Short communication

A giant fossil Mimarachnidae planthopper from the mid-Cretaceous Burmese amber (Hemiptera, Fulgoromorpha)

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ABSTRACT

Dachibangus trimaculatus sp. nov. of a newly established genus Dachibangus gen. nov. from the Upper Cretaceous Burmese amber deposit is described. It is the largest representative of the family known so far, presenting peculiar morphological characters. This finding corroborates wider distribution of Mimarachnidae and their wider ecological spectrum.

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1. Introduction

The Burmese amber is a major fossiliferous deposit of Cretaceous amber in southeastern Asia, and it is considered to harbor the most diverse Cretaceous biota in amber by preserving rich and well preserved plants, arthropods, reptiles, and even bird and dinosaurs (Grimaldi et al., 2002; Guo et al., 2017; Xing et al., 2017). They are the greatest materials for studying the Cretaceous Terrestrial Revolution, which are marked by the radiation of angiosperms, social insects, and early mammals (Lloyd et al., 2008). Among the Burmese amber inclusions, more than fifty species of Hemiptera had been described, including a few planthopper species of families like Cixiidae Spinola, 1839 and Achilidae Stål, 1866 (Cockerell, 1917; Szwedo, 2004; Brysz and Szwedo, 2018) and extinct ones like: Perforissidae Shcherbakov, 2007a, Mimarachnidae Shcherbakov, 2007b and Dorytocidae Emeljanov et Shcherbakov, 2018

(Shcherbakov, 2007a; Ross, 2017; Zhang et al., 2017; Shcherbakov, 2017; Emeljanov and Shcherbakov, 2018).

The extinct Fulgoromorpha family Mimarachnidae is one of the so called "cixiidae-like" group, and characterized by its simplified venation with weakened basal cell closing, rounded anterior margin of pronotum, double carination of pronotum and mesonotum (Shcherbakov, 2007b). The other characters as head with trigons, double carination of fastigium, setigerous metatibial pecten are symplesiomorphic with other Cretaceous and Recent planthoppers. Spider-like dark svilhouette and black eyespots of tegmina which were considered to be the earliest recognized spider mimicry pattern (Shcherbakov, 2007b) are not distinctive for the family. The family Mimarachnidae comprises six species (Bourgoin, 2018): Mimarachne mikhailovi Shcherbakov, 2007 and Saltissus eskovi Shcherbakov, 2007 from the Berriasian-Barremian (ca. 145—125 Ma) deposits in Baissa, Transbaikalia, Russia; Nipponoridium matsuoi (Fujiyama, 1978) from early Cretaceous (ca. 140—120 Ma) Kaseki-kabe locality in Kuwajima, Japan (Szwedo, 2008); Mimamontsecia cretacea Szwedo et Ansorge, 2015 and Chalicoridulum montsecensis Szwedo et Ansorge, 2015 from Sierra del Montsec (Szwedo and Ansorge, 2015), north-eastern Spain of

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early Barremian (ca. 130.0—125.5 Ma) age; *Burmissus raunoi* Shcherbakov, 2017 from mid-Cretaceous Burmese amber (Shcherbakov, 2017). Some not described specimens are also known from localities like Turga (central Siberia) of early Cretaceous, Khurilt (Mongolia) of Barremian or Aptian, Khetana (East Siberia) of Middle Albian, Kzyl-Zhar Hill (Kazakhstan) of Turonian (Shcherbakov, 2007b, 2017).

2. Material and method

The specimen described here comes from the amber deposit Noije Bum in the Hukawng Valley in Kachin State, northern Myanmar (Kania et al., 2015; Fig. 1A and B). The age of the Burmese amber has been previously assigned as middle-late Albian by the discovery of the ammonite *Mortoniceras* (Cruickshank and Ko, 2003) and as Turonian-Cenomanian based on arthropods (Grimaldi et al., 2002). More recently, U—Pb dating of zircons from the volcaniclastic matrix of the amber has provided a refined age estimate of 98.79 ± 0.62 Ma (earliest Cenomanian) for the deposits by Shi et al. (2012).

General understanding of the geology in the region during the time of amber deposit formation has been gained from the Noije

Bum site studied by Cruickshank and Ko (2003), and a few other localities, recently summarized by Thu and Zaw (2017).

Deposits that host the burmite are a variety of clastic sedimentary rocks, with thin limestone beds, and abundant coaly and carbonaceous material. Amber nodules are found in laminated coals interspersed among fine clastic rocks thought to be the product of subtidal deposition in a bay, lagoon, or estuary and the depositional environment was suggested to be a nearshore marine setting close to deltas. Accompany with the records of macrofossil like ammonite, gastropods and bivalve, the microfossils including dinoflagellates, foraminiferans and algal remains and myodocopid ostracod were found (Xing et al., 2018). Marine bivalves (Myoida: Pholadidae) are known to have bored into amber pieces from the Noije Bum summit site (Smith and Ross, 2018). Some other amber localities placed nearby, were probably in more inland position at time of amber formation (Xing et al., 2018).

Palaeoenvironmental details and palaeoecological reconstructions for Burmese amber forest have not been fully elaborated yet. Palynological study suggested a humid warm temperate climate (Cruickshank and Ko, 2003). Both pollen and plant fossils identified so far, suggest the the amberiferous forests were placed in the equatorial floristic realm (Vakhrameev, 1988). The Sibumasu terrane, which might be the nearest land mass of the burmite
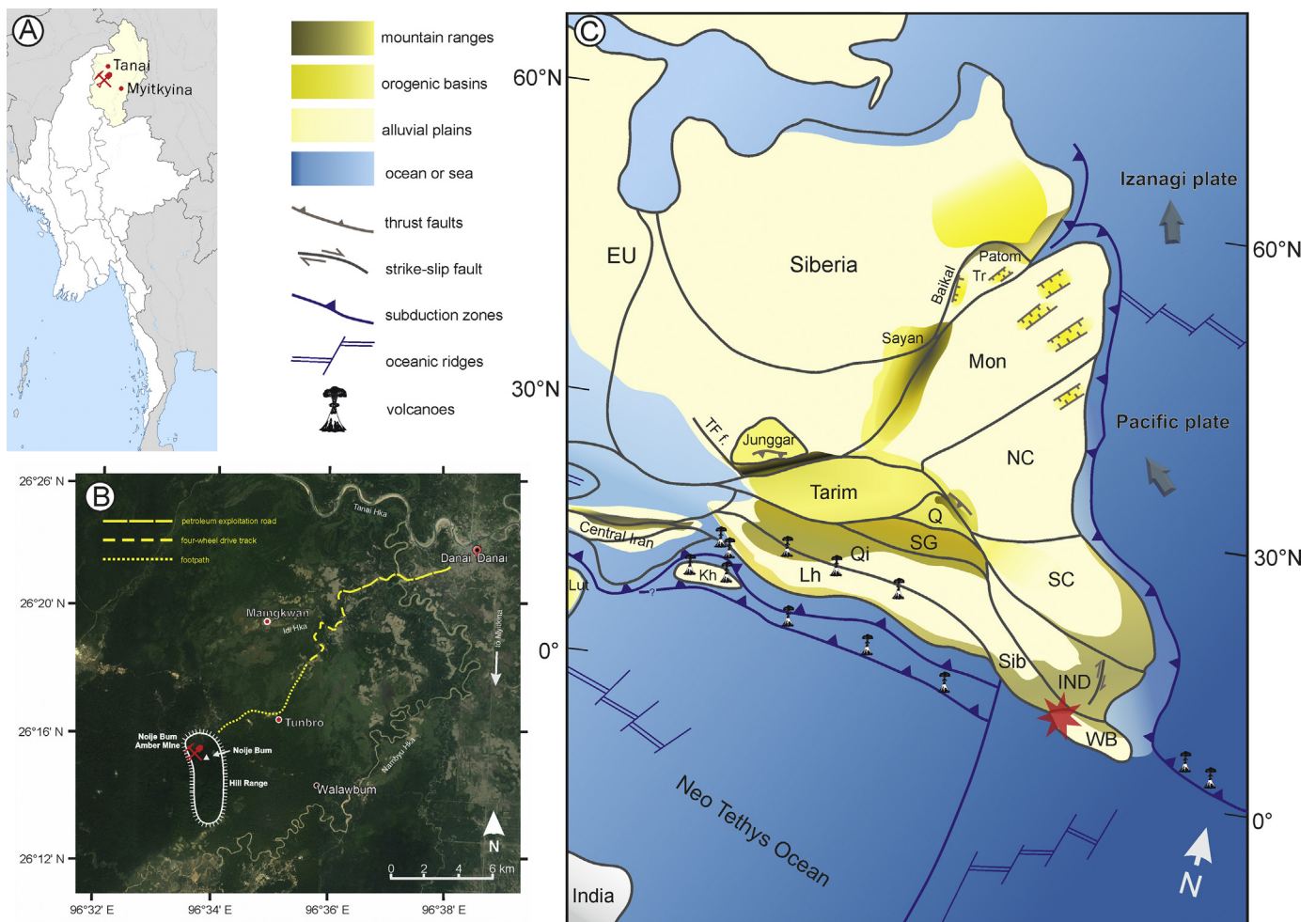
Fig. 1. A, B. Location of the amber deposits. B. Satellite view of the amber mines area (Google Earth Pro), track and location of mining area after Thu and Zaw (2017). C. Simplified palaeogeographic map of Palaeoasia for the mid-Cretaceous (ca. 100 Ma), major continental blocks and oceanic plates; EU, European Craton; Hel, Helmand Block; IND, Indochina Block; Kh, Kohistan Block; Lh, Lhasa Block; Mon, Mongolian Block; NC, North China Block; Q, Qaidam Block; Qi, Qiangtang Block (including North and South Qiangtang for simplicity); SC, South China Block; SG, Songpan—Garze prism; Sib, Sibumasu Block; TF f., Talas Fergana Fault; Tr, Transbaikal region; WB, West Burma Block; asterisk — probable Burmese amber forests area (map redrawn after Jolivet, 2015).

deposit locality, was in the tropical zone (Hay and Floegel, 2012; Metcalfe, 2013). The amber locality lies within the West Burma terrane (Broly et al., 2015) which finally collided with the Eurasian marginal Sibumasu terrane at around 80 Ma (Heine and Müller, 2005; Seton et al., 2012). This suggest some island or archipelago environments for at least part of the amberiferous area at time of resin formation and deposition (Fig. 1C). Burmese amber was proposed as derivative of the resin exuded from the gymnosperm trees of family Araucariaceae (Poinar et al., 2007), but recently the Cupressaceae, with *Metasequoia* were proposed as mother-plant for this resin (Grimaldi and Ross, 2017).

The specimen was observed under a stereoscopic microscope with varying illumination and filters to increase contrast of pigmentation. Drawing was made by Nikon microscope (SMZ1000) with a drawing tube, and photographs were taken using a Zeiss AXIO Zoom. V16 microscope system, in the Nanjing Institute of Geology and Palaeontology, Chinese Academy of Sciences.

The venational nomenclature follows the proposals presented by Bourgoin et al. (2015).

3. Systematic palaeontology

Order Hemiptera Linnaeus, 1758
Suborder Fulgoromorpha Evans, 1946
Superfamily Fulgoroidea Latreille, 1807
Family Mimarachnidae Shcherbakov, 2007

Genus: **Dachibangus** gen. nov.
Type species: *Dachibangus trimaculatus* sp. nov. by present designation and monotypy.

Etymology. Generic name is derived from Chinese words 'da chi bang' meaning "big wing". Gender: masculine.

Diagnosis. Differs from other genera of Mimarachnidae by narrow costal area (costal area absent in *Mimarachne* Shcherbakov, 2007, *Saltissus* Shcherbakov, 2007 and *Chalicoridulum* Szwedo et Ansorge, 2015; very narrow costal area reaching anteroapical angle in *Mimamontsecia* Szwedo et Ansorge, 2015; narrow costal area reaching half of tegmen length in *Burmissus* Shcherbakov, 2017) very short common stem ScP + R, about ½ of basal cell length (common stem ScP + R more than ½ of basal cell length in *Chalicoridulum*, as long as basal cell or longer in *Mimarachne*, *Saltissus*, *Mimamontsecia*; more than twice as long as basal cell in *Burmissus*); branches ScP + RA and RP very close and subparallel to each other, subparallel to costal margin (stems ScP + RA and RP diverging in *Mimarachne*, *Saltissus*, *Mimamontsecia* and *Chalicoridulum*); both branches MP$_{1+2}$, and MP$_{3+4}$ forked (MP forked once in *Saltissus*, *Mimamontsecia*, *Chalicoridulum* and *Burmissus*, three terminals of MP, with MP$_{3+4}$ not forked in *Mimarachne*); branch CuA$_2$ strongly curved mediad at level of tornus (no such curving in *Mimarachne*, *Saltissus*, *Mimamontsecia*, *Chalicoridulum* and *Burmissus*); terminal portion of Pc + CP weakened before the margin, submerging to ScP + RA, these fused veins weakened before margin, submerging to RP (no such character in other known Mimarachnidae; superficially similar pattern of Pc + CP submergence is present in *Paravarcia* Schmidt, 1919 of tribe Varciini Fennah, 1978 in family Nogodinidae Melichar, 1898).

Description. Pronotum subhexagonal, about 3 times as wide as long in mid line, punctate; anterior margin slightly concave, posterior margin almost straight; anterior angle roundly wide, posterolateral angle subacute, less than 90°, posterior angle obtuse, wide; median carina single, not reaching anterior margin of pronotum; anterior portion of pronotal disc separated by distinct arcuate furrow, subparallel to anterior margin.

Mesonotum about 1.5 times as wide as long in mid line, punctate; median carina double, distinct not reaching anterior margin and diverging laterad on scutellum; lateral carinae indistinct, sinuate, not reaching anterior margin, strongly diverging posteriad, reaching posterior margin, scutellum transversely wrinkled.

Tegula punctate, covered with short setae.

Tegmen coriaceous, about 3 times as long as wide, widened on membrane, tornus distinct, costal margin slightly curved at base, then almost straight, anteroapical angle acutely rounded, shifted anteriad, posteroapical angle widely rounded. Basal cell nearly 3 times as long as wide. Veins Pc + CP slightly shifted from costal margin, parallel to it, weakened in apical portion, submerged to ScP + RA; stem ScP + R leaving basal cell basad of stem MP. Longitudinal veins carinate, common stem ScP + R short, about half of basal cell length, branch ScP + RA subparallel to costal margin, in apical portion submerged to RP; branch RP subparallel to costal margin; stem MP strongly curved at base then subparallel to costal margin; first forking distinctly apicad of stem CuA forking, slightly apicad of base of tornus, branch MP$_{1+2}$ forked slightly basad of branch MP$_{3+4}$ forking, reaching margin with 6 terminals weakened before margin, branch MP$_{3+4}$ reaching margin with 2 terminals; the very base of stem CuA ('arculus' closing basal cell) weakened, stem CuA forked at basal $^1/_3$ of tegmen length, branch CuA$_1$ arcuate, branch CuA$_2$ sinuate, strongly curved mediad at level of tornus; clavus open, claval vein CuP curved mediad in apical portion at level of tornus, reaching margin apicad of posteroapical angle; claval veins Pcu and A$_1$ fused apicad of stem CuA forking, basad of stem MP forking, slightly basad of half of tegmen length, fused veins Pcu + A$_1$ curved mediad in apical portion subparallel to tornus margin, reaching margin at posteroapical angle; costal area narrow, with net of polygonal cells, costal cell about as wide as costal area, closed with reticulate junction with Pc + CP, with net of polygonal cells; cell C1 narrow, very long and apically closed by merging of veins Pc + CP + ScP + RA, cell C3 open, cell C5 curved lanceolate, open.

Hind wing membranous, anterior margin sinuate, anteroapical angle rounded; basal cell present, stem ScP + R leaving basal cell distinctly basad of stem MP, forked at level of wing coupling apparatus, stem MP single, stem CuA leaving basal cell slightly apical of stem MP, with stem slightly longer than basal cell, forked at very base of hind wing.

Mesotibia shorter than metatibia; metatibia with 5 apical teeth, subquadrate in cross section, with rows of short setae along.
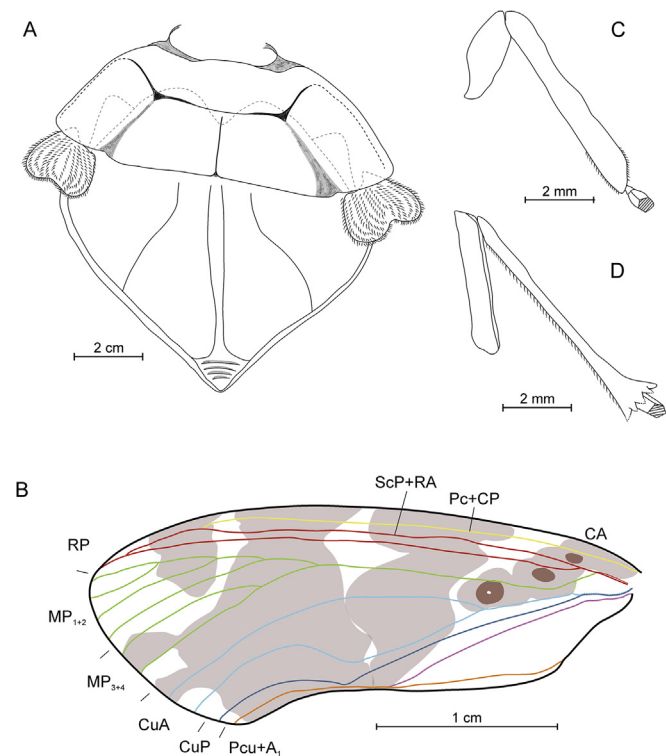
Dachibangus trimaculatus sp. nov.
(Figs. 2–6)

Etymology. Specific epithet refers to three distinct round spots at the base of tegmen.
Material. Holotype. Burmese amber, oval lump, 30 × 40 × 14 mm, weight 5 g. Specimen No. NIGP152466, deposited in Nanjing Institute of Geology and Palaeontology, Chinese Academy of Sciences, Nanjing. Holotype inclusion incomplete – head, prolegs, left mesoleg, left metaleg, abdomen missing, preserved parts: pronotum, mesonotum, left tegmen, right tegmen partly preserved, hind wings partly preserved. Syninclusions: nymph of Neazoniidae, ca. 5 mm long; remnants (part of tegmen and thorax) of unidentified Cixiidae-like planthopper.
Diagnosis. Tegmen with three small round spots at base, placed in oblique line. terminals of MP$_{1+2}$ weakened at apex reaching margin reticulately; stem MP with 6 terminals. Cell C3 about $^2/_3$ of cell C5 length.
Description. Preserved part of body (without head) 30.2 mm long. Pronotum subhexagonal, 2.9 mm long in mid line, 9 mm wide; disc

Fig. 2. *Dachibangus trimaculatus* sp. nov. A. Pronotum and mesonotum. B. Venation pattern of left tegmen. C. Preserved portion of mesothoracic (middle) leg. D. Preserved portion of metathoracic (hind) leg.

and lateral portions of pronotum punctate, anterior portion separated from posterior by arcuate furrow; anterior margin slightly concave, posterior margin almost straight, shallowly triangularly incised at median carina end, anterolateral margins slightly gibbous, posterolateral margin straight; anterior angle roundly wide, posterolateral angle subacutely rounded, less than 90°, posterior angle obtuse, wide; median carina single, not reaching anterior margin, reaching posterior margin; disc of pronotum separated by wide, shallow furrows, diverging posteriad, widened apicad as triangular concavities at junction to anterior transverse furrow; puncturation (remains of nymphal sensory pits?) slightly bigger on lateral lobes of pronotum than on disc.

Mesonotum pentagonal, 7.5 mm wide, 5.0 mm long, densely punctate; anterior portion of mesonotum, covered by pronotum, bilobate, with distinct median incision, prealar bridge (?) triangularly lobate; median carina double, reaching anterior margin, in posterior portion, diverging posteriad before mesoscutellum; mesoscutellum acutely triangular with transverse wrinkles.

Tegula wider than long in mid line, punctate and covered with short bristles.

Tegmen 29.7 mm long, 9.4 mm wide at level of tornus (maximum width 10.9 mm); coriaceous, with distinct longitudinal veins and polygonal net of transverse veinlets, elongate, obliquely truncate apically. Coloration of tegmen: three darker rounded spots, arranged obliquely at base, surrounded by lighter circles, crescent-shaped spot in middle of tegmen length, irregular transverse band from tornus to costal margin, irregular spot at level of posteroapical angle at costal margin, some longitudinal marking along terminals at anteroapical portion.

Mesofemur shorter than mesotibia, mesotibia 4.8 mm long, subquadrate in cross section; tarsomeres not preserved. Metacoxa

without metacoxal process, metatrochanter short, circular, metafemur 4.2 mm long, slightly flattened, metatibia 7.4 mm long, subquadrate in cross section, with rows of short bristles along, widening apicad, with row of five apical teeth. Metatarsus not preserved.

Abdomen and genital structures not preserved.

4. Discussion

The narrow costal area in *Mimamontsecia*, which seems similar to the newly established genus *Dachibangus* gen. nov., is formed by very tightly spaced veins Pc, CA, CP and without transverse veinlets. Szwedo and Ansorge (2015) suggested it differ from the character present in some Jurassic Fulgoridiidae Handlirsch, 1939. However in *Dachibangus* gen. nov., the costal area is slightly wider with irregular transverse veinlets, seems more related with that part in at least some of the genera placed in the paraphyletic family Fulgoridiidae. Apart from the features of the costal area, Mimarachnidae also shares with Fulgoridiidae the character of early forking of stem R and CuA before the nodal line level. Shcherbakov (2007a) suggested Mimarachnidae and another Cretaceous family Perforissidae are descendants from Jurassic Fulgoridiidae, and they constitute the most primitive, pre-cixioid section of planthoppers together with the Mesozoic Lalacidae Hamilton, 1990 and Permo-Triassic Surijokocixiidae Shcherbakov, 2000. Bourgoin and Szwedo (2008) and Szwedo and Ansorge (2015) assigned Mimarachnidae into the "cixiidae-like" planthoppers group, which contain extinct families Fulgoridiidae, Lalacidae, Neazoniidae Szwedo, 2007 and extant families Cixiidae, Delphacidae Leach, 1815, Kinnaridae Muir, 1925, Meenoplidae Fieber, 1872, Achilidae, Achilixiidae Muir, 1923 and Derbidae Spinola, 1839. The relationships within the basal lineages of extinct and modern Fulgoroidea are not clear. There are several reasons for that situation. First, Fulgoridiidae is a paraphyletic group, with numerous taxa known from isolated tegmina only, with other body structures weakly known, and very generalised features of the taxa for which more morphological characters were available. The Fulgoridiidae is in need of urgent revisionary studies, not only taxonomic and nomenclatorial, but also morphological. Fulgoridiidae are known from the Jurassic deposits of Europe and Asia (Szwedo et al., 2004; Bourgoin, 2018). Cixiidae-like group of families from the Cretaceous period comprises highly differentiated and morphologically specialised taxa. Shcherbakov (2017) stated that morphological similarities between Perforissidae and Mimarachnidae as narrowing of the costal area, reduction of forking of stems on membrane, open clavus, presence of nymphal sensory pits in adults, destabilization and underdevelopment of the hind leg armature, presence of double median carina on pronotum and mesonotum in Mimarachnidae indicate the paedomorphic (neotenous) nature of these families. We agree that these morphological features could result from neoteny, but these do not prove the close relationship between these families. Retention of nymphal characters, presence of sensory pits in adults especially, are present in various, unrelated distinctly representatives of planthoppers, e.g. Delphacidae, Issidae, Caliscelidae. Variability and modification of venational patterns as well as destabilization of hind leg armature are also observed among representatives of those families. Head capsule characters as presence of trigones (Shcherbakov, 2017) is character found also in Cixiidae, Delphacidae and Achilidae; double carination of fastigium is present in Fulgoridiidae, Lalacidae, Perforissidae, Mimarachnidae, Cixiidae, Delphacidae and Achilidae. Then these characters should be regarded as symplesiomorphic in Cixiidae-like complex of families. Cixiidae-like families, including Mimarachnidae should be treated rather as sister-groups in respect to Fulgoridiidae, than their descendants (Szwedo, 2009). Placement
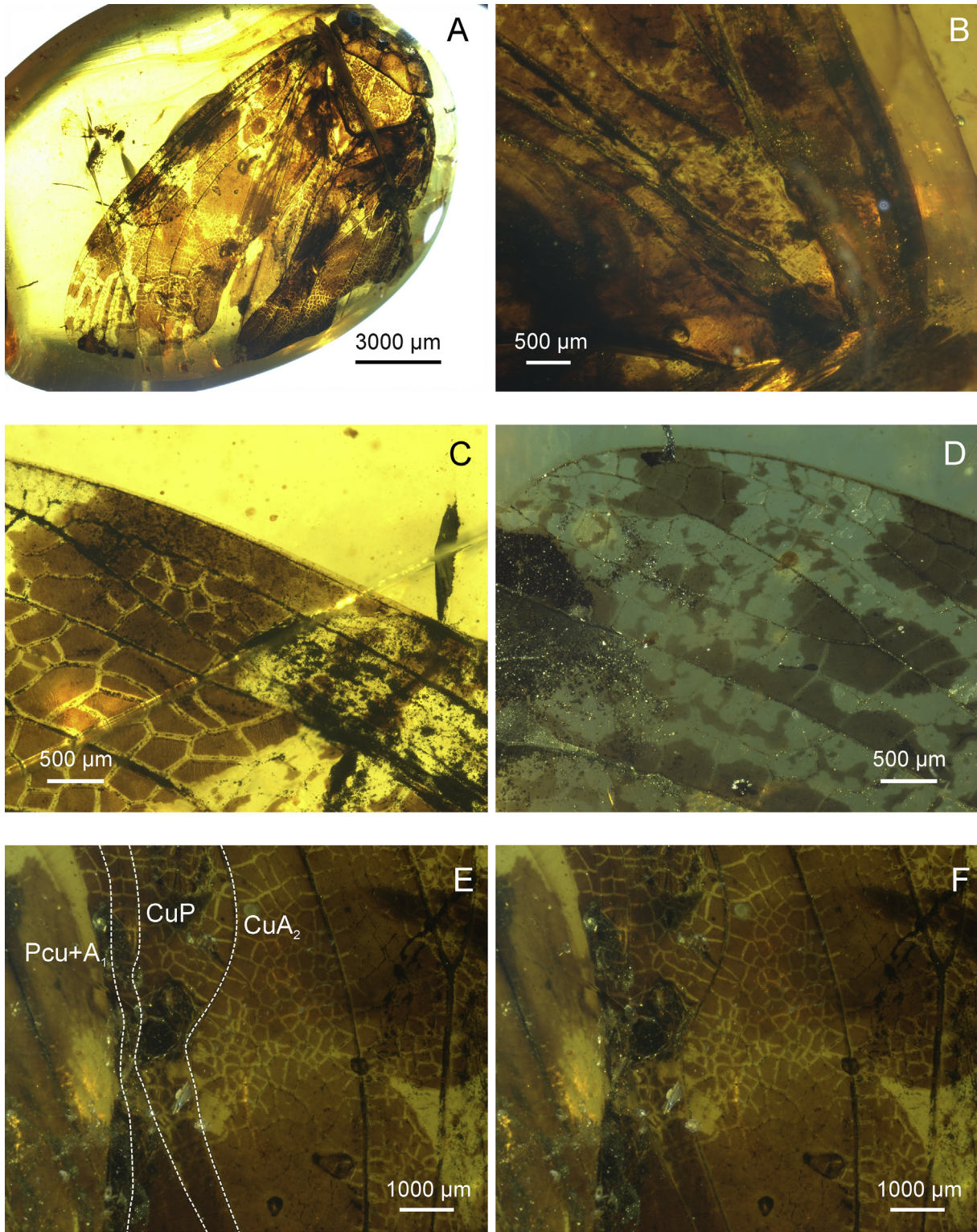
Fig. 3. Detailed photographs of *Dachibangus trimaculatus* sp. nov., holotype. A. Photograph of dorsal view. B. Basal cell. C. Costal area. D. Irregular veinlets on the tegmen. E–F. Claval apex.

and relationships of Mimarachnidae and other Cretaceous families of planthoppers still need to be reconsidered.

Striking character of *Dachibangus* gen. nov. is the strong curve of branch CuA_2 mediad at level of tornus, which has no comparative character in any known already genera of Mimarachnidae. In *Mimamontsecia*, CuA_2 is distinctly wavy, and in *Mimarachne*, the CuA_2 curve slightly apicad of the margin. The curving or wavy shape of the branch CuA_2 seems to be more derived, as the representatives of Fulgoridiidae has no such character and instead, the branches of CuA_1 and CuA_2 straight, parallel and curved to posteroapical angle are more typical characters of Fulgoridiidae (Szwedo and Ansorge, 2015). Curving or wavy shape of CuA_2 is also not known in Perforissidae (Shcherbakov, 2007a; Peñalver and Szwedo, 2010; Szwedo et al., 2013; Zhang et al., 2017).
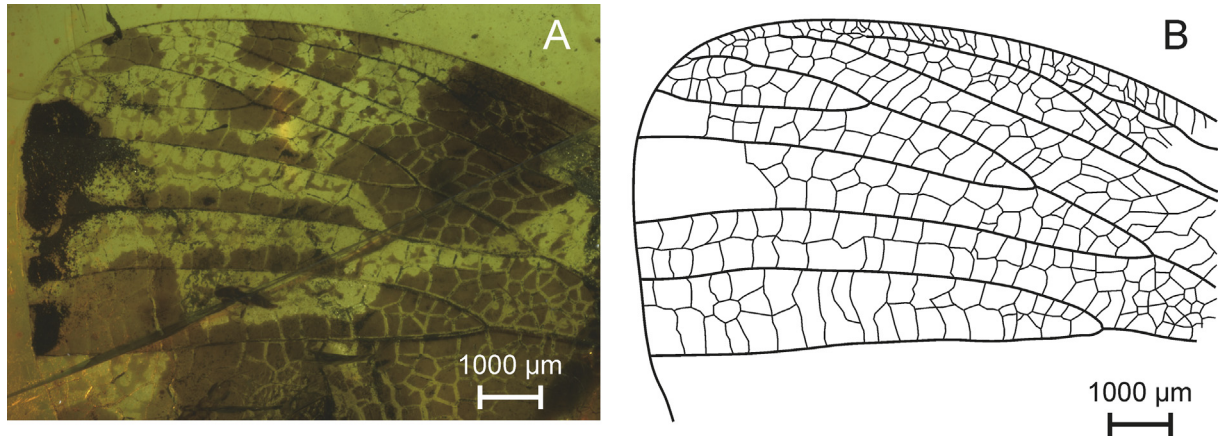
Fig. 4. *Dachibangus trimaculatus* sp. nov. Detailed photograph and line drawing of the veins and irregular veinlets on the membrane of left tegmen.
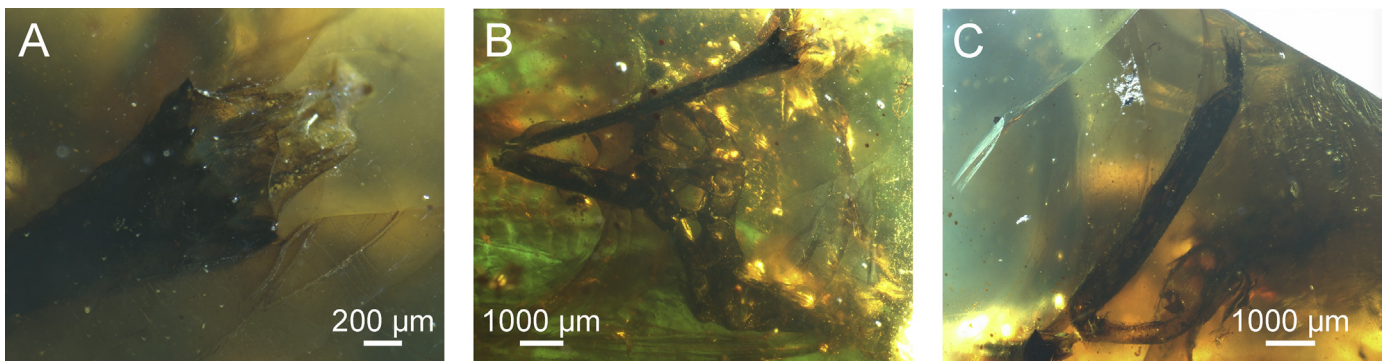

Fig. 5. Detailed photographs of *Dachibangus trimaculatus* sp. nov., holotype. A. Left metatibia apical teeth. B. Preserved portion of left hind leg. C. Preserved portion of right mesothoracic leg.

Structure of claval veins CuP and Pcu + A$_1$ in *Dachibangus* gen. nov. is very exceptional. Veins CuP and Pcu + A$_1$ are tightened each other at breaking point from claval margin to tornus. The clavus is open, but with vein CuP surpassing far beyond this point and reaching the margin apicad of posteroapical angle of tegmen. Also fused veins Pcu + A$_1$ running close to the claval margin and tornus are distinctly surpassing breaking point and reach the margin of tegmen at posteroapical angle. Such conformation with prolonged veins CuP and Pcu + A$_1$ is present in some Fulgoridae (Dworakowska, 1988), and convergence of cubital veins at the level of breaking point between claval margin and tornus, with formation of postclaval knot is known in the Fulgoridae genus *Odontoptera* Carreño, 1841 (Bourgoin and O'Brien, 1994). It could be assumed that such form of these structures is rather analogous in nature and associated with relative size of the tegmina and their mechanical properties.

Prealar bridge (*prealare*) of mesothorax in *Dachibangus* gen. nov. is well developed in form of large, triangular lobes. As far as it is known, in Fulgoroidea this structure is not such enlarged (Kramer, 1950), and its diversity is virtually unknown in Fulgoromorpha (Taylor, 1918; Kramer, 1950). Despite of detailed morphological studies of thorax in Sternorrhyncha (Wegierek, 2002; Drohojowska, 2015), the question of potential value of this structure for morphophylogenetic investigations remains unclear.

Before findings of Mimarachnidae among Burmese amber inclusions, these planthoppers were believed to occur only in the Cretaceous localities of middle to high latitudes. The insect fauna in Baissa are mainly lacustrine and composition indicating a subtropical climate with a gradient trend from wet to humid and semiarid (Zherikhin et al., 1999; Vršanský et al., 2002). Various kind of fossils in the Kuwajima "Kaseki-kabe" constituted a rich terrestrial biota in a paralic river and lake situated in the continental margin of Asian with warmer and drier conditions (Matsukawa et al., 2006). The aquatic insect fauna from Montsec, coincide with the fresh or brackish lagoon depositional condition of the fossil bearing limestone, with a subtropical climate of alternating wet and semiarid periods (Szwedo and Ansorge, 2015). Recent finding of Mimarachnidae among Burmese amber inclusions (Shcherbakov, 2017) spread distribution of the family more southward, to the warm and wet tropical zone (Hay and Floegel, 2012). The area of mid-Cretaceous Burmese amber forest is reconstructed as placed in tropical zone, warm and humid, probably with mosaic habitats.

The retaining of sensory pits in imagines of Fulgoromorpha is rare, and it is considered to be related with environmental and habitat conditions, especially extreme dry (xerophilous) or humid (hygrophilous). Sensory pits of planthoppers usually form a pattern of distinct rows and groups associated with the system of carinae. Mimarachnidae demonstrate very small sensory pits, superficially resembling coarse punctures and cover the pronotum and mesonotum more or less evenly. Shcherbakov (2017) suggested that it is more primitive condition, but it is disputable. Dense puncturation of the body (head, pronotum, mesonotum, base of tegmina), with small punctures armed with seta (with function to be explained, probably not only mechanoreceptive) are to be found also in unrelated representatives of Cicadomorpha, living in various conditions. Sensory pits preserved in Perforissidae adults were suggested to indicate highly variable environmental humidity, possibly
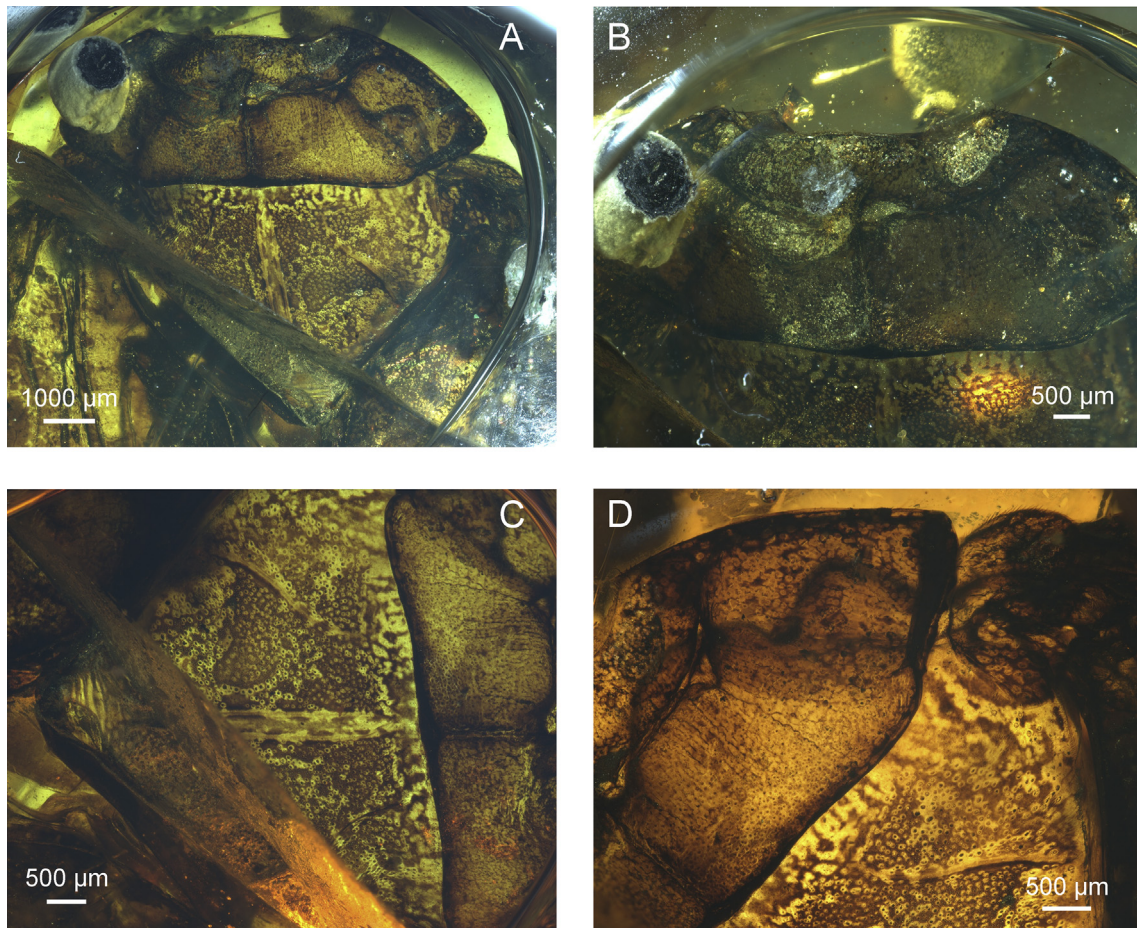
Fig. 6. Detailed photographs of *Dachibangus trimaculatus* sp. nov., holotype. A. Pronotum and mesonotum in dorsal view. B. Pronotum. C. Mesonotum. D. Tegula and part of mesonotum with prealar bridge beneath the pronotum.

related to coastal littoral environments (Shcherbakov, 2007a; Zhang et al., 2017). Opinion on hygroreceptory function of planthopper's sensory pits was contested by Bräunig et al. (2012) indicating that these receptors derive from mechanoreceptive hairs, but have been modified for the perception of another sensory modality that awaits identification. Numerous small sensory pits persisting in adult on head and thorax in Mimarachnidae, the numerous sensory pits persisted even on the tegula in the newly established genus *Dachibangus* gen. nov. suggested that these sensory structures were very important in the Cretaceous planthoppers.

5. Conclusion

The new genus and species described above is the second mimarachnid from Burmese amber, the largest known so far, with estimated total length about 35 mm. The newly established genus *Dachibangus trimaculatus* gen. et sp. nov. has peculiar venation pattern especially the narrow coastal area and strong curving of CuA_2. Mimarachnidae were previously thought to be restricted to the middle to high latitudes with wet, humid and cool to half arid, dry and warm climate (Shcherbakov, 2007b), probably with the seasonal alteration (Szwedo and Ansorge, 2015). Findings of *Burmissus* Shcherbakov, 2017 and *Dachibangus* gen. nov. from a tropical palaeoequatorial region, indicate that this family could also live in the tropical zone forests. This new find thus enhances our

understanding of the palaeogeographic and palaeoecological distribution of Cretaceous mimarachnids.

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