New fossil Mesochrysopidae (Neuroptera) from the Mesozoic of China

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Abstract

A new genus and two new species of extinct Mesochrysopidae (Neuroptera) are described from the Mesozoic of China: Protoaristenymphes daohugouensis sp. nov., from the Middle Jurassic of Daohugou, Inner Mongolia; and Kareninoides llii gen. et sp. nov., from the Early Cretaceous (Yixian Formation) of Dakangpu, Liaoning Province. The presence of CuP in one hind wing of K. llii gen. et sp. nov. is interpreted as an atavism. Armandochrysopa Nel et al. is regarded as a new junior synonym of Karenina Martins-Neto. Armandochrysopa inexpecta Nel et al. is tentatively transferred to Kareninoides gen. nov.

Key words: Neuroptera, Mesochrysopidae, Daohugou, Yixian Formation, Mesozoic, China

Introduction

The Mesozoic family Mesochrysopidae Handlirsch, 1906 was hitherto considered to consist of 14 genera and 24 species occurring from the Early Jurassic to the Early Cretaceous of Eurasia and South America (Makarkin & Menon 2005; Nel et al. 2005; Menon & Makarkin 2008; Ren et al. 2010; Makarkin et al. 2012). Chimerochrysopa incerta Nel et al., 2005 from the Spanish Las Hoyas locality was preliminary assigned to this family by Makarkin et al. (2012). Here, we remove it from Mesochrysopidae, as we consider that its characters do not allow confident placement to family. We also describe one new genus and two new species from the Mesozoic of China, and synonymize the genus Armandochrysopa Nel et al. 2005. Therefore, we treat the family as comprising of 13 genera and 25 species (Table 1).

The occurrence of specialized mesochrysopids is the most characteristic feature of Early Cretaceous neuropteran assemblages, distinguishing them from those that are both older and younger (Makarkin et al. 2012). Herein, one new genus and species of such a derived taxon are described from the Aptian/Barremian Yixian Formation of Liaoning Province, China. This family occurs very rarely in the Jurassic; hitherto, only four specimens were known. Recently, one poorly preserved specimen was found among approximately 2000 neuropteran specimens examined from the Middle Jurassic locality at Daohugou, Inner Mongolia in China. This is described here as representing a new species of the genus Protoaristenymphes Nel et Henrotay, 1994, hitherto only known by the type species from the Early Jurassic of Europe.

Material and Methods

This work is based on two specimens, collected from the Daohugou and Dakangpu localities, and housed in the Key Laboratory of Insect Evolution and Environmental Changes, College of Life Sciences, Capital Normal University, Beijing, China (CNUB; Dong Ren, curator).

Daohugou Village is situated in Shantou Township, Ningcheng County, Inner Mongolia, China. The insect-bearing beds of the Daohugou locality are considered as belonging to the Jiulongshan Formation, and dated as

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Bathonian, Middle Jurassic (Gao & Ren 2006). The Dakangpu locality is situated in Liulongtai Township, Yixian County, Liaoning Province, China (see map in Shen et al. 1998: Fig. 1). Its insect-bearing bed is considered to be equivalent to the Dawangzhangzi Member (Bed) of the middle Yixian Formation, which is dated as early Aptian, Early Cretaceous (Wang & Zhou 2008; Carpenter & Ishida 2010; Makarkin et al. 2012).

FIGURE 1. Protoaristenymphes daohugouensis sp. nov. Holotype CNU-NEU-NN2011103PC. A, part. B, counterpart. Scale bar is 10 mm.
<table>
<thead>
<tr>
<th>Species</th>
<th>Age</th>
<th>Locality</th>
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</thead>
<tbody>
<tr>
<td>1 Protoaristenymphes bascharagensis Nel &amp; Henrotay, 1994</td>
<td>Early Jurassic (Early Toarcian)</td>
<td>Bascharage, Luxembourg</td>
</tr>
<tr>
<td>2 Protoaristenymphes daohugouensis sp. n.</td>
<td>Middle Jurassic (Bathonian/ Callovian)</td>
<td>Daohugou, Inner Mongolia, China</td>
</tr>
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<td>3 Macronympha elegans Parfilov, 1980</td>
<td>Late Jurassic (Oxfordian/ Kimmeridgian)</td>
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</tr>
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<td>4 Aristenymphes perfectus Panfilov 1980</td>
<td>Late Jurassic (Oxfordian/ Kimmeridgian)</td>
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<td>5 Mesochrysopa zitteli (Meunier, 1898)</td>
<td>Late Jurassic (Early Tithonian)</td>
<td>Solnhofen (Eichstätt), Germany</td>
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<tr>
<td>6 Mesotermes heros (Hagen, 1862)</td>
<td>Late Jurassic (Early Tithonian)</td>
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<td>7 Tachinymphes ascalaphoides Ponomarenko, 1992</td>
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<td>8 Tachinymphes delicatus (Ren &amp; Yin, 2002)</td>
<td>Early Cretaceous (Barremian)</td>
<td>Huangbanjigou, Liaoning, China</td>
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<tr>
<td>9 Tachinymphes magnificus Nel et al., 2005</td>
<td>Early Cretaceous (Barremian)</td>
<td>Huangbanjigou, Liaoning, China</td>
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<tr>
<td>10 Mesascalaphus yangi Ren in Ren et al., 1995</td>
<td>Early Cretaceous (Barremian)</td>
<td>Huangbanjigou, Liaoning, China</td>
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<tr>
<td>11 Longicellochrysa yixiana Ren et al., 2010</td>
<td>Early Cretaceous (Barremian)</td>
<td>Huangbanjigou, Liaoning, China</td>
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<td>12 Nanochrysopa pumilio Nel et al., 2005</td>
<td>Early Cretaceous (Barremian)</td>
<td>Las Hoyas, Spain (La Huerguina Fm)</td>
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<td>13 Tachinymphes paicheleri Nel et al., 2005</td>
<td>Early Cretaceous (Barremian)</td>
<td>Las Hoyas, Spain (La Huerguina Fm)</td>
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<tr>
<td>14 Tachinymphes penalveri Nel et al., 2005</td>
<td>Early Cretaceous (Barremian)</td>
<td>Las Hoyas, Spain (La Huerguina Fm)</td>
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<tr>
<td>15 Kareninoides inexpectus (Nel et al., 2005)</td>
<td>Early Cretaceous (Barremian)</td>
<td>Las Hoyas, Spain (La Huerguina Fm)</td>
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<tr>
<td>16 Triangulochrysopa sanzi Nel et al., 2005</td>
<td>Early Cretaceous (Barremian)</td>
<td>Las Hoyas, Spain (La Huerguina Fm)</td>
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<td>17 Allopterus mayorgai Nel et. al., 1991</td>
<td>Early Cretaceous (Barremian)</td>
<td>Nanliezhuang, Shandong, China</td>
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<tr>
<td>18 Allopterus luianus J.Zhang 1991</td>
<td>Early Cretaceous (?Barremian)</td>
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<td>19 Kareninoides lii gen. et sp. nov.</td>
<td>Early Cretaceous (Aptian)</td>
<td>Chapada do Araripe, Brazil (Crato Fm)</td>
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<tr>
<td>20 Karenina breviptera Martins-Neto, 1997</td>
<td>Early Cretaceous (Late Aptian)</td>
<td>Chapada do Araripe, Brazil (Crato Fm)</td>
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<td>21 Karenina borschukewitzi (Nel et al., 2005), comb. nov.</td>
<td>Early Cretaceous (Late Aptian)</td>
<td>Chapada do Araripe, Brazil (Crato Fm)</td>
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<tr>
<td>22 Karenina leilana Makarkin &amp; Menon, 2005</td>
<td>Early Cretaceous (Late Aptian)</td>
<td>Chapada do Araripe, Brazil (Crato Fm)</td>
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<tr>
<td>23 Karenina longicornis Makarkin &amp; Menon, 2005</td>
<td>Early Cretaceous (Late Aptian)</td>
<td>Chapada do Araripe, Brazil (Crato Fm)</td>
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<td>24 Triangulochrysopa formosa Menon &amp; Makarkin, 2008</td>
<td>Early Cretaceous (Late Aptian)</td>
<td>Chapada do Araripe, Brazil (Crato Fm)</td>
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<tr>
<td>25 Dryellina placida Martins-Neto &amp; Rodrigues, 2009</td>
<td>Early Cretaceous (Late Aptian)</td>
<td>Chapada do Araripe, Brazil (Crato Fm)</td>
</tr>
</tbody>
</table>
The specimens were examined under a Leica MZ12.5 dissecting microscope; line drawings were prepared with CorelDraw 12 graphics software with the aid of Adobe Photoshop CS3; photographed by a Nikon SMZ1000 stereomicroscope; the specimen CNU-NEU-LY2011001PC was photographed by Nikon D100 Digital Camera.

Wing venation terminology in general follows Kukalová-Peck & Lawrence (2004) except for the median vein, which we treat as in Yang et al. (2012). Terminology of wing spaces and details of the venation (e.g., subcostal veinlets) follows Oswald (1993). Principal crossveins in the basal part of the wing are designated by the longitudinal veins to which they connect, and numbered in sequence from the wing base, e.g., 1m-cu, 2m-cu, basal and second crossveins between M (MA) and Cu (CuA).

Venational abbreviations: AA, Analis Anterior; AP, Analis Posterior; Cu, Cubitus; Cubitus Anterior; CuP, Cubitus Posterior; im, first intramedian cell; M, Media; MA, Media Anterior; MP, Media Posterior; R, Radius; RA, Radius Anterior; RP, Radius Posterior; RP1, proximal-most branch of RP; ScP, Subcosta Posterior.

Systematic paleontology
Insecta Linnaeus, 1758
Neuroptera Linnaeus, 1758
Mesochrysopidae Handlirsch, 1906
Genus Protoaristenymphes Nel et Henrotay, 1994

Type species. Protoaristenymphes bascharagensis Nel et Henrotay, 1994, by original designation.

Diagnosis. Medium-sized, forewing length 16–25 mm [20 mm in Aristenymphes Panfilov, 1980; 46 mm in Macronympha Panfilov, 1980]; in forewing, M forked somewhat distal to or at level of origin of RP [shared with Aristenymphes; strongly distal in Macronympha; im long, 5–6 times as long as wide [shared with Macronympha; 4 times in Aristenymphes]; MP with four branches [shared with Macronympha; two in Aristenymphes]; AA3+4 deeply forked [unknown in Macronympha; shallowly forked in Aristenymphes].

Species included. Two species from the Jurassic of Eurasia: Protoaristenymphes bascharagensis Nel et Henrotay, 1994 from the Early Jurassic of Bascharage, Luxembourg, and P. daohugouensis sp. nov. from the Middle Jurassic of Daohugou, China.

Remarks. The venation of this genus is very similar to that of the genera Macronympha and Aristenymphes known from the Late Jurassic of Kazakhstan (Panfilov, 1980). These three genera are oldest in the family (Early Toarcian to Oxfordian/Kimmeridgian) and clearly closely related. Their forewing venation strongly differs from those of other (younger) genera of Mesochrysopidae, mainly in the arrangement of their crossveins, the presence/absence of Banksian folds (lines), the configuration of MP and CuA and by the veinlets of ScP+RA. The generic status of Macronympha, Aristenymphes and Protoaristenymphes needs further confirmation as the differences between them are minimal (see diagnosis of Protoaristenymphes). However, the discovery of a new species whose character states well agree with those of one genus shows that these minimal differences may be indeed generic.

Protoaristenymphes bascharagensis is represented by a forewing, lacking the apex. The estimated complete length of this wing is about 16.5 mm, not 18 mm as estimated by Nel & Henrotay (1994).

Protoaristenymphes daohugouensis sp. nov.
(Figs 1–3)

Diagnosis. May be distinguished from P. bascharagensis by larger size [forewing 25 mm long in P. daohugouensis, about 16.5 mm in P. bascharagensis]; M forked distal to origin of Rs [at same level in P. bascharagensis]; distal crossvein between CuP and AA3+4 located proximal to fork of AA3+4 [distal in P. bascharagensis].

Description. Body incompletely preserved. Head, prothorax not preserved. Mesonotum and metanotum relatively well preserved, morphology as usual for Neuroptera with large meso- and metascutum (Fig. 2, mssc, mtsc). Mid-, hindleg femora and tibiae covered with dense short hairs alternating with scarce stouter black hairs; tibial spurs not detected; basitarsus of hindleg covered with dense short hairs. Other leg segments not preserved. Metapostnotum not preserved. Abdomen almost complete, but poorly preserved; first tergite not preserved except distinct transverse stout transverse suture divided medially (Fig. 2, ts).
Forewing 19.5 mm long as preserved (estimated complete length 24–25 mm), 7.5 mm wide. Costal space narrow for entire preserved length. Subcostal veinlets simple, widely spaced in proximal half, becoming more closely spaced towards pterostigma. Subcostal space rather narrow, slightly dilated towards apex; subcostal crossveins not detected. RA space tapering basally, with widely spaced crossoveins. RP originated very far from wing base, slightly zigzagged; its branches regularly pectinately branched. Crossveins in radial space arranged in two gradate series. M basally fused with R for considerable distance, forked distal to origin of RP, MA and MP running nearly parallel to each other. MA clearly arched. MP pectinate, with three simple branches. Intramedian
cell in elongate, about 5 times as long as wide. Basal crossvein m-cu long, nearly at right angle to M. Cu dividing into CuA, CuP at level of origin of M. CuA, CuP both with two simple pectinate branches. Two crossveins between CuA, CuP. Distal crossveins between MP, CuA (2m-cu) and distal crossveins between CuA, CuP aligned. Two crossveins between CuP and AA3+4. Distal crossvein between CuP and AA3+4 and crossvein between AA3+4 and AP1+2 long, aligned. AA3+4 slightly arched, with deep wide terminal fork. AP1+2 probably forked (poorly preserved); AP3+4 short, simple, strongly arched.

Hind wing about 21 mm long as preserved (estimated complete length 23–23.5 mm), 6 mm wide. Costal space relatively narrow. Subcostal veinlets simple, widely spaced. ScP and RA fused distally. Subcostal space rather narrow, slightly dilated towards apex; subcostal crossveins not detected. RA space tapering basally. RP originated far from wing base (but more proximal than in forewings), slightly zigzagged, with eight preserved branches (estimated number 9–10); at least RP2 and RP3 deeply forked distal to outer gradate series. Crossveins in radial space arranged in two gradate series. M forked far distal to origin of RP. Two crossveins between MA and MP, belonging to inner and outer gradate series respectively. MA probably simple, arched. MP deeply forked, each branch again deeply forked; between these branches one crossvein belonging to outer gradate series. One crossvein preserved between MP and CuA belonging to outer gradate series. CuA and AA3+4 only partially preserved.

**Material.** Holotype CNU-NEU-NN2011103PC (part, counterpart), deposited in CNUB. An incomplete, poorly preserved specimen.

**Type locality and horizon.** Daohugou, Inner Mongolia, NE China; Middle Jurassic, Jiulongshan Formation.

**Etymology.** From Daohugou, the type locality of the new species.

**Remarks.** We assigned the new species to the genus *Protoaristenymphes* as its characters fully agree with the generic diagnosis. It differs from *Protoaristenymphes bascharagensis* as indicated in the species diagnosis.

A structure showed in Figure 2 (labeled ts) is preliminarily interpreted here as the transverse suture of the first abdominal tergite (‘Transversalnaht’ of Achtelig 1975). We make this determination because of its position, which is characteristic of such transverse sutures of other species (see below).

**FIGURE 3.** *Protoaristenymphes daohugouensis* sp. nov. Holotype CNU-NEU-NN2011103PC (counterpart), right wings wetted with ethanol. Scale bar is 10 mm.

**Genus Kareninoides gen. nov.**

**Type species.** *Kareninoides lii* gen. et sp. nov.

**Etymology.** Karenin- (from *Karenina* Martins-Neto, 1997, a genus-group name), and -oides (the Latin suffix meaning “resembling”, from the Greek eidos, resemblance), referring to the similarity of its venation to that of the genus *Karenina*. Gender: masculine.

**Diagnosis.** Most similar to *Karenina* but distinguished from it as well as from the other three genera with MP touching CuA (or connected by very short crossvein) (i.e., *Allopterus* J. Zhang, 1991, *Triangulochrysopa* Nel et al.,
Kareninoides lii gen. et sp. nov.

(Figs 4–6)

‘Mesochrysopidae’: Makarkin et al. 2012: Fig. 4D.

Diagnosis. In both wings, crossvein between RP and MA (before origin of RP1), and basal crossvein between Cu and AA3+4 present [absent in Kareninoides inexpectus]; in hind wing, M forked distinctly proximal to origin of RP [at same level in K. inexpectus].

Description. Head rather elongate; vertex with indistinct longitudinal coronal (epicranial) suture; antennae poorly preserved, only visible as impression in matrix, filiform or moniliform, with scapus, pedicel slightly broader than segments of flagellum; antennal sockets situated rather closely to each other; mandibles apparently quite large (poorly preserved). Prothorax long, slightly longer than maximal length of head. Mesothorax only fragmentarily preserved. Metathorax nearly complete, but very poorly preserved. Femora, tibiae of forelegs and midleg partly preserved; details otherwise not visible. Abdomen about 21.8 mm long; eight segments preserved. First abdominal tergite possesses distinct mediolongitudinal suture (‘Transversalnaht’ of Achtelig 1975) distally bifid into parts of transverse suture (‘Transversalnaht’ of Achtelig 1975); portion of 1st tergite distal to transverse suture (i.e., ‘Posterotergit’ of Achtelig 1975) rather long. Second abdominal tergite long, slightly longer than its width; acrotergite of 2nd tergite not identified or absent.

Forewing elongate, rather narrow, with rounded apex, 44.5 mm long, about 10.5 mm wide. Costal space only slightly expanded in proximal part, equaally narrow before fusion of ScP with RA. All subcostal veinlets simple, rather closely spaced. Pterostigma not preserved. Veinlets of ScP+RA poorly preserved, simple; two connected by crossvein. Subcostal space very narrow, crossveins not detected. RA space (between RA and RP) tapering basally, narrowed distally, with 15 (right wing) and 17 (left wing) crossveins proximal to fusion of ScP+RA. Stem of RP smooth, with 15 regularly pectinate, slightly zigzagged branches. Crossveins in radial space numerous, mostly not forming gradate series. Two short Banksian lines present, converging apically; Banksian folds not detected (wings preserved as flattened). Crossvein present between RP before origin of RP1 and MA, which connects stem of RP and first intramedian cell (im). M basally fused with R for considerable distance; divided into MA and MP well proximal to origin of RP1, somewhat distal to origin of RP. MA arched, slightly zigzagged, with deep terminal fork. MP strongly zigzagged, with terminal shallow fork and two simple, strongly zigzagged branches. im short, somewhat different in shape in right and left wings. Basal crossvein 1m-cu at origin of M long; crossvein 2m-cu connecting im and CuA very short. Branches of M and CuA, crossveins between them form reticulation. Cu appears fused with R basally, divided into CuA and CuP nearly opposite 1m-cu. CuA straight proximally, then bent towards MP at crossvein 2m-cu, strongly zigzagged distally; with terminal fork, one forked branch not zigzagged. Basal part of MP (within im), medial part of CuA, and its branch form straight line. CuP short, with deep terminal fork; two crossveins between CuA and CuP. AA3+4 with terminal fork. AP1+2 and AP3+4 probably simple. One
basal crossvein between Cu and AA3+4. Two crossveins between CuA and AA3+4, of these distal one connecting CuA and anterior branch of AA3+4 fork.

Hind wing elongate, narrow, with sub-acute apex; length about 40.5 mm (left wing); width 9.7 mm (left wing), 9.2 mm (right wing). Costal space narrow, with simple subcostal veinlets. Pterostigma not distinct. Veinlets of ScP+RA distal to pterostigma not connected by crossveins. Subcostal space very narrow, crossveins not detected. RA space tapering basally, narrowed distally, with 14 (right wing), 16 (left wing) crossveins proximal to fusion of ScP+RA. Stem of RP slightly zigzagged, with 15 slightly zigzagged branches (right wing lacking apical-mot

FIGURE 4. Protoaristenymphes daohugouensis sp. nov. Wing venation of the holotype CNU-NEU-NN2011103PC. A, left forewing. B, right forewing. C, right hind wing. D, left hind wing. Scale bar is 10 mm (all to scale).
portion); RP1 short in left wing, fused distally with MA; two distal branches of RP fused with each other in right wing. Crossveins in radial space numerous, mostly not forming gradate series. Two rather long Banksian lines present, converging apically; posterior Banksian line slightly arched; Banksian folds not detected (wings preserved as flattened). Crossveins present between RP and MA (before origin of RP1). M divided into MA and MP well proximal to origin of RP. MA simple for most of length, arched, with two terminal forks. MP occupying greater space, strongly reticulated, deeply forked two times in right wing, appearing pectinate in left wing. CuA short, with two pectinate branches. CuP absent in right wing, present in left wing. AA3+4 well developed, pectinate, with three short pectinate branches. AP1+2 and AP3+4 not preserved.

**Material.** Holotype CNU-NEU-LY2011001PC (part, counterpart), deposited in CNUB. An almost complete, quite poorly preserved specimen.

**Type locality and horizon.** Dakangpu, Liulongtai Township, Yixian County, Liaoning Province, NE China; Early Cretaceous (Early Aptian), Yixian Formation (see Makarkin et al. 2012).

**Etymology.** The specific epithet is formed from the surname of Yanjun Li, in recognition of his donation of this specimen to the fossil collections of CNUB.

**Remarks.** The new species differs from the second species preliminarily assigned to the genus (see below) by some details in the venation as indicated in the species diagnosis.

The presence of the distally-bifid mediolongitudinal suture in the first abdominal tergite is a synapomorphy of Neuroptera (Achtelig 1975; Kristensen 1991). This structure in *Kareninoides lii* gen. et sp. nov. is well developed, although not especially different in shape from that of the extant osmylid *Osmylus fulvicephalus* Scopoli (Achtelig 1975: Fig. 9). In general, the structure of the first abdominal tergite is examined only in few taxa of Neuroptera, although it might be useful in phylogenetic reconstructions.

We explain the slight difference in shape especially noted between the left (wider) and right (longer) hind wings as a result of post-mortem plastic distortion, extension of the matrix along the plane of the length of the right hind wing.

The presence of CuP in the Mesochrysopidae hind wing

A longitudinal vein is present in one of the hind wings of *Kareninoides lii* gen. et sp. nov. and absent in the other. Its location fully coincides with that of CuP of other neuropterans. If so, the presence of CuP is extraordinary for Mesochrysopidae. Hitherto, no species of the two closely related families Mesochrysopidae and Ascalochrysidae were known to possess this vein (Ren & Makarkin 2009). The well preserved hind wing bases of the mesochrysopid *Tachynymphes ascalaphoides* Ponomarenko, 1992 and the ascalochrysid *Ascalochrysa megaperta* Ren et Makarkin, 2009 are illustrative examples of this reduction (Ponomarenko 1992: Fig. 4; Ren & Makarkin 2009: Fig. 3). The reduction of CuP in the hind wing may be treated as an important synapomorphy of these
families. The hind wing possessing CuP is generally abnormal; its venation is different: besides the presence of CuP, RP1 is abnormally fused with MA; the configuration of MP is strongly different from that of the other hind wing in this specimen. Therefore, the presence of CuP may be reasonably considered as an example of an ‘atavistic phenotype’ (Palsson & Gibson 2000). By this hypothesis, the apparent loss of some veins in advanced taxa may be explained as the repression of these for many millions of years (Stark et al. 1999; Palsson & Gibson 2000). It is evident that CuP was developed in hind wings of ancestral taxa of Mesochrysopidae. Abnormities which can be treated as atavistic are also present in the venation of Chrysopidae, a family closely related to this family. MA and MP in the most species of Chrysopinae are fused to form triangle shape of the first intramedian cell (see Nel et al. 2005: Fig. 1). Sometimes, this cell in these species is abnormally four sided (i.e., MA and MP are not fused and connected by a crossvein) (e.g., Verdcourt 1949; Makarkin 1985; Canbulat & Kiyak 2004), a condition occurring in all species of more primitive subfamilies, Nothochrysinae and Limaiinae.

FIGURE 7. Kareninoides lii gen. et sp. nov. Wing venation of the holotype CNU-NEU-LY2011001PC. A, right forewing. B, left forewing. C, right hind wing. D, left hind wing. Scale bar is 10 mm (all to scale).
Taxonomic status of Armandochrysopa Nel et al., 2005

The genus Armandochrysopa was described to include two species, A. borschukewitzi Nel et al., 2005 from the Crato Formation of Brazil (type species) and A. inexpecta Nel et al., 2005 from the Las Hoyas locality, Spain (Nel et al. 2005). According to these authors, it was considered similar to the genus Karenina, but can be distinguished from it by the following four character states: [1] the forewing MP touches CuA “in one point, instead of being simply connected by a short crossvein as in Karenina”; [2] the forewing inner gradate crossveins are less well aligned than in Karenina; [3] in the hind wing, the first crossvein between MA and RP1 is “more distinctly oblique instead of being perpendicular to both veins”; [4] the hind wing is less triangular than in Karenina (Nel et al., 2005, p. 41). Of these characters, only the first might be considered ‘generic’ in principle; however, the genera Armandochrysopa and Karenina are actually not distinguished by this at all: MP in the right forewing of the type species of Armandochrysopa is connected with CuA by a short crossvein, whereas those in the left forewing are touching (see Nel et al. 2005: Figs. 10, 12). In general, this condition is somewhat variable within Karenina, from the presence a short crossvein between MP and CuA, to the touching of these veins. We find that the other diagnostic states listed by Nel et al. (2005) are too vague to distinguish these genera. Therefore, these two genera cannot be confidently separated.

The two species included in the genus strongly differ from each other by their wing shape, venation, and fore-/hind wing length ratio. The wings of Armandochrysopa borschukewitzi do not significantly differ from those of species of Karenina Martins-Neto, 1997 at the genus level. In particular, its hind wings are markedly shorter than forewing (0.8 of the forewing length; 0.6–0.8 in the Karenina species); the shape of fore- and hind wings is same as those of the Karenina species; the venation of both wings is very similar in both A. borschukewitzi and Karenina species, especially in the absence of the Bankesian lines in the hind wing. Armandochrysopa borschukewitzi differs from Karenina species only in the absence of Bankesian lines in the forewing, but these lines are rather indistinct in Karenina in any case. Therefore, Armandochrysopa borschukewitzi most probably belongs to the genus Karenina, and Armandochrysopa is here considered as a synonym of Karenina.

We find that “Armandochrysopa” inexpecta cannot be confidently assigned to a genus. While its forewing is incompletely preserved, its hind wing venation is concordant with that of the type species of Kareninoides gen. nov. In particular, the hind wing possesses long Bankesian lines, and it is not significantly shortened (0.9 of the forewing length). However, the forewing of Kareninoides borschukewitzi is nearly half the length of K. lii gen. et sp. nov., 23 and 44.5 mm, respectively. Therefore, the former species is only tentatively assigned to this genus.

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Haase, E. (1890) Bemerkungen zur Palaeontologie der Insecten. Neues Jahrbuch für Mineralogie, Geologie und Paläontologie, 2(1), 1–33.
Appendix

We found the following three important errata in our previous paper after it was published (Ren D., Makarkin V.N. & Yang Q. 2010. A new fossil genus of Mesochrysopidae (Neuroptera) from the Early Cretaceous Yixian Formation of China. Zootaxa, 2523, 50–56).

p. 53, line 8 from below: instead ‘Macronymphes’ should be read ‘Macronympha’.

p. 53, line 6 from below: instead ‘Cratovoluptia’ should be read ‘Dryellina’.

p. 55, line 9 in the chapter ‘Epicranial suture on the head of Longicellochrysa’: instead ‘Ascalochrysa magna’ should be read ‘Ascalochrysa megaptera’.