

FOSSIL MAMMALS AND THE AGE OF THE CHANGXINDIAN FORMATION, NORTHEASTERN CHINA

by

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CONTENTS

	Page
Abstract, Résumé	134
Introduction	134
Taxonomy	134
Eutheria	134
<i>Hypsimilus beijingensis</i> ZHAI, 1977	135
cf. <i>Miacis</i> sp.	135
<i>Forstercooperia grandis</i> (PETERSON, 1919)	136
Anthracotheriidae	137
Age	137
Acknowledgments	139
References	139
Legend of the plate	140

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ABSTRACT

Re-evaluation of the small collection of mammal fossils from the Changxindian Formation near Beijing, China indicates the following taxa are present: Eutheria, *Hypsimilus beijingensis*, cf. *Miacis* sp., Anthracotheriidae and *Forstercooperia grandis*. The presence of *Forstercooperia grandis* indicates an Irđinmanhan age and does not support previous assignment of a Sharamurunian age to the Changxindian Formation.

RESUME

Le réexamen de la petite collection de mammifères fossiles de la Formation Changxindian près de Pékin, Chine, indique que les taxa suivants y sont présents: Eutheria, *Hypsimilus beijingensis*, cf. *Miacis* sp., Anthracotheriidae et *Forstercooperia grandis*. La présence de *Forstercooperia grandis* indique un âge irđinmanhanien et ne s'accorde pas avec l'âge sharamurunien attribué précédemment à la Formation Changxindian.

INTRODUCTION

In northeastern China, Eocene fossil mammals occur at an outcrop just southeast of Changxindian, a suburb of Beijing located 20 km southwest of the city (Fig. 1). These fossils are derived from the Changxindian Formation (Hsieh 1933), an approximately 100-m-thick fanglomerate deposit of red-bed, igneous-cobble conglomerates, sedimentary breccias and minor mudstones. Young (1934), Chow (1953) and Zhai (1977) described the mammal fossils from the Changxindian Formation, and Russell & Zhai (1987) tentatively assigned the mammal fauna a Sharamurunian age. My purpose here is to re-evaluate the identifications and age significance of the fossil mammals from the Changxindian Formation. All specimens reported on here, except those that have apparently been lost, are in the collection of the Institute of Vertebrate Paleontology and Paleoanthropology (IVPP), Beijing.

TAXONOMY

Eutheria

Chow (1953, fig. 2) illustrated an incomplete tooth crown with a single preserved root that he identified as a right M^2 or M^3 of ?*Tupaiodon* sp. This specimen apparently has been lost, so my evaluation is from Chow's illustration, redrawn here (Fig. 2A-C).

This small upper cheek tooth has a very large protocone, a somewhat smaller metacone that is much lower than the protocone and a posterior, shelf-like cingulum that

bears a small swelling (hypocone?) just posterior to the protocone. It bears no close resemblance to any upper cheek tooth of *Tupaiodon* (Matthew & Granger 1924, fig. 1). Thus, the very large and tall protocone, extensive posterior cingulum and lack of a large and distinct hypocone preclude assignment of the Changxindian Formation tooth to *Tupaiodon*.

Unfortunately, upper cheek teeth of the other, most readily comparable Chinese Paleogene insectivoran, *Ictopidium lechei* ZDANSKY, 1930, are unknown. The possibility also exists that this incomplete tooth could be part of an upper cheek tooth of a didymoconid. Because this incomplete tooth has been lost, I am unable to assign it with certainty to any of a number of possible groups, including Lipotyphla, Proteutheria and Didymoconidae. For that reason, I only identify this tooth as Eutheria.

Hypsimilus beijingensis ZHAI, 1977

Zhai (1977) named the eurymylid *Hypsimilus beijingensis* for IVPP V 5242, a left dentary fragment with DP₄-M₁ and a detached DP₃ talonid (Zhai 1977, pl. 1, figs. 7-9) from the Changxindian Formation. *Hypsimilus* is a very hypsodont, *Rhombomylus*-like eurymylid. Nothing can be added to Zhai's (1977) description and illustrations.

cf. *Miacis* sp.

Two teeth of carnivorans, IVPP V 5245, a right P⁴ (Pl. 1, figs. 1-3), and IVPP V 5244, an incomplete left M₁ (Pl. 1, figs. 4-6), are known from the Changxindian Formation. Zhai (1977) identified IVPP V 5245 as Canidae and V 5244 as *Miacis* sp.

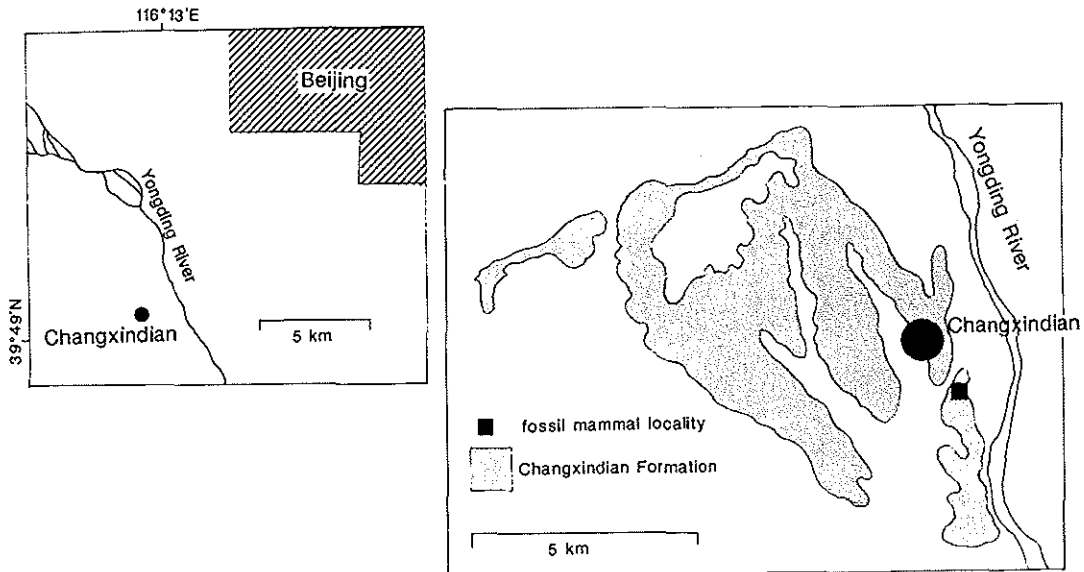


Figure 1.— Location map (left) and outcrop map (right) of Changxindian Formation fossil-mammal locality near Beijing (modified from Hsieh 1933).

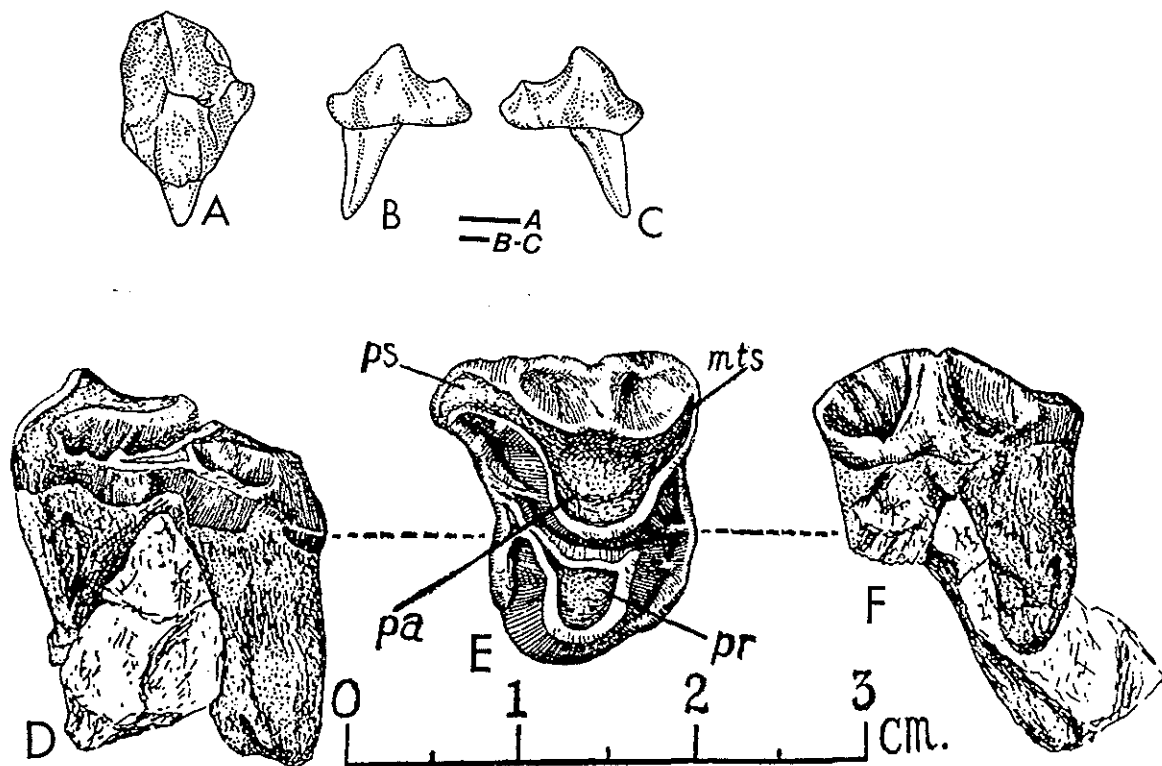


Figure 2.— Isolated teeth of fossil mammals from the Changxindian Formation that have apparently been lost. A-C, Eutheria, incomplete right M^2 or M^3 , occlusal (A), anterior (B) and posterior (C) views, bar scales = 1 mm; D-F, Anthracotheriidae, left P^4 , anterior (D), occlusal (E) and labial (F) views. A-C redrawn from Chow (1953); D-F from Young (1934).

IVPP V 5245 has a very small cingular parastyle cusp and a small protocone, features that identify it as a member of the *Caniformia sensu* Flynn & Galiano (1982). It closely resembles the P^4 of *Miacis* (Matthew 1909, fig. 7) but is much larger. I identify it as cf. *Miacis* sp.

Zhai (1977) identified V 5244 as a left M_1 of *Miacis* sp. This tooth is the right size and morphology to represent a species of *Miacis* as large as is represented by V 5245, so I also identify V 5244 as cf. *Miacis* sp.

Forstercooperia grandis (PETERSON, 1919)

Zhai (1977) identified the most abundant fossil mammal from the Changxindian Formation, a hyracodontid, as *Imequincisoria*. The fossils are IVPP V 5241, an incomplete right P^2 (Pl. 1, fig. 8), left M_1 (Pl. 1, fig. 7), left M^1 (Pl. 1, fig. 9), left M^3 (Pl. 1, fig. 10) and right M^{1-3} (Pl. 1, fig. 11). Significant features of these teeth are the nonmolariform (*sensu* Radinsky 1967) P^2 , distinct but small M^3 metacone and the

well-developed lingual cingula on P² and M¹⁻². Length of M¹ is 30 mm, and width is 35 mm. Length of M³ is 31 mm and width is 34 mm.

Imequincisoria is a junior subjective synonym of *Juxia*, known only from the type species *J. sharamurunense* (Lucas *et al.* 1981, Lucas & Sobus 1989). However, the Changxindian specimens are much smaller than the corresponding teeth of *Juxia* (also see Zhai 1977, p. 174), and the distinct metacone on the Changxindian M³ is not a characteristic feature of *Juxia*. Instead, the Changxindian teeth are metrically and meristically indistinguishable from teeth of *Forstercooperia grandis* (PETERSON, 1919), to which they are referred.

Anthracotheriidae

Young (1934) described and illustrated an upper cheek tooth that he identified as a left P³ or P⁴ of the coryphodontid pantodont ?*Eudinoceras* sp. indet. This specimen apparently has been lost, so I evaluate it from Young's illustration reproduced here (Fig. 2D-F). This evaluation indicates that the tooth Young illustrated is of an anthracothere, not a pantodont.

The Changxindian premolar shares the following features with upper premolars of anthracotheres: (1) ectoloph is broad and shallow and bears a distinct median ridge (style); (2) parastyle is longer than metastyle and projects anterior to the transverse line of the protocone and paracone; and (3) paracone very closely appressed to the protocone, and both cusps wear on their apices. None of these features are present on the upper premolars of *Eudinoceras* (see Osborn & Granger 1931), and I am thus confident the tooth Young illustrated is a left P⁴ of an anthracothere.

Estimated measurements of the Changxindian P⁴ from Young's illustration are length = 13 mm, width = 16 mm. Relatively large size and the large styles preclude assignment to the common Asian Eocene anthracothere *Anthracokeryx* (see Colbert 1938, Wang 1985). In size, the Changxindian P⁴ is closer to *Anthracothema* (see Colbert 1938), but differs morphologically in its relatively large styles and selenodont labial cusps. In size and morphology, the Changxindian premolar is closest to "*Bothriodon* " *tientongensis* XU, 1977 from Guangxi. However, the Guangxi form is not actually *Bothriodon* (Russell & Zhai 1987), so I simply refer the Changxindian premolar to the Anthracotheriidae. It may belong to Xu's (1977) taxon, but until that taxon is correctly assigned I do not perpetuate the name.

AGE

Russell & Zhai (1987) tentatively regarded the Changxindian mammal fauna as of Sharamurunian age, which they termed late Eocene but which I term middle Eocene in light of recent revision of the Eocene-Oligocene boundary so that it is between the Ergilian and Shandgolian land-mammal "ages" (Ducroq 1993). Re-evaluation of the identification of the mammals from the Changxindian Formation (Table 1) does not

PREVIOUS IDENTIFICATION	REVISED IDENTIFICATION
<i>Tupaiodon</i> ? sp.	Eutheria
<i>Hypsimilus beijingensis</i>	<i>Hypsimilus beijingensis</i>
<i>Miacis</i> sp.	cf. <i>Miacis</i> sp.
Canidae	cf. <i>Miacis</i> sp.
<i>Imequincisor</i> sp.	<i>Forstercooperia grandis</i>
<i>Eudinoceras</i> ? sp.	Anthracotheriidae

Table 1.— Previous (from Russell & Zhai 1987) and current (this paper) identifications of the fossil mammals from the Changxindian Formation.

support this age assignment. Instead, the mammalian fauna of the Changxindian Formation appears to be slightly older, of Irдинmanhan age

The small Changxindian eutherian is of no biochronological significance other than to not contradict an Eocene age. Its earlier tentative and incorrect identification as *Tupaiodon* was biochronologically anomalous because this taxon is of early Oligocene (Shandgolian) age (Russell & Zhai 1987).

Hypsimilus beijingensis is endemic to the Changxindian Formation. It is one of the youngest known eurymylids if the Changxindian mammals are of Irдинmanhan age because an indeterminate eurymylid is also known from Irдинmanhan-age strata of the Sargamys svita in the Zaissan basin of northeastern Kazakhstan (Russell & Zhai 1987).

Miacis is well known from Irдинmanhan-age faunas of Asia, but its only supposed Sharamurunian-age occurrence is in the Changxindian Formation (Russell & Zhai 1987). The specimens of cf. *Miacis* sp. from the Changxindian Formation thus are more consistent with an Irдинmanhan than with a Sharamurunian age.

Anthracotheres are very abundant in Sharamurunian-age strata of Asia (Russell & Zhai 1987). However, they are also present in Irдинmanhan-age strata (Zhang *et al.* 1978). Therefore, the presence of an anthracothere in the Changxindian Formation is consistent with an Irдинmanhan age assignment. Nevertheless, this anthracothere is not an obviously Irдинmanhan form. It is most similar to a form described by Xu (1977) from the Gongkang Formation in the Bose basin of Guangxi, a unit that produces a composite mammalian fauna of middle-late Eocene (Irдинmanhan?-Ergilian) age (Russell & Zhai 1987). The precise age of the Gongkang anthracothere thus is not clear, so the biochronological significance of the Changxindian Formation anthracothere also is uncertain.

Assignment of an Irдинmanhan age to the Changxindian mammals rests primarily on the occurrence of *Forstercooperia grandis*. This hyracodontid is restricted to Irдинmanhan-age strata in Asia (Russell & Zhai 1987). It provides strong evidence, not contradicted by the other mammalian taxa, that the Changxindian mammal fossils are of Irдинmanhan age.

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REFERENCES

- CHOW, M., 1953. — Note on the age of the Changsintien Gravels. *Acta Pal. Sinica*, 1: 201-205 [Chinese].
- COLBERT, E.H., 1938. — Fossil mammals from Burma in the American Museum of Natural History. *Bull. Amer. Mus. Nat. Hist.*, 74: 255-436.
- DUCROCQ, S., 1993. — Mammals and stratigraphy in Asia: is the Eocene-Oligocene boundary at the right place? *C. R. Acad. Sci. Paris*, (2), 316: 419-426.
- FLYNN, J.J. & GALIANO, H., 1982. — Phylogeny of early Tertiary Carnivora, with a description of a new species of *Proticitis* from the middle Eocene of northwestern Wyoming. *Amer. Mus. Novitates*, 2725: 1-64.
- HSIEH, C.Y., 1933. — Note on the geology of Changsintien-Tuoli area, S. W. of Peking. *Bull. Geol. Soc. China*, 12: 513-529.
- LUCAS, S.G. & SOBUS, J., 1989. — The systematics of the indricotheres. In: PROTHERO, D.R. & SCHOCH, R.M. (Eds.), *The evolution of perissodactyls: 358-378*. Oxford University Press, New York.
- LUCAS, S.G., SCHOCH, R.M. & MANNING, E., 1981. — The systematics of *Forstercooperia*, a middle to late Eocene hyracodontid (Perissodactyla: Rhinoceroidea) from Asia and western North America. *J. Paleont.*, 55: 826-841.
- MATTHEW, W.D., 1909. — The Carnivora and Insectivora of the Bridger basin, middle Eocene. *Mem. Amer. Mus. Nat. Hist.*, 9: 289-567.
- MATTHEW, W.D. & GRANGER, W., 1924. — New insectivores and ruminants from the Tertiary of Mongolia, with remarks on the correlation. *Am. Mus. Novit.*, 105: 1-7.
- OSBORN, H.F. & GRANGER, W., 1931. — Coryphodonts of Mongolia, *Eudinoceras mongoliensis* Osborn, *E. kholobolchiensis* sp. nov. *Amer. Mus. Novitates*, 459: 1-13.
- PETERSON, O.A., 1919. — Report upon the material discovered in the upper Eocene of the Uinta basin. *Ann. Carnegie Mus.*, 12: 40-168.
- RADINSKY, L.B., 1967. — A review of the rhinocerotoid family Hyracodontidae (Perissodactyla). *Bull. Amer. Mus. Nat. Hist.*, 136: 1-46.
- RUSSELL, D.E. & ZHAI, R., 1987. — The Paleogene of Asia: mammals and stratigraphy. *Mem. Mus. Nat. d'Hist. Natur.*, 52: 1-488.
- WANG, J., 1985. — A new species of *Anthracokeryx* from Shanxi. *Vert. PalAsiatica*, 23: 52-59 [Chinese, English summary].
- XU, Q., 1977. — New materials of *Bothriodon* from Bose basin of Guangxi. *Vert. PalAsiatica*, 15: 203-206 [Chinese].
- YOUNG, C.C., 1934. — A review of the early Tertiary formations of China. *Bull. Geol. Soc. China*, 13:

469-503.

- ZDANSKY, O., 1930.— Die alttertiären Säugetiere Chinas nebst stratigraphischen Bemerkungen. *Palaeont. Sinica (C)*, 6: 1-87.
- ZHAI, R., 1977.— Supplementary remarks on the age of the Changxindian Formation. *Vert. Palaeontologia*, 15: 173-176 [Chinese, English abstract].
- ZHANG, Y., YOU, Y., JI, H. & DING, S., 1978.— Cenozoic stratigraphy of Yunnan. *Prof. Papers Strat. Paleont.*, 7: 1-21 [Chinese, English summary].

LEGEND OF THE PLATE

PLATE 1

- Figures 1-3.— cf. *Miacis* sp., IVPP V 5245, right P⁴, posterior (1), labial (2) and occlusal (3) views.
- Figures 4-6.— cf. *Miacis* sp., IVPP V 5244, incomplete left M₁, lingual (4), labial (5) and occlusal (6) views.
- Figures 7-11.— *Forstercooperia grandis*, IVPP V 5241, occlusal views of left M₁ (7), incomplete right P² (8), left M¹ (9), left M³ (10) and right M¹⁻³ (11)

