Lower, Middle, and Upper Jurassic subdivision in the Lufeng region, Yunnan Province

by

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Introduction

The Jurassic redbed system of Yunnan Province, known as the "Lufeng Group", is extensively distributed in the middle to eastern regions of the province. To the north, sedimentation becomes progressively well developed, passing through the Xinjiang-Yunnan Axis to become contiguous with the "red beds" in Sichuan Province. The eastern Yunnan redbeds are noted in the Oushan, Yuanmou, Wuding, Lufeng, Chuanjie, Anning, Hedong, Taoyuan, Songhua, Jincheng, Shuitang, and Dadacun basins, the largest of which is the Lufeng Basin which is 414 km^2, and the smallest being the Songhua Basin at 8 km^2. In 1998-99, the authors conducted systematic biostratigraphic work in the redbeds of the Chuanjie Basin, Lufeng Co., continuing detailed research and revising the stratigraphic section at Laochangqing-Dajianfeng (Fig. 1). The Chuanjie Basin bounds the Lufeng Basin with an area of approximately 75 km^2 and displays a stratigraphic sequence and depositional characteristics that are fundamentally consistent with the Lufeng Basin. It is distinct, however, in that overlying the "wine red beds" is a thicker set of variegated sediments.

The authors hereby subdivide the Mesozoic red beds (Lufeng Group) in this region by erecting the following nomenclature for the Lufeng region's Lower, Middle and Upper Jurassic (Table 1): the Lufeng Fm. (including the Shawan and Zhangjia'ao members), Chuanjie Fm., Laoluocun Fm., and Madishan Fm.. The uppermost Anning Fm. is retained from prior literature.

Lachangqing-Dajianfeng cross-section

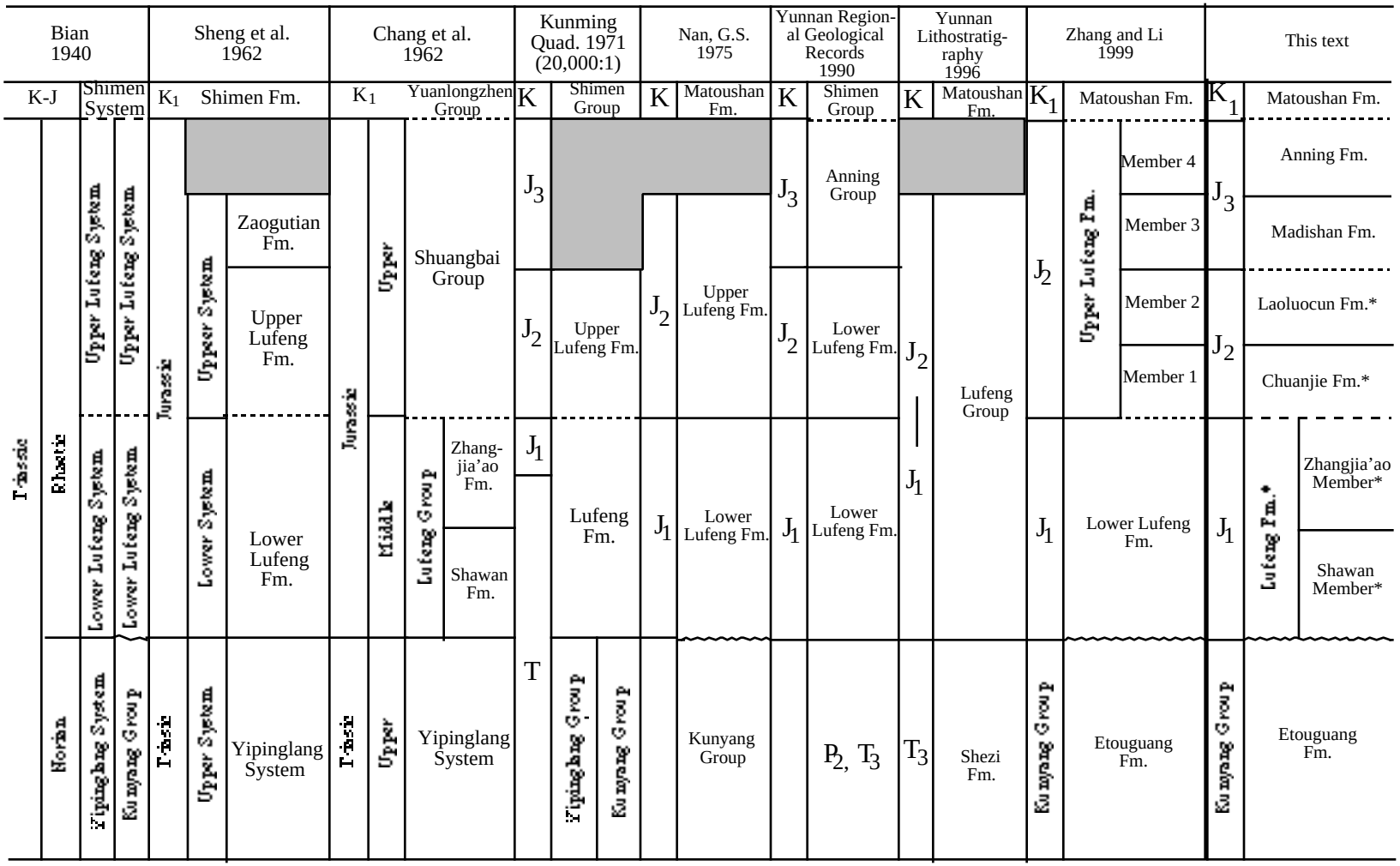
The Lachangqing-Dajianfeng cross-section is located 20 km south of the city of Lufeng between the northeastern foot of Mt. Dajianfeng and the village of Lachangqing in the township of Chuanjie. This section was initially measured by Zhang and Li (1997). Early in 1999, the authors resumed detailed biostratigraphic research, recognizing five formations and two members, while amassing collections of vertebrates, ostracods, conchostracans, charophytes, and pollen. A simplified stratigraphic description from top to bottom is provided as follows (Figure 2).

(1) Upper Jurassic

Anning Fm. (J_3an)

Represented by units 72-63, the nomenclature is taken from Anning (county seat) 32 km west of the provincial capital of Kunming. Zhu (1927) initially erected the nomenclature "Anning System" which was later reduced to formational status by Jiang (1984) to include the evaporite beds in the upper section of the "Upper Lufeng Fm.," where he also erected two Late Jurassic conchostracan zones. The Yunnan Provincial Office of Geology and Mines (1996) recognized the Anning Fm. as overlying the Upper Lufeng Fm., thus correlating it to the variegated beds overlying the wine red beds in the Lufeng Basin. This text supports the recognition of the upper variegated beds as the Anning Fm. The unit is 152.3 m thick, consisting of purple-red, yellow-green moderately bedded mudstones interbedded with yellow-green, gray-yellow thinly laminated siltstones and silty sandy mudstones. The lower section consists of purple-red moderately bedded mudstones interbedded with multistoried yellow-green and purple-gray thinly laminated micritic limestones with calcareous silty mudstones that produce conchostracans and fragmentary dinosaur bone. The base is conformable with the underlying Madishan Fm. but is disconformable with the overlying Early Cretaceous Matoushan Fm. which consists of light purple-red massive conglomerates and sandstones. This Fm produces the conchostracans "*Euestheria* cf. *ziliujingensis*" "*E.* cf. *haifanggouensis*" and dinosaurs. The genus *Eoestheria* represents a biostratigraphic zone in the Anning Basin and the dinosaurs from the lower section should represent *Mamenchisaurus.*

Table 1. Changes in nomenclature and Jurassic subdivision in the Lufeng region of Yunnan.



*Newly erected or revised nomenclature

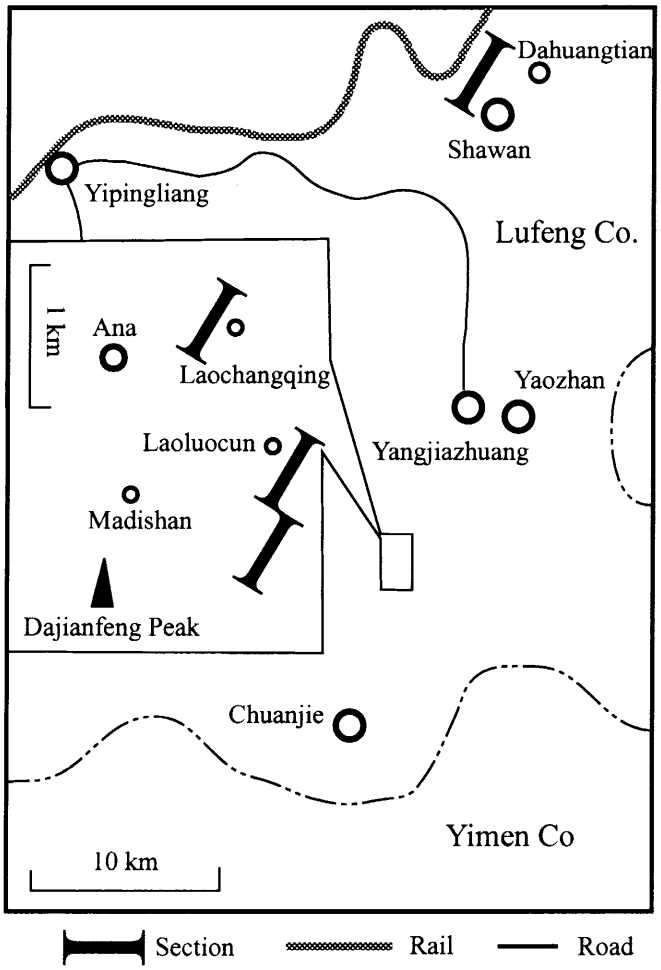


Figure 1. Jurassic cross-sections in Lufeng Co.

Madishan Fm. (J_3m)

Represented by units 62-49 which are usually designated “upper redbeds” or “wine redbeds”, the new nomenclature comes from the village of Madishan which lies 1.8 km SW of the village of Laochangqing in Chuanjie Township, or 20 km south of the city of Lufeng. Sediments consist of light purple-red (wine red) moderate to massive, tabular, and cross-bedded mudstones and silty mudstones with a thickness of 265.5 m. The formation disconformably overlies the Laoluocun Fm. and conformably underlies the Anning Fm. Charophytes produced from the unit include *Aclistochara abshirira, A. brevis, A. jaisalmerensis, A. Karierica, A. maanshaensis, A. nuguishanensis, A. sichuanensis, A. subaevis, A. yunnanensis,* and *Mesochara voluta;* ostracods include *Darwinula changxinensis, D. incurva, D. lufengensis, D. paracontracta, D. subparallela,* and *Damonella depressa;* bivalves include *Psilunia thailandicus,* and *P. lufengensis;* gastropods are documented with *Laternoides drepanostama;* and vertebrates with the fish *Hybodus* and fish scales.

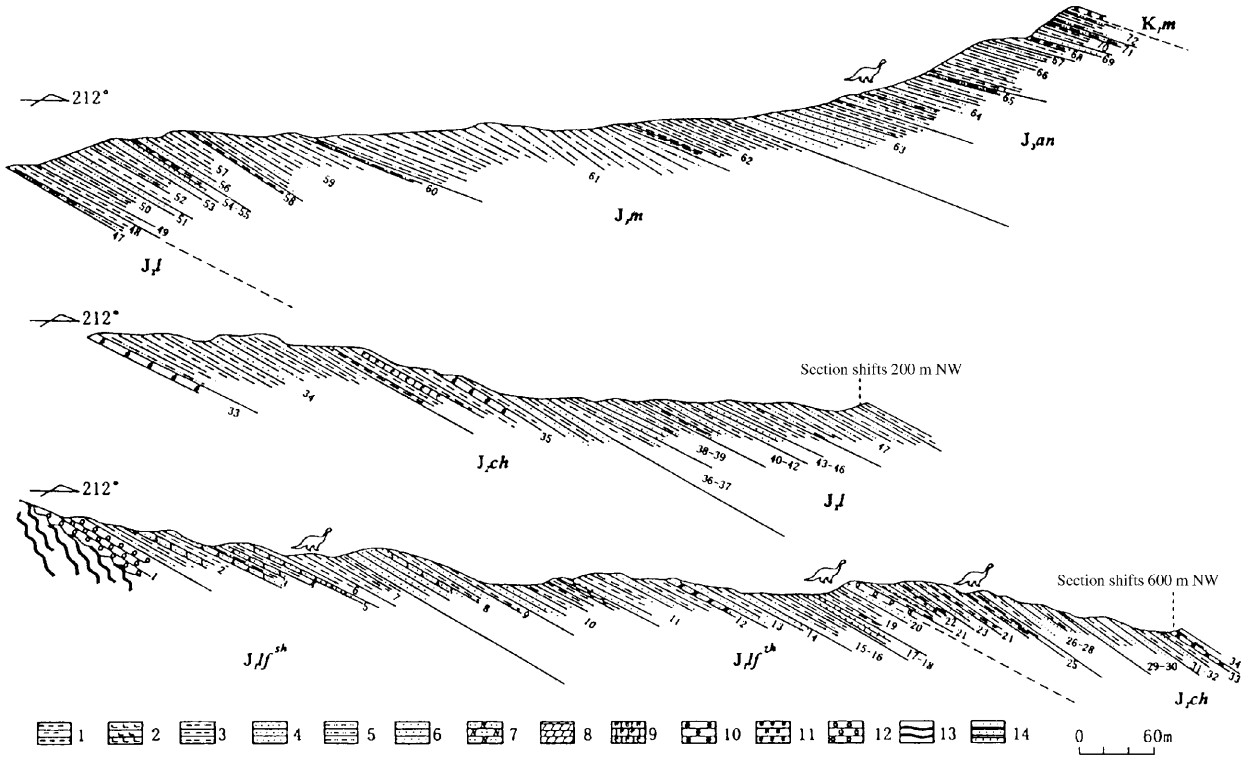


Figure 2. Cross section measured from Laochangqing to Dajianfeng in Chuanjie Township, Lufeng Co.
1. Mudstone; 2. Calcareous mudstone; 3. Silty mudstone; 4. Siltstone; 5. Argillaceous siltstone; 6. Sandstone; 7. Arkosic sandstone; 8. Limestone; 9. Bioclastic limestone; 10; Micritic limestone; 11. Bioclastic micritic limestone; 12. Conglomerate. 13; Slate; 14. Quartz sandstone.

(2) Middle Jurassic

Laoluocun Fm. (J_2l)

Represented by units 38-46, the new nomenclature is taken from Laoluocun Village in Chuanjie Township, 20 km south of the city of Lufeng. Sediments are represented by the "lower variegated beds" underlying the wine redbeds as a set of purple-gray and purple-red moderate to massively bedded mudstones interbedded with purple-red, gray-white, and yellow-green thinly laminated siltstones and argillaceous siltstones with a thickness of 127.8 m. The formation is conformable with the underlying Chuanjie Fm. and disconformable with the overlying Madishan Fm. The upper boundary is recognized as a 2.8 m thick gray-white, gray-green polygonally cracked mudstone. Bivalves produced from the unit include *Psilunio thailandicus,* and *P. lufengensis*; ostracods include *Darwinula changxinensis, D. impudica, D. lufengensis,* and *D. sarytirmenensis;* the gastropod *Laternoides drepanostoma* is present, and vertebrates are represented by fish scales and the selachian, *Hybodus*.

Chuanjie Fm. (J_2ch)

Represented by units 21-35, the new nomenclature is taken from the town of Chuanjie which is south of the city of Lufeng. The formation is equivalent to the former "Upper Lufeng System," "red sandstones," or "lower redbeds." It consists predominantly of 221.2 m of purple-red moderate to massively bedded interfingering mudstones and siltstones interbedded with gray-purple and gray-green thinly laminated micritic limestones. The base is recognized as a 1.5 m thick

gray-yellow conglomerate with 0.2-5 cm diameter, relatively well rounded clasts, cemented by argillaceous sands. The unit disconformably overlies the Zhangjia'ao member of the Lufeng Fm. and is conformable with the overlying Laoluocun Fm. Vertebrates from this unit include the sauropod *Chuanjiesaurus a'naensis* gen. et sp. nov., theropod, turtle fragments, fish scales and other fragmentary bone. Coexisting paleontological data include paleobotanical data with *Pinuspollenites, Abietineaepollenites* sp., Pinaceae, and *Podocarpidites* sp.; charophytes record *Aclistochara abshirira, A. karierica, A. maanshanensis, A. nuguishanensis, A. sichuanensis, A. sublaevis,* and *A. yunnanensis;* ostracods include *Darwinula changxinensis, D. impudica, D. lufengensis, D. sarytirmenensis, D. magna,* and *Metacypris* sp.; bivalves include *Psilunio lufengensis, P. ovalis, P. yuanmouensis, P. thailandicus, Lamprotula (Eolamprotula) guanyuonensis, Undulatula sichuanensis, U. (Ancyrunio) onogoides, U. (Ancyrunio) yunnanensis, Cuneopsis sichunensis, C.* aff. *lingjiaogouensis,* and *Pseudocarolinia.*

(3) Lower Jurassic

Lufeng Fm. (J_1lf)

Formational nomenclature is erected by the authors based upon a comprehensive review of prior literature. Its 272.2 m thickness encompasses units 1-20 in the cross-section. Initial revision was proposed by the First National Stratigraphic Congress (1959) which reassigned the Mesozoic "Red Beds" of Yunnan to the "Lufeng Group," further redesignating the "Upper Lufeng System" as the "Upper Lufeng Fm." and the "Lower Lufeng System" to the "Lower Lufeng Fm." Subsequently, Chang et al. (1962) advocated the Lufeng Group be recognized as only those sediments producing a *Lufengosaurus* Fauna and furthermore erected the Zhangjia'ao Fm. which represented the former "deep red sediments" and the Shawan Fm. which represented the former "dark purple sediments." Because the type section of the Lufeng Group represents conglomeratic beds further to the south, the nomenclature hierarchy should be discontinued in the current region studied. But because the Lufeng nomenclature is so widely infused in the geological literature, this text hereby retains it with formational status in this region representing those sediments Chang et al. (1962) referred to as the Lower Lufeng Fm. (Lufeng Group). The formations Chang et al. (1962) erected are hereby reduced to member status.

Zhangjiawa Member (J_1lf^{zh})

Recognized as cross-section units 8-20 with a thickness of 164.5 m. The type section is at Shawan and Dahuangtian, Lufeng Co., originally noted as the "deep red beds" of the upper member of the Lower Lufeng Fm. The unit is dominated by deep red and tan-red mudstones interbedded with a small amount of thinly laminated siltstones. It is conformable with the underlying Shawan Member but disconformable with the overlying dark yellow sandy conglomerates of the Chuanjie Fm. In the Shawan region of Lufeng it is 202 m thick and represents units 7-9 in the cross-section measured by the Yunnan Redbed Corps (1967).

The vertebrate fauna in this unit include the following taxa: *Anchisaurus sinensis, Yunnanosaurus huangi, Y. robustus, Lufengosaurus huenei, L. magnus, Kunmingosaurus wudingensis, Morganucodon oehleri, Eozostrodon hekuopengensis, Sinoconodon rigneyi, S. parringtoni, S. changjiawaensis, S. yangi, Tatisaurus oehleri, Tawasaurus minor, Dianchongosaurus lufengensis, Lufengia delicata, Yunnania brevirostre, Dianzhongia longirostrata, Oligokyphus sinensis, Bienotherium magnum, Kunminia minima,* Brachiosauridae, Megalosauridae, Carnosauria, Prosauropoda, Pseudosuchia, Protosuchia, Carnosauria, Capitosauridae, and *Gyposaurus.*

Shawan Member (J_1lf^{sh})

Represented by units 1-7 with a thickness of 107.7 m, the type section is at Shawan and Dahuangtian, Lufeng, Co. It was originally recognized as the "dark purple beds" of the Lower Member of the Lufeng Fm. and is dominated by dark purple-red and dark purple mudstones interbedded with thinly laminated siltstones. Visible at the base are tabularly bedded, well rounded, argillaceous cemented, dark purple or dark tan gravels and conglomerates with 2-3 cm diameter clasts. Fining upwards, the unit becomes interbedded with mudstones. It is conformable with the overlying Zhangjia'ao Member and is unconformable with the underlying purple phyllites of the Proterozoic Etou'an (chang?) Fm. of the Kunyang Group. In the Lufeng Basin this unit is 528 m thick and was recognized as units 1-6 in the section measured by the Yunnan Redbed Corps. In the Chuanjie Basin it is over 500 m in thickness.

The vertebrate fauna includes: *Anchisaurus sinensis, Yunnanosaurus huangi, Y. robustus, Lufengosaurus huenei, L. magnus, Jinshanosaurus xinwaensis, Sinosaurus triassicus, Lukousaurus yini, Bienotherium yunnanensis, B. elegans, B. minor, and Dawasaurus.*

Conclusion

In summary, the cross-section described in this text documents the Early Jurassic Lufeng Saurischian Fauna, the Middle Jurassic *Chuanjiesaurus* Fauna, and the Late Jurassic *Mamenchisaurus chuanjieensis*[*] Fauna. Although this extensive sequence represents a breakthrough in Jurassic biostratigraphy, much additional research is required to clarify the faunal nature of the latter two faunas.

The well-known Early Jurassic Lufeng Saurischian Fauna was first studied by C.C. Young and has been of extensive use globally. Lucas (1996) erected zonation nomenclature for Chinese Mesozoic terrestrial vertebrates, in which he designated the Dawan Vertebrate Faunichron to replace the traditional Lufeng Saurischian Fauna. This paper finds this reassignment extremely inappropriate. Firstly, the nomenclature spelling Dawan is in the broad sense inaccurate (it should read "Dawa"). Secondly, even though he applied the Chinese etymology Dawa, he neglected to clarify the concept of the Lufeng Saurischian Fauna produced from the Lufeng region. This readily causes confusion. Thus this text in accordance with the erection of the Lufeng Fm. and the recognition that it is restricted to the Lower Jurassic and characterized by the presence of the prosauropod *Lufengosaurus,* proposes the nomenclature Lufeng Vertebrate Faunichron to represent the Early Jurassic "Saurischian Fauna." The nomenclature Dawan Vertebrate Faunichron is hereby abandoned.

[*] Translator's note: This is apparently *nomen nudem.*

Description of a new genus and species of sauropod

Saurischia seeley, 1888

Cetiosauridae Lydekker, 1888

***Chuanjiesaurus* gen. nov.**

***Chuanjiesaurus a'naensis* gen. et sp. nov.**

(Plate II, Figure 3)

Etymology: Chuanjie being Pinyin Chinese for the township where the specimen was excavated. Species nomenclature a'na commemorates the village at the locality.

Type: A relatively complete postcranial skeleton (Lufeng Museum No. Lfch 1001).

Locality and stratigraphic position: Lower Middle Jurassic Chuanjie Fm. at Laochangqing, Chuanjie Township, Lufeng Co. Yunnan Province.

Preservational condition: Skull and dorsal vertebrae are missing. Preserved on the postcranial skeleton are nine cervical vertebrae, 17 caudals, two ribs (one being relatively complete), one haemal arch, left and right scapulacoracoids, ?humerus, both radii and ulnae, right ilium, left pubis and ischium, both femora, tibiae, fibulae, and a single ungual phalanx.

Diagnosis: Cervical vertebrae are relatively long and opisthocoelous. Pleurocoels are relatively well-developed but shallow, and neural spines are low. Anterior caudals are procoelous but posteriorly the posterior condyle weakens and the centra become gently amphicoelous. Neural spines lower and alter in morphology from baton-shaped to plate-shaped, and haemal spines are bifid. Proximal scapula is conspicuously broadened and proximal coracoid is oval. Ilium is relatively large, nearly semicircular, and there is a well developed pubic peduncle located anterior to the midline. The iliac peduncle is weak. Forelimb/hind limb index is 0.83/1. ulna/humerus index is 0.65/1, and tibia/femur index is 0.65/1.

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Explanation of Plate II

1-2. Laochangqing-Dajianfeng cross-section in the Chuanjie region of Lufeng, Yunnan.

1. Sediments overlying the Chuanjie Fm.

2. Sediments underlying the Laoluocun Fm.

3. *Chuanjiesaurus a'naensis* gen et sp. nov. during excavation. Type No. Lfch 1001.