

The First Finds of Eomyids (Rodentia) from the Late Oligocene – Early Miocene of the Northern Junggar Basin, China

by

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Abstract

Eomyids are first discovered from the Late Oligocene Tie'ersihabahe Formation and the Early Miocene Suosuoquan Formation of Northern Junggar Basin. Almost all specimens belong to a new genus, characterized mainly by having *Eomys*-like upper cheek teeth in combination with *Pseudotheriomys*-simulated lower molars: the entoloph of upper cheek teeth connecting to the posterior end of protocone, and the hypolophid of lower cheek teeth connecting to the anterior arm of hypoconid or the hypoconid. The new genus distributes from Late Oligocene to Early Miocene chronologically and central Asia geographically, and is thus named as *Asianeomys*. Three new and one indeterminate species are recognized from the Northern Junggar Basin: *A. junggarensis*, *A. fahlbuschi*, *A. engesseri* and *Asianeomys* sp. The previously named *Pseudotheridomys asiaticus* from the Late Oligocene of Saint Jacques, Nei Mongol, *Eomyodon dangheensis* from the Late Oligocene of Danghe Area, Gansu, Eomyidae indet. from the Late Oligocene biozone C of Valley of Lakes of Central Mongolia, and perhaps *Pseudotheridomys yanshini* from the Early Miocene of Aral Region, Kazakhstan are reassigned to this genus.

Keywords: *Asianeomys* gen. nov., *A. junggarensis* sp. nov., *A. fahlbuschi* sp. nov., *A. engesseri* sp. nov., *Asianeomys* sp. indet., Late Oligocene, Early Miocene, Northern Junggar Basin, China

Zusammenfassung

Im nördlichen Junggar Becken wurden Eomyidae zuerst in der spätoligozänen Tie'ersihabahe Formation und in der

altmiozänen Suosuoquan Formation gefunden. Nahezu alle Fundstücke gehören zu einer neuen Gattung, die vor allem durch *Eomys*-artige obere Molaren und *Pseudotheridomys*-ähnliche untere Molaren charakterisiert wird: der Entoloph der oberen Backenzähne inseriert am hinteren Ende des Protocons und das Hypolophid der unteren Mahlzähne verbindet sich mit dem vorderen Arm des Hypoconids oder mit dem Hypoconid selbst. Die chronologische Verbreitung des neuen Genus reicht vom späten Oligozän bis ins Jungmiozän, die geographische Verbreitung beschränkt sich auf Zentralasien. Der Name des neuen Genus ist folglich *Asianeomys*. Es werden drei neue Arten aus dem nördlichen Junggar Becken aufgestellt und beschrieben: *A. junggarensis*, *A. fahlbuschi*, *A. engesseri*, eine vierte Art, *Asianeomys* sp., wird lediglich beschrieben. Die zuvor beschriebenen Taxa *Pseudotheridomys asiaticus* (oberes Oligozän, Nei Mongol), *Eomyodon dangheensis* (oberes Oligozän, Danghe Region, Gansu), Eomyidae indet. (oberes Oligozän, Biozone C, zentrale Mongolei) und möglicherweise auch *Pseudotheridomys yanshini* (unteres Miozän, Aral Gebiet, Kasachstan) werden der neu errichteten Gattung zugeordnet.

1. Introduction

During the past eleven years we have carried out extensive fieldwork in the Northern Junggar Basin investigating Tertiary beds ranging from Eocene to Middle Miocene and collected abundant fossils, mainly small mammals. Among numerous specimens of small mammals, eomyids were first sorted out from screenwashed residues collected in 1999 from two localities, XJ98035 (46°40.416' N; 88°28.958' E) and XJ99005 (46°39.415' N; 88°20.623' E).

XJ98035 is one of localities found from the Late Oligocene Tieersihabahe Formation in 1998 at Tieersihabahe cliff, which is rich in small mammal fossils.

XJ99005 is a locality of the latest Oligocene, Early Miocene Suosuoquan Formation found in 1999 (YE et al. 2003) located over 10 km west of Tieersihabahe, which is also fossiliferous. Eomyid fossils discovered from these two sites, represented by a few teeth only, were originally

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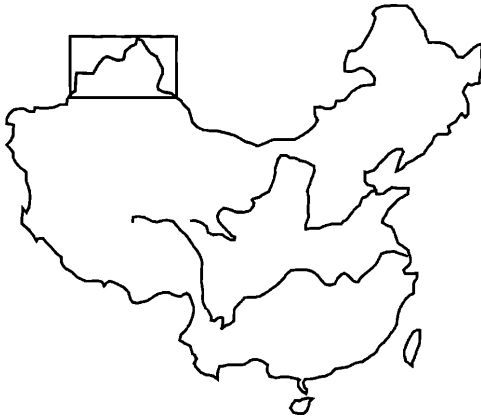
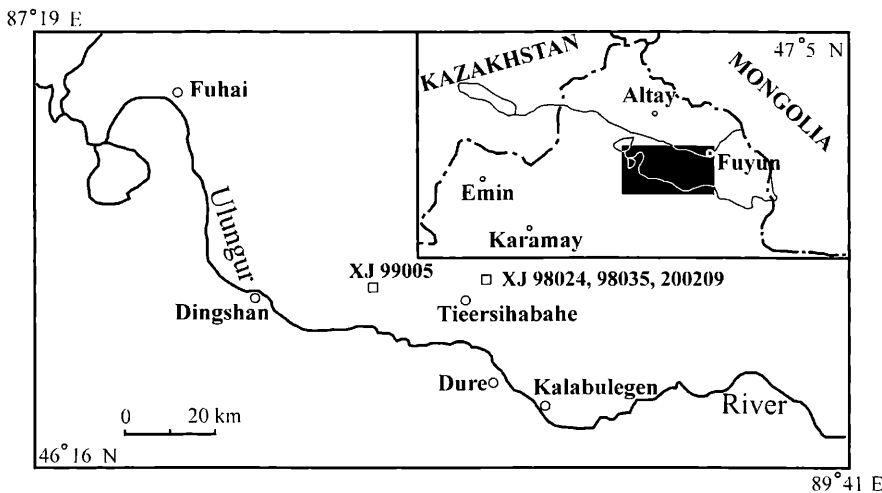


Figure 1: Sketch map showing the studied area in the Northern Junggar Basin of China and the Tiersihabahe localities and locality XJ99005 (modified from DAXNER-HÖCK & WU, 2003).



assigned to *Pseudotheridomys asiaticus* and *Pseudotheridomys* sp. respectively (YE et al., 2001a,b, YE et al., 2003). Additional specimens were collected by extensive screenwashing from XJ99005 and four Late Oligocene localities during the next a few field seasons – XJ98024 (46°40.363' N; 88°28.325' E), XJ98035, XJ200208 (46°40.381' N; 88°28.340' E) and 200209 (46°40.378' N; 88°28.341' E) (Fig.1).

Altogether, ten teeth were obtained from Late Oligocene samples: two from XJ98024, six from XJ98035 and two from XJ200209; eleven teeth were retrieved from the Early Miocene XJ99005 section: one from level 2 m and ten from level 4–4.5 m of the section. In a separate paper (MENG et al., 2006) the lithostratigraphy, biostratigraphy, magnetostratigraphy that are relevant to the Oligocene-Miocene boundary of North Junggar Basin are analyzed in detail. Fossils from localities XJ99024, 98035 and 200209 are attributed to the Late Oligocene Tiersihabahe Mammal Assemblage Zone-I (T-I zone), whereas those from levels 0–9.5 m of XJ99005 to the Early Miocene Suosuoquan Mammal Assemblage Zone II (S-II zone).

The present paper is the first formal report on the eomyid collection from the North Junggar Basin, Xinjiang. Four species are recognized, three of which are new, although each species is represented by a few teeth only. All species are assignable to one genus that differs from either *Pseudotheridomys* SCHLOSSER 1926, *Eomys* SCHLOSSER 1884 or *Eomyodon* ENGESSER 1987.

2. Material and methods

All specimens collected from the above mentioned localities are described and figured. We follow ENGESSER (1990), not MCKENNA & BELL (1997), for classification. We adopt the terminology of EMRY et al. (1997) for dental structures. Tooth dimensions are measured at the maximum length and width in millimeters under the Wild M7A stereomicroscope. SEM pictures were taken on gold-coated specimens using a JSOM-T200 Scanning Electronic Microscope at the Institute of Vertebrate Paleontology and Paleoanthropology (IVPP), Beijing. Specimens are housed in IVPP.

3. Systematic Paleontology

Ordo Rodentia BOWDICH, 1821

Familia Eomyidae WINGE, 1887

Asianeomys gen. nov.

Etymology: asianeomys (= “Asian” + “eomys”), implying an eomyid genus currently known only in Asia.

Diagnosis: Small to medium-sized eomyids, cheek teeth brachyodont with bunolo-phodont pattern; lower m1-2 with four roots; the anterolophid and metalophid absent on dp4 and p4. Similar to *Eomys* but differing from *Pseudotheridomys* in having the entoloph connecting to the posterior end of the protocone instead of the protoloph, and the protoloph

joining lingually to the anteroloph or the anterior arm of the protocone so that the syncline II is longer than syncline I; the hypolophid usually connecting to the anterior arm of the hypoconid as in *Pseudotheriomys* or to the hypoconid occasionally but differing from *Eomys* in which the hypolophid extends posterolingually to join the posterolophid. Differs from *Eomyodon* in having the hypolophid extending transversely and connecting to the anterior arm of the hypoconid or to the hypoconid to form a better developed and longer synclinid IV, the entoloph and ectolophid incompletely interrupted, and the entoloph always connecting or directing to the posterior end of the protocone.

Type species: *Asianeomys junggarensis* sp. nov. from the Late Oligocene of the North Junggar Basin, Xinjiang Uygur Autonomous Region, China.

Included species:

Asianeomys junggarensis sp. nov.

Asianeomys fahlbuschi sp. nov.

Asianeomys engesseri sp. nov.

Asianeomys sp.

Pseudotheridomys asiaticus WANG & EMRY, 1991

Eomyodon dangheensis WANG, 2002

? *Pseudotheridomys yanshini* LOPATIN, 2000

Eomyidae indet. (HÖCK et al., 1997:116, fig. 20/12)

Stratigraphic range and geographic distribution: Late Oligocene of Saint Jacques, Nei Mongol and Yandantu Gou, Gansu; Late Oligocene of North Junggar Basin (Mammal zone I of the Tie'sihabahe Formation); Late Oligocene of Central Mongolia (biozone C of the Valley of Lakes); Early Miocene of North Junggar Basin (Mammal zone II of the Suosuoquan Formation); Early Miocene of North Aral Region, Kazakhstan (Bone bed II of the Aral Formation, Alтынshokysu).

***Asianeomys junggarensis* sp. nov.**

(Plate 1, figs. 1a-1k)

2001a *Pseudotheridomys asiaticus* — YE et al.: p. 198

2001b *Pseudotheridomys asiaticus* — YE et al.: p. 285

2003 *Pseudotheridomys asiaticus* — YE et al.: p. 576, fig. 21.4f, table 21.2

Etymology: Named after the Junggar Basin

Holotype: A left M1/2, IVPP V 14452.1 (Plate 1, fig. 1d)

Paratypes: Two left P4s (V 14452.2-3); one right dp4 (V 14452.4); one left p4 (V 14452.5); one damaged left m1/2 (V 14452.6).

Type locality and horizon: Locality XJ98035, Tiersi-habahe of North Junggar Basin; Tiersi-habahe Mammal Assemblage Zone-I (Meng et al., 2006); Late Oligocene.

Referred specimens: one left M1/2 and one left m2 (V 14453.1-2) from XJ98024; one right M3 and one right dp4 (V 14454.1-2) from XJ200209.

Diagnosis: P4, M1 and M2 proportionally narrower than those of *Asianeomys asiaticus* and having a quadrate outline in occlusal view; P4 with or without the anteroloph; the protoloph on P4, M1 and M2 extending anterolingually to the point near the junction of the anteroloph and anterior arm of the protocone to form a labial syncline I on P4 and M1/2, which is shorter than, or as long as, the syncline III but much shorter than synclines II and IV; syncline IV straight; the mesoloph on upper molars convex anteriorly and reducing labially; the anteroconid present on the lower molar; the metalophid meeting the anterior part of the protoconid. The m1/2 has four roots.

Measurements: P4 (V 14452.2): 1.07 x 1.14; P4 (V 14452.3): 0.93 x 1.02; M1/2 (V 14452.1): 0.98 x 1.12; M1/2 (V 14453.1): 1.05 x 1.14; M3 (V 14454.1): 0.80 x 1.00; dp4 (V 14452.4): 1.04 x 0.80; dp4 (V14454.2) 1.01 x 0.75; p4 (V 14452.5): 1.07 x 0.93; m1/m2 (V 14452.6, damaged): ca.0.99 x 1.01; m2 (V 14453.2, damaged): 1.01 x 1.04.

Description: The holotype, a slightly worn left M1/2, is rounded trapezoid in shape, wider anteriorly than posteriorly, and triple-rooted. The occlusal surface of the tooth is moderately concave (Fig. 2). The four principle cusps are distinct and the labial cusps higher than the lingual ones. The anteroloph extends transversely and then bends posterolingually to merge gently into the anterior arm of the protocone. The protoloph and metaloph are higher than the anteroloph, posteroloph and mesoloph. The protoloph extends anterolingually to merge into the junction of the anteroloph and the anterior arm of the protocone;

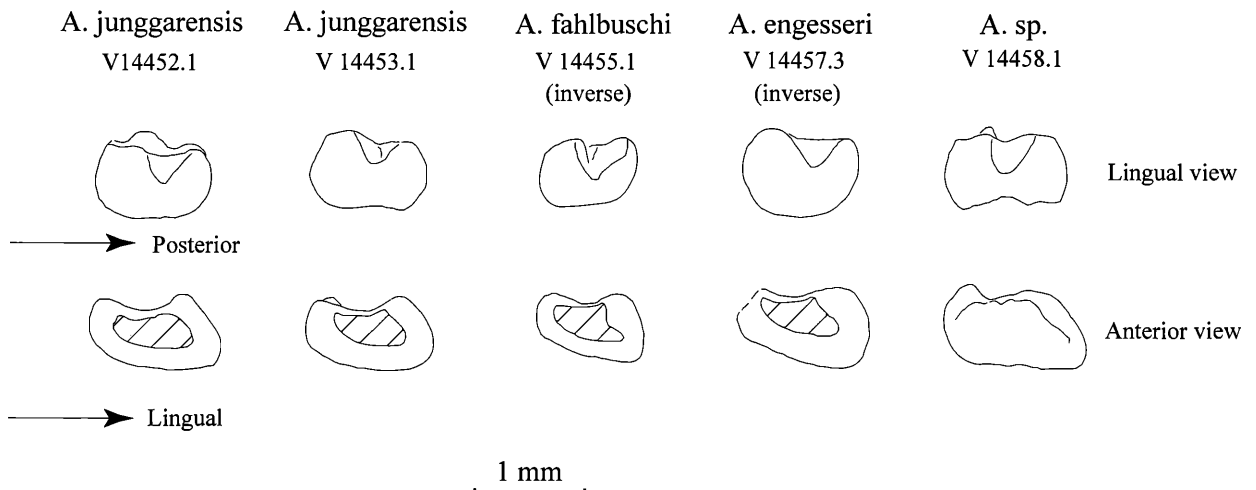


Figure 2: Lingual and anterior crown views of M1/2 showing the crown height and the concave occlusal surface of the various species of *Asianeomys* from the North Junggar Basin. The diagonal lines indicate the anterior contact facet.

it becomes much thinner lingually and its posterior edge directs anterolingually. The metaloph is transverse, parallel to both the anteroloph and posteroloph, and joins lingually the anterior arm of the hypocone. The entoloph is complete but slim, situated lingual to the midline of the tooth, and connects the posterior arm of the protocone anteriorly and the anterior arm of the hypocone posteriorly. The anterior part of the entoloph directs anterolingually, whereas the posterior part directs posterolingually. The anteriorly convex mesoloph stretches out from the well-developed mesocone and extends to the labial border of the tooth; it is interrupted on the midway and becoming lower and thinner labially. Synclines I and III are narrow and short, about half the tooth width, whereas the synclines II and IV are much longer, reaching to the labial side of the protocone and hypocone, respectively. The sinus is shorter than half of the tooth width, which extends anterolabially, and surpasses the lingual end of the synclines II and IV. The other M1/2 (V 14453.1) is similar to the holotype except its being more quadrate and having a continuous mesoloph and thicker posterior part of the entoloph.

The P4 (2 teeth) is rounded trapezoid, much narrower posteriorly than anteriorly. The four principle cusps are distinct. The anteroloph is absent (V 14452.3), or short and low, if present, with an enclosed, narrow and short syncline I between it and the protoloph (V 14452.2). The entoloph is lingual to the midline of the tooth; its connection with the protocone is extremely weak (V 14452.3) or thick (on V 14452.2). Otherwise the P4 is similar to M1/2. In V 14452.2, a left fragmental maxilla with the P4 in the alveolus, two premolar foramina are present on the palatal process of the maxilla. Both foramina are lingual to the P4, with the small one situated anteriorly at the level of the sinus of the tooth and the large one posteriorly about the level of syncline IV of the tooth.

M3 (V 14454.1) is trapezoid in shape and much wider anteriorly than posteriorly. The basic tooth pattern is similar to M1/2. However, its hypocone is more reduced and its anteriorly convex mesoloph contacts the protoloph by an anterior spur so that syncline II is divided into lingual and labial parts. The moderately worn M3 has a concave occlusal surface with the paracone being the highest cusp.

The moderately worn dp4 (V 14452.4) is trapezoid in shape, much narrower anteriorly than posteriorly and with two roots that spread out. The trigonid is much higher than the talonid with a deep basin between them. The anterolophid and metalophid are absent. A very weak anteroconid is anterior to and below the protoconid. The metaconid and protoconid are closely situated but isolated from each other. The hypolophid is developed and extends transversely to the hypoconid. A low and short mesolophid and an ectomesolophid stretches out from a distinct but rather low mesoconid. The anterior portion of the ectolophid is absent, whereas the posterior ectolophid extends to the anterior base of the hypolophid. Another dp4 from XJ200209 (V 14454.2) is similar to V 14452.4 in general shape, but differs from the latter

in several aspects: the hypolophid joins the hypoconid immediately posterior to the hypoconid; the tiny anteroconid is below but between the metaconid and protoconid; the long mesolophid extends to the lingual tooth margin and terminates as a mesostylid that connects anteriorly the posterior base of the metaconid; a weak anterior part of the ectolophid is present, but the ectomesolophid is absent.

The double-rooted p4 (paratype V 14452.5) is unworn and is much wider than dp4. The protoconid, metaconid and entoconid are of similar height and distinctly higher than all ridges, but slightly higher than hypoconid. The anteroconid and metalophid are not present. A low crest extends posterolabially from the protoconid along the labial border for half of the tooth length, and a weak tubercle is present on the crest just behind the protoconid (similar to the protostylid named by WANG, 2002:141, 142). The mesolophid and ectolophid are very low; the former is long and reduces its size while extending anterolingually to the lingual margin. The ectolophid is situated much labially to the midline of the tooth, connecting the protoconid anteriorly and the anterior arm of the hypoconid posteriorly. As in the dp4 (V 14452.4) the hypolophid is developed but low and extends transversely (slightly backwards) to the hypoconid.

Two m1/2s (V 14452.6, 14453.2) are damaged, but most the diagnostic features are observable. An anteroconid is present on the anterolophid and situated slightly labial to the midline of the tooth, to which connect the metalophid and the anterior arm of the protoconid. The anterolophid extends transversely and connects lingually the metaconid, damming the synclinid I lingually. The metalophid and hypolophid extend transversely or slightly anterolabially, joining the anterior arm of protoconid and hypoconid (or the front part of the hypoconid on V 14453.2) respectively. The mesolophid is long and connects or nearly connects to the metaconid on the lingual margin. The mesoconid is distinct. The ectolophid is complete or only slightly interrupted (V 14452.6) and situated labial to the midline or almost on the midline of the tooth. The synclinid IV is equal to synclinid II, longer than synclines I and III. The m1/2s are four-rooted.

Comparisons: *Asianeomys junggarensis* differs from *A. asiaticus* in having more quadrate-shaped upper P4 and M1/2, a straight syncline IV on upper cheek teeth, and an anteroconid on the lower molars; from *A. dangheensis* in having the protoloph extended anterolingually and the mesoloph convex anteriorly, in lacking the posterior spur of the paracone on the upper cheek teeth, and in having the anteroconid on lower molars; from *Eomyidae* indet. from biozone C of the Valley of Lakes, Central Mongolia (Höck et al., 1999) in having more quadrate-shaped upper M1/2, a straight syncline IV and larger size; from *A. yanshini* in being larger. Because the lower molar of *A. yanshini* is unknown and the figures of the known specimens are insufficient, we are unable to make further comparison with this species. We suspect the reference of the species to *Asianeomys* and endorse that it does not belong to *Pseudotheridomys*.

Asianeomys fahlbuschi sp. nov

(Plate 1, figs. 2a-2e)

2001a *Pseudotheridomys* sp. — YE et al.: p. 1982001b *Pseudotheridomys* sp. — YE et al.: p. 2852003 *Pseudotheridomys* sp. — YE et al.: p. 578, table 21.3

Etymology: In honor of the German paleontologist, Prof. Dr. Volker Fahlbusch, who has made great contributions to the study of Eomyidae.

Holotype: A right M1/2, V 14455.1 (Plate 1, fig. 2a).

Paratypes: A right M1/2 (V 14455.2), and a left m1/2 (V 14455.5).

Referred specimens: Two left M3s (V 14455.3-4)

Type locality and horizon: Level 4-4.5 m of XJ99005 section (46°39.415' N; 88°20.623' E); Suosuoquan Mammal Assemblage Zone II, Early Miocene.

Diagnosis: A small-sized *Asianeomys*; M1/2 anteroloph transverse and meeting the anterior arm of the protocone at about two thirds of the tooth width, forming a sharp angle; the paracone having a posterior spur; the metaloph extending anterolingually to meet the anterior arm of the hypocone; the posteroloph bulging anteriorly on the midway to make syncline IV convex anteriorly; the mesoloph long and anteriorly convex; m1/2 with an anteroconid that is situated labial to the midline of the tooth; the hypolophid joining the anterior arm of the hypoconid; the entoloph and ectolophid on molars thin or incompletely interrupted.

Measurements: M1/2 (V 14455.1): 0.88 x 1.00; M1/2 (V 14455.2): 0.91 x 1.07; M3 (V 14455.3): 0.71 x 0.74; M3 (V 14455.4): 0.66 x 0.67; m1/2 (V 14455.5): 1.05 x 0.95.

Description: The holotype M1/2 (V14455.1) is rounded trapezoid in outline, wider anteriorly than posteriorly and triple-rooted. Main cusps are distinct with the labial cusps being much higher than the lingual ones. The paracone possesses a well-developed posterior spur that connects the mesostyle posteriorly. The anteroloph is transverse and parallel to the protoloph and posteroloph; it meets the anterior arm of the protocone at about two thirds of the tooth width and forms a sharp angle. The protoloph runs transversely and joins the anterior arm of the protocone lingually. The metaloph extends anterolingually to the anterior arm of the hypocone, while the posteroloph bulges anteriorly on the midway so that syncline IV between the metaloph and posteroloph is convex anteriorly. The mesoloph stretches from the prominent mesocone and becomes slightly lower and thinner while extending labially to the tooth margin where it terminates as a distinct mesostyle. The entoloph is initially interrupted, it is expected that with increasing wear of the tooth the entoloph will occur. Syncline II is equal to syncline IV in length and longer than half of the tooth width. Syncline I is slightly shorter than synclines II and IV, but much longer than syncline III. The sinus is slightly anterolabially oriented and shorter than half of the tooth width. Another M1/2 (paratype, V 14455.2) displays some variations: its anteroloph and protoloph extend slightly more posteriorly; the entoloph is thin but not interrupted; and the mesoloph has the constriction at the midpoint of the crest.

The M3 (V14455.3-4) is similar to M2 in general tooth pattern except that its posterior part is reduced, and the protoloph is anterolingual rather than transverse.

The entoloph is thin and low, almost interrupted. The sinus extends anterolabially. On specimen V14455.3 an extremely low crest spanning the mesocone and protoloph is present at the bottom of syncline II. Because of high contrast in the SEM image (Plate 1, fig. 2c), the crest and the funnel lingual to it appear more prominent than they actually are. The attribution of these two specimens to this genus and species is uncertain and tentative.

The m1/2 (V 14455.5) is rounded rectangle in outline and has four roots. The anterolophid extends transversely; its labial branch is much shorter than the lingual one. An anteroconid is present just labial to the midline of the tooth and meets posterolabially the anterior arm of the protoconid; its posterolingual connection with the metalophid is incomplete. The metalophid, mesolophid and hypolophid are transverse. The connection of the metalophid with the protoconid is interrupted. The mesolophid extends to the lingual margin of the tooth and diminishes lingually. The hypolophid joins labially the anterior arm of the hypoconid. The mesoconid is well developed. The ectolophid is rather low, thus incompletely interrupted. Synclinids I and III are about half of the tooth width and synclinid II and IV are longer than half of the tooth width. The sinusid extends posterolingually.

Comparisons: *Asianeomys fahlbuschi* differs from *A. junggarensis* in several aspects, including its smaller size, the presence of a developed posterior spur of the paracone on M1/2, longer syncline I on M1/2, anterior bulge of the posteroloph and the syncline IV convex anteriorly, and the initially interrupted entoloph and ectolophid. *Asianeomys fahlbuschi* differs from *A. asiaticus* in having proportionally narrow cheek teeth, a well-developed posterior spur of paracone, and an anteroconid on the lower molar. It differs from *A. dangheensis* in having an anteriorly convex mesoloph on M1/2, the anteriorly bulged posteroloph and anteriorly convex syncline IV, and an anteroconid on the lower molars; from Eomyidae indet. in the well-developed posterior spur of paracone.

Asianeomys engesseri sp. nov.

(Plate 1, figs. 3a-3d)

Etymology: In honor of Swiss paleontologist Dr. Burkart Engesser, in recognition of his great contributions to the study of Eomyidae.

Holotype: A right m1, V 14457.1 (Plate 1, fig. 3d)

Paratypes: A right DP4 (V 14457.2) and a right M1/2 (V 14457.3).

Type locality and horizon: Type specimens are from level 4-4.5 m of the section of Suosuoquan Formation at locality XJ99005, North Junggar Basin; S-II zone; Early Miocene.

Referred specimen: A left M1/2 (V 14456) from 2m of the section of Suosuoquan Formation at locality XJ99005, North Junggar Basin; S-II zone.

Diagnosis: A relatively large *Asianeomys*; the protoloph

transverse, and joining the anterior part of the protocone on M1/2; the paracone possessing a posterior spur; the mesoloph on M1/2 convex anteriorly and about half the length of the protoloph without reaching the labial margin of the tooth; the posteroloph bulged anteriorly to make syncline IV convex anteriorly; lower molars with an anteroconid. The entoloph and ectolophid complete on upper and lower molars.

Measurements: DP4 (V 14457.2): ca. 1.02 x 0.96; M1/2 (V 14456): 0.96 x 1.22; M1/2 (V 14457.3): 1.01 x ca. 1.19; m1 (V 14457.1): 1.14 x 1.15.

Description: The holotype, an m1 dex, is slightly worn and the four main cusps are distinct. The anteroconid is at the middle of the anterolophid and tapes posterolingually to meet the anterior end of the protoconid. The metalophid and hypolophid are transverse and join the protoconid and anterior arm of the hypoconid, respectively. The mesolophid is long and straight and runs from the distinct mesoconid lingually to the margin of the tooth. There is no mesostylid. The ectolophid is thin but continuous. Synclinid IV is as long as synclinid II; both are longer than half of the tooth width and the other two synclinids. The sinusid is posterolingually directed and is shorter than half of the tooth width.

The DP4 (V 14457.2) is heavily eroded and in a shape of rounded triangle with the anterior apex protruded anteriorly. The paracone possesses a low but distinct posterior spur that connects to the metacone at its anterolabial base. The anteroloph and posteroloph are much lower than other ridges. The anteroloph is also short, as an anteriorly convex ridge running along the anterior border of the tooth and joins the protoloph lingually at the middle of the latter. The protoloph extends anterolingually, and connects to the anterior end of the protocone. The metaloph runs anterolingually and joins the anterior arm of the hypocone. The mesoloph is extremely short. Syncline II and III are confluent as a wide labial sinus, in contrast to the narrow and shallow synclines I and IV. The lingual sinus is anterolabially extended, and the entoloph is interrupted.

The M1/2 (V 14457.3, V 14456) are trapezoid-shaped, wider anteriorly than posteriorly. The paracone possesses a distinct posterior spur as in DP4. The anteroloph extends transversely across the midline of the tooth and joins the anterior arm of the protocone to confine an obvious angle. The transverse protoloph meets lingually the anterior part of the protocone. The metaloph extends anterolingually to join the anterior arm of the hypocone. The posteroloph is bulged anteriorly, and, with the anterolingually extended metaloph, defines an anteriorly convex syncline IV. The mesoloph is about half as long as the protoloph and convex anteriorly; it thins labially. The entoloph is complete. Synclines I, II and IV are longer than half of the tooth width, whereas syncline III is about half of the tooth width; Syncline II and III unite labially. The sinus is anterolabially directed and shorter than half of the tooth width.

Comparisons: *Asianeomys engesseri* is most similar to *A. fahlbuschi* in general morphology but differs in being larger and having a shorter mesoloph and a complete entoloph and ectolophid on upper and lower molars. *Asianeomys*

engesseri differs from *A. junggarensis* mainly in have a posterior spur of the paracone, a shorter mesoloph on upper molars, the posteroloph bulged anteriorly, syncline IV convex anteriorly and a longer syncline I.

Asianeomys engesseri differs from *A. asiaticus* mainly in lacking a mesostyle on upper molars, in having an anteroconid on lower molar, and the complete entoloph and ectolophid; from *A. dangheensis* in having shorter and anteriorly convex mesoloph, the anteriorly bulged posteroloph and the anteriorly convex syncline IV on upper molars, an anteroconid on lower molar, and the complete entoloph and ectolophid. *Asianeomys engesseri* is generally similar to Eomyidae indet. from biozone C of the Valley of Lakes, Mongolia, but differs from the latter in being larger, and having a well-developed posterior spur of the paracone and a shorter mesoloph.

Asianeomys sp.

Material: A left M1/2 (V 14458.1) and a left m2 (V 14458.2) from level 4-4.5m of the Suosuoquan Formation at locality XJ99005, north Junggar Basin; Early Miocene; S-II zone.

Measurements: M1/2 sin 1.09 x 1.27; m2 sin (damaged) 1.05 x 1.17

Description: On the unworn M1/2 all lophs and synclines are straight and uniform, and the main cusps are higher than the lophs. The anteroloph is transverse and parallel with the mesoloph, metaloph and posteroloph. The anteroloph runs transversely for about three fifth of the tooth width to meet the anterior arm of the protocone at a right angle. The protoloph extends slightly anterolingually to join the anterior end of the protocone. The mesoloph is straight and becomes lower and thinner towards the labial border. From the top of the mesocone initiates a weak ridge that extends along the anterior slope of the cusp. Synclines I and III are equal in length; so are synclines II and IV, which are longer than the formers. The entoloph is complete and in an upside down V-shaped, with its apex pointing labially. The sinus extends almost transversely. On the m2 all lophids extend transversely; the anteroconid is absent, and the anterolophid connects to the protoconid anterolingually; the metalophid and hypolophid join the posterior end of protoconid and the anterior arm (or anterior end) of hypoconid, respectively. The mesolophid stretches out from the distinct mesoconid and is interrupted just before its reaching the labial border, forming a mesostylid on the border. The ectolophid is complete. The labial sinusid is shorter than half of the tooth width. It extends almost transversely, only its lingual end bending slightly backwards. The roots are broken away. However, it is probably four-rooted according to the remnants of the roots at the base of the tooth.

Comparisons: This form is distinctly different from other species in being larger and having the upside down "V"-shaped lingual sinus on M1/2. It further differs from *A. junggarensis* in having a straight mesoloph on the upper molar, and lacking an anteroconid on the lower molar. It differs from *A. fahlbuschi* in having complete entoloph,

the straight and continuous mesoloph, and the straight syncline IV, furthermore in lacking a posterior spur of the paracone on upper molar and an anteroconid on the lower molar; from *A. engesseri* in having a longer and straight mesoloph, a straight syncline IV, and in lacking a posterior spur of paracone and an anteroconid on lower molar. It differs from *A. asiaticus* and Eomyidae indet. also in having a straight syncline IV and a straight and continuous mesoloph on upper molar; from *A. dangheensis* in having complete entoloph and ectolophid and lacking the posterior spur of the paracone on upper molar. It is larger than *A. yanshini*. This form belongs undoubtedly to *Asianeomys*, but is distinctive from other species of the genus. Given the limited sample, we choose not to assign it to a new species.

Except for *Asianeomys junggarensis* each of the above-described species is represented by a few teeth only; however, they can be distinguished from each other in morphology and size. Nonetheless, it is possible that with additional specimens found in the future their taxonomy may be subject to modification.

4. Discussion

WANG & EMRY (1991) described the first finds of eomyids of mid-Tertiary from Asia: *Eomys orientalis*, *Eomyodon* sp., *Pseudotheridomys asiaticus*, *Pseudotheridomys* sp. from Saint Jacques and Qianlishan District of Nei Mongol, China. Since then more material has been found and described from Asia, including Eomyidae indet. from the Late Oligocene (C biozone) of Valley of Lakes in Central Mongolia (HÖCK et al., 1997), *Pseudotheridomys yanshini* and *Eomyodon bolligeri* from the Early Miocene (Aral Formation) of North Aral Region, Kazakhstan (LOPATIN, 2000); and *Eomyodon dangheensis* of the Late Oligocene from Yandantu Gou in Danghe area of Gansu, China (WANG, 2002). While describing the new species *Eomyodon dangheensis* from Yandantu Gou, Gansu, WANG (2002) transferred *Pseudotheridomys asiaticus* to genus *Eomyodon*, retaining the m1/2(V 9575) assigned to that species as *Pseudotheridomys* sp.

Eomyodon was established by ENGESSER (1987). The diagnostic features of this genus include: *Eomys*-like tooth pattern but with a tendency to develop lophodont cheek teeth; longitudinal crest of upper and lower molars often interrupted; hypolophid of p4, m1 and m2 joining the posterolophid respectively the posterior arm of the hypoconid as in *Eomys* (ENGESSER, 1987, 1990, 1999). Based on these features, *Eomyodon* can be easily distinguished from both *Pseudotheridomys* and *Eomys*.

Because of the dental similarity to *Pseudotheridomys* from Saint Jacques, we previously assigned the few specimens collected in 1999 from XJ98035 and 4–4.5 m of XJ99005 section to *Pseudotheridomys asiaticus* and *Pseudotheridomys* sp., respectively (YE et al., 2001a, b; YE et al., 2003). In the course of further study on eomyids from the north Junggar Basin we have perceived that the eomyids from Junggar Basin actually do not belong to *Pseudotheridomys*. Although the lower cheek teeth are *Pseudotheridomys*-

simulated in having the hypolophid joining the anterior arm of the hypoconid or the hypoconid itself, the upper cheek teeth are *Eomys*-like, quite different from those of *Pseudotheridomys*. This combination of characters has not been reported from other eomyid genera known to date and forms the basis for the new genus, *Asianeomys*, we propose herein. *Asianeomys* differs not only from *Eomys* and *Pseudotheridomys* evidently but also from *Eomyodon* although *Asianeomys* is similar to *Eomyodon* in certain respects: both have *Eomys*-like upper cheek teeth and transverse hypolophid on the lower molars. It can be distinguished from *Eomyodon* in following features: the longitudinal crest is infrequently interrupted, and if interrupted, is usually incompletely, and with the increasing wear the entoloph and ectolophid become complete. Moreover, the remnant entoloph is always directed to the posterior end of the protocone on upper cheek tooth like in *Eomys*, which we have not found in European *Eomyodon* (except *E. volkeri*), judging from the description and figures illustrated by ENGESSER (1987, 1990). The hypolophid in *Asianeomys* always transversely or slightly anterolabially extended and joining the anterior arm of the hypoconid or the hypoconid, while the hypolophid in *Eomyodon* runs posterolabially, connecting to the posterolophid or posterior arm of the hypoconid with only rare exceptions, e.g. *Eomyodon mayoi*, whose hypolophid is transverse and occasionally joins the hypoconid or posterior arm of the hypoconid (ENGESSER, 1990: figs. 52, 54, 56).

Our study reveals that *Pseudotheridomys asiaticus* (WANG & EMRY, 1991), *Eomyodon dangheensis* (WANG, 2002), Eomyidae indet. (HÖCK et al., 1997:116, fig. 20/12) and probably *Pseudotheridomys yanshini* (LOPATIN, 2000) should be referred to *Asianeomys* because of their shared similarities.

Our taxonomic treatment of Asian eomyids indicates that *Asianeomys* by far exists only in Central Asia, ranging from Late Oligocene through Early Miocene and is much more diverse than *Pseudotheridomys* and *Eomyodon*, which are up to now scarcely discovered in Asia: one m1/2 of *Eomyodon* sp. (WANG et al., 1991: fig. 4-L) and one m1/2 of *Pseudotheridomys* sp. (WANG et al., 1991: fig. 4-V; WANG 2002) from Nei Mongol, China; *Eomyodon bolligeri* from Kazakhstan (LOPATIN, 2000) if the attribution is certain. In contrast, *Pseudotheridomys* and *Eomyodon* spread widely in Europe during the period of Late Oligocene to Early Miocene (ENGESSER, 1987, 1990, 1999). According to present knowledge *Asianeomys* is derivable from European *Eomys* and then diversified in Central Asia as a lineage independent of *Eomyodon*. An evolutionary tendency is not yet clear, neither distinct tendency to lophodonty nor difference in crown height between the Late Oligocene and Early Miocene species (Fig. 2) has been indicated.

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PLATE 1

Asianeomys junggarensis gen. et sp. nov. from Tieersihabahe

- Fig. 1a P4 sin. (V 14452.2, Loc. XJ98035); paratype.
 Fig. 1b Fragmentary left maxilla with P4 (V 14452.2, Loc. XJ98035); paratype (same specimen as in 1a).
 Fig. 1c P4 sin. (V14452.3, Loc. XJ98035); paratype.
 Fig. 1d M1/2 sin. (V 14452.1, Loc. XJ98035); holotype.
 Fig. 1e M1/2 sin. (V 14453.1, Loc. XJ98024).
 Fig. 1f M3 dex. (V 14454.1, Loc. XJ200209).
 Fig. 1g dp4 dex. (V 14452.4, Loc. XJ98035); paratype.
 Fig. 1h dp4 dex. (V 14454.2, Loc. XJ200209).
 Fig. 1i p4 sin. (V 14452.5, Loc. XJ98035); paratype.
 Fig. 1j Fragmentary m1/2 sin. (V 14452.6, Loc. XJ98035); paratype.
 Fig. 1k Fragmentary m1/2 sin. (V 14453.2, Loc. XJ98024).

Asianeomys fahlbuschi gen. et sp. nov. from XJ99005

- Fig. 2a M1/2 dex. (V 14455.1, 4-4.5 m of section XJ99005); holotype.
 Fig. 2b M1/2 dex. (V 14455.2, 4-4.5 m of section XJ99005); paratype.
 Fig. 2c M3 sin. (V 14455.3, 4-4.5 m of section XJ99005).
 Fig. 2d M3 sin. (V 14455.4, 4 m of section XJ99005).
 Fig. 2e m1/2 sin. (V 14455.5, 4-4.5 m of section XJ99005); paratype.

Asianeomys engesseri gen. et sp. nov. from XJ99005

- Fig. 3a DP4 dex. (V 14457.2, 4-4.5 m of section XJ99005); paratype.
 Fig. 3b M1/2 sin. (V 14456, 2 m of section XJ99005).
 Fig. 3c M1/2 dex. (V 14457.3, 4-4.5 m of section XJ99005); paratype.
 Fig. 3d m1 dex. (V 14457.1, 4-4.5 m of section XJ99005); holotype.

Asianeomys sp. from XJ99005

- Fig. 4a Fragmentary m2 sin. (V 14458.2, 4-4.5 m of section XJ99005).
 Fig. 4b M1/2 sin. (V 14458.1, 4-4.5 m of section XJ99005).

All are of occlusal view and enlarged as the scale bar indicates except fig. 1b.

PLATE 1

