



First record of the genus *Symphorobius* (Neuroptera: Hemerobiidae) from Baltic amber

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Abstract

Symphorobius completus sp. n. from the Eocene Baltic amber is described. Its venation is probably the most generalized in the genus. The systematic position of the species, as well as hemerobiid wing venational terminology are discussed.

Key words: Baltic amber, Eocene, fossil Hemerobiidae, *Symphorobius*, new species

Introduction

The family Hemerobiidae is today one of the most widely distributed groups of Neuroptera, with some 550 extant species described. They have been found as far back as the Jurassic, and are known to occur in all major Tertiary localities. See Oswald (1993) and Makarkin *et al.* (2003) for a review of their fossil record and Engel & Grimaldi (2007) for a list of named taxa.

Until now, three hemerobiid species of monotypic extinct genera have been known from Baltic amber: *Prolachlanus resinatus* (Hagen in Pictet & Hagen, 1856), *Prospadobius moestus* (Hagen in Pictet & Hagen, 1856), and *Prophlebonema resinatum* (Krüger, 1923) (Pictet & Hagen 1856; Krüger 1923), all strongly in need of re-description. Photographs of three other, possibly new species were provided by Bachofen-Echt (1949: Fig. 121) and Weitschat & Wichard (1998: Pl. 56, Figs. c, e). In this paper, we describe a new species of *Symphorobius* Banks, 1904, a genus which, with *Hemerobius* Linnaeus, 1758, *Micromus* Rambur, 1842, *Wesmaelius* Krüger, 1922 is today one of the most speciose of hemerobiid genera. Hitherto, the fossil record of *Symphorobius* was limited to a single unnamed species from Miocene Dominican amber (Engel & Grimaldi 2007).

Material and methods

The specimen examined is from the part of the former amber collection of the University of Königsberg (today Kaliningrad) now kept at the Geowissenschaftliches Zentrum der Georg-August-Universität Göttingen, Germany.

Venational terminology principally follows Comstock (1918) as modified by Archibald & Makarkin (2006). Further, we use the ‘oblique radial branches’ (“ORB”) concept of Oswald (1993), used to designate the several ‘radial sectors’ that appear to independently originate from the radius in the hemerobiid forewing, a feature peculiar to the family. It should be kept in mind that individual ORB’s may not be unambiguously, immediately recognizable as homologous to particular branches of Rs as expressed in other groups. Some

(except the distal-most ORB) do appear to be usually homologous with correspondingly placed branches of Rs in other families, *i.e.*, the most proximal ORB appears homologous with the most proximal branch of Rs (Rs1) irrespective of its origin, from Rs or R. The distal-most ORB, however, appears to be homologous with Rs proper. For example, in a species with three ORB's, ORB3 appears to be homologous with Rs proper, and its most proximal branch is assumed to be homologous with Rs3, the next branch of ORB3 homologous with Rs4 (poorly developed in this genus, see Fig. 3). In the majority of *Symphorobius* species, Rs1 and Rs2 are fused basally, forming a single ORB (Fig. 8).

Terminology of wing spaces and designation of crossveins mainly follows Oswald (1993). Principal crossveins are designated after the longitudinal veins which they connect, and numbered by gradate series to which they belong in sequence from the wing base, *e.g.*, 2m-cu, crossvein connecting M and Cu in second gradate series, 4im, intramedian crossvein (*i.e.*, between MA and MP) in the fourth gradate series.

Abbreviations used in the text and figures are as the follows: 1A–3A, first to third anal veins (A); CuA, CuP, anterior and posterior branches of the cubital vein (Cu); MA, MP, anterior and posterior branches of the medial vein (M); ORB, oblique radial branch; R1, anterior branch of the radial vein (R); Rs1, most proximal branch of the radial sector (Rs); Rs2, branch of the radial sector located distal to Rs1; Rs3, branch of the radial sector located distal to Rs2; Sc, the subcostal vein.

Institutional abbreviations: GZG, Geowissenschaftliches Zentrum der Universität Göttingen [=Geoscience Centre of the University of Göttingen].

Systematic palaeontology

Family Hemerobiidae Leach, 1815

Subfamily Sympherobiinae Comstock, 1918

Genus *Symphorobius* Banks, 1904

Type species. *Hemerobius amicus* Fitch, 1855, by monotypy.

Diagnosis. Separated from other hemerobiid genera by the following combination of characters: crossveins 2sc-r, 4r-m, 4im, 4m-cu absent in forewing; outer gradate series of crossveins absent in hind wing.

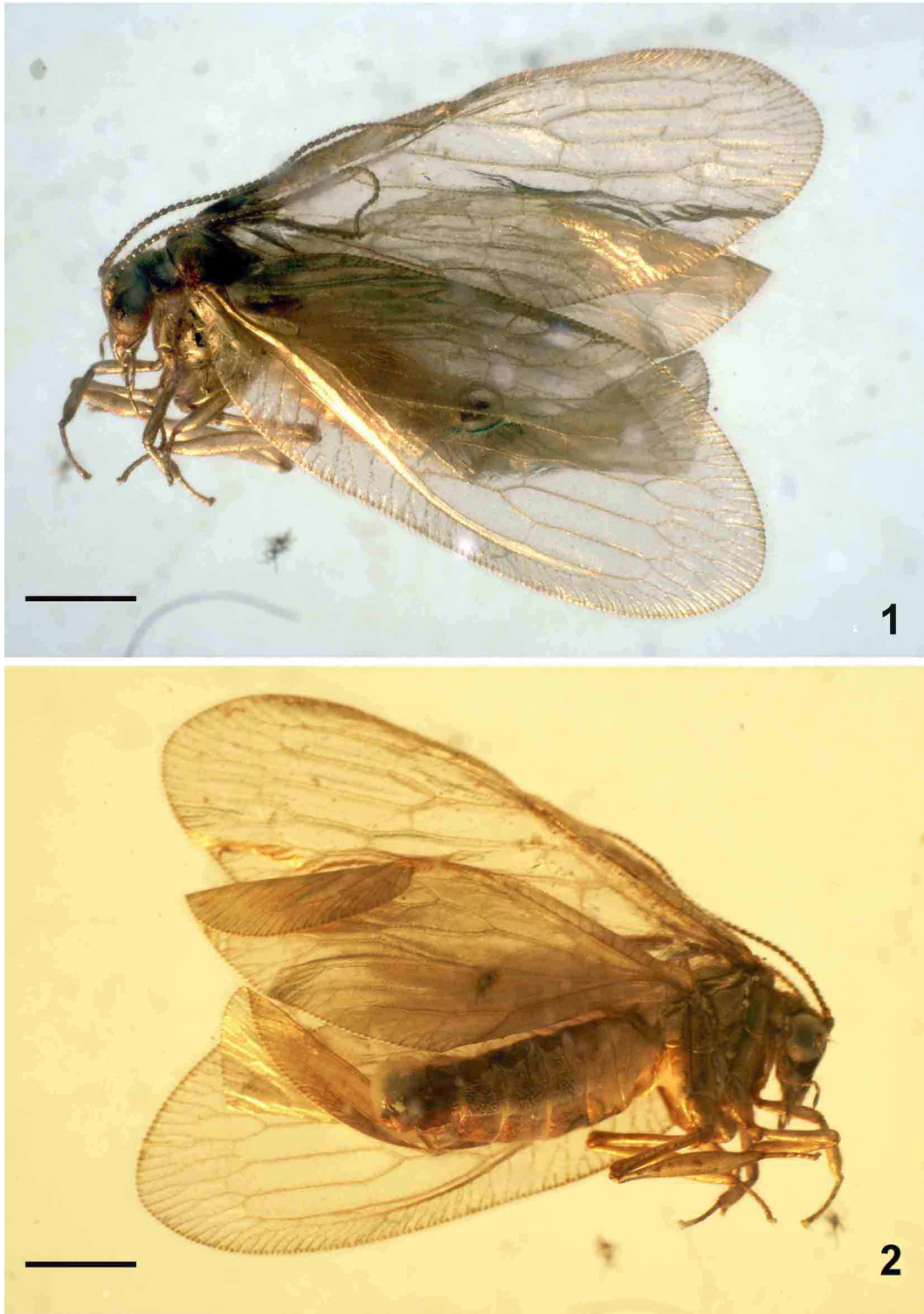
Species included. More than 50 extant species, distributed nearly worldwide, except Australia and tropical regions of Africa and Asia (Tjeder 1961; Oswald 1988). Fossil records include *Symphorobius completus* **sp. n.** from Eocene Baltic amber, and *Symphorobius* sp. from Miocene Dominican amber (Engel & Grimaldi 2007).

Remarks. Although characters of the male genitalia are not known in this species (this only known specimen is female), we confidently assign it to the genus *Symphorobius*. This is evident from characters such as size, the stylus borne on the ninth gonocoxites, strongly swollen tibiae, and wing venation that is entirely concordant with that of this genus.

Symphorobius completus **sp. n.**

(Figs. 1–3)

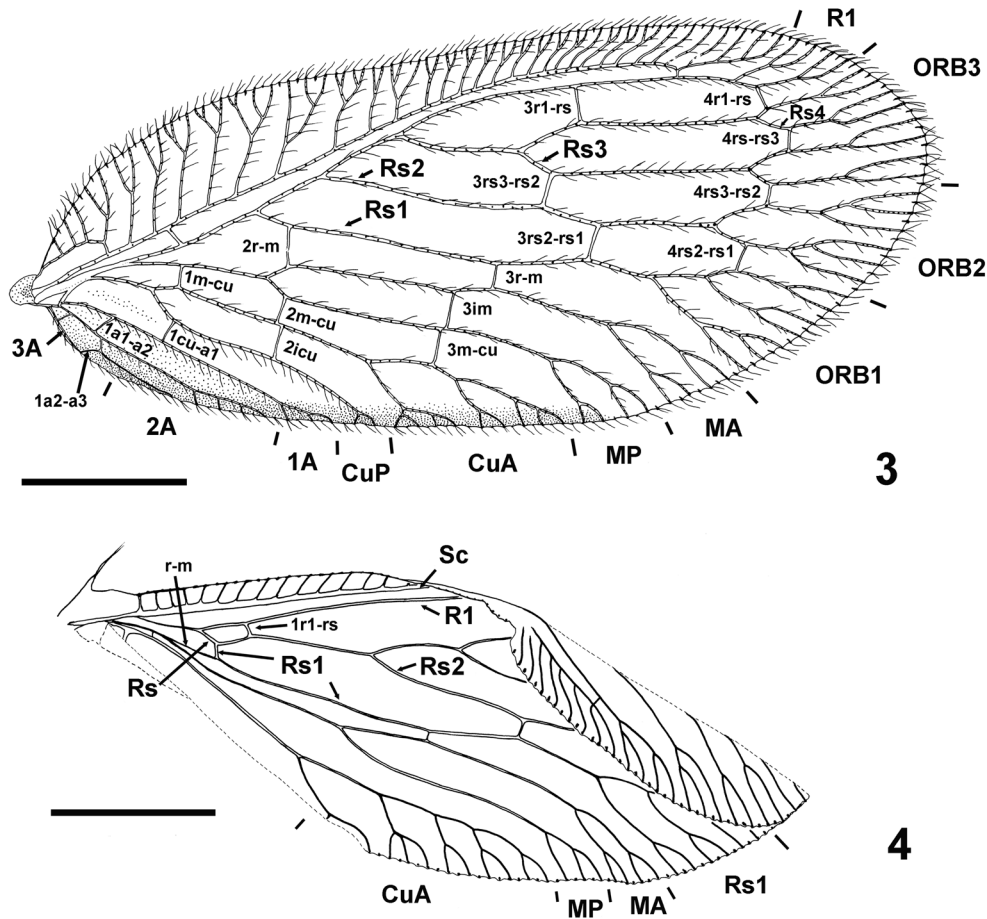
Diagnosis. This species may be easily distinguished from others of the genus by the following forewing character states [alternative character states are given in brackets]: (1) crossvein 3rs3-rs2 present, located distally, connecting Rs3, Rs2 [absent in many species, or strongly shifted proximally in other species connecting R (or Rs) with Rs2 (see comments below)]; (2) crossvein 3rs2-rs1 located far distally relative to next crossveins of the series [proximally to slightly distally in other species]; (3) two crossveins 4rs-rs3, 4rs3-rs2 located distally to primary forks of Rs3, Rs2 [proximally in vast majority of other species].



FIGURES 1–2. *Sympherobius completus* sp. n. Holotype GZG-BST-5245, lateral view of the specimen. 1, left side; 2, right side. Scale bar = 1 mm.

Description. Head prolonged in lateral view. Antennae: scape rather large; pedicel smaller than scape but larger than first flagellar segments; left flagellum 44-segmented, right flagellum 45-segmented. Maxillary palpi 5-segmented, labial palpi 3-segmented, both slender; apical 6th and 4th pseudo-segments respectively strongly slender, acute. Pronotum short. Femora of all legs markedly swollen. Leg measurements (where confident by preservation): right foreleg: femur 0.56 mm, tibia 0.56 mm, tarsus (complete) 0.52 mm,

basitarsus 0.2 mm; right midleg: femur 0.68 mm, tibia 0.76 mm; right hindleg: femur 0.88 mm, tibia 1.36 mm, tarsus 0.48 mm, basitarsus 0.2 mm. Left foreleg: femur 0.6 mm, left midleg: tarsus 0.44 mm, basitarsus 0.18 mm; left hindleg: femur 0.92 mm, tibia 1.32 mm, tarsus 0.48 mm, basitarsus 0.2 mm. Abdominal terminalia constructed typically for female *Sympherobius*. 9th gonocoxites (=gonapophysis lateralis) bears distinct stylus. Body length (head to apex of abdomen) 4 mm.



FIGURES 3–4. *Sympherobius completus* sp. n. Holotype GZG-BST-5245, wing venation. 3, left forewing (converted to standard right dorsal view); 4, right hind wing. Scale bar = 1 mm.

Forewing oval with rounded apex, 5.5 mm long, 2.4 mm wide. Trichosors prominent along entire wing margin. Costal space very wide, broader basally. Majority of prestigmal subcostal veinlets branched once or twice; stigmal subcostal veinlets simple. Humeral veinlet (*i.e.*, basal-most subcostal veinlet) recurrent, pectinately branched, with four branches (three short, simple and one longer, forked). True crossveins lacking in costal space. Subcostal space moderately wide for entire length, with two crossveins (basal 1sc-r, distal 3sc-r). R1 forked apically, with one branch forked once. R1 space normal in width with comparison to other species of genus. Three separate branches originated from R [=ORB's, see Material and Methods]; ORB1 [=Rs1], ORB2 [=Rs2] configuration very similar, not forked proximal to fourth gradate series; ORB3 [=Rs proper] possesses two branches, originating proximal to third, fourth gradate series (Rs3, Rs4 respectively). M appears fused basally with R1 for some distance. M forked proximal to second gradate series; MA, MP parallel before terminal branching. CuA pectinately branched, with three branches, all of which have marginal forks. CuP with only one marginal fork. 1A with two simple pectinate branches. 2A deeply forked; proximal branch probably simple (not seen clearly due to recurvature of anal region), distal branch with three very short simple pectinate branches. 3A probably simple (not clearly preserved). Four gradate series of crossveins (series 1-4 of Oswald 1993) posterior to R1. First series consists of four

crossveins: 1m-cu, 1cu-a1, 1a1-a2, 1a2-a3; an additional [aberrant?] crossvein seems be located basad of 1a2-a3, indistinctly visible in left forewing only (in right forewing this area cannot be seen). Second series includes three crossveins: 2r-m, 2m-cu, 2icu. Third ('inner') series with six crossveins (from 3r1-rs to 3m-cu); 2rs2-rs1 shifted far distally relative to next crossveins in the series. Fourth ('outer') series incomplete, with four crossveins (from 4r1-rs to 4rs2-rs1). Crossveins absent between branches of CuA. Wing without markings, slightly fuscous.

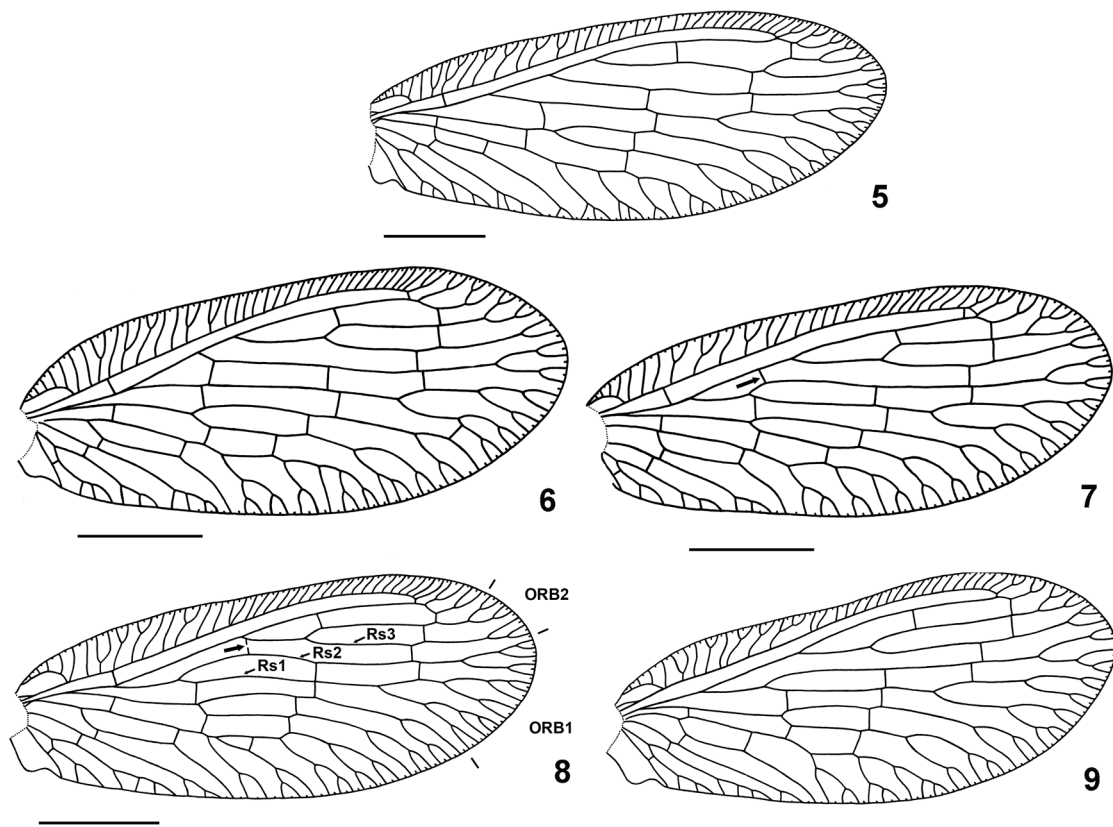
Hind wing 4.5 mm long, about 1.7 mm wide. Trichosors prominent along entire margin. Crossvein 1r1-rs short. Basal crossveins r-m connecting M with Rs1. Two crossveins in inner gradate series, none in other. M forked slightly distal to origin of most proximal branch of CuA, slightly proximal to origin of Rs2. CuA with four branches, each forked.

Holotype. Female specimen GZG.BST.5245, deposited in GZG. Old labels: "B[ernstein]. S[ammlung]. d[er]. Univers[ität]. Koenigsberg i[n]. Pr[eußen]."; "N 21"; "5245" "5871".

Locality and horizon. Baltic amber (precise collecting site unknown, probably near present-day Kaliningrad). Middle/ Late Eocene.

Etymology. From Latin *completus*, complete, in reference to the complete third ('inner') series of gradate crossveins.

Remarks. An undescribed hemerobiid specimen from Baltic amber (Weitschat & Wichard 1998: Pl. 56, Fig. e) most probably belongs to this species judging from its forewing venation, which possesses all of the diagnostic features of *Sympherobius completus* **sp. n.**



FIGURES 5–9. The forewing venation of some extant species of *Sympherobius*. 5, *S. fuscescens*; 6, 7, *S. fallax* Navás, 1908; 8, *S. fuscinervis*; 9, *S. pygmaeus*. The arrow indicates the different location of crossvein 3rs3-rs2. Scale bar = 1 mm.

Comments on ‘radial crossveins’ in the forewing

The ‘distal radial’ and ‘proximal radial’ crossveins were identified as two independent characters by Oswald (1988: Fig. 4). Previously, they were interpreted by Carpenter (1940) as a single homologous crossvein of variable location; he identified three positional states for it: (1) connecting R1 with Rs1+Rs2, located seemingly belonging to the second gradate series, (2) connecting Rs with Rs1+Rs2, located proximal to the third gradate series and (3) lost. The former state was called by Oswald (1988) as ‘the proximal radial crossvein’, and the second as ‘the distal radial crossvein’. ‘The distal radial crossvein’ is present among *Symphorobius* only in a few extant New World species: in the Nearctic *S. amicus* (Fitch, 1855) and *S. umbratus* (Banks, 1903), the Neotropical *S. amazonicus* Penny & Monserrat, 1985 and *S. ariasi* Penny & Monserrat, 1985, and in the fossil *Symphorobius* sp. from Dominican amber (Penny & Monserrat 1985: Figs. 2, 3; Oswald 1988: Fig. 4; 1993: Fig. 82; Engel & Grimaldi 2007). This crossvein occurs as an anomaly in the Central Asian *S. fuscineris* Kozhanchikov, 1953, in which it was found in one forewing of five examined (Fig. 8). The ‘proximal radial crossvein’ is present as a consistent feature in many species (at least eleven), and as an anomaly in at least more three species, *S. pygmaeus* (Rambur, 1842), *S. elegans* (Stephens, 1836), *S. manchuricus* Nakahara, 1960. It may be reasonable to assume, however, that both of these conditions belong to a single transformation series, and this crossvein in each case may be named 3rs3-rs2. Indeed, in all species of *Symphorobius* there is single crossvein in this region, *i.e.*, no species exists in which both the ‘distal radial crossvein’ and the ‘proximal radial crossvein’ are present together. In *Symphorobius completus*, the oldest known species of the genus, the location of 3rs3-rs2 as belonging to 3rd series is obvious (Fig. 3). This condition as is found in *S. completus*, therefore, is certainly plesiomorphic (state 0), and further transformation of the 3rs3-rs2 location includes: proximal shift to the ‘distal radial crossvein’ position (state 1) (Fig. 8), then to the ‘proximal radial crossvein’ position (state 2) (Fig. 7), and lastly its loss in many species (state 3) (Figs. 5, 6, 9). Therefore, we agree with the Carpenter’s (1940) interpretation. Oswald (1988) considered the presence of the distal radial crossvein to be plesiomorphic (our apomorphic state 1). Engel & Grimaldi (2007) assumed, however, that “it is certainly plausible that this character is a plesiomorphy for the fossil [species from Dominican amber] and a synapomorphy for the two living species [*S. amicus* and *S. umbratus*] rather than a character uniting all three taxa” (p. 24). There are, however, no data for this conclusion. We preliminary consider state 1 as apomorphic in all species which possess it, until otherwise is shown.

Systematic position of *Symphorobius completus*

In the vast majority of species of *Symphorobius* the forewing has two ‘radial sectors’ which originate separately from R (*i.e.*, with two ORB’s, see Material and Methods), each of which is deeply forked (Figs. 7–9). Only a few extant species have a configuration of Rs as is found in *S. completus* (*i.e.*, with three ORB’s). Of them, four western Palaearctic species are usually separated into the subgenus *Niremberge* Navás, 1909, whereas the rest are considered to belong to the nominate (paraphyletic) subgenus (Aspöck *et al.* 1980); these *Niremberge* species are: *Symphorobius fuscescens* (Wallengren, 1863), occurring also in East Asia; *S. pellucidus* (Walker, 1953); *S. riudori* Navás, 1915; and *S. klapakeki* Zeleny, 1963. Oswald (1988) proposed informal groupings of these, such as the ‘*fuscescens* species group’ for the species of the subgenus *Niremberge*. Few other species also having three ORB’s certainly don’t belong to this ‘*fuscescens* species group’ judging from the structure of their male genitalia, *e.g.*, *S. wuyianus* Yang, 1981 and *S. mirandus* Navás, 1920 (Nakahara 1960; Yang 1981; Monserrat 1990). It should be noted that *Symphorobius* has a marked intraspecific variability of its Rs branching. It is well known that some species which normally have two ORB’s do possess three, or a single Rs as anomalies (Fig. 6; see also Martynov 1932: Fig. 8; Oswald 1988: Fig. 104–105).

S. completus appears not to belong to the subgenus *Niremberge* (or ‘*fuscescens* species group’), although

this could be determined with confidence only if a male specimen is found. In all species of this group, the crossvein 3rs2-rs1 is located considerably proximal to 3r-m (but considerably distal in *S. completus*), and the crossvein 3rs3-rs2 is absent (but present in *S. completus*). The occurrence of an Eocene species with three ‘radial sectors’ (ORB’s) separately originating from R indicates that this character state may be plesiomorphic. This agrees with plesiomorphy of some other characters (e.g., the position of crossvein 3rs3-rs2). In general, the venation of *S. completus* is probably the most generalized in the genus.

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