

An Extraordinary Early Jurassic Planthopper from Hunan (China) Representing a New Family Qiyangiricaniidae fam. nov. (Hemiptera: Fulgoromorpha: Fulgoroidea)

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Abstract: A new family of planthoppers Fulgoromorpha from the Lower Jurassic of southern China is described to comprise *Qiyangiricania cesta* Lin, 1986. The new family differs in venation pattern from the other Jurassic representatives of Fulgoroidea, presenting particular model of tegmen venation, not found among extinct and recent planthoppers. The Mesozoic stage of Fulgoroidea evolution is discussed. The extinct taxon *Ricaniites fulgens* (Brodie, 1845) from the Purbeck of United Kingdom is excluded from the Hemiptera.

Key words: new family, Hemiptera, Lower Jurassic, taxonomy, evolution

1 Introduction

The suborder Fulgoromorpha (Insecta: Hemiptera) comprises three superfamilies: Permian Coleoscytoidea Martynov, 1935 with the sole Coleoscytidae Martynov, 1935, Permian and Triassic Surijokocixioidea Shcherbakov, 2000, with single family Surijokocixiidae Shcherbakov, 2000 and Fulgoroidea Latreille, 1807, the latter known since the Jurassic. Over 20 families of Fulgoroidea, extinct and extant, are recognized (Szwedo et al., 2004; Bourgoin and Szwedo, 2008). Extinct families of Fulgoroidea are: Jurassic Fulgoridiidae Handlirsch, 1906 and Cretaceous ones – Lalacidae Hamilton, 1990, Neazoniidae Szwedo, 2007, Perforissidae Shcherbakov, 2007, Mimarachnidae Shcherbakov, 2007 and Eocene Weiwoboidae Lin, Szwedo, Huang et Stroński, 2010 (Hamilton, 1990; Szwedo, 2007, 2008, 2009; Shcherbakov, 2007a, 2007b; Lin et al., 2010). The recently recognised extant Fulgoroidea families are: Achilidae Stål, 1866 + Achilixiidae Muir, 1923, Caliscelidae Amyot et Serville, 1843, Cixiidae Spinola, 1838, Delphacidae Leach, 1815, Derbidae Spinola, 1839, Dictyopharidae Spinola, 1838, Eurybrachidae Stål, 1862 + Gengidae Fennah, 1949, Flatidae Spinola, 1838 + Hypochthonellidae China et Fennah, 1952, Fulgoridae Latreille, 1807, Issidae Spinola, 1838 + Acanaloniidae Amyot et Serville, 1843, Kinnaridae

Muir, 1925 + Meenoplidae Fieber, 1872, Lophopidae Stål, 1866, Nogodinidae Melichar, 1898, Ricaniidae Amyot et Serville, 1843, Tettigometridae Germar, 1821 and Tropiduchidae Stål, 1866.

In the Jurassic Fulgoromorpha up to now only family Fulgoridiidae Handlirsch, 1906 is known (Szwedo et al., 2004; Bourgoin and Szwedo, 2008; Szwedo & Żyła, 2009). This group of insects is paraphyletic, and believed as ancestral to highly diversified extinct and recent families of this unit (Shcherbakov and Popov 2002, Szwedo et al., 2004, Bourgoin and Szwedo, 2008).

The species named *Qiyangiricania cesta* Lin, 1986, have been described from the Lower Jurassic Guanyintan Formation of Qiyang County, Hunan Province, China (Lin, 1986). It was attributed in original, brief description to the family Ricaniidae. Later, Szwedo et al. (2004) excluded it from Ricaniidae, placing in *incertae sedis* section. As representative of Ricaniidae family *Qiyangiricania cesta* appeared in Ross and Jarzembowski (1993) and Wang et al. (2006) reviews of fossil faunas.

The site in which the fossil *Qiyangiricania* Lin, 1986 was found is located near Guanyintan Town, Qiyang County, Yongzhou City, Hunan Province, southern China. The insect specimen occurs in the Fengjiachong Member of Guanyintan Formation, which consists of three units: the lower unit is Paijiachong Member; the middle unit is Dabakou Member; the upper unit is Fengjiachong Member. Paijiachong Member yields 13 insect specimens, of which

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one is Coleoptera and others are Blattoidea (Lin, 1986). Fengjiachong Member yields 15 specimens: three are Blattoidea, three are Heteroptera, one is Fulgoromorpha and eight are Coleoptera (Lin, 1986). Chen et al. (1980) provided a description of the fauna and general geology. Zhou (1984) described fossil plants within 72 species of 33 genera from the Guanyintan.

The Guanyintan plant assemblage belongs to the *Dictyophyllum-Clathropteris* flora. The age of Guanyintan Formation is attributed to the Early Jurassic, according to the analysis of fossil plants, spores, gastropods, bivalves, ostracods and fishes (Chen and Xu, 1980; Zhou, 1984). Furthermore, based on the analysis of fossil plants, the age of Fengjiachong Member is probably from the Late Pliensbachian or Toarcian to Aalenian (Zhou, 1984). This Formation represents the coastal lacustrine facies with some probable lagoon deposits. Generally, the palaeoclimate in Early Jurassic time in southern China was humid/semi-humid, tropical/subtropical temperate (Rees et al., 2000). Fossil plants showed that the Early Jurassic palaeoclimate in southwestern Hunan including Qiyang area was wet and warm temperate, and evidently cooler than the Late Triassic tropical/subtropical temperate (Zhou, 1984). However, spores analysis indicated that the Early Jurassic palaeoclimate in this area was dry and hot temperate (Shang, 1981).

Reexamination of the type specimen and another specimen preserved in NIGP CAS in Nanjing gave the possibility of finding additional characters of this taxon given below. As it differs clearly from any other known Jurassic planthoppers, and presents characters exceeding rank of the only recorded in the Jurassic deposits family of Fulgoromorpha – Fulgoridiidae Handlirsch, 1906, the genus *Qiyangiricania* is placed in the new family Qiyangiricaniidae fam. nov.

2 Material and Methods

Holotype of *Qiyangiricania cesta* Lin, 1986 was examined – imprint of tegmen, specimen number NIGP70053, deposited in Nanjing Institute of Geology and Palaeontology, Chinese Academy of Sciences, Nanjing. Additional material examined – imprint of tegmen, very probably counterpart of type specimen, but not mentioned in original paper, stored together with the type-specimen but not separately numbered. Observations were made using Nikon SMZ1000 stereomicroscope and drawings were prepared with camera lucida. Photographs were taken using Nikon D100 digital camera attached to the stereomicroscope, and readjusted using image editing software Combine ZP and Adobe® Photoshop Elements 6.0. We follow the wing venation nomenclature according

to Szwedo and Żyła (2009) and present synonymy according to open nomenclature principles proposed by Matthews (1973) and Bengtson (1988).

3 Systematics

Ordo Hemiptera Linnaeus, 1758

Subordo Fulgoromorpha Evans, 1946

Superfamilia Fulgoroidea Latreille, 1810

Familia **Qiyangiricaniidae fam. nov.** Szwedo, Wang et Zhang

Type genus: *Qiyangiricania* Lin, 1986; here designated.

Diagnosis: Superficially resembling so-called ‘higher’ Fulgoroidea in tegmen shape and venation. It differs from ‘Fulgoridiidae’ (paraphyletic unit) by following combination of characters: anterior margin of tegmen distinctly thickened; costal area developed, without veinlets, slightly widened in apical, prenodal portion and probably more chitinized (costal area, if developed then with transverse veinlets at least in distal portion, or costal area not developed in known ‘Fulgoridiidae’), stem Pc+CP shifted from stem CA for about half of costal cell width (costal area narrow at base, or if stem Pc+CP shifted from CA then costal area about as wide as costal cell in ‘Fulgoridiidae’); stigmal area not developed; longitudinal veins with small tubercles; stem Sc+R short, branch RP forked at level of nodal line (stem Sc+R longer, branch RP forked more distad than level of nodal line in most ‘Fulgoridiidae’); stem M forked distinctly apicad of nodal line veinlets *r-m* and *m-cua*; stem CuA very short, branch CuA₁ not forked before margin (branch CuA₁ forked before margin in ‘Fulgoridiidae’); vein CuP thickened, but claval suture distinct (claval vein not thickened in ‘Fulgoridiidae’); claval veins Pcu and A₁ thickened at base (claval veins not thickened in ‘Fulgoridiidae’); distinct sigmoid oblique veinlets *m-cua* and *icua* in well basad half of tegmen; apical portion of tegmen with supranumerary irregular veinlets and secondary veinlets forming polygonal cells and false longitudinal ‘veins’; postclaval portion slightly widened; the part of apical margin occupied by terminals of M distinctly smaller than part occupied by terminals of CuA.

Genus *Qiyangiricania* Lin, 1986

Type species: *Qiyangiricania cesta* Lin, 1986; by original designation.

1986 Lin: 65, 23, 102.

2004 Szwedo et al.: 127.

2006 Wang Y. et al.: 296.

Diagnostic characters: Tegmen with costal margin thickened, apex of clavus exceeding two-thirds of tegmen length, anterior and posterior apical angles widely angulate. Costal margin thickened, costal area developed; veins of costal complex (i.e. CA and Pc+CP) shifted; basal cell twice as long as wide, arculus straight, transverse; longitudinal veins with scarce tubercles along, stem Sc+R leaving basal cell slightly basad of stem M, thickened basally; stem Sc+R forked at level of second CuA forking, branch Sc+RA forked basad of branch RP, basad of claval

apex, terminal ScRA₁ reaching margin apicad of level of claval apex; branch RP forked at level of claval apex; stem M in basal portion, thickened leaving basal cell; stem M forked distinctly apicad of nodal line level, branch M₁₊₂ forked distinctly basad of branch M₃₊₄ forking; stem CuA thickened leaving basal cell, with 4 longitudinal branches, first branching very basad, second branching at level of stem Sc+R forking, third branching slightly basad of claval veins Pcu+A₁ junction, branch CuA₁ reaching margin as single terminal, branches CuA_{2a} and CuA_{2b1} and CuA_{2b2} reaching margin with a few terminals. Claval suture, vein CuP thickened; claval veins Pcu and A₁ thickened in basal

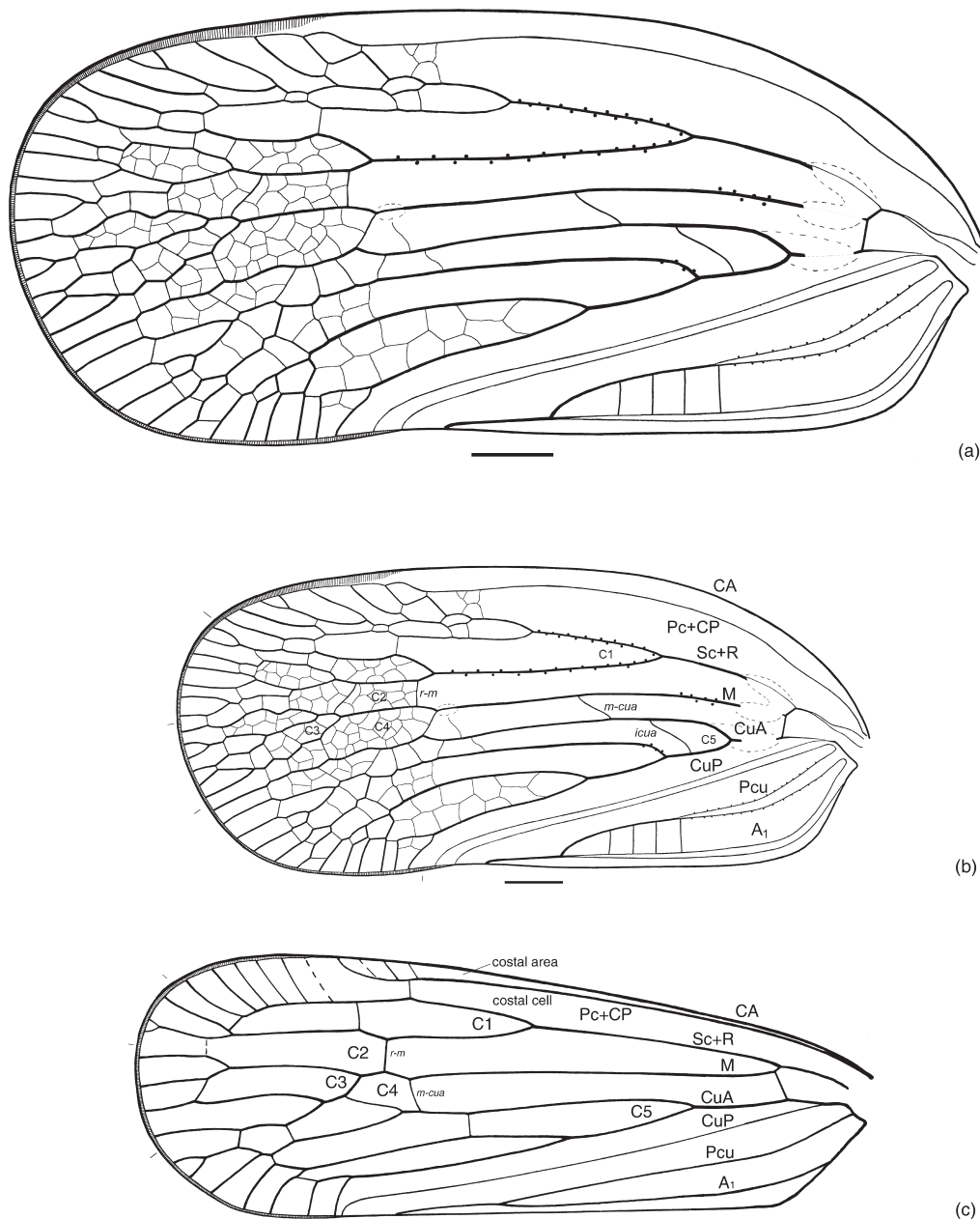


Fig. 1. *Qiyangiricania cesta* Lin, 1986.

(a) tegmen's venation pattern, partly reconstructed; (b) nomenclature of tegmen veins and cells; (c) *Fulgoridium balticum* (Geinitz, 1880) – tegmen venation pattern and vein and cells nomenclature. After Szwedo and Żyła (2009), modified.

portion basad of their junction; claval veins junction apicad of half of clavus length, apicad of third forking of stem CuA; transverse veinlets between Pcu and A₁ in median portion of clavus present. Oblique veinlets *m-cua* and *icua* present at very base of tegmen, nodal line veinlets *r-m* and *m-cua* distinct; indistinct secondary veinlets forming polygons basad of stigmal area, between Sc+RA₁ and Pc+CP visible, a few indistinct prenodal veinlets *ir*, *m-cua* and *icua* present; postnodal veinlets not forming distinct lines; a net of secondary irregular veinlets, forming polygonal cells between longitudinal veins present; cell C5c with more distinct secondary veinlets forming polygonal net with false longitudinal 'vein' in the middle of cell; postclaval portion slightly widened; reinforced between claval apex and apex of costal area with minute striations.

Qiyangiricania cesta Lin, 1986 (Figs. 1a, 1b; Plate I)

1986 Lin: 65, 23, 102, Pl. 10, fig. 1, Text-fig. 58.

2004 Szwedo et al.: 127.

Age and occurrence: Lower Jurassic, Fengjiachong Member of the Guanyintan Formation, Guanyintan Town, Qiyang County, Yongzhou City, Hunan Province, China.

Diagnostic characters: Tegmen about twice as long as wide, costal cell about as wide as radial cell, median and cubital cells narrower, of similar width; clavus exceeding 0.6 of tegmen length; branch RA reaching apical margin with 5 terminals, branch RP reaching margin with 8 terminals, vein M with 6 terminals reaching apical margin, vein CuA reaching margin with 12 terminals; first prenodal veinlet *icu* sigmoid, oblique, basad of second forking of vein CuA, first prenodal veinlet *m-cua* slightly more apicad, sigmoid, oblique, basad of third forking of vein CuA; nodal line veinlets *r-m* and *m-cua* distinct; nodal veinlet *r-m* straight, apicad of nodal veinlet *m-cua*, nodal veinlet *m-cua* oblique.

Description: Length of tegmen about 11.25 mm, width of tegmen 5.5 mm, length of clavus about 0.7 mm. Coloration: background of tegmen light brown-yellowish, anterior half with two transverse red-brownish bands, narrower and wider bands anterior of nodal line level, with lighter staining from costal margin to vein CuA₁ on wider one, and narrower band in apical portion; less distinct (incomplete?), more arcuate bands at level of nodal line and apical of nodal line; bases of stems Sc+R, M and CuA with oval, lighter, whitish spots; second band with lighter elongated spots at level of longitudinal veins; both bands anterior of nodal line level with lighter, whitish spots; less distinct spots on bands at nodal line and apical of nodal line; longitudinal veins emarginated with brownish

coloration; very distinct at veins CuP, Pcu and A₁; thickened parts of claval veins lighter, whitish.

4 Discussion

The Jurassic Fulgoroidea was placed in the single family Fulgoridiidae (Szwedo et al., 2004). However this family seems to be a paraphyletic unit and calls for revisionary studies (Bourgoin and Szwedo, 2008; Szwedo and Żyła, 2009). The genus *Qiyangiricania* Lin, 1986 was originally placed in the recent family Ricaniidae and proposed to be in relationship with fossil taxon *Ricaniites fulgens* (Brodie, 1845) from the Lower Cretaceous of Purbeck, United Kingdom. Examination of material of this taxon deposited in Natural History Museum in London proved that *Ricaniites fulgens* is not a Hemiptera, as the hind leg presents four segmented tarsus, of which the basitarsomere is strongly elongated, and the visible portion of tegmen venation only superficially resemble the pattern of so-called 'higher' Fulgoroidea (Plate II-1-4).

The newly erected family Qiyangiricaniidae fam. nov. is characteristic of particular set of characters clearly placing it as separate unit. It shares some characters with some known 'Fulgoridiidae' taxa, but with unique combination of characters. The tegmen is about twice as long as wide; while in most taxa placed in 'Fulgoridiidae' it is distinctly longer, with length/width ratio about 2.5-3.3. Thickened costal margin with veins of costal complex Pc+CP shifted from CA is also present in some species placed in 'Fulgoridiidae', e.g. *Fulgoridium reduncum* Bode, 1953, from Lower Jurassic (Upper Liassic) of Germany, but usually costal area is narrow at base, distinctly narrower than costal cell, sometimes slightly more shifted in apical portion. If costal veins are distinctly shifted as for example in '*Fulgoridium schandelachense*' Szwedo, Bourgoin et Lefebvre, 2004, '*Fulgoridium inconspicuum*' Handlirsch, 1939 it is not reaching the level of claval apex and transverse veinlets are present in costal area (Bode, 1953; Handlirsch, 1939). On the other hand in '*Fulgoridium paulodilatatum*' Bode, 1953, costal complex of veins is distinctly shifted, costal area is as wide as costal cell, with a few transverse veinlets, and with apex exceeding apex of clavus. In *Fulgoridulum* Handlirsch, 1939 the costal margin is thickened, but the veins of costal complex are not shifted. In *Qiyangiricania* costal area is developed but lacking veinlets and seems to be sclerotized up to level of stigmal area; such character is not known in 'Fulgoridiidae'. The wide basal cell is characteristic feature of taxa placed in 'Fulgoridiidae'; this character is shared by Qiyangiricaniidae with 'Fulgoridiidae'. In the recent 'higher' Fulgoroidea, e.g. Ricaniidae and Nogodinidae the wide basal cell is also developed. However, if this character

is probably symplesiomorphic condition in 'Fulgoridiidae' and Qiyangiricaniidae, in 'higher' Fulgoroidea seems to be rather homoplastic, and related to widening of tegmina. Stem Sc+RA leaving basal cell more basad than stem M is a symplesiomorphic condition, shared by Qiyangiricaniidae with Jurassic 'Fulgoridiidae', Cretaceous Perforissidae and Mimarachnidae, and some extinct and extant Cixiidae; it could appear also in some recent 'higher' Fulgoroidea. This condition seems to be inherited from common relatives of Fulgoroidea – Permian Coleoscytidae and Upper Permian–Upper Triassic Suriyokocixiidae. Most of 'Fulgoridiidae' is characteristic of forking of stem Sc+R apicad than half of tegmen length (seldom slightly basad), in Qiyangiricaniidae this fork is clearly more basad. Such basad forking of Sc+R stem is also found among so-called 'higher' Fulgoroidea, e.g. in some Lophopidae, Flatidae, Acanaloniidae, Nogodinidae, Ricaniidae. It could be hypothesized that this character is homoplastic, related with widening of tegmen in respect to its width. The characters shared by Qiyangiricaniidae and 'Fulgoridiidae' are late forking of stem M, apicad of nodal line. Similar placement, with distal forking of stem M is observed in the Cretaceous Mimarachnidae, with somewhat reduced and transformed venation pattern, with open clavus. In Upper Permian–Upper Triassic Suriyokocixiidae and Permian Coleoscytidae, this fork is about level of nodal line. Similar placement is found in Perforissidae (Cretaceous), Cixiidae, Delphacidae, Dictyopharidae, Kinnaridae, most Tropicuchidae, while in numerous 'higher' Fulgoroidea stem M is forked distinctly more basally, sometimes nearly or at level of basal cell (some Ricaniidae). Early forking of stem CuA is present among various Fulgoroidea. The particular character of Qiyangiricaniidae, clearly separating it from 'Fulgoridiidae' is single branch CuA₁, while branch CuA₂ is more branched. In 'Fulgoridiidae' both branches are forked, often branch CuA_{1a} is shifted to branch of M (Handlirsch, 1906, 1939; Bode, 1953; Ansoerge, 1996). Thickened vein CuP is a unique character of Qiyangiricaniidae. In Fulgoroidea claval vein do not differ from the other longitudinal veins or it is thinned, present as claval suture. Thickened basal portion of claval veins is another particular character of Qiyangiricaniidae, not known among Jurassic 'Fulgoridiidae'. Thickened and tuberculate vein Pcu or both Pcu and A₁ are known among the recent Meenopliidae. Meenopliidae is recently grouped with Kinnaridae (Bourgoin, 1993, 1997) as monophyletic taxon. This unit is placed in cixiid-like group of families, comprising the oldest recent representatives of Fulgoroidea. If this character in Meenopliidae is homologous with Qiyangiricaniidae or developed independently is still under question. Another striking character of Qiyangiricaniidae is presence of distinct,

oblique, sigmoid veinlets *m-cua* and *icua* at very base of tegmen. If there are veinlets in this part of tegmen (e.g. some recent Flatidae, Eurybrachidae, Ricaniidae), the veinlets in prenodal portion are usually numerous, not single. Elongate, oblique veins *m-cua* are present in the Upper Jurassic *Aulieezidium* Szwedo et Żyła, 2009, but placed more distad, however basad of nodal line (Szwedo and Żyła, 2009). The net of secondary veinlets, forming polygonal cells present in the apical portion of the tegmen of Qiyangiricaniidae resemble the pattern found in Lower Cretaceous Mimarachnidae (Shcherbakov, 2007b). Secondary irregular veinlets are also present in some representatives of 'higher' Fulgoroidea, but also in some Fulgoridae and Dictyopharidae. The formation of crossveins was discussed by Marcus (2001). He postulated the model of formation and capacity of modulation of crossvein structure is divided into three stages, and that altering components of these three stages can independently regulate presence or absence, the number and placement, and the thickness and flexibility of the crossveins. It seems reasonable that these mechanisms could be also applied in Fulgoromorpha, resulting in variability (and similarity) of crossveins patterns in various Fulgoromorpha units. Therefore, Qiyangiricaniidae fam. nov. present a mosaic of characters known among other Jurassic Fulgoroidea, mixed with apomorphic features, the characters shared with other Fulgoroidea, and homoplastic ones, making them superficially similar to so-called 'higher' Fulgoroidea.

The Jurassic Fulgoroidea is still weakly known. With exception of 'Fulgoridiidae' recorded from the Lower Jurassic of Europe and Middle Jurassic of Asia (Szwedo et al., 2004; Zhang et al, 2004; Szwedo and Żyła, 2009), unidentified Fulgoroidea (different than known 'Fulgoridiidae') are also reported from the Lower Jurassic of Western Australia (Martin, 2008). During the Jurassic drastic tectonic differentiation of the land masses had place. Laurasia (more or less corresponding to modern Eurasia) became separated from the block of southern continents, i.e. Gondwana by the Tethys Ocean. The Southern continental block had been divided by the newly formed Indian and Atlantic Oceans into Western Gondwanaland (South America, Antarctica, Australia, New Zealand) and Eastern Gondwanaland, which began further dividing into Africa, Indian subcontinent and Madagascar (Ali and Aitchison, 2005; Golonka, 2007). Numerous groups of insects originated during the Jurassic in the equatorial belt, and subsequently appeared at higher latitudes (in Siberia and Gondwana). On the other hand, it was the time when apparent movement occurred also in the opposite direction, from high to low latitudes. During the Early and Middle Jurassic, however, there are a whole series of taxa which

had originated in the temperate Siberian region (including Mongolia and northern China) and some time later penetrated into the Equatorial region (Eskov, 2002). Due to this reason, Zherikhin (1980a, b, c) noted that the Siberian entomofaunas of the Early Jurassic are very advanced and seem to be more similar to the Late Jurassic ones than to the equatorial (Indo-European) faunas of the Early Jurassic. Both the above trends can be regarded as departures from the operating regime of the “equatorial pump”; they can be directly attributed to the establishment of a less contrasting world climate in the geologic time under consideration (Eskov, 2002). The Lower Jurassic representatives of ‘Fulgoridiidae’ appear in the fossil record in the warm temperate zone. Also Qiyangiricaniidae are found in warm temperate zone, as well as Fulgoroidea from Western Australia (Rees et al., 2000). Regarding the distribution of Suriokocixiidae, presumed ancestors of Fulgoroidea, i.e. Upper Permian *Suriokocixius* Becker-Migdisova, 1961 (Suriokova, Kuznetsk Basin), *Scytocixius* Martynov 1939 (Kuznetsk Basin and Orenburg: Priuralye), and Triassic *Boreocixius* Becker-Migdisova, 1955 (Taimyr Peninsula), and *Tricrosbia* Evans, 1971 (Mt. Crosby, Queensland) the “equatorial pump” could be a reason of differentiation and variability of Fulgoroidea in the Lower Jurassic. During the Late Triassic, the climatic zonality was not strongly pronounced and a frostless climate prevailed at this time (Meyen, 1987; Ziegler et al., 2003), while in the Early Jurassic the distinctive biomes can be recognized (Rees et al., 2000; Willis and McElwain, 2002). However, the relationships among early Fulgoroidea and their descendants seem to be unclear and need further studies. The ‘Fulgoridiidae’ genus *Eofulgoridium* Martynov, 1939 is known from the Lower Jurassic Sangonghe Formation of northwestern China (Zhang et al., 2004). Other genera and species of ‘Fulgoridiidae’ are reported from the Lower Jurassic deposits of Central Asia (Szwedo et al., 2004). All these taxa are reported from the warm temperate climatic zone (Rees et al., 2000). It seems that separation of Qiyangiricaniidae, ‘Fulgoridiidae’ and Fulgoroidea from Australia took place earlier, and may be related to rapid radiation after the Triassic/Jurassic extinction event (Tanner et al., 2004; Deng et al., 2005), floral changes related to evolution and radiation of gymnosperms (McElwain et al., 1999; Willis and McElwain 2002; Taylor et al., 2009).

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Explanation of plates

Plate I. *Qiyangirania cesta* Lin, 1986

1. Holotype, specimen no. NIGP70053, venation pattern.
2. Holotype, specimen no. NIGP70053, coloration.
3. Counterpart (?) of holotype, venation pattern.
4. Counterpart (?) of holotype, coloration.
5. Counterpart (?), coloration and venation pattern in other view.

Plate II. *Ricaniites fulgens* (Brodie, 1845)

1. Holotype, part number I. 3505, deposited in Department of Palaeontology, Natural History Museum in London. Preserved part of body, wings and legs. Photo V. Blagoderov (NHM).

2. Holotype, part number I. 3505, deposited in Department of Palaeontology, Natural History Museum in London. Wings. Photo V. Blagoderov (NHM).
3. Holotype, part number I. 3505, deposited in Department of Palaeontology, Natural History Museum in London. Specimen. Photo V. Blagoderov (NHM).
4. Counterpart, number I. 3995, deposited in Department of Palaeontology, Natural History Museum in London. Preserved part of body, wings and legs. Photo V. Blagoderov (NHM).
5. Label of holotype, part, number I. 3505, deposited in Department of Palaeontology, Natural History Museum in London. Preserved part of body, wings and legs. Photo V. Blagoderov (NHM).
6. Label of counterpart, number I. 3995, deposited in Department of Palaeontology, Natural History Museum in London. Preserved part of body, wings and legs. Photo V. Blagoderov (NHM).

Plate I



Plate II

