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The Fossil Insectivora of Lemoyne Quarry (Ash Hollow Formation, Hemphillian), Keith County, Nebraska

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The fossil insectivore fauna of Lemoyne Quarry is the most diverse and most cosmopolitan of any recorded from Hemphillian deposits of the Great Plains; four genera and six species of shrews and five genera and five species of moles are known. The soricines *Sorex edwardsi* n. sp., *Sorex yatkolai* n. sp., and *Sorex* sp. most closely resemble *Sorex hagermanensis* and *S. rexroadensis* from the Hagerman and Rexroad local faunas of Idaho and Kansas, respectively. Lemoyne *Alluviosorex* (Soricini) is indistinguishable from *A. arcardentes* from Barstovian rocks of Oregon, and Lemoyne *Diuromys* or *L. niobrarensis* (Limnoecinae) has larger teeth than Barstovian *L. tricuspis* (including *L. niobrarensis*). Lemoyne *Anouroneomys* magnus n. gen. and n. sp. (Neomyini) is larger than *A. minimus* sp. nov. from Clarendonian rocks of Oregon; *Anouroneomys* is closely related to the *Anourosorex-Amblycoptus* of neomyine shrews and may be a Late Miocene immigrant from Eurasia. *Achlyoscapter* sp., and *Talpinae* undetermined genus and species 2 and 3 have close morphologic counterparts from Barstovian rocks of Oregon. Talpine, undetermined genus and species 1 is closest to *Scaphurus* (Hesperoscalops) from the Rexroad Formation but is similar in some respects to *Scapanulus* and *Scalopoides*. Lemoyne *Dipoides* sp. (Desmaninae) is the first record of the water moles from the Western Hemisphere. *Lemoynea* is closest morphologically to “Vindobonian” *Mygalea* and “Pontian” *Mygalinia*, from France and Hungary, respectively. The desmanines are aquatic moles and the closest-living relatives of *Anouroneomys* are aquatic (*Neomys*) or forest-dwelling (*Anourosorex*), and support earlier suggestions that Late Miocene Holarctic mammal exchange involved principally forest and aquatic forms.

INTRODUCTION

Several fossil vertebrate localities were discovered in the Ash Hollow Formation near Lemoyne, Nebraska, in 1969, by a University of Nebraska State Museum field party incident to a program of highway-salvage paleontology. Most of the fossils were recovered from a dark-grey silty claystone about 3 m below the top of exposures developed on a north-facing roadcut on Nebraska State Highway 92 in the S1/2 Sec. 3, T. 15 N., R. 40 W., about 6.4 km west of the present townsite of Lemoyne, Keith County, Nebraska. This locality, the Lemoyne Quarry (UNSM Kh-101), yielded principally microvertebrate rami, maxillae, teeth, and a few fragmentary postcranial bones that were distributed more-or-less throughout the 15-30 cm thickness of the claystone unit. Bones and teeth of larger vertebrates are also known in this unit, but are more common and better preserved in blowout and roadcut exposures west of Lemoyne Quarry.

The quarry is situated in an area of limited exposures that are largely confined to stream-cuts, railroad-cuts, roadcuts, blowouts, and bluffs on the north shore of Lake McConaughy. The lake is a landfill reservoir on the North Platte River and is bounded on the south by an east-west trending scarp about 90 m high.

Hesse (1935) described a small fauna from Ogallala Group rocks on this scarp about 4 km ENE of the townsite of Ogallala, Nebraska (Feldt Ranch fauna). The Lemoyne Quarry has yielded a somewhat more diverse fauna than the Feldt Ranch site, and the preliminary identification of some of the mammals, other than insectivores, suggests a Hemphillian age (probably Late Miocene) for these mammals.

Associated large mammals in the Lemoyne quarry fauna include *Prosthenops*, possibly *P. serus* (Tayassuidae), *Blastomeryx*, possibly *B. elegans* (Cervidae), *Canis* sp. (Canidae), *Teleoceras* sp. (Rhinocerotidae), *Plochippus* sp. (Equidae), *Mylagaulus* sp. (Mylagaulidae), and *Dipodetes* sp. (Castoridae). A large rodent fauna awaits description, but Martin (1975)
has described a new genus and species of arvicoline from the Lemoyne Quarry. The shrews and moles are a unique assemblage and appear related to a variety of forms known from Barstovian through Hemphillian deposits of the Great Plains region, the west coastal United States, and Miocene and Pliocene rocks of Europe and Asia.

This report is a preliminary description of the insectivore taxa from Lemoyne Quarry and acknowledges that a fuller treatment of many of these mammals may become necessary with future recovery of positively associated postcranial and gnathic remains. Soricids were identified to genus following the descriptions and key of Repenning (1967a), where this was possible, and by comparisons with specimens and casts of fossils of 18 genera and specimens of 7 living genera, and with descriptions and figures of most other described soricid species.


**SYSTEMATIC PALEONTOLOGY**

Class Mammalia

Order Insectivora

Superfamily Soricoidea

Family Soricidae

Subfamily Soricinae Fischer von Waldheim, 1817

Tribe Soricini Fischer von Waldheim, 1817

Genus *Sorex* Linnaeus, 1758

*Sorex edwardsi* n. sp.

**Etymology:** *edwardsi*—in memory of Paul Edwards, graduate student in vertebrate paleontology at the University of Nebraska, Lincoln.

**Holotype:** UW 6724 (Fig. 1C), fragment of right ramus with /I, P4–M1; collected by R. Henritze and T. Bown, 1973.

**Hypodigm:** Type and UW numbers 6722, 6723, 6725 (Fig. 1A), 6726, 6727, 6728 (Fig. 1B), 6729, 6730; UNSM 27601, 27624 (Fig. 7A); see Table I.

**Locality:** Lemoyne Quarry (UNSM Kh–101), Ash Hollow Formation, Keith County, Nebraska.

**Diagnosis**

Posterior unicuspid and molars about the size of those teeth in *Sorex sandersi* and *S. hagermanensis* and somewhat larger than in *S. meltoni, S. rexroadensis*, and *S. yatkolai* n. sp. (infra). Single mental mandibular foramen situated in depressus beneath the hypoflexid of M1, not beneath the anterior M1 root as in *S. sandersi* and not twinned as in *S. powersi, S. hagermanensis*, and *S. meltoni*. Mental foramen open anteriorly, not posteriorly as in *S. sandersi* and *S. taylori*. Lower articular condyle more robust than in *S. sandersi* and more lingually inflected than in the latter species, *S. powersi, S. hagermanensis*, *S. rexroadensis*, and *S. taylori* and similar to the condition in some Bliarini. Inferior sigmoid notch deep, about as in *S. rexroadensis*. Mandible deeper than in *S. yatkolai* n. sp. Posterior unicuspid smaller in relation to M1 than in *S. sandersi* and *S. powersi* and with a more weakly developed lingual cingulid. M1–2 virtually identical to those teeth in *S. sandersi* and *S. hagermanensis* but M3 relatively larger and M2 talonid wider transversely than in *S. sandersi, S. taylori*, or *S. yatkolai* n. sp., more as in *S. hagermanensis* with the M2 entoconid distinct. M1–2 protoconids set medi ally beyond anteroposterior midline of tooth as in *S. taylori, M1–2* entoconids upright as in *Antesorex compressus* and *S. taylori*, not posterolingually inflected as in *S. yatkolai* n. sp. *S. powersi* and entoconids posteriorly more removed from the metaconids than in *Altisorex*.

**Discussion**

*Sorex edwardsi* is a medium-sized shrew that appears to be most closely allied to *S. hagermanensis* of Hibbard and Bjork (1971) and differs from that species principally in the lack of a posterior opening for the mental foramen and in the lingual inflection of the inferior articular condyle. The species differs from *Petenyia* in having the paraconid farther removed from the metaconid on M1–2, in having an emarginate paraconid on M2, and not twinned as in *S. hagermanensis, M1–2* entoconids distinct, M1–2 protoconids set medially beyond anteroposterior midline of tooth as in *S. taylori, M1–2* entoconids upright as in *Antesorex compressus* and *S. taylori*, not posterolingually inflected as in *S. yatkolai* n. sp. *S. powersi* and entoconids posteriorly more removed from the metaconids than in *Altisorex*.

**Etymology:** *yatkolai*—in memory of Daniel Yatk, graduate student in vertebrate paleontology at the University of Nebraska, Lincoln.

*Sorex yatkolai* n. sp.

**Etymology:** *yatkolai*—in memory of Daniel Yatk, graduate student in vertebrate paleontology at the University of Nebraska, Lincoln.
### Table I. Measurements (mm) of teeth of *Sorex edwardsi* n. sp.

<table>
<thead>
<tr>
<th>Museum No.†</th>
<th>Tooth *</th>
<th>P₄ L</th>
<th>P₄ B</th>
<th>M₁ L</th>
<th>M₁ B</th>
<th>M₂ L</th>
<th>M₂ B</th>
<th>M₃ L</th>
<th>M₃ B</th>
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<tr>
<td>UNSM 27522</td>
<td></td>
<td></td>
<td></td>
<td>1.22</td>
<td>0.84</td>
<td></td>
<td></td>
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<tr>
<td>UW 6727</td>
<td></td>
<td></td>
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<td>1.30</td>
<td>0.78</td>
<td></td>
<td></td>
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<tr>
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<td>0.77</td>
<td>1.33</td>
<td>0.87</td>
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<td>0.93</td>
<td>1.23</td>
<td>0.86</td>
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<td>UW 6724</td>
<td>0.90</td>
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<td>0.82</td>
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<td></td>
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<td>1.24</td>
<td>0.84</td>
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<td>UW 6729</td>
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<td>0.78</td>
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<td>UW 6728</td>
<td>1.22</td>
<td>0.83</td>
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<td></td>
</tr>
<tr>
<td>UW 6723</td>
<td></td>
<td></td>
<td></td>
<td>1.31</td>
<td>0.82</td>
<td>1.00</td>
<td>0.67</td>
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<tr>
<td></td>
<td>M₁ L = 1.41, M₁ B = 1.68</td>
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<td></td>
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</tr>
</tbody>
</table>

* B = greatest transverse measurement (breadth); L = greatest anteroposterior measurement (length).

† Museum abbreviations as in INTRODUCTION.

**Holotype:** UW 6731 (Fig. 1D), fragment of left ramus with M₁-₃; collected by R. Henritze and A. Burtis, 1973.

**Hypodigm:** Type and UW numbers 6732, 6733 (Fig. 7B); see Table II.

**Locality:** Lemoyne Quarry (UNSM Kh-101), Ash Hollow Formation, Keith County, Nebraska.

**Diagnosis**

Molar size, jaw size and configuration about as in *Sorex meltoni* and *S. rexroadensis*. Mandible shallower than in *S. taylori* or *S. edwardsi*. Solitary preserved mental foramen occurs beneath P₄ as in *Antesorex*, not beneath the anterior root of M₁ as in *S. powersi* and *S. sandersi* or beneath the M₁ hypoflexid as in *S. taylori*, *S. rexroadensis*, and *S. edwardsi*. Mental foramen opens anteriorly as in *S. edwardsi* with a long anterior sulcus, not posteriorly as in *S. sandersi* and *S. taylori*. Articular condyles developed about as in *S. powersi* but medial face of interarticular area less invaginated. Posterior mandibular foramen moderately large and situated beneath middle of inferior border of posterointernal ramal fossa as in cf. *S. rexroadensis* of Hibbard and Bjork (1971:175). Superior articular condyle less labially deflected than in *Antesorex compressus* and lingual emargination of interarticular area less strong than in that taxon. Interarticular area less broad than in *Petenzia concisa*. Condyles less robust than in *S. taylori* and developed about as in *S. rexroadensis*. Coronoid spicule small but distinct as in *Petenzia concisa* and anteriorly placed as in *S. cinereus* and *S. powersi*. Dorsal lip of posterointernal ramal fossa much more deeply excavated than in *S. rexroadensis*.

Molars not as mediolaterally compressed as in *Alluvisorex* and molar entoconids farther removed posteriorly from metaconids than in that taxon. M₁ protocristid relatively longer than in *S. taylori* and protoconid and metaconid more removed from each other than in that species. M₁ protoconid extends lingually to or past anteroposterior midline of tooth as in *S. rexroadensis*. Molar entoconids tilted posterointernally as in *S. powersi*, not upright as in *Antesorex, S. taylori,* and *S. edwardsi*. M₁-₂ hypoconids, entocristids, and cristids obliqua developed as in *S. sandersi* but entoconid more anteriorly situated than in that species, less so than in *Alluvisorex*. M₂ entoconid more weakly developed than in *Antesorex*. M₃ similar to that tooth in *S. rexroadensis* with narrow, reduced heel as in *S. meltoni* and *S. sandersi*, not broad as in *S. hagermanensis* and *S. edwardsi*, and M₃ not reduced as in *Anchiblarinella*.
FIGURE 1. Dentitions of Lemoyne Soricini (stereophotographs, 10X).  
A. *Sorex edwardsi* n. sp., occlusal aspect of UW 6725, right M$_1$–2.  
B. *S. edwardsi* n. sp., occlusal aspect of UW 6728, left M$_2$–3.  
C. *S. edwardsi* n. sp., occlusal aspect of UW 6724 (Type), right I, P$_4$–M$_1$.  
D. *Sorex yatkolai* n. sp., occlusal aspect of UW 6731 (Type), left M$_1$–3.
Table II. Measurements (mm) of teeth of Sorex yatkolai n. sp.

<table>
<thead>
<tr>
<th>Museum No.</th>
<th>Tooth</th>
<th>M₁₁</th>
<th>M₁₂</th>
<th>M₂₁</th>
<th>M₂₂</th>
<th>M₃₁</th>
<th>M₃₂</th>
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<td>0.74</td>
<td>1.07</td>
<td>0.67</td>
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<td></td>
<td>1.08</td>
<td>0.70</td>
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<td></td>
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</tbody>
</table>

*Abbreviations as in Table I.

Discussion

Sorex yatkolai is a diminutive shrew that is clearly distinguished from S. edwardsi by virtue of its smaller size, shallower mandible, anteriorly-situated mental foramen, tilted M₁₋₂ entoconids, and transversely reduced M₃ talonid. In many characters, S. yatkolai resembles S. rexroadensis, differing from that species principally in the placement of the anterior mandibular foramen and in the more deeply excavated dorsal border of the posterointernal ramal fossa. S. yatkolai specimens do not preserve pigmented teeth as in S. rexroadensis.

Sorex sp., probably new

Referred Specimens: UW 6736, 6737 (Figs. 2A, 7C), 6738; see Table III.

Description

Three specimens represent a soricinine shrew larger than Sorex edwardsi, S. yatkolai, S. meltoni, S. powersi, S. rexroadensis, S. hagermanensis, or S. taylori and about the size of Adeloblarina birklandi. The mandible possesses a double posterior mandibular foramen with closely appressed moieties housed in a very deep depression beneath the posterior part of the posterointernal ramal fossa as in Petenyia concisa and Sorex powersi. The anterior opening has a short posterior sulcus and the posterior moiety opens ventrally. The solitary preserved mental mandibular foramen is situated beneath the posterior root of M₁, not beneath the hypoflexid as in Anchiblarinella and S. edwardsi, and is preceded by a long sulcus. The coronoid spicule is strong, better developed that in Petenyia concisa, and is medial, not situated posterior to the midline of the coronoid process as in that species. The articular condyles are developed much as in Petenyia concisa or even Cryptotis adamsi, but the lower condyle is not medi ally inflected and has a less deeply excavated inferior pterygoid fossa than in the latter species. No groove separates the ventral condyle from the inferior sigmoid notch as in Hesperosorex (Neomyini), and the interarticular area is not expanded lingually as in Limnoecus (Limnoecinae). The interarticular area is less broad than in Petenyia concisa, and the condyles appear to be relatively more widely separated than in that species. The external temporal fossa is much better defined inferiorly and is somewhat deeper than in Petenyia.

The molars are quite similar to those of the neomyinine Hesperosorex lovei, but the M₁ protolophid is more oblique. The M₁₋₂ entoconids are low and upright and are nearer the metaconids than in Petenyia, Anchiblarinella, Adeloblarina, Hesperosorex, or S. sanderi, and the entocristid is only weakly developed. The M₁ protocristid is relatively wider and the protoconid and metaconid are farther apart in this species than in Anchiblarinella, and the paraconid is more removed from the metaconid than in Petenyia. The M₁₋₂ ectocingulids are well developed and slightly stronger than in Adeloblarina. Pigmentation, if present in teeth of the living animal, was not preserved.

A maxillary fragment, UW 6738, preserving M₁₋₂, is provisionally referred to this group. The teeth compare favorably with those of genus Sorex, but are too large to occlude satisfactorily with lower molars of S. edwardsi or S. yatkolai and are much too small to represent the new neomyinine described below. The teeth do not appear to possess any specific diagnostic characters.

Table III. Measurements (mm) of teeth of Sorex sp.*

<table>
<thead>
<tr>
<th>Museum No.</th>
<th>Tooth</th>
<th>M₁₁</th>
<th>M₁₂</th>
<th>M₂₁</th>
<th>M₂₂</th>
<th>M₃₁</th>
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<td>UW 6738</td>
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<td>1.58</td>
<td>1.78</td>
<td>1.21</td>
<td>1.68</td>
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</table>

*Abbreviations as in Table I.

Discussion

UW specimens 6736–6738 probably represent an undescribed species of Sorex characterized by the combination of its relatively large tooth size, the position and construction
FIGURE 2. Dentitions of Lemoyne Soricine (A and B), Limnoecinae (C), and Neomyini (D) (stereophotographs, 10X). A. Sorex sp., occlusal aspect of UW 6737, right M₂. B. Alluvisorex, probably A. arcadentes, occlusal aspect of UW 6734, left M₁. C. cf. Limnoecus sp., occlusal aspect of UW 6739, right M₁. D. Anouronecomys magnus n. gen. and n. sp., occlusal aspect of UNSM 27602 (Type), left M₁.
of the mandibular foramina, the anatomy of the coronoid process and articular condyles, and by the close appression of the entoconids and metaconids on M\textsubscript{1-2}. Knowledge of the anatomy of M\textsubscript{3}, the unicuspids, and serially associated lower molars is desirable before the specimens at hand can be confidently assigned to species.

Genus Alluvisorex Hutchison, 1966

Alluvisorex sp., cf. A. arcadentes Hutchison, 1966

Referred Specimens: UW 6734 (Fig. 2B), 6735, 7722; UNSM 27515; see Table IV.

Discussion

These four specimens do not differ in size or morphology from comparable elements of Alluvisorex arcadentes of Hutchison (1966) from Barstovian rocks of Oregon. None of the Lemoyne specimens is well enough preserved to demonstrate the presence or absence of P\textsubscript{3} or the structure of P\textsubscript{4}. The molars, however, possess the peculiar rectangular shape of molars of A. arcadentes, and the mental mandibular foramen is situated beneath the M\textsubscript{1} hypoflexid as in the type material.

Among the Lemoyne shrews, Alluvisorex sp. cf. A. arcadentes specimens most closely resemble Sorex edwardsi and S. yatkolai in size but are clearly separable from those species and from Petenyia and Antesorex in having the M\textsubscript{1-2} entoconids closer to the metaconids and in the development of a very tall entocristid that closes the talonid basin lingually. The condylar structure differs from that in S. edwardsi in lacking the robust bosses of bone bordering the posterior mandibular foramen. The molars are relatively narrower than in Petenyia. The teeth do not appear to have been pigmented.

TABLE IV. Measurements (mm) of teeth of Alluvisorex, probably A. arcadentes.*

<table>
<thead>
<tr>
<th>Museum No.</th>
<th>Tooth</th>
<th>M\textsubscript{1} L</th>
<th>M\textsubscript{1} B</th>
<th>M\textsubscript{2} L</th>
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<td>1.15</td>
<td>0.75</td>
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</tbody>
</table>

*Abbreviations as in Table I.

Tribe Neomyini Repenning, 1967

Genus Anouroneomys n. gen.

Authorities for Name: Hutchison and Bown.

Etymology: in allusion to the relationships of this shrew to Anourosorex and Neomys.

Type: Anouroneomys magnus n. sp.

Included Species: A magnus Hemphillian, Nebraska; A. minimus n. sp. (infra), Clarendonian, Oregon.

Diagnosis

Dental formula; 1/1, 4/2, 3/3. Upper articular condyle triangular as in Notiosorex, Paranourosorex, and Anourosorex, not oval as in Hesperosorex, Chimarrogale, Beremedia, and Petenyiella. Articular condyles strongly deflected anterolingually with groove separating lower articular condyle from lower sigmoid notch. M\textsubscript{1} with less deeply emarginated posterior border and M\textsubscript{3} relatively narrower transversely than in Crusafontia. Teeth pigmented in A. minimus, possibly so in A. magnus, in contrast to "Anourosorex" kornosi and Anourosoricidion. Molar entocingulids strong in contrast with "Anourosorex" kornosi. M\textsubscript{3} present in contrast with Amblycoptus and this tooth considerably reduced in contrast with Neomys, Episoriculus, Soricus, Nesotites, Nectogale, Megasorex, and Chodsigoa. Talonid of M\textsubscript{3} present (absent in Anourosorex) and with crescentic hypolophid as in Chimarrogale and Beremedia. M\textsubscript{4} with two talonid cusps, not one as in Petenyiella. M\textsubscript{3} with entoconid and this tooth less reduced anteroposteriorly in contrast with Notiosorex. Tip of coronid process massive and with robust coronoid spicule, not small as in Notiosorex. Posterior emargination of P\textsubscript{4} strong but less so than in Notiosorex or Chodsigoa. P\textsubscript{3} (last upper unicusp) minute, peglike, and situated beneath the anteromedial precingulum of P\textsubscript{4} as in "Anourosorex" kornosi, Paranourosorex, and Paracryptotis, not absent as in Anourosoricidion and Chimarrogale. P\textsubscript{4} of Anouroneomys, Paranourosorex, and Chimarrogale not squared anterolingually as in Anourosorex.

Anouroneomys magnus n. sp.

 Authorities for Name: Hutchison and Bown.

Etymology: Latin magnus = large, in allusion to the large tooth size.

Holotype: UNSM 27602 (Fig. 2D), fragment of left ramus with M\textsubscript{1-3}, coronoid process and articular condyles.
Hypodigm: Type and UNSM numbers 27501, 27505-27508, 27511-27514, 27519, 27525-27528, 27600, 27603-27623; UW numbers 6143, 6677, 6678 (Fig. 7D), 6682-6688, 6689 (Fig. 3D), 6690 (Fig. 3C), 6691-6700, 6701 (Fig. 3B), 6702-6707, 6710-6721; see Table V.

Locality: UNSM Kh -101 (Lemoyne Quarry), Ash Hollow Formation, Keith County, Nebraska.

Diagnosis

Largest teeth 40% larger than smallest teeth of A. minimus n. sp. (infra), and smallest teeth 20% larger than largest teeth of A. minimus n. sp. Coronoid process and spicule more robust than in A. minimus and tip of coronoid process relatively much longer anteroposteriorly than in the latter species. External temporal fossa relatively much deeper and more continuous on face of coronoid process beneath coronoid spicule than in A. minimus. Internal temporal fossa oval, not round as in A. minimus.

Description

In lateral view, the crown of the upper incisor is not noticeably bifid, is smoothly arcuate, and carries two principal cusps, the largest of which is anterior and curvilinear posterodorsally. A basal, bladelike cusp is present behind but connate with the primary cusp at the labial margin of the crown (Fig. 3D). A labial cingulum is present at the base of the crown and is roughly perpendicular to the long (dorsoventral) axis of the crown. The root of the incisor is mediolaterally compressed, arcuate and bladelike, and tapers gently to a point.

The three unicuspids between the incisor and P⁴ decrease in size posteriorly. The last unicusp is minute, peglike, and is situated partially beneath the parastylar shelf of P⁴, similar to the condition seen in Paracryptotis gidleyi (see Hibbard and Bjork, 1971). The anterior unicuspids are flattened dorsoventrally, are attenuated anteroposteriorly, and overlap anteriorly. These teeth have a strongly-developed postero-lingual basin and endocingulum.

P⁴ is falciform with pronounced posterior margination. The protocone, protoconule, and para style are roughly equal in size. M⁴ is quadrate in occlusal outline with the para- and metastyles roughly equal in size. M₂ are generally 80% or less than the length of M₁. M⁴ is trapezoidal in occlusal outline with a greatly expanded para style. M₃ is much reduced over M₂ and possesses no talon shelf but, like M₂, has a greatly expanded para style. The base of the zygomatic process originates above the M² para style.

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*Measurements in millimeters. Abbreviations: N = number of observations; OR = range of measurements; X = mean of measurements; S = standard deviation; CV = coefficient of variation; L = greatest anteroposterior measurement (length); B = greatest transverse measurement (breadth).

The lower incisor is large and with the anterior extremity of the crown upturned. The occlusal surface of the crown possesses three rather weakly defined serrations, the anteriormost as long as the distance between the two posterior serrations. The enameled ventral surface of the crown extends 60% farther posteriorly than does the enameled dorsal surface.

As judged by alveoli, two single-rooted teeth were present between the incisor and M₁.
Hypodigm: Type and UNSM numbers 27501, 27505-27508, 27511-27514, 27519, 27525-27528, 27600, 27603-27623; UW numbers 6143, 6677, 6678 (Fig. 7D), 6682-6688, 6689 (Fig. 3D), 6690 (Fig. 3C), 6691-6700, 6701 (Fig. 3B), 6702-6707, 6710-6721; see Table V.

Locality: UNSM Kh–J01 (Lemoyne Quarry), Ash Hollow Formation, Keith County, Nebraska.

Diagnosis

Largest teeth 40% larger than smallest teeth of *A. minimus* n. sp. (infra), and smallest teeth 20% larger than largest teeth of *A. minimus* n. sp. Coronoid process and spicule more robust than in *A. minimus* and tip of coronoid process relatively much longer anteroposteriorly than in the latter species. External temporal fossa relatively much deeper and more continuous on face of coronoid process beneath coronoid spicule than in *A. minimus*. Internal temporal fossa oval, not round as in *A. minimus*.

Description

In lateral view, the crown of the upper incisor is not noticeably bifid, is smoothly arcuate, and carries two principal cusps, the largest of which is anterior and curvilinear posteroventrally. A basal, bladelike cusp is present behind but connate with the primary cusp at the labial margin of the crown (Fig. 3D). A labial cingulum is present at the base of the crown and is roughly perpendicular to the long (dorsoventral) axis of the crown. The root of the incisor is mediolaterally compressed, arcuate and bladelike, and tapers gently to a point.

The three unicuspids between the incisor and P₄ decrease in size posteriorly. The last unicusp is minute, peglike, and is situated partially beneath the parastylar shelf of P₄, similar to the condition seen in *Paracryptotis gidleyi* (see Hibbard and Bjork, 1971). The anterior unicuspids are flattened dorsoventrally, are attenuated anteroposteriorly, and overlap anteriorly. These teeth have a strongly-developed postero-lingual basin and endocingulum.

P₄ is falciform with pronounced posterior emargination. The protocone, protoconule, and parastyle are roughly equal in size. M₁ is quadrate in occlusal outline with the para- and metastyles roughly equal in size. M₂ are generally 80% or less than the length of M₁. M₂ is trapezoidal in occlusal outline with a greatly expanded parastyle. M₃ is much reduced over M₂ and possesses no talon shelf bet, like M₂, has a greatly expanded parastyle. The base of the zygomatic process originates above the M₂ parastyle.

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**TABLE V. Numerical data for teeth of Anouroneollemur magnus n. gen. and n. sp.**

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<td>0.66-0.77</td>
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<td>.03725</td>
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*Measurements in millimeters. Abbreviations: N = number of observations; OR = range of measurements; X = mean of measurements; S = standard deviation; CV = coefficient of variation; L = greatest anteroposterior measurement (length); B = greatest transverse measurement (breadth)."

The lower incisor is large and with the anterior extremity of the crown upturned. The occlusal surface of the crown possesses three rather weakly defined serrations, the anterior-most as long as the distance between the two posterior serrations. The enameled ventral surface of the crown extends 60% farther posteriorly than does the enameled dorsal surface.

As judged by alveoli, two single-rooted teeth were present between the incisor and M₁.
The general configuration of the tooth is exodont. The paraconid is well removed anteriorly from the metaconid and protoconid and is connected to the paraconid by a deeply notched paracristid. The labial wall of the protoconid is stout, obscuring in occlusal view the continuous labial cingulid. The protoconid is the tallest and largest cusp, the metaconid second in size, and the paraconid and entoconid are subequal in height. The entoconid is only slightly removed from the metaconid and is connected with the base of that cusp by an anteriorly sloping entocristid. On unworn teeth a small hypoconulid is present, appressing the entoconid but separated from it by a deep notch.

$M_2$ is similar to $M_1$ but about 20% smaller. The entoconid is less bulbous than on $M_1$ and somewhat more mediolaterally compressed.

$M_3$ is greatly reduced (less than 50% the anteroposterior length of $M_2$) and possesses strong ecto- and anterior endo-cingulids. The protocristid is not notched but slopes gently from the protoconid to the metaconid. The talonid is much reduced relative to the condition of $M_2$, but still retains a distinct hypoconid and entoconid surrounding a small circular basin. The hypolophid is crescentic. The mental mandibular foramen is single and lies beneath the hypoflexid of $M_1$.

The condylar process is robust. The intertemporal fossa is oval in outline. The masseteric fossa is broad and relatively shallow. The coronoid spicule is robust and is situated above a very deeply excavated external temporal fossa.

The condylar facets are widely separated by a relatively narrow interarticular ridge. The dorsal facet is triangular to hemicylindrical in shape and the long axis is oriented posteriorly—anterolaterally. The ventral facet is buttressed anteriorly by a lingual extension of the ascending ramus. This facet is elongate labiolingually and faces posteriorly and ventrally. The posterior mandibular foramen opens just anterior to the lingual neck of the ventral articular condyle.

Discussion

Hutchison (written communications, 1975 and 1976) first recognized specimens referable to the new genus *Anouroneomys* from Clarendonian rocks of the Juntura Formation of Oregon. His comments on the affinities of *Anouroneomys* are abstracted below:

*Anouroneomys* is aligned with the *Anourosorex--Amblycopterus* group [*Anourosoricini of Gureev (1971); Amblycoptinae of Kormos (1926)] of neomyinine shrews (Repenning, 1967a) on the basis of a small suite of characters which appear to be derived within the Neomyinae:

1. dental formula 1–4–3/1–2–3, or less;
2. lower molars with broadly open trigonids;
3. $M_2$ length less than 80% of $M_1$ length; $M_3$ comparably reduced and upper molars similarly ranked;
4. $M^1$ with metastyle reduced and medially situated so as to form a markedly concave labial margin in occlusal view; and
5. upper incisor with unibifid tip.

Aside from *Anouroneomys*, there are eight nominal species in four genera of which only one species is extant (*Anourosorex squamipes*). All the latter forms are Palaearctic. *Anouroneomys* differs from all these genera in generally lacking such derived characters as 1) the anterior situation of the internal temporal fossa, mandibular foramen, and lower condylar facet; and 2) the change in shape of the internal temporal fossa from subtriangular to ovoid accompanied with a reduction in size of the opening. Discussion of these genera and additional characters which distinguish them from *Anouroneomys* follows.

*Crusafontia endemica* was described by Gibert (1975) from the Vallesian of Can Llobateres, Spain, based on a series of isolated teeth and fragmentary dentaries. Unfortunately, only some of the teeth were figured in the 1975 paper. The $M^1$ is primitive in having a more deeply emarginate posterior border and is a relatively wider tooth than in *Anouroneomys*. Gibert (1975) made no mention of any difference in the ascending ramus from that of *Anourosorex kormosi* to which it was compared. *Crusafontia* is the most primitive and oldest of the recognized anourosoricine shrews in Europe.

*Paranourosorex gigas* of Rzebik-Kowalska (1975) from the Middle Pliocene locality of Podlesice, Poland, resembles *Anouroneomys* in such primitive features as the dental formula, sporadic tooth pigmentation, well-defined cingula, size of $M^1$ mesostyle, and size and presence of $M_3$, but shares derived character states with *Anourosorex* in the reduction of posterior emargination of $P^4$-$M^1$, size and position of internal temporal fossa, greater lateral deflection of coronoid process, narrower interarticular area, and loss of lower incisor serrations.

*Anourosoricidon pidoplitschkoi* of Topacevski (1965) is known only from “Middle Pliocene” deposits in the vicinity of the villages of Kamenskoy and Plavnii, Ukrainian SSR. Known only from dentary fragments and lower teeth, this shrew is not
satisfactorily distinguished from Anouroneomys, Crusafontia, or Anourosorex kormosi (non-Russian authors were apparently unaware of its publication). The teeth are said to be unpigmented, unlike Anouroneomys. Crusafontia and A. kormosi teeth seem to be variably pigmented.

Anourosorex kormosi of Bachmayer and Wilson (1970) described from a Late Pannonian fissure near the village of Kohfidisch, Austria, is well represented by jaws and teeth. It shares advanced characters of the ascending ramus and reduction of the M3 with Anouroneomys but retains an additional upper antemolar (as in Anouroneomys), more prominently serrated lower incisor, and is generally more primitive in other details. Although materials of Anourosoricidon are very incomplete, A. kormosi resembles it in comparable parts, i.e., both are generally more primitive than other Anourosorex species. Relative geographic position and nearly comparable age argues for placing A. kormosi near or in the genus Anourosoricidon rather than extending the concept of Anourosorex, a genus that is based on a highly derived Quaternary species. A. kormosi is additionally advanced over Anouroneomys in the weakness or absence of tooth pigmentation and in reduction of the cingulids.

Anourosorex inexpectatus of Schlosser (1924) from Pontian deposits of Ertemte, Mongolia, is based on a single fragmentary and edentulous dentary lacking the anterior part and tip of the coronoid process. Miller (1927) noted its similarity to Anourosorex and, as noted by Repenning (1967a), the presence of the M3 eliminates it from Amblycoptus Kormos. Bachmayer and Wilson (1970:533) distinguished A. inexpectatus from A. kormosi by the more anterior position of the lower articular condyle in relation to the internal temporal fossa (apparently mis-cited as the superior pterygoid fossa). Continued assignment of this poorly known species to Anourosorex seems appropriate.

Amblycoptus and Anourosorex are the most advanced of this group of shrews. Both have increased the mass of the horizontal ramus and coronoid process, have squared the occlusal outline of the P4, have increased the relative length of the M1, and have reduced the dental formula. Amblycoptus oligodon of Kormos (1926), from the Pliocene of Polgardi, Hungary, has lost the third molar above and below. Recent and Pleistocene species of Anourosorex have lost an upper antemolar (Young and Peiho, 1950).

The comparisons above and in the diagnosis of Anouroneomys appear to relate the genus most closely to the Anourosoricidon—Anourosorex’ kormosi complex of shrews.
FIGURE 4. *Anouroneomys minimus* n. sp. (scale is 1 mm). A. Lingual aspect of UO 24711 (Type), fragment of right ramus with *M*₁₋₂, coronoid process and articular condyles. B. Labial aspect of UO 24711 (Type). (Figure prepared by J. H. Hutchison.)
**FIGURE 5.** *Anouroneomys minimus* n. sp. (scale is 1 mm). A. Occlusal aspect of UO 24711 (Type), right *M*₁₋₂. B. Occlusal aspect of UO 24728, left *M*². C. Occlusal aspect of UO 25165, left *P*₄. (Figure prepared by J. H. Hutchison.)

*M*₁₋₂ are approximately 20% larger than in the types of *L. niobrarensis* of Macdonald (1947) and *L. tricuspis* of Stirton (1930), species that James (1963) concluded were synonymous. *M*₁ possesses a metaconid and protoconid that are very closely appressed (more so than in *Sorex taylori* or in any other Lemoyne shrew), with a short protocristid, and with the protoconid situated to the lingual side of the midline of the tooth as in *S. taylori*. This close appression of the protoconid and metaconid cusps was noted by Stirton (1930) for the type of *L. tricuspis*. The molars possess pillarlike and trenchant entoconids as in *L. tricuspis*, *L. niobrarensis*, and “*Megasorex*.” The talonid is wider than the trigonid on *M*₁ and equal in width with the trigonid on *M*₂. The entoconids are well removed from the metaconids on *M*₁₋₂ and there is no entocristid closing the talonid basin lingually as in *Sorex meltoni*, *S. rexroadensis*, *Adeloblarina*, *Anchiblarinella*, *Alluvisorex*, and *Petenyia*. The degree of this separation is much like that in *Crocidura russula russula* (figured by Stirton, 1930: 218).

The *M*₁ entoconid is nearly as tall as the hypoconid and is situated on the postcristid. On *M*₂, this cusp is shorter but still very strongly developed and is anteriorly separated from the postcristid by a small notch. The hypoflexid on *M*₁...
emerges labially well above the buccal cingulid. The mental foramen is small, has a slight anterior accessory sulcus, and is situated slightly ahead of the anterior root of M₁. Only the tips of M₁-2 are pigmented as in *Limnoecus* and *Angustidens*. Small ectocingulids are developed on both M₁ and M₂. Measurements (mm): M₁ L = 1.63; M₁ B = 1.14; M₂ L = 1.52; M₂ B = 0.96.

If actually *Limnoecus*, UW 6708 and 6739 possibly represent a species distinct from *L. tricuspis* or *L. niobarensis*, both of which are presumably Barstovian in age and possess considerably smaller teeth.

**Superfamily Talpoidea**

**Family Talpidae**

**Subfamily Desmaninae** Thomas, 1912

**Genus Lemoynea** n. gen.

*Etymology:* for Lemoyne, Nebraska, and Lemoyne Quarry, provenance of all known specimens referable to this genus.

**Type:** *Lemoynea biradicularis* n. sp. and only known species.

**Diagnosis**

Parastyle separated from paracorne by deep commissur on M₁, contra most *Desmana* species. M₁-3 protoconule much larger than metaconule, not equisized as in most *Desmana*. M₂ with five labial cusps (four in most *Desmana* and in *Galemys*). M₂ metaconule less well developed than in *Mygalea antiqua*, M₃ hypocone strong in contrast to *M. antiqua* and *Galemys*. M₃ with no postcingulid as occurs in recent *Desmana* species. Upper molars more triangular and less squat' in occlusal outline than in *Desmana*.

Double mental mandibular foramen in contrast commonly tri- or quadripartite mandibular foramen in many *Desmana*. Angle between anterior border of coronoid process and alveolar border of horizontal ramus forms an angle of approximately 110° as in *Mygalinia hungarica*, not about 90° in most other desmanine species.

I₃ is much larger than the canine as in *Mygalea antiqua* and in contrast to most *Desmana* species. Canine with short...
TABLE VI. Measurements (mm) of teeth of *Anouroneomys minimus* n. sp.

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<tr>
<td>UO 25162</td>
<td></td>
<td></td>
<td>1.40</td>
<td>0.85</td>
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*Abbreviations as in Table I.

Abbreviations as in Table I.

*Etymology: biradicularis; in allusion to the double-rooted P₁-4.*

*Holotype: UNSM 27518 (Figs. 8A, 8D), fragment of right ramus with canine, P₁-4.*

*Hypodigm:* Type and UNSM numbers 27500, 27509, 27510, 27516, 27517, 27625 (Fig. 8C), 27626-27628; UW numbers 6666 (Fig. 8B), 6667-6669, 6672 (Fig. 9A), 6673 (Fig. 9A), 6674, 6676 (Fig. 9A); see Tables VII and VIII.

**Diagnosis**

Intermediate in size between *Mygalinia hungarica* and *Mygalea antiqua,* M₃L/M₂L ratio about as high (0.86) as in *Mygalea antiqua* (0.84) and *Mygalinia hungarica* (0.88). Two mental foramina; that beneath the canine very small. Cingulids very strong on P₂-₄.

**Description**

*Lemoyne biradicularis* resembles the true watermole (Desmaninae) in the completely twinned M₁-₃ mesostyles, arcuate lingual borders of the upper molars (primitive for desmanines), junction of the molar cristids obliqua with the metaconids, possession of double-rooted and complex premolars, and relative development of the molar and premolar cingulids. These characters exclude *Lemoyne* from any talpine taxa known to me and *L. biradicularis* does not closely resemble any other known North American talpid.

The mesostyles are twinned on M₁-₃, and the para- and mesostyle is separated from the protocone by a deep valley on M₁. The posterior moiety of the para- and mesostyle is connected to the paracone on M₂ and M₃. The paracone and paraconule are distinct on M₁-₃. The metaconule is very small and is incorporated into the postprotocrista on M₁-₂ as in *Galemys* and *Desmana* and is absent on M₃. The protoconule is much larger than the metaconule on M₁-₃, not equal in size as in most species of *Desmana,* M₁-₂ possess four roots, the smallest of which occurs in the middle of the crown near the labial side. Weak pre- and postcingula are present on M₁-₂ and extend lingually to a point beneath the paraconule and hypocone, respectively. The para- and mesostyle is twinned on M₂ and the resultant cusps are separated by a deep, narrow valley as in Schreuder (1940:228) described for *Mygalea antiqua,* *Desmana kormosi,* and *D. thermalis.* The most anteroextreme moiety is developed about as in *M. antiqua,* and there are therefore five labial cusps on M₂ contra the four in many *Desmana* and *Galemys* species. The M₂ mesostyle is twinned by a deeper valley than in *M. antiqua* or *M. jaegeri,* and the M₂ metaconule is less distinct than in those species. The para- and metacones are equally strong as in *M. antiqua.*

*Convex paracristid and long, concave cristid that connects the protoconid to the heel of the tooth, in contrast to *Galemys,* P₁ two-rooted as in *D. pontica* and in contrast to *Mygalea antiqua,* *M. jaegeri* (see, e.g., Hutchison, 1974), and most other desmanines. P₃ larger than P₂ as in *M. antiqua* and in contrast to most other desmanines. P₃ unreduced as in *D. kormosi* and not set obliquely in jaw as in *D. nehringi.* P₄ with no metaconid (weak in *M. antiqua*) in contrast to *Mygalinia hungarica,* *Galemys,* and many *Desmana* species.*
The $M^3$ parastyle is twinned as on $M^2$, like the condition in *M. antiqua*, and in contrast to that in *Desmana kormosi*. The $M^3$ hypoconule is very strong in contrast to *M. antiqua* and *Galemys*, and the tooth possesses no postcingulum as occurs in recent *Desmana*.

The ventral border of the horizontal ramus becomes deeply inflected posteriorly beneath the $M_1$ hypoflexid and anteriorly beneath the anterior root of $P_3$. The mandible is deepest beneath $M_2$ as in most *Desmana moschata* (beneath $M_2$ in *D. moschata hungarica*). Lemoyne a possesses a large mental mandibular foramen situated beneath the posterior root of $M_1$, about one-third the distance from the inferior border of the mandible to the alveolar border of the tooth row. A second, very small foramen is developed immediately beneath the canine root. This foramen is considerably smaller than that situated beneath the canine in *Desmana kormosi*. The foramina contrast with those in most *Desmana* where they are generally tripartite or, as in *D. kormosi*, quadripartite (Schreuder, 1940:244).

The angle formed by the anterior border of the coronoid process and the alveolar border of the horizontal ramus is about 110° as in *Mygalinia hungarica* and not about 90° as in most other desmanine species.

$I_1$ and $I_2$, as judged from alveoli, appear to have been roughly equal in size and with $I_2$ much larger than the canine as in *Mygalea antiqua* and in contrast to most species of *Desmana*.

The canine possesses a short, convex paracristid and a long, concave crista that connects the protoconid with the heel of the tooth as in *D. pontica* and *Mygalea antiqua*, and in contrast to *Galemys*.

The premolars increase in size posteriorly. $P_1$ is two-rooted as in *D. pontica* and in contrast to many other desmanines, including *M. jaegeri* and *M. antiqua*. $P_1$ is obliquely set in the jaw as in *D. pontica* and possesses a distinct postero-labial cusp (?hypoconid). $P_{1-4}$ have strong entocingulids and postcingulids but the entocingulids fade in strength considerably across the lingual face of the protoconid. $P_{2-4}$ are double-rooted, $P_1$ possesses a distinct paracristid at the anterior margin of the paracristid. $P_2$ has a weaker paracristid that is less tall than that for $P_1$ and that is situated at the antero-basal margin of the steep paracristid at the confluence of the ento- and ecto-cingulids. $P_3$ has a strong paracristid as in *Desmana nehringi*, *Mygalea antiqua*, and *Galemys* and this cusp is separated from the anterior part of the paracristid by a shallow re-entrant valley entering from the lingual side. The $P_4$ Paracristid is very large and the lingual re-entrant valley is much stronger than on $P_3$. The $P_4$ paracristid is strongly notched at a point between the base of the protoconid and the postparacristid. $P_4$ is larger than $P_4$, as in *M. antiqua*, not smaller as in most desmanines (Schreuder, 1940:246), and with the roots not compressed. $P_4$ is not obliquely set in the jaw as in *D. nehringi*. $P_{2-3}$ have prominent postero-basal cusps and $P_3$ has a small postero-lingual basin that is bounded lingually by a high entocristid. $P_4$ has a strong hypoconid and a well developed basined heel with a faint entoconid as in *Mygalea antiqua*. The $P_4$ postprotocristid is strongly developed and extends ventrally from the protoconid to the labial re-entrant (hypoflexid). $P_4$ does not have a metaconid, a cusp that is weakly developed in *M. antiqua* but is quite strongly expressed in *Mygalinia hungarica*, *Galemys*, and most species of *Desmana*.

As noted by Schreuder (1940:254–255), the lower molars of desmanines can be distinguished from those of their talpine counterparts in that "... the anterior horn of the hypoconid extends almost up to the top of the (unworn) metaconid ... whereas in the others it ends low against the middle of the high posterior horn of the protoconid." Lemoyne shares this characteristic with the Desmanineae and possesses it to the exclusion of the ursupline and talpine moles. $M_{1-3}$ are strongly exoaeonodont and have strong precingulids. The ento- and postcingulids are absent. $M_{1-3}$ have the entocingulid well developed across the hypoflexid and $M_{1-2}$ have a postcingulid (absent on $M_3$).

Subfamily Talpinae Fischer von Waldheim, 1817, incertae sedis

Genus *Achlyoscapter* Hutchison, 1966

*Achlyoscapter* sp.

Referred Specimen: UW 6670 (Fig. 10).

Discussion

A solitary right ramal fragment preserving $M_1$ is referred to this genus, originally described from Oregon. $M_1$ is morphologically identical with that in UO 22412 (the type of *A. longirostris*) but is slightly shorter anteroposteriorly. Two mental foramina are present, one beneath the middle of $P_2$ and the second beneath the posterior root of $P_4$. The mandibular symphysis extends posteriorly to a point beneath the posterior root of $P_2$. From preserved alveoli, it appears that at least $P_{2-4}$ were double-rooted, but this is not certain. Measurements (mm): $M_1$ L = 1.27, $M_1$ B = 1.07.

The type of *Achlyoscapter longirostris* was recovered from deposits of Barstovian age (Late Miocene) in Oregon. No other West Coast material is known. The Lemoyne specimen resembles this species more closely than any other previously described talpine. The lack of antemolar crowding, the
TABLE VII. Numerical data for lower teeth of *Lemoynea biradicularis* n. gen. and n. sp.*

<table>
<thead>
<tr>
<th>Tooth</th>
<th>N</th>
<th>OR</th>
<th>X</th>
<th>S</th>
<th>CV</th>
</tr>
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<tbody>
<tr>
<td>/C L</td>
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<td></td>
<td>0.89</td>
<td></td>
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<tr>
<td>/C B</td>
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<td></td>
<td>0.59</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>P1 B</td>
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<td></td>
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<td></td>
</tr>
<tr>
<td>P2 L</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>P2 B</td>
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<td></td>
<td>0.76</td>
<td></td>
<td></td>
</tr>
<tr>
<td>P3 L</td>
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<td>1.29-1.44</td>
<td>1.35</td>
<td>.0814</td>
<td>6.05</td>
</tr>
<tr>
<td>P3 B</td>
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<td>6.35</td>
</tr>
<tr>
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</tr>
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<td>P4 B</td>
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<td>0.90-1.00</td>
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<td>4.59</td>
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<td>M1 L</td>
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<td>2.52</td>
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<td>M1 B</td>
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<td>1.55-1.76</td>
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<td>.0907</td>
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<td>2.17-2.28</td>
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<td>.0455</td>
<td>2.04</td>
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<tr>
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<td>1.56-1.75</td>
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<td>.0632</td>
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<td>1.22</td>
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*Measurements in millimeters; abbreviations as in Table V.

TABLE VIII. Measurements (mm) of upper teeth of *Lemoynea biradicularis* n. gen. and n. sp.*

<table>
<thead>
<tr>
<th>Museum No.</th>
<th>Tooth</th>
<th>M4 L</th>
<th>M4 B</th>
<th>M2 L</th>
<th>M2 B</th>
<th>M3 L</th>
<th>M3 B</th>
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</thead>
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<td>2.72</td>
<td>2.92</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>UW 6674</td>
<td></td>
<td>2.71</td>
<td>3.08</td>
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<td></td>
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<td></td>
</tr>
<tr>
<td>UW 6676</td>
<td></td>
<td>2.14</td>
<td>2.55</td>
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</tbody>
</table>

*Abbreviations as in Table I.

morphism of M1, the essentially straight and untapering mandible, and the very small size make this specimen distinct from known Hemphillian talpines of the Great Plains.

### Talpinae, undetermined genus and species 1

**Referred Specimens:** UW 6671 (Fig. 9B), 10527 (Fig. 9B)

**Discussion**

Two teeth, an M2 and an M2 (Fig. 9B) probably belong to the same species on the basis of size and faunal association but are of uncertain generic placement within the Talpinae. M2 differs from that in *Scalopus (Hesperoscalops)* in: (1) the transversely much broader protocone and its lingual base; (2) the absence of discernible conules; (3) the relatively narrower trigon basin (anteroposterior dimension); and (4) apparently in the stronger development of the para- and metastyles. In the first and fourth characters, this tooth resembles M2 in *Scapanulus, Scalopoides*, and, to a lesser degree, *Mystipeterus*, but the absence of conules is unusual.

M2 resembles the homologous tooth in the paratype of *Scalopus (Hesperoscalops) rexroadi* of Hibbard (1941) but possesses a transversely broader anterior accessory cusp and a lower entocristid than in that taxon. Measurements (mm): M2 L = 2.75, M2 B = 2.00; M2 L = 2.71, M2 B = 3.18.

### Talpinae, undetermined genus and species 2

**Referred Specimens:** UW numbers 10521 (Fig. 9C), 10522, 10523, 10524 (Fig. 9C), 10525, 10526 (Fig. 9C).

**Discussion**

These specimens may represent unusually small teeth of undetermined genus and species 1 but M1-2 differ from the latter in the confluence of the cristids obliqua with the entocristid (as in *Scapanulus*), forming a small metastyle. M1 (?) is virtually identical with M1 (?) of *Talpidae, incertae sedis* figured by Hutchison (1968: Fig. 96). In both forms, the trigonid is transversely much compressed and the occlusal outline of the tooth is trapezoidal, much as in dP 4 of mammals with tribosphenic molars. The Lemoyne specimens differ from the Oregon specimens in the presence of disk, metastyloid and metastylid (entoconulid?) cusps (Fig. 9). An anterolingular trigonid cusp, present in UO 25289 and 25124 (Hutchison, 1968: Fig. 96), occurs in UW 10521, 10522 but is absent in UW 10523. M3 (?) resembles but is smaller and possesses no posterior accessory cusp. Hutchison (1975, written communication) now believes UO specimens to be talpid, and I agree with his assignment.
FIGURE 8. Dentitions of *Lemoynea biradicularis* (Desmaninae) n. gen. and n. sp. (stereophotographs). A. Occlusal aspect of UNSM 27518 (Type), right canine, $P_{1-4}$ (6X). B. Occlusal aspect of UW 6666, right $P_3-M_2$ (6X). C. Occlusal aspect of UNSM 27625, right $M_{1-3}$ (10X). D. Labial aspect of UNSM 27518 (Type), right canine, $P_{1-4}$.
FIGURE 9. Composite dentitions of Lemoyne Desmaninae (A) and Talpinae (B, C, D) (stereophotographs, 10X). A. Lemoynea biradicularis n. gen. and n. sp., occlusal aspect of UW 6672, 6673, 6676, right M¹, left M²-³. B. Talpinae, undetermined genus and species 1, occlusal aspect of UW 6671, 10527, left M² and right M₃. C. Talpinae, undetermined genus and species 2, occlusal aspect of UW 10521, 10524, 10526, left M₁-², right M₃. D. Talpinae, undetermined genus and species 3, occlusal aspect of UW 6675, right M¹.
FIGURE 10. Achlyoscapter sp. (Talpinae, incertae sedis), occlusal aspect of UW 6670, fragment of right ramus with M1 (stereophotograph, lOX).

Measurements (mm): M1 L (N=3) = 2.07-2.20, M1 B (N=3) = 1.31-1.36; M2L (N=2) = 2.18-2.21, M2B (N=2) = 1.38-1.42; M3L = 1.88, M3B = 1.10.

Talpinae, undetermined genus and species 3

Referred Specimen: UW 6675 (Fig. 9D).

Discussion

This specimen, an isolated right M1, is virtually identical to a specimen referred by Hutchison (1968:101, Fig. 89A) to Talpinae, incertae sedis. The mesostyle is twinned but is not separated by a deep linguolabial valley as in Lemoynea and the Desmaninae. The lingual base of the tooth is squared as in the UO specimen and as in Parascalops, and the protocone is small and is flanked by enlarged para- and metaconules as in P. breweri. Strong pre- and postcingula are present. Additional material is necessary to determine the relationship, if any, of this form to Parascalops and the subtribe Parascalopina.

Measurements (mm): M1 L = 2.78, M1 B = 2.13.

DISCUSSION

The Lemoyne Quarry insectivore fauna is a unique assemblage of shrews and moles. Individual elements in the fauna are related to a variety of species previously described from later Tertiary rocks of the Great Plains, the West Coast area, and Eurasia. Close relatives of the better-known Great Plains Soricini and Talpinae described in a large number of papers by the late C.W. Hibbard and his students are conspicuously absent in the Lemoyne fauna. Sorex edwardsi and S. yatkolai, however, are most closely related to S. hagermanensis and S. rexroadensis from the Hagerman and Rexroad faunas of Idaho (Glens Ferry Formation) and Kansas (Rexroad Formation), respectively.

Alluvisorex, Limnoecus, Achlyoscapter, and undetermined talpines 2 and 3, aside from relatively minor differences, mirror their originally described counterparts, all of which, excluding Limnoecus niobrarensis of Macdonald (1947) were earlier known only from the west coastal United States. Lemoyne Anouroneomys magnus has, similarly, a smaller and less robust counterpart in A. minus in the Juntura Formation of Oregon. The generic affinities of Anouroneomys, however, lie with the Eurasian Anourosorex-Anourosoricidon-Amblycoptus complex of neomyinine shrews, and Anouroneomys does not closely resemble any form hitherto described from the Western Hemisphere.

Lemoynea biradicularis is an exciting new taxon and constitutes the first record of the watermoles in the New World. The Lemoyne taxon shares a complex assortment of characters with Late Miocene to Recent desmanines of Europe but most closely resembles Schreuder’s (1940) “Vindobonian” and “Pontian” genera Mygalea and Mygalina [probably Early and Late Miocene, respectively; see Berggren and Van Couvering (1974)]. The Hemphillian occurrence of L. biradicularis postdates that of Mygalea and is approximately the same as that of Hungarian Mygalinea.

Repenning (1967b) has recently reviewed the record of Late Cenozoic Palearctic-Nearctic mammalian dispersal and has noted (p. 290-291), as did Simpson (1947), that “the similarity of the North American Hemphillian faunas to those Old World faunas generally correlative to the Pannonian (or Hipparion or ‘Pontian’) is one of the strongest in the Tertiary; this may reflect a relatively long period of faunal exchange.” Repenning (1967b:291-292) also noted that the bulk of this exchange (in whatever direction) was confined to forest or aquatic forms. Lemoynea, a derivative of a primitive member of the aquatic Desmaninae, conforms with this generalization regarding Palearctic-Nearctic exchange. Anouroneomys is closest in known morphology to penecontemporary or younger Eurasian neomyinine shrews; however, the record of this tribe (Neomyini) is good for the North American Late Miocene, and it is not impossible that Anouroneomys is a descendant of an early off-shoot of this group that had a Holarctic dispersion. Neomys is an aquatic shrew and Anourosorex is a burrowing shrew that apparently prefers a forested, highland habitat (Walker et al., 1975).
Burrowing shrews and moles commonly show a marked preference for soil textures and their aquatic counterparts are restricted to dominantly moist habitats proximal to streams or ponds. These animals also maintain relatively small home ranges. In view of our knowledge of Late Miocene paleogeography of western North America, the mutual occurrence of *Alluvisorex*, *Limnoecus*, *Achlyoscapter*, and indeterminate talpines 2 and 3, as well as *Anouroneomys*, in both west coastal and central North American faunas of this age is truly remarkable. These animals were apparently fully capable of crossing or circumnavigating the topographically and climatically complex Rocky Mountain and Basin and Range provinces.

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**REFERENCES**


