第48卷 第1期
2010年1月

古 脊 椎 动 物 学 报
VERTEBRATA PALASIATICA

pp.11-18
figs.1-3

中国上白垩统窃蛋龙科一新属种（兽脚类：窃蛋龙类）[1)]

徐 星[1] 韩凤禄[1,2]

（1 中国科学院古脊椎动物与古人类研究所，脊椎动物进化系统学重点实验室 北京 100044）
（2 中国科学院研究生院 北京 100049）

摘要：根据可能发现于江西赣州晚白垩世南雄组地层中一件标本报道了窃蛋龙科一新属种——斑嵴龙。新标本具有以下不同于其他窃蛋龙属种的特征：由前颌骨和鼻骨形成的脊冠具有阶梯状的后端，表面有两个纵向的沟槽和许多倾斜的条痕；外鼻孔延长，其后侧与眶骨相近；翼骨腭骨支背缘有一深窝；齿骨后背缘有纵向沟槽；上隅骨前背缘有小结节。斑嵴龙腭部和下颌的一些特征不同于窃蛋龙科的其他属种，但近似于更原始的窃蛋龙类。这些特征表明斑嵴龙代表窃蛋龙科中相对原始的一个属种。这一系统发育假说得到了定量的系统发育分析的支持。斑嵴龙的发现不仅增加了晚白垩世窃蛋龙科的分异度，而且为这一类群的特征演化提供了重要信息。

关键词：中国；晚白垩世；窃蛋龙科，兽脚类

中图法分类号：Q915.864 **文献标识码**：A **文章编号**：1000-3118(2010)01-0011-08

A NEW OVIRAPTORID DINOSAUR (THEROPODA: OVIRAPTOROSAURIA) FROM THE UPPER CRETACEOUS OF CHINA

XU Xing[1] HAN Feng-Lu[1,2]

(1 *Key Laboratory of Evolutionary Systematics of Vertebrates*, *Institute of Vertebrate Paleontology and Paleoanthropology*, *Chinese Academy of Sciences* Beijing 100044 xingxu@vip.sina.com)
(2 *Graduate University of Chinese Academy of Sciences* Beijing 100049)

Abstract Here we report a new oviraptorid taxon based on a specimen possibly collected from the Upper Cretaceous Nanxiong Formation of Ganzhou, Jiangxi, China. This new taxon is distinguishable from other species based on the following features: a crest formed by the premaxillae and nasals having a step-wise posterior end and bearing two longitudinal grooves and numerous oblique striations on each of its lateral surfaces, an extremely elongate external naris that is posteriorly situated and close to the orbit, a deep fossa on the dorsal surface of the palatal ramus of the pterygoid, several longitudinal grooves along the posterior part of the dorsal margin of the dentary, and several tubercles along the lateral shelf at the dorsal margin of the surangular. This new taxon possesses some palatal and mandibular features not seen in other oviraptorids but similar to those in more basal oviraptorosaurs, suggesting a relatively basal position for this taxon within the Oviraptoridae. This systematic hypothesis is supported by a numerical cladistic analysis. This discovery not only adds to the known diversity of Late Cretaceous oviraptorids, but provides significant new information on the evolution of some oviraptorid features.

Key words China; Late Cretaceous; Oviraptoridae, Theropoda

1）中国科学院百人计划，中国科学院、国家外国专家局创新团队国际合作伙伴计划和国家自然科学基金重点项目（编号：40830210）资助。

收稿日期：2009-09-18

1 Introduction

The oviraptorids are a theropod group in which the skull and mandible are highly modified. Oviraptorids are characterized by a short snout, the absence of teeth, a tall mandible, a long parietal, an enlarged tooth-like process on the palate, and a large, anteriorly located external mandibular fenestra (Osmólska et al., 2004). Ten oviraptorid taxa have been reported from Late Cretaceous deposits in Asia, including *Oviraptor philoceratops* from the Djadokhta Formation of Bayn Dzak, Mongolia (Osborn, 1924), *Ingenia yanshini* and *Conchoraptor gracilis* from the Barun Goyot Formation of Hermiin Tsav, Mongolia (Barsbold, 1981, 1986), *Rinchenia mongoliensis* from the Nemegt Formation of Hermiin Tsav (Barsbold, 1986, 1997; Osmólska et al., 2004), *Citipati osmolskae* and *Khaan mckennai* from the Djadokhta Formation of Ukhaa Tolgod, Mongolia (Clark et al., 2001, 2002), *Heyuannia huangi* from the Dalangshan Formation of Guangdong Province, China (Lü, 2002, 2005), *Nemegtomaia barsboldi* from the Nemegt Formation of the Nemegt locality, Mongolia (Lü et al., 2004, 2005), *Shixinggia oblita* from the Pingling Formation of Shixing County, Guangdong Province, China (Lü and Zhang, 2005), and *Luoyanggia liudianensis* from the lower Upper Cretaceous "Mangchuan Formation", Henan Province, China (Lü et al., 2009). Here we briefly describe a nearly complete skull and mandible possibly from the Upper Cretaceous Nanxiong Formation of the Hongcheng Basin near Ganzhou City, Jiangxi Province, which represents a new oviraptorid taxon. A specimen preserving an embryonic oviraptorid skeleton has been reported from the same basin (Cheng et al., 2008), but lacks informative cranial features that can be compared with our specimen.

2 Systematic paleontology

Theropoda Marsh, 1881
Oviraptorosauria Barsbold, 1976
Oviraptoridae Barsbold, 1976
***Banji long* gen. et sp. nov.**

Holotype IVPP V 16896 (housed in the Institute of Vertebrate Paleontology and Paleoanthropology, Beijing), a nearly complete skull and mandible.

Type locality and horizon The specimen was acquired from an amateur collector who is not willing to reveal his identity. The only information concerning the provenance of the specimen provided by this collector is that the specimen was collected in the Hongcheng Basin near Ganzhou City, Jiangxi Province. The red beds exposed in the Hongcheng Basin are normally correlated with the Upper Cretaceous Nanxiong Formation (Sato et al., 2005).

Etymology Genus name from 'ban', speckle, but sometimes referring to stripes in Chinese, and 'ji', crest; refers to the animal's bearing a crest with distinctive striations over the snout. The species name 'long' is a transliteration of the Chinese word for dragon.

Diagnosis An oviraptorid distinguishable from other species based on the following features: a crest formed by the premaxillae and nasals having a step-wise posterior end and bearing two longitudinal grooves and numerous oblique striations on each of its lateral surfaces, an extremely elongate external naris that is posteriorly situated and close to the orbit, a deep fossa on the dorsal surface of the palatal ramus of the pterygoid, several longitudinal grooves along the posterior part of the dorsal margin of the dentary, and several tubercles along the lateral shelf at the dorsal margin of the surangular.

3 Description and comparison

The specimen is small (about 65 mm in basal skull length) (Fig. 1), and the lack of ex-

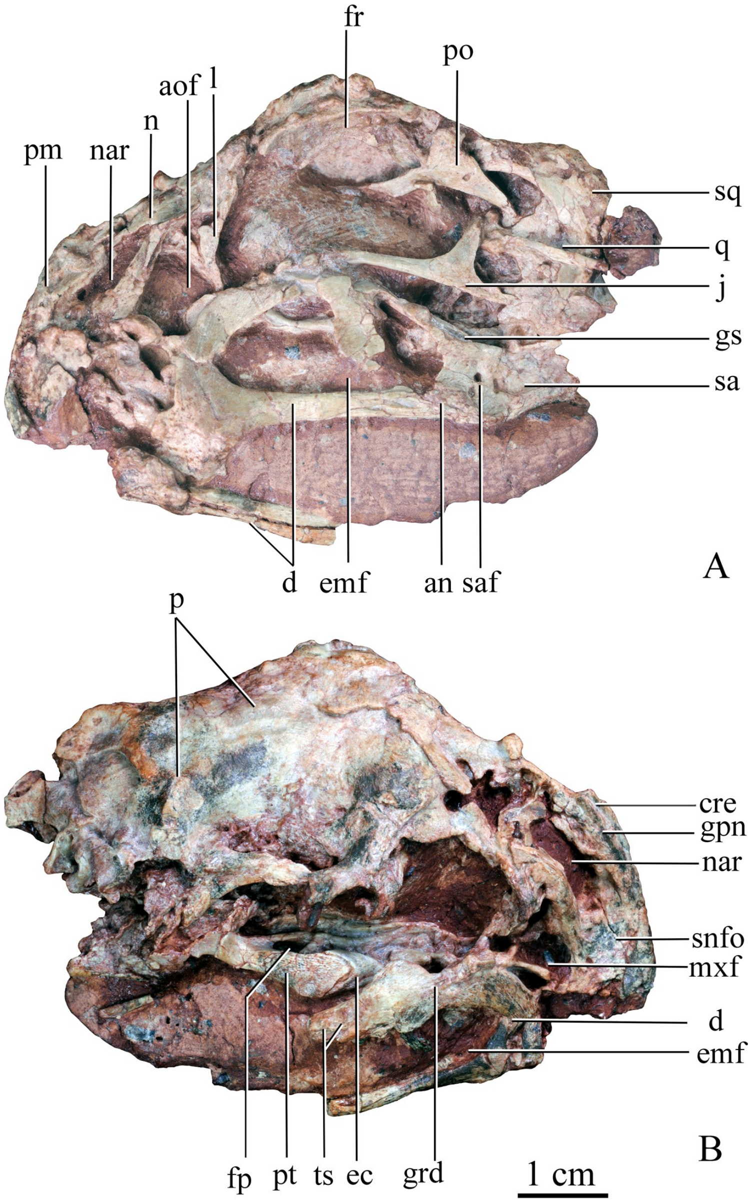

Fig. 1　Photographs of the *Banji long* gen. et sp. nov., holotype, IVPP V 16896

Skull and mandible in left (A) and right (B) lateral views

Abbreviations: aof. antorbital fossa 眶前窝; an. angular 隅骨; cre. crest 脊冠; d. dentary 齿骨; ec. ectopterygoid 外翼骨; emf. external mandibular fenestra 外下颌孔; fp. fossa on pterygoid 翼骨上的小窝; fr. frontal 额骨; gpn. grooves on premaxilla and nasal 前颌骨和鼻骨上的沟槽; grd. grooves and ridges on dentary 齿骨上形成的沟槽和脊; gs. grooves on surangular 上隅骨上的沟槽; j. jugal 颧骨; l. lacrimal 泪骨; mxf. maxillary fenestra 上颌孔; n. nasal 鼻骨; nar. naris 鼻孔; p. parietal 顶骨; pm. premaxilla 前颌骨; po. postorbital 眶后骨; pt. pterygoid 翼骨; q. quadrate 方骨; sa. surangular 上隅骨; saf. surangular foramen 上隅骨孔; snfo. subnarial fossa 鼻下窝; sq. squamosal 鳞骨; ts. tubercles on surangular 上隅骨上的突起

pected fusions among some cranial and mandibular bones (the articular and basioccipital are separated from the surangular and exoccipital, respectively) suggests that it is probably a juvenile individual. However, the left and right nasals are fused to each other without any trace of a suture, as are the contralateral frontals, parietals, and probably dentaries. These fusions indicate that IVPP V 16896 had probably matured beyond an early juvenile ontogenetic stage.

Banji has a typical oviraptorid skull profile — the skull is short and tall, with a short snout (Clark et al., 2002; Osmólska et al., 2004). The large external naris is high and posterior in position (posterior margin near the orbit), extremely elongate (long axis nearly three times length of short axis), and surrounded by several distinctive pneumatic fossae (Figs. 1, 2). The small antorbital fossa contains an anteroposteriorly narrow antorbital fenestra and a large sub-triangular maxillary fenestra (Figs. 1B; 2). As in other oviraptorids (Osmólska et al., 2004), a large infratemporal fenestra is present. The premaxillae and nasals form a crest with a stepwise posterior end. Each lateral surface of the crest bears two longitudinal grooves and numerous distinctive, oblique striations, in addition to several pneumatic fossae (Figs. 1B; 2).

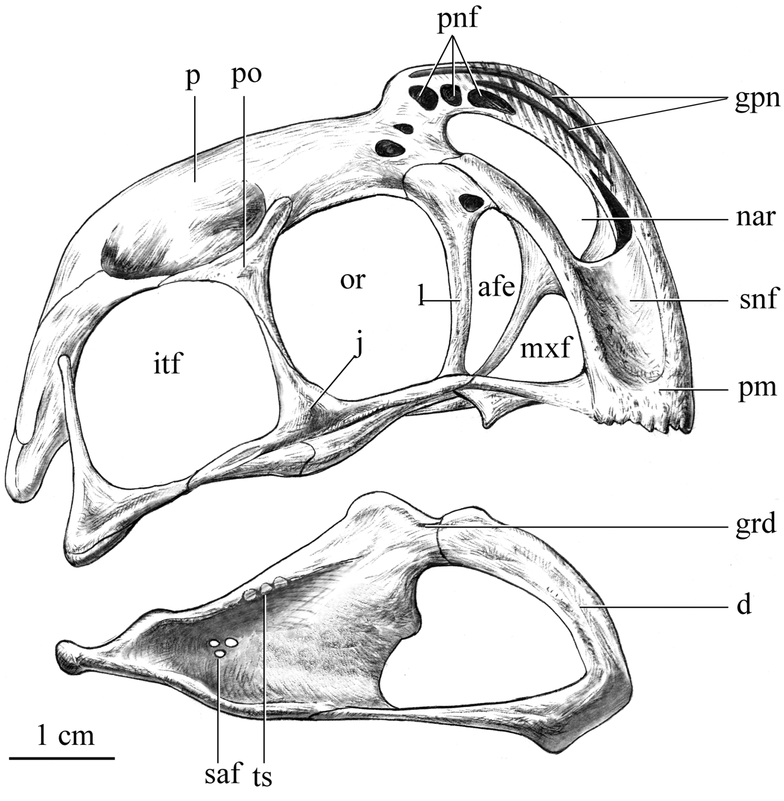

Fig. 2 A reconstruction of *Banji long* gen. et sp. nov. in lateral view, based on the holotype IVPP V 16896
Abbreviations: afe. antorbital fenestra 眶前孔; d. dentary 齿骨; gpn. grooves on the premaxillae and nasals 前颌骨和鼻骨上的沟槽; grd. grooves and ridges on dentary 齿骨上沟槽和脊; itf. infratemporal fenestra 下颞孔; j. jugal 颧骨; l. lacrimal 泪骨; mxf. maxillary fossa 上颌骨窝; nar. naris 鼻孔; or. orbit 眼眶; p. parietal 顶骨; pm. premaxillae 前颌骨; pnf. pneumatic fossae 气腔窝; po. postorbital 眶后骨; saf. surangular fenestra 上隅骨孔; snf. subnarial fossa 鼻下窝; ts. tubercles on surangular 上隅骨结节

The large premaxilla borders most of the external naris, apart from the posterodorsal end, and also borders the anterior and anterodorsal margins of the antorbital fossa. A large distinctive subnarial fossa is present on the lateral surface of the premaxilla. As in other oviraptorids (Clark et al., 2002; Lü et al., 2004; Osmólska et al., 2004) (Figs. 1B; 2), the frontal is anteroposteriorly short, whereas the parietal is long (Fig. 1A). There is a shallow longitudinal groove rather than a sagittal crest along the midline of the fused parietals. The descending process of the pneumatic lacrimal has strongly convex anterior and lateral surfaces (Figs. 1A; 2). The suborbital ramus of the jugal is slender and slightly flattened mediolaterally. As in *Citipati* (Clark et al., 2002), it is perpendicular to the postorbital process, which is strongly upturned (Fig. 1A). The quadrate is very robust, and terminates ventrally in two large condyles separated by an oblique groove (Fig. 1A). The occiput faces posterodorsally. Both the nuchal transverse crest and the supraoccipital crest are weak. The paroccipital process is short and ventrally pendant. The palate exhibits several features intermediate in condition between basal oviraptorosaurs and other oviraptorids. The pterygoid has an anteroposteriorly long palatal ramus in comparison to other oviraptorids (Osmólska et al., 2004), amounting to about one-third of the basal skull length. There is a longitudinal trough along the dorsal surface of the palatal ramus, the lateral border of which is formed by the pterygoid-ectopterygoid bar (Fig. 1B). Other oviraptorids lack this feature, although they possess a trough along the ventral surface of the palatal ramus (Osmólska et al., 2004). A deep fossa is present on the medial wall of the dorsal trough of *Banji*, a feature unknown in any other oviraptorosaur (Osmólska et al., 2004) (Fig. 1B). The long ectopterygoid lies anterolateral to the pterygoid, a condition intermediate between typical non-avian theropods and other oviraptorids (Figs. 1B; 2). The maxillary process of the ectopterygoid extends anteriorly and lacks a strong dorsal extension as in other oviraptorids (Osmólska et al., 2004). This feature is consistent with the position of the vomer, which lies at about the same level as most of the other palatal elements.

The mandible is massive, with an extremely anteriorly located mandibular fenestra, the anterior border of which even extends beyond the anteroventral corner of the dentary when the ventral edge of this bone is horizontally oriented (Figs. 1, 2). The symphyseal portion of the dentary is downturned in lateral view and U-shaped in ventral view. The dentary has a highly convex dorsal margin, in contrast to the gentler convexity seen in more basal oviraptorosaurs such as *Incisivosaurus* (Xu et al., 2002) and in therizinosaurs (Clark et al., 2004). In most other oviraptorids, the dentary has a concave anterodorsal margin in lateral view (Osmólska et al., 2004). A few sharp ridges and grooves are present on the posteriormost part of the dorsal margin of the dentary, and posterior to the coronoid process are several small but distinct tubercles along the lateral shelf at the dorsal margin of the surangular (Figs. 1B; 2) These features have not been reported in any other oviraptorosaur. Immediately posterior to the mandibular fenestra is a prominent, well defined fossa, which contains several large foramina. Above the fossa is a distinct groove along the dorsal margin of the surangular (Fig. 1A). A similar groove is also known in *Incisivosaurus* (IVPP V 13326) and some maniraptorans, but in oviraptorids the dorsal edge of the surangular in this region is relatively narrow and rounded.

4 Discussion

Several discernible cranial features of IVPP V 16896 distinguish this specimen from other known oviraptorid taxa. At least some of these distinctive features, such as the unique morphology of the crest, the deep fossa on the dorsal surface of the pterygoid palatal ramus, and the deep groove along the dorsal margin of the surangular, are unlikely to be related to ontogeny. Consequently we erect a new taxon to reflect this unique combination of cranial morphological features, though future discoveries may demonstrate that the specimen belongs to an established taxon currently known only from postcranial material.

Banji long is clearly an oviraptorid because it shares with other oviraptorids many unique features, such as a tall, short snout, robust toothless jaws, a long parietal, and a large, anteriorly located external mandibular fenestra. Among known oviraptorids, several features of the palate and mandible indicate that *Banji long* is probably relatively basal. Oviraptorids have a peculiar palate unique among dinosaurs. Although *Banji long* has a palate very similar to that of other oviraptorids, several palatal features are in an intermediate condition between more basal oviraptorosaurs and typical oviraptorids. Relative to other oviraptorids, *Banji long* has a proportionally longer palatal ramus of the pterygoid, and a less anteriorly located ectopterygoid that lacks a strong dorsal extension. The vomer is also at about same horizontal level as the other palatal elements, again in contrast to other oviraptorids. *Banji long* also resembles more basal oviraptorosaurs in several mandibular features, such as the convex dorsal margin of the dentary and the presence of a groove along the dorsal margin of the surangular. It is likely that some of these features are ontogeny-related given the juvenile status of the only known *Banji long* specimen, but currently there are no available data to indicate which features this is most likely to apply to.

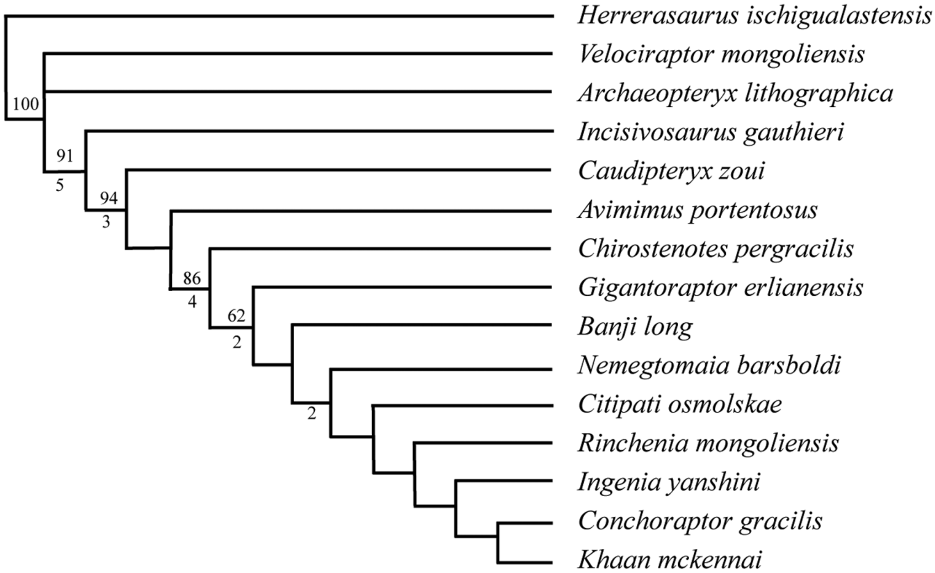

Fig. 3 A phylogeny of oviraptorosaurs showing the systematic position of *Banji long* gen. et sp. nov. The analysis resulted in 2 most parsimonious trees, each with a length of 299 steps (CI = 0.64 and RI = 0.70); values above nodes represent bootstrap proportions (%); values beneath nodes represent Bremer support, and values of +1 or less are not shown

In order to confirm this phylogenetic hypothesis, we further investigated the systematic position of *Banji long* using a dataset (Appendix 1) revised from a recently published one (Xu et al., 2007, which was in turn based on the analysis by Osmólska et al., 2004). Because ontogenetic variation is poorly understood in oviraptorids, we tentatively scored all features visible in IVPP V 16896. However, it is possible that some of these scorings were influenced by ontogeny and thus had a spurious effect on the results of the analysis. The data matrix was analyzed using the NONA (ver 2.0) software package (Goloboff, 1993), and formatting and character exploration were performed in WinClada (Nixon, 1999). The analysis protocol consisted of 1000 Tree Bisection and Regrafting tree searches followed by branch swapping. Settings included collapsing unsupported branches and counting all states in polymorphic codings. Other settings, including character ordering, follow Osmólska et al. (2004). The analysis resulted in 2 most parsimonious trees, the strict consensus of which is shown in Fig. 3. The relatively basal position of *Banji long* is confirmed by our analysis, which shows that *Banji long* is the most basal oviraptorid apart from *Gigantoraptor*.

As a relatively basal oviraptorid from the Late Cretaceous of southern China, *Banji long* represents an important addition to the known diversity of Late Cretaceous oviraptorids. Its discovery provides significant new information concerning the morphological evolution of the group and demonstrates the evolutionary sequence of some important oviraptorid features. A more detailed morphological description, accompanied by a discussion of the possible implications for understanding oviraptorid ontogeny (Norell et al., 2001), will be presented elsewhere.

Acknowledgements The authors thank X. Q. Ding for preparing the specimen, Z. K. Gai for taking the photograph of Figure 1, R. S. Li for drawing Figure 2, C. Sullivan for editing the ms, Dr. J.-C. Lü and an anonymous reviewer for valuable comments. This study was supported by the National Natural Science Foundation of China, the Chinese Academy of Sciences, and the National Ministry of Science and Technology.

References

Barsbold R, 1981. Toothless carnivorous dinosaurs of Mongolia. Trudy Sovm Sov Mong Paleont Eksped, **15**: 28–39 (in Russian with English summary)

Barsbold R, 1986. Raubdinosaurier Oviraptoren. In: Vorobyeva E I ed. Herpetological Studies in the Mongolian People's Republic. Moskva: Akad Nauk SSSR Inst A M Severtsova. 210–223 (in Russian with German summary)

Barsbold R, 1997. Oviraptorosauria. In: Currie P J, Padian K eds. Encyclopedia of Dinosaurs. Berkeley: University of California Press. 505–508

Cheng Y N, Ji Q, Wu X C et al., 2008. Oviraptorosaurian eggs (Dinosauria) with embryonic skeletons discovered for the first time in China. Acta Geol Sin, **82**(6): 1089–1094

Clark J M, Maryańska T, Barsbold R, 2004. Therizinosauroidea. In: Weishampel D B, Dodson P, Osmólska H eds. The Dinosauria, 2nd ed. Berkeley: University of California Press. 151–164

Clark J M, Norell M A, Barsbold R, 2001. Two new oviraptorids (Theropoda: Oviraptorosauria), Upper Cretaceous Djadokhta Formation, Ukhaa Tolgod, Mongolia. J Vert Paleont, **21**: 209–213

Clark J M, Norell M A, Rowe T, 2002. Cranial anatomy of *Citipati osmolskae* (Theropoda, Oviraptorosauria), and a reinterpretation of the holotype of *Oviraptor philoceratops*. Am Mus Novit, (3364): 1–24

Goloboff P A, 1993. NONA (ver 2.0) published by the author, S M de Tucuman, Argentina Computer program and manual available at http://www.cladistics.com

Lü J C, 2002. A new oviraptorosaurid (Theropoda: Oviraptorosauria) from the Late Cretaceous of southern China. J Vert Paleont, **22**: 871–875

Lü J C(吕君昌), 2005. Oviraptorid Dinosaurs from Southern China. Beijing: Geological Publishing House. 1–208 (in Chinese)

Lü J C, Tomida Y, Azuma Y et al., 2004. New oviraptorid dinosaur (Dinosauria: Oviraptorosauria) from the Nemegt Formation of southwestern Mongolia. Bull Natl Sci Mus Ser C (Tokyo), **30**: 95–130

Lü J C, Tomida Y, Azuma Y et al., 2005. *Nemegtomaia* gen. nov., a replacement name for the oviraptorosaurian dinosaur *Nemegtia* Lü et al., 2004, a preoccupied name. Bull Natl Sci Mus Ser C (Tokyo), **31**: 1–51

Lü J C, Xu L, Jiang X J et al., 2009. A preliminary report on the new dinosaurian fauna from the Cretaceous of the Ruyang Basin, Henan Province of central China. J Palaeont Soc Korea, **25**(1): 43–56

Lü J C, Zhang B K, 2005. A new oviraptorid (Theropoda: Oviraptorosauria) from the Upper Cretaceous of the Nanxiong Basin, Guangdong Province of southern China. Acta Palaeont Sin, **44**: 412–422

Nixon K C, 1999. Winclada (BETA) ver. 0.9.9 published by the author. Ithaca, New York, USA

Norell M A, Clark J M, Chiappe L M et al., 2001. An embryonic oviraptorid (Dinosauria: Theropoda) from the Upper Cretaceous of Mongolia. Am Mus Novit, (3315): 1–17

Osborn H F, 1924. Three new Theropoda, *Protoceratops* zone, central Mongolia. Am Mus Novit, (144): 1–12

Osmólska H, Currie P G, Barsbold R, 2004. Oviraptorosauria. In: Weishampel D B, Dodson P, Osmólska H eds. The Dinosauria, 2nd ed. Berkeley: University of California Press. 165–183

Sato T, Cheng Y N, Wu X C et al., 2005. A pair of shelled eggs inside a female dinosaur. Science, **308**: 375

Xu X, Cheng Y N, Wang X L et al., 2002. An unusual oviraptorosaurian dinosaur from China. Nature, **419**: 291–293

Xu X, Tan Q W, Wang J M et al., 2007. A gigantic bird-like dinosaur from the Late Cretaceous of China. Nature, **447**: 1–4

Appendix 1

1. Modified and newly added characters:

Character 61 of Osmólska et al., 2004:

Ectopterygoid position: lateral to (0), anterolateral to (1), or anterior to the pterygoid (2).

Character 162 (newly added). Surangular, distinct groove on dorsal surface: present (0) or absent (1).

Character 163 (newly added). Vomer, position: level with (0) or ventral to (1) other palatal elements.

2. Character scorings for *Banji long* gen. et sp. nov. based on IVPP V 16896 and *Nemegtomaia barsboldi*

	10	20	30	40	50
Banji long	11?210111?	??01111021	2111111101	1??11101??	??0??11?11
Nemegtomaia barsboldi	1112221111	11011110?1	?1?1111?11	1?110101??	??1?1112?1
	60	70	80	90	100
Banji long	11????????	1111121?01	11??11?212	1??000110?	???11?121?
Nemegtomaia barsboldi	111121??1?	1111121111	1111111211	1111001111	1111121211
	110	120	130	140	150
Banji long	1?????????	??????????	??????????	??????????	??????????
Nemegtomaia barsboldi	110111????	??????1???	??????????	????100021	?00?????1?
	160				
Banji long	??????????	?00			
Nemegtomaia barsboldi	??????????	?11			