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Late Paleocene Mammals from the Cypress Hills, Alberta

Leonard Krishtalka

In September 1961, as part of a study on the surficial geology of the Cypress Hills, southeastern Alberta, Dr. J. A. Westgate, of the Department of Geology, The University of Alberta, and a student assistant, Mr. L. Hansen, collected rock for radiometric dating from bentonitic beds exposed by a slump in Cypress Hills Provincial Park, at a site known locally as Police Point. The sample, inadequate for potassium-argon dating because of microcline contamination, was found to contain abundant broken skeletal parts of small fossil vertebrates, including freshwater actinopterygian fishes, salamanders, turtles, lizards and mammals; these were recognized in 1966 by Dr. R. C. Fox of the departments of Geology and Zoology, The University of Alberta. In the spring and summer of 1966, 1967, and 1969, field parties from The University of Alberta, under the direction of Dr. Fox, made small collections of fossiliferous rock totaling about 1000 pounds from the Police Point locality. To recover the small vertebrate remains, the rock matrix was dissociated and flushed with water through 60-mesh per inch screens in the laboratory, leaving a concentrate rich in bones, teeth and scales (McKenna, 1960; Clemens, 1963); this was then dried, sorted under 10 magnifications, and identifiable fossils were removed for study. In 1969, at the suggestion of Dr. Fox, I began a study of the mammalian fossils in The University of Alberta collections from the Police Point locality, a project that had been initiated by Mr. W. G. Morris in 1967.

The bone in the fossiliferous beds is poorly mineralized and is further softened by continuous groundwater seep, which permeates the layers of bentonitic clays *in situ*. Consequently, most of the specimens collected for the study are isolated teeth, and many of these are broken (both probably from disturbance during field collecting and from washing and screening). Only a small number of fragmentary jaws with more than one tooth have been recovered, all eutherian. Among multituberculate remains, lower fourth premolars are rare, and all are incomplete. Fortunately, upper fourth premolars, highly diagnostic in distinguishing among ectypodontid multituberculates, are relatively abundant. Undisturbed blocks of matrix, collected from the Police Point locality in the spring of 1969 by Mr. D. B. Schowalter and myself, were prepared in the laboratory in an attempt to obtain associated mammalian dentitions, with fruitless results.

The fossiliferous beds, approximately three feet thick and exposed by a slump, occur on the south wall of a ravine, approximately 4372 feet above sea level and below about 150 feet of Lower Oligocene conglomerate, which caps the Cypress Hills. The Police Point locality, UAR-1, is about 16 miles east of the village of Elkwater, Alberta, in Lsd. 16, Sec. 15, Tp. 8, R. 1, W4 (approximately longitude 110° 03′ 40″ W, latitude 49° 38′ 55″ N). All but three of the teeth described here were collected from UAR-1; UA 5826, UA 5645, and UA 5783 were col-

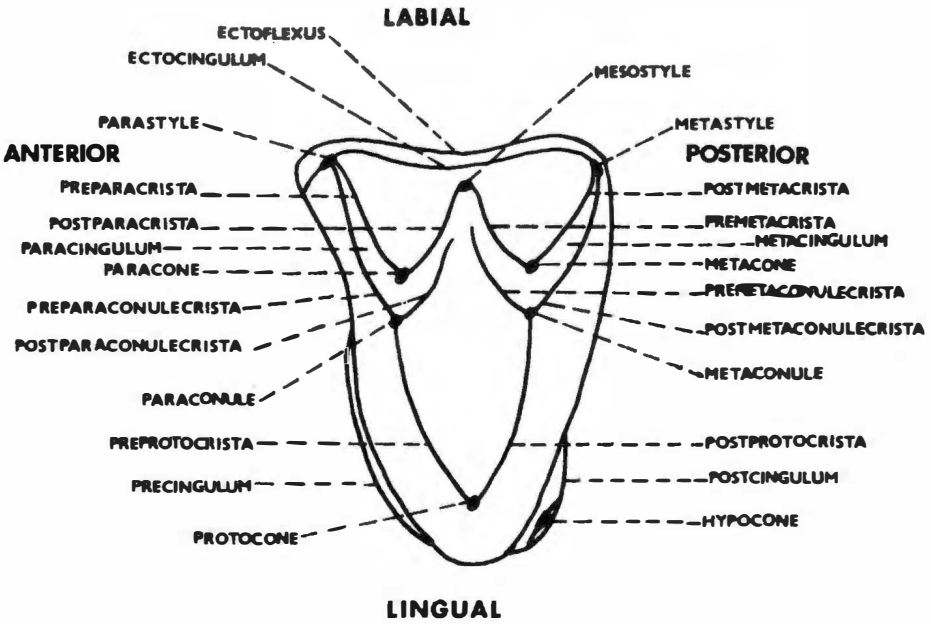

FIG. 1.—Diagram of hypothetical eutherian upper molar illustrating the tooth nomenclature used in this paper (modified from Szalay, 1969).

lected from UAP-13, L. S. Russell's (1967) Locality 1 in Lsd. 4, Sec. 16, Tp. 67, R. 10, W5 (approximately longitude 115° 26′ 40″ W, latitude 54° 47′ 40″ N), Swan Hills area, Alberta, by Mr. L. A. Lindoe in July 1969.

Paleocene mammals from Alberta were first discovered by Barnum Brown, American Museum of Natural History, in 1910 from the Paskapoo Formation, near the city of Red Deer, Alberta; these were described by him (Brown, 1914) and later, in greater detail, by Simpson (1927). Subsequent work by L. S. Russell (1926, 1929; 1932*b*, 1948, 1958, 1967) in the Paskapoo augmented the known diversity of Paleocene mammals from Alberta, although many of his original identifications have since been revised (see Simons, 1960; Van Valen, 1966; D. E. Russell, 1967). Fox (1968) described the only known possibly Torrejonian mammal from the Paskapoo; all mammals previously described from that formation are Tiffanian in age. This study provides the first record of mammalian remains from the Ravenscrag Formation.

The terminology and measurements used in describing multituberculate dentitions follow Simpson (1937*a*), Jepsen (1940), and Clemens (1963); that for therian dentitions (Figs. 1 and 2) follows Clemens (1966) and Szalay (1969). However, two terms as used here need further clarification: *internal* is in reference to the position of the most lingual row of cusps on multiuberculate molars and lower fourth premolars, and medial, to the position of the middle row of cusps on multituberculate upper molars. The term *medial*, in description of therian dentitions, refers to the position near or on an imaginary midline drawn labiolingually

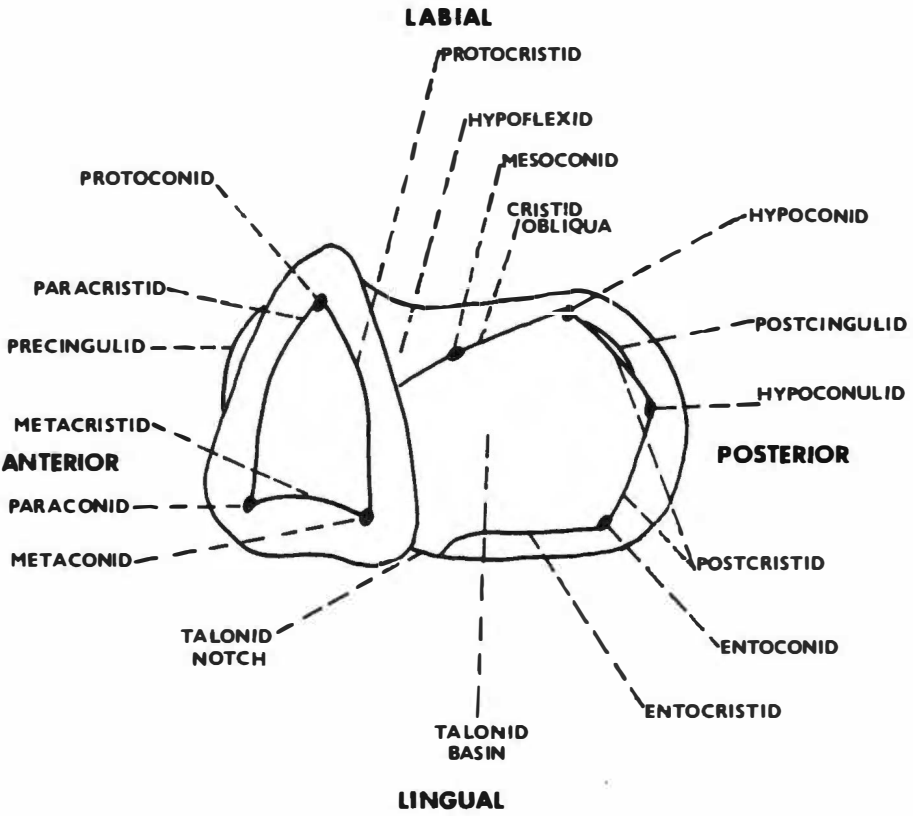

FIG. 2.—Diagram of hypothetical eutherian lower molar illustrating the tooth nomenclature used in this paper (modified from Szalay, 1969).

through teeth of the upper dentition, and anteroposteriorly through those of the lower dentition.

Abbreviations in this paper are as follows: UA, The University of Alberta, Edmonton; AMNH, American Museum of Natural History, New York City; PU, Princeton University, Princeton, New Jersey; L, length; W, width; AW, anterior width; PW, posterior width; UAR, University of Alberta Ravenscrag Formation, UAP, University of Alberta Paskapoo Formation; P or p, upper or lower premolar, dP or dp, upper or lower deciduous premolar, M or m, upper or lower molar. All measurements are in millimeters.

GEOLOGY

The Cypress Hills are an erosional remnant located in southeastern Alberta and southwestern Saskatchewan. The Hills (approximately 2500 feet above the Alberta plains) were uplifted during a major early Tertiary, pre-Oligocene Laramide orogenic pulse. Subsequently, large rivers flowed eastward from the Rocky Mountains across Alberta and Saskatchewan; these rivers deposited what is now

the Lower Oligocene conglomerate of the Cypress Hills Formation. The conglomerate subsequently acted as a protective cap during post-Oligocene erosion of the southern plains of Alberta and Saskatchewan (J. A. Westgate, personal communication).

The type section of the Ravenscrag Formation is "extensively exposed in the valley of the Frenchman River, from Ravenscrag to Eastend" (L. S., Russell, 1965: 134) and was first measured by McConnell (1885) and described by McLearn (in Fraser *et al.*, 1935). McLearn grouped post-Battle Formation rocks in southeastern Saskatchewan into the Ravenscrag Formation, which was separable into two lithologic units: a lower phase of "thick, massive or coarsely cross-bedded, medium grained sandstones with rare coal seams" (Furnival, 1946:94), and an upper phase of "fine sandstones, clays and shales light gray to buff . . . [and] lignite beds, many of them workable coal seams" (L. S., Russell, 1950:31). Furnival (1946) restricted the Ravenscrag Formation to this upper unit and recognized the lower part, which yielded dinosaur bone, as the Cretaceous Frenchman Formation, equivalent in age to the Lance and Hell Creek Formations in Wyoming and Montana, respectively. L. S. Russell (1950) used the stratigraphically lowest workable coal seam in the Ravenscrag as the boundary between that and the Frenchman Formation.

In southwestern Saskatchewan, the Ravenscrag Formation, as defined by Furnival and followed here, is approximately 200 feet thick, is overlain by the Lower Oligocene conglomeratic sandstone of the Cypress Hills Formation, and contains fossil plants and molluscs similar to those from the Fort Union Series in Montana (L. S. Russell, 1950). The Ravenscrag is divisible into two lithologic phases: a lower gray unit, "comparable to the Ludlow and Lebo Formations of eastern Montana and adjacent North Dakota" (L. S. Russell, 1950:31), and an upper, buff unit, "almost identical lithologically with the Tongue River Formation" of North Dakota (*loc. cit.*).

L. S. Russell (1932*a*, 1950:32) assigned post-Battle Formation rocks in southeastern Alberta to the Ravenscrag Formation and correlated these "from gray to buff, fine-grained, cross-bedded sandstones" with the upper, buff unit of the Saskatchewan Ravenscrag. This implied that the lower gray phase of the latter was absent on the Alberta side of the Cypress Hills. Furnival (1946), however, correlated the Alberta Ravenscrag as defined by Russell with the sandstones of the Frenchman Formation in Saskatchewan. This disagreement was partially resolved in 1950 when Russell showed that post-Battle sediments of Saskatchewan and Alberta are progressively younger from east to west; these sediments are overlain by Cretaceous deposits (Frenchman Formation) only as far west as Ravenscrag village, which is east of the Saskatchewan-Alberta border. The lower gray part of the Ravenscrag is present between this village and the border, whereas "farther west only the upper, buff portion of this formation is present" (L. S. Russell, 1950:35). Fossil nonmarine molluscs from Ravenscrag beds near Eagle Butte in the Cypress Hills of Alberta were described in Williams and Dyer (1930), revised by L. S. Russell (1932*a*) and L. S. Russell and Landes (1940), and are similar to those from the Fort Union Series, Montana, Ravenscrag Formation, Saskatchewan, and Paskapoo Formation of central Alberta (L. S. Russell, 1965).

The Alberta Ravenscrag, exposed only in the Cypress Hills, "is predominantly a sandstone formation, the typical beds being of medium to rather coarse grain, massive, cross-bedded, buff in color, and with indurated lenses" (Russell and Landes, *op. cit.*, 93). However, in some sections, higher beds of the Ravenscrag Formation "include a large proportion of clays and clayey sandstones" (Russell and Landes, *op. cit.*, 95). UAR-1 occurs within these bentonitic clay beds. Coal bearing beds underlie the Ravenscrag sediments in Alberta and are correlated with the carbonaceous beds that separate Furnival's Frenchman and Ravenscrag Formations in Saskatchewan. Westward, the Ravenscrag of the Cypress Hills is equivalent to at least part of the Paleocene Paskapoo Formation of the Alberta plains (Russell and Landes, *op. cit.*). It should be noted that correlation of the Alberta Ravenscrag with the type section of that formation in Saskatchewan has never been demonstrated by continuous mapping, and is supported only by inference from Russell's evidence, reported above.

The extremely fine-grained nature of the distinct, thinly bedded, bentonitic deposits of the Police Point locality implies that the ash beds were deposited in a low energy environment. The great abundance of tooth plates, scales, and vertebrae of freshwater fish indicates that the Police Point area may have been an inland lake during Paleocene time, in which ash falls accumulated.

SYSTEMATIC ACCOUNTS

Order **MULTITUBERCULATA** Cope, 1884*a*

Family PTILODONTIDAE Gregory and Simpson, 1926

Ptilodus montanus Douglass, 1908
(Fig. 3, Table 1)

Referred specimens.—P4, UA 5643-45; M1, UA 5646-48; p4, UA 5649; m1, (tentatively referred) UA 5650-52; m2, UA 5653-54; and fragments P4, M1, and m1.

Locality.—UAR-1, Ravenscrag Formation, Alberta; UAP-13, Paskapoo Formation, Alberta.

Known distribution.—Ravenscrag Formation, Alberta; Paskapoo Formation, Alberta; Gidley Quarry, Lebo Formation, Fort Union Series, Montana; Hoback Formation, Wyoming; Bison Basin Tiffanian, Fort Union Series, Wyoming; Shotgun local fauna, Fort Union Series, Wyoming.

Upper fourth premolar.—The internal cusps are heavily worn on UA 5643 (cusp formula, 6:11) and UA 5644; the posteroexternal two-thirds of the crown is broken on UA 5644 (cusp formula, 3+:11); the cusp formula on UA 5645 is 6:9.

The crown on UA 5643 and 5644 is long, low, and concave in lateral profile; in occlusal view, the anteroexternal bulge is wide and approximately one-third of the length of the crown. On UA 5645, the crown is straight in lateral profile and the anteroexternal bulge is about one-half of the length of the crown. The external cusps on the three premolars are pyramidal and well separated from each other. On UA 5643 and 5644, the second external cusp is largest and opposite the third internal cusp. A small cuspule, larger on UA 5644, occurs anterior to the first ex-

ternal cusp, and on UA 5643, posterior to the ultimate external cusp. On UA 5645, the largest external cusp, the third, is opposite the fourth internal cusp; accessory cuspules are lacking. On all three premolars, much of the enamel on the crown and lateral faces of the cusps is vertically wrinkled and rugose. The anterior and posterior margins of the crown do not overhang the roots; the posterior root is much longer anteroposteriorly than the anterior root.

Upper first molar.—The three referred upper first molars are posterior fragments. On UA 5648, the internal row, nearly complete, consists of seven cusps. The cusps preserved on the three molars are large and pyramidal, except for the posterior medial cusp, which is subcrescentic. The internal cusps are smaller than those in the medial and external rows and progressively decrease in size anteriorly. In both the external and internal rows the ultimate and preultimate cusps are joined into a ridge that extends obliquely to the base of the posterior medial cusp. Deep vertical grooves occur on the medial faces of the external and internal cusps and on the lateral faces of the medial cusps.

Lower fourth premolar.—UA 5649 is the central part of a broken right p4, which lacks the inferior three-quarters of the labial face. The fragment is large (length, 4.3; lingual height, 4.5), bears 7 serrations, and 12 ridges are preserved on its lingual face.

Lower first molar.—The three molars thought to pertain here are nearly complete, and have an identical cusp formula of 7:6. On each specimen, the base of the crown bulges slightly externally below the second external cusp, the anterior edge of the crown is concave and the posterior edge is oriented obliquely posteroexternally. The cusps are large and the two cusp rows converge anteriorly.

The external cusps are broader at the base and approximately one-third lower than the internal cusps. In the external row, the cusps decrease in height progressively anteriorly and posteriorly from the third, which is large, pyramidal and four-sided. The fourth and fifth cusps are subcrescentic and three-sided, with the anterior and internal faces of each forming a continuous convex surface. On UA 5651, the vertical posteromedial edge of the fourth and fifth cusps continues posteriorly, internal to the base of the next posterior cusp at its side. The sixth and seventh cusps are joined together almost to their apices.

In the internal row, the size of the cusps decreases progressively anteriorly and posteriorly from the fourth cusp, the highest on the crown. The anteriormost cusp (smallest on the crown) is pyramidal, and bears a vertical ridge on its medial face. The second, third, and fourth cusps are subcrescentic, and each bears two vertical ridges on its medial face that enclose a shallow, vertical depression. These ridges branch approximately two-thirds down the medial face of the fourth cusp on the three referred molars, and only the posterior vertical ridge branches on the second and third cusps on UA 5651 and 5650. In addition, two short, vertical ridges occur on the posterior slope of the fourth cusp on UA 5651. The fifth cusp on the three molars is more crescentic than the other internal cusps. The posterior slope of the cusp is concave, faces posteromedially, and is separated from the convex anterior slope by a sharp, internal vertical edge. One or two small ridges occur on the anteromedial face of the cusp. The fifth and sixth cusps are

TABLE 1.—*Dimensions of teeth of* Ptilodus montanus, *loc. UAR-1, Ravenscrag Formation, Cypress Hills, Alberta, and loc. UAP-13, Paskapoo Formation, Swan Hills, Alberta.*

Specimens	P4		M1		m1		m2	
	L	W	L	W	L	W	L	W
UA 5644	5.4	2.4						
UA 5643	6.2	2.7						
UA 5645	4.8	2.3						
UA 5646			—	2.6				
UA 5648			—	2.4				
UA 5647			—	2.9				
UA 5650					3.7	1.6		
UA 5651					4.1	2.0		
UA 5652					4.1	1.8		
UA 5653							2.5	1.9
UA 5654							2.5	2.0

joined; the sixth is developed as a crest that curves medially, ventrally, and posteriorly, and is continuous with the ultimate external cusp. A variable number of tiny cuspules occur on the crest of the sixth internal cusp.

Lower second molars.—The teeth referred here have a cusp formula of 4:2. The four cusps of the external row are subequal in height, lower than the internal cusps, and united into a crest. The apex of the first external cusp is free, whereas the apices of the second, third, and fourth cusps are joined. The median face of each external cusp bears a heavy vertical ridge that on the first three cusps divides approximately half way down the height of the cusp. The last external cusp is elongate, possibly from the union of two cusps.

The anterior internal cusp, largest and highest on the crown, is subcrescentic. The second internal cusp leans strongly posteriorly; its anterior slope is long, low, convex, and nearly horizontal in lateral profile; its posterior slope is short, straight, and nearly vertical. These two cusps are separate almost to their bases. Their median faces bear strong ridges separated by deep vertical grooves. A low, cuspidate cingulid extends posteroexternally from the posterior side of the base of the last internal cusp to the vertical posterior edge of the last external cusp, and forms the posterior and posterointernal border of the crown.

Remarks.—The fourth upper premolars referred here are similar in size and cusp formula to those of *Ptilodus* and *Prochetodon cavus* Jepsen, 1940, but are most similar in shape of the crown to the former; P4 of *Prochetodon cavus* (PU 14435) is much narrower labiolingually than P4 of *Ptilodus* and those described here. A third row of cuspules labial to the anteroexternal row is generally present on P4 of *Ptilodus mediaevus* Cope, 1881*a*, usually lacking in *P. montanus*, and is absent from PU 14468, the only described P4 of *P. wyomingensis* Jepsen, 1940, and from the P4 referred here. In resembling *P. montanus*, the

fourth upper premolars from Cypress Hills are wider than those of *P. wyomingensis*, bear more robust cusps, and have a longer internal row. The wide range in length of the fourth upper premolars (4.8-6.2) is almost identical to that observed by Simpson (1937*a*) for *P. montanus*. The fragment of p4 described here cannot be assigned with certainty, and is tentatively referred on the basis of size alone. The allocation of the first lower molars is also tentative; their cusp formula (7:6) is high compared to the formula 5-6:4-5 for first lower molars of known species of *Ptilodus*, but the size and shape of the crown is similar to the first lower molars of known species of the genus. Among Paleocene multituberculates, the ml of *Parectypodus jepseni* Simpson, 1935*a*, and *Ectypodus musculus* Matthew and Granger, 1921, have a cusp formula (8-7:6) similar to that of the first lower molars described here, but are much smaller than the Cypress Hills specimens. The assigned second upper and lower molars do not differ significantly from *P. montanus*.

Family ECTYPODONTIDAE Sloan and Van Valen, 1965

Neoplagiaulax hunteri (Simpson, 1936)
(Fig. 4, Table 2)

Referred specimens.—P4, UA 5655-56, and fragments, UA 5657-65; M1, UA 5666-67, and fragments, 5668-78, M2, UA 5679; m1, UA 5680-84, m2, UA 5685-88.

Locality.—UAR-1, Ravenscrag Formation, Alberta.

Known distribution.—Ravenscrag Formation, Alberta; Circle local fauna, Fort Union Series, Montana; Scarritt Quarry, Melville Formation, Fort Union Series, Montana.

Upper fourth premolar.—UA 5655 and 5656, the most nearly complete of the referred specimens, have a cusp formula of 2:8. The anteroexternal bulge is pronounced and widest slightly posterior to the second external cusp. The anterior and posterior edges of the crown overhang the anterior and posterior roots, respectively.

The first external cusp is small and opposite the first internal cusp. The second external cusp is large, pyramidal, broad at the base and opposite the second and third internal cusps. On UA 5657 and 5658, two broken teeth, the large external cusp occurs opposite the third and fourth internal cusps.

The anterior slope of the blade is high and arcuate in lateral profile; the posterior slope is gently concave. On UA 5655, the penultimate internal cusp is highest; the last two internal cusps are heavily worn on UA 5656, and their relative heights cannot be determined. The internal cusps are large and the intercusp grooves do not extend vertically below the bases of the cusps. A small, weak posterobasal cusp occurs on UA 5655 and 5656.

Upper first molar.—The referred teeth vary slightly in cusp formula: 8:11:7 on UA 5666, and 9:10:7 on UA 5667. The crown on both specimens is concave in lateral profile and the internal row is approximately two-thirds (on UA 5666) or three-quarters (on UA 5667) of the total length of the crown. Either the penultimate or antepenultimate cusp can be largest in the external and internal rows; the ultimate cusp is largest in the medial row.

The external cusps are subcrescentic and the internal face of each is worn flat. The medial cusps are large and crescentic posteriorly and are progressively smaller and more subcrescentic anteriorly. The crescentic cusps have broad, short bases, and are more nearly vertical than the crescentic medial cusps on M1 of *Mesodma* sp. P from the Ravenscrag Formation, Cypress Hills, Alberta. The internal cusps, much smaller than the medial or external cusps, are large and crescentic posteriorly and are progressively smaller and more subcrescentic anteriorly. The ultimate internal cusp is tiny. On one broken specimen, UA 5672, deep grooves occur on the occlusal faces of the cusps.

Upper second molar.—The only referred m2 (UA 5679) has a cusp formula of 1:4:4. The anterior wall of the crown is shallowly concave. A strong cingulum runs posterointernally from the anterior external cusp to the posterior medial cusp and forms the external margin of the crown. The medial cusps, of which the fourth is largest, are broad at the base, and crescentic; a deep, wide valley separates the third and fourth medial cusps. The internal row is developed as a high, laterally compressed ridge that curves posteriorly to the internal side of the posterior medial cusp at its base. The medial faces of the internal cusps are worn and flat, and bear deep, vertical grooves.

Lower first molar.—UA 5680 (cusp formula, 8:5) and 5681 (cusp formula, 9:5) are the most complete of the referred teeth. In occlusal aspect the anterior edge of the crown is slightly concave and the posterior margin is oriented obliquely posteroexternally. The size of the cusps in the external row decreases progressively anteriorly and posteriorly from the fourth external cusp, except for the ultimate external cusp, which is largest in the row and highest on the crown. The first external cusp is smallest; the second and third are pyramidal and are upright; the fourth is subcrescentic and the fifth to penultimate cusps are fully crescentic, with their apices directed posteriorly. The ultimate external cusp seems to be a union of two cusps, and its posterointernal edge descends to the floor of the crown to join the cuspidate posterior crest of the ultimate internal cusp. Dimplelike depressions occur on the external faces of the external cusps.

The internal cusps, of which the second is highest, are pyramidal, and bear heavy vertical ridges on their medial faces. The first four internal cusps are joined along approximately one-half of their height, the fourth and fifth along about three-quarters of their height. The apices of the first three internal cusps are directed nearly vertically, whereas those of the fourth and fifth cusps are tipped slightly posteriorly.

Lower second molar.—The cusp formula is 6:2 on UA 5685, and 7:2 on UA 5686. The external cusps are crescentic and united into a high crest in which the apices of the cusps are progressively more distinct anteriorly. The first internal cusp is high and subcrescentic; its apex is directed posteriorly and a shallow depression occurs on its internal face. The anterior face of the second internal cusp is almost horizontal in lateral profile; its posterior face is long and ridgelike, and curves posteriorly and externally to the floor of the crown; it is continuous with the posterior vertical edge of the last external cusp.

Remarks.—The family name Ectypodontidae is an emendation by Van Valen and Sloan (1966:270) from Ectypodidae Sloan and Van Valen, 1965.

TABLE 2.—*Dimensions of teeth of* Neoplagiaulax hunteri, *loc. UAR-1, Ravenscrag Formation, Cypress Hills, Alberta.*

Specimens	P4		M1		M2		m1		m2	
	L	W	L	W	L	W	L	W	L	W
UA 5655	3.7	1.3								
UA 5656	3.7	1.5								
UA 5666			2.7	1.2						
UA 5667			2.7	1.3						
UA 5679					1.8	1.7				
UA 5680							2.8	1.2		
UA 5681							2.9	1.4		
UA 5685									1.4	1.2
UA 5686									1.5	1.2

Ectypodus hunteri, described by Simpson (1936) from the Tiffanian Scarritt Quarry, was referred to *Neoplagiaulax* by Sloan (*in* Van Valen and Sloan, 1966: 270, Fig. 5; D. E. Russell, 1967). On P4 of *Neoplagiaulax* and those described here, the penultimate or antepenultimate internal cusp is highest, and the posterior slope of the blade is straight or gently concave; the ultimate internal cusp is highest on P4 of *Ectypodus* and *Mesodma*, and the posterior slope of the blade is strongly concave on P4 of *Parectypodus* (R. E. Sloan, personal communication). The teeth described here are significantly smaller in known parts of the dentition than are those of *Neoplagiaulax grangeri* (Simpson, 1935*a*), *N. hazeni* (Jepsen, 1940) and *N. douglassi* (Simpson, 1935*a*), and do not differ significantly from AMNH 33869-70, 33995-96, all specimens of *N. hunteri* from Scarritt Quarry, Montana (R. E. Sloan, personal communication).

Parectypodus sinclairi (Simpson, 1935*a*)
(Fig. 5, Table 3)

Referred specimens.—P4, UA 5689-90, 5721, and fragments, UA 5691-93; M1, UA 5694-95, and fragments, 5696-99; M2, UA 5700-02; p4, UA 5703-08; m1, UA 5709-16, and a number of broken teeth; m2, UA 5717-19, and fragment, 5720.

Locality.—UAR-1, Ravenscrag Formation, Alberta.

Known distribution.—Ravenscrag Formation, Alberta; Gidley Quarry, Lebo Formation, Fort Union Series, Montana.

Upper fourth premolar.—The referred premolars have a cusp formula of 2:6. Of the two external cusps, the first is smaller and opposite the first internal cusp. The second external cusp may be opposite either the second internal cusp or the groove between the second and third internal cusps. The blade is low and its cusps are progressively smaller and closer together posteriorly. The external

face of the blade is nearly vertical above its base; the internal face slopes obliquely to the internal edge of the base of the crown. In lateral profile, the anterior slope of the blade is convex, with the penultimate internal cusp highest; the posterior slope is concave. Posterobasal cuspules are present on UA 5721 and 5691, the latter a posterior fragment of a right P4. On UA 5689 and 5690, the base of the crown is too worn posteriorly to discern the presence of accessory cuspules.

Upper first molar.—The cusp formula is 9:10:7 on UA 5694 and 8:9:6 on UA 5695. In occlusal view the crown tapers anteriorly and its anterior edge is oriented obliquely posteroexternally. The anterior root is longer anteroposteriorly and narrower than the posterior root.

The cusps of the external and internal rows are progressively smaller anteriorly from the penultimate cusp. The external cusps are upright, pyramidal, with flat, worn medial faces. In the medial row the posterior cusps are large and crescentic; anteriorly the cusps are smaller and more subcrescentic. The internal row of cusps occupies approximately the posterior three-fourths (on UA 5694) or two-thirds (on UA 5695) of the lingual border of the crown. The internal cusps are subcrescentic and lean strongly anteriorly. The ultimate internal and external cusp is small and united into a ridge with the penultimate cusp.

Upper second molar.—The cusp formula is 1:4:4-5. A cingulum runs obliquely posterointernally from the low, ridgelike anterior external cusp to the ultimate medial cusp and forms the external margin of the crown. The medial cusps are crescentic and lean anteriorly; the apex of the first is depressed and joined to the second medial cusp; the second and third medial cusps are joined almost to their apices; the fourth cusp is separate. The internal cusps, more nearly subcrescentic than the medial cusps, are united into a high ridge that is progressively lower posteriorly. The apices of the internal cusps are free and point anteriorly. Vertical grooves occur on the medial face of each internal cusp and are most pronounced on the ultimate internal cusp.

Lower fourth premolar.—All of the lower fourth premolars allocated to *P. sinclairi* are posterior fragments, so that determination of the number of serrations or ridges is not possible. Posteriorly, the blade and base of the crown form an angle of approximately 140 degrees. The size of the serrations increases posteriorly, and the last two serrations approach the size of the cusps on m1 of this species. On the internal face of the broken fourth premolars, two strong ridges curve posteroventrally, one from between the antepenultimate and penultimate serrations, the other from between the penultimate and ultimate serrations. Anteroventrally directed ridges do not originate from the last two serrations on either face.

Lower first molar.—The cusp formula is 7:4, except for UA 5713, on which there are eight external cusps. A tiny cuspule occurs on the anterior slope of the anteriormost external cusp on those molars with seven external cusps. On UA 5713, this cuspule is large enough to be counted as a true cusp.

The rows of cusps diverge posteriorly. The anterior edge of the crown is shallowly concave and projects anteriorly slightly beyond the anterior root. The posterior margin of the crown is oriented posterointernally and is continuous with

TABLE 3.—*Dimensions of teeth of* Parectypodus sinclairi, *loc. UAR-1, Ravenscrag Formation, Cypress Hills, Alberta.*

Specimens	P4		M1		M2		m1		m2	
	L	W	L	W	L	W	L	W	L	W
UA 5721	2.1	0.7								
UA 5689	2.3	0.9								
UA 5690	1.9	0.7								
UA 5694			2.3	1.0						
UA 5695			2.2	1.1						
UA 5700					1.5	1.5				
UA 5701					1.4	1.4				
UA 5702					1.5	1.5				
UA 5710							1.7	0.8		
UA 5709							1.7	0.8		
UA 5711							1.9	0.9		
UA 5712							1.8	0.9		
UA 5713							1.9	0.9		
UA 5714							1.9	0.9		
UA 5715							2.0	0.9		
UA 5719									1.0	1.0
UA 5717									1.0	0.9
UA 5718									1.1	0.9

the posterior root. An interradicular crest joins the two roots along the base of the crown.

The external cusps progressively increase in size posteriorly; anteriorly these are conical, posteriorly subcrescentic to crescentic. The internal cusps, except for the first, are higher and larger than the external cusps. The anteriormost internal cusp is nearly conical, the second and third are subcrescentic and the fourth is long and ridgelike, resembling the union of two cusps. The medial face of each of the three posterior internal cusps is straight, vertical, and marked by a shallow depression.

Lower second molar.—The cusp formual is 4:2. The anterior face of the crown is nearly flat. The external cusps are crescentic, subequal in height and united into a ridge, in which only the third and fourth cusps are joined together to their apices.

The first internal cusp is crescentic, tallest on the crown and directed nearly vertically. The second internal cusp is pyramidal and lower and longer anteroposteriorly than the first internal cusp. The two cusps are well separated from each other and a deep, vertical depression occurs on the medial face of the first internal cusp. A cingulid runs posteroexternally from the ultimate internal cusp

to the last external cusp and forms the posterior and posterointernal border of the crown.

Remarks.—The specimens from Cypress Hills agree in size and coronal morphology and the lower molars in cusp formula with *Parectypodus sinclairi*, previously known only from Gidley Quarry, from parts of the lower dentition (Simpson, 1935*a*). Sloan (*in* Van Valen and Sloan, 1966: 270, Fig. 5; D. E. Russell, 1967) referred Simpson's ?*Ptilodus sinclairi* to *Parectypodus* partly on the basis of the large obtuse angle formed by the posterior slope of the crown and its base on p4 (R. E. Sloan, personal communication).

The isolated upper fourth premolars from Cypress Hills resemble those of known species of *Parectypodus* in cusp formula and in the strongly concave posterior slope of the internal crest (R. E. Sloan, personal communication). The isolated parts of the upper dentition differ significantly in size and cusp formula from *Parectypodus laytoni* (Jepsen, 1940), and are referred to *P. sinclairi* on size association with the isolated parts of the lower dentition.

Mesodma sp. P
(Fig. 6, Table 4)

Referred specimens.—P4, UA 5722-25, 5758, and a number of fragments; M1, UA 5726-28; M2, UA 5729-41; p4, fragments UA 5742-51; m1, UA 5752; m2, UA 5753-57, and a number of fragments.

Locality.—UAR-1, Ravenscrag Formation, Alberta.

Known distribution.—Ravenscrag Formation, Alberta; Gidley Quarry, Lebo Formation, Fort Union Series, Montana (R. E. Sloan, personal communication).

Upper fourth premolar.—The cusp formula of the referred premolars is 2-3:6-7. In occlusal view the labial margin of the crown resembles an elongate sigmoid curve, with a moderate anteroexternal bulge and a much smaller expansion above the fifth and sixth internal cusps. The crown slightly overhangs the roots anteriorly and posteriorly.

The size of the external and internal cusps increases posteriorly. On the premolars with three external cusps, the latter occur opposite the first, second, and third internal cusps, respectively (UA 5725 and 5724), or opposite the second to fourth internal cusps, respectively (UA 5723). When two external cusps occur, they are opposite the first and second internal cusps, respectively. The anterior slope of the internal crest is straight and low in lateral profile; the posterior slope is short and straight or slightly convex. The ultimate internal cusp is highest on the crown and is the first cusp to wear. The intercusp grooves on the blade progressively increase in length posteriorly and extend along approximately one-third the height of the blade. Two posterobasal cuspules occur on either side of a pitlike depression, and are heavily worn on most of the referred premolars.

Upper first molar.—The molars thought to pertain here have a cusp formula of 8-9:9-10:5. The crown in occlusal aspect narrows anteriorly, is concave in lateral profile and its anterior and posterior edges slightly overhang the roots beneath. In the external and internal rows, the cusps are subcrescentic, and the penultimate cusp is largest and forms a ridge with the ultimate cusp. The medial

cusps are large and crescentic posteriorly and become progressively smaller and subcrescentic anteriorly. The crescentic cusps of the medial row are lower, lean more strongly anteriorly and have a longer base than those on the upper first molars of *Neoplagiaulax hunteri* and *Parectypodus sinclairi.* On UA 5727 and 5728, the internal row is one-half the length of the crown and ends anteriorly at the fifth medial cusp. On UA 5726 the internal row provides two-thirds of the lingual border of the crown and meets the medial row anteriorly at the fourth medial cusp.

Upper second molar.—The cusp formula on the referred molars is 1:3:3. The anterior face of the crown is concave and the anterior and posterior edges of the crown do not overhang the roots. A narrow cingulum runs posterointernally from the low, ridgelike external cusp to the ultimate medial cusp, and forms the external margin of the crown. The first medial cusp is depressed and arises from the anterior slope of the second medial cusp. The second and third medial cusps are high, crescentic, with a large space between, and lean anteriorly. The internal cusps, more nearly vertical than the medial cusps, are subcrescentic and progressively decrease in size posteriorly. The first two internal cusps are joined along most of their height; the last internal cusp is more nearly separate.

Lower fourth premolar.—All of the referred premolars are either anterior or posterior fragments. The posterior slope of the blade and the base of the crown form an angle of approximately 110 degrees. In lateral profile, these premolars are lower than p4 of *Parectypodus sinclairi* (posterior angle approximately 140 degrees) and slightly higher than that of *Mimetodon silberlingi* (posterior angle approximately 100 degrees). Anteroventrally directed ridges do not originate from the posterior two serrations. On UA 5742, the most nearly complete tooth, a deep groove extends posteroventrally from between the posterior two serrations to the posteroexternal depression.

Lower first molar.—UA 5752, a left molar, has a cusp formula of 6:4. The anterior edge of the crown is concave in occlusal aspect and slightly overhangs the anterior root. The crown in occlusal outline is more nearly rectangular than the m1 crown of *Parectypodus sinclairi.* The two rows of cusps barely converge anteriorly, and the external row extends posteriorly for only a short distance beyond the internal row. The posterior edge of the crown is oriented slightly posteroexternally, in contrast to the greater degree of obliquity of the posterior coronal margin of similar-sized lower first molars of *P. sinclairi.* An interradicular crest, present on m1 of *P. sinclairi,* is absent on UA 5752.

The relative sizes of the external cusps cannot be determined because of wear. The first two external cusps appear nearly conical; the remaining external cusps are subcrescentic. The internal cusps are subcrescentic, and are larger than the external cusps and approximately twice as high. The medial faces of the internal cusps are worn flat, whereas their external faces are convex in occlusal aspect. The ultimate internal cusp is long, high, and ridgelike.

Lower second molar.—All of the referred molars have a cusp formula of 3:2. The anterior face of the crown is concave in occlusal aspect. The external cusps increase in size posteriorly; the first two are crescentic, the third is sub-

TABLE 4.—*Dimensions of teeth of* Mesodma *sp. P, loc. UAR-1, Ravenscrag Formation, Cypress Hills, Alberta.*

Specimens	P4		M1		M2		m1		m2	
	L	W	L	W	L	W	L	W	L	W
UA 5722	1.7	0.7								
UA 5725	2.1	0.7								
UA 5723	2.0	0.7								
UA 5724	2.0	0.7								
UA 5758	1.7	0.7								
UA 5726			2.1	1.1						
UA 5727			2.1	1.0						
UA 5728			2.2	1.1						
UA 5729					1.0	1.0				
UA 5730					1.0	0.9				
UA 5731					0.9	1.0				
UA 5733					1.0	1.0				
UA 5734					1.0	1.0				
UA 5736					0.9	0.9				
UA 5735					0.9	0.9				
UA 5737					0.9	0.9				
UA 5738					0.9	0.9				
UA 5739					1.0	1.0				
UA 5740					1.1	1.1				
UA 5752							1.6	0.7		
UA 5753									0.9	0.8
UA 5754									1.0	0.9
UA 5756									0.9	0.8
UA 5755									0.9	0.8
UA 5757									0.9	0.8

crescentic and bears a vertical groove on its large medial face. A narrow cingulum curves anterointernally from the third external cusp to the second internal cusp.

The anterior internal cusp is crescentic and highest on the crown. The second internal cusp is crestlike, with a long, convex anterior slope, a short, straight, vertical posterior slope, and a flat, vertical medial face.

Remarks.—Mesodma sp. P is presently being described by Dr. R. E. Sloan, University of Minnesota. The parts of the lower dentition described here do not differ significantly from AMNH 35298, a fragment of a lower jaw with p4-m2, from Gidley Quarry, Montana, which typifies this species (R. E. Sloan, personal communication).

The parts of the upper dentition are referred partly on the basis of size association with the isolated parts of the lower dentition. Additional *Mesodma*-like fea-

tures of the upper fourth premolars described here include a cusp formula of 2-3:6-7, the ultimate internal cusp as the highest, and a straight or somewhat convex posterior slope of the blade. The first and second upper molars are *Mesodma*-like in the shape of the crown and cusp formula (Clemens, 1963; R. E. Sloan, personal communication). *Mesodma* sp. P is the smallest known Paleocene species of *Mesodma.*

Mimetodon silberlingi (Simpson, 1935*a*)
(Fig. 7)

Referred specimen.—p4, UA 5759.

Locality.—UAR-1, Ravenscrag Formation, Alberta.

Known distribution.—Ravenscrag Formation, Alberta; Rock Bench Quarry, Polecat Bench Formation, Wyoming; Gidley Quarry, Lebo Formation, Fort Union Series, Montana; Olive local fauna, Fort Union Series, Montana; Shotgun local fauna, Fort Union Series, Montana.

Lower fourth premolar.—The only tooth of *M. siberlingi* in the assemblage from Cypress Hills is a posterior fragment of a right p4 (UA 5759). The angle formed by the posterior slope of the blade and the base of the crown is approximately 100 degrees. Three strong ridges, one from each of the posterior three serrations, curve posteroventrally toward the depression on the posterodorsal corner of the tooth.

Remarks.—In its low lateral profile and in possessing three strong posterior ridges, UA 5759 resembles AMNH 35499, a partial lower jaw with p4-m1 of *Mimetodon silberlingi* from Gidley Quarry, Montana (Simpson, 1935*a*). Sloan (*in* Van Valen and Sloan, 1966; D. E. Russell, 1967) provisionally referred Simpson's *Ectypodus silberlingi* to *Mesodma*, but now considers it a species of *Mimetodon* (R. E. Sloan, personal communication).

Order MARSUPIALIA Illiger, 1811

Family DIDELPHIDAE Gray, 1821

Peradectes cf. **elegans** Matthew and Granger, 1921
(Fig. 8)

Referred specimens.—M1, UA 5760; probable m1 or m2, UA 5761-62.

Locality.—UAR-1, Ravenscrag Formation, Alberta.

Known distribution.—Ravenscrag Formation, Alberta; Circle Local Fauna, Fort Union Series, Montana; Mason Pocket, San Jose Formation, Colorado; Saddle Locality, Bison Basin Tiffanian, Fort Union Series, Wyoming (distribution of *P. elegans*).

Upper first molar.—The protocone, paracone and metacone are high and well developed on UA 5760 (length, 1.6; anterior width, 1.5; posterior width, 2.1). The protocone, slightly lower than the metacone, is as tall as the paracone. The metacone is slightly taller, larger and more lingual than the paracone; both cusps lean labially and are labially concave in lateral profile. In occlusal view, the labial face of the metacone is convex anteriorly and concave posteriorly. A sharp

median ridge, accentuated by a depression on each side, descends the labial face of the paracone between the pre and postparacristae and ends on the stylar shelf, lingual to stylar cusp "B."

The metastylar area is wider than the parastylar area and the ectoflexus is median and shallow. The stylar shelf bears five stylar cusps along its labial edge. Stylar cusp "A" is anterolabial, and stylar cusp "B" is directly labial to the paracone. Stylar cusp "C" is the smallest stylar cusp, barely discernable on the labial edge of the ectocingulum. Cusps "D" and "E" are subequal in height and closer to each other than are the others. Stylar cusp "A" is slightly lower than "B" (the tallest stylar cusp), and slightly higher than either "D" or "E."

The paraconule and metaconule are rudimentary. The preparaconulecrista runs labially to stylar cusp "A" and forms the anterior edge of the paracingulum. The preparacrista extends to cusp "B" and the postmetacrista to cusp "E," on the posterolabial corner of the crown. The trigon basin is deep and narrow.

Lower first or second molar.—The metaconid, entoconid and postcingulid are broken on UA 5761 (length, 1.8; anterior width, 1.0 posterior width, 1.1), an isolated left m1 or m2. The protoconid, the largest trigonid cusp, is tall and vertical. The paraconid, approximately one-half the height of the protoconid and anteroposteriorly compressed, leans anteriorly and is slightly more labial than the metaconid. The size of the base of the broken metaconid implies that, when complete, the cusp was taller than the paraconid but shorter than the protoconid.

The talonid is about one-half the height of the trigonid, and is slightly shorter and wider. The hypoconulid, smallest of the talonid cusps, leans posteriorly and is closely twinned with the broken entoconid. The cristid obliqua meets the posterior wall of the trigonid approximately midway between the ventral apex of the protocristid and labial margin of the trigonid. The postcingulid, broken on UA 5761, is well developed on UA 5762, a talonid of a right m1 or m2, and extends ventrolabially along the posterior wall of the talonid, below the postcristid. The entoconid, complete on UA 5762, is conical and opposite and slightly lower than the hypoconid. The talonid basin on both of the referred lower molars is deep, closed, and rounded.

Remarks.—Referral of UA 5760 and UA 5761 to the Metatheria is based on the occurrence of five stylar cusps on a wide stylar shelf on the upper molars, and twinned entoconid and hypoconulid on the lower molars.

UA 5760, with nearly subequal paracone and metacone, and UA 5761, with a high protoconid relative to the paraconid and metaconid, are closer to *Peradectes* than to *Peratherium.* On upper molars of *Peratherium* the paracone is much lower than the metacone, and, on the lower molars, the metaconid is higher than on UA 5761 and lower molars of *Peradectes* (Gazin, 1956; McKenna, 1960).

The specimens from Cypress Hills are smaller than corresponding parts of the dentition of *Peradectes pauli* Gazin, 1956, from the Bison Basin Tiffanian, but agree in size with those of *P. elegans* from Mason Pocket, Colorado. However, allocation to *P. elegans* is tentative, inasmuch as UA 5760, with a tiny stylar

cusp "C," differs from the M1 of *P. elegans* (AMNH 17382), on which "C" is the largest stylar cusp (Simpson, 1935*b*).

Order INSECTIVORA Illiger, 1811

Family PANTOLESTIDAE Cope, 1884*b*

Propalaeosinopa diluculi (Simpson, 1935*a*)

(Fig. 9, Table 5)

Referred specimens.—M1, UA 5763-64, and fragments UA 5765, UA 5766; M2, UA 5767-69, and fragments 5770-74; M3, UA 5775-76; m1, UA 5777-78, and fragments, 5779-81.

Locality.—UAR-1, Ravenscrag Formation, Alberta.

Known distribution.—Ravenscrag Formation, Alberta; Gidley Quarry, Lebo Formation, Fort Union Series, Montana.

Upper first molar.—Most of the enamel is worn from the labial faces of the paracone and metacone on UA 5763, the most complete of the upper first molars thought to pertain here. The molar is moderately transverse and bears a tall, well-developed protocone, paracone, and metacone. A large, bunodont hypocone, considerably lower than and well separated from the protocone, occurs posterolingual to that cusp, at the lingual end of a broad, shelflike postcingulum. The protocone leans strongly labially and slightly anteriorly; a broad, flat ridge occurs on its labial face, between two wear facets. The paracone and metacone are subequal and connate along approximately one-half of their heights. The metacone is somewhat laterally compressed, the paracone more nearly conical. The paraconule is low and rounded and near the protocone. The metaconule is pyramidal, more labial than the paraconule, and approximately twice as large. The postmetacrista is high and curves posterolabially from the metacone to the metastyle, which is worn flat, and extends labially beyond the parastyle. The ectocingulum is faint, and the ectoflexus very shallow. There is virtually no stylar shelf. The metacingulum is wider than the paracingulum and curves around the lingual and posterior parts of the base of the metacone; the paracingulum is limited to the anterior side of the base of the paracone. The precingulum is singificantly shorter and narrower than the postcingulum.

Upper second molar.—Most of the metacone and the edge of the parastyle are missing from UA 5767, the most complete of the three isolated molars. UA 5767 resembles the M1 in possessing a large, bunodont hypocone posterolingual to and lower than the protocone, a wide, shelflike postcingulum, high and well-developed paracone and protocone and an elevated postmetacrista. The size of the base of the broken metacone implies that the cusp was as well developed as the paracone.

Relative to the upper first molars, UA 5767 is considerably more transverse, possesses a much larger metastyle, a slightly larger parastyle and a deeper ectoflexus. The paraconule is larger than the metaconule on M2, but as on M1, is nearer the protocone. The preprotocrista is higher than the postprotocrista, and, consequently, the anterior and lingual walls of the trigon basin are higher than the posterior wall.

TABLE 5.—*Dimensions of teeth of* Propalaeosinopa diluculi, *loc. UAR-1, Ravenscrag Formation, Cypress Hills, Alberta.*

Specimens	M1		M2		M3		m1	
	L	W	L	W	L	W	L	W
UA 5763	2.7	3.7						
UA 5764	2.5	3.4						
UA 5767			2.8	4.6				
UA 5768			3.0	4.2				
UA 5769			—	4.2				
UA 5776					—	3.8*		
UA 5777							2.8	2.0
UA 5778							2.9	2.0

*Parastyle broken.

Upper third molar.—The parastylar salient is missing from UA 5776, the most nearly complete of the referred molars. The line of breakage is along the anterolabial part of the base of the paracone. The molar is highly transverse, and the protocone and paracone are well developed. In comparison to the first and second upper molars, there is no metastyle or postmetaconulecrista on UA 5776, the metacone is only approximately one-half the height of the paracone, and the paraconule is smaller than on the preultimate molars. On M3 the metaconule is large, bunodont and about one-half the height of the metacone. A tiny cuspule, lacking on the anterior molars, occurs on the posterior edge of the crown, between the bases of the metacone and metaconule. The length of the broken labial edge on UA 5776 may imply that the parastyle was long. The ectocingulum runs anterolabially from the base of the metacone to the broken margin of the tooth. The postmetacrista, barely discernable on the labial face of the metacone, is continuous with the ectocingulum. The postcingulum on UA 5776 is slightly wider than the precingulum and is damaged lingually. However, on UA 5775, an isolated lingual fragment of a left M3, the postcingulum is complete and terminates lingually in a tiny hypocone.

Lower first molar.—The trigonid is moderately higher than, but approximately as wide as, the talonid. The protoconid and metaconid are large, bunodont, and subequal in height. The paraconid, anterior and moderately labial to the metaconid, is low, bulbous, and slightly compressed anteroposteriorly.

The talonid bears a large and bulbous hypoconid, entoconid, and hypoconulid. The entoconid is slightly higher than and directly opposite the hypoconid; both cusps are taller than the medial and more posterior hypoconulid. The cristid obliqua meets the posterior wall of the trigonid below and labial to the ventral apex of the protocristid. The talonid basin is deep, with its lowest point near the

posterior wall of the trigonid. There is no postcingulid on the referred lower first molars.

Remarks.—The teeth described here are much smaller than those of *Palaeosinopa*, larger than *Propalaeosinopa thomsoni* (Simpson, 1936) and similar in size to those of *Propalaeosinopa diluculi.* The anterior upper molars, with a concave labial margin and an ectoflexus, are similar to those of *Propalaeosinopa* and differ from M1 and M2 of *Palaeosinopa*, on which the labial border is convex, with no ectoflexus.

Apart from absolute size, the upper molars of *P. diluculi* are proportionately longer lingually than those of *P. thomsoni* and possess broader pre and postcingula. In addition, the upper first molars are not as constricted anteroposteriorly across the conules and possess a larger hypocone; the upper second molars have a wider stylar shelf, a shallower ectoflexus, and a smaller, less labially projecting parastylar salient. The m1 of *P. diluculi* is significantly wider than that of *P. thomsoni* and the cusps, although similarly placed, are more robust.

Family Mixodectidae Cope, 1883

Elpidophorus elegans Simpson, 1927
(Fig. 10, Table 6)

Referred specimens.—Fragment of left maxilla with P3-4M1, UA 5782; M1, UA 5783, and fragments, UA 5784-87, fragments of M2, UA 5788-89; fragments of M3, UA 5791; ?dp4, UA 5792; trigonids of m1 or m2, UA 5793-96; talonid of m1 or m2, UA 5797, and fragment, UA 5798.

Localities.—UAR-1, Ravenscrag Formation, Alberta; UAP-13, Paskapoo Formation, Alberta.

Known distribution.—Ravenscrag Formation, Alberta; Paskapoo Formation, Alberta; Scarritt Quarry, Melville Formation, Fort Union Series, Montana.

Upper third premolar.—The P3 of UA 5782, hourglass-shaped in occlusal outline, is constricted anteroposteriorly labial to the protocone, and bears three cusps. The paracone and metacone, connate along approximately two-thirds of the height of the latter, are large and broad at the base, with the paracone more nearly conical and about one-third taller. The protocone is small and approximately one-half the height of the paracone. There are no conules on the P3. The parastyle, directly anterior to and separated from the paracone, is large and conical. The metastyle is merely a cuspule at the base of the posterior slope of the metacone. The postprotocrista is absent on P3; the preprotocrista is short and is stronger at its labial end. Two ridges, one each near the parastyle and metastyle, represent the ectocingulum. Tiny cuspules occur anteroposteriorly along the labial edge of the crown between these two ridges. The anterior and posterior cingula are short and barely discernable.

Upper fourth premolar.—The occlusal outline of P4 is triangular. The paracone is slightly taller and more nearly conical and vertical than the metacone, which leans somewhat posteriorly. The protocone is low, medial and subcrescentic. The conules are robust, with the metaconule slightly larger, taller and more labial. The parastyle, almost as large as the paraconule, is directly anterior

to the paracone. The metastyle is small, at the posterolabial part of the base of the metacone. The protocristae are very strong, and curiously, end lingual to the conules—the postprotocrista, directly lingual to the apex of the metaconule, and the preprotocrista, anterolingual to the apex of the paraconule. The postcingulum, well developed and not cuspidate, and the precingulum, comparatively narrower, are not continuous lingually. The ectocingulum is strong and dips dorsally at the base of the paracone.

Upper first molar.—The crown of the M1 on UA 5782 is transverse and rectangluar in occlusal outline. The paracone and metacone are low, yet well developed, with the metacone broader at the base and subcrescentic, and the paracone more nearly conical. The protocone is low, broad, and slightly anterior to the midline. The hypocone, posterolingual to the protocone, is small, anteroposteriorly compressed and ridgelike. The conules are large, bulbous, subequal in height and broad at the base, occupying almost the entire area of the crown between the protocone and the paracone and metacone. The postparacrista and premetacrista run directly labially to a well-developed mesostyle and form a U-shaped centrocrista. The metastyle is slightly more lingual than the mesostyle but considerably more labial than the parastyle; the three styles are worn, but appear to have been subequal in size. As on the P4, the protocristae on the M1 end lingual to the conules. Each postconulecrista meets the lingual cingulum at the labial part of the base of the conule. Both cingula are equally well developed and broad, but are not continuous lingually. The ectocingulum is strong between the parastyle and mesostyle, but is weaker and incomplete between the latter and the metastyle.

Upper second molar.—UA 5788, a lingual fragment, is the most complete of the three specimens. The lingual edge of the crown is straight and extends slightly posterolabially. In resembling the M1, the protocone on M2 is large, low and anterolingual on the crown, the hypocone is small, ridgelike and posterolingual to the protocone, the conules are robust, subcrescentic, with strong conulecristae, and the protocristae terminate lingual to the conules. A well-developed cuspule, lacking on the upper first molars, occurs on the preparaconulecrista, near the base of the paraconule, on M2. The postcingulum is strong and broader than the precingulum.

Upper third molar.—The referred M3, UA 5791, is a lingual fragment that bears the protocone and paraconule. The crown is more nearly triangular than those of the preultimate molars, and a hypocone is not developed. The protocone is large, broad at the base, and medial on the crown. As on M1 and M2, the paraconule on the M3 is large, bulbous, and bears a well-developed cuspule on the preparacrista. The preprotocrista, shorter than on the preultimate molars, is strong and ends anterolingual to the base of the paraconule. The precingulum is broad and terminates lingually below the apex of the protocone.

?Deciduous lower fourth premolar.—Most of the talonid is missing from UA 5792, a probable dp4. The cusps on the tooth lean lingually, and the crown is progressively wider posteriorly. The trigonid is nearly quadrate in occlusal outline and bears four cusps, one at each corner. The metaconid, the largest and tall-

est cusp, is slightly compressed laterally. Its posterior face is vertically excavated and bears a series of rugose enamel ridges near the anterior end of the cristid obliqua. The protoconid is lower and more rounded than, and opposite the metaconid. The paraconid, on the anterolingual corner of the crown, lies directly anterior to the metaconid. A wide notch separates the high metacristid, on the posterior slope of the paraconid, from the base of the metaconid. A well-developed anterior accessory cusp, on the anterolabial corner of the trigonid, is directly anterior to the protoconid and directly labial to the paraconid. The anterior accessory cusp is equal in height to, but more nearly conical than the paraconid; both cusps are approximately two-thirds as high as the protoconid. A high, straight crest, and a strong, V-shaped cristid extend from the anterior accessory cusp to the paraconid and protoconid, respectively. The precingulid is shelflike and runs horizontally between the bases of the paraconid and the anterior accessory cusp. The trigonid basin is deep and open at the notch between the posterior end of the metacristid and the base of the metaconid. The protoconid, the anterior accessory cusp, and the interconnecting V-shaped cristid partially enclose a triangular labial space, similar in shape to the hypoflexid. A cuspidate labial cingulid is notched between the anterior accessory cusp and the protoconid.

The cristid obliqua bears a mesoconid and joins the posterior wall of the trigonid just below the ventral apex of the protocristid. The remainder of the talonid is missing, except for a small portion of the anterior face of the entoconid.

Lower first or second molar.—The cusps on the isolated trigonids lean anterolingually. The metaconid is slightly more posterior than the protoconid, and approximately twice as tall. The paraconid, anterior and slightly labial to the metaconid, is small, low, and shelflike. The base of the metaconid occupies approximately the posterior three-fourths of the lingual length of the trigonid. A vertical ridge on the posterolingual face of the metaconid is broad and heavily worn on UA 5795, well developed and unworn on UA 5793, and comparatively weak on UA 5794. The posterior face of the metaconid is deeply excavated between this ridge and the protocristid on all three specimens. In contrast, the lingual, anterior, and labial faces of the metaconid are convex. A series of short, rugose, enamel ridges are oriented ventrolingually on the posterior part of the base of the metaconid, ventral to the concave excavation. The paracristid is strong, the protocristid, strong and obtuse angled. A low, short metacristid joins the metaconid and paraconid. The floor of the trigonid slopes posteroventrally from the paracristid to the bases of the protoconid and metaconid. The anterior end of the cristid obliqua is preserved on the referred isolated trigonids, labial to the enamel ridges and directly below the junction of the protocristid and the protoconid. The precingulid is well developed and slopes ventrolabially along the anterior wall of the trigonid and around the labial wall of the protoconid; here the precingulid is variably wrinkled or cuspidate.

On UA 5797, talonid of an m1 or m2, the hypoconid is large and crescentic, the entoconid taller and conical. A mesoconid occurs on the cristid obliqua at the broken anterior edge of the talonid. The postcristid is strong and nearly straight between the hypoconid and hypoconulid, which is tiny and bumplike, at the pos-

TABLE 6.—*Dimensions of teeth of* Elpidophorus elegans, *loc. UAR-1, Ravenscrag Formation, Cypress Hills, Alberta, and loc. UAP-13, Paskapoo Formation, Swan Hills, Alberta.*

Specimens	P3		P4		M1		M2		?dp4		m1 or m2	
	L	W	L	W	L	W	L	W	L	W	AW	PW
UA 5782	3.6	3.8	3.9	4.7	4.0	5.0						
UA 5783					—	5.0						
UA 5788							2.3*	—				
UA 5792									—	2.7**		
UA 5793											3.2	
UA 5794											3.4	
UA 5795											3.4	
UA 5797												4.3

*Lingual length.
**Anterior width.

terolabial part of the base of the entoconid. A small cuspule, adjacent and ventrolabial to the hypoconulid, is joined to that cusp and the postcingulid by two tiny ridges. The entocristid, on the anterior face of the entoconid, is strong. A second, weaker crest occurs on the labial face of the cusp. The postcingulid, broad and shelflike, ends at the posterolabial part of the base of the hypoconid. The posterior end of a cuspidate buccal cingulid occurs at the anterolabial part of the base of the hypoconid.

On UA 5798, the postcristid is somewhat more curved than on UA 5797, but, as on the latter, is not cuspidate.

Remarks.—The mixodectid affinities of the teeth referred here to *Elpidophorus* are inferred from the presence of a mesostyle, a transversely aligned centrocrista, and a wide stylar shelf on M1, and twinned large entoconid and tiny hypoconulid on the lower molars. As in *Elpidophorus*, the upper molars possess a small hypocone and bulbous conules, and the postcristid on the lower molars is straight between the hypoconid and hypoconulid. In other known mixodectid genera the hypocone is significantly larger, the conules are smaller and less bulbous and the postcristid is curved. In addition, three features, omitted by Szalay (1969) in his discussion of *Elpidophorus*, are unique to that genus among known mixodectids: the deep vertical excavation of the posterior face of the metaconid, a large cuspule on the preparaconulecrista of M2-3, and protocristae that terminate lingual to the conules on the upper molars.

The referred specimens are larger than *Elpidophorus minor* Simpson, 1937*a*, in known parts of the dentition and do not differ significantly from AMNH 25963, 33899, hypodigm of *E. elegans*, except for the absence of a cuspule on the postcristid on the molars described here.

In resembling the lower molars of *E. elegans*, the protoconid and metaconid on UA 5792, ?dp4, are well developed, bunodont, and lingually inclined; the posterior face of the metaconid is vertically excavated and bears a number of enamel ridges, and the cristid obliqua bears a mesoconid. The paraconid on ?dp4 is higher and more nearly conical than on the molars.

Family ADAPISORICIDAE (Schlosser, 1887)

Leptacodon tener Matthew and Granger, 1921
(Fig. 11, Table 7)

Referred specimens.—P4, UA 5799, and fragments, 5800-04; M1, UA 5805-09; M3, UA 5810-12; fragment of lower jaw with p4, UA 5813-15; fragment of lower jaw with talonid of p4-m1, UA 5822; p4, UA 5816-21, and a number of fragments; fragment of lower jaw with m1, UA 5825-26; fragment of lower jaw with talonid of m1-m2, UA 5823-24; m1, UA 5827-28; m2, UA 5829-31; m3, UA 5832.

Localities.—UAR-1, Ravenscrag Formation, Alberta; UAP-13, Paskapoo Formation, Alberta.

Known distribution.—Ravenscrag Formation, Alberta; Paskapoo Formation, Alberta; Mason Pocket, San Jose Formation, Colorado; Scarritt Quarry, Melville Formation, Fort Union Series, Montana.

Upper fourth premolar.—UA 5799 is the most complete of the isolated fourth premolars assigned to *Leptacodon tener*. The crown, short and nearly rectangular lingually, becomes wider and more nearly triangular labially. The paracone and metacone are connate along approximately one-half their heights. The paracone, with a strong postparacrista, is tall and conical, and more convex lingually than labially in occlusal outline; the metacone, labiolingually compressed, is approximately two-thirds of the height of the paracone. The protocone, taller than the metacone and shorter than the paracone, leans anterolabially and occupies almost the entire lingual area of the crown. There are no conules on UA 5799. The parastylar salient is large and juts anteriorly from the base of the paracone. The metastylar salient, small and partially broken, bears a tiny metastyle at the junction of the postmetacrista, postprotocrista, and ectocingulum, at the posterior part of the base of the metacone. The preprotocrista extends directly labially to the lingual edge of the parastylar salient, curves anterolingually to the parastyle, and forms the anterior margin of the crown. The postprotocrista runs obliquely posterolabially to the metastyle. The postcingulum is short and narrow, and is limited to the posterior part of the base of the protocone. There is no precingulum on UA 5799. The ectocingulum is narrow and not cuspidate.

Upper first molar.—The crown of the referred upper first molars, as on the upper fourth premolars is short and almost quadrate lingually, and longer and more nearly triangular labially. The protocone is medial and leans strongly labially and slightly anteriorly. On UA 5806, the least worn of these molars, a weak crest occurs on the labial face of the protocone, between the protocristae. The paracone is higher and more nearly conical and vertical than the metacone; both cusps are tall and well developed. The metacone leans posteriorly and is more convex lingually than labially, in occlusal outline. A small hypocone occurs

at the lingual end of the postcingulum, posterolingual to the protocone, and is not linked to that cusp. The conules are strong, with the metaconule larger and more labial than the paraconule. The stylar shelf is narrow, and the ectoflexus is shallow. The metastylar area projects posteriorly well beyond the postcingulum, and labially beyond the parastylar salient. The parastyle is small, on the anterolabial corner of the stylar shelf. The metastyle, higher than the parastyle, lies on the posterolabial corner of the shelf, at the end of the postmetacrista. The preparacrista and the preparaconulecrista extend to the parastyle. The paracingulum passes anterior to the base of the paracone and is broader than the metacingulum, which curves around the lingual part of the base of the metacone. The postcingulum runs obliquely toward the base of the molar and ends directly below the metaconule. The precingulum terminates lingually in a small cuspule, anterolingual to the protocone. On UA 5809, a broken M1, a tiny accessory cuspule occurs anterior and slightly lingual to the hypocone, on the posterolingual slope of the protocone.

Upper third molar.—The parastylar salient, broken on UA 5810 and 5811, is large on UA 5812, but heavily worn, as is the entire crown. On UA 5811, the least worn of these molars, the paracone is tall and conical. The metacone, approximately two-thirds of the height of the paracone, is convex lingually and flat labially in occlusal view, and occurs on the posterolabial corner of the crown. The protocone is medial, leans directly labially, and is smaller than that on the isolated upper first molars referred to *L. tener.* The metaconule is close to the base of the metacone; the paraconule, more lingual, occurs on the preprotocrista, near the apex of the protocone. The postcingulum is narrower than the precingulum and does not bear a hypocone. Both cingula are reduced relative to those on the upper first molars.

Lower fourth premolar.—The lower fourth premolars of this species lean lingually and are submolariform, with a prominent trigonid and a shorter, narrower, tricuspid talonid. The talonid basin is extremely shallow. The protoconid is the largest cusp on p4. A weaker, conical paraconid projects anteriorly and slightly lingually from the base of the protoconid. The metaconid, on the posterior part of the lingual face of the protoconid, is approximately one-half the height of the latter and slightly higher than the paraconid. The cusps on the talonid are small; the relative heights of the entoconid and hypoconulid vary, but both are taller and larger than the hypoconid. The cristid obliqua is lower than the entocristid and meets the posterior wall of the trigonid below the ventral apex of the protocristid. A faint ridge on the posterior face of the metaconid terminates at the base of the cusp between the cristid obliqua and the entocristid. The hypoflexid is wide, and slopes ventrolabially to the depressed labial edge of the talonid. On UA 5822, the hypoconulid of p4 abuts against the anterior wall of m1 directly lingual to the precingulum.

Lower first molars.—These molars lean anterolingually; their trigonids bear a high, well-developed protoconid and a slightly lower more lingually inclined metaconid; the paraconid, more labial than the metaconid, is low, anteroposteriorly compressed and bladelike. The talonid is slightly wider and longer

TABLE 7.—*Dimensions of teeth of* Leptacodon tener, *loc. UAR-1, Ravenscrag Formation, Cypress Hills, Alberta.*

Specimens	P4		M1		M3		p4		m1		m2		m3	
	L	W	L	W	L	W	L	W	L	W	L	W	L	W
UA 5799	1.6	1.9												
UA 5805			1.4	1.8										
UA 5806			1.4	1.9										
UA 5808			1.4	1.8										
UA 5812					0.9	1.4								
UA 5810					0.9	1.4								
UA 5816							1.4	0.8						
UA 5813							1.3	0.9						
UA 5814							1.4	0.9						
UA 5815							1.2	0.8						
UA 5817							1.3	0.9						
UA 5818							1.4	0.9						
UA 5819							1.4	0.9						
UA 5820							1.3	0.9						
UA 5821							1.3	0.8						
UA 5825									1.5	0.9				
UA 5822									1.5	0.9				
UA 5827									1.5	0.9				
UA 5828									1.5	1.0				
UA 5829											1.3	1.1		
UA 5824											1.2	1.0		
UA 5831											1.3	1.1		
UA 5830											1.3	1.1		
UA 5823											1.1	0.9		
UA 5832													1.1	0.8

than the trigonid, and approximately one-half as high. The entoconid is directly opposite and slightly higher than the hypoconid. The hypoconulid, the lowest cusp on the talonid, occurs lingual to the midline, moderately close to the entoconid. The cristid obliqua is medial on the posterior wall of the trigonid. As on the lower fourth premolars, a ridge on the posterior wall of the metaconid on the lower first molars terminates medial to the junction of the entocristid and metaconid. The talonid basin is deepest medially, close to the posterior wall of the trigonid. On UA 5824 the hypoconulid on m1 abuts against the anterior wall of m2 slightly dorsolingual to the precingulid and ventral to the paracristid.

Lower second molar.—In contrast to m1, on which the protoconid is higher than the metaconid, the two cusps are subequal in height on m2. In addition, the paraconid on m2 occurs more lingually relative to the metaconid than

on m1. The lower second molars resemble the lower first molars in that the paraconid is low and bladelike, the talonid bears a high entoconid, a slightly lower hypoconid and a strong hypoconulid, moderately close to the entoconid, and the cristid obliqua is medial on the posterior wall of the trigonid.

Lower third molar.—The talonid is slightly narrower than the trigonid. Relative to the anterior molars, the hypoconulid is closer to the entoconid, the metaconid is larger, and the paraconid is lower and more nearly medial on the crown. The cristid obliqua meets the posterior wall of the trigonid below and labial to the ventral apex of the protocristid.

Remarks.—Of the teeth referred here to *Leptacodon tener*, only UA 5799, a left P4, differs significantly from AMNH 17179, holotype of *L. tener*; a precingulum is lacking on UA 5799, but is well developed on the P4 of the holotype (McKenna, 1968). The specimens from Cypress Hills are slightly smaller than *L. ladae* Simpson, 1935*a* (AMNH 35944) and are nearer the size of *L. tener* and *L. munusculum* Simpson, 1935*a* (AMNH 35942). In addition, the metaconid on the lower fourth premolars described here and in *L. tener* is stronger than in *L. ladae*, the paraconid on the lower molars is larger and the hypoconulid weaker. The pre and postcingula, which do not meet lingually on the upper first molars described here or on the holotype of *L. tener*, are continuous lingually on *L. munusculum*. The paraconid on the m1 and m2 of *L. munusculum* is more labial relative to the metaconid than on the specimens from Cypress Hills, or on the holotype of *L. tener*. UA 5832, the single referred lower third molar, with only a slightly reduced talonid, is similar to *L. tener* and differs from *L. munusculum*, in which the m3, especially the talonid, is markedly reduced.

Leptacodon packi Jepsen, 1930
(Fig. 12)

Referred specimens.—M1, UA 5833-34, and fragments, 5835-36; M2, UA 5837, and fragments, UA 5838-40.

Locality.—UAR-1, Ravenscrag Formation, Alberta.

Known distribution.—Ravenscrag Formation, Alberta; Hoback Formation, Wyoming; Silver Coulee local fauna, Polecat Bench Formation, Wyoming.

Upper first molar.—The crown of UA 5833 and 5834 (length, 1.2, 1.1; width, 1.7, 1.6 respectively) is moderately transverse and slightly contricted across the conules; the labial margin of the crown is shallowly concave, the lingual margin, V-shaped. The protocone is well developed, low, and leans anterolabially. The paracone is broken on both molars, but, when complete, may be equal in height to, or taller than the metacone. The hypocone, at the lingual end of the postcingulum, is small, conical, and slightly lingual to the protocone. The conules are well developed and conical. The stylar shelf is moderately wide, but the parastylar and metastylar salients are small. The metastyle is higher and larger than the parastyle. The metacingulum, wider than the paracingulum, projects posteriorly well beyond the postcingulum. The postmetacrista is high. The precingulum, narrower than the postcingulum, terminates lingually in a tiny cuspule, anterior and slightly labial to the protocone.

Upper second molar.—In comparison to the upper first molars, UA 5837 (length, 1.1; width, 1.8) is more transverse, the hypocone is slightly larger, the ectoflexus is deeper, and the metastylar salient is larger and projects farther labially.

Remarks.—On the molars referred here, as on *L. packi* (PU 14166), the lingual edge of the crown is V-shaped, the labial edge is only shallowly concave and the metastylar salient is small. The crown on preultimate upper molars of *L. tener* is comparatively less transverse, more concave labially, more nearly straight lingually, and the metastylar salient is larger and projects farther labially and posteriorly. Relative to *L.munusculum*, the protocone on the M1-2 of *L. packi* from Cypress Hills is less compressed anteroposteriorly, the pre and postcingula are not continuous lingually, and the hypocone is farther from the protocone.

Litolestes notissimus Simpson, 1936
(Fig. 13, Table 8)

Referred specimens.—M1, UA 5841; M2, UA 5842-46; M3, UA 5847-48; m1, UA 5849-51; m3, UA 5852-53.

Locality.—UAR-1, Ravenscrag Formation, Alberta.

Known distribution.—Ravenscrag Formation, Alberta; Scarritt Quarry, Melville Formation, Fort Union Series, Montana; Circle local fauna, Fort Union Series, Montana.

Upper first molar.—The metacone and metastyle are missing from UA 5841. The crown narrows lingual to the protocone and labial to the conules. The protocone is large, medial, and crescentic. The paracone is conical and slightly taller than the protocone. The hypocone, at the posterior part of the base of the protocone, is small and slightly more lingual than that cusp. The conules are well developed and nearly equidistant from the apex of the protocone, with the paraconule larger, slightly more lingual, and approximately one-third taller than the metaconule. The stylar shelf is narrow labial to the paracone. The parastylar salient does not project labially but juts anteriorly beyond the precingulum. The ectoflexus is median and extremely shallow. The precingulum, narrower than the postcingulum, terminates lingually in a tiny cuspule that is smaller than the hypocone and directly anterior to the protocone.

Upper second molar.—All of the teeth referred here are lingual fragments. Relative to M1, the crown of M2 is shorter anteroposteriorly lingual to the protocone and more nearly triangular in occlusal outline. The hypocone is larger on M2 and the paraconule is nearer the protocone; on M1 the conules are nearly equidistant from the protocone.

Upper third molar.—The crown, transverse and triangular in occlusal outline, is anteroposteriorly compressed lingual to the protocone, as on M1 and M2. In comparison with the preultimate molars, the paracone and protocone are weaker on M3, and there is no hypocone on the postcingulum or cuspule on the precingulum. The metacone is approximately one-half of the height of the paracone. The metaconule is larger than the paraconule, and more labial. The para-

TABLE 8.—*Dimensions of teeth of* Litolestes notissimus, *loc. UAR-1, Ravenscrag Formation, Cypress Hills, Alberta.*

Specimens	M1		M3		m1		m3	
	L	W	L	W	L	W	L	W
UA 5841	—	2.5						
UA 5848			1.6	2.4				
UA 5847			1.5	2.3				
UA 5850					2.2	1.8		
UA 5849					2.0	1.7		
UA 5851					2.2	1.6		
UA 5853							1.9	1.3
UA 5852							1.9	1.3

stylar salient is strong; a metastyle does not occur on M3. The precingulum is as wide as and longer than the postcingulum.

Lower first molar.—The trigonid is slightly narrower and moderately higher than the talonid. The protoconid and metaconid, slightly posterior to it, are broad at the base, bunodont, with their heights relative to each other affected by the degree of wear: the protoconid is taller than the metaconid on UA 5851 and 5850, but is slightly lower than the metaconid on UA 5849. The paraconid, slightly more medial than the metaconid, is low and conical. The paracristid is flat and shelflike. There is no metacristid. On UA 5849, a large, bulbous cuspule occurs on the protocristid, at the posterolabial part of the base of the metaconid.

The hypoconid is higher, larger, and more posterior than the entoconid; both cusps are well developed, bunodont, and taller than the low, bulbous hypoconulid, which occurs lingual to the midline, moderately close to the entoconid. The postcristid is strong between the hypoconid and hypoconulid, but weaker between the hypoconulid and entoconid. Anteriorly, the cristid obliqua occurs below and labial to the ventral apex of the protocristid and on UA 5850 and 5849 bears a small bifid mesoconid. A sharp notch separates the entocristid from the base of the metaconid on the three referred lower molars. The postcingulid, a narrow shelf on the posterior wall of the hypoconid, is shorter than the precingulid. On UA 5851 the internal faces of the hypoconulid and entoconid form a continuous wear facet.

Lower third molar.—The referred third molars are significantly smaller than the lower first molars of this species. The trigonid is more compressed anteroposteriorly on the m3, and the talonid is longer and narrower, with the hypoconulid more posterior and more closely twinned with the entoconid.

The protoconid and comparatively taller metaconid are directly opposite each other and are broad at the base and bunodont. The paraconid is low and flattened

at the end of the shelflike paracristid. On UA 5852, as on the m1 (UA 5849), a cuspule occurs on the protocristid at the base of the metaconid. The talonid is lower than the trigonid and on UA 5853 bears subequal entoconid, hypoconid, and hypoconulid. The hypoconid is substantially lower on the more worn m3, UA 5852. The entocristid is notched and the mesostyle bifid on UA 5852, but not on UA 5853. The precingulid is long and the postcingulid short and spurlike on both specimens.

Remarks.—*Litolestes*, classified ?Insectivora by Jepsen (1930*b*), was referred to the Hyopsodontidae by Simpson (1936) and subsequently to the Adapisoricidae by Van Valen (1967). The molars described here do not differ significantly from AMNH 33831 and AMNH 33830, holotype and paratype, respectively, of *Litolestes notissimus*. In resembling *L. notissimus*, the upper second molars described here are more transverse than the upper first molars and more anteroposteriorly compressed lingual to the protocone; the paraconid is small on the lower molars and the metaconid is higher than the protoconid on m3. The precingulum is slightly stronger on the specimens from the Cypress Hills, and m3 is somewhat less reduced relative to m1. The teeth are larger than *L. ignotus* Jepsen, 1930*b*, in known parts of the dentition, approximately one-third smaller than *L. lacunatus* Gazin, 1956, and are within the size range of *L. notissimus* (Simpson, 1936).

Litolestes sp.
(Fig. 14)

Referred specimens.—Fragment of left maxilla with M1-2 parastyle of M3, UA 5856.

Locality.—UAR-1, Ravenscrag Formation, Alberta.

Known distribution.—Ravenscrag Formation, Alberta; Scarritt Quarry, Melville Formation, Montana; Circle local fauna, Fort Union Series, Montana; Silver Coulee local fauna, Polecat Bench Formation, Wyoming; Bison Basin Tiffanian, Fort Union Series, Wyoming (distribution of *Litolestes*).

Upper first molar.—On UA 5856, the M1 (length, 1.3; width, 1.9) is triangular in occlusal outline with well-developed parastylar and metastylar salients, a medial and crescentic protocone, tall and conical paracone and metacone, and a large, bulbous hypocone, lower than and slightly more labial than the protocone. The metacone, although distorted from breakage at its base, is clearly somewhat smaller than the paracone. The conules, broken at the apices, are well developed, with the paraconule larger and more lingual than the metaconule. The stylar shelf is distorted, in that the metastylar salient, larger and more labial than the parastylar salient, is depressed to well above the level of the latter. Both salients are triangular in occlusal outline; however, the labial edge of the metastylar area is oriented posterolabially, whereas that of the parastylar salient is oriented more nearly anteroposteriorly. The preprotocrista is worn away, the postprotocrista is well defined. The paracingulum extends along the lingual and anterior parts of the base of the paracone. The metacingulum is hidden by the close appression of M1 and M2. The precingulum is extremely short, narrow, and not cuspidate. The postcingulum is longer and somewhat broader. The trigon basin is deep and narrow.

Upper second molar.—Relative to M1, the M2 on UA 5856 (length, 1.5; width, 2.2) is more transverse, the hypocone is stronger, the parastylar salient is larger and directed more labially, and the metastylar salient is somewhat smaller and less labial. The size and shape of the bases of the broken paracone and metacone imply that the cusps were tall and conical when complete. The hypocone occurs at the lingual end of the postcingulum, and is lower and slightly more labial than the protocone. As on M1, the metastylar salient on M2 is more dorsal than the parastylar salient due to distortion of the labial wall of the crown. In resembling M1, the conules are well developed and conical on M2, the postcingulum is longer and slightly broader than the precingulum, and the trigon basin is deep and narrow. The M2 extends lingually beyond M1, whereas M1 projects labially beyond M2.

Upper third molar.—On UA 5856, only the parastyle and the labial half of the base of the paracone are preserved. The parastylar salient, U-shaped in occlusal outline, extends labially as far as the metacone on M2 and, with only a small labial exposure, is much shorter anteroposteriorly than the salient on the preultimate molars.

Remarks.—The M1 on UA 5856 closely resembles UA 5841, M1 of *Litolestes notissimus* from Cypress Hills and AMNH 33831, holotype of *L. notissimus* from Scarritt Quarry: the crown is nearly triangular in occlusal outline, the protocone is medial, the conules are well developed, with the paraconule larger than the metaconule, the parastylar salient is oriented nearly directly anteroposteriorly, and the precingulum is short and narrow. As in *L. notissimus*, M2 on UA 5856 in comparison to M1 bears a stronger hypocone, the parastylar salient is larger and more labial, and the metastylar salient is smaller and less labial.

However, UA 5856 is much smaller than *L. notissimus* in comparable parts of the dentition, the hypocone is proportionately better developed and slightly more lingual, both on M1 and M2, and M2 is longer lingually than M1; in *L. notissimus*, M2 is shorter lingually than M1. Additionally, the stylar shelf on UA 5856 appears wider than in *L. notissimus*, although this may be due to the distortion of the shelf on the specimen from Cypress Hills.

The small size of UA 5856 suggests that this specimen may represent M1-2 of *L. ignotus*, the smallest known species of the genus, the upper dentition of which has never been described. However, verification of this possibility requires recovery of associated and more complete material.

cf. **Nyctitherium** Marsh, 1872
(Fig. 15)

Referred specimens.—Probable M1 or M2, UA 5854-55.

Locality.—UAR-1, Ravenscrag Formation, Alberta.

Known distribution.—Wasatch Formation, Wyoming, Colorado and New Mexico; Bridger Formation, Wyoming; Huerfano Formation, Colorado; ?Ravenscrag Formation, Alberta.

Upper first or second molar.—The two specimens assigned to cf. *Nyctitherium* are small, lingual fragments with protocone, conules, and hypocone, and are equal in size (lingual length, 0.8). The protocone is anterolingual, upright, and with well-

defined occlusal edges. The hypocone is small and occurs on the posterolingual edge of a hypoconal shelf; the shelf, approximately one-half of the lingual length of the crown, projects posteriorly from the part of the crown below the protocone and metaconule. The conules are well developed, with the paraconule larger, higher and more lingual than the metaconule, and about one-half of the height of the protocone. The protocristae and conulecristae are strong, narrow, and well defined. The precingulum, broken on UA 5855, is a tiny, worn, narrow spur on UA 5854.

Remarks.—Among Early Tertiary adapisoricids known to me, only *Nyctitherium* exhibits the expansive hypoconal shelf similar to that on UA 5854 and 5855. In addition, in resembling *Nyctitherium*, the protocone on the molars is not compressed anteroposteriorly and only a single lingual root occurs. However, known species of the genus are approximately twice as large as the specimens from Cypress Hills in comparable parts of the dentition. The possible occurrence of *Nyctitherium* in the Paleocene would be a temporal extension for that genus from the Early Eocene, and would suggest an Early Tiffanian or Late Torrejonian origin from *Leptacodon* or a *Leptacodon*-like adapisoricid.

Order PRIMATES Linnaeus, 1758

Family CARPOLESTIDAE Simpson, 1935*c*

Carpodaptes cf. **hazelae** Simpson, 1936
(Fig. 16, Table 9)

Referred specimens.—Fragment of upper jaw with P3, UA 5857-58; P4, UA 5859-61; M1, UA 5862-64, and fragments 5865-68; M2, UA 5869-70; M3, UA 5872; fragment of lower jaw with p4, UA 5873-75; p4, UA 5876; m1, UA 5877; m2, UA 5878-79; fragment of lower jaw with m3, UA 5880; m3, UA 5881, and fragment, 5871.

Locality.—UAR-1, Ravenscrag Formation, Alberta.

Known distribution.—Ravenscrag Formation, Alberta; Melville Formation, Fort Union Series, Montana (distribution of *C. hazelae*).

Upper third premolar.—The referred premolars, UA 5857 and UA 5858, are quadrate in occlusal outline and bear three rows of cusps, aligned anteroposteriorly. The crown is bilobed lingually, and, in lateral profile, is progressively higher labially.

The four cusps of the external row, along the labial edge of the crown, are homologous to the parastyle, paracone, metacone and metastyle, from anterior to posterior (Simpson, 1936). The bases of the paracone, metacone and metastyle are united, but their apices are free, small, and close together. The parastyle, conical and bulbous, is much lower than and well separated from the paracone. The paracone, the largest external cusp, is slightly higher than the metacone. The metastyle is smaller than the parastyle and slightly lower than the metacone. The V-shaped cristae between the three posterior cusps are shallow and of nearly equal size, whereas the preparacrista is long and deep.

The median row of two cusps is low, crest-like, and labial on the crown. The anterior cusp is large, laterally compressed, and as high as the parastyle. The posterior cuspule is small, weak, and directly lingual to the paracone. A straight

and a V-shaped crista each connect the anterior cusp to the parastyle and the posterior cuspule, respectively. A sharp ridge, on the lingual face of the paracone, extends to the posterior cuspule. The crest of the median row runs directly posteriorly from the anterior cusp and continues labially to the posterior face of the metastyle.

Two cusps, laterally compressed and joined by a V-shaped crista, form the inner cusp row along the lingual edge of the crown. The anterolingual cusp, or protocone (Simpson, 1936), is higher and larger than the posterolingual cusp. The postcingulum runs labially toward the median cusp row from the postcrista of the posterolingual cusp and bears a small pyramidal cuspule. The ectocingulum, on the labial wall of the crown, extends from the anterior face of the parastyle to the posterior face of the metastyle. Between the median and internal rows, the crown is extensive, flat, and not basined. A small ridge crosses the crown from the posterior cuspule of the median row toward the posterolingual cusp of the inner row.

Upper fourth premolar.—The crown on UA 5861, the most complete of these referred fourth premolars, is trapezoidal in occlusal outline, with parallel labial and lingual edges. The crown is longer labially than lingually, and the posterior and anterior margins are straight and converge lingually.

Three rows of cusps, aligned anterospsteriorly, occur on P4. The labial row, shallowly concave externally, consists of six cusps, which correspond to an anterior cingular cusp, the parastyle, paracone, metacone, metastyle, and posterior cingular cusp. The sizes and heights of the cusps decrease progressively anteriorly and posteriorly from the paracone.

Three bunodont, conical cusps occur lingually, one anterolingually, one posterolingually, and a relatively central and more labial protocone. The bases of the three cusps are joined lingually. The protocone is tallest and largest and closer to the anterolingual cusp. The latter is slightly higher than the posterolingual cusp. The crown is depressed on each side of the protocone.

The median cusp ridge bears a central, large, crestlike cusp, taller and more posterior than the protocone. A tiny cuspule occurs on either side of the central cusp, near the anterior and posterior edges of the median ridge.

A pair of small, pyramidal cuspules, one each on the pre and postcingulum, occurs lingual to the median cusp ridge and medial to the anterior and posterior margins of the crown.

Upper first molar.—The crown of M1, approximately rectangular in occlusal outline, is transverse, gently convex anteriorly, and concave posteriorly. The lingual border is straight and oriented obliquely anterolingually. There is virtually no stylar shelf. The protocone is bunodont, anterolingual on the crown and leans labially. The hypocone, equal in size to the conules, is conical, bulbous, and slightly more lingual than the protocone. The paracone is taller, more nearly conical, and its base broader relative to the metacone. The conules are large and bunodont; the metaconule is conical, the paraconule is pyramidal, broader at the base and more lingual on the crown than the metaconule. The parastyle is tiny and anterior to the paracone at the labial end of the paracingulum. The metastyle, on the posterior slope of the metacone, is minute, but slightly higher than

the parastyle. The ectoflexus is shallow and posterior to the midlength of the crown. The ectocingulum is short and weak, and on UA 5862 terminates posteriorly in a tiny cuspule, directly labial to the metacone. The crista on the posterior slope of the protocone extends to the hypocone, and, with the postcingulum, encloses a small posterointernal basin.

Upper second molar.—The lingual edge of the crown is broken on UA 5870, and both specimens are heavily worn. The crown of M2 differs from that of M1 in being rounded and convex lingually, with nearly straight anterior and posterior margins. In resembling M1, the M2 is nearly quadrate in occlusal aspect, bears conical, low, bulbous cusps, and an extremely narrow stylar shelf. The paracone is larger and slightly taller than the metacone, and is lingually more convex. A sharp ridge occurs on the lingual face of the paracone. The protocone is anterolingual on the crown and leans anteriorly. The hypocone, broken on UA 5869, is small, conical and more lingual than the protocone on UA 5870. The conules are large and bulbous, with the paraconule more lingual than the metaconule. The conulecristae are strong and a tiny cuspule occurs on both the pre and postparaconulecristae. The preprotocrista is short, the postprotocrista, longer. A third crista, on the posterior face of the protocone, extends to the hypocone. The lingual cingula are broad and well developed, and the postcingulum encloses a large posterointernal basin. The trigon basin is wide and shallow.

Upper third molar.—UA 5872 is the only carpolestid M3 in the assemblage from Cypress Hills. Relative to the preultimate molars, the crown of M3 is more nearly triangular in occlusal outline, its lingual margin is more nearly rounded and convex, the protocone is medial rather than anterolingual, the metacone is smaller, and the hypocone is not developed. The protocone is low and bunodont. The paracone is larger and more labial than the metacone, and approximately twice as tall. The paraconule is well developed and is larger and more lingual than the metaconule. The parastyle is minute and occurs at the junction of the preparacrista, preparaconulecrista, and ectocingulum, directly anterior to the paracone. A metastyle does not occur on UA 5872. The postparaconulecrista terminates in a small cuspule near the base of the paracone. The postcingulum is broad and continuous lingually with the crista on the posterior face of the protocone. The precingulum is strong, and the ectocingulum is narrow and bears a small bump labial to the paracone.

Lower fourth premolar.—These teeth are laterally compressed and bladelike, with bases that are quadrate in occlusal outline. The external face is wider and extends farther ventrally than the internal face. The base of the crown is bilobed, both internally and externally. The internal lobes are subequal ventrally and bifurcate at the medial junction of the anterior and posterior roots. Externally, the posterior lobe projects ventrally beyond the anterior lobe.

Five apical cuspules occur anteroposteriorly on UA 5876 and 5875; the second and third cuspules are highest and subequal. On UA 5874, the apex of the crown is damaged, but includes the fourth and fifth cuspules of the six normally present. A tiny cuspule, absent on UA 5874 and 5875, occurs on the anterior face of the crown on UA 5876, below the first apical cusp. The talonid on all lower

fourth premolars in the sample is short, crestlike, unicuspid, and well differentiated from the main blade.

Lower first molar.—The trigonid on the single specimen, UA 5877, is laterally compressed and bladelike, and its lingual face is nearly vertical. The talonid, approximately equal in length to the trigonid, is much less compressed and extends labially well beyond the trigonid. The labial faces of the trigonid and talonid are inclined about 45 degrees to the base of the tooth.

The trigonid cusps are lingually placed and are aligned almost directly anteroposteriorly. The protoconid is large, crestlike, and higher and slightly more labial than the conical paraconid; the two cusps are continuous labially, but are separated lingually by a notch. The metaconid, on the posterolingual face of the protoconid, is partially damaged but is clearly a small cusp. The precingulid, broken on its labial end, occurs on the anterolabial slope of the paraconid.

The talonid is broken anterolingually, but enough remains to indicate that a deep basin was present. The entoconid, on the posterolingual corner of the talonid, is much lower than the large, labial hypoconid. An elongated wear facet on the postcristid makes the presence of a hypoconulid indeterminable. The cristid obliqua is high, the postcristid is lower and anteriorly concave, in occlusal view. The entocristid is broken away.

Lower second molar.—The trigonid is small, bears low cusps, and is much narrower and shorter than the talonid. The paraconid, on the anterolingual corner of the trigonid, is well developed and conical. The metaconid, the largest and highest trigonid cusp, is slightly more lingual than the paraconid. In occlusal view, the metaconid is convex anteriorly and concave posteriorly. The protoconid, slightly higher than the paraconid, is more anterior than the metaconid and more labial than on m1.

The talonid, with a broad shallow basin, is lower than the trigonid. The hypoconid is large, crescentic and opposite the smaller, more nearly conical entoconid. The hypoconulid, worn away on UA 5879, is small and medial on UA 5878. The cristid obliqua is strong, the postcristid, arcuate. A lingual wedge-shaped notch separates the entoconid from a tiny bulge on the base of the metaconid. The precingulid is long and weak, and the postcingulid, on the posterior part of the base of the hypoconid, is faint and short.

Lower third molar.—The paraconid is damaged on UA 5880, in addition to a damaged metaconid on both specimens. The trigonid of m3 is shorter than either lobe of the bilobate talonid. The metaconid, highest of the trigonid cusps, is posterior and slightly lingual to the paraconid. The protoconid is low and directly labial to the metaconid; their bases meet far labially on the trigonid.

The lobes of the talonid are high and crestlike lingually, and much lower and more nearly flat labially. The anterior lobe is well differentiated from the shorter, narrower posterior lobe. The labial edge of the posterior lobe is considerably internal relative to the hypoconid. The hypoconid is large and flat. The entoconid, long, high, and crestlike, is notched between the anterior and posterior lobes. A deeper, wider notch separates the entoconid from the trigonid. The hypoconulid, on the posterolabial edge of the posterior lobe, is double, with the

TABLE 9.—*Dimensions of teeth of* Carpodaptes *cf.* hazelae, *loc. UAR-1, Ravenscrag Formation, Cypress Hills, Alberta.*

	P3		P4		M1		M2		M3		p4		m1		m2		m3	
Specimens	L	W	L	W	L	W	L	W	L	W	L	W	L	W	L	W	L	W
UA 5857	1.7	1.9																
UA 5858	1.8	1.9																
UA 5861			1.7	2.2														
UA 5862					1.4	2.2												
UA 5864					1.4	2.0												
UA 5869							1.3	1.9										
UA 5870							1.3	1.9										
UA 5872									1.1	1.9								
UA 5876											2.3	1.7						
UA 5874											2.5	1.9						
UA 5875											2.2	1.5						
UA 5877													1.7	1.4				
UA 5878															1.5	1.5		
UA 5879															1.2	1.5		
UA 5881																	1.9	1.2
UA 5880																	1.9	1.1

lingual cuspule slightly larger than the labial one. The cristid obliqua is labial on the posterior wall of the trigonid. The precingulid is short and weak and ascends the anterolabial wall of the trigonid.

Remarks.—In comparison to *Carpolestes* (AMNH 33980), P3 of *Carpodaptes* and the upper third premolars described here bear four labial cusps instead of five, one cusp in the medial row, as opposed to two, and lack an anterolabial spur; P4 is less transverse than in *Carpolestes*, and p4 is lower, with fewer apical cuspules and a more strongly differentiated talonid. On m1-2, the talonid is shorter and the protoconid more labial than in *Carpolestes*, and the posterior lobe of the talonid on m3 is not as well set off from the anterior lobe.

The referred specimens are nearer in size to those of *Carpodaptes hobackensis* Dorr, 1952, than to those of *C. hazelae*, but are closer morphologically to those of the latter. The lower fourth premolars from Cypress Hills have a higher profile than those of *C. hobackensis*, and the trigonid is less compressed anteroposteriorly on m2. The p4 of *C. aulacodon* Matthew and Granger, 1921, is higher in lateral profile and less quadrate in occlusal aspect than those described here, and the apical cusps are less prominent and closer together.

Apart from their slightly smaller size, the upper third premolars from Cypress Hills are somewhat more triangular in occlusal outline than those of *C. hazelae*, and the talonid of p4 is slightly larger. The remainder of the dentition does not differ significantly from *C. hazelae*.

L. S. Russell (1967) named *Carpolestes cygneus* from the Paskapoo Formation, Swan Hills area, Alberta. As described and pictured, P3 does not bear a pronounced anterolabial spur, and possesses four cusps in the labial row; p4 has six apical cuspules and a well-differentiated talonid. These features are diagnostic of *Carpodaptes* (Simpson, 1936, 1937*b*) and differ from those of *Carpolestes* as described above. The holotype and paratypes of *C. cygneus* probably should be referred to *Carpodaptes*; they are smaller than known specimens of *C. hazelae* and *C. aulacodon*, but are within the size range of *C. hobackensis*.

Family PAROMOMYIDAE (Simpson, 1940)

Phenacolemur frugivorus (Matthew and Granger, 1921)

Referred specimens.—probable m2, UA 5882.

Locality.—UAR-1, Ravenscrag Formation, Alberta.

Known distribution.—Ravenscrag Formation, Alberta; San Jose Formation, Colorado; Melville Formation, Fort Union Series, Montana.

?Lower second molar.—Extensive wear and erosion have removed the enamel from UA 5882 (length, 1.7; anterior width, 1.0; posterior width, 1.3) and the cusps are merely low, rounded bumps on the crown. The trigonid leans anteriorly and its rectangular occlusal surface faces anterodorsally. As a result, the protocristid is the highest structure on the crown, and the posterior wall of the trigonid is inclined posteroventrally. The trigonid is anteroposteriorly compressed, and is much higher, shorter, and narrower than the talonid. The lingual edge of the trigonid is oriented anterolabially. The metaconid is posterolingual on the crown, the protoconid is posterolabial, and paraconid is anterolingual and slightly posterior to the anterior margin of the crown.

The talonid basin is deep, very broad, and closed. The talonid is approximately three times higher labially than lingually. The hypoconid, on the posterolabial corner of the talonid, is large and flat. The entoconid is lower and smaller, and the postcristid is gently convex posteriorly, in occlusal outline. The cristid obliqua is labial to the midline on the posterior wall of the trigonid. There is no hypoconulid, precingulid, or postcingulid on UA 5882.

Remarks.—UA 5882 resembles *Phenacolemur* and differs from all other known paromomyid genera in lacking external cingulids, in possessing a nearly rectangular trigonid that leans strongly anteriorly, and in having an extremely broad talonid basin (Simpson, 1955). Only two Paleocene species of *Phenacolemur* are known: *P. frugivorus* and *P. pagei* Jepsen, 1930*b*, both from Tiffanian horizons. UA 5882 is smaller than m2 of *P. pagei* (Simpson, 1955), but does not differ significantly from AMNH 33987, hypodigm of *P. frugivorus*, the smallest known species of *Phenacolemur*.

Paromomys depressidens Gidley, 1923
(Fig. 18)

Referred specimens.—m2, UA 5883, and fragment, 5884.

Locality.—UAR-1, Ravenscrag Formation, Alberta.

Known distribution.—Gidley Quarry, Lebo Formation, Fort Union Series, Montana; Ravenscrag Formation, Alberta.

Lower second molar.—On UA 5883 (length, 1.9; width, 1.4) the trigonid leans anteriorly. Its rectangular occlusal surface faces only slightly anteriorly relative to that of UA 5882, probable m2 of *Phenacolemur frugivorus* from Cypress Hills. The metaconid, protoconid, and paraconid are small, low cusps on the posterolingual, posterolabial, and anterolingual corners of the crown respectively; the metaconid is largest and tallest. On UA 5884, fragmentary trigonid of a left m2, the paracristid and protocristid are strong, gently convex anteriorly, and extend labially in parallel from the paraconid and metaconid, respectively.

The talonid on UA 5883 is slightly wider and much longer than the trigonid. The hypoconid is large and flat, the entoconid is higher and more crestlike. There is no hypoconulid, precingulid or postcingulid on m2. A narrow, short labial cingulid occurs at the base of the crown, near the hypoflexid. The cristid obliqua is ventral and slightly lingual to the protoconid on the posterior wall of the trigonid. The talonid basin is broad, closed and moderately shallow.

Remarks.—As in *Paromomys*, UA 5883 bears an external cingulid, an anteroposteriorly compressed trigonid that leans moderately anteriorly, low conical cusps, and a broad, closed talonid basin. Among known paromomyid genera, the trigonid on UA 5883 leans less anteriorly than in *Phenacolemur*, and the talonid basin is not as broad; relative to *Palaechthon* and *Palenochtha*, the trigonid is more nearly rectangular and less elevated above the talonid, and the talonid basin is broader. Only two species of *Paromomys*, *P. maturus* Gidley, 1923, and the smaller *P. depressidens*, are known, both from Torrejonian deposits and (except for m3) are separable mainly on the basis of size. UA 5883 is within the size range of *P. depressidens* (Simpson, 1955) and does not differ significantly from AMNH 35609, hypodigm of the species.

Family Plesiadapidae Trouessart, 1897

Plesiadapis fodinatus Jepsen, 1930*b*

(Fig. 19)

Referred specimens.—P4, UA 5885.

Locality.—UAR-1, Ravenscrag Formation, Alberta.

Known distribution.—Ravenscrag Formation, Alberta; Polecat Bench Formation, Wyoming; Bison Basin Tiffanian, Forth Union Series, Wyoming; Evanston Formation, Wyoming; Wasatch Formation, Wyoming.

Upper fourth premolar.—UA 5885 (length, 2.5; width, 4.3) is the only plesiadapid tooth in the assemblage from Cypress Hills. The crown is moderately transverse and slightly hourglass-shaped in occlusal outline. Four cusps occur anteroposteriorly along the labial edge of the crown: three, the paracone, metacone and metastyle, are united into a high, large crest; the parastyle is large, set lower on the crown than the adjacent paracone, and is isolated from that cusp by a semicircular valley. The paracone is slightly higher than the metacone; both cusps are large and conical. The anterior face of the paracone bears three ridges: an antero-

labial ridge descends onto the labial face of the parastyle; a strong anterolingual ridge and a weaker anterior one each extends to the semicircular valley that separates the paracone and parastyle. The metastyle is small and lies on the posterior slope of the metacone.

The protocone is massive and slightly more anterior than the paracone. The paraconule, at the base of the paracone, is long, laterally compressed and ridgelike, and bears a small cuspule lingually. A groove separates the paraconule from the paracone and runs anteriorly to the semicircular valley. The preprotocrista reaches the parastyle and bears a small cuspule between the bases of the protocone and paraconule. A second, well-developed crista on the posterior face of the protocone turns labially as a postcingulum along the posterior margin of the crown and encloses a large posterointernal basin, in which the enamel is slightly wrinkled. A small bulge occurs on the postcingulum near the metastyle. The precingulum is broad and short, and joins the preprotocrista near the parastyle.

Two small, narrow shelves occur on the labial wall of the crown: an anterior one at the labial end of the semicircular valley, and a larger, posterior one below the metacone.

Remarks.—The plesiadapid affinities of UA 5885 are inferred from the hourglass-shaped occlusal outline, the large posterointernal basin, unconnected strong protocone and ridgelike paraconule, the absence of a metaconule, and the labial alignment of the strong parastyle, large paracone, weaker metacone and poorly developed metastyle. In possessing a large parastyle, UA 5885 differs from *Pronothodectes* and resembles *Plesiadapis*. Among species of *Plesiadapis*, in which the P4 has been described, UA 5885 is closest in size to specimens of *P. fodinatus*, *P. gidleyi* (Matthew, 1917), and *P. farisi* Dorr, 1952. In resembling *P. fodinatus*, UA 5885 is more nearly hourglass-shaped in occlusal outline than is P4 of *P. gidleyi* and *P. farisi*, the paraconule is smaller and more elongate, and the paracone and metacone are more nearly connate than in *P. gidleyi*, and less nearly so than in *P. farisi*.

Order DELTATHERIDIA Van Valen, 1965

Family PALAEORYCTIDAE (Winge, 1917)

Pararyctes sp.

(Fig. 20)

Referred specimens.—P4, UA 5886, and fragments 5887-90; lingual fragment of probable M1 or M2, UA 5891; labial fragment of M2, UA 5892; M3, UA 5893; probable m2, UA 5894, and fragment, 5895.

Locality.—UAR-1, Ravenscrag Formation, Alberta

Known distribution.—Saddle Locality, Bison Basin Tiffanian, Fort Union Series, Wyoming; Ravenscrag Formation, Alberta (distribution of *Pararyctes*).

Upper fourth premolar.—One specimen, UA 5886 is nearly complete (width, 2.0), but its labial area is crushed anteroposteriorly. The remaining specimens are labial fragments, of which UA 5887 is the most complete (length, 1.6). A composite P4 would be short lingually and much longer labially, with the crown concave anteriorly in occlusal outline, and more nearly straight posteriorly.

The protocone on UA 5886 is subequal in height to the metacone and about one-third lower than the paracone. The paracone is approximately twice as large as the metacone and the two cusps are connate almost to the apex of the metacone. The parastyle, broken away from UA 5886, is a well-developed conical cusp on UA 5887, and is more labial than the paracone and slightly larger and much lower than the metastyle. The postmetacrista, higher than on the molars, is continuous with approximately the lower three-fourths of the metacone. The postcingulum is preserved on both specimens and runs along almost the entire posterior length of the crown. The precingulum is complete and is limited to the anterior part of the base of the protocone. The ectocingulum is narrow and occurs only between the paracone and metastyle.

Upper first or second molar.—The broken labial edge of UA 5891, a lingual fragment of a left M1 or M2, is lingual to the metaconule. The protocone is high and anteroposteriorly compressed. The paraconule is small and near the protocone. The protocristae are high and narrow, and the trigon basin slopes posterodorsally from the preprotocrista to the comparatively lower postprotocrista. The precingulum, on the anterior part of the base of the crown, is well developed. The postcingulum is completely broken away.

Upper second molar.—On UA 5892, a labial fragment of a left M2 (length, 1.9), the paracone and metacone are connate almost to their apices, with the paracone taller and more nearly conical. The ectoflexus is deep and median and separates large parastylar and metastylar salients; the metastylar salient is wider and projects farther labially. The parastyle is higher than the metastyle. The ectocingulum is slightly raised and bears a small stylocone near the parastyle. The preparacrista is low and extends to the stylocone. The paracingulum is broad and continuous with the parastyle. The metacingulum is narrower and ends near the base of the crown, bleow the postmetacrista. The metastyle, stylocone and paracingulum are heavily worn.

Upper third molar.—Extensive wear has removed most of the enamel from the occlusal surface of UA 5893, a left M3. As preserved, the molar is strongly transverse (anterior width, 2.7; posterior width, 1.7) and narrow anteroposteriorly (length, 0.7). The stylar shelf is expanded anterolabially into a wide, short, triangular parastylar salient. The buccal margin of the crown extends anterolabially from the base of the metacone. The protocone is worn and leans slightly anteriorly. The paracone and metacone are high and connate almost to their apices, with the paracone more nearly conical and slightly more labial. The conules are tiny, and the paraconule is higher and more lingual than the metaconule. At least partly owing to differential wear, the prevallum is much higher than the postvallum. The parastyle, small and faint, occurs markedly lingual to the anterolabial corner of the crown. The paracingulum is broad. There is no metacingulum or metastyle. The preparacrista is sigmoid in shape, runs to the parastyle, and separates the paracingulum from the stylar area. The postcingulum is broad and short, the precingulum longer and narrower. The ectocingulum is very faint.

?Lower second molar.—The trigonid on UA 5894 (length, 1.7; anterior width, 1.4; posterior width, 1.0) is longer, wider, and more than twice as high as

the talonid. The protoconid, worn to the level of the trigonid basin, is V-shaped in occlusal outline, with postero and anterolingual wings. The metaconid, directly opposite the protoconid, is less worn, higher and more rounded. The paraconid is broken, but appears to have been slightly lingual to the midline. The precingulid rises almost vertically from the anterolabial part of the base of the crown.

The entoconid, the tallest talonid cusp, is more posterior than the hypoconid. The hypoconulid is higher than and closely twinned with the hypoconid. The cristid obliqua is medial on the posterior wall of the trigonid. The talonid basin is deep and closed, with the deepest point near the talonid notch.

Remarks.—Van Valen's (1966:58) diagnosis of *Pararyctes* employed the presence of pre and postcingula on the upper molars in distinguishing *P. pattersoni* Van Valen, 1966, from known species of palaeoryctids. Since 1966, however, upper molars of the palaeoryctid *Cimolestes magnus* Clemens and Russell, 1965, with anterior and posterior cingula, have been recovered by Lillegraven (1969:73) from the Late Cretaceous Upper Edmonton Formation of Alberta. *C. magnus* is approximately three times as large as *Pararyctes* in known parts of the dentition.

The upper molars described here are similar to *Pararyctes* in size and in possessing pre and postcingula. UA 5892, the labial fragment of an M2, and the probable m2, UA 5894, are within the range in size of *Palaeoryctes puercensis* Matthew, 1913, and *Pararyctes*. On M2 of *Pararyctes* and UA 5892, the paracone and metacone are less connate than in *P. puercensis*; the parastyle is weaker and the ectoflexus shallower. On the lower molars of *Pararyctes* and that described here, the talonid is wider and larger than in *P. puercensis*; also the trigonid is less compressed anteroposteriorly, and the hypoconid and hypoconulid are more closely twinned.

On the upper fourth premolars described here, as on *Pararyctes*, the anterior margin of the crown is concave, the posterior margin nearly straight, and the metacone is present. On P4 of *Palaeoryctes puercensis*, the anterior and posterior borders of the crown are nearly parallel, and the metacone is absent.

The upper fourth premolars from Cypress Hills, with well-developed pre and postcingula, differ from P4 of *Pararyctes pattersoni*, which does not bear lingual cingula.

Order CONDYLARTHRA Cope, 1881*b*

Family PHENACODONTIDAE Cope, 1881*b*

Ectocion osbornianus Cope, 1882

(Fig. 21)

Referred specimen.—dP4, UA 5896.

Locality.—UAR-1, Ravenscrag Formation, Alberta.

Known distribution.—Ravenscrag Formation, Alberta; Buckman Hollow local fauna, Almy Formation, Wyoming; Plateau Valley local fauna, De Beque Formation, Colorado; Polecat Bench Formation, Wyoming; Wasatch Formation, Colorado and Wyoming.

Deciduous upper fourth premolar.—UA 5896, a moderately worn right dP4 (length, 5.4; width, 6.3), is nearly quadrate in occlusal outline; the anterolingual edge of the crown is oriented obliquely at approximately 45 degrees to the lingual margin. The root beneath the paracone, the anterior face of the parastyle, and the labial part of the precingulum are broken. The crown bears a large, bunodont protocone, smaller, conical paracone and metacone, a mesostyle anterolabial and close to the metacone, and a small bunodont hypocone, directly posterior to and separated from the protocone. The paracone is taller than the metacone and more convex labially in occlusal outline. The paraconule is at the base of the more posterior paracone; a ridge on the lingual face of the paracone joins the two cusps. A short furrow separates the bases of the metaconule and metacone. The postparacrista and shorter premetacrista link the mesostyle to the paracone and metacone, respectively. The parastyle, lower than the paracone, is anterior and slightly labial to that cusp, at the raised junction of the preparacrista, precingulum, and ectocingulum. The metastyle, much smaller than the parastyle and approximately one-half the height of the metacone, is formed by the union of the postmetacrista, postcingulum and ectocingulum, posterior and slightly labial to the metacone. The ectocingulum is concave anteriorly, convex posteriorly, and bears two cuspules, one on either side of the mesostyle. The precingulum and postcingulum are continuous lingually and are cuspidate anterolingual to the hypocone and anterior to the protocone.

The conules differ from one another in their wear patterns: the wear facet on the paraconule is triangular and continuous with the preprotocrista; that on the metaconule is tearshaped and not continuous with the postprotocrista, which ends on the lingual face of the metaconule. Both protocristae are well worn.

Remarks.—The phenacodontid affinities of UA 5896 are inferred from the nearly quadrate occlusal outline of the crown, the presence of a large mesostyle, strong and continuous cingula that enclose the crown, bunodont cusps and conules, and a well-developed hypocone, directly posterior to the protocone. Referral of UA 5896 to *E. osbornianus* is on the basis of resemblance to PU 14247, dP4 of *E. osbornianus* from Silver Coulee deposits; both specimens are of equal size. However, on UA 5896, the precingulum is slightly stronger lingual to the protocone and the mesostyle is somewhat larger than on the Princeton specimen.

CONCLUSIONS

The Ravenscrag Formation in the Cypress Hills, southeastern Alberta, has never been dated radiometrically, nor correlated with certainty with other known Paleocene formations. Although fossil molluscs from the Alberta Ravenscrag closely resemble those from the Fort Union Series (L. S. Russell, 1950), the fossil mammals from Police Point remain the best fossil indicators of the age of the bentonitic fossiliferous beds.

Table 10 lists the known species in the assemblage from Cypress Hills and their geological occurrence in other known Paleocene mammalian local faunas of North America. Six species in this list occur in the Torrejonian; of these, *Ptilodus montanus* and *Mimetodon silberlingi* are also found in Tiffanian and "Clark-

TABLE 10.—*Mammalian species in the Cypress Hills local fauna and their biostratigraphical occurrence in North America (McKenna, 1960; D. E. Russell, 1967).*

Ptilodus montanus	Torrejonian — Wyoming, Montana; Tiffanian — Wyoming
Neoplagiaulax hunteri	Tiffanian — Wyoming
Parectypodus sinclairi	Torrejonian — Montana
Mesodma sp. P	Torrejonian — Montana
Mimetodon silberlingi	Torrejonian — Montana, Wyoming; "Clarkforkian"— Montana
Peradectes cf. *elegans*	Tiffanian — Montana, Wyoming, Colorado
Propalaeosinopa diluculi	Torrejonian — Montana
Elpidophorus elegans	Tiffanian — Montana, Alberta
Leptacodon tener	Tiffanian — Montana, Alberta, Colorado
Leptacodon packi	Tiffanian — Wyoming
Litolestes notissimus	Tiffanian — Montana
Litolestes sp.	Tiffanian — Montana, Wyoming
cf. *Nyctitherium*	Wasatchian — Wyoming, Colorado, New Mexico; Bridgerian — Wyoming
Carpodaptes cf. *hazelae*	Tiffanian — Montana
Phenacolemur frugivorus	Tiffanian — Montana, Colorado
Paromomys depressidens	Torrejonian — Montana
Plesiadapis fodinatus	Tiffanian — Wyoming; Wasatchian — Wyoming
Pararyctes sp.	Tiffanian — Wyoming
Ectocion osbornianus	Tiffanian — Colorado; "Clardforkian" — Wyoming; Wasatchian — Colorado, Wyoming

forkian" deposits. Thus, of the 19 species described here, four are restricted to the Torrejonian, and 14 are known from Tiffanian or younger horizons; *Nyctitherium*, possibly present in the assemblage, is exclusively Eocene in known distribution. This compilation implies a Tiffanian age for the assemblage from the Cypress Hills, which, with exception of the condylarths, is closest in faunal composition to that from the Tiffanian Scarritt Quarry (see Table 11). The Cypress Hills local fauna provides the first Tiffanian record of *Parectypodus sinclairi*, *Mesodma* sp. P, *Propaleosinopa diluculi* and *Paromomys depressidens* and, possibly, the first Paleocene record of *Nyctitherium*.

Except for a single dP4 of *Ectocion osbornianus*, condylarths and other large mammals are conspicuously absent from the Cypress Hills local fauna, of which small multituberculates, insectivores, and primates comprise the major part. Inasmuch as more than 800 mammalian specimens were collected from the Police Point locality, the absence of large mammals from the local fauna is more than a consequence of sampling error. It appears that the low energy depositional regime of the Police Point locality—inferred from the extremely fine-grained nature of the thinly bedded, bentonitic clays—may have biased the local fauna in favor of remains of smaller mammals. Large fragments of bone of actinopterygian fishes, salamanders, turtles, lizards and crocodilians are abundant in the death assemblage, and, in view of the nature of the bentonitic clays, imply that the environment of the Police Point locality during the Late Paleocene may have been a large inland lake, with streams emptying from the west. It seems likely that these remains of large, aquatic and amphibious lower vertebrates are partially represen-

TABLE 11.—*Comparison of local faunas from the Cypress Hills, Ravenscrag Formation, Alberta, and Scarritt Quarry, Melville Formation, Fort Union Series, Montana.*

Cypress Hills local fauna	Scarritt Quarry local fauna (Simpson, 1936, 1937*a*, 1937*b*; D. E. Russell, 1967)
Ptilodus montanus	———
Neoplagiaulax hunteri	*Neoplagiaulax hunteri*
Parectypodus sinclairi	———
Mesodma sp. P	———
Mimetodon silberlingi	———
Peradectes cf. *elegans*	———
Propalaeosinopa diluculi	*Propalaeosinopa thomsoni*
———	*Palaeosinopa simpsoni*
Elpidophorus elegans	*Elpidophorus elegans*
Leptacodon tener	*Leptacodon* cf. *tener*
Leptacodon packi	———
———	*Unuchinia asaphes*
cf. *Nyctitherium*	———
Carpodaptes cf. *hazelae*	*Carpodaptes hazelae*
Phenacolemur frugivorus	*Phenacolemur frugivorus*
Paromomys depressidens	cf. *Paromomys*, gen. and sp. indet.
Plesiadapis fodinatus	*Plesiadapis anceps*
———	*Plesiadapis rex*
Pararyctes sp.	———
———	*Paleotomus senior*
———	*Arctocyon ferox*
———	*Thryptacodon ?australis*
———	cf. *Chriacus* sp.
———	?*Ellipsodon* sp.
———	cf. *Haplaletes* sp.
Litolestes notissimus	*Litolestes notissimus*
Litolestes sp.	———
———	*Anisonchus sectorius*
Ectocion osbornianus	———
	Tetraclaenodon cf. *puercensis*
	Tetraclaenodon sp.
	Gidleyina montanensis
	?*Gidleyina silberlingi*
	?*Gidleyina superior*
	?*Gidleyina* sp.
	Titanoides sp.
	Titanoides zeuxis

tative of the fauna that inhabited the lake and its surrounding shores. On the other hand, the biased and fragmentary nature of the mammalian remains from Police Point suggest stream transport to their site of deposition, with larger mammals perhaps being deposited first, farther west, in a higher energy environment. The presence of large mammals in the Paskapoo Formation (see Table 12) — in part, the equivalent of the Ravenscrag Formation on the Alberta plains, west of Cypress Hills — agrees with this interpretation.

TABLE 12.—*Large mammals known from the Paskapoo Formation, Alberta, and absent from the Cypress Hills local fauna.*

ERICKSON'S LANDING LOCAL FAUNA (Simpson, 1927)
Catopsalis calgariensis (Multituberculata)
?*Phenacodus* (Condylarthra)

LOCALITY 2E, CALGARY (L. S. Russell, 1958; D. E. Russell, 1967)
Catopsalis calgariensis (Multituberculata)
?*Chriacus* (Condylarthra)
?*Neoclaenodon* (Condylarthra)
Tetraclaenodon cf. *puercensis* (Condylarthra)

LOCALITY 1, COCHRANE (L. S. Russell, 1958; D. E. Russell, 1967)
?*Ectocion collinus* (Condylarthra)

LOCALITY 11, COCHRANE (L. S. Russell, 1958)
Chriacus orthogonius (Condylarthra)
Meniscotherium semicingulatum (Condylarthra)

SWAN HILLS LOCAL FAUNA (L. S. Russell, 1967)
Claenodon sp. (Condylarthra)

SAUNDERS CREEK LOCALITY (L. S. Russell, 1948; Simons, 1960)
Caenolambda (Pantodonta)

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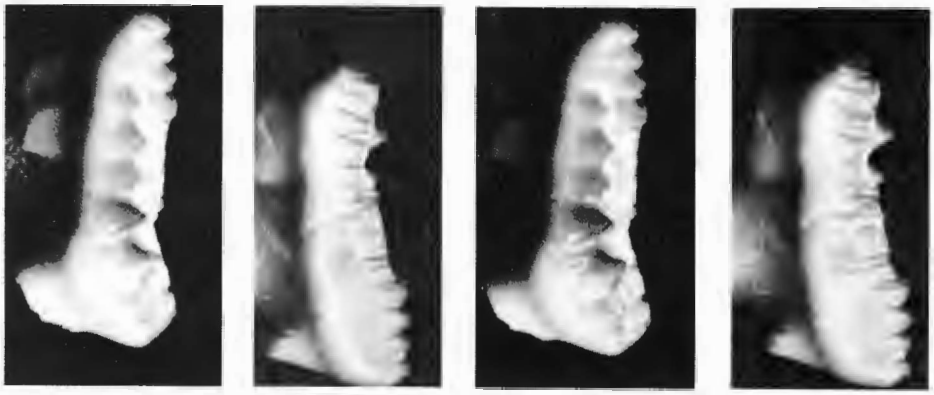
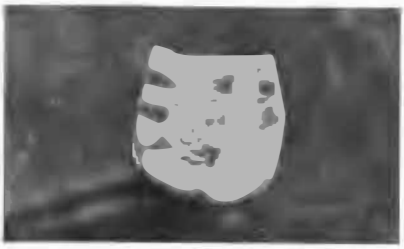
FIG. 3.—*Ptilodus montanus*: A and B, labial and lingual view of UA 5643, left P4 (about 7×), length, 6.2; C, occlusal view of UA 5646, right M1 (about 7×), width, 2.6; D, lingual view of 5649, right p4 (about 7×); E, occlusal view of UA 5650, right m1 (about 7×), length, 3.7; F, occlusal view of UA 5653, left m2 (about 7×), length, 2.5.



A B



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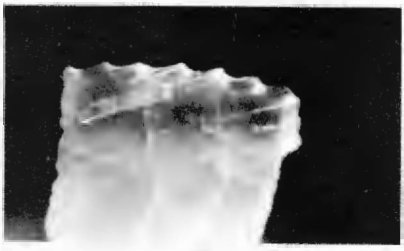

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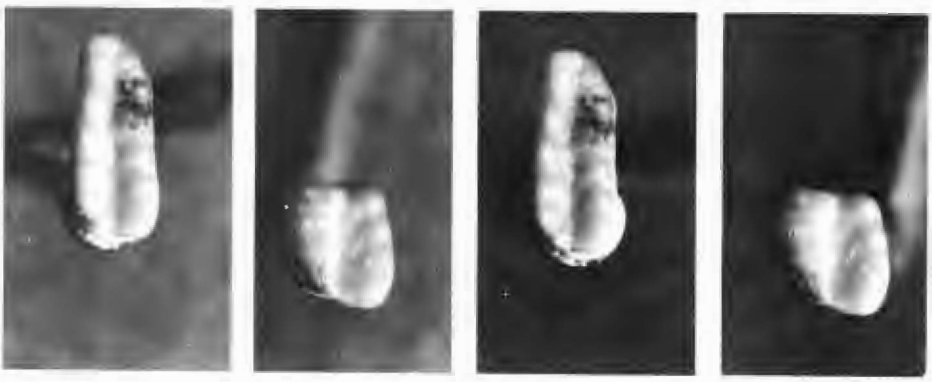
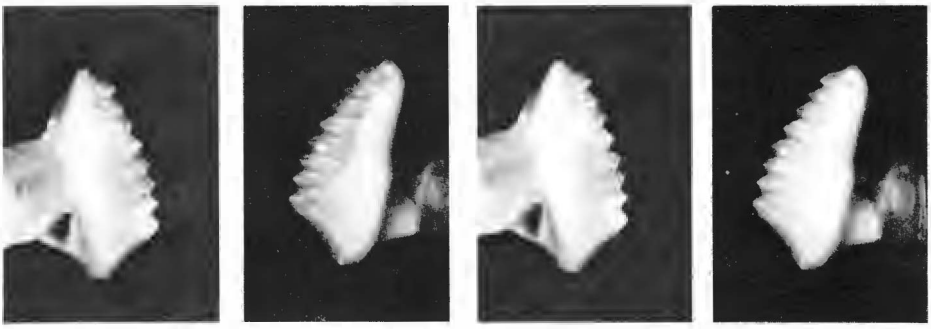


FIG. 4.—*Neoplagiaulax hunteri*: A and B, labial and lingual view of UA 5655, right P4 (about 7×), length, 3.7; C, occlusal view of UA 5667, right M1 (about 7×), length, 2.7; D, occlusal view of UA 5679, left M2 (about 7×), length, 1.8; E, occlusal view of UA 5681, left m1 (about 7×), length, 2.9; F, occlusal view of UA 5656, right m2 (about 7×), length, 1.5.



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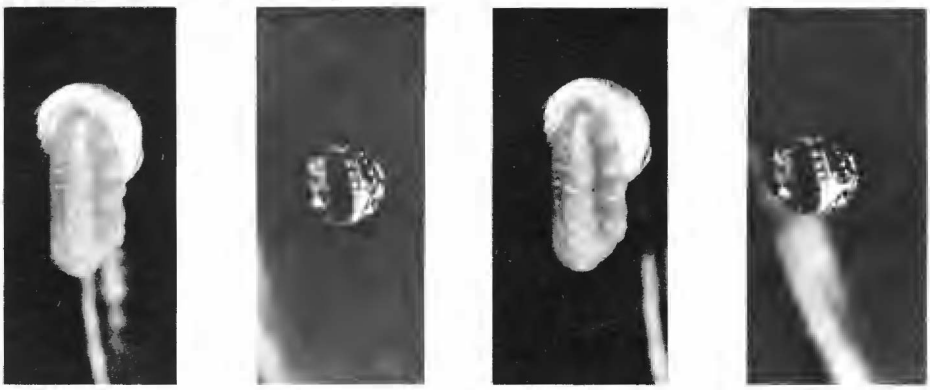

E F

FIG. 5.—*Parectypodus sinclairi:* A and B, labial and lingual view of UA 5721, left P4 (about 25×), length, 2.1; C, occlusal view of UA 5694, right M1 (about 7×), length, 2.3; D, occlusal view of UA 5700, left M2 (about 7×), length, 1.5; E and F, labial and lingual view of UA 5704, left p4 (about 25×); G, occlusal view of UA 5713, left m1 (about 7×), length, 1.9; H, occlusal view of UA 5717, right m2 (about 7×), length, 1.0.

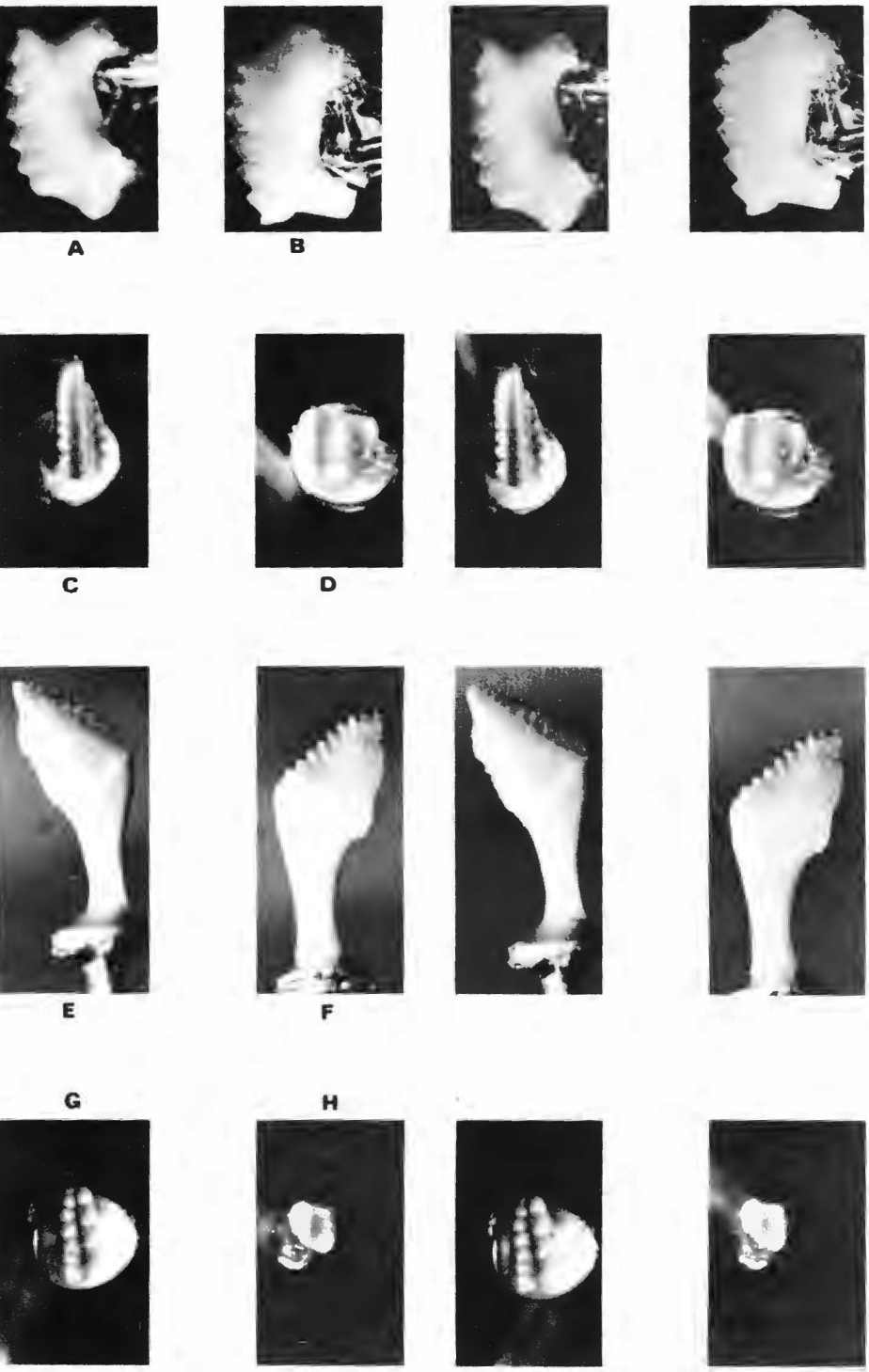
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FIG. 6.—*Mesodma* sp. P: A and B, labial and lingual view of UA 5723, right P4 (about 25×), length, 2.0; C, occlusal view of UA 5726, left M1 (about 7×), length, 2.1; D, occlusal view of UA 5727, left M1 (about 7×), length, 2.1; E, occlusal view of UA 5739, right M2 (about 25×), length, 1.0; F and G, labial and lingual view of UA 5742, right p4 (about 25×); H, occlusal view of UA 5752, left m1 (about 7×), length, 1.6; I, occlusal view of UA 5757, left m2 (about 25×), length, 0.9.

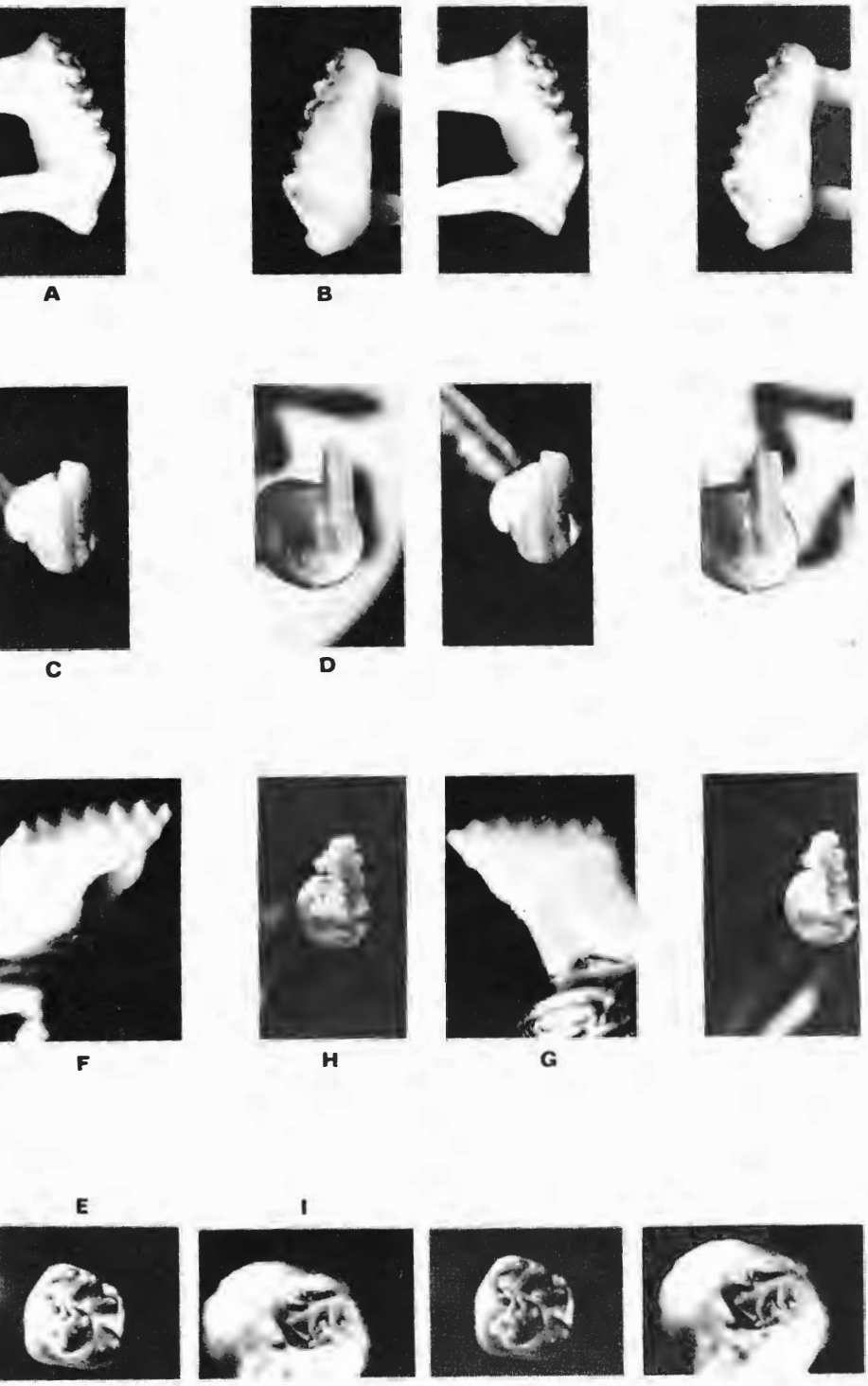
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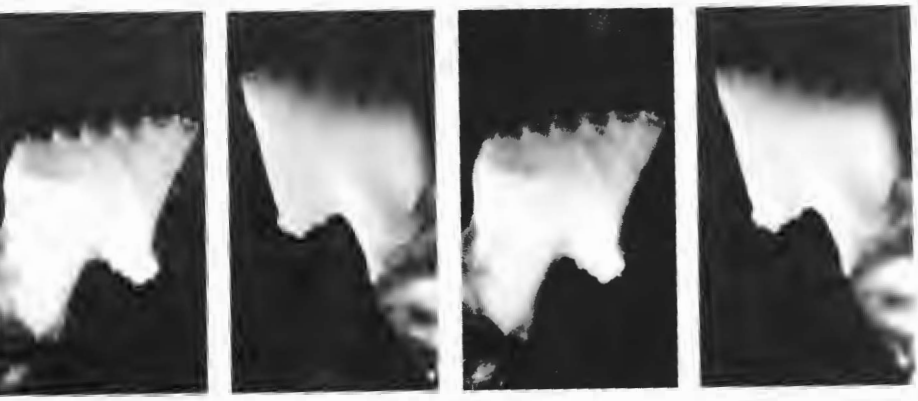
FIG. 7.—*Mimetodon silberlingi*: A and B, labial and lingual view of UA 5759, right p4 (about 25×).

FIG. 8.—*Peradectes elegans*: A, occlusal view of UA 5760, left M1 (about 25×), length, 1.6; B, occlusal view of UA 5761, left m1 or m2 (about 7×), length, 1.8; C, occlusal view of UA 5762, right m1 or m2 (about 7×), width, 1.0.

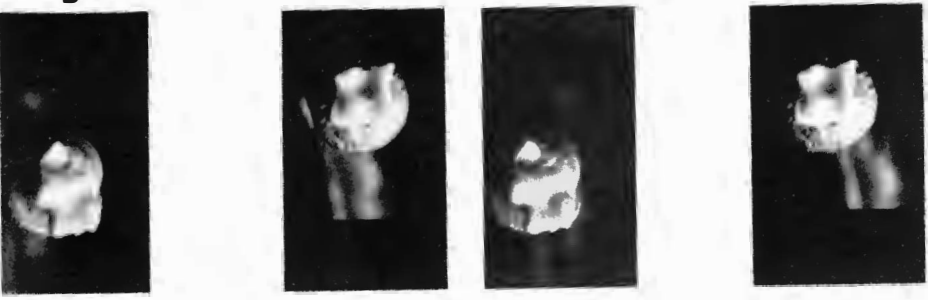


A B

Fig. 7

Fig. 8

A



B C

FIG. 9.—*Propalaeosinopa diluculi*: A, occlusal view of UA 5763, left M1 (about 7×), length, 2.7; B, occlusal view of UA 5767, right M2 (about 7×), length, 2.8; C, occlusal view of UA 5776, right M3 (about 7×), width, 3.8; D, occlusal view of UA 5778, right m1 (about 7×), length, 2.9.

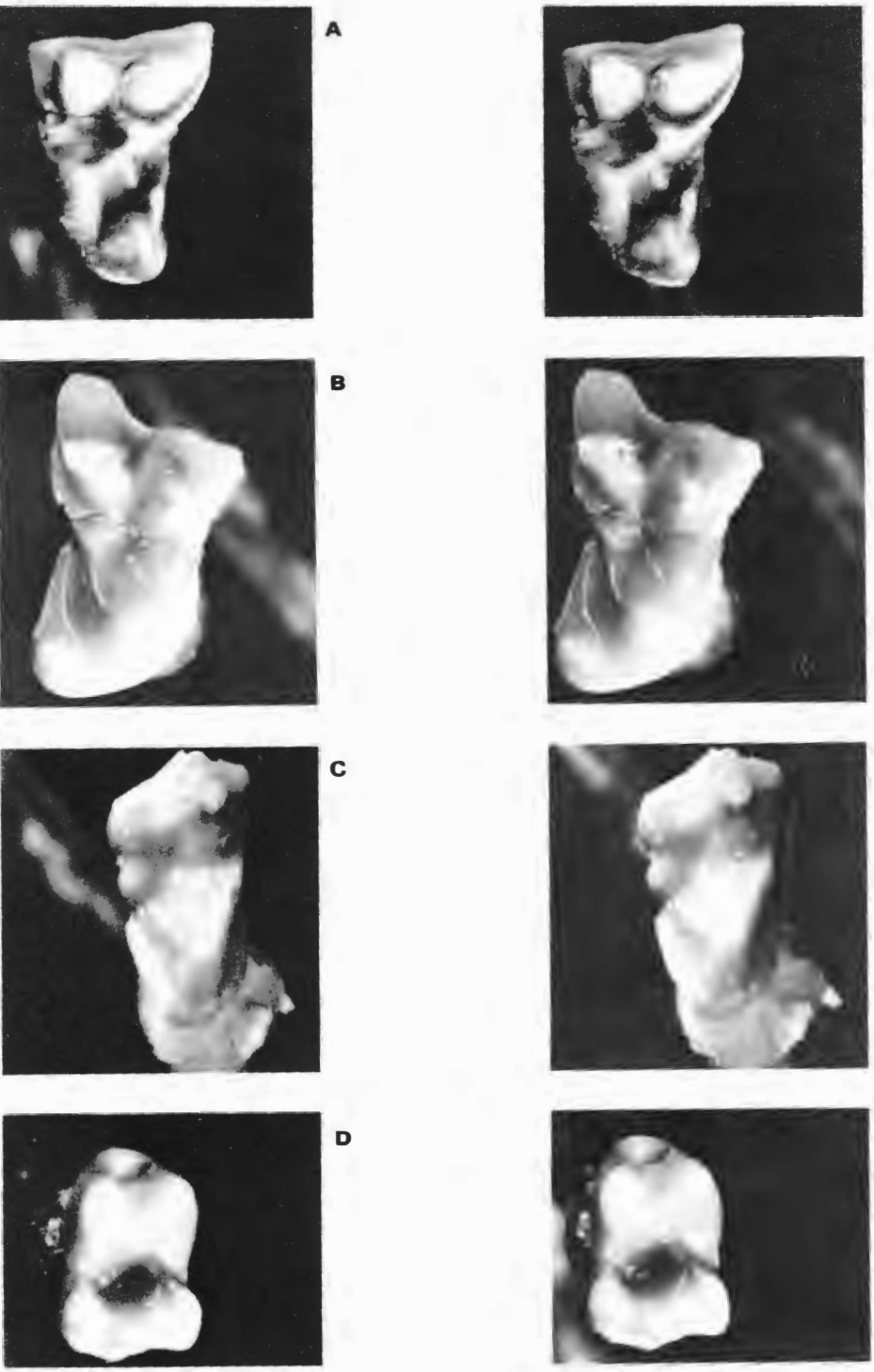

A
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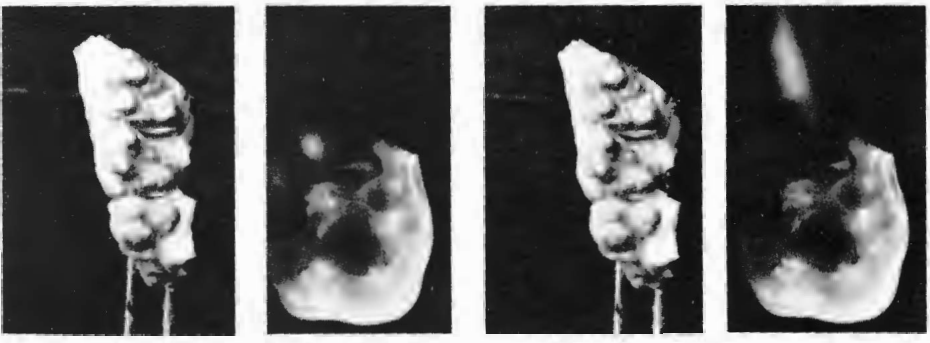
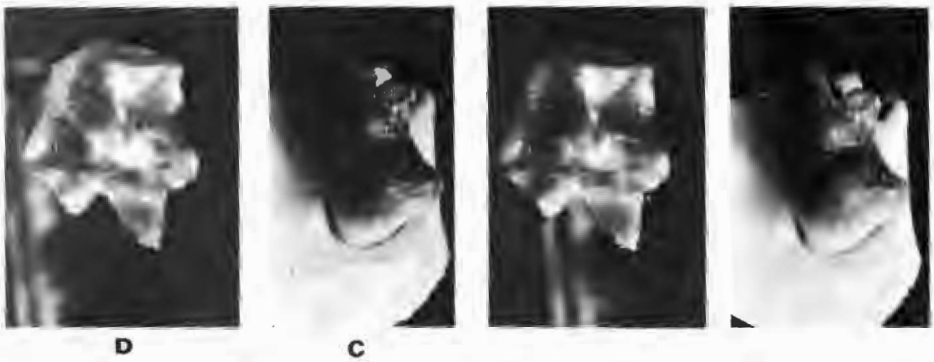
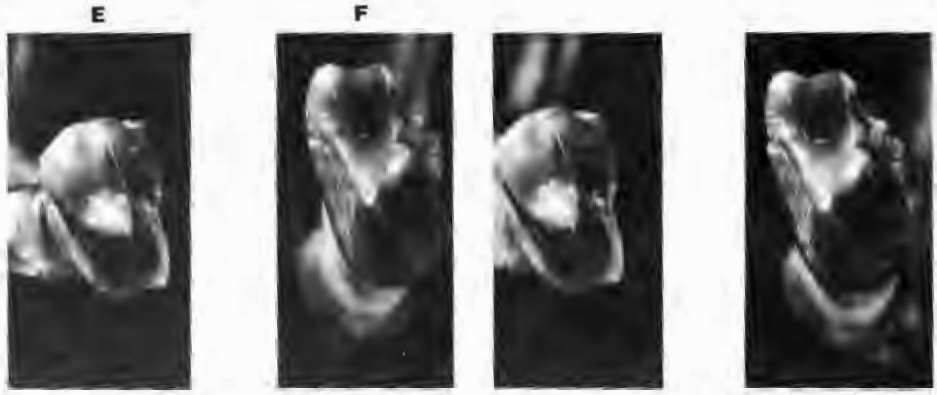
FIG. 10.—*Elpidophorus elegans*: A, occlusal view of UA 5782, fragment of left maxilla with P3-M1 (about 2×), length of M1, 4.0; B, occlusal view of UA 5788, right M2 (about 7×), lingual length, 2.3; C, occlusal view of UA 5791, left M3 (about 7×) D, occlusal view of UA 5792, left ?dp4 (about 7×), width, 2.7; E, occlusal view of UA 5794, left m1 or m2 (about 7×), width, 3.4; F, occlusal view of UA 5797, right m1 or m2 (about 7×), width, 4.3.



A B



D C



E F

FIG. 11.—*Leptacodon tener*: A, occlusal view of UA 5799, left P4 (about 7×), length, 1.6; B, occlusal view of UA 5806, left M1 (about 25×), length, 1.4; C, occlusal view of UA 5810, right M3 (about 25×), length, 0.9; D, occlusal view of UA 5820, left p4 (about 7×), length, 1.3; E, occlusal view of UA 5822, fragment of right mandible with p4-m1 (about 7×), length of m1, 1.5; F, occlusal view of UA 5823, fragment of left mandible with m1-m2 (about 7×), length of m2, 1.1; G, occlusal view of UA 5632, right m3 (about 25×), length, 1.1.

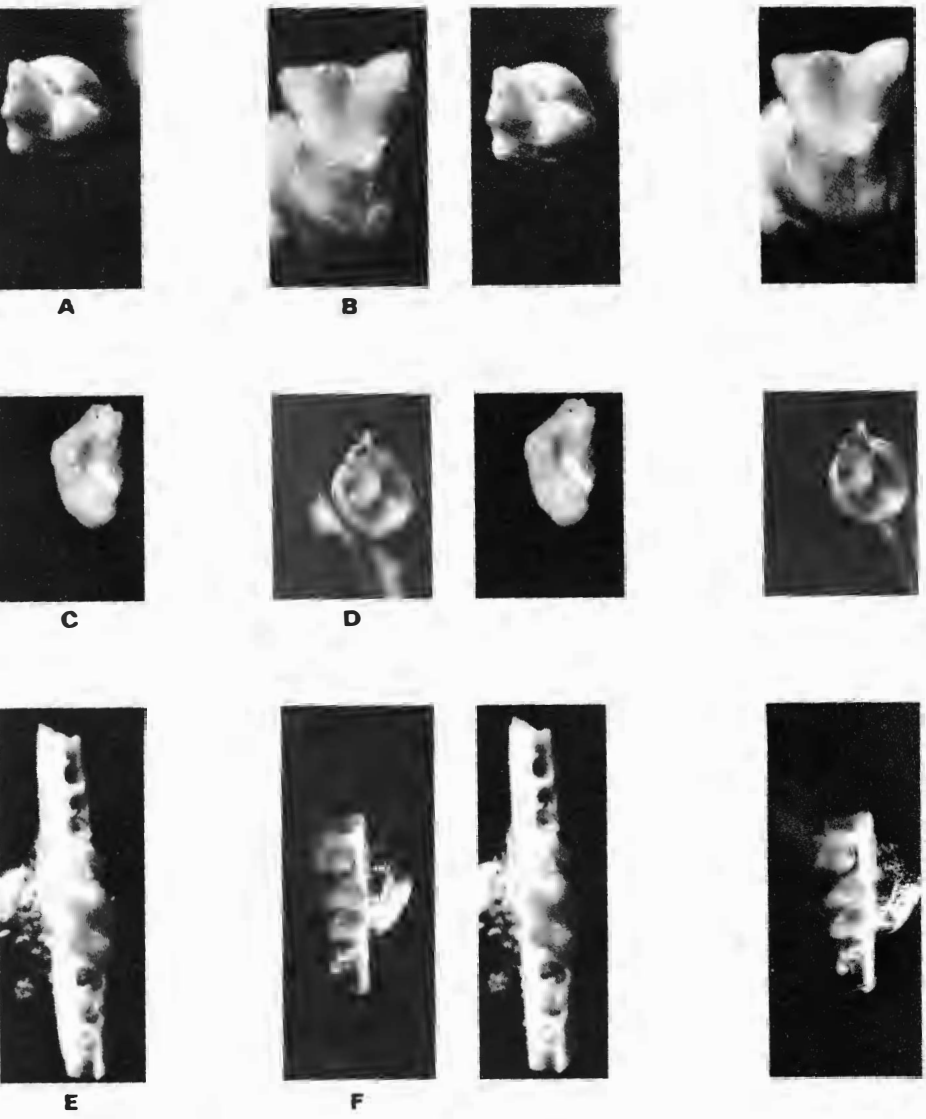

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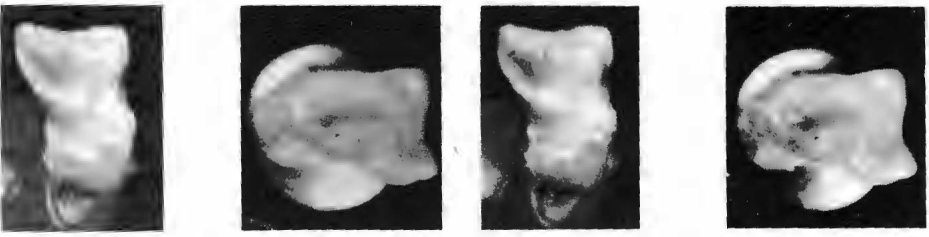
FIG. 12.—*Leptacodon packi*: A, occlusal view of UA 5833, right M1 (about 7×), length, 1.2; B, occlusal view of UA 5837, left M2 (about 7×), length, 1.1.

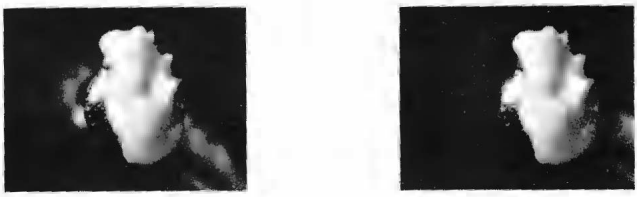
FIG. 13.—*Litolestes notissimus*: A, occlusal view of UA 5841, left M1 (about 7×), width, 2.5; B, occlusal view of UA 5843, left M2 (about 7×); C, occlusal view of UA 5848, right M3 (about 7×), length, 1.6; D, occlusal view of UA 5849, fragment of right mandible with m1 (about 7×), length of m1, 2.0; E, occlusal view of UA 5853, left m3 (about 7×), length, 1.9.



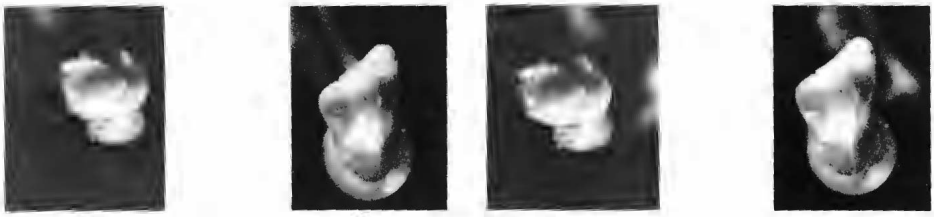
A B

Fig. 12

Fig. 13



A



B C

D E

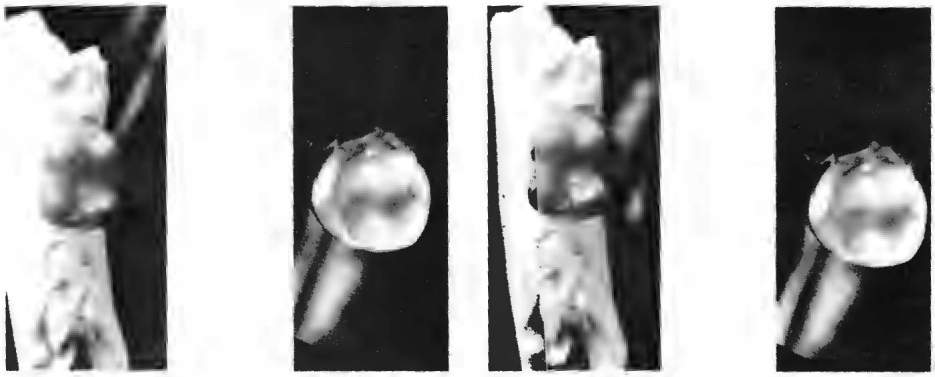
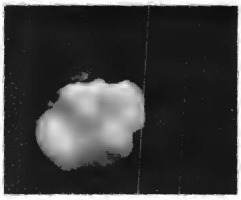


FIG. 14.—*Litolestes* sp.: occlusal view of UA 5856, fragment of left maxilla with M1-2 and parastyle of M3 (about 7×), length of M1, 1.3.

FIG. 15.—cf. *Nyctitherium*: A, occlusal view of UA 5854, right M1 or M2 (about 25×), lingual length, 0.8; B, occlusal view of UA 5855, right M1 or M2 (about 25×), lingual length, 0.8.

Fig.14

Fig.15



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B

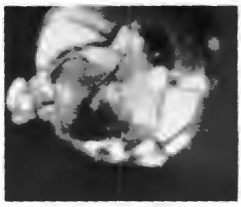

Fig.14

Fig.15

A

B

FIG. 16.—*Carpodaptes* cf. *hazelae*: A, occlusal view of UA 5857, right P3 (about 7×), length, 1.7; B, occlusal view of UA 5861, right P4 (about 7×), length, 1.7; C, occlusal view of UA 5864, right M1 (about 7×), length, 1.4; D, occlusal view of UA 5870, right M2 (about 7×), length, 1.3; E, occlusal view of UA 5872, left M3 (about 7×), length, 1.1; F and G, labial and lingual view of UA 5876, left p4 (about 7×), length, 2.3; H, occlusal view of UA 5877, right m1 (about 7×), length, 1.7; I, occlusal view of UA 5879, right m2 (about 7×), length 1.2; J, occlusal view of UA 5880, left m3 (about 7×), length, 1.9.

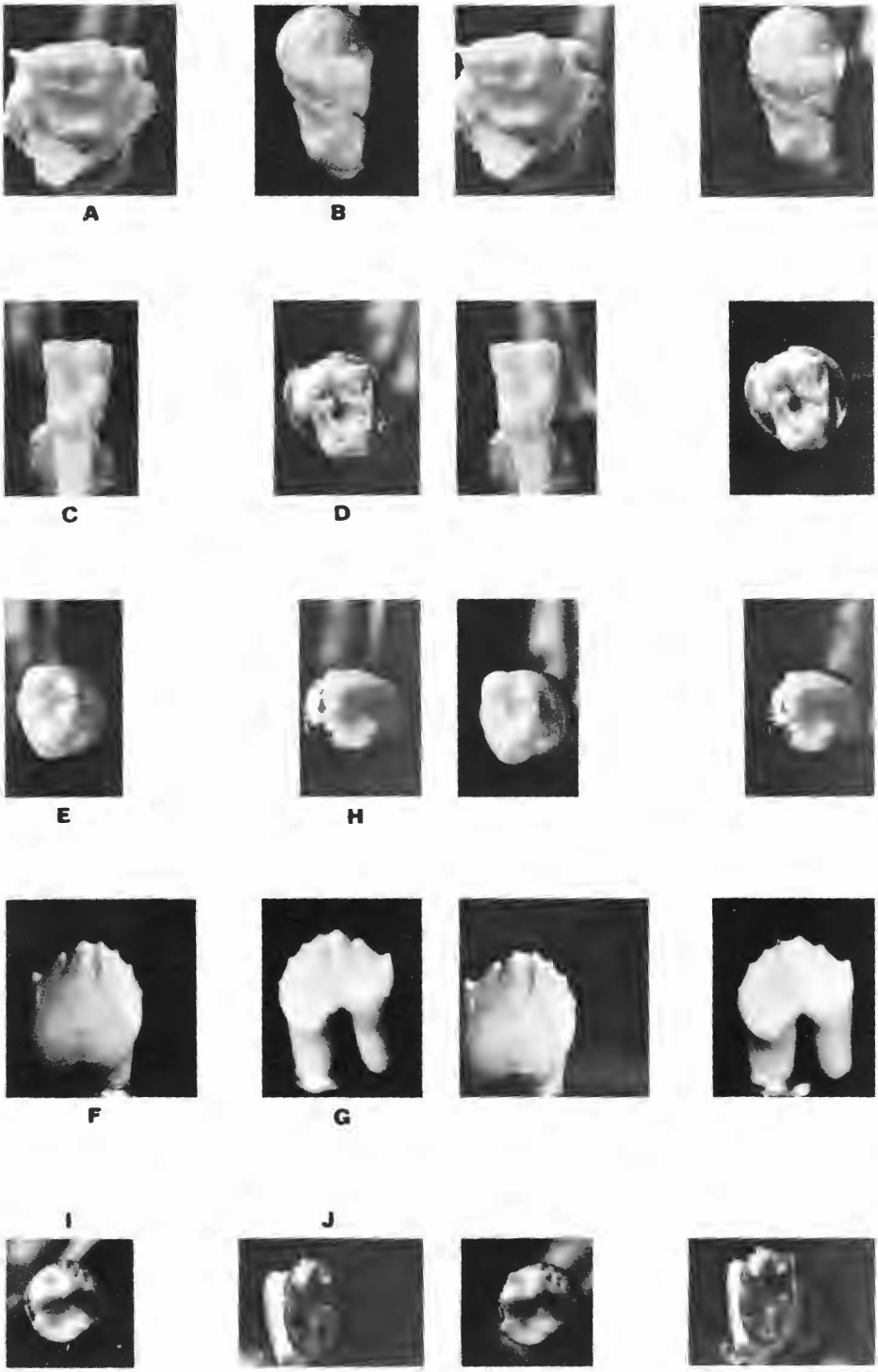
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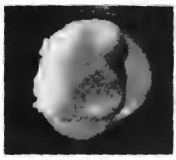
FIG. 17.—*Phenacolemur frugivorus*: occlusal view of UA 5882, right m2 (about 7×), length, 1.7.

FIG. 18.—*Paramomys depressidens*: A, occlusal view of UA 5883, right m2 (about 7×), length, 1.9; B, occlusal view of UA 5884, left m2 (about 7×), width, 1.5.

FIG. 19.—*Plesiadapis fodinatus*: occlusal view of UA 5885, right P4 (about 7×), length, 2.5.

Fig. 17

Fig. 18



A

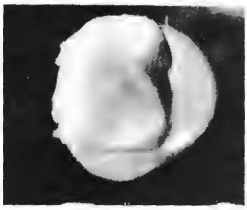
B

Fig. 19

Fig. 17

Fig. 18

A



B

Fig. 19

FIG. 20.—*Pararyctes* sp.: A, occlusal view of UA 5886, left P4 (about 25×), width, 2.0; B, labial view of UA 5887, left P4 (about 7×), length, 1.6; C, occlusal view of UA 5891, left M1 or M2 (about 25×); D, occlusal view of UA 5892, left M2 (about 7×), length, 1.9; E, occlusal view of UA 5893, left M3 (about 7×), length, 0.7; F, occlusal view of UA 5894, right ?m2 (about 7×), length, 1.7.

FIG. 21.—*Ectocion osbornianus*: occlusal view of UA 5896, right dP4 (about 6×), length, 5.4.

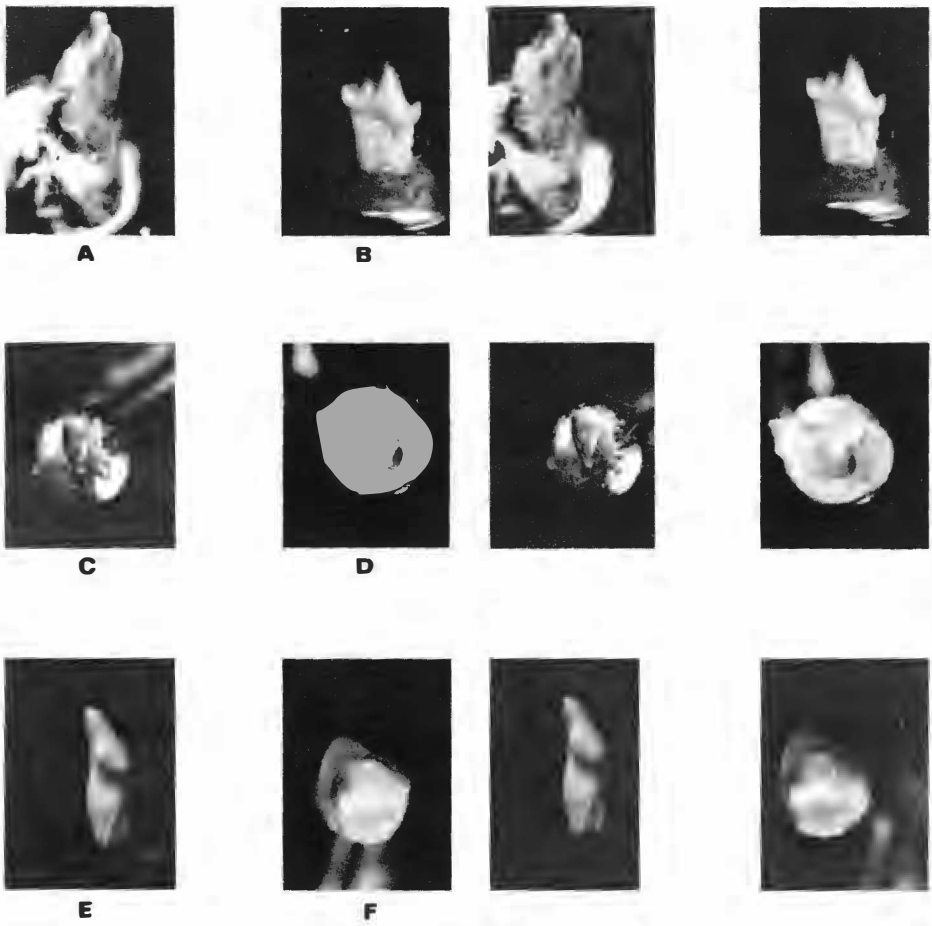


Fig. 20

Fig. 21