

陕西蓝田晚中新世灞河组鼠科化石¹⁾

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摘要: 详细描述了陕西蓝田晚中新世灞河组发现的两种鼠科化石: 中华原裔鼠 *Progonomys sinensis* sp. nov. 和 Muridae gen. et sp. indet.。新种的特征是: 个体通常比 *Progonomys cathalai* Schaub, 1938 大; 下臼齿的唇侧齿带和附属尖很弱; 三分之二的 m1 具有一很小的中间前边尖 (tma); M1 的 t1 和 t3 偶见后刺, 在个别的 m1 中有一短的中脊; 臼齿的尺寸落入 *P. woelferi* 的变异范围, 但 t6 ~ t9 间的连接没有该种那样常见, 而 t12 较为明显。新种产于灞河组下部层位, 其牙齿的大小和形态特征介于 *Progonomys cathalai* Schaub, 1938 与 *P. woelferi* Bachmayer et Wilson, 1970 之间。据此可证实, 把灞河组下部层位的时代置于晚中新世早期, 相当欧洲瓦里士期晚期或 MN10 的时代比较恰当。新种的重要意义不仅在于它具有狭义 *Progonomys* 属的特征, 而且是我国现知鼠科动物最古老的一种。未定种产于灞河组较上部层位, 牙齿形态与 *Progonomys sinensis* 的相似, 很可能与其有较接近的亲缘关系。

关键词: 陕西蓝田, 晚中新世, 灞河组, 鼠科

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MURIDS FROM THE LATE MIOCENE BAHE FORMATION, LANTIAN, SHAANXI

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Abstract Two forms of Muridae, *Progonomys sinensis* sp. nov. and Muridae gen. et sp. indet. from the late Miocene Bahe Formation at Lantian, Shaanxi Province are described. The new species, occurring in lower horizons of the formation, demonstrates intermediate characters between *P. cathalai* and *P. woelferi* in dimension and morphology. The new murid argues for an age of early late Miocene for the lower portions of the Bahe Formation, corresponding to early Baodean of Chinese Land Mammal Age, which can be correlated with late Vallesian or MN10 of Europe. Consequently, the new species is important because it represents diversity in the species of the genus *Progonomys* and the oldest murid known in China. The indeterminate species was probably closely allied to the new species.

Key words Lantian, Shaanxi, late Miocene, Bahe Formation, Muridae

1 Introduction

Remains of Muridae are commonly known from the Pliocene and Pleistocene deposits of China. No murids, however, are recorded from the middle Miocene, although 10 genera and 10 species are distinguished in the late Miocene (Storch, 1987; Qiu and Storch, 1990; Wu and Flynn, 1992;

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Storch and Ni, 2002; Qiu et al., 2003). The early representatives of murids in China are *Progonomys* cf. *P. cathalai* from Lantian, Shaanxi, *Hansdebruijnina perpusilla* from Baogedawula, Nei Mongol (Inner Mongolia), *Linomys yunnanensis*, *Yunomys wui*, and *Leilaomys zhudingi* from Lufeng and Yuanmou, Yunnan. Except *Progonomys* cf. *P. cathalai*, their age was considered to be middle late Miocene, corresponding to middle Baodean of Chinese Land Mammal Age or early Turolian of Europe (Qiu and Qiu, 1995). The oldest known murid, obviously is the "*Progonomys* cf. *P. cathalai*" from Lantian, which was generally compared with the Vallesian forms of Europe and West Asia.

Progonomys, based on *P. cathalai* Schaub, 1938 from Montredon of France, is an early genus of Muridae. *Progonomys* nearly became a "waste basket" genus as almost all the early murids from the Old World have been allocated to this genus (de Bruijn et al., 1971; de Bruijn, 1976; van de Weerd, 1976; Jaeger, 1977; Jacobs, 1978; Bachmayer and Wilson, 1980; Unay, 1981; Lungu, 1981; Qiu and Storch, 1990). In order to clarify *Progonomys* and make it as a monophyletic genus, Mein and others (1993) redefined the genus and excluded several Asian, African and European populations and species from the genus. They restricted *Progonomys* to two named species *P. cathalai* and *P. woelferi*, and one indeterminate species, with the oldest record, *Progonomys* sp. from the early Vallesian of Sinap Tepe 1 of Ankara, Turkey (MN9), and the last records from Europe (MN11) and South Asia (Nagri, earliest Turolian correlative). There is no doubt that their work is meaningful in the study of early murids. However, discussion on the phylogenetic relationship and taxonomy of the genus appears to remain unresolved (Aguilar and Michaux, 1996; van Dam, 1997; Storch and Ni, 2002).

In addition to the record of *Progonomys* from Lantian, two other species of the genus, "*P. orientalis* Schaub, 1938 from Ertemte, Nei Mongol and "*P. yunnanensis* Qiu and Storch, 1990 from Lufeng, Yunnan, were documented in the late Miocene of China. The former has been transferred to *Apodemus* (Storch, 1987), while the latter was excluded from *Progonomys* (Mein et al. 1993) and assigned to *Linomys* (Storch and Ni, 2002). It seems evident that the two taxa possess a suite of characters that set them apart from *Progonomys*, such as the development of cusp t7 and convergent tendency for union of t6 and t9 on M1, and the presence of a strong tma on m1.

The material which forms the basis of this study was collected from Lantian, Shaanxi Province by the team members of a joint project supported by the Chinese Academy of Sciences and the Finnish Academy of Sciences during the field season of 1997 ~ 2000 by means of screenwashing. In addition to the murids described in this paper are 15 forms of small mammals and some other large mammals from 7 localities of the Bahe Formation. Preliminary reports on the micromammalian fauna, and implications for biochronology and paleoecology of the fauna have already been given (Qiu et al., 2003). For the geological background of these localities, the reader is referred to Zhang and others (2002) and Kaakinen and Lunkka (in press).

2 Systematics

Muridae Illiger, 1811

Murinae Illiger, 1811

Progonomys Schaub, 1938

Type species *Progonomys cathalai* Schaub, 1938.

Diagnosis (emended by Mein et al., 1993) Muridae with lengthened and slender molars, without longitudinal connections between the tubercles, and slightly larger than those of the extant *Mus musculus*. M1 with an almost elliptical outline, with the t1 in an anterior position (not placed backwards) and without t1 bis. t4 united to t5 by a high connection, and with a tendency to fuse with t8 by a low crest, that never forms a t7. Upper molars with t6 and t9 generally separated. m1

with a reduced or absent tma; the anteroconid-metaconid connection is generally absent, except in very much worn specimens. Upper molars with one single lingual root. m1 with two main roots and a small central one.

Remarks The authors follow J. van Dam's opinion that "The general absence of the anteroconid-metaconid connection in m1 should not be used as a character" (van Dam, 1997). The connection is generally present not only in the type species *Progonomys cathalai* as mentioned by van Dam, but also in the reference taxa as selected by Mein and others (1993), such as *P. cathalai* from Peralejos (van de Weerd, 1976) and *P. woelferi* from Siwalik deposits of Pakistan (Jacobs, 1978).

Progonomys sinensis sp. nov.

(Fig. 1)

2002 *Progonomys* cf. *P. cathalai* Zhang et al., p. 171 [partim]

2003 *Progonomys* cf. *P. cathalai* Qiu et al. (in press) [partim]

Etymology "sino"-referring to China, where the new species was found.

Holotype A left M1; V 13717 (2.20mm × 1.40mm).

Type locality Loc. 19, Lantian County, Shaanxi Province (China).

Stratum typicum Bahe Formation, early Baodean, early late Miocene.

Paratypes Loc. 19: 60 isolated teeth (15 M1, 7 M2, 3 M3, 14 m1, 17 m2, 4 m3, some are damaged), V 13718. 1 ~ 60;

Loc. 12: 6 isolated teeth (2 M1, 2 M2, 2 m1, 3 m2, only one M2 is preserved well), V 13718. 61 ~ 66;

Loc. 38: 8 isolated teeth (1 M1, 1 M3, 3 m1, 3 m2, some are damaged), V 13718. 67 ~ 74;

Loc. 13: 1 damaged m2, V 13718. 75.

Measurements (Table 1)

Table 1 Measurements of molars of *Progonomys sinensis* sp. nov. from Locs. 19 (type locality), 12, 38 and 13

(mm)

Tooth	Loc.	N	Length Mean	Range	N	Width Mean	Range
M1	19	6	2.22	2.15 ~ 2.30	12	1.38	1.30 ~ 1.45
	38	1	2.10		1	1.30	
M2	19	6	1.44	1.40 ~ 1.50	6	1.28	1.25 ~ 1.30
	12	1	1.40		1	1.25	
M3	19	3	0.87	0.85 ~ 0.90	3	1.00	0.95 ~ 1.05
	38	1	0.95		1	1.00	
m1	19	8	1.94	1.80 ~ 2.05	11	1.17	1.10 ~ 1.25
	12	1	1.95		1	1.25	
	38	2	1.93	1.90 ~ 1.95	2	1.18	1.10 ~ 1.25
m2	19	15	1.42	1.35 ~ 1.50	14	1.24	1.15 ~ 1.35
	38	2	1.47	1.45 ~ 1.50	2	1.23	1.20 ~ 1.25
	13				1	1.20	
m3	19	4	1.10	1.05 ~ 1.20	4	0.95	0.90 ~ 1.00

Diagnosis *Progonomys* of size generally larger than *P. cathalai*. Lower molars with very weak labial cingulum and cuspsules. A minuscule tma present in about two third of m1. A posterior spur from t1 and t3 on M1, and a short medial ridge on m1 present occasionally. Molars falling

within the size range of *P. woelferi*, but t6 ~ t9 connection less frequent and t12 more pronounced than in *P. woelferi*.

Description

1) Material from the type locality

M1: The t1 is rounded or elliptical, united to the t2 by a short and narrow crest; it presents a weak posterior spur towards the t5 on one specimen; its anterior limit is almost opposite the posterior limit of the t3. The t3 is distinctly smaller than the t1; a posterior spur is present in one specimen. The t4 is slightly posterior to the t6 and similar to t6 in size; it is united to t5 by a crest that is as high as the connection of t5 ~ t6; all the specimens have t4 united to t8 by a narrow and low crest. The t6 is separated from t9 in 10 out of 11 specimens, connected to t9 by a very low and thin crest on one tooth (Fig. 1, 1), and presents a short posterior spur in one specimen. The orientation of the t8 ~ t9 pair is variable from an acute angle to perpendicular to the longitudinal axis of the molar. The t12 and a clear fold between t9 and t12 are always present. A prestyle between t2 and t3 is variably developed in 6 of 9 teeth, and a tiny t0 is present on one molar. There are three main roots (a single lingual root) and a trace of central rootlet.

M2: The t1 is well developed and connected either with the t5 or with the weak t3 by a very thin crest via the anterior wall of t5. The t3 is smaller than t9. The second chevron is similar to that of M1 in structure, with the t4 being slightly posterior to t6, united to t5 by a crest as high as the connection of t5 ~ t6, and united to the t8 by a narrow crest. The t6 and t9 are usually well separated, but show a tendency to connect in one specimen. The t12 and the fold between t12 and t9 are as described on M1. There are three roots; in two of three specimens a shallow vertical groove is present on the inner face of the lingual root.

M3: The t1 is pronounced, rounded or oval, and separated from or united to t5 by a thin crest. The t3 is very minute or absent. The t4, t5 and t6 merge into a strong chevron. The t6 and t9 are convergent. The t8 and t9 is nearly or completely fused. Three roots are present.

m1: Both lobes of the anteroconid are similar in shape and of subequal size, and united in 9 of 10 specimens; the labial lobe is slightly posterior relative to the lingual one. A minuscule tma usually attached to the anterolingual lobe is present in 8 of 12 specimens. The anteroconid joins the protoconid-metaconid connection in 9 of 11 teeth by a low and short anterior mure from the labial lobe of anteroconid. The labial (protoconid and hypoconid) and lingual (metaconid and entoconid) principle cuspids are similar in size and shape, respectively, with the labial situated slightly posterior relative to the lingual cuspids. There is no longitudinal connection between the two posterior pairs of tubercles, although a short medial ridge is present in one of 13 specimens. The labial cingulum is narrow but continuous, from the posterolabial limit of the labial anteroconid to the posterolabial border of the tooth, with a small c1 in about half of the specimens; a c2 is not developed. The posterior tubercle is low and ridge-like. There are two main roots and a trace of central rootlet on all specimens with roots preserved.

m2: The labial anteroconid is small, low and united to the anterior wall of the protoconid. The two chevrons comprised of the major cuspids are similar to the two posterior pairs of tubercles on m1 in shape, but the posterior chevron is more reduced. There is no connection between the two chevrons, but a vestige of a longitudinal spur can be seen in 2 or 3 teeth. The labial cingulum extends posteriorly from the anteroconid to the hypoconid; a tiny c1 is present in most of the specimens and a c2 is visible in some. The posterior tubercle is low, flattened oval or ridge-like. Two roots are present.

m3: The labial anteroconid is small and low but always present. The protoconid is incorporated with the metaconid to form a strong and nearly transverse ridge on the tooth. The posterior cuspid represented by the fused hypoconid and entoconid is displaced towards the lingual side. A clear labial cingulum and a cuspid c are absent. Two roots are present.

2) Comparisons with the material from the other localities

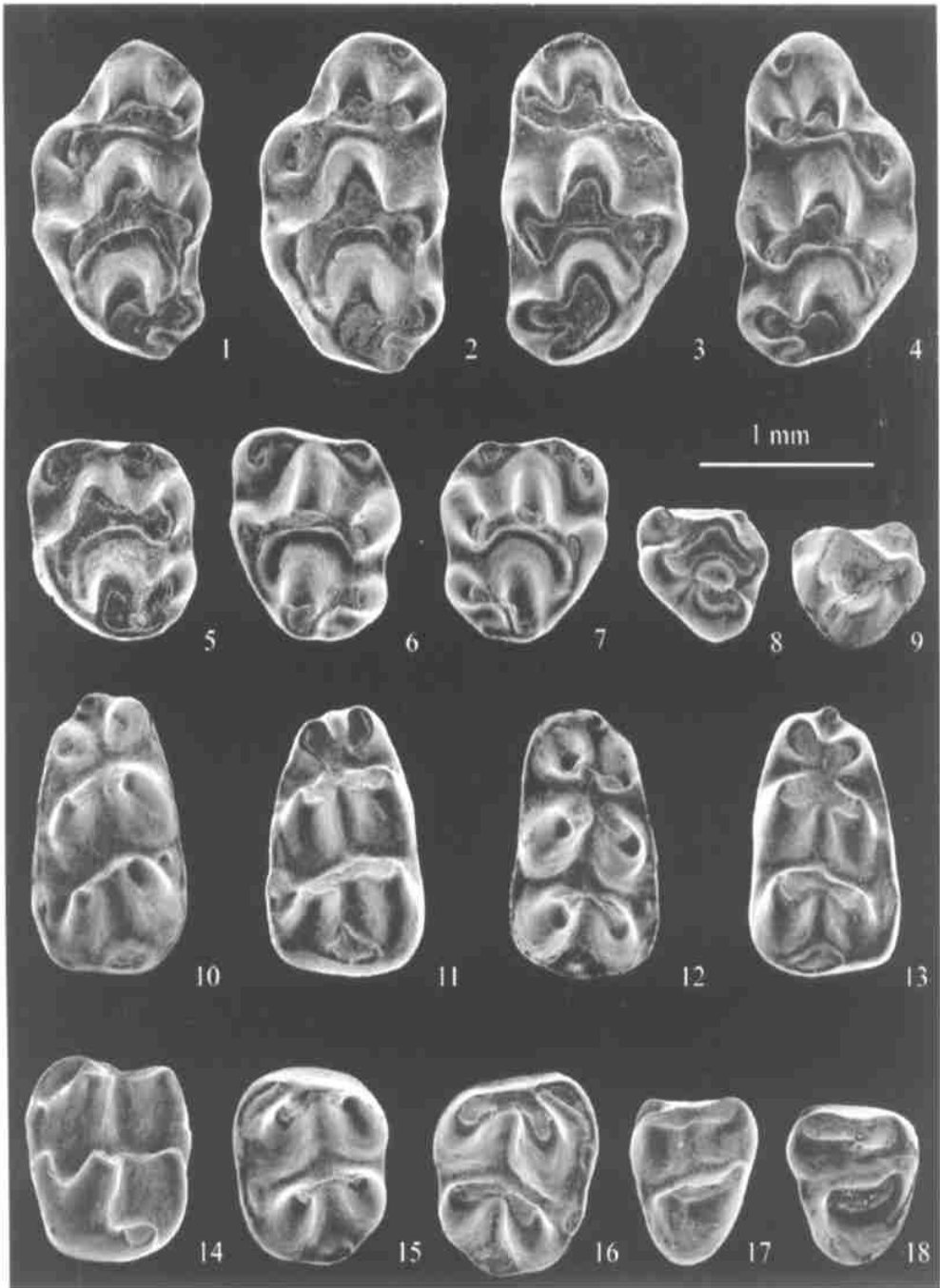


Fig. 1 *Progonomys sinensis* sp. nov., occlusal view

1. 1 M1 (V 13718. 1) ; 2. 1 M1 (V 13718. 2) ; 3. r M1 (V 13718. 3) ; 4. r M1 , Holotype (V 13717) ;
 5. 1 M2 (V 13718. 61) ; 6. 1 M2 (V 13718. 4) ; 7. r M2 (V 13718. 5) ; 8. 1 M3 (V 13718. 6) ;
 9. r M3 (V 13718. 7) ; 10. 1 m1 (V 13718. 67) ; 11. 1 m1 (V 13718. 8) ; 12. r m1 (V 13718. 68) ;
 13. r m1 (V 13718. 9) ; 14. 1 m2 (V 13718. 10) ; 15. 1 m2 (V 13718. 11) ;
 16. r m2 (V 13718. 12) ; 17. 1 m3 (V 13718. 13) ; 18. r m3 (V 13718. 14)

Specimens from Loc. 12 are scarce and rather damaged except for an M2 (Fig. 1, 5). Two broken M1, with very low t4 ~ t8 connection, appear to be smaller than those of the type-population. Other fragmentary teeth fall in the variation shown by the specimens from the type locality both in size and morphology.

An unworn M1 from Loc. 38 has low crests, especially the connection t4 ~ t8, and falls into the lower end of measurements for the corresponding teeth from Loc. 19. A minuscule tma is present in three m1, but an anteroconid-metaconid connection is missing in two of the three teeth (Fig. 1, 10, 12).

A damaged m2 from Loc. 13 is arbitrarily referred to this species, as it is identical with the corresponding tooth from the type locality.

Comparisons and discussion The murid described is characterized by having molars without longitudinal crests, three-rooted M1 with t4 connected to t8 by a low crest bearing no t7, t6 separated from t9, by M1 and M2 having a distinct t12, m1 having no or a very small tma and a trace of a small central root. These characters readily distinguish the Lantian taxon from early murids like *Huerzelerimys*, *Occitanomys*, *Hansdebruijnina*, *Parapodemus* and *Linomys*, but correspond to the diagnosis of *Progonomys* as emended by Mein and others in 1993.

In comparison with *Progonomys cathalai* from Montredon, the Lantian species is clearly larger in size, with relatively distinct tma, a small c1 and narrow labial cingulum on m1, but almost with the same frequency of the t6 ~ t9 connection on M1 (Schaub, 1938; van de Weerd, 1976). The population of *P. cathalai* from Biodrak, Crete, is considered the oldest record of *P. cathalai*. It is similar to the Lantian taxon in having a weak cingulum with small cusplids on lower molars, but differs in smaller size, and having a more pronounced t12 and a clearer fold between t9 and t12 (de Bruijn, 1976). The Lantian form can also be distinguished from the population from Ravin de la Pluie (de Bonis and Melentis, 1975) by its larger size and less pronounced t12 and less clear fold between t9 and t12. A comparison of the Chinese sample with the population attributed to *P. cathalai* from Masia del Barbo B, Spain shows close similarity in development of a tma on m1, but the Chinese sample has lower frequency of t6 ~ t9 connection of M1 and narrower labial cingulum bearing smaller accessory cusplids on m1 (van de Weerd, 1976; van Dam, 1997). The M1 from Bayraktepe, Turkey, referred to *P. cathalai* (Mein et al., 1993), is small with poorly developed connection of t4 ~ t8 (Ünay, 1981).

Comparing *Progonomys sinensis* with *P. woelferi* from the type locality (Köhfidsch, Austria), it is noted, that the Lantian species is close to the Köhfidsch population in size and development of tma, but differs in having much lower frequency of the t6 ~ t9 connection on M1 and more reduced labial cingulum and cusplids on m1 (Bachmayer and Wilson, 1980). The populations from Kastellos Hill and Torrent de Febulines are slightly larger, on an average, than the Lantian population, and show more reduced t12 and higher frequency of a posterior spur of t1 on M1 (de Bruijn et al., 1971; de Bruijn and Zachariasse, 1981; Mein et al., 1993). *Progonomys woelferi* from Lo Fournas 6 (France), is also larger with more robust cusps than the Lantian species, and shows slightly stronger development of cingulum cusplids on m1. *P. woelferi* (Jacobs, 1978) from YGSP 182A, Pakistan, is very similar to *P. sinensis* both in dimension and general habitus of molars, but differs from *P. sinensis* in having t1 and t4 located more anterior on M1 and better developed labial cingulum and accessory cusplids on m1. Based on these morphological differences, Storch and Ni (2002) questioned the assignment of the Siwalik taxon to *Progonomys*.

Cheema and others (1983) reported two new murid species, "*Kamimata* n. sp." and "*Progonomys* n. sp." based on a small sample from Jalalpur, Pakistan. Mein and others (1993) excluded the latter from *Progonomys* and suggested it might be related with the "*Mus*" group, because of its relatively large size and more posterior placement of t1 and t4 on M1. Additional collection from the same locality resulted in an assignment of only one species of murid in the fauna, e. g. *Progonomys hussaini* (Cheema et al., 2000). Although the sample of *P. hussaini* shows considerable

variation, it falls within the range exhibited by the genus *Progonomys* both as to size and morphology. In our opinion, the specimens of *P. hussaini* correspond to the diagnosis of *Progonomys* sensu stricto and there seems no reason to exclude this species from the genus. *P. hussaini* is smaller, with better developed labial accessory cusplids on m1 than in the Lantian taxon. The smaller size is currently interpreted as a more primitive feature for *P. hussaini*.

Mein and others (1993) have pointed out that the lineage *P. cathalai* - *P. woelferi* shows a size increase and morphological stability in the course of time. In overall size, *P. sinensis* is slightly larger than *P. cathalai* and falls within the size range of *P. woelferi* (Fig. 2). *P. sinensis* also demonstrates great similarities to *Progonomys cathalai* and *P. woelferi* in morphology of molars. Morphologically, *P. sinensis* differs evidently from these two species in having a weak labial cingulum and cusplids on m1 and m2. In addition, on the m1 of *P. sinensis* the tma is more frequent than in *P. cathalai*; on the M1 a posterior spur from t1 and t3 and on the m1 a short medial ridge present occasionally on *P. sinensis* have not been found in *P. cathalai*. On the M1 of *P. sinensis* the t6 ~ t9 connection and the posterior spur of t1 and t3 are less frequent, and the t12 is less reduced than in *P. woelferi*. Judging from the evolution tendency of the lineage *Progonomys* - *Huerzelerimys* (i. e. gradually convergence and union of t6 and t9, reduction of t12, development of tma, and strengthening of longitudinal connections), *P. sinensis* appears intermediate in morphology between the two named species of *Progonomys*. This suggests that *P. sinensis* may be younger than *P. cathalai*, but slightly older than *P. woelferi* in age. *P. cathalai* appeared in Europe at the beginning of the late Vallesian (MN10), and the last *P. woelferi* occurred in Europe and southern Asia in the early Turolian (MN11) or its equivalence. Thus, the age of *P. sinensis* can probably be correlated with late Vallesian or MN10 of Europe.

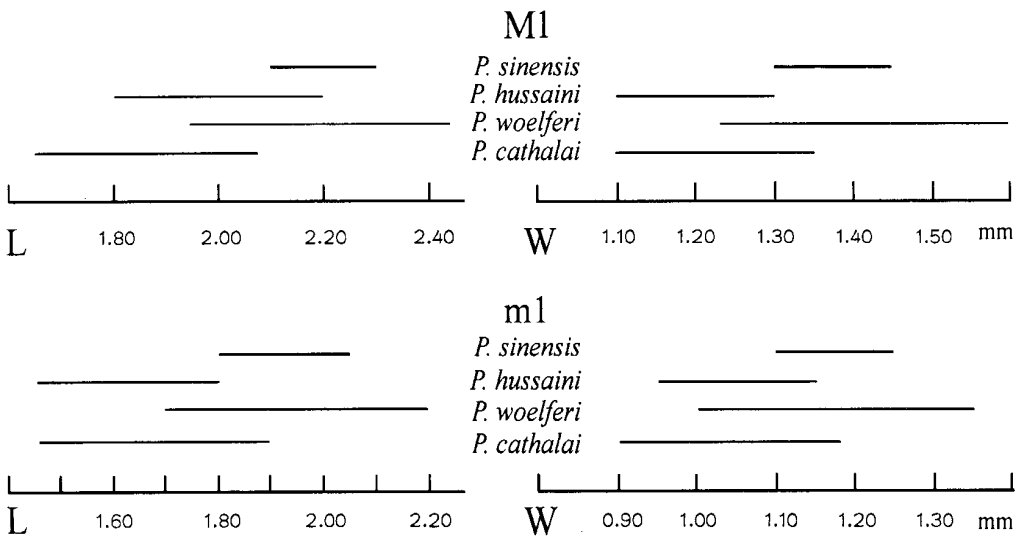


Fig. 2 Size ranges of the first molars of *Progonomys sinensis*, *P. hussaini*, *P. woelferi* and *P. cathalai*. Dimension data for *P. cathalai* and *P. woelferi* are quoted from Mein and others (1993)

Muridae gen. et sp. indet.

(Fig. 3)

2002 *Progonomys* cf. *P. cathalai* Zhang et al., p. 171 [partim]

2003 *Progonomys* cf. *P. cathalai* Qiu et al. (in press) [partim]

Material and measurement Loc. 6: 1 M1 (1.85 mm × 1.15 mm), 2 M2 (1.30 mm ×

1.10 mm; 1.35 × - mm), 1 m2 (1.20 mm × 0.95 mm), 1 m3 (0.80 mm × 0.70 mm), V 13719.1 ~ 5;

Loc. 46: 1 damaged M2, V 13719.6;

Loc. Ms21: 1 M2 (1.15 mm × 0.95 mm), 1 damaged m1, V 13719.7 ~ 8;

Loc. Ms36: 1 m1 (1.50 mm × 0.95 mm), V 13719.9;

Loc. Ms40 + 44: 2 damaged m1, V 13719.10 ~ 11.

Description The only M1 from the middle part of the Bahe Formation is similar to that of *Progonomys sinensis* in occlusal outline, but the lingual inflection between the t1 and t2 is less pronounced. The t1 is incipiently twinned, with the anterior lobe slightly larger than the posterior; the t1 is united to the t2 by a short and strong crest; it presents a thin posterior spur to join the base of the connection t4 ~ t5; its anterior limit is almost opposite the posterior limit of the t3. The t3 is smaller than the t1; a narrow posterior spur is connected to the base of t6. The t4 is slightly posterior relative to the t6 and similar in size to t6; it is united to t5 by a short crest and to the t8 by a more distinct crest. The t6 is separated from t9, but with a vestigial posterior spur directed toward it. The t12 and a deep fold between t9 and t12 are well developed. There are three main roots, with the lingual root enlarged anteroposteriorly and a shallow vertical groove on the lingual face.

M2 is broader anteriorly than posteriorly. The t1 is well developed, united either to the t5 or to the small t3 by a very thin crest via the anterior wall of t5. The t3 is smaller than t9. The t4 is slightly posterior to t6, united to the t8 by a high crest. The t6 is separated from t9. The t12 and the fold between t12 and t9 are distinct. There are four roots in one specimen and three in another (both specimens with two anterior roots).

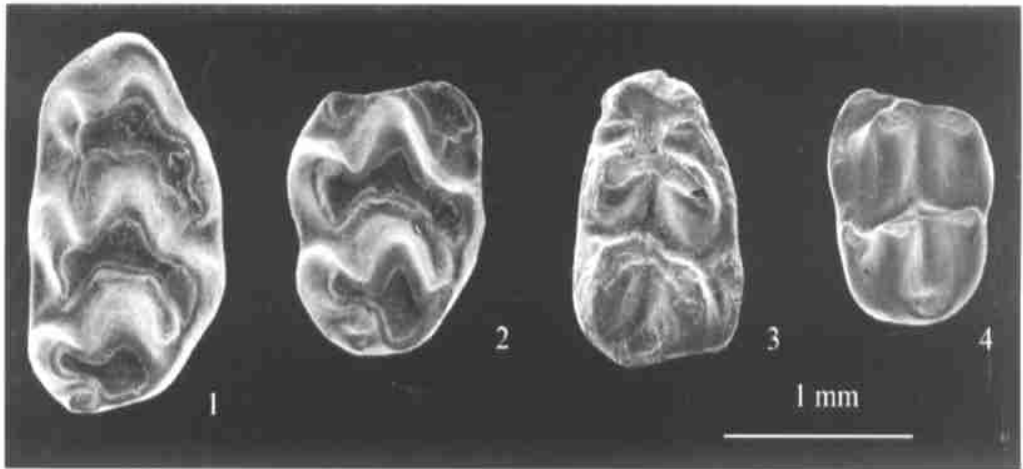


Fig. 3 Muridae gen. et sp. indet., occlusal view

1. r M1 (V 13719.1); 2. r M2 (V 13719.2); 3. r m1 (V 13719.9); 4. 1 m2 (V 13719.3)

The m1 specimens are damaged. The anteroconid joining the protoconid-metaconid connection by a low and short anterior mure, generally extending from the labial lobe of anteroconid can be seen in 2 teeth. The lingual principle cuspids are situated slightly anterior relative to the labial ones. There is no longitudinal connection between the two posterior pairs of tubercles, but an incipient medial ridge is present in 2 of 3 specimens. The labial cingulum is narrow, bearing a small c1 in 3 of 4 specimens; a c2 is not developed. The posterior tubercle is low and ridge-like. On the specimens with roots preserved they have two roots without any trace of a central rootlet.

m2 has a small and low labial anteroconid united to the protoconid. A low longitudinal spur is visible between the two chevrons. The labial cingulum extends posteriorly from the anteroconid to the hypoconid and bears a tiny c1. The posterior tubercle is low, flattened oval in shape. Specimens are

two-rooted.

A minute and low labial anteroconid is present on the m3. The anterior transverse ridge derived from the protoconid and metaconid is strong and the posterior cuspid derived from the fused hypoconid and entoconid is displaced toward the lingual side. A labial cingulum and C cusplids are absent. Specimens are two-rooted.

Remarks This taxon described above is similar to *Progonomys sinensis* in outline and shares some plesiomorphous characters with the latter, such as a three-rooted M1 with t4 connected to t8 by a low crest bearing no t7; t6 being separated from t9; M1 and M2 having a distinct t12; m1 having no longitudinal connection. Nevertheless, it differs from *P. sinensis* in having M1 with a twinned t1, a less deep lingual inflection between the t1 and t2, long posterior spurs of t1 and t3 that join to the posterior tubercles, and in having M1 with an expanded lingual root and M2 with two lingual roots, as well as M1 and m1 without any trace of a central rootlet. The twinned t1 and less deep lingual inflection may be individual variation, but the long posterior spurs of t1 and t3, the two lingual roots on M2, and the absence of a central rootlet can only be interpreted as derived morphological characters for this unnamed species.

It is likely that this murid shows closest affinities with *Progonomys sinensis*, but seems incongruent with the latter in morphology. It probably represents a taxon with more advanced characters. The higher stratigraphic occurrence of this taxon might be consistent with such a conjecture (Zhang et al., 2002). Unfortunately, it is really too poorly preserved to allow definition below the family level.

3 Conclusion

The Bahe Fauna contains two taxa of Muridae, *Progonomys sinensis* sp. nov. and Muridae gen. et sp. indet. *P. sinensis* possesses characters corresponding very well to the diagnosis of *Progonomys* sensu stricto as emended by P. Mein and others in 1993. It represents a reliable and secure record of the genus *Progonomys* in China. The indeterminate genus and species was probably closely allied to the named species of *Progonomys*, with the new named species occurring in the lower horizons of the Bahe Formation and the latter in the higher ones.

Comparison of the known species of *Progonomys* with the new Chinese species appears to have an evolutionary grade intermediate between *Progonomys cathalai* and *P. woelferi*. On the basis of current *Progonomys* biochronology, an age equivalent to late Vallesian (MN10) of the European mammal chronology can be inferred for the lower part of the Bahe Formation, which produces *Progonomys sinensis*. Thus, the new species *Progonomys sinensis* represents the oldest known record of murids from China. This assumption is corroborated by the coexistence of other taxa in the fauna, such as *Protalactaga* commonly known from the Chinese middle Miocene deposits and *Myocricetodon* known from the Quantougou Fauna of middle Miocene.

Among the early murids, both *Progonomys sinensis* and *Hansdebruijnina perpusilla* occur in North China, and have a wide Eurasian distribution. They offer not only an approach to biogeography, but also a possibility of biochronological correlations between Europe and Asia.

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