

Two new anaxyelid sawflies (Insecta, Hymenoptera, Siricoidea) from the Yixian Formation of western Liaoning, China

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Received 30 November 2002; accepted in revised form 28 November 2005

Available online 7 February 2006

Abstract

Two new species, *Brachysyntexis robusta* and *Syntexyela continentalis*, are described from the Yixian Formation of Beipiao, Liaoning Province, China and assigned to the subfamily Anaxyelinae of the Anaxyelidae. Their palaeobiology is briefly discussed. A review of anaxyelid sawflies previously described from the Mesozoic of China indicates that they do not belong in Anaxyelidae. Based on the new material, the character in the forewing with vein Sc meeting R just at the beginning of Rs is supplemented to the groundplan of the Anaxyelidae.

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Keywords: Hymenoptera; Anaxyelidae; Anaxyelinae; New taxa; Palaeobiology; Yixian Formation; China

1. Introduction

The Anaxyelidae is a small family with only one living species, *Syntexis libocedrii* Rohwer, in western North America (Rohwer, 1915; Benson, 1935). This family, however, flourished from the Late Jurassic to the Early Cretaceous and contains four subfamilies, Syntexinae Benson, Dolichostigmatinae Rasnitsyn, Kependajinae Rasnitsyn and Anaxyelinae Martynov (Rasnitsyn, 1968, 1969, 1980, 1990). So far, 11 genera and 24 species assigned to the family have been reported from the Upper Jurassic of Kazakhstan and Lower Cretaceous of Russia, England, and Spain (Martynov, 1925; Rasnitsyn, 1963, 1968, 1969, 1990; Rasnitsyn et al., 1998; Rasnitsyn and Martínez-Delclòs, 2000) (see Table 1).

Here we describe two new species from the lower part of the Yixian Formation in Beipiao, Liaoning Province, China.

The stratigraphy of the locality has been described in detail by Zhang et al. (2002).

2. Systematic palaeontology

Order: Hymenoptera Linnaeus, 1758
Suborder: Symphyta Gerstaecker, 1867
Superfamily: Siricoidea Billberg, 1820
Family: Anaxyelidae Martynov, 1925
Subfamily: Anaxyelinae Martynov, 1925

Genus *Brachysyntexis* Rasnitsyn, 1969

1968 *Syntexyela* Rasnitsyn, p. 202, pl. 23, fig. 7; text-fig. 9
1969 *Brachysyntexis* Rasnitsyn, pp. 65, 70–71, pl. 6, fig. 15; text-figs. 101–103
1992 *Brachysyntexis* Carpenter, p. 459, fig. 248.2

Type species of Brachysyntexis. Syntexyela brachyura Rasnitsyn, 1968. By original designation. South Kazakhstan, Upper Jurassic.

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Table 1
Distribution of the known taxa of Anaxyelidae^a

Taxa	Distribution	References
Syntexinae Benson, 1935		
<i>Cretosyntexis montsecensis</i> Rasnitsyn and Martínez-Delclòs, 2000	L. Cret. lithographic limestones; La Cabrúa, Montsec Range, Lleida, Spain	Rasnitsyn and Martínez-Delclòs (2000)
<i>Eosyntexis catalonicus</i> Rasnitsyn and Martínez-Delclòs, 2000	L. Cret. lithographic limestones; La Cabrúa, Montsec Range, Lleida, Spain	Rasnitsyn and Martínez-Delclòs (2000)
<i>Eosyntexis tuffinae</i> Rasnitsyn and Jarzembowski in Rasnitsyn et al., 1998	L. Cret. Lulworth Fm; Durlston Bay, Dorset, England	Rasnitsyn et al., 1998
<i>Eosyntexis senilis</i> Rasnitsyn, 1990	L. Cret. Turga Fm; Turga, Transbaikalia, Russia	Rasnitsyn (1990)
<i>Syntexis libocedrii</i> Rohwer, 1915	Extant; western North America	Rohwer (1915)
Dolichostigmatinae Rasnitsyn, 1968		
<i>Dolichostigma tenuipes</i> Rasnitsyn, 1968	L. Cret. Zaza Fm; Baisa, Transbaikalia, Russia	Rasnitsyn (1968, 1969)
Anaxyelinae Martynov, 1925		
<i>Anasyntexis strophandra</i> Rasnitsyn, 1968	U. Jur. Karabastau Fm; Karatau, South Kazakhstan	Rasnitsyn, 1968, 1969
<i>Anaxyela destructa</i> Rasnitsyn, 1969	U. Jur. Karabastau Fm; Karatau, South Kazakhstan	Rasnitsyn (1969)
<i>Anaxyela gracilis</i> Martynov, 1925	U. Jur. Karabastau Fm; Karatau, South Kazakhstan	Martynov (1925); Rasnitsyn (1969)
<i>Anaxyela parvula</i> Rasnitsyn, 1963	U. Jur. Karabastau Fm; Karatau, South Kazakhstan	Rasnitsyn (1963, 1969)
<i>Anaxyela nana</i> (Rasnitsyn, 1968)	U. Jur. Karabastau Fm; Karatau, South Kazakhstan	Rasnitsyn (1968, 1969)
<i>Brachysyntexis brachyura</i> (Rasnitsyn, 1968)	U. Jur. Karabastau Fm; Karatau, South Kazakhstan	Rasnitsyn (1968, 1969)
<i>Brachysyntexis micrura</i> Rasnitsyn, 1969	U. Jur. Karabastau Fm; Karatau, South Kazakhstan	Rasnitsyn (1969)
<i>Brachysyntexis nova</i> Rasnitsyn, 1969	U. Jur. Karabastau Fm; Karatau, South Kazakhstan	Rasnitsyn (1969)
<i>Brachysyntexis robusta</i> sp. nov.	U. Jur. or L. Cret. Yixian Fm; Beipiao, Liaoning, China	this paper
<i>Kulbastavia macrura</i> (Rasnitsyn, 1963)	U. Jur. Karabastau Fm; Karatau, South Kazakhstan	Rasnitsyn (1963, 1969)
<i>Sphenosyntexis antonovi</i> (Rasnitsyn, 1963)	U. Jur. Karabastau Fm; Karatau, South Kazakhstan	Rasnitsyn (1963, 1969)
<i>Sphenosyntexis pallicornis</i> Rasnitsyn, 1968	U. Jur. Karabastau Fm; Karatau, South Kazakhstan	Rasnitsyn (1968, 1969)
<i>Syntexyela asiatica</i> Rasnitsyn, 1968	U. Jur. Karabastau Fm; Karatau, South Kazakhstan	Rasnitsyn (1968, 1969)
<i>Syntexyela continentalis</i> sp. nov.	U. Jur. or L. Cret. Yixian Fm; Beipiao, Liaoning, China	this paper
<i>Syntexyela gracilicornis</i> Rasnitsyn, 1968	U. Jur. Karabastau Fm; Karatau, South Kazakhstan	Rasnitsyn (1968, 1969)
<i>Syntexyela inversa</i> Rasnitsyn, 1968	U. Jur. Karabastau Fm; Karatau, South Kazakhstan	Rasnitsyn (1968, 1969)
<i>Syntexyela media</i> (Rasnitsyn, 1963)	U. Jur. Karabastau Fm; Karatau, South Kazakhstan	Rasnitsyn (1963, 1968, 1969)
<i>Urosyntexis depressa</i> Rasnitsyn, 1969	U. Jur. Karabastau Fm; Karatau, South Kazakhstan	Rasnitsyn (1969)
<i>Urosyntexis drepanura</i> (Rasnitsyn, 1968)	U. Jur. Karabastau Fm; Karatau, South Kazakhstan	Rasnitsyn (1968, 1969)
<i>Urosyntexis magna</i> (Rasnitsyn, 1968)	U. Jur. Karabastau Fm; Karatau, South Kazakhstan	Rasnitsyn (1968, 1969)
Kempendajinae Rasnitsyn, 1980		
<i>Kempendaja jacutensis</i> Rasnitsyn, 1968	L. Cret.; Kempendaj, Yakutia, Russia	Rasnitsyn (1968, 1969, 1980)

Abbreviations: U. Jur., Upper Jurassic; L. Cret., Lower Cretaceous.

^a *Anaxyela dubia* Rasnitsyn, 1963 was transferred to *Symphyopteris* Rasnitsyn assigned to Ephialtitidae (Rasnitsyn, 1975, p. 43, fig. 31).

Species included. Four species including the new one described below (see Table 1).

Diagnosis. Antenna thick basally, gradually becoming thin apically. Mesoscutellum with anterior margin acute. Forewing with pterostigma sclerotized, ending before middle of cell 3r; Rs + M shorter than section CuA between M and cu-a, ending before middle of 1m-cu; section M between 2m-cu and 3r-m longer than half of 2m-cu. Hindwing with r-m close to m-cu; cu-a near the middle of m-cu. Ovipositor with sheaths not longer than half of valvifer.

Remarks. Rasnitsyn (1968) erected the genus *Syntexyela* consisting of eight species including *Syntexyela brachyura*. Soon after he (Rasnitsyn, 1969) established a new genus, *Brachysyntexis*, and designated *S. brachyura* as its type species.

Brachysyntexis robusta sp. nov.

Fig. 1

Derivation of name. Latin, *robustus*, strong.

Material. Holotype LBSH98017/NIGP135548 (female), part and counterpart, from Huangbanjigou Village, Beipiao, Liaoning Province, China; deposited in the Nanjing Institute of Geology and Palaeontology, Chinese Academy of Sciences.

Diagnosis. Three species of *Brachysyntexis* are known, *B. brachyura* (Rasnitsyn), *B. nova* Rasnitsyn and *B. micrura* Rasnitsyn from the Upper Jurassic of South Kazakhstan (Rasnitsyn, 1968, 1969). Unlike all previously described species, this anaxyelid has a transversely oval head, comparatively large eyes, and a forewing with cell 3r rounded apically. Besides these characters, it differs from *B. brachyura* in having a body with prescutum as large as the scutellum, ovipositor sheaths are comparatively short, and crossvein 3r-m is longer than 2m-cu. It differs from *B. nova* in having a prescutum distant from the scutellum, thin hind femora, and distinct crossvein Sc, and from *B. micrura* in having a broad mesonotum and a forewing with crossvein 3r-m longer than 2m-cu.

Description. Female (male unknown). In dorsal aspect with antenna, legs and wings slightly damaged; brown. Head

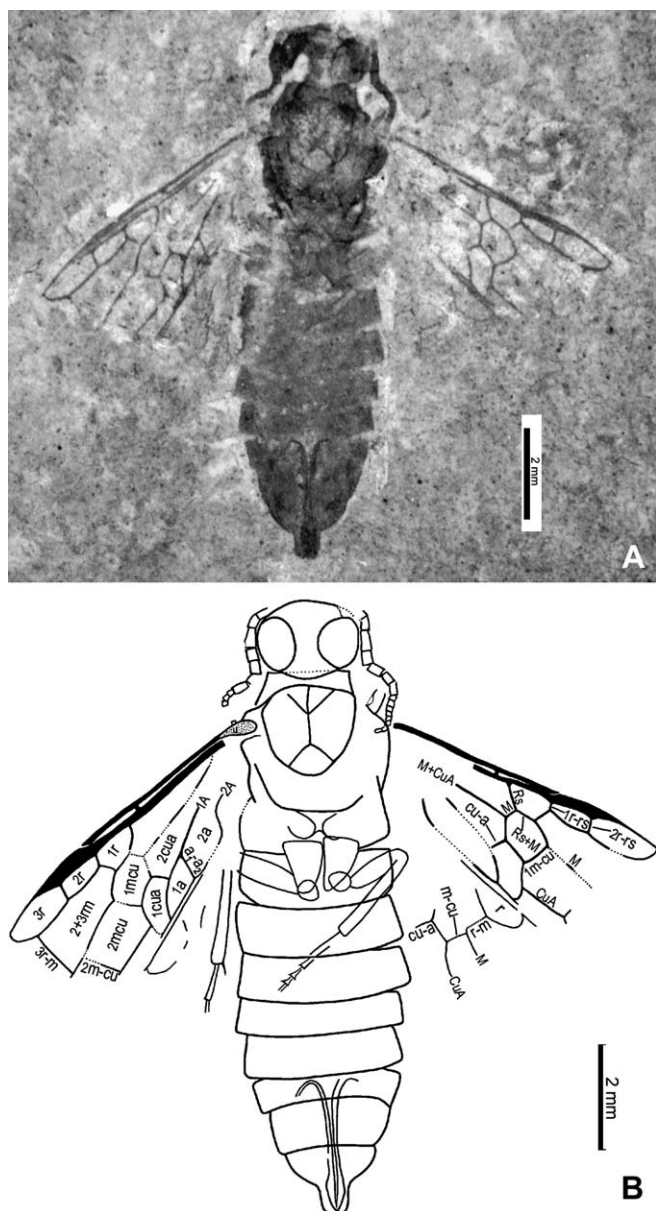


Fig. 1. *Brachysyntexis robusta* sp. nov. A, holotype, female, dorsal aspect, NIGP135548a. B, camera lucida drawing of holotype.

transversely oval. Eyes large and oval. Antenna short, 15-segmented with scape ill-preserved; pedicel thin, slightly longer than wide; first flagellomere slightly thinner than pedicel basally, gradually increasing in thickness apically, and 1.5 times as long as wide; second nearly parallel-sided, slightly thinner than first apically, and a little longer than wide; third to fifth similar to second, gradually becoming smaller; others thin and short; terminal very thin, longer than wide. Pronotum broad but short with anterior margin straight and posterior concave. Mesonotum with prescutum small; scutellum as large as prescutum, with anterior margin acute; distance between prescutum and scutellum as long as scutellum. Fore femur thin. Hindleg with coxa large, subtriangular; trochanter small, oval; femur thin and short; tibia slender, distinctly longer than femur, with a distal spur; tarsus slender with basitarsus longest, others

distinctly short. Forewing with C straight and slightly thickened; R much thickened and slightly curved beyond origin of Rs; costal area narrow; Sc short and thick, nearly perpendicular to C and joining in R basad of Rs base; pterostigma narrow, strongly sclerotized and extending into cell 3r at two-fifths its length; first abscissa of Rs twice as long as that of M; cell 2r 2.5 times as long as wide and slightly enlarged apically; cell 3r 2.5 times as long as wide, rounded apically; Rs + M extending into 1mcu just basal of its midlength; 3r-m meeting cell 3r at its two-thirds length; section M between 2m-cu and 3r-m half as long as 2m-cu; 3r-m slightly longer than 2m-cu; 2 + 3r-m more than twice as long as wide; 1m-cu slightly longer than section of CuA beyond 1m-cu; cu-a meeting 1mcu slightly before its middle. Hindwing ill-preserved; r rounded apically; r-m close to m-cu. Abdomen broadest at middle, with 9 segments discernable; each segment transversely broad. Ovipositor slightly protruding from abdominal apex; sheaths very short. Body 11.5 mm long; antenna 2.7 mm long as preserved; forewing 6.5 mm long as preserved, 2.5 mm wide; hindwing 2.3 mm long as preserved, 1.9 mm wide; ovipositor 2.6 mm long.

Genus *Syntexyela* Rasnitsyn, 1968

Type species. *Anaxyela media* Rasnitsyn, 1963. By original designation. South Kazakhstan, Upper Jurassic.

Species included. Five species including the new one described below (see Table 1).

1963 *Anaxyela* Rasnitsyn, p. 94, pl. 8, fig. 3; text-fig. 6

1968 *Syntexyela* Rasnitsyn, pp. 199, 201–206, pl. 23, figs. 9–11; text-figs. 8, 11, 12

1969 *Syntexyela* Rasnitsyn, pp. 65, 69; text-figs. 106–109

1992 *Syntexyela* Carpenter, p. 461, fig. 249,3

Diagnosis. Antenna with one or several basiflagellar segment(s) thick, and following ones distinctly narrow. Mesoscutellum with anterior margin rounded. Forewing with pterostigma sclerotized, ending before middle of cell 3r; section M between 2m-cu and 3r-m slightly shorter than 2m-cu. Hindwing with r-m distal of m-cu; section M between m-cu and r-m shorter than m-cu. Ovipositor long but not longer than body.

Remarks. *Anaxyela media* Rasnitsyn was assigned to *Anaxyela* Martynov when established on the basis of a sawfly from the Upper Jurassic of Karatau, South Kazakhstan (Rasnitsyn, 1963). Later, the genus *Syntexyela* was erected with *A. media* as its type species (Rasnitsyn, 1968).

Syntexyela continentalis sp. nov.

Fig. 2

Derivation of name. Latin, *continentalis*, continental.

Material. Holotype LBSH98016/NIGP135549 (female) from Huangbanjigou Village, Beipiao, Liaoning Province,

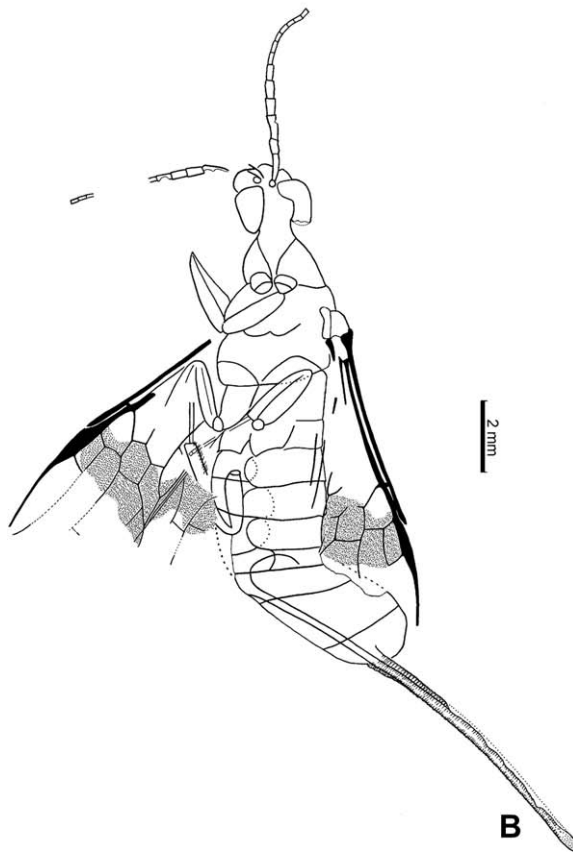
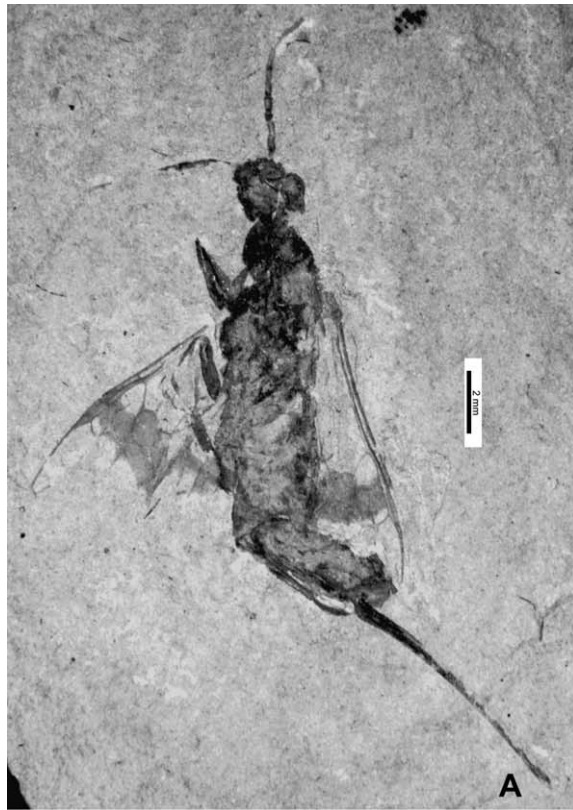


Fig. 2. *Syntexyela continentalis* sp. nov. A, holotype, female, lateroventral aspect, NIGP135549. B, camera lucida drawing of holotype.

China; deposited in the Nanjing Institute of Geology and Palaeontology, Chinese Academy of Sciences.

Diagnosis. *Syntexyela* Rasnitsyn is composed of four known species, *S. media* (Rasnitsyn), *S. asiatica* Rasnitsyn, *S. inversa* Rasnitsyn and *S. gracilicornis* Rasnitsyn from the Upper Jurassic of South Kazakhstan (Rasnitsyn, 1963, 1968). Unlike the previously described species, this new species has dark-banded wings with Sc meeting R just at origin of Rs in the forewing. Moreover, it differs from *S. media* in that the latter has an antenna with first flagellomere composed of eight short segments. It differs from *S. asiatica*, *S. inversa* and *S. gracilicornis* in having an antenna with four thickened basiflagellar segments followed by segments that are abruptly narrow.

All the known anaxyelid sawflies have forewings with vein Sc basad of the beginning of vein Rs or completely absent (Martynov, 1925; Rasnitsyn, 1963, 1968, 1969, 1990; Rasnitsyn et al., 1998), which has been defined as one character of the Anaxyelidae (Rasnitsyn, 1968, 1969). The new species, *Syntexyela continentalis*, shows a different character in the forewing with vein Sc meeting R just at the beginning of Rs. This is an additional character for diagnosis of Anaxyelidae.

Description. Female (male unknown). Body in lateroventral aspect with antennae, legs and wings incomplete; infuscated except abdomen pale; fore- and hindwings with infuscated stripes. Head moderately large, slightly longer than wide. Eyes large, subovate. Antenna with 13 segments preserved; scape thin basally and gradually thickened apically, four times as long as wide; pedicel as thick as scape basally, slightly thickened apically and 1.5 times as long as wide; first flagellomere, with base as wide as pedicel, gradually increasing in thickness apically, and 2.5 times as long as wide; second similar to first in shape, two-thirds as long as latter; third slightly thinner than second; fourth slightly shorter and thinner than third; followed by segments that are distinctly thinner and shorter. Prothorax with anterior margin distinctly narrower than head and posterior as broad as head; meso- and metathorax broad. Fore- and midleg thin. Hindleg with coxa broad; femur as long as mid femur but a little thicker; tibia thin but greatly longer than femur, with inner side densely setose; tarsus thin. Forewing with Sc short, crossvein-like; pterostigma narrowed and extending into cell 3r at one-fourth its length; first abscissa of Rs slanted towards apex of wing and 2.5 times as long as that of M; cell 2r twice as long as wide; cell 3r 3.5 times as long as wide and 3 times as long as 2r; Rs + M slightly beyond midlength of 1mcu. Hindwing with section M between r-m and m-cu shorter than m-cu. Abdomen with 9 segments discernible. Ovipositor slightly shorter than body; sheaths slightly curved downwards and transversely ribbed. Body (excluding antennae and ovipositor) 15.0 mm long; antenna as preserved 5.2 mm long; forewing as preserved 8.4 mm long, 3.5 mm wide; ovipositor 12.1 mm, and sheath 7.8 mm long.

3. Palaeobiology

Anaxyelidae are represented by only one living species, *Syntexis libocedrii* Rohwer, and 26 Mesozoic species (Rohwer, 1915; Martynov, 1925; Benson, 1935; Rasnitsyn, 1963, 1968, 1969, 1980, 1990; Rasnitsyn et al., 1998; Rasnitsyn and Martínez-Delclòs, 2000; this paper).

Syntexis libocedrii Rohwer, the incense cedar wasp distributed in western North America, lays eggs in the sapwood of coniferous trees including the incense cedar (*Libocedrus decurrens*), yellow juniper (*Juniperus occidentalis*), giant red cedar (*Thuja plicata*), and probably Douglas fir (*Pseudotsuga menziesii*), and its larvae bore in the wood (Smith, 1979). Probably similar to this extant wasp, *Brachysyntexis robusta* used its short ovipositor to bore through the bark of some coniferous stems and laid eggs in the sapwood. *Syntexyela continentalis*, having a long ovipositor, probably bored deeper into the wood of coniferous trees for oviposition, just like some modern sawflies. The bored holes may be as deep as the ovipositor length. The fact that some cypress fragments have been found from the same locality and horizon (Wu, 1999; Sun et al., 2001) seems to support the deduction.

4. Discussion

Four genera and species from China have previously been assigned to the Anaxyelidae. These are *Sinanxyela dorunensis* Hong, 1982, from the Upper Jurassic of Hsilin Kuole, Inner Mongolia; *Nygmatius beipiaoensis* Hong, 1983, from the Middle Jurassic Haifanggou Formation of Beipiao, Liaoning Province; *Hebeianaxyela clavicornuta* Hong, 1983, from the Middle Jurassic Jiulongshan Formation of Chengde, Hebei Province; and *Xaxexis longhuaensis* (Hong, 1984) from the Yixian Formation of Longhua, Hebei Province (Hong, 1982, 1983, 1984). Based on the drawings and photographs by Hong (1982, 1983, 1984), however, their systematic positions are problematic.

According to the drawing by Hong (1982, p. 175, text-fig. 154), *Sinanxyela dorunensis* lacks the apical one-third of the forewing, has the basal section of Rs short and nearly perpendicular to R, and cell 1mcu very large, which does not place this species in the Anaxyelidae. Moreover, due to the absence of enough information from the drawing and extremely unclear photos (see Hong, 1982, pl. 34, figs. 3, 4), its systematic position remains uncertain (Darling and Sharkey, 1990). In addition, considering its lithology and other associated insects such as *Ephemeropsis trisetalis* (Ephemeroptera), *Coptoclava longipoda* (Coleoptera), the bed yielding this insect should not belong to the Upper Jurassic but the Lower Cretaceous Jiufotang Formation.

Nygmatius beipiaoensis has the forewing (see Hong, 1983, pp. 136–138, pl. 25, fig. 1, text-fig. 129) with vein Sc extremely developed and crossvein 2r-m present, and the hindwing with two r-m and two m-cu crossveins present. These characteristics are not consistent with Anaxyelidae and so this hymenopteran cannot be placed in the Anaxyelidae.

Hebeianaxyela clavicornuta, which has a xyelid-like antenna with the third segment thickened and elongate, the forewing with Sc developed and 1mcu open, and the hindwing with 1r, 2r and 3r present based on the drawing (see Hong, 1983, p. 139, text-fig. 130) and the unclear plate (see Hong, 1983, pl. 26, fig. 1), is different from Anaxyelidae and even other hymenopterans. So before the holotype having been rechecked, it is difficult to decide its systematic position.

Euryxyela Hong, 1984, preoccupied by *Euryxyela* Rasnitsyn, 1963, was renamed *Xaxexis* by Pagliano and Scaramozzino (1990). This genus, originally referred to the Anaxyelidae, was later transferred to Sepulcidae (Darling and Sharkey, 1990). Hong (1984) probably considered both of the right forewing and hindwing, which might overlap in preservation, to be a single forewing, judging from the drawing by Hong (1984, text-fig. 54) and the extremely unclear photo (see Hong, 1984, pl. 74, fig. 1).

Based on the above discussions, the two species, *Brachysyntexis robusta* and *Syntexyela continentalis*, described below are possibly the first records of Anaxyelidae in China.

Acknowledgements

We are grateful to Dr. D. J. Nichols (United States Geological Survey) and two anonymous reviewers for critical comments and improving the previous version of the manuscript. The study has been financially supported by the Grant-in-Aid for University and Society Collaboration of the Japanese Ministry of Education, Science, Sports and Culture (Matsukawa, no. 1179102, 1999–2001), the Major Basic Research Projects of Ministry of Science and Technology, China (G2000077700), and the National Natural Science Foundation of China (40272002, 40472001).

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