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OF SPECIES FORMERLY REFERRED TO *PELYCODUS***

BY

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ANN ARBOR

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**DENTITION OF EARLY EOCENE *PELYCODUS JARROVII*
(MAMMALIA, PRIMATES) AND THE
GENERIC ATTRIBUTION OF SPECIES FORMERLY REFERRED TO *PELYCODUS***

By

Philip D. Gingerich¹ and Richard A. Haskin²

Abstract.—New specimens of the poorly known species *Pelycodus jarrovii* (Cope, 1874) from the late Wasatchian of New Mexico and Colorado indicate that *P. jarrovii* is distinct from all other North American Adapidae in having more squared upper molars lacking mesostyles and in having quadrate lower molars with reduced paraconids on M₂ and M₃. *P. jarrovii* is the type species of *Pelycodus*, and we here restrict this genus to include the type species only. The holotype of *P. jarrovii* has been lost for many years, and we designate a topotype specimen from the San Juan Basin as the neotype of this species. Other species formerly referred to *Pelycodus* are here referred to *Cantius* Simons, 1962. *Pelycodus*, like *Copelemur*, appears to have been characteristic of early Eocene faunas in southern North America (New Mexico and vicinity), whereas *Cantius* was a more cosmopolitan genus distributed across both North America and Europe.

INTRODUCTION

Edward Drinker Cope described the first North American early Eocene primate species from New Mexico in 1874. He originally called this species *Prototomus jarrovii*, but the following year transferred it to a new genus *Pelycodus* (Cope, 1875). *P. jarrovii* is the type species of the genus *Pelycodus*. Cope mentioned that he had three fragmentary specimens of *P. jarrovii* from New Mexico available for study, and figured two of these (Cope, 1877, Pl. 39, figs. 17 and 18). Subsequently all three of Cope's specimens of *P. jarrovii*, including the holotype, were lost.

W. D. Matthew (1915) described an additional specimen of *Pelycodus jarrovii*, a left mandibular ramus with M₁₋₂ (AMNH 16298), from the Almagre facies of the San José Formation, the same facies and formation to yield Cope's type and referred specimens of *P. jarrovii*. Matthew's specimen is more complete than any of the three described by Cope, and yet he wrote "In the absence of adequate topotypes I designate as *neotype* [AMNH] No. 15018, associated upper and lower jaws from the upper Gray Bull, head of Dorsey Creek, Bighorn Basin [Wyoming]" (Matthew, 1915, p. 439). The designated neotype comes from a different geographic area than Cope's original type (Wyoming rather than New Mexico), it is from strata older in age (upper Graybullian-Lysitean equivalent rather than Lostcabinian equivalent), and it is significantly smaller in size. Gingerich and Simons (1977) included Matthew's neotype of *P. jarrovii* as

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part of the hypodigm of a new species *P. abditus*. The name *P. jarrovii* was used to include Lostcabinian-equivalent specimens from Wyoming formerly classified as *P. venticolis*.

In this paper we describe additional topotype specimens of *Pelycodus jarrovii* from New Mexico. These differ considerably from contemporary Lostcabinian-equivalent specimens known from Wyoming, necessitating some revision of the generic level systematics of North American early Eocene Adapidae. The name *Pelycodus* Cope, 1875, is here restricted to late Wasatchian *P. jarrovii* known from southern localities in New Mexico and Colorado. The name *Cantius* Simons, 1962, previously considered a junior synonym of *Pelycodus*, is used to include most other North American and European species formerly referred to *Pelycodus*. In addition, *Cantius venticolis* is recognized as the valid name for large late Wasatchian specimens from Wyoming synonymized with *Pelycodus jarrovii* by Gingerich and Simons (1977).

Institutional abbreviations used in this paper are as follows: AMNH, American Museum of Natural History (New York); PU, Princeton University Natural History Museum (Princeton, N.J.); UALP, University of Arizona Laboratory of Paleontology (Tucson); UM, University of Michigan Museum of Paleontology (Ann Arbor); and USNM, U.S. National Museum of Natural History (Washington, D.C.).

DENTITION OF *PELYCODUS JARROVII*

A total of twelve specimens of *Pelycodus jarrovii* have been collected from the San Juan Basin of New Mexico since Cope's description of this species. These supplement Cope's original specimens (now lost), and include the first upper molars of *P. jarrovii* from the type area. San Juan Basin specimens available for study are listed in Table 1. In addition, a left mandible with M_2 from the Huerfano Basin of Colorado, AMNH 17550, probably represents this species. The Huerfano specimen preserves alveoli for the lower canine, four premolars, and three molars (Text-fig. 1), with P_1 being single-rooted and the remaining premolars and molars double-rooted. *P. jarrovii* apparently retained the full dental formula 2·1·4·3 characteristics of primitive and generalized Adapidae. The mandibular ramus of the Huerfano specimen is shallow, and the mandibular symphysis was unfused.

No upper incisors of *Pelycodus jarrovii* are known. The upper canine (Text-fig. 2A) is a large, stout, projecting tooth measuring 5.5 mm mesiodistally and 4.2 mm labiolingually at the base of the crown. Crown height measured from the base to the tip of the crown is 8.4 mm. The crown flares noticeably when seen in anterior view, being concave to the labial side. It has a prominent groove on the anterior face bordered by wear facets made by a projecting lower canine (however the form of the lower canine is not yet known). The posterolingual face of the crown of the upper canine is also grooved, and it exhibits traces of honing premolar wear.

The only crown of an upper premolar known is that of P^3 in the maxilla AMNH 48691 (Text-fig. 3A). It is not well preserved, but appears to be triangular in outline with a prominent labial paracone and a much smaller lingual protocone. Judging from its outline, P^4 was broad labiolingually, as it is in *Cantius*.

It is difficult to be certain of the tooth position of isolated upper first and second molars in Adapidae. In general, M^1 tends to be more square in occlusal outline, whereas M^2 is more rectangular. By this criterion UALP 7102 (Text-fig. 2B) is almost certainly an unworn M^1 . The protocone, paracone, and metacone are subequal in size. There is a small paraconule on the preprotocrista. The centrocrista connecting the paracone and metacone is straight. There are no styler cusps and only a very narrow styler shelf. The hypocone is a distinct cusp on the postprotocingulum behind the protocone. There is no postprotocrista as such, but a crest in this

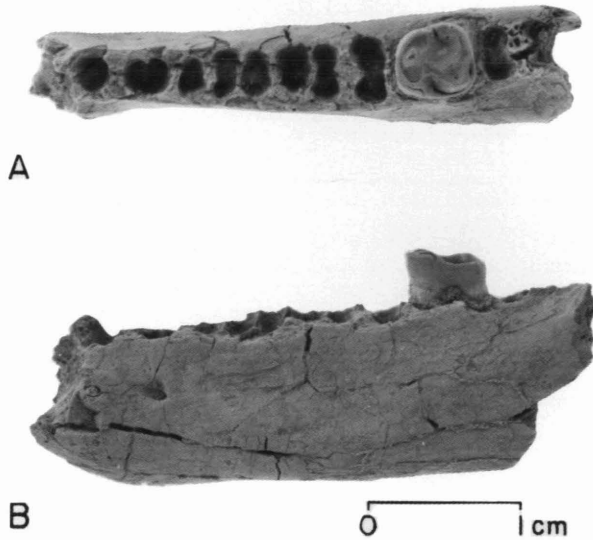
TABLE 1 — Specimens of *Pelycodus jarrovi* from the San Juan Basin, New Mexico. All specimens are from the Almagre facies of the San José Formation (late Wasatchian). *L* = crown length, *W* = crown width, all measurements in mm.

Specimen	Locality and date of collection	Description	Measurements		
			Tooth	L	W
AMNH 16298 (Neotype)	Arroyo Almagre (1912)	Left mandible with M ₁₋₂	M ₁ : M ₂ :	5.6 5.6	4.7 5.2
AMNH 48613A	E. corner Sec. 7/18, T23N, R1W (1946)	Right M ₂	M ₂ :	5.9	5.3
AMNH 48613B	E. corner Sec. 7/18, T23N, R1W (1946)	Left M ³	M ³ :	5.4	7.1
AMNH 48691	Arroyo Blanco (1947)	Left maxilla with broken P ³ and M ³	M ³ :	5.0	7.0
AMNH 55514	Chavez Ranch (1948)	Right mandibular ramus with M ₃	M ₃ :	7.3	4.8
UALP 7102	NW Rim Arroyo Almagre, UALP-7404 (1974)	Left M ¹	M ¹ :	5.4	6.7
UALP 11544	Highway 95/Continental Divide, UALP-7747(1977)	Left M ²	M ² :	—	7.7
UALP 11571	Highway 95/Continental Divide, UALP-7747(1977)	Right M ₂	M ₂ :	5.4	5.0
UALP 11574	Highway 95/Continental Divide, UALP-7747(1977)	Right M ²	M ² :	5.8	7.1
UALP 13599	Highway 95/Continental Divide, UALP-7747(1978)	Right M ³	M ³ :	5.5	6.9
UALP 13600	Highway 95/Continental Divide, UALP-7747(1978)	Right C ¹	C ¹ :	5.5	4.2
USNM 5718	5 mi. SW of Gallina (1907)	Right M ₂	M ₂ :	6.1	5.7

position connects the hypocone directly to the metacone with no distinct metaconule present. There is a small anterior cingulum, and a larger posterior cingulum parallel to the posterior margin of the crown. Judging from its occlusal outline, UALP 11544 appears to represent an M² of *P. jarrovi*. It is somewhat worn and the metacone is broken, but in other respects it resembles M¹ described above. UALP 11574 (Text-figs. 2C, 6B), probably an M², resembles both of these teeth.

UALP 13599 (Text-fig. 2D) and AMNH 48613B are isolated specimens of M³. These are broad, flat teeth with a low, rounded protocone, a distinct paracone, and a reduced metacone. There is a very small paraconule, no metaconule, and no hypocone. The postprotocrista connects the protocone directly to the metacone. The styler shelf is very narrow like that of M¹ and M², with no styler cusps. There is only a trace of an anterior cingulum, but the posterior cingulum is well developed.

The lower incisors, canine, and premolars are not yet known in *Pelycodus jarrovi*. M₁ is preserved in AMNH 11298 (Text-fig. 4). It has a distinct protoconid, paraconid, and metaconid on the trigonid, and a broad basined talonid with a distinct hypoconid and a squared entoconid corner. There is no hypoconulid. M₁ in *P. jarrovi* appears to differ from M₁ in large specimens



TEXT-FIG. 1 — Left mandible of *Pelycodus jarrovii* with M_2 , AMNH 17550, from AMNH locality VI in the Huerfano Basin, Colorado. *A*, occlusal view. *B*, lateral view. Note unfused mandibular symphysis, alveolus for large canine, alveolus for single-rooted P_1 , shallow horizontal ramus of the mandible, and broad rounded outline of the crown of M_2 . There is no trace of a paraconid on M_2 in this specimen.

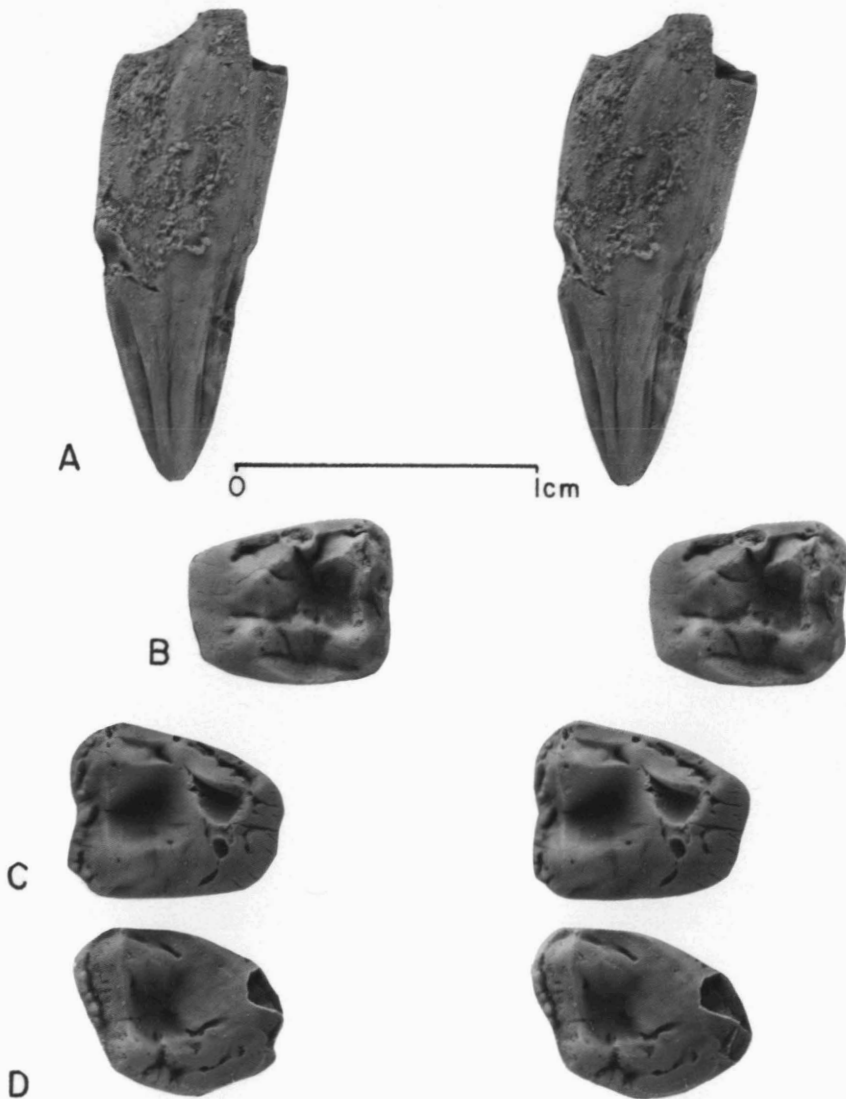
of *Cantius abditus* or *Cantius venticolis* only in being slightly wider, but it differs markedly from M_1 in *Copelemur tutus* in lacking the large entoconid notch characteristic of the latter.

Five specimens are known preserving M_2 . In the four of these where it can be determined, all lack a distinct paraconid cusp (Text-figs. 1,4,5B). The protoconid and metaconid are connected directly by a straight protocristid, and indirectly by a looping paracristid. The talonid is broadly basined with a distinct hypoconid and entoconid, but no hypoconulid cusp or entoconid notch.

AMNH 55514 (Text-fig. 3B,C) is the only specimen preserving M_3 . This is a relatively large, broad tooth with a large hypoconulid lobe on the talonid. The protoconid and metaconid are distinct and well separated, but joined by a straight protocristid. Immediately in front of the metaconid there is a very small paraconid, which is joined to the protoconid by a looping paracristid. The hypoconid is large but low and rounded, and the hypoconulid lobe is also broad and low. There is no distinct entoconid, but the lingual edge of the talonid has several small cuspules in a row, one of which is probably homologous with the entoconid. The crown of M_3 is unusually broad and flat, but it otherwise resembles M_3 in *Cantius venticolis* rather closely.

Cusps and crests on upper and lower molars of *Pelycodus jarrovii* are low and rounded like those of some *Cantius*. In this respect they differ from the more sharply crested molars typical of *Copelemur*, *Notharctus*, and *Smilodectes*. The enamel is smooth on all molars. Measurements of upper and lower cheek teeth of *Pelycodus jarrovii* from the San José Formation are given in Table 1. M_2 in the Huerfano Basin specimen, AMNH 17550, measures 5.3 mm in length and 5.0 mm in width.

The only anatomical details worthy of note on the maxillary fragment AMNH 48691 are the size and conformation of the infraorbital foramina. Two distinct foramina are present adjacent to each other and opening above P^{3-4} . These measure approximately 1.5 by 1.0 mm and 1.0 by 1.0 mm, respectively, in diameter.

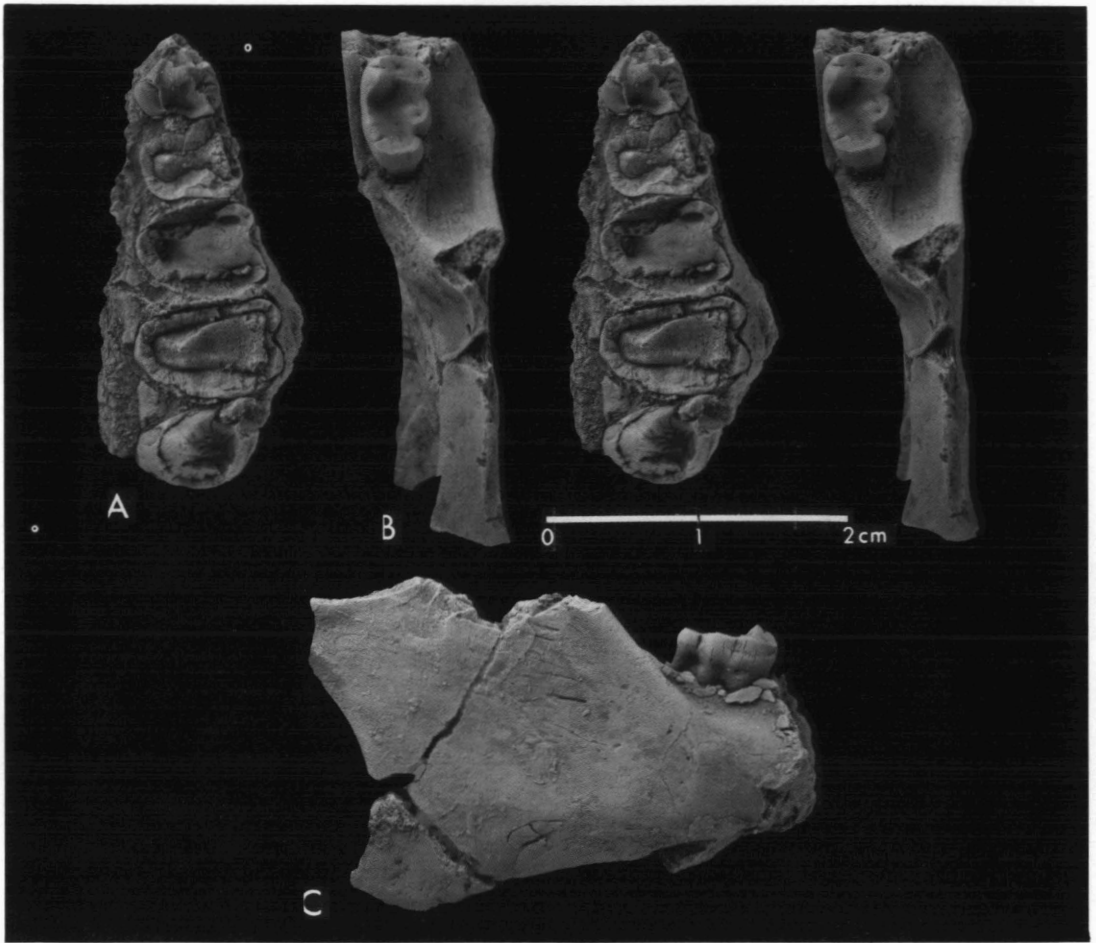


TEXT-FIG. 2 — Isolated upper teeth of *Pelycodus jarrovi* from the San José Formation, San Juan Basin, New Mexico. *A*, right canine, UALP 13600, stereophotograph of lingual side. *B*, left M^1 , UALP 7102, stereophotograph in occlusal view. *C*, right M^2 , UALP 11574, stereophotograph in occlusal view. *D*, right M^3 , UALP 13599, stereophotograph in occlusal view. Note reduced stylar shelf and absence of a mesostyle on all upper molars.

DISTINCTIVE CHARACTERISTICS OF *PELYCODUS JARROVII*

Cope (1877, p. 137) described the crown of M_3 , the only intact tooth in the holotype of *Pelycodus jarrovi*, as follows:

The base of its crown is an elongate oval, narrower behind. It supports two low cusps in front, a lobe on the middle of its outer border, and a lobe-like heel. The inner

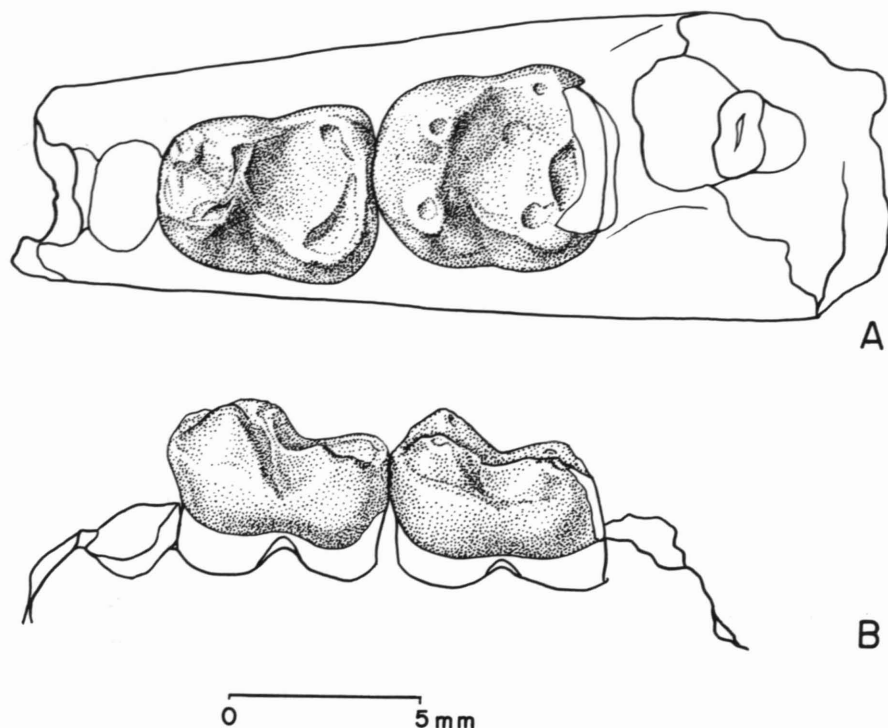


TEXT-FIG. 3 — Maxilla and mandible of *Pelycodus jarrovi* from the San José Formation, San Juan Basin, New Mexico. *A*, left maxilla with P³ and M³ (crowns of P⁴M¹⁻² broken away), AMNH 48691, stereophotograph in occlusal view. *B*, right partial mandible with M₃, AMNH 55514, stereophotograph in occlusal view. *C*, AMNH 55514 in lateral view.

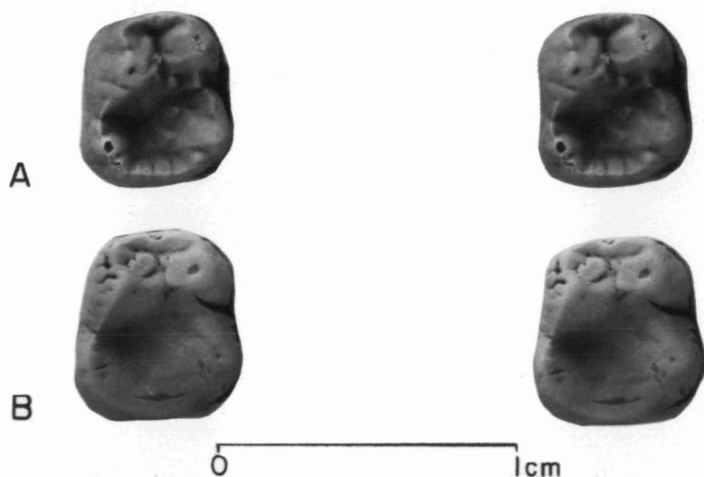
border is low, and continuous to the anterior cusp. The latter has a small tubercle on its anterior border, which is continued into the border of the crown without interruption to the anterior outer cusp. The center of the crown is concave and basin-shaped; an external cingulum at the front of the crown only.

This description and measurements given for the holotype by Cope match those of M₃ in AMNH 55514 (Text-fig. 3B,C) very closely. Cope (1877, p. 138) described the paraconid and metaconid on M₂ in a referred specimen as being "closely approximated," and his illustration of this specimen (Cope, 1877, Pl. 39, fig. 18) suggests that in fact the paraconid is much reduced in size by comparison with the metaconid. Cope characterized the enamel on this tooth as being of "glassy smoothness," which conforms closely to that of both AMNH 55514 (Text-fig. 3B) and USNM 5718 (Text-fig. 5B).

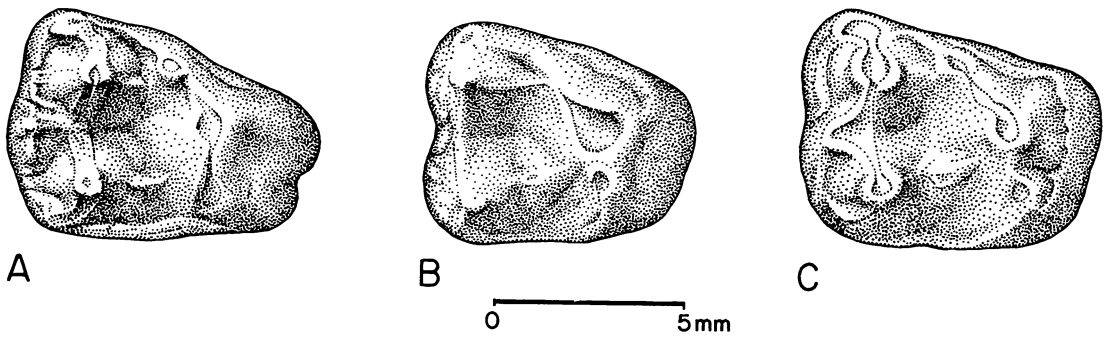
Lower molars of *Pelycodus jarrovi* described here differ from those of *Copelemur* in having a well developed entoconid corner on the talonid and no trace of the entoconid notch



TEXT-FIG. 4 — Neotype specimen of *Pelycodus jarrovi*, partial left mandible with M_{1-2} (AMNH 16298) from the San José Formation, San Juan Basin, New Mexico. *A*, occlusal view. *B*, lateral view. Note the smooth enamel, low rounded cusps, broad shallow talonid basins, and absence of a paraconid on M_2 characteristic of this genus and species.



TEXT-FIG. 5 — Isolated lower molars of *Pelycodus jarrovi* from the San José Formation, San Juan Basin, New Mexico. *A*, right M_2 , UALP 11571, stereophotograph in occlusal view. *B*, right M_2 , USNM 5718, stereophotograph in occlusal view.



TEXT-FIG. 6 — Comparison of upper molars of late Wasatchian *Copelemur*, *Pelycodus*, and *Cantius*. All specimens are right M^2 in occlusal view. A, *Copelemur tutus*, UALP 11377, from the San José Formation, New Mexico. B, *Pelycodus jarrovii*, UALP 11574, from the San José Formation, New Mexico. C, *Cantius venticolis*, PU 13445, from the Wind River Formation, Wyoming. Note the narrow stylar shelf and absence of a parastyle and mesostyle distinguishing *Pelycodus* from late Wasatchian *Copelemur* and *Cantius*.

characteristic of the latter genus. Lower molars of *P. jarrovii* differ from those of both *Copelemur* and Wyoming “*Pelycodus*” in having more rounded cusps and crests, broader and shallower talonid basins, smooth enamel, and more reduced paraconids on M_2 and M_3 . All of these distinctive features were recognized by Cope in the type material available to him, and there can be little doubt that the specimens described here are correctly referred to *Pelycodus jarrovii*.

Upper molars of *Pelycodus jarrovii* illustrated here are the first to be described from the same geographic area and stratigraphic interval as the original type specimen of *P. jarrovii*. They are even more distinctive than lower molars, differing from upper molars of contemporary North American late Wasatchian Adapidae in a number of features. Upper molars of *P. jarrovii* from New Mexico differ from those of late Wasatchian *Copelemur* from New Mexico and “*Pelycodus*” from Wyoming in having a more squared occlusal outline, more rounded cusps and crests, and a reduced stylar shelf with no trace of the parastyle or mesostyle so prominent in advanced *Copelemur* or Wyoming “*Pelycodus*” (Text-fig. 6).

On the basis of these differences, we regard *Pelycodus jarrovii* as generically distinct from all other species formerly referred to *Pelycodus*, and we here restrict the genus *Pelycodus* to include only *P. jarrovii*. When early and middle Wasatchian faunas are discovered in New Mexico and vicinity, other species of this genus may be recognized. At present the type species is unique.

NEOTYPE OF *PELYCODUS JARROVII*

Matthew (1915, p. 439) designated AMNH 15018, associated upper and lower jaws from the head of Dorsey Creek in the Bighorn Basin, Wyoming, as a neotype specimen of *Pelycodus jarrovii*. G. G. Simpson, in reviewing an earlier draft of this paper (letter dated October 17, 1980), notes that Matthew’s neotype does not meet requirements of Article 75 of the International Code of Zoological Nomenclature (ICZN, 1964) for two reasons: Matthew’s neotype is inconsistent with the original type material in retaining distinct paraconid cusps on M_2 and M_3 , and Matthew’s neotype did not come as nearly as practicable from the original type locality or geological horizon. In addition, as discussed above, recently discovered upper molars

of San Juan Basin *P. jarrovi* differ greatly from those included in Matthew's neotype of this species. Thus we do not regard Matthew's Wyoming neotype of *P. jarrovi* as valid, and we follow Gingerich and Simons (1977) in referring Matthew's neotype specimen, AMNH 15018, to "*Pelycodus*" *abditus* (see also below).

In the interest of nomenclatural stability we here designate the topotype specimen AMNH 16298, a left mandibular ramus with M_1 and M_2 intact, as the valid neotype specimen of *Pelycodus jarrovi*. Strictly speaking, our neotype specimen is from Arroyo Almagre (*fide* specimen label and AMNH archives) whereas Cope's holotype came from Arroyo Blanco (see Simpson, 1951, pp. 14–15), but these arroyos are separated by a distance of only 3–5 km and both yield faunas of the same age (late Wasatchian) from the Almagre facies of the San José Formation. The neotype designated here exhibits all of the features cited above (low rounded cusps and crests, broad shallow talonid basins, smooth enamel, and a reduced paraconid on M_2) as characterizing the type sample of *P. jarrovi* available to Cope, and the neotype closely matches Cope's holotype in the one comparable measurement (breadth of M_2 in the neotype, AMNH 16298, is 5.2 mm, whereas Cope, 1874, gives this measurement as 5.0 mm in his holotype).

In designating AMNH 16298 as the neotype of *Pelycodus jarrovi*, we note that all of the following qualifying conditions specified by the International Code of Zoological Nomenclature (ICZN, 1964) are satisfied: (1) *P. jarrovi* is distinguished from all other species of early Eocene Adapidae by the characteristics cited above in the section on distinctive characteristics of *Pelycodus jarrovi*. (2) The designated neotype is figured in Text-fig. 4. (3) Cope's original type material of *P. jarrovi* has been lost for many years. It should be conserved with other parts of Cope's early Eocene collection in either the AMNH or USNM. None of this material was available to Matthew (1915), and recent thorough search of both of these collections by the senior author indicates that the specimens in question are still missing. (4) The neotype designated here is consistent with all published descriptions and measurements of the type material (see previous section of this paper). (5) The neotype and Cope's original holotype came from adjacent arroyos exposing the same facies of the San José Formation in the San Juan Basin (see previous paragraph). (6) The neotype is in the permanent collection of the American Museum of Natural History, where it is available for study by qualified scholars.

GENERIC ATTRIBUTION OF SPECIES FORMERLY REFERRED TO *PELYCODUS*

In the latest revision of North American early Eocene Adapidae, six species from Wyoming and adjacent areas are referred to *Pelycodus* (Gingerich and Simons, 1977). Two species of European early Eocene Adapidae are referred to *Pelycodus* (Gingerich, 1977). In view of the marked dissimilarity of the type species of *Pelycodus*, *P. jarrovi* from New Mexico, to any of the other species referred to this genus from North America or Europe, all of these other species must be referred to a different genus. The genus *Cantius* Simons, 1962, is generally regarded as a junior synonym of *Pelycodus* (Gingerich and Simons, 1977), but *Cantius* clearly represents an older, more primitive, and more generalized stock of early Eocene Adapidae and it is not congeneric with *Pelycodus* in the restricted sense advocated here. *Cantius* is the only name available in the literature that can be applied to generalized species formerly referred to *Pelycodus*, and we here transfer all of the species listed in Table 2 from *Pelycodus* to the genus *Cantius*.

Cantius, based originally on a primitive European species, is an appropriate generic name for early Eocene "*Pelycodus*" in North America for a second reason (although this does not

TABLE 2 — List of European and North American early Eocene species formerly referred to *Pelycodus* Cope, 1875, and here referred to *Cantius* Simons, 1962. "*Protoadapis*"*eppi* Cooper, 1932, is the type species of *Cantius*.

Genus and species	Age	Type locality
EUROPE		
<i>Cantius eppi</i> (Cooper, 1932)	Early Sparnacian	Abbey Wood, Kent (England)
<i>Cantius savagei</i> (Gingerich, 1977)	Sparnacian-Cuisian	Avenay, Marne (France)
NORTH AMERICA		
<i>Cantius ralstoni</i> (Matthew, 1915)	Early Wasatchian	Vicinity of UM SC-89/SC-139, Clark's Fork Basin, Wyoming
<i>Cantius mckennai</i> (Gingerich and Simons, 1977)	Early Wasatchian	UM locality SC-133, Clark's Fork Basin, Wyoming
<i>Cantius trigonodus</i> (Matthew, 1915)	Middle Wasatchian	5 miles south of Otto, central Bighorn Basin, Wyoming
<i>Cantius abditus</i> (Gingerich and Simons, 1977)	Mid-Late Wasatchian	UM locality YM-45, central Bighorn Basin, Wyoming
<i>Cantius frugivorus</i> (Cope, 1875)	Late Wasatchian	Arroyo Almagre, San Juan Basin, New Mexico
<i>Cantius venticolis</i> (Osborn, 1902)*	Late Wasatchian	Lost Cabin beds, Wind River Basin, Wyoming

* *Cantius venticolis* includes all specimens referred to *Pelycodus jarrovii* by Gingerich and Simons (1977) except the New Mexico specimens listed in Table 1 of this paper. This species is intermediate stratigraphically and morphologically between early Eocene *Cantius* and middle Eocene *Notharctus*, and it could also be classified in the latter genus as Osborn (1902) proposed.

contribute in any way to the necessity or justification for replacing "*Pelycodus*" with *Cantius*). Gingerich (1980) and Godinot (1981) have both suggested, independently and for different reasons, that notharctine Adapidae reached North America by dispersal from or through Europe. It is fitting that the stem genus of the North American notharctine radiation should bear the name of a part of its former range in the Old World. *Cantius* is Latin for Kent, county in southeastern England from which this genus was first described.

Recognition of the distinctiveness of *Pelycodus jarrovii* brings to three the number of genera of adapid primates present in the late Wasatchian San José Formation of New Mexico. The late Wasatchian species of Adapidae from New Mexico are, in order of decreasing tooth size and body size: *Pelycodus jarrovii*, *Copelemur tutus*, *Cantius frugivorus*, and *Copelemur consortutus*. New Mexico specimens referred to the last of these species may represent a small species of *Cantius* rather than *Copelemur*, but the material at hand is not yet sufficient to permit certain identification. The generic diversity of early Eocene Adapidae in New Mexico is greater than that known from Wyoming, and further work is required to clarify the relationship of faunas known from these two areas.

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History, New York; D. Baird, Princeton University, Princeton; and R. J. Emry, National Museum of Natural History, Washington, permitted access to specimens described here. We thank Mr. David W. Krause for his thorough reading of the manuscript. Karen Payne drew the specimens in Text-figures 4 and 6, and Karna Steelquist is responsible for photography. This research was supported by grants from the National Science Foundation (DES 75-13616 and EAR 78-03326 to E. H. Lindsay and R. F. Butler; and DEB 80-10846 and BNS 80-16742 to P. D. Gingerich).

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