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Proptychopterina (Diptera: Eoptychopteridae) from the Jurassic of Northeastern China

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Abstract—A complete well-preserved male fly from the Jurassic of Daohugou locality (Northeastern China) is described as *Proptychopterina opinata* sp. nov. The distribution of *Proptychopterina* is discussed, this genus is re-diagnosed, and a key to species is provided based on the wings.

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INTRODUCTION

Recently, a vast number of fossil remains, including thousands of insect impressions, have been collected at the locality of Daohugou, Ningcheng County, Inner Mongolia, China. The geological age of these continental deposits remains debatable and has been estimated by various authors over a wide range from early Middle Jurassic to Early Cretaceous (Wang et al., 2000; Ji and Yuan, 2002; Ren et al., 2002; Zhang, 2002; Gao and Shubin, 2003; Shen et al., 2003). Descriptions of dipterous insects, which are as usual very abundant and diverse, started appearing recently from this locality; usually the authors of these descriptions attribute these sediments either to the Middle Jurassic (Aalenian–Bajocian, Jiulongshan Formation, Krzemiński and Ren, 2001) or to the uppermost Middle–lowermost Upper Jurassic (Callovian–Kimmeridgian, Daohugou Formation, Zhang and Zhang, 2003). Regrettably, our data have very little to contribute to this discussion.

Representatives of the family Eoptychopteridae from Daohugou were among the first dipterans described (Ren and Krzemiński, 2002; Zhang, 2004). As it turned out, a reason for that was not only the large size and good preservation of these nematocerans, but their unusually frequent occurrence in this locality. The study of Dr. D. Huang's collection revealed 41 compression fossils of Eoptychopteridae among 400 dipterans examined, and their abundance is comparable with that of Tipulomorpha. The majority (37 specimens) are represented by *Eoptychopterina* Kalugina, 1985, whereas *Eoptychoptera* Handlirsch, 1906 and *Proptychopterina* Kalugina, 1985 are much more poorly represented (by two impressions each).

Usually, Ptychopteroidea form approximately 1% of total Diptera in a locality, and are far less numerous than the crane-flies (e.g., Lukashevich et al., 2001). Among 36 Mesozoic localities containing ptychopteroids, we know only one example when adult eoptychopterids play such an important role in the oryctocenosis (incidentally, this is the only example of domination of the genus *Proptychopterina*). Eoptychopterids constitute not less than 20% of all dipterans in the locality of Kubekovo (Siberia, Middle Jurassic, Itat Formation); among 260 compression fossils, 55 specimens undoubtedly belong to this family, with at least 29 specimens being *Proptychopterina*. It is still unclear what caused this pattern of domination.

The discovery of *Proptychopterina* in the Jurassic of China is not surprising, since this genus has been described from numerous Jurassic localities in Asia (Kalugina and Kovalev, 1985; Kalugina, 1988, 1989, 1992; Lukashevich, 1993, 2000); however, complete males with well-preserved hypopygia are known from only two specimens (*P. gracilis* and *P. yeniseica*). The new species described below clearly demonstrates how different nematocerans with identical wings can be. The only difference that has been revealed between the new species and *P. gracilis* from Karatau is the absence of pubescence on the wing blade of the first species, but the presence of pubescence in poorly preserved material is unclear, which can easily lead to a wrong conclusion.

Probably for a variety of reasons, the genus *Proptychopterina* has not yet been recorded in European localities, neither in Germany nor England. This genus is known from the Early Jurassic (locality of Krasnoyarsk, Siberia); thus, its absence from well-studied collections from the Toarcian of Germany such as Grimmen (Ansorge, 1996) and Braunschweig and Dobbertin (Lukashevich et al., 1998) can most probably be attributed to peculiarities of its geographical distribution. However, any conclusions must be tentative, for there are too few dipterans, and only one eoptychopterid, described from the early Tithonian of Germany (Solnhofen) (Krzemiński and Ansorge, 1995). No undoubted Early Cretaceous locality (e.g., the well-studied locality of Baissa, Transbaikalia) has yielded this genus, it has only been recorded from Siberian localities of debatable age (Unda, Daya, Kempendyai), which most probably belong to the Late Jurassic. Thus, the absence of *Proptychopterina* from Early Cretaceous localities in England (Durlston Bay, Clockhouse) may support the extinction of this genus during the Late Jurassic, rather than its complete absence from Europe.

MATERIAL

The type material is housed in the Nanjing Institute of Geology and Palaeontology (NIGPAS).

SYSTEMATIC PALEONTOLOGY

Subfamily Proptychopterininae Lukashevich, 1995

Proptychopterininae: Shcherbakov et al., 1995, p. 97.

Diagnosis. Wing immaculate. Rs and R_{4+5} straight or slightly curved, vein M_4 not shorter than vein M_{3+4}; always straight distal section of CuA (beyond m–cu) smoothly continuing direction of basal section.

Remarks. The subfamily includes the type genus from Jurassic and ?Cretaceous deposits of Asia.

Genus *Proptychopterina* Kalugina, 1985

Proptychopterina: Kalugina and Kovalev, 1985, p. 40.

Type species. *P. handlirschi* Kalugina, 1985.

Diagnosis. Slender nematocerans of medium and large size. Eyes and labella large. Antennae long, with no more than 20 segments; antennomeres elongated, cylindrical, with a crown of a few long setae and, probably, even and short pubescence. Wing narrow, always without color spots, sometimes quite densely pubescent; sc–r before or immediately beyond very proximally diverging radius-sector. Rs stem almost straight, forking symmetrically, vein R_{2+3} equidistant from R_1 and R_4. Transverse r–m connects midlength of R_{4+5} and M_{1+2} before im, with r–m being at level or distad of M_{3+4} fork. Stem of M distinct, rarely weakened; four medial veins, im connecting vein M_{1+2} well before its bifurcation and vein M_3. Vein M_{3+4} not longer than M_4. CuA almost straight around m–cu and beyond it. Claval fold present, but often poorly developed and runs not exactly to CuA tip. CuP curved basally, cu–a entering Cu close to fork, vein 1A distad of cu–a usually retained as rather long spur. Alular incision weakly developed or absent, alula absent. Abdomen slender and long, with unmodified segments (normally developed segment 1, slightly longer segment 2, segments 2–5 subequal and longer than others, segment 7 noticeably shorter than segment 6 and not modified into narrow ring, Figs. 2d, 2e). Cerci elongated, downcurved, sometimes forming typical sclerotized ovipositor. Hypopigium narrower or slightly wider than segment 7; gonostyles complex, pubescent, without apical spine, with elaborated processes and chitinous teeth.

Species composition. Twelve species from the Lower Jurassic–Upper Jurassic or Lower Cretaceous of Asia.

Remarks. Judging from the wing structure, it is logical to consider *Proptychopterina* as the most primitive genus of Eoptychopteridae, with the least modified venation in comparison with Nadipteridae (Shcherbakov et al., 1995): the veins are of approximately equal thickness; Rs is long and straight and bifurcates symmetrically; r–m is at the midlength of R_{4+5}, with no tendency toward developing the cord, i.e., a vertical fusion of r–m, basM_{3+4}, and m–cu (Alexander, 1927) that is characteristic of ptychopterids, because both the median bifurcation and m–cu are always situated much proximad of r–m; the median stem is not desclerotized; only a gentle smooth bend is possible near the attachment of m–cu to CuA, but much more frequently CuA is practically straight here. Naturally, *Proptychopterina* possesses all apomorphies of its family; namely, the transverse R_2, the M stem aligned along the anterior margin, M_{3+4} angular in its proximal third at m–cu, and the characteristic CuP being convex distally and diverging from the cubital fold. Only this subfamily is characterized by R_{2+3} being equidistant from R_1 and R_4, not approximated to R_1 as in all other subfamilies, and by a long fork of M_{3+4}, which is not shorter (usually longer) than the M_{3+4} stem (a similarly long fork occurs in two Cretaceous species of *Eoptychoptera* from England, but that is clearly a later exception to the general rule). The placement of *Proptychopterina* at the base of the tree is somewhat impeded by the absence of this genus from the Sinemurian localities, where other, in our opinion more advanced, genera, *Eoptychoptera* and *Architendipes* Rohdendorf, 1962, are found. However, at this stage of the study, this could be explained by the scarcity of records from the oldest localities: only seven compression fossils of eoptychopterids are known from Charmouth (England) and Sogyuty (Kyrgyzstan) (Lukashevich et al., 1998).

An identification key to species of the genus *Proptychopterina* based on wings

1(8) Transverse r-m remote from im: disM_{1+2} at most twice as long as medM_{1+2}

2(5) Apex of Sc situated level with or proximad to R_{4+5} bifurcation

3(4) R_{4+5} bifurcation distad of im…*P. amota* Lukashevich, 1993

4(3) R_{4+5} bifurcation level with or proximad to im………………………………………………………*P. oleynikovi* Kalugina, 1989

5(2) Apex of Sc distad to R_{4+5} bifurcation

6(7) Wing densely pubescent anteriorly and apically………………………………………………………*P. gracilis* Lukashevich, 1993

7(6) Wing not pubescent………………………*P. opinata* sp. nov.

8(1) Transverse r-m close to im: disM_{1+2} longer than two medM_{1+2}

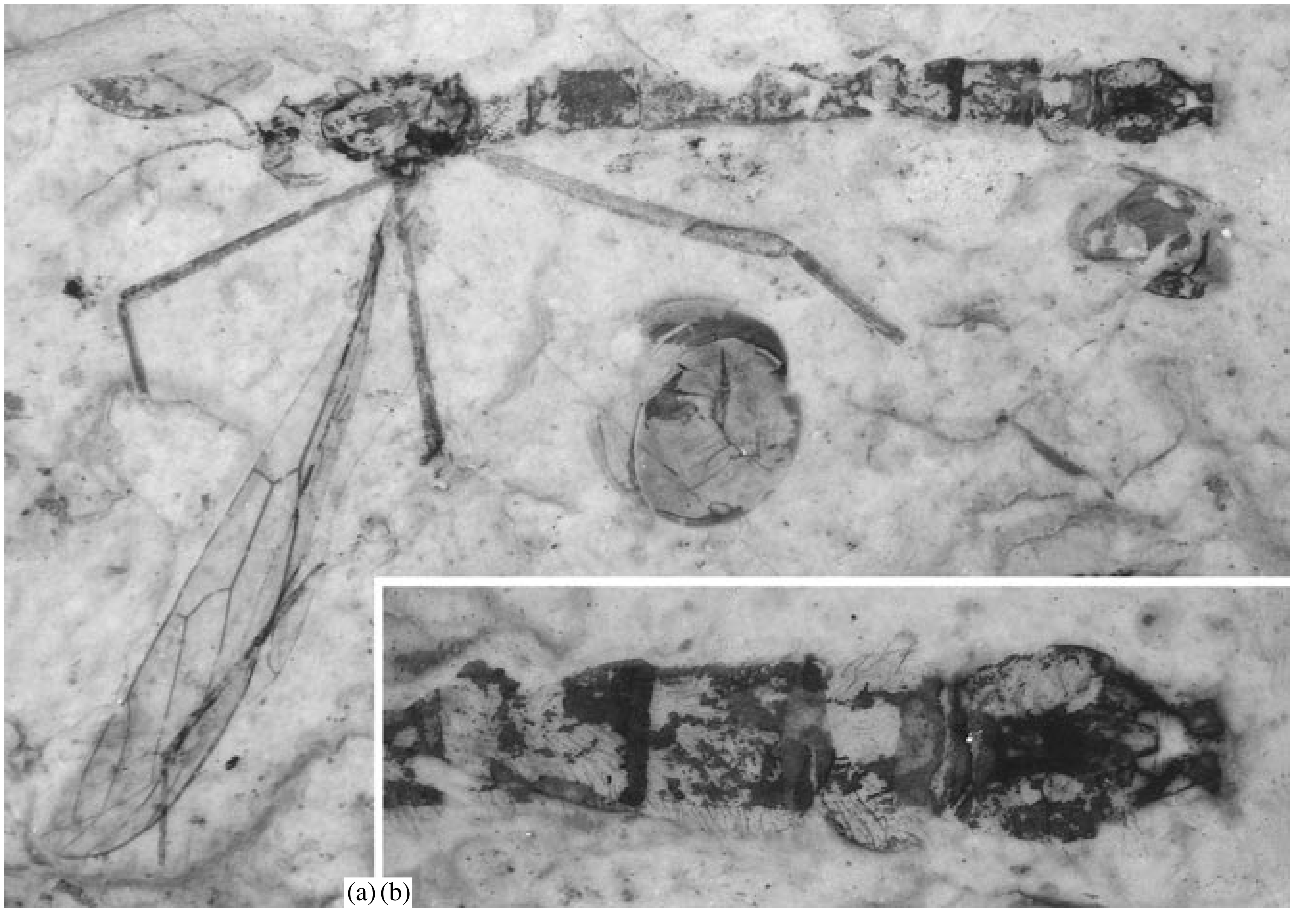

Fig. 1. *Proptychopterina opinata* sp. nov., holotype: (a) general appearance (wing length, 12.5 mm) and (b) tip of abdomen.

9(10) Rs bifurcating early, almost level with the base of discal cell, near 0.15 of its length; wing large, 15 mm long...*P. immensa* Lukashevich, 2000

10(9) Rs bifurcating more distally, at least at 0.3 of the length of discal cell, usually later; wing smaller

11(16) Wing small, about 5.5–6.5 mm

12(13) Apex of Sc distad of CuA apex if measured perpendicularly to the long axis of wing............*P. handlirschi* Kalugina, 1985

13(12) Apex of Sc level with CuA apex if measured perpendicularly to the long axis of wing

14(15) $disM_{1+2}$ 3 times as long as $medM_{1+2}$...*P. makarova* Lukashevich, 2000

15(14) $disM_{1+2}$ 6 times as long as $medM_{1+2}$...*P. sharategica* Kalugina, 1992

16(11) Wing larger

17(18) Line connecting bifurcations Rs and M_{3+4} entering wing margin noticeably proximad of CuA apex...*P. yeniseica* Lukashevich, 1993

18(17) Line connecting bifurcations Rs and M_{3+4} entering wing margin noticeably distad of or exactly to CuA apex

19(20) Rs bifurcating distad of M_{3+4} bifurcation...*P. tenera* Lukashevich, 2000

20(19) Rs bifurcating proximad of M_{3+4} bifurcation

21(22) Radius-sector long, constituting approximately 82% of the total wing length........................*P. evecta* Lukashevich, 1993

22(21) Radius-sector shorter, constituting less than 75% of the total wing length..........................*P. mongolica* Kalugina, 1988

***Proptychopterina opinata* Lin et Lukashevich, sp. nov.**

E t y m o l o g y. From the Latin *opinatus* (expected).

H o l o t y p e. NIGPAS, no. 133708, part and counterpart of a well-preserved male; China, Inner Mongolia, locality of Daohugou; Middle or Upper Jurassic.

D e s c r i p t i o n (Figs. 1, 2a–2d). Male. The wing is not pubescent, 3 times as long as broad. The apex of Sc is situated distad of the R_{4+5} fork. The R_{4+5} bifurcation is 2.6 times as long as its stem. The transverse r–m is developed at the level of the M_{3+4} bifurcation. Section $disM_{1+2}$ is 2 times as long as $medM_{1+2}$, which is 3 times as long as im. The M_{3+4} fork is somewhat longer than the discal cell. The $basM_{3+4}$ section is slightly shorter than m–cu and twice shorter than $basM_3$. The abdomen is long, similar in length to the wing, and densely pubescent. The hypopygium is not wider than the last segment, pubescent; there are two pairs of processes directed toward the median line, one pair is long, fingerlike, pubescent and situated dorsally, the other pair is much shorter, chitinized, with numerous teeth, and situated ventrally.

M e a s u r e m e n t s, mm. Length of antenna, 3.2; length of thorax, 3.0; length of wing, 12.5; length of abdomen, 12 (including hypopygium, which is 2);

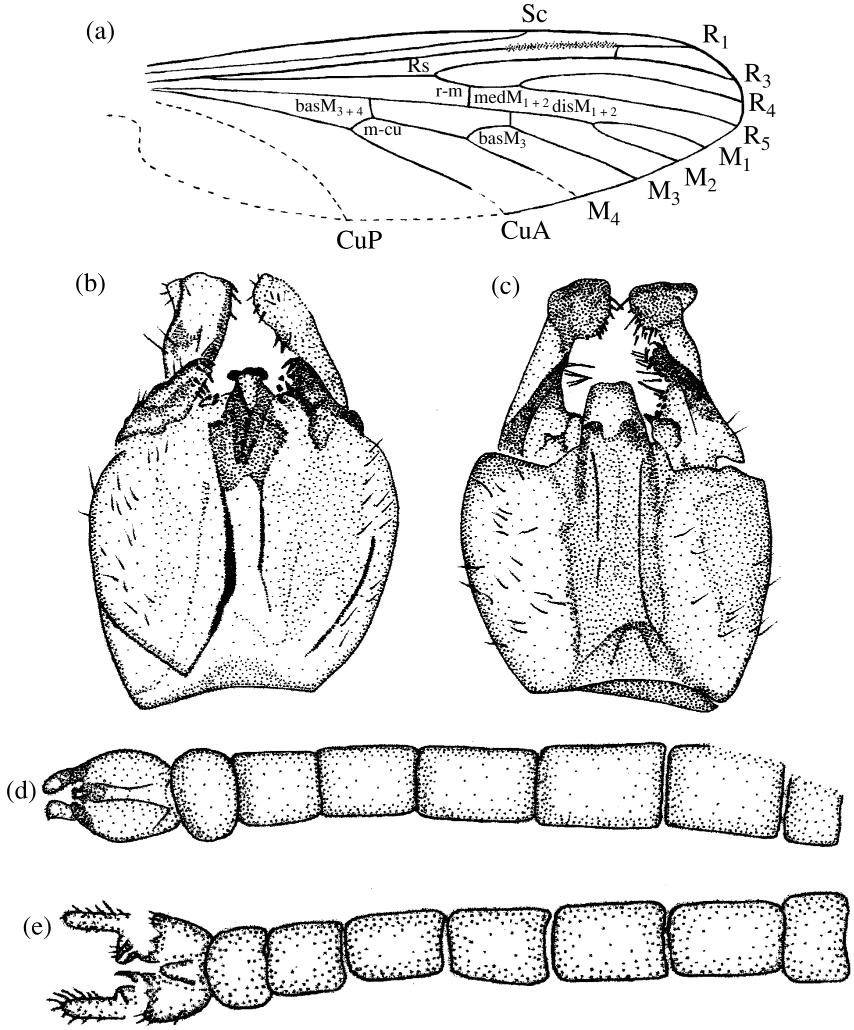

Fig. 2. Details of *Proptychopterina*: (a–d) *P. opinata* sp. nov., holotype: (a) wing (combined drawing from part and counterpart), (b, c) details of hypopigium visible on part and counterpart, (d) abdomen; (e) abdomen of *P. gracilis* Lukashevich, holotype, locality of Karatau, Middle–Upper Jurassic. Not to scale.

length of fore femur, 5.0; length of middle femur, 4.5; length of middle tibia, 6.7; length of hind femur, 5.6.

Comparison. In its wing venation, this species is closest to *P. gracilis* from Karatau, differing only in having a bare wing membrane. The male genitalia differ remarkably (Figs. 2d, 2e).

Remarks. In ptychopterids, one of the characteristic features of male genitalia is a well-developed ninth tergite with peculiar lateral processes (lateral arm of lateral lobe according to Alexander, 1927, surstyli according to Peus, 1958); these surstyli being simple in Bittacomorphinae and usually more complex in Ptychopterinae are usually comparable to gonostyli in their size.

A complex hypopygium of *P. gracilis* was previously described elsewhere (Lukashevich, 1993, p. 116, fig. 5c). In both cases (*P. gracilis* and *P. opinata* sp. nov., Figs. 2d, 2e), there are two closely approximated pairs of processes, one of them is long, fingerlike, pubescent and situated dorsally, the other is much shorter, strongly sclerotized, having numerous teeth and situated ventrally. It is difficult to tell from these specimens whether these pairs are compound gonostyli, or whether the ventral pair with teeth consists of simple gonostyli and the larger dorsal pair consists of surstyli (such proportions are absolutely untypical among modern ptychopterid genera). The boundary of the ninth tergite is well traceable laterally (the marginal points are even marked with fascicles of setae in *P. gracilis*) and becoming poorly discernible medially. However, no distinct articulation of it with the dorsal pair of processes is observable; moreover, there is a distinct hiatus in this place in both cases. Therefore, this complex structure has been interpreted by us as compound gonostyli in the absence of surstyli (Lukashevich and Azar, 2003). It cannot be entirely excluded that the structure discussed represents gonostyli plus surstyli, but this cannot be unambiguously identified in a case of dorsoventral burial.

M a t e r i a l. In addition to the holotype, an incomplete imago NIGPAS, no. 133710 from the same locality probably belongs to this species.

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