THE FOSSIL RECORD OF MESOZOIC MAMMALS IN CHINA

by

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I. FOREWORD

Heretofore, although paleontologists have all bestowed considerable prominence upon Mesozoic mammalian fossils, as two thirds of the evolutionary history of mammals occurred during the Mesozoic, this aspect of research has nevertheless progressed at an extremely lymphatic rate from its inception at the time of Cuvier through to the present century. Mesozoic mammal research outside of China, in the past twenty to thirty years, has enjoyed more rapid development due to advancements in the collection and preparation techniques of small vertebrate fossils. Although China has lacked endemic scholars specializing in the study of Mesozoic mammal fossils, a rather substantial number of specimens has been discovered over the past half century. The geographic distribution of these fossils is extensive, as they are produced from Liaoning Province in the northeast, Xinjiang Autonomous Region in the northwest, and provinces such as Yunnan and Sichuan in the southwest. The fossils are also produced from all three Mesozoic periods of the Triassic, Jurassic, and Cretaceous. Presently, although the quantity and diversity of Mesozoic mammal fossils are few, they are, in fact, absolutely essential toward research upon mammalian origins, evolution, and taxonomy. As China's geographic and geologic conditions are exceptional, and Mesozoic mammals are abundantly housed, future endemic research should be strongly advocated.

II. A SYNOPSIS OF CHINESE MESOZOIC MAMMAL RESEARCH

Birger Bohlin (1953), while classifying the large quantity of fossil vertebrates accumulated by the Sino Swedish expeditions in Mongolia and Gansu Province fifty years ago, reported a small Mesozoic specimen as possibly belonging to the mammalia. If this observation is accurate, it would constitute the first record of Mesozoic mammals in China. The fossil, discovered in 1930-31, was recorded by Bohlin to have come from Tsondolien Khuduk, approximately 500 km from the Ordos bend of the Yellow River, which at that time was in the northern section of Gansu Province, but is currently in the Ningxia Autonomous Region. The specimen was collected from brick-red Late Cretaceous depoits and associated with dinosaurs. The specimen consists of an axis that is morphologically very similar to that of the mammalia, exhibiting a large odontoid process and an extremely expansive posterior articular surface to facilitate the corresponding atlas. The length of the axis is approximately 20.5 mm and its breadth is approximately 16.5 mm. As the currently known Mesozoic mammals are all small, and these measurements are clearly too large, this fossil should be referred to as questionably Mammalia. During the period of the Sino-Japanese war, H. Yabe and T. Shikama (1938) described the symetrodont *Manchurodon simplicidens*. The fossil locality is at the Zhadzyao Coal Mine, 3.6 km east of Wujian (then named Wafangdian) in southern Liaoning Province. The lithology of the locality is the Fuxin Coal Fields. The fossil material consists of the central portion of a damaged right mandible and a scapula fragment that may possibly belong to the same individual. The length of the preserved mandible is 29.5 mm and maintains the complete post canine dentition of eight teeth, represented by three premolars and five molars. A diastema is present. As the total number of teeth is unclear, the dental formula is considered I:?, C:?, P:3, M:5. The lower molars are unicusped with the protoconid comparatively high and situated labially. A cingulum exists posterior to the metacone, and a talonid basin is absent. The premolar cusps are more acute than those of the molars, but molar cusps are higher. The dentary is relatively high. The initial authors considered it to resemble *Amphidon* and recognized its age to be Middle Jurassic.

Shikama, in 1947, documented the fossil eutherian *Endotherium niinomi* that represented a new family of Therictoidea (Gregory, 1910). The fossil locality is the Xinqiu Coal Mine, 10km north of the city of Fuxin in Lioaning Province, where the lithology is represented by Late Jurassic coal seams. The specimens consist of one edentulous anterior left mandible with a distinct dental trough preeserved in a piece of coal together with a lacertid reptile; three teeth preserved in a right mandible that lacks the anterior and posterior extremities; and fragments of scapula and humerus.

The preserved length of the right mandible is 6 mm and its height is 3 mm with straight dorsal and ventral margins that suggest a relative mandibular weakness compared to the teeth. The three teeth gradually decrease in size anteriorly to posteriorly and are tribosphenic. Both the trigonid and talonid are completely well developed with the latter maintaining all three cusps and being transversely broadened, however it is not absolutely clear whether there is a distinct division between two of the cusps. The trigonid is comparatively high and the talonid is expansive. The m1 talonid is oblique with a 50° dip toward the dental trough, and the m3 talonid is comparatively smaller. The parastyle is well developed as preserved on the m2. The initial author considered it to be very close to *Zalambdalestes*.

During the period of the Sino-Japanese war 1938, Chinese paleontologists Meinian Bian and C.C. Young discovered a well preserved fossil skull of *Bienotherium* in Lufeng County of Yunnan Province that aroused the attention of global paleontologists due to the general consensus that the Tritylodontia were mammals. The Tritylodontia have henceforth been reassigned to the reptillia because *Bienotherium* was discovered to preserve reptillian characters in the mandibular region (accessory mandibular elements).

C.C. Young, in 1939, discovered *Kunminia minima* (Young, 1947) in the Lufeng Group's Deep Red System around the vicinity of Huangjiatian. The material consists of a relatively complete skull with an articulated mandible. The diagnostic characters are: individual small, rostral region comparatively broad, post orbital absent, orbit and temporal fenestra large, and the possible existence of a post frontal and septomaxilla. The frontal is small, lacrimal large, and cranium relatively large. The mandible is low and straight without a clearly expressed ascending ramus. The angular and articular are present, the anterior dentition consists of solitary conical teeth, but the posterior dentition expresses paired roots and multiple cusps with the dental formula as I:?, C:1, Pc:10. The original author considered it to be a member of the Ictidosauria.

Subsequently, the president of Catholic University (H.W. Rigney), in 1948, dispatched an envoy to Lufeng to accumulate a large collection of fossils. Many important specimens from this collection were smuggled out of China even though this individual was detained by the Government after the establishment of the People's Republic. *Sinoconodon rigneyi* (Patterson & Olson, 1961) was among these specimens. The *Sinoconodon* material consists of a skull, mandible, and several limb bones. The fossil localities are Dadi and Heiguopeng, and lie stratigraphically at the top of the Dark Purple System. The diagnostic characters are: a primitive triconodont with a dental formula of I:3, C:1,Pc:4 / i:3, c:1, pc4. The diastema between the canine and molars is extensive, the canine has a general hooked configuration, the molars are triconodont, arranged rectilineally, and lack either internal or external cingula. The primary central cusp is the largest and highest, the anterior cusp is the most acute on the crown, and a cingulum is absent. The posterior cusp is not significantly separated from the central cusp. A small posterior cuspule is situated lingually to a small anterior cuspule on the succeeding molar creating an interconnecting system of shearing grooves. The posterior palatal fenestra is large. The dorsal and ventral margins of the mandible are nearly straight and there exists a trough of the dentary as well as a pseudangular process. The original worker considered it to belong to the Triconodonta.

H.W. Rigney himself, in 1963, described a relatively well preserved cranium of *Morganucodon oehleri* which, at that time, constituted the best specimen of a skull of a pre Late Cretaceous Mesozoic mammal. Kermack et al. (1973,1981) conducted a detailed examination of this specimen and provided a new genus diagnosis: individual relatively large with a dental formula of P:4, M:3, p:3, m:4. The upper molars differ from *Morganucodon watsoni* and lower molars display distinctive labial cingula. The locality is north of Lufeng at Yangcaodi where the stratigraphic interval represents the lower Lufeng Group's first fossil horizon. The original author considered the time period as Early Jurassic.

In 1972, Guihai Cui and Zuyin Yuan collected small vertebrate skulls which C.C. Young identified as belonging to a third new genus of primitive mammal. These fossils were all produced from the Dark Red System. The *Eozostrodon heiguopengensis* (Young, 1978) specimens consist of two skulls. The Changjiawa specimen is a relatively good skull with an articulated mandible in occlusion. The Huiguopeng specimen is also a skull and mandible but displays a damaged anterior and posterior portion. The general diagnosis of this genus is identical to *Morganucodon oehleri* with the diagnostic characters of five instead of four premolars, the most posterior upper incisor and canine extremely close together, and the first molar, as opposed to the second molar, as highest.

Sinoconodon parringtoni (Young, 1982) was discovered at Zhangjiawa. The specimen consists of a mandible and skull lacking the occipital region. The diagnostic characters are basically similar to *Morganucodon oehleri*; however, the skull is proportionately higher, the rostrum relatively more robust and short, and the canine larger.

Lufengoconodon changchiawaensis (Young, 1982) consists of a skull, mandible, and anterior limb. Its locality is Zhangjiawa with the diagnostic characters as follows: Skull low and flat, rostrum slightly oblique, ventral margin of the mandible straight and level, temporal region broad, temporal line and saggital crest well developed, orbit relatively unenclosed, and dental formula as preserved by the alveolae as I:4, C:1, P:4, M:3, i:4, c:1, p:4, m:3.

In 1978, the residents of Shilong Village, from Gangchang Commune of Nanjiang County in Sichuan Province, discovered several vertebrate fossils which were donated to the Zhongqing (Chungking) Natural History Museum. A mandible fragment of a primitive mammal was among the specimens subsequently studied by Minchen Chow and T.H. Rich, and designated *Shuotherium dongi* (Chow & Rich, 1982), representing a new order of mammals. The specimen consists of a left mandible clearly exhibiting the trough of the dentary with an approximate length of 1.2 cm. The anterior mandible is lacking, and the posterior portion, of which relatively more is missing, lacks the articular process, coronoid process, and reflective angle. There are seven teeth in the mandible consisting of three premolars and four molars. The diagnostic characters are: Trigonid and talonid of the lower molars well developed, but with the talonid situated anterior to the trigonid. The prevallid maintains a distinctive wear facet, and a trough of the dentary is present. Its stratigraphic position lies in the midsection of the upper Shaximiao Formation within the Zhongqing (Chunking) Group. The time period represents either the early Late Jurassic or the late Middle Jurassic.

Xijin Zhao, in 1980, discovered two Mesozoic mammal specimens in the Kelamaili (Karamay) region of the eastern Junggar Basin in Xinjiang Province. Among the two is a mammal designated *Klamelia zhaopengi* by Minchen Chow and T.H.V. Rich (1984). The locality is Jianshan Wash, lying stratigraphically in the basal section of the Shishugou Group, and considered to be early Late Jurassic or late Middle Jurassic. The specimen consists of a damaged mandible with only the central section preserved and containing the last premolar and four molars, as well as vestiges of tooth roots situated anterior and posterior to the teeth. The specimen is large with a mandible comparatively higher than those mentioned previously, and there is a comparatively short section of jaw anterior to the molars. The labial aspect of the mandible displays three mental foramena with the anterior and posterior cavities large and the central one small. The mandible's lingual aspect displays a Meckelian groove. The posterior margin of the symphysis is situated between the second and third molars. There are at least six molars which constitutes the highest count among the morganucodontids. The occlusal surfaces are paralellograms, analogous to the occlusal wear facets of the Sinoconodontidae, in which the occlusal function is laterally directed, as opposed to dorso ventally directed. The lower premolars lack an anterior cusp and a fully developed lingual and labial cingulum lacking accessory conules exists on the lower molars, being very similar to the Swiss Hallau LXIV specimens.

There is an additional fossil mammal mandible that has been subjected to severe weathering obliterating the cusps, although the teeth are preserved. Currently, it has yet to be studied. The locality is outside the western boundary of Huangnitian, lying stratigraphically in the lower section of the Early Cretaceous Tugulu Group. The author of this paper has collected several Triconodont skulls and postcrania from the Deep Red System at Lufeng, among which is a sinoconodontid skull representing the new species *Sinoconodon youngi* (Zhang, 1983). The diagnostic characters include the presence of four incisors, which is one incisor more than the type species *S. rigneyi*. One additional small jaw exists from Fuxin, Liaoning, that has currently not been studied.

III. Taxonomy of Chinese Mesozoic mammals

The entire Class Mammalia may be subdivided into the two major groups of the Theria and atheria. The atheria include the Eotheria, Allotheria, and Prototheria. The Prototheria contains the single order Monotremata that is distributed solely in Australia and fossils of which are found only in Cenozoic deposits. The Allotheria also contains the single order, the Multituberculata, which has yet to be discovered in the Mesozoic of China, although they have been found in relative abundance in the Tertiary of Inner Mongolia. Predictably, these animals will be discovered in the future, as a relatively plentiful collection of Multituberculates was made in the 1920s from the Mesozoic of Outer Mongolia. The Eotheria encompasses the two orders Triconodonta and Docodonta, the latter of which has yet to be found in China. The Triconodonta is composed of the three families Morganucodontidae, Triconodontidae, and Amphilestidae. The latter two are not yet represented in China, but morganucodontid specimens are abundant. Both *Eozostrodon* and *Morganucodon* have been recognized in China and numerous publications have addressed the problem of synonymy. But regardless of whether or not these two genra are synonomous, a large quantity of the English species exhibit a wide range of morphological variation, most probably do not represent a single species, and may even suggest generic status. Due to the extreme fragmentary nature of the English specimens, a precise method for taxonomic analysis is lacking. It may, perhaps, be advantageous if the comparatively better African and Chinese morganucodontid material were used as a foundation to facilitate the diagnosis.

Klamelia is relatively advanced morphologically and its age is relatively young. The original authors have considered it a new genus as it is a relatively large individual with a high mandible that maintains a shortened anterior section of the dentary, with a symphisis that extends posterior to the level of the third molar. The flattened rhombohedric dentition suggests an occlusal function utilizing lateral power strokes.

The original workers of *Sinoconodon* considered it to belong to the Triconodontidae. In 1969, Crompton et al. reassigned it to the Morganucodontidae, and again, in 1971, it was elevated to the family level by Mills. In 1983 the author of this text eliminated it from the Mammalia and reassigned it to the Reptillia based on its retention of auxilliary mandibular bones. This work has currently endured peer review.

The taxonomic position of the genus *Lufengoconodon* is not precisely clear. Text illustrations suggest the morphology of the skull and mandible to be similar to the Sinoconodontidae as it displays the diagnostic character of a relatively long diastema (posterior to the canine). However, the dental formula of I:4, C:1, P:4, M:3 is closer to the Morganucodontidae than the Sinoconodontidae. Perhaps this may be explained as being characteristic of juvenile sinoconodontids. Because the dentition, and particularly the cusps and cingula, have yet to be suitably described, it is currently difficult to provide *Lufengoconodon* with an accurate taxonomic assignment.

The Theria encompasses the Symetrodonta, Eutheria, Pantotheria, and Metatheria. Among this group are the Eutheria and Metatheria that have yet to be been found in the Mesozoic of China. The Metatheria have also never been reported from Asia or Africa, and enjoy a geographic

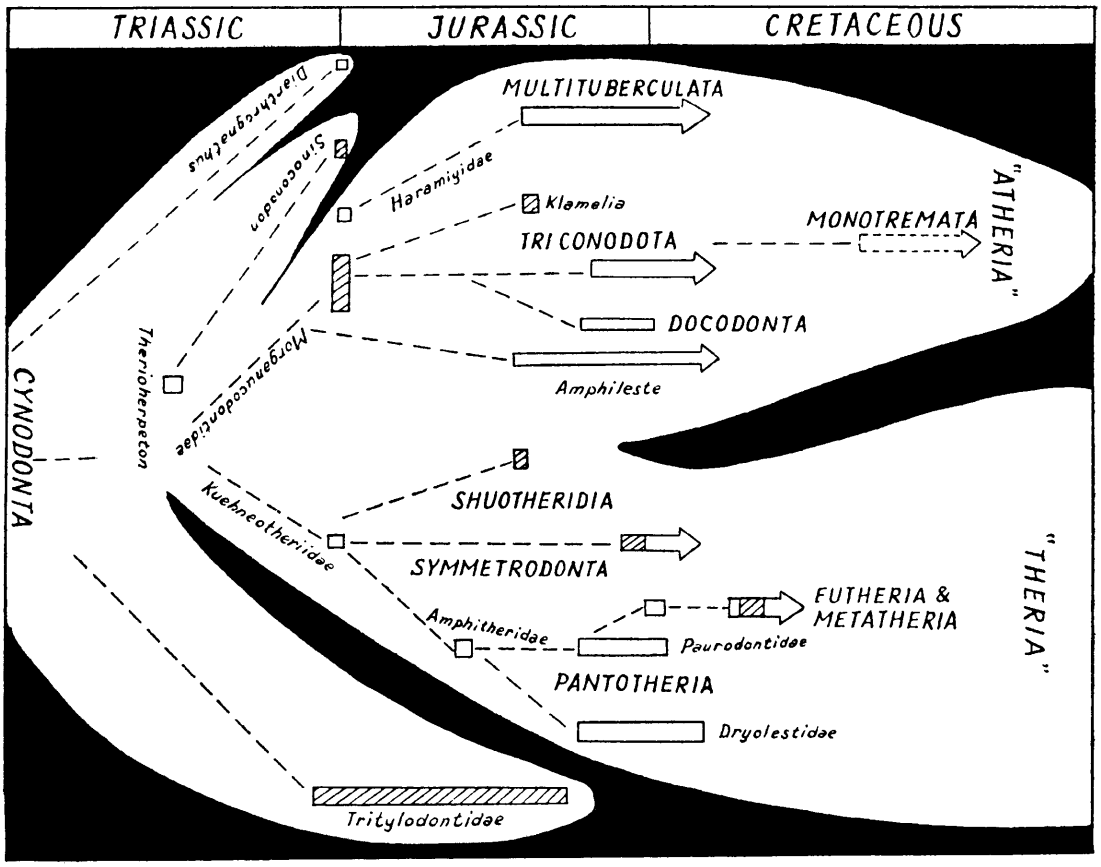

Figure 1. Evolutionary relationships between early Mammalia (Revised from Crompton and Jenkins 1979. Hatched blocks indicate Chinese Mesozoic mammals.)

distribution restricted almost exclusively to Australia and the American continents. Most probably it would be futile to expect the discovery of metatherian fossils in China. The Pantotheria hold an important and fundamental evolutionary position and should be diligently pursued. The Symetrodonta in China is represented by *Manchurodon*. The original authors assigned it to a systematic position lying between *Amphidon* and *Spalacotherium* as the anterior and posterior cusps of the former are small, and those of the latter are large. All the posterior cusps of *Manchurodon* being large allow it to be placed in the newly erected family, the Amphidontidae. Teilhard de Chardin, in 1942, reconsidered the uncertain taxonomic position of *Manchurodon* and reassigned it to the Allotheria. Patterson, in 1956, recalculated the dental formula as I:?, C:?, P:1, 4, m:4 based on the size of the premolars and molars which suggested the presence of four instead of three premolars. Thereupon the dental formula became consistent with the Amphidontidae and it was possible to assign it to this position.

Kunminia holds an appropriate taxonomic position in these discussions. The specimen appears to be relatively good, although its sutures are unclear and obscure the morphology of each of the cranial elementrs and their structural relationships, to the point of creating an uncertainty about whether such elements such as the postfrontal actually is present. This author believes that an ascending ramus is present although the original author believed that there was no evidence to support the existence of one, and believed the teeth at the anterior region were not under the influence of an ascending ramus condyle. There is a large break on the mandible, posterior to which the bone has been shifted. The height of this portion of the mandible clearly indicates the

existence of a coronoid process that lacks only its apex. The original author considered the posterior portion of the left mandible complete and associated with an angular, surangular, and articular. This author believes that the posterior portion of the mandible may actually be either the jugal or another associated bone of that region. Because there is a vacuity that is too wide, the original author considered the cavity lying between the surangular and angular to be unnatural. The retention of a surangular and angular on the dentary is not a diagnostic character for mammals, which display at the posterior section of the mandible and ascending process that is projected upward from the anterior section of the surangular, and is, moreover, generally expanded. In this manner, *Kunminia's* advanced mandible and derived skull in the high degree of a mammal leaves the problem in a state of compromise. *Kunminia* is similar to other taxa produced from Lufeng that are represented by skulls. The closest resemblance is to *Morganucodon*, but it differs from this taxon by maintaining a greater dental count of six single cusped, post canine teeth. The observation of well distinguished cusps on the right posterior dentition also distinguishes it from *Diarthrognathus*. Applying *Kunminia's* high degree of dental enumeration as a diagnostic character relates it to *Kuhneotherium*, both of which are produced from the same time period. Whether or not it is possible to assign *Kunminia* to the mammalia must await a further well prepared specimens in order to describe the dentition in detail, which will determine whether its tooth cusps are arranged in a tribosphenic fashion.

Among the therian Mesozoic mammal fossils of China is *Endotherium*, which Shikama (1947) originally considered to be a new family in the order Therictoidea. Obviously, it differs from the Symetrodonta and Pantotheria based on the well developed trigonid and talonid of the molars, and relates more closely to the Theria and Metatheria. It is particularly close to *Zalamdalestes* in the breadth and length of the talonid and trigonid, but displays some distinctions as well, such as the relatively large third cusp on the talonid, and the reduced lower third molar. Chow (1953) also recognized the similarity to *Zalamdalestes*, while Patterson (1956) expressed the possibility of the molar count existing as 4 and not 3, thereupon placing the taxonomic position of *Endotherium* into an uncertain infraclass, and finally Kielan-Jaworowska (1979) considered *Endotherium* to be a therian, but in a taxonomic position of uncertain affinities.

Shuotherium is an extremely autapomorphic form. The initial authors assigned it to an independent order: the Shuotheridae, representing a unique form within the animal kingdom, delegated as Legion Yinotheria, and regarded it as differing from all other taxa (Symetrodonta, Pantotheria, Metatheria, and Eutheria). The trigonid and talonid of *Shuotherium* are relatively derived and nearly equivalent to the Theria, except the talonid basin lies anterior to the trigonid. This unique character is diametrically opposed to the general therian condition as well as that of *Khuneotherium.* The *Shuotherium* mandible contains a trough of the dentary, and accessory mandibular elements are present, but not as in the general therian condition where the accessory elements are separated from the mandible to develop into the small auditory ossicles within the inner ear. Apparently, the structure of the *Shuotherium* middle ear is primitive and not developed to the general level of the Theria. In this manner, *Shuotherium* is similar to *Khuneotherium* but relatively distant from the general mammalian condition.

IV. CHRONOLOGY OF CHINESE MESOZOIC MAMMALS

As it produces among the earliest primitive mammals, Lufeng is one of the world's rare fossil localities that facilitates the study of the origin of mammals. Currently, a consenses has not been reached regarding the age of the Lufeng System, although many fossil vertebrates have been produced there. Meinian Bian initially considered the entire Lufeng Sequence to belong to the Triassic. C.C. Young, in 1951, elevated the Upper Lufeng Sequence to the Jurassic, but still maintained the Lower Lufeng Sequence in the Late Triassic. However, since the 1950s an increasing number of geologists and paleontologists have come to consider the Lower Lufeng sequence as Early Jurassic, and some even believe this sequence to be Middle Jurassic. C.C. Young, representing the main vertebrate paleontological worker, believed that the Lower Lufeng

system was, without a doubt, Late Triassic, based on a large quantity of vertebrate taxa. Recently, however, there have been other vertebrate paleontologists (Gueihai Cui, 1976; K.A. Kermack et al., 1973) who believe the Lower Lufeng belongs to the Early Jurassic. Currently, there is a dilemma regarding a consensus between the ideas of geologists and paleontologists. A method of compromise would be to consider the age of the Lower Lufeng system as Late Triassic to Early Jurassic. Several primitive mammal's stratigraphic positions are noted to be from the Lower Lufeng, but stratigraphic positions and locality descriptions from non Chinese may be in error, as there exist ambiguities within certain authors' literature. All the mammals are produced from the Zhangjiawa, Dahungtian, Dadi, and Heiguopeng horizon with the exception of *Morganucodon*. This sequence constitutes the Deep Red Horizon. It is possible that the stratigraphic position of *Morganucodon oehleri* is lower and is produced from the first, or lowest, fossil horizon. The locality is stated as being Yangcaodi; however, inquiries to the local populace by this author found the region to be unknown.

Shuotherium was discovered in Sichuan from the formation that produces the *Mamenchisaurus* Fauna. More specifically, from the midsection of the upper Shaximiao Formation in the Zhongqing (Chungking) Group. The upper Shaximiao Formation is generally considered to be Upper Jurassic in age, or possibly correlative to North America's Morrison Fm. and Western Europe's Tithonian Stage. Although there are several workers who have considered the upper Shaximiao to be late Middle Jurassic, currently it is regarded as early Late Jurassic.

Klamelia, produced from the Junggar Basin of Xinjiang in the lower section of the Shishugou Group is either early Late Jurassic or late Middle Jurassic, and is the latest fossil record of the Morganucodontidae.

Manchurodon, produced from the Tuchengzi Formation of southern Liaoning Province, was established by the original worker to be Middle Jurassic. Teilhard (1942), Chow (1953), and Patterson (1956) all believed the age should be assigned to the Early Cretaceous. After the establishment of the People's Republic, it was generally considered that the age of the Fuxin Coal System was Late Jurassic. Therefore, *Manchurodon* should also be Late Jurassic, which would make its age consistent with that of *Amphidon*. Based upon the 1979 material of colleague Guang Pan, it is appropriate that the age be assigned to the Late Jurassic. *Endotherium*, produced from the coal measures of the Fuxin Coal System in the Fuxin region, was considered by the original authors to be Late Jurassic. Chow (1953) remarked on the close similarity between *Endotherium* and *Zalamdalestes*, and suggested that the age difference between the two should not be extensive and that it would be suitable to recognize the age as Early Cretaceous. Patterson (1956) also believed the age of *Endotherium* to be Early Cretaceous. Fox (1972) considered the age of *Endotherium* to be even younger. Based on data from the Second Chinese National Stratigraphic Conference (1979), the Fuxin Formation is Early Cretaceous, and therefore the age of *Endotherium* should also be recognized as such.

Chinese Mesozoic mammal localities' stratigraphic positions may be summarily arranged as follows: The Lower Lufeng System (Late Triassic to Early Jurassic) produces *Morganucodon*, *Kunminia*, and *Sinoconodon*, the latter two holding uncertain taxonomic positions. The Jurassic period is represented by the Chungking Group's Shaximiao Formation (early Late Jurassic) that produces *Shuotherium.* Equivalent time periods are also represented in Xinjiang by the basal section of the Shishugou Group, which produces *Klamelia*, and at Liaoning by the Tuchengzi Formation, which produces *Manchurodon*. The Cretaceous is represented by the northeastern Fuxin Formation, which produces *Endotherium*. The equivalent time period is also represented in Xinjiang by the basal section of the Tugulu Group (Early Cretaceous) which has produced a specimen as yet unstudied. If the axis described by Bohlin is indeed mammalian, then a mammalian fossil from the Late Cretaceous horizon is also represented in China.

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Table 1. A list of Mesozoic mammals of China.

Taxon	Locality	Age	Specimen	Characters	Classification
Manchurodon simplicidens Yabe and Shikama 1938	Liaoning	Late Jurassic	Midportion of right mandible and fragmentary scapula.	I:?, C:?, P:4, M:4. Lower molar functionally unicusped with basal cingulum and an accessory cuspule on posterior cutting edge.	Amphiodontidae
Endotherium niinomi Shikama 1947	Liaoning	Early Cretaceous	Anterior half of mandible, midportion of right mandible with three molars, fragmentary humerus and scapula.	Well developed trigonid and talonid, talonid broad and with three cusps, parastyle developed.	Eutheria
Sinoconodon rigneyi Patterson and Olson 1961	Lufeng	Rhaeto-Liassic	Four complete skulls, five incomplete mandibles, and fragmentary humerus.	I:3, C:1, Pc:4. Diastema long, three cusps of "molar" in line, cingulum absent, interlocking mechanism between adjacent teeth of an inner and outer form.	Cynodontidae?
Sinoconodon parringtoni Young 1982	Lufeng	Rhaeto-Liassic	Skull and mandible	Skull high, snout short and stout, canine large.	Cynodontidae?
Sinoconodon youngi Zhang 1983	Lufeng	Rhaeto-Liassic	Skull and mandible	Four incisors	Cynodontidae?
Morganucodon oehleri Rigney 1963	Lufeng	Rhaeto-Liassic	Skull and mandible	P:4, M:3, p:4, m:4. Lower molar bearing cingulum on labial side	Morganucodontidae
Rostrodon heikuopengensis Young 1978	Lufeng	Rhaeto-Liassic	Two skulls and mandibles	P:5. Last incisor and canine close, M1 is largest in series.	Morganucodontidae
Lufengoconodon changchiawaensis Young 1982	Lufeng	Rhaeto-Liassic	A skull with lower jaw, forelimb elements	I:4, C:1, P:4, M:3. Diastema present. Interparietal region low and wide, sagittal crest and lateral crest of parietal strong. Lower border of lower jaw straight.	?Sinoconodontidae

Table 1 cont.

Kunminia minima Young, 1947	Lufeng	Rhaeto-Liassic	Skull and mandible	I:?, C:1, Pc:10. Anterior cheek teeth single rooted and unicusped, posterior cheek teeth double rooted and multiple denticles	?Kheuneotheria
Shuotherium dongi Chow and Rich 1982	Sichuan	Late Jurassic	Mandible midportion with seven cheek teeth.	Trigonid and talonid developed, but the talonid lies anterior to trigonid, retention of medial flange of mandible, a wear facet on prevallid.	"Theria"
Klamelia zhaopengi Chow and Rich	Xinjiang	Late Jurassic	Midportion of mandible with five cheek teeth	Lower jaw large and high, shortened before molars, symphysis ends behind m2, large mental foramen, interlocking mechanism between adjacent molars is of the inner-outer form	Morganucodontidae
unnamed mammal	Xinjiang	Early Cretaceous	Mandible with badly weathered teeth.		
unnamed mammal	Liaoning	Early Cretaceous	Mandible		
unnamed mammal Bohlin 1953	Ningxia	Late Cretaceous	Axis	Odontoid process very large, first articulation in cervical region within atlas only.	Mammalia?