

记山西榆社上新世鼯鼯科两新种

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关键词 山西榆社 上新世 鼯鼯科

内 容 提 要

本文记述了山西榆社盆地上新世鼯鼯科的两个新种: *Peisorex pliocaenicus* sp. nov., *Soriculus praecursus* sp. nov., 并列出了该盆地晚新生代地层中采集到的其它食虫类名单。

一、前 言

食虫类对于了解华北晚新生代小哺乳动物群的古地理和古生态环境具有重要意义。本文仅记述中美古生物科考队于 1987 及 1988 年两次野外考察期间在山西榆社云簇盆地采集到的鼯鼯科的两个新种,对其它食虫类只列出初步名单。关于榆社盆地各化石地点的地质背景和有关动物群,读者可参考邱占祥与 Tedford(1990), Tedford 与邱占祥(1991), 陈冠芳(1991), 吴文裕与 Flynn(1992), Flynn 等(1991)及 Tedford 等(1991)的文章。

榆社合作项目的参加者中,除邱占祥和 Tedford 外,参加野外工作的还有 Neil Opdyke (美国佛罗里达大学)、William R. Downs (北亚利桑那大学),李玉清(天津自然博物馆),贾文亮、王太明(榆社博物馆)及中国科学院古脊椎动物与古人类研究所的阎德发、叶捷、陈冠芳、朱根柱、陈晓峰、李亦征及本文作者。我们的工作还得到了榆社人民的大力支持。

本文电镜照片由美国自然历史博物馆 Peling Fong 和哈佛大学应用科学部 Yuan Lu 制作。美国自然历史博物馆 Guy G. Musser 和哈佛大学比较动物学博物馆 Maria Rutzmoser 女士提供了现生动物骨骼对比标本。Berkeley 的 Howard Hutchison 也提供了对比标本。沈文龙先生精心加工插图。作者在此谨表衷心感谢。本文由弗林执笔,吴文裕译成中文。

二、描 述

食虫目 *Insectivora* Cuvier

鼯鼯科 *Soricidae* Fischer von Waldheim, 1817

鼯鼯亚科 *Soricinae* Fischer von Waldheim, 1817

肥鼯族 *Blarinini* Stirton, 1930

裴氏鼯属 *Peisorex* Kowalski and Li, 1963上新裴氏鼯(新种) *Peisorex pliocaenicus* sp. nov.

(图 1 E; 图版 1 3)

正型标本 带 M_{1-3} 的右下颌骨残块 V8900, 其前端破损, 喙突残缺。**模式地点** 时代及层位: YS5; 3.2 百万年, 中上新世; 麻则沟组。**鉴别特征** 个体较渤海裴氏鼯 (*P. pohaiensis*) 约大 15%; 下颌孔较小, 髁突下关节面较后位, 髁突上下关节面间的骨板较厚。 M_3 较大。**命名由来** 相对于更新世属型种 *P. pohaiensis* 该种的时代为上新世。**描述** 尺寸较大(见表 1)。下颌水平枝较纤细, 在 M_1 下次尖处的高度为 2.5mm。颞孔位于 M_1 后齿根的前方。喙突相对于下颌水平枝明显地向侧方倾斜。髁突为 Blarinine 型, 由上、下两个分离的关节突组成, 此两关节突由舌侧凹陷的关节突间骨板连接。下关节突很靠前, 接近下颌孔, 由唇侧看不见。上翼窝开阔下凹, 具有一细弱的翼刺。外颞窝高于水平枝。咬肌窝大而浅, 位于上 S 形切迹之下。内颞窝大, 并与下颌孔相通。下臼齿三角座的角度大, 下原尖较靠舌侧。 M_1 和 M_2 的下内尖前壁很斜; 下次尖后臂末端不达下内尖; 下次小尖不发育。下臼齿唇侧齿带发育、舌侧齿带弱。 M_3 退化, 尤其是其跟座非常窄而无齿尖; 下次尖为新月形脊, 终止于下内尖的位置。**讨论** 裴氏鼯的属型种渤海裴氏鼯的喙突简单且不具翼刺。虽然 V8900 标本的喙突大部分缺损, 但其它一些特征表明该标本应归入裴氏鼯属: 髁关节突发育, 尤其是下关节突的前位; 间关节突板宽且凹陷; 深凹的上翼窝; 内颞窝与下颌孔沟通。这些特征表明裴氏鼯 *Peisorex* 与肥鼯 *Blarina* 的关系更近, 而离 *Cryptotis* 较远。新种明显地大于渤海裴氏鼯, 其下关节突不如后者的那样靠前, 下颌孔较小, 颞孔较靠后。两个种的下臼齿相似, 只是上新裴氏鼯的 M_3 不如渤海裴氏鼯的退化。至于上新裴氏鼯的狭窄的、新月形脊的下跟座则属于变异性的特征, 由于每个种仅有一块标本, 因此在种的鉴别上不起作用。下内尖脊的缺失、颞孔后位和宽凹的上翼窝等特征表明, 新种应和 Repenning(1967) 对渤海裴氏鼯所假设的那样归于肥鼯族 Blarinini。在欧亚北部及北美还有一些大型鼯鼯。新近, 一些学者 (Zazhigin, 1980; Cai, 1987; Qiu, 1988) 记述了东北亚新第三纪晚期的一些大型鼯鼯, 一般都暂将它们归入东欧的常见属 *Beremendia*。 *Beremendia* 的某些特征与裴氏鼯相近, 特别是: 简单的喙突, 宽凹的上翼窝, 下关节突的前位, 凹陷的关节突间板(或称间关节区)以及翼窝与下颌孔之间的窄骨片。但裴氏鼯的这些特征更为进步, 尤其是下关节突的前位和进一步突向近中面。除 *Beremendia-Peisorex* 支系外, 榆社还有一种大型鼯鼯 (YS 87), 是华北新第三纪晚期小哺乳动物群中的重要分子。它与 *Blarinoidea* 相似, 在东欧也常见。 Rzebik-Kowalska (1976) 将它与 *Beremendia* 清楚地区分开。 *Shikamainosorex* (Hasegawa, 1957) 可能是这一类的成员。这个属在日本更新世常见, 与北美上新世的 *Paracryptotis* 关系很近 (Rzebik-Kowalska and Hasegawa, 1976)。这些属的共同特征是: 喙突抹刀状, 有明显的喙刺; 关节突间板宽, 不凹陷; 上翼窝浅。在这一支系中, 下关节突不像 *Peisorex* 那样靠前和突向近中面。在榆社盆地的 YS 87 地点(与 YS 5 大致同时代), 也有可能 YS

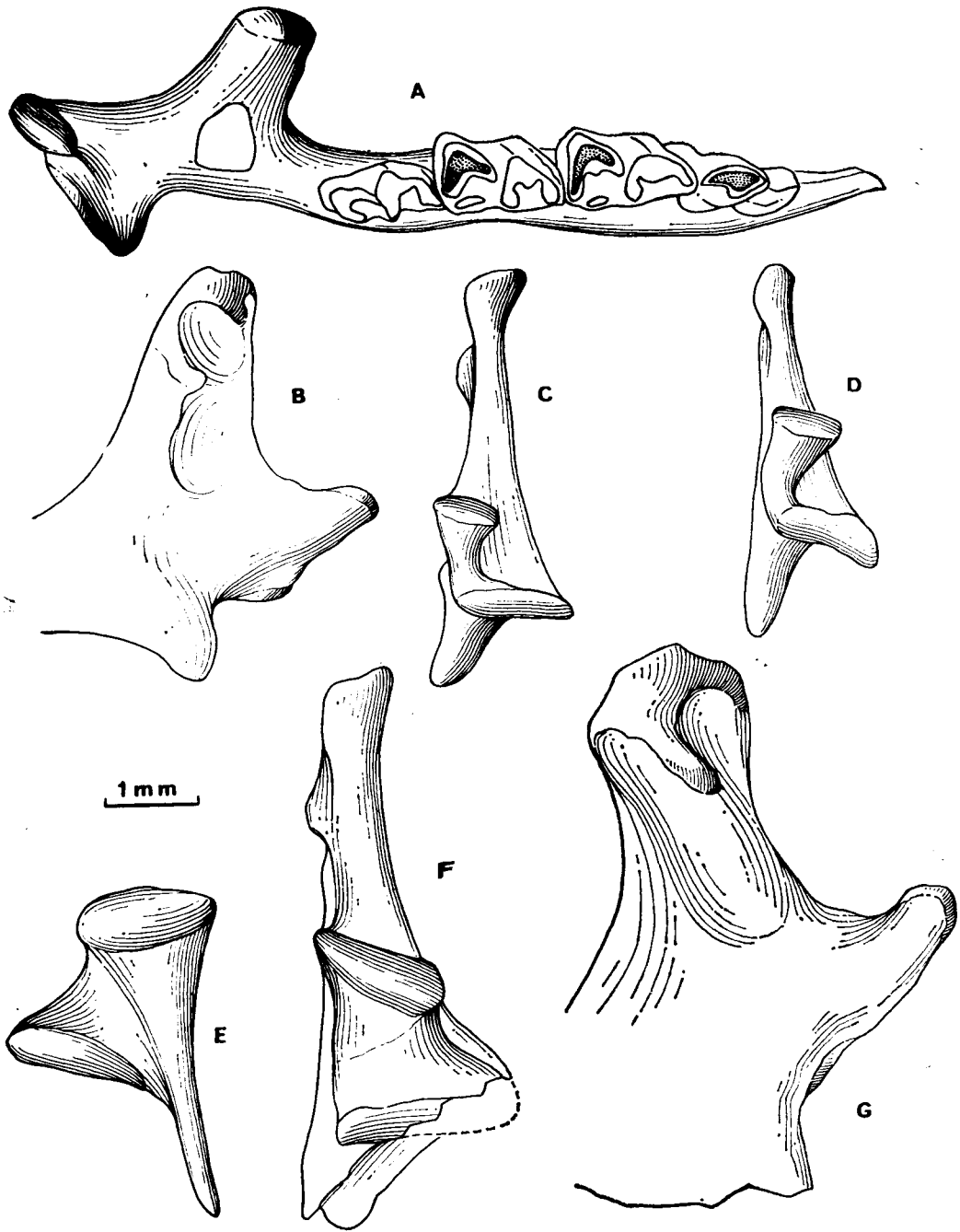


图1 A—C. 先鼯(新种) *Soriculus praecursus* sp. nov. 正型标本, V 8898.1, 左下颌骨, A. 冠面视; B. 侧视; C. 后视。 D. 长尾鼯 *Episoriculus caudatus*, MCZ 20726, 示髁关节构造。 E. 上新裴氏鼯(新种) *Peisorex pliocaenicus* sp. nov. 正型标本, V8900, 髁关节后视, F—G. YS87 大型鼯, V8895.4, 示下关节面的形态和后位。

Fig. 1 Holotype of *Soriculus praecursus*, V8898.1, in occlusal (A), lateral (B) and posterior view (C). Its condyle structure is compared to that of *Episoriculus caudatus*, MCZ 20726 (D). Condyle of V8900 (E), holotype of *Peisorex pliocaenicus*, showing sculpted interarticular area, which contrasts with that of another large shrew from YS87, V8895.4, in both shape and less anterior position of the lower facet (F,G). All drawn to same scale.

50(4.2 百万年)及 YS 32 (5.4 百万年)地点找到有 *Blarinoides-Shikamainosorex* 类的齿骨和牙齿化石(图 1F、G, 图版 1,5,6)。

鼯族 *Soriculini* Kretzoi, 1965

鼯属 *Soriculus* Ellerman and Morrison-Scott, 1951

先鼯(新种) *Soriculus praecursus* sp. nov.

(图 1 A,B,C; 图版 1,1,2,4)

正型标本 带完整齿列的一完整左下颌骨, V8898.1

众型 V8898. 1; V8898. 2, 带 M_{2-3} 的左下颌残段; 两枚右 M^2 , V8898. 3 和 V8898.4(1.35 × 1.6; 1.3 × 1.5⁺mm)

模式地点、时代及层位 YS 50, 4.2 百万年, 早上新世; 高庄组, 南庄沟段。

鉴别特征 小于 *S. nigrescens*, 与 *S. (Chodsigoa) lamula* 的尺寸接近。前部牙齿排列紧密, 门齿的唇侧凸缘终止于 P_4 的后部下方。下关节突横向不伸长, 不前位。喙突高而粗壮。上 S 形切迹和喙突端点间的中部有一短喙刺。颊齿不侧扁, M_1 不十分退化。 M^2 的次尖弱, 后缘不很凹陷。

种名由来 拉丁文。意“先驱、祖先”。以示该种出现于亚洲其它 *Soriculine* 型鼯类之前。

描述与比较 水鼯型下颌关节。髁突的两个关节突由一窄而凹的间关节区分开, 使髁突后面近乎 L 形, 其垂直臂长而细, 与下臂成 105° 交角。下臂粗壮、呈圆柱形; 上臂较小并稍倾斜。喙突偏离下颌水平枝, 向侧方倾斜, 髁突仅稍倾斜。下关节突以一沟与下 S 形切迹分开。V8898.1 标本的这些特征与 *Soriculus (Episoriculus) caudatus* 很相似。与大型的水鼯 *Neomys fordians* 和 *Soriculus nigrescens* 也相像; *S. (Chodsigoa)* 具有较粗壮的髁突, 且下关节突前位, 喙突更倾斜。榆社的新种的喙突较 *S. (E.) caudatus* 的粗壮, 其顶端并不强烈向前倾斜, 但像 *S. (Chodsigoa)* 那样具有一浅沟。喙突小刺仅下降至 S 形切迹与喙突端点的中部。上翼窝及翼刺不发育。外颞窝向腹侧延伸接近下关节突的顶部。较大的内颞窝和下颌孔及其所处位置如同 *S. (E.) caudatus*。颞孔位于 M_1 正中下方。

该标本的牙齿不着色。在 *Neomys* 和 *Soriculus* 的各个种内牙齿着色很浅。在 *Chodsigoa* 亚属内几乎不着色。门齿顶端破损, 很可能较短而简单, 仅具一背侧齿尖, 在该标本上几乎已被磨蚀掉。门齿的内外侧都具基部齿带, 门齿外侧伸至 P_4 的后方。两枚臼前齿粗壮, 紧靠在一起; P_4 的外叶低于臼齿列。臼齿具有很发育的舌侧和唇侧齿带。 M_1 及 M_2 的下内尖高, 具中等发育的下内尖脊, 并以一窄沟与低矮的下次小尖相隔。 M_3 退化程度中等, 其下跟座窄, 下内尖低矮。

两枚 M^2 , V8898.3 在后附尖处破损; V8898.4 磨蚀很深, 保存在部分上颌骨上。 M^2 低冠, 嚼面为矩形, 其前前尖脊 (preparacrista) 和前后尖脊 (postmetacrista) 大致等长。后尖较前尖大而高。外脊为对称的 W 形, 没有附尖。对称的 V 形原尖居中、正对着后前尖脊 (postparacrista), 前原尖脊 (preprotocone crista) 与前尖基部相连, 但后原尖脊 (postprotocone crista) 后端不伸及后尖。没有明显的小尖 (conule)。次尖低, 其凸缘在

齿中部有一不太深的缺刻。后齿带伸展于牙齿后缘,与牙齿等宽。无前齿带和舌侧齿带。

两枚产自 YS50 的上门齿可能归入此种。一枚已磨蚀,但保存好,构造简单,前端无内侧小尖。

表 1 数种现生及化石鼯鼠的测量数据(单位:毫米)

Table 1 Dimensions (mm) of selected fossil and Recent Soricidae

<i>Soriculus praecursus</i> sp. nov.		
V8898.1	M/1: 1.65 × 1.05	M/1 - 3: 4.2
	M/2: 1.5 × 1.0	P/4 M/1 - 3: 5.1
	M/3: 1.25 × 0.7	Incisor tip to condyle: 10.5 (门齿前端至髁突)
V8898.2	M/2: 1.4 × 0.9	
	M/3: 1.15 × 0.6	
<i>S. (Episoriculus) caudatus</i>		
MCZ 20726	M/1: 1.6 × 0.8	M/1 - 3: 3.7
	M/2: 1.4 × 0.75	P/4 M/1 - 3: 4.5
	M/3: 1.1 × 0.6	
<i>S. (Chodsigoa) hypsibius</i>		
MCZ 20730	M/1: 1.7 × 1.1	M/1 - 3: 4.5
	M/2: 1.7 × 0.95	P/4 M/1 - 3: 5.3
	M/3: 1.3 × 0.8	
<i>Peisorex pliocaenicus</i> sp. nov.		
V8900	M/1: 2.95 × 1.6	M/1 - 3: 6.7
	M/2: 2.3 × 1.45	
	M/3: 1.65 × 1.0	
<i>Peisorex pohaiensis</i>		
V2671	M/1: 2.6 × 1.7	M/1 - 3: 5.8
	M/2: 2.1 × 1.4	
	M/3: 1.5 × 0.86	
<i>Shikamainosorex densicingulata</i>		
holotype	M/1: 2.45 × 2.0	M/1 - 3: 5.75
	M/2: 1.85 × 1.7	
	M/3: 1.55 × 1.0	

注: MCZ 哈佛大学比较动物学博物馆

讨论 *Soriculus* 属内各种的系统关系至今尚未解决。主要由于该类的特征分布和极性尚不明确。Hoffman (1986) 深入地重新研究了东亚的鼯鼠,发现过去被归入 *Soriculus*, *Chodsigoa* 和 *Episoriculus* 属的各种之间关系密切。这些种分别属于 *Soriculus* 属内具有同等级别的亚属。它们都具有紧密排列在一起的臼前齿。它们都与相近的类外群 *Neomys* 具有共同的特征: 纤细的 L 形髁突、轻微着色的牙齿、M₁ 的跟座具有两个

齿尖。

Soriculus 亚属的唯一代表 *S. nigrescens* 是 *Soriculus* 属内最具衍生特征的种。它表现出对穴居生活的适应,其臼齿明显地侧扁。*S. (Chodsigoa)* 的五个种都具有粗壮和拧扭的下颌关节、向侧方偏斜的喙突和前位的下关节突。*S. (Episoriculus)* 的四个小型种的门齿都具有两个齿尖。

目前,人们认为这三个亚属是单系的,但它们之间的关系并不清楚。如果对种的特征的分支分类分析能解决它们之间的关系问题或者通过较长时间段的化石记录能追溯到较高分级的分类单元,那么可以有理由改变分类级别。由于化石记录零散,并且根据近裔性状建立的这些亚属在 2.5 百万年前界限并不清楚,我们暂决定将现生的和化石的鼯族归入单一的 *Soriculus* 属。这一选择是由于没有更好的解决办法。

周口店更新世的 *S. (C.) bohlini* (Young, 1934) 具有 *Soriculus (Chodsigoa)* 的特征:下关节突前位;喙突偏斜;M₁ 跟座退化、无下内尖 (Repenning, 1967)。

Kotlia (1991) 命名了克什米尔 2.4 百万年前的一个新种 *Episoriculus repenningi*。这个种尺寸小,与现生的 *Soriculus (Episoriculus)* 接近;下门齿有两个小齿尖。

晚上新世的 *Episoriculus gibberodon* 的平均尺寸较 *E. caudatus* 小;其下门齿形态相似,但颊齿列不那么紧密排列。该种广泛分布于波兰、匈牙利、罗得斯岛和土耳其的阿纳托里 (Anatolia), 出现的时代可能较早 (Kormos, 1934; Repenning, 1967; De Bruijn et al., 1970; Engesser, 1980; Reumer, 1984)。将该种置于 *Episoriculus* 亚属的做法与其共有的原始特征是吻合的,但其根据仅仅是门齿上具有两个小齿尖。

Soriculus praecursus 落入 *Chodsigoa* 亚属的尺寸范围之内,但这个早上新世的种不具有该亚属的近裔性状。与现生种 *Soriculus (Episoriculus) [caudatus (MCZ20726, 云南省。见表 1)]* 比较,后者尺寸小,臼齿较窄;臼前齿纤细;下颌髁关节较 *S. praecursus* 的长而纤细;下门齿终止于 P₄ 的前端下方。*S. praecursus* 虽具有 *Soriculus* 的特征,但是不具有现生各亚属的近裔自性,因此将其作为 *Soriculus* 属内的一个种而不归入任何亚属。*S. praecursus* 的大部分特征很可能保留了包括 *Neomys* 在内的 *Soriculine* 鼯类的一些原始形态。

表 2 山西榆社盆地食虫类名单。各岩石地层组名称 依据邱占祥等,1987 年;年龄数 系指各组内产小哺乳动物化石层位 (Tedford 等,1991 年)

Table 2 Insectivora from the Yushe Basin, Shanxi Province. Taxa listed by rock units, which follow Qiu et al. (1987). Dates (Tedford et al., 1991) refer to horizons within formations that yield small mammals.

马会组 Mahui Formation 5.7—5.3Ma (百万年)	高庄组 Gaozhuang Formation 4.3—4.0Ma	麻则沟组 Mazegou Formation 3.4—2.9Ma	海眼组 Haiyan Fm. <2.5 Ma
<i>Soricidae</i> indet. cf. <i>Blarinini</i> <i>Talpinae</i> indet	<i>Soriculus praecursus</i> <i>Blarinini</i> sp. indet. <i>Desmana kowalskæ</i> <i>Yanshuella primaeva</i> <i>Scaptochirus</i> sp.	cf. <i>Erinaceus</i> sp. cf. <i>Blarinoides</i> sp. nov. <i>Peisorex pliocaenicus</i> <i>Yanshuella primaeva</i> <i>Scaptochirus</i> sp.	<i>Sorex</i> sp.

其它食虫类 表 2 按地层顺序列出了中美考察队在榆社云簇盆地中采集到的食虫类名单。唯一的猬类标本与 *Erinaceus* 的特征相吻合,但不排除是 *Hemiechinus* 的可能性。鼯鼠类以鼯鼠类和肥鼯鼠类为代表,它们看来出现于除海眼组以外的整个剖面中。麻则沟的“cf. *Blarinoides*”也与 *Shikamainosorex* 相似。鼯鼠属 *Sorex* 在海眼组才开始出现。麝鼯 *Crocidura* 仅出现于黄土中。榆社早上新世的水鼯 *Desmana* 可归属欧洲的一个已知种,是这类化石在中国的首次发现之一。*Yanshuella* 在榆社出现的时代晚于二叠图(参阅 Storch 和邱铸鼎,1983)。榆社早上新世的 *Scaptochirus* 是在这一支系中最早出现的代表,并表明这个属有别于 *Talpa* 属。

三、结 论

虽然,在榆社发现的食虫类化石标本很少,种类却较多:一种蝟类、数种鼯鼠、一种水鼯,还有至少其它三种鼯鼠。其中大多数种类与现生种有密切关系。蝟类的牙齿很可能属于现今仍生活在山西的 *Erinaceus*。晚上新世的 *Sorex* 与亚洲的现生种很接近;早上新世种类的亲缘关系尚不确切。晚上新世还有两种肥鼯 *Peisorex* 和 cf. *Blarinoides*。鼯鼠类以先鼯 *Soriculus praecursus* 为代表,它还不具有现生亚属的特征。

鼯鼠科和鼯鼠科在榆社的时代分布是稳定的,但又反映了种类的变更。在时代较早的地层中发现的种类并没在较晚的层位中出现。5.7 百万年前的一个可能属于 Scalopini 或 Talpini 的种在较晚的层位中并没有它们的近亲。上新世的化石组合较稳定。Soriculini 和 Blarinini 的记录表明鼯鼠可能一直种类较多样。上新世的鼯鼠中,一种 Scalopini 和鼯亚科,很可能是连续出现的。水鼯 *Desmana* 的存在表明鼯鼠的分化程度较高和较潮湿的栖息环境。

榆社唯一的更新世食虫类化石是常见的鼯鼠 *Crocidura*。令人不解的是 *Crocidura* 和在中国更新世广为出现的无尾鼯 *Anourosorex* (郑,1985) 在榆社盆地上新世地层中没有出现。

鼯鼠和鼯鼠具有生物地理学上的意义。因为其较低级分类单元在新生代晚期广布于全北区。*Yanshuella* 是鼯鼠科在旧大陆上新世 Scalopini 中新发现的分子。榆社盆地晚上新世地层中的全北区鼯鼠属 *Sorex* 可能是一现生种。肥鼯鼠现今生活在北美,在榆社盆地出现在上新世,也有可能在最晚中新世就已出现。如果肥鼯鼠族 (Blarinini) 起源于北美中新世 (*Adeloblarina*, Repenning, 1967), 那么,向亚洲扩散的时间是在晚中新世。如果裴氏鼯 *Peisorex* 与 *Blarina* 接近,它在榆社盆地上新世地层中的出现则表明 *Blarina* 可能起源于亚洲。它在北美的出现是在早更新世之后 (Jones et al., 1984)。

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TWO NEW SHREWS FROM THE PLIOCENE OF YUSHE BASIN, SHANXI PROVINCE, CHINA

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Key words Yushe Basin; Pliocene; Soricidae

Introduction

Insectivorans are biogeographically and paleoecologically important in late Cenozoic small mammal assemblages of northeastern China. Under the direction of Drs. Qiu Zhanxiang and Richard H. Tedford, a Sino-American team is investigating the faunal history of the last 6 m.y. in Yushe Basin, Shanxi Province, 100 km south southeast of Taiyuan. Here we provide preliminary lists of insectivorans recovered by that project and a description of two new species. Qiu and Tedford (1990), Tedford and Qiu (1991), Chen (1991), Wu and Flynn (1992), Flynn et al. (1991), and Tedford et al. (1991) provide the geological and temporal setting of the localities and discuss associated faunas.

Our project is a collaborative effort by many, including in addition to Qiu and Tedford, Neil Opdyke (University of Florida), and William R. Downs (Northern Arizona University), without whom this work would not have been realized. Li Yuqing (Tianjin Museum), Jia Wenliang and Wang Taiming (Yushe Museum) and IVPP colleagues Yan Defa, Ye Jie, Chen Guanfang, Zhu Genzhu, Chen Xiaofeng, and Li Yizheng assisted in many ways, both scientifically and in friendship. Our progress depended, of course, on the support of the people of Yushe. In preparing the photomicrographs, we were assisted by Peling Fong, American Museum of Natural History, and by Yuan Lu, Applied Sciences, Harvard University. Mammal collections of the American Museum of Natural History and the Museum of Comparative Zoology, Harvard University, under the care of Guy G. Musser and Maria Rutzmoser, respectively, formed the basis of comparison for the following systematic account. Howard Hutchison, Berkeley, kindly provided access to comparative material.

Systematic paleontology

Order Insectivora Cuvier

Family Soricidae Fischer von Waldheim, 1817

Subfamily Soricinae Fischer von Waldheim, 1817

Tribe Blarinini Stirton, 1930

***Peisorex* Kowalski and Li, 1963**

***Peisorex pliocaenicus* sp. nov.**

Holotype and only known specimen V8900, right dentary fragment broken anteriorly and missing coronoid, with M/1—3 (see Table 1).

Locality and age YS 5, 3.2Ma, middle Pliocene.

Diagnosis Larger (15%) than *P. pohaiensis*, with smaller mandibular foramen, less anterior position of lower condyle articulation, heavier bony plate between upper and lower condyle articulations; relatively larger M/3.

Etymology Reference to the age of the species, in contrast to the Pleistocene age of the genotypic species.

Description This large shrew (see Table 1) has a relatively slender horizontal ramus (depth below M/1 hypoconid = 2.5mm). The mental foramen lies in front of the posterior root of M/1. The coronoid is strongly deflected laterally with respect to the horizontal ramus. The condyle is blarinine in structure with two articulations separated by a bony interarticular plate that has a sculpted lingual margin. The lower articular facet is placed far anteriorly, near the mandibular foramen and not visible in labial view. Superior pterygoid fossa is a broad basin with a weak spicule. External temporal fossa does not descend low on ramus; large masseteric fossa is a shallow depression below the superior sigmoid notch. Internal temporal fossa large and confluent with mandibular foramen. Trigonid angles broad, protoconids relatively lingual in position. Entoconids on M/1—2 have sloped anterior surfaces; posterior arms of hypoconids terminate short of entoconids; hypoconulids undeveloped. Cingula on molars strong labially, weak lingually. M/3 reduced, especially its heel: talonid very narrow and without cusps, crescentic ridge representing hypoconid terminates at position of entoconid.

Discussion Unfortunately V8900 lacks much of the coronoid, which is very simple and lacks a spicule in the genotypic species. However, development of the condyle articulations, especially the anterior position of the lower one and broad but sculpted interarticular plate, presence of a strongly basined superior pterygoid fossa, and confluence of internal temporal fossa with mandibular foramen argue for assignment of this species to *Peisorex* Kowalski and Li (1963). These features in turn suggest closer affinity of *Peisorex* to *Blarina* than *Cryptotis*. *Peisorex pliocaenicus* is markedly larger than *P. pohaiensis*. The lower articular process is not as far forward, the mandibular foramen is smaller and the mental foramen is more posterior in *P. pliocaenicus*. Molars are similar, except that M/3 is relatively less reduced; the narrow and crescentic talonid crest of *P. pliocaenicus* is a feature subject to variation and of limited usefulness in differentiating species based on samples of one each. Lack of entoconid crests, posterior position of the mental foramen, and basined superior pterygoid fossa show this species (and *P. pohaiensis*, as hypothesized by Repenning, 1967) to be a blarinine.

Several other large shrews are known from northern Eurasia and North America. Recent researchers (e.g., Zazhigin 1980, Cai 1987, Qiu 1988) have noted large shrews in the late Neogene of northeastern Asia, usually referring them tentatively to *Beremendia*, a taxon well known in eastern Europe. In some features, particularly

the simple coronoid, basined superior pterygoid fossa, anteriorly positioned lower articular process, emarginated interarticular area, and narrow bar between pterygoid fossa and mandibular foramen, *Beremendia* approaches *Peisorex*. *Peisorex* is more derived in these features, particularly the anterior position of the lower articular process, which also projects farther medially.

In addition to a *Beremendia*-*Peisorex* clade, another kind of large shrew was a distinctive element in the late Neogene microfauna of northern China. This shrew resembled *Blarinoides*, which is well known in eastern Europe and is readily differentiated from *Beremendia* (Rzebik-Kowalska, 1976). *Shikamainosorex* (Hasegawa, 1957) may be a member of this group. The genus is well represented in Pleistocene deposits of Japan and is closely related to Pliocene North American *Paracryptotis* (Rzebik-Kowalska and Hasegawa, 1976). These genera share a spatulate coronoid with a prominent spicule, a wide and unsculpted interarticular area, and a weakly basined superior pterygoid fossa. The lower articulation in this lineage is not so far anterior or medially projecting as in *Peisorex*. The *Blarinoides*-*Shikamainosorex* group is represented in Yushe Basin by dentary and dental material (Fig. 1, Plate 1) from locality YS 87 (about the same age as YS 5) and possibly localities YS 50 (4.2 Ma) and YS 32 (5.4 Ma).

Tribe Soriculini Kretzoi, 1965

Soriculus Ellerman and Morrison-Scott, 1951

Soriculus praecursus sp. nov.

Holotype V8898.1, complete left dentary with all teeth.

Hypodigm V8898.1; V8898.2, left dentary fragment with M/2—3; V8898.3 and V8898.4, two right M/2 (1.35×1.6 ; $1.3 \times 1.5^+$ mm).

Locality and age YS 50, 4.2 Ma, early Pliocene.

Diagnosis Smaller than *S. nigrescens*, about the size of *S. (Chodsigoa) lamula*, with crowded anterior dentition, labial incisor flange ending below back of P/4; lower condyle not transversely elongated, and not anterior in position; coronoid process strong and high, with short spicule midway to upper sigmoid notch; cheek teeth uncompressed laterally, M/3 not greatly reduced, M\2 with weak hypocone and not deeply emarginated (see Table 1).

Etymology Latin, forerunner, to reflect that this species precedes other Asian soriculines, although it is not clearly assignable to any living subgenus.

Description Neomyine jaw articulation with the two portions of condyle separated by a narrow, emarginated interarticular area. The articulation is nearly L-shaped, the vertical arm being long and slender, but making an angle of about 105° with the lower arm. The lower arm is a heavy, cylindrical articulation; the upper articulation is slightly inclined and smaller. Whereas the coronoid tilts laterally from the horizontal ramus, the condyle is only slightly tilted. The lower articulation is separated from the lower sigmoid notch by a groove. In these features V8898.1 is much like *Soriculus (Episoriculus) caudatus*, and similar to the larger *Neomys fodiens* and *Soriculus nigrescens*; *S. (Chodsigoa)* has a heavier condyle with anteriorly displaced lower articulation, and the coronoid is more tilted. The coronoid is heavier than in *S. (E.) caudatus*, with no strong anterior inclination of its tip, but with a faint su-

lcus at its summit, as in *S. (Chodsigoa)*. The small coronoid spicule descends only half way down to the sigmoid notch. The superior pterygoid fossa and its boss are undeveloped. External temporal fossa extends ventrally to near top of lower articulation. Position and relatively large size of internal temporal fossa and mandibular foramen as in *S. (E.) caudatus*. The mental foramen is located below the middle of M/1.

The teeth as preserved in this sample show no pigment; pigment is minor in species of *Neomys* and *Soriculus*, nearly absent in subgenus *Chodsigoa*. The incisor tip is broken, but was probably relatively short and simple with one low dorsal cusp, now nearly removed by wear. There is a basal cingulum both internally and externally. Externally, the incisor extends to the back of P/4. Two antemolars are robust but crowded; external lobe of P/4 descends well below level of molar row. Molars with strong cingula labially and lingually. Entoconid on M/1—2 high with moderate crest, separated from low hypoconulid by narrow trough. M/3 moderately reduced, having a low entoconid on a narrow talonid.

Upper cheek teeth are represented by two M/2, V8898.3 (broken in the metastylar region) and heavily worn V8898.4 preserved in a portion of maxilla. The molar is low crowned and rectangular in occlusal view, with preparacrista and postmetacrista of about the same length. The metacone is larger and higher than the paracone, but the W-shaped ectoloph is symmetrical and lacks styles. The symmetrical V-shaped protocone is centered opposite the postparacrista. The preprotocone crista contacts the base of the paracone, but the postprotocone crista terminates short of the metacone. No conules are evident. The hypocone is low and its flange is moderately indented at the middle of the tooth, but a postcingulum spans the entire width of the tooth. There is no precingulum or lingual cingulum.

Two upper incisors from YS 50 may represent this taxon. One, although worn, is well preserved. It is simple, without indication of the secondary medial cusp at the apex.

Discussion The systematics of the species of *Soriculus* and its allies is far from settled, mainly because polarities and character distributions within the group have not been established. Hoffman (1986) thoroughly reviewed eastern Asian shrews, recognizing the close relationship of species traditionally assigned to *Soriculus*, *Chodsigoa*, and *Episoriculus*. Without considering hierarchy among them, he recognized these clusters of species as equivalent subgenera within *Soriculus*. In dental and mandibular features, the three are united by a crowded anterior dentition. All share with *Neomys*, their close outgroup, a slender L-shaped articulation, slight pigmentation and M/3 with two-cusped talonid.

S. nigrescens, the single representative of subgenus *Soriculus*, is the most derived of the species of *Soriculus*. It shows fossorial adaptations and its molars are distinctly laterally compressed. The five species of *S. (Chodsigoa)* show a heavy and twisted jaw articulation, laterally deflected coronoid, and anteriorly placed lower condyle. The four small *S. (Episoriculus)* species have incisors with two cuspules.

As presently understood, these subgenera are monophyletic, but their interrelationships are not clear. Change in taxonomic rank could be warranted if cladistic analysis of the features of the species resolves relationships, or if the higher taxa can

be traced through a long fossil record. Given a spotty fossil record, and the fact that subgenera based on derived features are not unequivocally recognizable before about 2.5 Ma, we elect to submerge living and fossil soriculines into the single genus *Soriculus*. This decision is based on lack of a better immediate solution; it is not a desirable situation, given that the namebearer of the genus is perhaps the most derived member of the group and that no fossil shows its autapomorphies.

Features of *Soriculus* (*Chodsigoa*) are preserved in the Pleistocene *S. (C.) bohlini* from Zhoukoutien (Young, 1934). These include anterior placement of the lower condyle articulation, inclination of the coronoid, and reduced M/3 talonid lacking entoconid (Repenning, 1967).

Kotlia (1991) named *Episoriculus repenningi* from 2.4 Ma rocks of Kashmir. This small species occurs near the range of living *Soriculus* (*Episoriculus*) and exhibits two cuspules on the lower incisor.

Late Pliocene *Episoriculus gibberodon* is on average somewhat smaller than *E. caudatus*. The cheek tooth row of *E. gibberodon* is not as crowded although the lower incisor morphology is similar to that of *E. caudatus*. This species is widespread from Poland and Hungary to Rhodes and to Anatolia, where it possibly has an earlier record (Kormos, 1934; Repenning, 1967; de Bruijn et al., 1970; Engesser, 1980; Reumer, 1984). Placement of this species within subgenus *Episoriculus* is consistent with shared primitive features, and supported only by the presence of two cuspules on the incisor.

Soriculus praecursus occurs within the range of *Chodsigoa*, but this early Pliocene species does not possess the derived features of the subgenus. It does not compare precisely with living *Episoriculus*. *Soriculus* (*Episoriculus*) *caudatus* (MCZ 20726 from Yunnan Province, see Table 1) is small, has proportionately narrow molars and gracile antemolars, and has a lower jaw articulation that is more slender and elongated than in *S. praecursus*; its incisor terminates below the anterior end of P/4. Given that this early Pliocene species presents soriculine features, but none of the autapomorphies of living subgenera, it is considered a member of *Soriculus* without reference to subgenus. In most features *S. praecursus* probably preserves the primitive morphotype for soriculines, including *Neomys*.

Other yushe insectivora

Table 2 lists insectivorans collected by the IVPP-AMNH expedition from the Yunzhu Subbasin of Yushe Basin by stratigraphic occurrence. Our group has recovered a single hedgehog specimen, which is consistent with *Erinaceus*, although the genus *Hemiechinus* can not be ruled out. Shrews are represented by soriculines and blarinines, which seem to occur throughout the section, except for the Haiyan Formation. The Mazegou "cf. *Blarinoidea*" is similar also to *Shikamainosorex*. *Sorex* does not occur until Haiyan time and *Crociodura* is not recorded except in overlying loess deposits. The water mole *Desmana* in the early Pliocene of Yushe is attributable to a known European species; it is among the first records of the group for China. Yushe records of *Yanshuella* extend to a younger time than the record of this Ertemte scalopine (see Storch and Qiu, 1983). The early Pliocene *Scaptochirus* represents the

oldest known record of this lineage, and supports generic distinction from *Talpa*.

Conclusion

Despite the biases of poor representation in fossil assemblages, the insectivoran fauna of Yushe Basin is shown to be rather diverse, with a hedgehog, several shrews, a desman, and at least three other moles, most of which are closely related to living species. The hedgehog tooth probably represents *Erinaceus*, which is present in Shanxi Province today. Other soricines are well represented. Late Pliocene *Sorex* is close to living Asian species; affinity of early Pliocene specimens is less certain. In the later Pliocene, two blarinine shrews are present, *Peisorex* and cf. *Blarinoides*. Soriculines are represented by *Soriculus praecursus*, which does not show the special features of any living subgenus.

The temporal distribution of Soricidae and Talpidae shows stability with some turnover. The oldest sites contain taxa not found in younger levels. A mole at 5.7 Ma represents a species of Scalopini or Talpini without a close relative in later Yushe horizons. Pliocene assemblages show stability in composition. Records of soriculines and blarinines indicate that shrews probably were diverse at all times. Of the Pliocene moles, a scalopine and talpine are probably continuously present. A desman record shows higher mole diversity and argues for some moist habitat.

The single Pleistocene insectivoran represents the ubiquitous shrew *Crocidura*. Oddly, this diverse genus and *Anourosorex*, which is common in the Pleistocene of China (Zheng, 1985), are not indicated in the Pliocene of Yushe Basin.

Biogeographically, shrews and moles are interesting because they have holarctic distribution at low taxonomic levels, reflecting Late Cenozoic dispersal. For Talpidae, *Yanshuella* adds to the known Old World record of scalopines in the Pliocene. The holarctic shrew *Sorex*, possibly a living species, is present in the late Pliocene of Yushe Basin. Blarinini live today in North America, but are present in the Pliocene of Yushe Basin and possibly appear there in the latest Miocene. If blarinines originated in the middle Miocene of North America (*Adeloblarina*, Repenning, 1967), this date would indicate dispersal of the tribe to Asia by the late Miocene. If *Peisorex* is close to *Blarina*, its Pliocene record could indicate Asiatic origin of *Blarina*, which is not known in North America before the early Pleistocene (Jones et al., 1984).

图版说明 (Explanations of plate)

图版 I (Plate I)

先鼯 (新种) *Soriculus praecursus* sp. nov.

(1) V. 8898.2, 左下颌带 M_{1-3} , 冠面视; (2) V8898.3, 右 M^1 , 冠面视; (4) V8898.1, 左下颌带 M_{1-3} , 斜侧视。上新裴氏鼯 (新种) *Peisorex pliocaenicus* sp. nov. (3) 正型标本, V8900, 左下颌带 M_{1-3} , 冠面视。似肥鼯 cf. *Blarinoides* sp. (5) V8895.1, 右 M^1 , 冠面视, YS87. 似肥鼯类 cf. Blarinini, (6) V8897, 右 M^1 冠面视, YS32。

Yushe shrews: *Soriculus praecursus*(1,2,4) and blarinines (3,5,6). V8898.2 (1) and V8898.3 (2) in occlusal view and at same scale; V8898.1 (4) in oblique lateral view. *Peisorex pliocaenicus*, holotype, V8900, (3) in occlusal view. V8895.1, cf. *Blarinoides* sp. from YS87 (5), and V8897, cf. Blarinini from YS32 (6), both upper right M^1 , at same scale.

