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侏罗纪恐龙动物群

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FAUNAS IN ZIGONG

彭光照 叶勇 高玉辉 舒纯康 江山 著

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内 容 提 要

自贡地区地表广泛出露着中生代陆相红色沉积地层，尤其是侏罗系地层分布特别广泛。这套地层沉积连续，层序清楚，其中蕴藏着大量的恐龙及其它脊椎动物化石。产出的化石不仅数量丰富，门类众多，保存完好，而且在几个地点恐龙及其他脊椎动物化石集中埋藏在一起，形成规模宏大的恐龙化石埋藏群，使自贡成为名副其实的“恐龙之乡”。

自贡恐龙的发现和研究已有整整九十年的历史。本书是关于自贡地区出土的恐龙及其他脊椎动物化石的系统总结。书中从动物群的角度对九十年来自贡地区所发现的脊椎动物化石材料进行系统的描述，对以往的化石记录作了补充和修订，对一些新发现的材料进行了鉴定研究，提出了一些新的认识和存在的问题，指出了今后工作的重点方向。全书共 32.6 万字，包括 144 幅插图、9 个表格、参考文献及英文摘要。

本书可供地质学、地层学和古生物学工作者、大专院校师生及恐龙爱好者参考。

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序

记得三十年前，陪同先师杨钟健院士到自贡市考察恐龙，杨老曾风趣地说：“四川恐龙多，自贡是个窝”，并嘱我关注自贡地区的恐龙化石。当时自贡大山铺恐龙化石刚刚露出来，杨老凭借渊博的知识、敏锐的洞察力，对自贡地区的恐龙化石做出了准确的判断。在以后的岁月里，随着大山铺恐龙化石的大规模清理发掘，数以万计的恐龙骨骼被发现，证实了杨老的判断准确。目前，自贡这个有着千余年井盐生产历史的城市，成为了中国恐龙学者们云集的地区，也是国际恐龙学界人士必须朝拜的“圣地””。

1989 年，加拿大著名恐龙学家罗素博士(Dr. Dale Russell)在考察了自贡大山铺的恐龙化石之后说：“这是近二十年来世界恐龙发掘研究史上的最大收获”。上世纪八十年代初，中国第一座专业性的恐龙遗址博物馆——自贡恐龙博物馆的建立，把我国恐龙的发掘、研究工作推向了一个新的阶段，成为我国恐龙研究史上的一个新的里程碑。

自贡地区广泛出露着中生代陆相红色沉积岩层，尤其是侏罗系地层分布广泛，沉积连续，层序清楚，其中蕴藏着大量的恐龙及其它脊椎动物化石。化石产出不仅数量丰富，门类众多，保存也非常完好，常常形成规模宏大的恐龙化石埋藏群。这使自贡成为世界上发掘研究侏罗纪恐龙化石最理想的地区。

1915 年，美国地质学家乔治·D·劳德伯克，在自贡荣县发现了四川盆地第一块恐龙化石。至今，自贡恐龙化石的发掘和研究工作整整九十年了。九十年来，中国的地质古生物工作者在自贡地区进行了一系列艰苦卓绝的调查、发掘和研究工作，取得了丰硕的科研成果。迄今为止，发现了 180 多个恐龙及其它古脊椎动物化石的产出地点，采集到成百上千古脊椎动物个体，数以万计的骨骼化石。几乎盖含了这个时代陆地上生存过的所有脊椎动物门类: 如原蜥脚类、蜥脚类、兽脚类、鸟脚类、剑龙类，以及鱼类、两栖类、龟鳖类、蛇颈龙类、鳄类、似哺乳爬行类和翼龙类等。其中研究鉴定出的恐龙化石种 20 多个，占四川盆地所发现的恐龙种类的一半以上，约为中国所发现的恐龙种类的 1/5。自贡不愧有“恐龙之乡”的美誉。

在自贡地区已出土的恐龙及其他脊椎动物化石标本中，许多是具有重要科学研究价值的珍品，如目前世界上所知最早的剑龙——太白华阳龙，对于研究剑龙类的起源和早期演化非常重要；寓原始性和进步性于一身的李氏蜀龙，在形态上比较进步的巴山酋龙、峨眉龙、马门溪龙等属种，是探讨蜥脚类的起源和系统演化关系的重要材料；自贡地区蜥脚类恐龙所特有的骨质尾锤对于破解蜥脚类的生活习性之谜提供了非常重要的实物依据；四川巨棘龙和杨氏马门溪龙皮肤印模化石的发现，使我们对剑龙类和蜥脚类的表皮构造有了新的了解；四川巨棘龙肩棘的发现，改变了人们对剑龙类所具有的这一对特殊“骨骼”的认识；扁头中国短头鲵的发现把迷齿两栖类在亚洲地区生存时代，向后推延了两千多万年，等等。

三十多年前，我曾在四川盆地进行过恐龙化石的考察和发掘工作，领导过大山铺恐龙化石的一期发掘工作，对自贡恐龙化石有着深切的爱。二十世纪七十年代我与周世武等曾对四川盆地发现的恐龙化石作了研究和整理工作，汇集成《四川盆地侏罗纪恐龙化石》一书出版。最近二十多年来，自贡恐龙博物馆在自贡地区作了许多重大的、新的发现，对许

多新材料进行了初步的研究和报告，但研究报告发表在不同的刊物上，使其它研究者缺乏对资料的全面认识，查阅也困难。现今，本书的作者们通过大量的资料和材料收集工作，从动物群的角度对九十年来自贡地区所发现的材料和研究成果进行了系统整理，对一些新材料作了鉴定研究，并对以往发表的化石记录作了补充和厘订，提出了一些新的认识和观点。这为我们提供一本新的非常有价值的参考资料，在此特表示祝贺。我也衷心希望：今后不断有各恐龙主要产出地区的系统专著问世，繁荣中国的恐龙事业。

中国科学院古脊椎动物与古人类研究所研究员
自贡恐龙博物馆科学顾问

2005 年 9 月 15 日于北京

前　　言

自贡，这座人杰地灵、蕴秀含珍的历史文化名城，以“千年盐都”、“恐龙之乡”、“南国灯城”著称于世。自贡地处四川盆地南部，在幅员 4373.13 平方千米的土地上，广泛出露着地质历史时期中生代陆相红色沉积地层，尤其是恐龙演化的鼎盛时期——侏罗纪红色地层分布特别广泛。这套地层沉积连续，层序清楚，其中蕴藏着大量的恐龙及其它脊椎动物化石。自 1915 年美国地质学家劳德伯克(George D. Louderback)在荣县首次科学地发现恐龙化石以来，已发现 180 余个恐龙及其他脊椎动物化石地点，其中恐龙化石产出地点 130 余处，分布于自贡市所辖的四区两县，赋存于侏罗纪各个时期的地层之中。产出的恐龙化石不仅数量丰富，门类众多，保存完好，而且在几个地点恐龙化石集中埋藏在一起，形成规模宏大的恐龙化石埋藏群，使自贡成为世界上探索侏罗纪恐龙化石最理想的地区。自贡地区分布广泛、类群齐全、组合面貌独特的恐龙动物群，对探讨恐龙分类、演化、生活环境和生活习性以及划分对比地层提供了极其重要的材料。

九十年来，许多古生物学者来到这块神奇的土地上辛勤地耕耘，采集到无数的恐龙及其他脊椎动物化石标本，取得大量科研成果，特别是最近三十年，取得了具有历史性的重大发现和突破，成为古生物学家们注目的焦点。为此，我们通过对自贡地区所发现的恐龙及其他脊椎动物化石和研究成果进行系统整理，结合近几年的一些新发现，从动物群角度把自贡地区的恐龙及其他脊椎动物编纂成书，以此献给劳德伯克博士以及广大为自贡恐龙事业作出过贡献的人们。

本书是集体智慧的结晶，是自贡恐龙博物馆大力支持的结果。我们特别感谢余勇先生和凌曼女士绘制文中插图，余刚先生提供部分插图照片。对关心、支持和协助本书编纂和出版工作的女士和先生们在此也一并致谢。

本书第 1、4 部分由叶勇执笔，第 2 部分由江山执笔，第 3 部分由叶勇、舒纯康、江山执笔，第 8 部分由彭光照执笔，鱼类、两栖类和似哺乳爬行类描记由江山执笔，翼龙类和剑龙类描记由舒纯康执笔，足迹、兽脚类和蛇颈龙类描记由高玉辉执笔，原蜥脚类、蜥脚类和龟鳖类描记由叶勇执笔，鸟脚类和鳄类描记由彭光照执笔，最后由彭光照和叶勇汇总修订而成。

JURASSIC DINOSAUR FAUNAS IN ZIGONG

By

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SUMMARY

Zigong, a famous historical and cultural city of China, is situated in southern Sichuan province and covers an area of about 4373.13 km^2. It is a hilled region that exposes a continuous and widespread Mesozoic red beds in which contains rich fossil vertebrates, especially the Jurassic fossil dinosaurs. Since 1915 of the first dinosaur fossil discovered by an American geologist Dr. George D. Louderback from Rongxian (Jung Hsien), more than 180 localities of fossil vertebrates have been found from Zigong region, among which about 130 localities of fossil dinosaurs. As a result, Zigong has become the most famous region of fossil dinosaurs and other vertebrates, and is named as the Hometown of Dinosaurs.

After the works of ninety years by numerous geologists and paleontologists from home and abroad, countless of fossil dinosaurs and other vertebrates have been excavated and a great of academic achievements have been made. Especially in recent 30 years or more, a lot of important discoveries and historical breakthroughs have been achieved, Zigong has become a focus region to which paleontologists pay more attention. This book is a step systematic conclusion about the discoveries of fossil dinosaurs and other vertebrates from Zigong region and achievements of scientific researches as well as a few new finds from the aspect of the vertebrate assemblages. It is dedicated to Dr. George D. Louderback and all the people that have made contributions to the discoveries, excavations and studies of fossil dinosaurs and other vertebrates from Zigong region.

The Jurassic continental sediments in Zigong region are well developed. The thickness of the deposits is about 1,034~2,220 m, composed mainly of grey limestones, purplish red mudstones and light grey sandstones, and covers about 75% of the earth surface of this region. These sediments present characteristic of the fluvial or lacustrine facies, and were classified from lower to upper as the Early Jurassic Zhenzhuchong and Ziliujing formations, the Middle Jurassic Xintiangou and Xiashaximiao (Lower Shaximiao) formations, the Late Jurassic Shangshaximiao (Upper Shaximiao), Suining and Penglaizhen formations. Rich and various remains of dinosaurs and other vertebrates have been found in these strata and can be divided into three related faunas: the Early Jurassic Prosauropoda-*Lufengosaurus* Fauna, the Middle Jurassic Sauropoda-*Shunosaurus* Fauna, and the Late Jurassic Sauropoda-*Mamenchisaurus* Fauna. Here describes them as follows:

Early Jurassic Prosauropoda-*Lufengosaurus* Fauna

The Early Jurassic Prosauropoda-*Lufengosaurus* Fauna contains prosauropods, primitive sauropods and coelurosaurs of dinosaurs. Other vertebrates of the fauna include fishes, turtles and plesiosaurs. They mainly distributed in the Ziliujing formation.

Class Osteichthyes
Subclass Actinoplerygii
Order Semionotiformes
Family Semionotidae Woodward, 1890
Genus *Lepidotes* Agassiz, 1932

Diagnosis Medium to large semionotids characterized by body compressed with spindle-shaped outline; operculum well-developed; narrow and arc-shaped preoperculum; few branchiostgal rays lacking gular plate; more or less enameled skull and operculum with smooth surface or ornamented by warty eminences; robust and strong teeth; well developed spinal scales of fins; dorsal and anal fins short but deep; dorsal fin anterior to anal fin; caudal fin with shallow bifurcation; and thick, large pile-tiled body scales with smooth surface or striations.

***Lepidotes* sp.**

Material An incomplete skeleton. ZDM 00411.

Locality and horizon Changyantang, Daan, Zigong; Ziliujing Formation, Early Jurassic.

Order Saurischia
Suborder Theropoda
Infraorder Coelurosauria
Family Anchisauropodidae Lull, 1904
Genus *Grallator* Hitchcock, 1858 (Lull,1904)

Diagnosis Three-toed footprints made by small, bipedal coelurosaurs. Each footprint is narrow and pentagonal in outline, with clear impressions of pads and claws. Digit III is much longer than digit II and IV. No impressions of hallux and tail.

***Grallator s-satoi* (Yabe et al., 1940) Zhen et al., 1989**

Revised diagnosis Three-toed footprints made by small, bipedal and digitigrate coelurosaurs. Length of each footprint is about twice of its width. The divarication between digit II and III is 14°~29°, and that between digit III and IV is 13°~27°. Digit III is much longer than digit II and IV. No impressions of hallux and tail.

Included material More than 350 footprints. ZDM 00129.

Locality and horizon Hejie, Gongjing, Zigong; Maanshan Member of Ziliujing Formation, Early Jurassic.

Suborder Sauropodomorpha

Infraorder Prosauropoda

Family Plateosauridae Marsh, 1895

Genus *Lufengosaurus* Young, 1932

Diagnosis Medium-sized prosauropod characterized by moderately elongated skull with triangular naris and large, rounded orbit; short but deep antorbital fenestra; supratemporal openings facing dorsally; straight and slightly compressed teeth with small serrations along anterior and posterior margins; long neck; presacrals rather massive; 10 cervicals, 14 dorsals, 3 sacrals and 45 caudals; long and narrow scapula; elliptical-shaped sterna; short forelimb; radius lacking radial crest; long hindlimb; tibia shorter than femur; digit I of manus and pes strongly proportioned; and digits IV and V reduced.

Type species *Lufengosaurus huenei* Young, 1932.

cf. *Lufengosaurus magnus* Dong, 1984

Diagnosis Relatively larger prosauropod recognized by relatively heavy body; robust vertebrae with bigger but shorter centra; strongly arched scapula; humerus and radius short but massive; shortened metacarpals; very big pelvic girdle; long ilium; slender pedal phalanges with thickened distal end; elongated tibia; metatarsal I 1/2 of length of tibia; and both manus and pes completely developed.

Material A damaged mandible with a tooth. ZDM 0011 (field no.: ZV. 2).

Locality and horizon Liangshuijing, Zigong; Daanzhai **Member** of Ziliujing Formation, Early Jurassic.

Plateosauridae gen. et sp. indet.

Material Two caudals and two metatarsals. ZDM 0005-2.

Locality and horizon Liangshuijing, Zigong; Daanzhai **Member** of Ziliujing Formation, Early Jurassic.

Intraorder Sauropoda

Family Cetiosauridae Lydekker, 1888

Cetiosauridae gen. et sp. indet.

Material A caudal in the middle portion of the tail. ZDM 0005-1.

Locality and horizon Liangshuijing, Zigong; Daanzhai **Member** of Ziliujing Formation, Early Jurassic.

Cetiosauridae gen. et sp. indet.

Material A right coracoid and a left fibula. ZDM 0010.

Locality and horizon Liangshuijing, Zigong, Sichuan; Maanshan **Member** of Ziliujing Formation, Early Jurassic.

Cetiosauridae gen. et sp. indet.

Material Twelve caudals in the middle and posterior portion of the tail. ZDM 0115.

Locality and horizon Liangshuijing, Zigong; Daanzhai **Member** of Ziliujing Formation, Early Jurassic.

Middle Jurassic Sauropoda-*Shunosaurus* Fauna

The Sauropoda-*Shunosaurus* Fauna mainly contains sauropods, carnosaurs, ornithopods and stegosaurs of dinosaurs. Other vertebrates include fishes, labyrinthodont amphibians, turtles, crocodiles, plesiosaurs, pterosaurs, and mammal-like reptiles. They distributed in the Xintiangou and Xiashaximiao formations. The Dashanpu Dinosaur Quarry is the most typical locality of this fauna.

Class Chondrichthyes
Subclass Elasmobracnchii
Order Selachii
Family Hybodontidae Owen, 1846
Genus *Hybodus* Agassiz, 1837

Diagnosis Medium-sized hybodontid characterized by spindle-shaped body; anterior dorsal fin positioned between pectoral and pelvic fins, and posterior dorsal fin anterior to anal fin; conical, sharp and straight teeth with a main cusp and one or more inferior cusps on both side; teeth on anterior margin of stout fewer but larger; hard spine of dorsal fin with longitudinal ridges and grooves, and posterior edge of hard spine with two rows of tooth-like processes; anal fin lacking hard spine; and heterocercal fins.

***Hybodus zigongensis* sp. nov.**

Diagnosis Medium-sized hybodont recognized by lower and enameled tooth crown with obvious ∧-shaped striations coming from base of crown and joining together at tip; slightly retreated tip of main cusp; only one inferior cusp anterior or posterior to main cusp; main cusp about half width of tooth; and inferior cusps connect to main cusp at base of crown.

Holotype A nearly complete tooth. ZDM 1004-a.

Paratype An incomplete tooth. ZDM 1004-b.

Referred material Seven incomplete teeth. ZDM 1004-c, ZDM 1004-d, ZDM 1004-e, ZDM 1004-f, ZDM 1004-g, ZDM 1004-h and ZDM 1004-i.

Locality and horizon Dashanpu, Zigong; Xiashaximiao Formation, Middle Jurassic.

Etymology Specific name refers to Zigong where the specimens were unearthed.

***Hybodus huangnidanensis* Wang, 1977**

Diagnosis Tooth relatively large with moderate height; tooth crown with straight ∧

-shaped striations originated from base of crown and joining together at tip; short and straight tooth boot with many small pits; base between crown and boot slightly retreated.

Holotype A well-preserved tooth. Field no.: Huang 4802-9-1.

Locality and horizon Huangnitang, Qiyang, Hunan; Tangjiawu Formation (Tangjiawu Section, Fengjiqchong Formation), Middle Jurassic.

Included material A complete tooth. ZDM 1004-j.

Locality and horizon Dashanpu, Zigong; Xiashaximiao Formation, Middle Jurassic.

***Hybodus* sp.**

Material A dorsal fan spine. ZDM 1005.

Locality and horizon Dashanpu, Zigong; Xiashaximiao Formation, Middle Jurassic.

Class Osteichthyes

Subclass Actinoplerygii

Order Semionotiformes

Family Semionotidae Woodward, 1890

Genus *Lepidotes* Agassiz, 1932

Diagnosis Medium to large semionotids characterized by body compressed with spindle-shaped outline; operculum well-developed; narrow and arc-shaped preoperculum; few branchiostgal rays lacking gular plate; more or less enameled skull and operculum with smooth surface or ornamented by warty eminences; robust and strong teeth; well developed spinal scales of fins; dorsal and anal fins short but deep; dorsal fin anterior to anal fin; caudal fin with shallow bifurcation; and thick, large pile-tiled body scales with smooth surface or striations.

***Lepidotes dashanpuensis* sp. nov.**

Diagnosis Large semionotid recognized by compressed and spindle-shaped body; long skull about 1/5 of body length; 4 suborbits; large opercula with its height 1.2 times of its width; enameled rhombic scales; and sensory-line scales lack notch around postero-ventral corner.

Holotype A complete skeleton. ZDM 1001.

Locality and horizon Dashanpu, Zigong; Xiashaximiao Formation, Middle Jurassic.

Etymology Specific name refers to Dashanpu where the specimen was unearthed.

Subclass Sarcopterygii

Order Diploi

Family Ceratodontidae Gill, 1872

Genus *Ceratodus* Agassiz, 1838

Diagnosis Body covered with big and thin scales; dorsal and anal fins connected to protocercal fin; pectoral and pelvic fins with hard fin ray; neural arch, spine, rib and sustentacular bone of fin ossified; cranial roof formed by anterior and posterior median plates and two pairs of lateral plates; long parasphenoid flooring cranium and laterally surrounded by pterygoid-palatine;

anteriorly, both pterygoid-palatines closed together and meet in front; and one big triangular dental plate with many radiating ridges on each pterygo-palatine and mandible.

***Ceratodus zigongensis* Yu, 1990**

Diagnosis Relatively large and thick dental plate with triangular crown surface; interior corner dental plate about 105°; five thick and big ridges without dental eminence on distal surface; surface of dental plate irregularly ornamented with dense small pits; platform at interior corner very distinct; and a belt-like plane present along posterior edge of dental plate.

Holotype A left upper dental plate lacking first ridge. ZDM 1003.

Locality and horizon Dashanpu, Zigong; Xiashaximiao Formation, Middle Jurassic.

Class Amphibia

Subclass Labyrinthodontia

Order Temnospondylia

Suprafamily Brachyopoidea

Family Brachyopoidae Lydekker, 1885

Genus *Sinobrachyops* Dong, 1985

Diagnosis As for type species *Sinobrachyops placenticephalus* Dong, 1985.

***Sinobrachyops placenticephalus* Dong, 1985**

Diagnosis Medium-sized brachyopod recognized by skull with labyrinthodontian sculptures; sensory-line groove survived dorsal to orbit; broad and round snout; nostrils anteriorly positioned and closed each other; large orbit positioned laterally and slightly anteriorly; broadened interorbital; large interpterygoid vacuities; slender cultriform of parasphenoid extending forward to anterior margin of interpterygoid vacuities; and presence of pairs of tusks on palatine, vomer and ectopterygoid.

Holotype A complete skull and a pair of incomplete lower jaws. ZDM 2001.

Locality and horizon Dashanpu, Zigong; Xiashaximiao Formation, Middle Jurassic.

Order Testadines Linnaeus, 1758

Suborder Casichelydia Gaffney, 1975

Infraorder Cryptodira (Cope, 1868)

Family Chengyuchelyidae Yeh, 1990

Revised diagnosis Medium to large casichelidians characterized by oval-shaped shell oval-shaped without obvious sculptures; 8 hexagonal neural plates with short anterior border; slightly broadened vertebral scutes; anterior and posterior margins of plastron shorter than those of carapace; posterior margin of plastron straight or convex backward; mesoplastron situated in area of abdominal scute or between pectoral and abdominal scutes; broad bony bridge; and 3~4 pairs of inframarginal scutes.

Genus *Chengyuchelys* Young et Chow, 1953

Diagnosis Medium-sized chengyuchelyid diagnosed by flattened or slightly arched carapace; anterior margin of carapace slightly notched; presence of a longitudinal groove along neural plates; mesoplastron situated in area of abdominal scute or between pectoral and abdominal scutes; mesoplastron narrowed medially; and anal scute extending forward and overlapping hypoplastron.

Type species *Chengyuchelys baenoides* Young et Chow, 1953.

Chengyuchelys baenoides Young et Chow, 1953

Diagnosis Carapace flattened with a wide longitudinal groove along midline of neural plates; first neural plate subquadrate and other neural plates hexagonal, with broader anterior border and narrower posterior border; width of vertebral scute same as that of costal one; plastron completely ossified; long and rhombic entoplastron; mesoplastron narrowed medially and broadened laterally; abdomino-femoral sulcus arched forward; femoro-anal sulcus arched forward to hypoplastron; broad and fan-shaped bony bridge; and 3 pairs of inframarginal scutes.

Holotype Two incomplete turtle shells. IVPP V 708 and V 710.

Locality and horizon Uncertain locality and horizon along the Chengdu-Chongqing railway, Late Jurassic?

Included material Five incomplete turtle shells. IVPP V 6507, V 8805, ZDM 3003, ZDM 3007 (field no.: ZDM 1) and ZDM 3008 (field no.: ZDM 3).

Locality and horizon Dashanpu, Zigong; Xiashaximiao Formation, Middle Jurassic.

Chengyuchelys zigongensis Yeh, 1982

Diagnosis Elliptical-shaped carapace slightly arched; 8 hexagonal neural plates with short anterior border; broad vertebral scutes; width of fourth vertebral scute nearly twice of its length; short but broad costal scutes; second costal scute is broadest; anterior border of third vertebral scute notched anteriorly and crosses sixth neural plate; lateral border of first neural plate just contacts anterior two marginal plates; plastron long and narrow, and its anterior end extends forward anterior to carapace; broad and fan-like bony bridge; leaf-like entoplastron with a sharp point directed posteriorly; presence of intergular scute; 3~4 pairs of inframarginal scutes; last inframarginal scute attaining largest; gulo-humeral sulcus crossing entoplastron; mesoplastron situated between pectoral and abdominal scutes, and not narrowed medially; and anal scute extending forward and overlapping hypoplastron.

Holotype A turtle shell with carapace and plastron. CV 00678.

Included material Three incomplete turtle shells. ZDM 3012 (field no.: I-Z1), ZDM 3006 (field no.: ZDM 7) and ZDM 3009.

Locality and horizon Dashanpu, Zigong; Xiashaximiao Formation, Middle Jurassic.

Chengyuchelys dashanpuensis Fang, 1987

Diagnosis Flattened and elliptical-shaped carapace with 8 neural plates; broad and hexagonal vertebral scutes; width of fourth vertebral scute nearly twice of its length; anterior border of third vertebral scute notched and crosses sixth neural plate; second costal scute is the

greatest; plastron long and narrow, but its anterior end not extends forward anterior to carapace; broad bony bridge; presence of intergular scute; 3~4 pairs of inframarginal scutes; last inframarginal scute is the largest; peach-shaped entoplastron; mesoplastron limited in area of abdominal scute and extremely narrowed medially; and anal scute extending forward and overlapping hypoplastron.

Holotype A nearly complete turtle shell. ZDM 3011 (field no.: I-T19).

Locality and horizon Dashanpu, Zigong; Xiashaximiao Formation, Middle Jurassic.

***Chengyuchelys* sp.**

Material Five incomplete turtle shells. CV 00679, I-L1 (whereabouts unknown), ZDM 3019 (field no.: I-L2), ZDM 3005 (field no.: KI7) and ZDM 3004.

Locality and horizon Dashanpu, Zigong; Xiashaximiao Formation, Middle Jurassic.

Genus *Sichuanchelys* Ye et Pi, 1997

Diagnosis As for type species *Sichuanchelys chowi* Ye et Pi, 1997.

***Sichuanchelys chowi* Ye et Pi, 1997**

Diagnosis Small chengyuchelyid recognized by flattened and oval-shaped carapace lacking obvious sculptures; anterior margin of carapace obviously notched; hexagonal neural plates with shorter anterior border; extremely broadened vertebral scutes; width of second and third vertebral scutes more than 3.0 of their length; slightly narrowed costal scutes; extremely narrowed middle marginal scutes; plastron long and narrow, and its posterior border much shorter than that of carapace; broad bony bridge; 3~4 pairs of inframarginal scutes; presence of gular and intergular scutes; small entoplastron; humero-pectoral sulcus far behind endoplastron; mesoplastron situated in abdominal scute, and narrowed medially; and femero-anal sulcus arched anteriorly, but not meets hypo-xiphiplastral suture.

Holotype A complete turtle shell. ZDM 3014.

Reference material Two incomplete turtle shells. ZDM 3001 and ZDM 3017.

Locality and horizon Dashanpu, Zigong; Xiashaximiao Formation, Middle Jurassic.

Chengyuchelyidae gen. et sp. indet.

Material An incomplete turtle shell. ZDM 3002.

Locality and horizon Dashanpu, Zigong; Xiashaximiao Formation, Middle Jurassic.

Order Sauropterygia

Suborder Plesiosauria

Suprafamily Pliosauroidea

Family Rhomaleosauridae Kuhn, 1961

Genus *Bishanopliosaurus* Dong, 1980

Revised diagnosis Medium-sized short-necked pliosauroids characterized by slender and

sharp teeth; short but deep centra and laterally compressed neural spines; double-headed cervical ribs in anterior cervicals and single-headed cervical ribs in posterior cervicals; bifurcated sacral ribs; expanded dorsal end of scapula; narrow and elongate coracoid with straight lateral edge posterior to glenoid; presence of a pronounced projection at posterior edge near capitulum of humerus; small ilium; broad and compressed pubis; large and rounded pubio-ischial fenestra between pubis and ilium; and humerus as long as femur length.

Type species *Bishanopliosaurus youngi* Dong, 1980.

***Bishanopliosaurus youngi* Dong, 1980**

Diagnosis Medium-sized pliosauroid about 4 m of body length. It is recognized by short but high cervical centra with ventral keel; anterior cervical ribs with double heads, while posterior ones with single head; amphicoelous dorsal centra with its length about 1/2 of its width; plate-like dorsal spines; long but narrow coracoid; undeveloped posterolateral corner of coracoid; Width across posterior end of coracoid less than interglenoid breadth; small ilium; compressed and broad pubis; presence of a pubio-ischial fenestra between pubis and ischium; humerus same as length of femur; and ulna longer than its width.

Holotype An incomplete skeleton with well-preserved pectoral and pelvic girdles. IVPP V 5869.

Locality and horizon Tuanbaopo, Gaoqiao, Zitong, Bishan, Chongqing; Dongyuemiao Section of Ziliujing Formation, Early Jurassic.

Included material Two teeth, three cervicals, a dorsal, two dorsal ribs, left tibia and fibula. ZDM 4001.

Locality and horizon Dashanpu, Zigong; Xiashaximiao Formation, Middle Jurassic.

***Bishanopliosaurus zigongensis* Gao et al., 2004**

Diagnosis Midium-sized pliosauroid recognized by amphicoelous dorsal centra lacking ventral keel; plate-like dorsal neural spines; long mid-dorsal ribs; short and small sacral ribs with broadened and thin plate-like distal ends; ilium with small and compressed sacral end and robust acetabular end; tibia about 2/5 of femur length; metatarsal I and V compressed, while metatarsal II, III and IV massive; and pedal digit V with 8 phalanges.

Holotype An incomplete skeleton includes 22 articulated dorsals and sacrals, dorsal and sacral ribs, left pelvic girdle and hindlimb. ZDM 0185.

Locality and horizon Sixth Team of Pengshi, Yongan, Zigong; Xiashaximiao Formation, Middle Jurassic.

Order Crocodyliformes

Suborder Mesoeucrocodylia

Family Goniopholididae Cope, 1875

Genus *Sunosuchus* Young, 1948

Diagnosis Medium-sized mesoeucrocodilians characterized by a narrow stout more than

twice length of postorbital region; a small cranial table less than 60% maximum width of skull along a line across supratemporal fenestrae; a pair of maxillary depressions; frontal with a ridge along midline; large pits wider than long on posterior surface of frontal; a pair of anterior palatal fenestrae located well anterior to suborbital fenestrae; a pair of narrowed and elongated choanae partly extending behind suborbital fenestrae; crest B on ventral surface of quadrate strongly developed; dorsal surface of retroarticular process expanded; symphysis of dentaries elongated and with a short contribution from splenial.

Type species *Sunosuchus miaoi* Young, 1948.

***Sunosuchus shunanensis* Fu et al., 2005**

Diagnosis Relatively narrow and elongate snout attains a length 3 times that of postorbital region; well-developed maxillary depression occupies posterior half of maxilla; relatively short but wide cranial table attains a ratio of 0.65 of its length to width; interfenestral region wider than interorbital region; lacrimal with a flange along anterior border of orbit; frontal entering supratemporal fenestra; infratemporal fenestra small and split-shaped; squamosal lacking thickened or grooved lateral side; presence of a flange along lateral margin of basioccipital and medioventral margin of exoccipital; lacking a ridge-like structure and depression or fossa on the dorsal surface of distal portion of quadrate body lacking a ridge-like structure and depression or fossa; pterygoid with a deep step between main body and palatal process; and palatine with a narrow anterior part and a broad posterior part.

Holotype A nearly complete skull. ZDM 3401.

Locality and horizon Dashanpu, Zigong; Xiashaximiao Formation, Middle Jurassic.

Family Hsisosuchidae Young et Chow, 1953

Genus *Hsisosuchus* Young et Chow, 1953

Diagnosis Medium-sized mesoeucrocodylian characterized by a narrow and longer snout; presence of an elongate posteromedian depression between nasals; maxilla having a sinusoidal wave along dental margin; presence of antorbital fenestra bordered by maxilla and lachrymal; external naris terminally positioned; large jugal longitudinally curved along midline; postorbital bar unsculptured and slightly sunken; ascending process of jugal excluded from orbit by descending process of postorbital; posterolateral process of squamosal extraordinary large; suborbital fenestra enclosed; presence of a strong transverse ridge on ventral surface of pterygoid, resulting in a deep step-like structure between palatal process and main body of bone; elliptical choanae elongate and surrounded by a distinct ridge; posttemporal fenestra enclosed in occiput; exoccipital forming a pronounced transverse ridge above magnum foramen; symphysis of lower jaws long, and splenial entering symphysis anteriorly; external mandibular fenestra enclosed in adult; retroarticular process less developed; teeth compressed with serrations along anterior and posterior margins; coracoid about half length of scapula; trunk and tail covered with dermal plates; dorsal osteoderms lacking anterolateral process.

Type species *Hsisosuchus chungkingensis* Young et Chow, 1953.

Hsisosuchus dashanpuensis Gao, 2001

Diagnosis Medium-sized hsisosuchid recognized by snout twice of length of cranial table; a pair of external nares situated at anterior end of snout; orbit larger than supratemporal fossa; anteriorly positioned choanae surrounded by maxillary and palatine; very small suborbital fenestra very small; elongated palatal process of pterygoid; lamella-like paroccipital process; relatively slender posterolateral process of squamosal; compressed teeth with serrations on anterior and posterior margins; and tooth formula Pm5 + M14.

Holotype A complete skull, a cervical, a lumbal, and seven dorsal plates. ZDM 3405 (field no.: jc).

Locality and horizon Dashanpu, Zigong; Xiashaximiao Formation, Middle Jurassic.

Order Pterosauria

Suprafamily Rhamphorhynchoidea

Family Rhamphorhynchidae Seeley, 1870

Subfamily Angustinaripterinae He et al., 1983

Diagnosis Primitive rhamphorhynchid characterized by low and long skull with height about 1/4 of its length; anterior end of snout relatively blunt; long and large antorbital; elongated and narrowed external naris; and orbit separated from antorbital and naris.

Genus *Angustinaripterus* He et al., 1983

Diagnosis As for type species *Angustinaripterus longicephalus* He et al., 1983.

Angustinaripterus longicephalus He et al., 1983

Diagnosis Primitive rhamphorhynchid recognized by low and elongate skull with completely co-ossified cranial elements; relatively blunt snout; narrowed quadrate inclined anteroventrally; large and round orbit; large infratemporal fenestra gradually narrowed ventrally; large and long antorbital fenestra triangular-shaped; external naris extremely elongated and narrowed; antorbital fenestra and external naris separated from orbit; a low but long ridge extending from anterior end of snout to frontal above orbit; straight and slender lower jaw with straight ventral margin; anterior end of dentary slightly deepened; relatively elongated upper dentition bearing 9 teeth, and lower dentition comprising 9 or 10 teeth; slender and sharp teeth lacking ornaments.

Holotype A nearly complete skull and lower jaws. ZDM 8001 (provincial excavation team no.: T8001).

Locality and horizon Dashanpu, Zigong; Xiashaximiao Formation, Middle Jurassic.

Order Therapsida

Suborder Theriodontia

Family Tritylodontidae Cope, 1884

Genus *Bienotheroides* Young, 1982

Diagnosis Broad and short skull with extremely shortened snout; zygomatic arch greatly deepened; maxilla largely retreated both in lateral and palatal surfaces; presence of an opening between nasal and frontal; lachrymal and palatine extraordinary developed; premaxilla directly connecting palatine on palatal surface; short, broad and flattened basi-parasphenoid region lacking any keel-like structure; absence of diastema between incisor and canine; cusp formula of upper postcanine teeth 2-3-3 to 2-2-2; and lower postcanine teeth single-rooted.

Type species *Bienotheroides wansienensis* Young, 1982.

***Bienotheroides zigongensis* Sun, 1986**

Diagnosis Medium-sized tritytodontid recognized by broad and short skull; greatly deepened zygomatic arch; extremely retreated maxilla; extraordinary extension of lachrymal and palatine; direct connection of premaxilla and palatine on palatal surface; short, broad and flattened basisphenoid-pterygoid region lacking keel-like structure; subquadrangular postcanine teeth with breadth slightly exceeding length; bigger cuspules in front of main cusp and minute cuspule at outer cusp-row not observed; and doubled prootic foramen on lateral flange of prootic.

Holotype A skull without snout and dorsal bones of braincase. ZDM 8602.

Locality and horizon Dashanpu, Zigong; Xiashaximiao Formation, Middle Jurassic.

Genus *Polistodon* He et Cai, 1984

Diagnosis As for type species *Polistodon chuannanensis* He et Cai, 1984.

***Polistodon chuannanensis* He et Cai, 1984**

Diagnosis Skull roof with low and short sagital crest; zygomatic arch gradually deepened backwards so as to giving a triangular outline in lateral aspect, but not arched laterally as in *Bienotheroides*; angular and articular processes of mandible obviously differentiated; coronoid process of dentary broad and high; medio-posterior process of mandible indistinct; dental formula 1-0-13/2-0-7~8; subquadrangular upper postcanine teeth with breadth obviously exceeding length and cusp formula of 2-2-2; lower postcanine teeth 3/4 length of upper ones, and with its breadth less than its length; cusp formula of lower postcanine 2-2; presence of a tiny cuspule in front of each cusp row.

Holotype A complete skull and lower jaws, and some postcranial remains such as vertebrae, humerus and femur probably belong to the same individual. ZDM 8601 (provincial excavation team no.: T8601).

Locality and horizon Dashanpu, Zigong; Xiashaximiao Formation, Middle Jurassic.

Order Saurischia

Suborder Theropoda

Infraorder Carnosauria

Family Megalosauridae Huxley, 1869

Genus *Gasosaurus* Dong et Tang, 1985

Diagnosis As for type species *Gasosaurus constructus* Dong and Tang, 1985.

Gasosaurus constructus Dong et Tang, 1985

Diagnosis Small megalosaur attains a length of approximately 3.5 m. It is recognized by laterally compressed teeth; amphiplatyan cervical centra with incipient weak ventral keel; dorsals with amphiplatyan centra, low neural arches and plate-like neural spines; dorsal neural spines lacking expanded bulks at tips; five sacral centra and arches firmly fused while neural spines not fused; presence of a humeral foramen; low ilium with a less developed anterior process; and distal ends of pubis and ischium expanded but lacking foot-like processes.

Holotype A incomplete skeleton including 4 cervicals, 7 dorsals, 5 sacrals, 7 caudals, both humeri, left ilium, left pubis, left ischium and complete left hindlimb. IVPP V 7264 (field no.: C-0.2).

Referred material 3 teeth. IVPP V 7265.

Included material A complete ischium. ZDM 9008.

Locality and horizon Dashanpu, Zigong; Xiashaximiao Formation, Middle Jurassic.

Genus *Szechuanosaurus* Young, 1942

Revised diagnosis Medium-sized megalosaur with body length of 4~7 m. It is characterized by skull shorter than neck; large first antorbital fenestra, orbit and infratemporal fenestra; very small second antorbital fenestra; penetrative maxillary fossa; low dentary; distinctly compressed teeth with serrated anterior and posterior margins; dental formula Pm4 + M15~17 / D15~16; 9~10 cervicals, 13 dorsals, 5 co-ossified sacrals; sacral neural spines not fused; posterior caudals with elongated prezygapophyses; low ilium; distal end of pubis with an undeveloped foot-like process; distal end of ischium expanded but lacking foot-like process; and metatersals not fused.

Type species *Szechuanosaurus campi* Young, 1942.

Szechuanosaurus zigongensis Gao, 1993

Revised diagnosis Medium-sized megalosaur about 6 m of body length. It is recognized by skull shorter than neck; large first antorbital fenestra, orbit and infratemporal fenestra; small second antorbital fenestra; penetrative maxillary fossa; low dentary; dental formula Pm4 + M15~17 / D15~16; 10 cervicals; last two platocoelous cervical centra with ventral keel; 13 amphiplatyan dorsals with high and plate-like neural spines; 5 sacrals with fused centra and neural arches and infused neural spines; neural spine of anterior caudals narrowed; posterior caudals with elongate prezygapophyses; deltopectoral crest of humerus well developed; radius about 56% of humerus length; metacarpal IV survived; very low ilium; pubis with a small foot-like process; distal end of ischium expanded; tibia approximately 94% of femur length; and forelimb about 41% of length of hindlimb.

Holotype A nearly complete skeleton including lower portion of the right quadrate, 10 articulated cervicals, 13 dorsals, 5 sacrals, 33 disarticulated caudals, right scapula, left forelimb,

complete pelvic girdle, femur, tibia and fibula. ZDM 9011.

Referred material 1. An incomplete skeleton including left and right maxillae and jugals, left dentary, articulated cervicals and dorsals, left ilium, left femur. ZDM 9015.

2. A left maxilla. ZDM 9012.

3. Crowns of two teeth. ZDM 9013.

4. Complete right femur, tibia and fibula. ZDM 9014.

Locality and horizon Dashanpu, Zigong; Xiashaximiao Formation, Middle Jurassic.

Suborder Sauropodomorpha

Infraorder Sauropoda

Family Cetiosauridae Lydekker, 1888

Genus *Protognathosaurus* (Zhang, 1988)

Diagnosis As for type species *Protognathosaurus oxyodon* (Zhang, 1988)

***Protognathosaurus oxyodon* (Zhang, 1988)**

Diagnosis Medium-sized primitive sauropod recognized by thick and heavy dentary with a deepened anterior end and gradually decreased dorsal margin; middle portion of dentary relatively contracted; meckelian canal quite deep and long; elongate dentition with 19~20 dentary teeth; slender and pointed dentary tooth crown with an undeveloped median ridge, metrical anterior and posterior ridges and 4~5 obvious serrations.

Holotype A complete left dentary. CV 00732.

Locality and horizon Dashanpu, Zigong; Xiashaximiao Formation, Middle Jurassic.

Genus *Shunosaurus* Dong et al., 1983

Diagnosis As for type species *Shunosaurus lii* Dong et al., 1983.

***Shunosaurus lii* Dong et al., 1983**

Diagnosis Medium-sized primitive sauropod with largest body length of 12 m. It is recognized by relatively low and heavily built skull with height about 1/2 of its length; low and flattened braincase roof; broad and long facial region; anterior end of snout smoothly rounded; median ridge of nasal not arched upward; external naris and orbit large, while antorbital and supratemporal fenestra relatively small; infratemporal fenestra long but narrow; Quadrate inclined anteroventrally; external mandibular foramen present but small; slender and spoon-shaped teeth with few serrations along anterior and posterior margins; dental formula Pm4~5 + M17~19 / D18~21; 12 cervicals, 13 dorsals, 4 sacrals and about 45 caudals; massive presacrals lacking cavernous; short opisthocoelous cervical centra with obvious elongate pleurocoels; cervical neural spines not bifurcated with broad posterior spinal lamellae; anterior dorsal centra slightly opisthocoelous, middle and posterior dorsal centra generally platycoelous or faintly amphicoelous; dorsal neural spines generally not bifurcated; sacrals with developed yoke-like sacricostal processes; last 3~5 caudals fused as a bony tail club; scapula long but

narrow; low ilium with massive pubic peduncle; humerus about 2/3 of femur length; radius about 3/5 of humerus length; tibia less than 3/5 length of femur; presence of 3~4 carpals; manual phalangeal formula 2-2-2-2-2?; first manual ungual well developed; and pedal phalangeal formula 2-3-3-3-2.

Holotype An incomplete skeleton. IVPP V 9065.

Included material Included 5 specimens:

1. ZDM 5006 (field no.: I-Q; provincial excavation team no.: T5401), a very complete juvenile skeleton.

2. ZDM 5003 (field no.: II-A; provincial excavation team no.: T5402), a very complete adult skeleton.

3. ZDM 5007 (field no.: I-Z; provincial excavation team no.: T5403), a very complete skull.

4. ZDM 5008 (field no.: I-N; provincial excavation team no.: T5404), a complete skeleton lacking skull.

5. IVPP V 7261, some cranial fragments and complete postcranial skeleton.

Locality and horizon Dashanpu, Zigong; Xiashaximiao Formation, Middle Jurassic.

Family Camarasauridae Cope, 1877

Genus *Datousaurus* Dong et Tang, 1984

Diagnosis As for type species *Datousaurus bashanensis* Dong et Tang, 1984

***Datousaurus bashanensis* Dong et Tang, 1984**

Revised diagnosis Large-sized sauropod recognized by big and heavily built skull; short but high facial region; anteriorly positioned external naris; small antorbital fenestra; quadrate slightly inclined forward; robust premaxilla and maxilla; deep and heavily built lower jaws lacking external mandibular fenestra; big and spoon-shaped teeth with higher crown; dental formula Pm4 + M10~12 / D12~14; 12 cervicals, 13 dorsals, 5 sacrals and more than 45 caudals; moderately elongated cervicals with longest one about 2.5 times of average length of dorsals; opisthocoelous cervical centra with developed pleurocoels and ventral keels; relatively low cervical neural arches and spines with developed lamellar structures; spines of posterior cervicals and anterior dorsals transversely broadened but not bifurcated; weakly opisthocoelous or plateocoelous dorsal centra with weak pleurocoels; neural spines of posterior dorsals high and bar-like; all sacral centra and arches and first four spines fused; weakly amphicoelous anterior caudals with short and high centra; elongate scapula; oval-shaped coracoid; low and elongate ilium with developed pubic peduncle and plate-like ischial peduncle; and bones of limbs relatively straight and robust.

Holotype An incomplete skeleton and an incomplete skull. IVPP V 7262 and V 7263.

Included material Including two individuals:

1. CV 00740, an incomplete skull.

2. ZDM 5021, a complete skeleton.

Locality and horizon Dashanpu, Zigong; Xiashaximiao Formation, Middle Jurassic.

Genus *Dashanpusaurus* gen. nov.

Diagnosis As for type species *Dashanpusaurus dongi* gen. et sp. nov.

***Dashanpusaurus dongi* gen. et sp. nov.**

Etymology **"**Dashanpu" is a township where the specimen was unearthed. The specific name refers to Prof. Dong Zhiming, a distinguished Chinese dinosaurologist for his important contributions to the excavation, preservation and study of the Dashanpu Dinosaur Quarry.

Diagnosis 12~13 cervicals, 13 dorsals, 4 sacrals and more than 45 caudals; short opisthocoelous cervical centra with elongate and deep pleurocoels and weak keels; relatively low cervical neural spines; spines of posterior cervicals and anterior dorsals transversely broadened and slightly bifurcated; dorsals plateocoelous or weakly amphicoelous; anterior dorsal centra with developed pleurocoels; higher and thick plate-like neural spines of middle and posterior dorsals with an expanded tip; all sacral centra and first three sacral spines fused; anterior caudals plateocoelous, middle and posterior caudals amphicoelous; short and robust scapula with obviously expanded distal end; straight and robust humerus with obviously expanded proximal end; low and elongate ilium with developed anterior process; relatively slender femur with a developed head; straight and robust tibia; radius about 66% of humerus length; and tibia about 59% of femur length.

Holotype An incomplete skeleton including 6 cervicals, 12 dorsals, 4 sacrals, 33 caudals, left ulna, pelvic girdle and hindlimb. ZDM 5028 (field no.: I-K).

Paratype An incomplete skeleton including 12 dorsals, some ribs, left pectoral girdle, left humerus and radius. ZDM 5027 (field no.: II-D).

Locality and horizon Dashanpu, Zigong; Xiashaximiao Formation, Middle Jurassic.

Family Mamenchisauridae Young et Chao, 1972
Genus *Omeisaurus* Young, 1939

Diagnosis Medium to huge sized sauropod characterized by moderately high skull; robust and spoon-shaped teeth with few or no serrations on anterior and posterior margins; 17± cervicals, 12 dorsals, 4 sacrals and more than 50 caudals; spines of posterior cervicals and anterior dorsals simple and not bifurcated; anterior caudals slightly amphicoelous; and first caudal rib more or less fan-shaped.

Type species *Omeisaurus junghsiensis* Young, 1939.

***Omeisaurus junghsiensis* Young, 1939**

Diagnosis Medium-sized sauropod characterized by opisthocoelous cervical centra with developed pleurocoel; low and extraordinarily extend anteroposteriorly cevical neural spines with straight dorsal margins; opisthocoelous dorsal centra with developed pleurocoel; fan-shaped first caudal rib; semicircular coracoid with big coracoid foramen and straight suture to scapula; straight humerus with expanded proximal end; robust pubis and ischium with expanded proximal end; very remarkable femoral fourth trochanter; slender fibula with round cross-section.

Holotype An incomplete skeleton including 20 vertebrae, 8 left ribs, left scapula and

coracoid, left humerus, pairs of ilium and ischium, left pubis, proximal portion of left femur, left fibula. Unnumbered.

Locality and horizon Xiguashan, Rongxian (Jung Hsien), Zigong; Xiashaximiao Formation, Middle Jurassic.

Omeisaurus tianfuensis He et al., 1984

Diagnosis Huge-sized sauropod about 20 m of biggest body length. It recognized by skull with its height more than 1/2 of its length; larger supratemporal fenestra; relatively small antorbital fenestra; slightly posteriorly positioned naris; presence of intermaxillary foramen; high maxillary with a larger ascending process; articular surface of skull with lower jaws bellow mandibular dentition; relatively posteriorly positioned external mandibular foramen; deeper anterior end of dentary; dentary occupies 2/3 of mandible length; Pm4+M11/D13~15 dental formula; robust and spoon-shaped teeth with developed serrations on anterior margin and few or no serrations on posterior margin; 17 cervicals, 12 dorsals, 4 sacrals and more than 36 caudals; longest cervical about 3 times of length of longest dorsal; opisthocoelous cervical centra with well developed pleurocoel laterally and keel ventrally; low cervical neural spines elongated longitudinally with a straight dorsal margin; well developed laminar structures of posterior cervicals; extremely elongated cervical ribs (the longest rib about 2.5 times of length of the longest cervical centra); opisthocoelous dorsals with developed pleurocoel and not bifurcated neural spine; fused sacral centra and partially fused sacral neural spines; slightly amphicoelous anterior caudals with fan-shaped ribs on the first one; chevrons of middle caudals with bifurcated distal end; elongate oval-shaped sternum; long clavicle spear-shaped; remarkably expanded proximal end of scapula; nearly oval-shaped coracoid; ilium with robust pubic peduncle and undeveloped ischial peduncle; forelimb about 4/5 or more of length of hindlimb; ulna about 2/3 or more of humerus length; tibia about 2/3 of femur length; manual phalangeal formula 2-2-2?-2?-1?; pedal phalangeal formula 2-3-3-3-2; manual digit I and pedal digit I~III with unguals.

Holotype A complete skeleton including 15 cervicals, 12 dorsals, 4 sacrals, 25 caudals, left scapula and coracoid, both sterna, left humerus and radius, complete pelvic girdle and left hindlimb. ZDM 5701 (field no.: II-C-9 and II-E).

Paratype A nearly complete skull, 3 cervicals in the middle portion, complete left forelimb and hindlimbs. ZDM 5702 (field no.: I-U).

Referred material 8 skeletons of individuals:

1. An incomplete skeleton including incomplete skull, 13 cervicals, left scapula and coracoid, right humerus, pairs of ulnae and radius, some metacarpals, phalanges, metatarsals and digits. ZDM 5703 (field no.: I-N1).

2. A complete skeleton including 8 cervicals, 12 dorsals, 4 sacrals, 36 caudals, complete pectoral and pelvic girdles, nearly complete forelimbs (lacks right ulna and radius), complete hindlimbs. ZDM 5704 (field no.: I-J).

3. An incomplete skeleton including incomplete skull, a cervical, 10 dorsals, 4 sacrals, 32

caudals, left scapula, complete left forelimb, nearly complete pelvic girdle and hindlimbs. ZDM 5705 (field no.: AF).

4. An incomplete skeleton including 5 dorsals, 4 sacrals, right ilium, and right digits. ZDM 5706 (field no.: I-Y).

5. An incomplete skeleton including 11 dorsals, 11 caudals in the anterior portion, sterni, complete pelvic girdle and some limb bones. ZDM 5707 (field no.: I-A).

6. An incomplete skeleton including 6 cervicals and some limb bones. ZDM 5708 (field no.: I-G).

7. An incomplete skeleton including left maxilla and 3 cervical in the middle portion. ZDM 5709 (field no.: I-Z).

8. An incomplete juvenile skeleton including a cervical, 5 dorsals, 2 sacrals, 6 caudals, right scapula, right humerus and radius, both ilia, left pubis and ischium, and left femur. ZDM 5710 (field no.: I-N2).

Locality and horizon Dashanpu, Zigong; Xiashaximiao Formation, Middle Jurassic.

Genus *Abrosaurus* (Ouyang, 1989)

Diagnosis As for type species *Abrosaurus dongpoi* (Ouyang, 1989).

Abrosaurus dongpoi (Ouyang, 1989)

Diagnosis Medium-sized sauropod identified by lightly constructed skull with large external openings; cranial length about 2.5 times of its width; narrow and elongate facial region; nasal bridge arched upwards; very slender ascending processes of premaxilla and maxilla; external naris larger than orbit; large and triangular antorbital fenestra; narrowed interfenestral region; nearly vertical quadrate; low and elongate mandible with small external mandibular fenestra; slightly deepened anterior end of dentary; dental formula Pm5+M15~17/D16~18; slender and spoon-shaped teeth with developed vertical median ridge medially; premaxillary teeth without serrations on anterior and posterior margins, and cheek teeth with few serrations.

Holotype A very complete skull. ZDM 5038.

Referred material A skull with the posterior portion. ZDM 5033.

Locality and horizon Dashanpu, Zigong; Xiashaximiao Formation, Middle Jurassic.

Mamenchisauridae gen. et sp. indet.

Diagnosis Dorsal neural arches with developed pits and laminae; plate-like dorsal neural spines transversely expanded with not bifurcated dorsal end; extraordinarily developed suprapostzygapophysial lamina extending backwards and outwards to form an obvious wing-like process.

Material A dorsal just with neural arch and spine. ZDM 5031.

Locality and horizon Dashanpu, Zigong; Xiashaximiao Formation, Middle Jurassic.

Sauropoda incertae sedis

Diagnosis Higher dorsal neural arches; high, robust and rod-shaped dorsal neural spines

with an expanded dorsal end; well developed postparapophysis.

Material 3 dorsals just with neural arches and spines. ZDM 5032.

Locality and horizon Dashanpu, Zigong; Xiashaximiao Formation, Middle Jurassic.

Order Ornithischia

Suborder Ornithopoda

Family Fabrosauridae Galton, 1972

Genus *Xiaosaurus* Dong et Tang, 1983

Diagnosis As for type species *Xiaosaurus dashanpensis* Dong et Tang, 1983

***Xiaosaurus dashanpensis* Dong et Tang, 1983**

Diagnosis Small cursorial ornithopod recognized by laterally compressed teeth with Buddha's-hand-like outline and symmetrical medial and lateral surfaces; tooth crown lacking wear surface and vertical ridge; serrated anterior and posterior margins of teeth; undeveloped cingula of teeth; straight and slender humerus with undeveloped deltopectoral crest; lesser trochanter of femur lower than femoral head and greater trochanter; lower positioned fourth trochanter forming a fan-like crest that attains an index of 0.53; short tibia about 1.1 times of femur length; Metatarsal III about 64% of femur length; slender and straight pedal phalanges.

Holotype A damaged maxilla, a complete tooth, 2 cervicals, 4 caudals, left humerus, and complete right hindlimb. IVPP V 6730A (field no.: Cr. 003).

Referred material Two teeth, a dorsal, 2 articulated sacrals, some ribs, complete right femur, and some digits. IVPP V 6730B.

Included material A complete humerus. ZDM 6015.

Locality and horizon Dashanpu, Zigong; Xiashaximiao Formation, Middle Jurassic.

Genus *Agilisaurus* Peng, 1990

Diagnosis Small primitive ornithopod with a body length of about 1~2 m. It is characterized by short but deeper skull; long nasal with a longitudinal median depression; posterior process of premaxilla no contact lachrymal; maxilla and dentary with remarkable depression marking for M. buccinatoris; higher coronoid eminence of mandible; scapula shorter than humerus; forelimb less than 1/2 of length of hindlimb; lower positioned less trochanter of femur; metatarsal III more than 1/2 of femur length.

Type species *Agilisaurus louderbacki* Peng, 1990.

***Agilisaurus louderbacki* Peng, 1990**

Diagnosis Small cursorial primitive ornithopod recognized by short but deeper skull, strongly contracted interfenestral region of parietal; long nasal with a longitudinal median depression; posterior process of premaxilla no contact lachrymal; slightly dorsally positioned antorbital vacuity; orbit positioned laterally in posterior half of skull; quite well developed palpebral bridging over orbit; robust quadrate with transversely expanded mandibular condyle;

higher coronoid eminence of mandible; lower positioned articular cavity; absence of external mandibular fenestra; dental formula Pm5 + M14 / D20; premaxillary teeth and first three dentary teeth recurved and canine-shaped while remaining dentary teeth and maxillary teeth diamond or leaf shaped with wear surface of varied degree; 9 cervicals, 15 dorsals, 5 sacrals, and at least 45 caudals; neck and trunk short while tail longer than half of its body length; ossified tendons confined to trunk and hip; scapula shorter than humerus; long ilium with a extraordinarily developed supra-acetabular flange; slender and rod-like postpubis; proximally placed obturator process of ischium; lesser trochanter of femur lower than greater trochanter, and presence of a deep cleft between them; pendent fourth trochanter of femur with a nutritive foramina at its base medially; tibia longer than femur; matatarsal III longer than 1/2 of femur length; pedal phalangeal formula 2-3-4-5-0; all pedal digits clawed.

Holotype A skeleton with completeness more than 90% including very complete skull and lower jaws, articulated vertebrae, and most of bones of girdles and limbs. ZDM 6011.

Locality and horizon Dashanpu, Zigong; Xiashaximiao Formation, Middle Jurassic.

***Agilisaurus multidens* (He et Cai, 1983)**

Diagnosis Small cursorial primitive ornithopod recognized by small, short but deep skull; relatively short snout; large orbit slightly anteriorly positioned; small and triangular antorbital vacuity lower positioned and enclosed medially; large infratemporal fenestra; extraordinarily developed occipital crest; straight ventral margin of jugal; much more cheek teeth with obvious lateral ridges, but without median ridge; scapula shorter than humerus; forelimb less than 1/2 of length of hindlimb; lower placed less trochanter of femur; tibia about 118% of femur length; metatarsal III more than 1/2 of femur length.

Holotype A nearly complete articulated skeleton including skull, presacrals, sacrals, 14 caudals in the anterior portion, and most of bones of girdles and limbs. ZDM 6001 (field no.: T6001).

Paratype An incomplete skeleton including a pair of maxillae with teeth, a pair of dentaries with teeth, some dorsals and caudals, right scapula, right humerus and ulna, left ilium, part of right ilium, and right prepubis, incomplete left and right femora, both tibiae, left fibula, both astragali, some metatarsals and digits. Field no.: T6002. It was housed in the museum of Chengdu University of Technology.

Locality and horizon Dashanpu, Zigong; Xiashaximiao Formation, Middle Jurassic.

Suborder Stegosauria

Family Stegosauridae Marsh, 1880

Subfamily Huayangosaurinae Dong et al., 1982

Diagnosis Small to medium sized stegosaur diagnosed by well developed jugal; 2~3 supraorbitals; presence of premaxillary teeth; presence of antorbital vacuity; mandible with external mandibular fenestra and prominent coronoid eminence; low dorsal neural arches; sacral foramens not enclosed; femur a little longer than humerus with undeveloped fourth trochanter;

distal ends of tibia and fibula fused with astragalus and calcaneum; pedal digit II and III with 3 phalanges; dermal plates varied in shape.

Genus *Huayangosaurus* Dong et al., 1982

Diagnosis As for type species *Huayangosaurus taibaii* Dong et al., 1982.

Huayangosaurus taibaii Dong et al., 1982

Diagnosis Small to medium sized primitive stegosaur recognized by bigger and heavy skull; presence of a notch between premaxilla and maxilla; presence of a small horn core on dorsal aspect of postorbital; developed jugal with a short ascending process and a elongated posterior process; two supraorbitals above large and triangular orbit; massive mandible with small and edentulous predentary, small and triangular external mandibular fenestra, and prominent coronoid eminence; 7 premaxillary teeth, 28 maxillary teeth and 27 dentary teeth; leaf-like cheek teeth lacking cingula; 8 cervicals, 16 dorsals, 4 sacrals, and at least 35 caudals; co-ossified sacrals with 3 pairs of unenclosed sacral foramens; well developed processus hamularis of anterior dorsal ribs; prepubis shortened and laterally compressed; elongated postpubis extending to distal end of ischium and having an expanded distal end; humerus about 0.88 of femur length; proximal carpals co-ossified together as an egg-shaped bone; pedal digits II and III with 3 phalanges; varied morphology of dermal plates.

Holotype A compositive skeleton including a complete skull, some vertebrae, some bones of girdles and limbs, and some dermal plates. IVPP V 6728.

Included material 7 individuals with different completeness:

1. A nearly complete skeleton including complete skull, 64 associated vertebrae (all of cervicals, dorsals and sacrals, and 35 caudals), some ribs, both scapulae and coracoids, right humerus, both ilia, right pubis and ischium, both femora, both tibiae and fibulae, some metatarsals and phalanges of right pes, 12 dermal plates respectively belong to neck, dorsal and tail portions. ZDM 7001 (provincial excavation team no.: T 7001).

2. An incomplete skeleton including fragmentary skull, 28 vertebrae, right humerus, left ulna and radius, proximal carpals, both ilia, left femur, left tibia and fibula, phalanges of pedal digit II, III and IV, and 20 dermal plates. CV 00720.

3. A partial skeleton including 18 vertebrae (cervicals, dorsals and sacrals), both ilia, right tibia. CV 00721.

4. A partial skeleton including 8 vertebrae, both ilia, and 2 dermal plates. Provincial excavation team no.: T 7002.

5. A left pubis. Provincial excavation team no.: T 7008.

6. A right scapula and coracoid. Provincial excavation team no.: T 7004.

7. A complete parascapular spine. ZDM 7010.

Locality and horizon Dashanpu, Zigong; Xiashaximiao Formation, Middle Jurassic.

Late Jurassic Sauropoda-*Mamenchisaurus* Fauna

The Sauropoda-*Mamenchisaurus* Fauna contains sauropods, carnosaurs, ornithopods and stegosaurs of dinosaurs. Other vertebrates include fishes, turtles, crocodiles and plesiosaurs. They mainly distributed in the Shangshaximiao formation. At present, there are no fossil vertebrates from the Suining and Penglaizhen formations in Zigong region. The Wujiaba Dinosaur Quarry is the most typical locality of this fauna.

Order Testadines

Suborder Casichelydia

Infraorder Cryptodira

Family Plesiochelyidae Rutimeyer, 1873

Genus *Yanduchelys* gen. nov.

Diagnosis As for type species *Yanduchelys delicatus* gen. et sp. nov.

***Yanduchelys delicatus* gen. et sp. nov.**

Diagnosis Small plesiochelyid turtle recognized by flattened and heart-shaped carapace with its length same as its width; plastron much shorter than carapace, with short anterior and posterior lobes; broad bony bridge; anterior lobe with a lateral process; large and leaf-like entoplastron.

Holotype A nearly complete turtle shell with associated carapace and plastron. ZDM 0162.

Locality and horizon Uncertain locality and horizon of Zigong, Middle or Late Jurassic.

Etymology The generic name refers to Zigong which is named as “Yandu” because of its long history of well salt production. The specific name refers to the little and beautiful holotype.

Genus *Plesiochelys* Rutimeyer, 1873

Diagnosis Large plesiochelyid turtles characterized by thick, circular or cordiform carapace; anterior border of carapace slightly concaved; 8 neural plates long and narrow; 3 subrapygal plates; broad endoplastron with rounded posterior border; relatively long hypoplastron; intergular scutes separated each other; narrow inframarginal scutes not extending on marginal plates; abdomino-femoral sulcus ascended toward hyo-hypoplastron suture and ended in inguinal notch; broad bony bridge; presence or absence of median fontanelle.

Type species *Plesiochelys solodurensis* Rutimeyer, 1873.

***Plesiochelys radiplicatus* Young et Chow, 1953**

Diagnosis Large plesiochelyid turtle recognized by ellipitical-shaped and slightly arched carapace; dorsal surface of vertebral and costal scutes ornamented with distinct and radiated striations; sulci of vertebral and costal scutes double-lined; 8 neural plates hexagonal-shaped; 2 suprapygal plates; broad and subquadrate-shaped pygal; relatively broad plastron; broad bony bridge containing four inframarginal scutes; anal scutes extending forward and overlapping hypoplastron.

Holotype An incomplete turtle shell. IVPP V 707.

Locality and horizon Uncertain locality and horizon along the Chengdu-Chongqing railway, Late Jurassic?

Included material A nearly complete carapace. ZDM 0013.

Locality and horizon Yongjia, Daan, Zigong; Shangshaximiao Formation, Late Jurassic.

***Plesiochelys zigongensis* sp. nov.**

Diagnosis Large plesiochelyid recognized by oval-shaped carapace with its anterior width less than its posterior width; broad vertebral plates ornamented with a few radiated striations; narrow and elongate plastron; presence of intergular scutes; narrow bony bridge with three inframarginal scutes; calabash-shaped entoplastron; anal scutes extending forward and overlapping hypoplastron.

Holotype An incomplete turtle shell. ZDM 0048.

Locality and horizon Rongxian, Zigong; Shangshaximiao Formation, Late Jurassic.

Etymology The specific name refers to Zigong in which the specimen was found.

***Plesiochelys* sp.**

Material ZDM 0044, an incomplete turtle shell with impression of carapace and complete plastron. ZDM 0084, a turtle shell just with plastron.

Locality and horizon Xinmin of Daan and Fuhe of Fushun, Zigong; Shangshaximiao Formation, Late Jurassic.

Order Crocodyliformes

Suborder Protosuchia

Unnamed Group B Wu et al., 1994

Genus *Sichuanosuchus* Peng, 1995

Diagnosis A primitive crocodyliform diagnosed by nasal excluded from external naris and internasial bar formed by premaxilla; anterior and posterior frontal slightly arched dorsally; jugal with a short and transversely broadened posterior process; quadratojugal with a fan-like lateral process; postorbital excluded from infratemporal fenestra; basisphenoid with a prominent median ridge; elongated and belt-like palatine; choanae surrounded by ridges; ventral edge of angular transversely expanded to form longitudinal ridges medially and laterally; surangular with a dorsolateral ridge anterolateral to articular vacuity; first one or two maxillary teeth canine-like; other cheek teeth with low and file-shaped crowns; dentary with a edentulous anterior end anterior to caniniform tooth.

Type species *Sichuanosuchus huidongensis* Peng, 1995.

***Sichuanosuchus huidongensis* Peng, 1995**

Diagnosis Small primitive crocodyliform with a head of 6 cm long. It is recognized by nasal excluded from external naris and internasial bar formed by premaxilla; laterally expanded jugal forming a broad shelf below orbit and infratemporal fenestra; laterally expanded posterior

region of quadratojugal forming a fan-like process; postorbital excluded from infratemporal fenestra; oval-shaped supratemporal fossa diverged anteriorly; frontal with a faint crescent crest around posterodorsal corner of orbit; lateral groove of squamosal for ear flap extending anteriorly onto dorsal surface of postorbital; presence of a transverse groove across posterior margin of cranial table; palatine elongate and narrow; in ventral view, symphysis anteriorly grooved but posteriorly ridged; transversely expanded ventral edge of angular forming longitudinal ridges medially and laterally; second maxillary tooth expanded as a large caniniform tooth; dentary with an edentulous anterior end anterior to caniniform tooth; cheek teeth with file-shaped crowns.

Holotype An incomplete skeleton including complete skull and lower jaws, 23 articulated presacrals, at least 13 associated posterior caudals, dorsal and ventral osteoderms, and some bones of forelimbs and hindlimbs. ZDM 3403.

Locality and horizon Daquekou, Huidong, Zigong; Shangshaximiao Formation, Late Jurassic.

Suborder Mesoeucrocodylia

Family Hsisosuchidae Young et Chow, 1953

Genus *Hsisosuchus* Young et Chow, 1953

Diagnosis Medium-sized mesoeucrocodylian recognized by: a narrow and longer snout; presence of an elongate posteromedian depression between nasals; maxilla having a sinusoidal wave along dental margin; presence of antorbital fenestra bordered by maxilla and lachrymal; external naris terminally positioned; large jugal longitudinally curved along midline; postorbital bar unsculptured and slightly sunken; ascending process of jugal excluded from orbit by descending process of postorbital; posterolateral process of squamosal extraordinary large; suborbital fenestra enclosed; presence of a strong transverse ridge on ventral surface of pterygoid, resulting in a deep step-like structure between palatal process and main body of bone; elliptical choanae elongate and surrounded by a distinct ridge; posttemporal fenestra enclosed in occiput; exoccipital forming a pronounced transverse ridge above magnum foramen; symphysis of lower jaws long, and splenial entering symphysis anteriorly; external mandibular fenestra enclosed in adult; retroarticular process less developed; teeth compressed with serrations along anterior and posterior margins; coracoid about half length of scapula; trunk and tail covered with dermal plates; dorsal osteoderms lacking anterolateral process.

Type species *Hsisosuchus chongkingensis* Young et Chow, 1953.

***Hsisosuchus chowi* Peng et Shu, 2005**

Diagnosis A medium-sized mesoeucrocodylian recognized by a shallow longitudinal depression between nasals; a ridge along orbital margin of frontal; a faint ridge along suture between frontals; a distinct ridge along medial margin of supratemporal fossa; a median anterior process of parietal wedging between posterior processes of frontals; ventral margin of jugal distinctly waved in lateral view; postorbital with an angular anterolateral corner; extraordinarily elongated posterolateral process of squamosal extending outwards, downwards and backwards so

that lateral margin of squamosal distinctly arched medially; exoccipital not contacting its opposite on occipital condyle; a median ventral ridge of pterygoid originated from main body of pterygoid; and anteriorly positioned choanae.

In addition, splenial entering symphysis anteriorly for a relatively long distance, well-sculptured outer surface of dentary and ventral surface of splenial, extraordinarily expanded scapular blade, presence of coracoid foramen, strongly thickened and expanded head of humerus, well-developed deltopectoral crest, a developed process of radiale for ulna, six rows of ventral osteoderms of presacral, and three rows of ventral osteoderms of caudal may be unique to *H. chowi* , while these characters are uncertain in *H. dashanpuensis*.

Holotype A nearly complete skeleton including complete skull and lower jaws, most of vertebrae, some bones of girdles and limbs, and most osteoderms. ZDM 0146.

Locality and horizon Zigong Dairy Factory, Huidong, Zigong; Shangshaximiao Formation, Late Jurassic.

Order Saurischia

Suborder Theropoda

Infraorder Carnosauria

Family Megalosauridae Huxley, 1869

Genus *Szechuanosaurus* Young, 1942

Revised diagnosis Medium-sized megalosaur with body length of 4~7 m. It is characterized by skull shorter than neck; large first antorbital fenestra, orbit and infratemporal fenestra; very small second antorbital fenestra; penetrative maxillary fossa; low dentary; distinctly compressed teeth with serrated anterior and posterior margins; dental formula Pm4 + M15~17 / D15~16; 9~10 cervicals, 13 dorsals, 5 co-ossified sacrals; sacral neural spines not fused; posterior caudals with elongated prezygapophyses; low ilium; distal end of pubis with an undeveloped foot-like process; distal end of ischium expanded but lacking foot-like process; and metatarsals not fused.

Type species *Szechuanosaurus campi* Young, 1942.

***Szechuanosaurus campi* Young, 1942**

Revised diagnosis Medium-sized theropod about 5 m of body length. It is recognized by distinctly compressed teeth with serrated anterior and posterior margins; thicker premaxillary teeth trending to incisors, with symmetrical and medially bent crowns; 9 cervicals, 13 dorsals, 5 coalesced sacrals, and about 45 caudals; plate-like dorsal neural spines with a robust expanded dorsal tip; sacral neural spines not fused; narrow neural spines of anterior caudals; posterior caudals with elongate prezygapophyses; low ilium with its anterior process shorter than posterior process; distal ends of pubis with an undeveloped foot-like process; forelimb about 2/5 of length of hindlimb; femur longer than tibia; metatarsal II, III and IV not fused; metatarsal I and V reduced; and compressed claws.

Holotype Several isolated teeth. IVPP V 235, V 236, V 238 and V 239.

Locality and horizon Suburb of Guangyuan, Sichuan; Chongqing Group (Guangyuan Group), Late Jurassic.

Included material A partial skeleton including complete premaxillary and maxillary teeth, 7 associated cervicals, 8 unarticulated dorsals, 2 sacrals, several caudals, incomplete pectoral and pelvic girdles, and complete forelimbs and hindlimbs. CV 00214.

Locality and horizon Wujiaba, Zigong; lower part of Shangshaximiao Formation, Late Jurassic.

Genus *Yangchuanosaurus* Dong et al., 1978

Revised diagnosis Large-sized megalosaur 7~10 m of body length. It is characterized by large but narrow skull with its width less than 1/3 of its length; 6 pairs of big external cranial openings and 1~2 maxillary fossa in skull; parietal process developed; frontals co-ossified with parietal; supraoccipital with developed dorsal keel; straight quadrate; quadratojugal with slender and elongate dorsal process; posterior end of dentary obviously bifurcated; large external mandibular foramen; premaxillary teeth with subcircular in cross section; compressed maxillary and dentary teeth with serrated anterior and posterior margins; dental formula Pm4 + M13~15 / D14~16; 9~10 opisthocoelous cervicals; posterior cervical centra with ventral keel; 13~14 opisthocoelous-amphiplatyan dorsals; high and plate-like dorsal neural spines; 5 sacrals with firmly co-ossified centra and neural spines; amphicoelous caudals; anterior caudals with high and plate-like neural spines; middle and posterior caudals with elongate prezygapophyses; moderate scapular shaft; massive pelvic girdle; both shafts of pubis and ischium co-ossified; distal end of pubis with a foot-like process; distal end of ischium expanded but lacking a foot-like process; femoral shaft bent, longer than tibia; and ascending process of astragalus undeveloped.

Type species *Yangchuanosaurus hepingensis* Gao, 1992.

Yangchuanosaurus hepingensis Gao, 1992

Diagnosis Large-sized megalosaur more than 8 m of body length. It is recognized by large but narrow skull with low and elongate facial region; cranial width about 28% of its length; large triangular-shaped first antorbital fenestra with elongated ventral border; small and quadrilateral second antorbital fenestra; elliptical maxillary fossa penetrated ventrally; parietal with developed wing-like plates and posterolateral processes; small and narrow supraoccipital with a developed dorsal keel; lachrymal inclined anteroventrally and posteriorly contacting anterior process of postorbital above orbit; frontal and prefrontal excluded from orbit; long and narrow palatine; developed pterygoid; thickened dentary; mandible with large external mandibular foramen; teeth with serrated anterior and posterior margins; premaxillary teeth with subcircular in cross section; dental formula Pm4 + M13~14 / D16; 9 opisthocoelous cervicals with developed pleurocoels; posterior cervical centra with developed ventral keel; 14 short dorsals with developed ventral keel; anterior dorsals opisthocoelous and other dorsals amphiplatyan; high and plate-like dorsal neural spine about 58% of height of vertebrate in posterior dorsals; 5 sacral centra firmly co-ossified; last 4 sacral neural spines fused as a plate; caudals amphicoelous; middle and

posterior caudals with elongated prezygapophyses; scapular shaft broad; relatively deepened ilium with a ventrally curved anterior process; pubis with a small obturator foramen and short but broad foot-like process; and ischium with a expanded distal end.

Holotype A nearly complete skeleton including complete skull and lower jaws, associated 9 cervicals, 14 dorsals, 5 sacrals and 35 caudals, both scapulae and coracoids, both pelvic girdles, and left femur. ZDM 0024.

Locality and horizon Tianwan, Heping, Zigong; Shangshaximiao Formation, Late Jurassic.

Suborder Sauropodomorpha

Infraorder Sauropoda

Family Camarasauridae Cope, 1877

Subfamily Bellusaurinae Dong, 1990

Genus *Daanosaurus* Ye et al., 2005

Diagnosis As for type species *Daanosaurus zhangi* Ye et al., 2005.

***Daanosaurus zhangi* Ye et al., 2005**

Diagnosis Medium-sized sauropod recognized by spoon-shaped teeth; anterior end of frontal M-shaped in dorsal view; slightly elongated cervicals with longest centra less than twice of average length of dorsal centra; axis very short but high; opisthocoelous cervical centra with long and deep pleurocoels, but lacking ventral keels; low cervical neural arches with well developed cavities; low and longitudinally elongated cervical neural spines with straight and horizontal dorsal margins; neural spines of posterior cervicals slightly transversely expanded but not bifurcated; short cervical ribs; middle cervical ribs with a bifurcated anterior process; opisthocoelous dorsal centra with developed pleurocoels; transversely broadened and plate-like dorsal neural spines no bifurcated; Y-shaped chevrons with penetrative canals; straight femur with a well developed fourth trochanter.

Holotype An incomplete skeleton including fragmentary skull, more than 20 presacrals, some ribs, and complete right femur. ZDM 0193.

Locality and horizon Yongan, Yantan, Zigong; Shangshaximiao Formation, Late Jurassic.

Family Mamenchisauridae Young et Chao, 1972

Genus *Mamenchisaurus* Young, 1954

Diagnosis Huge derived sauropod characterized by extremely small skull with large cranial openings; well developed occipital crest; slender mandible with an external mandibular foramen and dorsally arched ventral margin; long dentition with much more teeth; primitive teeth with serrated anterior and posterior margins while serrations disappeared in derived teeth; 18~19 cervicals, 12 dorsals, 4~5 sacrals, and more than 50 caudals; opisthocoelous presacrals with cacellous structure in varied degree; bifurcated neural spines in posterior cervicals and anterior dorsals; long neck with elongated cervical centra and ribs; precoelous anterior caudals and amphiplatyan middle and posterior caudals; forked distal ends of middle and posterior chevrons;

scapula longer than femur; sternum small and subcircular-shaped; forelimb about 3/4 ~ 4/5 of length of hindlimb; and small manus and pes.

Type species *Mamenchisaurus constructus* Young, 1954.

Mamenchisaurus youngi Pi et al., 1996

Diagnosis Medium-sized mamenchisaurid about 16 m of body length. It is recognized by a very light-built skull with large external openings and a V-shaped dorsal view; external naris dorsolaterally situated in mid-skull; pear-shaped orbit and triangular antorbital; length of infratemporal fenestra equals to its height; posterior cranial roof inclined backward; quadrate extending anteroventrally; large maxilla and premaxilla forming relatively broad facial region; lachrymal, postorbital and quadratojugal slender; occipital ridge of supraoccipital well developed; long dentary with a remarkable droopy anterior end; external mandibular foramen slightly posteriorly positioned; long dentary dentition containing much more teeth; dental formula Pm4 + M18 / D23~24; spoon-shaped teeth with slender crowns; tooth crown with prominent wear facet; serrations of anterior margin more than posterior margin in unworn teeth; 18 cervicals, 12 dorsals, 5 sacrals and more than 50 caudals; opisthocoelous presacral centra with developed cellular structures but simple laminar structures; neural spines of posterior cervicals and anterior dorsals slightly bifurcated; longest cervical centrum 2.5 times of length of longest dorsal centrum; cervical centra with undeveloped pleurocoel and lacking ventral keel; extremely slender cervical ribs; middle cervical ribs with a forked anterior process; dorsal centra with a slightly developed pleurocoel; all sacral centra and first four sacral neural spines co-ossified; anterior caudals strongly precoelous and distal caudals amphiplatyan; long and broad scapula; small sternum; low and elongate ilium with developed anterior process and pubic peduncle; humerus almost 72% of femur length; ulna about 69% of humerus length; tibia about 57% of femur length; small manus and pes; only manual digit I with an ungual; manual digit formula 2-2-1?-1?-1?; pedal digit I and II with unguals; and pedal digit formula 2-3-3-2?-1?.

Holotype A nearly complete skeleton including nearly complete skull and lower jaws, 18 cervicals, 12 dorsals, 5 sacrals, 14 caudals, many ribs and chevrons, nearly complete girdles and limbs, and a piece of skin impression. ZDM 0083.

Locality and horizon Jiujingba, Xinmin, Zigong; Shangshaximiao Formation, Late Jurassic.

Mamenchisaurus hochuanensis Young et Chao, 1972

Revised diagnosis Huge mamenchisaurid about 20~22 m of body length. It is recognized by light-built skull; small and spoon-shaped teeth with well serrated anterior and posterior margins; dental formula Pm4 + M18 / D19; 19 cervicals, 12 dorsals, 4 sacrals and more than 50 caudals; presacrals opisthocoelous; neural spines of posterior cervicals and anterior dorsals slightly bifurcated; extraordinarily elongated cervicals with longest centra about 3.3 times of average length of dorsal centra; dorsal centra with well developed pleurocoels; robust dorsal ribs with broad distal end; anterior caudals precoelous and distal caudals amphiplatyan; last several

caudals fused each other with remarkably expanded neural arches; long scapula with a slender shaft and expanded proximal and distal ends; coracoid egg-shaped; small sternum oval-shaped; clavicle short; low and elongate ilium with extraordinarily developed pubic peduncle; ischium slender; bones of limbs broad and slightly compressed; humerus almost 70% of femur length; ulna about 70% of humerus length; and tibia 59% of femur length.

Holotype A very complete postcranial skeleton including 19 cervicals, 12 dorsals, 4 sacrals, 35 anterior caudals, most chevrons, and some girdles and limbs. It is housed in the museum of Chengdu University of Technology.

Locality and horizon Taihe, Hechuan, Chongqing, Shangshaximiao Formation, Late Jurassic.

Referred material An incomplete skeleton. It is housed in the Institute of Vertebrate Paleontology and Paleoantropology.

Locality and horizon Haishiwan, Yongdeng, Gansu; Hengtang Group, Late Jurassic.

Included material An associated complete skeleton including fragmentary skull, many scattered teeth, associated vertebrae, complete pectoral girdles and right forelimb, incomplete pelvic girdles, and complete right hindlimb. ZDM 0126.

Locality and horizon Yuandingyuan, Huidong, Zigong; Shangshaximiao Formation, Late Jurassic.

Genus *Omeisaurus* Young, 1939

Diagnosis Large to huge sized sauropod characterized by moderate-sized skull; robust and spoon-shaped teeth; anterior margin of tooth crown with well developed serrations while posterior margin with few or lacking serrations; 17 cervicals, 12 dorsals, 4 sacrals, and more than 50 caudals; neural spines of posterior cervicals and anterior dorsals no bifurcated; anterior caudals weak amphicoelous; first caudal rib expanded as a fan-like plate.

Type species *Omeisaurus junghsiensis* Young, 1939.

Omeisaurus fuxiensis Dong et al., 1984

Diagnosis Smaller *Omeisaurus* recognized by low and elongate skull; narrow occipital region; long and low snout; small teeth with low crowns; dental formula Pm4 + M14 / D17~19; and elongate axis without ventral keel.

Holotype Basioccipital, a part of maxilla with teeth, left dentary, and axis. CV 00267.

Locality and horizon Wujiaba, Zigong; Shangshaximiao Formation, Late Jurassic.

Genus *Zigongosaurus* Hou et al., 1976

Diagnosis As for type species *Zigongosaurus fuxiensis* Hou et al., 1976.

Zigongosaurus fuxiensis Hou et al., 1976

Diagnosis Medium-sized sauropod about 14 m of body length. It is recognized by deep skull with short snout; maxilla with a narrow horizontal branch and a laterally compressed ascending process; broad and rhombohedral occipital region; thickened dentary with an expanded

anterior end; spoon-shaped teeth with serrated anterior and posterior margins; dental formula Pm4 + M14 / D16; 17 cervicals, 12~13 dorsals and 4 sacrals; opisthocoelous presacrals with well developed pleurocoels; low cervical neural spines; neural spines of anterior cervicals and posterior dorsals slightly bifurcated; precoelous anterior caudals with fan-like ribs; long and broad scapula; oval-shaped coracoid with a penetrative coracoid foramen; oval-shaped sternum; short but deep ilium with a developed pubic peduncle; limb bones rather straight and slightly compressed; and tibia about 3/5 of femur length.

Holotype A compositive skeleton including incomplete skull. CV 02501.

Paratype A compositive skeleton. It is housed in the Zigong Salt History Museum.

Locality and horizon Wujiaba, Zigong; Shangshaximiao Formation, Late Jurassic.

Order Ornithischia

Suborder Ornithopoda

Family Fabrosauridae Galton, 1972

Genus *Gongbusaurus* Dong et al., 1983

Diagnosis As for type species *Gongbusaurus shiyii* Dong et al., 1983。

***Gongbusaurus shiyii* Dong et al., 1983**

Diagnosis Small primitive ornithopod recognized by rounded premaxillary tooth crown with symmetrically serrated anterior and posterior margins; compressed and thin enameled cheek teeth with a median ridge and 6~7 serrations on anterior and posterior margins respectively.

Holotype A complete left premaxillary tooth and a complete cheek tooth. IVPP V 9069 (field no.: Rong H6-2).

Locality and horizon Duxin, Rongxian, Zigong; Shangshaximiao Formation, Late Jurassic.

Family Hypsilophodontidae Dollo, 1882

Genus *Yandusaurus* He, 1979

Diagnosis As for type species *Yandusaurus hongheensis* He, 1979.

***Yandusaurus hongheensis* He, 1979**

Revised diagnosis Medium-sized ornithopod about 3.2 m of body length. It is recognized by triangular maxilla with a narrow but long dorsal process and a longitudinal lateral ridge; triradial jugal with a extremely ventrally arched ventral margin; broad and Buddha hand-shaped maxillary teeth with developed wear surfaces so that outer side of crowns deeper than its inner side; tooth crown with a short lateral ridge along anterior and posterior margins, but lacking median ridge; platyancoelous cervical centra with obvious ventral keels; amphiplatyan dorsals; scapula with laterally convex shaft; coracoid with an obvious anteroventral ridge; length of humerus same as that of scapula; obviously arched radius less than 2/3 of humerus length; inner distal condyle of femur much bigger than outer one.

Holotype An incomplete skeleton including right maxilla with 12 complete teeth, left jugal, left quadrate, right ectopterygoid, 5 cervical (4^{th} and 6^{th} to 9^{th}), 7^{th} and 8^{th} cervical ribs, more than ten fragmentary dorsals, 5 caudals, both scapulae and coracoids, both humeri and radia, some metacarpals and manual phalanges, proximal portion of right femur, distal portion of left femur, proximal portion of left tibia, distal portion of both fibulae, incomplete metatarsals and pedal phalanges. It is housed in the museum of Chengdu University of Technology.

Locality and horizon Hongheba, Zigong; Shangshaximiao Formation, Late Jurassic.

Suborder Stegosauria

Family Stegosauridae Marsh, 1880

Subfamily Huayangosaurinae Dong et al., 1982

Genus *Gigantspinosaurus* Ouyang, 1992

Diagnosis As for type species *Gigantspinosaurus sichuanensis* Ouyang, 1992.

***Gigantspinosaurus sichuanensis* Ouyang, 1992**

Diagnosis Medium-sized primitive stegosaur recognized by relatively large skull; mandible with an external mandibular fenestra and developed coronoid eminence; dentary with an obvious lateral ridge that connects to coronoid eminence forming an elongate ridged lamina; small and leaf-like teeth densely arranged; about 30 dentary teeth; tooth crown with obvious median and lateral ridges, cingula and wear surface; anterior and posterior margins of crown serrated with 5 bulky denticles; short but broad presacrals massive and lacking ventral keel; dorsal centra with pleurocoels; low dorsal neural arches; broadened plate-like dorsal neural spines; 4 sacrals firmly co-ossified; sacral diapophysis and rib fused to form a broad dorsal plate; 3 sacral foramen not enclosed; sacral neural spines and first caudal neural spine fused as an elongated vertical plate; high neural spines of anterior caudals lacking expanded dorsal tip; scapula and coracoid trending to fused; proximal end of scapula not expanded; acromion process of scapula undeveloped; humerus with obviously expanded proximal end and indistinct deltopectoral crest; ulna about 80% of humerus length and with a developed olecranon process; carpals co-ossified; short but robust metacarpals; manual phalangeal formula 2-3-3-2-1; ilium slightly longer than femur; postpubis and ischium slender; prepubis about 1/2 of postpubis length; straight and slightly compressed femur with reduced less and fourth trochanter; length of femur about 1.48 times of that of humerus; tibia with slightly compressed proximal end and undeveloped cnemial crest; straight and slender fibula; triangular dermal plates in neck small and thin; quadrilateral dermal plate in back thick and low; presence of a pair of large parascapular spines.

Holotype A nearly complete skeleton including a pair of complete lower jaws, associated 8 cervicals, 16 dorsals and 4 sacrals, some anterior caudals, some girdles and limbs, some dermal plates, 4 small scutes, a pair of parascapular spines, and a piece of skin impression near the right parascapular spine. ZDM 0019.

Locality and horizon Pengtang, Zhongquan, Zigong; Shangshaximiao Formation, Late

Jurassic.

Gigantspinosaurus sp.

Material A complete pelvic girdle. ZDM 0156.

Locality and horizon Chenjia, Fuquan, Zigong; Shangshaximiao Formation, Late Jurassic.

Subfamily Stegosaurinae Nopcsa, 1917
Genus *Tuojiangosaurus* Dong et al., 1977

Diagnosis As for type species *Tuojiangosaurus multispinus* Dong et al., 1977.

Tuojiangosaurus multispinus Dong et al., 1977

Diagnosis Large-sized stegosaur about 7 m of body length. It is recognized by low and elongate skull; undeveloped jugal; 2~3 pairs of supraorbitals with bulky dorsal surfaces; upper and lower dentitions densely arranged teeth that overlapped each other; 4 fused sacrals co-ossified with sacral ribs and forming a broad sacrum; sacral foramen not completely enclosed; varied morphology of dermal plates that oval-shaped in neck, elongate triangular in back, and compressed conical-shaped in sacrum and tail; femur with an indistinct fourth trochanter; length of femur about 1.57 times of that of humerus; and scapula with an indistinctly expanded distal end.

Holotype A nearly complete skeleton including incomplete skull, 10 cervicals, 14 dorsals, 4 sacrals, 33 caudals, both scapulae, incomplete coracoids and sterna, both humeri, metacarpal II or III, both ilia, both femora, both tibiae and fibulae, metatarsal II, pedal digit II, and 15 dermal plates. CV 00209.

Paratype A partial skeleton including fragmentary skull, a cervical, 3 dorsals, 4 sacrals, 1 caudal, both scapulae, and a dermal plate. CV 00210.

Locality and horizon Wujiaba, Zigong; Shangshaximiao Formation, Late Jurassic.

All the three dinosaur faunas mentioned above lived in the same region but varied environments in different ages, so as to each fauna contains different components and members. In the Early Jurassic Prosauropoda-*Lufengosaurus* Fauna the prosauropods and primitive sauropods co-existed. cf. *Lufengosaurus magnus* is a typical prosauropod member. The primitive sauropods represented by some fragments of caudal vertebrae. The footprints of *Grallators satoi* from the Maanshan Member of Gongjing show that small coelurosaurs probably were the important members of this fauna. It is a pity that at present there is no better, articulated complete individual skeleton of dinosaurs unearthed in Zigong region. It is difficult to recognize its whole components. We should pay more attention to it in the future work.

The Sauropoda-*Shunosaurus* Fauna is a special transition fauna characterized by co-existing of much more kinds of vertebrates and co-existing of primitive and derived dinosaurs. Up to now, 23 genera and 28 species of vertebrates have been identified.

The Sauropoda-*Mamenchisaurus* Fauna is the continuation and development of the *Shunosaurus* Fauna. However, the components of the vertebrate assemblages have changed. In this fauna, the sauropods are very monotonous, cetiosaurids disappeared and replaced by huge derived mamenchisaurids. The carnosaurs, ornithopods and stegosaurs became large sized and diversified.

The rich fossil dinosaurs and other vertebrates and their wide geological and horizontal distributions in Zigong region are very important to deeply and systematically study the evolution, distribution, living habits and biopsychology(biophysical?):

1. During the Early and Middle Jurassic ages, there was a world-wide transgression period on the earth. Marine water invaded into inlands. The continents were retreated and the terrestrial deposits were decreased. After the Late Triassic, terrestrial vertebrates including dinosaurs became reduced. The continental deposits and vertebrate fossils of the Late Jurassic and Middle Jurassic are very rare. There is no better vertebrate assemblage of this period discovered all over the world, especially the Middle Jurassic there is no complete dinosaur skeleton discovered except for Sichuan Basin. Amount of well preserved fossil dinosaurs and other vertebrates from the Middle Jurassic of Zigong region fill this gap and play some roles of middle ties in the evolutionary lines of vertebrates.

2. It was generally believed that sauropods directly originated from prosauropod during the Late Triassic. But some authors (Charig et al., 1965) suggested that the ancestors of sauropods should be some early thecodonts rather than prosauropods. The remains of the primitive sauropods from Zigong and other regions of Sichuan Basin evidenced that sauropods surely originated from prosauropods and evolved along a line of primitive sauropods (*Barapasaurus*, *Gongxianosaurus*, *Shunosaurus* etc.) to advanced sauropods (*Datousaurus*, *Omeisaurus*, *Mamenchisaurus* etc.).

3. It is generally considered that stegosaurs evolved from a kind of scelidosaurs during the Late Triassic or Lias Period of the Early Jurassic and Europe is the radiating center (Haffestetter, 1957; Stell, 1969). However, recent studies (ie. Serreno and Dong, 1992) show that *Scelidosaurus* is the sister-taxon of thyreophorans composed of ankylosaurs and stegosaurs and Huayangosaurus is the sister-taxon to all other stegosaurs. Lots of complete stegosaurian remains unearthed from Zigong region suggested that Sichuan basin probably is the original place and a major radiating center.

4. Sauropods were large or huge herbivore. It is commonly believed that they lacked positive defending power to their enemies, and usually lived in herbs and negatively defended their enemies by their huge bodies. The bony tail clubs of sauropods found in *Shunosaurus*, *Omeisaurus* and *Mamenchisaurus* from Zigong region show that sauropods usually equipped with strong weapons for defending their enemies and struggling for their females in mating seasons.

In addition, the discovery of bony tail clubs and the other skeletal characteristics prove that sauropods lived on land rather than in water.

5. The skeletons of *Mamenchisaurus* found earlier lacked cranial material. So this famous

sauropod was mounted a low, flat diplodocid-like skull with rod-like teeth. A complete articulated skeleton with a beautifully preserved skull of *M. youngi* from the Late Jurassic of Xinmin, Zigong shows that *Mamenchisaurus* should have a narrow, deep and light-built skull with large cranial openings and densely arranged spoon-shaped teeth. According to this, the authors suggested that like *Mamenchisaurus*, the long necked *Omeisaurus* also should have a small light-built skull rather than a heavy built one of an earlier suggestion.

6. The dinosaurian skin was soft tissue and hard to preserved as fossil. Its impression would accasionally preserved under a special condition. So skin impressions very rare. To date there are only several samples of dinosaurian skin impressions found in the world. The skin impression of *Gigantspinosaurus sichuanensis* from the Late Jurassic of Zhongquan, Zigong was the first sample of stegosaurian skin impression in the world. The skin impression of *Mamenchisaurus youngi* from the Late Jurassic of Xinmin, Zigong was the first sample of sauropod skin impression found in China and one of few samples of sauropod skin impressions in the world. These dinosaurian skin impressions show that the bodies of stegosaurs and sauropods covered with small, polygonal scales rather than smooth surface.

7. It was generally suggested that a pair of special comma-shaped spines were appended on the ilia of the sacrum and named as “parasacral spines”. However, both spines of *Gigantspinosaurus sichuanensis* from Zhongquan, Zigong were articulately preserved on the shoulders. It was proved that this kind of spines is parascapular spines appended on the scapulae rather than parasacral spines appended on the ilia. They mainly protected the naked belly.

8. Twenty or more years ago, it was generally considered that labyrinthodont amphibians disappeared before the end of the Late Triassic and do not survived to the Jurassic. The discovery of *Sinobrachyops placenticephalus* in the early of the eighties last century from the Middle Jurassic of Dashanpu, Zigong evidenced first time that labyrinthodont amphibians survived to the Middle Jurassic. After that, a series of discovery from Xinjiang, China and Queensland, Australia further evidenced that labyrinthodont amphibians survived to the Late Jurassic, and probably to the Early Cretaceous.