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**SYSTEMATIC REVISION OF THE GENUS *PROCHETODON*
(PTILODONTIDAE, MULTITUBERCULATA) FROM THE LATE
PALEOCENE AND EARLY EOCENE OF WESTERN NORTH AMERICA**

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SYSTEMATIC REVISION OF THE GENUS *PROCHETODON* (PTILODONTIDAE,
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DAVID W. KRAUSE¹

Abstract.—*Prochetodon* is one of four valid genera in the multituberculate family Ptilodontidae. Although originally described from a single late Tiffanian locality, specimens of *Prochetodon* are now known from 33 localities ranging in age from middle Tiffanian to middle Clarkforkian distributed throughout the northern part of the Western Interior of North America. These additional specimens permit the identification of two new species, *Prochetodon foxi* and *P. taxus*, and revised diagnoses for both the genus and the type species, *P. cavus*.

INTRODUCTION

Prochetodon, a ptilodontid multituberculate, is an uncommon element in mammalian faunas from the late Paleocene and early Eocene of western North America. *Prochetodon* is the latest surviving genus of the Ptilodontidae. *Kimbetohia* (early Paleocene), *Baiotomeus* (middle Paleocene), and *Ptilodus* (early Paleocene to late Paleocene, possibly earliest Eocene) are the remaining members of the family (Krause, 1982, 1987). Prior to this study only one species of *Prochetodon*, *Pro. cavus*, had been described (Jepsen, 1940). *Prochetodon cavus* was first known from Princeton Quarry, a late Tiffanian (late Paleocene) locality in the Bighorn Basin of northwestern Wyoming (Jepsen, 1940). Since the description of this one species from a single locality, specimens of *Prochetodon* have been discovered from 32 additional localities geographically distributed in Alberta, Saskatchewan, Montana, North Dakota, and Wyoming and temporally distributed from the middle Tiffanian to the middle Clarkforkian (early Eocene), an interval of approximately 2.5 million years (Berggren et al., 1985). Not all of the new specimens, however, can be referred to the single known species. In this report I describe two new species of *Prochetodon*, *Pro. foxi* from the middle Tiffanian and *Pro. taxus* from the early and middle Clarkforkian, and provide revised diagnoses for the genus and for *Pro. cavus*.

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ABBREVIATIONS

Acronyms of institutions referred to in this paper are:

CM - Carnegie Museum of Natural History, Pittsburgh.

MCZ - Museum of Comparative Zoology, Harvard University, Cambridge.

MMMN - Manitoba Museum of Man and Nature, Winnipeg.

YPM-PU - Yale Peabody Museum, Yale University, New Haven - Museum of Natural History, Princeton University, Princeton.

SMM - Science Museum of Minnesota, St. Paul.

UA - The University of Alberta, Edmonton.

UM - Museum of Paleontology, The University of Michigan, Ann Arbor.

DENTAL MEASUREMENTS AND TERMINOLOGY

The terms employed in the description of the dentition of *Prochetodon*, and the measurements taken, are the same as those described in detail by Krause (1982, 1987). In referring to species of *Prochetodon*, the abbreviated *Pro.* is used to make the distinction from *Ptil.*, the abbreviation employed for *Ptilodus*. The terminology of Archibald et al. (in press) is used in referring to the faunal zones that have been employed to subdivide the Tiffanian and Clarkforkian Land-Mammal Ages. The Tiffanian has five zones, which, from oldest to youngest are abbreviated as Ti1 to Ti5. The next youngest zone spans the Tiffanian-Clarkforkian boundary and is therefore divided into two subzones, Ti6 and Cf1, which in turn is followed by zones Cf2 and Cf3. Thus, as used here, early Tiffanian includes Ti1 and Ti2, middle Tiffanian includes Ti3 and Ti4, and late Tiffanian includes Ti5 and Ti6. Similarly, Cf1, Cf2, and Cf3 are referred to as early, middle, and late Clarkforkian, respectively.

SYSTEMATIC PALEONTOLOGY

Class MAMMALIA Linnaeus, 1758

Subclass ALLOTHERIA Marsh, 1880

Order MULTITUBERCULATA Cope, 1884

Suborder PTILODONTOIDEA Sloan and Van Valen, 1965

Family PTILODONTIDAE Gregory and Simpson, 1926

Prochetodon Jepsen, 1940

Prochetodon Jepsen, 1940, p. 309.

Type species.—*Prochetodon cavus* Jepsen, 1940.

Included species.—*Prochetodon cavus* Jepsen, 1940; *Pro. foxi*, new species; and *Pro. taxus*, new species.

Distribution.—Early middle Tiffanian (Ti3) to middle Clarkforkian (Cf2) of western North America (Alberta, Saskatchewan, Montana, North Dakota, and Wyoming).

Revised diagnosis.—A genus of large ptilodontids, much larger than *Kimbetohia* and *Baiotomeus*, but equivalent in size to some species of *Ptilodus*. Differs from *Kimbetohia*, *Baiotomeus*, and *Ptilodus* in possession of lenticular, rather than conical, cusps buccally on P¹⁻³; arcuate arrangement of mesial

and buccal cusps on P² (condition unknown in *Baiotomeus*); presence of 8 to 9 cusps on P³; relatively long and narrow P⁴ with persistent absence of cusps on mesiobuccal bulge; P₄ with broad, flat mesial face, reduced exodaenodont lobe, and distally canted shape in lateral view; and presence of shallow vertical grooves buccally on buccal cusps of M₁.

***Prochetodon foxi*, new species**

Figure 1; Tables 1, 2

Ptilodus sp. (in part). Krishtalka, Black, and Riedel, 1975, p. 183, fig. 1.

Prochetodon cf. *cavus* (in part). Krause, 1977, p. 13, Pl. 2: 8–13, Pl. 3: 1, 3–6.

Prochetodon sp., Krause, 1977, p. 14, Pl. 3: 2; Holtzman, 1978, p. 25, figs. 3.6, 3.8, 3.9.

Holotype and locality.—YPM-PU 21223, right dentary with base of I₁ and P_{3,4}; from Long Draw Quarry in SE1/4, NE1/4, Sec. 24, T9S, R23E, Carbon Co., Bighorn Basin, Montana.

Hypodigm and localities.—Long Draw Quarry: Holotype only.

Roche Percée sites UAR2, UAR2a, and UAR2g, Williston Basin, Saskatchewan (Krause, 1977): UA 9753, 9796, 9825, 9830, 9919, 9960, 9975, 9979, 9991, 10017, 10036–10040, 10053, 10060, 10095, 10098, 10106, 10124, 10161, 10194, 10305, 10317, 10386, 10390, 10397, 10409, 10417, 10421, 10432, 10433, 10442, 10465, 10482, 10523, 10542, 10557, 10565, 10583, 10584, 10619, 10622, 10640, 10643, 10659, 10668, 10729, 10730, 10768, 11303–11306, 11317, 11326, 11418–11420, 11450, 11537–11539; MMMN 523.

Divide Quarry, Bighorn Basin, Wyoming (Gingerich, 1976): UM 77318.

Malcolm's Locality, Wind River Basin, Wyoming (Krishtalka et al., 1975): CM 12451, 12490, 16120, 16133, 16135, 16138, 23685, 23687.

Swan Hills Site 1, central Alberta (Russell, 1967): UA 11997, 11998.

Judson Locality, Williston Basin, North Dakota (Holtzman, 1978): SMM P77.7.55, P77.7.56.

Known distribution.—Early middle Tiffanian (Ti3) of North Dakota (Williston Basin) and late middle Tiffanian (Ti4) of central Alberta, Saskatchewan (Williston Basin), Montana (Bighorn Basin), and Wyoming (Bighorn and Wind River basins).

Etymology.—Named for Professor Richard C. Fox of The University of Alberta, in recognition of his important contributions to the study of early mammals and in appreciation of his early profound influence upon me as a student.

Diagnosis.—Slightly larger (mean length of P₄ at Roche Percée = 8.10 mm) than *Pro. cavus* (mean length of P₄ at Princeton Quarry = 7.25 mm) and similar in size to *Pro. taxus* (length of P₄ of holotype = 8.0 mm). Buccal row of cusps on P⁴ well-developed (extending well past mid-length) and with greater number of cusps (6.5–8) than in *Pro. cavus* (2.5–5) or *Pro. taxus* (1). Mesial part of crown of P⁴ much lower than distal part and therefore relatively lower than in *Pro. cavus* and, particularly, *Pro. taxus*. Mesial margin of crown of P₄ evenly rounded in lateral profile and exodaenodont lobe indistinct. Crown of P₄ lower, relative to its length, than in *Pro. cavus* and *Pro. taxus*.

Description and discussion.—The largest sample of *Pro. foxi* is comprised entirely of isolated teeth and comes from the Roche Percée sites. A detailed description of the specimens in the Roche Percée sample has been given previously (Krause, 1977) and it is therefore necessary to describe only those details from other samples that augment the variability already observed, as well as those that further serve to distinguish *Pro. foxi* from *Pro. cavus* and *Pro. taxus*. Dental measurements of *Pro. foxi* are provided in Tables 1 and 2. The holotype is illustrated in Figure 1E, F. Illustrations of *Pro. foxi* from other localities are available in the following sources: Roche Percée - Krause, 1977, Pl. 2, figs. 8–13

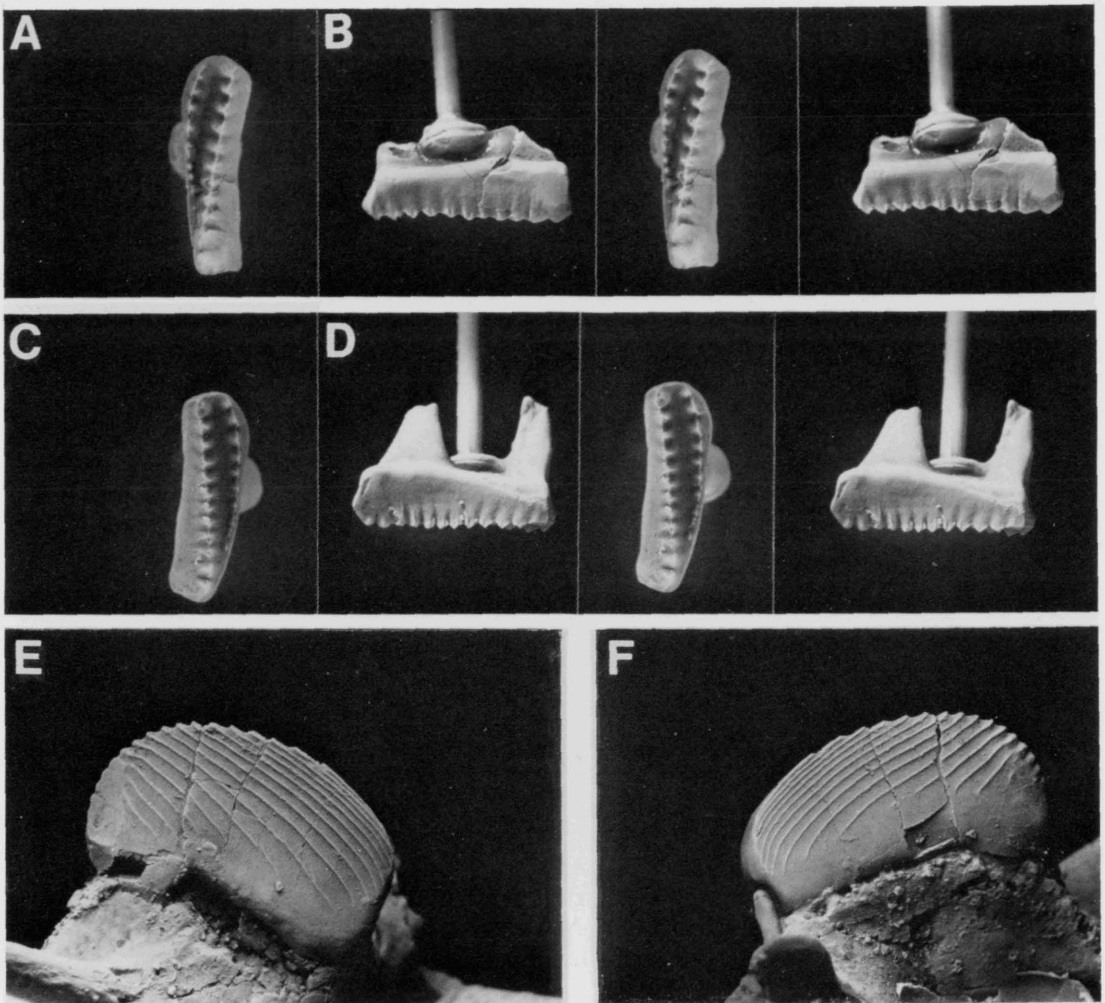


FIG. 1— *Prochetodon foxi*, new species. 1 and 2, UA 10194, right P_4 from Roche Percée Site UAR2a, stereophotographs of occlusal and lingual views. 3 and 4, SMM P77.7.56, left P_4 from the Judson Locality, stereophotographs of occlusal and lingual views. 5 and 6, YPM-PU 21223 (holotype), right dentary fragment with $P_{3,4}$ from Long Draw Quarry in buccal and lingual views. Approximately $\times 5$.

and Pl. 3, fig. 1; Malcolm's Locality -Krishtalka et al., 1975, fig. 1 and Krause, 1977, Pl. 3, figs. 3–6; Swan Hills Site 1 - Krause, 1977, Pl. 3, fig. 2; and the Judson Locality - Holtzman, 1978, figs. 3.6, 3.8, and 3.9.

P_3 is present in the holotype of *Pro. foxi*. As in other ptilodontids, it is reduced to a long, slender, vertical peg that rests under the mesial part of the crown of P_4 .

P_4 of *Pro. foxi* has a long, low crown and bears 15 to 16 serrations. The exodaenodont lobe is not distinctly set off from the rest of the crown. In addition, the mesial margin of the crown is smoothly rounded and circular in outline. In these respects, P_4 's from Long Draw Quarry and Roche Percée bear closer resemblance to each other than either does to P_4 's from Malcolm's Locality. The P_4 's from Malcolm's Locality resemble, to some degree, those of *Pro. cavus* in having a weakly developed exodaenodont lobe and a less rounded mesial margin, perhaps indicating a relatively derived condition

TABLE 1— Measurements of the lower dentition of *Prochetodon foxi*, new species, from Long Draw Quarry and Roche Percée sites UAR2 and UAR2a.

Specimen	P ₄						M ₁		
	L	W	L1	H	D	S	L	W	C
<i>Long Draw</i>									
YPM-PU 21223	8.7	2.4	2.8	2.9	2.2	16			
<i>UAR2</i>									
MMMN 523	8.0	—	—	—	—	16			
<i>UAR2a</i>									
UA 10317	8.2	2.3	2.4	2.9	2.0	16			
UA 10397	—	2.2	—	—	—	16			
UA 10421	8.1	2.3	2.3	2.9	2.1	15			
UA 10095							3.5	1.6	6.5:5
UA 10124							4.2	1.9	8:5
UA 10622							4.1	1.8	8:5
UA 11326							3.9	1.8	7.5:5
UA 11418							—	1.7	—
UA 11419							3.7	—	7:5

and therefore a slightly younger age for Malcolm's Locality. The lateral profiles of P₄ in *Pro. foxi*, *Pro. cavus*, and *Pro. taxus* are compared in Fig. 2. Despite its greater length, P₄ of *Pro. foxi* has a relatively low crown.

In a previous paper I suggested that the specimens of *Prochetodon* from Roche Percée are different from those from Princeton Quarry "primarily in that they are slightly larger, the mesial margin of P₄ is more evenly curved . . . , the exodaenodont lobe of P₄ is less distinctly set off from the rest of the crown, P² has four, rather than three, cusps (YPM-PU 14434, a maxillary fragment from Princeton Quarry, bears a P² with an incipiently developed anterior cusp), and P³ has, in the labial row, five, rather than four, cusps" (Krause, 1977, p. 15). It was also noted that specimens from Schaff and Fritz quarries show a mixture of characteristics: the size and shape of the P₄'s are more like those from Princeton Quarry but the cusp number on P²⁻³ are more like those from Roche Percée. Unfortunately, all of the available samples from Princeton, Schaff, and Fritz quarries are small, particularly those from the latter two. Reanalysis of these samples, coupled with the study of specimens from isolated occurrences in the same general area, leads to the conclusion that the differences observed in the size and shape of P₄ of *Pro. foxi* from Roche Percée and *Pro. cavus* from Princeton, Schaff and Fritz quarries are real, whereas the number of cusps on P² and P³ is not a consistent and reliable taxonomic indicator. As noted in the quotation above, one of the Princeton Quarry P²'s has an incipient fourth cusp. Conversely, and not noted previously, two of the four cusps on a P² (UA 9960) from Roche Percée are fused at their bases and appear as one. Unfortunately, there are no upper premolars known from Fritz Quarry and there is only one specimen known from Schaff Quarry that retains P² and P³. A fragmentary P³ (YPM-PU 23950) from Princeton Quarry does have five cusps in the buccal row. A well-preserved and relatively complete specimen (MCZ 20039) from a locality (NE1/4, Sec. 22, T57N, R100W) at a level slightly higher than Princeton Quarry (and Schaff Quarry) (C. R. Schaff, pers. comm.) has a P² with four cusps and a P³ with five cusps in the buccal row. Similarly, UM 73684 from UM locality SC-277, is a P³ with five cusps in the buccal row. In short, therefore, the known specimens indicate that *Pro. foxi* has a P² that usually has four cusps (but occasionally two of them are twinned) and a P³ with five cusps in the buccal row. *Pro. cavus*, by contrast, has three to four cusps on P² and four to five cusps in the buccal row of P³. These differences may simply be correlated with size:

TABLE 2— Measurements of the upper dentition of *Prochetodon foxi*, new species, from Roche Percée sites UAR2 and UAR2a, Malcolm's Locality, Swan Hills Site 1, the Judson Locality, and Divide Quarry.

Specimen	P ¹		P ²			P ³			P ⁴		
	L	W	L	W	C	L	W	C	L	W	C
<i>UAR2</i>											
UA 9960			2.7	2.2	4						
UA 9975			2.8	2.1	4						
<i>UAR2a</i>											
UA 10390	2.1	1.8									
UA 10433	2.3	1.9									
UA 10465	2.2	1.8									
UA 10482	2.1	1.7									
UA 11420	2.2	1.9									
UA 9753			2.6	2.0	4						
UA 9825			2.8	2.2	4						
UA 10417			2.6	2.2	4						
UA 10432			2.6	2.1	4						
UA 10442			2.5	2.0	4						
UA 10523			2.7	2.2	4						
UA 10668			2.5	2.1	4						
UA 10557						3.7	2.2	5:4			
UA 10584						3.5	2.0	5:4			
UA 10730						3.5	2.0	5:4			
UA 11303						3.5	2.1	5:4			
UA 10194									5.5	1.8	(0)6.5:11:0
<i>Malcolm's Locality</i>											
CM 16138	2.3	1.8									
CM 16135						3.5	2.1	5:4			
<i>Swan Hills Site 1</i>											
UA 11998									—	2.0	(0)—:—:—
<i>Judson Locality</i>											
SMM P77.7.55	2.3	1.9	4								
SMM P77.7.56									5.6	1.8	(0)8:12:0
<i>Divide Quarry</i>											
UM 77318						3.8	2.2	5:4			

Pro. foxi is generally slightly larger than *Pro. cavus* and usually has the greater number of cusps on P² and P³.

Very small samples of *Prochetodon* from Swan Hills Site 1, the Judson Locality, and Divide Quarry are tentatively referred to *Pro. foxi*. The two fragments of P⁴ from Swan Hills Site 1 show that the buccal row of cusps is well-developed and extends well past mid-length, as is characteristic of *Pro. foxi*. The single specimen, a P³ (UM 77318), from Divide Quarry is identical to P³'s of *Pro. foxi* from Roche Percée. Finally, although the P² (SMM P77.7.55) from the Judson Locality is identical to those of *Pro. foxi* from Roche Percée, the P⁴ (SMM P77.7.56) has more cusps (eight) in the buccal row than in the only other complete P⁴ (UA 10194) referred to *Pro. foxi*. As shown by the progressively lower number of cusps in this row in the progressively later species of *Prochetodon*, this trait appears to be primitive in the Judson Locality specimen. This apparent primitiveness is corroborated by the

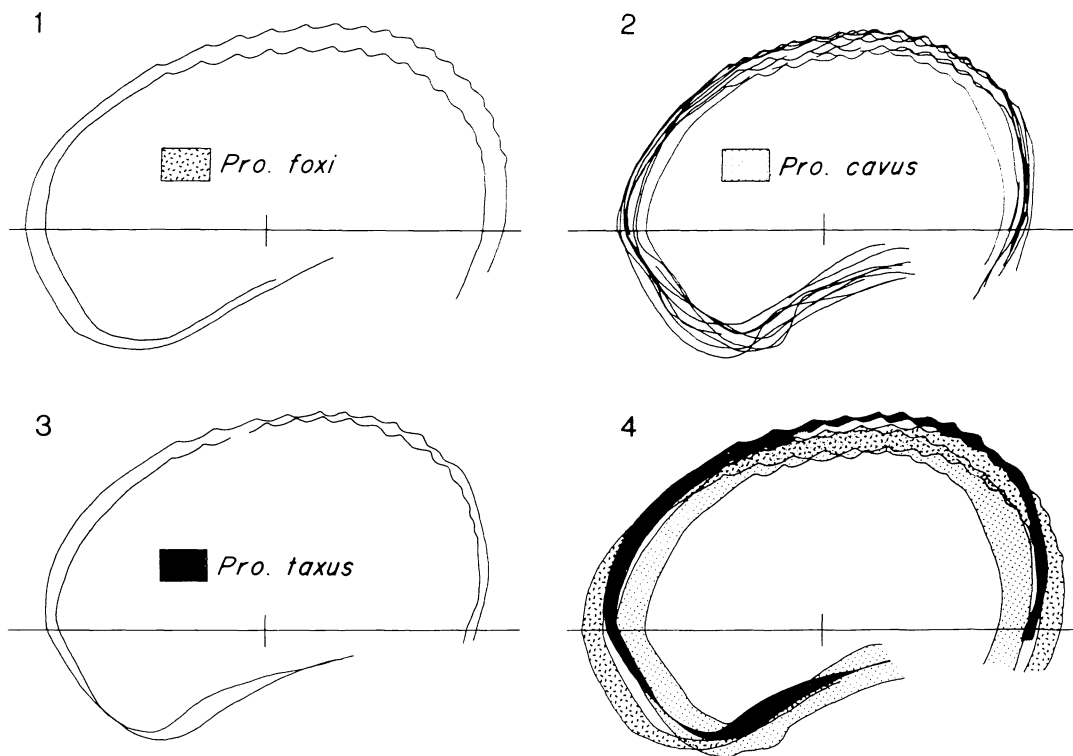


FIG. 2— Camera lucida outline drawings of lateral profiles of all available unworn or only slightly worn lower fourth premolars of *Prochetodon*. 1, *Pro. foxi*: YPM-PU 21223 from Long Draw Quarry and UA 10421 from Roche Percée Site UAR2a. 2, *Pro. cavus*: YPM-PU 13362, 14436, 17923, 19015, 19099, 19121, 19492, 19848, and UM 73384 from Princeton, Schaff, and Fritz quarries and the surrounding vicinity. 3, *Pro. taxus*: UM 71311 from UM locality SC-226 and YPM-PU 14542 from Paint Creek (= UM locality SC-143). 4, Comparison of P_4 profiles of *Pro. foxi*, *Pro. cavus*, and *Pro. taxus* - see legends in 1, 2, and 3. All specimens were orientated about a baseline passing through the most mesial point above the mesiobasal concavity and along the base of the distobuccal ledge; they were registered about a point midway along the baseline.

presence in the Judson Local Fauna of primates which suggest that the Judson Local Fauna (Holtzman, 1978) is older than those at Long Draw (Gingerich, 1976), Malcolm's Locality (Gingerich, 1976), Roche Percée (Krause, 1978), and Swan Hills Site 1 (Krause, 1978). Additional specimens of *Prochetodon* from the Judson Locality may show that the sample should be referred to a new species but, for the present, these specimens are tentatively allocated to *Pro. foxi*.

Molars other than M_1 remain unknown for *Pro. foxi*. An isolated M^2 (CM 12454) from Malcolm's Locality referred by Krishtalka et al. (1975, Fig. 2) to *Ptilodus* sp. (= *Ptil. kummae* - see Krause, 1977, 1982) was later tentatively allocated to *Prochetodon* cf. *cavus* (now *Pro. foxi* - see above) by Krause (1977). Now that M^2 's are known for *Pro. cavus* and *Pro. taxus* it appears unlikely that CM 12454 is referable to either *Pro. foxi* or *Ptil. kummae*. Its large size ($L = 2.8$ mm, $W = 2.8$ mm) suggests that it belongs to a taxon that is otherwise unknown from Malcolm's Locality.

Prochetodon cavus Jepsen, 1940

Figure 3; Tables 3, 4

Ptilodus sp., Jepsen, 1930, p. 510, Pl. IX: 6.*Prochetodon cavus* Jepsen, 1940, p. 310, fig. 19, Pl. IV: 4-7; Krause, 1977, p. 15, Pl. 3: 10-11.*Prochetodon cavus?*, Krause, 1977, p. 15, Pl. 3: 7-9.

Holotype and locality.—YPM-PU 13925, right dentary with base of I₁, P₃, and mesial fragment of P₄; from Princeton Quarry in center of SE1/4, Sec. 21, T57N, R100W, Park Co., Bighorn Basin, Wyoming. (This specimen has been damaged considerably since first described by Jepsen in 1940, as is indicated by comparisons with his Pl. IV, fig. 4. At that time both I₁ and P₄ were relatively complete.)

Hypodigm and localities.—All of the localities listed below are in Park Co., Bighorn Basin, Wyoming.

Princeton Quarry: Holotype and YPM-PU 13362, 14034, 14336, 14433-14436, 14527, 23950-23952; UM 76858.

Schaff Quarry: YPM-PU 19369, 19492, 19503, 23953; MCZ 19441; UM 78893.

Fritz Quarry: YPM-PU 17922, 17923.

Hail Quarry: YPM-PU 23954.

NE1/4, Sec. 28, T58N, R101W: YPM-PU 23955.

SE1/4, Sec. 35, T58N, R101W: YPM-PU 23956.

UM locality SC-258: UM 73352, 73384.

Sec. 7, T57N, R100W: YPM-PU 19099.

North center, Sec. 7, T57N, R100W: YPM-PU 19015.

Sec. 18, T57N, R100W: YPM-PU 19090.

UM locality SC-266: UM 73511.

SE1/4, Sec. 17, T57N, R100W: YPM-PU 18949.

NW1/4, Sec. 21, T57N, R100W: YPM-PU 18979.

SW1/4, Sec. 22, T57N, R100W: YPM-PU 19848.

UM locality SC-277: UM 73684.

NE1/4, Sec. 22, T57N, R100W: MCZ 20039.

SW1/4, Sec. 22, T57N, R100W: MCZ 20018.

Sec. 22, T57N, R100W: YPM-PU 19121.

UM locality SC-198 (= YPM-PU Fossil Hollow Locality): YPM-PU 20512, 23957, 23958; UM 69242.

UM locality SC-165: UM 69256, 77930-77932.

UM locality SC-228: UM 71706.

Sec. 10, T56N, R99W: YPM-PU 18290.

Known distribution.—Early late Tiffanian (Ti5) of Wyoming (Bighorn Basin).

Revised diagnosis.—Smallest known species of the genus but only slightly smaller than *Pro. foxi* and *Pro. taxus* (compare measurements in Tables 1 to 6). Buccal row of cusps on P⁴ extending to approximately mid-length and with greater number of cusps (2.5-5) than in *Pro. taxus* (1), but fewer than in *Pro. foxi* (6.5-8). Mesial part of crown of P⁴ only slightly lower than distal part; it is therefore relatively lower than in *Pro. taxus* and relatively taller than in *Pro. foxi*. Exodaenodont lobe small but more distinctly set off from rest of crown than in other two species.

Description and discussion.—*Pro. cavus* is known only from localities in the Polecat Bench area of the northern Bighorn Basin. Jepsen (1940, p. 310-314) described the teeth then known of *Pro. cavus*

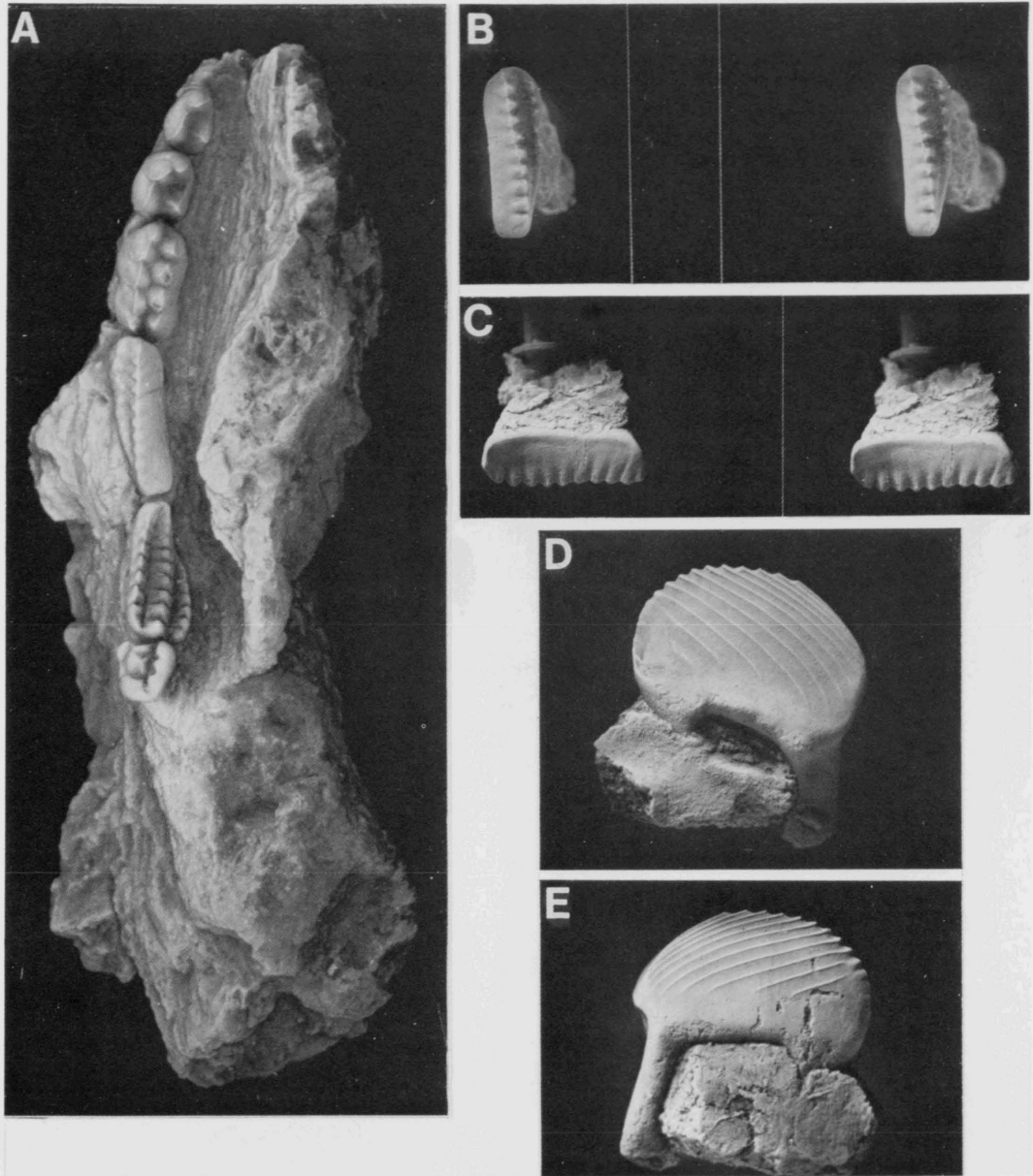


FIG. 3—*Prochetodon cavus*. 1, MCZ 20039, partial skull with left P^{3-4} (not shown) and right $P^{1-4}M^{1-2}$ from NE1/4, Sec. 22, T57N, R100W, Park Co., Wyoming, occlusal view. 2 and 3, MCZ 20039, left P^4 , stereophotographs of occlusal and lingual views. 4 and 5, YPM-PU 19099, right dentary fragment with P_4 from Sec. 7, T57N, R100W, Park Co., Wyoming, buccal and lingual views. Approximately $\times 5$.

in detail, including the long, slender (and now missing) I_1 of the holotype. At the time of Jepsen's writing, none of the molars were known and the allocation of P^4 to *Pro. cavus* was not based on any direct association with other remains. YPM-PU 19369 and MCZ 20039 confirm Jepsen's identification of P^4 . MCZ 20039 is a partial skull with left P^{3-4} and right $P^{1-4}M^{1-2}$, thus also providing the first record of M^{1-2} in this species (Figure 3). An isolated M^2 (YPM-PU 23953) from Schaff Quarry can therefore also be assigned to *Pro. cavus*.

TABLE 3— Measurements of the lower dentition of *Prochetodon cavus* from various localities in the northern Bighorn Basin, Wyoming.

Specimen	P ₄						M ₁		
	L	W	L1	H	D	S	L	W	C
<i>Princeton Quarry</i>									
YPM-PU 13362	7.1	2.2	2.1	2.6	—	—			
YPM-PU 14436	7.4	2.4	2.3	2.7	2.5	13			
<i>Schaff Quarry</i>									
YPM-PU 19492	6.6	2.1	2.3	2.6	2.1	—	3.5	1.5	7:4.5
YPM-PU 19503	6.8	2.3	—	—	2.1	—			
<i>Fritz Quarry</i>									
YPM-PU 17922	7.5	2.5	2.3	3.0	2.4	—			
YPM-PU 17923	7.7	2.6	2.5	2.9	2.5	15			
<i>UM loc. SC-258</i>									
UM 73384	7.1	2.2	2.2	2.7	2.4	—			
<i>Sec. 7, T57N, R100W</i>									
YPM-PU 19099	7.3	2.3	2.4	2.7	2.6	—			
<i>NC, Sec. 22, T57N, R100W</i>									
YPM-PU 19015	7.5	2.4	2.5	2.7	2.3	—			
<i>SW1/4, Sec. 22, T57N, R100W</i>									
YPM-PU 19848	7.3	2.4	2.5	2.6	2.2	—			
<i>Sec. 22, T57N, R100W</i>									
YPM-PU 19121	7.4	2.0	2.5	2.6	2.0	—			
<i>UM loc. SC-165</i>									
UM 77931							3.5	1.6	7.5:4

M¹ of *Pro. cavus* is similar to those of *Ptilodus* but the buccal row appears to be much narrower relative to the middle row and the mesial margin appears more rounded in occlusal view. Likewise, M² of *Pro. cavus* appears to differ from those of *Ptilodus* in having a less widely flaring buccal cusp, an incipient connection between the first and second cusps of the middle row, and a less evenly spaced lingual row of cusps (the second and third are more widely separated than the first and second). However, when these distinguishing criteria are applied to a mixed sample (i.e., one that probably contains both *Prochetodon* and *Ptilodus* - such as at Roche Percée) there appear to be intergradations that diminish the utility of the criteria despite the recognition of extremes. It remains to be seen if undoubted *Prochetodon* upper molars can be consistently separated from those of *Ptilodus*; additional molars of *Prochetodon* are required.

The lateral profiles of P₄'s of *Pro. cavus* are compared with those of *Pro. foxi* and *Pro. taxus* in Figure 2. P₄'s of *Pro. cavus* are generally shorter than those of *Pro. foxi* and *Pro. taxus* and have a more angled mesial margin and a more distinct exodaenodont lobe.

Illustrations of specimens of *Pro. cavus*, in addition to those presented in Figure 3, are available in Jepsen (1930, Pl. IX, fig. 6; 1940, fig. 19, and Pl. IV, figs. 4-7) and Krause (1977, Pl. 3, figs. 7-11).

TABLE 4— Measurements of the upper dentition of *Prochetodon cavus* in small samples from various localities in the northern Bighorn Basin, Wyoming.

Specimen	P ¹			P ²			P ³			P ⁴			M ¹			M ²		
	L	W	C	L	W	C	L	W	C	L	W	C	L	W	C	L	W	C
<i>Princeton Quarry</i>																		
YPM-PU 14034	2.1	1.5	2.3	1.7	3	3.7	1.9	4:4										
YPM-PU 14336			2.4	1.8	3	3.5	2.1	4:4										
YPM-PU 14433						3.6	2.1	4:4										
YPM-PU 14434	1.9	1.5	2.4	1.7	3													
YPM-PU 14435									5.2	1.7	(0)2.5:10:0							
YPM-PU 23950						—	—	5:4*										
<i>Scheff Quarry</i>																		
YPM-PU 19369	2.1	1.6	2.3	1.9	4	3.6	—	5:4	4.7	1.6	(0)5:10:0				2.0	2.0	1:3:3	
YPM-PU 23953																		
<i>NE1/4, Sec. 28, T58N, R101W</i>																		
YPM-PU 23955									—	1.7	(0)——:—:—							
<i>UM loc. SC-277</i>																		
UM 73684						3.6	2.1	5:4										
<i>NE1/4, Sec. 22, T57N, R100W</i>																		
MCZ 20039(R)	2.0	1.5	2.4	1.8	4	3.6	2.2	5:4	4.9	1.7	(0)5:10:0	4.5	2.0	7:10	2.0	1.9	1:3:3	
MCZ 20039(L)						3.6	2.1	5:4	4.9	1.7	(0)3.5:10:0							
<i>UM locality SC-198</i>																		
UM 69242	2.0	1.6																
<i>UM locality SC-165</i>																		
UM 69256	2.4	—																
UM 77930						3.4	2.1	4:4										

*Estimated

Prochetodon taxus, new species

Figure 4; Tables 5, 6

Prochetodon cavus (in part). Jepsen, 1940, p. 327.*Prochetodon* cf. *P. cavus*. Krause, 1980, p. 1165, Text-figs. 1-3.*Prochetodon* cf. *cavus*. Rose, 1981, p. 33.

Holotype and locality.—UM 71311, partial skull with $LP^{1-4}M^{1-2}$ and $RP^{2-4}M^{1-2}$, left dentary with root of $I_1P_3M_{1-2}$, right dentary with RP_4M_{1-2} ; from UM locality SC-226 at intersection of sections 15, 16, 21, and 22, T57N, R101W, Park Co., in Badger Basin area of northern Bighorn Basin, Wyoming.

Hypodigm and localities.—UM locality SC-226: Holotype only.

UM locality SC-143 (= YPM-PU Paint Creek Locality): YPM-PU 14542 (includes YPM-PU 13320).

UM locality FG-6: UM 72649-72651, 77555.

Known distribution.—Early to middle Clarkforkian (Cf1 to Cf2) of Wyoming (Bighorn Basin).

Etymology.—Latin *taxus* (badger), in reference to Badger Basin, area of provenance of the holotype.

Diagnosis.—Slightly larger (approximately 10-15%) than *Pro. cavus* and similar in size to *Pro. foxi* (compare measurements in Tables 1 to 6). Buccal row of cusps on P^4 relatively poorly developed with only a single cuspule present mesially. Mesial and distal parts of P^4 of approximately equal height, the mesial part therefore being relatively taller than in *Pro. cavus* and, particularly, *Pro. foxi*. Exodaenodont lobe on P_4 not well set off from rest of crown.

Description and discussion.—Few specimens of *Pro. taxus* are known but the holotype (UM 71311) is remarkably complete. This specimen was described previously (Krause, 1980, text-figs. 2, 3) but further careful preparation has permitted the separation of upper and lower dentitions, thus revealing additional morphological detail (Figure 4).

P_4 of *Pro. taxus* (also known in YPM-PU 14542 from UM locality SC-143 - see Krause, 1977, text-fig. 1) is generally larger than in *Pro. cavus* and is higher-crowned, particularly distally, than in *Pro. foxi*. In an earlier paper (Krause, 1980), I suggested that the teeth that are now assigned to *Pro. taxus* are more similar to those allocated to *Pro. foxi* from Roche Percée than to those of *Pro. cavus*. To some extent this is true, but many of these similarities (e.g., number of cusps on P^2 and P^3) are probably correlated with size. However, the progressive loss of cusps in the buccal row of P^4 from *Pro. foxi* to *Pro. cavus* to *Pro. taxus* is not size related. If these three species do comprise a single lineage, it appears that there was a reversal in size through time with a decrease from *Pro. foxi* to *Pro. cavus* and then a subsequent increase from *Pro. cavus* to *Pro. taxus*. Correspondingly, *Pro. foxi* and *Pro. taxus* usually have more cusps on P^2 and P^3 than does *Pro. cavus*.

Prochetodon sp.

Buckman Hollow (Green River Basin, Wyoming).—An isolated incisor (UM 68358) from Buckman Hollow may represent *Prochetodon* (Krause, 1980). UM 68358 is extremely long and slender as is typical of *Prochetodon* (Jepsen, 1940, Pl. IV, fig. 4). The Buckman Hollow Local Fauna is Clarkforkian in age (Dorr and Gingerich, 1980; Rose, 1981). The only species of *Prochetodon* currently known from Clarkforkian horizons is *Pro. taxus*.

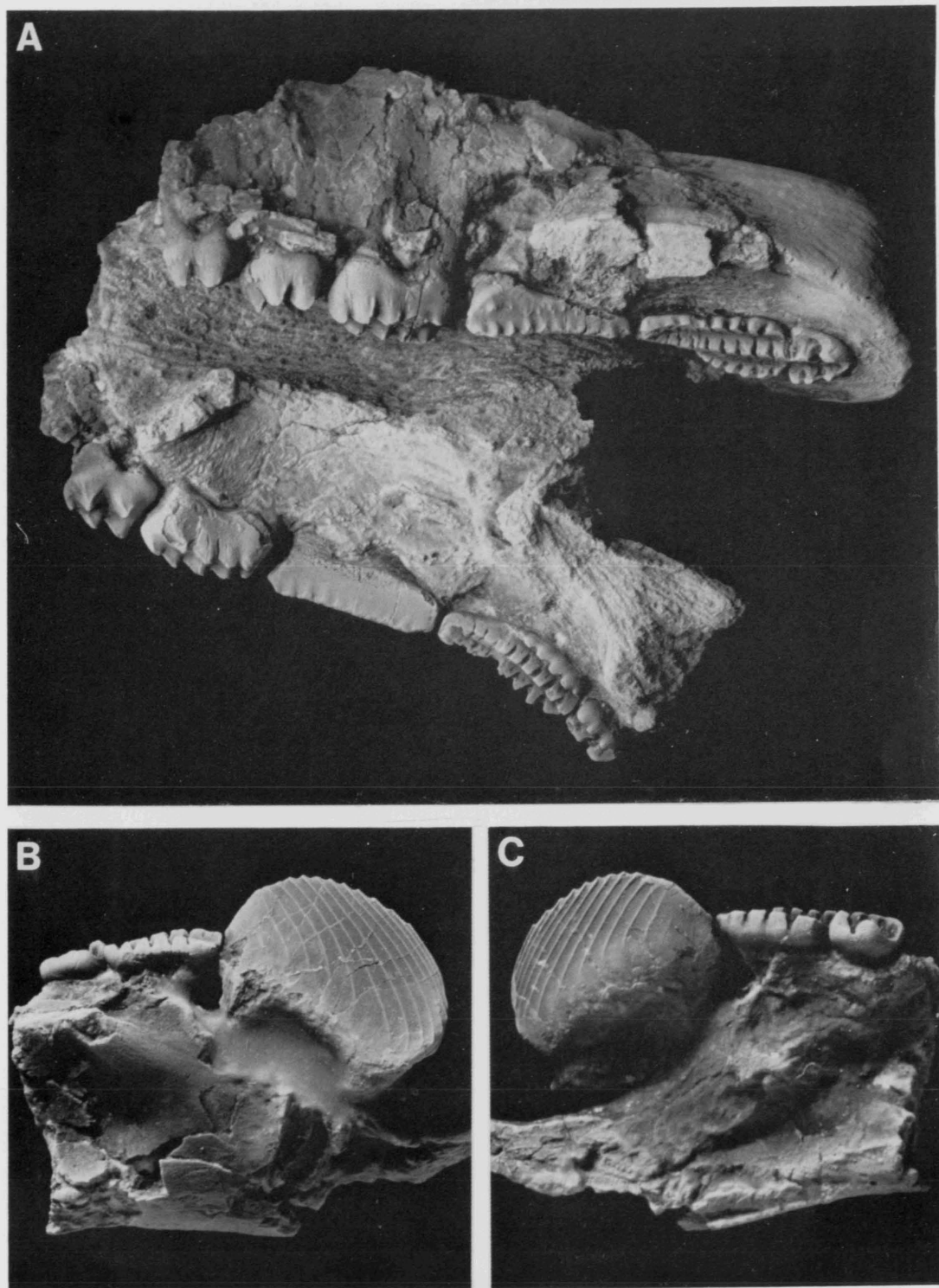


FIG. 4—*Prochetodon taxus*, new species. UM 71311 from UM locality SC-226. 1, skull fragment with left $P_1^4M_{1-2}$ in left lateral view. 2 and 3, right dentary fragment with $P_4M_{1,2}$ in buccal and lingual views. Approximately $\times 5$.

TABLE 5— Measurements of the lower dentition of *Prochetodon taxus*, new species, from UM localities SC-226, SC-143, and FG-6 in the northern Bighorn Basin, Wyoming.

Specimen	P ₄						M ₁			M ₂		
	L	W	L1	H	D	S	L	W	C	L	W	C
<i>UM loc. SC-226</i>												
UM 71311(R)	8.0	2.3	2.5	3.1	2.1	16	3.9	1.7	7:5	2.1	1.9	3:2
UM 71311(L)							3.8	1.7	7:5	2.1	—	—:2
<i>UM loc. SC-143</i>												
YPM-PU 14542	7.7	2.8	2.5	2.6	2.0	—						
<i>UM loc. FG-6</i>												
UM 72651										2.4*	1.9	4?:2

*Estimated

PHYLOGENY AND DISTRIBUTION OF *PROCHETODON*

Prochetodon, like *Kimbetohia* and *Baiotomeus*, is much less well represented in the early Cenozoic fossil record than is *Ptilodus*. It is known only from dental and gnathic remains and, until recently (Krause, 1977, 1980), none of its molars had been identified. *Prochetodon* appears to have been a component only of northern faunas. Although faunas of the same general age (middle Tiffanian to middle Clarkforkian) are known from more southerly areas, *Prochetodon* has not been found south of the Wind River Basin of south-central Wyoming. *Prochetodon* is the latest surviving member of the family Ptilodontidae.

None of the three known species of *Prochetodon* have ever been found to occur with any other species of the genus. As determined from available biostratigraphic information, *Pro. foxi* precedes *Pro. cavus*, which precedes *Pro. taxus*. Although there appears to have been a reversal in size trend (from larger to smaller to larger), a progressive trend can be discerned in the morphology of P⁴. In *Pro. foxi* the buccal row of cusps on P⁴ is well-developed, extending distally to well past mid-length and possessing 6.5 to 8 cusps. Furthermore, the distal part of the crown of P⁴ is distinctly higher than the mesial part. In *Pro. cavus* the buccal row of P⁴ is shorter, possesses only 2.5 to 5 cusps in the known specimens and the distal part of the crown of P⁴ is lower than in *Pro. foxi*. In *Pro. taxus* the buccal row of P⁴ is extremely reduced and possesses only a single cusp, while the mesial and distal parts of the crown are of approximately equal height. It should be noted, however, that the trends described above are based on small samples and additional specimens will be required to clarify patterns.

The origin of *Prochetodon* remains elusive. Although probably derived from a Torrejonian or early Tiffanian species of *Ptilodus*, no species of *Ptilodus* has yet been identified that serves as a structural ancestor for *Prochetodon*.

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TABLE 6— Measurements of the upper dentition of *Prochetodon taxus*, new species, from UM localities SC-226 and FG-6 in the northern Bighorn Basin, Wyoming.

Specimen	P ¹			P ²			P ³			P ⁴			M ¹			M ²				
	L	W	C	L	W	C	L	W	C	L	W	C	L	W	C	L	W	C		
<i>UM locality SC-226</i>																				
UM 71311(R)				2.9	2.2	4.5	4.5	2.4	2.4	5.4	5.8	1.7	(0)	1:11:0	5.3	2.3	8*:10	2.1	2.1	1:3:3
UM 71311(L)	2.6	1.8		3.0	—	4	4.3	—	5:4	5.9	1.8*	1.8*	(0)	1:11:0	5.2	2.3	8:10	2.2	2.1	1:3:3
<i>UM locality FG-6</i>																				
UM 72649				2.6	2.0	4														
UM 77555							3.9	2.2	5:4											

*Estimated

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