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Two New Insects from the Upper Permian (Tatarian) of Belmont, New South Wales, Australia (Insecta: Hypoperlida: Anthracoptilidae = Permarrhaphidae; Grylloblattida: Sylvaphlebiidae)

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Abstract—New insects, *Jarmilacladus variabilis* gen. et sp. nov. (Insecta: Hypoperlida: Anthracoptilidae = Permarrhaphidae) and *Belmophenopterum pectinatum* gen. et sp. nov. (Insecta: Grylloblattida: Sylvaphlebiidae) are described from the Upper Permian (Tatarian) of Belmont, New South Wales, Australia. Strephocladidae and Strephoneuridae are synonymized under Anthracoptilidae, *Homocladus* Carpenter, 1966 is synonymized under *Spargoptilon* Kukalová, 1965 (= *Spargopteron* Carpenter, 1992, lapsus calami). An identification key for genera of Anthracoptilidae is compiled.

Key words: Australia, Upper Permian, Hypoperlida, Grylloblattida, new taxa, new synonymy, identification key.

INTRODUCTION

Upper Tatarian deposits of the Upper Permian locality of Belmont (Newcastle Coal Measures at Belmont and Warner's Bay, New South Wales) are the most ancient within the territory of Australia. According to Riek (1970), the fauna of this locality includes insects, phyllopods, and fish scales, and plants are represented by the genus *Glossopteris*. The insect fauna of this locality differs from that in coeval localities in the Northern Hemisphere in being unbalanced. Among Scarabaeiformes, dominating Mecoptera and rare Glosselytrodea, Neuroptera, Coleoptera, and Trichoptera have been discovered, while, among Cimiciformes, numerous Homoptera and several Psocida have been found. In addition to these orders, Scarabaeones are represented by a single undescribed dragonfly (Odonata). The entire infraclass Gryllones is represented by one species of Plecoptera.

Four specimens of undescribed insects from Belmont are stored in the collection of the Natural History Museum, London (NHM). According to their labels, three were identified by J. Kukalová-Peck (Carleton University, Ottawa, Canada) as belonging to the family Strephocladidae (currently Anthracoptilidae, order Hypoperlida), and the fourth turned out to be a member of the order Grylloblattida. Neither order has been previously recorded in Australia. Moreover, these are the latest records for the order Hypoperlida and the family Sylvaphlebiidae.

During Rasnitsyn's visit to the NHM, the abovementioned specimens, which were generously provided by A.J. Ross, were sketched, and these drawings became the basis of the present work. The final drawings were prepared by Aristov, while the specimens were photographed in the NHM at Ross' initiative.

SYSTEMATIC PALEONTOLOGY

Order Hypoperlida

Suborder Strephocladina

Family Anthracoptilidae Handlirsch, 1922

Anthracoptilidae: Handlirsch, 1922, p. 98.

Strephocladidae: Martynov, 1938, p. 100 (= Anthracoptilidae: Rasnitsyn, 2002, p. 112).

Permarrhaphidae: Martynov, 1931, p. 190 (syn. nov.).

Strephoneuridae: Martynov, 1940, p. 14 (= Permarrhaphidae: Rasnitsyn, 2002, p. 112).

D i a g n o s i s. This family differs from other members of suborder Strephocladina (for details, see Rasnitsyn, 2002) in the presence of oblique and forking anterior branches of SC that form neither several rows of cells, as in very large Hypermegethidae, nor series of simple, oblique or nearly vertical anterior branches, as in other families (Synomaloptilidae, Tococladidae, Heteroptilidae, and Nugonioneuridae). The body structure is insufficiently well known to use it in diagnosis of the family.

C o m p o s i t i o n. Genera *Anthracoptilus* Laméere, 1917 and *Mesoptilus* Laméere, 1919 from the Upper

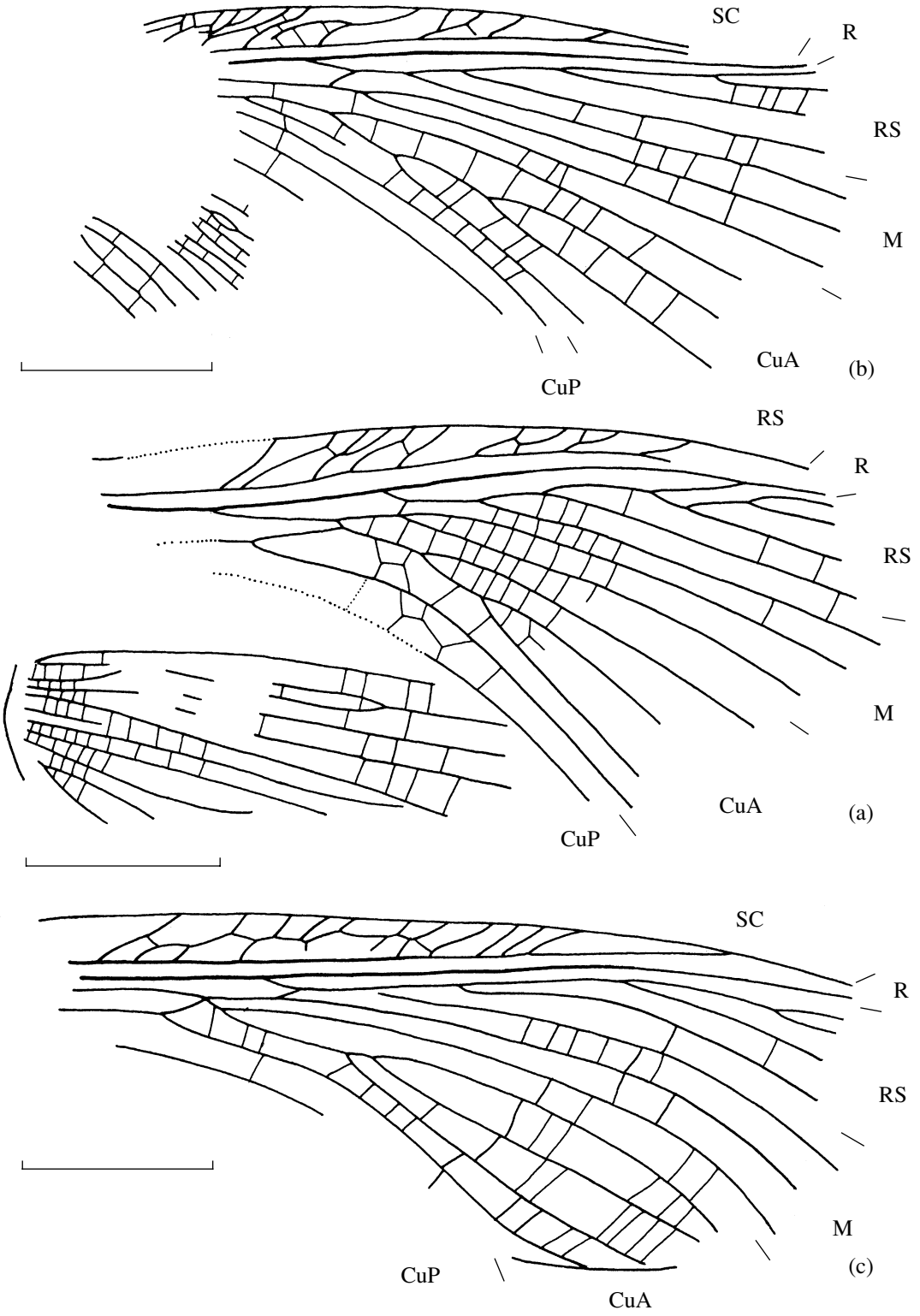

Fig. 1. Details of *Jarmilacladus variabilis* sp. nov.: (a) holotype NHM, In. 45933; (b) paratype NHM, In. 45620; and (c) paratype NHM, In. 45627. Scale bars 5 mm in Figs. 1 and 3.

Carboniferous (Stephanian B–C) of Commentry, France; *Strephocladus* Scudder, 1885 from the Upper Carboniferous (Stephanian A) of Germany; *Spargoptilon* Kukalová, 1965 (= *Spargopteron* Carpenter, 1992, lapsus calami; = *Homocladus* Carpenter, 1966, syn. nov. from the Lower Permian of Elmo, the United

States) from the Lower Permian (Lower Artinskian) of Obora, Czech Republic; *Paracladus* Carpenter, 1966, and *Opistocladus* Carpenter, 1966 from the Lower Permian (Upper Artinskian) of Elmo; *Strephoneura* Martynov, 1940, *Rhinomaloptila* Rasnitsyn, 1977, and *Mycteroptila* Rasnitsyn, 1977 from the Lower Permian (Kungurian) of Tshekarda, the Urals; *Permarrhaphus* Martynov, 1931 from the Upper Permian (Lower Kazanian) of Tikhie Gory, Tatarstan; and a new genus from the Upper Permian (Tatarian) of Belmont, Australia, which is chronologically the last representative of the whole order Hypoperlida.

Remark. The taxonomy of Anthracoptilidae is confused and needs revision to justify the description of a new genus. Preliminary results of such a revision are presented in the key below. The genera *Permarrhaphus* and *Mycteroptila* are not included in the key, since their venation is insufficiently well known. *Permarrhaphus* is similar to *Strephoneura* in the anal field and is most likely a closely related (if not identical) genus. *Mycteroptila* may be even a synonym of *Spargoptilon* in so far as can be judged from the type species. On the contrary, the species *M. armipotens* Novokshonov is more similar to representatives of *Strephoneura* (Novokshonov, 1998) and may represent another species of the same genus. The main diagnostic feature of *Mycteroptila*—wings folded flatly over the abdomen—is not obvious in the single known specimen, in which the hind margins of the wings are not overlapped. In any case, to accept or reject the proposed synonymy, one needs better material.

The synonymy of *Homocladus* and *Spargoptilon* is supported by the striking similarity between their type species; however, in the former species, the wing is narrow, and, in the latter, the wing is wide, which may be easily accounted for by the deformation of host rocks that is characteristic of Obora.

Identification key to genera of the family Anthracoptilidae

1. SC terminating at C……2

SC terminating at R……4

2. Anterior branches of SC relatively short, sometimes forming double row of cells. CuA with at least four branches, its branching pattern variable. M three-branched, with one or two free branches, which may be connected to RS and CuA in different ways. Anal veins rarely or not anastomizing in middle part of anal field. There are no anal veins intercepting CuP near posterior margin of wing……*Jarmilacladus* gen. nov.

Anterior branches of SC long and oblique……3

3. Venation highly polymerized……*Rhinomaloptila* Rasnitsyn

Venation less polymerized. CuA pectinate frontward……*Spargoptilon* Kukalová

4. SC with long basal branch that intercepts several subsequent simple and relatively short anterior branches. CuA is pectinate rearward……*Opistocladus* Carpenter

SC without intercepting basal branch. CuA is pectinate frontward or not pectinate……5

5. RS starting near or soon beyond wing midlength. M with four or more branches. CuA irregularly branches……6

RS starting before wing midlength. M with three or fewer free branches. CuA (CuA_1 in *Strephoneura*) is pectinate forwardly……7

6. Typical (long and oblique) M_5 linking M and CuA. Branches of CuA bifurcating beyond their midlength, secondary branches not strictly parallel……*Anthracoptilus* Laméere

Anterior branches of CuA straightly linking to M, branches of CuA bifurcating subbasally, secondary veins strictly parallel. Anal veins abundantly anastomizing in middle of anal field……*Paracladus* Carpenter

7. CuA_1 intercepting cubital comb (separate CuA_2 present). A_2 curved subapically along posterior margin of wing and intercepting A_1, CuP, and CuA_1……*Strephoneura* Martynov

Separate CuA_1 absent. Anal veins not intercepting CuA and CuP……8

8. Separate base of RS absent (it starting with M). CuA curved in such way that areas between its forks short and subvertical. Anal veins abundantly anastomizing in middle of anal field……*Mesoptilus* Laméere

RS starting independently of M. CuA forks not condensed into short subvertical ladder……*Strephocladus* Scudder

Genus *Jarmilacladus* Rasnitsyn et Aristov, gen. nov.

Etymology. In honor of Jarmila Kukalová-Peck, who identified the taxonomic assignment of the described material and the genus *Strephocladus*. Masculine gender.

Type species. *J. variabilis* sp. nov.

Diagnosis. Costal field moderately narrow. SC terminating on C. Anterior branches of SC relatively short, frequently branching and connecting with crossveins, occasionally forming double row of cells; very long basal branch absent. RS having its base near wing midlength, posteriorly pectinate. M three-branched, its anterior branch fused with RS at short distance or free, its posterior branch free or fused with CuA_1. CuA four-branched, posterior branch always free (weakly separated as CuA_2), divergence between other branches variable, but not forming short subvertical ladder. Clavus large, with numerous subparallel veins that are not anastomizing in mass in the middle part of anal field and not intercepting CuA and CuP along posterior margin of wing. Crossveins numerous and mainly simple.

Species composition. Type species.

***Jarmilacladus variabilis* Rasnitsyn et Aristov, sp. nov.**

Undescribed Anthracoptilidae: Rasnitsyn, 2002, p. 115.

Etymology. From Latin *variabilis* (variable).

Holotype. NHM, In. 45929 (45933), part and counterpart of forewing without base and apex, clavus preserved separately but not far from remigium; locality of Belmont; Upper Permian.

Description (Figs. 1, 2). The wing venation is very variable. Anteriorly, the costa is bordered by a narrow ribbon of membrane. The SC length constitutes about two-thirds of the wing length, and the SC has 10–15 anterior branches of various shapes. In the holotype, RS has preserved four branches (out of, apparently, four or five); there are characteristic oblique crossveins between R and RS. The posterior branch of M is fused