

New Mesozoic Protopleciidae (Insecta: Diptera: Nematocera) from China

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Abstract

Four extinct new species referable to the genus *Mesoplecia* Rohdendorf, 1938 and a new genus *Epimesoplecia* gen. nov. within Protopleciidae have been recovered from the Daohugou Formation in Chifeng, Inner Mongolia, China: *Mesoplecia sinica*, *M. mediana*, *Epimesoplecia shcherbakovi* and *E. elenae*. The diagnosis of *Mesoplecia* is supplemented based on information from the new species. All species described earlier as Protopleciidae from China do not belong to this family: *Paraoligus exilus* Lin, 1976, *Mesoplecia xinboensis* Hong, 1984, *Sinoplecia parvita* Lin, 1976, *Sunoplecia curvata* Hong and Wang, 1990, *S. liaoningensis* Hong, 1983, *?S. longa* Hong, 1983, *Hebeiplecia brunnea* Hong, 1983, *Pleciopsis longa* Hong, 1983 and *Pseudoplecia ovata* Hong and Wang, 1990. *Lichnoplecia kovalevi* Ren et al., 1995 might be a member of the Protopleciidae.

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Keywords: Palaeoentomology; Diptera; Protopleciidae; New taxa; late Mesozoic; Daohugou Formation; China

1. Introduction

Protopleciidae is a diverse, extinct group known from the Mesozoic. Previously, it included three genera: *Protoplecia* Handlirsch, 1906 (type species: *Macropeza liasina* Geinitz, 1884), *Mesoplecia* Rohdendorf, 1938 (type species: *Mesoplecia jurassica* Rohdendorf, 1938) and *Mesopleciella* Rohdendorf, 1946 (type species: *Mesopleciella minor* Rohdendorf, 1946). Some genera previously placed in Pleciopungivoridae were subsequently transferred to the family by Kovalev (1987). Recently, three families were synonymized under Protopleciidae: Palaeopleciidae, Phragmneuridae and Protoligoneuridae, with 23 species in six genera (Blagoderov, 1996): *Archipleciomima curta* (Rohdendorf, 1964), *A. brevicornis* Kovalev, 1985, *A. defectiva* Kovalev, 1985, *A. destructimedia* (Rohdendorf, 1964), *A. longicornis* Kovalev, 1985, *A. obtusipennis* Rohdendorf, 1962, *Mesoplecia jurassica*, *M. oleynikovii* Kovalev, 1990, *M. sibirica* Kovalev, 1985, *M. stigma* Rohdendorf, 1964, *Mesopleciella lepida* (Kovalev, 1990), *M. longipennis* (Rohdendorf, 1962), *M. incorporalis*

(Kovalev, 1985), *M. minor*, *M. phryneoides* (Rohdendorf, 1962), *Palaeoplecia rhaetica* Rohdendorf, 1962, *Protoligoneura fuscicosta* (Rohdendorf, 1962), *P. mediocubitalis* (Rohdendorf, 1964), *P. minor* (Rohdendorf, 1964), *P. quadrimedialis* (Rohdendorf, 1964), *P. subcosta* (Rohdendorf, 1962), *Protoplecia liasina* (Geinitz, 1884) and *P. magna* (Rohdendorf, 1964).

Simulidium priscum Westwood, 1854 was placed in Protopleciidae (Crosskey, 1988), however, it was later determined to belong to the Rhagionidae (Brachycera) (Mostovski et al., 2003).

Many Chinese genera and species have been assigned to the Protopleciidae (Lin, 1976, Hong, 1983, 1984; Hong and Wang, 1990), most of which have been subsequently found to not belong to this family (Blagoderov, 1996). In addition, the *Paraoligus exilus* Lin, 1976, and *Mesoplecia xinboensis* Hong, 1984, are reassessed here, and are excluded from the Protopleciidae (see discussion below). Thus, the present new genus and new species described herein are the sole undoubted occurrences of Protopleciidae from the Mesozoic of China; they extend the geographical distribution of this group to northeastern China.

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Venational nomenclature herein follows Wootton and Ennos (1989: the vein traditionally named 1A in fact is CuP) and Shcherbakov et al. (1995).

2. Systematic Paleontology

Order: Diptera Linnaeus, 1758

Suborder: Nematocera Latreille, 1825

Family: Protopleciidae Rohdendorf, 1946

Genus *Mesoplecia* Rohdendorf, 1938

Type species. Mesoplecia jurassica Rohdendorf, 1938

Species included. M. jurassica Rohdendorf, 1938, *M. stigma* Rohdendorf, 1964 from the Karabastau Formation in Mikhailovka (Karatau, Kazakhstan), *M. sibirica* Kovalev, 1985, from the Ichetuy Formation in Novospasskoe (western Transbaikalia, Siberia, Russia), *M. oleynikovii* Kovalev, 1990 from the Glushkovo Formation in Savina (eastern Transbaikalia, Russia), *M. sinica* sp. nov. and *M. mediana* sp. nov. from the Daohugou Formation in Chifeng (Inner Mongolia, China).

Emended diagnosis. Medium-sized protopleciids that may be distinguished from all others of this family by combination of: head small; antennae 16-segmented, elongate-conical, at least more than twice length of head. Vein bRs not more than twice length of dRs; M_1 , M_2 at least five times longer than dM_{1+2} ; bM_{1+2} usually longer than dM_{1+2} (sometimes both nearly equal length). Legs with coxae, femora thick, clavate, tarsal spurs of hindleg well developed.

Remarks. The diagnosis of *Mesoplecia* is supplemented on the basis of the new material described here, especially the characteristics of body.

Mesoplecia sinica sp. nov.

Figs. 1A, B, 2A–D

Derivation of name. The specific epithet is formed from the Latin for China, where the fossil was collected.

Material. Holotype DHG200381, DHG200382, part and counterpart, an incomplete protopleciid from the Middle Jurassic–Lower Cretaceous Daohugou Formation, in the vicinity of Daohugou, Ningcheng, Inner Mongolia, China (for detailed discussion of its age, see Zhang, 2006); deposited in the Nanjing Institute of Geology and Palaeontology, Chinese Academy of Sciences.

Diagnosis. May be distinguished from other species of *Mesoplecia* by combination of leg, wing characters. Second tarsomere of foreleg thick. Wing with Sc long, ending before midwing; bRs twice length of dRs; R_1 , R_{2+3} convergent terminally; R_{2+3} strongly sigmoid; bM_{1+2} twice length of dM_{1+2} ; r-m, CuA apex nearly level with Sc apex; R_{4+5} , M_1 parallel; cell ba distinctly wider than cell bp.

Description. Wing 2.2 times longer than wide, veins thick, except Sc, R_{2+3} , M, CuP (somewhat thinner). Sc long, little shorter than one-half length of wing; Pt large, suboval; R_1 three-fourths wing length; Rs arising from basal one-third wing length, furcated slightly distal level of M_{1+2} fork, stem of Rs nearly as long as R_{2+3} , bRs twice length of dRs; R_{2+3} strongly sigmoid, convergent R_1 terminally; R_{4+5} weakly curved upward medially, less than twice length of R_{2+3} , ending just below apex of wing; crossvein r-m about one-third length of bRs, slightly oblique, curved, located somewhat basad midwing, almost at level of Sc end; M stem well developed with exception of basal section, furcated slightly distad level of origin of Rs; M_{1+2} stem about three times length of r-m, with bM_{1+2} twice length of dM_{1+2} , latter subequal to r-m length, about one-eighth length of M_2 ; M_1 , R_{4+5} parallel; bM_{3+4} quite short, nearly quarter length of m-cu, dM_{3+4} straight, nearly vertical to m-cu; CuA short, strongly curved, ending at hind margin of wing basad midwing, almost at level of r-m; CuP nearly straight; cell bp narrow, at apex nearly one half width of cell ba. Forelegs relatively thin, short, covered with sparse, short setae, dense hairs, femora clavate, barely shorter than tibiae, tarsal spurs poorly developed (probably missing), tarsi slightly longer than tibiae, with basitarsi thin, long, slightly longer than remaining tarsomeres combined, terminal portion barely thickened, second tarsomere distinctly thickened, third through fifth gradually thinned, shortened terminally; midlegs evidently longer than forelegs, femora distinctly shorter than tibiae, with tibial spur well developed, tarsi normal (not thickened); hindlegs similar to midlegs, but slightly longer.

Length of wing, 7.2 mm; width of wing, 3.3 mm. Length of femur of foreleg, 1.8 mm; tibia, 2.3 mm, tarsus, 2.6 mm (1.4:0.4:0.3:0.3:0.2); femur of midleg, 2.4 mm; tibia, 3.6 mm; tarsus, 3.1 mm (1.7:0.6:0.4:0.2:0.2); femur of hindleg, 2.5 mm; tibia, 3.9 mm; tarsus, 3.3 mm (2.0:0.6:0.3:0.2:0.2).

Remarks. The wings of this new species bear a close resemblance to those of *M. stigma*, but may be separated from them by their longer bRs, twice the length of dRs; longer R_{2+3} , greater than one-half the length of R_{4+5} ; and longer bM_{1+2} , which is about twice the length of dM_{1+2} . *M. sinica* sp. nov. is also similar to *M. oleynikovii*, and may be separated from it by its longer Sc and R_{2+3} ; and shorter CuA, which ends clearly distad r-m.

Mesoplecia mediana sp. nov.

Figs. 1C, 2E–J

Derivation of name. From the Latin, *mediana*, “centered”, alluding to the crossvein r-m located at midlength of M_{1+2} .

Material. Holotype DHG200383, a single nearly complete impression of a female. Locality and repository as for *M. sinica* sp. nov.

Diagnosis. Separated from other species of *Mesoplecia* by combination of following: second foreleg tarsomere normal (not thickened); wing with Sc ending before midwing; bRs

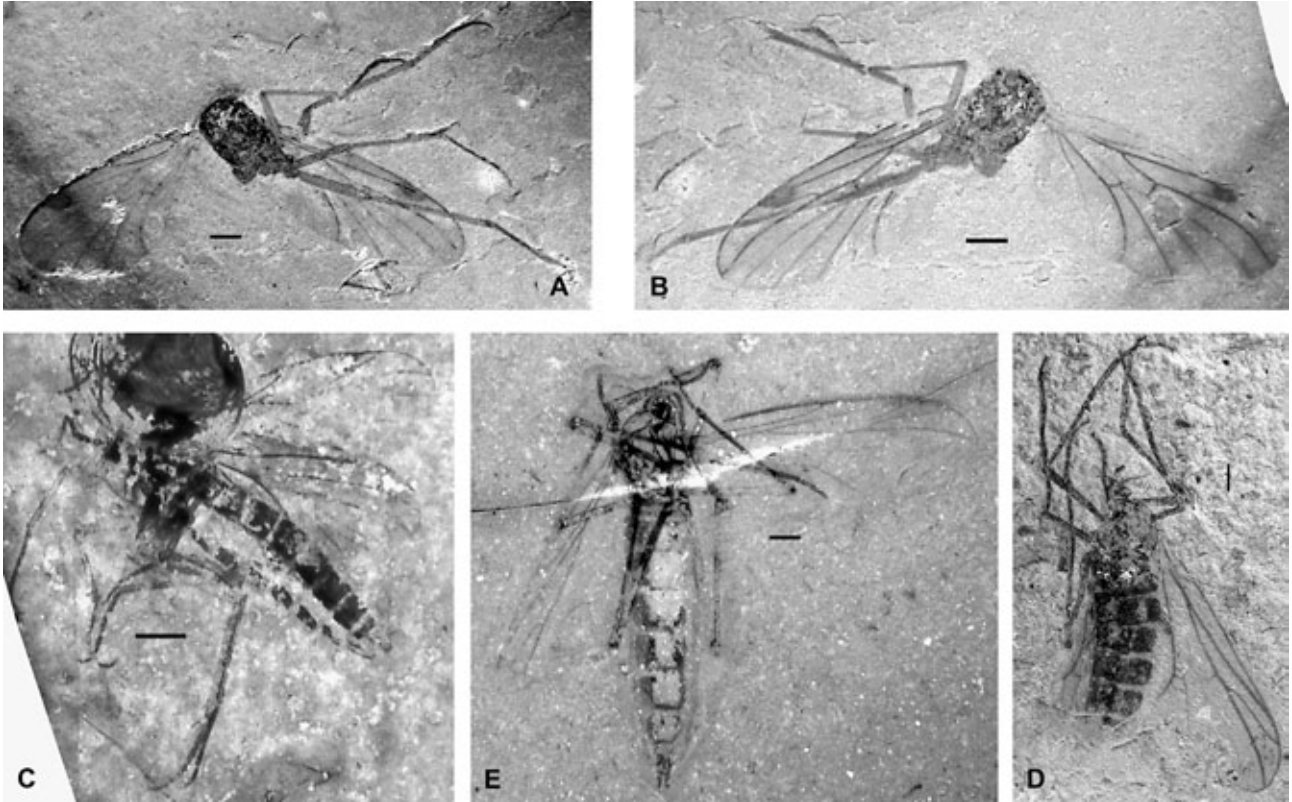


Fig. 1. A, *Mesoplecia sinica* sp. nov.; holotype, part, DHG200381; B, *Mesoplecia sinica* sp. nov., holotype, counterpart, DHG200382; C, *Mesoplecia mediana* sp. nov., holotype, DHG200383; D, *Epimesoplecia shcherbakovi* sp. nov., holotype, DHG200384; E, *Epimesoplecia elenae* sp. nov., holotype, DHG200385. All scale bars represent 1 mm.

1.3 times longer than dRs; both R_1 , R_{2+3} subparallel terminally; R_{2+3} not sigmoid, less than two-thirds length of R_{4+5} ; R_{4+5} , M_1 parallel; bM_{1+2} nearly as long as dM_{1+2} ; CuA apex distad r-m; cell ba slightly narrower than cell bp terminally.

Description. Head apparently small. Antennae 16-segmented, thin, filiform, at least more than twice longer than head, with scape and pedicle quite short, transverse, each of flagellomeres longer than wide, gradually thin terminally. Wing twice longer than wide, veins relatively thick; Sc shorter than one-half wing length; Pt present (incompletely preserved); R_1 seven-tenths wing length; Rs arising from basal one-third of wing, furcated slightly distal to level of fork of M_{1+2} , with Rs stem longer than R_{2+3} , bRs 1.3 times longer than dRs; R_{2+3} weakly curved (not sigmoid), subparallel to R_1 terminally; R_{4+5} weakly curved upward medially, nearly 1.7 times longer than R_{2+3} , ending just before wing apex; crossvein r-m about one-third as long as bRs, slightly oblique, located somewhat basal to midwing, almost at level of Sc terminus; stem of M fairly weak, thin, furcated slightly distal to level of origin of Rs; M_{1+2} stem about three times length of r-m, with bM_{1+2} nearly as long as dM_{1+2} , and 1.5 times length of r-m, about one-fifths length of M_2 ; M_1 , R_{4+5} parallel; bM_{3+4} quite short, nearly quarter length of m-cu, dM_{3+4} straight, not vertical to m-cu; CuA short, ending at hind margin of midwing (slightly distad level of r-m); CuP nearly

straight; cell bp somewhat narrower than cell ba terminally. Legs relatively short, femora covered with very long hairs ventrally; forelegs with femora clavate, slightly shorter than tibiae, covered with sparse, short setae, dense short hairs, tarsal spurs poorly developed (probably missing), tarsi slightly longer than tibiae, with basitarsi thin, long, shorter than remaining tarsomeres combined; midlegs almost same in characteristics, ratio of femora, tibiae, tarsi to that of foreleg, but its basitarsi shorter; hindlegs correspondingly elongate, with femora clearly shorter than tibiae, tarsal spur well developed, nearly one-half length of basitarsus, tarsi markedly shorter than tibiae.

Length of antenna, 1.8 mm; wing, 5.0 mm. Width of wing, 2.5 mm. Length of foreleg femur 1.4 mm; tibia, 1.2 mm; tarsus, 1.7 mm (0.8:0.4:0.3:0.2); femur of midleg, ca. 1.4 mm; tibia, 1.5 mm; tarsus, 1.9 mm (0.8:0.4:0.3:0.2:0.2); femur of hindleg, 1.7 mm; tibia, 2.4 mm; tarsus, 2.0 mm (0.9:0.4:0.3:0.2:0.2); abdomen, 5.0 mm.

Remarks. This new species shares a close resemblance to *M. sinica* sp. nov. in characteristics of both its legs and wing venation. It differs in having the normal (not thickened) foreleg tarsi, basitarsi which are shorter than the remaining tarsomeres combined, R_{2+3} not sigmoid and subparallel to R_1 terminally, and its shorter bM_{1+2} , nearly as long as dM_{1+2} . *M. mediana* sp. nov. can be easily separated from other known species of *Mesoplecia* by its specialized wing characters discussed above.

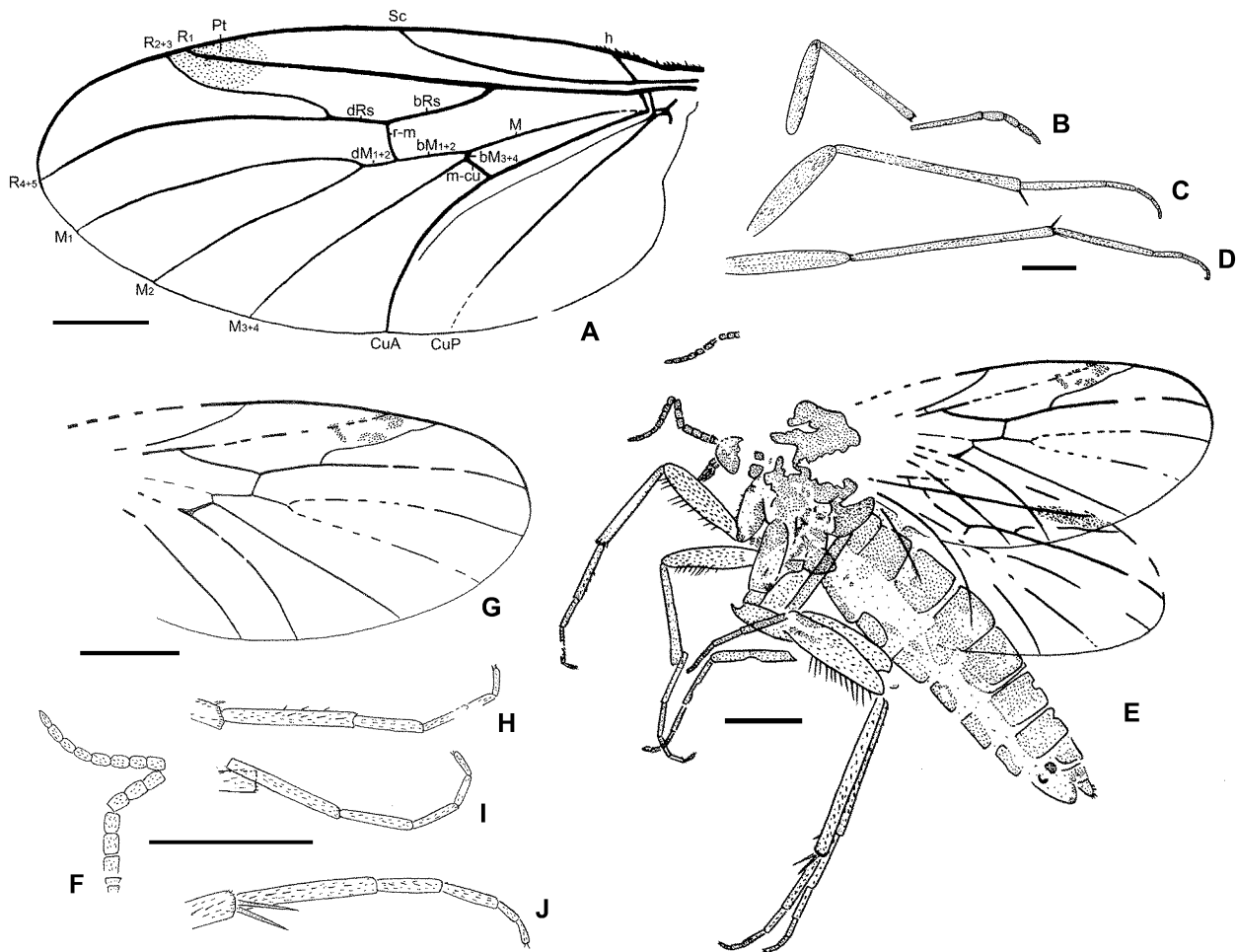


Fig. 2. A–D, *Mesoplecia sinica* sp. nov.; A, left wing; B, foreleg; C, midleg; D, hindleg; camera lucida drawing of specimen DHG200381. E–J, *Mesoplecia mediana* sp. nov.; E, female, lateral aspect; F, antenna; G, wing; H, tarsus of foreleg; I, tarsus of midleg; J, tarsus of hindleg; camera lucida drawing of specimen DHG200383. Scale bars represent 1 mm.

Genus *Epimesoplecia* gen. nov.

Derivation of name. The genus name is formed from the Greek, *epi*, “upon”, + *mesoplecia* (gender, feminine), referring to the extinct genus *Mesoplecia*.

Species included. The type species *Epimesoplecia shcherbakovi* sp. nov., and *E. elenae* sp. nov.

Diagnosis. Medium-sized protopleciids, distinguished from other genera of family by following. Head small. Antennae filiform, at least greater than twice head length. Wing narrow, long; wing fore margin straight; Sc elongate, nearly one-half wing length; bRs more than 2.5 times dRs length; R_{2+3} long, more than two-thirds R_{4+5} length; bM_{1+2} slightly longer (in *E. shcherbakovi* sp. nov.), or a bit shorter (in *E. elenae* sp. nov.), than dM_{1+2} , latter less than one-fifth length of M_1 , M_2 ; bM_{3+4} longer (in *E. shcherbakovi* sp. nov.), or slightly shorter (in *E. lukashevichae* sp. nov.), than m-cu. Legs thin, long, femora cylindrical.

Remarks. The present new genus has a short dM_{1+2} , less than one-fifth the length of M_1 and M_2 . With this a specialized feature resembling that of *Mesoplecia*, but may be distinguishable from that genus by the following: the wing is narrow and long, with a straight fore margin; bRs is more than 2.5 times longer than dRs; R_{2+3} , and more than two-thirds longer than R_{4+5} ; bM_{3+4} is long (longer, or sometimes slightly shorter, than m-cu); its legs are thin and long, with the femora cylindrical (not thickened, forming clava). *Epimesoplecia* gen. nov. is also similar to *Protoplecia* by the longer bRs which is more than 2.5 times longer than dRs. It differs from that genus in its longer Sc, which ends near midwing, its shorter dM_{1+2} , less than one-fifth length of M_1 and M_2 , and the longer bM_{3+4} which is longer, or only slightly shorter, than m-cu.

Epimesoplecia shcherbakovi sp. nov.

Figs. 1D, 3A–F

Derivation of name. The specific epithet is a patronym in honour of Dr Dmitri Shcherbakov, an entomologist at the

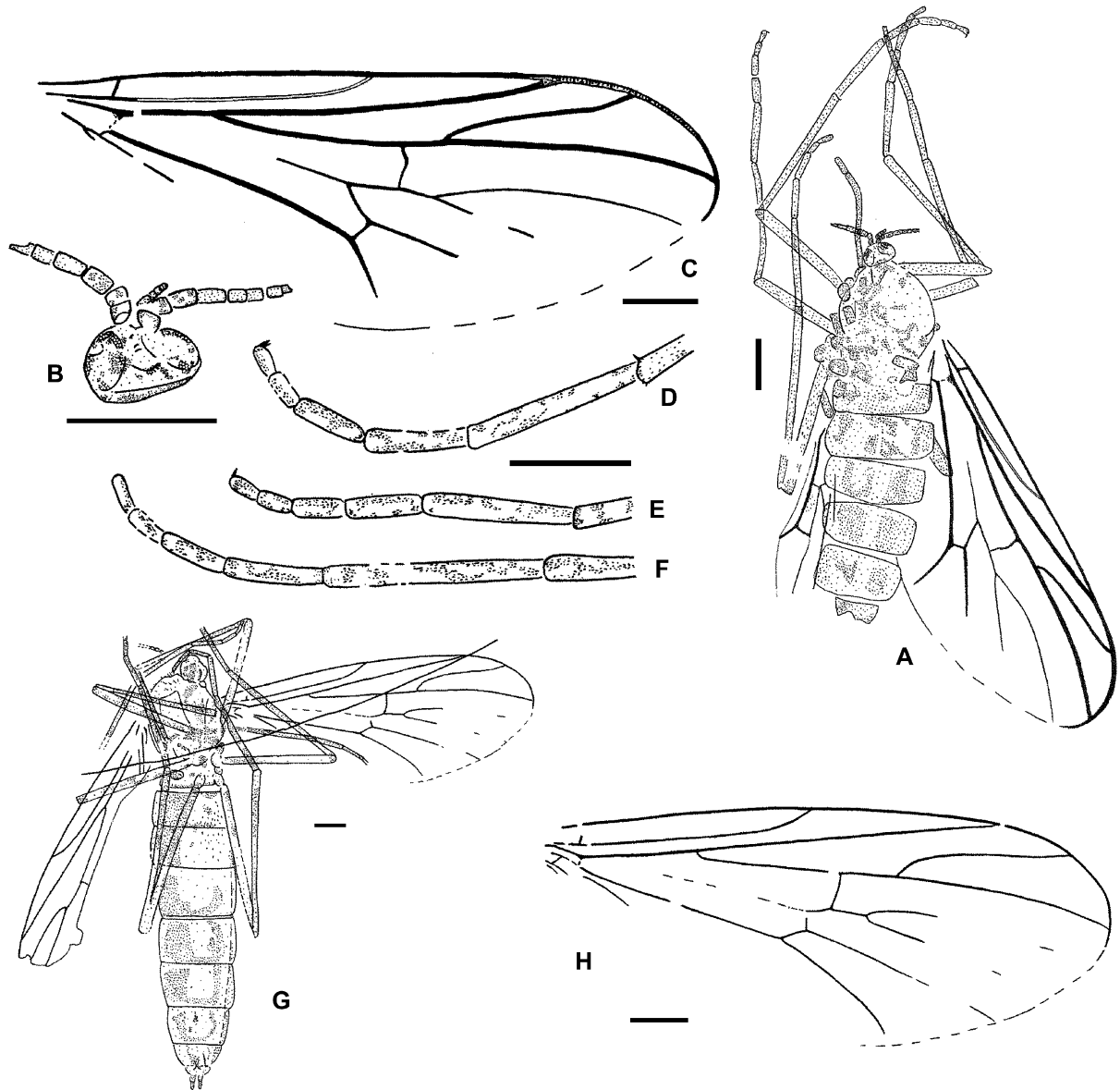


Fig. 3. A–F, *Epimesoplecia shcherbakovi* sp. nov.; A, female (?), nearly dorso-ventral aspect; B, head; C, wing; D, tarsus of foreleg; E, tarsus of midleg; F, tarsus of hindleg; camera lucida drawing of specimen DHG200384. G, H, *Epimesoplecia elenae* sp. nov.; G, female, dorso-ventral aspect; H, right wing; camera lucida of specimen DHG200385. Scale bars represent 1 mm.

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Material. Holotype DHG200384, a single, nearly complete impression, with abdomen apex missing. Locality and repository as for *M. sinica* sp. nov.

Diagnosis. May be easily separated from *E. elenae* by a combination of fore margin of wing straight; R_1 , R_s , CuA strikingly thickened; bR_s 4.5 times longer than dR_s ; bM_{1+2} longer than dM_{1+2} ; bM_{3+4} clearly longer than $m-cu$; CuA strongly curved at $m-cu$.

Description. Head small, transverse, suboval. Antenna with scape, pedicel short, clearly longer than wide, first, second

flagellomeres nearly twice longer than wide, remaining flagellomeres short, each clearly longer than wide. Eyes relatively large, suboval. Thorax relatively large, oval, nearly as wide as abdomen. Wing nearly 2.7 times longer than wide; fore margin of wing straight; veins R_1 , R_s , CuA strikingly thickened, others relatively thin; R_s arising from about a quarter length of wing, furcated at nearly same level of fork of M_{1+2} , bR_s 4.5 times length of dR_s ; R_{2+3} weakly curved, 0.7 times length of R_{4+5} , subparallel to R_1 terminally; $r-m$ curved, long, situated at midwing, slightly distad Sc apex; M furcated just little basad Sc apex; bM_{1+2} longer than dM_{1+2} ; bM_{3+4} nearly twice length of $m-cu$; CuA strongly curved at $m-cu$. Legs with femora distinctly shorter, thicker than tibiae; tarsi at least not thinner than tibiae; tibial spur of foreleg minute; basitarsi shorter than remaining tarsomeres combined; claws

than dM_{1+2} ; bM_{3+4} nearly length of m-cu; CuA weakly curved at m-cu.

Description. Head small, suboval. Antenna with several flagellomeres preserved, each longer than wide. Thorax relatively small, oval, nearly as wide as abdomen. Wing nearly 2.5 times longer than wide; fore margin of wing feebly arched; veins R_1 , Rs, CuA slightly thickened, others thin; Rs arising from about 0.7 times wing length, furcated distad fork of M_{1+2} , bRs 2.7 times length of dRs; R_{2+3} weakly curved, 0.7 times length of R_{4+5} , subparallel to R_1 terminally; r-m curved, long, situated just beyond midwing, slightly distad Sc apex; M furcated just at level of wing apex; bM_{1+2} somewhat shorter than dM_{1+2} ; bM_{3+4} slightly shorter than m-cu; CuA weakly curved at m-cu. Legs with femora slightly shorter, thicker than tibiae; tarsi, more or less thinner than tibiae; tibial spurs not detected (probably very small or poorly preserved); basitarsi shorter than remaining tarsomeres combined. Abdomen subcylindrical, widest in third, fourth segments. Cerci thin, two-segmented.

Length of head, 0.8 mm; thorax, 3.1 mm; wing, 10.0 mm. Width of wing, 4.1 mm. Length, of femur of foreleg, 3.9 mm; tibia, 4.1 mm; tarsus, as preserved, 4.5 mm; femur of midleg, 3.8 mm; tibia, 4.4 mm; tarsus, as preserved, 4.2 mm; femur of hindleg, 5.2 mm; tibia, 5.6 mm; tarsus, 5.7 mm (2.7:1.3:0.7:0.5:0.5); abdomen, 10.4 mm.

Remarks. By the diagnosis above-mentioned this new species can be easily separated from *E. shcherbakovi* sp. nov.

3. Discussion

Seven Chinese species in five genera have been considered as members of the Protopleciidae, however, none belong to the family (Blagoderov, 1996). These include: *Sinoplecia parvita* Lin, 1976, (J_2 – J_3), *Sinoplecia liaoningensis* Hong, 1983, (J_2 – J_3), ?*S. longa* Hong, 1983, (J_2 – J_3), *S. curvata* Hong et Wang, 1990 (J_3 – K_1), *Hebeiplecia brunnea* Hong, 1983 (J_2 – J_3), *Pleciopsis longa* Hong, 1983 (J_2 – J_3) and *Pseudoplecia ovata* Hong et Wang, 1990 (J_3 – K_1) from the Haifanggou Formation in Liaoning, and the Laiyang Formation in Shandong, respectively. It is difficult to see from their descriptions and line drawings (Figs. 4A–E, G, I, J) how they might be related to the Protopleciidae. Until the holotypes of these species can be reexamined, the taxonomic placements of them are uncertain at familial level.

Paraoligus exilus, from the Haifanggou Formation, was originally placed in the Protopleciidae. By its quite long Sc, nearly three-fourths wing length, and the very long and thin legs (Lin, 1976, p. 110, fig. 11, pl. 2, fig. 1; Fig. 4H), it might not be a relative of the Bibionomorpha. Its familial placement is uncertain until the specimen can be reexamined.

Another species, *Mesoplecia xinboensis*, from the Dabegou Formation in Hebei, China, was previously recognized as a member of *Mesoplecia*. However, the peculiar wing venation (R_{2+3} not oblique anteriorly, both dRs and dM_{1+2} very long, and m-cu meeting stem of M instead of M_{3+4}), the

21-segmented (or more) antennae, the entirely exposed clypeus under eyes and what appears to be its strikingly enlarged labrum following clypeus (Hong, 1984, p. 176–177, fig. 51; Figs. 4K, L) all suggest that this species does not belong to *Mesoplecia*. Nevertheless, an alternate placement cannot be suggested at the present time, and until further investigations of the specimen are possible, the species might be considered *Bibionomorpha incertae sedis*.

On the contrary, *Lichnoplecia kovalevi* Ren et al., 1995 from the Yixian Formation in Hebei, China is likely a representative of Protopleciidae, based on Sc short, ending near midwing (Ren et al., 1995, p. 102–104, fig. 3-61; Fig. 4F); although it was previously regarded as an ancestor of the extant subfamily Pleciinae within Bibionidae (originally misspelled as Bibionidae: see Ren et al., 1995). However, an alternate placement cannot be accurately determined at the present time, until new material (especially well-preserved body) becomes available. This species remains an enigmatic element of the Bibionidae.

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