CANADA

DEPARTMENT OF MINES

GEOLOGICAL SURVEY BRANCH

HON. W. TEMPLEMAN, MINISTER ; A. P. LOW, DEPUTY MINISTER ;
R. W. BROCK, ACTING DIRECTOR.

CONTRIBUTIONS

TO

CANADIAN PALÆONTOLOGY

VOLUME III (Quarto).

PART IV.—THE VERTEBRATA OF THE OLIGOCENE OF THE CYPRESS HILLS, SASKATCHEWAN.

BY

LAWRENCE M. LAMBE, F.G.S., F.R.S.C.

Vertebrate Palæontologist.

OTTAWA
GOVERNMENT PRINTING BUREAU
1908

No. 1020.

This report on the Vertebrata of the Oligocene deposits of the Cypress hills forms the fourth part of volume III (quarto) of Contributions to Canadian Palæontology. Part I by Professor Edward D. Cope, on "The species from the Oligocene or Lower Miocene beds of the Cypress hills," published in 1891, is descriptive of specimens obtained during the years 1883, 1884, 1888 and 1889. The present part by Mr. Lawrence M. Lambe, is based on the collection made by him in 1904, and on the material of the earlier collections; it consists of 82 pages of letter press, illustrated by text figures and eight photogravure plates.

R. W. BROCK,
Acting Director.

DEPARTMENT OF MINES,
GEOLOGICAL SURVEY BRANCH,
OTTAWA, January 5, 1908.

GEOLOGICAL SURVEY OF CANADA

THE VERTEBRATA OF THE OLIGOCENE OF THE CYPRESS HILLS, SASKATCHEWAN.

By Lawrence M. Lambe.

INTRODUCTION.

The discovery in 1883 by Mr. R. G. McConnell of this Survey, of Tertiary beds in the Cypress hills, of later age than any that had been found in the North West, was announced in Dr. A. R. C. Selwyn's Summary Report of the operations for that year.* These beds capping the Cypress hills were assigned to the age of the Miocene by Mr. McConnell in his "Report on the Cypress hills, Wood mountain and adjacent country,"** published in 1886. After giving a general statement of the physical features of the country, Mr. McConnell in his report, devotes himself (1) to a description of the geology in different sections of the district in turn, and (2) to an account of the deposits of the formations observed of the Cretaceous, Tertiary, and Quaternary periods. In the Cypress hills and vicinity the rocks seen were referred to the Miocene, Laramie and Fox-hill–Pierre formations, of which the last three are conformable, but the first lies unconformably on the Laramie, in places overlapping it and resting on the Fox-hill. The Miocene beds "cap all the more elevated parts of the range of uplands extending in a direction a little north of east, from the west end of the Cypress hills to the east end of Swift-current Creek plateau; a distance of 140 miles. They have an average width of fifteen miles, and cover altogether an area of nearly 1,400 square miles."

The Cypress hills are divided into two unequal parts—of which the eastern one is much the larger—by the "Gap," a valley of erosion, running in a north and south direction. The Miocene deposits are best developed at the eastern end of the hills, where they attain a thickness of fully 500 feet, and consist of conglomerate, usually formed of quartzite pebbles, cemented together by carbonate of lime, associated with beds of sandstone, sands, clays, and marls. West of the "Gap" the formation is represented only by a sheet of hard conglomerate, about 50 feet thick.

To quote from Mr. McConnell's report: "the conglomerate which forms such a marked feature of the Miocene deposits of the Cypress hills, is usually composed of quartzite pebbles cemented together by carbonate of lime, but also appears under a number of other forms. In some places the pebbles lie loosely in a matrix of coarse yellowish sand, and in others they are

* Geol. and Nat. Hist. Survey of Canada, Report of Progress, 1882-83-84; Summary Report of the operations of the geological corps to 31st Dec, 1883 (published in Jan., 1884), p. 4.
** Geol. and Nat. Hist. Survey of Canada, Annual Report (new series), vol. 1, 1885, (1886), part C.

consolidated by a ferruginous cement. Beds several feet thick also occasionally occur, which contain nothing but loose pebbles." "Beds of pebble conglomerate, though more frequent and larger near the base of the Miocene, are found at irregular intervals all through it, and are of all thicknesses, from a single layer of pebbles up to beds fully 50 feet thick. In many cases the formation consists of a single thick bed of this rock. Besides the pebble conglomerate, beds composed of angular pieces of clays enclosed in a matrix of hard sandstone, and forming a species of breccia, are occasionally found."

"The sands of the Miocene sometimes form hard beds, from one to two feet thick, but are usually only slightly indurated, and are nearly always affected by false bedding."

The above deposits are best seen in Bone coulée which runs almost due north and south about nine miles west of the eastern escarpment of the hills. In this coulée two streams have their origin within a few hundred yards of each other, the north fork of Swift-current creek flowing north-easterly, and Frenchman creek (Fairwell creek of Mr. McConnell's report) flowing in an opposite direction to the south.

It is in this main coulée and its tributaries, that the collections of vertebrate remains from this horizon of the Cypress hills have been principally made.

The first vertebrate fossils received from Bone coulée were obtained in 1883 by Mr. McConnell whilst engaged in his geological exploration of that year. Later in the same season Mr. T. C. Weston visited this locality, and secured a collection; but unfortunately all the specimens then obtained were lost by the sinking in Lake Superior of the steamer *Glenfinlas* on which the collection had been shipped for the east from Port Arthur. During the summer of 1884 Mr. Weston revisited the eastern end of the hills, and obtained many mammalian and other vertebrate remains typical of the Cypress Hills fauna. In 1888, and again in 1889, a short time was spent by Mr. Weston in adding to the collections already made in Bone coulée. In 1904 the writer spent some weeks in the eastern end of these hills making a supplementary collection of the vertebrate remains.

The fossils collected by Messrs. McConnell and Weston in 1883, were submitted to Professor Edward D. Cope, who published a preliminary list of the genera and species in the American Naturalist, 1885, vol. XIX, p. 163.* The result of his subsequent study of the same material appeared in 1886 as an appendix to Mr. McConnell's report of 1886.** Further contributions to the American Naturalist *** by the same distinguished palæontologist, followed in 1889, after Mr. Weston's collection of 1888 had also been placed in his hands for determination and description. Professor Cope's final report on all the material from the Cypress hills, including the specimens obtained by Mr. Weston in 1899, appeared in 1891 as part I **** of this volume.

* The White River beds of Swift-current river, North West Territory.

** Op. cit., part C, p. 79, appendix I. The Vertebrata of the Swift-current Creek region of the Cypress hills, by E. D. Cope.

*** 1889. American Naturalist, vol. XXIII, p. 151, The Vertebrata of the Swift-current river, II; and p. 628, Vertebrata of the Swift-current river, III.

**** The species from the Oligocene or Lower Miocene beds of the Cypress hills; Geol. Survey of Canada, Contr. to Can. Palæont., vol. III (quarto), pt. I.

Cope, in his memoir of 1891, qualifies McConnell's assignment of the uppermost beds of the Cypress hills to the Miocene by describing them as of Oligocene or Lower Miocene age. Matthew would accord them a more definite horizon at the bottom of the Oligocene, and has expressed the opinion that they are probably of approximately the same age as the Titanotherium beds at Pipestone springs, Montana. This opinion appears to be borne out to some extent by the list of species from Pipestone springs, published by Dr. Matthew in 1903,* and the collections from the Cypress hills, supplemented by the material secured in 1904. A provisional list by the writer, of the genera and species included in the collection of 1904, appeared in the Summary Report of this Department for that year.

That the Cypress Hills Oligocene deposits were the result of rapidly flowing water from the west is evident. The thick basal beds of rounded pebbles represent the work of a strong transporting force, such as would be supplied by a turbulent stream of considerable size carrying eastward material from the Rocky mountains. The sands show false bedding as a result of varying currents. With the accumulation of material eastward, and a consequent reduction of the transporting force, beds of finer material were deposited at a higher level, and probably on extensive areas of overflow.

Regarding the Cypress hills as an outlier of the Wood Mountain area, Mr. McConnell has pointed out that, the part of the country " now covered by the Cypress hills has been changed from a depression in Miocene times into the highest plateau on the plains, which is its present position, entirely by the arrest of denudation over its surface by the hard conglomerate beds which cover it, whilst the surrounding country, destitute of such protection, has been gradually lowered; and so affords an index of the amount of material removed from the neighbouring plains in the age intervening between the deposition of the Miocene and the glacial period." " The absence of any ridge connecting the Cypress hills with the mountains is somewhat surprising, as one would naturally suppose that near their source the pebble-beds would be thicker, and their constituents coarser and better able to resist erosion. This may be due, however, to the fact that the valley of the transporting stream must have been more contracted in its upper part than in the dilated portion in which the existing Miocene beds were deposited. In such a case, its narrow shingle floor would be gradually undermined, and as denudation proceeded would soon perish."

During his expedition of 1904, the writer examined the exposures of the Oligocene deposits along the eastern escarpment of the Cypress hills as well as on their southern slope in the vicinity of Frenchman (Whitemud) river as far west as Fairwell creek, also in the valley of this creek northward to Bone coulée, and for some miles along the upper reaches of the north fork of Swift-current creek. Few fossils were obtained along the eastern, and southern escarpments.

The greater part of the collection was made in Bone coulée and its numerous tributary coulées, and in its southern extension for a few miles along Fairwell creek. Here the grass-covered slopes are broken by numerous small and isolated weathered outcrops which at first do not appear very promising from a palæontological standpoint. A careful and close search, however, reveals an abundance of—for the most part—mammalian remains.

* The fauna of the Titanotherium beds at Pipestone springs, Montana; Bulletin Amer. Mus. Nat. Hist., vol. XIX, article VI, 1903.

The most prolific beds are composed of a fine conglomerate that, on disintegration, has freed the enclosed fossils. Associated beds of coarse sand, of a rich brown colour, also yielded some interesting remains. Very few fossils were found in the coarser conglomerates, and, as might be expected, none at all in the beds of loose pebbles.

The generally fragmentary and dissociated nature of the remains at this locality detracts much from their value as definite horizon markers. Many of the specimens clearly show that they had been broken and often worn prior to being deposited in the beds where they were found. Some excellently preserved jaws with continuous series of teeth were obtained, and many separate and well preserved teeth, but bones of the feet were in all cases dissociated.

Although the beds of the Cypress Hills deposits in question probably belong, in a general sense, to the horizon of the Titanotherium beds of Montana, some of their upper members may be synchronous with the Oreodon beds. Whether the time equivalent of the uppermost division of the Oligocene (Protoceras beds) is present at all is problematical. The fossils in the finer conglomeritic beds show in some cases evidence of having been transported from a distance, and on this account it is possible that a certain admixture of remains from slightly different horizons has taken place.

The Cypress Hills Oligocene faunal list has been considerably enlarged in the following pages by the addition of a number of new species, and species previously known but not recorded, hitherto, from this horizon in Canada. The majority of the additions to the fauna have been supplied by the collection of 1904, but a few forms are represented by specimens from the earlier collections, that apparently were not placed in Professor Cope's hands.

The species described as new, with those not recorded, hitherto, from this locality, belong to the three classes of fishes, reptiles, and mammals. New species of fishes of the families Amiidæ and Lepidosteidæ are described. Among the reptiles are two chelonians, of which one species is new; also lizards, snakes, and crocodiles representing the orders Squamata and Crocodilia, both of which are additional to the fauna. The mammals preponderate in numbers and variety and include a marsupial, ungulates, rodents, and carnivores. The artiodactyl genera Ancodus, Anthracotherium ?, Agriochœrus, and Merycoidodon are now recorded from the Cypress hills, as well as new species of horses, hyracodonts, rhinoceroses, and titanotheres. A new species of Leptomeryx is described. Further evidence of the presence of Chalicotherium, an ancylopod, is gigen. The rodents include four families of which three, the Ischyromyidæ, Castoridæ, and ? Sciuridæ, are new to the list. Two known species of the creodont carnivores, three already described species of the Canidæ, and one of the Felidæ are also added.

The animals inhabiting this western tract of country during Oligocene times are thus seen to have belonged to a variety of groups. That the number of individuals in some of the groups was large is evident from the abundance of the fossil remains of some forms. Some of the groups have since become extinct, others have undergone great changes and are with difficulty recognized in their descendants of the present day; whilst a few are represented by existing species that show but slight differences in form and structure.

Twenty-five vertebrate species in all, have, hitherto, constituted the Oligocene fauna of the Cypress hills: this number is now raised to over fifty. The following is the fauna as known to date :—

Class **PISCES**.

Order ACTINOPTERYGII.

Suborder PROTOSPONDYLI.

Family *Amiidæ*.

* *Amia whiteavesiana*, Cope.
* *Amia macrospondyla*, Cope.
\+ *Amia exilis*, sp. nov.

AETHEOSPONDYLI.

Lepidosteidæ.

\+ *Lepidosteus longus*, sp. nov.

NEMATOGNATHI.

Siluridæ.

* + *Rhineastes rhæas*, Cope.
* + *Amiurus cancellatus*, Cope.
* + *Amiurus maconnelli*, Cope.

REPTILIA.

CHELONIA.

CRYPTODIRA.

Chelydridæ.

\+ *Anosteira ornata ?* Leidy.

Testudinidæ.

* + *Stylemys nebrascensis*, Leidy.
\+ *Testudo exornata*, Lambe.

TRIONYCHIA.

Trionychidæ.

* + *Trionyx leucopotamicus*, Cope.

\+ SQUAMATA.

LACERTILIA.

Anguidæ.

\+ *Peltosaurus granulosus*, Cope.

OPHIDIA.

Palæophidæ.

\+ *Ogmophis compactus*, sp. nov.

\+ CROCODILIA.

EUSUCHIA.

Crocodilidæ.

\+ *Crocodilus prenasalis ?* Loomis.

The signs before the names of species or groups signify as follows:—
* Represented in one or more of the collections made previous to 1904; but not in that of 1904.
\+ Represented in collection of 1904; but not in previous ones.
* + Represented in the 1904 as well as in one or more of the previous collections.

MAMMALIA.

+ MARSUPIALIA.

Polyprotodontia.

Didelphyidæ.

+ *Didelphys valens*, sp. nov.

UNGULATA.

Artiodactyla.

Anthracotheriidæ.

+ *Ancodus (Hyopotamus) brachyrhynchus*, Osborn and Wortman.
+ *Anthracotherium ? pygmæum*, sp. nov.

Elotheriidæ.

* + *Elotherium coarctatum*, Cope.

Agriochœridæ.

+ *Agriochœrus antiquus*, Leidy.
* + *Merychoidodon culbertsoni*, Leidy.

Camelidæ.

+ *Poëbrotherium wilsoni*, Leidy.

Tragulidæ.

+ *Leptomeryx esulcatus*, Cope.
* + *Leptomeryx mammifer*, Cope.
+ *Leptomeryx speciosus*, sp. nov.

Position uncertain.

* + *Leptomeryx semicinctus*, Cope.
* *Hypertragulus transversus*, Cope.

Perissodactyla.

Equidæ.

* + *Mesohippus westoni* (Cope).
+ *Mesohippus præcocidens*, Lambe.
+ *Mesohippus propinquus*, Lambe.
+ *Mesohippus brachystylus*, Osborn.
+ *Mesohippus stenolophus*, Lambe.
+ *Mesohippus planidens*, Lambe.
+ *Mesohippus assiniboiensis*, Lambe.

Hyracodontidæ.

* + *Hyracodon nebrascensis*, Leidy.
+ *Hyracodon priscidens*, Lambe.

Rhinocerotidæ.

* + *Aceratherium mite*, Cope.
* + *Aceratherium occidentale* (Leidy).
+ *Aceratherium exiguum*, sp. nov.
+ *Leptaceratherium trigonodon*, Osb. and Wort.

Titanotheriidæ.

* *Megacerops angustigenis* (Cope).
* *Megacerops selwynianus* (Cope).

* *Megacerops syceras* (Cope).
+ *Magacerops primitivus*, sp. nov.
+ *Magacerops assiniboiensis*, nom. prov.

ANCYLOPODA.

Chalicotheriidæ.

* + *Chalicotherium bilobatum*, Cope.

RODENTIA.

SIMPLICIDENTATA.

? Sciuridæ.

+ *Sciurus ? saskatchewensis*, sp. nov.

Ischyromyidæ.

+ *Ischryromys typus*, Leidy.

? Castoridæ.

+ *Cylindrodon fontis*, Douglass.
+ *Eutypomys parvus*, sp. nov.

DUPLICIDENTATA.

Leporidæ.

* *Palæolagus turgidus*, Cope.
+ *Palæolagus haydeni*, Leidy.

CARNIVORA.

CREODONTA.

Hyænodontidæ.

* + *Hyænodon cruentus*, Leidy.
+ *Hyænodon crucians*, Leidy.
* + *Hemipsalodon grandis*, Cope.

FISSIPEDIA (CARNIVORA VERA).

Canidæ.

+ *Cynodictis lippincottianus* (Cope).
+ *Daphænus felinus*, Scott.
+ *Protemnocyon hartshornianus* (Cope).

Felidæ.

+ *Dinictis felina*, Leidy.

PISCES.

ACTINOPTERYGII.

Amia whiteavesiana, Cope.

Amia whiteavesiana, Cope, 1891. The species from the Oligocene or Lower Miocene beds of the Cypress hills. Geol. Survey of Canada, Contr. to Can. Palæont., vol. III (quarto), pt. I, p. 2, plate I., figs. 1, 1*a* and 1*b*.

No remains of this species were obtained by the writer in his expedition of 1904 to the Cypress hills. The type of this species, as well as those of all of the species referred to or described in the following pages, are in the Museum of the Geological Survey at Ottawa.

Amia macrospondyla, Cope.

Amia macrospondyla, Cope, 1891. The species from the Oligocene or Lower Miocene beds of the Cypress hills. Geol. Survey of Canada, Contr. to Can. Palæont., vol. III (quarto), pt. I, p. 2, plate I, figs. 2, 2*a* and 2*b*.

Cope established this species on a single vertebra from the Cypress hills. No additional material is included in the collection of 1904, to throw further light on the structure of this fish.

Amia exilis, Sp. nov.

Plate I, figs. 1–6.

A number of centra, found separately, represent an apparently undescribed species of *Amia*, of small size as compared with *A. whiteavesiana*, Cope, and *A. macrospondyla*, Cope both of which species are from the Oligocene of the Cypress hills.

All the fossil remains of North American species of *Amia* so far described are of Eocene age, with the exception of the two Oligocene species above mentioned.

Amia exilis was about the size of *Amia elegans*, Leidy, from the Bridger Eocene of Wyoming; but had vertebral centra of quite a different shape.

The centra on which *Amia exilis* is founded are mostly from the dorsal region, and vary somewhat in size, being probably from a number of individuals. The one represented on plate I, figures 1, 2, and 3, from the middle dorsal series, is one of the largest of the specimens, and is about the best preserved (type). Its articular faces are oval in outline with the major axis horizontal, the height being but slightly over two-thirds of the breadth. Its thickness (length), is equal to about half the maximum height and there is a perceptible flattening of the upper surface. The concave articular surfaces exhibit a few concentric lines, but have the general appearance of being rather smooth. A small notochordal foramen, preserved in all the specimens, pierces the centrum at about mid-height. Above, in the median line of the upper surface, the floor of the neural canal appears as a narrow, oblong, transversely concave depression, with a shallowly excavated area, square in outline, on each side of it, marking the position of the base of the neurapophysis. The parapophyses are placed slightly below the middle of the sides; they are circular in section and were apparently very short. On the lower surface, one on each side of the median line and almost touching, are two poorly defined very shallow oblong depressions—(well defined and comparatively deep in one of the small centra). The sides of the centrum are slightly depressed between the raised margins of the articular faces; here the surface when preserved is seen to be marked by short inosculating ridges directed antero-posteriorly. The structure of the articular faces is dense; that of the remainder, which forms the greater part of the centrum, is finely cancellous.

Measurements.

	MM.
Type specimen, Plate I, figures 1, 2 and 3 :—	
Height of centrum	12·0
Breadth	16·8
Length	5·8
Smaller specimen: —	
Height of centrum	9·0
Breadth	11·0
Length	3·8

A basi-occipital bone that apparently belongs to this species is shown on plate I, figures 4, 5 and 6. Its posterior termination has the form of a vertebral centrum having a concave surface for articulation with the first vertebra. The bone narrows slightly forward; anteriorly it is incomplete, but apparently only a small portion is missing. Seen from above, (fig. 4), there is a deep excavation in the median line at some distance in advance of the posterior end, representing the hinder basal part of the brain cavity. Above, posteriorly, is seen the floor of the *foramen magnum*, extending backward from the brain cavity as a narrow smooth surface, on each side of which is an area indicating the probable position of occipital arches such as are found in the living *Amia calva*, Linn. Laterally, and directed upward and outward, occur concave facets for the articulation of the exoccipitals. Inferiorly, (fig. 5), the bone is flatly convex transversely, with a broad median longitudinal groove that does not extend backward to the border of the articulating cup. On each side of the basal surface is preserved the facet for the parasphenoid which evidently in this fossil form terminated posteriorly in two branches as in the living species. A canal enters the basi-occipital at the side (*c*, fig. 4) and finds an exit from the lower surface beside a similar opening of the corresponding canal of the opposite side of the bone; this pair of foramina have their position in the median line of the bone between the hinder ends of the parasphenoid. The posterior articulating cup, fig. 6, corresponds in general size and contour with the type centrum of *Amia exilis*, its breadth being considerably greater than the height. Slightly above mid-height in the cup is a minute notochordal foramen. As seen from behind, the outline of the cup is rather flat in the centre below, and laterally subangular. The limits of the vertebra forming the posterior end of the basi-occipital, being the third of the three vertebræ that are thought to enter into the composition of this bone, are faintly indicated in the specimen.

Lepidosteus longus, sp. nov.

Plate I, figs. 7, 8 and 9.

A species of *Lepidosteus* is represented by an opisthocœlous vertebra. A few thick, smoothly enamelled, rhomboid scales, included in the collection, probably belong to the same species as the vertebra.

The vertebral centrum is from about the middle of the dorsal series, and is long in proportion to its breadth and height. In end view the articular surfaces are six-sided, the anterior surface is slightly convex : the posterior one as slightly concave. The parapophyses are given off at the mid-height of the centrum a little in advance of the mid-length, *p*, fig. 9. Beneath each parapophysis is a deep fossa, long in an antero-posterior direction, occupying the lateral inferior face of the centrum and separated from its fellow by the narrow, flat inferior surface which is broadest at either end, where it is also most deeply impressed by a longitudinal median groove. The surface between the parapophyses and the neurapophyses, *n*, fig. 7, is deeply excavated. The floor of the neural canal channels the upper surface of the centrum, the depression being greatest at mid-length. There is also a small fossa above, a little behind the parapophyses. The surface of the centrum throughout is quite smooth.

A conspicuous character of the above centrum is its length as compared with its height and breadth ; length of centrum, along median line, inferiorly, 10 mm. ; height of posterior articular face, 6·8 mm. ; breadth of same, 8·3 mm.

The name *longus* is here made use of for the fossil gar represented by the Cypress Hills specimen.

RHINEASTES RHÆAS.

Plate I, figs. 10–16.

Rhineastes rhœas, Cope, 1891. The species from the Oligocene or Lower Miocene beds of the Cypress hills. Geol. Survey of Canada, Contr. to Can. Palæont., vol. III (quarto), pt. I, p. 3, pl. I, figs. 3, 3*a* and 3*b*.

A few broken vertebræ are apparently referable to this species. In comparison with the type material, the internal structure of the centrum in the present specimens is seen to be the same, viz., close set vertical laminæ parallel to the articular surfaces.

The vertebræ mentioned in the original description of the species consist of a median abdominal vertebra (the type specimen), and a second centrum that is referred by Cope to this species not without some doubt. There is with this material a third vertebra, not mentioned by Professor Cope, and possibly not seen by him, which is slightly larger, and more perfect than the type. This specimen, with little doubt, belongs to this species, but calls for remark in that it is definitely flattened below, and is without a fossa beneath the base of the diapophysis. In the type the inferior surface is broken away.

In the 1904 collection are a number of bases of pectoral spines, serrated on both the anterior and posterior borders, probably referable to *Rhineastes rhœas.* In the genus *Amiurus*, to which the other Siluroid remains in the collection belong, the pectoral spine is serrated on the posterior border only, whilst in *Rhineastes* this spine may be serrated on one or both borders.

All the pectoral spines are imperfect distally, and show a considerable range in size. One of the most perfect is small, but gives the details of ornamentation well. The sides are covered with low narrow longitudinal ridges which often inosculate. There is no sign of tuberculation here; such as is found in conjunction with longitudinal ridges on the spines of *Arius egertoni* of the middle Eocene of England, and Belgium. On the anterior border there is a median serrated ridge bounded on either side by a well-marked narrow groove.

There are nine outwardly directed serrations in a space of 3 mm. A similar ridge likewise occurs on the posterior border with slightly larger serrations, about six of the latter occurring in a space of 3 mm. These posterior serrations show a tendency to point backward, and they are not continued so far toward the base of the spine as are those of the anterior border. The measurements of this specimen are as follows:—length (distal half missing) 13 mm., greatest height at proximal end 6 mm., antero-posterior diameter at broken distal end about 2·8 mm., with a vertical diameter distally of about 1·6 mm. The pectoral spines in the collection are of various sizes, from 4 up to 16 mm., as measured in a vertical direction across the base, with the more anterior part in proportion.

The serrations in the majority of the specimens have been worn down, and in some cases almost entirely removed, although indications of them can still be seen. In the largest specimen (16 mm. across the base) the number of serrations in a space of 3 mm. is about six on both borders. In all, the ornamentation of the sides is the same.

A few dorsal fin spines, with sculpture similar to that of the pectoral spines, are, probably, also referable to this species. They are broken across at some distance from the base, and the distal end lost. One, of small size and somewhat worn, is serrated on both borders. In a second, a large spine, figs. 14, 15 and 16, the anterior border is rugose, and no satisfactory evidence of serrations can be made out; posteriorly its surface is deeply grooved proximally as in the smaller spine, and the specimen is broken off behind where the serrations would probably begin. The measurements of this large spine are—length of specimen 30 mm., breadth across proximal end 18 mm., antero-posterior diameter at fractured distal end 8 mm. transverse diameter distally 6·5 mm.

A number of fragments from the distal end of spines are, probably, also referable here They are longitudinally striated, and three are serrated on both borders. Another is serrated at least on the posterior border; whilst one bears on its posterior border comparatively long backwardly curved barb-like denticles (figure 13).

These spines appear to approach closely, in detail of ornamentation and shape, to those of *R. arcuatus*, described by Cope from the Bridger Eocene of Wyoming. In the Oligocene specimens the serrations of the borders, and the ornamentation generally, are on a smaller scale.

Amiurus cancellatus, Cope.

Amiurus cancellatus, Cope, 1891. The species from the Oligocene or Lower Miocene beds of the Cypress hills. Geol. Survey of Canada, Contr. to Can. Palæont., vol. III (quarto), pt. I, p. 3, pl. I, figs. 4, 4*a*–*b*. 5, 5*a*–*b*.

This species, founded on two vertebral centra from the Cypress hills, is one of two species of the genus described from this region.

In the 1904 collection are a few centra, with parts of others, that, judging from their form and structure in comparison with the type specimens, are apparently referable to Cope's species.

In the type specimens the dense tissue of the articular surfaces is succeeded within by vertical laminæ forming two thin layers which are connected by tissue, disposed for the most part longitudinally, in which are many openings of variable size having their longer axes in an antero-posterior direction. This open structure occupies the greater part of the thickness of the centrum.

The 1904 specimens have this general structure, with a considerable variance as to the number, size, and disposition of the openings in the inner tissue. Superiorly there is a central excavation or fossa, with one more or less developed on either side of the centre. Laterally a fossa is present beneath the base of the diapophyses, and on the lower surface there is a median, single, or double fossa.

AMIURUS MACONNELLI, Cope.

Amiurus maconnelli, Cope, 1891. The species from the Oligocene or Lower Miocene beds of the Cypress hills. Geol. Survey of Canada, Contr. to Can. Palæont. vol. III (quarto), pt. I, p. 4, pl. I, figs. 6, 6*a*–*b*, 7*a*–*b*.

The vertebræ of this species differ from those of the preceding principally in having the inner longitudinally disposed tissue more compact. This tissue, in which there is a conspicuous absence of large openings, is made up of slender longitudinal strands with secondary connecting ones at right angles to the former, leaving small interspaces. As in *A. cancellatus*, there are vertical laminæ beneath the dense articular surface layer of tissue, but they occupy a greater thickness and consequently restrict the innermost cancellous tissue to a narrower area.

Cope, in describing the two centra on which this species is based, states that they are without a fossa on the inferior face. This is no doubt an error of observation, as in the larger of the two type specimens there is a single deep fossa below, and in the smaller centrum there is also a single median inferior fossa.

A few imperfect centra and large vertebral fragments belonging to the collection of 1904 are probably referable to this species.

The lower or proximal ends of a few dorsal fin spines, differing from those that have been provisionally assigned to *Rhineastes rhæas*, are in the collection of 1904.

These spines may have belonged to one of the two species of *Amiurus* here referred to, or possibly both species may be represented. They differ considerably in size, and were apparently without tubercles, or longitudinal sculpture ridges on their sides. From the specimens it is impossible to state whether serrations were present along the anterior, and posterior edges, or not. The sides of the spines were apparently smooth, but the specimens are either slightly worn or weathered so that, any delicate markings, if they were present, have been obliterated. The largest specimen, figures 14, 15 and 16, has a maximum transverse diameter at the base of 13 mm., the smallest does not exceed 4·5 mm., measured similarly.

The largest spine is one that has been broken off farthest from the proximal end. It is subtriangular in section above the base, and is excavated longitudinally behind by a deep groove. Above, the ridge bounding the posterior groove on one side persists, on the other side it disappears, so that the spine is not bilaterally symmetrical. The lateral surface of the spine, on the side on which the posterior ridge continues, is convex, the opposite side is slightly concave. In the centre of the angular anterior surface is a longitudinal, shallow, but well-defined, narrow groove. The basal perforation is about 3 mm. wide. Seen sideways the anterior surface curves backward, the posterior outline is almost straight. Measured from back to front, near the distal end of the specimen, the diameter is 12 mm., the transverse measurement at the same height from the base is about 7 mm.

Compared with a dorsal spine* of *Arius egertoni*, var. *belgicus*, Leriche, from the Eocene of Belgium, the Cypress Hills spine is much more robust above, although the proximal end and the basal perforation are of about the same size in each.

REPTILIA.

CHELONIA.

Anosteira ornata? Leidy.

Plate I, figs. 17, 18 and 19.

Anosteira ornata, Leidy, 1871. Proc. Acad. Nat. Sci. Phila., p. 102.

A marginal plate of a turtle from the eastern escarpment of the Cypress hills (collection of 1904) bears so striking a resemblance in general form and ornamentation to those of Leidy's species from the Bridger Eocene of Wyoming, that it is, for the present, referred to that species.

The plate is triangular in section, the free edge being sharp and smooth, the inner surface excavated (figure 19). It is apparently the eleventh plate from the right side of the shell. The sculpture beneath, fig. 18, consists of distinct, discontinuous, radiating ridges of varying length with a few tubercles at the centre. The upper surface, fig. 17, is somewhat similarly, but more rugosely ornamented, the tubercles here predominating; although toward the margins of the plate they tend to coalesce into short divergent ridges. A furrow across the middle of the upper surface marks where contiguous epidermal shields met. This groove is continued, though very faintly, on the under surface of the plate. Leidy was doubtful as to the presence of shields in this species. In his description** he mentions that the shell "appears to be devoid of the usual outlines more or less strongly expressed, of the investing scutes."

A second marginal plate from the same locality bears a slightly different sculpture. The upper surface is granulose throughout, without the formation of definite ridges, although the tubercles frequently coalesce. The lower surface would be quite smooth but for an indistinct granulation near the free border. The plate is wedge shaped, shallowly concave above, but convex beneath, and grooved on the inner border. A sulcus also in this plate denotes the presence of epidermal shields. The anterior marginals in the type are stated to be smooth beneath, and it is probable that this plate belongs to that part of the shell anterior to the axillary notch.

In Bone coulée, Cypress hills, was found another specimen probably belonging to the species represented by the eastern escarpment marginals. It is a lateral marginal, probably the fifth of the right side, and is definitely sculptured in agreement with the type of *A. ornata*. This specimen also bears scute impressions.

More material is needed to more definitely determine the Cypress Hills species, which, from the evidence now available, and so far as a comparison can be made, apparently very closely resembles the Eocene species described by Leidy. Additional specimens, however, will probably prove the Cypress Hills species to be distinct from *A. ornata*, bringing to light a form representative of the Oligocene deposits.

---

* Mémoires du Musée Royal d'Histoire Naturelle de Belgique, t. III. Les Poissons Eocènes de la Belgique, par Maurice Leriche, 1905, p. 143, pl. IX, figs. 4 and 5.

** 1873. Contr. to the Extinct Vertebrate Fauna of the Western Territories. Report U. S. Geol. Survey Terrs., vol. I, p. 175, pl. XVI, figs. 1-6.

STYLEMYS NEBRASCENSIS, Leidy.

This species has already been recorded by Cope, (this volume, pt. I, p. 5) from the head-waters of Swift-current creek in Bone coulée (collection of 1884), who considered that certain fragments from this locality were not distinguishable from Leidy's species from the Oligocene of South Dakota and Colorado. The 1904 collection includes parts of the shell of a tortoise which is also, apparently, referable to the same species.

TESTUDO EXORNATA, Lambe.

Plate I, figs 20, 21 and 22.

Testudo exornata, Lambe, 1906. Ottawa Naturalist, vol. XIX, p. 187, pl. 3, figs. 1, 2 and 3.

Among the chelonian remains of the Cypress Hills Oligocene collection of 1904 are parts of a number of costal plates that were described in 1906, as appertaining to a new species of *Testudo*, under the above name.

The specimens were found separately, but were considered to belong, evidently, to the same species. The three figured are the proximal end of the left first costal, the distal half of the left fifth costal, and the proximal end of the left sixth costal.

All the specimens show decided groove markings. The distal end of the fifth costal plate, (figure 20, the type of the species), is particularly narrow and thick, but its outline indicates that the bone when entire had a considerable breadth proximally. Its upper surface presents a number of parallel shallow furrows in the direction of the length of the carapace. It is thickened along its posterior articular border where it joined the similarly thickened anterior border of the sixth costal, thus forming a stout ridge for the reception of the inguinal buttress.

The specimen shown in figure 21, is apparently the proximal end of the left sixth costal plate. This costal when complete was evidently much broader toward its outer end. Deep sulci on the upper surface mark the position of the fourth vertebral, also the third, and fourth costal shields. Distinct grooves also cross this plate from side to side near its inner end, where the sutural surfaces for articulation with the sixth and seventh neural plates are preserved.

The third specimen, figure 22, is the inner end of the left first costal. On its surface are concentric grooves indicating an epidermal shield pattern such as is found in some of the modern species of the genus.

These specimens show that the costal plates were alternately narrow and broad distally, and broad and narrow proximally: a common character of species of *Testudo*.

Measurements.

	MM.
1st Costal plate. Plate I, figure 22 :—	
Maximum thickness at centre of proximal end	7
Thickness of specimen at anterior suture	5
" " " posterior "	4
5th Costal plate. Type. Plate I, figure 20 :—	
Thickness at proximal end of specimen	5
" near distal end at anterior suture	5
" distally near posterior suture	8
6th Costal plate. Plate I, figure 21 :—	
Thickness at proximal end	8

This species is peculiar on account of the extreme narrowness and thickness of the 5th costal plate. The surface of the carapace bore a distinct pattern of grooves which were, anteriorly at least, arranged concentrically within the boundaries of the epidermal shields.

TRIONYX LEUCOPOTAMICUS, Cope.

This species was described by Cope in 1891*. The material on which it is based consists of part of a costal bone from Bone coulée, Cypress hills, (Mr. T. C. Weston's collection of 1884) and some well preserved fragments from the White buttes, Dakota.

In the collection of 1904 from Bone coulée are a number of fragments of shell, principally broken costals, that are evidently referable to this species.

Other fragments may be assignable to *T. punctiger*, Cope, from the Oligocene (White River) of South Dakota, but the material is too poor to admit of a satisfactory determination.

SQUAMATA.

PELTOSAURUS GRANULOSUS, Cope.

Plate 1, figs. 23, 24 and 25.

Peltosaurus granulosus, Cope, 1873. Palæontological Bulletin, No. 15, p. 5.
" " Cope, 1874. Annual Report U. S. Geol. and Geog. Survey Terrs. for 1873, p. 513.
Peltosaurus granulosus, Cope, 1884. The Vertebrata of the Tertiary Formations of the West, U.S. Geol. Survey Terrs., vol. III, p. 773, pl. LX, figs. 3–11.
Peltosaurus granulosus, Lambe, 1905. Geol. Survey of Canada, Summary Report for 1904, p. 366.

With this species are identified part of a left dentary (fig. 23) and the posterior half of a right maxilla (fig. 24), in both of which specimens a number of the teeth are preserved. A worn portion of a second dentary from which the teeth have been abraded, probably, also belongs to this species.

The type specimens described by Cope are from the Miocene of north-eastern Colorado; the Canadian specimens were obtained by the writer from the Oligocene beds of Bone coulée, Cypress hills, in 1904.

In the dentary shown in figure 23, the teeth are pleurodont, of fair size, chisel-shaped, and apparently in all particulars agreeing with those of the type specimens. There are four of the largest teeth in a space of about 5 mm. The mandibular groove, seen in the inferior surface of the specimen, is of large size, and the dentary canal is well shown, piercing the bone midway between the surface of attachment of the teeth and the exterior surface of the specimen in which occur a few small foramina.

In the maxilla there are eight teeth preserved, diminishing in size toward the back. Exteriorly the bone curves slightly outward behind, and above posteriorly is seen the surface for the articulation of the jugal. The teeth correspond in size with those of the dentary.

The Cypress Hills specimens are smaller than the corresponding bones on which the species is based, but there is no evidence to indicate that they belong to a different species.

* The species from the Oligocene or Lower Miocene beds of the Cypress hills. Geol. Survey of Canada. Contr. to Can. Palæont., vol. III, (quarto), pt. I, p. 5, pl. I, figs. 8 and 9.

A dermal scute, fig. 25, from Bone coulée, possibly referable to this species, may be mentioned here. It is quadrangular in shape, flat, longer than broad, and broadest behind, with straight sides, and a convexly curved, sharp-edged posterior margin. It attains a maximum thickness of 0·5 mm. in front and thins gradually to the rear. No overlapping surfaces are seen. Above it is finely tuberculated, the turbercles being distinct from each other, and close set, about three in a space of 1 mm. A well defined median ridge is developed in the direction of its length. This scute differs from those of this species described by Cope, in that it is keeled, and the granulation, apparently, more distinct.

Ogmophis compactus, Sp. nov.

Plate I, figs. 26–30.

Ophidian vertebræ, Lambe, 1905. Geol. Survey of Canada, Summary Report for 1904, p. 366.

Four dorsal vertebræ apparently belonging to the same species were found separately. They are all of different sizes, and, probably, are from different individuals. The maximum breadth is across the zygapophyses, which are broadly expanded laterally; it apparently exceeds the maximum height (unobtainable on account of the abrasion of the neural spine in all the specimens) and greatly exceeds the length measured so as to include the pre- and postzygapophyses. A marked character is the shortness of the centrum. The cup is wider than high with a well defined sharp rim, and is directed very slightly downward. The ball is as slightly inclined upward. The zygosphene is broader than the neural canal is wide, and has a plane upper surface, and a straight sharp front margin that slightly overhangs the upper rim of the cup. The neural spine starts as an angular ridge behind the upper surface of the zygosphene. The neural canal is subtriangular in cross section, the angles being rounded with the apical one the most obtuse; its sides are slightly incurved. A low rounded ridge occupies the centre of the floor of the canal longitudinally, corresponding in shape with the hypapophysial keel of the lower surface of the centrum. An angular interzygapophysial ridge is feebly developed, the surfaces above and below the ridge being shallowly concave. The front margin of the neural arch between the postzygapophyses is, in outline as seen from above, deeply emarginate, restricting the space available for the base of the neural spine. The facettes of the zygapophyses and of the zygosphene and zygantrum are inclined at a slight angle to each other, those of the zygapophyses being the less removed from the horizontal. The costal tubercle is not prominent; its articular face in all the specimens is a little worn, but sufficiently well preserved to show that it is single. Its face is higher than broad, and is directed obliquely outward and downward from beneath the prezygapophysis at a level corresponding with that of the cup. In the largest vertebra (No. 3) the articular face is seen to be convex above and slightly concave below posteriorly. A rounded ridge is developed near the base of the tubercle, and passes backward almost to the side of the ball at its mid-height. This ridge leaves a longitudinal depression on either side of the hypapophysial ridge which passes from the ball to the cup, and is well rounded and distinct but not prominent. There are slight variations in the above vertebræ but their general proportions are similar. The vertebra figured on plate I is No. 2 of the table of measurements given below.

Measurements in MM.

	Length of centrum.	Breadth of vertebra. ant.	post.	Height of vertebra. ant.	post.
No. 1	4·3	9·5			8·0
No. 2	5·0		7·75		6·0
No. 3		11·0		6·75	
No. 4	4·3		6·00		6·4

This species is distinct from *O. angulatus* described by Cope* from the White River (Oligocene) beds of north-eastern Colorado. The vertebræ of Cope's species approach more closely in general form those of the Cypress Hills species than do those of other described species of the genus. *O. arenarum*, Douglass,** from the Flint Creek beds (Miocene) of Montana, differs in important particulars.

CROCODILIA.

Crocodilus prenasalis? Loomis.

Crocodilus prenasalis, Loomis, 1904. Two new river reptiles from the Titanothere beds; Amer. Jour. Sci., vol. XVIII, p. 427, figs. 1–9.

Few crocodilian remains were found in the Oligocene deposits of the Cypress hills in 1904, and none had been secured previous to that date. The writer obtained in 1904 the following specimens:—two vertebral centra, two keeled scutes, a fragment of a pitted bone from the head and a tooth. These specimens were found separately, but probably belong to the same species.

The vertebræ are from the dorsal region. They are concave in front, and prominently convex behind, and in each case the base only of the neural arch remains. One specimen is much smaller than the other, and, probably, belonged to a young individual, as the suture between the neural arch and the centrum is strongly marked. The dermal scutes have numerous deep, rounded pits in the upper surface, are prominently keeled longitudinally, and their margins bear no evidence of having been in contact with other scutes. The under surface is even and flat. The tooth is elongate conical and curved slightly inward, and backward; its surface is quite smooth. The inner face is defined in front, and behind, by a well developed ridge that extends from near the base to the apex. The base of the tooth is deeply excavated.

Measurements.

	MM.
Large vertebra:—	
Maximum length at mid-height of centrum	35
Height of anterior articular face	20·6
Maximum breadth of same	22
Height of posterior articular face	18·2
Maximum breadth of same	17·8
Length of floor of neural canal	28·5
Length of inferior surface	22·5
Small vertebra:—	
Maximum length at mid-height of centrum	25
Height of anterior articular face	15
Maximum breadth of same	18
Height of posterior articular face	13
Maximum breadth of same	15
Length of floor of neural canal	18
Length of inferior surface	15·5

* Report U. S. Geol. Survey Terrs., vol. III, Tertiary Vertebrata, book I, 1884, p. 783.
** Annals of the Carnegie Museum, 1903, vol. II, Art. X, p. 171.

Larger dermal scute :—	
Length	20
Breadth	14
Maximum height or thickness	7·5
Average diameter of pits	3
Tooth :—	
Length	17·5
Antero-posterior diameter at base	9·2

The above crocodilian remains are referred provisionally to the species lately described by Dr. F. B. Loomis, from the Titanothere beds of South Dakota. The larger vertebra from the Cypress hills agrees well in size, and general proportions with the South Dakota dorsal centrum (p. 428, fig. 3, of Dr. Loomis's paper), whilst the larger dermal scute closely resembles the Dakota plates in the disposition and size of the surface pits.

MAMMALIA.

MARSUPIALIA.

Didelphys valens, sp. nov.

Plate VIII, figs. 1–7.

An upper right molar from Bone coulée, Cypress hills, is provisionally referred to this genus. The tooth in crown view, is triangular in outline, has three prominent V-shaped cusps, and a strong external style-bearing cingulum. Of the three cusps, the internal one (protocone) occupies the apex of the triangle, the other two (paracone and metacone) form an antero-posterior pair somewhat removed from the external face of the tooth by the strong development of the cingulum. The three primary cusps are compressed antero-posteriorly, the protocone to a less extent than the other two; all have their external slopes well excavated. The protocone is the stoutest, and is of about the same height as the paracone, which is the smallest; the metacone is conspicuously higher than the others. At the base of the posterior spur of the protocone, is a decided though small fourth cusp that may represent the hypocone. Three principal stylar cusps occur in the cingulum. Of these, the most prominent occupies a position only slightly posterior to the mid-length of the cingulum : it is compressed transversely, and has a vertical external face with a somewhat rounded internal slope; its height is nearly equal to that of the paracone. Of the other two stylar cusps one is at either end of the cingulum, the anterior one being the larger of the two. The demarcation between the anterior style and the large one posterior to it is very decided, and is accentuated by a furrow in the vertical external face of the cingulum. On the anterior slope of the central stylar cusp are two inconspicuous secondary styles. The cingulum is continued round the anterior base of the paracone as a narrow shelf. The crown is borne on three short roots.

This tooth, plate VIII, figures 1–4, probably the second or third upper molar, is considerably larger than (slightly more than one-third as large again as) the corresponding molars of *Didelphys* (*Peratherium*) *fugax*, which exceeds in size the other species of the genus described by Cope from the Oligocene of Colorado. For the species represented by the Cypress Hills tooth the name *valens* is proposed. Collection of 1904.

Measurements of type specimen.	MM.
Length of external face of crown	2·25
Transverse diameter	2·50
Length of interno-posterior face	3·30
Maximum height of crown (height of metacone)	1·30

The presence of an incipient hypocone is a decidedly progressive character, and one that has been considered by Bensley* in the Australian genus Perameles as an indication of a change from an "insectivorous to an omnivorous condition." The hypocone appears not to be present in the molars of *Didelphys*, and suggests that the Cypress Hills tooth may represent a distinct genus. Under the circumstances, however, with so little evidence to go on, a provisional reference to the above, mainly Oligocene genus is at present adhered to.

Another small tooth, plate VIII, figures 5–7, from the same locality as the above, deserves attention. It possibly represents an undescribed genus of marsupial of the polyprotodont section, but the one small tooth found is quite insufficient for any definite determination. The crown is triangular in cross section, and consists of a high, apical, principal cusp, subpyramidal in shape, with two less elevated, conical, subequal cusps occupying the base of the triangle. The tooth has one root which would suggest an anterior premolar, but the crown is molariform, and presumably a posterior molar is represented. Regarding the tooth as a lower molar, the principal apical cusp is the protoconid, the smaller pair being the metaconid and paraconid occupying internal posterior and anterior positions respectively. A cingulum is continuous round the base of the crown except internally. Anteriorly, and externally, the cingulum is feeble, but posteriorly it becomes accentuated, and ends abruptly beneath the posterior slope of the metaconid in a minute tubercle. On the internal face of the crown a vertical furrow occurs between the bases of the two smaller cusps.

Measurements.	MM.
Maximum antero-posterior diameter of crown	1·20
" transverse diameter of crown	1·50
Height of external cusp (protoconid)	1·80
" internal cusps (metaconid and paraconid)	0·85

The second lower molar of *Notoryctes typhlops**, Stirling, has a cusp arrangement very similar to that of the Cypress Hills tooth, suggesting that the dentition of this living Australian marsupial may be primitive in some of its characters rather than specialized. In the Cypress Hills tooth, however, the talonid is only indicated by a minute tubercle, or enlargement of the cingulum at the base of the metaconid, proportionately much smaller than the definite subsidiary cusp of *Notoryctes.*

It is possible that this tooth, and the upper molar above described, both of the collection of 1904, may belong to the same animal.

---

* On the Evolution of the Australian Marsupialia ; with remarks on the relationships of the marsupials in general, by B. Arthur Bensley, Ph. D., University of Toronto ; Trans. Linnean Society, vol. IX, part 3, 1903.

* This tooth is described and figured by Dr. Bensley in his memoir of 1903, p. 119, pl. 6, figs. 17 *a–b*.

UNGULATA

ANCODUS (HYOPOTAMUS) BRACHYRHYNCHUS, Osborn and Wortman.

Plate II, figs. 1–9.

Hyopotamus brachyrhynchus, Osborn and Wortman, 1894. Fossil Mammals of the Lower Miocene White River beds. Collection of 1892; Bulletin Amer. Mus. Nat. Hist., vol. vi, article vii, p. 220, fig. 6B.

This genus was not known from Canada prior to the publication of the writer's list of fossil remains from the Cypress hills in the Summary Report of the Geological Survey for the year 1904. Unfortunately, separate teeth are the only evidence that we as yet have of the existence of this artiodactyl in this country during Oligocene times.

A well preserved right upper third molar, fig. 1, belonging to this genus, is included in the collection of 1904, and is thought to be referable to *A. brachyrhynchus*, Osborn and Wortman, from the Protoceras beds of South Dakota. In this species there is a greater development of the cingulum in the upper premolars and molars than in *A. americanus*, Leidy, from a slightly lower horizon. The cingulum in the Cypress Hills molar is conspicuous, and in this respect as well as in its general proportions this tooth agrees better with the corresponding one of *brachyrhynchus* than with that of *americanus*. In the Cypress Hills tooth the mesostyle is prominent in the ectoloph, and apparently more protrudent than in *brachyrhynchus;* the protoconule is well defined and throughout the cingulum is moderately developed.

Measurements.	MM.
Antero-posterior diameter	29
Anterior transverse diameter	31·5
Posterior transverse diameter	26
Height of paracone	13·5
Height of protocone	12·5

Within a very short distance of the above tooth, and at the same level, were found four other teeth that appear to belong to this genus, and are probably referable to this species. These teeth are determined as follows:—a left lower first incisor, a right lower third incisor, a right lower canine, and an upper left third premolar, all figured in plate II. The premolar, fig. 2, is slightly smaller than the same tooth in *brachyrhynchus*, but is otherwise very similar, particularly as regards the shelf-like, interno-posterior expansion of the cingulum, which greatly increases the breadth of the tooth behind. As seen from below, fig. 3, the outline of the tooth is triangular, with the inner posterior angle obtusely rounded. The cingulum is continuous throughout, and is conspicuously prominent internally.

The lower canine agrees in shape with the corresponding tooth of the Hyopotamus from the Lower Miocene of Ronzon, near Puy-en-Velay (Haute Loire), France, as figured by Kowalevsky in the Philosophical Transactions of the Royal Society of London, 1873, vol. 163, pl. XXXIX, figs. 3, 3¹. Its crown, viewed from the side, is nearly triangular, sharply pointed above (unworn), with its height slightly in excess of the basal breadth. Its anterior and posterior slopes are sharp-edged, the former curving inward below. The exterior surface, fig. 5, is convex, somewhat flattened behind. Internally, fig. 4, it is excavated, with a median vertical rib breaking the general concavity.

Of the incisor teeth, the supposed lower third, figs. 6 and 7, is very similar in shape to the canine, but is smaller, less pointed above (worn), and the breadth of the crown below is greater than the height. The crown is set obliquely to the root. The left lower incisor, figs. 8 and 9, probably the first, is considerably worn above where the greatest breadth occurs. Its cutting edge forms an almost straight line across, and the later margins slope gently inward to the root, without the abrupt basal constriction observed in the third incisor. Internally the crown is concave, with a median longitudinal rib.

ANTHRACOTHERIUM? PYGMÆUM, sp. nov.

Plate VI, fig. 6.

A right upper molar of very small size indicates an artiodactyl with dental characters suggestive of an Anthracothere. As the tooth is imperfect, lacking some of the parts most essential for its exact determination, a description of it is given, in the hope that at some future date, better material may be forthcoming. For the present it is referred to *Anthracotherium*, but it is probable that an undescribed genus is represented. For the species the name *pygmæum* is proposed.

In crown view the outline of the tooth is quadrangular, with the antero-posterior diameter internally greater than the anterior transverse diameter, so that the tooth is longer than broad. In *Anthracotherium* and *Ancodus* these proportions are reversed. The margin of the tooth is perfect anteriorly and internally, but externally and posteriorly it is damaged. The specimen lacks the mesostyle and the posterior slopes of the metacone and hypocone. The four main cusps are crescent shaped and there is a distinct but small protoconule.

A deep transverse valley separates the anterior from the posterior cusps, a comparatively shallow longitudinal valley occurs between the protocone and the paracone, but a corresponding valley does not exist between the hypocone and metacone. The protocone is larger and more elevated than the hypocone, but both are prominent with steep inner slopes. A broad, median rib occupies the outer, otherwise slightly concave slope of the former. The paracone is low (in the specimen much worn), but the metacone rises nearly to the height of the hypocone, whose outer slope is short, and descends but little to meet it. The outer slope of the paracone (judging from the small portion of it preserved) resembled that of the protocone. The anterior spur of the protocone reaches to the protoconule, which is close to a well-defined anterior cingulum. The posterior spur of the protocone is long, crosses the median transverse valley, and rises on the anterior slope of the hypocone nearly to the apex of the metacone. The basal cingulum occurs on the anterior face of the crown, and in the inner end of the transverse valley The anterior spur of the hypocone connects with the posterior spur of the protocone almost at the apex of the metacone. The specimen shows the junction of the anterior spur of the metacone with the posterior one of the paracone, but the mesostyle is missing. The parastyle is very feebly developed.

The approximation of the posterior cusps in this tooth is a character probably sufficient to distinguish the species generically from any of the known genera of *Anthracotheriidæ*. The selenodont form of the main cusps, and the presence of a protoconule, makes it most probable that this species is properly assignable to the *Anthracotheriidæ*. The tooth pattern indicates a closer relationship to *Anthracotherium* than to *Ancodus*.

Measurements of type specimen.

	MM.
Internal antero-posterior diameter	9·00
Anterior transverse diameter	8·00
Height of protocone	4·70
Height of hypocone	3·80

Locality :—Bone coulée, Cypress hills. Collection of 1904.

ELOTHERIUM COARCTATUM, Cope.

Plate II, figs. 10–15, and plate III, figs. 1–6.

This species, based on the greater part of a left mandibular ramus discovered by Mr. T. C. Weston in the Cypress Hills deposits during the summer of 1888, was first described by Professor Cope in the American Naturalist, vol. XXIII, p. 628, July 1889, in his third article on the "Vertebrata of the Swift-current river." Cope's fuller description, with illustrations of the type specimen, appeared in 1891 in part I of this volume.

The original description of 1889 is worded as follows:—"*Elotherium coarctatum*, sp. nov.—Represented by a left mandibular ramus with condyle, which supports all of the molar teeth. The species differs from the *E. mortonii*, with which it agrees nearly in size, in having all the premolars in a series uninterrupted by diastemata, except a very short one between pm. iii and iv.* The second premolar is the most elevated, and the third and fourth are abruptly smaller. The fourth has one compressed grooved root. The molars are peculiar in having the two anterior cusps elevated above the three posterior ones, as in Mioclænus sp. The posterior, or fifth tubercle, is well developed, especially on the m. iii."

"Length from condyle to edge of canine alveolus, 295 mm.; do. to last molar, 125; do. of true molar series, 67; do. of m.i, 22; width of do., 13; elevation of pm. ii, 21; length of base of crown do., 28; depth of ramus at m.i, 55."

An upper molar, obtained by Mr. Weston at the Cypress Hills locality in 1884, and assigned to *Elotherium mortoni*, Leidy, by Cope in his earlier references** to the Survey collections, was, in 1891, referred to *E. coarctatum* in his final description of the species.

This upper tooth, plate II, fig. 10, is regarded as m^1 from the right side. It has six low tubercles arranged in two rows transversely, of which the inner posterior tubercle (hypocone) is apparently not separate from the cingulum. The two outer tubercles (paracone and metacone) are well developed, the paracone being the larger of the two. Both the inner tubercles in this specimen are injured, but the protocone has been apparently of fair size. The protoconule and metaconule are well marked but do not attain the height of the outer cones. The cingulum is conspicuous on the anterior and posterior faces of the crown. The tooth has three roots.

Another right upper molar, fig. 11, belonging to the writer's collection of 1904, is referred to this species. It is the posterior tooth of the series and is of about the same size as the first upper right molar just mentioned. It resembles the last upper molar of *E. mortoni*, as

* The usual premolar enumeration from front to back is here reversed.

** American Naturalist, 1885, vol. XIX. The White River beds of Swift-current river, North West Territory, p. 163 (*Entelodon mortoni*, Leidy); and Geol. and Nat. Hist. Survey of Canada, 1885, vol. I, new series, appendix I, p. 84 C (*Elotherium mortoni*, Leidy).

described by Leidy in 1853 in "The Ancient Fauna of Nebraska," plate VIII, fig. 1, but the six tubercles are more distinctly marked in the Cypress Hills tooth. The cingulum is continued round the entire crown, except for a short distance at the base of the inner slope of the protocone; it forms a broad shelf anteriorly, and is prominent posteriorly. Seen from above the crown in outline is unequally four-sided; it is transversely much narrower behind than in front. It is low with six conspicuous tubercles, of which the outer and inner anterior ones (paracone and protocone), are about equal in size and larger than the others. Of the three tubercles forming the transverse posterior row, the inner one (hypocone) is connected with the cingulum.

Two fragments of the lower jaw of this species were also obtained in 1904. These are a part of the left ramus with molars i, ii, and iii, and a small portion of the right half of the jaw holding the first molar. The teeth agree in all particulars with the corresponding ones of the type specimen.

Two teeth, the upper third and fourth premolars of the right side, collected in 1904, are, on account of their large size, referred to *E. coarctatum* with some hesitation. They were found together, and probably belonged to the same individual. If they properly belong to this species, and they are apparently not referable to any other described species from the Oligocene, they will indicate that in *E. coarctatum* the upper third and fourth premolars are considerably stouter in every way than the corresponding teeth of the lower jaw. Of these specimens, the third premolar, figs 12 and 13, is a simple robust cone, elongated antero-posteriorly, and supported on two roots, of which the hinder one is the thicker but shorter of the two. A cingulum passes round the base posteriorly and is present, but feebly developed, anteriorly. The enamel is roughened by short vermicular markings, which, toward the base, above the cingulum, pass into conspicuous wrinkles. The crown shows signs of wear toward the inner side behind and along the front slope. The fourth premolar, figs. 14 and 15, is a very strong, three-rooted tooth, with a transverse diameter greater than its maximum antero-posterior diameter. The crown consists of an outer conical cusp with a smaller, less elevated one on the inner side. A strong cingulum is present except at the centre of the base of the external slope. This tooth is also considerably worn on the front and back slopes of the crown, more particularly on the former. Except where worn the surface above the cingulum presents the same style of surface marking observed in the third premolar.

Measurements.

	MM.
Upper right m. iii, plate II, fig. 11 :—	
Transverse diameter of crown, maximum	22
Antero-posterior " "	22
Upper right m. i, plate II, fig. 10 :—	
Transverse diameter of crown	21
Antero-posterior "	20·5
Upper right pm. iv, plate II, figs. 14 and 15 :—	
Transverse diameter of crown, at base	29
Antero-posterior " " " maximum	26·7
Height of crown, external	23
Upper right pm. iii, plate II, figs. 12 and 13 :—	
Transverse diameter of crown at base, maximum	18
Antero-posterior " " "	32·5
Height of crown, external	27

The reader is referred to part I of this volume for Professor Cope's description of the type of this species.

Five separate teeth from Bone coulée may be mentioned here as apparently belonging to *Elotherium.* They resemble incisors in form, and may represent more than one species, as four of them are nearly of a size, whilst one is much smaller. Two of the larger specimens are shown in plate III, figures 1, 2, 3 and 4; the small one is shown in figures 5 and 6 of the same plate.

In his memoir on the Cypress Hills fauna Professor Cope alludes to the fewness of the remains of *Oreodonitdæ* in the collection studied by him. The only specimen mentioned by him is a left lower first premolar which was not assigned to any genus.

In 1904 a few additional separate teeth were obtained by the writer; these are noticed as under.

Agriochœrus antiquus, Leidy.

Plate II, figs. 16 and 17.

Three imperfect posterior upper molars, one from the left side and two from the right, represent one or more species of *Agriochœrus.* Comparing these teeth with the posterior molars of *Agriochœrus antiquus*, Leidy, from the Oligocene of South Dakota, as described and figured in the "Ancient Fauna of Nebraska" (Smith. Contr. to Knowledge, 1854, vol. vi) p. 24, pl. 1, the same general form of low cusps, pertaining to this genus, and distinguishing it from *Oreodon*, is observed. Of these molars, one is of about the size of the corresponding tooth of Leidy's figured types, the other two are slightly larger.

One of the above specimens (an upper right third molar, imperfect internally) may with little doubt be referred to *A. antiquus*; its dimensions slightly exceed those given by Leidy for this species. In this specimen the form of the external median buttress (mesostyle), seen also in a molar to be mentioned presently, is low and flattened from without, quite unlike the high antero-posteriorly compressed mesostyle of *Oreodon.* In the other posterior right molar the agreement in form with the teeth figured by Leidy is close, so far as can be judged; the ectoloph is missing and a full comparison is not possible. Its breadth is about the same, and the shape of the inner cusps is similar. This tooth is also referred to *A. antiquus.* The third specimen (plate II, fig. 16), the left posterior molar, has a greater proportionate as well as actual transverse diameter, and may represent a species distinct from *A. antiquus.*

Besides the three above mentioned specimens, there is in the collection of 1904 another left upper posterior molar (plate II, fig. 17). The low rounded form of the mesostyle is here well shown. The tooth exceeds in size the corresponding one of *A. antiquus*, and the proportions of the cusps are somewhat dissimilar; the flatness of the outer slope of the metacone (postero-exterior cusp) is particularly noticeable. In the absence of better material this tooth is provisionally referred to *A. antiquus.*

Merycoidodon culbertsoni, Leidy.

Plate II, figs. 18–26.

A second genus of *Agriochœridæ* (*Oreodontidæ*) is represented by separate teeth from the Cypress hills, included in the collections of 1884, 1889 and 1904. They are referred to *Merycoidodon culbertsoni*, Leidy, of the Oligocene of South Dakota, and consist of the following specimens:—The left lower caniniform premolar, mentioned by Cope in part I of this volume, but not assigned by him to any species (Weston, 1884), a left upper canine (Lambe, 1904) and a right lower second molar (Lambe, 1904).

The premolar, plate II, figs 18 and 19, agrees closely in size and form with the corresponding tooth of the female skull of *M. culbertsoni*, described and figured by Leidy in "The Ancient Fauna of Nebraska." This premolar shows signs of wear, in front on the outer side, and behind on the inner side, where it closed against the upper canine and the upper first premolar.

Measurements of lower first premolar.

	MM.
Exterior height of crown (worn)	13
Antero-posterior diameter of crown at base	13
Transverse diameter of crown at base	7·5

The left upper canine, figs. 20-23, is long, curved, and subtriangular in transverse section throughout its length. The posterior surface, fig. 21, is flattened, and the exterior and interior surfaces are nearly flat, the former being slightly more convex than the latter, fig. 20, in which a low, longitudinal median ridge is developed in the fang above the crown. In the exterior surface a shallow groove is noticed in a corresponding position. The forward angulation is evenly rounded. The crown of the tooth is worn flat posteriorly, where it came in contact with the lower first premolar, and its side angles are sharp. The immediate extremity of the crown is broken off but it seems to have been bluntly pointed. The enamel of the crown extended upward from the point, about 20 mm., measured along the forward angulation. The antero-posterior diameter of the tooth throughout its entire length exceeds the breadth of the posterior flattened surface (max. transverse diameter), otherwise the resemblance of the Cypress Hills tooth to that of *M. culbertsoni* is strong. In describing the upper canine of this species, Leidy, in his above mentioned memoir (p. 42), states that the posterior side "is a little larger than the other sides," that is the transverse diameter exceeded the antero-posterior diameter.

Measurements of upper canine.

	MM.
Total length of specimen along anterior curve	58
Max. transverse diameter at base of crown	9
Antero-posterior diameter at base of crown	10·5
Antero-posterior diameter near upper end of fang	12
Transverse diameter " " " "	10

The remaining tooth, referred to *M. culbertsoni*, is a lower right second molar, figs. 24, 25 and 26. Comparing the specimen with Leidy's figure of the corresponding tooth (op. cit. pl. III, fig. 4) no difference is noticed, except that the Cypress Hills molar is a little the larger of the two.

Poëbrotherium wilsoni, Leidy.

Plate VIII, figs. 8 and 9.

This species, made known by Leidy in 1847 (Proc. Acad. Nat. Sci. Phila., vol. III, p. 322), from the greater part of a skull from the Oligocene (White River) of Nebraska, is represented in the 1904 collection from the Cypress Hills beds by two separate lower last temporary molars, one of which remains in a portion of the jaw. These teeth are composed of three double lobes decreasing in size to the front. The jaw fragment in which the molar is preserved, has a depth agreeing with that of the lower jaw of the type skull, fully described and figured by Dr. Leidy in 1854* in his classic "Ancient Fauna of Nebraska" (Smith. Contr. to Knowledge, vol. VI). In advance of the molar in this specimen are the alveoli for the tooth next in front.

Measurements.

	MM.
Lower right last temporary molar :—	
Antero-posterior diameter	12·3
Posterior transverse "	7·0
Anterior " "	4·5
Lower left last temporary molar in jaw fragment :— (Plate VIII, figs. 8 and 9.)	
Antero-posterior diameter	10·0
Posterior transverse "	6·0
Anterior " "	4·0
Depth of ramus beneath molar	13·0

Leptemeryx esulcatus, Cope.

No teeth from Bone coulée belonging to the 1904 collection can with certainty be referred to this species, which is based on a worn upper, right molar of which the posterior half of the ectoloph is broken away. In size the type of *L. esulcatus* is between one-third and one-fourth smaller than the molars of *L. evansi*, Leidy. The lower teeth figured by Matthew in his paper on the fauna of the Titanotherium beds, 1903, p 223, fig. 15, and referred provisionally to *L. esulcatus*, belong evidently to a species considerably larger than the one represented by the type of *L. esulcatus*.

Leptomeryx mammifer, Cope.

? *Leptomeryx mammifer*, Cope, 1885. The White River beds of Swift-current river, North-West Territory, American Naturalist, vol. XIX, p. 163; name only.

Leptomeryx mammifer, Cope, 1885. Geol. and Nat. Hist., Survey of Canada, vol. I, new series, part C, appendix I, p. 84.

Leptomeryx mammifer, Cope, 1889. The Vertebrata of the Swift-current river, II, American Naturalist, vol. XXIII, p. 154.

Leptomeryx mammifer, Cope, 1891. The species from the Oligocene or Lower Miocene beds of the Cypress hills; Geol. Survey of Canada, Contr. to Can. Palæont., vol. III, (quarto), pt. I, p. 22, pl. XIV, figs. 6, 6*a*, 7, 7*a*.

Leptomeryx mammifer, Matthew, 1899. A provisional classification of the Fresh-water Tertiary of the west, Bulletin Amer. Mus. Nat. Hist., vol. XII, article III, p. 61.

* For this species see also, 1869. The Extinct Mammalian Fauna of Dakota and Nebraska; Jour. Acad. Nat. Sci. Phila., second series, vol. VII, p. 141, pl. XIII.

Leptomeryx mammifer, Matthew, 1902. The skull of Hypisodus, the smallest of the Artiodactyla, with a revision of the Hypertragulidæ., Bulletin Amer. Mus. Nat. Hist., vol. XVI, article XXIII, p. 313.

Leptomeryx mammifer, Matthew, 1903. The fauna of the Titanotherium beds at Pipestone Springs, Montana, Bulletin Amer. Mus. Nat. Hist., vol. XIX, article VI, p. 224, figs. 16 and 17.

Leptomeryx mammifer was founded on lower molars, from Bone coulée, by Cope, who, at a later date, arbitrarily associated with them upper molars from the same locality. The best preserved of these latter, the one figured in 1891, may be regarded as the cotype of the species. There are in the collection of 1904 separate upper molars that agree closely in size and form with the cotype, and are, therefore, regarded as belonging to this species. An upper fourth premolar, obtained in 1904, is also thought to be referable to *L. mammifer.*

It has been pointed out by Matthew (1902) that one of the characters of *L. mammifer* relied on by Cope as a distinguishing one, viz., the presence in the lower posterior molar of a "peculiar column intercalated between the heel and the posterior internal column," is in reality the small antero-internal cusp of the heel found in other species of the genus.

No lower molars are recognized in the collection of 1904 as belonging to *L. mammifer.*

Leptomeryx speciosus, sp. nov.

Plate VIII, figs. 10–15.

A species of *Leptomeryx* is represented by a large number of separate teeth, of which the upper molars are much larger than the type of *L. esulcatus*, Cope, considerably larger than those of *L. evansi*, but not reaching the size of those of *L. mammifer.* This species is apparently distinct from any of these three species.

In the upper molars the proportionate development of the mesostyle, the anterior (parastyle), and posterior (metastyle) styles, and the ribs of the external face are much the same as in *L. evansi.* The styles are quite different from the gibbous styles of *L. mammifer*, as seen in the cotype of that species.

In the upper molars a moderately strong cingulum is generally present for a short distance at the base of the anterior slope of the protocone, and, in a number of specimens there is a slight indication, as well, of a cingulum on the posterior slope of the hypocone. In two fourth premolars a cingulum is present for a short distance on both sides (anterior and posterior) of the inner crescent. In a majority of the upper molars a median internal cusp is present, smaller than that of the molars of *L. evansi.*

The lower molars referred to this species, relying on their size principally for their association here, agree in size and general shape with the mandibular teeth referred provisionally to *L. esulcatus* by Matthew in 1903, (op. cit, p. 222, fig. 15). The Cypress Hills lower molars have a slight anterior and posterior cingulum in the majority of cases, and there is also in most of the specimens a small median external cusp having about the same degree of development as the median internal cusp of the upper molars. No mention is made by Matthew of a cingulum, nor of a median internal cusp in the Pipestone Springs lower molars, which, however, in other respects, and as regards exact size, agree with the Cypress Hills specimens,

Measurements.

	MM.
Upper molar, plate VIII, figs. 10, 11. Type :—	
Maximum transverse diameter	10·20
" antero-posterior diameter	7·80
Lower molar, plate VIII, figs. 12, 13 :—	
Maximum transverse diameter	5·30
Antero-posterior diameter	8·00
Posterior lower molar, plate VIII, figs. 14, 15.	
Antero-posterior diameter	10·50
Upper molar of *L. esulcatus* (type) :—	
Maximum transverse diameter	6·00
Antero-posterior diameter, approx	6·+
Upper molar of *L. mammifer* (cotype) :—	
Maximum transverse diameter	11·50
" antero-posterior diameter	9·50
Lower posterior molar of *L. mammifer* (type specimen) :—	
Antero-posterior diameter, approx	12·70

The name *speciosus* is proposed for this apparently undescribed species of Leptomeryx.

Locality :—Bone coulée, Cypress hills, collection of 1904.

LEPTOMERYX SEMICINCTUS, Cope.

Leptomeryx semicinctus, Cope, 1889. The Vertebrata of the Swift-current river, II, American Naturalist, vol. XXIII, p. 154

Leptomeryx semicinctus, Cope, 1891. The species from the Oligocene or Lower Miocene beds of the Cypress hills; Geol. Survey of Canada, Contr. to Can. Palæont., vol. III (quarto), pt. I, p. 23, pl. XIV, figs. 8, 8*a*.

Leptomeryx semicinctus, Matthew, 1902. The skull of Hypisodus, the smallest of the Artiodactyla, with a revision of the Hypertragulidæ, Bulletin Amer. Mus. Nat. Hist., vol. XVI, article XXIII, p. 314.

This species was founded by Cope on two upper molars, and part of a third, from the Cypress hills. Additional upper molars were obtained in 1904, by the writer, in Bone coulée. This species is for the present referred to *Leptomeryx;* without the full dentition its generic affinities cannot be satisfactorily determined.

HYPERTRAGULUS TRANSVERSUS, Cope.

Hypertragulus transversus, Cope, 1889. The Vertebrata of the Swift-current river, II, American Naturalist, vol. XXIII, p. 154.

Hypertragulus transversus, Cope, 1891. The species from the Oligocene or Lower Miocene beds of the Cypress hills; Geol. Survey of Canada, Contr. to Can. Palæont., vol. III (quarto), pt. I, p. 22, pl. XIV, figs. 4, 4*a*.

Hypertragulus transversus, Matthew, 1902. The skull of Hypisodus, the smallest of the Artiodactyla, with a revision of the Hypertragulidæ, Bulletin Amer. Mus. Nat. Hist., vol. XVI, article XXIII, p. 316.

No teeth in the 1904 collection are recognized as belonging to this species. Matthew (1902) is of the opinion that the two worn upper molars from Bone coulée, described by Cope, under the above name, are probably not referable to the genus *Hypertragulus.*

MESOHIPPUS WESTONI, (Cope.)

Plate III, figs. 10, 11, 12 and 13.

Anchitherium, sp. indet., Cope, 1885. The White River beds of Swift-current river, North West Territory; American Naturalist, vol. XIX, p. 163.

Anchitherium westonii, Cope, 1889. The Vertebrata of the Swift-current river, II; idem, vol. XXIII, p. 153.

Anchitherium westonii, Cope, 1891. The species from the Oligocene or Lower Miocene beds of the Cypress hills; Geol. Survey of Canada, Contr. to Can. Palæont., vol. III (quarto), pt. I, p. 20, pl. XIV, figs. 1, 2 and 2*a*.

Mesohippus westoni, Osborn, 1904. New Oligocene horses; Bulletin Amer. Mus. Nat. Hist., vol. XX, p. 169.

Mesohippus westoni, Lambe, 1905. On the tooth-structure of Mesohippus westoni (Cope); American Geologist, vol. XXXV, p. 243, pl. XIV.

Mesohippus westoni, Lambe, 1905. Fossil horses of the Oligocene of the Cypress hills, Assiniboia; Trans. Royal Soc. of Canada, second series, vol. XI, section IV, p. 44, pl. II, figs. 1, 1*a*, 1*b*, and 1*c*.

The type material of this species, from Bone coulée, Cypress hills, consisting of a right upper molar, and two right lower molars in place in a fragment of the mandible, is in the Museum of the Geological Survey at Ottawa.

A right upper molar belonging to the collection of 1904, has been referred by the writer to this species. The upper molar described by Cope is imperfect, the outer slope of the ectoloph is missing and the anterior part of the tooth, including the protoloph, is much damaged.

The crown of the molar obtained in the summer of 1904 is practically perfect and had been subjected to little use during the life of the animal; it is most probably the second molar and is shown in figures 10-13 of plate III. This tooth is brachyodont, with well developed low cross crests (protoloph and metaloph). The crown, seen from below, is suboblong in outline, transversely broader in front than behind and relatively narrow in an antero-posterior direction. The outer border (ectoloph) rises higher than the cross crests. The latter are unequal in length, the protoloph being longer and better developed than the metaloph. The intermediate cusps (protoconule and metaconule) are both well defined, although the protoconule is larger than the metaconule, and more distinctly separated from the protocone than is the metaconule from the hypocone. The protocone is slightly larger at its base than the hypocone, but both have about the same height. There is no hypostyle. The parastyle is large, and adds considerably to the crown's anterior transverse diameter. The mesostyle and metastyle are distinct, and the ribs distinguishable, the anterior ribs being the better defined of the two. The cingulum is well developed and passes from the metastyle entirely round the inner side of the crown to the parastyle without interruption, except for a short distance on the front inner slope of the protocone; it connects in front with the parastyle, with which the outer end of the protoloph shows a marked tendency to unite. Outwardly the cingulum rises on to the parastyle, but does not cross it.

M. westoni, judging of its dental characters principally from the molar obtained in 1904, approaches closely to *M. latidens*,* Douglass, in tooth-structure, but its molars are distinguished principally by the presence of an internal cingulum, by the less pronounced parastyle, and a proportionately greater antero-posterior diameter, with the protoloph more nearly equal in length to the metaloph, as well as by other characters. *M. celer*, ** Marsh, and *M. montanensis*, *** Osborn, are two other nearly related, but apparently distinct species, from the Lower Oligocene. The presence of the highly developed internal cingulum is one of the most interesting characters in the dentition of *M. westoni*. This character, together with the absence of a hypostyle, points to this species being probably the most primitive of the known horses of Oligocene age.

A lower second premolar and a lower molar, are included in the collection of 1904. Figures of the two lower molars obtained by Mr. Weston are given in Cope's memoir of 1891.

	Measurements in mm. of upper molar of *M. westoni* obtained in 1904.	Measurements of type molar of *M. westoni* as given by Osborn.	Measurements of M^1 (type) of *M. montanensis* as given by Osborn.
Transverse diameter.	13·0	12 +	14 0
Antero-posterior diameter.	10·2	9·5	
Height of protocone.	4·5		10·5
Height of hypocone	4·5	4–	
Height of ectoloph.	6·2	5 +	

Mr. Gidley has expressed the opinion that, the tooth collected in 1904, approaches more closely to *M. montanensis* than to *M. westoni*, and would be inclined to refer it to the former species with some degree of doubt. In comparing it with *M. montanensis* he has noted the somewhat less elevated inner cones and the presence of an internal cingulum, regarded by him as differences of perhaps not more than varietal value, which may be explained by calling the tooth a premolar instead of a molar.

Judging from the characters of the teeth and their size, it is evident that the two species *M. westoni* and *M. montanensis* approach each other closely. The type of *M. westoni* is not as well preserved (nor as accurately figured in the original description) as is desirable, and the absence of the ectoloph and the anterior margin, including the front slope of the protoloph, precludes the taking of exact measurements. That the tooth of 1904 (figures 10-13) comes from the same locality as the type of *M. westoni*, and that it has a particularly well defined internal cingulum, are facts worthy of every consideration in determining its specific affinity.

MESOHIPPUS PRÆCOCIDENS, Lambe.

Plate III, fig. 14.

Mesohippus præcocidens, Lambe, 1905. Fossil horses of the Oligocene of the Cypress hills, Assiniboia; Trans. Royal Soc. of Canada, second series, vol. XI, section IV, p. 46, pl. II, fig. 2.

* 1903. New Vertebrates from the Montana territory by Earl Douglass; Annals of the Carnegie Museum, vol. II, p. 161, fig. 7.

** 1874. American Journal of Science, vol. VII, p. 251.

*** 1904. Op. cit.

DEPARTMENT OF MINES

GEOLOGICAL SURVEY

CANADA

Ottawa,..*190*....

It is requested that publications received from this Department be acknowledged by returning the attached form, duly signed and dated.

Failure to acknowledge the receipt of publications will be looked upon as an indication that they are not desired.

Exchanges, for the library of the Department are respectfully solicited,

The Librarian,
Geological Survey,
Ottawa,
Canada.

Left upper molar (imperfect). Type.

Measurement in mm :—

Height of protocone......4·7.

The left upper molar, on which this species is founded, lacks the ectoloph and the posterior border with the hinder slope of the hypocone, but is otherwise well preserved.

This tooth is about the size, or possibly smaller than *M. westoni*, but is more progressive in every way. There is an entire absence of an internal cingulum, the cross crests are better developed, and relatively higher, with steeper slopes. The protoconule is relatively larger, and the metaconule, although defined, scarcely breaks the continuity of the metaloph, which unites in a decided manner with the ectoloph. The protoconule is distinctly defined in the protoloph, and connects closely with the forward slope of the paracone. The hypocone has about the same height as the protocone. The anterior cingulum is strong. Mr. Gidley has informed the writer that he "would expect to see the hypostyle well developed, were that portion of the tooth present."

MESOHIPPUS PROPINQUUS, Lambe.

Plate III, figs. 15 and 16.

Mesohippus propinquus, Lambe, 1905. Fossil horses of the Oligocene of the Cypress hills, Assiniboia; Trans. Royal Soc. of Canada, second series, vol. XI, section IV, p. 47, pl. II, figs. 3 and 4.

2nd right upper premolar, worn (figure 16).
2nd left upper molar, unworn, (figure 15). Type.
2nd right upper molar, unworn.

The above teeth have been regarded by the author as characterizing a species of *Mesohippus* distinct from *M. bairdi*, Leidy, although closely allied to it and most resembling it.

They are of nearly the same size as those of *M. bairdi*, if anything slightly larger, and on the whole more primitive. Their general proportions are somewhat different.

Measurements in mm.

p^2 *a.p.*......13 *by tr.*......13·5.
m^2 *left a.p.*......12 *by tr.*......15·5, *height of protocone*......5.
height of protocone......5·7, *height of ectoloph*....8.
m^2 *right. a.p.*....12·2 *by tr.*....15.

In the unworn tooth, figure 15, (left upper m^2), the ectoloph is well elevated above the cross crests, in which the protocone and hypocone are conspicuously higher than the conules. The hypocone exceeds the protocone in height. The protoconule is well defined and distinctly breaks the continuity of the protoloph. The metaloph is fairly continuous and shows a disposition to unite with the ectoloph, which, however, it does not reach. The hypostyle is connected at its inner end with the posterior cingulum and outwardly abuts against the ectoloph; it is of fair size. In the ectoloph the mesostyle is conspicuous, the parastyle is flattened and connects with the protoloph, and the ribs are faintly shown. There is no trace of an internal cingulum.

Mr. Gidley has drawn the writer's attention to the interesting fact that the protocone in these teeth "is peculiar in having the slope of its anterior face about equal to that of its posterior face, while in *M. bairdi*, and all the middle and upper Oligocene horses, the anterior face of the protocone is always much more abrupt than the posterior one."

A right upper molar, presumably the third, arbitrarily associated with the foregoing, is considerably larger than the corresponding tooth of *M. bairdi*. A flatness of the ectoloph is principally noticeable, as well as the smallness of the hypocone, otherwise its characters are very similar to those of the left upper second molar already mentioned.

Mesohippus brachystylus, Osborn.

Plate III, fig. 17.

Mesohippus brachystylus, Osborn, 1904. New Oligocene horses; Bulletin Amer. Mus. Nat. Hist., vol. XX, p. 175, fig. 6.

Mesohippus brachystylus, Lambe, 1905. Fossil horses of the Oligocene of the Cypress hills, Assiniboia; Trans. Royal Soc. of Canada, second series, vol. XI, section IV, p. 48, pl. II, fig. 5.

4th *left upper premolar*, worn.

Measurement in mm.

p^4 *a. p.*.....12·5.

A fourth left upper premolar is referable to this species. The internal cingulum is slightly more accentuated than in the corresponding tooth of the type, but the general proportions and the size seem to be the same. In the Cypress Hills specimen the greater part of the ectoloph is unfortunately missing, but enough remains of its anterior end to show that the parastyle was rounded and of a relatively large size. There are certain slight differences of detail to be noticed but nothing apparently of importance.

The type of *M. brachystylus* is from the Upper Oligocene, Leptauchenia beds of the Cheyenne river, South Dakota, U.S.A.

Mesohippus stenolophus, Lambe.

Plate III, figs. 18, 19 and 20.

Mesohippus stenolophus, Lambe, 1905. Fossil horses of the Oligocene of the Cypress hills, Assiniboia; Trans. Royal Soc. of Canada, second series, vol. XI, section IV, p. 48, pl. II, figs. 6, 6*a* and 6*b*.

1*st left upper molar, unworn.*
3*rd right upper molar, unworn.* (*figures* 18, 19 and 20). Type.

Measurements in mm.

m^1 *a. p.*......14.
m^3 *a. p.* .....12·5 *by tr.*....15.

This species of *Mesohippus* is larger than *M. brachystylus*, but resembles it in some particulars of its dentition. The differences are: (1) The greater relative size of m^3, with a more pronounced obliquity of the cross crests in these teeth, (2) the greater length of the metaloph, which in m^3 is connected with the ectoloph, and (3) the intimate connexion of the hypostyle with both the posterior cingulum and the metastyle. The resemblances are (1) somewhat similar general proportions, with about the same degree of development of the protoconule and a like suppression of the metaconule, (2) the parastyle and internal cingulum similarly developed.

A special character of *M. stenolophus*, seen in m^3, is the oblique crossing of the parastyle by the external cingulum, which rises rapidly from without and appears very distinct on the upper anterior surface of the style (figures 19 and 20). The cross crests are narrow in proportion to their height, a feature suggested in the name that has been given to the species.

Mesohippus planidens, Lambe.

Plate III, fig. 21.

Mesohippus planidens, Lambe, 1905. Fossil horses of the Oligocene of the Cypress hills, Assiniboia; Trans. Royal Soc. of Canada, second series, vol. XI, section IV, p. 49, pl. II, fig. 7.

1st and 2nd left upper molars, worn. Type.

Measurements in mm.

m^1 m^2..... 31

m^1 *a. p.*......15 *by tr.*......17·8

These teeth indicate a species of about the size of *M. intermedius*, Osborn, from the Upper Oligocene, Protoceras beds of South Dakota, but smaller than *M. validus*, Osborn, from the same horizon and state. They differ from those of *M. intermedius* in the greater obliquity of the protoloph and metaloph, in which respect they resemble those of *M. obliquidens*, Osborn. The teeth are brachyodont, and are devoid of an internal cingulum. Externally, the ectoloph is noticeably flat, with only a slight development of the parastyle and mesostyle, the ribs are absent or but feebly indicated, and the metastyle is particularly inconspicuous. The hypostyle is of fair size, curved and attached at either end to the posterior cingulum. The cross crests are oblique to the ectoloph, well elevated, and moderately continuous, the metaloph more so than the protoloph. The protoconule slightly interrupts the protoloph, and unites with the parastyle. The metaconule scarcely breaks the continuity of the metaloph, which is sharply separated from the ectoloph and develops a rudimentary crochet. The protocone and hypocone are not so elevated as the ectoloph.

The specific name has reference to the flattened condition of the ectoloph.

Mesohippus assiniboiensis, Lambe.

Plate III, figs. 22, 23 and 24.

Mesohippus assiniboiensis, Lambe, 1905. Fossil horses of the Oligocene of the Cypress hills, Assiniboia; Trans. Royal Soc. of Canada, second series, vol. XI, section IV, p. 50, pl. II, figs. 8, 8*a* and 8*b*.

2nd right upper premolar, unworn. Type.

Measurements in mm.

p^2 *a. p.* .....18·5 *by tr.*....17, *height of tritocone*....10·5.

height of tetartocone....8.

This species is larger than *M. intermedius*, Osborn and Wortman, and apparently than *M. validus*, Osborn, from the Leptauchenia beds of S. Dakota. It resembles *M. brachystylus*, Osborn, from the Leptauchenia beds of S. Dakota, in the great development of the parastyle, which is, however, more distinctly separated in the Cypress Hills species.

In the above tooth (p^2) the antero-posterior diameter is greatly increased by the separation and large size of the parastyle. The cross crests are short, steep-sided and set almost at right angles to the ectoloph. The two inner cusps (deuterocone and tetartocone) are strongly and about equally developed. The protoconule* (anterior intermediate cusp) is very much smaller than the metaconule (posterior intermediate cusp), and passes posterior to, and beyond the inner end of, an inwardly directed spur from the protocone (antero-external cusp of the premolar, adopting Scott's nomenclature). The ectoloph has a distinct mesostyle, a broadly rounded and well detached parastyle, and strong ribs, of which the anterior one is particularly rotund. The hypostyle tends to separate from the posterior cingulum, to which it remains connected by a stout bar. The cingulum is robust, high and sharp edged behind, low and forming a narrow shelf abutting against the base of the parastyle in front, and is entirely absent within. The external cusps (protocone and tritocone) rise considerably higher than the internal ones (deuterocone and tetartocone).

This species, known only from the second premolar, in which the size of the parastyle would be expected to be accentuated, appears to approach most nearly in tooth development to the much smaller *M. brachystylus.* It exceeds *M. intermedius* and ? *M. validus* in size, but apparently, more closely resembles the latter. It is distinguished from the last two species by (1) the greater development of the protocone and deuterocone in this species, (2) the slight development of the protoconule, (3) the more complete separation of the parastyle, and (4) the intermediate height of the ectoloph.

The foregoing species of *Mesohippus* are related to, or resemble, previously described species of the genus from Montana and Dakota as follows:—

M. westoni, (Cope.)	More primitive than *M. latidens*, Douglass, and *M. montanensis*, Osborn, from the Lower Oligocene, Titanotherium beds.
M. præcocidens, Lambe.	Nearly related to and more advanced than *M. westoni* (and ? *M. montanensis* of the Titanotherium beds).
M. propinquus, Lambe.	Nearly related to and more primitive than *M. bairdi*, Leidy, of the Middle Oligocene, Oreodon beds.
M. brachystylus, Osborn.	The type of the species is from the Upper Oligocene, Leptauchenia beds.
M. stenolophus, Lambe.	Approaches closely *M. brachystylus* of the Leptauchenia beds.
M. planidens, Lambe.	Approaches in size *M. intermedius*, Osborn and Wortman, from the Upper Oligocene, Protoceras beds.
M. assiniboiensis, Lambe.	Some resemblance to, but larger than *M. validus*, Osborn, of the Protoceras beds.

It would seem probable then, that the species from the Cypress hills, in their relative degrees of progressiveness, are to be assigned to the horizons of the Oligocene in the following order:—

M. westoni, *M. præcocidens*	Lower Oligocene, Titanotherium beds.
M. propinquus	Middle Oligocene, Oreodon beds.
M. brachystylus *M. stenolophus*	Upper Oligocene, Leptauchenia beds.
M. planidens *M. assiniboiensis*	Upper Oligocene, Protoceras beds.

* It has been pointed out by Scott (The Evolution of the Premolar Teeth in the Mammals, Proc. Acad. Nat. Sci. Philadel. vol. XLIV, 1892) that the anterior and posterior intermediate conules of the premolar tooth are not homologous with the proto- and metaconules of the molar although they correspond in position.

HYRACODON NEBRASCENSIS, Leidy.

Aceratherium pumilum, Cope, in part, 1885. The White River beds of Swift-current river, North West Territory ; American Naturalist, vol. XIX, p. 163, name only.

Aceratherium pumilum, Cope, 1885. Geol. and Nat. Hist. Survey of Canada, vol. I, new series, part C, appendix I, p. 83, specimen II; and 1891, this volume, part I, p. 19, specimen II, pl. IV, fig. 4.

Hyracodon nebrascense, Osborn, 1898. The Extinct Rhinoceroses. Memoirs Amer. Mus. Nat. Hist., vol. I, pt. III, p. 138, fig. 28.

The principal specimen from the Cypress hills, representing this species, is the portion of mandible, holding teeth, described by Cope under the name *Cœnopus pumilus*, (specimen 2). This specimen, as pointed out by Osborn in 1898, is part of the right ramus of a young individual of *H. nebrascense*. A tooth, belonging to the collection 1904, is referred to this species; it is from the right side of the lower jaw, and is apparently a deciduous third premolar.

HYRACODON PRISCIDENS, Lambe.

Plate IV, figs. 1, 2, 3 and 4.

Hyracodon sp., Lambe, 1905. Geol. Survey of Canada, Summary Report for 1904, p. 368.

Hyracodon priscidens, Lambe, 1905. A new species of *Hyracodon* (*H. priscidens*) from the Oligocene of the Cypress hills, Assiniboia; Trans. Royal Soc. of Canada, second series, section IV, vol. XI, p. 37, pl. I, figs. 1, 1*a*.

Another species of *Hyracodon* is represented, in the collection of 1904 from the Oligocene deposits at Bone coulée, Cypress hills, by an upper jaw with teeth, giving the complete premolar-molar series. Three teeth are missing, viz., the fourth premolar from the left side, and the second and third premolars from the right. As the form of the tooth in each case is seen in the corresponding one of the opposite side, the details of structure of all the cheek teeth are presented. The ectoloph of the right third premolar remains. The teeth are in an excellent state of preservation and, as they are only slightly worn, evidently belonged to a young animal. The last molar on either side has not protruded from the jaw to its fullest extent. Both jugals are preserved, and, on the right side, part of the squamosal also.

The specimen to which the following remarks apply consists for the most part of the two maxillary bones holding teeth. These bones are imperfect in their lateral upward extension. The right maxilla is broken off slightly in advance of the first premolar, but, on the left side, the full extent of the diastema, separating the first premolar from the canine, is preserved. The lower margin of the orbital opening on either side is intact.

This specimen (type) indicates an animal of about the size of *Hyracodon nebrascensis*, Leidy, from the Oligocene of Nebraska, South Dakota and Colorado, from which, however, judging from its tooth structure, it differed specifically. The species has been described under the above name.

Hyracodon priscidens, as compared with *H. nebrascensis*, exhibits the following characteristics :—(1) The teeth are shorter or more brachyodont, (2) in the premolars the protoloph is continued in a curve round the inner end of the metaloph, the tetartocone being confluent with the deuterocone and arising from the protoloph, (3) in the last molar, m^3, the ectoloph is relatively much shorter, with a concomitant greater development of the metaloph, (4) the exterior cingulum is developed only on the posterior half of the base of the ectoloph in the seven teeth, and the internal cingulum is absent in p^1, (5) the parastyle in the premolars is only slightly developed, (6) the skull is apparently flatter and relatively more elongate, the lower margin of the orbit being less distant from the alveolar border, and the jugal less curved upward in the posterior halt of its length, (7) the diastema in advance of p^1 is proportionately longer and its margin is not so arched.

For this species of *Hyracodon* the name *priscidens* has been proposed, indicative of the less advanced stage of its dentition as compared with *H. nebrascensis.* In the form of its premolars it is decidedly primitive, and implies a position in a direct line of descent from *Hyrachyus.* A progressive character is seen in the squareness of the premolars which in *Hyrachyus* are triangular; also in these teeth the metaloph is much advanced in comparison with the Eocene genus.

In *H. priscidens*, as in the type species, m^2 is much the largest tooth, and m^1 is larger than p^4. The molars occupy about the same space antero-posteriorly as the premolars.

In the premolars there is a progression toward the molar pattern, but the advance has been slow. The anterior premolars are more progressive than the posterior ones in some respects. This is shown in the tendency to the separation of the tetartocone from the deuterocone seen in passing from p^4 forward. In p^4 the tetartocone and the deuterocone are very closely united, but in p^2, although still connected to the protoloph, the tetartocone has moved farther toward the posterior border of the crown, lengthening the anterior loph, and also effecting a junction with the metaloph.

In p^4 the cross lophs are unequal in length, the protoloph, in which the tetartocone is very intimately united with the deuterocone, not passing beyond a point in line with the inner end of the metaloph, which is short and curves slightly backward. In p^3 the protoloph is increased in length by the shifting backward of the tetartocone, with a tendency to separate from the deuterocone. The two lophs remain distinct, the anterior one passing slightly beyond the inner end of the metaloph, which in this tooth is developed to about the same extent as that of p^4, with a like backward obliquity. In p^2 the protoloph is still further increased in length, and curves round the inner margin of the crown considerably past the metaloph toward the posterior border of the tooth. The metaloph curves slightly forward and unites with the protoloph at a point some distance in advance of the latter's posterior termination. The increased length of the protoloph is due to the further recession of the tetartocone from the deuterocone, although the union of the two remains complete. In p^1 the protoloph is separate from the metaloph, a narrow but distinct sinus dividing them, and the tetartocone arises from the metaloph which in its inner half presents a concave surface forward. A variation is noticed in the right first premolar of the Cypress Hills specimen. In this tooth the sinus, seen in the left first premolar, in advance of the metaloph, does not occur, in which case the tetartocone would still be said to arise from the protoloph which, commencing at the ectoloph, behind the parastyle, forms a high continuous wall curving round the inner border of the tooth for some distance past its union with the metaloph, giving to the protoloph a length proportionately still greater than the corresponding loph of p^2. The left first premolar, above described, resembles the corresponding tooth of *H. nebrascensis* as figured by Leidy in plate XIV, figure 5, accompanying his description of the type species in "The Ancient Fauna of Nebraska," 1852, (Smithsonian Contributions to Knowledge). The other premolars in this figure denote a stage of evolution much in advance of the corresponding teeth of *H. priscidens.*

In the premolars of *H. priscidens* the deuterocone arises from the protoloph, as in p^3 and p^4 of *Hyrachyus agrarius*, Leidy, of the Bridger Eocene of Wyoming and Utah; also, in the second, third and fourth premolars, the general outline of the tooth is quadrangular instead of triangular as in *Hyrachyus*. The transverse diameter of p^4 is relatively greater than that of either p^3 or p^2. The second, third and fourth premolars are provided with a well defined cingulum that is continuous round the entire base of the crown, except at the base of the tritocone; at the base of the parastyle the cingulum is feebly shown, with increasing faintness in passing from p^4 to p^2. In the first premolar the exterior cingulum is developed only in the posterior half of the ectoloph, the posterior cingulum is strong, the anterior cingulum extends but a short distance from the parastyle, and there is no internal cingulum.

In the molars the cross lophs are nearly equal in length, the protoloph being slightly the longer, the hypocone is strongly developed and of the size of the protocone, from which it is separated by a deep anterior valley (medisinus). A crista, strongest in m^1, is developed from the ectoloph, and an antecrochet, of fair size in m^1, smaller in m^2 and incipient in m^3, is given off from the protoloph. In p^4, in addition to a small crista, and an indication of an antecrochet in the form of a decided tubercle, there is a delicate crochet* which is of interest as a decidedly progressive character. In the molors there is no internal cingulum, but posteriorly, anteriorly, and externally the cingulum is as in the premolars, except that externally it is scarcely more than suggested at the base of the parastyle. As already mentioned, the ectoloph in m^3 is short as compared witb that of m^2 and m^1, principally on account of the reduction in size of the metacone, which does not extend, as in the other molars, far posterior to its junction with the metaloph, but is curtailed at this point, in consequence of which there is only a slight indication of the formation of a posterior valley (postsinus) that in *H. nebrascensis* has reached a more advanced stage.

The order of premolar transformation in *H. priscidens* is apparently an exception to the usual metamorphosis of the Hyracodont premolars, which, as stated by Osborn in his memoir on " The Extinct Rhinoceroses" 1898, p. 90, is presented in three successive stages of evolution toward the molar pattern in the second, third and fourth premolars, the last premolar (p^4) being the most advanced.

In *H. priscidens* the fourth premolar is the least advanced, as regards the relation of the lophs to each other, although in other respects, viz., in the presence of secondary crest folds ("crista," "antecrochet" and "crochet"), a decided advance has been made, and it may be considered in this regard as more progressive than p^1, p^2 and p^3.

---

* Professor H. F. Osborn in his memoir on "The Extinct Rhinoceroses" (Memoirs of the Amer. Mus. of Nat. Hist., vol. I, part III, p. 89, 1898), has mentioned that the "crochet" is "peculiar to the true Rhinoceros molars" and is "only feebly developed, if at all, in the Amynodonts and Hyracodonts."

Measurements.

	H. priscidens. MM.	*H. planiceps*** MM.	*H. nebrascensis*** MM.
Upper molar series, length	62	103	70
Upper premolar series, length	62		
M^1 width, (tr.)	23·2	35	26
M^2 "	24·5	36	28
M^3 "	24	37	26
M^1 length (a.p.)	22		
M^2 "	23	35	27
M^3 "	19·5	40	
P^1 width (tr)	13·5		
P^2 "	20		
P^3 "	21·7		
P^4 "	23		
P^1 length (a.p.)	12·3		
P^2 "	16		
P^3 "	16·8		
P^4 "	17·3		

The anterior end of the mandible of a Hyracodon, obtained in 1904 from the Bone Coulée beds, is of special interest; it is provisionally assigned to this species.

The specimen (plate IV, figures 3 and 4) consists of nearly half the left ramus with that part of the right ramus anterior to the second premolar. Premolars 2, 3 and 4 are preserved, as well as the roots of the canines, and of the three pairs of incisors. The alveolus of the second premolar is partly seen on the right side.

A striking feature is the long diastema, between the canine and the second premolar, nearly equal to that of *Hyrachyus* (*H. agrarius*) in proportionate as well as actual length, and about twice as long as that of *Hyracodon nebrascensis*, Leidy. A basal cingulum is continuous round the entire crown of the premolars, except for a short distance internally, in the second and fourth teeth, posterior to their mid-length.

Measurements.

	MM.
Length of premolar series	44
Premolar 2:—	
Antero-posterior diameter	13
Transverse diameter	10
Premolar 3:—	
Antero-posterior diameter	15
Transverse diameter	12
Premolar 4:—	
Antero-posterior diameter	16·5
Transverse diameter	13·5
Depth of ramus in front of premolar 3	28·5
Maximum thickness of ramus beneath same tooth	15
Length of diastema behind canine	26
Breadth of mandible at mid-length of diastema	21
Length of symphysis	52
Thickness of mandible near posterior end of symphysis	14

** The measurements of the teeth of *H. planiceps* and *H. nebrascensis* are taken from the "Preliminary account of the Fossil Mammals from the White River formation, contained in the Museum of Comparative Zoology" by W. B., Scott and Henry F. Osborn. 1887, p. 171. Bull. Mus. Comp. Zool., Harvard College.

ACERATHERIUM MITE, Cope.

Plate IV, fig. 5.

Aceratherium mite, Cope, 1874. Annual Report U. S. Geol. and Geog. Survey Terrs. for 1873, p. 493.

Aceratherium mite, Cope, 1885. The White River beds of Swift-current river, North West Territory, American Naturalist, vol. XIX, p. 163.

Aceratherium mite, Cope, 1885. Geol. and Nat. Hist. Survey of Canada, vol. I, new series, part C, appendix I, p. 83.

Cœnopus mitis, Cope, 1891. The species from the Oligocene or Lower Miocene beds of the Cypress hills, Geol. Survey of Canada, Contr. to Can. Palæont, vol. III (quarto), pt. I, p. 19, pl. IV, fig. 2.

Cœnopus pumilus, Cope, in part, 1891. Idem, p. 19, specimen No. 1, pl. IV, figs. 3, 3*a*.

Aceratherium mite, Osborn, 1898. The Extinct Rhinoceroses, Memoirs Amer. Mus. Nat. Hist., vol. I, pt. III, p. 136.

In his 1891 report Cope assigned certain remains of Aceratheres from the Cypress hills to this species. They consist of parts of two left mandibular rami, and are referred to as specimens Nos. 1 and 2. The first specimen is a section of a left ramus holding the roots of the last two molars, and extending back beneath the base of the coronoid; the fragment is 87 mm. long. The second is part of the anterior half of another left ramus, with premolars 3 and 4 preserved, the roots of premolar 2, and the inner end of the alveolus of a procumbent canine. A figure was given (pl. IV, fig. 2, pt. I of this volume) of this second specimen viewed from above.

A symphysis of a mandible, also from the Cypress hills, described and figured by Cope in 1891, under the name *Cœnopus pumilus*, in the same publication as the above, is regarded by Osborn (op. cit. 1898) as properly referable to *A. mite*. The second of the two specimens on which *C. pumilus* was founded (pt. I, this volume, pl. IV, fig. 4) has been shown by Professor Osborn (op. cit. 1898) to be part of the lower jaw of *Hyracodon nebrascensis*.

In the type ramus from Colorado, described by Cope in 1874, the space occupied by the first three lower premolars (2, 3 and 4) is 80 mm. as given in the original description. A similar measurement, taken from the "type lower jaw" (and therefore presumably from the same specimen), is stated by Osborn (op. cit. p. 139) to be 55 mm. In specimen 2 from the Cypress hills (*A. mite*) the three premolars together measure in length 58 mm, and in the symphysial specimen (*C. pumilus*) a like measurement gives 43 mm. In one only of the three Cypress Hills specimens referred to *A. mite*, are premolar crowns preserved, and in the type ramus the crowns of the three premolars are imperfect.

A very perfect lower jaw from the Protoceras beds of South Dakota is referred doubtfully by Osborn (op. cit. p. 139) to this species. The premolar series in this last specimen occupies a space of 47 mm.

An upper left third molar tooth, obtained by T. C. Weston at the Cypress Hills locality in 1884, is probably referable to this species. Its dimensions are :—antero-posterior diameter, 25 mm., transverse diameter 28 mm.

A much larger tooth, plate IV, fig. 6, an upper right posterior molar of the 1904 collection, compares favourably in size and general proportions with the third molar of *Leptaceratherium trigonodon*, Osb. and Wort. Its diameters measure, antero-posterior, 31 mm., transverse 37 mm.

ACERATHERIUM OCCIDENTALE (Leidy).

Plate IV, fig. 7.

Rhinoceros occidentalis, Leidy, 1851. Proc. Acad. Nat. Sci. Phila., vol. V. p. 276.

This species is recorded by Cope (this volume, pt. I) from the Oligocene of the Cypress hills. A number of lower jaw fragments, belonging both to the collection of 1904 and to the earlier collections, apparently represent species distinct from *A. mite* and *A. occidentale*, but they are too imperfect for determination.

An inferior left posterior molar (collection of 1904) evidently belongs to this species. In it the basal cingulum is developed in front and behind but not on the exterior and interior surfaces. Diameters—antero-posterior 32 mm., transverse 21 mm.

ACERATHERIUM EXIGUUM, Sp. nov.

Plate V, figs. 3, 4 and 5.

A mandibular symphysis, collected by the writer in Bone coulée, Cypress hills, in 1904, has entirely different proportions to the symphysis (*Cœnopus pumilus*, Cope) from the same locality, already referred to *A. mite*. This specimen consists of almost exactly the same parts of the jaw preserved in the symphysis of *C. pumilus*, viz., the anterior end of the left ramus, and a short length of the right ramus united with it so as to show the extent and form of the symphysis. No crowns of teeth are preserved, but in the left ramus the roots of premolars 2 and 3 remain. The alveoli for the canine and for one incisor in each ramus are preserved, as well as the alveolus for premolar 2 in the right ramus, and the anterior half of the alveolus for premolar 3 in the left.

Comparing it with the symphysial specimen of *C. pumilus*, the following differences are apparent:—a narrower and longer symphysis, having increased depth behind; a more rapid deepening of the ramus from in front backward, with a corresponding increase in transverse thickness; a greater space occupied by the first two premolars; and very much larger canines as indicated by their alveoli. The greater depth of the ramus beneath the first two premolars is very noticeable.

In this specimen, belonging to the 1904 collection, the diastema is of about the same length as that of *C. pumilus*. The alveoli for the canines are 8 mm. apart in front, and close together at a lower level are those for two incisors, one on each side of the median line. Premolar 2 was a tooth of fair size with two well separated roots.

A small species of Acerathere, slightly exceeding *A. mite* (*pumilum*) in size, is here represented, to which the name *exiguum* is given. The jaw is more robust than in *A. pumilum*, its main characteristics being the contracted and lengthened symphysis and the enlarged canines.

Measurements.

Aceratherium exiguum compared with *A. mite (pumilum).*

	A. exiguum. MM.	*A. mite.* MM.
Length of symphysis, approx	58	40
Depth in front	18	18
Depth behind	26	21
Distance apart of premolars 2	27	32
Space occupied by premolars 2 and 3	30	23
Antero-posterior diameter of premolar 2	12·5	9
Breadth of jaw transversely across alveoli for canines	42	33
Height of alveolus for canine	12	7
Width " " " "	16	10·5
Depth of ramus below posterior end of diastema	38	32
Depth " " " premolar 3	46	39

MEGACEROPS ANGUSTIGENIS (Cope).

Menodus angustigenis, Cope, 1885. Geol. and Nat. Hist. Survey of Canada, vol. I, new series, part C, appendix I, p. 81.

Haplacodon angustigenis, Cope, 1889. The Vertebrata of the Swift-current river, II, American Naturalist, vol. XXIII, p. 153.

Menodus angustigenis, Cope, 1891. The species from the Oligocene or Lower Miocene beds of the Cypress hills; Geol. Survey of Canada, Contr. to Can. Palæont., vol. III, (quarto), pt. I, p. 13, pl. V, figs. 1 and 2, pl. VI, figs. 1, 2, 2a, pl. VII, figs. 1, 1a, 1b, pl. VIII, figs. 1, 2, 3 and figures of leg and foot bones.

Titanotherium angustigenis, Osborn, 1896. The Cranial Evolution of Titanotherium, Bulletin Amer. Mus. Nat. Hist., vol. VIII. p. 184.

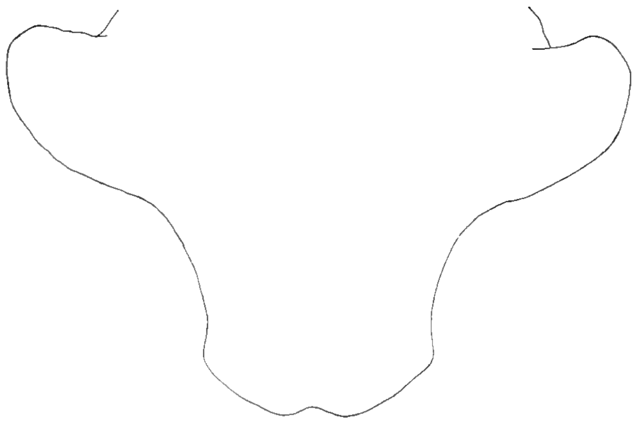
Megacerops angustigenis, Osborn, 1902. The Four Phyla of Oligocene Titanotheres, idem, vol. XVI, p. 99.

This species apparently approaches closest to *M. coloradensis*, Leidy, founded on coössified nasals with horns attached. In the Cypress Hills species the horns are much farther apart, with a flatter surface separating them. Also the nasals, besides being shorter, expand laterally in front instead of narrowing rapidly as in *M. coloradensis.*

Cope, in the American Naturalist, 1889, p. 153, made this species the type of *Haplacodon*, a generic term discarded by him in his later writings.

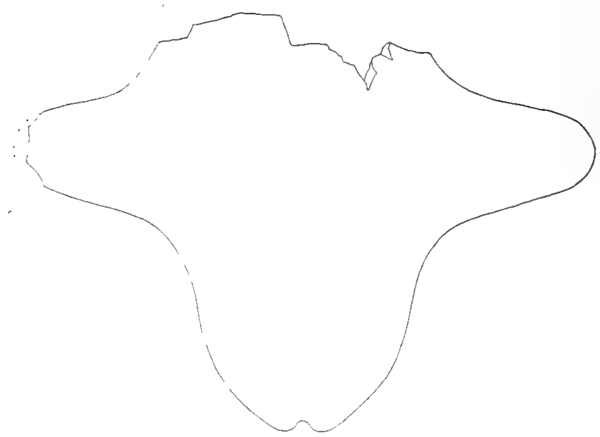
The species, of which the full description with figures is given in part I of this volume, is based on two maxillary bones from the same individual, a separate left ramus, and the symphysial part of another jaw. With these were associated, as probably belonging to the same species, an imperfect cranium, and certain separate leg and foot bones. One of the maxillary bones, the left ramus, and the nasal bones with horns and part of the frontal, were figured in plates V, VI, VII and VIII. In plate VI, figure I, a view from above was given of the coössified nasals shown in side and front view in plate VIII, and belonging to the cranium mentioned above. Through an error in the explanation of plate VI, these nasals (fig. 1) were ascribed to *Menodus ? americanus*, Leidy, instead of to *Menodus angustigenis.* This error has been repeated in Professsor H. F. Osborn's paper "The Cranial Evolution of Titanotherium," Bull. Amer. Mus. of Nat. Hist., 1896, foot note p. 175.

FIG. 1



$\times \frac{1}{4}$

FIG. 4



$\times \frac{1}{4}$

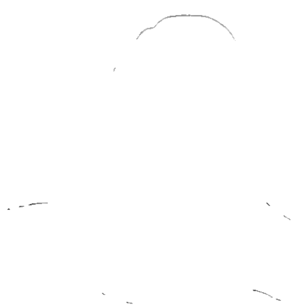
FIG. 2

$\times \frac{1}{4}$

FIG. 5

$\times \frac{1}{4}$

FIG. 3



$\times \frac{1}{4}$

FIG. 6

$\times \frac{1}{4}$

Coössified nasals and horns of *Megacerops angustigenis* as seen from above (fig. 1), from the front (fig. 2), and from the left side (fig. 3), for comparison with the nasals and horns of *Megacerops coloradensis* similarly viewed (figs. 4, 5 and 6 after Leidy). One-fourth the natural size. Figs. 1-3 after Cope.

MEGACEROPS SELWYNIANUS Cope).

Menodus selwynianus, Cope, 1889. Vertebrata of the Swift-current river, III, American Naturalist, vol. III, p. 628.

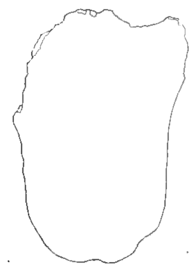
Menodus selwynianus, Cope, 1891. The species from the Oligocene or Lower Miocene beds of the Cypress hills; Geol. Survey of Canada, Contr. to Can. Palæont., vol. III (quarto), pt. I, p. 17, pl. V, figs 3, 3a and 3b.

Titanotherium selwynianus, Osborn, 1896. The Cranial Evolution of Titanotherium; Bulletin Amer. Mus. Nat. Hist., vol. VIII, p. 193.

Megacerops ? selwynianus, Osborn, 1902. The Four Phyla of Oligocene Titanotheres, idem, vol. XVI, p. 99.

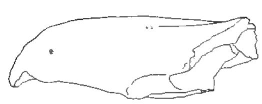
The coössified nasal bones of one individual constitute the type of this species. They are long and narrow, abruptly rounded in front and bent downward at the sides. The lower surface is deeply excavated in a longitudinal direction. Professor Cope's full description, with figures, will be found in part I of this volume.

FIG. 7



$\times \frac{1}{4}$

FIG. 8



$\times \frac{1}{4}$

Coössified nasals of *Megacerops selwynianus*, fig. 7 viewed from above, fig. 8 from the left side. One-fourth the natural size.

MEGACEROPS SYCERAS (Cope).

Menodus syceras, Cope, 1889. American Naturalist, vol. XXIII, p. 628.

" " Cope, 1891. The species from the Oligocene or Lower Miocene beds of the Cypress hills; Geol. Survey of Canada, Contr. to Can. Palæont., vol. III, (quarto), pt. I, p. 18, pl. VII, fig. 2, pl. VIII, figs. 4 and 5.

Titanotherium syceras, Osborn, 1896. The Cranial Evolution of Titanotherium; Bulletin Amer. Mus. Nat. Hist., vol. VIII, p. 193.

The type material of this species consists of the coössified nasal bones of three individuals, with a right horn, preserved in one of the specimens. Cope's description, with figures, appeared in part I of this volume

A separate left horn collected by T. C. Weston in 1884, closely resembles in shape the right horn with attached nasals, and is assigned to this species. The transverse subangulation of the surface between the horns, and the basal flattening of the horn on its antero-exterior surface, are well marked.

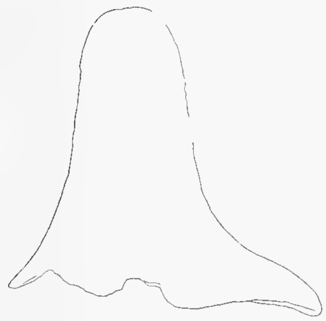
FIG. 9

× $\frac{1}{4}$

FIG. 10

× $\frac{1}{4}$

FIG. 11



× ¼

Nasals and horns of *Megacerops syceras*, fig. 9 viewed from above, fig. 10 from the front, fig. 11 from the right side. One-fourth the natural size; figs. 10 and 11, after Cope.

MEGACEROPS PRIMITIVUS, Sp. nov.

Plate VI, figs. 4 and 5.

In 1904 the writer was fortunate in securing, from the Oligocene deposits of the Cypress hills, a mandible of a Titanothere that is of considerable interest. It is the most perfect lower jaw obtained so far from this locality, and is the type of the above named species.

The specimen consists of both halves of the jaw. The left ramus is perfect, with the full number of teeth preserved; the right ramus lacks the fourth premolar, and the molars, with that part of the alveolar border that held these teeth.

The mandible is of fair size, and belonged to an adult individual. It presents the following dental formula : $I_{\bar{3}}$, $C_{\bar{1}}$, $P_{\bar{4}}$, $M_{\bar{4}}$. There is a diastema behind the canine, a character which, taken in conjunction with the presence of three incisors and four premolars, is indicative of a somewhat primitive species. The chief characters displayed are: incisors, in three pairs,with a space between the inner pair; canines, of small diameter, apparently short; a diastema between the canine and the first premolar; first premolar, small; third premolar, becoming molariform, fourth premolar, molariform; symphysis, long; symphysial surface between canines, narrow; jaw contracted at the diastema; external cingula, moderately developed; internal cingula, wanting; mental foramen, beneath the second premolar; coronoid process, short.

Megacerops avus (Marsh), from the Oligocene of South Dakota, has three pairs of inferior incisors but only three premolars below on each side, and there is a short diastema behind the lower canine. Its dimensions are greater than those of *M. primitivus*. These two species are apparently the only ones of the Oligocene Titanotheres in which there are three pairs of incisors in the lower jaw.

In the Cypress Hills specimen the crowns of the incisors are of a depressed spherical shape, with a tendency to come to a rounded central point above. The second incisor is the largest, and the first is slightly smaller than the third, which is the most upright. The first is more procumbent than the second. Between the inner pair is a very decided interval, leaving a space of 6·5 mm. between the crowns of the two teeth The crowns of the canines are broken off (that of the right tooth being restored in fig. 5 of plate VI), and the right first premolar is lost from its alveolus.

Compared with *Megacerops angustigenis* (Cope), (this volume part I, p. 13, plate V, fig. 2 and plate VI, figs. 2, 2*a*, *M. primitivus* differs in the following respects :— There are six incisors instead of four, and the breadth of the jaw between the canines, which are of smaller diameter, is relatively greater; the diastema between the canine and the first premolar is twice as long ; the symphysis is of greater length, reaching back to a point almost in line with the posterior edge of the fourth premolar (in *angustigenis* in line with the anterior root of the corresponding tooth); the exterior cingula are much less developed ; the coronoid process is shorter. In both species the premolars have reached about the same stage of development toward the molar pattern, and the molars have very much the same proportions. In *angustigenis* the internal cingula are partially developed. In *primitivus* the mandible is shorter, proportionately deeper, and not so thick in the neighbourhood of the alveolar border posteriorly.

Keeping in mind the differences due to sex in Titanotheres generally, and the apparent variability, both specific and individual, of certain dental characters, such as the degree of development of the cingula, the presence or absence of the first premolar, the size of the canines, and the number of the incisors, *M. primitivus* is apparently a well marked species, characterized principally, so far as known at present, by the breadth of the mandible anteriorly (as compared with *M. augustigenis*), and the presence of the full number of teeth, with a comparatively long diastema behind the canines.

This species, for which the name *primitivus* is used, is regarded as representing a rather early stage in the development of the Titanotheres. The general character of the dentition suggests the appropriateness of referring the species to the genus *Megacerops.* That the species is already represented by cranial fragments from the Cypress hills, found separately, is quite possible, and further material will probably prove the identity of some of the species, from this locality, described under different names.

Measurements of mandible of M. primitivus.

		MM.
Length of ramus		475
Depth of same at posterior end of fourth premolar		74
" " " " second molar		81
" " from tip of coronoid process to lower border		247
Maximum thickness of same beneath third molar		46
Length of symphysis		144
Distance apart of inside surface of base of canines*		31
Length of premolar series		103
" molar series		183
Diameter of canines at base	antero-posterior	18
	transverse	16
Diameter of second premolar	antero-posterior	26
	transverse	18
Diameter of third premolar	antero-posterior	32
	transverse	23
Diameter of fourth** premolar	antero-posterior	35
	transverse	27

* In the mandible of *M. angustigenis* (No. II) figured by Cope, op. cit., this measurement is about 18 mm., and in the symphysis of the jaw (No. I, also figured) a like measurement given, by the same authority, as 27 mm., should read 22 mm.
** First premolar in Cope's description of *M. angustigenis.*

Diameter of first molar	antero-posterior	48
	transverse	29
Diameter of second molar	antero-posterior	58
	transverse	33
Diameter of third molar	antero-posterior	82
	transverse	33

MEGACEROPS ASSINIBOIENSIS. Nom. prov.

Plate V, fig. 6, and plate VI, fig. 3.

A robust, short, left mandibular ramus, belonging to the 1904 collection, indicates a species distinct from *M. angustigenis* and *M. primitivus.* In this specimen the three molars and the fourth premolar are preserved, with the roots of the third premolar. The posterior end of the ramus is missing, as well as the anterior end in advance of the third premolar. A part of the right ramus next to the symphysis remains.

The jaw is much deeper, thicker and relatively shorter than in *angustigenis* and *primitivus,* and the teeth are much larger than in these species. It is narrow anteriorly, and the symphysis extends back to a point in line with the division between the fourth premolar and the first molar. The bone is massive and heavy throughout. The mental foramen is placed beneath the posterior root of the third premolar, farther back than in *M. primitivus.*

The cingula are very slightly developed. The external cingulum is present for a short distance only, on the anterior face of each of the four teeth, and in the third molar in advance of the heel. The only trace of an internal cingulum is to be seen in the third molar on the posterior slope of the heel.

The fourth premolar is fully molariform. The teeth are stout, and of about the size of the corresponding ones in *M. marshi,* Osborn, but the jaw is relatively shorter than in this species.

From the material available, the species, for which the provisional name *assiniboiensis* is proposed, cannot be definitely characterized.

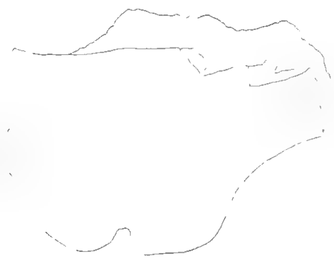
Measurements of ramus. Type.

		MM.
Depth of ramus at posterior end of fourth premolar		80
" " " third molar		156
Thickness of ramus above lower border beneath posterior end of first molar		55
Vertical thickness of symphysis a little in advance of its posterior termination		53
Vertical thickness of symphysis in line with front root of third premolar		31
Space occupied by fourth premolar and the molars		260
Diameter of fourth premolar	antero-posterior	41
	transverse	31
Diameter of first molar	antero-posterior	55
	transverse	36
Diameter of second molar	antero-posterior	71
	transverse	41
Diameter of third molar	antero-posterior	99
	transverse	43
Space occupied by roots of third premolar (antero-posterior)		34
Space between fourth premolars (twice the distance of fourth premolar from vertical plane through symphysis)		60

With the left ramus, above described, is arbitrarily associated, as probably referable to the same species, the abbreviated coössified nasal bones figured in plate VI, fig. 3, (collection of 1904). The specimen includes the bases of the horns which are seen to have been placed far forward and some distance apart. The horns apparently pointed laterally outward and upward, as in *M. angustigenis* and *M. coloradensis*, but were much farther forward than in either of these species. These nasals are entirely different from those of *M. selwynianus*, and *M. syceras*; they are short, thick, and broadly obtuse in front where they are but slightly bent downward. The front and lateral margins are thick and rounded, and the former is deeply notched in the middle. The lower surface is, as a whole, shallowly concave, a low longitudinal median ridge marking the line of union of the two bones. The concave surface between the horn bases is shallowly and evenly curved. The horns at the base appear to have been longitudinally oval in transverse section, but a definite statement in this regard cannot be made, as the horn bases are imperfect posteriorly. The specimen is, on the line of coössification of the two bones, 70 mm. back from the front margin, 44 mm. thick.

The shortness and general robustness of the nasals, with like characters noticeable in the proportions of the above ramus, makes it appear probable that these specimens represent a single species.

FIG. 12



× $\frac{1}{4}$

FIG. 13

× $\frac{1}{4}$

Coössified nasals of *Megacerops assiniboiensis*, fig. 12 superior aspect, fig. 13 left lateral aspect. One-fourth the natural size.

The two species, *angustigenis* and *syceras*, have the general form of horn found in the type of the genus *Megacerops*, viz., *M. coloradensis*, Leidy. In the other three species from the Cypress hills the horns are not known. In four of the five species, however, the nasals are known and show a wide variation in shape, all differing from those of the type.

A comparison of the nasals and horns of *M. coloradensis*, with those of Cypress Hills species, is set forth in the table given below :—

	Nasals.	*Horns.*
M. selwynianus.	Long and narrow, obtusely rounded in front, under surface deeply excavated, lateral margins produced downward.	Unknown ; probably short.
M. angustigenis.	Thick and rather long, expanded anteriorly, front margin very obtusely pointed, under surface moderately excavated.	Short, far apart, flattened at base on anterior outer surface, and cylindrical above, directed decidedly outward.
M. coloradensis.	Of moderate length, thin and bent downward anteriorly.	Of moderate length, cylindrical above, flattened on posterior outer surface at base, directed obliquely outward and upward.
M. syceras.	Rather short, evenly rounded in front, stout, shallowly excavated beneath.	Lengthening, close together and upright, more rounded in section near base than in *M. angustigenis.*
M. assiniboiensis.	Very short and thick, ending squarely in front, under surface only slightly concave.	Placed very far forward and rather far apart ; probably long.

A series seems to be represented here with *selwynianus* and *assiniboiensis* as extreme forms, and *coloradensis* occupying an intermediate position. Compared with the type species, *selwynianus* has long and narrow nasals, whilst those of *assiniboiensis* are broad and very short. In *angustigenis* the nasals are rather long and the horns short. In *syceras* the reverse is the case, the nasals are rather short and the horns are lengthened. *Coloradensis* has both nasals and horns of medium length. A lengthening of the horns appears to have accompanied a shortening of the nasals, and it is probable that *selwynianus* had short horns and *assiniboiensis* long ones. *Selwynianus*, *primitivus* and *assiniboiensis* are, for the present, referred to the genus *Megacerops.*

A portion of a right maxilla, holding the second, third and fourth premolars, and a separate left horn, are mentioned by Cope in the first part of this volume, under the name *Menodus americanus* (Leidy), dimensions and figures of the horn being given. Two separate horns, also belonging to the Cypress Hills collection of 1884, were referred by the same author in the same publication to *Menodus proutii* (O. N. and E.). These two species are not determinate, and the specimens referred by Cope to them do not present characters sufficient for their identification with described forms. The horns evidently represent two species distinct from *Megacerops angustigenis* and *M. syceras.* It is possible that, with the advent of new material, they may be found to be assignable to two of the other three species of *Megacerops* from the Cypress hills, viz., *M. selwynianus*, *M. assiniboiensis* and *M. primitivus*, of which the horns are not known.

CHALICOTHERIUM BILOBATUM, Cope.

Plate III, figs. 7, 8 and 9.

Chalicotherium bilobatum, Cope, 1889. The Vertebrata of the Swift-current river, II, American naturalist, vol. XXIII, p. 151.

Chalicotherium bilobatum, Cope, 1891. The species from the Oligocene or Lower Miocene of the Cypress hills; Geol. Survey of Canada, Contr. to Can. Palæont., vol. III, (quarto), pt. I, p. 8.

The type specimen of this species has been described and figured by Cope in part I of this volume. It consists of the coössified anterior ends of the mandibular rami, of which the left is preserved backward a short distance beyond the posterior end of the symphysis, and displays the alveoli of the second, third and fourth premolars, and of the first molar, with part of that of the second molar. In advance of the second premolar are the remains of alveoli for the canine, and three incisors. The bone is here slightly abraded, the alveoli appearing as distinct but shallow depressions. Of those for the incisors, the first or innermost is the largest and deepest, and the third is the least distinct. That for the canine is narrow transversely and twice as long as wide. A smooth surface to the bone passes outward between the second premolar and the canine, representing a narrow diastema. It is probable that the canine and incisor teeth were not present in the adult animal. There is no indication of a first premolar. The roots of the three premolars are partially preserved.

In his observations on the genus, following the specific description in the American Naturalist (p. 152), Professor Cope proposed the order Ancylopoda for the reception of the two genera *Chalicotherium* and *Ancylotherium*. These remarks, which do not appear in the Contributions to Canadian Palæontology, were as follows :—

" Although this is the first announcement of the discovery of the genus Chalicotherium in America, it is not the first discovery. Professor Scott showed me a series of superior molars from the Loup Fork formation of Kansas, from the Agassiz Museum, which he identified as belonging to this genus. The present species is of larger size than the Kansas form, and is apparently equal to the *C. goldfussi* of the Upper Miocene of Europe. The occurrence of this form in the Lower Miocene (White River), as well as the Upper Miocene (Loup Fork), of this country, is a noteworthy fact, but is parallel to its history in Europe. Described from the Upper Miocene by Kaup, it was afterwards found in the Middle Miocene (*C. grande*) by Lartet, and in the Upper Eocene (*C. modicum*) by Gaudry."

" The remarkable character of this genus, as discovered by Filhol, has been already mentioned in the *Naturalist*.* It has little relation to the family of Perissodactyla, to which it has given the name, and which it so resembles in molar dentition. It must form a family by itself, and the genera with which it has been associated must form a family to which the name Lambdotheriidae may be applied. The anterior ungual phalanges of Chalicotherium are of prehensile character, and not ungulate, but rather unguiculate. The phalanges resemble those of the Edentata, but the carpus and tarsus are, according to Filhol, diplarthrous in structure, while the Edentata are taxeopodous. We have in the Chalicotheriidae the antithesis of the Condylarthra. While the latter is ungulate, with an unguiculate carpus and tarsus, the former is unguiculate, with an ungulate (diplarthrous) carpus and tarsus.

* "Osborn on Chalicotherium, 1888, p. 728."

Thus the Chalicotheriidae must be referred to a distinct order of unguiculate Mammalia, which I propose to call the Ancylopoda, with the above definition. Two genera belong to the single family, the Chalicotheriidae, viz., Chalicotherium Kaup, and Ancylotherium Gaudry. In the former, the phalanges are distinct; in the latter, the first and second are coössified (Lydekker). Marsh has not yet shown how his genus Moropus differs from Ancylotherium. The species described by Marsh under this name are from the Loup Fork bed of Kansas."

A separate lower left premolar of a Chalicotheroid (collection of 1904) is probably referable to this species. The tooth (plate III, figs. 7, 8 and 9) is regarded as the third premolar, and has an antero-posterior diameter about equal to the space for the corresponding tooth, of which the roots are preserved, in the above (type) mandible. Professor W. B. Scott, of Princeton University, has kindly examined this specimen, and, although agreeing with the writer that it is the lower premolar of a Chalicotheroid, considers it unlikely "that the genus Chalicotherium should be found in the Titanotherium beds, for that genus is typical of the Middle and Upper Miocene of Europe." He is of the opinion that "much more probably the species of Cope will prove to be referable to one of the genera of the French Oligocene, such as Schizotherium."

The Cypress Hills species needs to be studied from better material before its true generic affinity can be determined.

RODENTIA.

SCIURUS ? SASKATCHEWENSIS, sp. nov.

Plate VIII, figs. 16, 17.

A species of rodent, most nearly allied apparently to *Sciurus*, is represented by a molar tooth. As enough characters are not supplied by the single tooth for the proper definition of the undescribed genus seemingly indicated, a provisional reference to *Sciurus* is made for the present. The species is described as new.

The tooth is apparently an upper left molar. The crown, which is borne on three roots, is subquadrangular in outline as seen from below, with the antero-posterior diameter slightly less than the transverse diameter. The maximum antero-posterior measurement (length) is near the outer side. Of the three roots, one is internal and is much the largest, the other two are external and subequal. The height of the enamelled surface of the crown is twice as great internally as externally.

The tooth is only slightly worn. The pattern consists of an external median enamel inflexion, extending inward nearly across the crown, and two fossettes, one anterior, the other posterior. The enamel inflexion has a depth greater than half the height of the external face of the crown but the two fossettes are not so deep. Of these latter, the posterior one is the larger and is complete, the anterior one is closed outwardly but communicates inwardly with the median inflexion. A narrow marginal ridge is continuous round the crown except where it is interrupted by the external enamel inflexion. This ridge is most prominent internally, anteriorly and posteriorly it sinks to a lower level, rising again to enclose the fossettes externally.

The inner face of the crown is not strongly tumid as in *Sciurus* typically, but approaches the marginal ridge as a moderately convex slope, in contrast to the other faces, which contract toward the base. The anterior cross crest is formed of two distinct cusps, recalling the subdivision of the crests described by Matthew in *Sciurus* (*Prosciurus*) *vetustus**. A minute style occurs in the marginal ridge external to the posterior fossette, breaking the continuity of the ridge to a slight extent. No style is present at the outlet of the median enamel inflexion.

From the above description it will be seen that the tooth pattern implies a near approach to *Sciurus*, but the radical differences apparent preclude its definite reference to that genus. The comparative prominence of the marginal ridge in front and behind is probably a primitive character.

Measurements of crown of type specimen:—Antero-posterior, 2·30 mm., transverse diameter, 2·70 mm.

Locality:—Bone coulée, Cypress hills, Saskatchewan.

Ischyromys typus, Leidy.

Plate VIII, fig. 18.

A slightly worn molar is referred to this species described, originally, in 1856, from the Oligocene of Nebraska. The Cypress Hills tooth is apparently a second lower molar from the right side, and was mentioned in the writer's preliminary list of species contained in the 1904 collection (Summary Report for 1905) as probably referable to this species. Its tooth pattern agrees fairly well with that of the corresponding tooth, figured by Leidy, in his "Extinct Mammalian Fauna of Dakota and Nebraska," 1869, pl. XXVI. In size the Cypress Hills tooth is slightly smaller. The antero-posterior diameter of the crown measures 3 mm. and is about equal to the transverse diameter.

Bone coulée, Cypress hills. Collection of 1904.

Cylindrodon fontis, Douglass.

Plate VIII, figs. 19, 20.

Cylindrodon fontis, Douglass, 1901. Fossil Mammalia of the White River beds of Montana; Trans. Amer. Philos. Soc, vol. XX, p. 15, pl. IX, figs. 9, 9*a*.

Cylindrodon fontis, Matthew, 1903. The Fauna of the Titanotherium beds at Pipestone Springs, Montana; Bulletin Amer. Mus. Nat. Hist., vol. XIX, article VI, p. 212, figs. 7 and 8 A, B, C, D.

Douglass established this genus and species on two parts of right mandibular rami, with well worn teeth, from the Pipestone beds (Oligocene), near Pipestone Springs, in south-western Montana. The variation of the tooth-pattern through wear has been worked out by Matthew from a series of lower jaws, and an upper jaw, from the same locality.

In the writer's provisional list of the fauna of the Oligocene beds of Cypress hills, as represented by the collection of 1904, part of a left mandibular ramus was referred to a species of *Steneofiber* distinct from *S. nebrascensis*, Leidy. This specimen is now seen to be properly referable to *Cylindrodon fontis*, Douglass.

* The Fauna of the Titanotherium beds at Pipestone Springs, Montana, 1903.

The Cypress Hills fragment of lower jaw is from the middle of the left ramus, and holds one tooth, the first molar. Anterior to the tooth is part of the alveolus for the fourth premolar, and behind it the alveolus for the second molar, and the remains of that for the posterior or third molar. The tooth is only moderately worn, and has reached the stage of wear shown by Matthew in his figure 8 B. Of the three fossettes in the worn surface of the crown, the anterior one is closed internally, a slight inflexion of the enamel remains to the posterior one, but there is still a very decided inflexion to the median one. When further worn the posterior fossette becomes complete internally, and later the median one also. The crown of this molar measures, antero-posteriorly 2·25 mm., transversely 2·20 mm. The full depth of the ramus is not preserved, but enough of the bone remains to show that the jaw was deep.

Matthew places the species with some doubt in the Castoridæ. It is interesting to find this small species included in the 1904 collection, thereby adding to the number of species common to the faunas of the Cypress Hills and Pipestone Springs Oligocene beds.

Locality :—Bone coulée, Cypress hills, Province of Saskatchewan.

Eutypomys parvus, Sp. nov.

Plate VI, figs. 1 and 2.

A single molar represents this species. In the Summary Report of the Geological Survey for the year 1904, the writer specially mentioned this tooth as being worthy of notice on account of the large number of isolated enamel loops or lakes present in the worn surface of the crown, and in a foot-note, added whilst the report was being printed, the opinion was expressed that it was probably referable to Matthew's then newly established genus *Eutypomys*.

The Cypress Hills tooth, thought to be the lower third molar of the left side of the jaw, closely resembles, in tooth pattern, the teeth of *E. thomsoni*, Matthew, the type species of the genus* from the Oligocene (Lower Oreodon beds of the White River formation, Cheyenne river) of South Dakota. It is considerably smaller than the lower teeth of the type, and indicates a proportionately smaller animal.

Seen from above the crown is subtriangular in outline, the transverse diameter in front being greater than behind; the antero-posterior diameter exceeds the maximum transverse diameter. A view of the worn surface of the crown is given in plate VI, figure 2, in which are shown the numerous isolated lakes characteristic of the genus. In all about twenty lakes are seen. The tooth is constricted behind its mid-length exteriorly, the crown being well rounded and tumid on each side of the constriction or valley, in which are three or four shallow infoldings of the enamel below the level of the worn surface. On the inside, at mid-length, the crown is slightly inflected above, but the decided constriction of the external surface is wanting. The tooth is two rooted, the anterior fang being much the stouter of the two. The anterior surface of the crown is flattened, and has the appearance of having been preceded by a tooth in front. Posteriorly, however, the surface is rounded, as if no tooth pressed against it from behind; these considerations, together with the somewhat triangular shape of the tooth, suggest its being the last of the series.

*Notice of two new genera of Mammals from the Oligocene of South Dakota; Bulletin Amer. Mus. Nat. Hist., vol. XXI, p. 21.

Measurements of type specimen.

	MM.
Total height of tooth posteriorly	28
Height of crown posteriorly	16
Antero-posterior diameter of crown	27
Anterior transverse diameter of crown	23
Posterior transverse diameter of crown	18

PALÆOLAGUS TURGIDUS, Cope.

A left mandibular ramus from the Cypress hills was referred by Cope, in 1891 (part I, this volume, p. 5, pl. XIV, figs. 9, 9*a*), to this species. The specimen lacks the upper part of the anterior lobe of P_3 and the upper end of the incisor. The posterior molar is missing, but its approximate size is given by its alveolus. The other lower teeth are perfect.

Comparing the specimen with the rami of this species figured by Cope, in his "Tertiary Vertebrata," 1884, pl. LXVII, it is seen that the space occupied by the molar-premolar series is slightly greater, but the depth of the jaw is the same, as is also the size of the diastema behind the incisor. The teeth appear to have the same relative size to each other, and the internal enamel inflexion, apparently, has a like development. Matthew has placed this specimen, described by Cope in 1891, in his species *P. brachyodon* (op. cit., 1903, p. 217) which is of the size of *P. turgidus*, but differs from it, as the name implies, by being more brachyodont. Other characters ascribed to *P. brachyodon* as distinguishing it from *P. turgidus* are —— P^2 smaller and more conical, m^3 apparently larger, the internal enamel inflexion less persistent. In lower jaw P_3 shorter, more conical, and the inflexion disappearing earlier than in *P. turgidus*. These distinguishing characters are not apparent, to the writer, in the Cypress Hills specimen, which is here left under Cope's name.

Measurements of Cypress Hills specimen

	MM.
Molar-premolar series	18·0
Third premolar :	
Antero-posterior diameter	3·4
Transverse "	2·4
Height above alveolar rim	5+
Posterior molar :	
Antero-posterior diameter	2·8
Transverse "	2
Length of diastema behind incisor	11·2
Depth of ramus beneath P_1	9·8

PALÆOLAGUS HAYDENI, Leidy.

Plate VIII, figs. 21–25.

Another species of *Palæolagus*, distinct from the preceding, is represented by teeth, from both jaws, included in the collection of 1904. These teeth agree in size with those of *P. haydeni*, the type species of the genus (Oligocene (White River) of Nebraska, South Dakota, &c.), established by Leidy in 1856; they are for the present referred to that species. On plate VIII, are figured three of these teeth, an upper premolar, an upper molar, and a lower molar, from which the following measurements are taken:—

Measurements.

	MM.
Upper left premolar, ? fourth premolar (plate VIII, figs. 22 and 23) :—	
Antero-posterior diameter of grinding surface	2·0
Transverse diameter of grinding surface	2·8
Upper right molar, ? first molar (plate VIII, fig. 21) :—	
Antero-posterior diameter of grinding surface	2·0
Transverse diameter of grinding surface	2·6
Lower right molar (plate VIII, figs. 24 and 25) :—	
Antero-posterior diameter of tooth above	2·3
Transverse diameter of anterior lobe above	2·2

It is likely that more than two species of *Palæolagus* are represented from the Cypress hills. Among the separate teeth, obtained in 1904, are a number of incisors of rodents, some of which are probably referable to *Palæolagus.*

CARNIVORA

Hyænodon cruentus, Leidy.

Plate VII, 1, 2 and 3.

Hyænodon cruentus, Leidy, 1853. Proc. Acad. Nat. Sci., Phila., vol. VI, p. 392.

" " Leidy, 1869. The extinct mammalian fauna of Dakota and Nebraska; Jour. Acad. Nat. Sci. Phila., second series, vol. VII, pp. 47 and 369, pl. V, figs. 10, 11.

The anterior half of a left mandibular ramus is referred to this species, and represents the second member of the Hyænodontidæ to be recorded from this locality, the first being *Hemipsalodon grandis* described by Cope.

This specimen shows the alveoli of the canine, of the four premolars, and of the first molar; the roots of these teeth, with the exception of those of the canine and first premolar, being preserved. The alveolus of the canine indicates that the tooth was of large size, directed well upward, and oval in transverse section, with its greatest diameter in an antero-posterior direction. The first premolar, as shown by its alveolus, was single rooted, and followed closely behind the canine. The roots of the first and second premolars passed downward obliquely backward, those of the third and fourth as obliquely forward. The first molar was of small size, its antero-posterior diameter being about equal to that of the second premolar.

Although the crowns of the teeth are missing in the Cypress Hills specimen, it is apparently properly referable to *H. cruentus*, Leidy, from the Oligocene of South Dakota and Colorado, judging from its size and general proportions, and the relative spaces occupied by the teeth, in comparison with the published figures of Leidy and Scott.

The anterior end of the specimen, inside the alveolus for the canine, is broken away, and no trace of the alveoli for the incisors is preserved. Following the plane of the symphysis forward, however, it is seen that there could have been little room for the incisors, which must have been crowded. At the symphysis a small piece of bone, belonging to the right ramus, remains attached to the specimen, and, along the line of junction, indicates a rather thorough coössification of the two rami. The hinder end of the symphysis is in line with the front root of the third premolar. Two mental foramina are present, the larger of the two beneath the anterior root of the third premolar, the other beneath a point slightly in advance of the second premolar.

Measurements.

		MM.
Length of specimen		89
Length of premolar series		54
Length of alveolar space of	1st premolar	4
	2nd "	11
	3rd "	15·5
	4th "	16
	1st molar	11
Antero-posterior diameter of alveolus of canine		10
Transverse diameter of same, approx		7
Space between alveoli of canine and 1st premolar		3
" " " 1st and 2nd premolar		3·5
Depth of ramus at point between 4th premolar and 1st molar		34
Depth of ramus at mid-height beneath same point		12
Thickness of ramus at posterior end of symphysis		16

Collector T. C. Weston. Headwaters of Swift-current creek (Bone coulée), Cypress hills, 1888.

A left lower tooth, found separately in 1904, plate VII, fig. 3, has the proportions of the second premolar of *Hyænodon*. The alveoli (containing roots) of the second premolar of the left ramus, mentioned above and referred to *H. cruentus*, indicate by their size that this separate tooth is probably referable to this species.

HYÆNODON CRUCIANS? Leidy.

Plate VII, figs. 4, 5 and 6.

Hyænodon crucians, Leidy, 1853. Proc. Acad. Nat. Sci. Phila., vol. VI, p. 393.

A second species of *Hyænodon* is represented by a superior left fourth premolar (collection of 1904). The tooth is not quite as large as the corresponding premolar of *H. crucians*, as described and figured by Leidy in 1869 in "The Extinct Mammalian Fauna of Dakota and Nebraska"*, but approaches closely to it in shape ; it is referred to this species provisionally.

In the Cypress Hills tooth the protocone is large and compressed, the tritocone (posterior cusp) is small and slightly trenchant, the deuterocone (interior cusp) is fairly developed on the inner side in line with the protocone. There is an inconspicuons protostyle (anterior basal cusp) and exteriorly, at the mid-length of the crown, the basal cingulum is feebly developed.

Measurements.

	MM.
Max. height of crown of tooth	8 2
" length " " "	10·16
" breadth " " "	7·8

The specimen represents a species of about the same size as *H. crucians*, Leidy, but possibly distinct.

* The extinct mammalian fauna of Dakota and Nebraska. Jour. Acad. Nat. Sci. Phila., second series, vol. VII, pp. 48 and 369, pl. II.

Hemipsalodon grandis, Cope.

Plate VII, figs. 7 and 8.

Hemipsalodon grandis, Cope, 1885. The White River beds of Swift-current river, North West Territory, American Naturalist, vol. XIX, p. 163; and Geol. and Nat. Hist. Survey of Canada, vol. I, new series, part C, 1885, appendix I, p. 80.

Hemipsalodon grandis, Cope, 1891. The species from the Oligocene or Lower Miocene beds of the Cypress hills; Geol. Survey of Canada, Contr. to Can. Palæont., vol. III (quarto), pt. I, p. 6, pl. II.

The material on which this genus and species were established consists of a right mandibular ramus, a complete and well preserved right femur, and a left femur, of slightly smaller size, from which the distal end is missing. Cope's full description, with figures, is given in part I of this volume.

Hemipsalodon is the representative, in North America, of the European Upper Eocene Pterodon. It differs from the latter in the form of the enlarged posterior lower true molar.

Among the characters of *H. grandis*, which is the largest of all known creodonts, are to be noticed the great depth of the mandible, the length of the symphysis, and the immense size of the canine, which so crowds the incisors that the second of these teeth is behind the other two. The symphysis reaches back to a point nearly below the middle of the fourth premolar.

Through an error, in printing probably, the length of the premolar series is given, in the description on p. 6, of part I, of this volume, as 108 mm. This measurement should read 87 mm.

In the 1904 collection from the typical locality is a large canine tooth, plate VII, figs. 7 and 8, that apparently belongs to this species. Its dimensions, at the point of greatest thickness, agree with those of the canine in the type specimen. In this separate tooth the upper part of the crown is broken off, but the whole of the root is preserved, giving a length to the specimen of 111 mm., with an estimated total length to the tooth, when perfect, of about 129 mm.

Cynodictis lippincottianus (Cope).

Plate VII, figs. 9–14.

There are in the collection of 1904 four teeth that apparently belong to this species, of which Cope was uncertain as to whether it was distinct from, or only a large variety of *C. gregarius* (Cope), one of the commonest of the White River (Oligocene) carnivores described from Colorado, Nebraska and South Dakota.

The teeth from the Cypress hills were obtained separately, and agree in size most closely with those described by Cope under the name *Galecynus lippincottianus* (see Cope's Tertiary Vertebrata, vol. III, book I, 1884, p. 919, pl. LXVII*a*). They are, a left lower third premolar, a left lower fourth premolar, and a right lower first molar of which the anterior cusp is missing. Another tooth, slightly damaged, from the left side, is apparently a lower fourth premolar.

DAPHÆNUS FELINUS, Scott.

Plate VII, figs. 15 and 16.

Daphœnus felinus, Scott, 1898. Notes on the Canidæ of the White River Oligocene; Trans. Amer. Philos. Soc., vol. XIX, p. 361.

The hinder part of a right maxilla, in which is preserved the sectorial tooth, is referred to this species with a certain amount of doubt. The specimen includes the alveoli of the third premolar and of the three molars.

In his "Oligocene Canidæ," Hatcher* has made known the complete dentition of this species, from excellent material from the Oreodon beds of Bad Lands creek, Sioux county, Nebraska. In comparing the dentition of the Cypress Hills specimen, so far as its incompleteness will admit, with that of the species as set forth by Hatcher in his description and figures (plates XIV and XVI) it is seen that there is a fair agreement in the size of the sectorial (fourth premolar), and the space occupied by the teeth from the third premolar to the second molar, both inclusive, is almost the same, giving about a corresponding size to the third premolar,and the first and second molar teeth. A difference is noted in the position of the alveolus of the third molar, which is placed farther outward in the Canadian specimen, being in line rather with the exterior borders of the first and second molars than with the inner margins of the same as shown by Hatcher. The alveolus of the third molar is very close to the hinder border of the second molar, and indicates a greater crowding of these teeth, with a probably smaller antero-posterior diameter to the second molar. There seems also to have been a greater backward obliquity to the outer border of the second molar. In the sectorial tooth of the Cypress Hills specimen the antero-internal cusp (deuterocone) is longer and narrower, and is directed more forward, so as to form with the base of the external cone a decided fork, into which the posterior border of the third premolar fitted closely. The deuterocone has a slightly convex upper surface (within the cingulum),on which is developed a distinct longitudinal median ridge. The antero-external cone (protocone) and the posterior cone (tritocone) apparently agree well with the corresponding parts of the sectorial of the Nebraska skull. A basal cingulum is present; it is moderately developed internally, and includes the anterior border of the deuterocone, but is rather weak externally.

Hatcher (op. cit., p. 67) has drawn attention to the difference in the position of the upper third molar relative to the two preceding molars in the genera *Amphicyon* and *Daphœnus*, His remarks appeared as follows:—"The chief generic distinctions between *Daphœnus*, Leidy, and *Amphicyon*, Lartet, in so far as they are at present known, are to be found in the relative size of the premolars, structure of canines, and position of the superior third tubercular molar. The canines of *Daphœnus* are without either anterior or posterior cutting edges, while these are present in *Amphicyon*. The premolars are reduced in size in *Amphicyon*, while those of *Daphœnus* show little or no reduction. In *Daphœnus* the superior third tubercular molar is pushed inward and aligned with the internal cones of the preceding molars, while in *Amphicyon* this tooth occupies a more external position."

In the Cypress Hills specimen (1) the canine is not preserved, so that a comparison cannot be made in this connexion, (2) the fourth premolar at least is not reduced in size (*Daphœnus*) and (3) the third molar is in line with the external cones of the preceding molar (*Amphicyon*).

* Memoirs of the Carnegie Museum, Pittsburgh, vol. I, No. 2, Sept., 1902.

From this it appears that the Canadian specimen combines characters that, according to Hatcher, belong to both of the above genera.

The Cypress Hills specimen represents an animal of about the size of *D. felinus*, and it is provisionally referred to that species, although there is not an exact agreement in the form of the sectorial, and although a difference is noticed in the alignment of the molars. The incompleteness of the specimen precludes a satisfactory comparison.

Locality:—eastern escarpment of the Cypress hills, nine miles due east of Bone coulée. Lawrence Lambe, 1904.

PROTEMNOCYON HARTSHORNIANUS (Cope).

Plate VII, figs. 17, 18, 19 and 20.

A left upper fourth premolar (sectorial), belonging to the collection of 1904, is referred to this species. The tooth, from which the inner anterior cusp (deuterocone) has been broken off, is well worn, and probably belonged to an old individual.

This species is known from rather meagre material from the Oligocene of Colorado and South Dakota. Cope has referred to his species *Amphicyon hartshornianus** certain fragments of jaws, holding teeth, that Leidy, in his memoir on "The Extinct Mammalian Fauna of Dakota and Nebraska," 1869, included in his description of *Amphicyon vetus* (p. 32. pl. I, figs. 3, 4 and 6). The superior sectorial, obtained in 1904 from the Cypress hills, agrees very closely in size and form (without considering the inner anterior cusp which is missing in our specimen) with the sectorial shown by Leidy in his figure 6.

A second upper sectorial, also from the left side, obtained from the Cypress Hills locality by Mr. T. C. Weston in 1884, may belong to this species. It is slightly smaller than the 1904 specimen but is otherwise very similar. The protocone is robust and has a broad anterior face; posteriorly it narrows to a sharp, steep edge directed obliquely inward. The tritocone is compressed laterally and forms a good cutting edge. The deuterocone is of fair size and is well detached from the base of the protocone. A distinct cingulum encircles the entire base of the crown. The posterior root is laterally compressed, its antero-posterior diameter proximally greatly exceeding the transverse one. The root supporting the deuterocone is likewise compressed, but to a less extent.

Measurements.

	MM.
Sectorial of 1884; plate VII, figs. 18, 19 and 20:	
Length from posterior end to antero-external base of protocone	12·5
Length from posterior end to antero-internal base of protocone	13·0
Breadth anteriorly at base of protocone	7·2
Height of protocone, including cingulum	8·5
Sectorial of 1904; plate VII, fig. 17:—	
External length	12·0
Internal length	13·6
Breadth anteriorly	7·2
Breadth anteriorly at base of protocone	6·3
Height of protocone, including cingulum	8·2

* 1884. The Vertebrata of the Tertiary Formations of the West. Report U. S. Geol. Survey Terrs., vol. III, p. 783.

According to Hatcher, *Daphænus hartshornianus* is properly referable to his genus *Protemnocyon*,* founded on excellent material from the Oligocene deposits of Hat Creek basin, Sioux county, Nebraska.

DINICTIS FELINA, Leidy.

Plate VII, figs. 21, 22, 23 and 24.

Dinictis felina, Leidy, 1856. Proc. Acad. Nat. Sci. Phila., vol. VIII, p. 91.

" " Leidy, 1869. The extinct mammalian fauna of Dakota and Nebraska; Jour. Acad. Nat. Sci. Phila., vol. VII, pp. 64 and 368, pl. V, figs. 1–4.

A right lower first molar, belonging to the 1904 collection, is referred to this species. The three figures of it in plate VII will give a fair idea of its proportions. The two large cusps, the principal one and the smaller anterior one, together form an admirable cutting edge. The posterior cusp or heel is well developed, trenchant and larger than the heel of the corresponding tooth in *Hoplophoneus*. A small postero-internal cusp is present, high on the posterior border of the principal cusp. There is also a very small anterior basal cusp or tubercle. The tooth has not been subjected to much wear, and its cutting edges are, throughout, slightly denticulated.

Another tooth, fig 24, an upper canine, probably also belongs to this species. It curves slightly backward and ends below in a moderately sharp point. In transverse section above it is narrowly elliptical. The posterior border is denticulated and sharper than the anterior one on which no denticles are seen. The surface of the specimen is weathered. Length (imperfect above), 28·5 mm.; max. antero-posterior diameter, 14 mm.; max. transverse diameter, 8 mm.

* Oligocene Canidæ. Memoirs of the Carnegie Museum, vol. I, 1902, p 104.

INDEX.

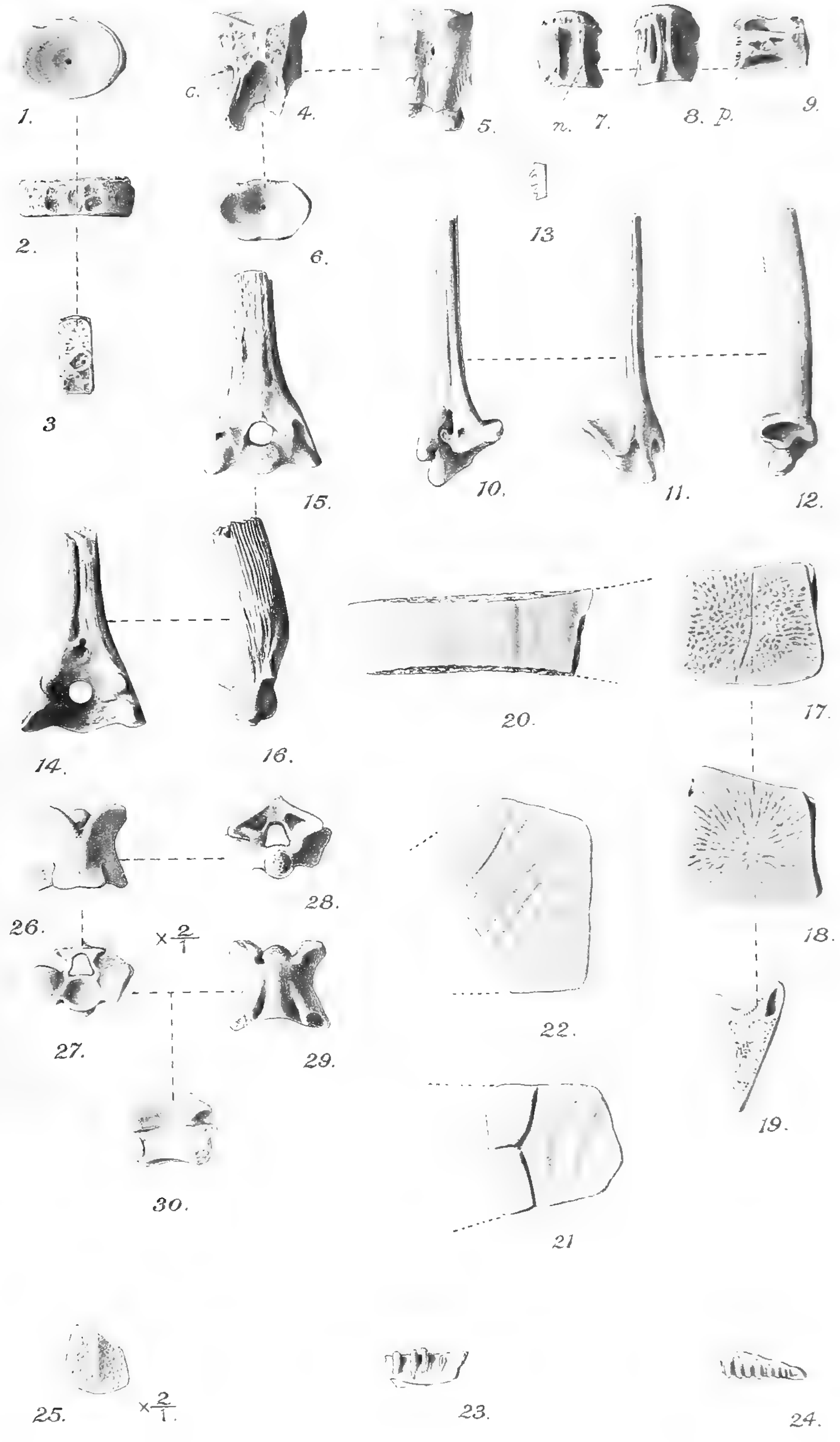
PLATE I.

PLATE I.*

Fig. 1. *Amia exilis*, Lambe; dorsal vertebral centrum, articular face. Type. Page 12.
Fig. 2. The same specimen from above.
Fig. 3. Lateral view of the same.
Fig. 4. *Amia exilis*, Lambe; basi-occipital, superior aspect.
Fig. 5. The same bone, viewed from below.
Fig. 6. The same, posterior view.
Fig. 7. *Lepidosteus longus*, Lambe; vertebral centrum, superior view. Type. Page 13.
Fig. 8. The same centrum, inferior view.
Fig. 9. The same, lateral view.
Fig. 10. *Rhineastes rhœas*, Cope; pectoral spine collected by Mr. T. C. Weston, inner view. Page 14.
Fig. 11. Same specimen, outer view.
Fig. 12. Same specimen, view from above.
Fig. 13. ? *Rhineastes rhœas*, Cope; fragment from distal end of spine
Fig. 14. *Rhineastes rhœas*, Cope; dorsal spine, anterior view.
Fig. 15. The same, posterior view.
Fig. 16. The same, lateral view.
Fig. 17. *Anosteira ornata*, Leidy; marginal plate from the right side of the carapace, seen from above. Page 17.
Fig. 18. The same plate viewed from below.
Fig. 19. End view of the same.
Fig. 20. *Testudo exornata*, Lambe; distal half of left fifth costal plate, upper surface. Type. Page 18.
Fig. 21. *Testudo exornata*, Lambe; proximal end of left sixth costal plate, upper surface.
Fig. 22. *Testudo exornata*, Lambe; proximal end of left first costal plate, upper surface.
Fig. 23. *Peltosaurus granulosus*, Cope; part of left dentary, interior view. Page 19.
Fig. 24. *Peltosaurus granulosus*, Cope; posterior half of right maxilla, interior view.
Fig. 25. ? *Peltosaurus granulosus*, Cope: dermal scute, upper surface; twice the natural size.
Fig. 26. *Ogmophis compactus*, Lambe; dorsal vertebra, superior aspect; twice the natural size. Type. Page 20.
Fig. 27. The same, anterior aspect; similarly enlarged.
Fig. 28. The same, posterior aspect; similarly enlarged.
Fig. 29. The same, from below; similarly enlarged.
Fig. 30. The same, right lateral view; similarly enlarged.

*In this and the following seven plates all the figures are of natural size unless otherwise stated.

PLATE I.



L.M. LAMBE, Delt.

PLATE II.

PLATE II.

Fig. 1. *Ancodus brachyrhynchus*, Osb. and Wort.; right upper third molar, viewed from below. Page 24.

Fig. 2. *Ancodus brachyrhynchus ?*, Osb. and Wort.; left upper third premolar, external view.

Fig. 3. The same tooth viewed from below.

Fig. 4. *Ancodus brachyrhynchus ?* Osb. and Wort.; right lower canine, viewed from within.

Fig. 5. The same tooth, viewed from without.

Fig. 6. *Ancodus brachyrhynchus ?* Osb. and Wort.; right lower third incisor, exterior view.

Fig. 7. The same tooth, interior view.

Fig. 8. *Ancodus brachyrhynchus ?* Osb. and Wort.; left lower first incisor; exterior view.

Fig. 9. The same, seen from within.

Fig. 10. *Elotherium coarctatum*, Cope; right upper first molar, viewed from below. Page 26.

Fig. 11. *Elotherium coarctatum*, Cope; right upper third molar, as viewed from below.

Fig. 12. *Elotherium coarctatum ?* Cope; right upper third premolar, outer aspect.

Fig. 13. Same tooth, seen from below.

Fig. 14. *Elotherium coarctatum ?* Cope; right upper fourth premolar, inner aspect.

Fig. 15. The same specimen, viewed from below

Fig. 16. *Agriochœrus antiquus ?* Leidy; left upper third molar, crown view from below. Page 28.

Fig. 17. *Agriochœrus antiquus ?* Leidy; left upper third molar, viewed from below.

Fig. 18. *Merycoidodon culbertsoni*, Leidy; left lower first premolar (caniniform), outer aspect. Page 29.

Fig. 19. The same as seen from within.

Fig. 20. *Merycoidodon culbertsoni*, Leidy; left upper canine, inner aspect.

Fig. 21. The same tooth, posterior aspect.

Fig. 22. Outline of transverse section of same at *a*.

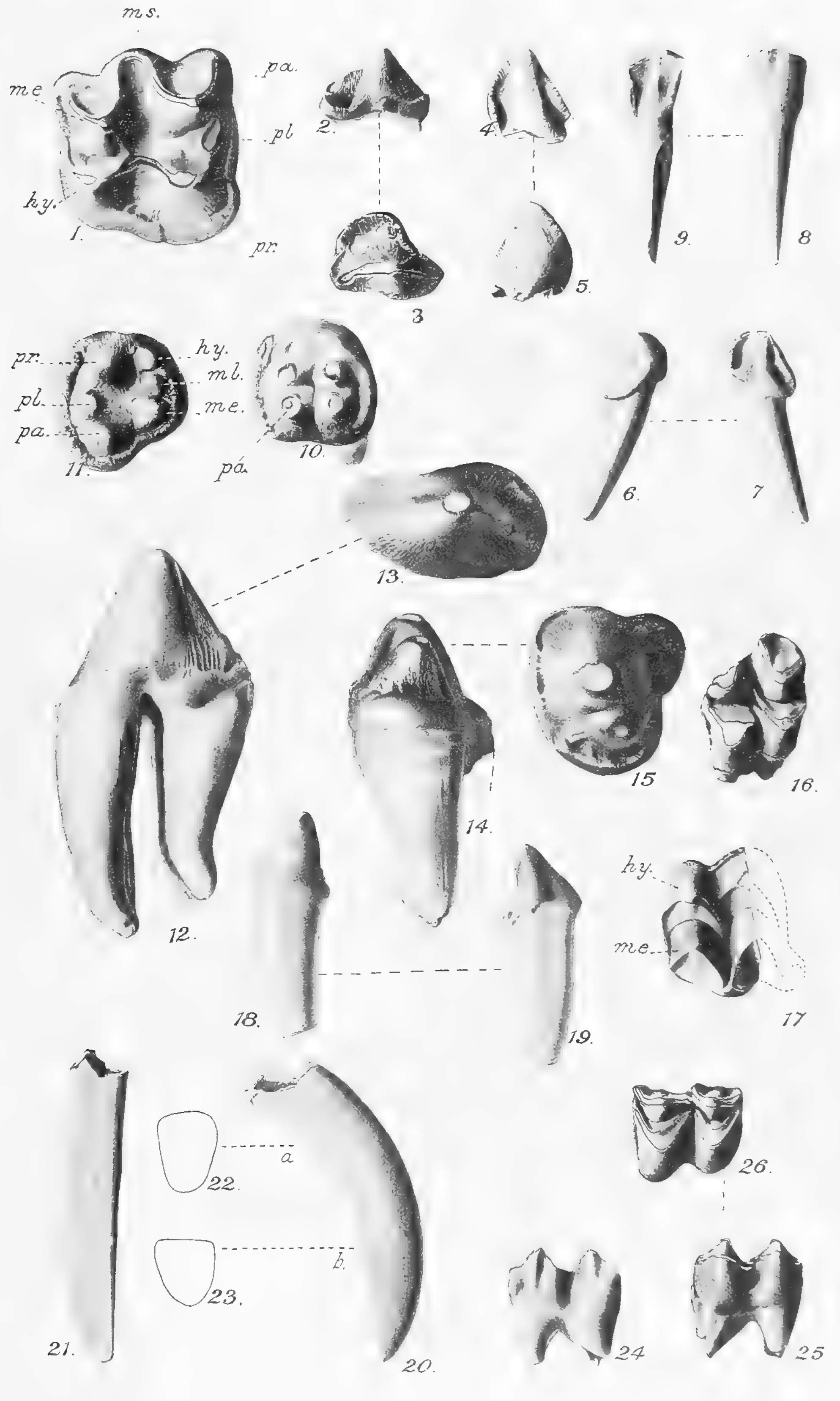
Fig. 23. Outline of transverse section at *b*.

Fig. 24. *Merycoidodon culbertsoni*, Leidy; right lower second molar, inner view.

Fig. 25. The same tooth, viewed from without.

Fig. 26. The same, viewed from above.

Abbreviations for cusps, etc., as in plate III.



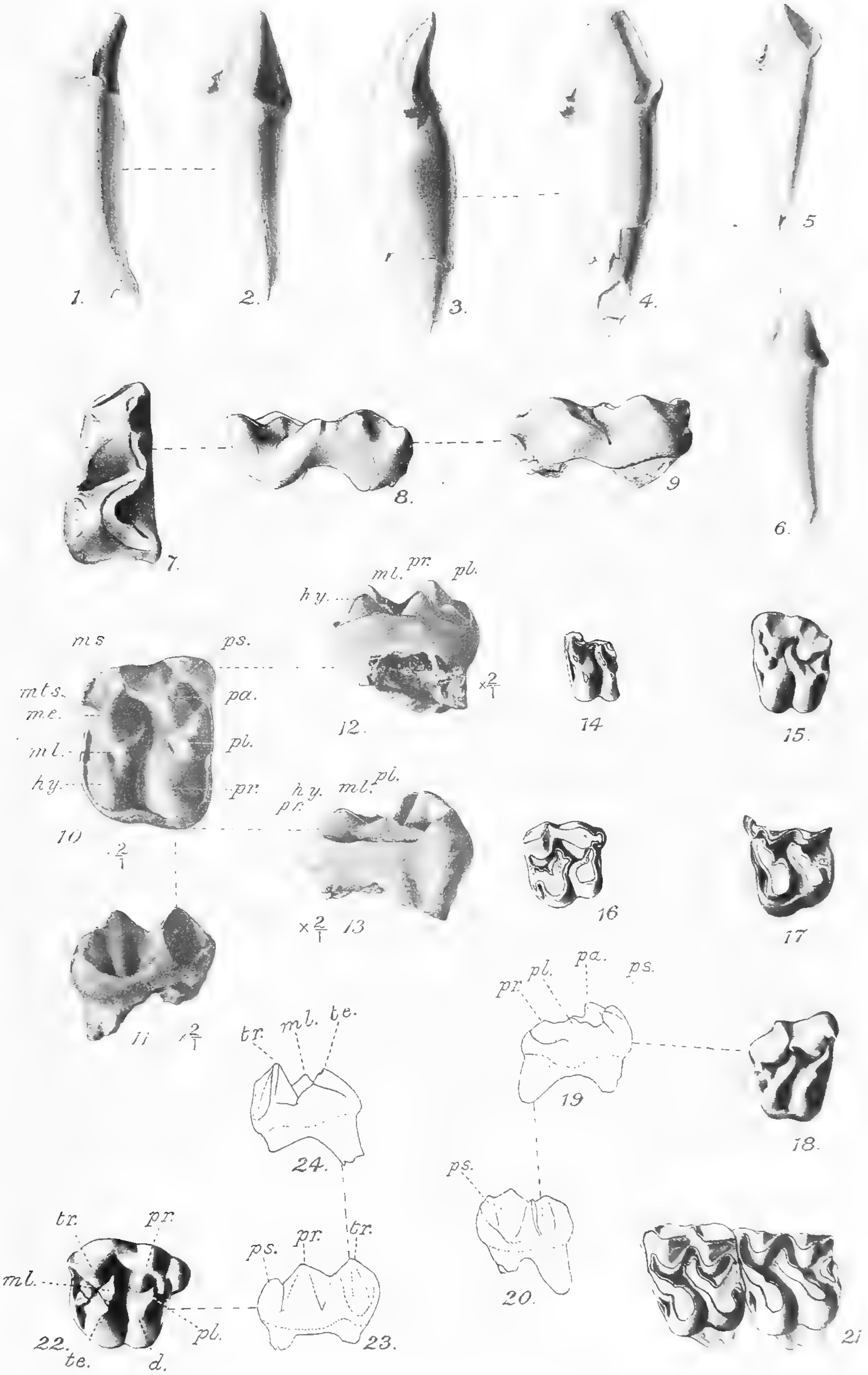
L.M. LAMBE, Delt.

PLATE III.

PLATE III.

Fig. 1. *Elotherium* sp.; incisor, lateral view. Collection of 1889. Page 28.
Fig. 2. The same tooth, inner aspect.
Fig. 3. *Elotherium* sp.; incisor, lateral view. Collection of 1904.
Fig. 4. The same tooth, inner aspect.
Fig. 5. *Elotherium* sp.; incisor, inner view. Collection of 1904.
Fig. 6. Same specimen, viewed from without.
Fig. 7. *Chalicotherium bilobatum*, Cope; left lower third premolar, viewed from above. Page 54.
Fig. 8. The same tooth, inner aspect.
Fig. 9. The same, outer aspect.
Fig. 10. *Mesohippus westoni*, Cope; right upper second molar, viewed from below; twice the natural size. Page 33.
Fig. 11 The same tooth, exterior aspect; twice the natural size.
Fig. 12. The same, inner aspect; similarly enlarged.
Fig. 13. The same, anterior aspect; similarly enlarged.
Fig. 14. *Mesohippus praecocidens*, Lambe; left upper molar, as seen from below. Type. Page 34.
Fig. 15. *Mesohippus propinquus*, Lambe; left upper second molar, viewed from below. Type. Page 35.
Fig. 16. *Mesohippus propinquus*, Lambe; right upper second premolar, viewed from below.
Fig. 17. *Mesohippus brachystylus*, Osborn; left upper fourth premolar, as seen from below. Page 36.
Fig. 18. *Mesohippus stenolophus*, Lambe; right upper third molar, viewed from below. Type. Page 36.
Fig. 19. The same tooth, anterior aspect.
Fig. 20. The same tooth, outer aspect.
Fig. 21. *Mesohippus planidens*, Lambe; left upper first and second molars, seen from below. Type. Page 37.
Fig. 22. *Mesohippus assiniboiensis*, Lambe; right upper second premolar, viewed from below. Type. Page 37.
Fig. 23. The same tooth, outer aspect.
Fig. 24. The same tooth, posterior aspect.

pa., paracone; *me.*, metacone; *pr.*, protocone; *hy.*, hypocone; *pl.*, protoconule; *ml.*, metaconule; *ps.*, parastyle; *ms.*, mesostyle; *mts.*, metastyle; *d.*, deuterocone; *te.*, tetartocone; *tr.*, tritocone.



L.M. LAMBE, Delt

PLATE IV.

PLATE IV.

Fig. 1. *Hyracodon priscidens*, Lambe; left maxilla with premolar and molar teeth. Type. Page 39.

Fig. 2. The same specimen, outer aspect.

Fig. 3. *Hyracodon priscidens*, Lambe; anterior end of mandible, outer view from the left.

Fig. 4. The same specimen, seen from above.

Fig. 5. *Aceratherium mite*, Cope; left upper third molar, seen from below. Page 43.

Fig. 6. *? Leptaceratherium trigonodon*, Osb. and Wort.; right upper third molar, as seen from below. Page 44.

Fig. 7. *Aceratherium occidentale* (Leidy); left lower third molar, view from above. Page 44.

pr., protocone; *d.*, deuterocone; *tr.*, tritocone; *te.*, tetartocone; *c.*, canine; P_2, second premolar.

L.M. LAMBE, Delt.

PLATE V.

PLATE V.

Fig. 1. *Aceratherium* sp.; left upper first premolar, outer aspect. Cypress hills, 1904.
Fig. 2. The same tooth, viewed from below.
Fig. 3. *Aceratherium exiguum*, Lambe; anterior end of mandible, left outer aspect. Type. Page 44.
Fig. 4. The same specimen viewed from above.
Fig. 5. The same specimen viewed from the front.
Fig. 6. *Megacerops assiniboiensis*, Lambe; left mandibular ramus, outer aspect; one-half the natural size. Type. Page 51.

c., canine; *i.*, incisor; P_2, second premolar.

L.M. LAMBE, Delt

PLATE VI.

PLATE VI.

Fig. 1. *Eutypomys parvus*, Lambe; left lower third molar, as seen from above; four times the natural size. Type. Page 57.

Fig. 2. The same tooth, outer aspect; four times the natural size.

Fig. 3. *Megacerops assiniboiensis?* Lambe; coössified nasals, viewed from above; one-half the natural size. Page 52.

Fig. 4. *Magacerops primitivus*, Lambe; mandible viewed from the left; one-third the natural size. Page 49.

Fig. 5. The anterior end of the same specimen as seen from above; one-half the natural size.

Fig. 6. *Anthracotherium? pygmæum*, Lambe; right upper molar, crown view; twice the natural size. Type. Page 25.

pl., protoconule; *pr.*, protocone.

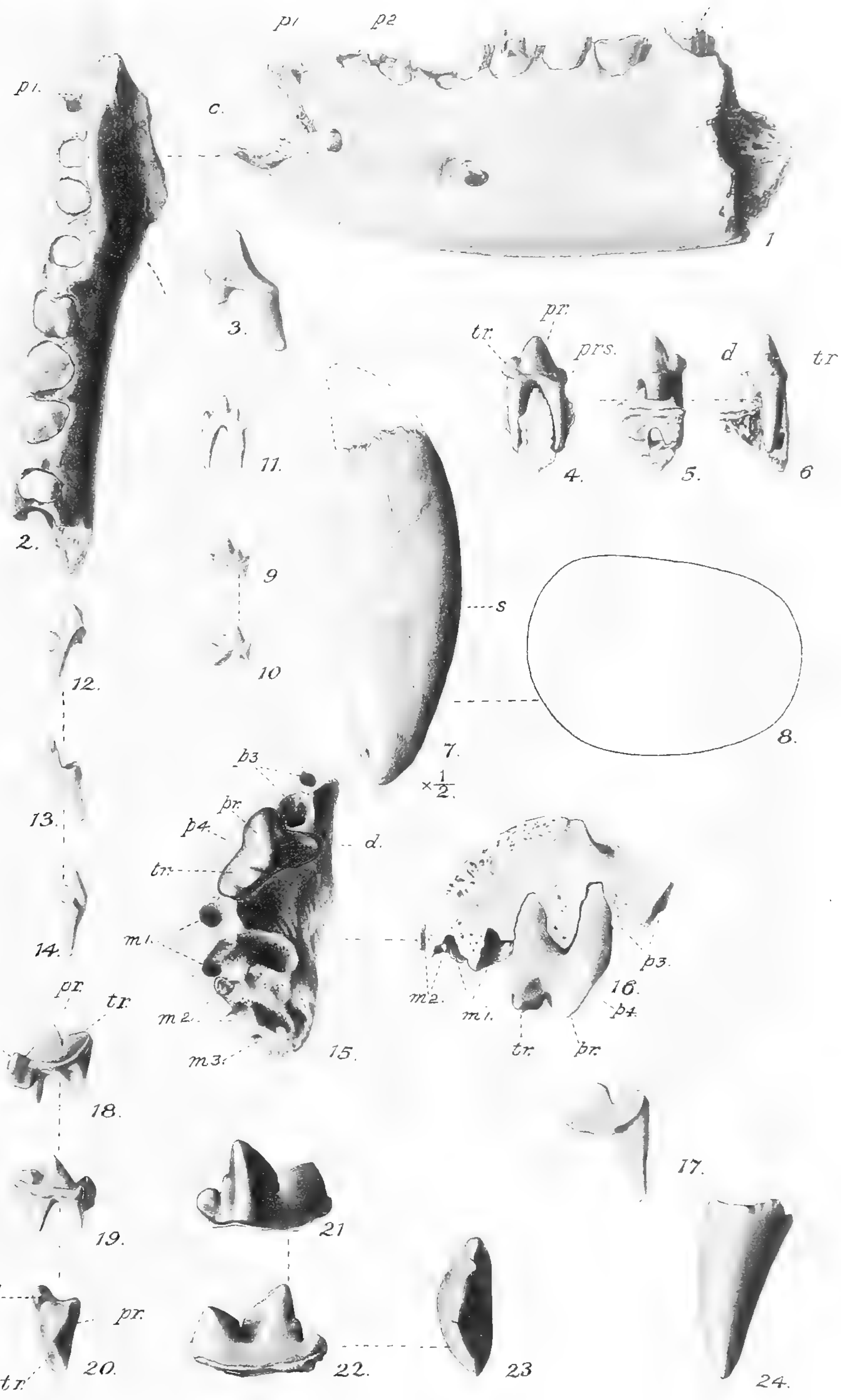
L.M. LAMBE, Delt.

PLATE VII.

PLATE VII.

Fig. 1. *Hyænodon cruentus*, Leidy; left manibular ramus viewed from without. Page 59.
Fig. 2. The same specimen viewed from above-
Fig. 3. *Hyænodon cruentus*, Leidy; left lower second premolar, outer side view.
Fig. 4. *Hyænodon crucians?* Leidy; upper left fourth premolar, exterior aspect. Page 60.
Fig. 5. The same tooth, interior aspect.
Fig. 6. The same tooth, posteriör aspect.
Fig. 7. *? Hemipsalodon grandis*, Cope; left lower canine, inner side view; one-half the natural size. Page 61.
Fig. 8. Outline of transverse section of same at *s*.
Fig. 9. *Cynodictis lippincottianus* (Cope); left lower third premolar, viewed from without. Page .
Fig. 10. The same as seen from within.
Fig. 11. *Cynodictis lippincottianus* (Cope); left lower fourth premolar, exterior view.
Fig. 12. *Cynodictis lippincottianus* (Cope); right lower first molar, external view.
Fig. 13. The same, internal view.
Fig. 14. The same, posterior view.
Fig. 15. *Daphænus felinus*, Scott; hinder portion of the right maxilla holding the fourth premolar, viewed from below. Page 62.
Fig. 16. Same specimen, external view.
Fig. 17. *Protemnocyon hartshornianus* (Cope); left upper fourth premolar, internal aspect. Page 63.
Fig. 18. *Protemnocyon hartshornianus* (Cope); left upper fourth premolar, viewed from within.
Fig. 19. The same tooth, viewed from without.
Fig. 20. The same tooth, from below.
Fig. 21. *Dinictis felina*, Leidy; right lower first molar, outer view. Page 64.
Fig. 22. The same, inner view.
Fig. 23. The same, view from above.
Fig. 24. *Dinictis felina*, Leidy; left upper canine, external view.

c., canine; *d.*, deuterocone; *m.*, molar; *p.*, premolar; *pr.*, protocone; prs., protostyle; *tr.*, tritocone.



L.M. LAMBE, Delt.

PLATE VIII.

PLATE VIII

Fig. 1. *Didelphys valens*, Lambe; right upper molar, crown view; four times the natural size. Type. Page 22.

Fig. 2. The same tooth, posterior aspect; similarly enlarged.

Fig. 3. The same tooth, anterior view; similarly enlarged.

Fig. 4. The same tooth, exterior view; similarly enlarged.

Fig. 5. ? *Didelphys valens*, Lambe; lower molar, viewed from above; enlarged four times.

Fig. 6. Same tooth, inner aspect; same enlargement.

Fig. 7. Same tooth, posterior view; same enlargement.

Fig. 8. *Poëbrotherium wilsoni*, Leidy; part of a left mandibular ramus with last temporary molar in place; outer aspect. Page 30.

Fig. 9. Crown view of the molar shown in figure 8; enlarged three times.

Fig. 10. *Leptomeryx speciosus*, Lambe; crown view of right upper molar; three times natural size. Type. Page 31.

Fig. 11. The same tooth similarly enlarged, outer aspect.

Fig. 12. *Leptomeryx speciosus*, Lambe; right lower molar, crown view; three times the natural size.

Fig. 13. The same tooth, outer aspect; three times natural size.

Fig. 14. *Leptomeryx speciosus*, Lambe; left posterior lower molar, crown view; enlarged three times.

Fig. 15. The same molar, inner aspect; similarly enlarged.

Fig. 16. *Sciurus ? saskatchewensis*, Lambe; left upper molar, crown view; four times the natural size. Type. Page 55.

Fig. 17. The same tooth, posterior aspect; similarly enlarged.

Fig. 18. *Ischyromys typus*, Leidy; right second lower molar, crown view; four times the natural size. Page 56.

Fig. 19. *Cylindrodon fontis*, Douglass; portion of left mandibular ramus in which is preserved the first molar; enlarged three times. Page 56.

Fig. 20. The same specimen, as seen from above; four times the natural size.

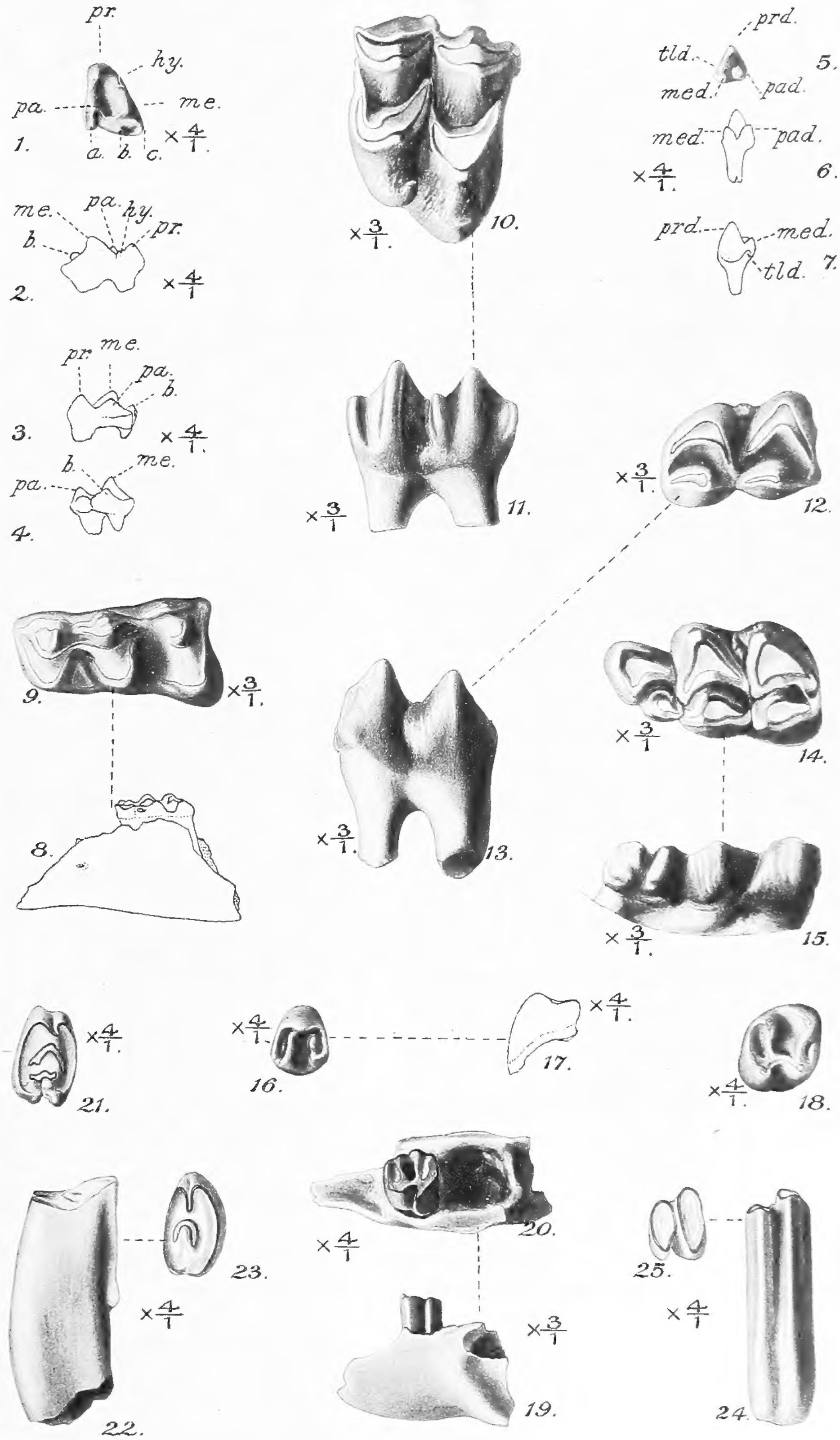
Fig. 21. *Palæolagus haydeni*, Leidy; right upper first molar, crown view; slightly over four times the natural size. Page 58.

Fig. 22. *Palæolagus haydeni*, Leidy; left upper fourth premolar, posterior view; slightly over four times the natural size.

Fig. 23. The same tooth, crown view; similarly enlarged.

Fig. 24. *Palæolagus haydeni*, Leidy; right lower molar, outer aspect; four times the natural size.

Fig. 25. The same tooth, viewed from above; similarly enlarged.



L.M. LAMBE, Delt.