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NEW MULTITUBERCULATA TAXA (MAMMALIA)  
FROM THE LATE PALEOCENE OF NORTH AMERICA

by  
RICHARD C. HOLTZMAN  
Minnesota Geological Survey  
and  
DONALD L. WOLBERG  
Department of Geology and Geophysics  
University of Minnesota

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THE MICROCOSMODONTINAE AND *MICROCOSMODON WOODI*,  
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In 1930 and 1940 Jepsen described two unusual multituberculates, *Microcosmodon conus* and *Pentacosmodon pronus*, from Princeton Quarry in the Late Paleocene deposits of the Bighorn Basin of Wyoming. For many years these species stood as anomalies among the known Paleocene multituberculates. In the late 1960's additional specimens of *M. conus* were recovered from nearby Schaff Quarry, and a distinct, but obviously related, form was recognized in collections from the Circle and Shotgun local faunas by R. E. Sloan. More recently the authors have obtained additional specimens of the new form in their studies of the Circle and Brisbane local faunas. Subsequently, additional material referable to *M. conus* was identified in the Roche Percee (Krause, MS) and Badwater Creek local faunas (Krishtalka *et al.*, 1975). This paper describes the new form and erects the Microcosmodontinae in recognition of the distinctive character of these three species.

Abbreviations used are: MCZ, Museum of Comparative Zoology, Harvard University; SMM, The Science Museum of Minnesota; and UMVP, University of Minnesota, Vertebrate Paleontology Collection. The tooth traditionally designated as P<sub>4</sub> in multituberculates is here labelled Mb in response to evidence that it had no deciduous precursor (Sloan, personal communication, 1977).

## ACKNOWLEDGEMENTS

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## SYSTEMATICS

### Order **Multituberculata**

Suborder **Taeniolabidoidea** (Granger and Simpson, 1929)

Family **EUCOSMODONTIDAE** (Jepsen, 1940)

*Type* – *Eucosmodon* Matthew and Granger, 1921.

*Included Genera* – *Neoliotomus* Jepsen, 1930a; *Microcosmodon* Jepsen, 1930b; *Pentacosmodon* Jepsen, 1940; and *Stygimys* Sloan and Van Valen, 1965, from the Late Cretaceous through Early Eocene of North America. *Buginbaatar* Kielan-Jaworowska and Sochava, 1969; *Kryptobaatar* Kielan-Jaworowska, 1970; *Bulganbaatar* Kielan-Jaworowska, 1974a; and *Nemegtbaatar* Kielan-Jaworowska, 1974b, from the Late Cretaceous and possibly earliest Paleocene of Asia.

*Microcosmodon* and *Pentacosmodon* are closely related and differ considerably from the remainder of the Eucosmodontidae. These differences almost certainly represent a major phylogenetic division within the family that is recognized here by subfamilial separation. The Eucosmodontinae is resurrected in new usage to include eucosmodontids exclusive of *Microcosmodon* and *Pentacosmodon*, which are accommodated in the new subfamily described below.

Subfamily **MICROCOSMODONTINAE**, new subfamily

*Type* – *Microcosmodon* Jepsen, 1930b.

*Included Genera* – *Pentacosmodon* Jepsen, 1940.

*Diagnosis* – Small eucosmodontids with greatly enlarged  $I_1$  and reduced  $M_b$  thin enamel on labial surface of  $I_1$  persisting into adulthood;  $M_b$  shorter than  $M_1$  with five or six serrations and poorly developed lateral ridges; accessory roots common on  $M^1$  and  $M_1$ ; pterygoid fossa greatly expanded and excavated.

*Distribution* – Tiffanian of North America including Princeton Quarry (Jepsen, 1930b, 1940) and Schaff Quarry (Krause, MS), Polecate Bench Formation, Wyoming; Badwater Creek locality (Krishtalka *et al.*, 1975), Shotgun Butte Member, Fort Union Formation, Wyoming; Roche Percee local fauna (Krause, MS), Ravenscrag Formation, Saskatchewan; Circle local fauna (Russell, 1967), Tongue River Formation, Montana; Brisbane local fauna, Tongue River Formation, North Dakota.

*Comments* – Characters primitive for the family include enamel covering tip and much of labial side of  $I_1$ ; smooth arcuate profile and eight to nine serrations on  $M_b$  and molars with simple cusp structure and few, if any, accessory roots. Primitive characters retained by the microcosmodontines and not shared with the eucosmodontines include the relatively extensive enamel covering on  $I_1$  and the simple molar cusp structure. Derived characters shared only by the microcosmodontines are the small size overall, the small size of  $M_b$ , presence of accessory molar roots, and the large, deep pterygoid fossa.

This distribution of characters suggests a major phylogenetic division within the Eucosmodontidae. Because the incisors of the microcosmodontines are more primitive than any known eucosmodontine, the latest common ancestor must predate the earliest known eucosmodontines, which occur in the Coniacian or Santonian Djadokhta Formation of the Gobi Desert.

Kielan-Jaworowska (1974a) argues convincingly for an Asiatic origin of the eucosmodontids and their subsequent migration to North America, by way of a *Nemegtbaatar-Eucosmodon* lineage. Since the microcosmodontines are not derivable from the *Nemegtbaatar* lineage, it is probable that a distinct microcosmodontine lineage existed in Asia and migrated independently to North America.

Genus **Microcosmodon** Jepsen, 1930b

*Type* – *Microcosmodon conus* Jepsen, 1930b.

*Included Species* – *Microcosmodon woodi*, new species.

*Distribution* – As for subfamily.

*Revised Diagnosis* – I<sub>1</sub> greatly enlarged with enamel extending far up labial side and engulfing tip; M<sub>b</sub> reduced, with five or six serrations formed by lingual grooves intersecting a smooth, almost featureless, labial face; cusps on molars simple, largely lacking lateral grooves; little differentiation of cusps in internal row of M<sup>1</sup>; accessory roots common on M<sub>1</sub> and M<sup>1</sup>.

**Microcosmodon woodi**, new species

*Type* – Right M<sub>b</sub> MCZ 19963.

*Paratype* – Right M<sub>b</sub>, MCZ 19964.

*Type Locality* – New Anthill locality, anthill L, Shotgun Member, Fort Union Formation, Fremont County, Wyoming. (Precise geographic location on file at the Harvard Museum of Comparative Zoology.)

*Referred Specimens* – Right P<sup>4</sup>, UMVP 5938, SMM P77.8.1, SMM P77.8.2; right M<sup>1</sup>, SMM P77.8.6; left M<sup>1</sup>, SMM P77.8.7; right I<sub>1</sub>, SMM P77.8.3; left M<sub>b</sub>, SMM P77.8.4, SMM P77.8.5; right M<sub>b</sub>, UMVP 5001.

*Localities* – Circle locality, Tongue River Formation, NW1/4 Sec. 7, T.18N., R48E., McCone County, Montana; Brisbane locality, Tongue River Formation, NW1/4SW1/4SW1/4 Sec. 3, T.133N., R.86W., Grant County, North Dakota (see Figure 1).

*Etymology* – Named for Craig B. Wood, who collected the type and paratype.

*Diagnosis* – Differs from *M. conus* by the presence of a larger, longer, and lower M<sub>b</sub> that exhibits more distinct serrations, five or six in number, the first of which is set low on the apical crest.

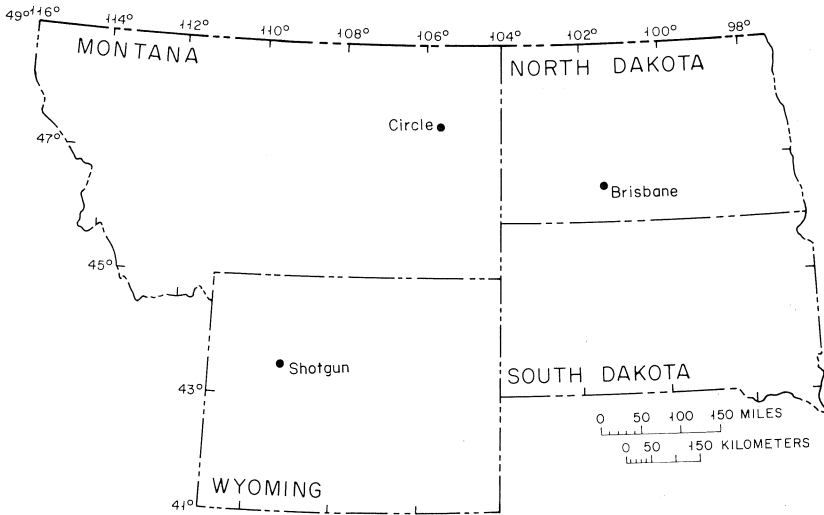


Figure 1

Local faunas from which *Microcosmodon woodi* is known.

*Description* –  $P^4$  cusp formula 2-3:4-5; cusps large, well-separated, with main cusp row arranged diagonally across crown (Figure 2.7); unworn cusps increase in height linearly with ultimate cusp highest (Figure 2.5); crown widest anteriorly on Brisbane specimens, posteriorly on Circle specimen; posterior region flattened, recumbent triangular area bearing a longitudinal groove in unworn state; wear consists of a broad abrasion surface on posterior face and a longitudinally striated facet on lingual face.

$M^1$  cusp formula 6:8:75); cusps conical to pyramidal; anteriormost three or four cusps of median row concave anteriorly; cusp sides only weakly grooved; internal cusp row ridge-like with indistinct cusps (Figure 2.8); entire crown concave ventrally; two or three accessory roots present between two major roots.

$I_1$  large, laterally compressed and tightly curved (Figure 2.9); medial side flattened except for shallow groove and ridge along inferior margin; enamel extends up about 80% of labial side of crown and engulfs the tip; small enamel ridge on superior labial margin extends back from tip about one third of crown; tip bearing small, horizontal wear facet; maximum diameter 1.9 mm; minimum diameter 1.0 mm.

$M_b$  bearing five or six well differentiated serrations in a low arc (Figures 2.1, 2.3, 2.4, and 2.6); posterior serrations cusp-like; all serrations formed by the intersection of deep lingual grooves with very flat labial surface (cf. Figures 2.1 and 2.2); first serration sharply defined and set low on apical crest; labial ridges weak or absent; exodaenodont lobe and posterolabial ledge reduced; anterior basal concavity suggests the presence of  $P_3$ ; roots subequal and joined by keel; triangular wear facet at posterior end of labial side bearing striations nearly parallel to a line through apices of last three serrations.

Measurements shown in Table 1.

TABLE 1. MEASUREMENTS OF *MICROCOSMODON WOODI*

Coll.	Number	Tooth	Length	Width	Cusps	Locality
UMVP	5938	$P^4$	2.2	0.9	2:4	Circle
SMM	P77.8.1	$P^4$	2.3	1.0	3:5	Brisbane
SMM	P77.8.2	$P^4$	2.1	0.9	3:4	Brisbane
SMM	P77.8.6	$M^1$	2.8	1.5	6:8:25	Brisbane
SMM	P77.8.7	$M^1$	2.9	1.5	6:8:25	Brisbane
MCZ	19963	$M_b$	3.2	1.1	6	Shotgun
MCZ	19964	$M_b$	3.1	1.0	5	Shotgun
UMVP	5001	$M_b$	3.1	1.1	6	Circle
SMM	P77.8.4	$M_b$	2.8	0.9	6	Brisbane

*Comments* – *M. woodi* had a wide geographic distribution in the early to middle Tiffanian, as shown in the distribution map, (Figure 1). At each locality, however, it was a relatively rare element in the mammalian community. In the middle to late Tiffanian *M. woodi* was replaced by *M. conus*, apparently occupying a similar niche and geographic range. The more primitive shape of  $M_b$  and relative size of  $M_b$  and  $I_1$  in *M. woodi*, together with its lower stratigraphic position, suggests that *M. woodi* may, in fact, be ancestral to *M. conus*. The absence of intermediate morphotypes is consistent with replacement by migration or by evolution in the style of punctuated equilibria (Eldredge and Gould, 1972), rather than by phyletic gradualism.

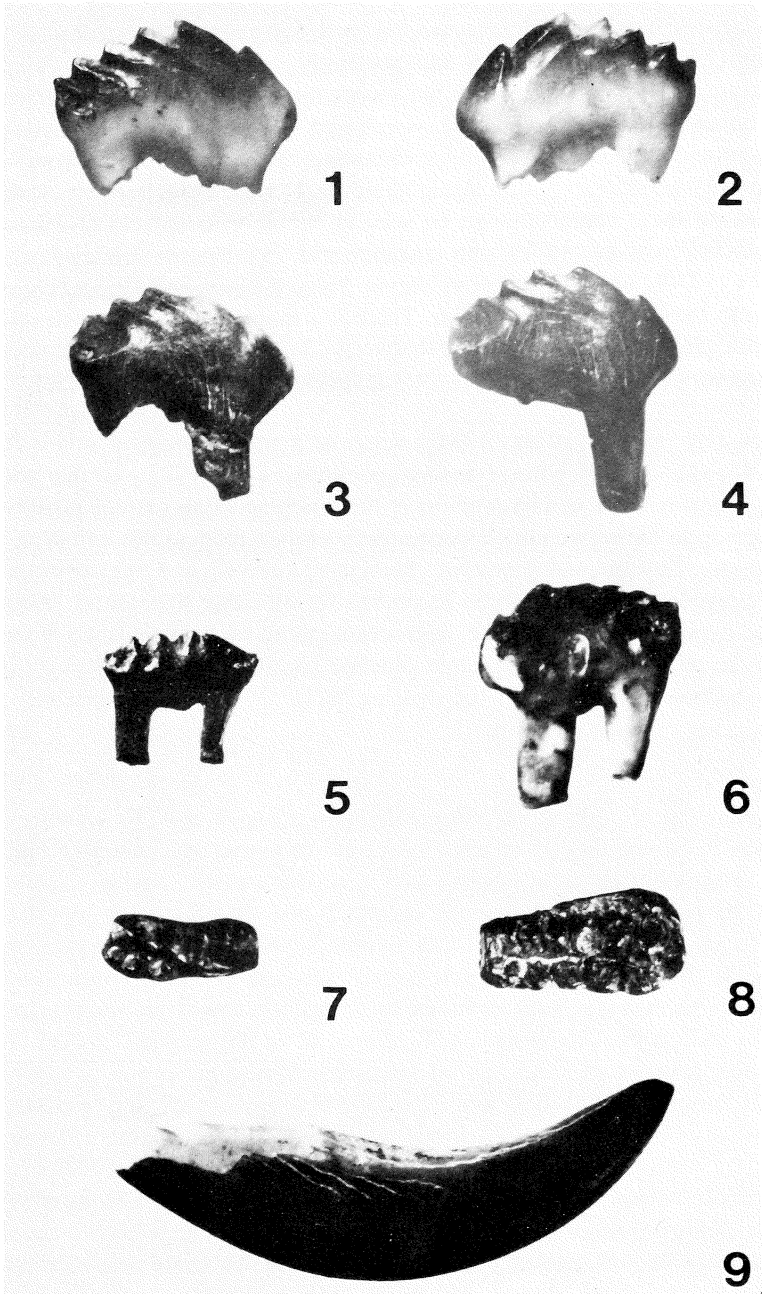
In contrast to *Pentacosmodon*, both species of *Microcosmodon* share an unusual serration morphology in  $M_b$ , which in both cases is probably to extreme to have given rise to the former genus. The latest common ancestor of the two genera, therefore, must predate *M. woodi*.



## DISCUSSION

Similarities between *Microcosmodon* and *Cimexomys* Sloan and Van Valen (1965) have been noted independently by the present authors and by Krause (MS). These include the morphology of  $M_b$  in *M. woodi* and the molar morphology in both *M. woodi* and *M. conus*. These similarities arise from the retention of primitive characters that occur commonly among the earliest ptilodontoids and taeniolabidoids. For example, various combinations of these characters can be seen in the neoplagiulacid *Gobiatarr* Kielan-Jaworowska (1970), the sloanbaatarid *Sloanbaatar* Kielan-Jaworowska (1970), and the eucosmodontids *Bulganbaatar* and *Kryptobaatar*, all from the Djadokhta Formation. There is, therefore, no reason to infer a close phylogenetic relationship between *Cimexomys* and the microcosmodontines.

Kielan-Jaworowska (1974a, 1974b) suggests a neoplagiulacid origin for the eucosmodontids. Sloan (personal communication, 1977), on the other hand, considers the variation amongst the late plagiulacoids adequate for that group to have given rise independently to the ptilodontoids and taeniolabidoids. The retained primitive characters observed in *Cimexomys* and the microcosmodontines can be accounted for by either hypotheses. Additional hypotheses deriving the microcosmodontines independently either from the ptilodontoids or plagiulacoids are possible, but would constitute complexities unwarranted by the existing data.



← Figure 2

- 1,2. Labial and lingual views of type specimen, MCZ 19963,  $RM_b$  from Shotgun.
  3. Labial view of paratype, MCZ 19964,  $RM_b$  from Shotgun.
  4. Labial view of UMVP 5001,  $RM_b$  from Circle.
  - 5,7. Labial and occlusal views of SMM P77.8.2,  $RP^4$  from Brisbane.
  6. Labial view of SMM P77.8.4,  $LM_b$  from Brisbane.
  8. Occlusal view of SMM P77.8.6,  $RM_b$  from Brisbane.
  9. Labial view of SMM P77.8.3,  $RI^1$  from Brisbane.
- All X10.

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