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REVISION OF THE WIND RIVER FAUNAS, EARLY EOCENE OF CENTRAL WYOMING. PART 1. INTRODUCTION AND MULTITUBERCULATA

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ABSTRACT

A P_4 and two molars of the neoplagiaulacid *Ectypodus* sp. cf. *E. childei* provide the first known occurrence of multituberculates in the Wind River Formation and in the late Wasatchian. The multituberculate localities (Deadman Butte and Viverravus) occur in sediments in the Deadman Butte area of the Wind River Basin and have also yielded a Lostcabinian mammalian fauna. These sediments represent a hitherto unrecognized lithological sequence of the Wind River Formation that is time equivalent to part of the Lysite and Lost Cabin Members.

INTRODUCTION: HISTORY OF INVESTIGATION

Fossil vertebrates were first found in sediments of the Wind River Formation in 1880 by Jacob L. Wortman, who was working in the northeastern part of the Wind River Basin for E. D. Cope (1880; see Tourtelot, 1948). Wortman's discovery of early Eocene fossil vertebrates confirmed the correlation of Wind River sediments with those of the Wasatch Eocene of northwestern New Mexico and southwestern Wyoming proposed on lithological grounds in 1878 by F. V. Hayden, who first described the "Wind River deposits" or "Wind River group" (Meek and Hayden, 1861).

Wortman made additional collections in the Wind River Formation

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in 1891 and 1896, but it was not until the early 1900's that Frederick B. Loomis of Amherst College and Walter Granger of the American Museum of Natural History made stratigraphically controlled collections of fossil vertebrates from these deposits. This work formed part of the nucleus for a series of papers that reviewed the systematics of many groups of North American early Cenozoic fossil vertebrates (Granger, 1908, 1910, 1915; Loomis, 1905, 1906, 1907; Matthew, 1910, 1915a, 1915b, 1915c, 1918; Matthew and Granger, 1915; Sinclair, 1914; Osborn and Wortman, 1892; Wortman, 1903, 1904) and resulted in the recognition of two distinct early Eocene faunal and lithological horizons. Sinclair and Granger (1911:104) named the lower horizon the "Lysite formation" and the upper horizon the "Lost Cabin formation." The faunal distinction was based on the absence of the perissodactyl genera *Lambdaotherium*, *Eotitanops*, and *Systemodon* (= *Homogalax*) in the Lysite Formation and the presence of *Lambdaotherium* and *Eotitanops* as well as absence of *Systemodon* in the Lost Cabin formation. Sinclair and Granger (1911:4) also summarized the geological differences between the two horizons. The Lysite formation sediments "comprise yellow, gray and brick-red shales or clays with interstratified buff, pale blue, yellow-brown and gray sandstones, dipping at a low angle away from the Bridger Range and passing beneath the bluish shales and gray and yellow sandstone with *Lambdaotherium* along Alkali Creek [lower boundary of the Lost Cabin formation]. These, in turn, lie *below* the red and blue banded beds, also with *Lambdaotherium*, forming the divide between Alkali and Poison Creeks north of Moneta. Throughout there is conformable superposition" (original emphasis in italics). It is evident from their discussion that, within the Lost Cabin formation, Sinclair and Granger recognized a lower unit dominated by gray-colored lithology as well as an upper unit dominated by variegated-colored lithology, each of which contained *Lambdaotherium*.

After 1918, collecting of fossil vertebrates from the Wind River Formation continued on almost a year by year basis (see Tourtelot, 1948; Guthrie, 1967, 1971). In 1941, Wood et al. indicated that the "Lysite member (or formation)" and the "Lost Cabin member (or formation)" were "valid, mappable lithologic unit(s)" of the "Wind River formation (or group)," but did not specifically state that these beds were exactly coincident with the faunal zones proposed earlier by Osborn (1929) and Wilmarth (1938). In a review of the fauna of the Wind River Formation Van Houten (1945) used the terms "Lysite" and "Lost Cabin" to refer to names of "beds" and "faunas." Tourtelot (1946, 1948, 1953), following Sinclair and Granger (1911), concluded that both the Lysite and Lost Cabin sediments should rank as members of the Wind

River Formation, and used the following criteria to distinguish between them: In the Lysite Member "1. Conglomerates . . . consist chiefly of debris from post-Cambrian Paleozoic rocks and locally contain some Mesozoic rock fragments. Pre-Cambrian rock fragments occur sporadically near the top of the member. 2. Brick-red and orange-red are the predominant colors in the variegated beds of the Lysite; violet shades are rare. 3. Variegated beds of the Lysite grade laterally into gray and drab-colored, fine-grained beds. 4. Sandstones contain only a little white mica and almost no black mica" (Tourtelot, 1948:57).

In the Lost Cabin Member "1. Conglomerates consist of debris from pre-Cambrian and Cambrian rocks. 2. The most prevalent red colors in the variegated beds are violet in shade; purple and purplish-red colors are common. 3. The variegated beds grade laterally into conspicuous gray and grayish-green beds of similar lithology. 4. Sandstones contain abundant black mica and some feldspar grains" (Tourtelot, 1948:60).

Subsequent workers in the Wind River Formation have recognized Tourtelot's distinctions between the Lysite and Lost Cabin Members (for example, Woodward, 1957; Keefer, 1965*a*; Guthrie, 1967, 1971; Love, 1978; and this paper). Lewis and Gazin (*in* Tourtelot, 1953) and Van Houten (1945) also confirmed the faunal distinctions established between the two members by Sinclair and Granger (1911). Kelley and Wood (1954) added new taxa to the mammalian fauna of the Lysite Member and discussed the utility of these taxa in biostratigraphic correlation. Keefer (1965*a*, 1965*b*, 1970) described the stratigraphy and structural geology of the Wind River Basin and Guthrie (1967, 1971) reconfirmed the distinct nature of the faunas from the Lysite and Lost Cabin Members. He also noted that he had recovered a tooth fragment of *Lambdaotherium* from "the upper part of the beds of Lysite lithology" (Guthrie, 1967:4).

Although no systematic review of the faunas from the Wind River Formation has been published since Guthrie's review, intensive paleontological collecting has proceeded in the Badwater Creek area of the Wind River Basin from 1968 to the present. Carnegie Museum of Natural History field parties led by Craig C. Black, Mary R. Dawson and, most recently, the junior author, have recovered the largest known assemblage of fossil vertebrates from the Wind River Formation, as well as significant collections from the Paleocene Fort Union Formation (Krishtalka et al., 1975), the series of Uintan and Duchesnean localities in the Hendry Ranch deposits (=Wagon Bed Formation, J. D. Love, personal communication, 1980; Lageson, 1980; Black and Dawson, 1966, and other papers in this series) and the Oligocene White River Formation (Setoguchi, 1978). This paper is the first part

of a comprehensive review of the geology, paleontology, and paleoecology of the Wind River Formation, and deals exclusively with a preliminary geological and paleontological assessment of the deposits in the Deadman Butte area as well as the systematics of the multituberculate remains recovered from the Deadman Butte and *Viverravus* localities. The geology of the Wind River Formation in the Badwater Creek and surrounding areas is currently under study (William W. Korth, University of Pittsburgh, in preparation) as are the systematics, relationships, and biostratigraphic implications of taxa recovered from these deposits.

PRELIMINARY GEOLOGY OF THE WIND RIVER FORMATION, DEADMAN BUTTE AREA

The Deadman Butte area is defined as the area of Wind River Formation exposures to the west of E-K Creek in Section 22, Township 38N, Range 87W, Natrona County, Wyoming. Sediments of the Wind River Formation are well exposed on both sides of a ridge that extends to the south into Section 34, Township 38N, Range 87W. These exposures lie in the extreme northeastern corner of the Wind River Basin (Fig. 1, see also Plate 1, Keefer, 1965*a*). Sediments of the Wind River Formation in this area strike nearly parallel to Dry Fork Fault (Tourtelot, 1953). These sediments are flat lying at the Deadman Butte (UCM V-80062) and *Viverravus* (UCM V-81008) localities. However, a monocline is developed to the south of these localities where dip is 10° South. En echelon faults of minor displacement (less than 10 m) trend parallel to Dry Fork Fault along the southern margin of the monocline. Stratigraphic relations of the Lysite and Lost Cabin Members of the Wind River Formation recognized in the Badwater area (Granger, 1910; Sinclair and Granger, 1911; Tourtelot, 1948; Keefer, 1965*a*; Love, 1978), cannot be applied with certainty to the sediments of the Wind River Formation in the Deadman Butte area. Tourtelot (1953) and Woodward (1957) did not distinguish the two members in this area, nor did they describe in detail the lithology of the sediments. Both authors, however, found fossil vertebrates near what is here named the Deadman Butte locality. Although Keefer (1965*a*) mapped the Lysite and Lost Cabin Members on the western flank of the Casper Arch and accepted Tourtelot's (1953) mapping of these members in the Badwater area, he did not map the intervening sediments in the Deadman Butte area and along Red Creek.

Geologic work conducted during 1979, 1980, and 1981 has clarified the relative stratigraphic positions of the Deadman Butte and *Viverravus* localities and the stratigraphic and lithologic relations of sediments of the Wind River Formation in the Deadman Butte area. Two

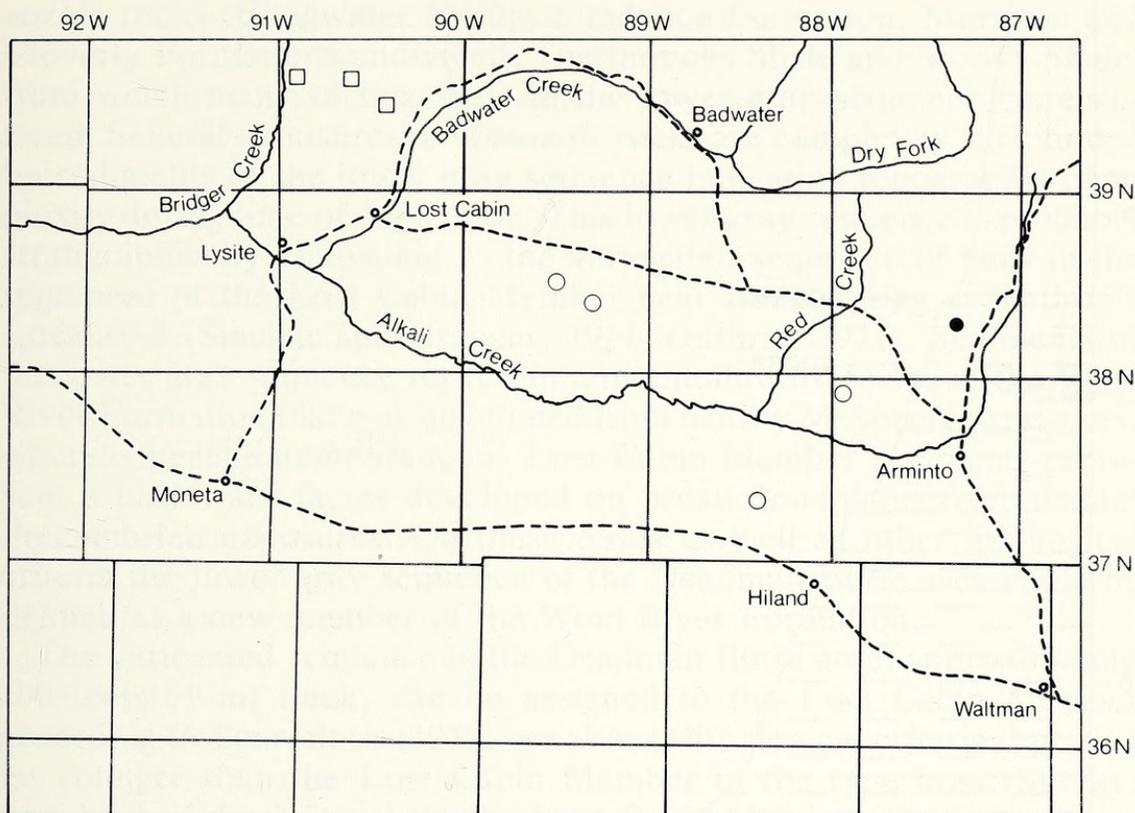


Fig. 1.—Sketch map of type area of the Lysite and Lost Cabin Members, Wind River Formation, Wyoming, showing localities in the Lysite Member (open squares), Lost Cabin Member (open circles), and the Deadman Butte and Viverravus localities (black circle). Modified from Guthrie (1971:49, Fig. 1).

lithostratigraphic sequences can be mapped in this area: 1) a lower gray sequence characterized by tuffaceous medium light gray to light olive brown mudstones and claystones and yellowish gray to grayish yellow sandstones that contain lenticular well-defined conglomerates derived from predominantly Mesozoic rocks; and 2) an overlying variegated sequence characterized by alternating red and drab mudstones, yellow-brown shoestring channel sandstones, and conglomerates with clasts derived from Precambrian rocks. The lower gray sequence, varying in thickness from a wedge edge to 120 feet (37 m), cannot be assigned to any member of the Wind River Formation; it differs lithologically from the gray unit of the Lost Cabin Member of Sinclair and Granger (1911) in the presence of predominantly Mesozoic as opposed to Precambrian clasts in conglomerates and sandstones and in its tuffaceous nature. This lower gray sequence differs from the Lysite Member in these attributes and in the lack of any red colored sediments. The lower gray sequence was deposited unconformably on top of Me-

sozoic rocks (Chugwater Group, Sundance Formation, Morrison and Cloverly Formations undivided, Thermopolis Shale and Mowry Shale) from which many of the clasts in the lower gray sequence were derived. Several exposures of Mesozoic rocks are completely surrounded by sediments of the lower gray sequence indicating topographic complexity during time of deposition. This lower gray sequence is probably stratigraphically equivalent to the variegated sequence of beds in the type area of the Lost Cabin Member near Buck Spring at Guthrie's Locality 3 (Sinclair and Granger, 1911; Guthrie, 1971). Sediments of the lower gray sequence represent a mountainward facies of the Wind River Formation that was developed from nearby Mesozoic exposures, whereas penecontemporaneous Lost Cabin Member sediments represent a basinward facies developed on broad floodplains from distant Precambrian exposures. On these bases as well as other lithological criteria the lower gray sequence of the Deadman Butte area could be defined as a new member of the Wind River Formation.

The variegated sequence in the Deadman Butte area, approximately 200 feet (61 m) thick, can be assigned to the Lost Cabin Member according to Tourtelot's (1948; see above) lithological criteria, but may be younger than the Lost Cabin Member in the type area (Stucky, unpublished data). As such, the Lost Cabin Member in the type area, the lower gray sequence in the Deadman Butte area, and the upper part of the Lysite Member (see Guthrie, 1967) may be time equivalent, and appear to represent sediments derived from different source areas deposited in an area of early Eocene topographic variability along the front of the Bighorn and Owl Creek Mountains.

The Deadman Butte (UCM V-80062) and Viverravus (UCM V-81008) localities differ in stratigraphic position but are nearly identical in lithology (Fig. 2). Both localities preserve a late Wasatchian fauna as indicated by the presence of *Lambotherium popoagicum* at each locality (Table 1). The Deadman Butte and Viverravus localities lie 62 feet (19 m) and 132 feet (38 m), respectively, below the lowermost sandstone of Lost Cabin Member lithology (see Fig. 2). Both localities are developed in yellowish gray to grayish yellow well-sorted fine to medium grained quartz arenites that are typical of the lower gray sequence. These sandstones are indurated and vertically weathering. Lenticular conglomerates with clasts derived from Mesozoic rocks are

←

aspect (sensu Tourtelot, 1948, see text). Vertical scale in feet. Key to lithologies of stratigraphic horizons: small circles indicate conglomerates; dots indicate sandstones; dashed lines indicate mudstones and siltstones; horizontal lines indicate carbonaceous shales; and blank horizons indicate claystones.

Table 1.—Preliminary mammalian faunal list, Deadman Butte (UCM V-80062) and Viverravus (UCM V-81008) localities, Natrona County, Wyoming.

Taxa	UCM V-80062	UCM V-81008
Multituberculata		
<i>Ectypodus</i> sp. cf. <i>E. childei</i>	X	X
Marsupicarnivora		
<i>Peratherium comstocki</i>	X	
<i>Peratherium</i> sp.	X	X
Proteutheria		
Palaeoryctid sp.	X	
<i>Didelphodus</i> sp.	X	
<i>Palaeictops</i> sp.	X	
<i>Apatemys</i> sp.	X	
Insectivora		
<i>Scenopagus edenensis</i>	X	X
<i>Scenopagus priscus</i>	X	
<i>Macrocranion</i> sp.	X	
<i>Talpavus</i> sp.	X	
<i>Nyctitherium</i> sp.	X	
<i>Centetodon</i> sp.	X	
Chiroptera		
Chiropteran sp.		X
Primates		
<i>Phenacolemur</i> sp.	X	X
<i>Microsyops</i> sp.	X	X
cf. <i>Niptomomys</i> sp.	X	
<i>Pelycodus</i> sp.	X	X
<i>Absarokius</i> sp.	X	
<i>Shoshonius</i> sp.	X	
<i>Loveina</i> sp.	X	X
Carnivora		
<i>Viverravus</i> sp. A (small)		X
<i>Viverravus</i> sp. B (large)		X
Miacid sp.	X	X
Creodonta		
unidentified sp.	X	
Tillodontia		
<i>Esthonyx</i> sp.	X	
Condylarthra		
<i>Hyopsodus</i> sp.	X	X
<i>Phenacodus</i> sp. A (small)	X	X
<i>Phenacodus</i> sp. B (large)	X	X

Table 1.—Continued.

Taxa	UCM V-80062	UCM V-81008
Pantodonta		
<i>Coryphodon</i> sp.		X
Perissodactyla		
<i>Hyracotherium</i> sp.	X	X
<i>Lambdaotherium popoagicum</i>	X	X
<i>Heptodon</i> sp.	X	
<i>Selenaletes</i> sp.	X	
Artiodactyla		
<i>Diacodexis</i> sp.	X	X
cf. <i>Bunophorus</i> sp.	X	X
Rodentia*		
Ischyromyidae sps.	X	X
Sciuravidae sps.	X	X
<i>Paramys excavatus</i>	X	
<i>Paramys copei</i>	X	
" <i>Paramys</i> " <i>francesi</i>	X	
<i>Microparamys</i> sp.	X	
" <i>Mysops</i> " <i>kalicola</i>	X	
<i>Knightomys depressus</i>	X	
<i>Knightomys huerfanensis</i>	X	
<i>Pauromys</i> sp.	X	

* Rodents from the Deadman Butte locality were identified by William W. Korth of the Carnegie Museum of Natural History (personal communication, 1981).

enclosed within the sandstones. Lower contacts of these fossiliferous horizons are not exposed at either locality, however, upper contacts with mudstones are sharp. Sediments at the Viverravus locality were apparently subaerially exposed, as the upper part of the fossiliferous sandstone unit contains rhizoliths and pedotubules that resemble invertebrate burrows. These sedimentary structures are not preserved at the Deadman Butte locality.

Fossil vertebrates are randomly distributed throughout the sandstone bodies, but are less common in conglomerates. The most common elements are isolated teeth of mammals. Although data is limited, observations of *in situ* individual bones indicates that the probability of nearest neighbor bone element and taxa are equal to their frequencies of occurrence in the entire bone assemblage; no elements of the same individual are apparently associated. Most likely, the fossil assemblages were fluviially transported prior to burial in a stream system with high variation in stream competence as indicated by rock frag-

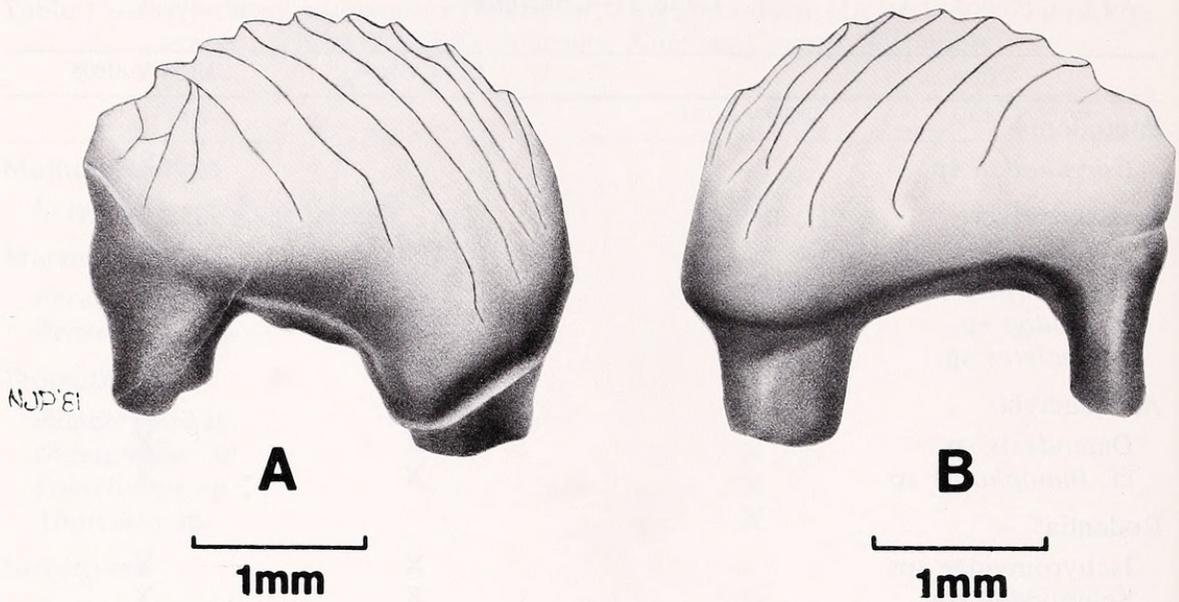


Fig. 3.—Labial (A) and lingual (B) views of UCM 46256, RP₄ of *Ectypodus* sp. cf. *E. childei*, from the late Wasatchian Viverravus locality, Wind River Formation, Wyoming.

ment size and size of individual bone elements (small rodent to large ungulate sized teeth). Fossils were recovered from each locality by surface prospecting and underwater screen washing (minimum Tyler screen size 35).

SYSTEMATICS

Order Multituberculata

Suborder Ptilodontoidea

Family Neoplagiaulacidae Ameghino, 1890

Eocene neoplagiaulacids are known in North America from the early Wasatchian of Wyoming, Colorado, and North Dakota (McKenna, 1960; Delson, 1971; West, 1973; Bown, 1979; Krishtalka, 1982; Krause, 1982), three Bridgerian and early Uintan localities (M. C. McKenna, J. Eaton, personal communication, 1979), and from late Uintan and Duchesnean sediments of Wyoming and Montana (Sloan, 1966; Krishtalka and Black, 1975). Described species include *Ectypodus tardus*, *Ectypodus* sp. cf. *E. childei*, *Parectypodus simpsoni*, *Parectypodus* n. sp. (Wasatchian), and *Ectypodus lovei* and *Ectypodus* sp. (late Uintan-Duchesnean), two species that also occur in Chadronian deposits and comprise the youngest known record of multituberculates (Krishtalka et al., 1982). The taxonomic affinities of the Bridgerian-early Uintan material is currently under study. If middle and late Clarkforkian records represent Eocene occurrences (Krause, 1980), *Parectypodus laytoni* and *Ectypodus powelli* should be added to this

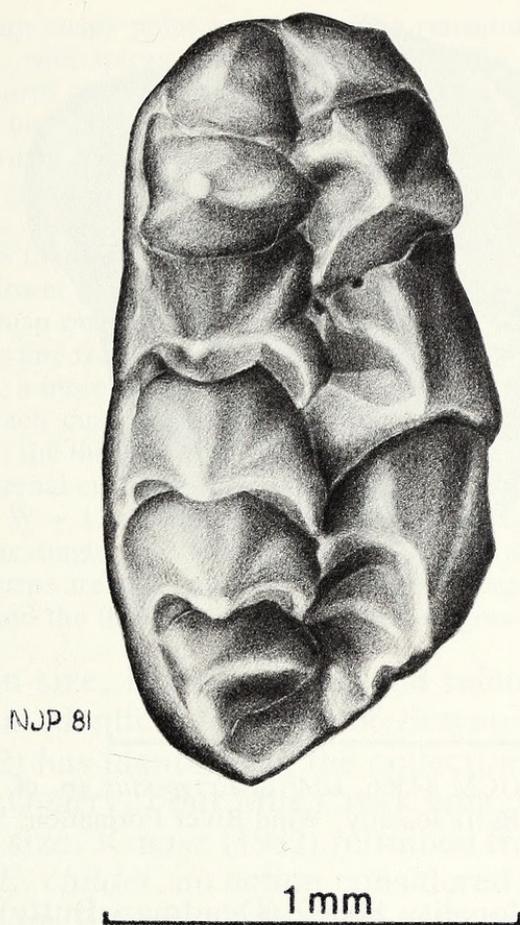


Fig. 4.—Occlusal view of UCM 44565, LM₁ of *Ectypodus* sp. cf. *E. childei*, from the late Wasatchian Deadman Butte locality, Wind River Formation, Wyoming.

summary. *E. powelli* may (Krishtalka, 1982) or may not (Krause, 1980, 1982) be conspecific with *E. tardus*. The Wasatchian neoplagiaulacid taxa *Parectypodus* n. sp. and *Ectypodus* sp. cf. *E. childei* mentioned above are currently being described by D. W. Krause (1982) in a review of Wasatchian multituberculates. *E. childei* has recently been recognized (Godinot, 1981) as a senior synonym of *Charlesmooria childei* Kuhne, 1969, from the Wasatchian Abbey Wood locality, England, an action with which Krishtalka (1982) and Krause (1982) concur.

All measurements listed below are in millimeters.

Ectypodus Matthew and Granger, 1921

Ectypodus sp. cf. *E. childei*

(Figs. 3, 4, 5)

Material.—UCM (University of Colorado Museum) 46256, P₄; UCM 44565, M₁; UCM 44566, M².

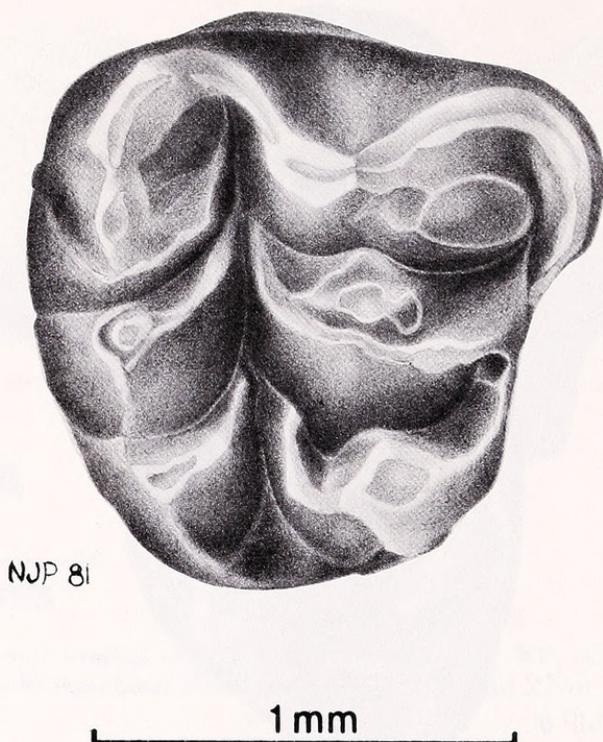


Fig. 5.—Occlusal view of UCM 44566, LM² of *Ectypodus* sp. cf. *E. childei*, from the late Wasatchian Deadman Butte locality, Wind River Formation, Wyoming.

Localities.—UCM locality 80062 (Deadman Butte) and 81008 (Viverravus), Wind River Formation, Wyoming.

Description.—P₄ [L (length) = 3.1] has nine serrations, of which the third is highest above the line for standard length. The relative height of the first serration—a diagnostic feature among neoplagiaulacids (Sloan, 1966; Krause, 1982; Krishtalka, 1982)—is 0.41. In labial profile the blade is higher anteriorly than posteriorly and is convex from the first to sixth serrations and more nearly straight from the latter to the last serration. The serrations become progressively more robust posteriorly; the last serration is especially large. The anterior edge of the blade between the anterobasal concavity and the first serration is straight, except for a slight flexure at a point one-third of the distance below the first serration. There is no appreciable overhang of enamel above the anterior root and the anterobasal concavity is extremely shallow. The anterior root bears a faint vertical groove on its anterior face. Each of the first eight serrations gives rise to a labial ridge, of which the second is weakest, and the sixth, longest. Two short posteroventral ridges arise from the eighth serration, and one from the last serration. These end in an area of wrinkled enamel above the posterolabial ledge. Lingually, the ridges from the first, and fourth to eighth serrations are strong, whereas that from the third is weak, and the one from the second is barely discernable. There are no discrete lingual posteroventral ridges, although the enamel is slightly wrinkled below the last serration.

The M₁ [L = 1.75; W (width) = 0.9] has a cusp formula of 6:4. The crown is rectangular in occlusal outline with slightly convex external and internal margins that diverge posteriorly to the level of the fifth external cusp. At this point the crown is widest and the external margin begins to curve posterointernally. The external row of cusps extends posteriorly beyond the internal one, so that the posterior margin of the crown is oblique. The first external cusp is small and conical, the second is larger and semi-pyramidal,

and the apices of both cusps point vertically. The remaining four external cusps are larger, subcrescentic, with apices directed posteriorly. The third cusp is slightly taller than the subequal fourth and fifth; the bases of the third and fourth cusps are longer than that of the fifth, but shorter than that of the sixth. The sixth external cusp appears structurally to be formed by the union of two cusps; its external face is smooth and long, but its internal face is divided by a deep vertical excavation that extends dorsally and faintly interrupts the elongate occlusal crest of the cusp into barely perceptible apices. In medial view then, the sixth cusp consists of an anterior cusp with a posteriorly directed apex and a lower posterior cusp with an anteriorly directed apex.

The first internal cusp on the M_1 is small and conical, whereas the remaining three are subcrescentic. A cline from the second to fourth internal cusps involves larger size, longer anterior slope, a more posteriorly directed apex and a deeper vertical groove on the medial face of each cusp. In occlusal view the first two cusps of each row are opposite one another, the third and fourth external cusps are opposite the third internal one, and the fifth external cusp is opposite the last internal one.

The M^2 ($L = 1.3$; $W = 1.3$; cusp formula 1:3:3) is triangular in occlusal view and moderately worn. The single anteroexternal cusp is small and ledge-like, whereas the medial and internal cusps are subcrescentic. The second cusp in the middle row is larger than the other two, and the three internal cusps are progressively smaller posteriorly.

Discussion.—In size, lateral profile, and relative height of the first serration the P_4 is identical to those of *Ectypodus* sp. cf. *E. childei* that Krause (1982) has identified in the collections from the early Wasatchian Despair Quarry, Four Mile Creek area, Colorado. Because of the small sample size, Krause (1982) refrained from referring the Four Mile material to *E. childei*, an action considered prudent and followed here for the P_4 from Viverravus locality and the two molars from the Deadman Butte locality. Godinot (1981) was similarly cautious in referring fragmentary material from the early Eocene of Rians, France to *Ectypodus* aff. *childei*.

UCM 46256 has nine serrations, whereas the P_4 s of *E. childei* ($n = 2$) from Abbey Wood and *Ectypodus* sp. cf. *E. childei* ($n = 4$) from Four Mile have eleven—a range of variation that is common for P_4 s of neoplagiaulacid species. On the other hand, a greater sample of P_4 s from these localities showing a consistently bimodal distribution in serration number may indicate that the late Wasatchian species of *Ectypodus* from the Wind River Basin is specifically distinct from the early Wasatchian *E. childei* and *Ectypodus* sp. cf. *E. childei*. In either case, the species of *Ectypodus* represented by the P_4 described here is very closely related to *E. childei*. P_4 s of the latter and *Ectypodus* sp. cf. *E. childei* have a higher lateral profile and a higher first serration than those of *E. tardus*, and a lower posterior profile than a recently recovered P_4 of the late Eocene *Ectypodus* sp.

The two molars from the Deadman Butte locality closely resemble those of a number of species of neoplagiaulacids described from Eocene and early Oligocene horizons—species of *Ectypodus* and *Parctypodus* that are recognized and differentiated by the morphology

of the last premolars rather than the molars. Isolated neoplagiaulacid molars are in general very difficult to identify to generic, much less specific, level; those of certain species of *Ectypodus* and *Parectypodus* (Krause, 1982) are virtually identical. Among known Eocene neoplagiaulacids, the Deadman Butte material bears comparison to molars of *E. tardus*, *E. lovei*, *Ectypodus* sp., and *Parectypodus* n. sp. Unfortunately, molars of *Ectypodus* sp. cf. *E. childei* are not known (Krause, 1982); those of *P. simpsoni* are much larger.

The M_1 is slightly longer than that of *E. lovei* ($L = 1.4-1.6$; $W = 0.8-1.0$; Krishtalka and Black, 1975), barely shorter than that of *Parectypodus* n. sp. ($L = 1.8-2.2$; $W = 0.9-1.1$; Krause, 1982), and within the range in size of M_1 of *E. tardus* ($L = 1.6-1.9$; $W = 0.7-0.9$; Krause, 1982) and *Ectypodus* sp. ($L = 1.6-1.95$; $W = 0.9-1.2$; Krishtalka and Black, 1975). The cusp formula of 6:4 agrees with that of *E. lovei* (6:4) and *Parectypodus* n. sp. (6-8:4) and is not significantly different from those of *E. tardus* (7-8:4-5) or *Ectypodus* sp. (7-8:4). A finer measure of taxonomic affinity of M_1 may be its length/width ratio and crown outline. M_1 s of late Eocene *E. lovei* ($L/W = 1.67-1.75$, mean = 1.68, $n = 6$) and *Ectypodus* sp. ($L/W = 1.6-1.8$, mean = 1.68, $n = 8$) have a lower length/width ratio than those undoubtedly assigned to *E. tardus* (Krause, 1982; $L/W = 1.89-2.43$, mean = 2.17, $n = 4$) and *Parectypodus* n. sp. (Krause, 1982; $L/W = 1.91$, $n = 1$) as well as a more oval outline; the lateral margins of the crown are more nearly convex than straight and diverge posteriorly for much of the length of the crown. M_1 s of *E. tardus* and *Parectypodus* n. sp. have comparatively more nearly straight and parallel borders. The M_1 from Deadman Butte, with a length/width ratio of 1.94 and a somewhat oval outline, is intermediate in these features between that of late Eocene species of *Ectypodus* and early Eocene *E. tardus*, but does not differ significantly in length/width ratio from that of *Parectypodus* n. sp.

M^2 is less diagnostic than is M_1 of specific neoplagiaulacid affinities. The M^2 from Deadman Butte is larger than described M^2 s of *E. tardus* and *E. lovei*, closer in size to that of *Ectypodus* sp., and equal in length to the only known (and broken) M^2 of *Parectypodus* n. sp. (Krause, 1982). Its cusp formula of 1:3:3 is the same as that of M^2 of all of these species.

The molars from Deadman Butte are referred, tentatively, to *Ectypodus* sp. cf. *E. childei*, the neoplagiaulacid represented by a single P_4 from the Viverravus locality. Two observations make this assignment plausible: 1) the relative size of the three teeth described here is, at least, not inconsistent with that of P_4 , M_1 , and M^2 of other species of *Ectypodus*; 2) both P_4 and M_1 from the Deadman Butte area are morphologically intermediate between those of early Eocene *E. tardus* and late Eocene species of *Ectypodus*.

SUMMARY AND CONCLUSIONS

The Deadman Butte and Viverravus localities occur in a hitherto unrecognized lithostratigraphic unit of the Wind River Formation exposed in the Deadman Butte area of the Wind River Basin. This "lower gray sequence" is lithologically distinct from any named member of the Wind River Formation, as they are currently defined, and underlies sediments attributable to the Lost Cabin Member of that formation. The mammalian fauna from the Deadman Butte and Viverravus localities are Lostcabinian (late Wasatchian), as they resemble the fauna derived from localities in the Lost Cabin Member of the Wind River Formation (Guthrie, 1971) and, specifically, as is indicated by the presence of *Lambdaotherium popoagicum*.

Three neoplagiaulacid teeth—a P_4 from the Viverravus locality, and an M_1 and M^2 from the Deadman Butte locality—represent the first known record of multituberculates from the late Wasatchian. This is not an unexpected occurrence, given the presence of neoplagiaulacids in early Wasatchian as well as Bridgerian through Chadronian deposits in North America. Underwater screening of fossiliferous sediments from known and new Eocene and Oligocene localities will undoubtedly result in the recovery of more multituberculate remains and a less biased understanding of multituberculate diversity and evolution during the middle and late early Tertiary.

The premolar and, more tentatively, the molars are assigned to *Ectypodus* sp. cf. *E. childei*, a species recently described from the early Wasatchian Four Mile Fauna, Colorado (Krause, 1982), but, with recovery of additional remains, they may prove to represent a new species of *Ectypodus*. The P_4 and M_1 are distinct from and morphologically intermediate between early Wasatchian *E. tardus* and Uintan-Duschesnean species of *Ectypodus* in a number of taxonomically significant character states.

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LITERATURE CITED

- AMEGHINO, F. 1890. Los plagiaulacideos argentinos y sus relaciones zoológicas, geológicas y geográficas. Bol. Instituto Geográfico Argentino, 9:143–201.

- BLACK, C. C., AND M. R. DAWSON. 1966. Paleontology and geology of the Badwater Creek area, central Wyoming. Part 1. History of field work and geological setting. *Ann. Carnegie Mus.*, 38:297-307.
- BOWN, T. M. 1979. Geology and mammalian paleontology of the Sand Creek facies, lower Willwood Formation (Lower Eocene), Washakie County, Wyoming. *Mem. Geol. Survey Wyoming*, 2:1-151.
- COPE, E. D. 1880. The bad lands of the Wind River and their fauna. *Amer. Nat.*, 14:745-748.
- DELSON, E. 1971. Fossil mammals of the early Wasatchian Powder River local fauna, Eocene of northeast Wyoming. *Bull. Amer. Mus. Nat. Hist.*, 146:309-364.
- GODINOT, M. 1981. Les mammifères de Rians (Éocène Inférieur, Provence). *Palaeo-vertebrata*, 10 (2): 43-126.
- GRANGER, W. 1908. A revision of the American Eocene horses. *Bull. Amer. Mus. Nat. Hist.*, 24:221-264.
- . 1910. Tertiary faunal horizons in the Wind River Basin, Wyoming, with descriptions of new Eocene mammals. *Bull. Amer. Mus. Nat. Hist.*, 28:235-251.
- . 1915. A revision of the lower Eocene Wasatch and Wind River faunas. Part 3. Order Condylarthra, Families Phenacodontidae and Meniscotheriidae. *Bull. Amer. Mus. Nat. Hist.*, 34:329-361.
- GUTHRIE, D. A. 1967. The mammalian fauna of the Lysite Member, Wind River Formation, (early Eocene) of Wyoming. *Mem. Southern California Acad. Sci.*, 5:1-52.
- . 1971. The mammalian fauna of the Lost Cabin Member, Wind River Formation, (Lower Eocene) of Wyoming. *Ann. Carnegie Mus.*, 43:47-113.
- HAYDEN, F. V. 1878. Wasatch group. *Amer. Nat.*, 12:831.
- KEEFER, W. R. 1965*a*. Stratigraphy and geological history of the uppermost Cretaceous, Paleocene, and Lower Eocene rocks in the Wind River Basin, Wyoming. *U.S. Geol. Survey Prof. Paper*, 495A:A1-A77.
- . 1965*b*. Geologic history of the Wind River Basin, central Wyoming. *Bull. Amer. Assoc. Petrol. Geol.*, 49:1878-1892.
- . 1970. Structural geology of the Wind River Basin, Wyoming. *U.S. Geol. Survey Prof. Paper*, 495D:D1-D35.
- KELLEY, D. R., AND A. E. WOOD. 1954. The Eocene mammals from the Lysite Member, Wind River Formation of Wyoming. *J. Paleont.*, 28:337-366.
- KRAUSE, D. W. 1980. Multituberculates from the Clarkforkian Land-Mammal Age, late Paleocene-early Eocene, of western North America. *J. Paleont.*, 54:1163-1183.
- . 1982. Multituberculates from the Wasatchian Land-Mammal Age, early Eocene, of western North America. *J. Paleont.*, in press.
- KRISHTALKA, L. 1982. Early Eocene multituberculates (Mammalia: Allotheria) from the Bighorn Basin, Wyoming. *Special Publ., Carnegie Mus. Nat. Hist.*, in press.
- KRISHTALKA, L., AND C. C. BLACK. 1975. Paleontology and geology of the Badwater Creek area, central Wyoming. Part 12. Description and review of late Eocene Multituberculata from Wyoming and Montana. *Ann. Carnegie Mus.*, 45:287-297.
- KRISHTALKA, L., C. C. BLACK, AND D. W. RIEDEL. 1975. Paleontology and geology of the Badwater Creek area, central Wyoming. Part 10. A late Paleocene mammal fauna from the Shotgun Member of the Fort Union Formation. *Ann. Carnegie Mus.*, 45:179-212.
- KRISHTALKA, L., R. J. EMRY, J. E. STORER, AND J. F. SUTTON. 1982. Oligocene multituberculates: youngest known record. *J. Paleont.*, in press.
- KUHNE, W. G. 1969. A multituberculate from the Eocene of the London Basin. *Proc. Geol. Soc. London*, 1658:199-202.
- LAGESON, D. R. 1980. Geology, Natrona County, Wyoming. *County Resource Series*, No. 6 (CRS-6). Geological Survey of Wyoming.

- LOOMIS, F. B. 1905. Hyopsodidae of the Wasatch and Wind River Basins. *Amer. J. Sci.*, 19:416-424.
- . 1906. Wasatch and Wind River primates. *Amer. J. Sci.*, 21:277-285.
- . 1907. Wasatch and Wind River rodents. *Amer. J. Sci.*, 23:123-130.
- LOVE, J. D. 1978. Cenozoic thrust and normal faulting, and tectonic history of the Badwater area, northeastern margin of Wind River Basin, Wyoming. Thirteenth Ann. Field Conf.—1978 Wyoming Geol. Assoc. Guidebook, 13:235-238.
- MATTHEW, W. D. 1910. On the osteology and relationships of *Paramys* and the affinities of the Ischyromyidae. *Bull. Amer. Mus. Nat. Hist.*, 9:43-71.
- . 1915a. A revision of the Lower Eocene Wasatch and Wind River faunas. Part 1. Order Ferae (Carnivora), Suborder Creodonta. *Bull. Amer. Mus. Nat. Hist.*, 34:4-103.
- . 1915b. A revision of the Lower Eocene Wasatch and Wind River faunas. Part 2. Order Condylarthra, Family Hyopsodontidae. *Bull. Amer. Mus. Nat. Hist.*, 34:311-328.
- . 1915c. A revision of the Lower Eocene Wasatch and Wind River faunas. Part 4. Entelonychia, Primates, Insectivora (part). *Bull. Amer. Mus. Nat. Hist.*, 34:429-483.
- . 1918. A revision of the Lower Eocene Wasatch and Wind River faunas. Part 5. Insectivora (part), Glires, Edentata. *Bull. Amer. Mus. Nat. Hist.*, 38:565-657.
- MATTHEW, W. D., AND W. GRANGER. 1918. A revision of the Lower Eocene Wasatch and Wind River faunas. *Bull. Amer. Mus. Nat. Hist.*, 34:1-4.
- . 1921. New genera of Paleocene mammals. *Amer. Mus. Novitates*, 13:1-7.
- MCKENNA, M. C. 1960. Fossil Mammalia from the early Wasatchian Four Mile local fauna, Eocene of northwest Colorado. *Univ. California Publ., Geol. Sci.*, 37:1-130.
- MEEK, F. B., AND F. V. HAYDEN. 1861. Descriptions of new Lower Silurian (Primordial), Jurassic, Cretaceous, and Tertiary fossils, collected in Nebraska Territory, with some remarks on the rocks from which they were obtained. *Proc. Acad. Nat. Sci. Philadelphia*, 13:415-448.
- OSBORN, H. F. 1929. The titanotheres of ancient Wyoming, Dakota and Nebraska. *U.S. Geol. Survey Monogr.*, 55:1-701.
- OSBORN, H. F., AND J. L. WORTMAN. 1892. Fossil mammals of the Wasatch and Wind River beds, collection of 1891. *Bull. Amer. Mus. Nat. Hist.*, 4:80-147.
- SETOGUCHI, T. 1978. Paleontology and geology of the Badwater Creek area, central Wyoming. Part 16. The Cedar Ridge local fauna (late Oligocene). *Bull. Carnegie Mus. Nat. Hist.*, 9:1-61.
- SINCLAIR, W. J. 1914. A revision of the bunodont Artiodactyla of the Middle and Lower Eocene of North America. *Bull. Amer. Mus. Nat. Hist.*, 33:267-295.
- SINCLAIR, W. J., AND W. GRANGER. 1911. Eocene and Oligocene of the Wind River and Big Horn Basins. *Bull. Amer. Mus. Nat. Hist.*, 30:83-117.
- SLOAN, R. E. 1966. Paleontology and geology of the Badwater Creek area, central Wyoming. Part 2. The Badwater multituberculate. *Ann. Carnegie Mus.*, 38:309-315.
- TOURTELOT, H. A. 1946. Tertiary stratigraphy in the northeastern part of the Wind River Basin, Wyoming. *U.S. Geol. Survey Oil and Gas Inv. Chart*, OC-22.
- . 1948. Tertiary rocks in the northeastern part of the Wind River Basin, Wyoming. Third Ann. Field Conf., Guidebook Wyo. Geol. Assoc., 1948:53-67.
- . 1953. Geology of the Badwater area, central Wyoming. *U.S. Geol. Survey Oil and Gas Inv. Map* OM-124.
- VAN HOUTEN, F. B. 1945. Review of the latest Paleocene and early Eocene mammalian faunas. *J. Paleont.*, 19:421-461.
- WEST, R. M. 1973. New records of fossil mammals from the early Eocene Golden Valley Formation of North Dakota. *J. Mamm.*, 54:749-750.

- WILMARTH, M. G. 1938. Lexicon of geologic names of the United States (including Alaska). U.S. Geol. Survey Bull., 896:1-2396.
- WOOD, H. E. II, ET AL. 1941. Nomenclature and correlation of the North American continental Tertiary. Bull. Geol. Soc. Amer., 52:1-48.
- WOODWARD, T. C. 1957. Geology of the Deadman Butte area, Natrona County, Wyoming. Bull. Amer. Assoc. Petrol. Geol., 41:212-262.
- WORTMAN, J. L. 1903. Studies of Eocene Mammalia in the Marsh Collection, Peabody Museum, part 2. Primates. Amer. Jour. Sci., ser. 4, 15:163-176, 399-414, 419-436; 16:345-368.
- . 1904. Studies of Eocene Mammalia in the Marsh Collection, Peabody Museum, part 2. Primates. Amer. Jour. Sci., ser. 4, 17:23-33, 133-140, 203-214.



Stucky, Richard Keith and Krishtalka, Leonard. 1982. "Revision of the Wind River faunas, early Eocene of central Wyoming. Part 1. Introduction and Multituberculata." *Annals of the Carnegie Museum* 51, 39–56.

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