Shenzhousia qilianshanensis gen. et sp. nov. (Protodonata, Meganeuridae), a giant dragonfly from the Upper Carboniferous of China*

ZHANG Zhijun[1]**, HONG Youchong[2], LU Liwu[1], FANG Xiaosi[1] and JIN Yuegao[1]

(1. Department of Palaeontology, the Geological Museum of China, Beijing 100034, China; 2. Beijing Museum of Natural History, Beijing 100050, China)

Received June 15, 2005

Abstract A new dragonfly of family Meganeuridae *Shenzhousia qilianshanensis* gen. et sp. nov., discovered from Ningxia Hui Autonomous Region in North China, is described in the present paper. It has an estimated wingspan of about 450—500 mm and may be the largest fossil insect in Late Carboniferous Namurian Stage discovered by far. The new species is referred to Meganeuridae because of the presence of the characteristic oblique vein between anterior branch of radius (RA) and posterior branch of radius (RP) near the base of RP_2. It differs from other genera within the family in the following characteristics: Precostal area short and not extending to the midwing; posterior branch of subcostal vein short, merging into costal vein near the level of originating point of IR_2; RP forking earlier than anterior branch of media basally; RP_{1+2} and RP_{3+4} parallel and close to each other for a long distance, and then diverge gradually surpass midwing.

Keywords: **Namurian, Meganeuridae, Ningxia Hui Autonomous Region, Upper Carboniferous Tupo Formation.**

Discussions of the Order Protodonata instantly bring to mind the two representatives of family Meganeuridae: *Meganeura monyi* (Brongniart, 1884) and *Meganeuropsis permiana* (Carpenter, 1939). The latter with a wingspan of about 710 mm, discovered from Upper Permian of North America, is the largest insect (among extinct and extant insects) up to now[1,2]. Family Meganeuridae is an extinct family and only known from the Upper Carboniferous to Permian. It includes 9 genera in three subfamilies and is referred to Protodonata of Odonatoptera[3—7]. The insects of the family Meganeuridae are usually large or extremely large in body size and with wingspan of at least 200 mm. They were distributed widely and became a predominant group during the Late Carboniferous and Permian.

The new species *Shenzhousia qilianshanensis* gen. et sp. nov. described in the present paper was discovered from the Tupo Formation (corresponding to Namurian C) of Upper Carboniferous of Ningxia Hui Autonomous Region, China. In recent years, more than 1000 pieces fossil insects specimens with at least 6 different orders have been discovered from the Tupo Formation, accompanied by many fishes, bivalves, ammonites and Cathaysia flora[8—10].

The new species has two type specimens (parts and counterparts): the holotype (97X101-a, b) and the paratype (04X001-a, b; 04X002-a, b). According to the breadth length ratio of wing in family Meganeuridae, the new species has an estimated wingspan of 450—500 mm and is the largest insect in the Namurian Stage (Formerly the largest insect in the Namurian Stage was *Namurotypus sippili* Brauckmann & Zessin, 1989 with a wingspan of 320 mm discovered from Ruhr, German. It has been transferred from family Meganeuridae to Namurotypidae Bechly, 1996)[11,12].

We follow the wing venation nomenclature of Riek and Kukalová-Peck[13] and the higher classification of Odonatoptera of Bechly[14].

Systematic palaeontology

Odonatoptera Lameere, 1900

Protodonata Brongniart, 1885 (= Meganisoptera Martynov, 1932)

* Supported by National Natural Science Foundation of China (Grant No. 40302006) and Programme of Excellent Young Scientists of the Ministry of Land and Resources, China

** To whom correspondence should be addressed. E-mail: zhjzhgmc@163.com

Meganeuridae Handlirsch, 1906

Shenzhousia gen. nov.[1)]

Type species: *Shenzhousia qilianshanensis* gen. et sp. nov.

Etymology: The generic name comes from Shenzhou, indicating the specimens are discovered from China.

Diagnosis: precostal area reduced and not extending to the midwing; Scp short and only reaching the originating level of IR_2 exceeding the midwing slightly; the forking point of RP nearer wing base than that of M; RP_{1+2} and RP_{3+4} close and parallel to each other for a long distance with only one row of cell between them; RP_{1+2} and RP_{3+4} diverging gradually after the midwing.

Age and distribution: Late Carboniferous; Ningxia Hui Autonomous Region, China.

Discussion: The most taxonomic characteristics of those specimens can be identified through parts of the wing preserved. The new genus is undoubtedly referred to family Meganeuridae because of the characteristic oblique vein between RA and RP, numerous crossveins and wing cells[12]. It differs from other genera in family Meganeuridae in the following characteristics: ScP short, merging into C at the origin point of IR_2; RP forking basally; RP_{1+2} and RP_{3+4} close and parallele to each other for a long distance with only one row of cell between them, then diverging gradually after the midwing. The new genus *Shenzhousia* is most similar to *Meganeuropsis* in the same characteristics of RP, but differs in precostal reduced area and short ScP.

Shenzhousia qilianshanensis gen. et sp. nov.

Material: Three pairs of specimens (parts and counterparts) are labeled with 97X101, 04X001 and 04X002. The holotype (97X101) of the new species preserved postmedian part of a wing of 68.5 mm long and 36.0 mm wide. The paratype (04X001, 04X002) preserved the antero-median and median parts of a wing, being 66.0 mm long, 45.0 mm wide and 26.0 long, 42.0 mm wide respectively. The type specimens are deposited in the Geological Museum of China.

Type specimens: holotype 97X101; paratype 04X001, 04X002.

Etymology: The specific name is from the locality of specimens, Qilianshan Mountains.

Description: The holotype (97X101) of *Shenzhousia qilianshanensis* gen. et sp. nov. preserved postmedian part of a wing of 68.5 mm long and 36.0 mm wide (Fig. 1). Precostal vein is invisible in our specimens, so it is not extending to midwing; costal area narrow, and the maximum width equals the separating area of ScP and RA; ScP short, merging into C at the origin level of IR_2 after the midwing; the characteristic oblique vein between obviously

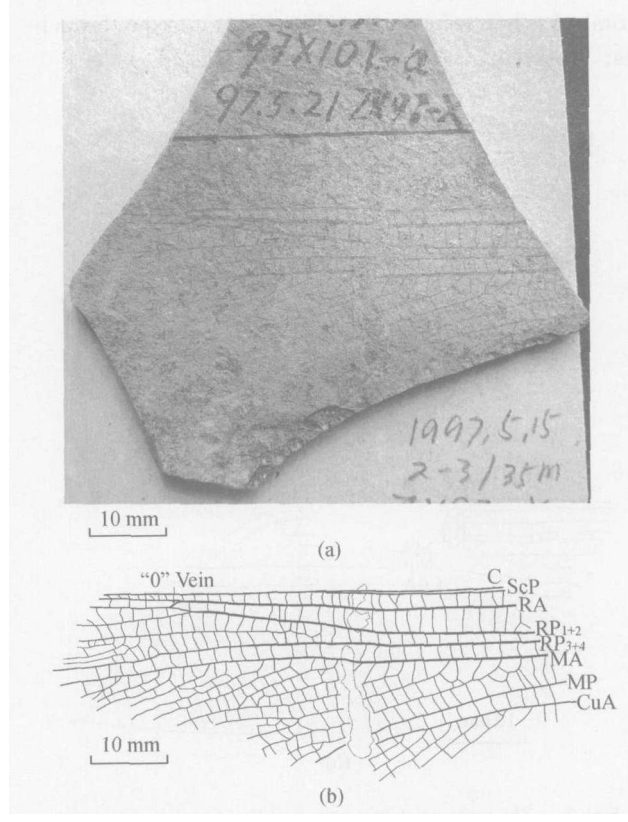

Fig. 1. The holotype of *Shenzhousia qilianshanensis* gen. et sp. nov. (97X101). (a) Photograph; (b) drawing. "O" Vein, oblique vein; C, costal vein; ScP, posterior branch of subcostal vein; RA, anterior branch of radius; RP_{1+2}, the 1st and 2nd branches of posterior branch of radius; RP_{3+4}, the 3rd and 4th branches of posterior branch of radius; MA, anterior branch of media; MP, posterior branch of media; CuA, anterior branch of cubitus.

1) Zhang Z.J. and Hong Y.C. take the responsibility for the nomenclature of the new genus and species.

thick; RA close to wing margin after the oblique vein; the forking point of RP near base of wing; RP_{1+2} and RP_{3+4} close and parallele to each other for a long distance with only one row of cell between them, then the two veins diverging gradually after the midwing; the area between RP_{1+2} and RP_{3+4} distinctly narrower than those of RA and RP_{1+2}, RP_{3+4} and MA; RP_2 forking before the oblique vein; MA with numerous branches and intercalary veins; RA and MA thicker than other longitudinal veins.

The paratype (04X001, 04X002) of *Shenzhousia qilianshanensis* gen. et sp. nov. preserved the antero-median and median parts of a wing. Two pieces are 66.0 mm long, 45.0 mm wide and 26.0 long, 42.0 mm wide respectively (Fig. 2). RP_{1+2} and RP_{3+4} close to each other, the area between two veins narrow; RP forking basally earlier than MA; anal area well-developed, the maximum width wider than total of other vein areas; Cu with numerous branches; crossveins and wing cells numerous.

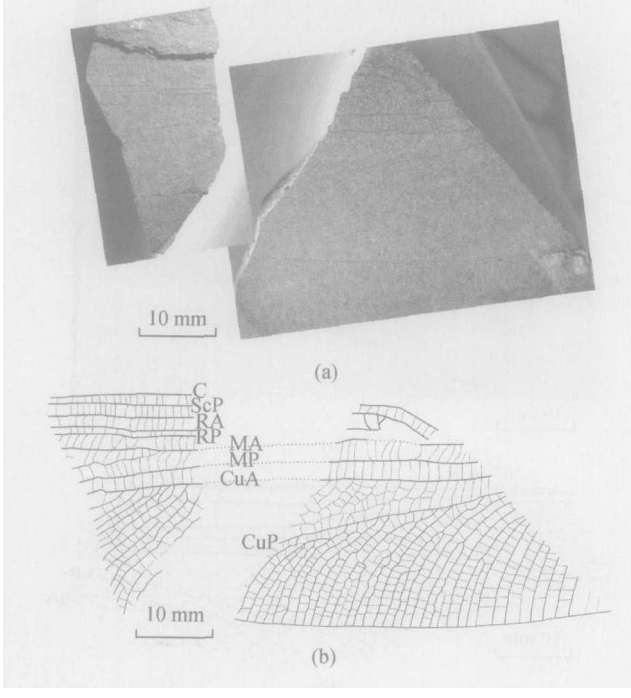

Fig. 2. The paratype of *Shenzhousia qilianshanensis* gen. et sp. nov. (a) photograph; (b) drawing. C, Costal vein; ScP, posterior branch of subcostal vein; RA, anterior branch of radius; RP, posterior branch of radius; MA, anterior branch of media; MP, posterior branch of media; CuA, anterior branch of cubitus; CuP, posterior branch of cubitus.

The wing of the new species is narrow and long, with many crossveins and wing cells. The wingspan can reach 450—500 mm, estimated by the breadth length ratio of wing in family Meganeuridae.

Locality and horizon: Xiaheyan Village of Zhongwei County, Ningxia Hui Autonomous Region; Tupo Formation of Upper Carboniferous (C_{2t}).

Acknowledgements We thank Dr. Peng Decheng for his work in 1990—1991, which provided some specimens to us.

References

1 Brongniart C. Sur un gigantesque Néurorthoptère, provenant des terrains houillers de Commentry (Allier). Comptes rendus hebdomadaires des séances de l'Academie des sciences, 1884, 98: 832—833.
2 Carpenter F. M. The Lower Permian insects of Kansas. Part 8. Additional Megasecoptera, Protodonata, Odonata, Homoptera, Psocoptera, Protelytroptera, Plecoptera, and Protoperlaria. In: Proceedings of the American Academy of Arts and Sciences, 1939, 73: 29—70.
3 Carpenter F. M. Treatise on invertebrate paleontology. Part R. Arthropoda 4. Volumes 3 & 4: Superclass Hexapoda. The Geological Society of America and The University of Kansas, 1992, 1—655.
4 Engle M. S. *Megatypus parvus* spec. nov., a new giant dragonfly from the Lower Permian of Kansas (Protodonata: Meganeuridae). Odonatologica, 1998, 27(3): 361—364.
5 Nel A. and Huguet A. Revision of the enigmatic Upper Carboniferous insect *Campyloptera eatoni* Brongniart, 1893 (Insecta: Odonatoptera). Org. Divers. Evol., 2002, 2: 313—318.
6 Whalley P. E. S. New species of Protorthoptera and Protodonata (Insecta) from the Upper Carboniferous of Britain, with a comment on the origin of wings. Bull. Brit. Mus. Nat. Hist. (Geol.), 1979, 32(1): 85—90.
7 Whalley P. E. S. *Tupus diluculum* sp. nov. (Protodonata), a giant dragonfly from the Upper Carboniferous of Britain. Bull. Br. Mus. Nat. Hist. (Geol.), 1980, 34(4): 285—287.
8 Lu L. W., Fang X. S., Ji S. A. et al. A contribution to the knowledge of the Namurian in Ningxia. Acta Geoscientia Sinica, 2002, 23(2): 165—168.
9 Bureau of Geology and Mineral Resources of Ningxia Hui Autonomous Region. Multiple Classification and Correlation of the Stratigraphy of China (64): Stratigraphy (Lithostratic) of Ningxia Hui Autonomous Region. Beijing: China University of Geosciences Press, 1996: 56—84.
10 Li X. X., Wu X. Y., Shen G. L. et al. The Namurian and its Biota in the East Sector of North Qilian Mountain. Jinan: Science and Technology Press of Shandong, 1993, 1—482.
11 Brauckmann C. Arachniden und Insekten aus dem Namurium von Hagen-Vorhalle (Ober-Karbon; West-Deutschland). Veröffentlichungen aus dem Fuhlorott-Museum, Wuppettal, 1991, 1—273.
12 Bechly G., Brauckmann C., Zessin W. et al. New results concerning the morphology of the most ancient dragonflies (Insecta: Odonatoptera) from the Namurian of Hagen-Vorhalle (Germany). J. Zool. Syst. Evol. Research, 2001, 39: 209—226.
13 Riek E. F. and Kukalová-Peck J. A new interpretation of dragonfly wing venation based upon Early Upper Carboniferous fossils from Argentina (Insecta: Odonatoidea) and basic character states in Pterygote wings. Canadian Journal of Zoology, 1984, 62: 1150—1166.
14 Bechly G. Phylogenetic Systematics of Odonata. http://www.bechly.de/phylosys.htm, http://www.bechly.de/odonatol.htm, (1998, 2002) [2005-03-08]