

New psychopoid Neuroptera from the Early Cretaceous of Baissa, Transbaikalia

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Abstract. Two new genera and five new species of the psychopoid Neuroptera (one of which is unnamed) are described from the Early Cretaceous locality at Baissa, Transbaikalia, Russia: *Epipsychopsis fusca* n. gen., n. sp., *E. variegata* n. sp. (Psychopsidae), *Pseudopsychopsis gradata* n. gen., n. sp., *P. baissensis* n. sp. (Brongniartiellidae), and *Sophogramma* sp. (Kalligrammatidae).

Résumé. Nouveaux Neuroptera Psychopsoidea du Crétacé inférieur de Baissa, Transbaikalie. Deux nouveaux genres et cinq nouvelles de Neuroptera Psychopsoidea (dont un non nommé) sont décrits du Crétacé inférieur de Baissa, Transbaikalie, Russie : *Epipsychopsis fusca* n. gen., n. sp., *E. variegata* n. sp. (Psychopsidae), *Pseudopsychopsis gradata* n. gen., n. sp., *P. baissensis* n. sp. (Brongniartiellidae) et *Sophogramma* sp. (Kalligrammatidae).

Keywords: Psychopsidae, Brongniartiellidae, Kalligrammatidae, Russia.

The ‘psychopsid-like’ neuropterans (psychopoids) form a group of broad-winged lacewings that includes one living family, the Psychopsidae, and several extinct families that were notably diverse and abundant in the Mesozoic, e.g., the Osmylopsychopidae, Brongniartiellidae, and Kalligrammatidae. The richest Early Cretaceous occurrences are in the Purbeck Limestone Group and Wealden Supergroup of Southern England, and the Baissa locality in Siberia (J. Jepson pers. comm.; Jepson *et al.* 2009; pers. obs.).

About 120 neuropteran specimens have been collected at the Baissa locality. Of these, 38 were described as representatives of 21 species belonging to the families Osmylidae, Chrysopidae, Mantispidae, Mesithonidae, Mesochrysopidae, Psychopsidae, Nymphidae, Palaeoleontidae, and Babinskaiidae (Makarkin 1990a–b, 1997a–c, 1999; Ponomarenko 1992; Wedmann & Makarkin 2007). Also, the family Polystoechotidae was recorded, without further detail (Archibald & Makarkin 2006). Psychopoids constitute the vast majority of undescribed material. In this paper I describe some of the largest specimens, which belong to the families Psychopsidae, Brongniartiellidae, and Kalligrammatidae.

Material and Methods

This study is based on five specimens collected at the Baissa locality situated on the left bank of the Vitim River, 8 km

below the mouth of the Baissa River, Buryat Republic, west Transbaikalia, Russia. These deposits are usually considered as belonging to the Zaza Formation (Zherikhin *et al.* 1999; Rasnitsyn & Zherikhin 2002), although Vršanský *et al.* (2002) assigned them to the Endandine Formation. Its age has been estimated as pre-Aptian Cretaceous (Rasnitsyn *et al.* 1988), early Valanginian (Zherikhin *et al.* 1999), earliest Barriasian to Valanginian (Vršanský *et al.* 2002), or late Neocomian (Rasnitsyn & Zherikhin 2002). Martinson (1961) divided the Baissa section into 43 numbered layers (from upper to lower), of which at least 13 contain significant insect assemblages. Three rather distinct climatic phases during the time of sedimentation have been determined: relatively warm and dry climate in the central layers (e.g. layer 15) and relatively cold and humid climate below and above (e.g. layers 2 and 31) (Vršanský *et al.* 2002). The surrounding area was rather densely forested. Detailed analysis of the environment was provided by Zherikhin *et al.* (1999).

The traditional (*sensu* Wootton 2003) venational terminology of Comstock (1918) is used, modified as in the recent interpretations of Oswald (1993a), Archibald & Makarkin (2006), and Wedmann & Makarkin (2007).

All wing drawings are presented in standard right dorsal view.

Institutional abbreviations: PIN, Paleontological Institute of the Russian Academy of Sciences, Moscow, Russia.

Family Psychopsidae Handlirsch 1906

Genus *Epipsychopsis* n. gen.

Type species. *Epipsychopsis fusca* n. sp.

Etymology. The generic name is derived from the Greek *epi*, near, and *Psychopsis*, a genus-group name. Gender feminine (ICZN 1999: Article 30.1.2).

Diagnosis. Large psychopoids (forewing length about 45 mm) which may be distinguished from other

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genera by the combination of the following hind wing character states: branches of Rs dichotomously branched; cross-veins in subcostal and R1 spaces numerous, closely spaced. MA, MP, and CuA parallel to hind margin; CuA regularly pectinate; numerous cross-veins in radial space arranged without order proximally, mainly in several gradate series distally.

Species included. *E. fusca* n. sp., *E. variegata* n. sp. from the Early Cretaceous of Transbaikalia.

Remarks. Both wings on which these two new species are based are interpreted as hind wings, by their concave CuA veins (convex in forewings).

The venation of *Epipsychopsis* n. gen. is very dissimilar to that of extant Psychopsidae, which are represented by only 26 species of two closely related subfamilies, Psychopsinae and Zygophlebiinae (Oswald 1993b). Of extinct genera, it is most similar to *Valdipsychops* Jepson *et al.* from the Early Cretaceous Wealden (Jepson *et al.* 2009), but may be distinguished from it by its very rich cross-venation. The structure of the costal and subcostal spaces in *Epipsychopsis* n. gen. is very similar to those of *Miopsychopsis* Makarkin 1991 (late Eocene/early Oligocene to late Oligocene/early

Miocene according to the dating of different authors), but the latter may be easily distinguished by numerous distal veinlets of R1 (up to ten). The new genus differs from *Angaropsychops* Martynova 1949 (Neocomian of Turga River in Transbaikalia) by the presence of numerous costal cross-veins.

Epipsychopsis fusca n. sp.
(Figs. 1A, 2A)

Material. Holotype PIN 1989/55 (part and counterpart), deposited in PIN. A well preserved incomplete hind wing. Collected at the Baissa locality (layer 31), Transbaikalia, Russia; Early Cretaceous.

Etymology. The specific epithet is derived from the Latin *fuscus*, fuscous, dark, in reference to the dark colouration of the holotype.

Diagnosis. May be distinguished from *Epipsychopsis variegata* n. sp. by longer, fewer gradate series of cross-veins in distal portion of radial space; further, by distinctive colour pattern.

Description. Hind wing broad-triangular; preserved length 34 mm (along R1) (estimated complete length approximately 45 mm), preserved width 18 mm (perpendicular to R1) (estimated complete width approximately 22 mm). Costal space almost

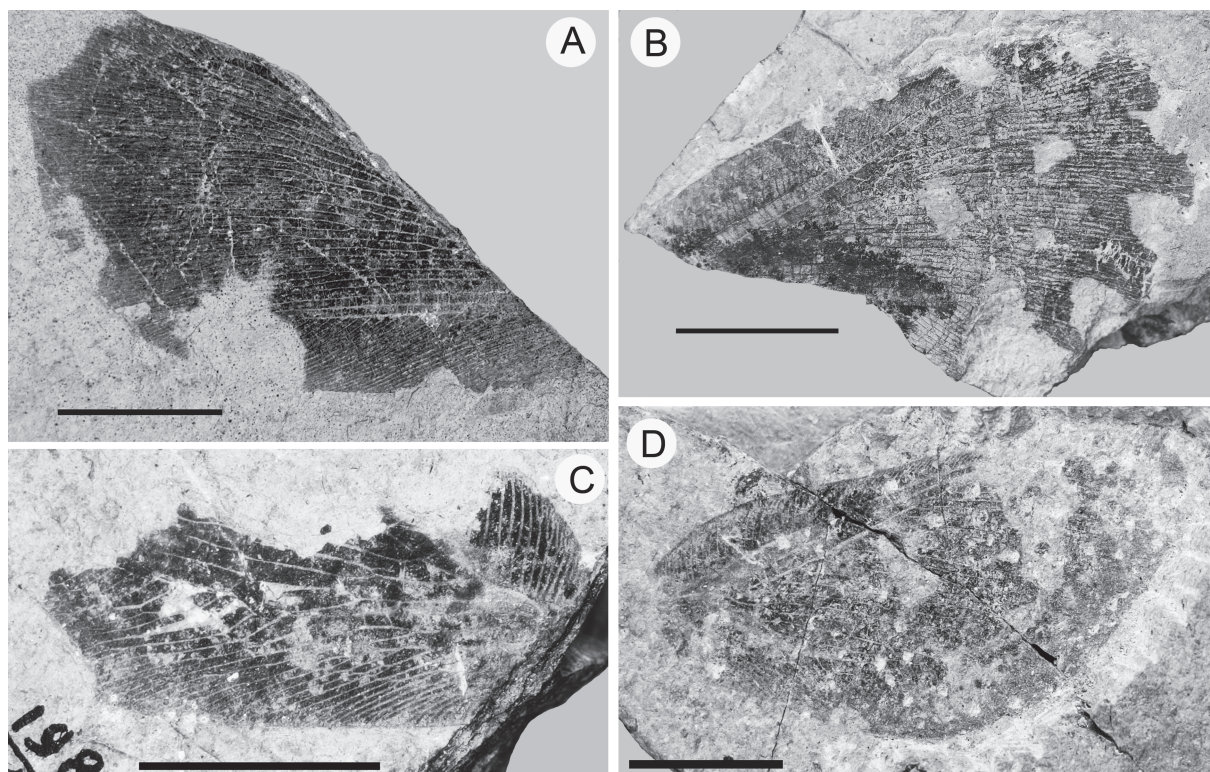


Figure 1 Psychopsoidea Neuroptera from the Baissa locality (Transbaikalia, Russia). **A**, *Epipsychopsis fusca* n. sp., holotype PIN 1989/55 (counterpart); **B**, *Epipsychopsis variegata* n. sp., holotype PIN 3064/2435 (part). **C**, *Pseudopsychopsis gradata* n. sp., holotype PIN 1989/2415. **D**, *Pseudopsychopsis baissensis* n. sp., PIN 3064/973. Scale bar, 10 mm.

entirely missing as preserved. Basal portions of apical subcostal veinlets only preserved; at least two deeply forked. Sc, R1, Rs widely spaced apically. Subcostal space moderately broad, with many cross-veins rather closely spaced in apical part; R1 space slightly narrower than subcostal space, with numerous cross-veins proximal to most distal branch of Rs. Rs with at most 14 branches (basal portion of proximal branches not preserved, some may be fused basally); each deeply, dichotomously branched. Fork of M not preserved, probably near wing base. MA slightly concave, straight, few branched apically (poorly preserved). MP convex, straight, pectinately branched distally, with at least two long branches. Cross-veins in radial to median

spaces numerous, irregularly arranged proximally, forming rather long gradate series distally. CuA slightly concave, straight, parallel to MA, MP; hind wing margin; with 13 oblique, almost straight parallel branches, some deeply forked, two distally fused. CuP incomplete, possibly pectinate with very oblique, parallel branches (branching mode undeterminable). Cross-veins connecting branches of CuA, CuP form several short gradate series. Anal veins not preserved (alternatively, 1A partly preserved). Colour patterning: almost solid blackish-brown; apparent large, pale spots in apical posterior portion of wing, but these might also be artifacts of preservation; veins proximally appear pale, distally dark.

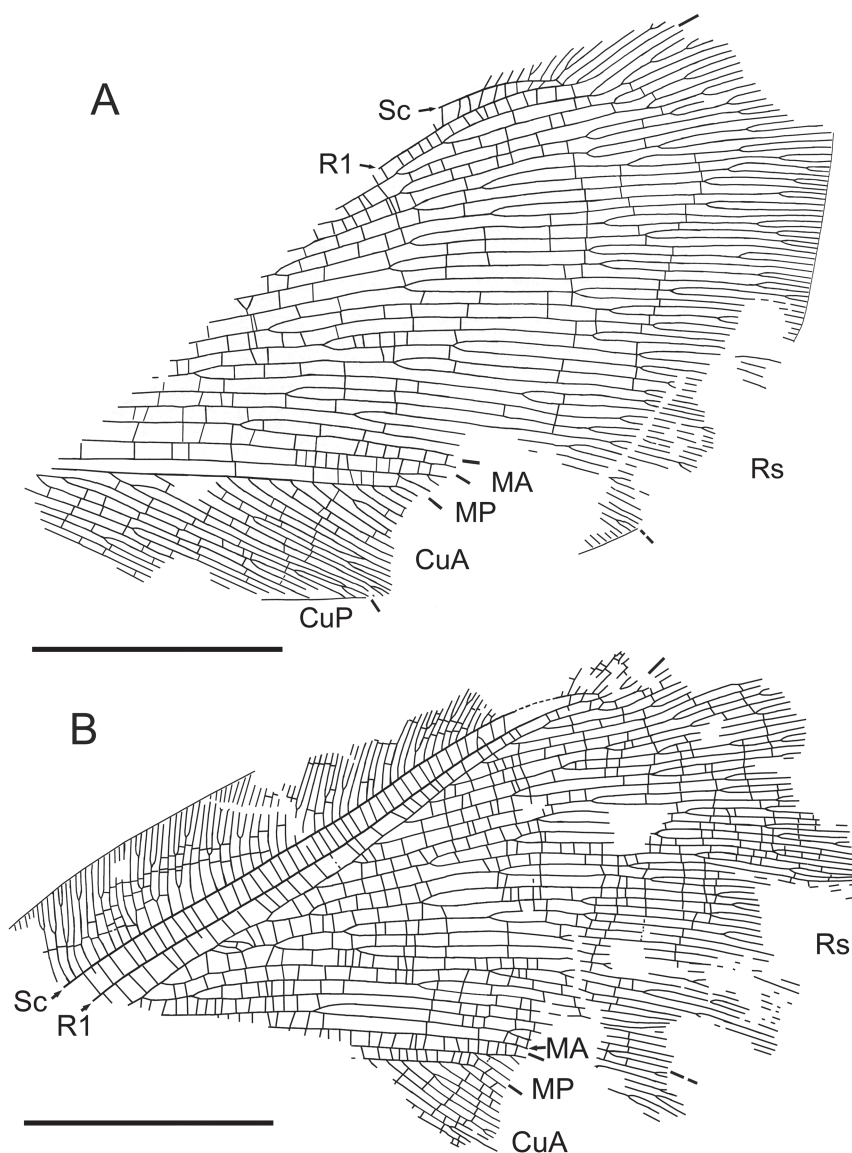


Figure 2

Genus *Epipsychopsis* n. gen., hind wing venation. **A**, *E. fusca* n. sp., holotype PIN 1989/55; **B**, *E. variegata* n. sp., holotype PIN 3064/2435. Scale bar, 10 mm. Abbreviations: CuA, anterior cubitus; CuP, posterior cubitus; MA and MP, anterior and posterior branches of media; R1, first branch of radius; Rs, radial sector; Sc, subcosta.

***Epipsychopsis variegata* n. sp.**
(Figs. 1B, 2B)

Material. Holotype PIN 3064/2435 (part and counterpart), deposited in PIN. A rather well preserved incomplete hind wing. Collected at the Baissa locality (layer 31), Transbaikalia, Russia; Early Cretaceous.

Etymology. The specific epithet is derived from the Latin *variegatus*, of different colours, in reference to bright, patchy colouration of the holotype.

Diagnosis. See *Epipsychopsis fusca* n. sp.

Description. Hind wing broad, preserved length 33 mm (estimated complete length 43–45 mm), preserved width 20 mm (estimated complete width 21 mm). Preserved portion of costal space equally broad. Subcostal veinlets closely spaced, many once or twice deeply forked, several single; connecting by many cross-veins which form several irregular costal gradate series. Sc, R1, Rs widely spaced apically. Subcostal space broad, with

many, closely spaced cross-veins. R1 space narrowed distally; slightly narrower than subcostal space; with numerous cross-veins. Rs with 15 branches, almost each deeply dichotomously branched. Fork of M not preserved, probably near wing base. MA concave, straight, few branched apically (poorly preserved). MP convex, straight, pectinately branched distally, with at least three long branches. Cross-veins in radial to median spaces very numerous, irregular proximally, forming many short to rather long gradate series distally. CuA concave, straight, parallel to MA, MP, hind margin; with seven preserved, almost straight parallel branches, one deeply forked, connecting by cross-veins forming four irregular gradate series in distal portion of cubital space. CuP, Anal veins not preserved. Colour patterning poorly determinable, probably not dark in life, possible variegate, with four rather large pale spots in middle portion of wing.

Remarks. The identical wing patterning in the part and counterpart indicate that at least four pale patches are actually present, not artifacts of preservation.

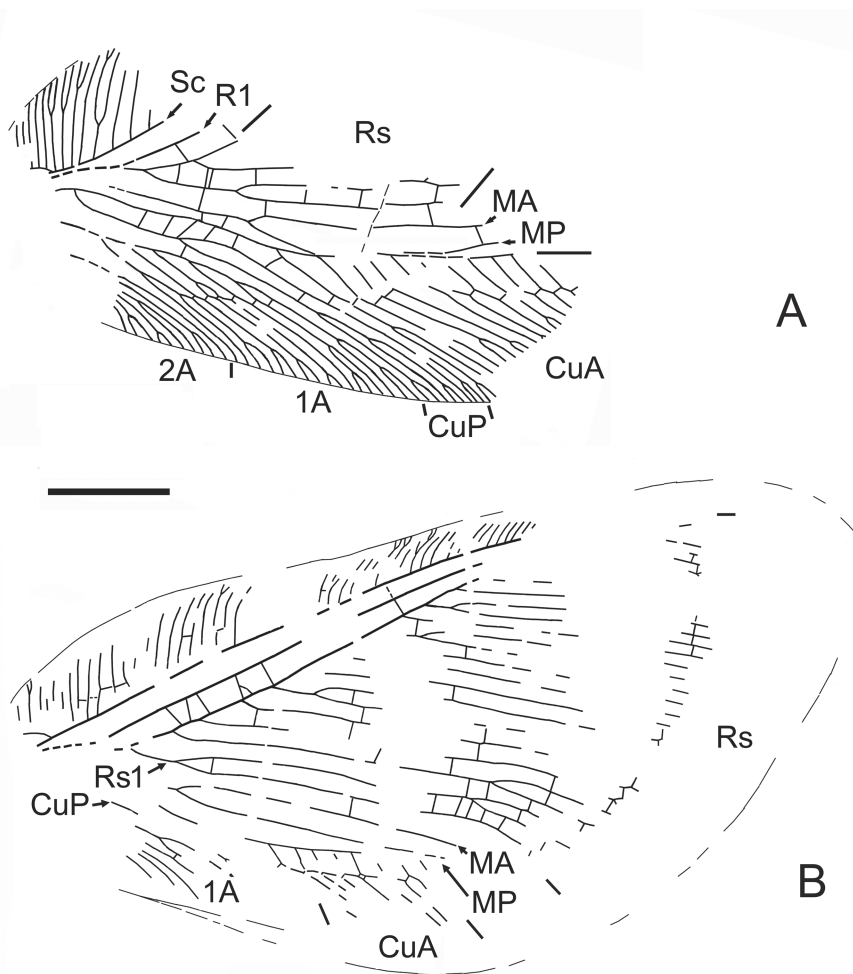


Figure 3
Genus *Pseudopsychopsis* n. gen., forewing venation. **A**, *P. gradata* n. sp., holotype PIN 1989/2415; **B**, *P. baissensis* n. sp., holotype PIN 3064/973. Both to scale; scale bar, 5 mm. Abbreviations: 1A, 2A, anal veins; CuA, anterior cubitus; CuP, posterior cubitus; MA and MP, anterior and posterior branches of media; R1, first branch of radius; Rs, radial sector; Rs1, most proximal branch of Rs; Sc, subcosta.

Family Brongniartiellidae Martynova 1949

GENUS *Pseudopsychopsis* n. gen.

Type species. *Pseudopsychopsis gradata* n. sp.

Etymology. The generic name is derived from Greek *pseudos*, lie, and *Psychopsis*, a genus-group name. Gender feminine (ICZN 1999: Article 30.1.2.).

Diagnosis. Forewing may be distinguished from that of *Brongniartiella* Meunier 1897 by branches of Rs parallel [dichotomously branched in *Brongniartiella*].

Species included. Two species, *P. gradata* n. sp., *P. baissensis* n. sp., from the Early Cretaceous of Transbaikalia.

Remarks. The Brongniartiellidae is one of most poorly understood neuropteran families, as its type species, *Brongniartiella gigas* (Weyenbergh 1869) from the Late Jurassic of Germany, was incompletely and inadequately described. The most recent work in which it was illustrated appeared more than 100 years ago (i.e., Meunier 1897).

Examination of new photographs of this type species shows that the principal forewing features of the genus *Brongniartiella* are very similar to those of *Pseudopsychopsis* n. gen. These include the following character states: broad-oval wing shape; relatively narrow costal space, particularly apically (width in the “pterostigmal region” equal to the combined width of the adjacent subcostal and R1 spaces); both the subcostal and R1 spaces broad; few cross-veins in the subcostal space; pectinately branched CuA; few-branched CuP, with two deeply forked branches; cross-veins posterior to R1 are present, proximally not numerous, distally arranged in a long gradate series running from the cubital to radial spaces nearly parallel to the wing margin, like the ‘outer’ gradate series of Hemerobiidae or Polystoechotidae; Rs is dichotomously branched.

This combination of forewing character states does not occur in any other genus now usually assigned to Brongniartiellidae (e.g., *Prerinoblattina* Scudder 1885, *Mesopsychopsis* Handlirsch 1906, *Epactinophlebia* Martynov 1927). Unfortunately, many species of these and other brongniartiellid genera are poorly described and in need of redescription. So, until these and other Mesozoic psychopsoids have been revised, I propose to include only *Brongniartiella* and *Pseudopsychopsis* n. gen. in the Brongniartiellidae.

Pseudopsychopsis gradata n. sp. (Figs. 1C, 3A)

Material. Holotype PIN 1989/2415 (part only), deposited in PIN. A rather well preserved basal part of a forewing. Collected at the Baissa locality (layer unknown), Transbaikalia, Russia; Early Cretaceous.

Etymology. The specific epithet is derived from the Latin *gradatus*, arranged in stairs, in reference to long gradate series of cross-veins in the cubital space.

Diagnosis. May be distinguished from *P. baissensis* n. sp. by costal spaces more broadened basally; Rs1, M forked more distad; gradate series of cross-veins in cubital space greater distance from CuA.

Description. Forewing preserved length 20 mm (estimated complete length about 35–40 mm). Basal portion of costal space dilated. Subcostal veinlets rather closely spaced, simple or one to twice forked proximally; humeral vein well-developed, recurrent, with several long simple branches. Subcostal space broad, narrowed basally; cross-veins in basal portion not detected. R1 space broad basally, with widely spaced cross-veins. Proximal branches of Rs widely spaced; Rs1 deeply forked. Cross-veins in radial space rather rare, not forming gradate series. M divided into MA, MP rather distant from wing base, slightly distal to fork of Rs1. MA, MP not branched in proximal half of wing (distal portion not preserved). Cu forked near wing base. CuA with 11 preserved parallel pectinate branches, some deeply forked once. CuP two-branched, each branch distally few branched. Several cross-veins between CuA, CuP. 1A with five long pectinate branches. 2A probably dichotomously branched. 3A not preserved. Cross-veins connecting branches of CuA to 1A form one gradate series running almost parallel to hand margin. Trichosors not detected (poorly preserved wing margins). Colour patterning: solid blackish-brown; veins appear mainly pale, with short dense hairs.

Remarks. The wing is slightly damaged across the mid-point of the preserved fragment: in this area, the membrane is damaged, tearing, causing an apparent split of MA into two branches (visible as a white triangular space on the dark membrane), although this is surely an artifact; MP is shifted posteriad and appears to fuse with CuA; one of the branches of CuA also appears to split.

Pseudopsychopsis baissensis n. sp. (Figs. 1D, 3B)

Material. Holotype specimen PIN 3064/973 (part only), deposited in PIN. A very poorly preserved, almost complete forewing. Collected at the Baissa locality (layer 15), Transbaikalia, Russia; Early Cretaceous.

Etymology. The specific epithet is a toponym, derived from Baissa, the locality of the holotype.

Diagnosis. See *Pseudopsychopsis gradata* n. sp.

Description. Forewing preserved length 36 mm (estimated complete length 38 mm), width 18 mm. Costal space relatively narrow, enlarged proximally, narrowed apically; its width at apical third equal to combined width of adjacent subcostal, R1 spaces. Subcostal veinlets simple or forked once, bent, some connecting by one cross-vein (seven cross-veins preserved); humeral vein well-developed, recurrent, branched. Subcostal space very broad, two cross-veins possible (poorly preserved). R1 space very broad, somewhat narrowed distally; cross-veins rather rare, widely spaced. Rs with more than 16 branches, rather widely spaced, nearly parallel to each other and hind

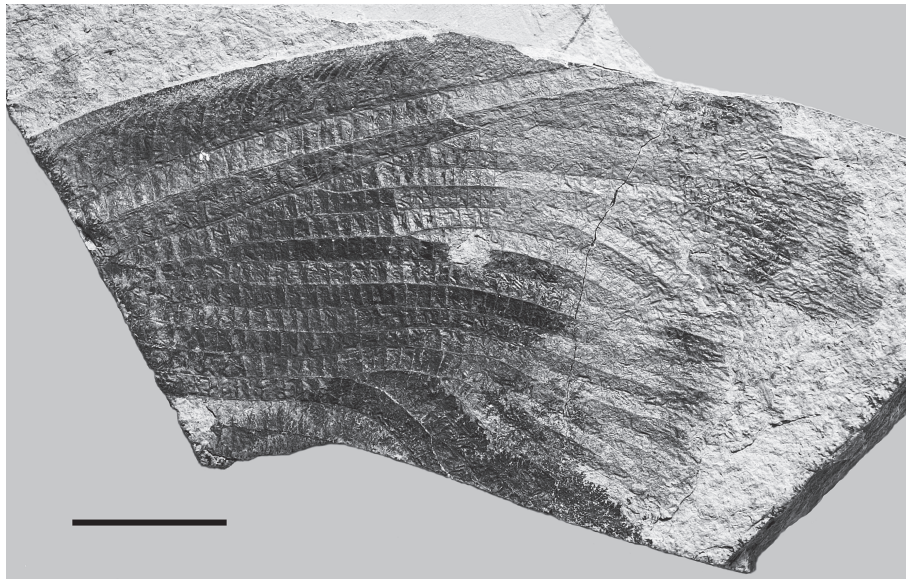


Figure 4
Sophogramma sp., PIN 1989/50. Scale bar, 10 mm.

margin, few deeply branched including Rs1. M forked slightly distal to fork of Rs1. MA, MP parallel, not branched until 'outer' gradate series of cross-veins. CuA with seven to eight preserved pectinate branches. CuP poorly preserved, probably few branched. 1A probably multi-branched. 2A, 3A poorly preserved. Cross-veins posteriad R1 poorly preserved, not numerous, distally arranged in long gradate series running

from cubital to radial spaces nearly parallel to wing margin, like 'outer' gradate series of Hemerobiidae. Preserved colour patterning solid blackish-brown. Veins look mainly pale.

Remarks. The specimen is poorly preserved, but there may be the narrow portion of a margin of a second wing present near the basal-posterior portion (Fig. 3B), as is present in the holotype of *Brongniartiella gigas*.

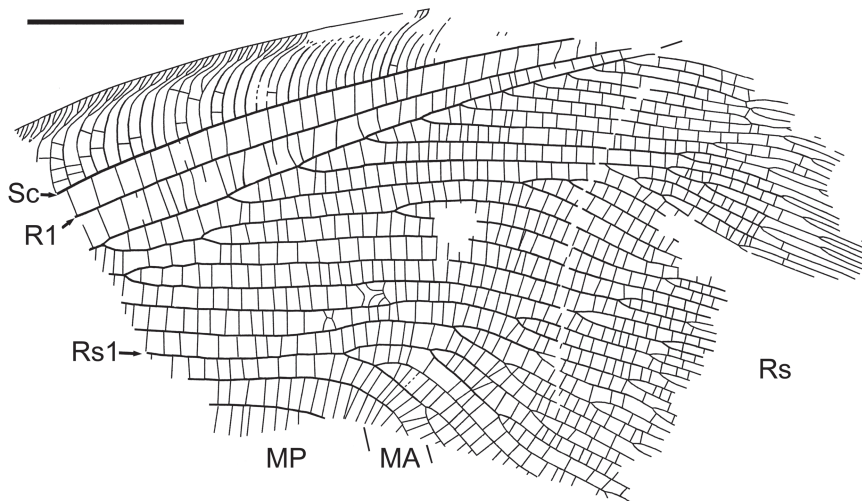


Figure 5
Forewing venation of *Sophogramma* sp., specimen PIN 1989/50. Scale bar, 10 mm. Abbreviations: CuA, anterior cubitus; CuP, posterior cubitus; MA and MP, anterior and posterior branches of media; R1, first branch of radius; Rs, radial sector; Rs1, most proximal branch of Rs; Sc, subcosta.

Family Kalligrammatidae Handlirsch 1906

Sophogramma sp. (Figs. 4, 5)

Material. Specimen PIN 1989/50 (part only), deposited in PIN. A rather well preserved fragmentary forewing. Collected at the Baissa locality (layer unknown), Transbaikalia, Russia; Early Cretaceous.

Description. Forewing preserved length 51 mm (along R1) (estimated complete length about 70–80 mm). Costal space equally broad; costa very concave, anterior end-twigging portion of space inclined downward (alternately, costal space conspicuously convex with ridge at beginning of end-twigging). Sc veinlets mostly forked one or twice forming distinct end-twigging, at apices strongly bent; connecting by one to four cross-veins, mainly in proximal portion. Subcostal space very broad, with numerous regularly spaced cross-veins. R1 space markedly narrowed apically, with dense cross-veins. Rs with 16 preserved branches, some deeply branched, curved. Rs1 profusely dichotomously branched distally, strongly curved. MA concave, strongly curved backward parallel to posterior trace of Rs1. MP very incompletely preserved, curved backward. Cross-veins in radial to median spaces numerous, rather regularly spaced; single anomalously curved. Colour patterning poorly determinable, blackish-brown to yellow; possibly variegated in life. Veins appear mainly pale.

Remarks. The assignment of this specimen to the genus *Sophogramma* Ren et Guo, 1996 is unquestionable, as its distinctive preserved venation is in perfect accord with that of its known species. Four apparently closely related species were described from the Early Cretaceous of the Yixian Formation (Liaoning Province, China): *S. eucallum* Ren & Guo, *S. papilionaceum* Ren & Guo, *S. plecophlebium* Ren & Guo and *S. lii* Yang *et al.* (Ren & Guo 1996; Yang *et al.* 2009). Judging from its colouration, it is likely that this specimen represents a new species, however, its fragmentary nature does not allow enough confidence in separation from (or association with) any of those currently recognized to warrant such a judgement at this time

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