also the first mayfly family from the Triassic which has been found in both Hemispheres, providing additional evidence of the presumed similarity of aquatic insect faunas in the Southern and Northern Hemispheres during the Triassic. The consistent wing venation of ancient mayflies with homonomous wings could be evidence that they originated from the same ancestor. The second new mayfly, *Palegonympha triassica* **gen. et sp. nov.** (Vogesonymphidae), is described on the basis of a single fossil nymph (imprint of the exuviae) and indicates the similarity of the Pałęgi arthropod assemblage to that described from the Middle Triassic of France. The presence of a mayfly nymph in the last instar stage suggests not only that the Pałęgi deposit represents a fluvial environment with well-oxygenated and limpid water but also that these conditions lasted long enough to allow for such development.

Key words: fossil insects; Olenekian-Anisian; Pałęgi; Ephemeroptera; Litophlebiidae; *Triassolitophlebia pategica* **gen. et sp. nov.**; Vogesonymphidae, *Palegonympha triassica* **gen. et sp. nov.**

Introduction

The Triassic period is heralded as one of the key stages in the evolution of insects. As a result of the mass extinction at the Permian/Triassic boundary, whole groups of organisms were reduced (Eskov 2002; Shcherbakov 2008). From the beginning of the Triassic it is possible to distinguish three main stages in the development of entomofaunas. First is Early Triassic, the so-called post-Palaeozoic stage, which is characterized by rather low diversity of assemblages that consist almost exclusively of Late Permian taxa. The second is the Anisian–Carnian stage, and it marks the time of the rise of the typical Triassic entomofauna. This includes the appearance of numerous typical Mesozoic and geologically younger taxa and also several groups endemic to the Triassic. The last stage, i.e., the Late Carnian–Norian, is characterized by the changing of the Triassic endemic fauna into key groups of the late Mesozoic and the appearance of new aquatic taxa (Shcherbakov 2008). The insect fauna of the terminal Rhaetian is indistinguishable from that of the Early Liassic (Jarzembowski 1999). Although deposits of Triassic insect remains have been discovered newly in recent times, this group is still a rarity.

The most ancient lineage of the winged insects are mayflies, retaining many plesiomorphic morphological features, features of biology and modes of life. They are the only insects that have a molting winged stage (subimago) that is a reminder of the archemetaboly of their ancestors. This ancient group, as the insects in general, is poorly known from the Triassic deposits and every paleontological record of it has scientific value. The oldest mayflies, as well as the majority of Triassic ones, belonged to the mayfly suborder Permoplecoptera (Staniczek *et*

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