

# 河北阳原—蔚县晚上新世鼠科化石

蔡保全

(福建漳州师范学院)

邱铸鼎

(中国科学院古脊椎动物与古人类研究所)

**关键词** 河北阳原、蔚县 晚上新世 鼠科

## 内 容 提 要

本文描述了泥河湾盆地晚上新世稻地组中发现的鼠科化石: *Apodemus cf. atavus* Heller, 1936; *Karnimata* sp.; *Chardinomys nihewanicus* (Zheng, 1981); *Micromys aff. sedfordi* Wu & Flynn, 1992; *Huaxiamys cf. downsi* Wu & Flynn, 1992 和 *Saidomys* sp. 六属六种。同时对这一鼠类群体的性质及指示的地质时代作了探讨。

1984 年, 本文前一作者在河北省阳原县、蔚县沿壶流河下游考察时, 于稻地、红崖南沟、钱家沙洼等八个地点的泥河湾层(广义)下部, 用筛洗法采集到一批小哺乳动物化石。在这之前, 该作者已对标本作了初步鉴定, 并详细描述了其中的兔形类(见蔡保全, 1987; 1989)。本文仅描述材料中啮齿类的鼠科化石。稻地地区的鼠类化石材料丰富, 种类较多, 对研究晚第三纪以来该科的演化及地层的划分具有一定的意义。

化石地点的地质概况详见蔡保全 1987 年《河北阳原—蔚县晚上新世小哺乳动物化石》一文。杜恒俭等(1988)已正式命名含化石层为稻地组。

本文描述中使用的牙齿构造术语, 参考了施托希 (Storch, 1987) 的图示和解析。M 代表上臼齿, m 代表下臼齿。

## 一、系统描述

### 鼠科 Muridae Gray, 1821

#### 姬鼠 *Apodemus* Kaup, 1829

#### 祖姬鼠(相似种) *Apodemus cf. A. atavus* Heller, 1936

(图 1A、B, 图 4; 图版 I, 图 1—8)

1987 *Apodemus* sp., 蔡保全, P129。

1988 *Apodemus* sp., Qiu Zhuding, P837。

**材料** 稻地: 2 M1, 2 m1, GV-N-8401.1-4; 红崖南沟: 1 M3, 2 m1, 1 m 2, GV-N-8402.1-4; 钱家沙洼: 3 M1 (一枚残破), 1 M2, GV-N-8403.1-4; 祁家庄:

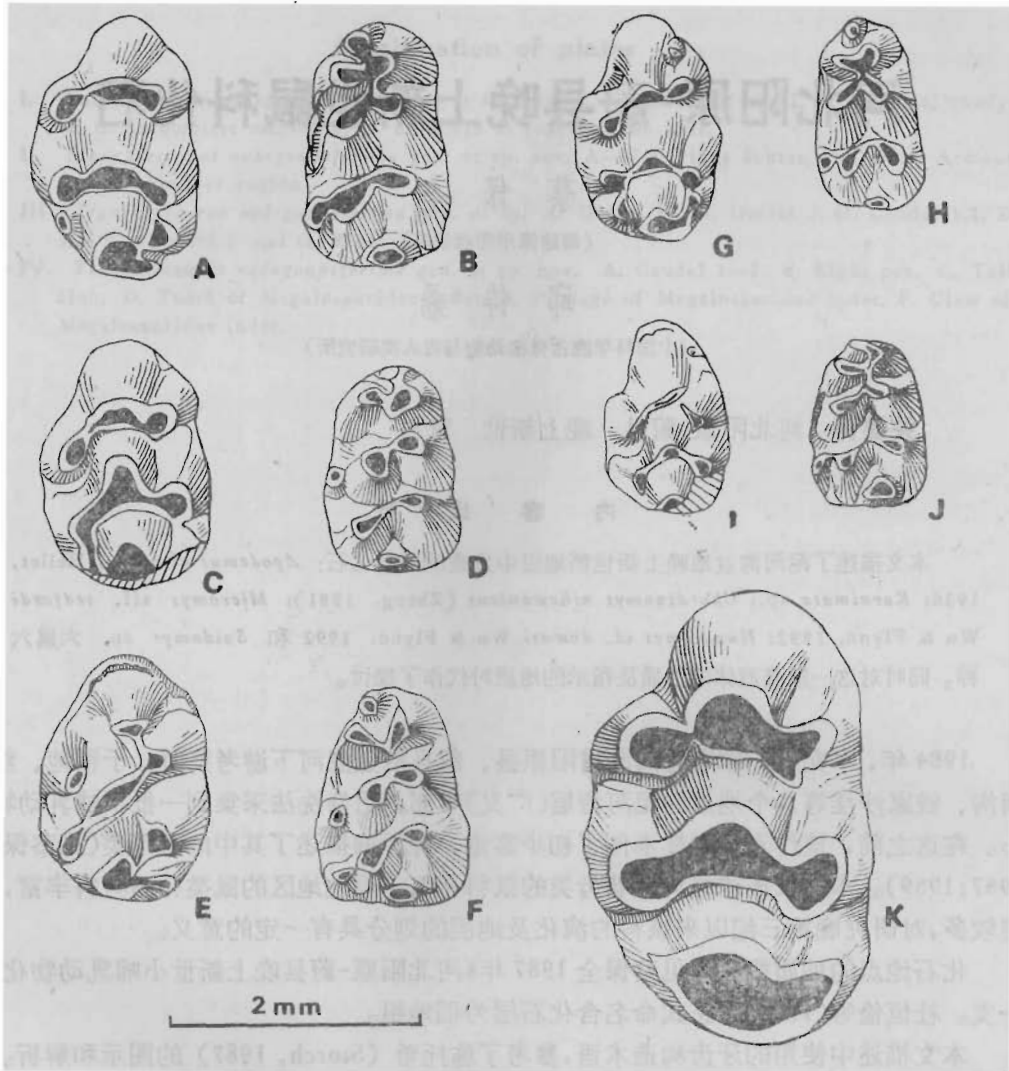


图1 稻地鼠科化石各种的上、下第一白齿,冠面视

*Apodemus cf. atavus*, A——右 M1(GV-N-8401.1), 反转 (inverse), B——左 m1 (GV-N-8401.3); *Karnimata* sp., C——左 M1(GV-N-8408), D——左 m1 (GV-N-8407); *Chardinomys nihewanicus*, E——左 M1 (GV-N-8409.21), F——左 m1 (GV-N-8409.137); *Micromys* aff. *redfordi*, G——左 M1 (GV-N8417.7), H——左 m1 (GV-N-8419.4); *Huaxiamys* cf. *downsi*, I——左 M1 (GV-N-8423.1), J——右 m1 (GV-N-8423.2), 反转 (inverse); *Saidomys* sp., K——右 M1 (GV-N-8424.1), 反转 (inverse)

Fig. 1 M1 and m1 of murids from Daodi, occlusal view

1 M1 (残破), 1 M2, 2 m2, GV-N-8404.1-4; 茈子沟: 1 m2, GV-N-8405; 铺路: 1 M2, GV-N-8406。

测量(长×宽, mm, 下同) (见图2) M1: 2.00—2.10 (4 标本) × 1.10—1.35 (6); M2: 1.35—1.40 (3) × 1.15—1.30 (3); M3: 0.85 × 0.85 (1); m1: 1.70—1.95 (4) × 1.10—1.20 (4); m2: 1.20—1.35 (4) × 1.10—1.15 (4)。

**描述 M1** (图 1A; 图版 I, 图 1,2): 齿尖粗壮、醒目。t1 位置比 t2 和 t3 靠后, 与 t2 连接; t2 比 t1 和 t3 都强大, 与 t3 紧靠; t1 和 t3 常有不甚明显的后刺; t6 与 t9 紧密连接; t7 在正型标本中较小, 靠近 t4, 在其它标本则明显发育, 且较远离 t4; 所有标本都有一清楚、但并不十分粗壮的 t12。未见 t0 及前附尖 (prestyle)。三齿根, 一标本具中央细根。

**M2** (图版 I, 图 3、4): t1 比 t3 大很多, 两尖常以一细而低的脊连接于 t5 的前缘; t7 在三个标本中有两个呈脊形、与 t4 连接, 另一标本的 t7 强大, 并以宽而深的谷与 t4 分开; t6 与 t9 紧密连接; t12 清楚。齿根破损, 但具三根的痕迹。

**M3:** t1 大, 圆形; 未见 t3; t4、t5 和 t6 连成不对称、凸向前方的强脊; t8 大小和形状接近 t1; 无 t7、t9 和 t12。三齿根, 以唇侧根最大。

**m1** (图 1B; 图版 I, 图 5、6): 冠面似长方形, 后部不特别扩大。三个标本均有一显著的中间下前边尖 (tma), 该尖在稍磨蚀的标本中即连接于舌、唇侧下前边尖联合部; 唇、舌侧下前边尖大小近等, 前后向压扁状, 两尖构成一略呈前舌-后唇向倾斜的横脊; 下原尖和下后尖大小亦接近, 分别向唇后和舌后向倾斜, 构成牙齿上强大、前凸的中间横脊; 下次尖比下内尖小, 两者的形状和排列分别与下原尖及下后尖相似。中间横脊前方具一弱的齿襞 (mure), 未见有明显的中间脊 (medial ridge)。c1 显著, 紧靠下次尖; c2 比 c1 小, 脊形。后齿带 (cp) 显著、孤立、椭圆形。两齿根。

**m2** (图版 I, 图 7、8): 中间横脊和后横脊的形状和排列与 m1 的相似。有唇侧下前边尖; 无唇侧附属尖, 但从唇侧下前边尖至下次尖的前外侧有一极弱、往往在下原尖外侧中断的齿带。后齿带明显, 椭圆形。两齿根。

**比较与讨论** 姬鼠属广布古北区, 最早出现于欧洲中新世晚期 (MN13), 一直延续至今。目前已知近 20 种, 其中 7—8 个化石种。

中国前全新世地层中发现的种有: *Apodemus orientalis* (Schaub, 1938) (内蒙古二登图、哈尔鄂博, 晚中新世保德期—早上新世榆社期, 见 Storch, 1987); *A. qiui* Wu et Flynn, 1992 (山西榆社, 早上新世榆社期); *A. zhangwagouensis* Wu et Flynn, 1992 (山西榆社, 晚上新世榆社期); *A. chevrieri* (Milne-Edwards, 1869)、*A. cf. peninsulae* (Thomas, 1906)、*A. latronum* (Thomas, 1911)、"*A. dominans*" Kretzoi, 1959 (湖北巫山, 早更新世, 见黄万波等, 1991); *A. "sylvaticus"* Linnaeus, 1758 (北京周口店、四川盐井沟, 中更新世, 见 Young, 1934; Colbert et al. 1953), *A. draco* Barrett-Hamilton, 1900 和 *A. latronum* Thomas, 1911 (云南呈贡, 晚更新世, 见邱铸鼎等, 1984)。

稻地这一姬鼠的牙齿尺寸比 *A. orientalis* 的大, 齿冠也高, 齿尖较粗壮, 总有 t7, t12 相对较弱, 显然具有较进步的特征而不同于内蒙古的姬鼠。

山西榆社的 *A. qiui* 和 *A. zhangwagouensis* 的不同在于下颌骨颞孔位置, 牙齿形态差异不大, 但两者的齿冠都比稻地姬鼠的低, 齿尖相对于齿谷较弱, M2 四根, 都有别于稻地姬鼠。

稻地姬鼠在牙齿大小和齿尖的粗壮程度上与巫山的 *A. chevrieri* 接近, 但后者的齿冠较高, M1 的 t2 和 t7 较发育, 而 t9 相对较弱, 又具四齿根, 似乎比前者进步。 *A. cf.*

*peninsulae* 的 M1 具发育的“皇冠型齿”构造, t12 非常显著。 *A. latronum* 的个体较小, 齿冠也低, m1 的唇侧附尖很发育。巫山的“*A. dominans*”似乎在大小和形态上都无异于该地发现的 *A. latronum*, 而与西亚及欧洲上新世具较弱齿尖的“*A. dominans*” (即 *A. atavus*) 有所不同。

稻地姬鼠以较大的个体、t1 位置较前、t7 较强, 以及没有 t0 和前附尖而异于周口店的 *A. “sylvaticus”*。

呈贡的两种分别与云南现生的 *A. draco* 及 *A. latronum* 相似, 前者的个体较小, M1 狭长, 后者个体大, 齿尖显著, 都异于稻地种。

欧洲第三纪晚期地层中发现的姬鼠有 *Apodemus ieanteti* Michaux, 1967; *A. primaevus* Hugueney & Mein, 1965 (= *A. gudrunae* Weerd, 1976); *A. etruscus* Engesser, 1989 和 *A. atavus* Heller, 1936 (= *A. dominans* Kretzoi, 1959)。

*A. ieanteti* 是一种大个体姬鼠, 其 M1 的 t3 常有一发育的后刺, t12 明显, m1 的前中间尖很退化, 稻地种易于与其区分。

*A. primaevus* 和 *A. etruscus* 是该属较原始的种, 大部分个体的 M1 和 M2 没有或只有极弱的 t7, 或缺少 t6 与 t9 间的连接。稻地标本没出现相似的情形。

*Apodemus atavus* 是黑勒 (Heller) 于 1936 年根据采自德国贡德斯海姆 (Gundersheim) 的材料建立的, *A. dominans* 是克莱佐依 (Kretzoi) 于 1959 年根据匈牙利萨诺塔 (Csarnota) 订立的。两者所产层位时代相同, 形态特征一致, 应为同物异名。对此, 施托希和菲法尔 (Storch & Fejfar; 1990, Fejfar & Storch, 1990) 已有所论述。在六十一七十年代, 这种中等大小的姬鼠先后在欧洲和西亚一些上新世一早更新世地点 (MN15—MN17) 被发现, *A. dominans* 这一种名被古生物学者广泛使用。尽管如此, 本文作者随施氏等按命名法的优先律, 使用 *A. atavus* 这一种名。

稻地姬鼠牙齿的一般形态和齿冠高度与 *A. atavus* 地模标本的接近, 不同只是个体略小, 齿尖相对于齿谷显得较突出, t3 的后刺稍弱。

从上比较看来, 稻地姬鼠在形态上与欧洲及西亚的 *Apodemus atavus* 最相似。它与后者确实存在一定的差异, 但这种差异不足以另立新种。鉴于它们在形态上的相似及微细差异, 这里把稻地标本指定为 *A. atavus* 的相似种。它具有比正型地点贡德斯海姆群体稍显著的齿尖及 M1 具较退化的 t3 后刺, 似乎属于较进步的特征, 可能说明其生存时代略晚。

### 仙鼠 *Karnimata* Jacobs, 1978

#### 仙鼠(未定种) *Karnimata* sp.

(图 1C、D; 图版 II, 图 15、16)

**材料** 稻地: 1 m1 (稍磨损), 1.68 × 1.05mm, GV-N-8407; 祁家庄: 1 M1 (后外角破损), 宽 1.45mm, GV-N-8408。

**描述** M1 (图 1C; 图版 II, 图 15): t1 位于 t2 与 t3 之后, 以一粗壮的脊与 t2 连接。t2 和 t3 紧靠, 两者连成垂直牙齿纵轴的脊。t3 比 t1 略小, 无明显的后刺。t4 与 t6 近等大, 位于 t5 与 t6 之后。t6 与 t9 间有弱脊连接。尽管该标本的后外角破损, 但仍可判

断牙齿无 t7。三齿根。

**m1** (图 1D; 图版 II, 图 16): 齿尖粗壮, 近圆形。标本虽经磨损, 但仍可见小而与舌侧下前边尖连接的中间下前边尖的痕迹。舌侧下前边尖和唇侧下前边尖大小近等、紧靠; 前者位置稍后, 后外方有一凸, 但未成齿襞。下原尖和下后尖粗壮, 两尖前方由一短脊相连。下内尖为冠面上最强大的齿尖, 下次尖相对显得弱小。无中间脊。具 c1 和 c2。后齿带弱, 与下次尖连接。

**比较与讨论** 这两枚牙齿在大小和齿尖排列上与 *Apodemus* 的相似, 易于混淆。但它以 M1 没有 t7, t1 和 t4 的位置分别在 t2 和 t5 之后, m1 较短宽, 齿尖近圆形而不呈压扁状, 无齿襞而不同于 *Apodemus* 者。

稻地动物群的这一种仙鼠, 在大小和形态上与内蒙古二登图和哈尔鄂博动物群中的三趾马层仙鼠 (*Karnimata hipparionum* Schlosser, 1924) 的特征相似, 不同仅在于 M1 中 t1 和 t4 的位置更明显靠后, 连接齿尖间的脊较粗壮。这些或许可以理解为较进步的特征。由于材料不足, 这里暂作仙鼠属的一未定种处理。

仙鼠属系雅各布斯 (L. Jacobs 1978) 研究西瓦立克鼠科化石时所建, 迄今已知有六种以上, 主要分布于巴基斯坦和阿富汗 (见 Jacobs, 1978; Brandy, 1981; Cheema & Sen & Flynn, 1983; Storch, 1987; Sen, 1983)。我国二登图及稻地的这两种, 虽然在具圆而醒目的齿尖, 齿尖、脊弱, M1 无 t7 等方面与西南亚种的特征一致, 但具有正如施托希 (Storch, 1987) 所注意到的明显差异, 即我国的仙鼠种都有稍发育的“皇冠型齿”构造 (t6 与 t9 连接, t4 与 t8 间的脊一般较清楚, t3 时见后刺)。因此, 它们是否代表不同于西南亚 *Karnimata* 的另一属, 尚有待今后进一步探讨。

### 日进鼠 *Chardinomys* Jacobs & Li, 1982

**模式种** *Chardinomys yusheensis* Jacobs & Li, 1982。

**特征(增订)** M1 的 t1 和 t4 很后位; t5 呈长轴后内-前外向的梭形; t3、t5 和 t4 连成一排, 构成对角线状的斜脊; t0、t2 和 t3 排在牙齿前内-后外向的直线上; t6 通常与 t8 连接; 无 t7。M2 具弱的“皇冠型齿”构造。m1 具两或三个唇侧附尖, 其中 c2 总比 c1 大。

### 泥河湾日进鼠 *Chardinomys nihewanicus* (Zheng, 1981)

(图 1E、F, 图 2-4; 图版 II, 图 1-12)

1981 *Orientalomys nihewanicus*, 郑绍华, P349。

1987 *Orientalomys nihewanicus*, Storch, P408。

1987 *Orientalomys* sp. nov., 蔡保全, P129。

1988 *Orientalomys* sp. nov., Qiu Zhuding, P837。

1988 *Chardinomys louisi*, *C. nihewanicus*, 周晓元, P189。

1991 *Orientalomys nihewanicus*, 郑绍华、蔡保全, P119。

**特征(订正)** 个体比属型种 *Chardinomys yusheensis* 稍小。M1 中 t5 与 t6 的连接数量不超过 20%, t6 与 t9 的连接不大于 5%, 前附尖及前齿带较弱。m1 一般具两个唇

侧附尖。

**材料** 稻地: 7件破碎的上颌骨,附有5 M1, 4 M2, 3 M3; 8件破碎的下颌骨,附5 M1, 6 M2; 223枚臼齿(45 M1, 42 M2, 22 M3, 43 m1, 39 m2, 32 m3); GV-N-8409.1—238。红崖南沟: 10件破碎的上颌骨,附8M1, 1 M2, 1 M3; 4件破碎的下颌骨,附3 m1, 2 m2; 219枚臼齿(44 M1, 36 M2, 20 M3, 49 m1, 39 m2, 31 m3); GV-N-8410.1—233。祁家庄: 5件破碎的上颌骨,附4 M1, 1 M2, 1 M3, 111枚臼齿(31 M1, 20 M2, 5 M3, 32 m1, 18 m2, 5 m3); GV-N-8411.1—116。钱家沙洼: 3件破碎的上颌骨,带2 M1, 1 M2, 1 M3; 5破碎的下颌骨,带4 m1, 3 m2, 2 m3; 69枚臼齿(15 M1, 12 M2, 2 M3, 19 m1, 18 m2, 3 m3); GV-N-8412.1—77。茺子沟: 19枚臼齿(6 M1, 4 M2, 5 m1, 4 m2); GV-N-8413.1—19。将军沟: 5枚臼齿(1 M1, 1 M2, 2 m1, 1 m3); GV-N-8414.1—5。铺路: 14枚臼齿(3 M1, 2 M2, 5 m1, 2 m2, 2 m3); GV-N-8415.1—14。北马圈: 4枚臼齿(1 M1, 2 m1, 1 m2); GV-N-8416.1—4。

**测量** 见表1,图2,4。

表1 河北稻地泥河湾日进鼠牙齿测量(单位:毫米)

Table 1 Measurements of the teeth of *Chardinomys nihewanicus* from Daodi, Hebei (in mm)

牙齿 Tooth	标本数 N	长度(L)		宽度(W)	
		平均 Mean	范围 Min.—Max.	平均 Mean	范围 Min.—Max.
M1	159	1.86	1.70—2.05	1.32	1.15—1.45
M2	122	1.30	1.15—1.45	1.28	1.10—1.50
M3	53	0.90	0.75—1.05	0.94	0.80—1.05
m1	160	1.72	1.60—1.90	1.22	1.05—1.35
m2	127	1.29	1.15—1.40	1.24	1.10—1.40
m3	75	0.99	0.80—1.15	0.97	0.85—1.05

**描述** 从保存的上颌骨看,颧弓前部起于M1前方,M1齿根前方偏唇侧0.5—1.0mm处有一明显的神经孔,门齿孔后缘伸达M1前缘稍后处。下颌骨保存也不好,但可见其上的咬肌嵴下支发达、前部向上增厚,无咬肌嵴下支,齿虚强烈下凹,颧孔大、位于齿虚凹处的齿骨外侧。

**M1** (图1E; 图版II, 图1、2): t1圆柱形,位置比t3稍后,远离t2,紧挨t5。t2比t1和t3都大,略侧向延展。t3略呈前后压扁状,靠近t2,分别与t2和t5连接。t4大小接近t1,多少呈压扁状,位于t8稍前处,与t5连接,与t8分开或在很低处连接。t5前唇—后舌向拉长,咀嚼面呈梭形;与t3和t4连接成牙齿上显著的中间斜脊。t6与t3形状相似,但较大;大部分标本(90例)的t6以一沟与t5隔开,部分(34例)两尖有连接的趋向,但其间的脊断开,小部分(22例)有一细脊在基部相连; t6在绝大部分牙齿中(125例)以一短而斜的脊与t8连接,明显向后伸出一脊与t9连接的仅两例,连接t8和t9联合部的也只有19例。无t7。t9横向伸开,外伸的程度接近t6者。通常看不到t12,只在个别磨

蚀轻微的标本中,方见该尖残存的痕迹。142 枚牙齿中,125 枚具发育程度不同的  $t_0$ , 32 枚具显著的前附尖,25 枚有  $t_2$  bis, 34 枚见发育的前齿带, 4 枚在  $t_4$  的前外侧残留了一小的附属尖。绝大部分标本具 5 齿根,一或两个后外侧的两根融合在一起,三或四个后部或中间具一小根。

**M2** (图版 II, 图 3、4):  $t_1$  比  $t_3$  稍大,两尖位置相当或前者略靠后,两者后方均以一弱脊与  $t_5$  连接。 $t_5$  多少有点横向扩展。无  $t_7$  和  $t_{12}$ 。在 122 件标本中, $t_6$  在半数以上的标本中与  $t_9$  和  $t_8$  都分开,在基部以一弱脊与  $t_9$  连接的有 6 件,与  $t_8$  连接的有 11 件。一般  $t_4$  与  $t_8$  以沟相隔,仅 8 例其间有一低脊相连。一般 5 根,但少数标本的后唇侧根有不同程度的愈合。

**M3** (图版 II, 图 5、6):  $t_1$  很显著,但  $t_3$  极退化甚至完全消失。 $t_5$  偏唇侧,与  $t_6$  几融合。 $t_8$  与  $t_9$  通常融汇成一孤立的齿尖。三齿根。

**m1** (图 1F; 图版 II, 图 7、8): 呈前宽后窄的三角形。所有标本都有中间下前边尖,该尖与后方尖甚靠拢,孤立或以一弱脊与它们连接;在 154 个牙齿中,63 例孤立,16 例与唇侧下前边尖连接,30 例与舌侧下前边尖连接,42 例连接于两尖的联合部。舌侧下前边尖和唇侧下前边尖大小近等,形状相似,几在同一垂直于牙齿中轴的直线上,但两尖间的脊极弱或缺失;在约三分之二的牙齿中,它们与由下原尖和下后尖组成的第二列横脊间由一弱而低的齿鬣 (mure) 连接,其余为一深沟分开。超过半数 (65%) 有一细弱、一般很低的下中间脊,其中半数伸达下后尖。所有标本都有显著的尖状  $c_1$  和  $c_2$ , 其中  $c_2$  总大于  $c_1$ 。约四分之一标本唇侧下前边尖的后外方具齿带,该齿带在 22 件标本中发育成尖状的  $c_3$ 。后齿带弱,横向拉长,椭圆形至脊形不等。三齿根。

**m2** (图版 II, 图 9、10): 唇侧下前边尖发达,基部与下原尖连接。在 119 枚牙齿中,有 63 枚具发育程度不同的中间脊。所有标本都有  $c_2$ , 但只有半数 (57 例) 具  $c_1$ 。大部分牙齿四根,小部分五根。

**m3** (图版 II, 图 11、12): 唇侧下前边尖低而小,仅在一个标本中未见此尖的痕迹。无中间脊。下次尖和下内尖融合成牙齿后方一不甚强大的齿尖。三或四根。

**比较与讨论** 根据  $M_1$  的  $t_4$ ,  $t_5$  和  $t_3$  连成一排,构成前外-后内向、跨过牙齿的斜脊, $t_0$ ,  $t_2$  和  $t_3$  排在垂直于上述斜脊的另一直线上,  $M_2$  具弱的“皇冠型齿”构造,稻地材料可以归入雅各布斯和李传夔 (Jacobs et Li, 1982) 确立的日进鼠属 (*Chardinomys*) 中。

对于具有上述臼齿构造的化石鼠类的归属,在研究者中并未获得共识。在文献中可以看到,它或被归入日进鼠属——*Chardinomys* Jacobs & Li, 1982 (见 Jacobs et Li, 1982; 周晓元, 1988), 或被归入东方鼠属——*Orientalomys* De Bruijn & Vander Meulen, 1975 (见郑绍华, 1981; Storch, 1987; 汪洪, 1988; 郑绍华、蔡保全, 1991)。日进鼠和东方鼠在形态上确实具有很多相似之处,如两者  $M_1$  的  $t_1$  和  $t_4$  都很后位, $t_1$  远离  $t_2$ ,  $t_3$ ,  $t_5$  和  $t_4$  排成对角线上的一排,  $t_0$ ,  $t_2$  和  $t_3$  排成与这一排成直角相交的另一排, 无  $t_7$ ,  $m_1$  都有显著的  $c_1$  和  $c_2$ 。但两者有所不同,它们的差异在于:

— *Chardinomys*  $M_1$  的  $t_3$ ,  $t_5$  和  $t_4$  不仅排成一直线,而且彼此相连成脊,但在 *Orientalomys* 中,这一脊不完整,总有部分缺失;

— 日进鼠 M1 的 t5 前外-后内向拉长, 磨蚀面呈前唇-后舌向的梭形, 而东方鼠的 t5 似圆锥形, 磨蚀面近圆形;

— 日进鼠中, 多数 M1 的 t5 与 t6 分开, 仅 15% 左右由一低弱的脊连接, 而东方鼠中这两个尖总由一强大的脊相连;

— 日进鼠的 M1, t6 罕见与 t9 连接, 而东方鼠 M1 的 t6 总与 t9 相连;

— 日进鼠 M1 的 c2 总大于 c1, 而东方鼠只在 *Orientalomys similis* 中 c2 比 c1 稍大(见 Argyropulo et Pidoplichaka, 1939; De Bruijn et Van der Meulen, 1975), *O. cf. similis* 和 *O. galaticus* 中, c2 都小于 c1。

以上的差异表明, 日进鼠属和东方鼠属的界限清楚, 都应属于有效的属。迄今日进鼠属所报道的种有: *C. yusheensis* Jacobs & Li, 1982 (正型地点: 山西榆社高庄, 早上新世); *C. louisi* Zhou, 1988 (山西静乐贺丰, 晚上新世); *C. nihewanicus* (Zheng, 1981) (河北蔚县东窑子头大南沟, 早更新世); *C. schaubi* (Teilhard de Chardin, 1940) (北京十八地点, 早更新世)。

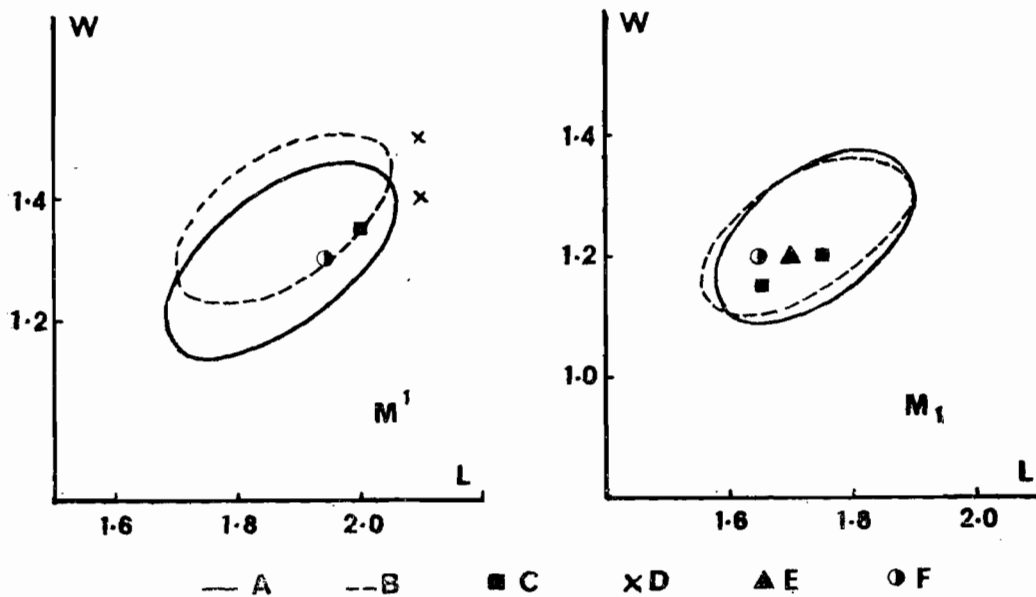


图2 日进鼠上、下第一臼齿测量图解

A. *C. nihewanicus*, 稻地 (Daodi); B. *C. nihewanicus*, 静乐 (Jingle); C. *C. nihewanicus*, 东窑子头 (Dongyaozitou); D. *C. yusheensis*, 高庄 (Gaozhuang); E. *C. sp.*, 渭南 (Weinan); F. *C. sp. nov.*, 比例克 (Bilike)

Fig. 2 Scatter diagrams showing length and width of M1 and m1 of *Chardinomys*

稻地的日进鼠不同于 *C. yusheensis* 在于其个体略小(图2), M1 的 t0 一般较弱, 标本中前齿带很少有像后者那样发育成显著的附属尖。

稻地标本 M1 宽度的平均值比静乐的 “*C. louisi*” 略小, 但两者在牙齿尺寸的变异范围上基本一致, 形态变异也十分相似(表2)。周晓元(1988)在记述静乐的日进鼠时就指出, 稻地标本与静乐标本“差异甚小”; 郑绍华等(1991)在论述东窑子头的“东方鼠”时,



也认为两地的标本同属一种。在这一点上,他们是正确的,但稻地标本不应称路易日进鼠或泥河湾东方鼠,而应称泥河湾日进鼠(见下)。

表 2 稻地、静乐泥河湾日进鼠 *M1* 形态变异统计(单位: 毫米)  
Table 2 Statistics of variable morphology for *M1* of *Chardinomys nihewanicus* from Daodi and Jingle (in mm)

	t5—t6 连接 t5—t6 connection	t6—t9 连接 t6—t9 connection	具 t0 t0	具前附尖 prestyle	具前齿带 precingulum
稻地	22*/146**	2/145	125/142	32/144	34/144
Daodi	15.1%***	1.3%	88.0%	22.2%	23.6%
静乐	11/78	2/77	15/77	16/78	16/77
Jingle	14.1%	2.6%	80.5%	20.0%	20.7%

\* 统计项在标本中所占数量

\*\* 被统计标本数量

\*\*\* 统计项在被统计标本中所占的百分数

*Chardinomys nihewanicus* 最先发现于河北蔚县东窑子头大南沟(见郑绍华, 1981; 郑绍华、蔡保全, 1991), 已知材料不多。正如上述研究者所注意到的, 这些牙齿的尺寸(见图 2)和形态都落入稻地或静乐日进鼠的变异范围。而周晓元根据原作者描述, 认为静乐的“*C. louisii*”不同于大南沟的 *C. nihewanicus* 在于后者的 *m2* 为三根, 以及其中的一个 *m3* 无唇侧下前边尖(周晓元, 1988)。经对大南沟标本的重新观察, 该 *m2* 的齿根破损, 但从保存的痕迹看, 它至少有 4 根; 该 *m3* 并非无唇侧下前边尖, 只是很弱而已, 也完全落入静乐或稻地标本的变异范围。这样看来, *C. louisii* 和 *C. nihewanicus* 应为同物异名。根据命名法则的优先律, 后者的名称应予以保留。因为稻地标本在形态特征上无异于静乐和大南沟者, 这里把它们统称 *C. nihewanicus*。另外, 汪洪(1988)记述采自陕西大荔的“*Orientalomys luohensis*”, 其大小和形态均落入稻地标本的变异范围, 似乎亦应归入这一种。

戴·布鲁耶等(De Bruijn et Van der Meulen, 1975)把德日进(Teilhard, 1940)记述的周口店的 *Stephanomys schaubi* 归入东方鼠属(*Orientalomys*), 周晓元(1988)在讨论静乐的日进鼠时, 又把它转入 *Chardinomys* 属。根据原描述和图版(标本可能已丢失), 该标本 *M1* 的 *t1* 不甚后位、*t5* 近圆锥形、*t6* 与 *t9* 连接, 似乎与日进鼠属的特征大相径庭, 因而应从 *Chardinomys* 属中剔除。

此外, 陕西渭南的一件下颌骨(见 Jacobs et Li, 1982)和内蒙比例克的几枚牙齿似乎也可以归入日进鼠属。前者被雅氏等归入存疑的日进鼠属; 其牙齿的形态与日进鼠下臼齿的特征完全一致, 大小和形态与静乐及稻地标本接近。无疑它属于一种日进鼠。但由于渭南的材料太少, 似作 *Chardinomys* sp. 处置为妥。后者被作为 *Muridae* gen. et sp. indet. 报道(见 Qiu Zhuding, 1988); 在形态和构造上这些牙齿符合日进鼠属的特征, 不同稻地标本在于其 *M1* 的 *t1* 不那么靠后、*t0* 的位置较靠前、前附尖和前齿带联合成强大的齿尖、*t1* 和 *t4* 舌侧具明显的齿带、*m1* 有显著的 *c3*, 因此, 它很可能代表该属的一新种(待刊)。

迄今所知,日进鼠属仅发现于我国。从上看来,它有以下各种: *Chardinomys yusheensis* (山西榆社), *C. nihewanicus* (河北东窑子头南大沟、稻地,山西静乐,陕西大荔), *C. sp. nov.* (内蒙比例克)和 *C. sp.* (陕西渭南)。其地史分布如图 3 所示。

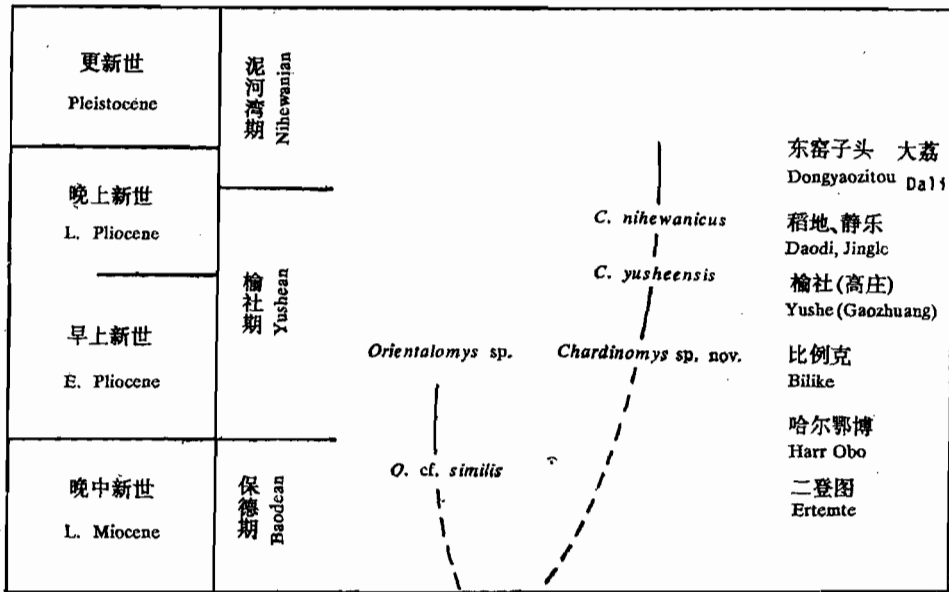


图 3 日进鼠属的地史分布及可能的系统关系

Fig. 3 Suggested phylogeny and stratigraphic distribution of *Chardinomys*

日进鼠属发现的种类还不多,其系统发育详情有待更多种类的发现和进一步的研究,从目前的材料看,该属的牙齿似乎具有 M1 的 t1 后移、前附尖和齿带退化及 m1 的 c3 退化的演化趋势。

*Chardinomys* 和 *Orientalomys* 同时在内蒙古比例克动物群中出现,前者是该属目前所知的最早代表,但它似乎不大可能从后者直接进化而来,因为它缺乏后者那种明显的衍生性状—“皇冠型齿”构造。但两属相似,共享鼠科种类中一些进步的特征,如 M1 的 t1 后位, M1 上有排成两斜列的齿尖等,或许说明它们共有相同的祖先。

### 巢鼠 *Micromys* Dehne, 1841

#### 戴氏巢鼠(亲近种) *Micromys aff. M. tedfordi* Wu & Flynn, 1992

(图 1G,H, 图 4; 图版 1, 图 9—20)

1987 Muridae gen. et sp. indet. 蔡保全, P130。

1988 Muridae gen. et sp. indet., Qiu Zhuding, P837。

**材料** 稻地: 一右破损上颌骨,带 M1, 一左破下颌骨,附 m1, 46 枚臼齿 (12 M1, 8 M2, 1 M3, 13 m1, 10 m2, 2 m3), GV-N-8417.1—48; 红崖南沟: 一破上颌骨,具 M2—3, 一附 m2 的破下颌骨,62 枚臼齿 (18 M1, 10 M2, 2 M3, 16 m1, 15 m2, 1 m3), GV-N-8418.1—64; 祁家庄: 14 枚臼齿 (2 M2, 1 M3, 5 m1, 6 m2), GV-N-8419.1—14; 钱家沙洼: 3 枚臼齿 (1 M1, 2 m1), GV-N-8420.1—3; 荒子沟: 1

m1, GV-N-8421; 铺路: 1 m1, GV-N-8422。

测量(见表 3, 图 4)

表 3 河北稻地戴氏巢鼠(亲近种)牙齿测量(单位: 毫米)  
Table 3 Measurements of the teeth of *Micromys aff. tedfordi*  
from Daodi, Hebei (in mm)

牙齿 Tooth	长度(L)			宽度(W)		
	标本数 N	平均 Mean	范围 Min.—Max.	标本数 N	平均 Mean	范围 Min.—Max.
M1	26	1.63	1.50—1.75	29	1.03	0.90—1.15
M2	19	1.02	0.90—1.15	19	0.94	0.75—1.00
M3	4	0.60	0.55—0.70	4	0.62	0.60—0.70
m1	32	1.48	1.40—1.60	38	0.89	0.80—1.00
m2	28	1.02	0.85—1.15	32	0.88	0.75—0.95
m3	2	0.73	0.70—0.75	2	0.70	0.60—0.80

**描述** 上颌骨和下颌骨都很破碎, 仅见颧弓前支始于 M1 前齿根稍前处, 下颌骨咬肌脊前端明显凸起, 颧孔位于咬肌脊凸起前方齿虚背面与齿骨侧方之间, 上升支起于 m2 前缘。

**M1** (图 1G; 图版 I, 图 9、10): t1 比 t2 小, 比 t3 大, 位于 t2 和 t3 之后; 后刺一般不清楚, 但紧靠 t5。t2 靠近 t3, 两者同位或后者稍后位。t3 仅在个别标本中有后刺。t4 大小和形状与 t1 的相似, 位于 t5 之后, 多少与 t6 对称排列, 只是前壁比 t6 的陡, 使其前基部一般在 t6 之后。所有保存后内角的标本都见 t7, 但在三个标本中该尖脊形; t7 一般比 t1 和 t9 小, 少数近等; 约在 90% 的牙齿中, t7 与 t4 隔开, 其余由一发育程度不同的脊与 t4 连接。t9 小, 由一脊与 t6 连接, 这一脊在个别标本中低弱。在轻磨蚀的牙齿中, 总见明显的 t12。两个标本具 t1bis, 一 M1 具有弱的前附尖。五齿根。

**M2** (图版 I, 图 11、12): t1 发育, 明显双尖 6 例, 弱双尖 5 例, 单尖 6 例。t3 很弱。t4 位于 t5 之后; t5 与 t6 同位或稍前。都有 t7, 但在三例中呈脊形; 四例的 t7 以一低脊与 t4 连接。约半数标本具清楚的 t12。5 齿根, 唇侧之下有双根, 其中后根小或很小。

**M3** (图版 I, 图 13、14): t1 相对较发育, 在四个标本中一个孤立, 三个的前方与 t5 连接。t5 高大, 占据牙齿前外角, 与 t4 和 t6 组成一向前的不对称凸脊。t8 与 t9 融为一体, 置于牙齿的后中央。无 t3、t7 和 t12。三齿根。

**m1** (图 1H; 图版 I, 图 15、16): 磨蚀不深的牙齿都见有发育程度不同的中间下前边尖, 该尖或孤立(占 33%)或与舌、唇侧下前边尖的联合部连接(占 19%), 或与舌侧下前边尖连接(占 48%)。舌、唇侧下前边尖与下原尖及下后尖构成不甚对称的“X”形。多数标本有一极弱的下中间脊, 只有两例的这一脊伸达下原尖和下后尖的联合部。总有后齿带, 但形状和发育程度因标本而异。c1 在多数标本中呈前后向伸长的齿尖, 少数脊形; 一般没有尖状的 c2 和 c3, 但都有明显的、从 c1 连续伸达 c3 的唇侧齿带。具两粗壮的前后齿根及一唇侧中央根, 中央根有时很小。

**m2** (图版 I, 图 17、18): 唇侧下前边尚清楚, 呈尖脊形; 24 枚牙齿中有 11 枚缺失舌

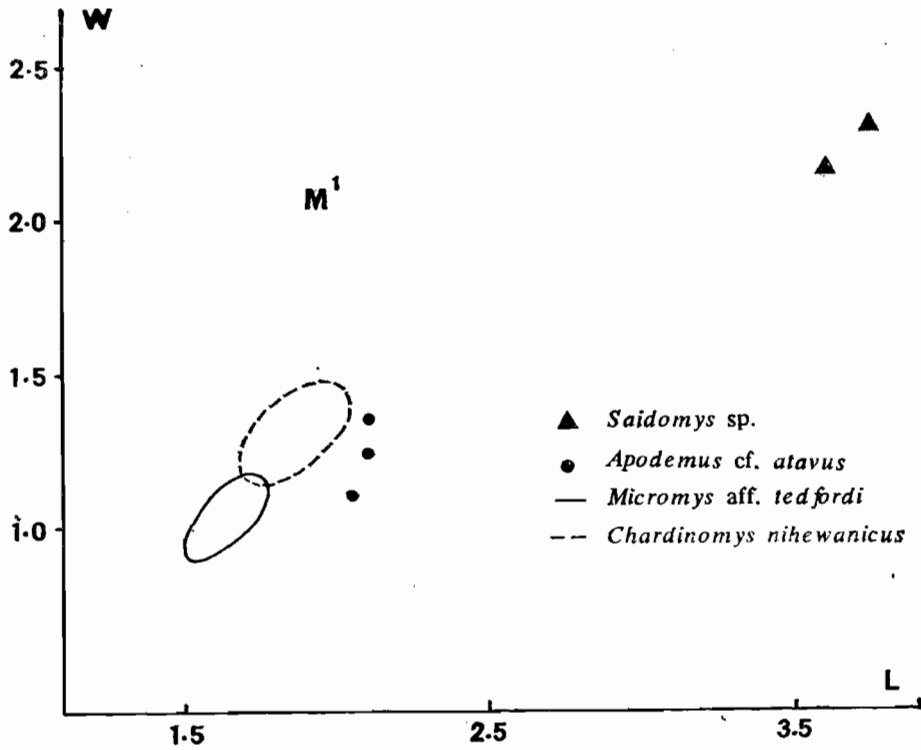


图4 稻地鼠科化石部分种第一上臼齿测量图解

Fig. 4 Scatter diagrams showing length and width of M1 for the four species of murids from Daodi

侧下前边尖,其余也仅有痕迹。未见有明显的  $c_2$ ,  $c_1$  只有两、三个标本中呈小尖状,一般都有从牙齿后外角连续伸至唇侧下前边尖的齿带。部分标本具短而细的下中间脊。总有后齿带,但形状和发育程度变异大。具两扁宽的前、后根。

**m3** (图版 I, 图 19、20): 具小的唇侧下前边尖。下原尖和下后尖清楚,形状和排列无异于  $m_2$  者。下次尖与下内尖融汇成牙齿后方中央尖。没有唇侧附尖及齿带。双齿根。

**比较与讨论** 上述标本在牙齿形状、齿尖排列与连接方式上与 *Apodemus* 的相似,但它们的尺寸较小(见图4)、M1的  $t_1$  较后位、 $t_6$  远离  $t_3$ 、M1和M2具4—5根、 $m_1$ 和 $m_2$ 的唇侧附尖较弱,使其不难与姬鼠属 *Apodemus* 者相区别。这些牙齿的大小和形态都表明它们属于巢鼠属 (*Micromys*) 的一种。

中国目前所报道的巢鼠属共有三种: *Micromys minutus* (Pallas, 1771); *M. chalcus* Storch, 1987 和 *M. tedfordi* Wu & Flynn, 1992。

*Micromys minutus* 是该属的唯一现生种,从西欧到东亚广大的古北区都有分布。它最早出现于早第四纪(见 Storch et al. 1973; Mein et al., 1983; Michaux, 1971)。稻地巢鼠与 *Micromys minutus* 相比,其个体较大,  $t_7$  较弱,  $t_9$  相对于  $t_7$  较大。

*Micromys chalcus* 见于内蒙古最晚中新世二登图和早上新世哈尔鄂博动物群。稻

地这一巢鼠比 *M. chalceus* 大, M1 和 M2 有 t7, M1 的 t9 相对 t6 小, M1 具五根, m1 的 c1 较退化。

稻地巢鼠比 *Micromys tedfordi* 稍小, 但在形态构造上两者异常相似, 如 M1 都不甚发育的“皇冠型齿”构造, M1 和 M2 总有适度发育的 t7, m1 唇侧附尖不发育等。前者不同于后者可能除个体较小外, 还在于其颞孔位置较靠虚位背面, 而不象 *M. tedfordi* 的那样明显位于齿骨侧方。另外, 在稻地标本的 m2 中未见有三根者。稻地巢鼠与 *M. tedfordi* 的相似以及它们之间的细微差异, 可能说明两者存在某种祖裔关系。

欧洲在上新统中发现了两种巢鼠: *Micromys praeminutus* Kretzoi, 1959 (模式产地: 匈牙利的 Csarnota, MN15) 和 *M. paricioi* Mein et al., 1983 (西班牙的 Celadas 4, MN 14)。目前这两种所发现的材料都不多, *M. paricioi* 比稻地巢鼠小些, 从梅氏等 (Mein et al., 1983) 的图示看, 其 M1 的 t7 脊形, t9 强大, t12 清楚, m1 的 c1 很发育, 似乎具有较原始的特征。至于 *M. praeminutus*, 尽管其 M1 的 t7 较弱, m1 的 c1 明显 (见 Michaux, 1969), 但它的尺寸和形态都落入稻地巢鼠的变异范围。因此, 稻地巢鼠, 甚至榆社的 *M. tedfordi* 是否应归入该种, 都是有待进一步研究的问题。基于比较材料有限, 在此暂不作变动。这里把稻地标本作为 *M. tedfordi* 的亲种处置, 亦纯属权宜之计。

一般认为, 巢鼠属牙齿的演化趋势是 M1 和 M2 的 t7 从无到有、从弱到强, M1 的 t9 退化、齿根增加。稻地巢鼠的牙齿特征, 表明其进化位置处于最原始的 *M. chalceus* 和现生的 *M. minutus* 之间, 大体与 *M. tedfordi* 靠近。吴文裕和弗林 (Wu et Flynn, 1992) 在研究榆社盆地的鼠科化石时, 注意到巢鼠类下颌骨颞孔的位置和 m1 中央小根的变化与产出层位的关系, 即层位自下而上, 颞孔逐渐从齿骨的侧方移向齿虚背面, m1 中央小根从牙齿中部渐移唇侧。稻地巢鼠的颞孔位于齿骨侧方与齿虚背面之间, m1 的中央小根一般靠唇侧。这样看来, 它似乎比榆社 YS50 (高庄组) 的 *M. tedfordi* 略进步, 而比 YS6 (海眼组) 的 *M. aff. tedfordi* 原始, 说明其时代很可能与麻则沟组相当。

### 华夏鼠 *Huaxiamys* Wu & Flynn, 1992

#### 唐氏华夏鼠(相似种) *Huaxiamys* cf. *H. downsi* Wu & Flynn, 1992

(图 11, J; 图版 II, 图 13, 14)

1987 *Mus* sp., 蔡保全, P129;

1988 *Mus* sp., Qiu Zhuding, P837。

**材料** 红崖南沟: 1 M1 (后外角稍破损, 宽 1.00 mm), 1 m1 (1.35 × 0.90 mm), GV-N-8423.1, 2。

**描述** M1 (图 11; 图版 II, 图 13): 齿尖强烈后倾。t1 位于 t2 之后; t2 前壁向前远伸; t1 和 t2 呈前唇-后舌向压扁状, 两尖在远处连接成与牙齿纵向约 45 度角的斜脊; t3 近圆柱形, 比 t2 稍后位, 后方有一伸达 t5 唇侧基部的弱脊; t3 由一低脊与 t2 连接, 两尖间有一宽深的谷; t4 位于 t5 之后, 大小与 t1 接近, 但都不那样侧向拉长; t5 位于牙齿的中后部, 分别由一较高而强的脊与 t4 和 t6 连接; t6 的大小和形状与 t3 的相似, 由于牙齿的破损, 无法判断它是否与 t9 连接。无 t7。t4 与 t8 间为一深谷隔开。有一显著的

前附尖。至少有三根。

m1 (图 1J; 图版 II, 图 14): 短宽, 后部明显扩大。中间下前边尖极小, 似由舌侧下前边尖向前外方伸出的短脊; 舌侧下前边尖比唇侧下前边尖稍前位, 两尖由一强脊连接。下原尖和下后尖前侧由低脊连接。齿襞短而弱。下中间脊发育, 伸达下原尖和下后尖的联合部。后齿带三棱形。c1 尖状, 前后向拉长, 前侧与下次尖连接; 无 c2 和 c3, 但其间有一明显的齿带。具两强大的前、后齿根。

**比较与讨论** 这两个牙齿的形态与华夏鼠属 (*Huaxiamys*) 的特征很相似(见 Wu & Flynn, 1992)。该属重要特征之一是 M1 具“皇冠型齿”构造。虽然稻地的这一 M1 破损, 无法确定 t6 与 t9 是否连接, 但它具有以下与华夏属完全一致的特征: 牙齿小, 低冠, 齿尖强烈倾向后方, t1 很后位、与 t2 连接成前唇-后舌向延长的斜脊, t2 前壁向前远伸、与 t3 间有一宽阔的谷, 无 t7。该 m1 与 *Micromys* aff. *tedfordi* 的 m1 有点相似, 但它较为短宽, 后部扩大, 中间下前边脊弱小, 舌侧下前边尖向前唇-后舌向膨胀, 且较下前边尖更向前伸而有所不同。

*Huaxiamys* 和 *Mus* 在大小上接近, 形态上相似, 乍看易于混淆。两属的差异在于: 前者 M1 具“皇冠型齿”构造, 齿尖强烈倾斜, t1 和 t2 连成斜脊, t2 和 t3 间具宽阔的谷; m1 具中间前边尖, 唇侧具附属尖或较显著的齿带。

吴、弗氏把榆社的华夏鼠指定为 *Huaxiamys primitivus* (晚中新世) 和 *H. downsi* (早上新世) 两种。这两个种的界限尚清楚, 可惜前者的材料偏少。但无论如何, 稻地华夏鼠与 *H. downsi* 的特征较一致, 尺寸也落入其个体变异范围之内。其 M1 的 t2 前壁向前明显变窄并远伸, t2 和 t3 间的谷很宽, m1 的中间下前边尖较弱等特征, 使它与 *H. downsi* 和 *H. primitivus* 相比, 与后者更为相似。但是, 其 M1 中 t3 的后刺相对较清楚, m1 的 c1 稍强, 中间脊较发育, 多少又与榆社种有所不同。由于材料的不足, 这里把它作为 *H. downsi* 的相似种处理。

### 赛多鼠 *Saidomys* James & Slaughter, 1974

#### 赛多鼠(未定种) *Saidomys* sp.

(图 1K, 图 4)

1987 *Rattus* sp., 蔡保全, P129;

1988 *Rattus* sp., Qiu Zhuding, P837.

**材料** 稻地: 2 M1 (3.75 × 2.30, 3.60 × 2.15mm), GV-N-8424.1, 2。

**描述** M1 (图 1K) 中等高冠。t1 似圆柱形, 近直立, 紧靠 t2, 但位置稍后。t2 强大, 略呈前后向压扁状。t3 比 t1 小, 趋于与 t2 融汇, 有一后凸。t4 的位置稍后于 t5, 前后向压扁, 向后倾斜。t5 横向扩张。t6 呈前舌-后唇向压扁状, 后缘向后突出。t4、t5 和 t6 紧密连接, 组成牙齿上强大、向后微弯的中间横脊。无 t7。t8 强大。t9 与 t6 隔开, 近与 t8 融汇成一稍后弯、偏向唇侧的第三列横脊。t12 极弱。两个标本的齿根都未保存, 但从保留的痕迹看, M1 至少有四根。

**比较与讨论** 根据硕大的尺寸, M1 的非“皇冠型齿”构造, t2、t5 和 t8 横向扩宽, 内侧尖比外侧尖稍大, t12 极弱, 稻地这两个牙齿的形态与 *Saidomys* 的特征一致。与

*Karnimata* 属的某些种(如 *K. huxleyi*)、*Arvicanthis* 及 *Dilatomys* 属,甚至是现生的 *Leopoldamys* 属或多或少相似。但以大得多的尺寸,横脊较直而不同于 *Karnimata*; 以 t6 无任何与 t9 连接的迹象有别于 *Arvicanthis* (见 De Bruijn et al. 1970); 以较小的尺寸, t1 近直立及 t12 极弱而异于 *Dilatomys*; 以齿尖较为独立、分明,尤其外侧齿尖 t3、t6 和 t9 分别不那么融汇于 t2、t5 和 t8 而易于与 *Leopoldamys* 区别(见 Musser, 1981)。

*Saidomys* 属的已知种有 *S. natrunensis* James & Slaughter, 1974; *S. afarensis* Sabatier, 1979; *S. afghanensis* (Brandy, 1979) 和 *S. ? transversus* Sen, 1983。据资料,这些种都采自上新统。稻地种的大小及在横脊较直和有极弱的 t12 方面与 *S. ? transversus* 最接近,但后者的 t9 较横向,又有明显的前附尖。

由于材料少,可比较的资料缺乏,难以作进一步的鉴定,这里暂把它指定为 *Saidomys* 的未定种。另外,雅各布斯和李传夔 (Jacobs et Li, 1982) 认为产于渭南游河的一枚 cf. *Rattus* sp. 的 m1 《原被薛祥煦(1981)订为 *Epimys* sp.》,虽然没有中间下前边尖,但在大小及有一发育的 c1 和外齿带方面,与 *Saidomys* 非常相似,也可能属于这一类动物。

现生亚洲东南部的 *Leopoldamys* 属与 *Saidomys* 属很相似,不同主要在于前者 M1 的三列横尖更为融汇, m1 没有 tma, 以及 m2 和 m3 没有唇侧下前边尖。它们的相似,可能说明两者多少具有接近的亲缘关系。

## 二、稻地鼠科群体的性质及所指示的地质时代

采自稻地地区 8 个地点的鼠科化石代表了该科的下列 6 属 6 种:

*Apodemus* cf. *A. atavus* Heller, 1936;

*Karnimata* sp.;

*Chardinomys nihewanicus* (Zheng, 1981);

*Micromys* aff. *M. tedfordi* Wu & Flynn, 1992;

*Huaxiamys* cf. *H. downsii* Wu & Flynn, 1992;

*Saidomys* sp.

其中 *C. nihewanicus* 和 *M. aff. M. tedfordi* 在动物群中相当常见,尤其是前者,它发现于所有的 8 个地点。其它属、种的材料则比较稀罕,一般只见于一或两个地点。从目前对这些材料的观察,还看不出同一属、种在不同地点或同一地点不同层位上的形态差异。因此,这里把采自上述各地点的材料都当作代表地质时代大体接近的同一动物群体。

稻地鼠科各属、种仅发现于旧大陆晚第三纪以来的地层,其中 *Apodemus* 和 *Micromys* 见于欧亚大陆, *Karnimata* 和 *Saidomys* 出现在西南亚, *Chardinomys* 和 *Huaxiamys* 则仅发现于华北。表 4 是稻地鼠科各属在我国其他晚第三纪地点的出现情况。

*Apodemus* 和 *Micromys* 在欧洲最早分别出现于晚中新世和早上新世。稻地这两个

表 4 稻地鼠科各属在我国其他晚第三纪地点的分布

Table 4 showing the occurrence of cogenera of Daodi fauna in the Neogene and early Pleistocene localities of China

晚中新世 M. Miocene (保德期) (Baodean) 二登图 Ertemte	上新世 Pliocene (榆社期) (Yushean) 哈尔鄂博 比例克 榆社 渭南 静乐 Harr Obo Bilike Yushe Weinan Jingle					更新世 Pleistocene (泥河湾期) (Nihewanian) 东窑子头(大南沟) Dongyaozitou (DN)	
<i>Apodemus</i>	*	-----	*	-----	*	-----	*
<i>Karnimata</i>	*	-----	*	-----	*	-----	*
<i>Chardinomys</i>			*	-----	*	-----	*
<i>Micromys</i>	*	-----	*	-----	*	-----	*
<i>Huaxiamys</i>					*		
<i>Saidomys</i>					*		

属的种在牙齿的形态进化水平上分别与欧洲上新世 (MN 15) 的种类——*A. atavus* 和 *M. praeminutus* 接近。在西南亚, *Karnimata* 虽然最早出现于晚中新世, 但它与 *Apodemus*, *Micromys* 和 *Saidomys* 共生却只见于上新统。稻地鼠类动物群有 *Apodemus*, *Karnimata* 和 *Micromys* 三属与我国二登图、哈尔鄂博动物群共有, 但前一动物群中这些属的种都比后两者相应属的种进步。以上似乎说明稻地动物群的时代不大可能早于上新世。

稻地动物群鼠科中有四属出现于我国的比例克动物群。虽然目前尚未对比例克动物群的鼠类作详细研究, 但根据该动物群的组成及所含 *Chardinomys* 明显比稻地的原始, 显然表明其所代表的地质时代较早。稻地动物群与榆社动物群也有较多相同的属, 其中 *Apodemus*, *Micromys* 和 *Huaxiamys* 各属的种, 在形态特征上更接近高庄组或麻则沟组中发现的相应种; 而稻地的 *Chardinomys* 要比高庄组发现的进步。因此, 稻地鼠类的进化水平似乎更接近麻则沟组者。稻地的日进鼠与静乐和东窑子头大南沟所产的日进鼠同种, 但稻地和静乐的 *C. nihewanicus* 的生存时代不大可能与大南沟的相同, 因为后者产出的层位较高, 并与 *Alticola simplicidentata*, *Myospalax tingi* 和 *Pitymys hintoni* 共生。这些显然属于第四纪的小哺乳动物都没有在稻地或静乐动物群中出现, 说明稻地动物群的时代要早于更新世。另外, *Chardinomys* 和 *Saidomys* 也见于陕西渭南游河。因此, 似乎稻地鼠科化石所指示的地质时代与榆社麻则沟、山西静乐和陕西渭南动物群的最为接近。本文第一作者在报道稻地动物群时(蔡保全, 1987), 将该动物群的时代定为上新世晚期, 并认为与欧洲陆相哺乳动物分带 MN16 的时代相当。邱占祥等(1990)在《中国晚第三纪地方哺乳动物群的排序及其分期》一文中, 认为稻地动物群的时代属于我国陆生哺乳动物时代的晚第三纪榆社期晚期(晚上新世晚期)。对该动物群鼠科化石的研究, 进一步坚定了对这一时代的确定。

邱占祥、李传夔、郑绍华和黄学诗及德国的施托希博士 (Dr. G. Storch) 为成文提



出过宝贵意见, 哈佛大学的弗林博士 (Dr. Lawrence J. Flynn) 为本文修改英文摘要和提供了有益建议, 张文定拍摄电镜照片, 杨明婉女士绘制插图, 作者在此一并表示感谢。

(1993年3月收稿)

### 参 考 文 献

- 汪 洪, 1988: 陕西大荔一更新世哺乳动物群。古脊椎动物学报, **26**(1), 59—72。
- 杜恒俭、王安德、赵其强、蔡保全, 1988: 泥河湾地区晚上新世一个新的地层单位——稻地组。地球科学, **13**(5), 561—568。
- 吴文裕、弗林 (L. J. Flynn), 1992: 记山西榆社晚新生代鼠科化石新属种。古脊椎动物学报, **30**(1), 17—38。
- 邱占祥、邱铸鼎, 1990: 中国晚第三纪地方哺乳动物群的排序及其分期。地层学杂志, **14**(4), 241—260。
- 邱铸鼎、李传夔、胡绍锦, 1984: 云南呈贡三家村晚更新世小哺乳动物群。古脊椎动物学报, **22**(4), 281—293。
- 周晓元, 1988: 山西静乐上新世小哺乳动物群及静乐组的时代。古脊椎动物学报, **26**(3), 181—197。
- 郑绍华, 1981: 泥河湾地层中小哺乳动物的新发现。古脊椎动物与古人类, **19**(4), 348—358。
- 郑绍华、蔡保全, 1991: 河北蔚县东窑子头大南沟剖面中的小哺乳动物化石。中国科学院古脊椎动物与古人类研究所参加第十三届国际第四纪大会论文选, 100—131。
- 黄万波、方其仁等, 1991: 巫山猿人遗址。海洋出版社, 230 页。
- 蔡保全, 1987: 河北阳原—蔚县晚上新世小哺乳动物化石。古脊椎动物学报, **25**(2), 124—136。
- 蔡保全, 1989: 河北阳原—蔚县晚上新世兔形类化石。古脊椎动物学报, **27**(3), 170—181。
- 薛祥煦, 1981: 陕西渭南一早更新世哺乳动物群及其层位。古脊椎动物与古人类, **19**(1), 35—44。
- Argyropulo, A. I., & Pidoplichka, I. G., 1939: Recovery of a representative of Murinae (Glires, Mammalia) in Tertiary deposits of the USSR. *C. R. [Dokl] Acad. Sci. URSS*, **23**(2), 209—212。
- Brandy, L. D., 1979: Rongeurs nouveaux du Néogène d'Afghanistan. *C. R. Acad. Sci., Paris, D*, **289**, 81—83。
- Brandy, L. D., 1981: Rongeurs muroidés du Néogène supérieur d'Afghanistan. Évolution, biogéographie, corrélations. *Palaeovertebrata*, **11**(4), 133—179。
- Bruijn, H. de, Dawson, M. R. & Mein, P., 1970: Upper Pliocene Rodentia, Lagomorpha and Insectivora (Mammalia) from the isle of Rhodes (Greece). I—II. *Proc. Kon. nederl. Akad. Wet.*, (B) **73**(5), 535—584。
- Bruijn, H. de & van der Meulen, A. J., 1975: The early Pleistocene rodents from Tourkobounia—1 (Athens, Greece). I—II. *Proc. Kon. nederl. Akad. Wet.*, (B) **78**(4), 314—338。
- Cheema, I. U., Sen. S. & Flynn, L. J., 1983: Early Vallesian small mammals from the Siwaliks of Northern Pakistan. *Bull. Mus. nat. Hist. natur.*, (4) **5** (C 3), 267—280。
- Colbert, E.H. & D.A. Hooijer, 1953: Pleistocene mammals from the limestone fissures of Szechwan, China. *Bull. Amer. Mus. Nat. Hist.*, **102**, 102—128。
- Engesser, B., 1989: The late Tertiary small mammals of the Maremma region (Tuscany, Italy). 2nd part: Muridae and Cricetidae (Rodentia, Mammalia). *Boll. Soc. Paleontologica Italiana*, **28**(2-3), 227—252。
- Fejfar, O. & G. Storch, 1990: Eine pliozäne (ober-ruscinische) Kleinsäugerfauna aus Gundersheim, Rheinhessen. — 1. Nagetiere: Mammalia, Rodentia. *Senckenbergiana lethaea*, **71** (1/2), 139—184。
- Huguency, M. & P. Mein, 1965: Lagomorphes et Rongeurs de Néogène de Lissieu (Rhône). *Trav. Labo. Geol. Fac. Sc. Lyon, N.S.* **12**, 109—123。
- Jacobs, L.L., 1978: Fossil rodents (Rhizomyidae & Muridae) from Neogene Siwalik deposits, Pakistan. *Mus. North. Arizona Press, Bull. Ser.*, **52**: I—XI, 1—103。
- Jacobs, L.L. & Li Chuankuei, 1982: A new genus (*Chardinomys*) of murid rodent (Mammalia, Rodentia) from the Neogene of China, and comments on its biogeography. *Geobios*, **15** (2), 255—259。
- James, G.T. & B.H. Slaughter, 1974: A primitive new middle Pliocene murid from Wadi el Natrum, Egypt. *Ann. Geol. Surv. Egypt, Cairo*, **4**, 333—362。
- Kretzoi, M., 1959: Insectivoren, Nagetiere und Lagomorphen der jüngstpliozänen Fauna von Csarnóta im Villányer Gebirge (Sudungarn). *Vert. Hungarica*, **1**(2), 237—246。
- Mein, P., Moissenet E., & Adrover, R. 1983: L'extension et l'âge des formations continentales pliocènes du fossé de Teruel (Espagne). *C.R. Acad. Sci. Paris*, (II) **296**, 1603—1610。
- Michaux, J., 1967: Origine du dessin dentaire *Apodemus* (Rodentia, Mammalia). *C.R. Acad. Sci. Pa-*

- ris, D, 264, 711—714.
- Michaux, J., 1969: Muridae (Rodentia) du Pliocène supérieur d'Espagne et du Midi de la France. *Palaeovertebrata*, 3(1), 1—25.
- Michaux, J., 1971: Données nouvelles sur les Muridae (Rodentia) néogènes d'Europe sudoccidentale. Evolution et rapports avec les formes actuelles. *Paléobiol. continent*, 2(1), 1—67.
- Musser, G.G., 1981: Notes on systematics of Indo-Malayan murid rodents, and descriptions of new genera and species from Ceylon, Sulawesi, and the Philippines. *Bull. Amer. Mus. Nat. Hist.*, 168, 229—330.
- Qiu Zhuding, 1988: Neogene micromammals of China. In: Chen, E.K.J. (ed.): The Palaeoenvironment of East Asia from the Mid-Tertiary. Hong Kong, 2, 834—848.
- Sabatier, M., 1979: Les Rongeurs des sites à Hominides de Hadar et Melka Kunture (Ethiopie). *Thèse 3 cycle, Univ. Sci. Tech. Languedoc, Montpellier*, 1—122.
- Sen, S., 1983: Rongeurs et Lagomorphes du gisement pliocène de Pul-e Charkhi, bassin de Kabul, Afghanistan. *Bull. Mus. nat. Hist. natur.*, (5)5(C1), 33—74.
- Storch, G., 1987: The Neogene mammalian faunas of Ertemte and Harr Obo in Inner Mongolia (Nei Mongol), China. -7 Muridae (Rodentia). *Senckenbergiana Lethaea*, 68 (5/6), 401—431.
- Storch, G. & O. Fejfar, 1990: Gundersheim-finding, a Ruscian rodent fauna of Asian affinities from Germany. In: Lindsay, E.H., V. Fahlbusch & P. Mein (eds): European Neogene mammal chronology. *NATO ASI, A*, 180, 405—412.
- Storch, G., Franzen, J.L. & Malec, F., 1973: Die altpleistozäne Säugerfauna (Mammalia) von Hohen-sülzen bei Worms. *Senckenbergiana Lethaea*, 54(2/4), 311—343.
- Teilhard de Chardin, P., 1940: The fossils from Locality 18 near Peking, *Pal. Sin.*, New Ser. C., (9), 1—94.
- Weerd, A. van de, 1976: Rodent faunas of the Mio-Pliocene continental sediments of the Teruel-Alfambra region, Spain. *Utrecht micropaleont. Bull., Spec. Publ.*, 2, 1—217.
- Young, C.C., 1934: On the Insectivora, Chiroptera, Rodentia and Primates other than *Sinanthropus* from Locality 1 at Choukoutien. *Pal. Sin. C*, 8(3), 1—160.

## MURID RODENTS FROM THE LATE PLIOCENE OF YANGQUAN AND YUXIAN, HEBEI

Cai Baoquan

(Teachers College of Zhangzhou, Fujian)

Qiu Zhuding

(Institute of Vertebrate Paleontology and Paleoanthropology, Academia Sinica)

**Key words** Daodi, Hebei; Late Pliocene; Muridae

### Summary

Daodi is considered to be a late Pliocene locality near Nihewan, a classic site well known for its abundant and diverse Plio-Pleistocene mammalian fossils. An assemblage of micromammals was collected by the first author from eight quarries at Daodi by screen-washing in 1984. Preliminary reports on 26 species of small mammals collected and more detailed studies of lagomorphs have been given (see Cai, 1987; 1989). This paper deals with the material of the rodent family Muridae in the collections.

### Systematics

#### Family Muridae Gray, 1821

#### *Apodemus* Kaup, 1829

#### *Apodemus* cf. *atavus* Heller, 1936

(Fig. 1 A, B, 4; pl. I 1-8)

**Material** Daodi: 2 M1, 2 m1, GV-N-8401. 1-4; Hongyanangou: 1 M3, 2 m1, 1 m2, GV-N-8402. 1-4; Qianjiashawa: 3 M1, 1 M2, GV-N-8403. 1-4; Qijiazhuang: 1 M1, 1 M2, 2 m2, GV-N-8404. 1-4; Yuanzigou: 1 m2, GV-N-8405; Pulu: 1 M2, GV-N-8406. (Stratigraphic relationships of fossil sites given in Cai, 1987).

**Remarks** *Apodemus* is a living genus with its first appearance in the latest Miocene. Nearly 20 species, including 7 or 8 fossil forms, have been recognized up to now.

The Daodi *Apodemus* differs from *A. orientalis* (Schaub, 1938) of Ertemte and Harr Obo, Inner Mongolia in: 1) larger dimension of molars; 2) higher crown with robust cusps; 3) constant presence of t7 in M1 and M2; 4) weaker t12.

*Apodemus qiui* Wu & Flynn, 1992 and *A. zhangwagouensis* Wu & Flynn, 1992 from Yushe, Shanxi are similar in dental morphology, and their differences are mainly in the position of the mental foramen. Both of them can be distinguished from the Daodi form by their lower crown with weaker cusps and in having four roots in M2.

Four species of *Apodemus*, *A. chevrieri*, *A. cf. peninsulae*, "*A. dominans*" and *A. latronum* have been reported from an early Quaternary locality of Wushan, Sichuan (see Huang et al, 1991). The Daodi species is close to *A. chevrieri* in size and development of cusps, but differs from the latter in lower crown, relatively weaker t2 and t7, stronger t9 in M1, and three-rooted M1. By its distinct stephanodonty and developed t12 *A. cf. peninsulae* is easily distinguished from the Daodi *Apodemus*. Specimens of the *A. latronum* and "*A. dominans*" may represent a single taxon, which differs from the Daodi species in smaller size, lower crown and pronounced labial accessory cusps in m1.

*A. "sylvaticus"* from Zhoukoudian (Choukoutien), Beijing and Yanjinggou, Sichuan (see Yang, 1934; Colbert et al., 1953) are distinguished from the form of Daodi by smaller size, more posterior position of t1, and its pronounced to and prestyle.

*A. draco* and *A. altronum* from the late Pleistocene of Chenggong are identical with two living species distributing in Yunnan area. The former, with an elongated M1, is smaller than the Daodi form, while the latter, with more heavily built cusps, is larger than the Daodi species.

*A. jeanteti* Michaux, 1967 from Europe is larger than the Daodi species. It possesses a posterior spur on t3 and a prominent t12 in M1, and a reduced medial anteroconid in M1, which differ in the Chinese form.

The European *A. primaevus* Huguency & Mein, 1965 (= *A. gudrunae* Weerd, 1976) and *A. etruscus* Engesser, 1989 are two rather primitive species of this genus. Connection between t6 and t9, and t7 are lacking in some M1 of the two taxa.

The Daodi *Apodemus* most resembles *A. atavus* Heller, 1936 (= *A. dominans* Kretzoi, 1959; see Fejfar & Storch, 1990) from Europe and western Asia in size and

in generally morphology. A comparison of specimens from Daodi with those from the type locality of *A. atavus* shows that the Daodi taxon is only slightly larger and its cusps are somewhat heavily built.

### ***Karnimata* Jacobs, 1978**

#### ***Karnimata* sp.**

(Fig. 1 C, D; pl. II 15, 16)

**Material** Daodi: one m1 (GV-N-8407, 1.65 × 1.05mm); Qijiazhuang: one M1 (slight damage, GV-N-8408, 1.45mm wide).

**Remarks** This taxon is close to *Apodemus* cf. *atavus* in size and in its prominent cusps, but differs from the latter in lacking of t7, rather posterior setting of t1 and t4 on M1, and rounded cusps on m1. It is close allied to *Karnimata* from the latest Miocene of Ertemte and the early Pliocene of Harr Obo, Inner Mongolia in morphology. Minor differences of the Daodi *Karnimata* from the Inner Mongolia *K. hipparionum* are the more posterior situation of t1 and t4 and stronger connection of the cusps on M1, which are here interpreted as being advanced for *K.* sp. from Daodi.

The genus *Karnimata* was established by Jacobs in 1978 and is mainly known from Pakistan and Afghanistan. Like *K. hipparionum*, the Daodi indeterminate species of *Karnimata* is distinguishable from those of Southwest Asia in having stephanodont M1, i.e. the t6 connected with t9, having usually a crest between t4 and t8, and presence of a posterior spur of t3. Storch (1987) correctly stated that the Chinese *Karnimata* do not correspond exactly to the diagnosis of *Karnimata* as given by Jacobs. Possibly the eastern Asian "*Karnimata*" represents a line different from southern genus *Karnimata*.

### ***Chardinomys* Jacobs & Li, 1982**

**Type species** *Chardinomys yusheensis* Jacobs & Li, 1982

**Diagnosis** (improved) Murid rodent having M1 with distinct posterior position of t1 and t4, t5 extended anterolabial-posterolingually with a shuttle-shaped grinding surface, t5 connected with t3 and t4 to form a posterolingual-anterolabial diagonal ridge across the tooth, to, t2 and t3 aligned in another diagonal row directed posterolabially to anterolingually, t6 usually connected with t8, t7 absent; M2 with weakly stephanodonty; m1 at least with two labial accessory cusps (c1 and c2), c2 always larger than c1.

### ***Chardinomys nihewanicus* (Zheng, 1981)**

(Fig. 1 E, F, 3, 4; pl. II 1-12)

**Diagnosis** (emended) Smaller than the type species *Chardinomys yusheensis*. On M1 t5 connected with t6 in less than 20% of known specimens, t6 connected with t9 less than 5%; prestyle and precingulum poorly developed on M1, m1 usually with two labial accessory cusps.

**Material** Daodi: 7 maxillary and 8 mandibular fragments, 223 isolated teeth,

GV-N-8409.1-238: Hongyanangou: 10 maxillary and 4 mandibular fragments, 219 isolated teeth, GV-N-8410. 1-233; Qijiazhuang: 5 maxillary fragments, 111 isolated teeth, GV-N-8411. 1-116; Qianjiashawa: 3 maxillary and 5 mandibular fragments, 69 isolated teeth, GV-N-8412. 1-77; Yuanzigou: 19 isolated teeth, GV-N-8413. 1-19; Jiangjungou: 5 isolated teeth, GV-N-8414. 1-5; Pulu: 14 isolated teeth, GV-N-8415.1-14; Beimajuan: 4 isolated teeth, GV-N-8416.1-4.

**Description M1** The t1 is set somewhat posterior to t3 and close to t5. The t3 is close to and connected with t2. The t3, t2 and t5 are aligned in a diagonal row directed posterolabially to anterolingually. The t4 is slightly anterior to t8, and connected with t3 via t5 to form a straight diagonal ridge from anterolabial to posterolingual across the tooth. The t5 is somewhat elongated anterolabially-posterolingually with a shuttle-shaped grinding surface. The t6 is separated from t5 in 90 out of 146 teeth, shows a tendency to join the cusp in 34 and is connected by a lower and small crest to the t5 in 22 cases; the t6 joins the t8 in most of the teeth, the yoke of t8 and t9 in 19 of 145, and the t9 in only 2 teeth. There is no t7. The t10 is present in 125 out of 142 specimens, but the development of this cusp is variable from quite distinct to very weak. The sample also shows variation in the development of prestyle, t2 bis and precingulum. Of 144 specimens the prestyle appears in 32, the t2 bis occurs in 25, and the precingulum is seen in 34 cases. 4-6 roots.

**M2** The t1 is slightly larger than t3. The t6 is connected by a low and weak poor crest with t9 in 46 of 122 teeth, with t8 in 11 cases. The t4 joins the t8 in only 8 teeth. 4-5 roots.

**M3** The t3 is very reduced or absent. The t5 is nearly incorporated with t6. The t8 is fused with t9 to form a round and posteromedial cusp. Three-rooted.

**m1** The medial anteroconid, present in all teeth, is isolated in 63 of 154, connected with labial anteroconid in 16, with lingual anteroconid in 30, with the yoke of the labial and lingual anteroconid in the rest. In about two thirds of these, there is a low and weak suture between the first and second chevrons. A medial ridge exists in about 65% of the teeth, and reaches the metaconid in half of these. All these teeth have two labial accessory cusps, a larger c2 and a smaller c1. A tiny c4 can be found in 22 cases. The posterior cingulid is weak and laterally elongated. Three-rooted.

**m2** A variably developed medial ridge is present in 63 of 119. All the teeth have c2, but only in less than half of these can be seen c1. 4-5 roots.

**m3** The labial anteroconid is lacking only in one tooth. The medial ridge and the labial accessory cusp are absent. The hypoconid and the entoconid are fused. 3 or 4 roots.

**Comparisons and Discussion** The teeth of this rodent correspond in morphology to the diagnosis of *Chardinomys* as given by Jacobs and Li in 1982. Murid rodents with such a dental pattern have also been assigned to *Orientalomys* (see Zheng, 1981; Storch, 1988; Zheng et al., 1991). It is true that the genus *Chardinomys* is most similar to *Orientalomys* in some structures: the M1 with distinctly posterior t1, diagonal alignment of t3, t5 and t4, another diagonal row of t10, t2 and t3, without t7, and the m1 with two obvious labial accessory cusps, etc. Nevertheless, *Chardinomys* can be distinguished from *Orientalomys* by having:

—its more developed connections between t3 and t5, and between t5 and t4 in M1, while they are rather poorly developed or lacking in *Orientalomys*;

—its anterolabially-posterolingually elongated t5 with a shuttle-shaped grinding surface in M1, when it is cone-like with a circular surface in *Orientalomys*;

—its domination of disconnections between t5 and t6 in M1, whereas in *Orientalomys* t5 always joined by a developed crest to t6;

—its rare connections between t6 and t9 (less than 5% of the M1), in contrast t6 is always connected with t9 in *Orientalomys*;

—its c2 always being larger than c1 in m1, in some species of *Orientalomys*, such as *O. galaticus* from Turkey and *O. cf. similis* from Ertemte, the c2 is smaller than c1.

Several species of *Chardinomys* were reported in the literature. They are *C. yusheensis* Jacobs et Li, 1982 from Yushe, Shanxi, *C. louisi* Zhou, 1988 from Jingle, Shanxi, *C. nihewanicus* (Zheng, 1988) from Dongyaozitou, Hebei, *C. schaubi* (Teilhard de Chardin, 1940) from Loc. 18, Beijing, and *C. louheensis* (Wang, 1988) from Dali, Shaanxi.

The Daodi *Chardinomys* differs from *C. yusheensis* in smaller size (Fig. 4) and seldom having a large and cuspidate precingulum on M1.

*Chardinomys louisi* was named by Zhou in 1982 on the basis of the abundant material from Jingle. The assumption that the specimens from Daodi can be referred to "*C. louisi*" (see Zhou, 1988; Zheng et Cai, 1991), seems to be corroborated by the statistics on the variable features of M1 (Table 2).

*Chardinomys nihewanicus* from Dongyaozitou and "*C. louheensis*" from Dali were originally assigned to *Orientalomys* by Zheng in 1981 and Wang in 1988, respectively. The present authors follow Zhou (1988) in transferring it to the genus *Chardinomys*. Specimens of *C. nihewanicus* described by Zheng in 1981 and Zheng & Cai in 1991, and those of *C. louheensis* described by Wang fall within the size range and variation exhibited by the material from Daodi or Jingle. Zhou (1988) distinguished *C. louisi* from *C. nihewanicus* based on Zheng's claim that the m2 of the latter is three-rooted and the m3 lacks anterolabial anteroconid. Reexamination of the two teeth shows that the damaged m2 had at least four roots judging from their remnants, and the m3 shows a very weak anterolabial anteroconid. Therefore, both *C. louisi* and *C. louheensis* are here considered to be a synonym of *C. nihewanicus*. The material from Daodi together with that of "*C. louisi*" and "*C. louheensis*" should be referred to *C. nihewanicus*.

"*Chardinomys schaubi*" was first assigned to *Stephanomys* by Teilhard in 1940 and was transferred to *Orientalomys* by De Bruijn and Van Meulen in 1975 and referred to *Chardinomys* by Zhou in 1988. The unique specimen of this taxon may have been lost and according to the figure in the original description, the specimen does not correspond to the diagnosis of *Chardinomys*: on M1 the t1 is not posterior in position, the t5 is nearly cone-like, the t6 is connected with the t9.

In summary, only two species of *Chardinomys*, *C. yusheensis* and *C. nihewanicus*, can be confirmed. In addition, the dentary with m1 and m2 from Weinan, Shaanxi, questionably referred to *Chardinomys* by Jacobs and Li in 1982, is identical well with that of *Chardinomys* and can be treated member of this genus, indetermi-

nate to species. Some isolated teeth from Bilike, Inner Mongolia reported by Qiu in 1988 as Muridae gen. et sp. idet. can also be referred to *Chardinomys*. They probably represent a new species of the genus based on M1 with relatively anterior to and t1, very strong prestyle and precingulum and distinct lingual cingulum, and m1 with a pronounced c4.

*Chardinomys* is only known in North China. Fig. 3 shows the suggested phylogeny and stratigraphic distribution of the genus. The phylogeny of *Chardinomys* is obscure. However, as represented from Bilike, early pliocene, to Dongyaozitou, early pleistocene, the genus apparently underwent a posterior shifting of t1 and reduction of prestyle and precingulum on M1, and a reduction of labial accessory cusps on m1.

### *Micromys* Dehne, 1841

#### *Micromys* aff. *M. tedfordi* Wu & Flynn, 1992

(Fig. 1G,H, 4; pl. 1 9-20)

**Material** Daodi: A maxillary and a mandibular fragment, 46 isolated teeth, GV-N-8417. 1-48; Hongyanangou: a maxillary and a mandibular fragment, 62 isolated teeth, GV-N-8418. 1-64; Qijiazhuang: 14 isolated teeth, GV-N-8419. 1-14; Qianjiashawa: 3 isolated teeth, GV-N-8420. 1-3; Yuanzigou: 1 m1, GV-N-8421; Pulu: 1 m1, GV-N-8422.

**Measurement** See the Chinese text.

**Remarks** The characters of these teeth, smaller size, posterior situation of t1 on M1, wide separation of t3 by an open valley from t6 on M1, and weakly developed labial accessory formations on m1 and m2, fit rather well the diagnosis of the genus *Micromys*.

Five species of *Micromys* have been so far recognized from the Palearctic region. They are *M. chalceus* from latest Miocene Ertemte and early Pliocene Harr Obo, Inner Mongolia; *M. tedfordi* Wu & Flynn, 1992, from YS50, Yushe, early Pliocene; *M. paricioi* Mein & Moissenet & Adrover, 1983 (type locality Celadas 4, Teruel Basin, Spain, MN14); *M. praeminutus* Kretzoi, 1959 (Csarnota 2, Hungary, MN 15) and the extent *M. minutus* (Pallas, 1771) which appeared first in early Pleistocene of Europe (see Mein, Moissenet & Adrover, 1983; Storch & Franzen & Maleo, 1973) and widely inhabits the Palearctic region.

The Daodi *Micromys* can be easily distinguished from the oldest species of the genus *M. chalceus* by its larger size, presence of t7 in M1 and M2, rather reduced t9 in relation to t6 on M1, having 5-roots on M1, and by its reduced c1 on m1 and m2.

It is slightly smaller than *Micromys tedfordi*, but very similar to the latter in morphology, such as in having weak stephanodonty on M1, having always t7 on M1 and M2, and poorly developed labial accessory cusps on m1. Minor differences between the Daodi *Micromys* and the Yushe *M. tedfordi* are the mental foramen which is located less laterally, and the m2 that is constantly double-rooted in the former. Their similarities seem to imply their close affinities.

*Micromys paricioi* from Europe is smaller than *M. aff. tedfordi* of Daodi and has a lophate t7, a strong t9, a distinct t12 on M1, and a developed c1 on m1. This

may indicate that *M. paricioi* is more primitive.

*Micromys* aff. *tedfordi* is close to *Micromys praeminutus* of Europe both in size and morphology. According to the figures in the original description, the teeth assigned to *Micromys praeminutus* by Michaux in 1969 fall within the variable range exhibited by the Daodi species, although the M1 has a weaker t7 and m1 has a stronger c1. Thus the systematic implications, (i.e. that *M. aff. tedfordi* from Daodi and *M. tedfordi* from Yushe could be synonyms of *M. praeminutus*) remains an open question.

*Micromys* aff. *tedfordi* is distinct from *M. minutus* in larger size and relatively weaker t7, and stronger t9 on M1.

In their study on the *Micromys* of Yushe, Wu and Flynn noted phylogenetic changes of *Micromys* from various horizons. These include progressive shifting of the mental foramen of the lower jaw, and of the central rootlet of m1 (see Wu et Flynn, 1992). In these characters, *M. aff. tedfordi* from Daodi is intermediate between *M. tedfordi* from YS50 (Gaozhuang Fm.) and *M. aff. tedfordi* from YS6 (Haiyan Fm.). This might indicate that Daodi is about equivalent to Mazegou Fm. in age.

#### ***Huaxiamys* Wu & Flynn, 1992**

#### ***Huaxiamys* cf. *H. downsi* Wu & Flynn, 1992**

(Fig. 1 I, J; pl. II 13, 14)

**Material** Hongyanangou: one M1 (slight damaged, 1.00 mm wide), one m1(1.35 × 0.90mm), GV-N-8423. 1, 2.

**Remarks** The authors concur with Wu and Flynn in recognizing the differences between the genera *Huaxiamys* and *Mus* (see Wu & Flynn, 1992). The two teeth agree with the genus *Huaxiamys* in possessing the following characters: (1) the cusps are extremely posterior inclined on M1; (2) t1 of M1 is set posteriorly and connected with t2 to form an anterolabial-posterolingually directed ridge; (3) t2 is projects remarkably forward; (4) there is a wide valley between t2 and t3 on M1; (5) presence of a medial anteroconid, c1 and distinct labial cuspid on m1.

Two species of the genus *Huaxiamys*, *H. primitivus* (from the late Miocene), *H. downsi* (from the early Pliocene) have been found in Yushe deposits. The Daodi *Huaxiamys* is mostly comparable to *H. downsi* in t2 of M1 narrowing sharply anteriorly and projecting further forward, t3 and t6 being more posterior in position, having a wider valley between t3 and t6, and a weaker medial ridge on m1. Minor differences of the former from the latter are the presence of more distinct posterior spur of t3 on M1 (probably can be interpreted as a derived feature), of more developed c1 and medial anteroconid on m1 (primitive or variable characters).

#### ***Saidomys* James & Slaughter, 1974**

#### ***Saidomys* sp.**

(Fig. 1K, 4)

**Material** Daodi: 2M1 (3.75 × 2.30, 3.60 × 2.15mm), GV-N-8424. 1, 2.

**Remarks** The two teeth are referred to *Saidomys* among markedly large murid



genera because of its large dimension, non-stephanodont M1 with transverse extended t2, t5, and t8, slightly larger internal cusps than external cusps, and very weak t12.

The Daodi murid is more or less similar to *Arvicanthis*, *Dilatomys*, *Leopoldamys* or some species of *Karnimata*, such as *K. huxleyi* in morphology. Nevertheless, it differs from *Karnimata* in much larger size, having transversely extended t2, t5 and t8, and straighter chevrons on M1. It is distinguished from the extant genus *Leopoldamys* by its more distinct cusps, and t3, t6 and t9 less merged with t2, t5 and t8, respectively. In smaller size, nearly erect t1 and very weak t12 on M1 it is distinguished from *Dilatomys*. It is close to *Arvicanthis* in size, but the t9 of M1 in the latter appears to have a tendency to join t6 (see De Bruijn et al., 1970).

All the known species of the genus, *S. natrunensis*, James & Slaughter, 1974, *S. afarensis* Sabatier, 1979, *S. afghanensis* (Brandy, 1979) and *S. ? transversus* Sen, 1983, are Pliocene in age. The Chinese form most resembles *S. ? transversus* in size, in having straight chevrons and very weak t12, except for its anterolabial-posterolingually elongated t9 and absence of prestyles on M1.

The two teeth may represent the first known *Saidomys* in China. A new species name will not now be given, because of the poor material available. In addition, a m1 from Weinan, Shaanxi, assigned to cf. *Rattus* sp. by Jacobs and Li in 1982, may be referred to this genus, although its lacking of medial anteroconid.

### Biogeography and age of the fauna

Of the 6 species of the Daodi murid fauna, *Chardinomys nihewanicus* is the most abundant and *Micromys* aff. *tedfordi* is also common. Measurements and morphology of each of the two species from the seven quarries show normal variation. The specimens of each species from those localities are considered to represent the same species without any difference in evolutionary stage. In contrast to the two species, the other four, *Apodemus* cf. *atavus*, *Karnimata* sp., *Huaxiamys* cf. *downsi* and *Saidomys* sp. are rather rare.

At the generic level, all these murids are known only in the old World, with *Apodemus* and *Micromys* being shared with Europe, *Karnimata* and *Saidomys* occurring in southwestern Asia, and *Chardinomys* and *Huaxiamys* confined to North China. Table 4 shows the distribution of the Daodi murids at the generic level in China.

In Europe, *Apodemus* and *Micromys* appeared first in the upper Turolian and the Ruscinian respectively. Morphologically, the Daodi species of *Apodemus* is compared to the European *A. atavus*, and *M.* aff. *tedfordi* to *M. praeminutus* in evolutionary grade. Although the first record of *Karnimata* in Southeast Asia is known from the upper Miocene, its occurrence together with *Apodemus*, *Micromys* and *Saidomys* happened in the Pliocene. *Apodemus*, *Micromys* and *Karnimata* from Daodi are more derived than those of Ertemte of the late Miocene. This would suggest that the age of Daodi is later than Miocene.

Four murid genera from Daodi are shared by the Bilike fauna, Inner Mongolia. Although material from Bilike has not been described in detail, the distinct primitive *Chardinomys* and the differences in composition of the fauna (see Qiu, 1988) appear to imply that the age of the Bilike fauna is older than the Daodi one. Daodi has

also four genera in common with Yushe, Shanxi. Three species, *Apodemus* cf. *atavus*, *Micromys* aff. *tedfordi* and *Huaxiamys* cf. *downsi* show more similar evolutionary grade with species of the corresponding genera from Gaozhuang or Mazegou Formation. *Chardinomys nihewanicus* is more advanced than *C. yusheensis* from Gaozhuang Formation, about the same as *Chardinomys* from Mazegou Formation. *Chardinomys nihewanicus* is commonly known from Daodi, Jingle and Dongyaozitou (Danangou). The age of Daodi fauna, however, would not be the same as that of Dongyaozitou, because the latter has such taxa as *Alticola simplicidentata*, *Myospalax tingi* and *Pitymys hintoni*, which are typical for the Pleistocene and absent in the Daodi fauna. This seems to indicate that the Daodi fauna is compared to the Mazegou, Jingle and weinan faunas in having the same species or species of similar evolutionary grade, but the Daodi fauna is older than the Dongyaozitou fauna in age.

The Daodi fauna has been considered to be late Pliocene or equivalent to MN 16 of the European mammalian ages (see Cai, 1987), and late Yushean of the Chinese mammalian ages (see Qiu et al., 1990). These conclusions have become stronger following the study of the murid fauna.

#### Acknowledgements

The authors want to express their gratitude to Dr. Lawrence J. Flynn from Harvard University Massachusetts for his providing valuable counsel and correcting the English summary. They also want to thank Dr. Storch from Forschungsinstitut Senckenberg, Frankfurt, Dr. Qiu Zhanxiang, Li Chuankuei, Zheng Shaohua and Huang Xueshi from IVPP for critiquing the manuscript.

**图 版 说 明**  
**(Explanations of plates)**

**图 版 I**

**祖姬鼠(相似种) *Apodemus cf atavus***

1.左 M1, GV-N-8403.2; 2.右 M1, GV-N-8401.1; 3.左 M2, GV-N-8404.2; 4.右 M2, GV-N-8406; 5.左 m1, GV-N-8401.3; 6.右 m1, GV-N-8402.4; 7.左 m2, GV-N-8405; 8.右 m2, GV-N-8402.2

**戴氏巢鼠(亲近种) *Micromys aff. tedfordi***

9.左 M1, GV-N-8418.13; 10.右 M1, GV-N-8418.5; 11.左 M2, GV-N-8417.21; 12.右 M2, GV-N-8418.19; 13.左 M3, GV-N-8418.29; 14.右 M3, GV-N-8417.9; 15.左 m1, GV-N-8417.40; 16.右 m1, GV-N-8418.41; 17.左 m2, GV-N-8417.25; 18.右 m2, GV-N-8419.14; 18.左 m3, GV-N-8418.59; 20.右 m3, GV-N-8417.16

**图 版 II**

**泥河湾日进鼠 *Chardinomys nihewanicus***

1.左 M1, GV-N-8410.26; 2.右 M1, GV-N-8410.15; 3.左 M2, GV-N-8410.57; 4.右 M2, GV-N-8410.48; 5.左 M3, GV-N-8410.74; 6.右 M3, GV-N-8410.70; 7.左 m1, GV-N-8410.89; 8.右 m1, GV-N-8410.76; 9.左 m2, GV-N-8410.124; 10.右 m2, GV-N-8410.108; 11.左 m3, GV-N-8410.151; 12.右 m3, GV-N-8410.135

**唐氏华夏鼠(相似种) *Huaxiamys cf. downsi***

13.左 M1, GV-N-8423.1; 14.右 m1, GV-N-8423.2

**仙鼠(未定种) *Karnimata sp.***

15.左 M1, GV-N-8408; 16.左 M1, GV-N-8407

冠面视 (occlusal view); 均约放大 20 倍, 但放大的水平轴与垂直轴不一致, 使照片多少有点变形 (all about 20X, but the pictures are slightly out of shape caused by unequal enlargement of horizontal and vertical axis)

