A new species of sauropod from the Early Jurassic of Gongxian Co., Sichuan

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Abstract

A new genus and species of a primitive sauropod, *Gongxianosaurus shibeiensis*, was recovered from the Lower Jurassic Dongyuemiao Member of the Ziliujing Fm. at Gongxian Co., Sichuan Province. Adult specimens are approximately 14 m in length and are nearly completely represented with the exception of the skull. The genus represents an early primitive sauropodomorph but does not share many synapomorphies with the Sauropoda. This is highly significant for understanding the origin and evolution of the superorder.

Introduction

In May of 1997, Fengyun Zhou and others from the 202nd Corps of the Sichuan Geological Survey were conducting a geological reconnaissance in the vicinity of Hongshacun Hamlet, Shibeixiang Village, Gongxian Co., where they discovered articulated caudals of a sauropod in dark purple silty mudstones of the middle to upper portion of the Dongyueshan Member, Ziliujing Fm. Authorities from the Sichuan Bureau of Mines and members of the County political leadership recognized the extreme significance of the discovery and organized a contingent to preserve and excavate the specimen. Work initiated in May of 1997 with an approximately 200 square meter excavation that resulted in the acquisition of relatively numerous specimens predominantly representing sauropods and a small proportion of other taxa including theropods. Preliminary analyses indicate the presence of a new Early Jurassic fauna which should postdate the Early Jurassic *Lufengosaurus* Fauna of Lufeng, Yunnan Province, but predate the Middle Jurassic *Shunosaurus* Fauna of Dashanpu, Zigong Co., Sichuan Province. The excavation has still not been fully completed, research is still in the preliminary stages, and full collection and complete analysis of the fauna still requires more research, but information about the sauropod is extremely abundant and indicates a rather primitive early stage sauropod that warrants the presentation of this short report (Fig. 1). More detailed research and analyses will be presented in due course.

Figure 1. Skeletal restoration of *Gongxianosaurus shibeiensis*

Description and phylogeny

Family indet.

Gongxianosaurus genus nov.

G. shibeiensis sp. nov.

Etymology: Derived from the county and village from which the specimens were excavated.

Locality and stratigraphic position: Lower Jurassic, middle to upper Dongyuemiao Member of the Ziliujing Fm.; Hongshacun Hamlet, Shibeixiang Village, Gongxian Co., southern Sichuan Province.

Description: There are probably three individuals represented, of which, one is slightly smaller, possibly a juvenile, and is represented by a scapular girdle, forelimb, and hindlimb. The two other adult individuals of similar size and morphology are selected as the type and paratypes. Because the two large specimens were not completely articulated there was some difficulty distinguishing which elements belonged to which individual. Elements represented include two right premaxillae, nearly complete left and right mandibles, many isolated teeth, incomplete and disarticulated cervical, dorsal, sacral, and caudal vertebrae, complete pectoral girdle, forelimb, pelvic girdle, hind limb, and hind foot. Additionally, there are isolated sternal elements, ribs, and gastralia.

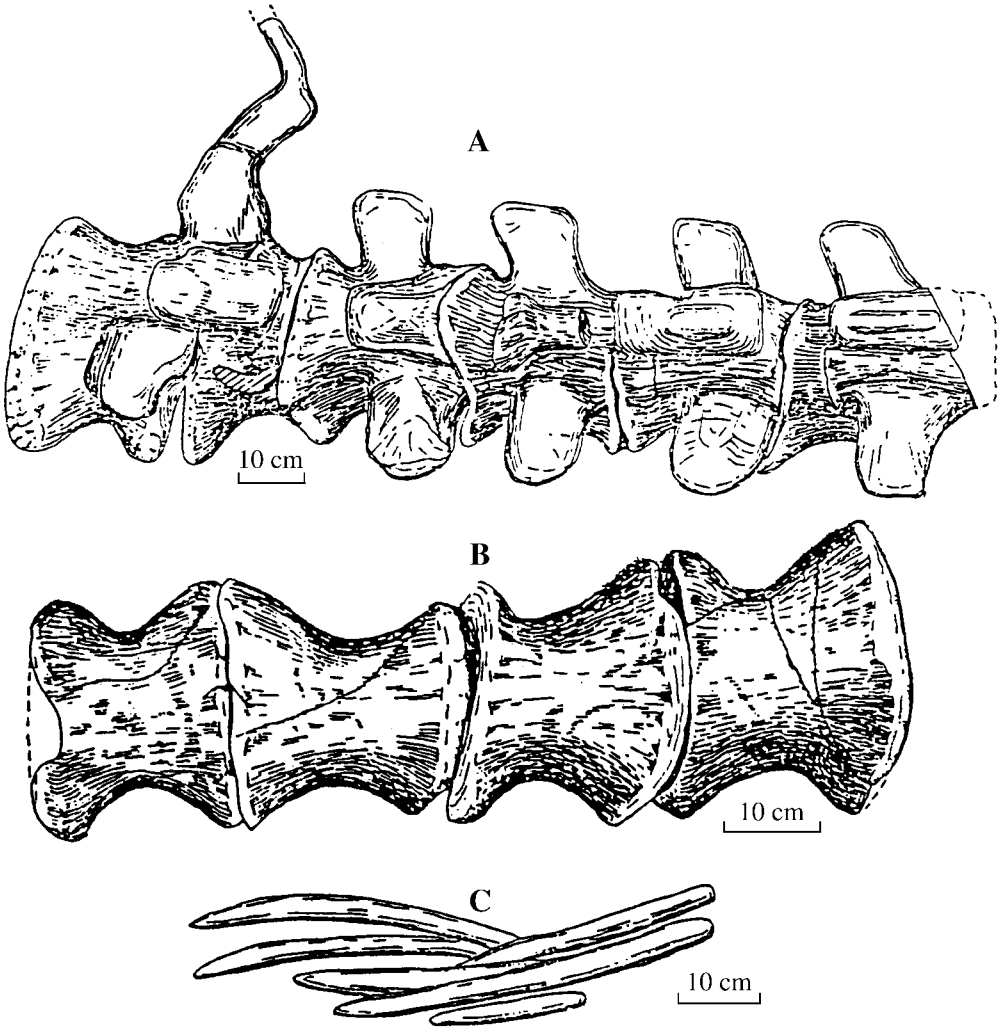

Figure 2. *Gongxianosaurus shibeiensis.* A. Dorsal view of six articulated dorsal vertebrae; B. Ventral view of four articulated dorsal vertebrae; C. Gastralia.

Genus diagnosis: As for species.

Species diagnosis: An early and primitive sauropod that is moderate to large in size with an estimated adult length of approximately 14 m. Premaxilla on the posterodorsal region has a well developed posterior process in addition to the anterodorsal process. Three to four

premaxillary teeth are present and mandibular dentition is relatively long with over 12 teeth in the sequence (estimated at 14-16). Dental morphology is typically spoon-shaped and lacks either anterior or posterior serrations. Lingual and labial surfaces have relatively thick longitudinal striations, lack attenuating folds, and the lingual surface lacks a medial ridge.

Cervical vertebrae are amphiplatyan and simple in morphology with relatively small neural spines that are rectangular in lateral perspective. Cervical ribs are particularly short, being only two-thirds the centrum length. Dorsal vertebrae are amphiplatyan to very weakly amphicoelus, medially constricted, and maintain a simple rectangular neural spine that is longer than high. Diapophyses are nearly horizontal with two nearly parallel transversely extended ventral lamina or spines (resembling ventral diapophyseal plates) (Fig2). Three fused sacral vertebrae are Probably represented which are very slightly constricted with relatively narrow neural spines. The anterior sacral vertebra is amphiplatyan to amphicoelus, the internal structure of the centra is compact and lacks conspicuous honeycombed fabric, pleurocoels are absent, and supporting laminar structure is undeveloped. Anterior caudals are amphiplatyan with broad and plate-shaped neural spines that dorsally become slightly extended posteriorly, and there are extremely well developed diapophyses that are distinctly extended, broad anteroposteriorly, and thin dorsoventrally. None of the vertebrae in the caudal series has a bifurcated haemal arch (Fig. 3).

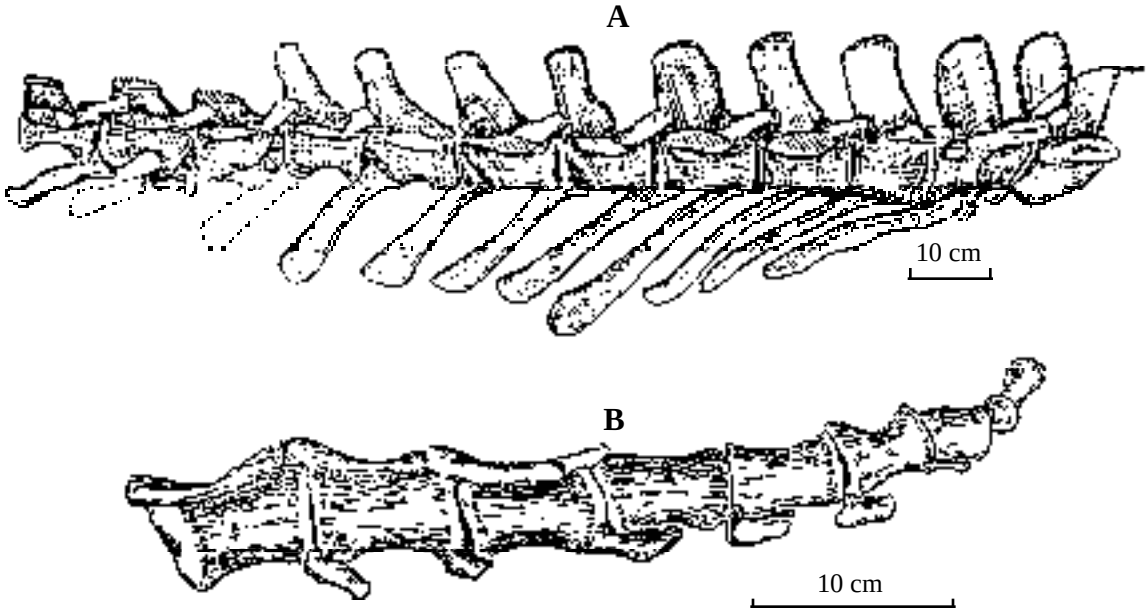

Figure 3. *Gongxianosaurus shibeiensis*. A. Twelve articulated proximal caudal vertebrae; B. Left lateral view of eight posteromedial caudal vertebrae.

The scapula is thin and plate-shaped with a broad distal end and strongly constricted medial shaft. Its anterior margin curves posteriorly in an arc. Scapula-coracoid contact is particularly straight and a coracoid foramen is not present. The sternal outline is an elongated oval. The humerus is typically sauropod in morphology with a relatively well developed deltopectoral crest. Ulna is 60% the length of the humerus, and the forelimb is 70-75% the length of the hindlimb (Fig. 4D). Pubic peduncle is particularly short and nearly equivalent in length to the ischiac peduncle. Iliac crest is appropriately high and conspicuously narrow posteriorly. Pubic shaft is broad and the anterior margins of the pubes are completely fused. Femur is relatively short but robust with a head that is not conspicuously set off from the shaft and a lesser trochanter is absent. Hindlimb is articulated with astragalus, calcaneum, and two distal metatarsi. Pes formula is 2,3,4,5,1 with ungual phalanges on digits I-IV. Digit and ungual morphology are typically sauropodomorph (Fig. 4B,C).

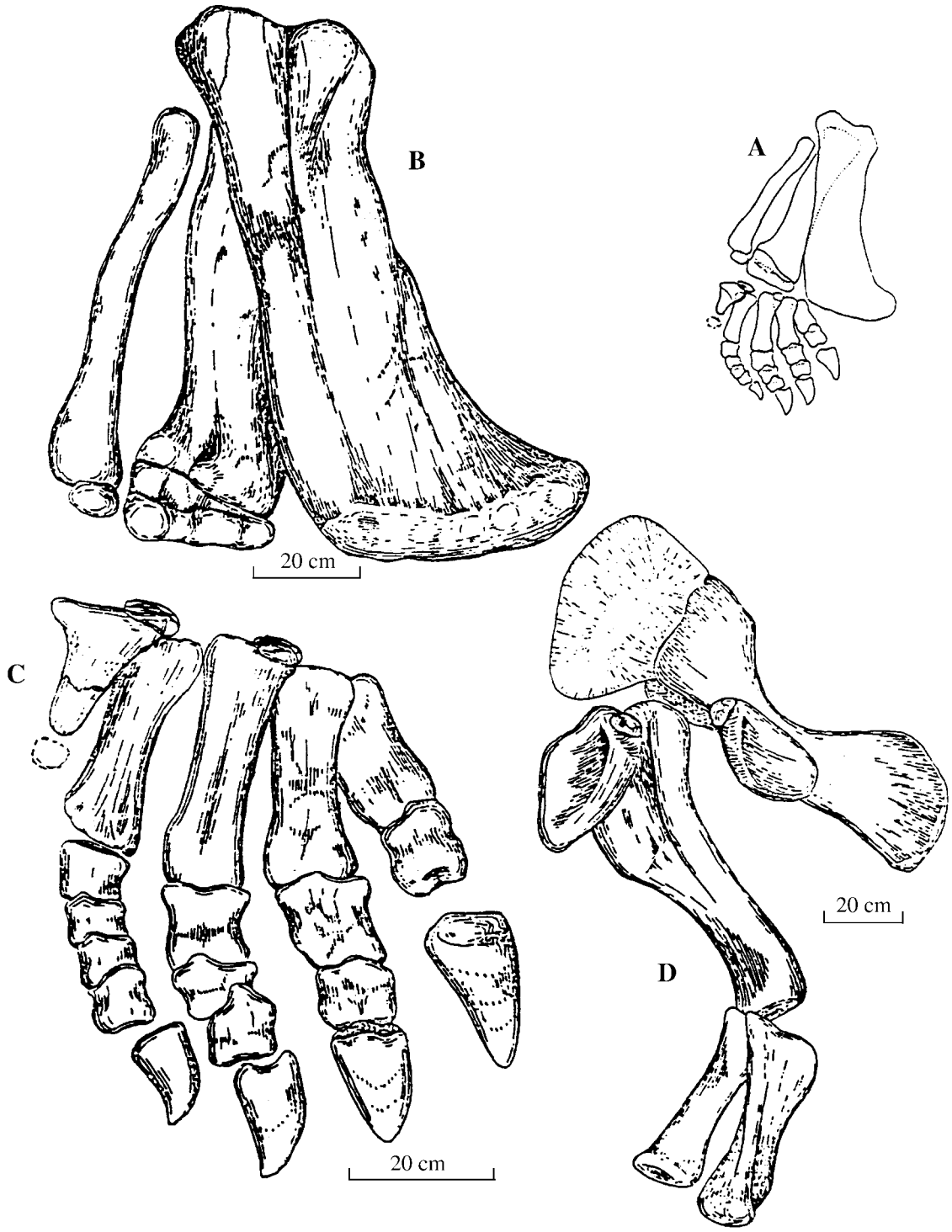

Figure 4. *Gongxianosaurus shibeiensis*. A. Schematic diagram of the left hindlimb in situ; B. Left hindlimb; C. Left pes; D. Shoulder girdle in general articulation with a pair of sterna and forelimb.

Phylogeny: Specimens representing *Gongxianosaurus shibeiensis* are relatively abundant and represent the best specimens of Early Jurassic Sauropoda from China to date. Although individual specimens are not completely articulated, the skull is incompletely known, and only half

the cervical vertebrae are represented, remaining skeletal elements are nearly completely represented, including the dorsal, sacral, and caudal vertebrae; pectoral and pelvic girdles, forelimb and hindlimb. Taphonomic conditions preserve a majority of elements in articulation suggesting that the specimens are conspecific, although the possibility exists that there are two species, or that specimens are separated at an even higher rank resulting in the remote possibility of a taxonomic mixing.

Numerous plesiomorphic characters are represented in *G. shibeiensis* including a well developed posterior process of the premaxilla, dense internal structure of anterior sacral vertebrae, absence of pneumatocoels, complete absence of opisthocoelus centra, neural spines unbifid, and the presence of gastralia. Furthermore, sacral centra count is low and caudal haemal arches are unbifurcated (medial caudal haemal arches are bifurcated on *Shunosaurus, Omeisaurus*, and *Mamenchisaurus*). The ankle joint preserves a calcaneum, and astragalus articulated to two distal tarsals and a pes with a formula of 2,3,4,5,1.

Gongxianosaurus shares numerous primitive characters with both *Lufengosaurus* and *Jinshanosaurus* as those noted above are symplesiomorphic for the Prosauropoda. In addition, the presence of extremely short cervical ribs, the scapula morphology, nearly rectangular and vertical dorsal and cervical neural spines, broad and plate-shaped proximal caudal neural spines and diapophyses are all characters shared with prosauropods from Yunnan Province. Worthy of notation is that hind limb elements, ankle articulation, and pes formula are all typical for the Prosauropoda and extremely distinct from the general condition of the Sauropoda.

But *Gongxianosaurus* is hereby placed in the Sauropoda for the following reasons: Teeth are extremely large and spoon-shaped as is typical for the Sauropoda and the morphology of several elements of the postcranial skeleton are also attributed to the Sauropoda. The forelimb length is extremely and conspicuously long, being 70-75% the length of the hindlimb, which is quite distinct from the Prosauropoda and lies within the range of the Sauropoda. Although the pes formula resembles the Prosauropoda, the phalanges are thick and short, lack proximolateral ligament depressions, and unguals lack dorsolateral longitudinal grooves, which more closely resembles the sauropod condition. From the perspective of size, the nearly 14 m length greatly exceeds the range of any know prosauropod. Therefore, it is concluded that *Gongxianosaurus* represents a taxon of early and primitive sauropod that shares numerous symplesiomorphies with the Prosauropoda, particularly taxa from Southwest China, and thus its genesis is recognized in Southwest China from that superorder. Consequently, further indepth research on this genus will have extreme significance toward understanding the origin of the Sauropoda.

There are important large distinctions between *Gongxianosaurus* and those sauropods from the Middle to Late Jurassic of Sichuan, including *Shunosaurus, Omeisaurus* and *Mamenchisaurus* but these characters will not be addressed in this short report and will be discussed in later and more detailed publications.

From a global perspective, the Triassic has yet to produce a legitimate member of the Sauropoda and consequently the Early Jurassic is regarded as the time of origin for the superorder. Taxa and localities producing early sauropods are rare and only represented by *Barapasaurus* and *Kolasaurus* from India, *Vulcanodon* from Zimbabwe, and *Rhoetosaurus* from Australia. These specimens are fragmentary and although they display numerous plesiomorphic characters, they are more typical of the Sauropoda and are quite distinct from *Gongxianosaurus*, which shares more characters with the Prosauropoda. Further discussion will not be addressed here due to the limited nature of this report.

Currently, in the Sichuan basin there are no legitamate members of the prolific Lufeng Saurischian Fauna in Yunnan documented in the literature, although an unpublished and unstudied specimen of the most characteristic member of the fauna, *Lufengosaurus,* is in the possession of

Professor Zhengwu Chen of the Chinese Academy of Geology which was collected from the Zhenzhuchong Mem. of the lower Ziliujing Fm. in Weiyuan Co. The Zhenzhuchong Mem. represents basal Jurassic red beds that directly overly the Late Triassic coal bearing Shunjiahe Fm. From the perspective of stratigraphic superposition, this resembles precisely the condition in Yunnan where the red beds of the Lower Lufeng Fm. producing the Lufeng Saurischian fauna directly overlie the Late Triassic coal bearing Yipinglang Fm. providing justification for the correlation of the Zhenzhuchong Mem. to the Lower Lufeng Fm. In Gongxian Co., the sediments producing *Gongxianosaurus* are undoubtedly assigned to the Dongyuemiao Mem. of the lower Ziliujing Fm. which directly overlie the Zhunzhuchong Fm. such that *Gongxianosaurus* represents only a single member of a new faunal complex that lies between the Lufeng Fauna and the Middle Jurassic Dashanpu Fauna from Zigong Co. Within an evolutionary context this genus may be recognized as an ancestral/descendant taxon.

As excavations have yet to be completed, research is still in a preliminary phase. Further advanced research, analytical comparisons, and discussion are forthcoming.

Acknowledgements

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Bibliography

Galton, P.M., 1990; Basal Sauropodomorpha- Prosauropoda. in Weishampel, D.B. et al., (ed.)., The Dinosauria. pp. 320-344.

He, X.L.; Li, K.; and Cai, K.J., 1988; The Middle Jurassic Dashanpu Fauna of Zigong Co., Sichuan. Number 4: *Omeisaurus tianfuensis.* Sichuan Science and Technical Press, Chengdu.

Huene, F. 1966; Vollständge Osteologie eines Plateosauriden aus dem schwäbischen Trias. *Geol. Palaeontol. Abhandl.* **15** pp. 129-179.

Jain, S.L. et al., 1975; The sauropod dinosaurs from the Lower Jurassic Kota Formation of India. *Proc. Royal. Soc. London*, Ser. B. 188 pp. 221-228.

Jain, S.L., 1979; Some characteristics of *Barapasaurus tagorei.* A sauropod dinosaur from the Lower Jurassic of Deccan, India. Proc. IV International Gondwana Symposium, Calcutta, India 1 pp. 204-216.

McIntosh, J.S., 1990; Sauropoda. In Weishampel et al. (ed.) *The Dinosauria.* pp. 345-401.

Novas, F.E., 1989; The tibia and tarsus in the Herrerasauridae and origin and evolution of the dinosaurian tarsus. *Jour. Pal.* **63** pp. 677-690.

Romer, A.S., 1956; Osteology of the Reptiles. University of Chicago Press.

Thulborn, R.A., 1980; The ankle joint of archosaurs. *Alcheringa* **4**(4) pp. 241-262.

Young, C.C., 1941; *Lufengosaurus huenei. Palaeontol. Sin.* New Ser. C, (7). pp. 1-53 (in Chinese).

Young, C.C., 1947; *Lufengosaurus magnus* (sp. nov.) and new material of *Lufengosaurus huenei Palaeontol. Sin.* New Ser. C, (12). pp. 1-49 (in Chinese).

Young, C.C., 1951; The Lufeng Saurischian Fauna. *Palaeontol. Sin.* New Ser. C, (13) (in Chinese).

Young, C.C., and Zhao X.J., 1972; *Mamenchisaurus.* Institute of Vertebrate Paleontology and Paleoanthropology Monograph Series I, No. 8. (in Chinese).

Zhang, Y.H. 1988; The Middle Jurassic Dashanpu Fauna of Zigong Co., Sichuan. Number 3: *Shunosaurus.* Sichuan Science and Technical Press. Chengdu.

Zhang, Y.H. and Yang, B.L., 1995 *Jinshanosaurus.* A new complete prosauropod from the Lufeng Basin. Yunnan Science Press, Kunming.