The earliest fully brachypterous auchenorrhynchan from Cretaceous Burmese amber (Homoptera: Fulgoroidea: Jubisentidae)

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KEY WORDS: planthoppers, Perforissidae, wing dimorphism, brachyptery, sensory pits, phylogeny, fossil, host plants, grasses, camouflage, mimicry.

ABSTRACT. Psilargus anufrievi gen. et sp.n. (Psilarginae subfam.n.) from mid-Cretaceous Burmese amber is assigned to the family Jubisentidae in basal (pre-cixioid) Fulgoroidea. The two formerly known genera of this family are placed in Jubisentinae stat.n. The only known specimen of the new species is a minute female with extremely shortened wings. It is the earliest recorded instance of extreme brachyptery in Auchenorrhyncha. All known Jubisentidae were flightless, camouflaged, and likely associated with herbs in the Burmese Cretaceous tropics.

The mid-Cretaceous Burmese amber (ca. 100 Ma) is a real Aladdin’s cave for paleoentomologists. This fossil resin was produced by araucarian trees in a rainforest [Poinar et al., 2007; Poinar, Buckley, 2008] on an island in the tropical Tethys Ocean between Gondwana and Laurasia [Westerweel et al., 2019], far from other Cretaceous Lagerstätten. Among many wonderful and unexpected insect taxa, three endemic planthopper families have recently been discovered in Burmese amber — Dorytocidae, Yetkhatidae and Jubisentidae [Emeljanov, Shcherbakov, 2018; Song et al., 2019; Zhang et al., 2019]. In the Burmese amber fauna these groups coexist with widespread Cretaceous families, such as Perforissidae [Shcherbakov, 2007a; Zhang et al., 2017] and Mimarachnidae [Shcherbakov, 2007b, 2017; Luo et al., 2020; etc.], and several extant families, such as Cixiidae and Achilidae [Shcherbakov, 2000; Szwedo, 2004] making up a rich and diverse planthopper assemblage [Perkovsky et al., 2019]. The latest find, recently offered on eBay, is an unusual brachypterous female planthopper described below as a new genus and subfamily of Jubisentidae.

The two Cretaceous planthopper families known from adults, Perforissidae and Mimarachnidae [Shcherbakov, 2007a, b] are referred to the basal, precixioid Fulgoroidea on account of having setigerous hind tibial pectens and the proximal CuA fork in the tegmen. The two other Cretaceous families based on nymphs with asetigerous hind tibial pectens, Neazoniidae [Szwedo, 2007] and Dorytocidae [Emeljanov, Shcherbakov, 2018] show other features in common with perforissids and mimarachnids. Subbrachypterous flightless Jubisentidae were described as related to Perforissidae [Zhang et al., 2019]. The new subfamily combines characters of typical jubisentids with a few perforissid characters and so bridges the gap between the two families.
The holotype female of the new species is extremely brachypterous, with tegmina covering only the meso- and metanotum. Such advanced brachyptery is common in planthoppers (Delphacidae, Dictyopharidae Orgeriinae, Caliscelidae) and leaffooters, as well as in some groups of true bugs [Schuh, Slater, 1995], occurs as a rare exception in froghoppers [Fennah, 1966], and is unknown in cicadas, treehoppers and Sternorrhyncha. Brachypterous leaffooters and planthoppers have been reported from Eocene Baltic amber (Szwedo, 2002, fig. 24; Szwedo, Stroinski, 2013; Dietrich, Goncalves, 2014), but appear to remain unknown from pre-Cenozoic strata. Therefore, the discovery of a strongly brachypterous planthopper in Cretaceous amber is of considerable interest. It seems to be the first record of a brachypterous Auchenorrhyncha from as far back as the Mesozoic.

In its general habitus, short veinless tegmina, and foliaceous fore and mid legs the new genus is similar to some Caliscelidae, especially Caliscelis de Lapeorte, 1833. Caliscelids sometimes show striking sexual dimorphism, with males mimicking jumping spiders [O’Brien, 1967] or ants [Gnedzilov, 2019]. Perforissidae also share many traits with Caliscelidae, though these two families are not closely related [Shcherbakov, 2007a].

Wing reduction occurs in Auchenorrhyncha feeding on herbs and forbs, but not in their arboreal relatives [Waloff, 1983]. Among grass feeding Auchenorrhyncha, flightless brachypterous forms are common in permanent habitats and rare in temporary ones [Denno et al., 1991; Novotny, 1994]. Caliscelidae and Delphaciidae largely feed on grasses and often display wing dimorphism; the macropterous form can be very rare, for example, in Caliscelidae. The new species may be of particular interest. Its hypothetical macropterous form is expected to retain such diagnostic characters of the new subfamily as sensory pits, reduced setation, and flaged due to its serrated dorsal outline with transverse sal humps, ridges and lobes and resemble small lumps of dirt. The flattened and slender forms of Dorycephalini and Hecalini leaffooters imitate grass seeds or twigs [Hamilton, 2000]. Brachypterous Orgeriinae planthoppers (Dictyopharidae) taking an unusual upright posture with their long legs stretched out [Ball, 1909] supposedly mimic the achenes of Asteraceae [Oshanin, 1913: 9] or salticid spiders [Emeljanov, 1980: 44]. The new apterous Burmese amber jubisentid appears camouflaged due to its serrated dorsal outline with transverse ridges, long foliaceous fore and mid legs fringed with setae, and brown colouration. On account of its long legs, it was likely mimicking spiders, seeds or plant debris rather than soil. A camouflage of this kind can be effective both on the host plant and near the ground.

The holotype of the new species is deposited at Borissiak Paleontological Institute, Russian Academy of Sciences, Moscow (PIN). Photographs were taken using a Leica M165C stereomicroscope with a Leica DFC425 digital camera and z-stacked with Helicon Focus 7.0. Nomenclature of the planthopper cranium is given after Anufriev and Emeljanov [1988].

Family Jubisentidae Zhang et al., 2019

REVISED DIAGNOSIS. Small and compact planthoppers, at least legs with long setae. Eumetope and clypeus with median carina; clypeus strongly raised, without lateral carinae; rostrum extending beyond hind coxae, apical segment longer than wide. Ocelli absent. Pronotum with anterior margin produced beyond eye midlength, lateral margin posterior to eyes very short, posterior margin shallowly incised. Subbrachypterous or brachypterous, venation of tegmina
ETYMOLOGY. From the Greek psilos (bare, smooth, naked), referring to the reduction of wings and body setae, and Argos (hundred-eyed guardian of Ilo), referring to dozens of round sensory pits; gender masculine.

*Psilargus anufrievi* Shcherbakov, sp.n.

Figs 1–8.

MATERIAL. Holotype brachypterous female PIN 5608/106 — Burmese amber, Hukawng Valley, Kachin State, Myanmar; mid-Cretaceous (Albian–Cenomanian).

DESCRIPTION. Body 3.6 mm long, compact, ovoid, somewhat compressed laterally, especially abdomen. Dorsal outline serrated in profile due to carina at head apex, raised or upcurved posterior edges of body segments, and transverse ridges on tegmina and abdominal tergites I–V. Dorsum without conspicuous longitudinal carinae or setae, finely longitudinally wrinkled, with one patch of transverse wrinkles in anterolateral part of tegmen. Head brown, dorsum unevenly suffused with brown, legs dark brown with pale spot under fore knee, sternites I–VI pale brown, sternite VII and ovipositor darker.

Head 1.3 mm wide, 1.9 mm high. Coryphete transverse, 3.5 times as wide as long, rising towards angulate anterior margin, with median carina. Eumetope 1.8 times as long as wide, gradually narrowed ventrally, twice as wide dorsally as ventrally, slightly tectiform in cross section, with median carina. Boundary of eumetope and coryphete arched in facial view, formed by single high carina faced dorsal. Each half of eumetope with about 15 sensory pits in two irregular rows, medial row of larger pits reaching level of antennae, lateral row of smaller pits restricted to dorsal half of eumetope. Clypeus as long as eumetope, with deeply arched median crest and oblique loroclypelic sulures not reaching it. Eyes large, ovoid. Antenna short, scape extremely short dorsally and slightly longer anteroventrally; pedicel ovoid, 1.5 as long as wide, with at least 12 sensory plaque organs. Rostrum 1.1 mm long, slender, reaching base of abdomen, with apical segment longer than wide.

Pronotum nearly 2.5 times as wide as long, with median carina; anterior margin trapezoidal, projecting forwards between eyes and somewhat overlapping coryphete; lateral margin very short, posterior margin W-shaped with shallow median incision; each half with nearly 15 sensory pits in two rows, anterior row of smaller pits and posterior row of larger pits with few smaller pits displaced posteriorly and forming rudimentary third row; pectoral lobe with 7 pits. Mesonotum subtriangular with apex truncate and upcurved, 1.7 times as long as wide, each half with 3 sensory pits anterolaterally; mesopleura small. Tegmina strongly brachypterous, truncate, wider than long, covering only thorax (abdominal tergite I free), not meeting with their commissural margins, without traces of veins, with narrow epipleuron separated by lateral carina, and transverse posterior submarginal ridge aligned with apex of mesonotum; metapleura large, anepisternum very dark, convex.

Coxae, femora and tibiae fringed along ribs with dark, erect, long and shorter setae. Coxae long, fore and mid coxae

**Psilargus Shcherbakov, gen.n.**

**Psilargus anufrievi Shcherbakov, sp.n.**

**Psilargus anufrievi gen. et sp.n., holotype female, Burmese amber: 1 — habitus, anterolateral view; 2 — habitus, lateral view; 3 — antenna, anterior view; 4 — distal parts of hind legs (arrows — tibial lobe and apical pectens); 5 — head, frontal view; 6 — head and thorax, anterolateral view (arrows — margin of tegmen); 7 — abdomen, lateral view; 8 — head and thorax, dorsal view. Scale bars: 1–2 — 1 mm; 3–4 — 0.2 mm; 5–8 — 0.5 mm.**

**Psilargus anufrievi gen. et sp.n., holotype female, Burmese amber: 1 — habitus, anterolateral view; 2 — habitus, lateral view; 3 — antenna, anterior view; 4 — distal parts of hind legs (arrows — tibial lobe and apical pectens); 5 — head, frontal view; 6 — head and thorax, anterolateral view (arrows — margin of tegmen); 7 — abdomen, lateral view; 8 — head and thorax, dorsal view. Scale bars: 1–2 — 1 mm; 3–4 — 0.2 mm; 5–8 — 0.5 mm.**
about as long as thorax height above them; fore coxae with outer edge foliaceous. Fore legs 3.8 mm long. Fore femora and tibiae foliaceous with outer margin more convex than inner margin; tarsi of subequal segments, 1st segment flattened laterally and highest; 3rd slender and longest. Mid legs 2.6 mm long, slender, femora flattened, tibiae narrow foliaceous, tarsi slender with 3rd segment longest. Hind legs 3.4 mm long. Hind trochanter largely membranous, with dark hook-like sclerotization along anteroventral side. Hind tibia quadrilateral, slightly curved, twisted distally, without lateral teeth, with fin-like lateral lobe on posterdorsal rib subapically. Apices of hind tibia and 1-2nd tarsomeres swallow-tailed with apical pectens of numerous setigerous teeth. Tibial pecten arched in apical view, all 8 teeth with long subapical setae. 1st tarsomere shortest, compressed laterally, inserted into 1st, with pecten deeply V-shaped in apical and dorsal views, of 14 teeth, both outermost teeth widened, without subapical setae. 2nd tarsomere slender. Claws simple, slender, strongly curved and tapered to apices; arolium well developed, wide, much shorter than claws.

Abdomen 2.6 mm long, tergites and sternites deeply arched or almost V-shaped. Tergites I-VI short with raised posterior margin, I-V also with anterior submarginal ridge and in each half with 1(2) submedian sensory pit and lateral row of several pits (I — 1, II — 4, III — 5, IV — 6, V — 3); tergite VI without pits. Spiracles visible as dark dots on membranous laterotergites near anterolateral angles of tergites I–V; laterotergite VI without spiracle, not separated from sternite. Stermites I-VI shorter than tergites. Tergites VII–VIII apparently somewhat reduced and/or hidden between membranous folds; sternite VII much longer, more convex and sclerotized than preceding, with shallow submedian posterior incisions. Segment IX (pygophore) elongate, tapered caudally, with anterior margin deeply incised, posterior submarginal ridge and lateral row of 5 sensory pits beyond it; ventral side concave, housing ovipositor. Ovipositor well developed, 1.2 mm long, occupying half of abdomen length. 3rd valvulae broad, lance-shaped, consisting of outer subcylindrical rachis downcurved and tapered to acutely rounded apex, and lip-like blades with arched edges directed ventromedially, meeting along midline and leaving only bases of cutting inner valvulae exposed. Segment X (anlagen) as long as wide; dorsal side roof-shaped with median carina; lateral carinae with rectangular acuminate posterior angles; apical side with paired drop-shaped epiprocts and short anal style.

ETYMOLOGY. The species is dedicated to the memory of a Russian expert in Auchenorrhyncha, Georgy A. Anufriev (1943–2017).

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