On a Small Ornithopod (*Gongbusaurus w..ucaiwanensis)* from Kelamaili, Jungar Basin, Xinjiang, China

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Abstract

The text describes a small ornithopod - *Gongbusaurus wucaiwanensis* sp. nov. A discussion of its phylogenetic position and stratigraphic age is conducted.

Introduction

In 1983 the Xinjiang Autonomous Region paleontological expedition was organized by The Institute of Vertebrate Paleontology, Paleoanthropology in the Wucaiwan region at the northeast boarder of the Jungar Basin. A collection of small ornithopod dinosaurs was recovered from a total of five fossil localities: 83007-5, 83007-6, 83007-7, 83007-8, and 83007-9. Preservation of this collection is poor, but it may noted as the first record of small ornithopods from Jurassic deposits of the Jungar Basin. This discovery provides a foundation for the correlation and subdivision of the fossiliferous Shishugou Formation.

I Description

Ornithischia Seeley, 1988
Ornithopoda Marsh, 1871
Hypsilophodontidae Doll, 1882
***Gongbusaurus* Dong et al., 1983**

***Gongbusaurus wucaiwanensis* sp. nov.**
(Plate I)

Diagnosis: A small unarmored hypsilophodontid with dental characters similar to *Gonbusaurus shiyii*. Single alignment of dentition erupting lingually to the occlusal surface. The tooth crowns are aligned obliquely to the axis of the jaw. Twelve to fourteen teeth are present in the mandible, progressively increasing in size anteroposteriorly. The posterolabial side of the mandible is swollen, the lingual side is slightly concave, the superior margin of the jaw is reduced lingually, and the dentition recurves anteroposteriorly along the medial side of the jaw. The sharp and long prepubic process differs from the plate shape of *Hypsilophodon.*

Locality and Age: Shishugou Formation, early Late Jurassic; Wucaiwan, Kelamaili, Jungar Basin, Xinjiang Autonomous Region.

Type Specimen: A 7.5 cm piece of left mandible, 3 caudal vertebrae, and a partially damaged anterior limb from Loc. 83007-8. IVPP specimen number V8303.

Paratype: Specimen V8304 from IVPP locality 83007-6 consisting of an incomplete individual, 2 sacral vertebrae, 8 caudal vertebrae, an incomplete pelvis, and complete hind limb.

Hypodigm: Specimen V8304, a damaged pes from Locality 83007-6; and specimen V8304 from Locality 83007-9, 4 dorsal vertebrae and fragentary caudal vertebrae.

Description: At the time of discovery, mandible V8302 was lying exposed on the surface with a partially damaged anterior limb and three caudal vertebrae to the right of it. Coloration is black, of good fidelity, and from its taphonomic context, is assumed to represent a single individual. Fossil site of V8302 is less than 10 meters from V8303 and lies on the same depositional surface. The caudal vertebrae of the two individuals display similar characteristics suggesting their assignment to the same species, with the description of the latter providing the paratype. Material from the remaining localities are predominantly fragmentary, incomplete, and are assigned as hypodigm.

Specimen V82302 is a 7.5 cm length of left mandible. Comparitively, the mandible is clearly robust, gracile anteriorly, partially edentulous and displays the trace of a lateral vertical recess that is the suture line for the predentary. The inferolateral margin of the mandible is robustly swollen forming the origin of the splenial that extends anteriorly to the third alveolae. Lingually there is a longitudinal depression representing the Meckelian groove.

The dentary is the predominant element of the mandible, compressed lingually at the superior margin, and contains 12 alveolae; the fourth and the twelfth alveolae contain erupting teeth. The total length of the dentary is indeterminate due to its broken posterior end, however it is estimated that one to two more teeth were present based upon the most posterior alveolar morphology and the context of the broken gap in the mandible. *Hypsilophodon* maintains a general dental count of 10±2. As a contrast to this figure mandible V8302 may possibly maintain 12-14 teeth, representing the maximum dental count among small ornithopods. The dentition is in single alignment with the teeth aligned obliquely at an approximate 30 degree angle to the dentary, and superimposed upon each other, features which are characteristic of the Hypsilophodontidae (Colbert, 1981). A gradual dental size increase occurs anteroposteriorly based upon the diameter of the alveolae. Mandibular breadth increases with the increase in the size of the dentition.

Among the two teeth preserved, it is only possible to recognize the tooth's apex within the fourth alveolus as the tooth is erupting. The twelfth tooth has erupted fully (Figure 1) out of the alveolus. The crown is complete and spear shaped in morphology with a small central swollen crest projecting up from its center. Anterior and posterior margins are symmetrical with 5 individual serrations on each side. The labial side is slightly protruded, and both sides are covered by a thin black enamel layer. The tooth morphology is consistent with *Gongbusaurus shiyii* but is larger with a relatively thicker crown.

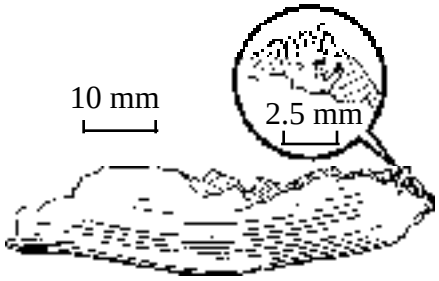

Figure 1. Left Mandible of *Gongbusaurus wucaiwanensis* sp. nov.

Specimen V8302 is represented by three amphicoelus caudal vertebrae. The posterior sulcus is slightly deep, and a ventral keel is present. The vertebral structure is that of a hypsilophodontid. The paratype specimen V8303 displays well-preserved transverse processes and neural arches. The anterior limb is represented by a distal humerus, an ulna, and metacarpals II, III, IV compressed together.

Although the proximal end of the humerus has been broken, the distal end is well preserved. The lateral and medial condyles (ulnar and radial condyles) are relatively well developed. The ulnar condyle is larger and a relatively deep trochlea lies between the two condyles. The preserved length of the ulna is 5.5 cm but the distal end has sustained slight damage. The olecranon is quite distinct, the ulnar shaft is slightly recurved medially, and the articular surface is round. Morphologically it resembles *Hypsilophodon*. Metacarpals II, III, and IV are compressed together (Plate I), and equivalent in length. Mc II and III are relatively flat. The three metacarpals differ from the short and robust metacarpals of *Hypsilophodon* by their long and gracile morphology.

Specimen V8303 is a damaged individual represented by two sacral vertebrae, 8 caudal vertebrae, an incomplete ilium, complete ischium, and only the prepubic process of the pubis, in addition to a complete pair of hind limbs and feet (Plate I). The size and morphology of the caudal vertebrae are equivalent to specimen V8302 implying they are the same taxon, and hence are selected as the paratype for supplemental description.

The two sacral vertebrae are damaged but fused together. Ventral keels are absent. It is speculated that specimen V8303 probably had 5 sacral vertebra, judging from the medial costal nodes on the ilium. The sacral vertebrae preserved are estimated to be Sc.IV and V. Posterior to the sacral vertebrae lie 8 articulated caudal vertebrae that are amphicoelus, maintain a low neural arch, a vertical plate-shaped neural spine, and long, narrow, horizontally extended transverse processes. A median keel is present ventrally. Between the centra is a crescentic shaped cavity which accommodates the insertion of chevrons anteriorly but posterior from the third centrum this cavity is open.

Pelvic bones preserved include a left ilium with its posterior process, a pair of completely preserved ischia, and a prepubic process.

The body of the ilium is low and robust, with a broad posterior process. Medially, it is compressed to form a deep longitudinal depression. The ventral margin becomes thinned, compressed medially, and there is a well-developed longitudinal crest on the upper margin of the constricted depression, beneath which lies a longitudinally long sulcus for the caudi-femoralis brevis. The pubic process of the ilium is relatively well developed.

A pair of completely preserved ischia have a length of 14 cm, are linear in shape, and extend posteroventally along their median. The proximal ends broaden to form the lower margin of the acetabulum. Only the right prepubic process is completely preserved on the pubis. This is in the form of a sharp projection which differs from the plate-shaped prepubic process of *Hypsilophodon*.

Hind limb and foot: a left proximal femur is preserved, but due to weathering the outer cortical bone has been corroded leaving only the infilled haversian canal system. A trochanteric neck is unobservable, but laterally there lies a small cracked depression that is the vestige of the lesser trochanteric node lying separate from the shaft. The femoral shaft is slightly recurved.

The left and right side of the tibia are completely preserved, although the left side has been weathered and the two ends have sustained some slight damage. The tibia lies articulated with the fibula, astragalus, and calcaneum preserving a primitive condition (Plate I).

The tibial shaft is straight with expanded terminal ends and is 19.5 cm long. Its lateral surface (medial fibula surface) is flat and level. The cnemial crest at the proximal end of the tibia is anteriorly projected and there are two small projected nodes on the lateral surface for articulation with the fibula that lie on the same plane as the cnemial crest. Consequently the shape of the proximal end of the tibia (femoral articulation) is triangular. The two condyles that articulate with fibular facets are equivalent in size. The distal end of the tibia is transversely expanded into a crescentic shape where it articulates with the calcaneum. Anteriorly there is a large sulcus (the tibia-calcaneum facet). Medially there is a foot-shaped process. The tibial shaft is hollow. The fibula is straight and gracile, with an expanded proximal end that is laterally convex and medially concave. Proximally, the fibula articulates with the tibia at two nodes (Figure 2). The distal end of the fibula is rounded for insertion into the calcaneum facet.

The calcaneum is a long concave element that articulates with the distal end of the tibia. A process projects anteriorly but is not well-developed. This tibia process differs from the moderately well developed tongue-shaped process of *Hypsilophodon.* The posterior margin of the

calcaneum is rounded with a shallow convexity that acts as a pully in its center. Laterally it is subrounded as a semicircular-shaped ridge that articulates with the astragalus.

The astragalus is a rounded multifaceted button. The proximal margin is convex for the reception of the fibula. The distal margin is rounded for the articulation with the lateral distal tarsal D_4. Laterally, a central shallow sulcus with thickened margins is present. At the medial side a sulcus is present for the articulation with the calcaneum. In the tarsal region, in addition to the astragalus and calcaneum and distal to them, lie four distal tarsals. Galton (1974) reported the presence of two small lateral distal tarsals on *Hysilophodon*, however the Kelamaili specimen maintains four (Figure 3). Four distal tarsals may also be observed on *Allosaurus*.

Figure 2. Tibia and fibula of *Gongbusaurus wucaiwanensis* sp. nov.

Figure 3. Hind foot of *Gongbusaurus wucaiwanensis* sp. nov.

D_1 is a small ovoid element proximal to Mt.II.

D_2 is a small saddle-shaped element that articulates with D_3 at the proximal margin between the Mt.II and Mt.III.

D_3 is a small disc shaped-element that lies on Mt.III. This is the largest element at the lateral metatarsal.

D_4 articulates and covers Mt.IV and Mt.V with a proximal sulcus for the articulation with the astragalus.

The metatarsals and phalanges on both feet are completely preserved (Plate I) and maintain a primitive condition. The proximal ends of all the metatarsals are compressed tightly together but diverge distally. Well-preserved complete hind feet of small ornithopods such as these are rarely observed.

Mt.I is short with a flat articulation with Mt.II at its proximal end. Its shaft is flattened and recurves distolaterally. It maintains a thickened triangularly shaped distal end with a deep medial sulcus that is fused to Mt.II. The terminus is rounded for the articulation with the first phalanx. Mt.I is approximately half the length of Mt.III.

Mt.II is relatively robust and nearly the length of Mt.IV. Its proximal end has the shape of a parallelogram with a longitudinal depression at its lateral side that accommodates the Mt.I. Medially, it is fused to Mt.III. Distally it is rounded and becomes convex laterally for the articulation with the first phalanx.

Mt.III is 9.8 cm long, being the longest of the metatarsals. The proximal end is square, its distal end becomes transversely broadened, the shaft is straight, and there is a broad rounded articulation surface. The articular surface for the first phalanx is a large convex surface with a large area for movement.

Mt.IV is slightly laterally recurved becoming broader and thinner proximally. The transverse articular surface is triangular. The distal end is not expanded, the medial side is concave and level, and the lateral side has a rounded margin.

Mt.V is a small vestigial nubbin that lies ventral to the Mt.IV. The proximal end is slightly flat and broad and becoming sharp at its distal end. The element is 2.2 cm and is fused to the shaft of the Mt.IV.

The phalanges are typical of the ornithopods, straight and long with short claws that are not too recurved. Phalangeal formula: 2◊3◊4◊5◊0 Figure (3).

Diagnosis and Discussion

The mandible of specimen V8302, containing two complete small leaf-shaped teeth, indicates it is a small ornithopod. As its dental characters are similar to the previously described *Gongbusaurus shiyii* discovered in the Sichuan Basin, there should be no doubt the two are congeneric. The dentition of the Kelaimeili specimen is relatively larger than the Sichuan specimen and the tooth crowns are slightly thicker, which may possibly indicate either differentiation at the species level or be the result of geographic differentiation. It is proposed here that the Kelameili specimen be erected as a new species: *Gongbusaurus wucaiwanensis* sp. nov.

The genotype for *Gongbusaurus shiyii* is represented by two isolated teeth with thin enamel layers on their lingual sides and symmetrical anterior and posterior margins. At the time of description it was unclear what method the dentition took upon erupting in the jaw, and was consequently assigned as a genus within the family Fabrosauridae. The discovery of the Kelamaili specimen confirms that the dentition of *Gongbusaurus* erupts from the lingual side of the mandible, being characteristic of the Hypsilophodontidae. Consequently it is now possible to reassign this genus to the family Hypsilophodontidae.

Former descriptions suggest that small ornithopods are principally composed of three families: the Fabrosauridae, Heterodontosauridae, and Hypsilophodontidae (Romer 1965, Galton 1972, Colbert, 1981). The former two families contain several taxa of small primitive ornithopods that lived from the Late Triassic to the Early or Middle Jurassic. The several taxa in the family Hypsilophodontidae are produced from the Late Jurassic and Cretaceous periods. Within their phylogenetic sequence, the Hypsilophodontidae from the early and middle stages maintain lingual enamel on their dentition, as exemplified by the dentition of *Xiaosaurus* (J_2). Derived taxa, however, have lost the enamel on the lingual side of their dentition. Additionally, dental wear facets appear to be interlocked on taxa such as *Dryosaurus* (J_3), *Hypsilophodon* (K_1), and

Parksosaurus (K_2). *Gongbusaurus wucaiwanensis* maintains a symmetrical dentition with equivalent enamel thickness on both sides suggesting plesiomorphic characters. Consequently, it may be concluded that *Gongbusaurus* lies at an early evolutionary stage of the Hypsilophodontidae as it existed during the Jurassic Period.

The type material for *Gongbusaurus shiyii* was derived from the upper Shaximiao Formation within the Zhongqing (Chungking) Group in the Sichuan Basin. A unified consensus has still not been reached between national biostratigraphers regarding the age of the Upper Shaximiao Formation. Several biostratigraphers believe this formation to be Middle Jurassic based upon ostracods and lamellibranchs. Dezao Su (1982) was inclined toward this observation during his research on the Pteycholepoidei fish. Abundant dinosaur material is known from the Upper Shaximiao Formation, including the large sauropods *Mamenchisaurus* and *Omeisaurus*, the theropods *Yangchuanosaurus* and *Szechuanosaurus*, the stegosaurs *Tuojiangosaurus* and *Chialingosaurus*, and the ornithopods *Yadosuarus* and *Gonbusaurus*. This assemblage is designated the *Mamenchsaurus* Fauna and recognized as early Late Jurassic. The discovery of the small ornithopod *Gongbusaurus wucaiwanensis* sp. nov. in the Jungar Basin provides evidence for the geologic age of the Shishugou Formation as being early Late Jurassic.

Bibliography

Charig, A. J. and A. W. Crompton, 1974: The alleged synonymy of *Lycorhinus* and *Heterodontosaurus*. *Ann. S. Afri. Museum* **64,** 167-189.

Colbert, E. H. 1981: A primitive ornithischian dinosaur from the Kayenta Formation of Arizona. Mus. N. Arizona Press Bull. Ser. 53, 1-61.

Chatterjee, S., 1984: A new ornithischian dinosaur from the Triassic of North America. *Naturwissenschaften* ***71,*** S. 630.

Dong, Zhiming; Zhou, Shiwu; Zhang, Yihong; 1983: Dinosauria from the Jurassic of Sichuan *Pal. Sin.* **162** (23), 1-145. (in Chinese)

Dong, Zhiming; Tang, Zhilu; 1983: Note on the ornithopods from the Dashanpu dinosaur fauna of Zigong, Sichuan *Vert. PalAs.* **21**(2), 168-173. (in Chinese)

Galton, P. M., 1972: Classification and evolution of ornithopod dinosaurs. *Nature* 239, 464-466.

Galton, P. M., 1973: The cheeks of ornithischian dinosaurs. *Lethia* ***6,*** 67-89..

Galton, P. M., 1974: The ornithischian dinosaur *Hypsilophodon* from the Wealden of the Isle of Wight. *Bull. Brit. Mus. (Nat. Hist.) Geol.* **25**, 1-152.

Galton, P. M., 1978: Fabrosauridae, the basal family of ornithischian dinosaurs (Reptilia, Ornithopoda). *Palaeont.* **52,** 136-159.

Galton, P. M., 1983: The cranial anatomy of *Dryosaurus*, a hypsilophodontid dinosaur from the Upper Jurassic of North America and East Africa, with a review of Hypsilophodontids from the Upper Jurassic of North America. *Geol. Paleont.* **17**, 207-243.

Galton, P. M. 1981: *Dryosaurus*, a hypsilophodontid dinosaur from the Upper Jurassic of North America and Africa postcranial skeleton, *Palaeont.* **55,** 271-312.

Gilmore, C. W. 1924: A new species of Laosaurus, an ornithischian dinosaur from the Cretaceous of Alberta. *Trans. Roy. Soc. Canada*, **18**(3), 1-6.

He, Xinlu; Kui, Kaiji; 1983: Ornithopoda from the Dashanpu Dinosaur fauna of Zigong, Sichuan .*Jour. Chengdu Acad. Geo.* 1-71 (in Chinese).

Steel, R. 1969: Ornithischia. in O. Kuhn (Ed.): Encyclopedia of Paleoherpetology 15, 1-84.

Thulborn, R. A., 1973: Teeth of ornithischian dinosaurs from the Upper Jurassic of Portugal. *Mem. Serv. Geol. Portugal* **22**, 89-134.