Article VI.—THE FAUNA OF THE TITANOTHERIUM BEDS AT PIPESTONE SPRINGS, MONTANA.

By W. D. Matthew.

The American Museum Expedition of 1902 in western Montana had for object to make a further search in the Tertiary deposits of that region, where Mr. Earl Douglas has recently discovered many new and interesting fossil mammals. In the White River formation near Pipestone Springs, Mr. Douglas had found a very interesting micro-fauna, and our collections at the same locality, which Professor Osborn has kindly turned over to me for study and description, enable us considerably to extend the list. I am indebted to Mr. Douglas for the opportunity to examine the type specimens of his various species, as well as for the information concerning localities, etc., contained in the stratigraphic part of his very excellent memoir recently published on the White River of Montana.

The majority of the species are small or minute forms, not found in the Titanotherium Beds of South Dakota or Colorado, where the scanty fauna is almost entirely of large animals, — Titanotheres, Elotheres, and Rhinoceroses. A few small species have been described from Swift Current Creek, Canada, based on very fragmentary materials. The Pipestone Springs fauna is therefore of much interest, as it illustrates the direct precursors of the numerous small species of the Oreodon Beds. In the species from the three successive stages of the White River we have the most favorable opportunities for study of the details of evolutionary progress in a given race that are presented among fossil vertebrata; for the materials are abundant and complete, the succession is unquestionable, and the character of the beds, and hence the local conditions of deposition, very uniform, so that we get the same facies of the three faunas. It is doubtful how far, if at all, the Eocene deposits of the Rocky Mountain divide and foothills contain the same facies of their respective faunas as do the Oligocene deposits of the plains. They contain an important aquatic contingent, fish, crocodiles, and water-turtles being comparatively abundant. In the White River fauna all these are absent, except in the sandstone lenses,[1] while a large element of it is apparently adapted to open grassy plains; this is not found in the Eocene faunas. But in the three zones of the White River a great part of their respective faunas appears to be in direct and exact genetic succession. We can therefore measure the amount and direction of change during the Oligocene epoch in many series.

The amount of evolution as thus measured appears small, but its direction somewhat constant. The species of the Titanotherium Beds are all distinct from their successors in the Oreodon Beds, but the difference is uniformly small. Between the Oreodon and Leptauchenia faunas the difference is often greater but less uniform, so far as present data go. Some genera run through the three horizons (*e. g.*, *Cynodictis*, *Palæolagus*, *Mesohippus*, *Cænopus*, *Leptomeryx*). Others have been found only in the two lower zones or in the two upper zones, while many are as yet known from one horizon only.

Stratigraphy. — Mr. Douglas refers all the Tertiary at this locality to one stage, correlating it with the Titanotherium Beds of South Dakota. We find, however, a lithologic distinction between the higher beds exposed north of the railroad, which resemble the Oreodon Beds of South Dakota, Colorado, and elsewhere, and the lower beds exposed south of the railroad, which resemble rather the Titanotherium Beds of some parts of South Dakota. Likewise on Thompson's Creek, not far from the Pipestone locality, we were able to distinguish between the Oreodon Beds exposed near the head of a small northerly branch of the creek, and the Titanotherium Beds exposed on the main western branch. At

[1] Mr. Douglas has recently discovered fish remains in strata which he refers to the White River *epoch*, so-called, in the Madison valley in Montana. But these strata are quite different in character from the beds in which White River mammals are found, apparently lacustrine or fluviatile in origin, and a very thorough search on his part failed to reveal any mammals in them except a skull of the beaver *Steneofiber*. I do not understand that he considers them as of the same formation or origin as the mammal beds, but merely as of equal age. The discovery of fish in them, therefore, does not at all invalidate the fluviatile-eolian hypothesis of origin of the White River formation maintained by Hatcher and myself. The same explanation probably applies to other reported occurrences of fish in the White River.

both localities the lithologic distinctions are confirmed by the fossils found.

The Titanotherium Beds are soft, easily weathering, banded clays, often sandy, crumbling to the usual weathered-clay surface, varying in color from dark reddish brown through buff to an almost greenish white. Cross-bedding is seen in the sandier layers. They are not unlike the Titanotherium Beds in South Dakota, but run to deeper and more contrasted coloring. At Pipestone Springs they dip quite steeply toward the north, lying up against the ancient crystalline rocks on the south side of the creek. We found in them the following fauna:

Marsupialia.

Peratherium titanelix, sp. nov.	Allied to *Peratheria* of Middle Eocene and Oligocene.

Insectivora.

Apternodus mediævus, g. et sp. nov.	Allied to ? *Centracodon* of Middle Eocene.
Micropternodus borealis, " "	Allied to ? *Centetodon* of Middle Eocene.
Ictops acutidens *Douglas* } " thomsoni, sp. nov. }	More primitive than any Middle Oligocene Leptictid.

Creodonta.

Pseudopterodon minutus (*Douglas*) ? Hyænodon sp.	{ Intermediate between the Oligocene *Hyænodon* and Middle Eocene *Sinopa*.

Carnivora Fissipedia.

Bunælurus infelix, sp nov.	
Cynodictis paterculus, sp. nov.	Somewhat more primitive than Middle Oligocene species.

Rodentia.

Ischyromys veterior, sp. nov.	Somewhat more primitive than Middle Oligocene species.
Cylindrodon fontis *Douglas*.	
Sciurus vetustus, sp. nov.	
Gymnoptychus minor (*Douglas*).	
" minimus, sp. nov.	

Palæolagus temnodon *Douglas.*	More primitive than Middle Oligocene species.
" brachyodon, sp. nov.	

Perissodactyla.

Mesohippus westoni *Cope.*	More primitive than Middle Oligocene species.
Hyracodon sp.	
? Cænopus sp.	
Titanotherium sp.	

Artiodactyla.

Stibarus montanus sp. nov.	
Bathygenys alpha *Douglas.*	
Limnenetes sp. div.	
Leptomeryx mammifer *Cope.*	
" ? esulcatus *Cope.*	
Leptotragulus profectus sp. nov.	Advanced species of an Eocene genus.

Lizards and Tortoises, sp. div.

Two species are reported by Mr. Douglas of which we obtained no further evidence: *Sciurus jeffersoni* Douglas, ? *Agriochœrus maximus* Douglas.

The Oreodon Beds are buff clays, somewhat harder than the Titanotherium Beds, finer, not sandy, more calcareous, and not unlike the Oreodon Beds of Dakota and Colorado. They were very barren so far as we could discover, and the only determinable fossils found at Pipestone Springs were: *Palæolagus haydeni*, *Eumys elegans*, *Mesohippus bairdii*, ? *Poëbrotherium.*

These are all characteristic species of the Oreodon Beds in South Dakota, Colorado, etc.

The fauna from the Titanotherium Beds is a quite remarkable one. Not a single species is identical with those of the Oreodon horizon; all are either new, or have been described by Douglas from the same locality, or by Cope from the same horizon at Swift Current Creek. The majority of the species, however, belong to genera of the Oreodon Beds, and these, though fairly distinct, are not widely divergent from their successors. We find that the Pipestone Beds are much nearer to the Oreodon horizon than to the upper Uinta or Diplacodon Beds. Fourteen genera are in common with the later horizon, while there is but one Uinta genus (*Leptotragulus*) and that represented by a rather divergent species. This contrast is partly explained by the fact that the known White River fauna is a very large one, while that from the Uinta is comparatively small; partly also by considerations of geographical distribution of the Oligocene mammals and by different conditions of deposition in the Uinta and White River beds. But, making allowance for all these, there seems still to be a considerable gap between the Diplacodon and Titanotherium faunas, while the latter is much closer to the Oreodon fauna. It shows some marked differences, however:

(1) There are two new insectivore genera of the primitive section (Zalambdodonta) of the order, which has hitherto been practically unknown in a fossil state, unless the Eocene species reported by Professor Marsh shall prove to belong to it.

(2) All the rodents are sciuromorphs [1] or lagomorphs. Myomorpha, more abundant than sciuromorpha in the Oreodon Beds, have not yet appeared. They are unknown in the Eocene, except *Protoptychus*, a form of doubtful affinities.

(3) The only Creodont from the Oreodon Beds is the highly specialized *Hyænodon*. At Pipestone Creek we have a more primitive type, intermediate between *Hyænodon* and *Sinopa*. At Swift Current Creek occurs *Hemipsalodon* (?=*Pterodon*), also less specialized than *Hyænodon*. (*Hyænodon* itself occurs also in the Titanotherium Beds.)

(4) *Oreodon* is not found, and two or three more primitive genera (*Bathygenys*, *Limnenetes*, ? *Agriochœrus*) take its place.

(5) *Hypertragulus*, common in the Middle and Upper Oligocene, is not found, while *Leptomeryx* of the Lower and Middle Oligocene is abundant and large.

(6) In place of *Poëbrotherium*, the camel of the Oreodon Beds, is found a brachyodont form, apparently the Eocene genus *Leptotragulus*.

From the above facts we would infer that the Pipestone Beds are at the base of the Oligocene, but above the Eocene, accepting Osborn's correlation of the White River formation

[1] If *Gymnoptychus* be considered a sciuromorph, as it was by Professor Cope and is by Dr. Hay.

with the Oligocene, and of the Uinta with the Upper Eocene. They are probably of approximately the same age as the White River beds of Swift Current Creek, Canada, with which they have three species in common, probably a fourth ("*Palæolagus turgidus*" from Swift Current Creek probably is *P. brachyodon*),— a fair proportion out of so limited a fauna.

Descriptions of Species.

MARSUPIALIA.

Peratherium titanelix, spec. nov.

Type, No. 9603, a lower law with p_3 and m_{2-4} and alveoli of the remaining teeth except incisors.

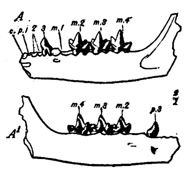

Fig. 1. *Peratherium titanelix.* Type specimen, twice natural size. *A*, outer, *A*[1], inner view of teeth.

This species is about the size of *P. huntii* of the Oreodon Beds, and resembles it in the rather short premolar region, the premolars and canine small, close together without any diastemata.

The molars are similar to those of typical *Peratheria* from the Phosphorites, but the premolars are very distinct, crowded, and reduced antero-posteriorly, the cusps recurved instead of symmetrical as in *Peratheria* from the Phosphorites, and in *P. fugax* of Cope. The anterior part of the jaw is rather short and deep and the canine directed more upward than in *P. fugax*.

Measurements.

Length p_1–m_4	7.3 mm.
Length m_{2-4}	4.2
Depth jaw under m_2	1.9

INSECTIVORA.

Apternodus mediævus, gen. et spec. nov.

Type, No. 9601, posterior half of a lower jaw with two complete molars and the root of another.

Molars composed of high trigonid and minute basal talonid. Protoconid high, sharp, and triangular, paraconid and metaconid subordinate. Dentition probably $i_?\, c_1\, p_3\, m_3$.

Talonid a small sharp cusp on m_3; on m_2 it is a minute postero-internal basal cusplet. The third molar a little smaller than the second; both are two-rooted, the anterior root wider transversely.

The cusps are all high, sharp, trigonal in cross-section, the whole tooth subtriangular with transverse and longitudinal diameters about equal and vertical diameter considerably exceeding either. The heel is much smaller than in Centetidæ, the protoconid higher and larger in proportion than in any other Insectivore or Chiropter.

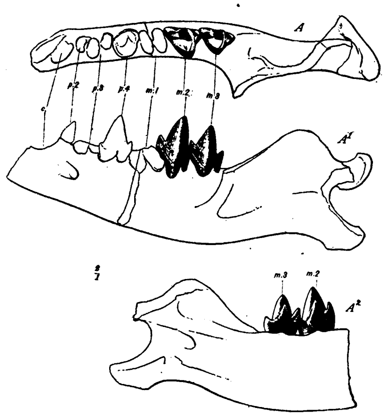

Fig. 2. *Apternodus mediævus.* Type, No. 9601, twice natural size, the outlines of front of jaw from No. 9607. *A*, crown; *A*[1], external, *A*[2], internal view.

No. 9608, a lower jaw without teeth, broken off in front at about the same point as the types, but with the condyle complete, appears to belong to the same species. The condyle is widely expanded transversely, on a level with the bases of the molars. The angle in the type specimen is extended into a rather long and stout flattened process with a sharp medial ridge on the internal side. The coronoid is broken off in both specimens, but was evidently high, stout, placed mostly external to the toothrow, and directed upwards instead of backwards.

No. 9607, the anterior part of a lower jaw, with one premolar preserved and the roots of other teeth, is provisionally referred to this species. The premolar is either the third or fourth; it is stout, two-rooted, composed of a round-conical protocone and small postero-internal basal cusp. The anterior root is wider than the posterior. The premolar in front of this was apparently similar but smaller, and was preceded by a small one-rooted premolar, and this by a larger tooth, probably a canine. Behind the premolar are roots of two teeth, one of which was probably m_1, the other certainly a molar, judging from comparison of the corresponding parts of the jaw in the three specimens.

The dentition is then probably c_1 p_3 m_3, but may be c_1 p_4 m_3. The weight of the anterior part of the jaw and doubtful indications of a large alveolus lead to the suspicion that one or more of the incisors was enlarged.

No. 9612, part of a lower jaw with the roots of the last two molars, is also referred here.

This remarkable little jaw is quite unlike any described species of Insectivore or Chiropter, except, perhaps, Marsh's *Centracodon.* So far as anything can be determined from his brief description, the last molar of *Centracodon* is like the second molar of *Apternodus.* *Centracodon* has four premolars. Although the short, deep jaw would appear to ally it rather with the Chiroptera, yet as the tooth without talonid is quite unknown in this order, while it does characterize a section of the Insectivora, I leave it provisionally in the latter group, without attempting to assign it to any especial family. Its nearest relatives are most probably the little Eocene Insectivora from the Bridger Basin, described by Professor Marsh in 1872. With the probable exception of these Eocene types and of a single South American species, no fossil Insectivores of the Zalambdodont division have hitherto been described, although according to the Tritubercular theory this, as the more primitive section, should have been more abundant in ancient times.

Measurements.

M_{2-3}	3.9 mm.
M_2 longit.	2.0
" transv.	2.0
" height.	3.7
M_3 longit.	2.0
" transv.	1.8
" height.	2.9
Depth of jaw.	3.5

Micropternodus borealis, gen. et spec. nov.

Type, No. 9602, a lower jaw with p_3-m_3 and alveoli of the anterior teeth.

Dentition $\overline{3.1.3.3}$. Molars somewhat like those of *Centetes* in composition, with high trigonid and small, low talonid. Trigonid very wide transversely with pr^d considerably overtopping pa^d and me^d. Talonid with sharp posterior margin and low median ridge. Molars and especially premolars, short, high, and recurved; p_4 sub-molariform, with small anterior and internal trigonid cusps and strong basal heel. P_3 much smaller and simpler, with small heel and no other accessory cusps. P_2 is small and one-rooted, canine small, incisors small, subequal. No diastemata except a slight one behind p_2. Jaw rather deep in front. Second molar slightly larger than the first, third much smaller.

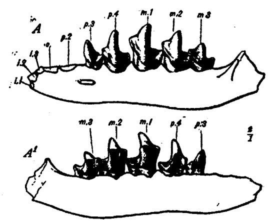

Fig. 3. *Micropternodus borealis.* Type specimen, twice natural size. *A*, outer, *A*[1], inner view of teeth.

Like the preceding genus, this must be placed among the Zalambdodonta, with no very near relatives among living species, although it is not so strikingly different from modern types. Its nearest allies are also quite probably some of the very inadequately described Insectivora from the Bridger Basin, but neither it nor *Apternodus* can be considered as possibly congeneric with any of the Bridger species, if Marsh's descriptions are correct.

Measurements.

Lower jaw, m_3 to incisive alveoli	12.4 mm.
Lower teeth p_3–m_3	8.4
Lower molars m_{1-3}	6.4
Lower molar, m_1 longitudinal, at base	1.8
" " " transverse	1.9
" " " height of crown	2.7

Ictops acutidens *Douglas.*

A fragmentary skull and jaws, with some limb-bones of one individual, and the upper and lower molars of another, confirm and extend the characters of this species as indicated by Douglas.

The distinctions from previously described species are:

Dimensions fifteen per cent. less than any of the Leptictidæ from the Oreodon Beds. First upper premolar one-rooted, two-rooted in *I. dakotensis* and *bullatus* and in *Leptictis haydeni.* Supra-temporal crests widely separated anteriorly and convergent posteriorly, instead of close together and parallel as in all the later species. Upper molars and p^4 more constricted between the inner and outer cusps than in any described Leptictid; cusps somewhat higher and last molar less reduced than in any later species.

No. 9604, a fragmentary skull and jaw, with humerus, radius, two phalanges, and a caudal vertebra, exhibits most of the permanent dentition well preserved.

Upper jaw. — Incisors not known. Canine of moderate size, compressed, somewhat ridged externally, with no indication of the incipient heel seen in *Palæictops*. P^1 one-rooted, smaller than canine. P^2 two-rooted, compressed, with small posterior basal cusp or heel. P^3 three-rooted, with strong, well-separated *de*, higher but less separated *tr*, and minute antero-external basal cusp; the protocone much overtopping the other cusps. P^4 molariform, but *tr* not yet as high as *pr*, *de* equalling *pr* in height, small *hy*, and strong protostyle. First and second molars with *pa* and *me* of equal size, *hy* better developed than in p^4, a small protostyle on m^1. M^3 with reduced *me* and rudimentary *hy*. All molars and p^4 wide transversely, with some constriction between inner and outer cusps. M^3 smaller than m^1 and m^2, but not so much reduced as in the later species.

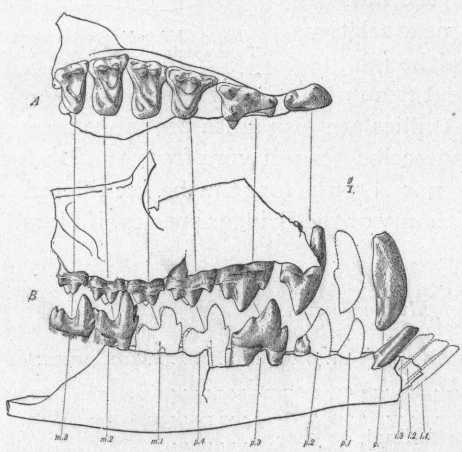

Fig. 4. *Ictops acutidens*. Teeth, twice natural size. *A*, crown view of upper teeth; *B*, external view of upper and lower teeth. No. 9604, the lower molars from No. 9605.

Lower jaw. — Dental series continuous without diastemata. Three small incisors. Canine small, incisiform, somewhat larger than incisors. P_1 one-rooted, p_2 two-rooted, p_3 two-rooted, compressed, with anterior and posterior cusps and small heel. The lower molars are not preserved in this specimen. In No. 9605 m_2 and m_3 are preserved; the trigonid is high, composed of two equal well-separated cusps, talonid much lower, bearing three posterior cusps, external, internal, and postero-median respectively, well separated from the trigonid but not from each other. M_3 is a little longer than m_2 but much narrower, especially the talonid, in which the hypoconulid is situated more behind the hypo- and entoconid instead of nearly between them.

The skull is wider between the eyes than those from the Oreodon Beds, the postorbital constriction less pronounced. The temporal crests begin on the posterior third of the frontal bones, eleven millimeters apart, and converge rapidly on the posterior half of the parietals.

The humerus is disproportionately smaller and more curved than in *I. dakotensis*, the deltoid crest is not so wide nor does it extend so far down. The radius is likewise strongly curved, its distal end bearing two ill-separated subquadrate facets for scaphoid and lunar, the scaphoid facet the wider of the two. Two rather long and slender phalanges are preserved, one somewhat compressed laterally. The caudal vertebra associated is from the middle part of the series and indicates a large, long tail.

This species is in some, but not in all respects intermediate between *Palæictops* and the Leptictidæ of the Oreodon Beds. The last molar is more reduced than in *P. bicuspis*, less than in any later Leptictid. The first premolar is one-rooted, as in *P. bicuspis*, while in the later species it is two-rooted. On the other hand, the molars are more compressed and more constricted medially, and the size is smaller than in either the Wind River species or those from the Oreodon Beds; and the temporal crests are further apart than in the later species, while in the earlier one they are united into a sagittal crest.

Ictops thomsoni, spec. nov.

Two upper jaws, Type, No. 9606, Cotype, No. 9606*a*, indicate a species closely allied to *Ictops acutidens*, but distinguished by smaller size, more compressed teeth, and other characters of less importance. The metacone on all the molars is decidedly smaller than the paracone; in *I. acutidens* they are nearly, and in other Leptictidæ quite, equal in size on m^{1-2}. The protocone on p^4–m^3 is more

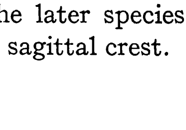

Fig. 5. *Ictops thomsoni.* Crown view of upper molars, × 3/1. Type specimen.

compressed antero-posteriorly, and the constriction between it and the outer cusps is more marked than in *I. acutidens*. The hypocone is smaller on m^1 and m^2, absent on m^3 and p^4. The trittocone of p^4 is smaller than in *I. acutidens*.

All these distinctions are exaggerations of the differences between *I. acutidens* and the Leptictidæ of the Oreodon Beds, but none of them ally it to *Palæictops*, in which the molars and premolars (except p^1) are fully as complicated as in the species of the Oreodon horizon.

The species is named in honor of Mr. Albert Thomson of the American Museum Expedition of 1902, who discovered the type specimens of this as well as those of four other new species described in this article.

Comparative Measurements.

	I. thomsoni Type.	I. acutidens Nos. 9604 and 9605.	I. dakotensis Type.[1]	I. bullatus Type.	Mesodectes. No. 9316.	Leptictis Type.[1]
Upper molar-premolar series		20.8		23.5		24.
" true molars and fourth premolar	9.3	10.4		11.7	11.7	12.
" m^1 longitudinal	2.7	2.6	3.3	3.4	3.4	3.
" " transverse	3.9	4.0	4.0	5.3	4.9	4.7
" m^3 longitudinal	1.5	2.1		1.6	1.9	2.4
" " transverse	3.6	3.5		3.2	3.9	4.9
Lower molar-premolar series		E. 20.0				
" true molars		E. 10.1				
" m_2 longitudinal		2.7				
" " transverse		2.1				
" " height		3.7				

[1] Measurements from Leidy's figure.

CREODONTA.

? Pseudopterodon minutus (*Douglas*).

Hyænodon minutus Douglas.

No. 9623, the upper jaw of a small Creodont of the family Hyænodontidæ is referred provisionally to Schlosser's genus, and may be identified specifically with the lower molar on which Mr. Douglas based his species "*Hyænodon*" *minutus*. This upper jaw, however, cannot be referred to *Hyænodon*, as the first molar shows a sharp antero-internal angle and small antero-internal cusp. It is not very close to Schlosser's type, and if, as Scott believes, *Pseudopterodon* is founded on milk teeth of *Hyænodon*, then our species represents an undescribed genus, which may well stand ancestral to *Hyænodon*, being directly intermediate between that genus and *Sinopa*.

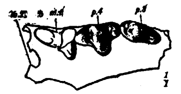

Fig. 6. *Pseudopterodon minutus*. Crown view of upper teeth, natural size. No. 9623.

The animal was a little smaller than *Cynohyænodon cayluxi* Filhol. P^3 is two-rooted, slightly compressed, set a little transversely in the jaw, moderately high, with small anterior basal cusp and heel. P^4 is three-rooted, the internal root well separated, median, supporting a strong internal buttress to the protocone and a basal cingulum, but no defined cusp. The antero-external cusp is of moderate size, the postero-external developed into a short cutting blade. M^1 is three-rooted, the inner root anterior and well separated, bearing a wide buttress ridge and a small internal cusp, which is worn off in the specimen. Only the front part of the tooth is preserved. M^2 was larger than m^1 and similar to it, judging from the character and position of the two anterior alveoli which indicate it on the specimen.

? *Hyænodont*, indet.

An upper premolar of singular character which I am unable to refer to any described species of Carnivore or Creodont. It has two roots, the posterior one broadened inwardly so as to support a median internal buttress to the protocone. The protocone is very high, its height exceeding the antero-posterior length of the tooth; somewhat compressed posteriorly, with a well-distinguished posterior cusp and small posterior cingular cusp. Cingulum obsolete except at anterior and posterior ends of tooth. Appears to be the third or, perhaps, second upper premolar of some Hyænodont, but not of *Hyænodon* or *Pterodon*.

CARNIVORA (Fissipedia).

Cynodictis paterculus, spec. nov.

Two lower jaws and parts of others, Nos. 9616, 9619, represent this species. Of these I take No. 9616 as type. Compared with a quite large series of specimens, including the types of *C. gregarius* and *C. lippincottianus*, these specimens show certain constant differences, chiefly in the construction of m_2. This tooth is proportionately larger and longer, the heel larger and wider, and the proto- and metaconids are raised above the paraconid, instead of being nearly on a level with it, as they usually are in *C. gregarius*. The shear of m_1 is somewhat more transverse, and m_3 is a little less reduced. The size is that of *C. gregarius*.

The above characters are slight distinctions indeed, but their constancy in the very considerable series of specimens compared makes them valid specifically. In *Procynodictis vulpiceps* of the Uinta, the shear is more transverse, but m_2 is smaller and its heel more reduced than in *C. gregarius*.

Measurements.

	Type, No. 9616	Cotype, No. 9618
P_1-m_3		35 mm.
M_1-m_3	18 mm.	17
M_1 longit	9.5	9.
" transverse	4.5	4.2
" height of pr_d	7.	
M_2 longit	5.5	5.2
" transv	3.5	3.3
M_3 longit	3.	..
" transv	2.5	..

Bunælurus infelix, spec. nov.

No. 9620, part of a lower jaw with p_4-m_1 and the stump of m_2, represent this species, which is with difficulty distinguishable from *B. lagophagus*. The protocone of m_1 is more rounded, the shear a little more transverse than in Cope's species. The fourth premolar appears to be stockier and longer than in the type of *B. lagophagus*, but it is not fully formed in the jaw in that specimen, so the comparison is questionable; the protocone is stout and round, with a small postero-external cusp, and external basal cingulum rising to a small heel behind. The second molar is a minute crownless stump.

Measurements.

P_4-m_2	10.2 mm.
P_4 longit.	4.1
" transv.	1.9
M_1 longit.	5.9
" transv.	2.3
Depth of jaw beneath m_1	6.

A larger Musteline is indicated by part of a jaw, No. 9621, with p_4 and the roots of the front teeth in it. It is about the size of *Cynodictis paterculus*, but the premolars are higher, shorter; the heel smaller, anterior basal cusp absent; and other details join to show that it is a Musteline.

RODENTIA.

ISCHYROMYIDÆ.

Ischyromys veterior, spec. nov.

The anterior part of a skull and some forty jaws or parts of jaws, upper and lower, represent this species. It is considerably smaller than a series of specimens from South Dakota, which agree well with Leidy's types of *I. typus*, and the teeth are narrower throughout with higher cusps. It is much closer to the variety or separate species from Colorado, *I. cristatus* (Cope, 1872), which Cope has referred to *I. typus* and described and figured in 'Tertiary Vertebrata.' From this species I find a constant distinction in the last molar, which in the Montana jaws has always a narrow heel with the last crest imperfect internally, while in all the Colorado specimens the heel is as wide as the rest of the tooth, and the third (last) crest perfectly developed.

In the upper teeth a corresponding difference is to be seen in the last molar, and also the valley between the anterior and posterior inner cusps is well marked on all the teeth, distinct nearly to the base of the enamel, while in the specimens from Colorado and from South Dakota it is obsolete on p^4 and on the molars does not extend so far down.

? CASTORIDÆ.

Cylindrodon fontis *Douglas.*

We have eight lower jaws and an upper jaw of this species, some of which exhibit the tooth pattern, and enable us to refer this curious little rodent provisionally to the Beavers. The two lower jaws on which the species was based were of comparatively old individuals, and the pattern had disappeared, so that it was not possible for Mr. Douglas to determine its relationship.

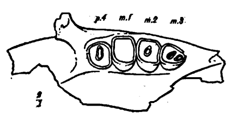

Fig. 7. *Cylindrodon fontis.* Upper jaw, twice natural size. No. 9639.

The dentition is I$\frac{1}{1}$ c$\frac{0}{0}$ p$\frac{1}{1}$ m$\frac{3}{3}$ — four cheek teeth in each jaw, as in Castoridæ, instead of five above and four below as in Sciuridæ and Ischyromyidæ. The pattern resembles that of *Steneofiber* more than any other related form, consisting in the lower molars of a deep and persistent external enamel inflection, and three fossettes corresponding in position to the internal enamel inflections of *Steneofiber* and *Castor*. Of these fossettes the median is the most persistent; the median and posterior are at first internal enamel inflections, the posterior inflection becoming a closed fossette at a very early stage of wear, while the anterior fossette is closed from the first.

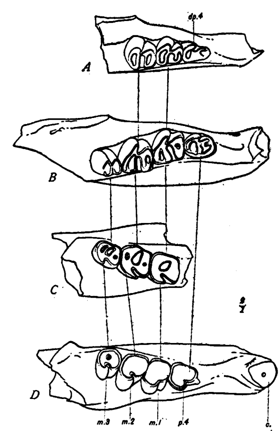

Fig. 8. *Cylindrodon fontis.* Crown views of lower teeth, showing the pattern at successive stages in their wear. All twice natural size. Nos. 9644, 9638, 9640, 9642.

It would appear from the history of those teeth that the enamel inflections did not originate on the sides of the tooth and become gradually deeper and more complicated as the tooth became more hypsodont, the fossettes being a secondary modification; but that the inflections and fossettes have both originated from the valleys and lateral notches of a brachyodont molar, such as that of *Ischyromys*. Either of these is easily derivable from a primitive tritubercular molar such as those of the Tillodonta, but not easily from such teeth as are displayed by *Paramys* and its allies, in which, as in the squirrels, the teeth appear to be specialized and degenerate rather than primitive.

The *upper jaw* of *Cylindrodon* (No. 9639) is that of an old individual, with but little indication of the pattern left on the teeth. From what there is present it appears that the pattern exhibited a strong median external inflection and anterior and posterior fossettes, and a trace remains on p^4 of an internal inflection. The pattern was probably like that of *Ischyromys*, in having the external inflection of greater persistence and depth than the internal. In other Castoridæ this condition is reversed. The upper molars decrease in size from before backward and are of rounded peg-like outline, fossettes on all but m^1. The incisor originates just above the roots of p^4 and m^1, and is stout, not grooved, with a moderate diastema between it and the grinding teeth. The antorbital foramen is small and the palate in front of it is narrow.

The depth of the jaw of *Cylindrodon* in its anterior portion is a very marked character. *Ischyromys* comes nearest to it in this respect.

SCIURIDÆ.

Sciurus (Prosciurus) vetustus, subg. et spec. nov.

Represented by an upper jaw, No. 9626, with complete unworn dentition.

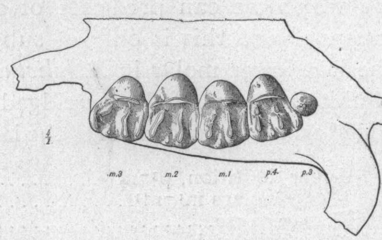

Fig. 9. *Sciurus vetustus.* Crown view of upper teeth, four times natural size. Type.

The species is smaller than *S. relictus* of the Oreodon Beds, and at least a third smaller than *S. jeffersoni* Douglas of the Pipestone Creek Beds, or *S. wortmani* of the John Day formation. It is larger than *S. ballovianus* of the John Day, the first molar (the only upper tooth preserved in the type of *S. ballovianus*) is considerably wider transversely, its anterior cingulum much less developed, its *mesostyle* or median external cusp (between the anterior and posterior transverse ridges) more prominent. In none of the other species is the upper dentition known, so that an exact comparison is not possible.

Compared with modern Sciuridæ this species shows some interesting points of difference. It is nearest to *Sciurus*, but differs in several points of importance:

1. The cross crests on the molars are less complete, and are partly broken up into separate cusps.

2. The third premolar is a much larger tooth and has a small accessory posterior cusp.

3. The heel of m_3 bears a short transverse crest and a strong posterior marginal ridge. In *Sciurus* the posterior part of m_3 is a slightly concave flat basin.

4. The base of the zygoma is anterior to p^3.

From *Tamias* and the other modern Sciuridæ it also differs in the retention of the mesostyle, in addition to most or all of the above-mentioned points. The ridges are not so high as in *Cynomys* and *Arctomys*, and their patterns differ in various other details. I have little doubt that with more perfect material it will be necessary to place this and all the other Oligocene *Sciuri* in a separate genus, nearest to *Sciurus*, but retaining the above primitive features in the dentition, and others of more importance in the skull. But with our present knowledge the distinction in the last molar is the only one which we can predicate of all the Oligocene species in common, and this is only of subgeneric importance at best. The last lower molar in *S. relictus*, *ballovianus*, and *wortmani* exhibits a correspondingly ridged and unreduced heel to the ridged and unreduced heel of the last upper molar in *S. vetustus*.

Upper dentition, p^3–m^3	7.7 mm.
" molars m^1–m^3	5.5
P^3 transverse	0.9
" longitudinal	0.8
P^4 transverse	2.3
" longitudinal	2.0
M^1 transverse	2.5
" longitudinal	1.8

M^2 transverse	2.5 mm.
" longitudinal	1.8
M^3 transverse	2.3
" longitudinal	2.0
Width of palate, including molars	9.6

? HETEROMYIDÆ.

Gymnoptychus minor (*Douglas*).

Eumys minor DOUGLAS, Trans. Am. Phil. Soc. 1901, 16.

The position of *Gymnoptychus* and *Heliscomys* has been variously given by different authors; they are, in fact, rather remote relatives of any modern type, and combine characters of Sciuridæ, Geomyidæ, and Heteromyidæ with others peculiar to themselves or shared by the Ischyromyidæ. The dental pattern strongly suggests that of *Ischyromys*, but the resemblance may be superficial; by simplification and hypsodonty it might be converted into a Heteromyid pattern. I place the genus in this family on Scott's authority.

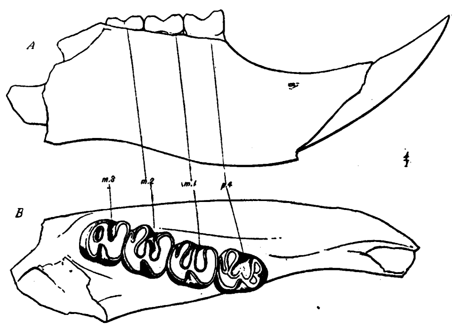

Fig. 10. *Gymnoptychus minor.* Lower jaws, four times natural size. *A*, external view, No. 9632; *B*, crown view of teeth, No. 9630.

The present species is intermediate in size between *G. minutus* and *G. liolophus*, but nearer to the latter. The type of *G. liolophus* retains the milk dentition; a specimen of *G. minor* of corresponding age shows a smaller and shorter d_4 and somewhat narrower and smaller m_1.

Seven lower jaws are referred to this species.

Measurements.

	Type (Douglas).	No. 9630.
Lower dentition p_4–m_3		5.5 mm.
" molars m_1–m_3		4.0
P_4 transverse	1.3 mm.	1.3
" longitudinal	1.5	1.4
M_1 transverse	1.7	1.7
" longitudinal	1.5	1.4
Diastema behind incisor		4.3

Gymnoptychus minimus, spec. nov.

A smaller species than *G. minutus* Cope. Fourth lower premolar larger in proportion to the rest of the dentition, its anterior and posterior halves of equal width; while in *G. minutus* the anterior half of p_4 is much narrower than the rest of the tooth. The first and second molars are narrower than in *G. minutus*, and the whole molar series is thus much more uniform in width.

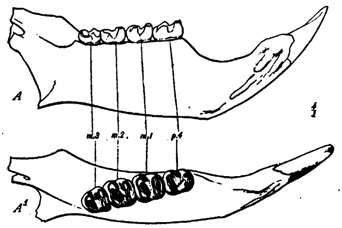

Fig. 11. *Gymnoptychus minimus.* Type specimen, four times natural size. *A*, internal, *A*[1], crown view.

Only one specimen of this tiny rodent was found by our party.

Measurements.

Length of dentition, tip of incisor to m_3.........	8.4 mm.
" " molar-premolar series, p_4–m_3..........	3.5
" " true molars, m_1–m_3..................	2.6

LEPORIDÆ.

Palæolagus temnodon *Douglas.*

This species is nearly related to *P. haydeni* of the Oreodon Beds. We have for comparison a series of about seventy-five jaws, upper or lower, but nothing more complete. Mr. Douglas distinguished the species by the presence of an antero-external groove on p^2.[1] On comparison of our series with several hundreds of jaws of *P. haydeni* in the American Museum collections, we are able to add a number of other changes less obvious on a single individual, owing to the great variation that age brings about in the characters of the teeth.

The size appears to be nearly constant, approximating that of the smaller specimen described by Mr. Douglas, which, as the first measured specimen, is the type of the species. The molars, and especially the premolars, are less hypsodont than

[1] Mr. Douglas says p^3, but this must be a slip of the pen.

in *P. haydeni.* The internal enamel inflection on the upper teeth is less deeply impressed and less persistent; it has disappeared on all the older individuals, as it does in *P. turgidus*, but at an earlier age; in *P. haydeni* only a few of the very oldest animals have lost this inflection. The last upper molar is larger than in *P. haydeni.* In the lower jaw p_3 has a less persistent external enamel inflection, so that in old individuals it becomes one-lobed, a character seen also in very old individuals of *P. turgidus*, but which I have not seen in any example of *P. haydeni.*

Measurements.

Upper molar-premolar series	12.	mm.
Lower " "	11.	
Post-canine diastema in lower jaw	8.	

Palæolagus brachyodon, spec. nov.

Palæolagus ? turgidus, P.? triplex, DOUGLAS, Trans. Am. Phil. Soc. 1901, Vol. XX, p. 6. Not of Cope, except:

Palæolagus turgidus COPE, Geol. Sur. Canada. Contrib. to Can. Palæont. Vol. III (quarto), p. 5, pl. xiv, fig. 9. Not of previous publications.

This species is of the size of *P. turgidus*, and probably the specimens referred by Mr. Douglas to that species and to *P. triplex* really belong here. It is more brachyodont than *turgidus*, and much more so than any other species of *Palæolagus.* P^2 is smaller and more conical, m^3 appears to have been larger, the internal enamel inflection less persistent. In the lower jaw p_3 is shorter, more conical, and the inflection disappears a little earlier than in *P. turgidus.*

Twelve specimens of more or less complete upper or lower jaws represent this species in our collection.

Measurements.

Molar-premolar series, upper jaw (m^3 estimated)	16.	mm.
" " " lower jaw	15.	
P^2, longitudinal	1.5	
" transverse	2.5	

It appears probable that this species and *P. temnodon* stand in direct or almost direct genetic relationship to *P. turgidus* and *P. haydeni* respectively. The occurrence of the species of *Palæolagus* is:

Oligocene	John Day		*Lepus ennisianus*	
	White River	Leptauchenia Beds	*P. agapetillus*	*P. intermedius*
		Oreodon Beds	*P. haydeni*	*P. turgidus*
		Titanotherium Beds	*P. temnodon*	*P. brachyodon*

The evolution in *Palæolagus* ran in parallel lines in the different species, some being more progressive in one character, some in another, but none exhibiting either wide divergence or retrogression. The characters in which progress is observed, as I have remarked in a previous paper,[1] are:

1. Superposition of the *Lepus* tooth-pattern over the older and simpler one inherited by *Palæolagus*. This pattern, showing at the crown in the older species, bites continually deeper into the tooth until it entirely replaces the older pattern during the whole life of the animal.

2. Increase in length of teeth, molarization of anterior premolars, and some reduction in size of $m\frac{3}{3}$.

3. Bending down of facial portion of skull on cranial portion. This is associated with lengthening of neck and legs.

4. Increase in brain-capacity, in supra-orbital processes, etc.

5. Increase in size.

It will be observed that in the first and second characters, our two species from the Titanotherium Beds are in all respects more primitive than those of the Oreodon Beds. The difference in size is trifling if any, the third and fourth characters cannot be observed in our specimens.

PERISSODACTYLA.

EQUIDÆ.

Mesohippus westoni *Cope.*

Parts of upper and lower jaws, fore and hind feet, and many fragmentary jaws and teeth represent one or more species certainly distinct from *M. bairdii*, which does not occur

[1] Bull. A. M. N. H., XVI, 1902, p. 306.

in these beds. It is provisionally referred to Cope's species, known hitherto by an upper and two lower teeth from Swift Current Creek, Canada. These specimens will be described by Professor Osborn in a later paper.

HYRACODONTIDÆ.

Hyracodon sp.

Two lower jaws and an upper molar belong to a species of *Hyracodon*. I do not observe any important distinctions from *H. nebrascensis* in the parts preserved; but in the absence of the diagnostic teeth (upper premolars) make no specific reference.

ARTIODACTYLA.

LEPTOCHŒRIDÆ.

Stibarus montanus, spec. nov.

No. 9668, a lower jaw containing the second, third, and fourth premolars, and the first molar, enables us to place the hitherto problematic genus *Stibarus* in the Leptochœridæ.

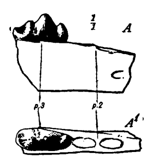

Fig. 12. *Stibarus obtusilobus* Cope, type specimen, natural size, from the Oreodon Beds of Northeastern Colorado. *A*, external, *A*¹, crown view.

Generic distinctions. — Molars like those of *Leptochœrus*. Premolars much like those of *Leptomeryx*, but with lower and more rounded cusps.

Specific distinction. — Third premolar with no posterior cingular cusp. The second premolar is long and laterally compressed, with three rounded cusps in line, the anterior the smallest, the median the highest. The third premolar has a similar form and composition, but the median and posterior cusps are somewhat larger, and there is a cingulum around the posterior end of the tooth. The fourth premolar is wider but not much over half as long as the third, it has a main cusp, protoconid, an anterior cusp connected by a ridge with it, a postero-internal and postero-external cusp, all worn off in the specimen and none marginal, and a

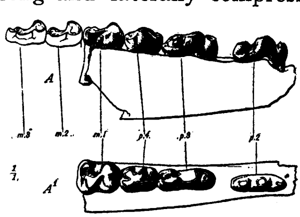

Fig. 13. *Stibarus montanus*, part of lower jaw, type specimen, natural size. *A*, external, *A*¹, crown view of teeth.

posterior cingulum. The first molar has four chief cusps, the external ones somewhat crescentic, the postero-internal smaller than the others, and a posterior cingulum with small hypoconid. P_2 with diastemata behind and in front of it.

No. 9670 shows the second and third molars of similar composition to the first except that the hypoconulid in m_3 is equal to the other cusps and posterior to them.

This species appears to be closely related to *S. obtusilobus* Cope, but the posterior cingular cusp (heel-cusp) is lacking, and p_2 has small diastemata before and behind it, while there are none in *S. obtusilobus*. In size and other characters it is identical as far as the type of Cope's species permits comparison.

Stibarus has been conjectured to be allied to the camels; its actual position has, I think, never been suspected. It is, in a way, a link between the Leptochœridæ and *Leptomeryx*, and makes it more certain that the former is truly an artiodactyl family. "*Leptochœrus*" *quadricuspis* Hatcher is probably a species of *Stibarus*.

Measurements.

Length p_2–m_1	27.3 mm.		
" p_2	7.	width	2.1 mm.
" p_3	7.6	"	2.7
" p_4	4.9	"	3.7
" m_1	5.0	"	4.2
Depth of jaw below p_2			7.
" " " m_1			10.

OREODONTIDÆ.

Bathygenys alpha *Douglas.*

We have three specimens referable to this genus and species: parts of two upper jaws and one lower jaw. I identify these with Mr. Douglas's species in spite of wide distinctions in the drawing of the teeth of his cotype specimen. These, if correctly drawn, could hardly be *Oreodon* teeth; they are fully as narrow and trenchant as those of *Leptomeryx*. As, however, he compares the teeth to those of *Merycochœrus*, which are short and wide and crowded, I assume that the error is in the drawing, especially as the other drawings of the type and cotype agree well with the description and with our specimens.

The best upper jaw shows the molars and fourth premolar. The premolar is simpler than that of *Oreodon*, lacking internal cingulum and antero-external accessory ridge, and consisting of external and internal crescent, the former with slightly concave external surface, the latter with a short postero-internal cingulum. The molars are composed of four crescents, no trace of the paraconule remaining on m^2 or m^3; m^1 is a little worn, so that it is uncertain whether or not a minute *pl.* existed. The anterior halves of m^1 and m^2 are wider transversely than the posterior, the protoselene projecting further inward on the palate than does the hyposelene. The posterior half of m^3 is nearly as wide as the anterior half, as in *Agriochœrus* and the Uinta Oreodonts, instead of reduced in width as in *Oreodon* and the other Oreodontidæ. The exterior surface of the inner crescents is slightly concave, as in *Agriochœrus*, instead of strongly concave as in the later Oreodonts, or convex as in *Protoreodon*. The exterior surface of the outer crescents is nearly flat.

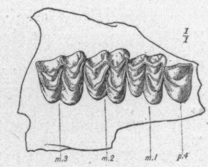

Fig. 14. *Bathygenys alpha*. Upper teeth, crown view, natural size.

The fourth lower premolar is oreodont in type, but differs from *Oreodon* and resembles *Promerycochœrus*, *Merycochœrus*, and *Merychyus*, in that the entoconid is a ridge extending down and back from the deuteroconid, instead of a separate cusp or distinct ridge. In *Protoreodon* the entoconid is rudimentary. This tooth is a little narrower anteriorly than p_4 in *Oreodon*, wider than in *Protoreodon*, *Merychyus*, or *Promerycochœrus*. The molars are proportioned nearly like those of *Oreodon*, but are more brachyodont. They are shorter, higher, and with more crescentic cusps than those of *Protoreodon*.

Bathygenys is in most respects between *Oreodon* and *Protoreodon*, but considerably nearer to the former. Some characters point toward a nearer relationship with the Merycochœrid group of Oreodonts than with *Oreodon* itself.

More complete material is needed before its place can be definitely determined.

Measurements.

Upper molars, m_{1-3}	1.7 mm.		
" premolar p^4, longitudinal	4.	transverse	5.2 mm.
Lower teeth, p_4–m_2	16.		
Upper molar m^1 longitudinal	5.3	"	6.8
" " m^2 "	5.8	"	7.3
" " m^3 "	6.2	"	7.

? **Limnenetes** sp.

A number of lower jaws and parts of jaws may be provisionally referred to this genus, although the characters of the teeth are nearer to those of *Bathygenys* than to *Oreodon;* while Mr. Douglas describes the teeth of *Limnenetes* as so like those of *Oreodon* as not to need a separate description. The premolars are narrower than those of *Oreodon*, the entoconid ridge not separated from the deuteroconid on p_4, and the structure of p_3 is intermediate between that of *O. culbertsoni* and *Merychyus elegans*, but more brachyodont than either. The lower molars are intermediate between those of *Protoreodon*, with conical internal cusps, and those of *Oreodon* with fully crescentic internal cusps. Heel of m_3 narrow, as in *Protoreodon.*

There is more than one species, and may be more than one genus, among these specimens, and it is inadvisable to attempt to place them very definitely at present.

HYPERTRAGULIDÆ.

Leptomeryx ? **esulcatus** *Cope.*

The type of Cope's species is an upper molar, probably m^1, from the Titanotherium Beds of Swift Current Creek, Canada.

We have a large number of parts of lower jaws and separate upper teeth, which belong to one or more species of *Leptomeryx* a little larger than *L. evansi*, but variable in size. These are referred provisionally to *L. esulcatus*, because it is within the limits of size, comes from the same geological horizon, and agrees well enough with other first molars in our series. The character by which Cope separated it from *L. evansi*, the absence of defining furrows to the rib of the external crescents, is exhibited only on first molars, and not on all of these; but two other characters of more importance are seen in our material, viz.:

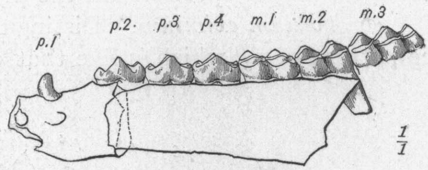

Fig. 15. *Leptomeryx esulcatus.* Lower jaw, natural size, external view, composite, Nos. 9696, 9706, 9702.

1. The median internal cusp, a strong cusp in m^3 of *L. evansi*, and a smaller one on m^2 and m^1, is quite small on m^3, and absent, or nearly so, on m^2 and m^1.

2. In the third lower premolar the protoconid has two posterior ridges, of which the internal one connects with the heel, and the external one does not; while in *L. evansi* and other species from the Oreodon and Leptauchenia Beds, the external ridge connects with the heel, and the internal one does not.

In the lower jaw I have observed no entirely constant distinctions, except in p_3. The first premolar is small, and is separated from p_2 by a diastema of about the same length as that of *L. evansi;* the size of the jaws averages larger than those of *L. evansi* from South Dakota, and all are larger than *L. evansi* of Colorado. The height of crowns and proportion of the teeth are about the same, and the premolar pattern, allowing for individual variation, is identical, except as above noted.

I have no doubt that better material will furnish more satisfactory distinctions, but, except for the characters noted above, I am unable to find any in the teeth.

Measurements.

Lower premolars p_{2-4}	19 mm.
Lower molars m_{1-3}	24
Upper molar, m^3, antero-posterior	8.
" " " transverse	8.5

Leptomeryx mammifer *Cope.*

A much larger species than the preceding, size about that of *Poëbrotherium eximium.* Distinguished from *L. evansi* by the pattern of p_3, which is like that of *L. esulcatus*, but with

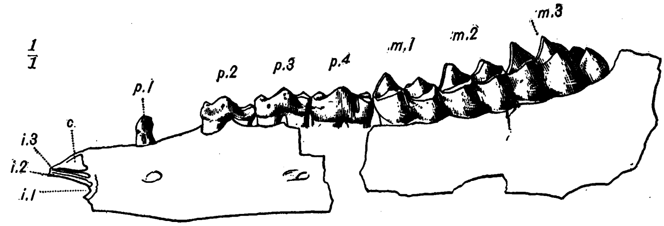

Fig. 16. *Leptomeryx mammifer.* Lower jaw, natural size, external view. No. 9684, p_3 and p_4 supplied from No. 9686.

the external ridge of the protoconid more clearly separate from the heel, and the postero-internal more clearly joined to it. The first lower incisor is large, second and third small, canine nearly as large as first incisor (larger than in *L. evansi*).

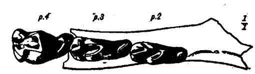

Fig. 17. *Leptomeryx mammifer.* Crown view of lower premolars, natural size. No. 9687; p_4 from No. 9689.

First premolar equally spaced between c and p_2; remaining premolars close set. Molars an enlarged copy of those of *L. evansi.* Parts of the feet of *Leptomeryces* of appropriate size were found at the locality; they show no important distinctions either in fore or hind foot, from *L. evansi.* The upper molars have a smaller median internal cusp than those of *L. evansi.* The size is nearly a third larger, lineally.

Lower premolars, p_{2-4}	24	mm.
" first premolar, p_1	2	
Space between c and p	17	
Lower molars, m_{1-3}	32	
Complete lower dentition, estimated	78	
Upper molar, longitudinal	9	
" " transverse	11	

CAMELIDÆ.

Leptotragulus profectus, spec. nov.

Parts of several lower jaws represent a species of Camelid nearly as large as *Poëbrotherium wilsoni*, but with brachyodont molars like *Leptotragulus*. No. 9681 (type) shows p_2–m_1; No. 9682 (cotype) p_{2-3} and the root of m_1; No. 9683 a number of lower molars and milk molars. Nearly all these teeth are unworn or very little worn.

The species is of about the same size as *Leptomeryx mammifer*, but is distinguished by the camelid pattern of the pre-

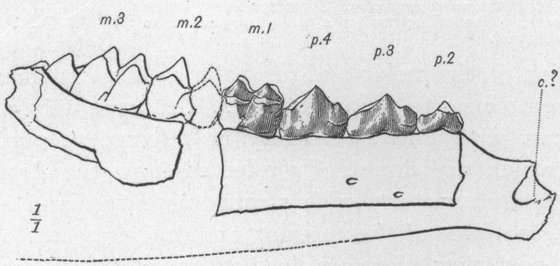

Fig. 18. *Leptotragulus profectus*. Type specimen, external view, natural size; second and third molars supplied from another individual.

molars. The molars are very difficult to separate from those of *L. mammifer;* they are a little wider and shorter-crowned, with the crescents placed less obliquely, and m_3 has but a vestigial postero-internal cusp. The fourth premolar has no deuterocone, but two strong posterior crests from protocone to heel sub-parallel, enclosing a narrow lenticular fossa. The third premolar is similar, but more compressed; the second has but one complete posterior ridge. Their pattern differs from that of *Poëbrotherium* chiefly in the completeness of the inner posterior ridge, which in *Poëbrotherium* does not reach the heel on p_3 and p_4, and is entirely absent in p_1.

The cotype shows a moderate diastema, considerably shorter than that of *L. proavus*, separating p_2 from the alveolus of a strong caniniform tooth.

The heel of the last molar in referred specimens is like that of *Leptomeryx* or *Leptotragulus*, with postero-external crescent and small antero-internal cusp. In *Poëbrotherium* is a posterior crest, not crescentic, and a small antero-internal cusp.

The species is about a fifth larger than *L. proavus*, with which its premolar pattern corresponds quite closely, according to Scott's description. The molars are a little wider and a little more hypsodont, and the diastema both relatively and absolutely less. It is throughout very suggestive of *Poëbrotherium*, much more so than either *Protylopus* or *Leptotragulus proavus*, in the details and conformation of the molar and premolar cusps. It shows much less resemblance to *Hypertragulus*. Unfortunately no upper teeth can with entire certainty be referred to our species. Those which are doubtfully referred have the *Leptomeryx-Poëbrotherium* pattern, with strong mesostyle and a rib on the external face of the anterior external crescent, but none on the posterior; they are less extended transversely than those of *Leptomeryx*, much more than those of *Poëbrotherium*. The upper molars of *Hypertragulus* are very easily distinguished by the entire absence of mesostyle and equal development of the external ribs on anterior and posterior crescents. No upper teeth of this pattern were found in the Pipestone beds. The upper molars of *Leptotragulus proavus* are not known.

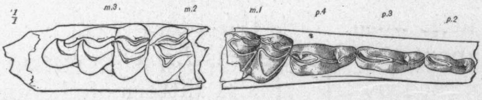

Fig. 19. *Leptotragulus profectus*. Type specimen, crown view of teeth, natural size; molars 2 and 3 supplied from another individual.

From the above facts I am inclined to believe that *Leptotragulus* — this species at least — is more nearly related to *Poëbrotherium* than Professor Scott has supposed, and that it has not much to do with *Hypertragulus*. It is probable in either case that the caniniform tooth is the first premolar. The species is really far nearer to *Poëbrotherium* than is *Protylopus petersoni;* how much of the resemblance is due to parallelism remains to be determined.

Mr. Gidley discovered last summer in the Oreodon Beds of South Dakota, a brachyodont camel, which may be a direct descendant of this species.

Measurements.

Lower premolars, p_2–p_4	25 mm.
Diastema in front of p_2	10
Last lower molar	15
Lower molars, m_{1-3} (from three specimens)	30