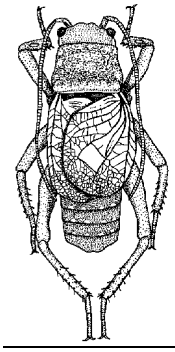

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THE FIRST DAMSELFLY (INSECTA: ODONATA, HEMIPHLEBIIDAE) RECORDED FROM THE TURONIAN OF ISRAEL

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The damselfly *Pantelusa krassilovi* Vassilenko, **gen.** et **sp. n.** of the family Hemiphlebiidae is described from the Turonian of Israel (Gerofit locality, Ora Formation) from a single fossil wing. It is the first odonate known from this locality. The new genus is considered close to Cretaceous representatives of the family, especially the genus *Electrohemiphlebia* Lak et al., 2009, known from the Albian amber of France. The possibility is discussed that some endophytic ovipositions known from Gerofit belong to similar small damselflies.

KEY WORDS: Damselfly, Hemiphlebiidae, taxomomy, endophytic ovipositions, Turonian, Ora Formation, Gerofit, Israel.

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Из турона Израиля (местонахождение Герофит, свита ора) по единственному остатку крыла описана первая в этом местонахождении стрекоза *Pantelusa krassilovi* Vassilenko, **gen.** et **sp. n.** из семейства Hemiphlebiidae. Новый

род сближается с меловыми представителями семейства, в частности с родом *Electrohemiphlebia* Lak et al., 2009, известным из альбских смол Франции. Обсуждается возможность принадлежности к стрекозам-гемифлебиидам или другим мелким Zygoptera некоторых известных из Герофита эндофитных яйцекладок.

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INTRODUCTION

Fossil insects were found in the locality Gerofit (mid-Turonian Ora Formation) in the early 1960s (by J. Lorch and his students) and subsequently in 1995 (by I.A. Dobruskina and A.P. Rasnitsyn). More insects were collected in Gerofit by V.A. Krassilov, in part jointly with A.P. Rasnitsyn, in 2003–2007. These records were summarized by Anisyutkin *et al*. (2008). Four insect orders and eleven families are recognized in the assemblage (Neuroptera: Palaeoleontidae; Hemiptera: Cicadellidae; Coleoptera: Carabidae, Dytiscidae, Hydrophilidae, Curculionidae; Blattodea: Mesoblattinidae, Blaberidae, Polyphagidae, Blattellidae, Anaplectidae). An unidentified cockroach or mantis ootheca was also described from Gerofit (Anisyutkin *et al*., 2008).

In addition, many plants and an assemblage of plant-insect interactions (traces of feeding, mines, galls, and endophytic oviposition) are known from this locality (Krassilov *et al*., 2008). Body fossils of Odonata are not known from Gerofit, but there are endophytic ovipositions recorded as belonged to them (Krassilov *et al*., 2007, Vasilenko & Rasnitsyn, 2007).

The first damselfly was found by the author in the Gerofit locality in 2009 during an excursion organized by Prof. Krassilov. The clay-containing horizon forms an overhanging ledge on a vertical wall at a height over 3 m from the bottom, and one cannot work at it without a ladder. The author used stones to knock pieces of rock out of the overhanging ledge and then examined these pieces. Only one insect fossil was obtained in this way, the one described below.

The nomenclature of wing venation generally accepted at present is based on homologization across different insect orders (Riek & Kukalová-Peck, 1984). The scepticism of colleagues towards the outdated Tillyard–Fraser system is understanddable; that system does have some serious drawbacks, but the currently dominant homologization-based system is also not free of them, nor is the terminology based on the newer system. L.N. Pritykina (*pers. comm*., March 2014) is now preparing for publication a new terminology of odonate wing venation, based on alternative homologization. Having this in mind, for the exclusively descriptive purposes of this study, I used the classical Tillyard–Fraser terminology here.

SYSTEMATIC PALEONTOLOGY

Order Odonata Fabricius, 1793
Suborder Zygoptera Selys, 1853
Family Hemiphlebiidae Tillyard, 1926

Genus *Pantelusa* Vassilenko, gen. n.

Type species: *Pantelusa krassilovi* Vassilenko, sp. n., here designated.

DIAGNOSIS. Base of vein IR_3 situated slightly proximal to sn. Vein A straight to level of mid distance between N and bifurcation of RS, then zigzagging. Crossvein under base of IR_3 not corresponding to crossvein between R_{4+5} and MA, thus forming no straight line together with it. Base of R_{4+5} situated at beginning of distal third of distance between base of IR_3 and MA. Distal margin of discoidal cell 2.7 times as long as anterior margin. Distal margin of discoidal cell 1.7 times as long as proximal margin.

COMPOSITION. Type species only.

ETYMOLOGY. From the planet Pantelusa in the collection of science fiction short stories *The Star Diaries* by Stanisław Lem. Gender feminine.

REMARKS. At present six genera with known wings are placed in the family Hemiplebiidae or considered close to it: *Parahemiphlebia* Jarzembowski et al., 1998 from the Lower Cretaceous of Brazil and England (Jarzembowski *et al*., 1998, Bechly, 1998), *Cretarchistigma* Jarzembowski et al., 1998 from the Lower Cretaceous of Brazil (Jarzembowski *et al*., 1998, Bechly, 1998), *Cretahemiphlebia* Jarzembowski et al., 1998 from the Lower Cretaceous of England (Jarzembowski *et al*., 1998), *Mersituria* Vasilenko, 2005 from the Upper Jurassic – Lower Cretaceous of Russia (Vasilenko, 2005), *Electrohemiphlebia* Lak et al., 2009 (Lak *et al*., 2009) from the Cretaceous amber of France, *Jordanhemiphlebia* Kaddumi, 2009 from the Lower Cretaceous amber of Jordan (Lak *et al*., 2009). Another likely Hemiphlebiidae fossil is a wing apex from the Upper Cretaceous amber of the United States (Nel *et al*., 2010). Members of this family typically have small wings, strongly reduced wing venation, and some specific characters: non-corresponding crossveins in the first and second spaces and open discoidal cell in the forewing. Sometimes, as in this case, only one wing with closed discoidal cell is preserved, and it can be difficult to determine by other characters whether the wing is a forewing or hindwing; therefore, the principal characters used to place this fossil in Hemiphlebiidae are the non-corresponding veins in the first two spaces and small wing size. It cannot be excluded that in the Cretaceous there were more than one family of small damselflies with non-corresponding crossveins, but to date there are no reliable data that would allow recognizing other families and reliably distinguishing them from Hemiphlebiidae.

Unfortunately, the wing described here has been preserved incompletely, and a number of characters important for characterizing genera, such as the structure of the pterostigma and its supporting vein, position of the base of IR_2, and type of the fracture of R_2, cannot be determined. Nevertheless, the available data proved sufficient for erecting a new genus. The proximal position of the base of IR_3 relative to sn is known, except in the new species, only in the genera *Mersituria* and *Electrohemiphlebia* (in the other genera the base of IR_3 is situated directly below sn, appearing together with it as one straight line). The shape of A distinguishes the new genus from all other known genera except *Mersituria* (they have A strongly zigzagging over

its entire length). On the whole, in the complex of examinable characters, *Pantelusa* gen. n. differs especially strongly from the modern genus *Hemiphlebia*, showing the highest similarity with the genera *Electrohemiphlebia* from the Albian of France and

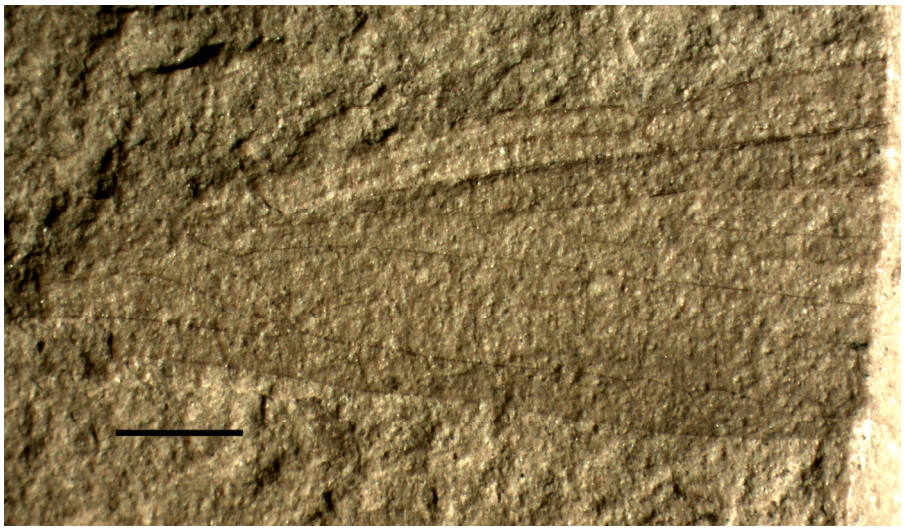

Fig. 1. *Pantelusa krassilovi* Vassilenko, gen. et sp. n., holotype PIN No. 5068/13, imprint of hindwing. Scale bar: 1 mm.

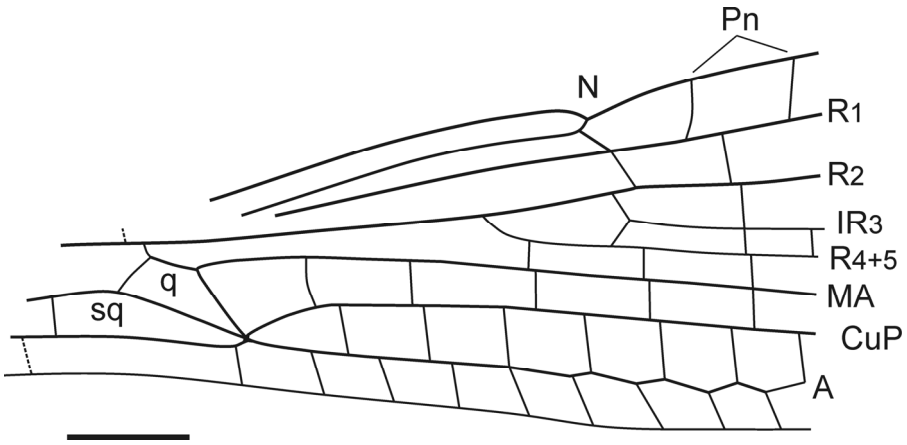

Fig. 2. *Pantelusa krassilovi* Vassilenko, gen. et sp. n., venation, holotype PIN No. 5068/13. (N – nodus; Pn – postnodal crossveins; R_1 – radius anterior; R_2 – R_{4+5} radius posterior veins; IR_3, – third intercalary radial vein; MA – median anterior; CuP – cubitus posterior; A – anal vein; q – discoidal cell ; sq – subdiscoidal cell). Scale bar: 1 mm.

Mersituria from the Upper Jurassic – Lower Cretaceous of Russia. It is distinctly distinguished from the genus *Mersituria* in the shape of the distal margin of the discoidal cell and in the position of the crossvein under this margin, position of the crossvein under the base of IR_3, relative width of spaces between CuP and MA and between MA and the common stem of RS in the area between the discoidal cell and nodus, and shape of the subdiscoidal cell. The new genus differs from *Electrohemiphlebia* in the more strongly reduced venation, in the shape of A, and in the stricter structure of the anal area.

***Pantelusa krassilovi* Vassilenko, sp. n.**
Figs 1, 2

MATERIAL. Holotype PIN No. 5068/13, Borissiak Paleontological Institute RAS, Moscow, Russia.

HORIZON AND LOCALITY. Upper Cretaceous, Turonian, Ora Formation, Gerofit locality (Krassilov *et al*., 2008), southern Negev, Israel.

DESCRIPTION. First postnodal vein slightly arcuate; first postsubnodal vein and crossveins situated under it in other spaces lying on one straight line, but not corresponding precisely; IR_3 in the area of its base straight; A visibly drawn towards distal angle of discoidal cell and connected with wing margin by vein diverging from subdiscoidal cell somewhat proximal to its distal margin; first and second wing fields comparable in width (second field slightly narrowed in area of base of subnodal vein).

ETYMOLOGY. In honor of the paleobotanist Prof. Valentin A. Krassilov.

DISCUSSION

The insect assemblage from the Gerofit locality is quite extraordinary and obviously distorted for taphonomic reasons. In spite of the abundance of well preserved plant remains, almost no insects with soft integument occur in this locality, and all fossils are strongly fractured. This may be explained by the mechanically or biologically aggressive aquatic environment (Anisyutkin *et al*., 2008). The taxonomic composition of insects of the Ora Formation is very peculiar and includes Cenozoic elements: two extant genera of cockroaches (*Paratropes* and *Ergaula*), beetles *Echinocnemus* and *Georissites,* especially close to Eocene forms, and Carabidae of Cenozoic aspect (Anisyutkin *et al*., 2008).

The single record of an odonate described here from the Turonian locality Gerofit contributes considerably to the paleontological description of this locality. The new genus *Pantelusa* is more strongly distinguished from members of the extant genus *Hemiphlebia* than from the previously known Cretaceous members of this rather small family (the new genus is especially close to the genera *Electrohemiphlebia* and *Mersituria*), thus not contradicting the notion about the Turonian age of the deposits.

The relatively rare occurrence of small Zygoptera in the Cretaceous is probably related more to their specific mode of life in plant communities and their low chances of fossilization than to zygopterans being rare during that period. By analogy with the modern Zygoptera, the chances of fossilization for these damselflies somewhat increase during the breeding period, when they actively fly over water and lay eggs into coastal plants and floating leaves. But even fossils of damselflies buried during this period can occur in deposits only very rarely, for various reasons (taphonomic and other). Sometimes indirect evidence of their presence and diversity can be obtained from traces of endophytic ovipositions, as can be seen in Gerofit, where the diversity and number of forms of ovipositions alone is incomparably greater than all fossils of insects associated with plants taken together.

Several forms of endophytic ovipositions have been described from Gerofit (Krassilov *et al*., 2007, 2008). Ovipositions of this type and size probably belong to damselflies (Krassilov *et al*., 2007, Vasilenko & Rasnitsyn, 2007, Vasilenko, 2008, Sarzetti *et al*., 2009, Moisan *et al*., 2012). These damselflies were adapted to maneuvering among dense vegetation and, like small modern zygopterans, could oviposit into fallen and floating leaves.

Judging by the size, small damselflies (such as Hemiphlebiidae or small Coenagrionidae) could be associated with the smallest of the described endophytic ovipositions (Krassilov *et al*., 2008: Pl. IV). Eggs in these ovipositions are arranged rather sparsely and in small numbers. Ovipositions consisting of numerous very small eggs shown in Figs. II, III (Krassilov *et al*., 2008) may also belong to these damselflies. Other endophytic ovipositions figured by Krassilov and coauthors (Pl. I) consist of somewhat large eggs that are differently arranged and may belong to other members of the suborder Zygoptera. It is also possible that some of the small forms of endophytic ovipositions figured by Krassilov may belong to some dipterans rather than damselflies. Endophytic ovipositions, as well as other kinds of evidence of interactions between insects and plants (various galls, mines, and traces of feeding), are numerous and diverse in the deposits of Gerofit, indicating the high level of interactions between insects and plants and great population size in insects associated with plants. But the rare occurrence and low taxonomic diversity of the insects themselves gives evidence of taphonomic restrictions of some nature that remains unclear. The currently available data on the fossil evidence of interactions between insects and plants are insufficient for broad generalizations and interpretations, but such data have recently been accumulating rather intensely. Localities such as Gerofit are especially important, since its deposits contain not only numerous and diverse evidence of interactions between plants and animals, but also insect fossils.

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