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## MAMMALIAN FAUNA AND CORRELATION OF THE PASKAPOO FORMATION OF ALBERTA

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In papers read before the Paleontological Society of America on January 1, 1914, Barnum Brown and W. D. Matthew announced the discovery by the former of a number of teeth and jaws of mammals in the Paskapoo formation of Alberta.<sup>1</sup> The collection was seen to be of the greatest interest, not only in itself but also as throwing much needed light on the age of the formation, but its treatment was necessarily summary, as it was introduced in the course of a discussion of a much larger problem, and the identifications made at that time were tentative and not accompanied by descriptions or figures. There seems, furthermore, to have been some confusion with material from another formation. Through the kindness of Dr. Matthew and Mr. Brown, this small but important fauna was recently placed in my hands for more thorough study, and the results are here presented.

The collection was made by Mr. Brown in the course of exploration for dinosaurs on the Red Deer River in 1910, the locality being given by him as follows, "Near Erickson's Landing, about 20 miles below the town of Red Deer, [in] . . . an enormous slide, the largest seen along the river, where a full section of the canyon wall 100 yards in length has slipped down to the river level." The mammals were found in an isolated block of sandstone in the slide, but the layer from which they must have come was located in the bluff at a point 150 feet above the river.

As now identified the fauna is as follows:

### MULTITUBERCULATA

#### Polymastodontidæ

*Catopsalis calgariensis* Russell

### INSECTIVORA

#### Pantolestidæ

*Propalæosinopa albertensis*, new genus and species

??Pantolestid, genus and species undetermined

### MENOTYPHLA

#### Plesiadapidæ

*Nothodectes* cf. *gidleyi* Matthew

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<sup>1</sup>1914, Bull. Geol. Soc. America, XXV, pp. 361-362 and 388-389.

## ?CARNIVORA

## ?Oxycænidæ

*Elpidophorus elegans*, new genus and species

## CONDYLARTHRA

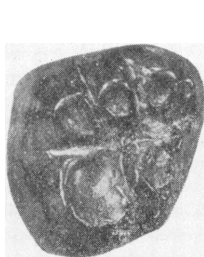
## Phenacodontidæ

? *Phenacodus*, species undetermined

## ?TALIGRADA

Genus and species undetermined

All these forms are from the same locality and horizon, save *Catopsalis calgariensis*, which was found at Calgary and at a somewhat higher horizon.



R  
Fig. 1. *Catopsalis calgariensis* Russell.  
Crown view of  $m_2$ .  $\times 3$ .

## MULTITUBERCULATA

## Polymastodontidæ

*Catopsalis calgariensis* Russell

Through the kindness of Mr. L. S. Russell, the original specimen of this interesting form and the manuscript of the description being published by him<sup>1</sup> were submitted to me for use in the present study, and I am therefore able fully to confirm the description as published and need not repeat it here in detail. I give, however, a new photograph. Comparison with the type of *Catopsalis foliatus* Cope in the American Museum shows that the Alberta specimen is quite distinctive, although probably correctly referred to the same genus. It is larger, more robust, wider in proportion to its length and has the last cusp of the outer row relatively somewhat reduced. The measurements compare as follows:

	Length $M_2$	Width $M_2$
<i>Catopsalis foliatus</i>	6.6 mm.	5.7 mm.
<i>C. calgariensis</i>	9.0 mm.	8.5 mm.

## INSECTIVORA

## Pantolestidæ

*Propalæosinopa albertensis*, new genus and species

TYPE.—Amer. Mus. No. 15543b, a left mandibular ramus, broken, with the crown of  $P_4$ , alveoli for  $M_{1-3}$ , and one alveolus for  $P_3$ .

CHARACTERS.— $P_4$  is not molariform, but is transversely compressed, with high central cusp, now truncated by wear, a very small anterior accessory cusp, and a heel with a small median posterior cusp united to the main cusp by a crest. There is a

<sup>1</sup>1926, American Journal of Science, not yet issued at the time of writing these words.

slightly developed basin internal to this crest (on the internal half of the heel), but external to it there is a lateral concavity with no approach to a basined condition. There were three molars of subequal size, the last with the posterior root elongated. The jaw is very slender, with a well-delimited masseteric fossa, its anterior border swollen. There is a relatively large and very distinct posterior mental foramen beneath the anterior root of  $M_2$ .

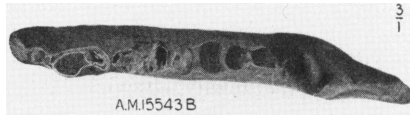


Fig. 2. *Propalæosinopa albertensis*. Type, A. M. No. 15543B.  
Top view of left mandibular ramus, showing  $p_4$  and alveoli of  $m_1-3$  and  $p_3$ .  $\times 3$ .

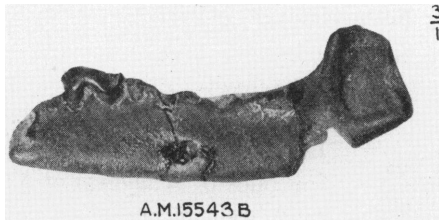


Fig. 3. *Propalæosinopa albertensis*. Type, A. M. No. 15543B.  
Side view of left mandibular ramus, showing  $p_4$ .  $\times 3$ .

DISCUSSION.—There is another jaw, Amer. Mus. No. 15543C, in the collection, probably representing the right ramus of the same species, perhaps individual, and of nearly identical character, but unfortunately it is crushed slightly and bears no teeth.

This form does not find any very close analogues except among the pantolestids, from all the previously known members of which it differs in its relatively minute size and slender proportions and in the fact that the posterior mental foramen is more posterior in position. The fourth lower premolar differs from that of *Pentacodon* (Torrejon) most noticeably, in that in the latter a very distinct accessory cusp is developed directly internal to the main cusp. The Bridger *Pantolestes* is somewhat more like *Propalæosinopa* as regards  $P_4$ , but the closest comparison is apparently with *Palæosinopa* (Wasatch), in which, however, the heel cusp of  $P_4$  appears to be constantly somewhat more developed. In at least one specimen of *Palæosinopa* there is on this tooth a small but distinct cusp internal to the main heel cusp (and a faint indication of such a cusp may, indeed, be seen even in the Paskapoo specimen), but in other examples of *Palæosinopa* this feature is lacking.

**??Pantolestid, genus and species undetermined**

Number 15543M is an isolated lower molar with a relatively lofty trigonid, prd higher than med and med than pad, narrow anterior cingulum, low heel separated from trigonid by a deep cleft and bearing three evenly spaced talonid cusps of equal height and quite posterior position. Although at first sight one would be inclined to assign this tooth to the didelphids, the heel structure prohibits such a reference. There are at least three orders and several families to which it might conceivably belong, and it is really not sufficiently distinctive for determination, but the closest comparison seems to be with the pantolestid lower molars (cf. *Palæosinopa*), and it may be very doubtfully placed in that family, although a little too large to belong to *Propalæosinopa albertensis*.

**MENOTYPHILA****Plesiadapidae*****Nothodectes* cf. *gidleyi* Matthew**

The most abundant form in the collection is manifestly a plesiadapid, apparently pertaining or most closely allied to the genus *Nothodectes*

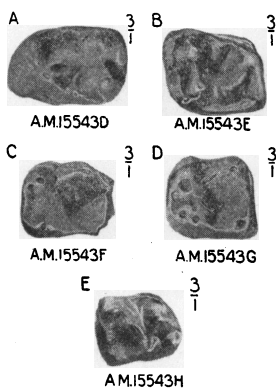


Fig. 4. *Nothodectes* cf. *gidleyi* Matthew. Crown views.

A, A. M. No. 15543D, m<sup>2</sup>; B, No. 15543E, m<sup>2</sup>; C, No. 15543F, m<sup>1</sup>; D, No. 15543G, m<sup>2</sup>; E, No. 15543H, m<sup>3</sup>. All  $\times 3$ .

Matthew. All the teeth here referred agree in being slightly larger than the corresponding ones of *N. gidleyi* or *N. dubius*, and they may well represent a new species, but it seems wise not to attempt to define it at present. Numbers 15543D and 15543E appear to be second upper molars. Both are worn, and No. 15543E is rolled and eroded, but their features are distinctive. They are subquadrate, with low cusps, pa and me subequal, pr a little larger, and with small equal para- and meta-conules of subcrescentic form. There are sharp external and anterior cingula, and a posterior cingulum turning at an angle in the ordinary position of the hypocone and running to the apex of the protocone, but there is no true internal cingulum.

No. 15543F is a nearly unworn first left lower molar of the same genus and, no doubt, species. Its characters are exactly those of *Nothodectes*. Numbers 15543G and 15543H represent respectively the second and third right lower molars. Both are quite worn, and No. 15543H is also broken, but they compare very closely (save in the slightly greater size) with the same teeth of *Nothodectes gidleyi* from the Tiffany. Number 15543I is a very badly worn and somewhat indefinite tooth, perhaps a first lower molar of this form.

So far as can be judged from the material, this is quite certainly a species of *Nothodectes* and closely related to the forms known from the Tiffany and Clark Fork. Comparison with the Fort Union plesiadapids and primates seems somewhat less close.<sup>1</sup> *Pronothodectes* Gidley is very similar, but is stated to have "no definite hypocone or posterior internal ridge, although the protocone is lengthened and slightly angulate in this region," while *Nothodectes* and the present form have a very definite ridge swinging posteroexternally from the protocone apex. *Palæchthon* and *Paromomys*, described by Dr. Gidley as tarsiiids, are also very similar as far as could be judged from isolated teeth, but have distinctive types of lower molars.

### ?CARNIVORA

### ?Oxycænidae

#### ***Elpidophorus elegans*, new genus and species**

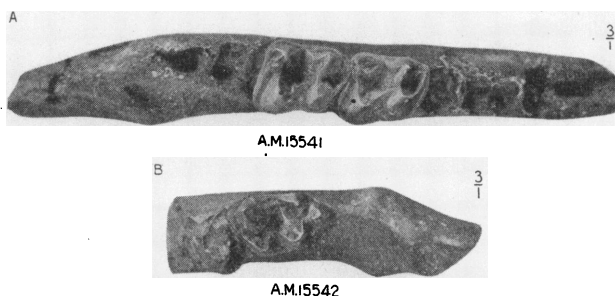


Fig. 5. *Elpidophorus elegans*.

A, Type, A. M. No. 15541. Top view of right mandibular ramus, showing m1-2.  
B, Paratype, A. M. No. 15542. Top view of left mandibular ramus, showing m2-3.  $\times 3$ .

TYPE.—Amer. Mus. No. 15541, a right lower jaw with  $M_{1-2}$ .

PARATYPE.—Amer. Mus. No. 15542, a left lower jaw with badly broken heel of  $M_2$  and nearly perfect  $M_3$ .

CHARACTERS.—The teeth preserved in the type were preceded by at least three closely spaced premolars, the alveoli of which increase regularly in size from front to back. The first molar is of tuberculo-sectorial type, with a small trigonid. The metaconid is the largest cusp of the tooth, the protoconid being about the same size as the reduced paraconid. The latter is almost directly anterior to the metaconid. There is a not very marked anterior cingulum, skirting the protoconid externally and then passing on to the anterior face, here running internally, rising as it goes, but not passing onto the internal face of the trigonid. The talonid is similar in structure to that of  $M_2$  but less well preserved. In the second molar the trigonid is slightly broader, the paraconid relatively smaller, and the  $prd$  and  $med$  relatively larger. The broad heel

<sup>1</sup>1923, J. W. Gidley, Proc. U. S. Nat. Mus., LXIII, pp. 1-38.

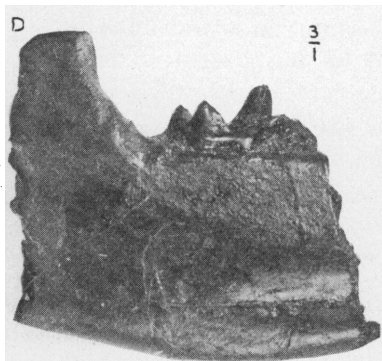
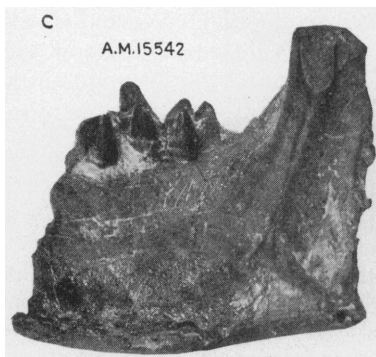
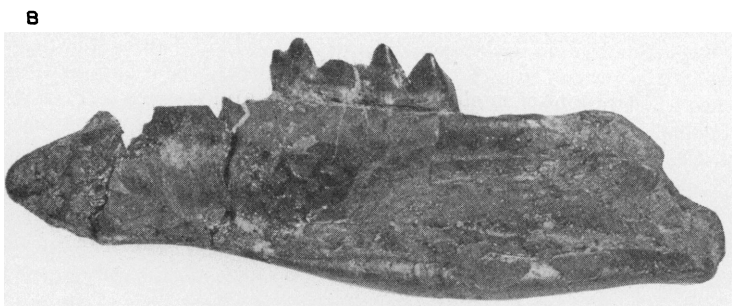
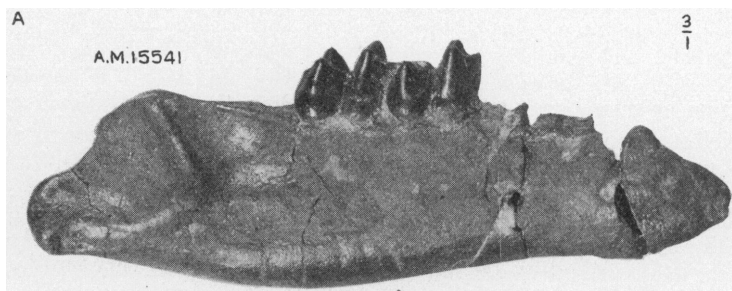


Fig. 6. *Elpidophorus elegans*.

A, *Type*, A. M. No. 15541. External view of right mandibular ramus, showing  $m_1-2$ ,  
 B, inner view of same.  
 C, *Paratype*, A. M. No. 15542. External view of left mandibular ramus, showing  $m_2-3$ .  
 D, inner view of same. All  $\times 3$ .

is distinctly basined, with large and high end, comparable to the *prd* in height but lower than the *med*, and a smaller *hyd*. A deeply notched crest unites the end and *med* internally, and another less prominent crest descends from the tip of the end anteroexternally into the talonid basin. A crest runs from the *hyd* to the connate bases of the *hyd* and *prd* below the notch which separates them. This crest bears a very small cuspule on the anterointernal slope of the *hyd*. Another crest runs from the *hyd* straight internally toward the end, but instead of uniting with the latter this forms a very small cusp at its base external and a little posterior to it. Beginning at a definite point on the posterior surface near this cusp a narrow posterior cingulum runs outward and downward, becoming narrower and not passing onto the external face of the *hyd*.

The third molar is not present in the holotype, but is well shown in the paratype. On this molar the *pad* is still distinct and internal in position, but it is very small, while the metaconid very greatly overtops the protoconid. The trigonid is wider relatively, being here about as wide as the talonid, while on *M*<sub>1-2</sub> it is narrower. The end and *hyd* are much as in the latter teeth in relative size and shape and in their relations to the trigonid and to each other, save that the very slight cusp-like swelling of the crest which runs from the apex of the *hyd* toward the end is absent. Posterior to the talonid, however, and in an almost median position is a third large cusp, the hypoconulid, corresponding in position and relationships to the upper end of the sloping posterior cingulum of the other molars. It is as high as the entoconid, only slightly angulate, and is entirely excluded from the talonid basin.

**AFFINITIES.**—Although apparently only a slight modification of the primitive placental type of lower molar, the teeth of this genus are very unusual in detail. There does not appear to be any other genus which compares at all closely, and even the ordinal position of the animal is uncertain. It is probably either an insectivore or an oxycœnid creodont, and for the present is referred with uncertainty to the latter group. Its greater completeness and its morphological peculiarity hold out hope that the Paskapoo will yield a mammalian fauna of the highest interest when it shall have been searched more thoroughly.

## CONDYLARTHRA

### Phenacodontidæ

#### ?*Phenacodus*, species undetermined

Condylarths are represented in the collection by No. 15543J, a right upper molar, and by No. 15543K, a left lower molar. Their size relations are such that they probably did not belong to the same individual, but there is no reason to suppose them representative of separate genera. There can be little question that both belong to the Phenacodontidæ, although the lower molar does somewhat approach that of *Pleuraspidotherrium*, and the fairly well-developed mesostyle of the upper molar places it, at least, among the genera which appear subsequent to *Tetra-*

*clænodon*. Only two genera, *Phenacodus* and *Ectocion*, are here recognized at present, and of these the Paskapoo specimen would belong, by

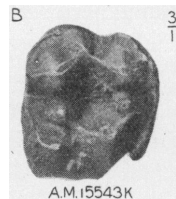
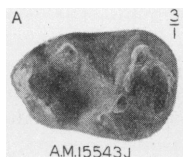


Fig. 7. ?*Phenacodus*, sp. indet.  
Crown views.

A, A. M. No. 15542J.  
M<sup>r</sup>.

B, A. M. No. 15543K.  
M<sup>l</sup>. X3.

definition, to the latter, since the metaconule is distinctly anterior to a line through the metacone and hypocone. It should be noted, however, that the metaconule is not more anterior than in *Phenacodus brachypternus*, a small species which is uncharacteristic of its genus in this respect and which agrees fairly well with the Paskapoo tooth, save in being a little larger, so that more complete material might place this form in *Phenacodus*, or in a new, somewhat more primitive genus. This upper molar appears to be closest to *E. ralstonensis* among the species of *Ectocion*, but it differs in being slightly smaller, with a stronger indentation of the outer border, and with the metaconule not quite so anterior. The lower molar agrees fairly well with the last molar of *Phenacodus brachypternus* in all its characters, including size.

#### ?TALIGRADA

The largest animal in the collection is represented by a single incisor, Amer. Mus. No. 15543L, apparently belonging to one of the taligrades, but not certainly identifiable at present with any more accuracy.

#### CORRELATION OF THE PASKAPOO FORMATION

J. B. Tyrrell, who named the Paskapoo formation (or series) concluded that it was the upper member of the "Laramie," but held that the lower molar member, the Edmonton, marked the end of the Cretaceous, and that the thick Paskapoo was the representative of the Eocene of Europe.<sup>1</sup> Subsequent papers by Canadian geologists have referred the Paskapoo somewhat indefinitely to the Eocene, apparently without exception. The flora and invertebrate fauna, while more or less comparable to those of the Fort Union, are not very completely known, and are noncommittal as to exact age relations, so that the evidence has been largely stratigraphic. The Paskapoo is everywhere found to lie unconformably on the Edmonton beds, which represent the time immediately preceding the deposition of the Lance, while in places it is itself overlaid by the Oligocene, so that its age may be anything from Lance to latest

<sup>1</sup>1886, Geol. and Nat. Hist. Surv. Canada, Ann. Rept., n.s., II, pp. 135E-138E.



Eocene, so far as this evidence goes. True Lance beds with dinosaurs are known in Montana and in Saskatchewan, but erosion of the intervening beds makes it impossible to trace the Paskapoo laterally into these regions. The present mammalian fauna, therefore, furnishes the first definite (although still not very abundant) evidence as to exact age.

Dr. Matthew's interpretation of this fauna (1914), based on preliminary identifications, was, in essence, that it contained certain unmistakable Lance elements together with others of Paleocene aspect but not closely comparable with any known Puerco or Torrejon genera. He therefore concluded that the former fact indicated essential contemporaneity with the Lance, while the latter indicated similarity of facies, but not necessarily of age, with the Paleocene. In the faunal list of Brown, checked and accepted by Matthew, the only genera identified are *Meniscoessus*, *Ptilodus*, *Cimolodon*, *Didelphops*, ?*Batodon*, and ?*Thlæodon*,—all but *Ptilodus* being Lance genera. On checking over the catalogue numbers preparatory to publication of the present paper, however, Mr. Brown found that an unfortunate error had been made and that all the specimens on which these generic identifications were based are not from the Paskapoo but from the Hell Creek (Lance equivalent) of Montana. The specimens here described, together with some not even roughly identifiable, are the only ones truly from the Paskapoo. There is thus only one known Paskapoo multituberculate at present, *Catopsalis calgariensis*, and no marsupials, and it is not true, so far as known, that "the multituberculates are those of the Lance and some of the trituberculates appear to be identical." However confidently we may expect some time to find a fauna of mingled Lance and early Paleocene aspect, such a one is not yet known.

This unexpected modification of the earlier faunal lists removes all anomalous character from the evidence for the age of the Paskapoo. There is nothing in it suggestive of Lance or of early Paleocene age. The known genera are few but significant. *Catopsalis* is known elsewhere definitely only from the Torrejon.<sup>1</sup> The Paskapoo species is very distinct from the Torrejon one, larger and rather more progressive, and while this does not in itself necessarily mean later age, it agrees with the evidence of the other mammals that the fauna is slightly later than the Torrejon. This form is from a somewhat higher horizon than the others, but it does not in any way suggest a later fauna. *Propalæosinopa* and *Elpidophorus* are so isolated as to be of little value in correlation. The nothodectid,

<sup>1</sup>*Catopsalis* generally figures in faunal lists as a Puerco genus, but in a letter dated Dec. 4, 1924, Dr. Matthew states, "*Catopsalis* rests on two specimens, one of which is doubtfully Puerco, the other certainly Torrejon."

however, is extremely suggestive. It belongs to a group not known before the Fort Union, and is slightly more advanced than *Pronothodectes* from the latter and either belongs to or is in an exactly comparable stage of evolution with *Nothodectes* of the Tiffany and Clark Fork. The same is even more strikingly true of the phenacodont. It belongs to a phylum the evolutionary development of which is fairly clear. It is certainly more advanced than the Torrejon-Fort Union *Tetraclænodon* (*Euprotogonia*) and rather less advanced than the Wasatch *Phenacodus* and *Ectocion*, thus appearing to belong in the intermediate horizon, the Clark Fork again. It may well belong with the form mentioned by Gidley from a Clark Fork equivalent in the Powder River Basin, Wyoming, as a "Phenacodont intermediate between *Phenacodus* and *Euprotogonia*."<sup>1</sup>

Further evidence will be very welcome, and the fauna when better known will certainly be one of considerable interest and significance; but it seems possible even on the basis of the few teeth of the present collection to establish the age of at least part of the Paskapoo as probably post-Torrejon—Fort Union and pre-Wasatch, that is, as equivalent to the Tiffany—Clark Fork—Cernaysian.

It remains only to mention very briefly the influence of this determination on the status of the Cretaceous-Tertiary problem. Matthew has tentatively suggested that the Puerco and the Lance may be about equivalent in time but widely different in facies.<sup>2</sup> The evidence for this view is, in brief, the fact that the Lance underlies the Fort Union, apparently without any significant time break, while the Puerco underlies the Torrejon, a Fort Union equivalent, in much the same way. As corroborative evidence there has been cited the supposed occurrence in the Paskapoo of Lance mammals in association with others of Paleocene aspect. This is now seen not to be the case, and while the chief basis for a Puerco-Lance correlation is not affected, its only really strong and more or less direct palæontological support is removed, since the Puerco and Lance themselves contain no faunal elements supporting such an equivalence.

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<sup>1</sup>1918, U. S. Geol. Survey, Prof. Paper 108, p. 59.

<sup>2</sup>1921, Amer. Jour. Science, (5) II, p. 209; and elsewhere.



