EARLY MIOCENE MAMMALIAN FOSSILS OF THE XINING BASIN, QINGHAI PROVINCE

By

Chuankuei Li and Zhuding Qiu

Vertebrata PalAsiatica
Vol. XVIII, No. 3,
pp. 198 209.
July 1980

Translated by
Will Downs
Bilby Research Center
Northern Arizona University
March, 1986

Abstract

Lithologies containing Early Miocene mammalian fossils have to date been completely absent in China. This text documents the discovery of an Early Miocene mammal fauna that consists predominantly of small mammals collected in 1978 in Huangzhong Co., Qinghai Province. Recorded are 10 genera and 14 species (8 new species). The age of the fauna is generally equivalent to the Aquitanian-Burdigalian stage.

Introduction

In the fall of 1978, Tujie Wang, the authors of this text and other colleagues were led by members of the Qinghai Provincial Petroleum Office to a locality (IVPP #78027) approximately one kilometer north of Tianjiazhai Commune at Xiejia Village in Huangzhong Co., where a collection of predominantly fossil micro-mammals was made consisting of 10 genera and 14 species. This text erects the nomenclature Xiejia Fauna to these specimens produced from the Xiejia Fm, which was recently named by the Qinghai Petroleum Survey. The locality is illustrated in Figure 8, where the Xiejia fauna was discovered associated with other fragmentary bone contained in a gray-green mudstone lens equivalent to unit 39 of the petroleum survey's Dongtougou cross-section.

Description of specimens

Order Lagomorpha Brandt, 1885
Family Ochotonidae Thomas 1897
Sinolagomys pachygnathus sp. nov.

(Plate 1, Fig. 1; Text figures 1, 2)

Type: One anterior right mandible with p/3-p/4 (V5985).

Hypodigm: One right p/4 m/1, two damaged mandibles, five upper third premolars, nine isolated upper molars, five isolated lower molars, and incisors (V5986).

Diagnosis: Resembles *Sinolagomys kansuensis*; mandible clearly swollen at the anterior premolar aspect; molars relatively hypsodont; P3/ anteroloph clearly developed and elongated with an anterolingual reentrant; p/3 with a deep labial fold; labial wall of trigonid sharp and posterior wall displays a wide "V" configuration at the midsection of the lower molars.

Description: On specimen V5986 the ventral border of the mandible is slightly bowed with the highest degree of curvature beneath the lower first molar. The height of the mandible is 6.1 mm. A foramen is situated at the midpoint of the diastema. The mandible at the labial p/3 p/4 is clearly swollen, and the molars are relatively hypsodont.

The P3/ has two asymmetrical reentrants in the crescentic valley between the anteroloph and metaloph. The anterior reentrant is relatively longer and extends to the anterolabial margin but is not completely enclosed. The hypoflexid is distinct, the anteroloph is well developed, and there is an anterolingual reentrant on the occlusal surface. As the premolars grade into molars, they become longer with the cementum filled external hypoflexid becoming bifoliate. The enamel surface on the anterior border of the trigonid is relatively thicker.

The lower third premolar is nearly square with a cementum filled hypoflexid between the trigonid and talonid that deepens to splitting the tooth in half. The anterior flexid is extremely shallow, the enamel is thicker on the posterior trigonid and on the anterolabial talonid. The

morphology of the lower fourth premolar to the lower second molar is similar, with the trigonids longer and the talonids shorter and thicker. The trigonid is round and blunt lingually, while labially it is acutely angled with its degree of acuteness increasing progressively from the p/4 m/2. The anterior margin on the p/4 is flat. The enamel is relatively thicker on the posterior trigonid at the midportion of the tooth on all of the molars, and forms an expanded "V." The talonid is nearly elliptical in outline with the lingual side slightly blunt and the anterior enamel thin.

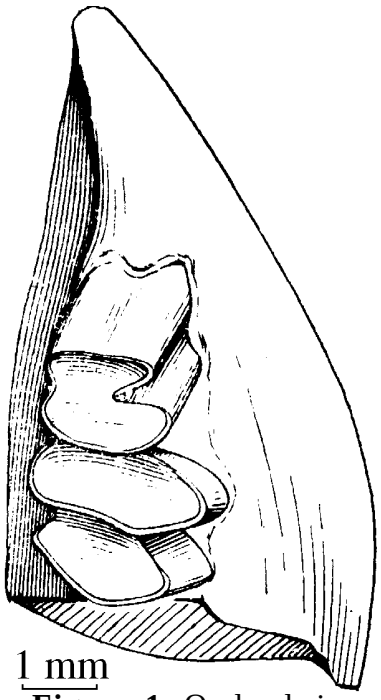

Figure 1. Occlusal view of *S pachygnathus* sp. nov. right mand p/4 (V5985, Type)

Discussion and comparison: When Bohlin (1937, 1942) studied the Oligocene ochotonids from the Danghe region of Gansu Province, the genus *Sinolagomys* was erected with three species established on the basis of tooth morphology: *S. kansuensis, S. major,* and *S. minor.* The Qinghai specimens compare closely to *S. kansuensis*, but display relatively clearly advanced characters, such as increased hypsodonty, and the anteroloph on the P3/ developed longer with the presence of an anterior lingual reentrant fold. The lower p/3 labial flexa is deep and the posterior margin of the trigonid in the center of the molars have developed into a wide "V". All of these characters are clearly advanced compared to the species *S. kansuensis*. These advanced characters are significant for *Sinolagomys kansuensis*, and are exhibited even more clearly in *Bellatona forsythmajori* Dawson from the Late Miocene of Inner Mongolia (Figure 2). In other words, the new Qinghai species is an intermediate form that lies morphologically between the Late Oligocene *Sinolagomys* and the Late Miocene *Bellatona forsythmajori*. This is not only temporally significant, but moreover confirms Dawson's (1961 p. 13) hypothesis that *Bellatona* probably evolved toward the derived branch of *Ochotona*, and that *Sinolagomys* is close to a branch that led to *Bellatona*..

There is one third upper premolar (V5987), the morphology of which is consistent with *Sinolagomys pachygnathus* in is possession of a derived anteroloph and anterolingual reentrant, although this specimen is larger with a length of 1.7 mm and a width of 2.7 mm.

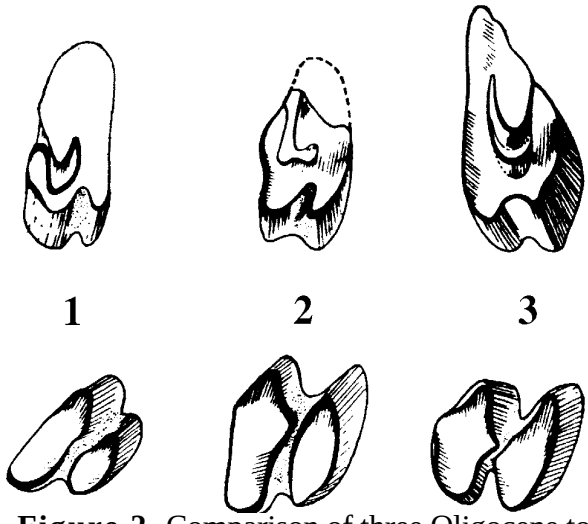

Figure 2. Comparison of three Oligocene to Miocene Ochotonids
1. *Sinolagomys kansuensis* Bohlin, upper: left P3/, sh429, lower: right m/1, sh593.
2. *Sinolagomys pachygnathus* sp. nov., upper: left P3/, V5986, lower: right m/1, V5986.
3. *bellatona forsythmajori* Dawson, upper: right P3/, AMNH26761m lower, right m/1 AMNH26770. x 3 x 6.5/10

Leporidae indet.

There is one upper and one left lower molar (V5988). The species is large with the upper molar length of 2.1 mm and width 4.8 mm. The lower molar length is 2.4 mm and width is 2.9 mm with a talonid width of 2.0 mm. The molars are very hypsodont, the upper molar is

clearly broad and flat, roots are absent, and only the basal section is reduced. It is clearly distinct from the known taxa such as *Desmatolagus* and perhaps represents a new genus of a relatively derived leporid.

Table 1. Dental measurements of *Sinolagomys pachygnathus* sp. nov. (mm).

	V5985 (Type)		V5986		
	p/3	p/4	P3/	P4/	M1/
Crown length	1.4	2.1	1.1	1.4	1.6
Trigonid breadth	1.4	2.4	1.3	1.5	1.5
Talonid breadth	1.7	1.8		1.1	1.2

Sciuridae Gray, 1821
Sciurid sp.

(Plate 1, Fig. 2)

There is one left first or second lower molar with a broken labial edge. The specimen is moderate in size, short, and rhomboid with a length of 2.12 mm and an approximate width of 2.44 m. In spite of the damaged protocone it is possible to observe an anterior cingulum and clearly separated metaloph, both of which encompass a small labial trigonid. The metaconid is large with a short ectolophid inclined lingually to form a relatively deep labial valley. A mesoconid is absent. The entoconid is distinct but not large and becomes confluent with the posterior cingulum to form a crescentic posterolingual angle. The mesostylid is lower than the hypoconid. The talonid basin is large. There is a strong anterior cingulum, but distinct autapomorphic characters are absent, such as presence of a mesoconid and a posteriorly facing external valley. This compares closely to the African ground squirrel family the Xerinae, which later appears prolifically in the Middle Tertiary of Europe as *Heteroxerus*. Tertiary sciurids in China are extremely rare, with the Pliocene data consisting only of two Taben Buluk specimens at Danghe, Kansu Province. The left m/2 (T.b. 593) is smaller than V5989, with its metaconid and hypoconid spaced relatively widely, and displaying a shallow labial valley and weak mesoconid. The relationship between the two is difficult to assess.

Cricetidae Rochebrune, 1883
***Eucricetodon youngi* sp. nov.**

(Text figure 3)

Type: Right maxilla with first and second molars, and lingual portion of third molar (V5990).

Paratype: Left maxilla with first and second molars (V5991).

Etymology: In commemoration of the first Chinese Vertebrate paleontologist, C.C. Young

Diagnosis: A small species, somewhat brachydont, broad and simple in morphology. Tooth cusps are large and lophs short. The posterosinus is extremely short and nearly lost. The protosinus is lost, ectoloph is short and entosinus is nearly transverse. The upper first molar anterocone is single and not bifid, while the upper second molar anteroloph is occasionally twined.

Description: The upper first molar maintains three roots, the labial side is projected, the anteroloph is not divided into two small conules (although this cusp is broadened transversely on

the type specimen), and a lingual protosinus is absent. The ectoloph (stylar cingulum or ectocingulum) is complete but very low, and the anterosinus and metasinus are enclosed. The labial spur of the anterolophule (protoloph I) is low and inclined toward the protocone. The four main cusps are large which shortens the distance between them and causes the transverse lophs also to be shortened. The two anterior and posterior transverse lophs (protoloph and posteroloph) are both extended posteriorly and are extremely short. The posteroloph is particularly short and stops in the center of the posterior margin of the tooth, causing the obliteration of the posterosinus. The entoloph is relatively short and twisted into an embayment. The entosinus is nearly transverse and the mesoloph is relatively short and extends to the center of the mesosinus.

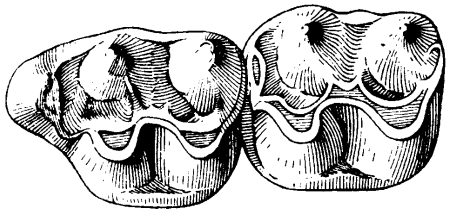

Figure 3. Occlusal view of *Eucricetodon youngi* sp. nov. left M1-2/ (V5991, paratype)

The upper second molar is nearly square. The type specimen displays an ectoloph to be distinctly separate from the mesosinus creating a confluence between the mesosinus and ectosinus. The protoloph is twinned forming a small gully between the protocone and paracone, as is commonly noted in *Eucricetodon asiaticus* and *Democricetodon*. Because the paratype is worn somewhat deeply, the entoloph appears to connect to form a single line. The anterior arm of the protoloph is very low such that an enclosed gully cannot be observed on the occlusal surface. The posterosinus on the upper second molar is extremely small.

Only a lingual portion of an upper third molar is preserved. It is clearly reduced with a large protocone approximately two thirds the length of those on the other teeth. A small hypocone is present.

Comparison: *Eucricetodon youngi* sp. nov. differs from each of the following cricetid genera:

1. *Pseudocricetodon* is much smaller with an even and straight labial wall and the cusps are inclined to be relatively more lophate with long transverse lophs.

2. *Cricetodon* is larger with four to five roots on the upper first molars.

3. *Democricetodon* has an increased amount of protosinuses with a relatively larger posterosinus.

4. *Megacricetodon* has longer and narrower teeth with a bilobed anterocone on the upper first molar and an increased amount of protosinuses.

Discussion: The cricetid rodents are relatively significant with regard to the subdivision of Middle and Late Tertiary continental deposits. More in-depth Cricetid research has been undertaken and discoveries have been particularly more numerous in Europe. The dentition of *Eucricetodon youngi* corresponds to the European *Eucricetodon* and is most closely related to two younger species: *Eucricetodon aquitanicum* from the Aquitanian and *Eucricetodon infracorensis* from the late Burdigalian. Both display two posteriorly directed transverse lophs, a very reduced posteroloph, and extremely small posterosinus. These features are exceptionally notable on *E. infractorensis* (ref. Roman & Viret, 1934, Figs. 5 and 6). A reduced posterosinus may be a derived trend for this genus in the later stages, for it appears as one moves stratigraphically higher, this derived condition becomes more notable. Both *E. youngi* and *E. infractorensis* share an equivalently derived condition in their autapomorphic characters, however, the European

Eucricetodon also have been shown to gradually increase in size, while *E. youngi* is small, which may either imply an older stage, or that it is possibly an Asian species variation.

E. youngi compares to *E. asiaticus* from the Middle Oligocene of Inner Mongolia by being relatively small with large cusps, short lophs, mesostyle absent, and posterosinus notably reduced. However, Kowalski (1974) described *E.* "near" *asiaticus* (Mg M--III/36/1), which is morphologically rather close to *E. youngi*.

The reduced posterosinus of the new species is similar to *Cricetodon* from the middle Late Miocene of Europe. The upper second molar has developed a twinned protoloph, the short embayment of the entoloph is unconnected, and the internal valley is transverse. It shares characters with *Democricetodon*, common among the Middle and Late Miocene taxa, and may indicate the time period represented by the new species is later than the Oligocene *Eucricetodon*

Recently, Boudelot & Collier (1978), while studying the Middle Miocene faunal stages of southern France, erected a *Eucricetodon infralactorensis* zone (generally equivalent to DeBruijn and Van Meurs [1967] *E. ibericus* [*Pseudodryomys*] zone, the chronological range being late Aragonian or Burdigalian). A deduction may be drawn merely from the scarce cricetid record of Qinghai that suggests the age of the Xiejia Formation corresponds to, or slightly predates the *Eucricetodon infralactorensis* stage (zone).

Zapodidae Coues 1875

***Plesiosminthus xiningensis* sp. nov.**

(Text figure 4)

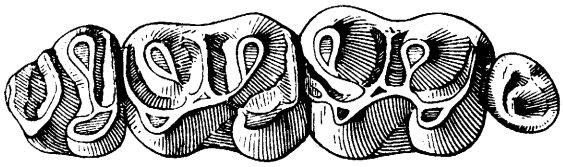

Figure 4. Occlusal view of *Plesiosminthus xiningensis* sp. nov. right P4/-M3/.

Type: One complete right maxillary dentition (P4/-M3/) (V5996).

Diagnosis: The species is large with a conical fourth upper premolar. The molars are narrow, long, and bunodont, with a spacious internal valleys and well developed mesolophs. The upper first molar is rectangular with a slightly compressed lingual side, a short protoloph (II), and a weak posteroloph that extends anterior to the hypocone. The upper second molar is rectangular with a single protolophule and a weak anterior cingulum that does not contact the protolophule. The upper third molar is small, nearly triangular with four lophs, and maintains a transverse valley at its midpoint that bisects the tooth into two halves.

Description: The species is relatively large and bunodont. The upper fourth premolar is very small and nearly conical with its principal cusp situated anteriorly but inclined posteriorly. The posterior tooth is composed of a semicircular crest that has a small cuspule projecting from the labial aspect. At the base of the crown there is a weak cingulum.

The upper first molar is narrow and rectangular with a shortened lingual side. Its cusps are rounded and there is a weak anterior cingulum that extends to the parastyle. The protoloph

terminates posterior to the protocone (neuer Vorjochkante). The metacone is anteroposteriorly flattened, the metaloph is weak, and the posterior cingulum is short. The mesocone is well developed with a low and long mesoloph and a moderate mesostyle. The entoloph is long with a slight embayment and a spacious lingual valley that is transversely oriented.

The morphology of the M2/ resembles the M1/ but it is longer and narrower. The anterior cingulum is low and broad and extends to the anterolingual corner. The protoloph is single and extends posteriorly to the entoloph. The mesoloph is relatively more well developed than on the M1/, the posteroloph is short, and the posterior cingulum is slightly elongated.

The upper third molar is reduced and nearly triangular in morphology being anteriorly broad and posteriorly narrow. Four transverse lophs are present. The paracone is well developed with a broad cingulum connected to it. The metacone is indistinct and the hypocone is weak. The entoloph is absent and the midportion of the tooth maintains a transverse valley with an anteriorly directed embayment that divides the tooth into two halves.

Table 2. Dental measurements of *Plesiosminthus xiningensis* sp. nov. (mm).

	P4/	M1/	M2/	M3/	P4/-M3/	M1/-M3/
Length	.68	1.40	1.34	.80	3.61	3.54
Anterior breadth	.64	1.02	.98	.90		
Posterior breadth		1.00	.80	.62		

Discussion: *Plesiosminthus* is distributed through the Oligocene and Miocene of the Northern Hemisphere. In actuality this genus is represented by approximately 15 species belonging to three genera that have been synonymized to include the European *Plesiosminthus* Viret, 1926; the Asian *Parasminthus* Bohlin, 1946; and the North American *Schaubeumys* Wood, 1935. The European species are generally recognized in two lineages, that of *Pl. schaubi* (Chattian) and that of *Pl. promyarion* (Chattian) to *Pl. myarion* (Aquitanian). The North American form is based on *Pl. grangeri*. The Asian *Plesiosminthus* is only documented in the Late Oligocene at Danghe, Gansu Province, and is represented by three species: *Pl. asiae centralis*, *Pl. taningoli*, and *Pl. parvulus*. Aside from lacking an anterior incisor groove, which differs from the European species, there are other characters that are shared with the taxa of Europe and North America. *Pl. xiningensis* is smaller only than *Pl. asiae centralis* and *Pl. huangshuiensis* sp. nov. (see below) and more close to *Pl. grangeri*. However, its relatively narrow and long upper molars; broad spacious transversely directed lingual valleys; and the reduced and bifurcated upper third molar, are all distinct from the other species. The limitations for erecting a new species are clear. However, this specimen may represent an independent lineage. Another Tibetan species is found at only one other locality in Qinghai (stratigraphically slightly higher) and shows even more similarities.

***Plesiosminthus huangshuiensis* sp. nov.**

(Text figure 5)

Type: Left M1/ and M2/ (V5997).

Diagnosis: A large species with bunodont molars transversely broadened and simple in morphology. Cusps are large, transverse lophs are short, medial valleys are deep and narrow, and posterosinus is extremely small. M2/ is posteriorly reduced with a single protolophule.

Description: This is the largest species in the genus. The upper first molar is nearly square with an interdental pressure facet for the P4/ near the midpoint of the anterior margin. The medial valley is deep and narrow with a slight anteriorly directed embayment. The cusps are

bunodont with only two of them being directed slightly labially. The protolophule is short and the posteroloph intersects the posterior cingulum. The mesoloph is low but extends to the labial margin as well as the meso- and metastyles. The anterior valley is deep and narrow and the posterior valley is extremely small. The M2/ is broad anteriorly and narrow posteriorly with its posterior section reduced. There is also a posterior pressure facet for the upper third molar. The interior valley is deep and narrow and anteriorly oblique. The mesoloph is long and the posterosinus is almost lost. The M1/ length, anterior width, and posterior width are 1.72, 1.52, and 1.6 mm; M2/ measurements are 1.64, 1.50, and 1.16 mm.

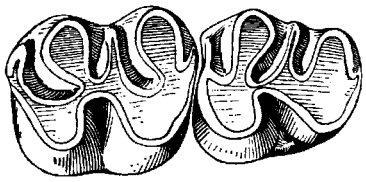

Figure 5. Occlusal view of *Plesiosminthus huangshuiensis* sp. nov. right M1/ andM2/ (V5997, Type)

Comparison: *Pl. huangshuiensis* shares several characters with the cricetodontines, however, with a dental formula of 1 0 1 3 it is assigned to the genus of *Plesiosminthus.* With the exception of its large size, it most closely resembles *Pl. asiae centralis.* However, the latter has its posterior portion of the dentition being slightly more lophodont, the M2/ posterior section is unreduced, the protoloph is twinned, the interior valley is comparatively broad and shallow, and the posterior valley is large. This new species, with its reduced second molar and the extremely small posterior valley suggests that it is more derived that *Pl. asiae centralis.*

***Plesiosminthus lajeensis* sp. nov.**

(Text figure 6)

Type: One left M1/ (or M2/) (V5998)

Diagnosis: Shares some similarities with *Pl. parvulus* in its lophodont morphology. The tooth valleys are narrow with the anterior valley particularly narrow and small, and the posterior valley long and enclosed. The mesoloph, mesostyle, and mesocone are all relatively well developed. The medial valley is narrow, opens anteriorly and is deeply excavated.

Description: The tooth is square, relatively small, and lophodont. The protocone and hypocone are relatively large. The medial valley is deep and anteriorly oblique. There is a small anterior cingulum that combines with the protolophule to surround the anterior valley. The protolophule is curved and terminates at the entoloph. The mesoloph and hypocone are rather strong and large, and the mesocone is relatively well developed. The posteroloph contacts the hypocone. The posterior cingulum is thick, encircles the tooth's posterior margin, and contacts the posteroloph to form an expansive enclosed posterior valley. The molar length, anterior width, and posterior width are 1.2, 1.14, and 1.02 mm.

Discussion: The new species is relatively close to *Pl. parvulus*; however, there are certain characteristics, such as the former being relatively larger, more lophodont, the posterior valley being large and enclosed, and displaying a very small anterior valley, that differentiates it from *Pl. parvulus* in addition to the rest of the species within the genus. Moreover, these autapomorphic characteristics are also, more or less, shared with other rodents of this time period, such as the Eomyidae. However, the data is too restricted to be absolutely certain.

There are two forms of molar morphology represented in the genus *Plesiosminthus* : 1) The emphasis on lophate molar morphology contains some small species such as *Pl. myarion, Pl. promyarion, Pl. parvulus* and *Pl. lajeensis.* 2) Bunodont forms tend to be large, such as *Pl. asiae*

centralis and *Pl. schaubi*. However, a discussion of the phylogenetic relationships among these species or the possibility of synonymizing them is currently difficult.

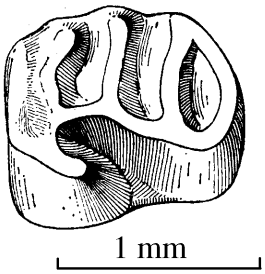

Figure 6. Occlusal view of *Plesiosminthus lajeensis* sp. nov. left M2/ (V5998, Type)

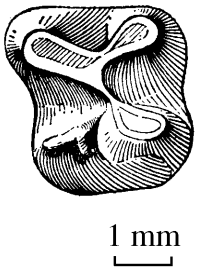

Figure 7. Occlusal view of *Tataromys suni* sp. nov. right p/4 (V5993)

Ctenodactylidae Zittel, 1883
***Tataromys suni* sp. nov.**

(Plate I, Figure 3, Text figure 7)

Type: Left maxilla with P4/-M3 (V5992)

Hypodigm: Four maxillas, four mandibles, five isolated p/4, three isolated m/1, four isolated m/2, three isolated m/3, ten isolated P4/, five isolated M1/, six isolated M2/, two isolated M3/ (or erupting M2/), one isolated DM1/ (or DM2/), several molar fragments, incisors, phalanges, and other miscellaneous elements (V5993).

Etymology: Species commemorates the Chinese Paleontologist Professor Yunzhu Sun.

Diagnosis: The species is large, or larger than *T. deflexus* and relatively hypsodont. The lower fourth premolar has a low and reduced hypocone that displays a distinctive small spur directed posteriorly from its midsection (ref. hyld. of Bohlin, 1946). The posterior cingulum of the P/4 is relatively well developed and composes nearly a single crest. The upper molars crests are transversely oriented, the M3/ lacks a crochet and antecrochet, and the central portion of the teeth contain vacuities that lack enamel.

Description: The P4/ posterior cingula are all very well developed, somewhat like Bohlin's (1946, Figure 19:7) extremely long "f" loph and lingually all posses the equivalent "e" loph. Size comparison of the upper molars indicates that M1/ is slightly small, as opposed to the M3/ which is slightly larger. The four upper molars lophs are all aligned nearly perpendicular to the long axis of the tooth. The lophs all lack secondary longitudinal projections or spurs, which differs from *T. deflexus* or *T. gobiensis*, but resembles *T. plicidens*. The mandible is clearly slightly high and thick, with the anterior attachment for the masseter situated slightly anteroventral to the trigonid of the M/1. The most notable diagnostic character of the P/4 is the reduced posterolingually projected spur off the hypocone. This small spur rather resembles the hypoconulid of Bohlin, a character also shared only on the lower fourth premolar of many of the Kansu specimens (T.b. 593f). The relatively well developed posterior cingulum on the P4/ suggests that the anterior molars of *T. suni* are more complicated and are slightly modified from the Oligocene morphology, which may be considered as a derived character. The trigonid and mesoloph on the lower molars are both moderate in size, and the enamel of the mesoloph and metacone encircles the posterior portion on some of the specimens. The ectolophid is inclined slightly lingually and the anterior cingulum is relatively distinct.

The large size and relative hypsodonty of *T. suni* distinguish it from the small species *T. sigmodon* and *T. grangeri.* Compared to the large species, *T. deflexus* displays an M3/ with its midportion enclosed and posteriorly inclined lophs; *T. gobiens* has an enclosed talonid and tends to be small. The morphology of the new species is relatively close to *T. plicidens,* to the degree that the latter may be considered to have descended into the Miocene. *T. suni* represents the latest fossil record of this genus. It is regrettable, however, that its relationship to other younger Miocene ctenodactylids from South Asia and Africa is not understood.

Table 3. Dental measurements of *Tataromys suni* sp. nov. (mm).

	P4/		M1/		M2/		M3/		P4/-M3/
	L	W	L	W	L	W	L	W	L
5992 (Type)	3.16	3.45	3.76	3.56	5.15	4.30	6.30	5.10	18.25
5993	3.15-4.40	3.45-4.25	3.76-4.60	3.20-4.00	4.80-6.00	4.30-5.05	5.65-6.40	4.65-5.25	
	p/4		m/1		m/2		m/3		p/4-m/3
5993	L	W	L	W	L	W	L	W	L
	3.00-3.76	3.00-3.05	3.92-4.60	3.05-3.50	4.95-6.10	4.05-4.55	6.45-6.90	4.15-4.65	18.0

Tataromys sp.

Specimens consist of two left maxillas with M1-2/, one right m/1 of an aged individual, and one right m/3 (V5994). Their size approach T. sigmodon. The lightly worn M1 2/ displays an isolated anterior cingulum which slightly resembles Yindertemys, but it lacks secondary longitudinally directed lophules or cuspules. The posterior valley is relatively reduced, the metacone is relatively large, and it is relatively hypsodont. Although the m/1 is worn nearly flat, it is still possible to distinguish a wide and deep labial valley. The morphology of the m/3 resembles T. sigmodon and T. grangeri. These specimens are assigned to the genus Tataromys, and are essentially closer to T. sigmodon based upon their size. Because relatively small taxa of ctenodactylids are not easily distinguished, such as Karakoromys, Leptotataromys, and Yindirtemys, as well as some species of small Tataromys, these specimens are provisionally assigned without species designation.

Table 4. Dental measurements of *Tataromys* sp. (mm).

M1/		M2/		m/1		m/2	
L	W	L	W	L	W	L	W
2.04-2.32	2.00-2.25	2.46-2.48	2.20-2.35	2.08	1.52	2.64	2.04

Rhizomyidae Miller & Gidley, 1918

***Tachyoryctoides kokonorensis* sp. nov.**

Type: A damaged skull with complete dentition.

Hypodigm: A left dentition with m/1-3, a complete right mandible, three incomplete mandibles, two isolated upper molars, three isolated lower molars, and several incisors (V6000).

Diagnosis: This species is relatively large with moderately hypsodont molars, spacious valleys, and a reduced mesostyle on the upper molars. A lingual groove beneath the tooth row is absent and the posterior incisor terminates far behind the m/1. The m/1 anteroconid is in contact with the protoconid and metaconid and there is a cusp lying between the two that is extended and inclined anteriorly to form a loph. The m/2 and m/3 anteroconids are not very well developed and the m/3 lacks a mettafossetid.

Description: The anterior and posterior portion of the skull is damaged. The masseteric fossa is shallow anterolabial to the M1/, is broadened anteriorly and narrow posteriorly to form a triangular morphology with its breadth reaching 7.3 mm. The incisive foramen is beloid-shaped with a length of 7.3 mm and width of 1.9 mm. The length of the palate is 12.5 mm. The posterior terminus of the zygomatic arch is situated at the posterior margin of the M3/. The4 mm diameter infraorbital foramen is extremely close to the shallow anterior margin of the masseteric fossa. The dorsomedial aspect of the skull is broad and flat. The upper incisor is triangular in cross-section, being 3.4 mm high, 2.1 mm wide, and enamel is restricted to the anterior surface. The molars are moderately hypsodont and although their size reduces progressively posteriorly, the molar morphology remains the same. The upper first molar is rectangular with four lophs. The protocone and robust anterior cingulum form the first loph which is severed at its midpoint by a vertical groove. The paracone and protoloph form the second loph, which is relatively shorter and converges with the entoloph. The metacone is connected to the metaloph and hypocone to complete the relatively long third loph. The posterior cingulum is well developed and contacts the posterolabial hypocone to form the fourth loph. The entoloph is relatively long, directed anterolabial-posterolingually, broken in half lingually, and maintains an extremely small mesoloph at its midpoint. The ectosinus is moderate in size, while the mesosinus is expansive, and there is a small labial mesostyle. The anterosinus and posterosinus are relatively small but not reduced. The medial valley is spacious and extends anteriorly. The M2/ is smaller than the preceding molar and is more worn than the M1/.* The M2/ has a reduced posterior section, the anterosinus is smaller than the posterosinus, and a mesostyle is lacking. The M3/ is newly erupted, the posterior section is reduced, being nearly circular in morphology, and the posterosinus is enclosed.

The medial aspect of the mandible is unlike *T. obrutschewi*, on which there is a ventral groove. The symphysis differs from the large thick and swollen morphology of *T. pachygnathus*. The posterior incisor terminates posterior to the m/3 with its height possibly approaching the m/3 crown. The mandibular dentition is shorter than *T. pachygnathus* being only 10.1 mm long. The lower incisor shearing surface is triangular with a height of 4.8 mm and a width of 4.3 mm. The m/1 is nearly elliptical with a crescentic anteroconid that is in contact with the combined protoconid-metaconid. The metaconid is very large with a reduced labial side. There is a cusp at the midpoint of the metaloph that has a crest projected directly anteriorly that divides the trigonid into two small grooves. The protocone is lophate and appressed to the oblique ectoloph. The entoconid is transversely oriented to form the hypolophid. The hypoconid is situated somewhat posteriorly with both its labial and lingual sides extended into a loph. The ectosinusid and mesosinusid are large, but the posterosinusid is relatively small. The m/2 is similar to the m/1, only the anteroconid is not in contact with the protoconid-metaconid, both of which are lophate. The m/3 is not reduced, the anteroconid is even smaller, and the posterosinus consists only of a small vertical groove.

Table 5. Dental measurements of *Tachyoryctoides kokonorensis* sp. nov. (mm).

	M1/	M2/	M3/	M1-3/	m/1	m/2	m/3	m/1-3
L	4.9	4.5	2.5	12.4	4.8	4.2	3.7	13.3
W	3.3	3.7	2.9		3.3	3.7	2.9	

Discussion: The new species of *Tachyoryctoides* is smaller than *T. pachygnathus* but larger than *T. obrutschewi* and *T. intermedius*. Certain autapomorphic characters distinguish this species from the three late Oligocene species mentioned above, among which are the morphology of the mandible, the length of the incisor, the relatively hypsodont molars, the open and spacious

*There is controversy regarding the dental formula of rhisomyids, as some workers believe it to be P4/,˙M1-2/. Others consider it M1-3/. Observations of specimen V5999 and others suggest it is very possible the formula is P4/-M2/, although here it will be referred to as M1-3/.

valleys of the teeth, and the anteroconid connected to the metaconid-protoconid (it should be noted here that the range of variation between *T. obrutschewi* and *T. intermedius* are not very clear).

The molar morphology of the new species is even more close to the genus *Aralomys* from the northern Aral Sea region. However, the Qinghai species is larger than both *A. gigas* and *A. glikman* and may also be distinguished by such features as a more well developed anteroconid on the m/1, and lack of a mesostylid.

The diagnostic characters for *T. kokonorensis* including its large size, hypsodonty, and well developed anteroconid on the m/1 are derived features for the genus, and reflect its age as perhaps Younger than Danghe (Taben Buluk).

Mustelidae gen. et sp. indet.

The specimen consists of a left third upper premolar, a left ? third lower premolar, and a calcaneum. The P3/ is small with a length of 6.6 mm and a width of 2.8 mm. The p/3 length is 6.1 mm and width is 3.2 mm. A more precise identification is relatively difficult.

Rhinocerotidae Owen, 1845
***Brachypotherium* sp.**

Material: One left P4/, one right ?m/2 of which there is only the posterior wall of the metaloph, one left p/2, and a left fourth metatarsal (V6006).

Description: The P4/ labial side is damaged, but it is completely molariform and moderately hypsodont with a length of 31.5 mm. The protocone is circular and blunt with the hypocone appressed to the highest part of the midsection. The two lophs are long and not very oblique posteriorly. The protocone is long and there is a well developed crochet, but an antecrochet and crista are absent. The posterior cingulum is well developed and together with the metaloph encircles the postfossette. The lingual cingulum is interrupted between the protocone and hypocone. The p/2 is narrow anteriorly and broad posteriorly with a length of 20.5 mm and a width of 20.4 mm. The ?m/2's labial wall of the metalophid is flat and straight and there is a shallow basin in the midsection. The metatarsal IV is short and gracile, its proximal end is quadrate, the midshaft is abruptly inflated, and the cuboid articular facet occupies approximately one half of the proximal surface. Its length is 10.43 cm, proximal width is 3.74 cm, distal width is 3.32 cm and midshaft width is 2.68 cm. These specimens are dissimilar from the Miocene *Plesiaceratherium*, *Aceratherium*, and *Caementodon*, but relatively close to *Brachypotherium* from the Burdigalian of Europe. The size and diagnostic characters of the metatarsal is very close to *Brachypotherium* cf. *brachypus* from in the Early Miocene of Romieu, France (see Roman & Viret, 1934, Fig. 13A).

Bovidae gray, 1821
***Oioceros* (?) *xiejiaensis* sp. nov.**

(Plate I, Fig. 8, 9a, 9b)

Type: One damaged right maxilla with M2-3/ (V6007)

Hypodigm: One left maxilla with M1 2/, one M1/, one M2/, and one left mandible with m/1-2 (V6008).

Diagnosis: The specimens are very small and hypsodont, upper molars display well developed folds, and a particularly well developed mesostyle. The metacone is not ribbed. The lower molar anterior folds are well developed compose a column labially.

Description: This species is much smaller than any known in the genus (see Chen et al., 1976, page 14). The molars are hypsodont. Using a slightly worn m/2 as an criterion, the tooth length is 7.9 mm and height is 14.0 mm, which provides a hypsodonty index (length/height x 100) of 62.8. The hypocone on the upper molar is very pronounced, the mesostyle is particularly prominent, with the other styles, in general, equally projected from the base. The paracone is ribbed and is connected to the parastyle at its base. The labial wall of the metacone is smooth. The two fosettes are narrow and long, and a cingulum or basal pillar is absent. The lower molars are high and flat with the anterolingual and anterolabial sides exhibiting a stylar fold that resembles the labial fold of *Oioceros*, being exceptionally well developed to compose a column. The mesostyle is prominent and the antero-- and posterostyles are relatively weakly ribbed.

This species is smaller than any other known species with a size that approaches *Eotragus artenensis* (Burdigalian), the earliest fossil bovid from France. However, the French species posterior portion of the crown is lower and the cusps become more constricted toward their apices, clearly distinguishing it from the new species. Bohlin (1946, p. 212) described a Late Oligocene fossil ruminant from Taben Buluk, Kansu Province, that consisted only of a single M2/ (T.b. 585) the size and morphology of which is similar to the new species; however, anteriorly it is clearly brachydont, the two fosettes are open and spacious, and the metacone displays a single weak vertical rib. *O. xiejiaensis* maintains teeth that are very hypsodont and the lower molar has an anterolabial style (pillar) that indicates it may possibly belong to the genus *Oioceros*. Since it may be the earliest record of the Bovidae, its morphology should reflect more derived characters than T.b.585.

Table 6. Dental measurements of *Oioceros* (?) *xiejiaensis* sp. nov. (mm).

	M1/	M2/	M3/	m/1	m/2
L	7.1	8.0	8.4	6.4	8.8
W		6.3	6.5		4.0

Conclusions:

1. Six new species from the Xiejia fauna belong to the genera *Sinolagomys*, *Plesiosmithus*, *Tachyoryctoides*, and *Tataromys*. All may be regarded as being descendent from the endemic Asian taxa found in the Late Oligocene Taben Buluk fauna from Danghe, Kansu Province. Morphologically, the new taxa are clearly more derived than the Taben Buluk fauna. The archaic Middle Oligocene taxa such as *Desmatolagus* and *Tsaganomys* have disappeared within the fauna, such that it is clear the age of the Xiejia Fauna can not predate Taben Buluk. Also, later Miocene elements commonly found in China are absent, clearly indicating that it cannot be younger than early Middle Miocene.

2. Morphologically, *Eucricetodon youngi* sp. nov. is very close to the Aquitanian-Burdigalian species from Europe. The oldest records of *Brachypotherium* are in South Asian Bugti Fauna, which is Early to Middle Miocene, and the late Aquitanian of Europe. *Oioceras xiningensis* sp. nov. may be compared to *Eotragus artenensis* from the Burdigalian of Europe. Therefore, the age of the Xiejia Fauna is probably equivalent to the Early Miocene Aquitanian-Burdigalian Stage of Europe, and would then constitute the first discovery of an Early Miocene mammalian fauna in China.

3. Additional faunal characters and correlations are addressed in "Discussion on Miocene Stratigraphy and Mammals from the Xining Basin, Qinghai," (Li et al., Vertebrata PalAsiatica Vol. 19, No. 4, Oct. 1981, pp. 313 320.)

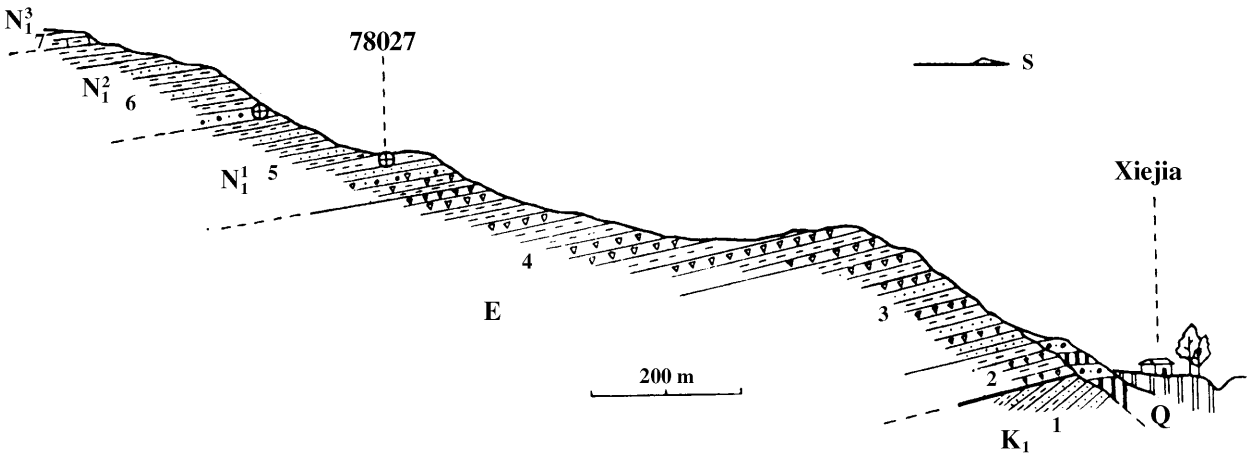

Figure 8. Cross-section at Beigou, Xiejia Village, Huangzhong Co. Qinghai Province

N (Neogene System):

7. N_1^3 ("Xianshuihe Fm.") Light buff yellow mudstone interbedded with gray-white marls. West of the measured section in the Diaogou region, exposure is relatively good and contains *Gomphotherium connexus.*

6 N_1^2 (Chetougou Formation) Light yellow-brown massive mudstones interbedded with sandy conglomerate lenses. Basal sandstone contains the cricetid ?cf. Eumyarion sp. .....100 m

5. N_1^1 (Xiejia Formation) Light yellow-brown mudstone grading to yellow-green, gray-green mudstones or sandy conglomerate lenses, and secondary gypsum veins. These represent the most significant fossil deposits.....110 m

E (Paleogene):

4. Gray-green and gray-brown gypsiferous beds with interfingering brown mudstones .....180 m

3. Brown-red sandstone and interfingering gypsiferous mudstones .....150 m

2. Dark brown sandy mudstone interbedded with gray-black argillaceous gypsum units .....50 m

K (Cretaceous):

1. Interfingering brown sandstones and silty mudstones. Base is unobservable.

Bibliography

Baudelot, S. and de Bonis, L.. 1968; Coniribution á, l'etude des Rongeurs de l'Aquitanien moyan et superieur de Agenais. *Bull, Soc. Hist, Nat, Toulouse,* **104**(1-2): 194--206.

Baudelot, S. and Crouzil, F., 1969; Sur un nouveau gisement aquitanien de Vertébres prés de Colomiere (HauteGaronne). *C. R. Som. Sean. Soc. Geol. France*.1969(2):58-9.

Baudelot. S. and Collier, A., 1978; Les faunes miocènes Haut Armagnae (Gers), 1. Les gisements *Bull. Soc. Hist. Nat. Toulouse*. **114**(1--2): 194--206.

Black. C. C., 1965: New Species of *Heteroxerus* (Rodentia, Sciuridae) in the French Tertiary. *Verhandl. Naturf. Ges. Basel,* **70**(1): 185-96.

Black, C.C.,1972; Holarctic Evolution and Dispersal of Squirrels (Rodentia: Sciuridae). *Evol. Biol.,* **6**: 305-322.

Bohlin, B., l937;Oberoligozäne Säugetiere aus dem Shargaltein-Tal (Western Kansu). *Pal. Sinica,* n. s. C, **3**: 1-66.

Bohlin, B., l942; The Fossil Mammals from the Tertiary Deposit of Taben Buluk, Western Gansu. *ibid. C,* 8(a): 1-113.

Bohlin, B., 1946; The Fossil Mammals from the Tertiary Deposit of Taben Buluk, Western Gansu. *ibid. C,* **8**(b): 1-259.

Chen, G.F. and Wu, W.Y., 1976; Miocene mammals from Jiulongkou, Cixian Co., Hebei Province. *Vert. PalAs.* **14**(1); 1-15 (in Chinese).

Dawson, M. R., 1961: On two Ochotonids (Mammalia, Lagomorpha) from the Later Tertiary of Inner Mongolia. *Amer. Mus.* Novitiates **2061:**1-15.

Fahlbusch, V., 1964; Die Cricetiden (Mamm.) der Oberen Susswasser-Molässe Bayerns. Bayer. Akad. Wisschaf. Abh., n.f., **118**: 1-136.

Freudenberg, H., 1941; Die Oberoligocänen Nager von Gaimersheim bei Ingolstadt und ihre Verwandten. *Palaeontographica,* **92**(A): 99-202.

Freudenthal, M. 1963; Entwicklungsstufen der Miozänen Cricetodontinae (Mammalia, Rodentia) Mittelspaniens und ihre Stratigraphische Bedeutung. *Beaufortia* **10** 119: 51-157.

Ginsburg, L. and Heintz. E., 1968; La plus ancienne Antilope d'Europe *Eotragus artenensis* du Burdigalien d'Artenay. Bull. Mus. Nat. Hist. Nat. 2 ser. **40**(4): 837-42.

Green, M., 1917; Neogene Zapodidae (Mammalia: Rodentia) from South Dakota, *Jour. Pal.* **51**(5):996-1015.

Hugueney, M., 1969; Les Rongeurs (Mammalia) de L'Oligocene superieur de Coderet-Bransat (allier). these. *Fafc. Sci. Niv. Lyon,* no. 2596: 1-220.

Kowalski, K., 1974; Results of the Polish-Mongolian Paleontological Expeditions.-part V: Middle Oligocene Rodents from Mongolia. *Pal. Polonica,***30**:147-78.

Li, C.K., 1976; A New Miocene Cricetodont Rodent of Fangshan, Nanking, Vert. PalAs. **15**(1): 67-75 (in Chinese)

Lindsay, E. H., 1978; *Eucricetodon asiaticus* (Matthew and Granger),an Oligocene Rodent (Cricetidae) from Mongolia. *Jour, Pal.* **52**(5):590--5.

Matthew, W.D. and Granger, W., 1923; Nine Rodents from the Oligocene of Mongolia, *Amer. Mus. Novit.,* **102**: 1--10,

Fahlbusch, V., 1964: Die Cricetiden T7~isschaf. Abh., n. i., 118:

Mein, P. and Freudenthal, M., 1971; Une nouvelle Classification des Cricetidae (Mammalia, Rodentia) da Terrtiaire de l'Europe. *Scrip. Geol.* 2: 1--35.

Mellett. J. S., 1968: The Oligocene Hsanda Gol Formation Mongolia: A Revised Faunal *Amer. Mus. Novit.* 2318: 1-16.

Pilgrim, G.E., 1934; Two New Species of Sheep-like Antelope from the Miocene of Mongolia. *Amer. Mus. Novit.,* 2318: 716.

Roman, F. and Viret, J. 1934; La Faune de Mammifères du Burdigalien de la Romieu (Gers). *Mem. Soc. Geol. France.* n.s. IX (2-3): 1-67

Schaub, S., 1925; Die Hamsterartigen Nagetiere des Tertiärs und ihre Lebenden Verwandten. Iabh. Schweiz. Pal. Gesell.,**45**: 1-114.

Schaub, S., 1930; Fissile Sicistinae. *Eclogae Geol. Helv.,* **23**(2): 616-37.
Sych, L., 1975; Lagomorpha from the Oligocene Mongolia. *Pal. Polonica,* **33**: 183-200.
Thaler, L., 1966 Les Rongeurs Fossiles du Bas-Languedoc dans leurs Rapports avec l'Histoire des Faunes et la Stratigraphie du Tertiaire d'Europe. *Mem. Mus. Natl. Hist, Nat,* C, **17**: 1--295.
Teilhard de Chardin, P., 1926; Description de Mammiféres Tertiaires de Chine et de Mongolie. *Ann. Pal.,* **15: 1-52**
Vianey-Liaud, M., 1972; Contribution à l'étude des Cricétidés d'Europe occidentale. *Palaeovert.,* 5(1): 1-44.
Viret, J. 1929; Les Faunes de Mammiféres de l'Oligocène Supèrieur de la Limagne Bourbonnaise. *Ann. Univ. Lyon*, n.s. 47.: 1-305.
Young, C.C., 1927; Fossile Nagetiere aus Nord-China *Pal. Sininca,* C, 5(3): 1-82.