第38卷 第4期
2000年 10 月

古 脊 椎 动 物 学 报
VERTEBRATA PALASIATICA

pp.287～302
figs.1～2, pl.I

甘肃兰州盆地中中新世泉头沟动物群的食虫类、跳鼠类和兔形类[1)]

邱 铸 鼎

(中国科学院古脊椎动物与古人类研究所 北京 100044)

摘要 记述了甘肃兰州永登下街泉头沟发现的5种小哺乳动物化石,其中包括3个首次在这一经典地点发现的种。化石组合的分析表明,泉头沟动物群的时代与内蒙古中中新世通古尔动物群接近,并有一个与通古尔动物群相似、指示温带干旱、半干旱丛林-草原的古环境。

关键词 甘肃,兰州盆地,中新世,咸水河组,小哺乳动物

中图法分类号 Q915.873

甘肃兰州永登县下街(咸水河)泉头沟是我国西北地区的一个新近纪(原称晚第三纪)的经典哺乳动物化石地点,最早发现的小哺乳动物化石由杨钟健先生研究,部分标本后经绍伯(S. Schaub, 1930, 1934)订正,现知的小哺乳动物化石共有 *Plesiodipus leei* Young 1927、*Paracricetulus schaubi* Young 1927、*Heterosminthus orientalis* Schaub 1930 和 *Protalactaga grabaui* Young 1927 四种(Young, 1927; Schaub, 1930, 1934)。这些发现和研究,对我国古哺乳动物的研究和西北的地层工作产生过重大影响。然而,这些属型种的确定都基于十分有限的材料。

为了在这一重要地点增加化石种类和加深对已知属、种的认识,自1987年以来甘肃省博物馆、甘肃省文物考古研究所和我所的有关科技人员,连续数年在兰州盆地开展了化石采集和地层考察。1991年春夏之交作者参与了对这一地点的发掘,于咸水河组的上部筛洗土样约150kg,获小哺乳动物化石一批。化石种类不多,但一些种类的材料相当丰富,使有可能对华北中中新世地层中常见的这些属型种的种内变异有所了解。

本文仅描述这一动物群中的食虫类、跳鼠类和兔形类。有关化石地点的地层概况,详见《甘肃兰州盆地咸水河组研究的新进展》一文(邱占祥等,1997)。

1 标本记述

食虫目 Insectivora Bodwich, 1821

猬科 Erinaceidae Fischer von Waldheim, 1817

中新猬属 *Mioechinus* Butler, 1948

1) 国家自然科学基金项目(编号:49472083和49872011)和中国科学院古生物学与古人类学科基础研究特别支持基金项目(编号:9708)资助。

收稿日期:2000-05-19

戈壁中新猬(?)*Mioechinus? gobiensis* Qiu, 1996

(图 1)

材料 3 枚前 P3 颊齿(分别为 C, DP2, P2), 1P3, 2 残破的 DP4, 1P4, 1 破损的 M1, 2M2; 左右破下颌骨两件, 分别具有 p4～m3(p4 和 m3 破损)和 m1～2, 1p3 和 1m2。V 12403.1～14。

测量 (长 × 宽, mm) C: 1.00 × 0.65; DP2: 0.95 × 0.45; P2: 1.00 × 0.60; P3: 1.30 × 1.05; P4: 1.90 × 2.90; M2: 1.45 × 2.40, 1.65 × 2.15; p3: 1.00 × 0.75; p4: 1.70 × 0.95; m1: 2.50 × 1.45, 2.70 × 1.90; m2: 2.10 × 1.30, 1.95 × 1.55, 2.00 × 1.90; m3: 1.00 × 0.70。

描述 上犬齿双根, 冠面由一尖锐的主尖和一后方小尖组成。P2 双根, 由一主尖及不甚显著的前脊和后脊组成。P3 前尖强大, 后前尖脊(postparacrista)宽, 前附尖不甚显著; 原尖明显, 无次尖; 三齿根。P4 前尖高大, 有一粗壮后前尖脊; 前附尖相当明显; 具弱的前、后齿带; 三齿根。M1 破损, 仅见原尖比次尖粗壮, 两者间的内缘有宽阔的凹缺。具弱的前、后齿带。M2 原尖最大, 具高而显著的前、后臂, 前臂中部变粗, 后臂伸达后齿带。其中一个标本具清楚的后小尖。次尖在主尖中最小, 孤立位于牙齿的后内角。前尖和后尖由一"V"形谷分开。无中附尖, 但具明显的前附尖和发育的后附尖。除内缘外, 齿带几乎连续。后缘凹入。四齿根。

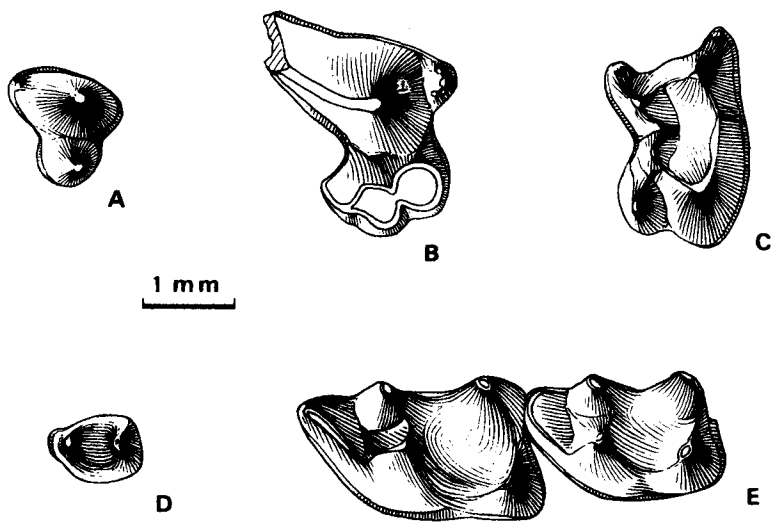


图1 戈壁中新猬(?)颊齿 冠面视

Fig.1 Ckeek teeth of *Mioechinus? gobiensis*

A. r P3(inv.), V 12403.4; B. r P4, V 12403.7; C. r M2, V 12403.9; D. l p3, V 12403.13; E. l m1～2, V 12403.12

p3 主尖粗大, 分别向前和唇后侧伸出一脊, 前脊短粗, 后脊细长; 后跟明显, 其上有一小尖; 单根。p4 下前尖高而显著, 后跟低; 双根。m1 的下前尖醒目, 下原尖最为高大, 下内尖比下次尖高; 下前脊侧视为一开阔的 V 形凹缺, 下原脊和下后脊都不发达; 斜脊低, 伸向下原尖唇侧基部; 齿凹比跟凹窄浅得多; 从下前尖的唇侧到下内尖的唇侧有一条几乎连续

的弱齿带；双齿根。m2 与 m1 的形状和构造相似，但个体小，短的下前脊更倾斜于牙齿纵轴，跟座相对短而宽。m3 冠面破损，但可见无跟座。

比较与讨论　上述标本的尺寸和形态与内蒙古通古尔动物群中的戈壁中新猬(?) *Mioechinus? gobiensis* 很接近(邱铸鼎，1996)，不同的是兰州标本 M1 和 M2 中的后小尖似乎稍弱，后缘较为凹入，宽度明显大于长度。尽管有这些差异，但并不妨碍把以上材料归入这一存疑属的同一种。

该种还发现于新疆准噶尔盆地，材料不多，牙齿的形态与泉头沟标本的接近，但尺寸稍大(毕顺东等，1999)。

啮齿目 Rodentia Bowdich, 1821

林跳鼠科 Zapodidae Caues, 1875

异跳鼠属 *Heterosminthus* Schaub, 1930

东方异跳鼠 *Heterosminthus orientalis* Schaub, 1930

(图版 I, 1～6)

材料　48 件残破上颌骨，带有 20 枚 P4，40 M1，16 M2，6 M3；55 件残破下颌骨，带有 35 枚 m1，36 m2，9 m3；191 枚脱落的牙齿(33 M1，40 M2，7 M3，43 m1，45 m2，24 m3)。V 12404.1～295。

测量　见表 1。

表1　东方异跳鼠牙齿测量

Table 1　Measurements of the teeth of *Heterosminthus orientalis*　(mm)

		Length		Width	
Tooth	N	Mean	Range	Mean	Range
P4*	20	0.46	0.40～0.55	0.59	0.45～0.76
M1	71	1.44	1.30～1.55	1.06	0.85～1.20
M2	53	1.31	1.10～1.45	0.96	0.80～1.05
M3	13	0.77	0.65～0.85	0.77	0.70～0.85
m1	68	1.32	1.15～1.50	0.90	0.75～1.00
m2	74	1.34	1.25～1.45	0.99	0.80～1.10
m3	32	0.93	0.70～1.10	0.76	0.65～0.85

* P4中可能包括了部分的DP4。

描述　颧弓起于 P4 前方。下颌上升支起于 m2；咬肌窝宽浅；窝前咬肌附着脊明显，伸达 m1 下前方；颏孔大，位于齿缺低弯处；门齿起于 m3 之后；齿缺长 2.1～2.4mm；m2 下的唇侧颌高 2.4～2.8mm。DP4 和 P4 单根。冠面由一主尖、前舌侧尖和后唇侧尖组成。DP4 与 P4 相似，但个体小，齿尖弱。

臼齿的齿尖比齿脊醒目。上臼齿的主尖略向后倾斜，舌侧尖比唇侧的大，位置略靠前；下臼齿的主尖则前倾，舌侧尖比唇侧的小，位置靠前。上臼齿除 M3 为 3 根外，其余均为 4 根；下臼齿双根。

M1 的原尖在 69 枚牙齿中，43 枚(占 62%)具有一舌后侧脊或棱，其中明显膨大有 7 例，4 例形成弱的原附尖；前边脊发育良好(仅在 6 个牙齿中极弱或中断)，末端在前外缘成前附尖；大部分标本都有前齿带；中尖小，紧靠次尖；中脊横向，在 68 个标本中，41 个

(60%)伸达唇缘,近达唇缘 14 个(21%),达半长 12 个(18%),短于半长的仅 1 个;内脊(endoloph)前部低弱,7 例前部中断,后部粗壮;原脊短细,一般后指与内脊前部连接;后脊后指与后边脊或次尖后臂连接,4 例后脊缺失。后边脊明显,在次尖后臂往往形成次小尖。M2 的原尖在半数以上标本(35 例)具舌后侧脊或棱,其中 11 例明显膨大,8 例成弱的原附尖;中尖明显;中脊横向,几乎都伸达外缘,少数末端膨大;内脊除两个标本外都连续,但前部低弱;原脊横向或略后指,一般与内脊前部连接;后脊横向或前指,一般与次尖连接;后边脊发育,从次尖后臂伸达后尖基部。M3 的次尖小,后尖很退化;前边脊显著;中尖在 5 个标本中尚明显,并伸出一弱的中脊;内脊甚弯;原脊或前指与前边脊连接,或横向与原尖连接,或后指与内脊前部连接;后脊前指与内脊后部连接;后边脊极弱,在两标本中近中断。

m1 在约 67% 的牙齿中有一个显著的下前边尖,完全缺失占 12%;大部分的下前边尖靠近下后尖,或以一小脊与其连接,小部分孤立于下后尖与下原尖的正前方;下中尖显著,几乎都向唇侧伸出一下外中脊;约半数的下外中脊比较弱,但 90% 以上都伸达齿缘,其中约 70% 末端膨大成小的外附尖;无下中脊;下后脊与外脊(ectolophid)连接,组成相对粗壮的外脊前部;下次脊短而细,一般向前与下中尖连接,13 个牙齿中的下次脊极低或完全缺失;外脊连接下次尖与下后尖,后部发育弱,近半数低弱或完全缺失,15 件标本从该脊的前部向下后尖后方伸出模糊的"下原尖后臂",27 个牙齿从下原尖伸出一极弱的脊,其中 24 个与下后尖或外脊连接,3 个与下中尖连接;下后边脊强大,多数发育成下次小尖。m2 的下前边尖显著,紧靠下后尖,并常以一低脊与下原尖连接;几乎所有标本的下原尖的舌后侧都伸出一弯向下后尖基部的"下原尖后臂";多数标本的下中尖清楚,8 例伸出可达齿缘的下中脊;下后脊前指与下前边尖连接;下次脊横向或稍前倾与下中尖或外脊连接;外脊短,从下次尖伸至下原尖,后部在部分标本中极低;下后边脊及其上的下次小尖都十分醒目。m3 后部收缩,下内尖融会于从下次尖伸向下后尖基部的下后边脊;大部分标本都有一清楚的"下原尖后臂",以及分明的下前边尖和下前边脊的唇侧支,极个别标本仍有可识别的下中尖和完整的外脊;连接下次尖或下中尖的下次脊常可辨认。

比较与讨论 上述标本的形态相对单一,但差异细微,难以识别出不同的种。牙齿的形态与 *Heterosminthus orientalis* 的特征完全一致。*H. orientalis* 是绍伯订正杨钟健描述的"绍氏副仓鼠"(*Paracricetulus schaubi*)而建立的一种林跳鼠。材料只有一具 m1～3 的下颌骨,产自兰州盆地咸水河的同一地点(Young, 1927; Schaub, 1930)。

该种除在兰州盆地发现外,还出现在青海西宁盆地和内蒙古通古尔地区。后两者的标本曾作为 *Protalactaga tunggurensis* 予以报道(Wood, 1936; 邱铸鼎等, 1981; Qiu et al., 1988),对此,本文作者作了修正(邱铸鼎, 1996)。通古尔的材料相当丰富,与兰州标本比较表明,两者的牙齿在大小和基本形态上没有明显的不同,差异可能在于后者 M1～2 中脊的平均长度稍短,m1 的前边尖略发育,下外中脊的平均长度稍长,m1～2 外脊发育较弱。

跳鼠科 Dipodidae Waterhouse, 1842

原跳鼠属 *Protalactaga* Young, 1927

葛氏原跳鼠 *Protalactaga grabaui* Young, 1927

(图版 I, 7～12)

材料 11 件残破上颌骨,附 8 枚 M1、8 枚 M2、1 枚 M3;4 件破下颌骨,附 3 枚 m1、1 枚

m3；单个牙齿 303 枚 (2 DP4, 3 P4, 53 M1, 42 M2, 32 M3, 57 m1, 47 m2, 67 m3)。V 12405.1～318。

测量　见表 2。

表2　葛氏原跳鼠牙齿测量

Table 2　Measurements of the teeth of *Protalactaga grabaui*　(mm)

		Length		Width	
Tooth	N	Mean	Range	Mean	Range
DP4	2	0.70	0.70～0.70	0.73	0.70～0.75
P4	3	0.80	0.80～0.80	0.87	0.85～0.90
M1	58	1.91	1.75～2.05	1.75	1.45～1.80
M2	50	1.86	1.65～2.05	1.52	1.35～1.70
M3	33	1.15	1.05～1.30	1.20	1.10～1.30
`m1	56	2.01	1.80～2.25	1.48	1.35～1.65
m2	39	1.93	1.75～2.10	1.49	1.25～1.65
m3	68	1.56	1.35～1.75	1.21	1.05～1.40

描述　附着咬肌的下脊不很发育，但在 m1 下方靠前处有一明显的突起；颏孔圆、大，位于齿缺中后部偏上方。在一个标本中，齿缺长 3.6mm。P4 单根；冠面由一主尖和一弧形脊组成；DP4 与 P4 相似，但个体较小，尖和脊间的新月形谷也浅。

M1 原尖的前臂和后臂分别与不甚发育的前边尖和中尖连接；中尖融会于内脊；原脊和后脊后指，前者多与内脊前部连接，后者或与后边脊或与次小尖连接；中脊发育，伸达唇侧，末端形成中附尖；内脊短，前部稍细弱。M2 与 M1 的不同在于：后部较窄，次尖和后尖相对弱；原脊横向或前指，总与原尖连接；后脊在 50 个牙齿中，27 例指向次小尖，23 例指向次尖；次小尖一般不明显；内脊常直。M3 的前部构造与 M2 的很接近，但后部退化；后尖融会于后边脊；几乎所有牙齿都有弱的中尖、中脊和中附尖；内脊退化，在约三分之一强的标本中，前部中断或接近中断。

m1 的下前边尖常位于下后尖一侧，靠前中部者少，在 55 个牙齿中，14 个明显，15 个极弱，完全缺失者众；下中尖醒目，向前内侧伸出粗壮的下中脊，向前外伸出完整的中下中脊；下中脊在舌缘膨大成中附尖；下外中脊除 8 例外，都伸达外缘，末端膨大成下外中附尖的有 17 例；外脊完整，但后部低弱；下后脊缺失，使下后尖总孤立于下原尖；下次脊伸向下中尖，短而弱，近半数几乎中断或完全缺失；后边脊强大。m2 的下前边尖明显，常以一低脊与下原尖前臂相连；下中尖相对比 m1 的弱，但依然常是下原尖、下次尖、下内尖和下中脊的会聚点；下中脊一般都直伸下中尖，但 11 例与外脊连接，3 例发育不良或中断；下次脊短、弱，明显与下中尖或外脊后部连接的有 27 例，在低处连接的有 9 例，完全中断连接的有 10 例。下后边脊发达。m3 的下次尖尚显著，但下内尖很弱，在部分标本中与下中附尖及下后边脊融会，形成围绕牙齿后外角的强脊。

比较与讨论　*Protalactaga grabaui* 是杨钟健根据采自甘肃“咸水河”一具 m1～3 的破碎下颌骨而建的属、种 (Young, 1927; Jacobs et al., 1985)。上述材料下臼齿的基本构造，如 m1 下后尖孤立于下原尖，下原尖、下中脊、下外中脊和下内尖汇聚于下中尖，以及下中脊未直接与下次脊连接等，都与正型标本一致。而正型标本中的 m1 无下前边尖，下中

附尖和下外中附尖相当显著，m2 的下前边尖与下原尖间有一明显的深谷，外谷较狭窄等也在上述标本中出现。总之，正型标本无论是尺寸大小还是形态特征，都落入新材料的变异范围之内。

迄今，除兰州盆地外，*Protalactaga grabaui* 在我国仅见于中中新世的内蒙古通古尔动物群，但材料不多，作者在记述通古尔材料时，曾对是否将其归入该种缺乏信心（邱铸鼎，1996）。现在看来，通古尔标本的大小和形态特征，也完全处于上述标本的变异范围。

在国外，该属确定的种有发现于摩洛哥的 *Protalactaga moghrebiensis*。该种比 *P. grabaui* 略大，牙齿的长明显大于宽，齿尖瘦削，齿脊相对较弱，M3 和 m3 较退化。

大原跳鼠 *Protalactaga major* Qiu, 1996

（图版 I，13～18）

材料 4 P4，5 M1，5 M2，4 M3，3 m1，2 m2，5 m3；V 12406.1～28。

测量 见表 3。

表3 大原跳鼠牙齿测量

Table 3 Measurements of the teeth of *Protalactaga major* (mm)

		Length		Width	
Tooth	N	Mean	Range	Mean	Range
P4	4	1.03	1.00～1.10	1.04	1.00～1.10
M1	5	2.44	2.35～2.50	2.16	2.05～2.25
M2	5	2.36	2.30～2.40	2.04	2.00～2.05
M3	4	1.43	1.35～1.55	1.40	1.35～1.45
m1	2	2.55	2.45～2.65	1.75	1.75～1.75
m2	2	2.50	2.40～2.60	1.88	1.85～1.90
m3	5	1.99	1.90～2.10	1.45	1.40～1.50

描述 P4 单根；冠面由一主尖及一起于主尖舌侧、绕过后缘的弧形脊组成。M1 内侧主尖比外侧主尖强大，外侧主尖呈前后压扁状；中尖不明显；内脊分别与次尖的前臂和原尖后臂连接，微弯，后部强壮，在一个标本中前部中断；原脊在 5 个标本中有 4 个很明显，后指与内脊前部连接，在一个标本中中断；后脊弱，后指与后边脊连接，在一个标本中中断；中脊粗壮，伸达唇缘，末端膨大；后边脊粗壮，但一般未伸达牙齿外缘。M2 不同 M1 在于：后部退缩，次尖、后尖和后边脊相对较弱，中脊横或稍前指，中附尖不甚发育；原脊和后脊都后指，前者与内脊前部连接，后者伸达次尖和后边脊的联结处。M3 的原脊横向，与原尖连接；次尖和后尖甚退化，并与后边脊融会，形成围绕牙齿后外侧的弧形脊；中脊完整，伸向后尖，并与后边脊封闭成盆状齿凹。

m1 的下前边尖在 2 个牙齿中明显，在 1 个中则完全缺失；下后尖近于孤立；下中尖醒目，但低矮；下中脊亦低，但相当强壮，斜向与外脊前部或下中尖连接，舌侧末端膨大成中附尖；下外中脊细，伸达唇缘；下次脊短粗，连接下中尖；外脊近直，后部低弱，前部在 1 个标本中中断；后边脊强大。m2 内、外侧主尖的大小和形状分别彼此相似，错位排列；下前

边尖明显，向内伸出一达下后尖基部的前边脊，后方在低处与下原尖的前臂连接；下中尖小；下中脊完整，斜向前内，末端膨大；无下外中脊和下后脊；下次脊完整，与中尖连接；外脊前部粗壮，后部低弱；后边脊强大。m3 的下次尖与后边脊融会，形成伸达下内尖后方的脊；下内尖未完全退化；下中尖尚明显，在浅磨蚀的标本中，可见下中脊与下次脊愈合，形成横隔第二和第四内谷的强脊。

比较与讨论　上述标本的形态和构造完全符合原跳鼠属的特征，即：颊齿低冠；丘脊型齿；M1～2 的原脊与原尖或内脊连接；m1 具明显的下外中脊，下原尖、下次尖、下内尖、下中脊和下外中脊会聚于下中尖。

Protalactaga major 明显不同于 *P. grabaui* 在于尺寸较大，齿冠相对较高，M2 的中脊没有那样横向，m1 的下后尖不那么孤立，M3 的中脊和 m3 的下中脊相对较退化。

Protalactaga major 最先发现于通古尔（邱铸鼎，1996）。甘肃标本的牙齿比通古尔的略小，齿尖不那么趋于脊状，m1 的前部不甚收缩，或许表明甘肃标本具有较为原始的特征。当然，该种在两地发现的材料都不多，差异意义的确定有待更多标本的发现和比较。

非洲的 *P. moghrebiensis* 在大小上与 *P. major* 的接近，不同在于后者的上臼齿较横宽，齿尖显得饱满，齿脊相对发育，M3 和 m3 不甚退化。

Protalactaga major 牙齿的尺寸接近于 *Paralactaga* 属中的个体较小者，如 *P. minor*（郑绍华，1982）。*Protalactaga* 与 *Paralactaga* 在形态和构造上确实有许多相似之处，但从目前发现的材料看，两者牙齿的主要差异至少有：1) *Protalactaga* 一般个体小，齿冠低；2) *Protalactaga* 上臼齿原脊和后脊相对横向，分别与内脊前部和次尖后臂连接，不像 *Paralactaga* 的那样明显指向后方，并分别与中脊和后边脊连接；下臼齿的下次脊相对较横向，多与外脊后臂连接，不像 *Paralactaga* 的那样明显指向前方，与下中脊连接；3) *Protalactaga* 的 M3 和 m3 不那么退化，M3 中脊尚明显，可见第三外谷，m3 的下中脊可辨，尚存第三或第四下内谷；*Paralactaga* 的 M3 和 m3 较退化，M3 的中脊与后尖后方脊融合，使第三外谷消失，m3 的下中脊与下次尖融合，使第三和第四下内谷消失；4) *Protalactaga* 上臼齿的原附尖和中尖不甚发达；5) *Protalactaga* 的齿脊相对于齿尖较弱，*Paratalactaga* 的齿脊相对于齿尖较强。据此，通常不难把 *Protalactaga major* 与 *Paratalactaga* 属中个体较小的种区分开来。

但 *Paratalactaga minor* 的牙齿既具有 *Protalactaga* 的特征，又具有 *Paratalactaga* 的特征。如牙齿的尺寸、冠高和上臼齿原附尖与中尖的发育程度都接近或相似于 *Protalactaga* 者；而其上臼齿原脊和后脊，以及下臼齿的下次脊的指向和连结方式却与 *Paratalactaga* 的相似。*P. minor* 种的材料发现得还很少，其变异情况尚不得而知，这里认为 *P. minor* 所具有的齿脊的指向和连结方式是跳鼠类的重要衍生性状，故暂时把它保留在 *Paratalactaga* 属中，但并不排除它代表 *Protalactaga* 属中一进步种的可能。

Protalactaga 与 *Paratalactaga* 的相似，表明两者可能具有最接近的祖裔关系。从前者向后者进化的趋势似乎表现为：个体增大；齿冠增高；上臼齿的原脊和后脊逐渐指向后，进而分别与中脊和后边脊连接，下臼齿的下次脊逐渐指向前，进而与下中脊连接；M3 和 m3 趋于退化；上臼齿的原附尖增强，而中尖则减弱；齿脊相对齿尖逐渐发达。

兔形目 Lagomorpha Brandt, 1855

鼠兔科 Ochotonidae Thomas, 1897

鼠兔科(属、种未定)Ochotonidae gen. et sp. indet.

(图 2)

仅有一 DP4(V 12407),长 1.00mm,宽 2.90mm。大小与 *Alloptox* 和 *Bellatona* 属都很接近,材料太少,无法进一步确定。

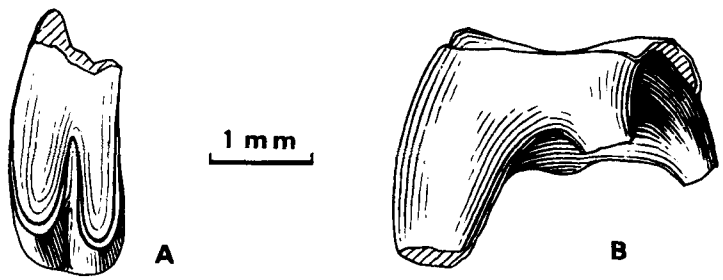


图2 鼠兔右上第四前臼齿 V 12407

Fig.2 Ochotonidae gen. et sp. indet. r. DP4, A. occlusal view; B. anterior view

2 动物群问题讨论

除仓鼠类和睡鼠类外,在泉头沟地点发现的小哺乳动物化石有 *Mioechinus? gobiensis*、*Heterosminthus orientalis*、*Protalactaga grabaui*、*P. major* 和 Ochotonidae gen. et sp. indet.五种。除 *H. orientalis* 和 *P. grabaui* 外,其余三种在这一地点属首次被发现。

以上各种均出现在内蒙古中中新世通古尔动物群,这表明泉头沟小哺乳动物组合所代表的时代与通古尔动物群的大致相同,属中中新世。当然,两地相同的种多少有些差别,如泉头沟 *Mioechinus? gobiensis* M1 和 M2 的后小尖比通古尔的稍弱,后缘较为凹入;*Protalactaga major* 的牙齿略小,齿尖不那么趋于脊状,m1 前部不甚收缩;*Heterosminthus orientalis* M1～2 中脊的平均长度稍短,m1 的前边尖略发育,下外中脊的平均长度稍长,m1～2 下外脊发育较弱。这些不同说明,泉头沟动物群与通古尔动物群的生存时代略有早晚。至于更确切的时代,仍有待仓鼠类的研究结果。

这五种小哺乳动物分属四科或亚科:刺猬亚科、林跳鼠科、跳鼠科和鼠兔科。从现生哺乳动物的分布看,刺猬亚科在我国主要分布在长江以北的广大地区,林跳鼠科和鼠兔科为全北界特有,跳鼠科则只见于古北界。因此,泉头沟小哺乳动物的组合具有浓厚的、与现代古北界类似的特色。

现代的林跳鼠类主要生活在温带和寒温带丛林、草地地区,跳鼠类则适应荒漠和干旱的草原环境,鼠兔类喜欢草原环境。因此,泉头沟小哺乳动物群反映了一个温带干旱、半干旱丛林—草原型的自然环境。从动物群中含有如此丰富的林跳鼠类看,也许当时的气候没有现在当地这样干燥,灌木丛林也会发育些。

致谢　作者感谢甘肃省文物考古研究所的谢俊义、陈善勤同志、甘肃省博物馆的颉光普同志和中国科学院古脊椎动物与古人类研究所的王伴月同志在采集标本中的通力合作和鼎力相助。承蒙所内同事，特别是王伴月研究员修改文稿和讨论有关问题，沈文龙同志绘图，张文定同志照相，哈佛大学 L. J. Flynn 博士修改英文概述，在此一并感谢！

INSECTIVORE, DIPODOIDEAN AND LAGOMORPH FROM THE MIDDLE MIOCENE QUANTOUGOU FAUNA OF LANZHOU, GANSU

QIU Zhu-Ding

(*Institute of Vertebrate Paleontology and Paleoanthropology, Chinese Academy of Sciences* Beijing 100044)

Key words　Lanzhou Basin of Gansu, Xianshuihe Formation, middle Miocene, Insectivora, Dipodoidea, Lagomorpha

Summary

Quantougou of Xianshuihe (Hsienshuho), Yongdeng (Pingfang Hsien), Gansu (Kansu) is a Neogene mammalian locality known since 1927. The Quantougou microfauna, first described by Young (1927) and revised by Schaub (1930, 1934), yielded four species, *Plesiodipus leei* Young 1927, *Paracricetulus schaubi* Young 1927, *Heterosminthus orientalis* Schaub 1930 and *Protalactaga grabaui* Young 1927. All these taxa, however, were represented by scarce material, and their intraspecific variation was unknown. It was highly desirable not only to get additional material from the type area, but also to increase the known taxonomic diversity for this important Miocene locality in northwestern China.

The material which forms the basis of this study was collected mainly in the field season of 1991 by means of screen-washing. Six families of small mammals, Erinaceidae, Gliridae, Zapodidae, Dipodidae, Cricetidae and Ochotonidae, represented by 898 fragmentary jaws and teeth were recovered from about 150 kg of sediments of the upper part of the Xianshuihe Formation. Although the collection is not so diverse taxonomically, the quantity of the specimens affords an opportunity to study the limits of individual variation of the type species, which are common in the Miocene deposits of North China. This paper deals in detail with the insectivore, dipodoidean and lagomorph. Description of the glirids and cricetids will be given in another forthcoming paper. For the geological background of the locality, the reader is referred to the paper "Recent Advances in Study of the Xianshuihe formation in Lanzhou Basin" by Qiu Zhanxiang and others (1997).

1 Systematics

Mioechinus? *gobiensis* Qiu 1996

(Fig. 1)

Material Two mandibular fragments with p4～m3 and m1～3 respectively, 12 isolated teeth (1 C sup., 1 P2, 1 P3, 1 P4, 1 M1, 2 M2, 1 p3, 1 m2, 1 DP2, 2 DP4); V 12403.1-14.

Description C sup. double-rooted with a high and sharp main cusp and a faint posterior protrusion. P2 double-rooted with a marked cusp and a ridge connecting its apex to the anterior and posterior extremities. P3 triangular and three-tooted with strong paracone, postparacrista, protocone, weak parastyle and no hypocone. P4 similar to P3 in shape, but larger in size and with more developed parastyle and a distinct hypocone closed to the protocone. M1 (the lingual portion preserved only) with a large hypocone, weak paracingulum and postcingulum. M2 wider than long and moderately emarginate posteriorly, the developed protocone with high pre- and postprotocrista; hypocone isolated from protocone; weak paracrista connecting paracone with small parastyle, high metacrista connecting metacone with the strong metastyle; paracone and metacone well-separated by a deep v-shaped valley; distinct metaconule present in one of the two teeth; continuous cingulum except for the lingual side.

p3 single-rooted with a short anterior and a long posterolabial ridge extending from its apex, pronounced postcingulid forms a small heel. A high and prominent paraconid and a low talonid heel can be seen in the damaged double rooted p4. m1 wedged shape with predominant protoconid crowded to the metaconid, paraconid well formed and rather high, paracristid wide v-shaped on labial view, protocristid and postcristid undeveloped, entocristid low and short, crista obligua low, directed anteriorly and extending to the posterolabial base of protoconid, trigonid basin much narrower and shallower than talonid basin. m2 similar to m1, but smaller in size and with shorter and wider trigonid. m3 without any trace of talonid.

Remarks The specimens described are comparable in size with those from the type locality Tunggur and fit in major morphological characters the diagnosis of *Mioechinus*? *gobiensis* (Qiu, 1996). Minor differences from the Inner Mongolian specimens are the relatively wide M2 with weaker metaconule and more distinct emargination.

Heterosminthus orientalis Schaub 1930

(pl. I, 1～6)

Material 48 maxillary fragments, 55 mandibular fragments, 191 isolated teeth (33 M1, 40 M2, 7 M3, 43 m1, 45 m2, 23 m3); V 12404. 1-294.

Description P4 bud-like and single rooted, with a large conical central cusp, and

anterolingual and posterolabial cuspules.

M1 subrectangular; a ridge or projecting spur present posterolingually to the protocone in 43 out of 69 specimens (in 7 it is swollen and in 4 it is a small protostyle); anteroloph well-developed and terminating with an anterostyle except in 6 teeth; mesocone small and close to hypocone; mesoloph present in all specimens, transverse, extending to the labial margin in 41, failing to reach half way in one case; mesostyle extreme rare; anterior part of endoloph low (lacking in 7); protoloph short and thin, usually posteriorly-directed to join the anterior part of endoloph, but transverse and connecting to the protocone in a few; metaloph oriented posteriorly and joining the posteroloph or posterior arm of hypocone, missing in four cases; posteroloph robust and extending to the labial base of metacone. M2 wider anteriorly with stronger cusps than posteriorly; a posterolingual ridge present posterointernal to the protocone in more than half of the teeth (35 cases), swollen in 11 and forming a weak protostyle in 8; anterocone and anterostyle incorporated into the prominent anteroloph; mesocone distinct; mesoloph transverse, extending to labial margin almost in all teeth, but seldom terminating with a cuspule; endoloph low in anterior part and interrupted in 2 cases; protoloph usually transverse or slightly posteriorly-oriented and connected with anterior part of the endoloph, oriented anteriorly and joining the protocone in 3 cases; metaloph transverse or oriented anteriorly to join with the hypocone in most teeth, connected with anterior arm of hypocone in a few; posteroloph well developed, extending to the posterior base of metacone. M3 subtrangular with very reduced metacone, distinct anteroloph and curved endoloph; mesocone visible and extending as a weak mesoloph in 5 out of 13 specimens; protoloph either directed anteriorly to join the anteroloph or oriented transversely to connect to the protocone or the anterior part of endoloph; metaloph oriented anteriorly and connecting with the posterior part of endoloph; posteroloph narrow and absent in two cases.

m1 narrower anteriorly than posteriorly; an obvious anteroconid existing in about 67% specimens, completely missing in 12%, anteroconid in most close to or connected with metaconid by a very thin crest; mesoconid pronouced, with ectomesolophid extending labially in all but one specimen; ectomesolophid weak in half of the teeth, but running to the margin of the tooth in more than 90% of the specimens, 70% of which terminate with a small ectostylid; a mesolophid absent; metalophid joins ectolophid; hypolophid short and thin, directed anteriorly and joining mesoconid, low or interrupted in 13 specimens; ectolophid running forward from hypoconid to metaconid, weak posteriorly and low or interrupted in 13 cases; a faint transverse crest (posterior arm of protoconid) extending from the anterior part of ectolophid in 15 specimens; a very narrow crest from protoconid in 27 of 72 specimens, 24 of which connect with metaconid or ectolophid, 3 with mesoconid; posterolophid strong, extending to the posterior base of entoconid, forming a

hypoconulid in the majority. m2 subrectangular; anteroconid distinct, close to metaconid and usually connected low on protoconid; a slightly curved "posterior arm of protoconid" running posterolingually from the protoconid to the posterior base of metaconid present in almost all the specimens; mesoconid individual in most teeth, with mesolophid extending to the edge of the tooth in 8 cases; metalophid directed anteriorly and joining anteroconid; hypolophid oriented transversely or slightly anteriorly to connect with the mesoconid or ectolophid; ectolophid running from hypoconid to protoconid, short and weak or interrupted posteriorly; posterolophid and hypoconulid striking. m3 reduced posteriorly with the entoconid and posterolophid almost fused with the crest extending from the hypoconid to the posterior base of metaconid; a distinct "posterior arm of protoconid" existing in most specimens, a visible mesoconid and complete ectolophid in a few teeth.

Remarks Despite some variation in size and morphology, the specimens described are homogenous and no break in the variation can be detected to distinguish different taxa. It is obvious that these specimens represent additional material of *Heterosminthus orientalis* Schaub 1930 from the same locality.

Specimens of *Heterosminthus orientalis* were also collected from Tunggur, Nei Mongol and Xining basin, Qinghai, and were once reported as *Protalactaga tunggurensis* (Wood, 1936; Qiu et al., 1981, 1988; Qiu, 1996). A comparison of the Quantougou material with that of Tunggur shows identification of teeth from the two localities both in size and morphology. Minor differences of the Quantougou specimens from those of Tunggur are the shorter mesoloph of M1～2 and the longer ectomesolophid of m1 on average, the slightly more developed anteroconid of m1 and the weaker ectolophid of m1～2.

Protalactaga grabaui Young 1927

(pl.I, 7～12)

Material 11 maxillary fragments, 4 mandibular fragments, 303 isolated teeth (2 DP4, 3 P4, 53 M1, 42 M2, 32 M3, 57 m1, 47 m2, 67 m3); V 12405.1-318.

Description P4 single-rooted with a main cusp and a ridge encircling the posterior margin of the tooth.

M1 subrectangular with a distinct anteroloph, weak mesocone, posteriorly-directed protoloph and metaloph; protoloph joining anterior part of endoloph in the majority (48 out of 58) and connecting with mesocone in the minority; metaloph joining either posteroloph or hypoconule; mesoloph robust extending labially and terminated with a mesostyle; prominent hypoconule connected with hypocone and strong posteroloph; endoloph short with weak anterior part. M2 similar to M1, but narrow posteriorly with weaker hypocone and metacone, transverse or anteriorly-directed protoloph joining always to protocone; metaloph directed to or connected with hypoconule in 27 out of 50 specimens, directed to or connected with hypocone in the rest; hypoconule usually

indistinct; endoloph straight, joining the posterior arm of protocone in most of the teeth, joining the junction of protoloph and the posterior arm of protocone in 8 specimens. M3 subtriangular with small mesocone, visible mesoloph and mesostyle; metacone incorporated into the posteriorly-curved posteroloph and joining hypocone; endoloph reduced, failing to reach protocone in one third of the teeth.

m1 narrower anteriorly than posteriorly, with hypoconid the predominant cusp in the tooth; anteroconid varies from absent (about half of specimens) to well developed (14 specimens); if present it is located close to metaconid in most, to midline in a few; mesoconid prominent; mesolophid robust and terminated with mesostyle; ectomesolophid ("G") complete, extending to the margin in 47 of 55 specimens, terminated with ectomesoconid in 17 cases; ectolophid complete with low and weak posterior part; metalophid absent; hypolophid short and weak, failing to connect with mesoconid in half of the teeth; posteroloph strong and extending from the posterolabial corner to the base of entoconid. m2 trapezoid with distinct anteroconid; mesoconid relatively weaker than that of m1, but still serving as a junction of protoconid, hypoconid, entoconid and mesolophid; mesolophid usually connected with mesoconid in majority, with ectolophid in 11 of 39 specimens, weak or interrupted in 3 cases; mesostylid usually marked, but ectomesolophid present only in two teeth; hypolophid short and low, joining mesoconid or the posterior part of ectolophid in 27 specimens, interrupted in 10 cases; posterolophid strong. m3 similar in pattern of the anterior portion to that of m2, but reduced and variable in the posterior portion; hypoconid still prominent, but entoconid faint and melting with the mesostylid and posterolophid in some specimens to form a strong crest encircling the posterolabial corner, mesoconid and mesolophid reduced or absent in some specimens.

Remarks *Protalactaga grabaui* was named by Young (1927) based on a mandibular fragment with m1～3 from Quantougou. The specimens described fully agree with the type specimen in morphology, such as metaconid isolated from protocone in m1, the four elements protoconid, mesolophid, ectomesolophid and entoconid converging on the mesoconid, and mesolophid being free from the hypolophid. Characters in the type specimen, for example, the absence of anteroconid, the presence of a pronounced mesostylid and ectomesostylid on m1, the lacking of connection between anteroconid and protoconid, and narrow ectosinusid on m2, can be observed in the additional material.

Protalactaga grabaui specimens also known from Tunggur, Nei Mongol, fall within the range exhibited by *P. grabaui* from Quantougou both as to size and morphology.

Protalactaga major Qiu 1996

(pl.I, 13～18)

Material 4 P4, 5 M1, 5 M2, 4 M3, 3 m1, 2 m2, 5 m3; V 12406.1-28.

Description P4 single-cusped and bud-shaped, with one root; a curved crest running from the cusp lingually and encircling the posterior margin of the tooth. M1 with robust anteroloph that is the melded anterior arm of protocone and protostyle; mesocone faint; endoloph slight curved, robust posteriorly, interrupted anteriorly in one tooth; protoloph posteriorly-oriented, connecting with the anterior part of endoloph in 4 out of 5 specimens, interrupted in one; metaloph weak, posteriorly-oriented, joining posteroloph, lacking in one teeth; mesoloph strong, swollen labially; posteroloph developed, but failing to reach the labial margin of the tooth. M2 trapezoid; different from M1 in being narrower posteriorly, having relatively weaker hypocone, metacone and posteroloph, slightly transverse or anteriorly-oriented mesoloph, undeveloped mesocone. Protoloph and metaloph slightly anteriorly-oriented, with the former connecting to the anterior part of endoloph and the latter to the union of hypocone and posteroloph. M3 subtriangular; protoloph transverse and joining protocone; hypocone and metacone incorporated into the posteroloph; mesoloph complete, joinning metacone with the curved posterior crest to enclose a posterocentral basin.

m1 with a distinct anteroconid in 2 teeth and without in 1 tooth; metaconid nearly isolated; mesoconid pronounced, but low; mesolophid low, but quite robust, joining the anterior part of ectolophid or the mesoconid, terminating lingually with a mesostylid; ectomesolophid narrow and extending to the labial margin; hypolophid short and thick, joining mesoconid; ectolophid straight with low and weak posterior portion, missing in 1 tooth; posterolophid strong and extending to the posterior base of entoconid. m2 slightly wider posteriorly than anteriorly with alternating arrangement of inner cusps and outer cusps; anteroconid prominent; mesoconid small; mesolophid robust, extending anterolingualy, swollen lingually; without ectolophid and metalophid; hypolophid complete, joining mesoconid; ectolophid robust with low posterior portion; posterolophid strong, extending to the posterior base of entoconid. m3 reduced posteriorly; hypoconid incorporated into posterolophid; entoconid melded with mesostylid to form a prominent cusp, mesoconid visible; a robust crest with melted mesolophid and hypolophid can be seen in one slightly worn tooth.

Remarks The Quantougou sample is identical morphologically with the specimens from the type locality Tunggur, Nei Mongol, but with minor differences from the latter in slightly smaller size, more bunodont cusps and less compressed anterior portion of ml.

Except for its smaller size, *Protalactaga major* differs from *P. grabaui* in relatively higher crown, less transverse mesoloph of M2, relatively reduced mesoloph of M3, and mesolophid of m3. It is close in size to *P. moghrebiensis* from Jebilet, Morocco, but distinguished from the latter by its shorter and wider molars with plumper cusps and more pronounced crests, and by its less reduced M3 and m3.

In size *Protalactaga major* is close to small species of *Paralactaga,* such as *P.*

minor. Generally, *Protalactaga* can be distinguished from *Paralactaga* by 1) its small size and low crown; 2) protoloph and metaloph of upper molars relatively transversely-directed and joining the anterior part of endoloph and posterior arm of hypocone, respectively; 3) less reduced M3 and m3 with distinct mesoloph (id) and IIIS in M3, IIIsd even IVsd in m3; 4) less developed protostyle and mesocone; 5) weaker crests relative to cusps. *P. minor* is retained in the genus *Paralactaga* for its relatively posteriorly-directed protoloph and metaloph joining the mesoloph and posteroloph, respectively, considered important derived characters for dipodoideans. However, a possibility of assignment of *P. minor* as an advanced species of *Protalactaga* can not be excluded until more material of the species is available.

The similarity of the genus *Paralactaga* to *Protalactaga* seems to imply their close affinity. A population of the latter might give rise to *Paralactaga* during the early late Miocene. A phyletic lineage toward *Paralactaga* would be characterized by an increase of size, a heightening of crowns, protoloph and metaloph gradual directed posteriorly and joining mesoloph and posteroloph respectively in upper molars, hypolophid gradual directed anteriorly and joining mesolophid in lower molars, reduction of M3 and m3, development of protostyle and mesocone (id), strengthening of crests relative to cusps.

Ochotonidae gen. et sp. indet.

(fig.2)

A DP4 (V 12407), similar to that of *Alloptox* or *Bellatona*, represents the occurence of this taxon.

2 Discussion

Besides glirids and cricetids, five taxa *Mioechinus*? *gobiensis*, *Heterosminthus orientalis*, *Protalactaga grabaui*, *P. major* and Ochotonidae gen. et sp. indet. are known in the collection, of which three are new in this micromammalian fauna.

All five species appear in the Miocene Tunggur fauna of Nei Mongol. This may be indicative of close age of the two faunas. The fact that *M.*? *gobiensis*, *H. orientalis* and *P. major* from Quantougou fauna show minute differences in feature as mentioned above, may suggest some difference in age of the faunas. Nevertheless, it seems secure to assign the age of the Quantougou fauna to middle Miocene with the Tunggur fauna. Further dating awaits a forthcoming study of cricetids from this locality.

Among the four families of small mammals, Zapodidae and Ochotonidae occur today throughout the Holarctic Region, Dipodidae are typical of the Palearctic Region, and Erinaceidae are widely distributed in North China. Dipodids and ochotonids are adapted to arid steppic environment, while zapodids require somewhat more dense shrub. Thus, the Quantougou fauna seems to reflect a temperate dry or subdry

forest-grassland environment, similar to that of the present-day Palearctic Region.

References

Bi S D (毕顺东), Wu W Y (吴文裕), Ye J (叶捷) et al., 1999. Erinaceidae from the middle Miocene of North Junggar Basin, Xinjiang Uygur Autonomous Region, China. Proc VII Ann Meeting CSVP (第七届中国古脊椎动物学学术年会论文集). Beijing: China Ocean Press. 157～166 (in Chinese with English summary)

Jacobs L L, Flynn L J, Li C K, 1985. Comments on rodents from the Chinese Neogene. Bull Geol Inst Univ Uppsala N S, **11**: 59～67

Jaeger J J, 1977. Les Rongeurs du Miocene moyen et superieur du Maghreb. Palaeovertebrata, **8**(1): 1～66

Qiu Z D, 1988. Neogene micromammals of China. Proc Second Conf the Palaeoenvironment of East Asia from the Mid-Tertiary. **2**: 834～848

Qiu Z D(邱铸鼎), 1996. Middle Miocene micromammalian fauna from Tunggur, Nei Mongol. Beijing: Science Press. 1～216 (in Chinese with English summary)

Qiu Z D (邱铸鼎), Li C K(李传夔), Wang S J (王士阶), 1981. Miocene mammalian fossils from Xining Basin, Qinghai. Vert PalAsiat (古脊椎动物学报), **19**(2): 169～182(in Chinese with English summary)

Qiu Z X (邱占祥), Wang B Y(王伴月), Qiu Z D(邱铸鼎) et al., 1997. Recent advances in study of the Xianshuihe Formation in Lanzhou Basin. In: Tong Y S, Zhang Y Y, Wu W Y et al. eds. Evidence for Evolution-Essays in Honor of Prof. Chungchien Young on the Hundredth Anniversary of His Birth. Beijing: China Ocean Press. 177～192 (in Chinese with English summary)

Schaub S, 1930. Fossile Sicistinae. Ecl Geol Helv, **23**(2): 616～637

Schaub S, 1934. Uber einige fossile Simplicldentaten aus China und der Mongolei. Abh Schw Pal Ges, **54:** 1～40

Wood A E, 1936. Two new rodents from the Miocene of Mongolia. Am Mus Novit, (865): 1～7

Young C C, 1927. Fossile Nagetiere aus Nord-China. Pal Sin, **3**(3): 1～82

Zheng S H(郑绍华), 1982. Middle Pliocene micromammals from the Tianzhu Loc. 80007(Gansu Province). Vert PalAsiat (古脊椎动物学报), **20**(2): 146～153(in Chinese with English abstract)

图版 I 说明(Explanations of Plate I)

1～6. 东方异鼹鼠 *Heterosminthus orientalis* Schaub, 1930

1. M1 (V 12404.49); 2. M2 (V 12404.82); 3. M3 (V 12404.122); 4. m1 (V 12404.209); 5. m2 (V 12404.250); 6. m3 (V 12404.288)

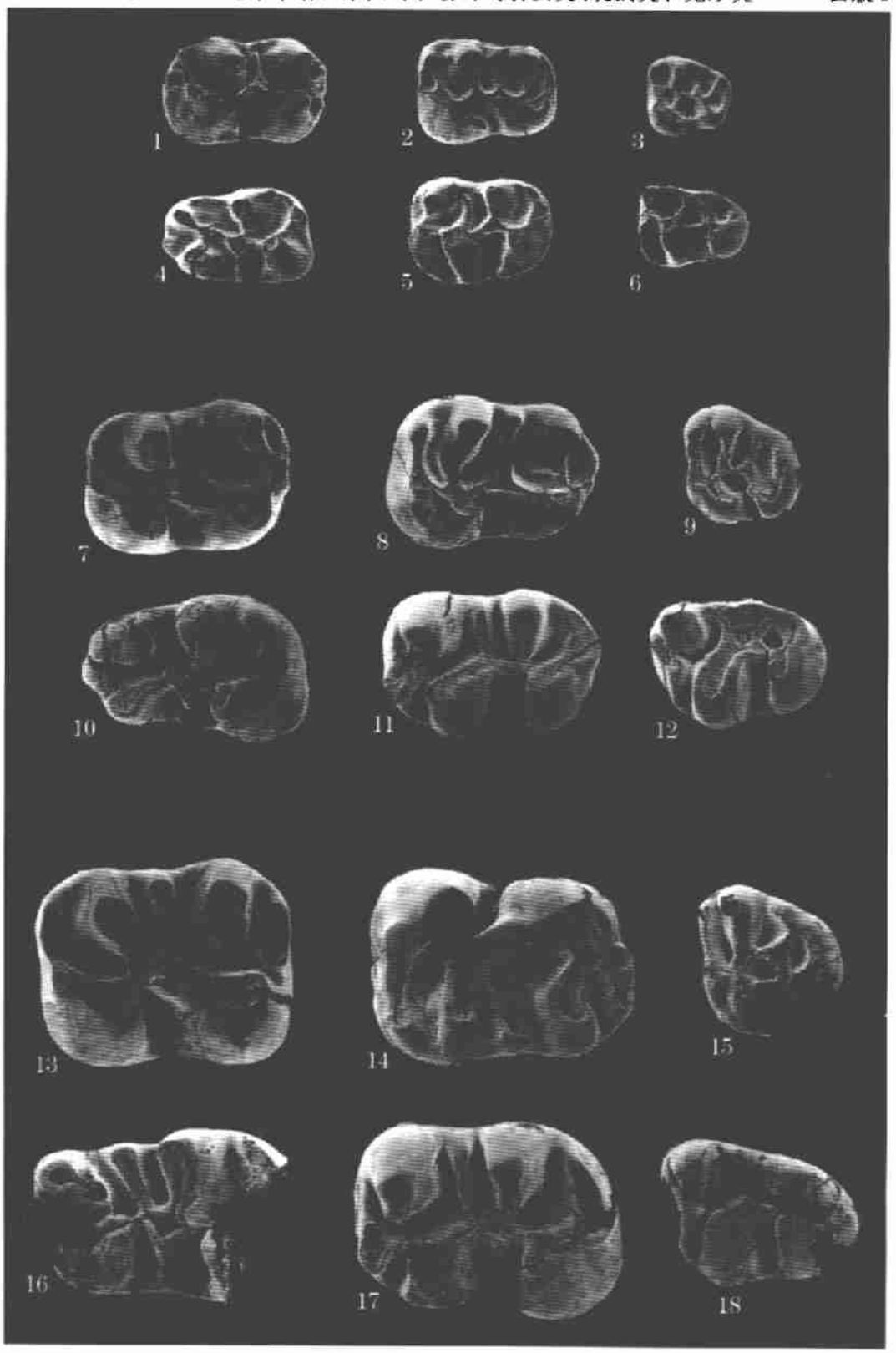
7～12. 葛氏原跳鼠 *Protalactaga grabaui* Young, 1927

7. M1 (V 12405.21); 8. M2 (V 12405.74); 9. M3 (V 12405.116); 10. m1 (V 12405.176); 11. m2 (V 12405.205); 12. m3 (V 12405.252)

13～18. 大原跳鼠 *Protalactaga major* Qiu, 1996

13. M1 (V 12406.5); 14. M2 (V 12406.9); 15. M3 (V 12406.11); 16. m1 (V 12406.15); 17. m2 (V 12406.17); 18. m3 (V 12406.18)

所有标本均为冠面视；放大 30 倍；除 14 外均为左侧齿(All occlusal view, ×30, left teeth except Fig.14)


1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18