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THE EXTINCT MAMMALIAN FAUNA

OF

DAKOTA AND NEBRASKA,

INCLUDING AN ACCOUNT OF SOME ALLIED FORMS FROM OTHER LOCALITIES,

TOGETHER WITH A

SYNOPSIS

OF THE

MAMMALIAN REMAINS OF NORTH AMERICA,

ILLUSTRATED WITH 30 PLATES.

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PRECEDED WITH AN INTRODUCTION

ON THE

GEOLOGY OF THE TERTIARY FORMATIONS OF

DAKOTA AND NEBRASKA,

ACCOMPANIED WITH A MAP.

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PHILADELPHIA, 1869.

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PREFACE.

The present work is intended as a record of facts, in palæontology, as the authors have been able to view them; a contribution to the great inventory of nature. No attempt has been made at generalizations or theories which might attract the momentary attention and admiration of the scientific community. We give this premonition at the outset, to prevent disappointment in those who might be expectant of more important results than we have obtained from the great amount of material at our command. We have endeavored to see and represent things correctly, nothing more, though we apprehend we have not been able to avoid the average amount of errors usual under such circumstances.

The materials of our work on the Extinct Mammalian Fauna of Dakota and Nebraska, etc., have been gradually and continuously accumulating the last twenty-three years. Those of the Synopsis of Mammalian Remains of North America, through a century and a half. The preparation of our book was commenced seven years ago, and, after various interruptions, was so far completed as to be presented to the Academy for publication in September, 1868.

ON THE GEOLOGY

OF THE

TERTIARY FORMATIONS OF DAKOTA AND NEBRASKA.

By Prof. F. V. Hayden.

The vast extent of our country west of the Mississippi seems to have been the arena on which were enacted, during the Mesozoic and Cenozoic times, some of the most important events in the geological history of the American continent. There are indications that in this region are still to be wrought out some of the most important problems in geological science. It seems even quite probable that the chasm that has always existed between the two great periods, the Cretaceous and Tertiary, will be bridged over by means of some transition beds, or beds of passage belonging to the lignite series, which will illustrate the continuity of growth of the Western Continent as has been shown in no other portion of the world. Much more study is required before we can arrive at any positive conclusions on this subject. A very large portion of the West has never yet been explored by the geologist, and all the work that has been done up to this time has been of necessity very superficial. The facilities which will soon be afforded for travel through those wild regions, on the completion of the Pacific Railroads, must give a very great impulse to explorations, and it is to be hoped that not many years will elapse before a sufficient number of facts may be gathered together from every portion of the West, to enable the geologist to work out the general plan of its geological structure with some degree of completeness.

From the observations which have already been made, we believe that at the close of the Cretaceous period the ocean rolled uninterruptedly across the area now occupied by the Rocky Mountain ranges. Whether some portions of the mountain peaks did not project above the ocean waters during that period it is impossible now to determine, but the evidence seems to be quite clear that the greater part of the country, at least, was beneath the ocean level during that period. Near the close of the Cretaceous era the surface had reached an elevation so great as to form long lines of separation between the waters of the Atlantic on the east and those of the Pacific on the west; and then this great water shed began to rise above the surrounding country. Then also began the existence of the first of that series of fresh-water lakes which we now know was a most prominent feature in the physical geography of this country during the Tertiary period. To obtain a clear idea of the plan of growth of the western portion of our continent, as it quietly and slowly emerged from the ocean, we have but to study the numerous barometrical sections which have been constructed by the U. S. Army officers and others for the past twenty or thirty years. Taking almost any point along the Missouri River below Council Bluffs, we find that as we proceed westward there is a gradual elevation or ascent of about one foot to the mile for the first hundred miles, then three feet for the second, five feet for the third, eight or nine feet for the fourth, &c., until at the foot of the mountains the ascent becomes eighty or ninety feet to the mile. We then pass over a series of mountain ranges of different elevations until we reach the western or Pacific slope, when we gradually descend into the ocean. We thus conclude that during the Cretaceous period there was a gradual slow elevation of the whole country west of the Mississippi; that about the close of that period the crust of the earth had been strained to its utmost tension, and long lines of fracture commenced, which formed the nucleus of our present mountain ranges; for the evidence seems to indicate that there was a long period of quiet elevation, the central force acting along the lines of upheaval. The barometrical profiles seem to indicate that the west forms a vast plateau, upon which are located a great number of ridges or mountain ranges, tending in the aggregate nearly north-west and south-east. At the close of the Cretaceous period, or in the early part of the Tertiary, when the crust had been elevated to its utmost tension, it broke, sometimes in long lines of fracture, which gave birth to these lofty continuous ranges with a granitoid nucleus along the eastern portion of the Rocky Mountains, as the Wind River, Big Horn, Laramie Mountains or the Black Hills, or the basaltic ridges, which are less regular in their structure, formed by outbursts of melted matter arranged in a series of sharp peaks, or sierras, as they are called in the Spanish countries, of which the Wasatch, Green River Mountains and numerous ranges on the Pacific coast are examples.

That the Tertiary beds were in part deposited before the upheaval of the mountain ranges seems to be indicated by the fact that the lignite beds inclined from both sides of the Wind River Mountains, which forms the main axis of elevation. There are many other proofs which tend to show that the first important crust movements must have been during the early part of the Tertiary period, or at least during the deposition of those beds of passage or transition between the well-defined Cretaceous and Tertiary.

The lowest beds of the Tertiary exhibit a somewhat brackish or estuary character, and a few fossils are found which are peculiar to such waters. Along the foot of the mountains in Colorado, where the lowest Tertiary beds are exposed, a species of oyster is found in the greatest abundance (*Ostrea subtrigonalis*), which appears to be identical with the one so abundant at the mouth of the Judith River, and near Fort Clark, on the Missouri River, holding a similar geological position. Other fossils are found, and other proofs are known which show that these beds are intermediate between the true marine formations of the Cretaceous and the strictly fresh water of the Tertiary. It is not our purpose in this brief introduction to present a detailed account of the geological features of this great region, but we wish simply to indicate that it is possible to trace the history of the growth of the continent step by step from the purely marine waters of the Cretaceous ocean, and the period when the mountain ranges were elevated in well-defined lines above the waters, causing the ocean to recede to the eastward on the one side and to the westward on the other; and that this elevating force continued to act throughout the Tertiary period as well as the Post-tertiary; and that it probably continues even up to the present time. At any rate the Rocky Mountains formed immense water-sheds, which gave birth to innumerable fresh-water streams, which fed those great Tertiary lakes along the eastern slope. As we have before remarked, the waters were brackish at first, but very soon, by the superabundance of fresh water, though with access to salt water, at first the lakes became entirely fresh, and the sediments reveal no remains but those of purely fresh-water or terrestrial animals or plants. That there have been periods of repose as well as subsidence, there can be no doubt, and this seems to be shown by the great system of terraces along all the streams of this country; but the general upward tendency has been continued without any marked interruption even up to the present time. The observations that have been made thus far point to the conclusion that during the Tertiary period there were at least four, and possibly five, fresh-water lakes in the west, and two of them were certainly of great extent.

1st. The Bad Lands of the Judith, the beds of which are included in the Section, in the Fort Union or Lignite group. This basin occupies an area about forty miles in length, and from fifteen to twenty in breadth. The Missouri River cuts a channel through it, separating it in two nearly equal portions. It is located near the mouth of the Judith River, near lat. 48° and long. 110°. This basin has never been carefully explored, and there is still so much doubt as to its age and exact position in the geological scale that it would be unsafe to venture an opinion in regard to it until more facts can be secured. We know that the strata are of both estuary and fresh-water character, and that they are composed of indurated sands, clays and impure lignites, the whole presenting a dark brown or sombre color, not unlike the lignite beds below Fort Union. Large numbers of shells and a few plants were preserved in its sediments, but it is chiefly remarkable for its peculiar Saurian fauna, calling to the mind of the palæontologist that of the Wealden of England.*

* Trans. Am. Philos. Soc. Vol. 11 p. 139.

2d. The great Lignite Basin, which occupies by far the most extensive area of any of the fresh-water lakes of this period. Its limits have not yet been explored, still we believe that it extends far southward, possibly even to California, westward far over the mountains to Utah, and possibly to the Pacific, and northward probably to the Arctic Sea, interrupted here and there by the upheaval of mountain ranges.

The beds composing this great basin seem to have been deposited in waters that were at first brackish, and then gradually becoming fresh. It is chiefly remarkable for the beauty and extent of its fossil flora, and for the numerous beds of Lignite, varying in thickness from a few inches to twelve or fifteen feet. The occurrence of immense fan palms, and many other plants now found growing only in tropical climates, points directly to the conclusion that along the shores of this great lake there grew most luxuriant forests, equalled only by those now existing in Central America or Brazil.

The characters of the mollusca all indicate a very mild temperature during this portion of the Tertiary period.

3d. The Wind River deposits are also quite remarkable, as holding a kind of intermediate position between the Fort Union group and the White River group, and the evidence seems to indicate that it was an independent fresh-water lake during the Tertiary period. The beds are intermediate in color and composition, but very few fossils have been found in them to give exactness to our conclusions. A few fragments of remains of mammals and *Testudo*, with a few terrestrial and fresh-water shells, allied to forms found in both the Lignite and White River groups.

4th. The White River group is the formation from which most of the vertebrate remains described in Dr. Leidy's memoir have been obtained. This formation is mostly composed of a series of whitish indurated clays, marls and sands, which have been worn and cut by the streams and other atmospheric agencies into myriads of deep valleys or gorges, so as to form a most wonderful and almost interminable labyrinth, which so impedes the course of the traveller that it has caused the native Indian tribes to give to this region the name of the Bad Grounds, or, as the Canadian voyageurs have translated it, Mauvaises Terres. That portion of the fourth Basin in the region of White River is regarded of Miocene age. Along the Niobrara and the Loup Fork, and extending southward, are a series of beds composed of incoherent materials, mostly fine marls and sands, which seem to have been deposited after the upper surface of the White River group had been worn into ravines and depressions. This occurs along the Niobrara River and the Loup Fork. This group of beds seems to have filled up the channels of the rivers after they had been worn out to nearly their present width and depth. The relations which these Tertiary Basins sustain to each other are pretty well shown by the following general section :

General Section of the Tertiary Rocks of Nebraska.

NAMES.	SUBDIVISIONS.		LOCALITIES.	FOREIGN EQUIV.
Loup River beds.	Fine loose sand, with some layers of limestone. Contains bones of *Canis, Felis, Castor, Equus, Mastodon, Testudo,* &c., some of which are scarcely distinguishable from living species; also *Helix, Physa, Succinea,* probably of recent species. All fresh-water and land types.	300 to 400 feet.	On Loup Fork of Platte River. Extending north to Niobrara River and south to an unknown distance beyond the Platte.	Pliocene.
White River group.	White and light drab clays, with some beds of sandstone, and local layers of limestone. Fossils: *Oreodon, Titanotherium, Hyopotamus, Rhinoceros, Anchitherium, Hyænodon, Machairodus, Trionyx, Testudo, Helix, Planorbis, Limnæa,* petrified wood, &c.,—all extinct. No brackish water or marine remains.	1000 feet or more.	Bad Lands of White River, under the Loup River beds on the Niobrara, and across the country to the Platte.	Miocene.
Wind R. deposits.	Light and ash colored sandstones, with more or less argillaceous layers; fossils; fragments of *Trionyx, Testudo* with large *Helix vivipara,* petrified wood, &c. No marine or brackish water types.	1500 to 2000 feet.	Wind River Valley; also west of Wind River Mountains.	?
Fort Union or great Lignite group.	Beds of clay and sand, with round ferruginous concretions, and numerous beds, seams, and local deposits of lignite; great numbers of dicotyledonous leaves, stems, &c., of the genera *Platanus, Acer, Ulmus, Populus,* &c., with very large leaves of true fan palms; also *Helix, Melania, Vivipara, Corbicula, Unio, Ostrea, Potamomya,* and scales of *Lepidotus,* with bones of *Trionyx, Emys, Compsemys, Crocodilus,* &c.	2000 feet or more.	Occupies the whole country around Fort Union. Extending north into the British possessions to unknown distances, also southward to Fort Clark. Seen under the White River group, on the North Platte River above Fort Laramie, also on west side of Wind River Mountains.	Eocene?

On the map I have designated both deposits, which are remarkable for containing the remains of vertebrata in great numbers, by one color, and in describing I have regarded them as forming one great basin. The Miocene fauna of the White River beds is entirely distinct from that of the Pliocene beds of the Niobrara and Loup Fork, and it is quite possible that a more careful study of the relations of these two deposits to each other may result in separating them completely. The sediments which compose the Pliocene beds appear to have been derived almost entirely from the eroded materials of the White River group, and the two groups evidently sustain some relation to each other in time, while the two seem to have no connection, either lithologically or palæontologically, with any other Tertiary deposits on the Upper Missouri, unless with the Wind River deposits, which are comparatively slight. The erosion of the Pliocene beds does not give to the surface of the country that wonderfully unique character which is so well shown on White River, but it undoubtedly supplies the materials for a singular formation called the Sand Hills, which are a striking feature of the country. That portion of Nebraska usually called the "Sand Hills" occupies an area of at least 20,000 square miles, and gives to the surface of the country, as far as the eye can reach, the appearance of a continued series of conical hills of sand, constantly wrought upon by the wind, so that it is even now slowly moving from point to point. Many of these hills have much the appearance of craters, the wind, as it were, scooping out a circular hole in the top. This is perhaps the most sterile portion of the West, and yet it is by no means destitute of vegetation. A variety of plants, including some grass, are found everywhere. In the little valleys among the hills there is a good growth of grass, and this region has always been the favorite resort of the Buffalo. A species of Yucca (*Y. angustifolia*) grows abundantly on the sides of the hills, and with its deep branching roots affords a great protection to them from the winds. Water is found in little lakes, which are abundant in the numerous depressions, but they are all very small, and of very little depth. The Miocene beds of the White River present some of the most wonderfully unique scenery in the world. Over an area of about one hundred miles from east to west, and fifty to sixty from north to south, they have been so worn and cut by streams, rains, and other atmospheric agencies, that it forms one continued series of gullies or dry gorges, with here and there isolated peaks and columns looking much like steeples or towers, giving to the whole the appearance of the ruins of some ancient city. Through the courtesy of Prof. James Hall, of Albany, N. Y., I am permitted to make use of the accompanying sketch, which was taken on the spot by Mr. F. B. Meek, while visiting that region under the auspices of Professor Hall. The following vertical section of the beds of this basin, although published some years since, is here repeated, from the fact that I have been unable

to make any important changes in it in my subsequent explorations. It is probably very nearly correct:

Vertical Section, showing the order of superposition of the different beds of the Tertiary basin of White and Niobrara Rivers.

		SUBDIVISIONS.	LOCALITIES.	ESTIMATED THICKNESS.
Post-tertiary.	Bed F.	Yellow siliceous marl, similar in its character to the loess of the Rhine, passing down into variegated indurated clays and brown and yellow fine grits. Contains remains of extinct mammals, mingled with those identical with recent ones; also a few mollusca, mostly identical with recent species so far as determined.	Most fully developed along the Missouri River from the mouth of the Niobrara to St. Joseph. Also in the Platte Valley and on the Loup Fork.	300 to 500 feet.

		SUBDIVISIONS.	LOCALITIES.	ESTIMATED THICKNESS.
Pliocene Tertiary.	Bed F.	1st. Dark gray or brown sand, loose, incoherent with remains of Mastodon, Elephant, &c. 2d. Sand and gravel incoherent. 3d. Yellowish-white grit, with many calcareous, arenaceous concretions. 4th. Gray sand with a greenish tinge; contains the greater part of the organic remains. 5th. Deep yellowish-red arenaceous marl. 6th. Yellowish-gray grit, sometimes quite calcareous, with numerous layers of concretionary limestone from two to six inches in thickness, containing fresh-water and land shells, *Succinea*, *Limnæa*, *Paludina*, *Helix*, &c., closely allied and perhaps identical with living species; also much wood of a coniferous character.	Covers a very large area on Loup Fork from the mouth of North Branch to source of Loup Fork; also in the Platte Valley. Most fully developed on the Niobrara River, extending from the mouth of Turtle River three hundred miles up the Niobrara. Also on Bijou Hills and Medicine Hills. Thinly represented in the valley of White River.	300 to 400 feet.
Miocene.	Bed E.	Usually a coarse-grained sandstone, sometimes heavy-bedded and compact, sometimes loose and incoherent; varies much in different localities. Forms immense masses of conglomerate, also contains layers of tabular limestone with indistinct organic remains. Very few mammalian remains detected, and those in a fragmentary condition. Passes gradually into the bed below.	Most fully developed along the upper portion of Niobrara River, and in the region around Fort Laramie. Seen also on White River and on Grindstone Hills.	180 to 200 feet.

		SUBDIVISIONS.	LOCALITIES.	ESTIMATED THICKNESS.
Miocene.	Bed D.	A dull reddish-brown indurated grit, with many layers of silico-calcareous concretions, sometimes forming a heavy-bedded, fine-grained sandstone. Contains comparatively few organic remains.	Niobrara and Platte Rivers; well developed in the region of Fort Laramie, also in the valley of White River; conspicuous, and composing the main part of the dividing ridge between White and Niobrara Rivers.	350 to 400 feet.

The geographical extent of this wonderful basin is not even yet clearly known, inasmuch as species identical with some found on the Niobrara River have been discovered in remote portions of the west. Fossils have been sent to Dr. Leidy from Texas and from California, apparently identical and closely allied with species found in the Bad Lands, and enveloped in a matrix which appears identical in composition and color. We have evidence of its existence in Colorado, in Middle Park, and on the Arkansas River, various parts of Utah, and in 1860 I saw isolated patches of the Pliocene beds in the valley of the Gallatin's Fork of the Missouri River. We may therefore look for the Pliocene beds in almost any portion of the Rocky Mountain range. By reference to the geological map accompanying this memoir it will be seen that the formation is now known to cover an area of at least 100,000 square miles, but as there are isolated patches extending far across the Missouri northward into Minnesota, we may reasonably infer that it once occupied a much larger area, and that these isolated portions, like Medicine Hill, Bijoux Hill, &c., are monuments left from erosion to point out minutely the former limits of the lake. We think therefore that some time during the Tertiary period this great lake must have covered an area of at least 150,000 square miles.

That the Rocky Mountain range had reached an advanced stage in its upward movements before the accumulation of the sediments composing this formation, seems to be indicated by the evidence already secured. While the lignite beds seem to have suffered an inclination equal with the older fossiliferous beds, by the disturbing influences that elevated the mountain ranges, the White River beds seldom incline more than 5° or 10°. All along the foot of the Black Hills and the main range the white marls and sands fill up the valleys and jut against the sides of the older rocks, always reposing unconformably upon them. Sometimes these beds are elevated several hundred feet, still remaining horizontal. We can thus see that, although the great mountain range had been fully marked out prior to the deposition of the sediments of the White River group, yet the elevation continued through that period and long after, slightly disturbing some of the beds, and elevating others much above their original position.

It seems to be an important inquiry, from whence were derived the materials which compose the sediments of the great basin. In their external appearance and in their mineral compositions, these beds differ from any other Tertiary formation known in the west,—so much so, that if I were to see isolated remnants in any portion of the Rocky Mountains I should be able to detect them at a glance. The matrix attached to the bones of *Titanotherium* has been analyzed by Dr. D. D. Owen, and found to contain a very large proportion of silica, lime, and some alumina. It seems to me quite possible that the numerous little streams that must have poured into the lake, having their sources in the Rocky Mountains, and especially in the Black Hills, which must at that time have begun to emerge from beneath the superincumbent fossiliferous formations, cut their way through the metamorphic rocks and the granitoid nucleus, distributing the decomposed silica, lime and alumina over the bottom of the lake. We know that feldspar is a predominant constituent of the granitoid nucleus of the mountains, and, when decomposed, forms a rock of a whitish or yellowish-white color, much like the mixed sediments of the Bad Lands. One of the most interesting features in regard to this great fresh-water lake is the evidence of its growth from a germ, as it were, until it spread over the great area on which it has left its traces by the deposition of its peculiar sediments. It seems to have commenced its existence near the south-eastern base of the Black Hills, gradually spreading southward and eastward from that point, as the surface, and especially the Black Hills, arose above the surrounding country. The lowest stratum, or the Titanotherium bed, is found only in the valley of White River, and near the Shyenne, occupying a comparatively small area; and as we proceed southward higher and more recent beds are seen, until the Pliocene beds appear, and then graduate into the Post-pliocene marls far southward toward the Arkansas. It seems to me that the law of growth from small beginnings must apply equally to all the fresh-water lakes, either of the past or present.

The basin-like character of this formation is most admirably shown. Along the northern border, extending for nearly one hundred miles, there is a high level plateau covered with grass. This plateau is cut through by numerous affluents of the Shyenne River, as Bear, Sage and Bull Creeks. It is underlaid by cretaceous rocks, and from it we descend quite abruptly forty or fifty feet to the Titanotherium bed, the concave outline revealing the ancient lake shore perfectly. Sometimes there were extensions of the upper beds across the Shyenne northward, overlapping the lignite beds, as the colors on the map will show.

Many scientific men have said to me, in a few years these fossil remains will be exposed even more abundantly than ever, by the erosive action of atmospheric agencies, so that we may look for novelties for a half-century to come. In reply, I can only say that during the summer of 1866 I examined with great care the ground so diligently searched by Mr. Meek and myself in 1853, just thirteen years previously; also the ground looked over by me in 1856, eleven years before; and I could find no evidence that during that time a single specimen had been exposed by the rains. Even the debris around a Turtle or Oreodon head, which we had removed thirteen years before, remained undisturbed. It is to be recollected that atmospheric influences do not operate here as in regions east of the Mississippi.

It is safe to say that not more than ten or fifteen inches of moisture ever fall in this district annually, and so thirsty is the air that it seems to absorb it all as quickly as it falls. The specimens are scattered over a large district, and are not abundant, and when once gathered from a certain area, the evidence seems to me clear that fifty years would do very little towards replacing them by the erosion of the beds in which the fossils are found. No amount of excavation would be productive of important results.

We answer the question, how did so many of these remains accumulate in these localities in this way? It has been shown by Dr. Leidy that the two extinct faunæ of this region were composed of carnivorous and herbivorous animals, as at the present time; that the *Oreodons* and *Merychyus* were gregarious, like the recent buffalo and antelope of the west; that they were subject to the predaceous attacks of the *Hyænodons*, the *Drepanodon* and *Dinictis;* and as we know that animals of similar nature at the present day frequent the borders of streams,—the herbivorous for food or drink and the carnivorous for shelter,—that the borders or valleys of these streams were the scenes of numerous conflicts, which were carried on by these savage beasts not only after their prey, but among themselves, their bones would be left in the valleys, and the high waters would sweep them down into the lake, where they would be buried in the sediments at the bottom. We find examples occurring continually in that country at the present time, which would throw much light on the matter. The wolves watch the deer, antelope, and other feebler animals as they go down to the streams to drink, and all over the wide bottoms are the skeletons of these animals in a more or less perfect condition. It is not an uncommon occurrence for a band of wolves to attack an aged buffalo, too old to offer a successful resistance. He must always betake himself to the river, where he is not unfrequently drowned, or is destroyed by the wolves on a sand bar or island. Annually thousands of buffalo are drowned in attempting to cross the Missouri on the ice, as it is breaking up in the spring. Their bodies have been seen floating down the Missouri at Fort Union and Fort Clark by hundreds, and, lodging on some of the islands or sand bars in the river, would fill the air with their stench. In the spring of 1858 several thousand bodies of buffalo passed down the Kansas River, below the mouth of Solomon's Fork and were carried into the Missouri. In the summer of 1856 an Indian came into Fort Union, bringing with him a large number of buffalo tongues, boasting that he had killed a band of these animals. His story was doubted, and it was afterwards discovered that about sixty of these animals had been mired in and perished in the mud of the Big Muddy, a stream which flows into the Missouri above Fort Union. Many other examples might be given, showing how easily the remains of animals roaming and feeding along the borders of the myriad streams flowing into some great lake could be transported in part or entire into the lake, and, sinking to the bottom, would be enveloped in the muddy sediments.

The following Catalogue of the animal remains thus far discovered in the basin is given to show the vertical range of the species:

	A	B	C	D	E	F
CARNIVORA.						
Canis sævus,						×
C. temerarius,						×
C. vafer,						×
C. (Epicyon) Haydeni,						×
Amphicyon vetus,		×				
A. gracilis,		×				
Hyænodon horridus,		×				
H. cruentus,		×				
H. crucians,		×				
Pseudælurus intrepidus,						×
Drepanodon primævus,		×				
D. occidentalis,		×				
Dinictis felina,		×				
Ælurodon ferox,						×
Leptarctus primus,						×
RUMINANTIA.						
Oreodon Culbertsoni,		×	×	×		
O. gracilis,		×	×	×		
O. major,				×		
O. affinis, var.,	×					
O. hybridus, var.,	×					
O. bullatus, var.,	×					
Merycochœrus proprius,				×		
Merychyus elegans,						×
M. medius,						×
M. major,						×
Leptauchenia major,				×		
L. decora,				×		
L. nitida,				×		
Agriochœrus antiquus,		×		×		
A. major,		×		×		
A. latifrons,		×				
Pœbrotherium Wilsoni,		×				
Procamelus robustus,						×

	A	B	C	D	E	F
P. occidentalis,						×
P. gracilis,						×
Homocamelus caninus,						×
Protomeryx Halli,				×		
Megalomeryx Niobrarensis,						×
Merycodus necatus,						×
Leptomeryx Evansi,		×				
Cervus Warreni,						×
Cosoryx furcatus,						×
PACHYDERMATA ARTIODACTYLA.						
Elotherium (Entelodon) Mortoni,		×		×		
E. ingens,		×				
E. ingens, large var.,		×				
Perchœrus probus,		×				
Leptochœrus spectabilis,		×				
Dicotyles?						×
PACHYDERMATA PERISSODACTYLA.						
Hyopotamus americanus,	×					
Rhinoceros occidentalis,	×	×	×	×	×	
R. crassus,						×
Hyracodon Nebrascensis,		×	×	×	×	
Titanotherium Prouti,	×					
Lophiodon occidentalis,	×					
Mastodon mirificus,						×
Elephas imperator,						×
SOLIDUNGULA.						
Equus excelus,						×
Protohippus perditus,						×
P. placidus,						×
Hipparion occidentale,						×
H. speciosum,						×
H. affine,						×
H. gratum,						×
Merychippus insignis,						×
M. mirabilis,						×
Anchitherium Bairdi,		×	×	×		
Hypohippus affinis,		×				
Parahippus cognatus,				×		
RODENTIA.						
Palæolagus Haydeni,			×	×		
Ischyromys typus,			×	×		
Palæocastor (Steneofiber) Nebrascensis,			×	×		
Eumys elegans,		×				
Castor tortus,						×
Hystrix venustus,						×
INSECTIVORA.						
Leptictis Haydeni,		×				
Ictops Dakotensis,		×				

ON THE

EXTINCT MAMMALIA OF DAKOTA AND NEBRASKA,

INCLUDING AN ACCOUNT OF SOME ALLIED FORMS FROM OTHER LOCALITIES.

By Prof. Joseph Leidy.

INTRODUCTORY REMARKS.

As indicated in the leading title of the present work, the succeeding pages mainly consist of descriptions of the remains of extinct mammals obtained from the tertiary deposits of the present States of Nebraska and Dakota, formerly comprised together in the territory of Nebraska. An account is also given of a few additional remains of allied forms and of cotemporary age, discovered in the States of Texas and California. The fauna to which all the remains belong apparently pertains to the middle and later tertiary periods, extending perhaps from the end of the eocene or the beginning of the miocene, and throughout this continuously and through the pliocene. The geology of the region related with the fauna in Nebraska and Dakota has been investigated by my colleague, Prof. Hayden, and forms the subject of the introduction prepared by him for the work.

The great occidental tertiary fauna of which we speak appears to be entirely distinct in character from that of the more recent or post-pliocene period, to which belong most of the mammalian remains hitherto described by authors from various parts of the North American continent. It is remarkable, from its bearing a nearer resemblance and relationship to the faunæ of corresponding age, and to those more recent, of the so-called old world, than it does to the post-pliocene and recent faunæ of the two Americas.

In comparing the various faunæ indicated, it would appear that in the evolution of mammalian life the miocene and pliocene faunæ of North America had proceeded from Asia, but subsequently in a great measure became extinct, while the post-pliocene and recent faunæ may partly have succeeded from the former, but mainly proceeded from South America and north-eastern Asia.

The tertiary deposits of the Mauvaises Terres of the Makisi-ta Wapka, or White River, of Dakota, are remarkable for the great quantity of fossil remains of mammals and turtles they have yielded without further exploration than picking them up from the surface of the country. Detached from the neighboring soft and readily disintegrating rocks, the fossils lie strewn about, and have often attracted the attention of the least curious of those who have traversed the district. The stone heads and turtles have even excited the wonder of the Indian. Most of the loose fossils have been gradually collected by travellers and others, so that few of a conspicuous character, I am told, now remain. Of those collected, by far the greater part have been submitted to my investigation, and these have amounted to the enormous quantity of between three and four tons in weight.

The mammalian remains of the Mauvaises Terres were first brought to notice through communications of Dr. Hiram A. Prout, of St. Louis, published in the American Journal of Science for 1846, p. 288, and for 1847, p. 248, giving an account of a portion of the lower jaw of a large animal, supposed to be a *Palæotherium.*

Nearly at the same time, a few specimens, collected by persons mostly connected with the American Fur Company, and sent to their friends as curiosities, were submitted to the author for examination, and form the subjects of short communications in the Proceedings of our Academy for 1847. Some of these specimens were afterwards presented to the Academy, and now form part of our museum.

In 1849 Dr. David Dale Owen, while engaged in a geological survey of Wisconsin, Iowa and Minnesota, extended his explorations into the then territory of Nebraska. One of his assistants, Dr. John Evans, visited the Mauvaises Terres, and made a collection of vertebrate fossils, which form the material of a contribution of the author to Dr. Owen's Geological Report, published in 1852.

In 1850 Mr. T. A. Culbertson, under the auspices of the Smithsonian Institution, visited the Upper Missouri region, and during the expedition obtained a collection of the Mauvaises Terres fossils. This material, together with that previously obtained, form the basis of a work of the author published in 1852, in the Smithsonian Contributions, under the title of "The Ancient Fauna of Nebraska."

In 1853 Dr. John Evans again visited the Mauvaises Terres incidentally, on his way overland to Oregon, for the purpose of making a geological survey of this territory. He made a large collection of mammalian fossils and remains of turtles, and sent it to the Smithsonian Institution, from whence it was transmited to the author for investigation. At the same time Dr. F. V. Hayden and Mr. F. B. Meek were employed by Professor James Hall to visit the Mauvaises Terres of White River, for the purpose of making a collection of fossils. The collection of vertebrate remains, in extent and number of peculiar species, almost equalled that of Dr. Evans, and this was likewise submitted to my examination, with the utmost liberality, by Prof. Hall.

Subsequent to all these expeditions, Dr. Hayden in 1855 again visited the territory of Nebraska, and spent the greater part of two years in exploring its geology. A large collection of fossils obtained by him in the Mauvaises Terres was equally divided, one part being purchased by the Academy of Sciences of St. Louis, the other part by this Academy.

Both divisions of the latter collection, together with all the collections and specimens previously indicated, constituted the material of a report on the tertiary vertebrate fauna of the Mauvaises Terres, accompanied with drawings, which was submitted by the author to Dr. John Evans, to be published with his Report on the Geology of Oregon and Washington Territories, prepared for the United States Government.

Dr. Evans died in 1861, while engaged in preparing his work for the press. Learning that Dr. Evans' Report was left in a very incomplete state, the author during several years made repeated attempts to procure his own contribution to the work from the proper authorities at Washington, with the view of publishing it through another source. The efforts to obtain the manuscript and drawings having proved unsuccessful, and there being no reasonable prospect that they could be procured by renewed trial, the author concluded that he once more would go through the labor of preparing the work for the press.

In 1857 Dr. Hayden accompanied Lieut. G. K. Warren, then of the U. S. Topographical Engineers, on an expedition to the country of the Upper Missouri. During this expedition he made the highly important discovery of a formation on the Niobrara River, in the present State of Nebraska, certainly newer than that of the Mauvaises Terres, of White River, Dakota, and supposed to be of pliocene age. The formation was rich in remains of mammals and a species of turtle, of which Dr. Hayden obtained a large collection, including many species evidently exhibiting a relationship on the one hand with the earlier forms of the Mauvaises Terres of White River, and on the other hand with still later or recent forms. The collection sent to the Smithsonian Institution was thence transmitted to the author, and is noticed in the Proceedings of the Academy for 1858. It also forms a most important portion of the material of the present work.

As a further contribution to the latter, additional material was obtained by Dr. Hayden, who made another expedition in the summer of 1866 to the Mauvaises Terres of White River, under the auspices of this Academy.

The Mauvaises Terres fossils are thoroughly petrified, their original peculiar animal matters being almost entirely replaced by ordinary mineral matter.

The bones are usually white or cream-colored, yellowish-white, and more rarely iron-gray. They are hard, compact and heavy; brittle, but rarely friable. The interior spongy substance, vascular canals, and generally the medullary cavities are occupied with dense mineral matter, usually silex in the form of chalcedony, which in the larger medullary cavities, partially occupied, has a botryoidal arrangement.

The bones are preserved in various degrees of integrity, many being nearly perfect, but generally the skulls are more or less fissured or otherwise fractured, and some are more or less crushed. Notwithstanding their fractured condition, usually the fragments are retained in their original relative position by the associated matrix, which occupied all the cavities and depressions of the fossils, and in many instances more or less enveloped the specimens.

The fossils exhibit the appearance of having been originally imbedded in soft mud, and subsequently submitted to more or less pressure, which will account for their fissured appearance without any great extent of displacement of the fragments.

The teeth are generally in a perfect state of preservation. Their dentine is white or cream-colored, and compact, though more friable than in the recent condition. The enamel is well preserved in texture, but is invariably stained. Its color varies in different specimens, from a light translucent brown with a corneous aspect, passing through different shades of brown to grayish and bluish-black. Its surface is highly lustrous, and when dark in color looks in some instances like polished iron.

None of the fossils have the appearance of being water-worn or rolled, but all the bones and teeth are preserved with their original freshness of shape and sharpness of detail. The condition of the specimens indicates the carcasses of the animals to which the bones belonged to have undergone decomposition in comparatively quiet water, on a soft muddy bed, which is further proved by the character of the associated matrix of the fossils.

The matrix, slightly variable in character from the different strata, is usually of a dull grayish, or whitish ash, or dusky cream color, sometimes with a pinkish aspect, homogeneous, and without admixture of pebbles or visible sand. It is harder than ordinary chalk, but softer than marble or ordinary limestones, is not crystalline, nor does it exhibit distinct lines of stratification. It is mainly composed of silica with carbonate of lime, or, in other words, it is a soft siliceous limestone.

It is a remarkable circumstance that among the large quantity of fossil bones brought from the Mauvaises Terres and submitted to the examination of the author, certainly amounting to several tons in weight, there were detected no trace of remains of birds or fishes, and the same may be said of reptiles, except one species of turtle. The remains of the latter are exceedingly numerous, consisting almost exclusively of the shells, or carapace and sternum, filled with matrix occasionally enveloping some of the bones of the interior skeleton. The fossil turtles were so abundantly strewed over the country of some parts of the Mauvaises Terres, that localities have been named after them.

The fossil turtle shells of the Mauvaises Terres exhibit considerable variety of form, varying in the relations of height to length and breadth, and also varying in anatomical details, so that the author was at first led to suppose they indicated five different species. Since describing these in the "Ancient Fauna of Nebraska," the examination of many other specimens has led him to view them all as pertaining to a single species. This appears to have been a land turtle, for which the name of *Testudo*, or *Stylemys Nebrascensis*, is retained.

The almost perfect shell of an adult specimen, in the Museum of the Academy, obtained by Dr. Hayden in the expedition of 1866, has the following measurements:

Length of sternum, ...	20 inches.
Breadth "	15 "
Length of antero-posterior curve of carapace, ...	27 "
Length of transverse " "	26 "
Height of carapace above level of sternum, ...	8 "

The collection of fossils from the Niobrara River in quantity forms but a comparatively small portion of those forming the material of the succeeding pages. It was exclusively obtained by Dr. Hayden in the only known visit made to the locality, in 1857. The fossils were for the most part picked up during the expedition, from the loose sands of the locality. They are remarkably well preserved, and are devoid of adherent matrix. The bones are not fissured, nor are they generally water-rolled, but usually retain their original freshness of shape. A few, however, are water-rolled, and many small fragments of teeth also present this appearance.

Most of the Niobrara fossils are like those of the Mauvaises Terres, completely petrified, but this concerns the structure of the bone and dental tissues alone. The interstices of the spongy substance of the bones, the medullary cavities, and the cavities and depressions of the skulls and teeth, are devoid of adherent matrix or infiltrated mineral matter. Other of the fossils appear only partially petrified, and some appear to have undergone but little change except in losing some of the bone cartilage. It is even uncertain that a few of the bones viewed as fossils may not have belonged to recent animals. Many of the fossils contained within their cavities loose quartzose sand, like the ordinary white quartzose sand of certain river and sea shores.

The collection of Niobrara fossils is almost equally devoid of any other than mammalian remains, and those of a species of turtle. A couple of nearly uncharacteristic fragments of bird bones are suspected to have belonged to the recent Sand-hill Crane. The remains of turtles, from a want of adherent matrix to hold the parts together, consist of a multitude of fragments of the shells, of all ages. They perhaps indicate a species distinct from that of the Mauvaises Terres, and the author in this view has named it *Testudo* or *Stylemys Niobrarensis*. It is certainly very like the Mauvaises Terres *Testudo*, and probably was the unchanged successor of the latter, and therefore not a distinct species.

The few remaining fossils described in the body of the work, from Texas and California, in general character bear a close resemblance to those of the Mauvaises Terres.

Of fossil invertebrata only a single species of mollusk was found in association with the fossil bones in the several localities mentioned. This consists of the casts of a land snail, occurring abundantly in the Mauvaises Terres, and described by Messrs. Meek and Hayden under the name of *Helix Leidyi*.

Among the fossil mammalian remains of the tertiary formations of Dakota and Nebraska thus far brought to our notice, there are no traces of Primates, neither of Man nor Monkeys; none of Bats, Edentates, Marsupials, Monotremes, Seals, Sirenians nor Cetaceans. The other orders are well represented, especially the Carnivora, Pachyderms and Ruminants. The Solidungulates are better represented than in the recent faunæ of any part of the world, and indeed the pliocene deposit of the

Niobrara would appear to indicate that the North American continent was at one time emphatically the country of Horses. Proboscidians, Rodents and Insectivores are fairly represented.

Besides the fossils described as characteristic of extinct species, the various collections submitted to my examination contain fragments indicating a number of others, mostly of Pachyderms, Ruminants and Carnivores, but too imperfect to determine their nature.

The Mauvaises Terres collections of fossils rarely contained any considerable portions of skeletons preserved in continuity in masses of matrix. With the exception of skulls, a few vertebræ in series, some leg bones together, and several feet, the collections for the most part consisted of isolated bones, and, of the long ones, generally the articular extremities. The absence of more complete parts of skeletons, no doubt, in a measure has depended on the difficulty of removal and transportation of large masses or slabs of rock containing them. They have been reported to exist, and in future, when in the progress of opening up of the country greater facilities will be afforded, they will no doubt be obtained and brought to the investigation of the student.

The Niobrara fossils, from the nature of the deposit from which they were obtained, in all cases consist of isolated bones and fragments, teeth, and portions of skulls, mingled pell mell.

In the present work only the more characteristic fossils are described and figured, such as skulls, portions of the same, jaws and fragments of the same, and teeth. Isolated bones and well preserved fragments of others, usually of the extremities, though abundant, have not been represented, and in many instances have not been described, as their peculiarities are too slight to be evident in description without accompanying figures. The pecuniary means at command precluded more complete illustration of the work than is given included in twenty-nine quarto plates. Economy of means, indeed, has been so important a consideration that in many cases views of specimens, when incomplete, have been restored from the opposite side, thus saving the necessity of giving a representation of the two sides of the same specimen.

CARNIVORA.

Of Carnivora there are fifteen extinct species, exclusive of Insectivora, described in the succeeding pages and referred to seven genera, of which all except one are extinct, and of which three are for the first time noticed.

Four species of the genus *Canis*, together with a supposed feline animal named *Ælurodon ferox*, and a feline animal of the genus *Pseudælurus*, belong to the pliocene tertiary formation of the Niobrara River. I am, however, not positive that the remains described under the names of *Canis sævus*, *C. temerarius* and *C. vafer* are all really pliocene fossils; it is not improbable that some of them may have belonged to varieties of more recent or even of existing Wolves.

Another extinct carnivore, apparently allied to the *Coatis*, and named *Leptarctus primus*, is indicated by an isolated tooth, found in a formation, also viewed as of the pliocene age, at Bijou Hill, east of the Mississippi River, about ten miles below the mouth of White River.

The remaining animals consist of three species of *Hyænodon*, two of *Amphicyon*, two of *Drepanodon*, and a genus of peculiar character allied to the latter, and named *Dinictis*. The remains of these were discovered in the silico-calcareous rock of the miocene bed B, of Dr. Hayden's section, in association with remains of Oreodon, Turtles, &c., in the Mauvaises Terres of White River, Dakota.

CANIDÆ.

CANIS.

Canis sævus.

An extinct species of Wolf, probably a near relative, if not the progenitor of the existing American Wolf, *Canis occidentalis*, is supposed to be indicated by two mutilated fossil fragments of lower jaws, obtained by Dr. Hayden from the sands of the Niobrara River.

Both specimens belonged to old animals. The best preserved one, represented in figure 9, plate I, retains the sectorial molar and the succeeding tubercular molar; the other specimen retains the latter tooth and the third premolar.

The fragments accord in form, proportions and size with the corresponding portion of the lower jaw of large varieties of the *Canis occidentalis*.

The measurements of the two specimens, in comparison with those of a large variety of the *Canis occidentalis* from Oregon, are as follows:

	C. sævus.		C. occid.
Space occupied by the back five molars, . .	33 lines.	36 lines.	39 lines.
Depth of jaw below sectorial molar, . .	14 "	$16\frac{1}{2}$ "	$16\frac{1}{2}$ "
Thickness " " " . .	7 "	7 "	7 "
Depth below the third premolar, . .	$10\frac{1}{2}$ "	14 "	14 "
Antero-posterior diameter of sectorial molar, .	13 "	14 "	14 "
Transverse " " " .	5 "	6 "	$5\frac{1}{2}$ "

Canis temerarius.

An extinct species of Wolf, or perhaps Fox, for which the above name has been proposed, is supposed to be indicated by two small fragments of jaws obtained by Dr. Hayden from the Niobrara sands.

One of the fragments consists of a portion of the upper jaw containing the sectorial molar and the succeeding tubercular molar, both mutilated. The other fragment, represented in figure 12, plate I, consists of a portion of the lower jaw containing the sectorial molar. The specimens are intermediate in size with the corresponding portions of the jaws of the Prairie Wolf, *Canis latrans*, and the Red Fox, *Canis fulvus*, and they accord with them in form and proportions.

The measurements of the specimens, in comparison with corresponding portions of the latter species, are as follows:

	C. tem's.	C. latrans.	C. fulvus.
Space occupied by the upper sectorial and first tubercular molars, ...	12 lines.	14 lines.	$10\frac{1}{2}$ lines.
Antero-posterior diameter of the upper sectorial molar, ...	$7\frac{1}{2}$ "	9 "	$6\frac{1}{2}$ "
Transverse diameter of first upper tubercular molar,	7 "	8 "	6 "
Depth of lower jaw at sectorial molar, . .	8 "	9 "	7 "
Antero-posterior diameter of sectorial molar, .	$7\frac{1}{2}$ "	10 "	7 "

Canis vafer.

A doubtfully extinct species of Fox, distinguished by the above name, was supposed to be indicated by the greater portion of both halves of a lower jaw, obtained by Dr. Hayden from the Niobrara sands, with other fossils. The better half of the specimen is represented in figure 11, plate I, and contains all the molar teeth except the first one, which has been introduced in the figure from the other side of the jaw. Notwithstanding its associations, it approaches so closely in character the corresponding portion of the lower jaw of the existing Swift Fox, *Canis velox*, that it may reasonably be supposed to belong to this animal. The ascending portion of the ramus is broken off on both sides, but sufficient remains to indicate that it was constructed as in the animal just named, and not as in the Gray Fox, *Canis virginianus*.

The measurements of the specimen, in comparison with those of a lower jaw of the recent *Canis velox*, are as follows:

	C. vafer.	C. velox.
Space occupied by the inferior molars,	21 lines.	22 lines.
Depth of the jaw at the sectorial molar,	6 "	5½ "
Depth of the jaw just back of the symphysis,	4½ "	4½ "
Antero-posterior diameter of the sectorial molar,	5½ "	5½ "

Canis Haydeni.

An extinct species of Wolf, distinguished by the above name, of more robust proportions than any now in existence, is indicated by a fragment of the right side of a lower jaw, from the Niobrara River.

The specimen is represented in figure 10, plate I. The jaw contains the sectorial molar and the preceding two premolars, very much worn, and therefore indicating an aged individual. It also contains the sockets of both tubercular molars.

The jaw fragment has the same form as the corresponding portion in the American Wolf, *Canis occidentalis*, or the European Wolf, *Canis lupus*, except that its ramus ascends a relatively shorter distance from behind the position of the sectorial molar. In consequence of the latter circumstance the tubercular molars appear crowded in position in comparison with their condition in the recent species just mentioned; and the last tooth was even directed forward from the ascending border of the ramus above the level of the worn heel of the sectorial molar.

The teeth remaining in the specimen, so far as can be judged in their worn condition, have had the same form and relative proportions as in the recent Wolves above named.

The last tubercular molar differed from the corresponding tooth of recent Wolves, and also from that of the extinct allied *Amphicyon* and *Cynodon*, in its having had two fangs, well separated, as indicated by the remaining pair of alveoli. The fangs of the first tubercular tooth were widely separated.

A pair of vasculo-neural foramina, communicating with the inferior dental canal, are situated below the back pair of premolars.

The huge species of extinct Wolf indicated by the fossil was dedicated to its discoverer, Dr. Hayden.

The measurements of the specimen, compared with those of the corresponding portion of the jaw and teeth of a large skull of the American Wolf, *Canis occidentalis*, from Oregon, and a nearly equally large one of the European Wolf, *Canis lupus*, from Germany, presented to the Academy by Prince Maximilian de Wied, are as follows:

	C. Haydeni.	C. occident's.	C. lupus.
Space occupied by the back five molars, . .	46 lines*.	39 lines.	36 lines.
Space occupied by the tubercular molars, .	14 "	10 "	8½ "
Depth of jaw below middle of sectorial molar, .	21 "	17 "	15 "
Thickness " " " " .	9½ "	7 "	7 "
Thickness of jaw below third premolar, . .	10 "	6 "	5½ "
Thickness of ascending border of ramus an inch above the alveolar border of the sectorial molar, ...	8 "	4¼ "	4 "
Thickness of do. an inch and a half above the same,	8 "	3 "	2½ "
Antero-posterior diameter of third premolar, .	7 "	7 "	6½ "
" " " fourth " .	10 "	8 "	7½ "
Thickness of do., ...	5 "	3½ "	3½ "
Antero-posterior diameter of sectorial molar, .	17 " †	14¼ "	14 "
Thickness of do., ...	7½ "	5½ "	5½ "
Antero-posterior diameter of first tubercular molar,	8½ " ‡	6 "	6 "
" " " second " "	5 " ‡	3 "	3 "

AMPHICYON.

An extinct genus of carnivorous animals, named *Amphicyon* by M. Lartet,§ from some fossil remains found in the miocene formation of Sansans, France, would appear, by the general form and contraction of the teeth, to belong to the family of the Wolves, *Canidæ*. From slight differences, however, in the dentition, together with characters drawn from the skeleton, M. De Blainville‖ viewed the genus as rather belonging to the family of "Petits-ours," or little Bears, or of "Subursus," as he calls it.

MM. De Blainville¶ and Gervais** ascribe to the molar series of *Amphicyon* a formula differing from that of other genera of *Canidæ*, in the possession of an additional or third tubercular molar to each side of both jaws. M. Lartet,†† who first indicated the genus, mentions as the chief character distinguishing it, the presence of a third tubercular molar to the upper molar series, but makes no mention of the number of teeth in the lower jaw. In M. De Blainville's figures of the specimens, in plate, Subursus, xiv, of the Ostéographie, upon which M. Lartet proposed the

* This space would be even greater if the tubercular molars were on the same level as in the two recent Wolves.

† Allowance made for the imperfection of the fore part of the tooth.

‡ Estimated, from the extent of the alveoli.

§ Bull. Soc. Geol. 1836, vii, 219. ‖ Ostéographie, Petits-ours, p. 96. ¶ Ibid., 81, 82. ** Zool. et Paléon. Franc., t. 1, p. 111. †† Supra.

genus, there appear to be represented, as the formula of the tubercular molars, three for the upper jaw and two for the lower one. Prof. Bronn* gives as the formula for the molar dentition of *Amphicyon*, for the upper series: 3 premolars, 1 sectorial molar, and 3 tubercular molars; for the lower series: 4 premolars, 1 sectorial molar, and 2 tubercular molars. Pictet† gives the same formula for the upper molar series, but for the lower series 4 premolars, 1 sectorial molar and 3 tubercular molars.

Fossil remains from the miocene deposits of France and Germany have been referred to a dozen different species of *Amphicyon*, though but a small proportion, from a paucity of material, have been well characterized. Several teeth, apparently of a huge species of the genus, were indicated by Cuvier‡ as having belonged to a "Chien d'une taille gigantesque."

The best characterized species of the genus, also of huge size, and thought by De Blainville and M. Gervais to be the same as the "Chien" just mentioned, is founded on the specimens obtained at Sansans by M. Lartet, and named by De Blainville *Amphicyon major*.

The remains of two species of carnivorous animals, apparently referrable to the genus *Amphicyon*, have been found in association with remains of *Oreodon*, etc., in the calcareous marl deposit of the Mauvaises Terres of White River, Dakota.

Amphicyon vetus.

Viewing the fossil remains from Sansans, France, as typical of the genus *Amphicyon*, indicated by M. Lartet, and specified under the name of *A. major* by M. De Blainville, the remains of a smaller species, apparently referrable to the same genus, were discovered by Dr. John Evans and Dr. Hayden in the Mauvaises Terres of White River, Dakota. They consist of a mutilated cranium, without the face, together with fragments of the jaws from the same individual, and small fragments of jaws, apparently of three other individuals.

The fossils indicate a skull approaching in size that of the Prairie Wolf, *Canis latrans*, but having a smaller cranium, more powerful jaws, and smaller and more numerous teeth.

The specimen of the cranium has lost the greater portion of the occipital region, one zygoma, and is otherwise mutilated and fissured. It belonged to an old animal, nearly all the sutures being so completely obliterated as not to be traceable in their course.

The cranium, as seen in the upper view, figure 1, plate I, is altogether smaller than in the Prairie Wolf, and does not much exceed that of the Red Fox, *Canis fulvus*. Proportionately to its size, it is longer, narrower, and of less depth and full-

* Lethaea geognostica, 3 ed., p. 1080. † Traité de Paleontologie, t. 1, p. 194. ‡ Ossemens Fossiles.

ness than in any of the existing canine race. It appears less ovoid than in the latter. From the parietal convexity it narrows more rapidly forward to a position opposite the commencement of the forehead, where it is even more constricted than in the Red Fox. It is divided by the remains of a long, strong and high sagittal crest, as in the European Badger, *Meles taxus*. This crest bifurcates far forward, as in the latter, the division being comparatively acute, and the forehead apparently has been proportionately narrow.

The zygomatic arch is of much greater strength and capacity than in recent Wolves of much larger size. It starts rather less abruptly outward than in the latter animals, being slightly directed forward even from its commencement.

The glenoid cavity is proportionately larger than in the Wolves, and is much more concave, this difference being mainly due to the production downward of the anterior border, as in many other carnivorous animals. The post-glenoidal tubercle is broader, and stronger than in the Wolves.

The occipital condyles and foramen have nearly the same form and size as in the Prairie Wolf.

The tympanic bulla appears to have been remarkably small, and was not at all prolonged outwardly in an auditory process, as in the Wolves. On one side of the specimen it is destroyed, but on the other side appears to be entire except internally, where it is open, perhaps is broken, and is filled with the matrix of the fossil. In its present condition, the tympanic bulla appears as a comparatively narrow arch, concave internally, with its posterior abutment joining the post-auditory process of the squamosal, and its anterior abutment resting on the fore and under part of the petrosal, extending inward to the Eustachian foramen.

Behind and internal to the back half of the auditory bulla, there is a remarkably large reniform fossa. At first it appeared to me as if this fossa had been enclosed with an auditory bulla, and what I have described as the latter was a peculiarly modified auditory process. The fossa is partly formed by a deep excavation of the basi-occipital; and at its bottom may be seen a portion of the petrosal. The outer extremity is bounded by the mastoid and paramastoid processes. It probably accommodated a dilatation at the commencement of the jugular vein.

The paramastoid process is a conical pointed appendage, widely separated from the auditory bulla by the intervening mastoid process and the outer extremity of the jugular fossa.

In consequence of the small size of the auditory bullæ, the intervening space appears of greater breadth than in the ordinary *Canidæ*, but independently of this modification, and the existence of the large jugular fossæ, the basi-occipital and sphenoids, the space at the roots of the pterygoids, and the anterior condyloid, Eustachian and oval foramina present very nearly the same condition as in the Wolf.

A small fragment of the upper jaw attached to the same mass of matrix, and belonging to the same individual as the cranium just described, served to indicate the genus to which the animal belonged. It consists of a small portion of the left maxillary bone containing the three tubercular molar teeth, represented in figure 5, plate I.

Notwithstanding the worn condition of these teeth, much of the enamel having been abraded away, they are observed to bear a near resemblance to the corresponding ones of the Wolf and of the extinct *Amphicyon major*. They have the same constitution as in these animals, and are intermediate in size to those of the Prairie Wolf and the Red Fox.

The third tubercular molar, peculiar to the genus *Amphicyon*, has a small transversely oval crown, with two tubercles, and is inserted into the jaw by a single fang.

Another small fragment of an upper jaw, belonging to a different, smaller, and less aged individual than the former, contains the sectorial molar, the succeeding pair of tubercular molars, and part of the alveolus for the third. The teeth are represented in figure 6, plate I, in which the tubercular molars are seen to be like the corresponding ones represented in figure 5, but are smaller. The sectorial molar has the same form, constitution and size as that of the Red Fox, except that it is thicker at the fore part.

A third small fragment of an upper jaw, belonging to a different individual from the former ones, contains the first and second tubercular molars and the sockets for the third. The teeth have nearly the same size as those of the last described fragment, but the second is slightly larger.

The tubercular teeth in all the three specimens described differ slightly in outline and size, as the corresponding teeth do in different individuals of any recent species of Wolf or Fox.

A fragment of the lower jaw belonging to the same individual as the cranium above described, represented in figure 2, plate I, consists of the posterior portion of the left ramus, containing the heel of the sectorial molar, and the two tubercular molars.

The jaw fragment in form and proportions bears a close likeness to the corresponding portion of the same bone in its giant relative, the *Amphicyon major*, as represented in plate, Subursus, xiv, of M. De Blainville's Ostéographie. It is proportionately very much more robust than in recent canine animals, while the contained teeth are proportionately rather smaller. It is absolutely larger and stronger than in smaller varieties of the *Canis occidentalis*. The body of the jaw below the back molars is considerably deeper, the coronoid process, while having nearly the same length, is very much wider, the external muscular fossa is very much deeper and capacious, and the condyle is far more robust. The base of the jaw rises less at its back part, and is longer in this position. The angle, though broken in the specimen, appears to have been shorter and more robust. The lower part of the masseteric fossa is more nearly parallel with the base of the jaw.

The tubercular teeth contained in the specimen resemble those of the Wolf in constitution, proportions, and mode of insertion. The first tubercular molar is rather less in size than that of the Prairie Wolf, while the second is in a trifling degree larger.

A small fragment of the right side of the same jaw, represented in figure 3, plate I, contains the sectorial or principal molar tooth. It has the same form and constitution as in recent canine animals, is much smaller than in the Prairie Wolf, and little exceeds that of the Red Fox, having about the same breadth, but being higher and much more robust or thicker.

Another fragment of the lower jaw, belonging to a different individual from any of the preceding specimens, and represented in figure 4, plate I, also contains the sectorial molar. The tooth is smaller than the one above described, and nearly approaches in size that of the Red Fox, being about the same length, rather thicker, but not quite so broad. The jaw fragment, containing the tooth, agrees nearly in robustness with the corresponding portion of the larger jaw specimen above described.

Measurements derived from the fossils referred to *Amphicyon vetus*, in comparison with those derived from skulls of *Canis latrans* and *Canis occidentalis*, are as follows:

	Amp. vetus.	C. latrans.	C. occid's.
Breadth of cranium immediately above the root of the zygoma and over the middle of the auditory meatus,	23 lines.	25 lines.	27 lines.
Greatest breadth of cranium in the parietal region,	21 "	25 "	26 "
Narrowest portion of the cranium,	10 "	16 "	17 "
Distance from the anterior margin of the occipital foramen to the anterior division of the sagittal crest,	34 "	30 "	37 "
Length of sagittal crest, estimated in the fossil,	31 "	24 "	27 "
Long diameter of occipital condyles, or distance between the two ends,	9 "	8½ "	9 "
Transverse diameter of occipital foramen, estimated in the fossil,	8 "	7½ "	8 "
Distance between anterior margin of occipital foramen and the oval foramen,	18 "	19½ "	21 "
Breadth of glenoid cavity,	12 "	10½ "	12 "
Extent of glenoid cavity between the fore and back margins,	6 "	5 "	6 "

			Amp. vetus.	C. latrans.	C. occid's.
Depth of zygoma just outside of the glenoid cavity,			6 lines.	5 lines.	5 lines.
Depth of lower jaw below the first tubercular molar,			12 “	8 “	9½ “
Depth of jaw from end of coronoid process to angle,			27 “	22 “	26½ “
Depth of jaw from condyle to level of angle, .			11½ “	10½ “	11½ “
Breadth of base of coronoid process, . .			20 “	14 “	15 “
Length of coronoid process to level with alveolar border, ...			18 “	13 “	16 “
Breadth of condyle, ...			12 “	10 “	10 “
Antero-posterior diameter upper sectorial molar, . .		6¼ lines.		9½ “	9¼ “
Transverse do. in front, .		4 “		4½ “	4¼ “
Antero-posterior diameter upper first tubercular molar, .	5 lines.	5 “	6 “	6¼ “	6¼ “
Transverse do., . .	7 “	7 “	7¾ “	8¼ “	8¼ “
Antero-posterior diameter upper second tubercular molar, .	3 “	3 “	3½ “	3½ “	3¾ “
Transverse do., . .	5 “	4½ “	5½ “	5½ “	6 “
Antero-posterior diameter upper third tubercular molar, .			1½ “		
Transverse do., . .			2¾ “		
Antero-posterior diameter lower sectorial molar, ...		6¾ “	7½ “	10 “	10½ “
Transverse diameter do., . .		3 “	3½ “	3½ “	3¾ “
Antero-posterior diameter lower first tubercular molar,			4½ “	4¾ “	4¾ “
Transverse “ “ “			3 “	3½ “	3½ “
Antero-posterior diameter lower last “			2½ “	2¼ “	2½ “
Transverse “ “ “			2 “	2 “	2¼ “

Amphicyon gracilis.

A small fragment of a lower jaw, containing two teeth, discovered by Dr. Hayden in the calcareous marl rock of the Mauvaises Terres of White River, apparently indicates another species of *Amphicyon* much smaller than the preceding, for which the name of *A. gracilis* is proposed. It was the only specimen appertaining to the animal that has been found, and is represented in figure 7, plate I.

The jaw fragment and teeth agree in their proportions with the corresponding parts of *Amphicyon vetus*, in comparison with those of recent canine animals. The portion of jaw is nearly as large as the corresponding portion in the Swift Fox, *Canis velox*, while the teeth are not only much smaller than in this animal, but are smaller than in the smallest existing species of American Foxes, the *Vulpes littoralis* of the island of San Miguel, on the coast of California, described by Prof. Baird.*

The teeth contained in the specimen consist of the sectorial molar and the premolar in advance. They have the same form and constitution, and nearly the same proportions as in existing canine animals.

The measurements of the specimen, in comparison with those of the Swift Fox, are as follows:

	A. gracilis.	C. velox.
Depth of lower jaw below sectorial molar,	5 lines.	$5\frac{1}{2}$ lines.
Antero-posterior diameter of sectorial molar,	$4\frac{1}{2}$ "	6 "
Transverse " " "	2 "	$2\frac{1}{2}$ "
Height of sectorial molar,	$2\frac{3}{4}$ "	3 "†
Antero-posterior diameter of premolar in advance,	3 "	$3\frac{1}{2}$ "
Transverse " " "	$1\frac{1}{2}$ "	$1\frac{3}{4}$ "
Height of premolar,	2 "	$2\frac{3}{4}$ "†

Dr. Hayden's last collection from the Mauvaises Terres contains several additional fragments of lower jaws, and the greater portion of the facial extremity of a skull of *Amphicyon gracilis.*

One of the lower jaw fragments contains the sectorial molar and the succeeding tubercular molars, which, together with the premolar in advance from the specimen first described, are represented in figure 9, plate V. The sectorial molar and the first tubercular molar are like those of the Dog. The second tubercular molar, though small, is not of the simple character of that of the latter, but is inserted by a pair of fangs and has a crown, which in form is the reduced likeness of its fellow in advance.

The facial portion of a skull represented in figures 6, 7, 8, plate V, resembles in its construction the corresponding part of the skull of the Dog or Fox. The face is relatively shorter, and the molar and canine teeth are closer together. The sagittal crest is linear, and remains undivided to within a few lines of the position of the postorbital processes. A slight depression of the surface exists just in advance of the ant-orbital margin, and a depression also exists over the post-orbital processes.

The specimen contains on the right side the sectorial molar and the succeeding tubercular molar, which agree in character with those of the Dog. In advance of these teeth are the sockets of all the others, which agree in number with those of the latter animal.

Measurements of the specimens are as follows:

* Rep. of Expl., &c., for a Railroad, vol. viii, p. 143.

† These measurements estimated, as the teeth are much worn in the specimen.

Antero-posterior diameter of lower sectorial molar, . . .	4½ lines.
Height of do., ...	3 "
Antero-posterior diameter of first lower tubercular molar, . .	2½ "
" " second " " . .	1½ "
" " upper sectorial molar, . . .	4¾ "
" " " first tubercular molar, . .	3½ "
Transverse diameter of " " " " . .	4 "
Distance from incisive alveoli to back of the latter tooth, . .	22 "
Breadth of face between the canine alveoli, ...	8 "
" " " sectorial molar alveoli, . . .	15 "
Distance from sagittal crest to end of nasal bones, . . .	21 "
Breadth of forehead at post-orbital processes, ...	9 "
Length of forehead, ...	9 "
Length of nasal bones, ...	12 "

HYÆNODONTIDÆ.

HYÆNODON.

Hyænodon is a remarkable extinct genus of carnivora, apparently the type of a family no longer in existence, partaking of characters of the Wolves, Cats, Hyæna, Weasels, and the smaller plantigrade animals, besides exhibiting resemblances to some of the carnivorous marsupials.

The genus was first indicated under the name of *Hyænodon* by MM. de Laizer and de Parieu, from a lower jaw with teeth, discovered in the inferior miocene formation of Auvergne, Puy-de-Dome, France. Remains, apparently of another species, found in association with those of *Palæotherium* and *Anoplotherium*, in the gypsum quarries of Montmartre, near Paris, had been described by Cuvier, who recognized their eminently carnivorous character, and, from the prolongation of the palate, considered them as belonging to an animal allied to the Raccoon, Badger, Coati and the Mangusta.

Altogether about five species of *Hyænodon* have been indicated from the tertiary formations of France, of which the best characterized, *H. leptorhynchus* and *H. brachyrhynchus*, were derived from the lower miocene, and the others belong to the upper eocene deposits.

The remains of three distinct species of the same genus have been discovered in the Mauvaises Terres of White River, Dakota, by Dr. John Evans, Dr. Benjamin Shumard, Dr. Hayden and Mr. Meek.

Hyænodon horridus.

The largest species of *Hyænodon* of Dakota, distinguished by the above name, probably the most sanguinary and dreaded enemy of its numerous ruminant associates, the *Oreodons*, etc., greatly exceeded in size any of the described European species; its skull fully equalling that of the largest individuals of the Black Bear, *Ursus americanus*.

Of this species we have the opportunity of examining a much mutilated skull, including the jaws and teeth, the greater part of a skull in a less fractured condition, and several small fragments of jaws with teeth from two other individuals.

Plate III represents the skull of *Hyænodon horridus*, of which the anterior portion and teeth are taken from the first mentioned specimen, and the posterior portion from the second specimen *

In general form the skull of *Hyænodon horridus* is unlike that of any recent animal, and is intermediate in shape to that of the Wolf and that of the Opossum. In comparison with the skull of the Black Bear, nearly the same size, the cranium is shorter and narrower; the face longer and narrower, but deeper.

Posterior view of the cranium.—The inion is triangular as in the Wolf, but appears to have projected less at its upper part, and is more hollowed or concave at the sides. The occipital condyle has the same form as in the Wolf, but is more horizontal in position. The occipital foramen appears to have been more circular, or higher in relation with its breadth, than in the latter animal.

The paramastoid process appears to have been feebly developed in comparison with its condition in the Wolf; the mastoid process is much better developed than in the latter.

The occipito-mastoid suture descends through the middle of the lateral concavity of the inion.

A moderately large mastoid foramen pierces the pars mastoidea within a short distance of the lateral border of the inion.

Superior view of the cranium.—Viewed above, the cranium of *Hyænodon horridus* bears a much more striking resemblance to that of an Opossum than to that of the Wolf, and, indeed, agrees with it also much more nearly in its proportions and relative capacity. It presents an hour-glass shape; is most constricted a short distance in advance of the middle of the temporal fossæ, and expands nearly equally backward and forward.

A long, high sagittal crest extends from an equally elevated border of the inion to near the middle of the frontal bone, separating the capacious temporal fossæ.

* Back of the dotted line, at the fore part of the temporal fossa, and of that in advance of the last tooth of the lower jaw.

The forehead is as broad as that of the Black Bear, is transversely convex, but depressed along the middle. It is bounded posteriorly by the temporal ridges, diverging more rapidly than in the Wolf from the sagittal crest, curving forward, outward, and then backward to the ends of the orbito-angular processes. Anteriorly it is defined by a wide-spread W-like suture between the frontal, lachrymal, maxillary and nasal bones.

Temporal fossæ.—The temporal fossæ are of great extent and capacity, quite equalling those of any other carnivorous animals. The zygomata are destroyed in the fossils, but their remaining abutments indicate that they were as wide-spread as those of the Wolf.

Posteriorly the temporal fossa is defined from the inion by a high, sharp border, which appears to have been less inclined than in the Wolf.

The pars squamosa contributes to the temporal surface in a different manner from that which is usual among recent carnivora. It ascends to within a short distance of the sagittal crest, and is much higher than the breadth. The parietal, in conseqence, sends its narrowest portion posteriorly to meet the occiput, while a broad plate descends in front of the squamosal to meet the ali-sphenoid.

The fronto-parietal suture descends nearly vertically at the most constricted or narrowest portion of the cranium.

The glenoid cavity is transverse, and is sustained behind by a strong, broad tubercle, as in the Bear. The articular surface, partly horizontal, also extends downward on the post-glenoid tubercle. The temporal surface of the zygomatic root forms a much greater inclination than in the Wolf or Bear, and the posterior surface inclines backward.

A high archway between the post-glenoid tubercle and mastoid process leads to the position of the auditory meatus, which is destroyed in the fossils. The space between the post-glenoid tubercle and the paramastoid process is small compared with that in the Wolf, and could have accommodated a comparatively small auditory bulla.

The face.—The face is relatively about as long as in the Wolf, but proportionately higher and wider, and therefore more robust. Its upper part continues the general convexity of the forehead, but is not depressed along the middle like the latter. It slopes nearly in a straight line to the end of the nose, and curves off laterally to the nearly vertical sides.

Laterally the face does not contract posteriorly, but widens in a triangular manner to the roots of the zygomata.

The infra-orbital foramina have the same form and relative position as in the Wolf, being situated just above the third premolar teeth.

The nasal bones are long and broad, and bear some resemblance to those of the

Opossum. They are strongly arched transversely, and are widest where they include the ends of the anterior angular processes of the frontal bone. Between the latter they form together a posterior triangle. In advance of their widest part they become rapidly narrowed for a short distance, and then proceed onward of nearly uniform breadth until, approaching the end of the nose, they slightly widen again. Their free ends are notched at the middle, leaving the intermediate and lateral processes of about equal length.

The anterior nasal orifice has about the same form as in the Wolf, but is less inclined.

The upper extremity of the intermaxillaries extends back about as far as the interval of the first and second premolars.

The lachrymal bone contributes an elongated surface to the side of the face, extending nearly the entire depth of the orbital entrance. At the orbital border near its middle it is elevated into a short obtuse process. The face between the position of the lachrymal process just mentioned and the infra-orbital foramen is somewhat depressed or slightly concave.

The orbits.—The orbits are relatively about the size of those of the Wolf, but they have a broader floor and their inner wall is more concave. They are also better defined by a more prominent, subacute ridge, proceeding from the superior orbito-angular process obliquely backward, downward and inward. The latter process is almost as well developed as that of the Black Bear. The inferior orbito-angular process appears feebly developed.

The orbital entrance has nearly the form of that of the Wolf, but the lower border has a more downward direction from the front part. The direction of the entrance is peculiar compared with that in ordinary carnivorous animals, being nearly vertical, with a slight inclination forward and upward.

The palatine region.—The hard palate expands to the back end of the alveolar borders, and is strongly arched transversely compared with its condition in the Wolf. Posteriorly, through the medium of the palate bones, it is prolonged into a cylindroid canal, as in the Raccoon, Weasel, Deer, etc.

The alveolar borders of the jaw diverge from the position of the premolars to their posterior extremity, which appears to be almost continuous outwardly, and backward with the zygoma. They gradually increase in depth posteriorly so as to form prominent ridges, which greatly contribute to the transverse arching of the back part of the hard palate.

The posterior extremity of the alveolar ridge forms the anterior abutment of the zygoma, and has inserted into it the sectorial molar, leaving no space sufficient for the lodgement of a tubercular molar. It is separated from the hard palate and its prolongation backward by a deep notch, the bottom of which reaches as far forward as the middle of the sectorial molar.

The inferior maxilla.—The lower jaw of *Hyænodon horridus* is intermediate in form to that of the Wolf and Bear. It is relatively as long as in the former, and its back portion is relatively as broad as in the latter.

The base intermediately is nearly straight or slightly convex, but approaching the angle it is directed slightly downward, and at the symphysis becomes strongly convex.

The symphysis is longer than in the Bear, convex longitudinally, and somewhat flattened transversely.

The sides of the jaw are vertical and slightly convex. A row, apparently of three, mental foramina, occupies the side of the chin.

The back portion of the jaw, in relation with that of ordinary carnivora, is of great breadth in comparison with its height. It is impressed externally with a deep triangular masseteric fossa, the longer side of which runs nearly parallel with the base of the jaw as far forward as the back third of the sectorial molar. The fossa is bounded below by a thick rounded ridge forming that portion of the base of the bone.

The coronoid process is comparatively short, as in the Bear. It has a wider base than in the latter; is shorter along its anterior sigmoid border, but longer upon its posterior concave border. It approaches more an equilateral triangle than in the Bear, and has its more abrupt apex less hooked posteriorly.

The condyle has the usual transversely ellipsoidal form of the carnivora generally, and resembles that of the Hyæna, etc.

Dentition.—The number of teeth possessed by *Hyænodon horridus* is the same as in the Wolf. They also hold the same relative position with one another, excepting that the posterior molars of both jaws continue to diverge to the last. The formula of dentition may be arranged as follows:

Incisors $\frac{3}{3}$, canines $\frac{1}{1}$, premolars $\frac{3}{4}$, smaller true molars $\frac{2}{2}$, sectorial molars $\frac{1}{1}$.

Molar teeth.—The molar series of *Hyænodon* is especially remarkable from the absence of the so-called tubercular form of teeth so common in ordinary carnivora.

The superior premolars, three in number, except the first one, are less separated from each other than in the Wolf.

The first upper premolar, better developed than in the latter animal, is inserted by a distinct pair of fangs. It has a broad, low, laterally compressed conical crown, with the base most extended behind, and with the posterior border longer than the anterior.

The second upper premolar, proportionately longer and narrower than that of the

Wolf, has an elongated conical crown, obtuse in front, subacute behind, and with a posterior mammillary basal heel.

The third upper premolar has the crown shorter and broader than the second, with nearly the same form, but provided with a better developed basal heel posteriorly. It bears a resemblance to the corresponding tooth of the Hyæna, but is not so long nor so robust in the proportions of its principal cusp.

The inferior premolars, four in number, except the first pair are closer together than the corresponding teeth of the Wolf.

The first lower premolar is lost in the fossils of *Hyænodon horridus*. The remaining premolars successively increase in size.

The second premolar has a conical crown, with the base considerably extended behind, and with the anterior border shorter than the posterior border, which is concave.

The third and fourth premolars have strong conical crowns, obtuse anteriorly, subacute posteriorly; and are provided posteriorly with a stout basal heel, which is subtrenchant at the extremity. These teeth resemble the corresponding ones of the Hyæna, but are proportionately less robust.

The superior true molars, three in number, consist of a smaller anterior pair and a large sectorial tooth.

The first upper true molar has its crown longer and thicker, but not so broad as that of the last premolar in advance. Externally it resembles the latter tooth in form, except that its basal heel is extended obliquely downward and has a subacute border. Internally it further differs in possessing a strong median extension of the base, which is supported by a third fang. A feeble basal ridge extends interruptedly along the inner part of the crown.

The second upper true molar, smaller than the tooth in advance or behind, appears apparently unnatural in position. Its crown is thickest anteriorly, and there appears to be supported by a pair of connate fangs, while it narrows posteriorly and is there sustained by a single fang. The inner surface of the crown forms an inclined plane. Viewed externally the crown appears as a modified form of that of the preceding tooth, with the principal cusp much reduced and the basal heel in a proportionate degree expanded into a wing-like lobe with a wide inferior trenchant edge. The summit of the principal cusp is slightly cleft. At the bottom of the crown anteriorly there is a transverse basal ridge.

The upper sectorial molar, the last of the true molars and the largest of the series, is a powerful and formidable looking weapon, well adapted to the penetration and cutting of all kinds of animal food, including bones. It is implanted by three fangs in the ordinary mode of the superior sectorial molars of ordinary carnivora. The crown is longer in proportion to its breadth than in the Wolf, Cat or Hyæna. It is thickest and longest in front, and becomes narrowed and shortened posteriorly. Its fore part is constituted of a pyramidal cusp; its back part of a broad wedge-like lobe, curving outwardly. The cusp and lobe are continuous excepting at the cutting margin of the tooth, where they are separated by a narrow indentation. From the sharp apex of the cusp a trenchant edge sweeps in a curve to the posterior obtuse termination of the crown. Antero-internally the crown forms a buttress-like column, sustaining the cusp and supported by the antero-internal fang of the tooth. The front surface of the crown forms an isosceles triangle, is depressed at the middle, and presents below a narrow oblique basal ridge.

The upper sectorial molar of *Hyænodon horridus* was worn away in a bevelled manner internally, the cusp more rapidly than the back portion, and in such a manner that the tooth always retained the form of a powerful gouge.

As previously intimated, the construction of the alveolar border of the upper jaw of *Hyænodon horridus* is such that no space is left behind the position of the sectorial molar for the lodgement of a tubercular molar.

The inferior true molars, as in the case of the upper ones, likewise consist of an anterior smaller pair, and a large sectorial tooth.

The anterior pair of lower true molars, from their comparatively small size, appear out of their natural position, which appearance is favored by the enamel of these teeth being smoother and thinner than in any other of the molars.

The first lower true molar is not only smaller than the succeeding teeth, but is much smaller than the last premolar. Its crown is trilobate, with the median conical lobe longest, the anterior lobe second in size, and with the posterior heel-like lobe subtrenchant at the summit.

The second lower true molar, less in size than the last premolar, has a trilobate crown, resembling in its construction that of the lower sectorial molar of the Hyæna. The anterior pair of lobes also have the form and relationship of the corresponding lobes in the lower sectorial molar of the Wolf. The third is a heel-like lobe, and resembles that of the tooth in advance.

The lower sectorial molar, or third true molar of *Hyænodon horridus*, resembles the corresponding tooth of the Cats, but in its relation with the size of the skull is larger and much broader in proportion with its height. The crown is composed of a pair of broad wedge-like, trenchant lobes, of which the posterior is much wider than the anterior. The latter is, however, the thicker, and is strengthened externally towards the base by an upright buttress-like ridge.

The inferior true molars were worn away from the apices and trenchant borders of their cusps and lobes in a bevelled or sloping manner externally.

The inner side of the first upper true molar wore a grooved surface externally upon the back part of the last lower premolar and the fore part of the first lower true molar. The inner side of the second upper true molar wore a broad grooved surface externally upon the back part of the first lower true molar and the fore part of the second lower true molar. The inner side of the principal cusp of the upper sectorial molar wore a grooved surface externally upon the back part of the second lower true molar and the fore part of the lower sectorial molar.

The premolars in the process of wear were blunted, as usual in the carnivora, by wearing from the apices of the constituent lobes of their crowns.

The enamel investing the molar teeth is thick and strongly rugose, except on the inferior first and second true molars, on which it is thinner and nearly smooth.

Canines and incisors.—The canine teeth are proportionately about as well developed as in the Wolves, hold the same relative position, and have nearly the same form. Their long curved conical crown is invested with thick and strongly rugose enamel. The acute linear ridges defining the inner from the outer surface, in ordinary carnivora, appear to be obsolete in *Hyænodon horridus*.

The upper incisor teeth of the two sides form a nearly transverse row, separated from the contiguous canines by an interval sufficiently large to accommodate the points of the canines below. They successively increase in size from first to last, and curve outward and downward. They resemble those of the Weasels in form. The intermediate ones have the crown convex in front, bevelled behind, and triangular at the sides. The lateral incisor, twice the size of the others, has a more conical crown. In the fossil they are all worn to the same level.

The lower incisor teeth, as in the Weasels, appear crowded into the narrow space of the contiguous canines, the second or intermediate one on each side being placed internally to the interval of the two others, apparently as if it had been pushed out of the row. They also hold the same relation of size to one another as in the Weasels—increasing successively from first to last. The crowns are worn and mutilated in the fossil, but appear to have had nearly the same form as in the Weasels.

The measurements taken from the specimens of *Hyænodon horridus* will be given hereafter in comparison with those of the smallest species of the genus from Dakota, *H. crucians*.

Prof. Hayden's last collection from the Mauvaises Terres of Dakota has afforded me an opportunity of examining another skull of *Hyænodon horridus*. The specimen is nearly complete, though much fractured. A portion of the occiput, the zygomata, and the back portions of the lower jaw, are the principal parts wanting. The jaws are closely interlocked, and most of the inferior molars are concealed within the included mass of matrix.

The skull belonged to an adult past maturity, and the teeth are considerably worn. It does not differ in any important character from those previously described, except that it is smaller. The upper molars are very little longer in their proportions than relates with the size of the lower molars contained in the portion of a lower jaw described in the succeeding chapter and referred to *Hyænodon cruentus*, so that I am led to suspect that the latter is probably not a distinct species.

The measurements derived from three skulls of *Hyænodon horridus*, including the one with the proportionately small teeth, above indicated, are as follows :

	Hyænodon horridus.		
Length from occipital condyle to upper incisive alveoli, ...	$12\frac{1}{4}$ inches.		$10\frac{3}{4}$* inches.
Length from do. to end of nasals, . .	$11\frac{1}{2}$ "		10* "
" post-glenoid tubercle to upper incisive alveoli, . .	11 "		$9\frac{1}{4}$ "
Length of sagittal crest, . . .		58 lines.	50* lines.
Length along middle of temporal fossa, .	63 lines.	62 "	59 "
Distance from occipital condyle to last molar tooth, ...	66 "	63 "	
Breadth of cranium at parietals where widest,		21 "	23 "
" " where narrowest,	16 "	15 "	16 "
Height from palate to end of sagittal crest,	42 "		
Length of forehead from sagittal crest to nasals,	17 "	14 "	18 "
Length of frontal at middle, . . .	25* "	30 "	29 "
Breadth of forehead at supra-orbital processes,	46 "	44 "	44 "
Distance from last molar to end of sagittal crest,	53 "	51 "	44 "
Distance from second premolar to internasal suture, ...	34 "	34* "	30 "
Length of nasals, ...	62 "		50 "
Breadth of nasals at frontal angular processes,	24 "	22* "	20 "
Breadth of nasals at ends of premaxillaries,	14 "		12 "
Breadth of face at ant-orbital margins,	40* "	39* "	38 "
Breadth of face at infra-orbital foramina,	23 "	23 "	23 "
Breadth at canine alveoli, . . .	26 "		25* "
Height of end of nose, . . .	20 "		
Breadth of end of nose, . . .	17 "		16 "
Distance from post-glenoid tubercle to last molar, ...	48 "	48 "	38 "
Breadth of face at back of alveolar border, .	46 "		42 "
Length of alveolar border to front of incisive alveoli, ...	86 "		70 "
Length of lower jaw from condyle to do.,	118 "		102 "

* Partially estimated.

		Hyænodon horridus.	
Height of lower jaw at condyle,		15 lines.	
" " at coronoid process,		36 "	
" " at last molar,	19 lines.	20 "	
" " at third premolar,	18 "		18 lines.
Length of symphysis,	42 "		35 "
" alveolar border of lower jaw,	80 "		
" upper molar series,	62 "		52 "
" lower molar series,	68 "		
" upper true molar series,	33 "	34 "	27 "
" lower true molar series,	30 "	30 "	
Breadth of last upper sectorial molar,	15 "	14½ "	11½ "

Hyænodon cruentus.

A second species of *Hyænodon* from the Mauvaises Terres of White River, Dakota, was founded upon a portion of a lower jaw discovered by Dr. John Evans. The specimen is represented in figure 10, plate V, and contains the third and fourth premolars and the sectorial molar. The species distinguished by the above name, as indicated by the fossil, was between a fourth and third less than *H. horridus*, and was rather larger than the *H. brachyrhynchus* of France.

The jaw fragment and the contained teeth agree in their form and proportions with the corresponding portions of *Hyænodon horridus*.

The measurements of the specimen are as follows:

Length of the lower molar series,	53 lines.
Space occupied by the three true molars,	25 "
Antero-posterior diameter of third premolar,	7 "
Height of do.,	6 "
Antero-posterior diameter of fourth premolar,	8 "
Height of do.,	7 "
Breadth of sectorial molar,	11 "
Height of do. in front,	6½ "
Height of do. posteriorly,	6 "

The recent collection of Dr. Hayden from the Mauvaises Terres contains a specimen of an upper tooth of a *Hyænodon*, which bears the proper relative proportion to those of the lower jaw above described to belong to the same animal. The tooth is the upper last molar of the right side, and is but little worn. It is represented in figure 11, plate V. From what has been observed in the concluding part of the chapter on *Hyænodon horridus*, both this tooth and the jaw originally referred to *H. cruentus* may really belong to the former, as a small variety, or perhaps to the female.

The antero-posterior diameter of the isolated upper last molar is 11 lines; its thickness anteriorly 5½ lines; the length of its anterior cusp 8 lines; and the depth of its back lobe posteriorly 3 lines.

Hyænodon crucians.

The remains of a third species of *Hyænodon*, from Dakota, distinguished by the above name, indicate an animal smaller than the *Hyænodon leptorhynchus* of France, but rather larger than the recent Red Fox, *Canis fulvus*.

The specimens of this species we have the opportunity of examining, derived from four different individuals, are as follows: a much fractured and otherwise mutilated skull, with the greater portion of the jaws and teeth; a second skull less fractured, but without the occipital portion, lower jaw and most of the teeth; fragments of a third skull, consisting of the forehead and portions of the jaws with teeth; and lastly some small fragments of jaws with teeth from a fourth skull.

Figure 1, plate II, represents a lateral view of the skull and lower jaw of the first mentioned specimen, with a portion of the side of the face restored from the second specimen indicated.

Figures 2 and 3, of the same plate, represent superior and inferior views of the second specimen.

As observed in the upper view of the latter, the cranium of *Hyænodon crucians* differs from that of *H. horridus* in being proportionately much less constricted and in having the constriction much more advanced in position. Thus in *H. horridus* the narrowest portion of the cranium is shortly in advance of the middle of the temporal fossæ; in *H. crucians* it is comparatively a short distance back of the forehead. In consequence of this relative change in the position of the cranial constriction in the two species, the posterior portion of the cranium in *H. crucians* appears proportionately longer and more capacious than in *H. horridus*, while the anterior portion appears much shorter and of less capacity.

The fronto-parietal suture, while descending at the sides of the narrowest portion of the cranium in *H. horridus*, is situated some distance back of the narrowest portion in *H. crucians*.

The forehead and face have the same form as in *H. horridus*, but are better preserved in the second of the specimens of *H. crucians* than in those of the former species. The frontal bone, as seen in figure 2, is single, a condition probably due to advanced age, the skull being an old one, as indicated by the remaining teeth, which are much worn. In the other specimens of *H. crucians* and those of *H. horridus*, a median frontal suture appears to have existed in part or throughout the whole extent of the bone, but is obscured by the contiguous fractures.

A comparatively good view of the palatine region is observable in the second mentioned specimen of *H. crucians*, as seen in figure 3. The alveolar borders form prominent ridges diverging to their posterior extremity, where they become continuous with the zygomata. Between the ridges the palate is strongly arched.

The posterior prolongation of the palate forms a cylindroid canal, compressed from below upwards and opening inferiorly by a remarkably narrow interval extending between the pterygoid bones. The under part of the prolongation exhibits a pair of strong ridges converging posteriorly to the pterygoids. External to the ridges the palate bones are impressed in a concave manner.

The palate bones together anteriorly form a triangle reaching as far forward as the middle of the first true molar. On each side it is pierced by a longitudinal row of posterior palatine foramina, three in number, decreasing in succession.

A wide and deep crescentoid notch is observed to separate the posterior extremity of the alveolar ridge from the palatine prolongation.

The orbits have the same form as in *H. horridus*. The entrance to the lachrymo-nasal duct, to the infra-orbital canal, and the spheno- and pterygo-palatine foramina, hold the same relative position as in the Wolf.

The optic and spheno-orbital foramina are about half an inch apart.

The lower jaw is like that of *H. horridus*, but the bone is more convex in the greater part of its length, and the coronoid process is proportionately rather longer. Three mental foramina occupy the side of the chin.

The first specimen mentioned of *Hyænodon crucians* contains complete series of both upper and lower molars. The canines and incisors are lost in all the specimens, except in one fragment which contains an upper canine tooth.

The molar teeth present no striking or obvious differences from those of *H. horridus*, excepting in a few instances.

The upper sectorial molar is longer in proportion with its breadth, and the back portion is more strongly curved outwardly than in *H. horridus*. The first upper true molar has a well developed tubercle at the fore part of its base, not existent in the latter species.

The first lower premolar, lost in the fossils of the other species of *Hyænodon*, is a peculiar looking tooth. The crown is a broad, low cone, with its back border twice the length of the front, and with the fore part of its base reaching a considerable distance in advance of the single fang, which is very obliquely inserted downward and backward.

Dr. Hayden's last collection of Mauvaises Terres fossils has afforded me the opportunity of examining two additional skulls, together with the jaws of a third individual of *Hyænodon crucians*. All three specimens indicate larger animals than any of those previously referred to this species. One of the skulls belonged to a very aged individual, as exhibited in the extremely worn condition of the teeth, the crowns of most of which have been obliterated. This specimen is larger than any others referred to *H. crucians*, and it presents a more marked development of all its points of muscular attachment. The sagittal crest and anterior divergent temporal ridges are relatively, as well as absolutely, very much stronger and more prominent than in any of the other skulls.

All the more complete specimens of *Hyænodon crucians* exhibit some variation in the proportion of their parts. In the two first-described skulls the face differs in being proportionately of greater length and depth, and less breadth than in the other, and also in being less depressed or flattened above. In the two skulls last obtained the face is more convex above than in either of the former; and it differs in them in being proportionately longer and narrower in the smaller skull.

Measurements derived from four skulls of *Hyænodon crucians* are as follows; those marked with an asterisk being estimated or approximative only:

	Hyænodon crucians.			
	Lines.	Lines.	Lines.	Lines.
Length of temporal fossa along the middle, . .	35		41	
Breadth of cranium where narrowest, . . .	11	10	11	11
Breadth of forehead at post-orbital processes, . .	26	27	30	32
Length of forehead from sagittal crest to nasals, .	9	12	11	12
Length of frontal in median line, . . .	14	19	19	20
Length of nasals, ...	29		33*	33
Breadth of nasals at frontal angular processes, . .	13	12	11½	14
" " at ends of premaxillaries, . .	7	7½	7½	10
Height from palate to end of sagittal crest, . .	20	19	23	28
Distance from last molar to back end of nasals, .	26	23	27	30
Distance from second premolar to internasal suture, .	18	15	19	19
Breadth of face at ant-orbital margins, . . .	27	26	29	33
" " at infra-orbital foramina, . .	16	14	15	19
" " at canine alveoli, . . .	17	15	18	20
Height of orbit, ...	11	11	12	13
Height of end of nose, ...		7*		13
Breadth of do., ...		8½*		11½
Distance from ant-orbital margin to incisive alveoli, .			39	40
Distance from post-glenoid tubercle to last molar, .	18			
Breadth at back extremity of alveolar borders, .	31	30	31	36

	Hyænodon crucians.			
	Lines.	Lines.	Lines.	Lines.
Length of alveolar border to front of incisors,			47	50
Depth of lower jaw at coronoid process,	21			
" " at last sectorial molar,	11½			13
" " at third premolar,	10		11	11
Length of alveolar border of lower jaw,			47	
" symphysis of lower jaw,			27	26
" upper molar series,	34	33	34	34
" lower molar series,	36		37	39
" upper true molar series,	16	15	18	18
" lower true molar series,	16			17

The following are comparative measurements of the teeth of *Hyænodon crucians* and *H. horridus*, taken from well preserved and little worn ones contained in two skulls:

	H. crucians.	H. horridus
	Lines.	Lines.
Breadth of first upper premolar,	5	6½
Length of " "	2½	3
Breadth of second "	5	9½
Length of " "	4	7½
Breadth of third "	6	10½
Length of " "	3½	7½
Breadth of first upper true molar (obliquely),	6	10½
Length of " " "	4½	9½
Breadth of second " " (obliquely),	5½	9
Length of " " "	4	6½
Breadth of upper sectorial molar,	6	15
Length of anterior cusp of "	5½	12
Length of posterior lobe of "	4	8
Breadth of first lower premolar,	5	
Length of " "	2	
Breadth of second "	5	8
Length of " "	3½	5½
Breadth of third "	5½	9½
Length of " "	3½	7½
Breadth of fourth "	5½	10
Length of " "	4½	7½
Breadth of first lower true molar,	4	6½

	H. crucians. Lines.	H. horridus Lines.
Length of first lower true molar,	3	5
Breadth of second " "	5	9
Length of " " "	4½	6½
Breadth of lower sectorial molar,	6½	14½
Length anteriorly of lower sectorial molar,	5	9
Length posteriorly of " "	4	7
Length of upper canine,	10	*23
Breadth of "	5	10
Thickness of "	3½	*6
Length of lower canine,		22
Breadth of "		9
Thickness of "		7

FELIDÆ.

PSEUDÆLURUS.

The genus *Pseudælurus* was proposed by M. Gervais, in the Zoologie et Paléontologie Francaises, volume I, page 127, on some remains of a feline animal from the miocene formation of Sansan, Gers, France. It was distinguished from the genus *Felis* by the single character of possessing an additional inferior premolar in advance of the others. The only species described, the *P. quadridentatus*, was previously indicated by De Blainville, in his Ostéographie, under the names of *Felis quadridentatus* and *F. tetraodon.*

Pseudælurus intrepidus.

A second species of *Pseudælurus* to which the above name has been given, appears to have been a member of the ancient fauna of Nebraska. It is indicated by a well-preserved specimen of the lower jaw, discovered by Dr. Hayden in the sands of the Niobrara River. One side of the specimen, the left ramus, is represented in figure 8, plate I. It contains the sectorial molar, the two premolars in advance, the canine tooth, and the lateral incisor. The right ramus contains the same teeth with the addition of the second incisor, but the canine tooth and lateral incisor are much mutilated. In both rami the premolar, considered as the chief character of the genus, is absent, but its alveolus remains midway in the hiatus back of the canine tooth.

The jaw is intermediate in size with that of the Panther, *Felis concolor*, and that of the Lynx, *Felis canadensis*. The form of the jaw and of the teeth is the same as in the cats generally.

In its details of form and proportions, the jaw resembles that of the Lynx more nearly than that of the Panther. The summit of the coronoid process is obtusely rounded as in the former, and not extended in a somewhat hook-like manner as in the latter.

The sectorial molar is absolutely broader, nearly as high, but not quite so thick as in the Panther. It also differs from the latter in possessing a strongly developed posterior indented talon, as in the European Lynx, *Felis Lynx.*

The first premolar occupied a position about mid-way in the hiatus between the canine tooth and the second premolar. It was a small tooth, inserted by a single fang. The second and third premolars have the same form as in the Panther, but are not so thick in proportion to their height and breadth.

The inferior canine tooth has the same form and about the same proportions as in the cats generally, but there is no trace of a furrow or narrow groove on the outer surface of the crown.

The measurements of the specimen, compared with those of a Panther, are as follows:

	P. intrepidus. Lines.	F. concolor. Lines.
Length of the lower jaw from the condyle,	58	64
Height " " "	12	15
" " " coronoid process,	27	34
" " at the middle molar,	11	12
Space occupied by the three molars,	21	22
Extent of hiatus from canine to large premolars,	7	5½
Length of crown of canine,	10	12½
Length of crown of first large premolar,	3½	4
Breadth " " "	5½	6½
Thickness " " "	2¾	3½
Length of crown of second large premolar,	5½	5
Breadth " " "	7	7½
Thickness " " "	3½	4
Length of crown of sectorial molar,	6	6
Breadth " " "	9¼	8½
Thickness " " "	4	4½

DREPANODON.

Drepanodon is an extinct genus of feline animals, particularly remarkable from its possessing, in the upper jaw, long sabre-like canine teeth, from which it has received the common name of the Sabre-toothed Tiger. A number of species have been indicated from remains discovered in the middle and later tertiary formations of Western Europe, Greece, the Himalayas of Asia, and Brazil. Among the collection of fossils from the Mauvaises Terres of White River, Dakota, there are also remains indicating a species of *Drepanodon* smaller than our existing Panther, *Felis concolor*.

Bronn, in the Lethæa Geognostica, has divided the various described species of *Drepanodon* into three groups, as follows:

Drepanodon, characterized by having the canines entire or without serrulation, and the first lower premolar with a trilobate crown and double fang.

Machairodus, with the acute edges of the canines serrulate, and the first lower premolar as in the preceding case.

Smilodon, with the canines serrulate, and with the first lower molar with a simple crown and single fang.

The Dakota *Drepanodon* belongs to the second group, or that of *Machairodus*.

Drepanodon primævus.

Of the Dakota Sabre-toothed Tiger, previously described under the name of *Machairodus primævus*, I have had the opportunity of examining four nearly complete skulls and small fragments of several others. One of the specimens is described and figured in the Ancient Fauna of Nebraska; two are represented in figures 1, 5, plate IV, as well as parts of a fourth in figures 2, 3, 4, of the same plate.

The skull of *D. primævus* varies in size and in its details of form, though not to a greater extent than in different individuals of the Panther.

The face is proportionately longer and shallower, and the cranium shorter and deeper than in the latter animal.

Lateral view of the skull.—The upper outline of the skull has nearly the same antero-posterior convex form as in the Panther, but the slope of the face, or of the forehead and snout together, is longer and straighter, and that of the cranium is shorter. The front of the snout is more sloping, arising from a greater degree of prominence of the alveolar portion of the premaxillaries. The chin is more vertical and deeper. The temporal fossa rises upon an equally high but shorter sagittal crest, and extends upon an equally prominent border separating it from the inion.

The zygoma encloses a more contracted or narrower space than in the Panther. Its posterior root has a deeper origin from the cranium, and descends more in its outward course. Its anterior root below the orbit is shallow and thick, while the masseteric impression is inferior and inconspicuous, in comparison with that of the Panther.

The temporal surface is less convex than in the latter animal, and upon the root of the zygomatic process is less horizontal or more sloping. A large vascular foramen pierces the back part of the parietal bone.

The entrance to the auditory meatus is a comparatively narrow archway, instead of a broad one as in the Panther. It is bounded posteriorly by a longer and much more robust mastoid process than in the latter. The process is directed obliquely downward and forward, and is trilateral, with a truncate apex.

The orbit is proportionately of much less capacity than in the Panther. The orbital entrance likewise is much smaller and more posterior in its position, or is more median in relation with the length of the skull. It is more rotund in form, and more vertical in its direction, or presents less upward and forward.

The post-orbital process of the frontal bone is about as well developed as in the Panther, but that of the malar bone is comparatively short and blunt. The intervening gap is rather greater.

The malar bone, forming the anterior root of the zygoma, is much less prominent than in the Panther. The infra-orbital foramen is considerably larger, and occupies a more elevated position in relation with the infra-orbital margin. It is situated above the position of the fore fangs of the upper sectorial molar.

The face in advance of the orbit is longer and shallower, or narrower and more pointed than in the true cats. It is convex, instead of being depressed as in the Panther, between the position of the forehead, the swell of the canine alveolus, and the orbit.

The premaxillaries project proportionately more in advance of the canines than in the Panther.

Superior view.—In the upper view of the skull of *Drepanodon primævus*, the cranium back of the temporal arches is observed to be proportionately much smaller than in the Panther. It is also less convex at the sides, and more constricted at its fore part.

The sagittal crest is as prominent, but is shorter than in the Panther.

The forehead is broader, more arched transversely between the orbits, but is more depressed along the middle.

The face in advance of the forehead and orbits has a more prolonged demiconoidal form than in the Panther, being proportionately longer and generally narrower. Its upper part, however, is wider, and is transversely convex.

The bones of the nose are less depressed along their adjacent parts. Posteriorly they are nearly flat; anteriorly they terminate together in a more prominent median point, and are not inverted to the same extent as in the Panther.

The anterior nasal orifice is smaller than in the latter. It has nearly the same form, but is less wide in relation with its height.

Posterior view.—The occipital region has nearly the same form as in the Panther. It is more prominent in the median line just above the occipital foramen. The mastoids, from their large comparative size, appear very conspicuously as the prolonged basal angles of the inion. The paramastoid processes are narrower and more pointed than in the Panther, and project obliquely backward and outward. In the side views of the skull they are conspicuously seen projecting from above the base of the mastoid processes.

The occipital condyles and foramen have about the same form and relations as in ordinary cats.

Inferior view.—The base of the skull of *Drepanodon primævus* is narrower in relation with its length than in the Panther. The basi-occipital and basi-sphenoid are much narrower. The former is produced into quite a deep gutter, by the downward projection of the lateral borders, internally to the position of the auditory bullæ.

The latter are broken away in the only specimen in which the base of the cranium is visible, but appear to have been proportionately as well developed as in the ordinary cats. The interval between the comparatively large mastoid and the root of the zygoma appears strikingly narrow in comparison with that of the Panther.

The glenoid articular cavity has nearly the same form and direction as in the latter, but is situated much lower from the strong downward projection of the root of the zygoma. In the Panther the articular surface is on a level with the basi-sphenoid, but in the fossils under examination is half an inch below it. The post-glenoid tubercle is nearly like that of the Panther, but more vertical; the ant-glenoid tubercle is wider, but not so long nor so distinct. The space enclosed by the zygoma, palate and pterygoid is much shorter in relation with its breadth.

The neural foramina of the sphenoids hold about the same relative position as in the cats.

The hard palate has nearly the same form as in the latter. The transverse palate suture is convex anteriorly, and not notched as in the Panther. The posterior palatine foramina pierce the palate plates of the maxillaries on a line with the intervals of the first and second premolars.

The posterior palatine notch is cordiform, and is more narrowed posteriorly than in the Panther. Its bottom extends on a line with the tubercular molar teeth.

Forms and connections of the bones of the skull.—The co-ossified parietals are proportionately shorter and deeper than in *Felis.* The antero-inferior angle, joining the alisphenoid, is wider than in the latter, as is also the case with the bone just mentioned. The squamosal is less wide, but proportionately somewhat deeper. The frontals co-ossified at an early period, as is observed in a specimen in which most of the other sutures are open, and the permanent canines had but partially protruded.

The fore part of the parietals together exhibit an angular notch receiving the summit of the frontals.

The fronto-parietal outline pursues a course somewhat like the letter W. The squamosal suture pursues a nearly uniform arching course from the acute border of the inion to its descent in conjunction with the alisphenoid.

The angular processes of the frontals are very short, and the notch between them comparatively shallow and rounded at bottom. The fronto-maxillary suture descends upon the side of the face almost transversely to the orbital margin.

The nasals posteriorly are spatulate and rounded at the extremities. From the latter position they are of nearly uniform breadth for about a third of their length, when they gradually widen to their anterior extremity, where they are notched in a semi-lunar manner.

The premaxillaries are more oblique than in the Panther, and their alveolar portion is not impressed for the accommodation of an inferior canine tooth.

Inferior maxilla.—The lower jaw of *Drepanodon primævus* has the same general form as that of the true cats, but exhibits certain important peculiarities.

The condyle occupies a relatively lower position than in the Panther. The coronoid process is proportionately much shorter, and instead of curving backward, as in the latter, holds an almost vertical position. The angle is proportionately shorter, thicker, and directed more downward and less inward.

The fossa below the coronoid process is more restricted to the ramus, independent of the former, than in the true cats.

The side of the lower jaw below the molar teeth is proportionately deeper, and is more vertical than in the latter. The fore part of the jaw increases in vertical depth, and is further prolonged in the same direction, in a remarkable manner, by means of an angular process, which serves to guard the point of the upper canine tooth when the mouth is closed. The margin of the jaw at the side of the chin is further everted into an acute, prominent ridge, which protects the sharp front edge of the upper canine tooth.

The chin is more vertical than in *Felis*. It is oblong-square, with the lateral inferior angles prolonged downward. It is nearly a plane, but is rendered slightly concave at the sides from the prominence of the lateral borders.

Several mental foramina exist as in *Felis*, both at the sides and front of the chin.

Dentition.—The formula of dentition of *Drepanodon primævus* is the same as in the species of *Felis*, as follows:

$$\text{In. } \frac{3-3}{3-3};\ \text{c. } \frac{1-1}{1-1};\ \text{p. m. } \frac{2-2}{2-2};\ \text{sect. m. } \frac{1-1}{1-1};\ \text{tub. m. } \frac{1-1}{0-0} = 30.$$

The molar teeth of *D. primævus* hold the same relative position with one another and with the other teeth as in ordinary species of *Felis*, except that the tubercular molar of the upper jaw is more posterior and external in its relation with the contiguous sectorial tooth. Their crowns generally are proportionately longer, narrower, more pointed and more trenchant than in the true cats. In the unworn condition the acute borders are all distinctly but minutely crenulate.

Superior molars.—The first upper premolar occupies the same relative position as in *Felis*. In a young skull, in which all the molars have protruded but are unworn, and the upper canines had but partially protruded, the first premolar, as represented in figure 2, plate IV, has about the same relative size as in *Felis*. It has a laterally compressed conoidal crown, longest in advance of the middle; and is inserted by a pair of fangs. In the skull represented in figure 1 it had been shed, and the alveoli have disappeared. In the older specimen (in which the upper sectorial molar has its crown more than half worn away) represented in figure 5, on one side it had been shed and the alveoli obliterated; but on the other side it appears to have been a single-fanged tooth, and the fang remains in its alveolus.

The second upper premolar is smaller in relation with the succeeding tooth than in *Felis*. Its crown is trilobed, and is of more uniform thickness at base than in the latter. The anterior lobe is the smallest, and less distinct than the others. It is represented in *Felis* by an extension forward of the base of the principal cusp. The posterior lobe is broad, simple and trenchant, and not indented or sub-divided as in the true cats.

The upper sectorial molar, besides the proportionately longer and narrower crown in relation with the breadth, exhibits other differences from the corresponding tooth of *Felis*. The anterior sub-lobe, proportionately smaller than in the latter, possesses a strong offset or heel projecting from its base antero-externally. The median cusp and the broad posterior trenchant lobe include between them externally, as in the cats, a wide depressed surface, but this does not converge into a conspicuous fossa, as in the latter.

The tubercular molar is proportionately much larger than in the cats, and is absolutely as large as that of the Lion. It is situated nearly transversely posterior to the position of the sectorial molar, extending inwardly in the usual manner in the cats. It is inserted by a pair of fangs, one internally to the other. The crown is rather ellipsoidal transversely, and slightly curved backward. The outer half is the thicker, and projects nearly on a level with the lower border of the back angle of the sectorial molar. The inner half is abruptly impressed, or cut out in an obtusely angular step or heel. A curved, linear, crenulated ridge crosses the crown near its middle from before backward. The crown of the tubercular molar was worn away at the fore part externally, in keeping sharp the point of the posterior trenchant lobe of the inferior sectorial molar.

Inferior molars.—The first lower premolar of *Drepanodon primævus* is proportionately smaller in relation with the succeeding tooth than in *Felis*. Its crown is trilobed, and is inserted by two fangs as in the latter. The thickness of the base of the crown is nearly uniform.

The second lower premolar repeats the form of the first, but is nearly twice as large.

The lower sectorial molar, besides the pair of broad trenchant lobes of the crown, as in the cats, possesses a well-developed posterior basal heel or sub-lobe sub-divided or notched at the middle. In this respect the tooth resembles the corresponding tooth of *Pseudælurus intrepidus*, from the Niobrara River. Neither the European *Drepanodon megantereon* nor the *D. neogæus* of Brazil present such a development of the sub-lobe. The angular valley between the principal lobes of the crown internally, as in the corresponding valley of the upper sectorial molar, does not converge into a fossa so conspicuously as in the cats. This absence of the fossa in the sectorial molars of *D. primævus* appears to be due to the narrowness or lateral compression of the crowns in comparison with those of the cats.

The lower molar teeth are separated from the inferior canine by a much wider hiatus proportionately than in the cats; a difference which probably relates to the comparatively excessive development of the upper canines and the proportionate reduction of the lower ones.

Canines.—The upper canine teeth, from their remarkable size and form, are characteristic of the genus of which *D. primævus* forms a member. They descend from their alveoli nearly parallel with each other, and not divergent as they are represented to be in the great Brazilian Sabre-toothed Tiger, *D. neogæus*. Curving forward, they descend behind the inferior canines and then behind the crested margin of the chin, and in the unworn condition appear to have extended as far as the points of the downward prolongations of the latter.

The crown of the upper canines is laterally compressed, with the anterior and posterior borders at their lower part trenchant and finely serrulated. The anterior border is trenchant and serrulated to within a few lines of the cessation of the enamel investment of the crown. On the posterior border the serrulation does not reach the latter position within nearly an inch.

The fang of the upper canine curves upward and backward along the antero-superior part of the maxillary bone. Its lower part is somewhat gibbous, producing a convexity of the alveolus externally corresponding with that in a similar position in the cats.

The inferior canines, comparatively small teeth both in relation with those above and with the homologous ones in *Felis*, project almost perpendicularly, with a slight backward curvature, in front of the upper canines. Those, in the only skull in which they are retained, are imperfect. An isolated specimen is represented in figures 4, 5, plate xviii, of the Ancient Fauna of Nebraska. It has a curved conical crown flattened behind, and with the posterior smaller surface defined by acute borders. The point of the inferior canine was received in the angular interval between the base of the crown of the upper canine and that of the upper lateral incisor.

Incisors.—The superior incisor teeth of the two sides together form a semi-circle occupying the interval of the upper canines. They are proportionately much longer than in the cats, and are isolated from one another and the contiguous canines by well-marked intervals increasing successively from the first to the last. They also successively increase in size from first to last. Their crown is curved, conical and pointed, flattened behind, and have the posterior surface defined by acute borders, as in the case of the inferior canines. Their base posteriorly appears somewhat widened, but not so as to form a conspicuous heel as in the cats.

The inferior incisors occupy the interval of the lower canines, without a hiatus separating them from the latter. They form a slightly curved row, and are more closely situated than the superior. They are smaller than those above, but like them successively increase in size. They are broken in the only specimen of a skull in which they are partially preserved, but appear to have had the same form as the upper ones.

The superior incisors curve forward and downward; the inferior ascend almost vertically, with a slight backward curvature. The points of the crowns of the latter occupy the angular intervals of the crowns of the former, when the jaws are closed.

The specimen of a skull of *Drepanodon primævus*, described in the Ancient Fauna of Nebraska under the name of *Machairodus primævus*, and represented in plate xviii of that work, was obtained during a geological survey of Dr. Owen, and is now preserved in the Museum of the Smithsonian Institution. It belonged to an adult individual, and is intermediate in size to the two skulls represented in plate IV of the present memoir.

The specimen represented in figure I of the latter plate is the largest skull of *D. primævus* which has been discovered. It was obtained during a geological survey of Dr. John Evans, and was presented by the Smithsonian Institution to this Academy. It is without the lower jaw; has but part of the zygomata, the auditory bullæ, and is otherwise mutilated, but is comparatively well preserved. It belonged to an adult individual. The upper sectorial molar is considerably worn; and the upper first premolars are lost and their alveoli obliterated. The frontal suture has also disappeared.

The specimen represented in figure 5 of the same plate is an almost complete skull obtained by Dr. F. V. Hayden, and purchased for the Museum of this Academy. It is the smallest of the skulls of *D. primævus* yet discovered, and probably belonged to a female, as well as an aged individual as proved by the sectorial molars, in which the crowns are nearly worn out.

Besides being smaller, the face is proportionately somewhat shorter and narrower, and the forehead less wide than in the preceding specimens. The orbits also are less vertical, or have a more upward direction.

The specimen is interesting from the fact of its exhibiting the marks of a conflict some time anterior to the death of the animal, with an equally bloodthirsty creature. On both sides of the forehead, above the orbits in front, and just back of the middle of the temporal arches, there are four pits or depressions, the result of fracture, and just such as might have been made by the opposed points of the canines of *Hyænodon horridus.* Those over the orbits are the larger, in consequence of the greater breadth of the cranium there presenting the first resistance. The edges of the fractured pits are somewhat spon y, or exhibit the traces of reparatory action during life. The pits have more the appearance of having been made by some equally powerful instrument, such as the upper and lower canines of a *Hyænodon,* than by the more unequally opposed weapons of one of its own kind.

The figures 2, 3, 4, plate IV, of the molar teeth of *D. primævus,* are taken from the specimen of the greater part of a skull of a young adult. The series of permanent molars had fully protruded, but the permanent canine had only partially protruded. The specimen was discovered by Dr. Hayden, and was purchased for the Museum of this Academy.

Measurements of the two skulls of *Drepanodon primævus* represented in the plate accompanying the present memoir are as follows:

Length of skull from occipital condyles to upper incisive alveoli,	6 inches.	7 inches.
	Lines.	Lines.
Distance from occipital condyles to end of post-orbital processes, .	40	43
Length of sagittal crest, partially estimated, . . .	30	32
Width of temporal fossa from border of inion at the squamosal suture to the middle of temporal ridge of the frontal, .	31	34
Height from glenoid cavity to sagittal crest, . . .	31	36
Breadth of inion at mastoid processes, ...	29	34
Length of occipital condyles, ...	9¼	10
Breadth of occipital foramen at back margin of the condyles, .	7¾	8
Width of space between zygoma and palate bone, or of the outlet of the temporal fossa,.		21
Width from anterior glenoid margin to back of maxillary, .	14	14

	Lines.	Lines.
Width of glenoid cavity,		12
Antero-posterior measurement of do.,	5	6
Breadth of face outside of tubercular molars,	30	33
Distance from latter position to back angle of forehead,	37	42
Length of face from sagittal crest,	39	48
Length of forehead as formed by the frontals,	16	22
Breadth between ends of post-orbital processes,	29	36
Breadth of skull at zygomata, estimated,	45	52
Breadth of face below post-orbital processes of malars,	42	46
Breadth at prominences of anterior orbital margin,	22	28
Breadth in front of infra-orbital foramina,	17	21
Breadth at canine alveoli, where most prominent,	19	23
Length of face from anterior orbital margin to incisive alveoli,	29	36
Length of nasals,	21	25
Breadth of nasals together, between angular processes of frontals,	5	6½
Breadth of nasals together, at anterior extremity,	8¼	11½
Height of nasal orifice, obliquely,	11	13
Breadth " "	9	11½
Height of orbital entrance,	13	15½
Breadth " "	10	12
Length of upper molar series without first premolar,	16	17½
Length of upper canines from the alveoli, estimated,	23	28
Breadth of upper canines at base of crown,	6¼	6¼
Width of space occupied by upper incisors,	12	14
Length of crown of lateral incisor,		6
Length of crown of second incisor,		4¼
Length of lower jaw at base from angle to symphysis,	32	
Depth of lower jaw at condyle,	8½	
" " at coronoid process,	16	
" " below second premolar,	11	
" " at side of chin,	18	
" " at symphysis,	17	
Length of coronoid process above condyle,	10	
Hiatus between lower canine and molars,	9	
Space between canines occupied by lower incisors,	10	

Measurements derived from slightly worn molar teeth, represented in figures 2, 3, 4, plate IV, belonging to an animal which had just reached the adult condition, are as follows:

Upper molars.

Breadth of crown of first premolar,			2	lines.
Length	"	"	$1\frac{1}{4}$	"
Breadth of crown of second	"		$5\frac{1}{2}$	"
Thickness	"	"	$2\frac{1}{4}$	"
Length	"	"	$3\frac{3}{4}$	"
Breadth of crown of sectorial molar,			$8\frac{3}{4}$	"
Thickness	"	" anteriorly,	$4\frac{3}{4}$	"
Length	"	"	$5\frac{1}{2}$	"
Breadth of crown of tubercular molar,			$6\frac{1}{4}$	"
Length	"	"	2	"
Width, fore and aft, of "		"	$2\frac{1}{2}$	"

Lower molars.

Breadth of crown of first premolar,			$3\frac{1}{2}$	lines.
Thickness	"	"	$1\frac{3}{4}$	"
Length	"	"	$2\frac{3}{4}$	"
Breadth of crown of second	"		$5\frac{3}{4}$	"
Thickness	"	"	$2\frac{3}{4}$	"
Length	"	"	$4\frac{1}{2}$	"
Breadth of crown of sectorial molar,			$8\frac{1}{4}$	"
Thickness	"	"	$3\frac{1}{2}$	"
Length of fore cusp of "		"	$4\frac{3}{4}$	"
Length of back cusp	"	"	6	"

Dr. Hayden's last collection of Mauvaises Terres fossils contains another skull of *D. primævus*, without the lower jaw. It belonged to an adult, and exhibits the same anatomical characters as the specimens already described. It is interesting from its apparently bearing the marks of a deadly conflict with some other carnivore. The forehead and cranium in the interparietal region are broken in from opposite sides, apparently from the entrance of pointed instruments, such as the canine teeth of the upper and lower jaws of the animal with which it may have been in combat. The crown of the upper sectorial molar in the specimen is $9\frac{1}{2}$ lines broad.

Drepanodon occidentalis.

Two small fragments of both sides of a lower jaw, found by Dr. Hayden, in his last trip to the Mauvaises Terres of White River, appear to indicate a species of *Drepanodon*, or *Machairodus*, larger than *D. primævus*.

The better of the two specimens, represented in figure 5, plate IV, contains the second premolar and the fangs of the teeth in front and behind. The space occupied by the three molars was about two inches, or half an inch more than in *D. primævus.*

The crown of the second premolar, preserved in the fragment, is seven lines wide and has been at least half an inch in length. The summit of its principal cusp is much worn off, and a groove is worn at the base externally of the posterior talon.

The jaw fragment below the second premolar is fourteen lines in depth.

A fragment of the right side of the upper jaw, containing the fang of the canine tooth, probably belonging to the same species, if not the same individual, as the former specimens, exhibits the fang throughout its length. This is about 2½ inches, while the breadth at middle is 13 lines and the thickness 6 lines.

DINICTIS.

Dinictis felina.

The above generic name has been given to a remarkable carnivorous animal which exhibits a relationship with the Weasels, *Putorius,* and the Sabre-toothed Tiger, *Drepanodon.* It has the same formula of dentition as the former, but in the general form and constitution of the skull and teeth it is more like the latter. A single species has been discovered, and was first indicated under the name of *Dinictis felina,* from the specimen of an almost complete but much mutilated skull, obtained in the Mauvaises Terres of White River, Dakota, by Messrs. Hayden and Meek, for Prof. Hall, by whom it was submitted to my examination. Subsequently Dr. Hayden discovered a second skull, the one represented in figure 1, of plate IV, which was purchased for the museum of this Academy.

The skull of *Dinictis felina* presents a near resemblance in size, proportions and constitution to that of its predatory accomplice, the *Drepanodon primævus.*

The upper part of the face, in relation with the cranium back of the bifurcation of the temporal ridges, forms a more inclined slope than in *D. primævus.* The cranium is proportionately rather larger and the face somewhat shorter. The forehead is rather narrower, more convex transversely and less depressed along the middle. The muzzle is shorter, while it retains about the same breadth. The orbits are larger, as in the true cats, but they are more open posteriorly than in either the latter or *Drepanodon primævus.* The post-orbital processes of the frontals appear to have been comparatively short; those of the malars were about as short as in the last named animal.

The temporal fossa has nearly the same form, proportions and relative capacity as in *D. primævus.* The posterior root of the zygoma does not originate so low, and occupies a relative position more like that of *Felis* than of *D. primævus.*

The occipital region, the mastoid process, and the archway to the auditory meatus between the latter and the root of the zygoma are almost identical in character with the same parts in *D. primævus*.

The infra-orbital foramen is as large as in the latter, and opens above the interval of the last premolar and the sectorial molar.

The parietals are co-ossified in the course of the well-developed sagittal crest. The fronto-parietal and squamous sutures are too much obscured by accidental fissures in the specimens under observation to judge accurately of their course. The frontals appear to have been co-ossified.

The nasals together posteriorly form a triangle received into a deep notch of the frontals. From the latter position they slightly and gradually widen to their anterior extremities, which end as in *D. primævus*.

Angular processes of the frontals, extending between the nasals and maxillaries in the Panther, and in a less degree in *D. primævus*, appear hardly to have existed in *Dinictis felina*. The fronto-maxillary suture is directed across the side of the face to the supra-orbital margin in a nearly transverse course.

The lower jaw of *Dinictis felina* has nearly the form of that of *Drepanodon primævus*. The condyle is not so low down, and the coronoid process is much longer and curved as in the true cats. The form of the chin is like that of *D. primævus*, but is smaller. It presents similar prolongations downward to protect the points of the upper canine teeth, but not quite to the same length. The side of the jaw below the molars is less deep than in *D. primævus*.

As in the Mink and common Weasel, *Dinictis* presents the following formula of dentition:

$$\text{In.}\ \frac{3-3}{3-3};\ \text{c.}\ \frac{1-1}{1-1};\ \text{p. m.}\ \frac{2-2}{3-3};\ \text{sec. m.}\ \frac{1-1}{1-1};\ \text{tub. m.}\ \frac{1-1}{1-1}=34.$$

The teeth of both jaws of *Dinictis* hold nearly the same relative position with one another as in *Drepanodon* and *Felis*.

Molars.—The molar teeth, as in *Drepanodon primævus*, generally have proportionately longer, narrower, sharper and more pointed crowns in relation with their breadth than in the true cats.

The upper first premolar is a small tooth occupying the same relative position as that of *Drepanodon* and the cats. As in the former, it has a simple, broad, laterally compressed conical crown, with the apex in advance of the middle; and it is inserted by a pair of fangs.

The second upper premolar is larger than the corresponding tooth of *Drepanodon primævus* in relation with the succeeding tooth. The crown consists of a single comparatively large, laterally compressed, conical cusp, with a small heel-like sub-lobe. The fore part of the crown forms a nearly straight slope, extended at the base in the feeblest degree compared with the condition in the cats.

The sectorial molar is intermediate in the length of its crown in relation with its breadth, compared with that of the cats and *Drepanodon primævus.* Its shape is intermediate to that of the cats and weasels. The crown is composed of a large anterior conical cusp as in *Putorius,* and a posterior shorter trenchant lobe as in *Felis.* Between the two lobes externally is a valley converging, as in the latter, though less conspicuously, in a fossa or funnel-like pit. The principal cusp of the crown at its inner part is extended as an abutment sustained by an internal fang, as in the cats and weasels.

The upper tubercular molar is a large tooth compared with that of the cats, though less in its proportions than in the weasels. It has about the same proportionate size as in *Drepanodon primævus,* and also resembles it nearly in form. It is situated behind the sectorial molar and extends transversely inward, as in the last mentioned animal and in the weasels. It is invested by a pair of fangs, and has a transversely clavate crown with the narrow portion internal. The outer half is double the depth and thickness of the inner, and reaches to a level with the lower back part of the sectorial molar. The inner half appears as if an angular segment had been removed from it. The lower surface of the outer half slopes fore and aft from a median acute ridge; that of the inner half is angularly concave transversely and convex from before backward.

The first lower premolar resembles the corresponding upper one.

The second and third lower premolars are like the corresponding teeth of cats, but are devoid of the basal expansion at the back part of the crown. This is composed of a median pointed cusp proportionately longer and sharper than in cats, with a small sub-lobe in front and behind, the former being the smaller.

The lower sectorial molar resembles that of *Drepanodon primævus,* and is intermediate in form to that of the cats and weasels. The crown consists of two broad trenchant lobes as in the former animals, but proportionately longer and less robust. Back of the principal lobes is a sub-lobe, less well-developed than that of the weasels. In one specimen it is double, as in the corresponding tooth of *Drepanodon primævus;* in the other skull the duplication is less marked. The internal valley of the principal lobes converges into a funnel-like fossa more conspicuously than in the same position in the last named animal, but less so than in cats.

The lower tubercular molar, the smallest tooth of the series, is like that of the weasels in its form. It has an oval crown inserted by a single fang.

The comparative measurements of the two specimens of skulls and teeth of *Dinictis felina* are as follows; premising that many of them are not exact, but approximative only, on account of imperfection in points of reference.

Length of skull from occipital condyle to upper incisive alveoli,	6¼ inches.	6¼ inches.
	Lines.	Lines.
Distance from occipital condyle to end of post-orbital process of frontal, partially estimated,	50	50
Length of occipital crest, partially estimated,	38	38
Width of temporal fossa from border of inion at squamosal suture to middle of temporal ridge of frontal,	38	38
Height from glenoid cavity to sagittal crest,	31	34
Breadth of inion at mastoid processes,	31	33
Length of occipital condyles,	8	
Breadth of occipital foramen at back margin of the condyles where nearest,	8	
Width of space between anterior glenoid margin and back of maxillary bone,	21	20
Width of glenoid cavity,		11
Breadth of face outside of tubercular molars,	40	40
Distance from latter position to back angle of forehead,	39	40
Length of face from latter position,	44	42
Length of forehead,	20	18
Breadth of forehead between post orbital processes,	24	24
Breadth of skull at zygomata, estimated,	66	66
Breadth below malar post-orbital processes, estimated,	60	60
Breadth at anterior orbital margins,	23	24
Breadth in front of infra-orbital foramina,	21	22
Breadth at canine alveoli where most prominent,	21	23
Length of face from ant-orbital margin to incisive alveoli,	29	32
Length of nasals,	22	24
Breadth of nasals together at frontal notch,	8	8
Breadth of do. at anterior extremities,	10	10
Height of nasal orifice,	11	11
Breadth of " "	11	11
Height of orbital entrance, estimated,		19
Length of upper molar series,	20	21
Length of lower molar series,	24	24
Breadth of crown of upper canine at base,	6¼	7
Thickness of " " "	3½	
Estimated length of do.,	20	18
Length of crown of lower canine,	7½	
Breadth of " "	3¾	

	Lines.	Lines.
Thickness of crown of lower canine, ...	3	
Width of space occupied by upper incisors, . . .	11½	11½
Width of space occupied by lower " . . .	6½	8
Length of lower jaw, partially estimated, . . .	58	
Depth of lower jaw at condyle, partially estimated, . .	10	
" " at coronoid process, . . .	25	
" " below third premolar, . . .	9½	11
" " at side of chin, ...	14	17
" " at symphysis, ...	11	15
Breadth of chin, ...	11	11
Length of coronoid process above condyle, . . .	15	13
Breadth of crown of upper first premolar, . . .	2½	
Length " " " " . . .	1½	
Breadth " " second " . . .	6¼	6½
Length " " " " . . .	3¾	4
Breadth " " sectorial molar, . . .	9	10
Length " " " " . . .	5	7½
Breadth " " tubercular " . . .	6¾	6¾
Length " " " " . . .	2	2¼
Width, fore and aft, " " " . . .	2½	2½
Breadth of crown of lower first premolar, ...	2¼	2¾
Length " " "	1½	1½
Breadth " " second "	5¼	5½
Length " " " "	3½	4
Breadth " " third "	6½	6½
Length " " " "	4½	4½
Breadth " " sectorial molar, . . .	8¼	9
Length of fore cusp " " "	4¾	4¾
Length of back cusp " " "	5¾	5½
Breadth of crown of lower tubercular molar, . . .	1½	1½
Length " " " " . . .	1	1

ÆLURODON.

Ælurodon ferox.

A single superior sectorial molar tooth of a large carnivorous animal, distinguished by the above name, apparently indicates an extinct genus and species, different from any previously characterized. The specimen was discovered by Dr. Hayden in the sands of the Niobrara River, in association with those of the wolves described in the preceding pages. It is perfect, unworn, and is represented in figures 13, 14, plate I.

The tooth belonged to an animal equal in size, if not somewhat larger than the largest variety of the existing American Wolf, *Canis occidentalis*, or its European representative, the *Canis lupus*. It perhaps may have appertained to the same animal as the jaw fragment referred to *Canis Haydeni*, though its size appears too small in relation with the sectorial molar of the latter, in comparison with the corresponding teeth of the recent Wolf. If subsequent discoveries should determine the two fossils to belong to the same animal, their distinctive characters together are amply sufficient to refer them to a distinct genus, for which the name of *Epicyon*, originally applied to *Canis Haydeni*, would be appropriate.

The tooth is intermediate in character to that of the wolves and cats. Larger than in the largest variety of the recent Wolf of America or Europe, it approaches in size to that of smaller individuals of the Bengal Tiger, *Felis tigris*.

The crown is longer, but not so broad as in the latter animal, the two measurements holding more the proportion to each other as in the wolves. It differs strikingly from that of the latter, as in the cats, in the possession of an accessory lobe in advance of the principal cusp, but proportionately less well-developed than in the Tiger. The principal cusp is better developed than in the latter animal, being both longer and broader. The posterior trenchant lobe is longer, but not so broad as in the Tiger. A tubercle at the antero-internal part of the crown, supported on the abutment-like projection of the base of the principal cusp, and sustained on the advanced antero-internal fang of the tooth, is not so well-developed as in the cats, but is about equal to that of the wolves.

In fewer words, the tooth has the proportions of that of the wolves, but has added to it the anterior accessory lobe of that of the cats.

The measurements of the tooth, in comparison with that of a Bengal Tiger from Hindostan and that of a Wolf from Germany, are as follows:

	A. ferox.	C. lupus.	F. tigris.
	Lines.	Lines.	Lines.
Antero-posterior diameter of crown externally,	13	12½	15
Antero-posterior diameter of crown internally,	14¼	12½	14
Length at principal cusp,	8½	7½	7½
Length at posterior lobe,	7	6	6
Thickness of base anteriorly,	7½	6	7½
Thickness at base of principal cusp,	5½	5	5

URSIDÆ.

LEPTARCTUS.

Leptarctus primus.

A small carnivorous animal, distinguished by the above name, suspected to be allied to the existing genus *Nasua*, is inferred to have existed from an isolated tooth, found by Dr. Hayden in association with remains of *Merychippus* and *Hipparion*, at Bijou Hill, east of the Missouri River, about ten miles below the mouth of White River, Dakota.

The specimen, represented in figures 15, 16, plate I, one and a half times the diameter of nature, is a left superior molar tooth, nearly resembling in size and construction the fourth upper molar of the Coati, of South America.

As in the latter animal, the tooth has a trihedral crown, and three fangs holding the same relative position.

The crown has nearly the same proportions as in the Coati, but is rather longer in relation with its other measurements. As in the Coati, it is constituted of three tubercles externally and two internally. In the fossil the median outer tubercle or cusp is the largest of the five. The postero-external tubercle is proportionately longer than in the Coati. The summits of the median and postero-external tubercles are continuous, through a trenchant curved edge. The antero-external tubercle is rather less well-developed than in the Coati, and is not conical, but crescentoid, with an acute edge or summit continuous with the bases of the median-external and the antero-internal tubercle. The latter is smaller than in the Coati, and is rather trihedral than conical, while the postero-internal tubercle is proportionately larger, so that the internal tubercles in the fossil are comparatively small and nearly equal in size, whereas in the Coati the antero-internal tubercle is not only much longer than the one behind, but is nearly or quite equal to the median external tubercle.

The measurements of the specimen, in comparison with those of the corresponding tooth of the Coati, are as follows:

Fourth superior molar.	Leptarctus.	Coati.
	Lines.	Lines.
Antero-posterior diameter of crown,	3½	3½
Transverse " "	3	3¼
Length of crown,	2½	2¼

RUMINANTIA.

Of this order, the extinct fauna under investigation presents the greatest number of species, and by far the greatest abundance of materials, indicating the animals to which they belong to have been the most abundant, at least of the larger terrestrial mammals, during the middle and later tertiary periods. The number of species, including some doubtful ones, which I have distinguished, is twenty-seven. These belong to fourteen genera, of which all except one are extinct. Five of the genera appear to represent two peculiar and extinct families; the others belong to the families of the Camels, the Musks, and the Deers. About one-half of the species belong to the miocene formations, the remains first appearing in bed A of Dr. Hayden's section, and extending through beds B, C and D. The others belonged to the pliocene period, their remains having been obtained from bed F of Dr. Hayden's section.

OREODONTIDÆ.

This peculiar and extinct family of ruminants is distinguished by well-marked characters. The skull has somewhat the form of that of the peccaries; the cranial portion especially resembles that of the Camel. It is hornless. The temporal fossæ are large, and separated by a median sagittal crest, as in the Camel. The zygomatic arches are strong. The orbits are closed behind by an arch. Large and comparatively deep fossæ impress the lachrymal bones in advance of the orbits. No unossified spaces occupy any part of the face. The auditory capsules are variable in degree of development. The paramastoids are long and strong. The lower jaw is broad and deep posteriorly, and impressed with a comparatively deep fossa below the lunar notch. The teeth in both jaws form nearly unbroken arches. The formula of dentition is:

$$\text{Incisors } \frac{3\ \ 3}{4\ \ 4};\ \text{c. } \frac{1\ \ 1}{1\ \ 1};\ \text{p. m. } \frac{4\ \ 4}{3\ \ 3};\ \text{m. } \frac{3\ \ 3}{3\ \ 3}=44.$$

Well-developed incisors in both jaws; the fourth of the lower jaw being a transformed canine, as in ordinary ruminants. Canines well-developed and strong in both jaws, suilline in their resemblance, those of the lower jaw being transformed premolars. The anterior three premolars having the crown in the form of a demi-cone, with more or less rudimental elements at the base internally. The fourth upper premolars and the true molars of both jaws constructed after the ordinary ruminant type, and most nearly resembling in form those of the Deer family.

What are supposed to be the bones of the fore arm and leg are discrete, as in the Hog, and the bones of the feet correspond in number with those of this animal.

The species belonging to this family I have referred to four genera, which are closely allied, and indeed are not separated by any very striking characters. Perhaps most naturalists would include them in a single genus, nor am I prepared to dispute such a view.

The genera are named *Oreodon*, *Merycochœrus*, *Merychyus*, and *Leptauchenia*.

The first genus, *Oreodon*, includes three species, besides several doubtful ones, or well-marked varieties. Their remains are by far the most abundant of those which have been brought from the Mauvaises Terres of White River. Occurring most frequently in bed B of Dr. Hayden's section of the miocene formation, they also extend into the higher beds C and D of the same section. *Oreodon Culbertsoni* and *O. gracilis* especially belong to the lower bed B, but *O. major* appears to have been a rather later form, and belongs to the higher bed D.

Merycoehœrus belongs to the latter bed, and looks as if it might have been a derivative of its cotemporary *O. major.*

Merychyus is represented by three species, the remains of which were obtained from bed F of Dr. Hayden's section of the pliocene formation of the Niobrara River. These look as if they might have been derived, perhaps by selection, according to the view of Darwin, from one or other of the species of *Oreodon* of the preceding period, from *Merycochœrus*, or from the succeeding genus.

Leptauchenia is represented by three species, the remains of which pertain to bed D of Dr. Hayden's section.

OREODON.

Of the great variety and abundance of mammalian fossils brought from the Mauvaises Terres of White River, by far the most numerous belong to a remarkable and peculiar genus of ruminants, which we have distinguished by the name of *Oreodon*. In the various collections of fossils from the locality mentioned which have been submitted to my inspection, I have estimated that I have observed skulls, fragments of others and teeth, together with other bones of the skeleton, of perhaps five hundred individuals of *Oreodon*, referable to three distinct species. With comparatively few exceptions, the specimens belonged to a species of intermediate size, to which I have given the name of *Oreodon Culbertsoni*. Those of the largest species, *Oreodon major*, are rare, comprising not more than one or two per centum of the whole. Specimens of the smallest species, *Oreodon gracilis*, are more abundant,—equal to about ten per centum of the whole.

Oreodon, in the anatomical character of its skeleton, exhibits a clear relationship to suilline animals, and, indeed, the character of the genus cannot probably be better expressed than when it is called a genus of ruminating hogs. From the comparative abundance of its remains we may suppose it to have existed in great numbers, and to have lived together in large herds, which once roamed over the extensive prairies and through the dense forests of ancient Nebraska, as the Peccaries do in our own times in South America.

The species of *Oreodon* exhibit a considerable range of variation in size, in the proportion of parts and in the details of form, and extreme varieties of each more or less closely approximate one another. A few specimens referred to one or other of the species present such differences as to leave it doubtful whether they have been properly placed, the imperfection of the fossils usually rendering the determination uncertain.

The skull of *Oreodon*, in its general form and construction, approximates that of its more ancient relative, the *Anoplotherium* of the eocene deposits of Europe. In the usual side-view it bears a general resemblance to that of the Peccaries, and many of its details of form and construction indicate a relationship of *Oreodon* with these animals.

Without the lower jaw, the skull of *Oreodon* has a decidedly wolfish aspect. Indeed, in the shape of the cranium, the form and extent of the temporal fossæ, separated by a well-developed sagittal crest, and in the form of the face, with the almost continuous row of teeth, *Oreodon* presents a more striking resemblance to a Wolf than it does to any of the existing members of its own order.

Among living ruminants, in the form and construction of the cranium and temporal fossæ, *Oreodon* most nearly approaches the Camel family. The form of the face is very unlike that of any living ruminant. The orbits are closed behind by a post-orbital arch, as in the order generally, and large lachrymal fossæ exist in front of them, as in the Deer and the extinct *Bootherium*.

The lower jaw approximates in form that of the Peccary.

Like *Anoplotherium*, *Oreodon* is remarkable for the completeness of its dentition. As in the former, it possesses forty-four teeth, arranged in series almost as continuous, being only broken to an extent sufficient to allow the passing and accommodation of the points of the upper and lower canines.

The true molar teeth of *Oreodon* are constructed after the same characteristic plan of those of all other ruminants, living and extinct, and therefore serve to fix the immediate relationship in classification of the genus.

Description of the skull.—The skulls of the different species of *Oreodon* are to some extent of variable size and general robustness, and also in the relative proportion of their different parts. (Plates vi, vii, viii.)

The side-view of the skull presents a triangular outline, as in the Peccary, but is of less proportionate depth posteriorly, and therefore slants less above.

The cranium is constricted, and is narrowest immediately behind the expansion of the forehead to the post-orbital arches. Posterior to the constriction it is ovoid, but expands in an elevated acute border and prominent obtuse summit to the inion, and in a long median sagittal crest.

The temporal fossæ extend about half the length of the skull, and are separated by a strong sagittal crest. Their depth, where greatest, corresponding with the posterior root of the zygoma, is about half their length.

The sagittal crest, long, narrow and high, resembles that of the Camel family, or that more frequently observed among carnivorous animals. It commences in a triangular expansion at the broad summit of the inion, and usually reaches to the commencement of the frontal bone, corresponding with the narrowest portion of the cranium, before it bifurcates.

The temporal ridges, defining the forehead from the temporal fossæ, curve outwardly to the post-orbital arches in the same manner as in the Camel family.

The temporal surface of the cranium has the usual triangular outline, with its apex curving outwardly on the post-orbital process of the frontal bone. Independently of the elevation of its borders, it is convex. In some skulls it is more or less abruptly depressed along the parietal border just in advance of the fore part of the tempero-parietal suture, giving rise to the appearance of a curved groove. At the back part of the tempero-parietal suture, but piercing the edge of the parietal bone, there is a large venous foramen, sometimes replaced by a pair of smaller ones. In some skulls the foramina pierce the parietal bone a short distance above the suture indicated.

The zygomata enclose a space intermediate in extent proportionately to that in the Camel family and some of the carnivora. They are proportionately stronger than in the Camel, and are more arched upward and more convex externally. Their posterior root above contributes a broad triangular surface to the temporal fossæ. Their course from the posterior root is outward, and then downward and forward to the face. They are proportionately of greater depth than in the recent ruminants and carnivora, and approach in this respect the Peccary.

The inion or occipital extremity of the cranium is intermediate in form to that of the last mentioned animal and that of the Wolf. It is triangular, with a broad convex summit and lateral sigmoid borders, ending in the large paramastoid processes which form the basal angles of the triangle.

The summit of the inion is produced backward on each side, as in the Peccary, in strong wing-like processes, terminating below by bifurcating into the prominent acute lateral border of the inion, and an obtuse ridge descending and expanding upon the occipital surface above the condyle. Between the ridge just indicated and the lateral border of the inion there is a deep fossa, expanding below upon the base of the paramastoid process. Between the wing-like processes at the summit of the inion, the surface forms a deep concavity, divided at the middle by a narrow vertical ridge.

The occipital foramen and condyles form the termination of a more prominent portion of the inion than in the Peccary. The occipital foramen is transversely oval, but differs little in its diameters The condyles resemble those of the Peccary, but approach less near together below.

The paramastoid processes are strong, and apparently of variable length in the different species.

The basi-occipital is of moderate breadth, and is produced inferiorly into a median crest, which expands in front to conjoin a similar enlargement of the basi-sphenoid. The under surface of the latter and that of the presphenoid form a continuous and moderate slope forwards into the nose.

The external pterygoid plates are directed obliquely downward and forward, and have an obtuse posterior margin. The internal pterygoid plates descend vertically, and end in a process projecting a little below the position of the external plates. A narrow angular groove or pterygoid fossa occupies the interval of the external and internal plates postero-inferiorly.

The pterygoid plates, conjoined in the usual manner with the prolongation backward of the palate bones, enclose between them and the latter a large median palatine notch, which extends nearly as far forward as the position of the last molar teeth. The sides of the notch as formed by the palatines are thick and rounded, and are impressed with muscular attachments.

Lateral palatine notches extend between the prolongations of the palate bones and the obtuse ends of the alveolar borders, with their bottom a little in advance of the middle palatine notch.

The glenoid articulation exhibits a broad surface extending outwardly on the under part of the posterior root of the zygoma. Its fore part is nearly straight and horizontal transversely, and is moderately convex antero-posteriorly, inclining forward internally and backward externally. Postero-internally it descends upon a remarkably large and strong post-glenoid tubercle, which is antero-posteriorly compressed mammillary in shape.

The tympanics form a bulla or auditory capsule, varying in extent of development in a remarkable degree in the different species of *Oreodon*. The bulla abuts behind against the paramastoid process, externally partially encloses a space accommodating the styloid process, and anteriorly extends between the basi-occipital, sphenoid and squamosal in the ordinary manner among ruminants. The auditory process or inferior boundary of the external auditory meatus is of moderate length, and extends outward, upward and backward in a high, narrow archway between the post-glenoid and post-auditory processes.

The condyloid foramen occupies a position in the angle of a rectangle between the occipital condyle and the paramastoid process.

The jugular foramen, occupying a position immediately behind the auditory bulla, appears to be comparatively of small size.

The foramen lacerum varies in size with the difference in development of the auditory bulla in the different species of *Oreodon*.

The stylo-mastoid foramen, oval foramen, and eustachian canal, occupy about the same relative position as in the Deer.

The spheno-orbital and optic foramina are likewise related to the oval foramen and each other, as in the latter animal, but are proportionately more distant.

The orbits are small compared with those of recent ruminants, and in this respect resemble more those of the suilline animals. They are proportionately longer than in either, and are directed more forward from the bottom.

The floor of the orbit is as broad as in recent ruminants. About its middle it presents a wide entrance to the infra-orbital canal.

The orbital entrance varies from vertically oval to round even in the same species of *Oreodon*. In its direction outward it inclines forward and upward to about the same extent it does in the Deer.

The post-orbital arch is proportionately about as strong as in the Camel, and, as in this, is directed from the forehead downward and backward to its conjunction with the zygoma.

The infra-orbital arch does not turn under below as in recent ruminants, but its outer surface continues the incline of the orbital entrance to its inferior margin.

The zygoma back of the orbital entrance extends considerably outward to it in position, as it continues the infra-orbital arch backward, as in the Hog and Peccary.

The margin of the orbital entrance is sub-acute. The upper margin is about as much below the level of the forehead as in the Hog. Its anterior margin is furnished with a vertical, compressed, mammillary lachrymal process, and is on a line with the fore part of the second true molar tooth. Above the process there is an oblique supra-orbital groove, varying in depth.

A pair of lachrymal foramina exist internal to the lower part of the lachrymal process, situated transversely; a smaller, outer, round one, and a larger, inner, oval one.

In advance of the orbital entrance, as in the Deer and extinct *Bootherium*, and to a less extent in the Sheep, Hog and Peccary, there is a lachrymal fossa. In *Oreodon* it is of remarkable depth, and forms a hemispherical concavity, in great part confined to the facial surface of the lachrymal bone.

The face of *Oreodon*, independent of the lower jaw, forms a demi-cone, the section of the cone corresponding with the alveolar border. In the same species it varies in proportionate depth and breadth, in some skulls being comparatively deeper, narrower and more convex above, in others lower, broader, and more flat above.

The forehead is lozenge-shaped in outline, and is usually moderately convex transversely, but varies from being nearly flat in some skulls to being quite prominently convex in others. It is usually more or less depressed along the middle, but in some skulls is quite even, and in others is depressed only for a short extent at the bifurcation of the temporal ridges.

A pair of frontal or supra-orbital foramina exist about the middle of the forehead, situated a short distance from each other. From them proceed grooves more or less deep towards the upper part of the nose, as in the Hog.

The upper part of the nose varies in breadth, and is more or less convex, but rarely nearly flat. The anterior extremities of the nasal bones together form a projecting triangle, as in the Hog and Sheep.

The end of the nose slightly slopes, as in the Peccary, but it projects comparatively little beyond the position of the canine teeth. The anterior nasal orifice appears rather quadrate shield-like, the lower border being prolonged between the premaxillaries. The lateral notch of the nasal orifice extends at its upper part between the nasals and maxillaries, so as to separate the premaxillaries from the former.

The side of the face is bounded by a convex alveolar border, and a sloping and slightly convex upper border. Posteriorly, over, below, and in front of the orbit, it forms an inclined plane, defined below by the inferior edge of the malar bone. Its fore part is more or less convex and vertical, and exhibits a curved prominence produced by the fang of the canine tooth. Back of the latter the alveolar border is at first concave, and then convex.

The infra-orbital foramen occupies a position above the third premolar tooth.

The hard palate is of nearly uniform breadth posterior to the position of the canine teeth, and is moderately arched, in a somewhat angular manner, towards the centre. The anterior palatine foramina are small compared with those of ordinary ruminants, but are proportionately about the size of those of the Camel family. They are situated within the position of the canine teeth, and are elliptical in form. The posterior palatine foramina pierce the maxillary bones almost opposite the interval of the third and fourth premolar teeth.

Forms, relations, and connections of the bones of the skull.—The back part of the occipital bone is triangular, with a broad convex apex extending backward into a pair of prominent wing-like processes, and extending forward on the top of the cranium, as in the Camel, to articulate with the parietals and temporals. The exoccipitals terminate below in strong paramastoid processes, and hold about the same relation to the lateral borders of the inion that they do in recent ruminants. The basi-occipital articulates with the basi-sphenoid on a line with the post-glenoid tubercles.

The squamosal, as in the Camel, contributes largely to the temporal surface of the cranium. The mastoid is seen, as in the Deer, as a narrow fusiform bone intercalated between the squamosal with its post-auricular process and the ex-occipital.

The mastoid process is almost obsolete, being smaller than the post-auricular process, between which and the paramastoid process it occupies a small angular interval.

As in all ruminant and suilline animals, there is a single symmetrical parietal, which, as in the Camel family, is very long compared with its condition in ordinary ruminants. It is narrow behind, and gradually widens to the fore part of the squamosals, where it sends downward a prolongation to join the ali-sphenoids In front it usually is more or less deeply notched to receive a triangular point of the frontals. In some skulls the front border forms a wide angular shallow notch ; and in others it is nearly straight or transverse in its course.

The frontal bones are usually found separated as in recent ruminants, and this is also the case in old skulls, but occasional specimens are seen in which the two bones are co-ossified at the posterior angular extremity. They contribute a small portion of surface to the temporal fossæ, just back of the orbits. They converge regularly from the post-orbital arches to the anterior angular processes, which are long, triangular and pointed, and which reach some distance in advance of the lachrymal bones. A deep notch between the angular processes receives the posterior extremities of the nasal bones.

The post-orbital arch receives about an equal contribution from the frontal and malar bones.

In the formation of the zygoma the malar bone is deeply notched from behind forward to receive the end of the zygomatic process of the squamosal. The lower arm of the notch, sustaining the end of the latter process, is bent slightly downward in its backward course, and is much longer than the upper arm.

The lachrymal bone forms two sides of an irregular cube, and the margin of union of the two sides is produced into the comparatively large lachrymal tubercle. The facial surface of the bone is in great part depressed to form the deep hemispherical lachrymal fossa.

As in recent ruminants, the lachrymal bone articulates with the frontal, maxillary, malar and palate bones, but is separated some distance from the nasal by the advance of the angular process of the frontal bone.

The nasal bones are of nearly uniform breadth, except at their converging extremities. They are usually slightly convex both transversely and in the length, but sometimes are nearly flat. In different skulls they vary much in breadth and degree of convexity.

The maxillary bone articulates on the facial surface behind with the frontal, lachrymal and malar bones. Above, it joins the nasal bone, and in front separates this from the upper extremity of the premaxillary.

The premaxillary bone is comparatively small, and projects very little beyond the line of the upper canines. The alveolar portion is constructed like that in the Wolf, but projects less forward. The ascending portion is hardly visible laterally except at its upper expanded end, which is partly received into a notch of the maxillary, and, as before indicated, is separated by an angular notch from the nasal bone.

The palate plates of the palate bones are large, and occupy nearly all the space between the position of the true molars, as in the Deer.

Inferior maxilla.—The lower jaw of *Oreodon* partakes of the form of that of the *Anoplotherium* and that of modern suilline animals.

The body of the jaw is comparatively short; the posterior portion, or ascending ramus, is broad and deep.

The outer side of the body is vertical and moderately convex. The symphysis slopes as in the Hog, and forms an angle of about 45°. The chin is convex, and not so broad as in the Peccary or Hog. The alveolar portion of the jaw ascends in a moderate degree posteriorly, so as to form a curvature. The base is nearly straight, or feebly convex in its length, but descends in a more convex manner at the angle, and is slightly protuberant below the symphysis.

The technical angle of the jaw forms a prominent expansion of the bone with a thick convex border, in the same manner as in the Peccary and Hog, but to a greater degree. The expansion is less prominent posteriorly than in *Anoplotherium,* but is higher, reaching to within a short distance of the condyle.

The condyle, the notch in advance, and the coronoid process approximate those of the Peccary in form and relationship. The condyle is almost identical in form and relative position, but is narrower externally. The notch is deeper and wider; intermediate in character to that of the Peccary and Hog. The coronoid process is intermediate in form and size to that of the latter animals.

Below the coronoid process and adjoining notch the ramus is depressed into a fossa better defined and much deeper than that in the Peccary.

The mental foramen occupies a position below the second premolar tooth, and usually a second is situated a short distance behind it.

The symphysis of the lower jaw remains open, or is unossified, even in old skulls of *Oreodon,* as in ordinary recent ruminants.

Dentition.—As previously intimated, the dentition of *Oreodon* is remarkable for its complete character; the teeth of the permanent set being forty-four in number, arranged in nearly unbroken series in both jaws. The genus besides presents many well marked peculiarities in the construction and arrangement of the teeth. The formula of the permanent dentition is as follows:

$$\text{Incisors } \frac{3-3}{4-4}, \text{ canines } \frac{1-1}{1-1}, \text{ premolars } \frac{4-4}{3-3}, \text{ molars } \frac{3-3}{3-3} = 44.$$

The molar teeth, seven in the upper jaw and six in the lower jaw on each side, form unbroken rows. When the jaws are closed the cusps of the lower molar teeth are included in the angular interspaces of those above. The premolars above and below have their outer faces nearly on the same plane; the lower true molars are situated considerably within the position of the outer portion of the upper true molars.

The true molars correspond in number, general proportions of size, relative position, and plan of construction, with those of existing ruminants. Among the latter they approach most nearly those of the Deer family, and, as in this, are inserted into the jaws by distinct fangs alone, when the crowns occupy their functional position.

The crowns of the upper true molars are composed, in the usual manner among ruminants, of four crescentoid demi-conoidal lobes. They are nearly square, the transverse and antero-posterior diameters being nearly equal, but their length is much less. They resemble those of the Deer, but are more spread transversely, more square, and of less proportionate length; the interlobular spaces are more open and shallow; the faces of all the lobes are more sloping from the perpendicular, and the inner lobes are uncomplicated with accessory folds. The outer lobes anteriorly, and consequently where the lobes conjoin in each tooth, form buttress-like columns more prominent than in the Deer. These columns are laterally compressed towards the masticating border, but expand towards the bottom of the crown. In the last molar a similar buttress-like column, but less well developed, occupies the back part of the postero-external lobe. The external faces of the outer lobes, concave transversely, exhibit a comparatively feeble median ridge, of variable distinctness in different skulls. The inner lobes conjoin the outer ones at about the basal third of the latter. Their outer face, concave transversely, also exhibits a slight median ridge. The summits of the inner lobes, in the worn and moderately worn teeth, are distinct or separated from each other at the extremities. The contiguous extremities of each pair of inner lobes, after being directed forward and parallel, cease abruptly in the interval of the outer pair of lobes.

Constituent elements of a basal ridge, rarely continuous throughout, surround the upper true molars, in various degrees of development in different skulls, sometimes being well marked, in other instances being almost obsolete. Usually portions exist between the buttresses of the outer lobes, and also, in festoons, in the intervals internally of the inner lobes.

In the trituration to which the upper true molars were subjected in mastication, the same steps were passed through as usual in living ruminants. The summits of the anterior lobes suffered abrasion first and most; the internal lobes more than the external ones, but subsequently the wearing appeared more equalized. When the dentine is first exposed on the outer lobes, the surface presents the form of a pair of crescents confluent where contiguous. At the same time the inner lobes exhibit broader crescents of the exposed dentine. As attrition proceeded, the dentinal crescents of the inner lobes likewise became continuous, while those of the outer lobes became wider. Subsequently the inner and outer crescents became conjoined, leaving upon the dentinal surface of each tooth a pair of central crescentic enamel islets, composed of a small portion of the external face of the inner lobes and a larger portion of the internal face of the outer lobes. The enamel islets next disappeared, leaving upon the teeth broad quadrate dentinal surfaces bordered by enamel.

The crown of the fourth upper premolar is composed of a pair of crescentoid demiconoidal lobes, like those of the true molars, but larger, as is the case with all the upper premolars of ordinary ruminants. Its outer face is cordiform and transversely concave, with a slight median ridge.

The anterior three upper premolars are constructed after the same plan. They decrease, successively in size and in the degree of development of their details of form, from the third to the first of the series. Their crown is a trilateral pyramid, with a pointed apex and a broad external cordiform surface. The narrower internal surfaces appear as triangular inclined planes, separated by a median acute ridge extending from the point to the base of the crown. The anterior of the internal surfaces forms at the base a pair of shallow pouches, defined by a double festoon. The posterior of the same surfaces forms a single and larger pouch at the base of the crown, included by a single and thicker festoon. This latter in the third premolar almost assumes the dignity of an additional lobe to the crown, resembling the internal lobes of the true molars.

The outer cordiform surfaces of the anterior three upper premolars become successively less concave, from behind forward, apparently from a gradual expansion of the slight median ridge, so that the first of the series is almost convex.

In some instances the fourth upper premolar exhibits a ridge or process dividing off the fore extremity of the crescentic interspace of the two constituent lobes of the crown.

Occasionally the antero-internal surface of the crown of one or more of the anterior three upper premolars forms three pouches at the base of the crown, and occasionally also only a single pouch.

The crown of the fourth premolar in wearing passed through the same steps as a corresponding pair of lobes of the true molars. In the abrasion of the other premolars, they became rapidly blunted, and were worn away much faster from the point than at the sides. A dentinal tract was first exposed along the back border of the crown, followed by one along the front border. A narrow tract next appeared along the course of the internal ridge of the crown. The posterior tract greatly exceeded the others in the rapidity of its expansion. As the tracts conjoined, the pouches on the inner side of the crown became more or less isolated, and formed islets before their final obliteration.

In some skulls a narrow interval or slight hiatus exists between the first and second premolars; in other specimens it is absent; and in others the first premolar crowds so closely on the third that this assumes a more than usually oblique position, with the outer face of its crown directed forward and outward.

The crowns of the lower true molars, as in other ruminants, have two pairs of symmetrical lobes, with an additional or fifth lobe to the last tooth. They bear a near resemblance to those of the Deer, but are proportionately shorter and wider, with the interlobular spaces wider and shallower, and the surfaces of the lobes more slanting. The median ridge internally of the inner lobes is less robust, and the outer lobes are more tapering. The posterior or fifth lobe of the last molar is ovoid, with an elliptical excavation at the triturating extremity.

Wearing from attrition passed through the same phases in the inferior true molars as in the Deer, excepting that from the shallower character of the interlobular spaces, the bottoms of these appeared much earlier as crescentic enamel islets on the exposed dentinal surfaces. The islets were finally obliterated, leaving broad dentinal surfaces bordered with enamel.

The lower premolars, three in number, bear less resemblance to those of the Deer than the true molars do to the corresponding teeth of the latter. They are constructed after the same plan, but decrease in size and degree of development from last to first. Their crown is a broad trapezoidal pyramid, widest behind, and with an acute crescentoid border rising in a median point. From the latter an oblique ridge descends internally, and in the third premolar terminates in a large, trilateral, pointed tubercle, which springs from the middle of the base of the crown, and rises nearly as high as the principal point. In the premolars in advance, the tubercle just mentioned is nearly obsolete, and the oblique ridge appears to expand into the base of the crown. Back of the oblique ridge the crown presents a fossa, more or less closed internally by a tubercle or ridge. In the third premolar the fossa is quadrate, and widest transversely; in the second it is more square; and in the first is less well-defined and narrow, or appears as a mere concave slope of the back portion of the crown. In advance of the oblique ridge mentioned, the inner part of the crown forms a broad sloping concavity, usually enclosed at bottom by a narrow festooned basal ridge. A ridge of the same character likewise exists at the back of the crown, both internally and externally, frequently more or less associated by a transverse basal ridge at the posterior part of the crown.

The structural arrangement thus described of the inferior premolars is subject to considerable variation, arising from difference in degree of development. In comparing the premolars with the true molars the outer portion of the crowns of the former appears to be homologous with the outer pair of lobes of the latter, and the postero-internal tubercle of a premolar appears to correspond with the antero-internal lobe of a true molar.

In tracing the effects of mastication upon the inferior premolars, it is noticed that the dentine is first exposed on their posterior slope, and subsequently on the anterior slope, while greatly widening in the former position. At an intermediate stage the exposed dentinal tract posteriorly encloses an enamel islet or lake.

In some specimens more than in others, the anterior pair of premolars appear somewhat crowded in position, and are inserted obliquely, crossing the alveolar border, so that the first one at its back part is situated externally to the second one, and its fore part is situated internally to the contiguous canine tooth.

All the molar teeth of *Oreodon* are inserted with the same number of fangs and in the same relative position as in ordinary existing ruminants.

The possession of well developed canine teeth in both jaws is one of the remarkable characters of *Oreodon*. The form of these teeth is peculiar, and among recent animals most resemble those of suilline animals, though comparatively of small size. They vary in size in different skulls, but usually are best developed in the largest skulls, which in many cases most probably indicate the male animal.

The superior canine is separated by a short hiatus from the contiguous premolar tooth, sufficient to accommodate the point of the inferior canine. It curves from the bottom of its alveolus, above the position of the interval of the first pair of premolars, forward and downward with a slight inclination outward. The fang is curved trihedral, with rounded borders. The crown protrudes downward and outward, and when the mouth is closed it occupies a position in front of and in contact with the fore part of the crown of the inferior canine.

The shape of the crown of the upper canine, in the unworn or slightly worn condition, is that of a sharp pointed, trilateral pyramid, with nearly equal sides and almost straight, or with the slightest curvature. One of its faces is directed outwardly, a second inwardly, and the third posteriorly. The outer face is slightly convex, with a feeble wide median groove. The inner face is also slightly convex, and is provided with a stout median ridge, narrowing away and disappearing towards the point of the tooth. The posterior face is slightly concave, but soon becomes a nearly vertical plane from attrition against the inferior canine. The anterior border of the crown is obtuse or sometimes sub-acute; the outer and inner borders are both acute. The apex of the crown, at rest, was received in the angular interval between the lower canine and the lateral incisor.

The inferior canine is straight, and is directed from the bottom of its alveolus obliquely upward, forward and outward. The fang, variable in form in different skulls, is quadrate with rounded margins, and more or less compressed from without inwardly. Sometimes the quadrate almost assumes the cylindroid form, at others the compressed cylindroid form. The crown is a broad, transversely compressed pyramid, with trenchant anterior and posterior borders converging to a slightly rounded but sharp summit. It is about the same length as that of the upper canine, but somewhat broader. Both inner and outer faces are angularly convex, the angular character varying in degree in different specimens, sometimes being very pronounced, at others obsolete. In one unworn specimen the inner surface is divided by an acute ridge, and the portions on each side are concave, though generally the divisions of both inner and outer surfaces exhibit towards the base of the crown a more or less feebly depressed condition.

The crown of the inferior canine projects externally to the contiguous premolar, and is separated from the lateral incisor by a narrow hiatus. It is usually crowded closely upon its contiguous premolar, and when at rest occupies the angular interval and hiatus between the first superior premolar and canine tooth.

From trituration the canine teeth became exceedingly blunted, their crowns wearing away nearly to the level of the molar teeth. The crown of the upper canine was worn away at the point and from the posterior surface. The crown of the lower canine was worn away obliquely at its fore part.

Enamel invested the crowns of the canine teeth to their base, on a level with the molars.

The crown of the inferior canine resembles that of the contiguous premolar enlarged and simplified by the suppression of the internal ridges. The position of the inferior canine in its relation with the one above, and the excess in number of the inferior incisors, indicate the former tooth to be a transformed premolar, or a caniniform premolar.

The incisor teeth of *Oreodon* are six in number in the upper jaw, including both sides; and they are eight in number, as in all recent ruminants, in the lower jaw. They hold about the same relative position with one another as in the Wolf, and they also bear considerable resemblance to those of the latter animal in form,—the lower or corresponding ones even more than they do those of recent ruminants. They form, together with the canines, nearly unbroken arches; a slight interval or hiatus existing between the lower lateral incisors and canines. They successively increase in size from first to last, in each jaw, but the fourth or lateral incisor of the lower jaw much exceeds all the others.

The superior incisors with their fangs curve forward and downward, and their crowns are directed downward. The inferior incisors are directed obliquely upward and forward.

The crowns of the upper incisors are ovoidal, convex externally, excavated internally, and have an acute rounded summit and lateral borders. The latter expand abruptly at about the middle of the crown, forming, as in the Wolf, short lateral offsets, which become continuous with an internal basal ridge.

The crowns of the inferior incisors are rather trapezoidal in their outline, and they have their external face more flat and their summit much broader than the upper ones. The inner face is angularly convex in the intermediate teeth, and forms a pair of inclined, slightly depressed planes, uniting in a median acute ridge. The lateral acute borders form offsets at or below the middle, and unite posteriorly through means of a strong basal ridge.

The inferior lateral incisor is twice the size of the others, and, as in other ruminants, is to be regarded as an incisiform canine.

Temporary dentition.—The temporary dentition of *Oreodon* was probably arranged according to the following formula:

$$\text{In. } \frac{3-3}{4-4}; \text{ c. } \frac{1-1}{1-1}; \text{ p. m. } \frac{2-2}{2-2}; \text{ m. } \frac{1-1}{1-1} = 30.$$

Specimens under examination contain the temporary molar teeth and the upper canines, but no others.

The upper temporary true molar has the same form as those of the permanent set, but is smaller.

The crown of the upper second temporary premolar is composed of three lobes like those of the true molar; two behind and transverse, the other in front. It has the appearance of the fourth permanent premolar conjoined with an anterior premolar. The anterior lobe internally is connected with the adjacent part of the postero-internal lobe by means of a festooned fold, enclosing between them a depression.

The upper first temporary premolar resembles the corresponding permanent tooth less well developed.

The first permanent premolar of the upper jaw protruded after the deciduous teeth behind, and appears not to have had a predecessor.

The lower temporary true molar, as in other ruminants, possesses three pairs of lobes, which hold the same relative position with one another and have the same form as the pairs of lobes in the permanent true molars.

The two lower temporary premolars closely resemble those of the permanent set.

Oreodon Culbertsoni.

The most abundant remains of *Oreodon*, from the Mauvaises Terres of White River, as previously mentioned, are referable to a species of intermediate size, to which the above name has been given in honor of Messrs. Alexander and Thaddeus A. Culbertson, who were among the first to collect specimens from, and direct the attention of naturalists to the rich fossil bone deposits of Dakota.

The skull of *Oreodon Culbertsoni*, figure 1, plate VI, figure 2, plate VII, is rather smaller than that of the domestic Sheep or the Collared Peccary. Different specimens exhibit considerable variation in size, and also in the relative proportion of parts, including the teeth.

The greater number of specimens of skulls and parts of the same, of smaller size and graceful proportions, are supposed to indicate females. Specimens of larger size and more robust proportions are supposed to have belonged to males. Specimens of the smallest size approach those of the smallest species of *Oreodon*, but retain other characters distinguishing them as appertaining to *O. Culbertsoni*. Some specimens, in comparison with the more common forms, exhibit a disproportion of parts. There are large skulls with comparatively small teeth, and small skulls with comparatively large teeth.

Skulls of *Oreodon Culbertsoni* differ more or less in every particular. They differ in the length and strength of the sagittal crest, in the prominence of the forehead, in the exact form and proportionate size of the orbital entrance, in the depth and relative breadth of the lachrymal fossa in advance of the orbit, and in the height, breadth, and exact form of the face.

The sagittal crest in *Oreodon Culbertsoni* gradually continues as an uninterrupted linear ridge to the frontal bone, but in some specimens of crania, especially in some of those supposed to pertain to the female skulls, it expands into a long narrow triangle, with a more or less deeply notched base receiving the pointed summits together of the frontals.

The lachrymal fossa, or the hemispheroidal pit in advance of the orbital entrance, is almost large enough to receive the end of a finger, and is always more strictly confined to the lachrymal bone than the corresponding depression in the Sheep, Hog and Peccary. It usually occupies nearly the whole facial surface of the lachrymal bone, and not unfrequently includes a small portion of the maxillary. Sometimes it is narrower or more contracted and deeper, at other times it is shallower than usual without being proportionately wider.

The nasal bones of *Oreodon Culbertsoni* vary in their proportionate breadth and transverse convexity in different skulls. Usually the posterior extremities together form an acute isosceles triangle between the anterior angular processes of the frontals. The triangle varies in length, and degree of acuteness. The sides are more or less slightly convex, especially towards the base. In a few instances the apex is observed to be more or less rounded, and rarely notched.

The auditory bulla of *Oreodon Culbertsoni* is remarkable for its small size, in comparison with that of recent ruminants and suilline animals, and with that also of the other species of the genus. It forms a moderate, convex prominence about half the size of the contiguous post-glenoid tubercle. It extends in a ridge to the paramastoid process, and in a vaginal ridge and auditory process to form the inferior boundary of the external auditory meatus. Between it and the basi-occipital and basi-sphenoidal there exists a wide crescentoid interval, at the bottom of which the periotic bone is visible.

Among the better-preserved specimens of skulls, and fragments of others, of *Oreodon Culbertsoni*, the following are especially mentioned as exhibiting the characters and variations in the species:

1. A nearly complete skull with the lower jaw and almost all the teeth, represented in figure 1, plate VI. This specimen, viewed as a whole, represents very well the ordinary variety and size of the skull of *Oreodon Culbertsoni.* From its somewhat narrower character, lesser robustness, and smaller canine teeth, it is suspected to have belonged to the female.

In the specimen, the sagittal crest begins to widen unusually early, as the temporal ridges gradually diverge from it near the middle of its course, enclosing upon the fore part of the parietal a long narrow triangle. The anterior border of the parietal is deeply notched to receive the angular summit of the frontals. The face is comparatively narrow, deep, and prominently convex above. The orbital entrance is vertically oval. The lachrymal fossa, in advance, is broad, deep, and encroaches on the contiguous part of the maxillary bone. The nasal bones are narrow, nearly parallel at the sides but slightly wider forward. Behind, they are slightly convex; in front more convex. The posterior nasal triangle, formed by the back extremities together of the nasal bones is subacute, about eleven lines long in the middle, and seven and a half lines wide between the pointed ends of the anterior angular processes of the frontals.

2. A skull less complete than the former, with part of the lower jaw. In form, size and most of the details it closely resembles the former. The sagittal crest is longer and remains undivided until it reaches the fronto-parietal suture. The orbits are rotund. The lachrymal fossæ are narrower and deeper. The fore part of the face is narrower.

3. A mutilated skull without the lower jaw. It more nearly resembles the latter

specimen, but the lachrymal fossæ are wider and the upper part of the snout flatter. The grooves from the supra-orbital foramina strongly impress the back part of the nasals, which is not the case in the former skulls. The posterior nasal triangle is acute, fourteen lines long at the middle, and eight lines wide at the ends of the frontal angular processes.

4. A mutilated skull with the lower jaw. It nearly agrees with the preceding. Sagittal crest undivided. Anterior parietal border deeply notched. The fore part of the squamo-parietal conjunction forms a stout ridge bounding a groove curving down in front of it. In the preceding specimens the corresponding ridge is more or less obsolete and the groove in advance inconspicuous. The supra-orbital foramina are double the distance apart they are in the other specimens, and the forehead on each side is more prominent. The orbits are rotund; the lachrymal fossæ broad and deep. The snout is wider above than in the preceding skulls, and less convex. The nasal bones are comparatively broad. The posterior nasal triangle is acute, fourteen lines long, and nine lines wide.

The teeth are very much worn in this specimen, more so than in any of those under special examination. The enameled crown of the first true molars in both jaws is nearly obliterated, and the canines are worn so that the breadth of their crowns much exceeds their length.

5. A mutilated skull, without the crowns of the upper teeth and the lower jaw. It is slightly more robust than the three preceding specimens.

The sagittal crest is comparatively long, and continues uninterrupted to the anterior border of the parietal, which is transverse or descends on each side in a slightly zigzag manner, without forming a notch for the reception of the frontals. The forehead is more depressed than usual along the middle. The orbits are subrotund. The lachrymal fossæ are wide and deep. The supra-orbital groove is more conspicuous. The snout is comparatively broad and more square in transverse section from the upper part being wider and more flat. The nasal bones are broad. The posterior triangle formed by the latter together is acute, seventeen lines long and over eleven lines wide between the frontal angular processes. From the remaining fangs of the upper teeth, these appear to have been of about the same size as in the preceding specimens.

6. A nearly complete skull, most injured at the snout. It has the lower jaw separated in a wide-open manner. Imbedded in the same mass of matrix, in continuity with the skull and bent around upon one side of it, there are fifteen mutilated vertebræ. The skull is about as robust as in the specimen last described, but the snout is less wide, and is narrower and more convex above. The forehead is also less de-

pressed along the middle, and the sagittal crest is not so long, from the parietal being deeply but narrowly notched to receive the triangular summit of the conjoined frontals. The nasal bones are broad and unusually convex. The posterior nasal triangle is sub-acute, fourteen lines long and ten lines wide. The molar teeth occupy very little more space than in the preceding specimens.

7. The greater portion of a skull nearly as robust as those last described. The sagittal crest long and narrow. The anterior border of the parietal forming a wide shallow notch. Orbits slightly smaller than in the preceding specimens, sub-rotund. Lachrymal fossæ as deep, but narrower and more defined than in the preceding two specimens. Snout broad, convex above. The nasals moderately wide and convex. The posterior nasal triangle obtuse, eleven lines long and eight and a half lines wide.

8. The greater portion of a skull nearly resembling the last, but having the posterior nasal triangle notched at the apex.

9. The greater portion of a skull, in which, in comparison with all other skulls of *Oreodon Culbertsoni*, the forehead is remarkable for its convexity both antero-posteriorly and transversely. The snout appears quite flat and shelving, but the depression may partly be due to accident. The nasal bones are comparatively flat, and moderately wide. The posterior nasal triangle is acute, thirteen lines long and ten lines wide. The skull is about as robust as in the preceding specimens generally, and, excepting in the differences mentioned, exhibits no peculiarity.

10. A skull, without the lower jaw, as robust as any of the preceding specimens, but with larger canines, the other teeth being about the same as in the former. Sagittal crest extended the whole length of the parietal, which presents a small comparatively narrow notch to accommodate the summit of the frontals. Orbits rather oval; lachrymal fossæ broad and deep. Snout broad; nasals broad and moderately convex. Posterior nasal triangle acute, fifteen lines long, ten and a half lines wide at base.

11. A mutilated skull without the lower jaw, more robust than any of the preceding; with large canines, and the other teeth occupying slightly more space than usual, though separately not larger. The sagittal crest is strong, and extends the length of the parietal. The latter is deeply notched to receive the nearly equilateral triangular summit of the frontals. The forehead is rather more convex than usual, and less depressed along the middle. Orbits slightly oval; lachrymal fossæ broad and deep. Face much more robust than in any of the preceding specimens. Snout broad, convex above. Nasals wide, convex, narrowing a short distance in advance of the frontal angular processes. Posterior nasal triangle acute, fourteen lines long and thirteen and a half wide.

A skull of nearly similar proportions, but with larger molar teeth, is represented in plate iii of "The Ancient Fauna of Nebraska." The two specimens probably belonged to males.

12. The fore part of a skull and lower jaw of a moderately robust individual, but less than that last described. The sagittal crest, though wanting, is seen to have extended the length of the parietal. The latter is deeply and widely notched for the reception of the summit of the frontals. Orbits oval. Face robust; above strongly convex. Nasals broad, convex. Posterior nasal triangle acute; sixteen lines long, ten and a half lines broad.

13. The fore part of a skull, without the lower jaw; nearly like the corresponding portion of the specimen last described, being slightly less robust. Orbits sub-rotund. Teeth slightly smaller than in the last specimen.

14. The anterior extremity of a skull, somewhat crushed, about as robust as the corresponding portion of the last two specimens. Lachrymal fossæ somewhat narrowed and deep. Nasals broad, nearly flat. Posterior nasal triangle obtusely rounded, fourteen lines long and ten and a half lines wide. Teeth of the usual size, except the canines, which are large, though not of the largest size. They are but little worn, and the crown of the lower canine is half an inch in both length and breadth.

15. The greater portion of a skull without the lower jaw, much smaller than the corresponding portion of any of the preceding specimens. The specimen is not larger than the corresponding portion of a large specimen supposed to belong to the smallest species of *Oreodon*, and the same is the case also with the true molar teeth, the only ones preserved in the specimen. The other anatomical characters indicate it to belong to *Oreodon Culbertsoni*,—viz.: the comparatively large orbits, the large and deep lachrymal fossæ, the acute posterior nasal triangle, and the small auditory bullæ. The forehead and top of the face are flatter than usual. The fore part of the parietal forms a wide notch for the reception of the frontals. The nasals are nearly flat and moderately wide. The posterior nasal triangle is thirteen lines long and eight wide.

16. A fragment of a skull, consisting of the greater portion of the left side of the face without the lower jaw. The fragment has been derived from a skull rather smaller than usual, though larger than in the last-described specimen. The forehead is more convex than usual at the side, and the back portion of the nasal bones more depressed. Orbit oval; lachrymal fossa moderately large. Teeth small as in the last-described specimen. Posterior nasal triangle obtuse, laterally sigmoid, twelve lines long and nine lines broad.

17. The fragment of a skull about the same size as that of the preceding specimen, but with the forehead and face above flatter than usual. Nasal bones flat, broad. Posterior nasal triangle acute, twelve lines long and ten broad. Teeth small, but slightly larger than in the preceding specimen.

All the specimens above mentioned belonged to adult animals of various ages, as indicated by the condition of the teeth.

Three additional specimens, consisting of skulls more or less complete, not yet arrived at maturity, hold nearly the same size, form and proportions as the specimen first indicated and represented in figure 1, plate VI. All the specimens yet retain the deciduous molar teeth, but the anterior two permanent true molars also occupy their functional position, and the last of the series was about to protrude. In all, the sagittal crest is undivided to the anterior border of the parietal, which is more or less deeply notched for the reception of the frontal summit.

In one specimen the nasals are wide, and the posterior nasal triangle acute with a length of twelve lines and a width of nine lines. In a second specimen the nasals are less parallel at the sides than usual, and more sigmoid; and the posterior nasal triangle is acute, ten and a half lines long and ten wide. In the third specimen the posterior nasal triangle is obtusely rounded, and is fourteen lines long and nine wide.

The table on page 92 exhibits the comparative measurements of the seventeen specimens above indicated. Many of the measurements are, however, only approximative or estimated, as the points of departure in the specimens are in frequent instances broken.

The teeth of *Oreodon Culbertsoni* usually present uniformity of character in the different fossils. In size they are generally proportionate with the size of the skulls, the more robust of the latter usually presenting more robust teeth, with many of the details of structure better developed. Thus the basal ridge becomes more evident and usually somewhat roughened, and other ridges of the premolars are more prominent, while the intervals appear more depressed. In some instances, however, the teeth appear to have been liable to variation in size and development not proportionate with the size of the skull, and thus specimens exist in which large skulls possess comparatively small teeth and the reverse.

Skull of Oreodon Culbertsoni.	Measurements of specimens in lines.																	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Length of skull from summit of inion to end of nose,	93	88	90	90	93	90				90	102							
Length from occipital condyles to incisive alveoli,	90																	
Length of lower jaw from back border to incisive alveoli,	75			70		75												
Distance from summit of inion to base of lower jaw,	67																	
Distance from end of nose to base of lower jaw,	36																	
Length of cranium from summit of inion to post-orbital margin,	51	44			48	45					52							54
Length of face from post-orbital margin to end of nose,	48	48		46	48					50								
Height of occiput or inion,	28																	30
Breadth of the same at base,	25																	28
Breadth of skull at zygomatic arches,	50	44			50	56					58				40			48
Breadth at the post-orbital arches,	38	36	36	32	36	36	34	36		38	46	40	40		32			40
Breadth of face at upper first premolars,	16	16	15	16	17	15				19	21	18	17					
Breadth of face above last molars,	32	29	30	30	31		31			33	37	32	32					
Length of parietal crest,	31	28			35	27		28			29							38
Length of frontals in median line,	25	25	20	20	16	23	21	24	22	22	25	24	20		19		20	19
Length of nasals,	32		36	34						37			40	38				
Breadth of face between frontal angular processes,	7½	7½	8	9	11	10	8½	9	10	10	13	11	10½	11	8	9	9½	10
Vertical diameter of the orbits,	14	13½	13	12	14	13½	13	12½	14	13½	14	14½	13½		12	13	13	15
Transverse diameter,	12	12½	12½	12	13	13	11			13	13	12	13		11	11½		13
Height of lower jaw at coronoid process,	40			38		42	41	38										
" " " condyle,	36			32		38	35											
" " " back of last molar,	16			18		21	19	19				20						
" " " second premolar,	13			12		14						13						
Breadth " " obliquely back of last molar,	27			26		29	26											
Length of symphysis of the lower jaw,	20			18					22			22						
Height of anterior nares,	12									12								
Width of anterior nares,	10									10½								
Distance between the supra-orbital foramina,	2½	3	3			3	3½	2½	5			5	3					2
Distance between the infra-orbital foramina,	17	15	16½	17	18½		17	18	18	20	21	18½	19	20		16	18	
Length of the hard palate,													50					
Width of the hard palate between the first molars,													16					
Length of the upper alveolar border,	49		50	49						50		52	49					
Length of the lower alveolar border,	48																	
Length of the upper molar series,	39½	40	40	38	40	40				40½	43	41	39			35		40
Length of the lower molar series,	37			36		39		37	36			40						
Length of upper true molar series,	21	21	21	20	21	21	21	19½		21½	23½	21½	20		18	18	18	21½
Length of lower true molar series,	23	23		21		23	22	21½	21			23						
Transverse diameter of upper canines at base of crown,	3½	3½	3½	3½	4	3½			4	5	5	4	3½					
Length of upper canines (varying with the extent of wear),	6		5	2½						10		5						
Length of lower canines,	5			2½								5						

The following table of measurements of the upper molar series, in five specimens, exhibits a considerable range of variation. The first specimen is a robust skull, supposed to be that of a male, above indicated under No. 11. The second specimen, likewise a robust skull, probably of a male, was indicated under No. 10. The third specimen consists of a portion of a medium-sized skull, indicated under No. 13. The fourth specimen consists of a fragment from a medium-sized skull. The fifth specimen also consists of a fragment from a medium-sized skull, previously indicated under No. 16.

UPPER TEETH OF OREODON CULBERTSONI.	*Measurements in lines.*				
	No. 11	No. 10	No. 13		No. 16
Length of series of upper molars,	43½	41	39		35
Length of series of upper true molars,	23½	21½	20½	19	17½
Length of series of upper premolars,	20½	19½	20		17½
Antero-posterior diameter of last true molar,	10	8½	8½	7¾	7
Transverse " " "	10½	9¼	8½	8½	7¼
Antero-posterior diameter of second true molar,	9¼	8½	7¾	7¼	6½
Transverse " " "	10	9	8¼	8½	7¼
Antero-posterior diameter of first true molar,	7	6½	6	6	5½
Transverse " " "	8½	7½	7	7½	6
Antero-posterior diameter of fourth premolar,	4¾	4¾	4½	4½	4¼
Transverse " " "	7	6½	6¼	6¼	6
Antero-posterior diameter of third premolar,	5¾	5¼	5¼	5¼	5
Transverse " " "	5¾	5¼	5¼	4¾	4½
Antero-posterior diameter of second premolar,	5¾	5¼	5¼		4½
Transverse " " "	4¾	5	4		3½
Antero-posterior diameter of first premolar,	4¾	5			3½
Transverse " " "	3½	3¾			
Antero-posterior diameter of upper canine,	4½	4	3¼		
Transverse " " "	5	4¾	3¾		

The following measurements are taken from fragments of lower jaws with teeth, which, while exhibiting their size, at the same time exhibit a range of variation:

LOWER TEETH OF OREODON CULBERTSONI.	*Measurements in lines.*									
	1	2	3	4	5	6	7	8	9	10
Inferior molar series,	40								36	
Inferior true molar series,	25	22							21	
Inferior premolar series,	15			15½	14½	15			15	16
Ant.-posterior diameter last molar,	11½	9¾					10½	12¼	11½	
Transverse " "	6¼	5½					5¾	7	5½	
Ant.-posterior diameter second molar,	7¼	6½	6½				7	7½	7¼	7
Transverse " " "	6¼	5¾	5¼				5¾	6¾	5½	5¾
Ant.-posterior diameter first molar,	6	5¾	5¼		5¼	6			5½	6
Transverse " " "	5½	5	4½		4½	5			5	5
Ant.-posterior diameter last premolar,	6	5	5	6½	5½	5¾			5½	6
Transverse " " "	5	4¾	4¼	4½	4½	4½			4½	4½
Ant.-posterior diam. second "	5½		4½	5½	5	5½			5½	5½
Transverse " " "	4		3¼	3½	3¼	3½			3¾	3½
Ant.-posterior diam. first "				4¾	4½	4¾			4½	5
Transverse " " "				2½	2½	2¾			2½	2½
Ant.-posterior diameter crown of canine,					5					5
Transverse " " "					3					3

Oreodon gracilis.

Remains of *Oreodon gracilis*, the smallest discovered species of the genus, occur much less frequently than those of *O. Culbertsoni*, probably not because the animal was formerly less abundant, but from the fact that the remains of smaller animals are more liable to the usual causes of destruction than those of larger ones.

The skull of *Oreodon gracilis* is on the average about two-thirds the size of that of *O. Culbertsoni*, and it has the same general form, proportions and construction, but differs in a few details. Different skulls of the species present considerable variation, as in the case of *O. Culbertsoni*. The usual size and form of skull is represented in the fine specimen of figures 2, 3, plate VI.

The principal distinctive characters of the skull of *Oreodon gracilis* compared with that of *O. Culbertsoni*, independent of the difference of size, are as follows:

The sides of the cranium are relatively more convex. The sagittal crest usually expands just in advance of the middle of its course into a triangle, which is rarely the case in *O. Culbertsoni*. The face or snout at its upper part is usually broader in relation with its size and is also less convex. The nasal bones are relatively wider, and their posterior extremities together, received between the frontal angular processes, usually form the half of an ellipse in outline. The supra-orbital foramina are absolutely much more removed from each other. The orbits are more rotund or the transverse diameter more nearly approaches the vertical, and occasionally even slightly exceeds it. The lachrymal fossæ are relatively more shallow, and are usually confined to the lachrymal bones. The auditory bullæ are relatively much larger, exceeding in size the contiguous post-glenoid tubercles.

All the distinctive characters are subject to modification, and in some specimens go so far as to assume the condition of those of the corresponding parts of *O. Culbertsoni*.

Among the many specimens of skulls of *Oreodon gracilis* I have had the opportunity of examining, the following have been selected as exhibiting the peculiarities and variations of the species:

1. An almost complete skull, represented in figures 2, 3, plate VI. The sagittal crest begins to expand about the middle of its course and forms a narrow triangular extension to the anterior deeply notched border of the parietal. The upper part of the face is rather narrower than usual in the species and more convex. The forehead is about as convex as is usual in *O. Culbertsoni*. The supra-orbital foramina include a space of half an inch. The posterior extremities of the nasal bones together form the half of an ellipse, seven lines long in the median line and eight and three-quarter lines wide between the frontal angular processes. The nasal bones are

broad. The orbits are quadrately rotund and the transverse diameter slightly exceeds the vertical. The lachrymal fossæ are comparatively of moderate depth.

The specimen retains the lower jaw and nearly all the teeth in both jaws, which closely resemble those of *Oreodon Culbertsoni.*

2. The greater part of a skull without the lower jaw. It agrees with the corresponding portion of the preceding specimen, both in size and details of form, except that the face is less convex above and is not so high. The posterior nasal half-ellipse is five lines long in the median line and seven and a quarter wide.

3. A specimen resembling the last, but with a flatter forehead, and with the upper part of the face wider and flatter. The posterior extremities of the nasal bones depart somewhat from the more common arrangement. For a short distance back of the ends of the frontal angular processes they are nearly parallel at the sides, and then terminate in an irregular obtuse triangle, with one bone at the apex shorter than the other. The length and breadth of the two bones enclosed between the frontals is eight lines. The lachrymal fossæ are slightly deeper than in the preceding specimens.

4. A mutilated skull, without the greater portion of the cranium and with the greater portion of the lower jaw. The forehead and upper part of the face are as flat as in the preceding specimen, but the posterior portions of the nasal bones form the usual half-ellipse, which is six lines long and nine lines wide. The right orbit, nearly entire, is slightly transversely oval. The lachrymal fossæ are more shallow than in any of the other specimens.

5. The greater part of a much fractured skull, rather more robust than the preceding specimens, but with proportionately much larger teeth. The true molars are as large as those of the smallest variety of skulls appertaining to *Oreodon Culbertsoni.* The back part of the nasal bones form the usual half-ellipse, slightly notched at the summits of the bones. The orbit is rotund. The lachrymal fossa of the usual depth in the species.

6. The greater part of a skull, without the lower jaw, of about the same form and proportions as the preceding specimen, and with teeth equally large.

7. The fore part of a skull, with portion of the lower jaw, nearly agreeing in its proportions with the corresponding part of the preceding pair of specimens, but with teeth of the usual size. The back extremities of the nasal bones form a half-ellipse, slightly notched at the summit. In this specimen the sagittal crest appears to have been uniform to the anterior border of the parietal, as the diverging temporal ridges commence at the summit of the frontals.

8. The mutilated facial portion of a skull of somewhat peculiar appearance. The specimen is more robust than the corresponding portion of the others usually are, and is about the size of that of No. 5. The teeth are of intermediate size. The orbits appear to have exhibited the usual form. The lachrymal fossæ are more than usually shallow. The forehead and contiguous portion of the face exhibit a more uniform and rather greater convexity than usual. The posterior ends of the nasal bones, between the frontals, are sigmoid at the sides, and comparatively deeply and widely notched at the summit. In this specimen the back part of the frontals are co-ossified. The temporal ridges, as in the preceding specimen, commence with the summit of the frontals. The grooves from the supra-orbital foramina diverge more than usual and descend upon the frontal angular processes some distance from the nasal bones.

9. The greater part of the facial portion of a skull, somewhat resembling the last specimen, but of smaller proportions. Though not from an aged animal, as indicated by the condition of the teeth, yet most of the sutural connections of the bones preserved in the specimen are completely obliterated, including the frontal, the fronto-nasal, the fronto-lachrymal of one side, the fronto-maxillary of the same side, both lachrymo-maxillaries, and the inter-nasal partially.

10. The facial portion of a skull, without the lower jaw, represented in figure 3, plate IX. It is remarkable for its size, as the specimen is not only much larger than the corresponding portion of any of the preceding specimens, but approximates in size that of some of the smaller skulls of *Oreodon Culbertsoni*. It has, however, small orbits, comparatively shallow lachrymal fossæ, and the posterior ends of the nasal bones together form a half-ellipse, nine lines long and ten lines wide, between the ends of the frontal angular processes. The teeth, though larger than usual, are not quite so large as in specimens No. 5 and 6. The specimen is again referred to as representing a doubtful species under the name of *O. affinis*.

11. The greater part of a lower jaw, with all the teeth except the incisors and one canine.

12. The greater part of a skull, including the lower jaw, obtained by Dr. Hayden, in his expedition to the Mauvaises Terres, in the summer of 1866. The collection made in the expedition just mentioned contained another skull of *O. gracilis*, besides fragments of half a dozen others.

The comparative measurements of these specimens are given in the following table, the number of the specimens corresponding with the numbers at the head of the latter:

Skull of Oreodon gracilis.	Measurements of specimens in lines.											
	1	2	3	4	5	6	7	8	9	10	11	12
Length skull fr. summit of inion to end of nose,	54		56									
Length lower jaw fr. back border to inc. alv.,	51										50	
Length cranium from summit of inion to post-orbital margin, ...	30		31									29
Breadth of cranium where narrowest, .	11½	12½	10½			13	11½	13				10½
Length face fr. post.-orb. margin to end of nose,	30		30									
Breadth cranium where most convex on the parietals, ...	16½	16½	18			18						16½
Height of occiput or inion, . . .	18		18									18
Breadth of occiput at base, . . .	18½	19	18½									18
Breadth of skull at zygomatic arches, .	36		36		40	40						36
Breadth at the post-orbital arches, . .	24		26	25	29	29	28			36		24
Breadth of face at anterior orbital margins, .	21	21½	22	19	25	23	23	25	23	28		19
Breadth of face at upper first premolars, .	11	10½	10½	9½			11	13	12½	13½		10½
Breadth of face above last molars, . .	22	20½	21			27	22	27	23	28		21
Length of parietal crest, ...	19	19	19		19	20						20
Length of frontals in median line, . .	17	18½	17½		19½	20	18	23		21		17½
Length of nasals, ...	19											
Breadth of snout between ends of frontal angular processes, ...	9	7½	8	9		7½	7½	9		10½		8
Vertical diameter of orbits, . . .	9	9	9	8	9½	10	8			11		9
Transverse " "	9½			8½	9½	10	8					8½
Height of lower jaw at coronoid process, .	28				32						28	28½
" " " condyle, . .	25				28						26	24½
" " " back of last molar, .	15			14	17						16	14
" " " second premolar, .	8			8							10	7½
Breadth of do. obliquely back of last molar, .	20										21	
Length of symphysis of lower jaw, . .	14										14	
Distance between the supra-orbital foramina,	5	5½	5½	5½	5	7	5	6	6	6½		6
Distance between the infra-orbital "	12½	12	11½	11	14	12	13	15	13	15½		12
Length of hard palate, ...			30				30	34	31			
Width of hard palate between first molars, .		9	8½			10	10	12	10	11½		
Length of the alveolar borders, . .	32						31					
Length of the upper molar series, . .	25½	25½	25	27			25	29	26	30		25½
" " lower " " . .	24			26							26	25
" " upper true molar series, .	14½	14	14	15	18	19	14	17	15	18		14
" " lower " " .	15			16½	20						17	15½

The teeth of *Oreodon gracilis* are identical in form with those of *O. Culbertsoni*, and are ordinarily distinguishable only by the size. In those specimens, however, in which the teeth of the former are fully equal in size to those of smaller teeth of the latter species, independently they would be undistinguishable.

The following table presents measurements of the upper teeth of *Oreodon gracilis*. Those of the first and second series are taken from the same specimens as Nos. 2 and 3 of the preceding table, and exhibit the usual sizes. Those of the third and fourth series correspond with Nos. 6 and 10 of the preceding table, and present sizes greatly in excess of the usual ones. Other specimens are at hand, exhibiting all gradations of intermediate sizes, but none in a condition to give complete series of measurements. The fifth series of the table gives measurements from a specimen of *Oreodon Culbertsoni* with small teeth, previously indicated as No. 16:

Upper Teeth of Oreodon gracilis.	Measurements in lines. No. 2.	No. 3.	No. 6.	No. 10.	No. 16. O. Culbertsoni.
Length of series of molars,	25	25		31	35
Length of series of true molars,	14	14	19	18	17½
Length of series of premolars,	12	11½		15	17½
Antero-posterior diameter of last molar,	5½	5¾	7½	7	7
Transverse " " "	5½	5½	8	7	7¼
Antero-posterior diameter of second molar,	5¼	5¾	7	7	6½
Transverse " " "	5½	5¼	7½	6½	7¼
Antero-posterior diameter of first molar,	4½	4½	5¾	5¼	5½
Transverse " " "	4½	4½	6	5¼	6
Antero-posterior diameter of fourth premolar,	2¾	3	4		4¼
Transverse " " "	3½	3¾	4¾		6
Antero-posterior diameter of third premolar,	3	3	3¾		5
Transverse " " "	2¾	3	3½		4½
Antero-posterior diameter of second premolar,	2¾	3			4½
Transverse " " "	2¼	2½			3½
Antero-posterior diameter of first premolar,		2¾			3½
Transverse " " "		2			
Antero-posterior diameter of canine,	2	2¾			
Transverse " "	2¼	3			

The following are measurements of the inferior teeth of *Oreodon gracilis.* The first series are taken from a lower jaw, previously indicated as specimen No. 11, and exhibits the ordinary sizes. They correspond closely with those of the specimen No. 1, represented in figure 2, plate VI. Several specimens of rami of lower jaws, and fragments of others with teeth, present very nearly the same sizes. The second series of measurements are taken from two teeth in a small fragment of a lower jaw:

Lower teeth of Oreodon gracilis.	Lines.	Lines.
Length of molar series,	26	
Length of true molar series,	17	
Length of premolar series,	10	
Antero-posterior diameter of last molar,	7½	8¾
Transverse " " "	3¾	4¾
Antero-postero diameter of second molar,	5½	6
Transverse " " "	3½	4¾
Antero-posterior diameter of first molar,	4¼	
Transverse " " "	3	
Antero-posterior diameter of last premolar,	4¼	
Transverse " " "	2¾	
Antero-postero diameter of second premolar,	4	
Transverse " " "	2	
Antero-posterior diameter first premolar,	3	
Transverse " " "	1¾	
Antero-posterior diameter of crown of canine,	3	
Transverse " " "	2¼	

OREODON MAJOR.

From a few small fragments of jaws with teeth it was early suspected that there was a third species of *Oreodon*, larger than the preceding, to which the above name was given. The subsequent examination of large collections of remains of *Oreodon Culbertsoni*, from the variations observed in different skulls of this species, led to the opinion that the specimens originally referred to *O. major* also belonged to the same. The collection of Dr. Hayden from the Mauvaises Terres of White River contains an almost entire skull, without the lower jaw, which confirms the view of the existence of a third and larger species of the genus, to which the name of *Oreodon major* must still be retained. The fine specimen proving the existence of this species is represented in figure 1, plate VII, and in those of plate VIII.

The skull is about a fifth larger than that of *O. Culbertsoni*, or about twice the size of that of *O. gracilis*. In general form, proportions and details of structure it approaches closely that of the latter species.

The cranium is more constricted immediately in advance and in the course of the border of the squamosals than is sometimes observed in *O. Culbertsoni*. The sagittal crest is not only stronger in relation with the size of the skull, but also higher, especially at its fore part, than in the other species. It bifurcates in front, and includes a triangular notch for the reception of the summit of the frontals. Its posterior extremity, as in the other species, forms, together with the summit of the occipital, a triangle, with the basal angles extended as a pair of diverging semicircular plates upon the sides of the inion.

The forehead is transversely convex, and not depressed along the middle except at the summit of the frontals, which are co-ossified at their posterior third. The supraorbital foramina are relatively as much separated as in *O. gracilis*, and the grooves from them are comparatively feeble.

The orbits are small, being absolutely no larger than in *O. Culbertsoni*. They are vertically slightly oval. The lachrymal fossæ in advance are relatively shallower than in the latter species, and do not extend to the anterior border of the lachrymal bones.

The face has the proportions of the more robust varieties of *O. Culbertsoni*. The upper part is transversely convex. The nasal bones are broad, and their posterior extremities together form an acuminate triangle, eighteen lines long and fourteen wide.

The most striking anatomical peculiarity in the skull of *O. major*,—one that could not have been anticipated from its general resemblance to the skulls of the other species,—is the comparatively enormous size of the auditory bulla. In *O. Culbertsoni* this is not only of very small size compared with its condition in ruminants generally, but is absolutely smaller even than in the smaller species, *O. gracilis*. As observed in the inferior view of the skull (Ancient Fauna of Nebraska, pl. iii, fig. 1; pl. v, fig. 2), it appears as a crescentoid convex prominence, curving from within the position of the post-glenoid tubercle to the root of the para-mastoid process. A ridge-like prolongation, forming the posterior horn of the crescent, abuts upon the latter process. A second ridge is directed outwardly backward and upward, forming the other horn of the crescent, and corresponds with the vaginal process of the human temporal. From the fore part of the bulla a short process projects exterior to the eustachian orifice. Between the convex inner surface of the bulla and the basi-occipital and basi-sphenoid there exists a wide reniform fissure, at the bottom of which the periotic bone is visible. The external concave surface of the bulla includes the space occupied by the styloid bone.

The prominence of the auditory bulla of *O. Culbertsoni* ordinarily does not project nearly so low as the contiguous post-glenoid tubercle, and usually is not more than half its bulk. In some instances the post-glenoid tubercle is proportionately smaller and the auditory bulla may be larger, when the difference appears not to be so great, though in all the skulls that have been examined the auditory bulla is considerably smaller than the adjacent post-glenoid tubercle.

The inflated portion of a full-sized auditory bulla in *O. Culbertsoni* measures five lines antero-posteriorly, four and a half lines transversely, and three lines in depth.

In *O. gracilis* (Ancient Fauna of Nebraska, pl. v, fig. 3; pl. vi, fig. 2) the auditory bulla is absolutely larger than in *O. Culbertsoni*, and exceeds in size the adjacent post-glenoid tubercle, projecting inferiorly to about the same depth. In consequence of its greater inflation than in the last-named species, the ridge abutting upon the paramastoid process, and that corresponding with the vaginal process, appear much less conspicuous. It forms an oval prominence, excavated postero-externally to accommodate the styloid bone. Between its inner convex side and the basi-occipital and basi-sphenoid there is a wide reniform interval, as in *O. Culbertsoni*.

The inflated portion of the bulla measures, in a skull of *O. gracilis*, five and three-quarter lines antero-posteriorly, four and a half lines transversely, and three and a half lines in depth.

In *O. major*, plate vii, fig. I, the auditory bulla exceeds in size that of the Hog. It is oval, with the long diameter antero-posterior, and slightly compressed at the sides. Posteriorly it abuts directly against the root of the paramastoid process, and anteriorly against the ali-sphenoid. Internally its base rests against the edge of the basi-occipital, the foramen lacerum occupying the interval between it and the basi- and ali-sphenoid. It is more than twice the bulk of the contiguous post-glenoid tubercle, and projects more than twice the extent inferiorly. It measures fourteen and a half lines antero-posteriorly, eleven lines transversely, and nine lines in depth.

In *Oreodon major* the basi-occipital is much more strongly keeled relatively than in the other species, and it appears narrower from the encroachment upon it laterally of the auditory bullæ. The basi-sphenoid is more convex transversely.

The teeth of *Oreodon major* are identical in form with those of the other species.

The measurements of the specimen of the skull of *Oreodon major* are as follows:

	Lines.
Length from summit of inion to end of nose,	112
Length from occipital condyles to incisive alveoli,	108
Height of inion from summit to lower edge of occipital foramen,	36
Breadth just above the auditory meatus,	36
Length of cranium from summit of inion to post-orbital margin,	62
Extreme length from lateral border of inion to post-orbital margin,	62
Breadth of cranium at anterior squamosal borders,	28
Breadth of narrowest portion of cranium,	19
Breadth at zygomata,	65
Breadth at post-orbital arches,	48
Breadth at anterior orbital margins,	36
Breadth at ends of frontal angular processes,	14
Breadth at canine alveoli,	24
Breadth at first molar alveoli,	22
Breadth at last molar alveoli,	40
Breadth at infra-orbital foramina,	21
Distance of supra-orbital foramina,	7
Length of face from post-orbital margin to incisive alveoli,	60
Height of orbital entrance,	14½
Transverse diameter of do.,	11
Length of alveolar border,	63
Length of hard palate,	60
Breadth of hard palate between first true molars,	18
Height of occipital foramen,	9
Transverse diameter of do.,	9
Length of parietal crest,	30
Length of frontals,	28
Length of the molar series,	48
Length of the true molar series,	26
Length of the premolar series,	23
Antero-posterior diameter of last molar,	10¼
Transverse " " "	11

	Lines.
Antero-posterior diameter of second molar, ...	10
Transverse " " "	10½
Antero-posterior diameter of first molar, ...	8
Transverse " " "	9
Antero-posterior diameter of last premolar, ...	6½
Transverse " " "	8½
Antero-posterior diameter of third premolar.	6
Transverse " " "	6¼
Antero-posterior diameter of second premolar, ...	6
Transverse " " "	5
Antero-posterior diameter of canine (fang), ...	5
Transverse " " "	5

Another specimen pertaining to *Oreodon major* consists of the greater part of a skull, without the lower jaw, of a young animal. All the temporary teeth are yet retained in the specimen, but the first and second permanent true molars had protruded, or hold their functional position. The permanent canines and last molars had commenced protrusion.

The corresponding teeth are as large as in the specimen of *O. major* first described, and the skull at maturity would perhaps have had nearly the same size and proportions as in that specimen.

An auditory bulla, preserved in the skull, has nearly the form and proportionate size as in the preceding specimen. It is, however, of less uniform depth, gradually decreasing in this respect forward, so as to be rather ovoid than oval. It measures eleven lines antero-posteriorly, nine lines transversely, and eight lines in depth.

The nasal bones are broad, and their posterior extremities together form a hemi-elliptical outline as in *O. gracilis*. The frontal angular processes are acute.

About a dozen small fragments of jaws, with from one to three teeth, have come under inspection, which appear to belong to *Oreodon major*. One of these, containing the three upper true molars, is represented in figure 6, plate iv, of the Ancient Fauna of Nebraska. The teeth are, however, smaller than in the nearly entire skull above described, which also is the case in most of the fragments just mentioned, and it is by no means certain that some of them, at least, do not belong to larger individuals of *Oreodon Culbertsoni*.

A specimen, consisting of a fragment of the upper jaw, containing the three true molars, belonging to *O. major*, or a large variety of *O. Culbertsoni*, in the case of the last tooth exhibits the anomaly of a third lobe, crowded in the interval between the two internal normal lobes.

An upper jaw much mutilated, and containing all the molar teeth except the first ones, together with the greater portion of a mutilated cranium, the fragment of a lower jaw and the isolated unworn crown of a fourth upper premolar tooth, from Eagle-nest Butte, between White River and the L'eau-qui-court, or Niobrara River, appear to belong to *O. major*. These specimens are more crushed than those from the Mauvaises Terres of White River are usually, and are imbedded in a matrix of a somewhat different color and texture. The former specimens, referred to *O. major*, are likewise imbedded in a matrix slightly differing from that found attached generally to the White River fossils, and approaching in appearance that of the last mentioned specimens, from which circumstance I am led to suspect that *O. major* belonged to a different stratum from *O. Culbertsoni* and *O. gracilis*. This may account for the comparative rarity of the remains of the large species in the collections brought from the localities of the latter.

In the upper jaw specimen above mentioned, from Eagle-nest Butte, the permanent premolars had just assumed their functional position, and are therefore nearly unworn. The teeth of this fossil are generally larger than those of the White River skull. Their measurements are as follow:

	Lines.
Length of the molar series,	50
Length of the true molar series,	27
Length of the premolar series,	26
Antero-posterior diameter last molar,	11
Transverse " "	10
Antero-posterior diameter second molar,	10
Transverse " "	10
Antero-posterior diameter first molar,	8
Transverse " "	8
Antero-posterior diameter last premolar,	7
Transverse " "	8
Antero-posterior diameter third premolar,	7
Transverse " "	6½
Antero-posterior diameter second premolar,	7
Transverse " "	5

A specimen in Dr. Hayden's collection of Mauvaises Terres fossils, of the expedition of 1866, consists of the mutilated facial portion of a skull, together with a small fragment of the lower jaw.

The bone is less hard and more chalky than in most of the other fossils with which the specimen is accompanied, and the attached matrix is rather softer, more ashen in hue and more homogeneous than that adhering to most of the fossils from White River.

The specimen nearly agrees in its size, general form and proportions with the corresponding part in the nearly entire skull of *O. major*, previously described. The posterior ends of the nasals are more obtuse and, apparently in consequence of their less prolongation backward, the forehead is rather longer in the median line.

The measurements of the specimen are as follows:

	Lines.
Length of face from post-orbital margin to incisive alveoli,	60
Length of alveolar border,	60
Length of upper molar series,	45
Length of upper true molar series,	24½
Antero-posterior diameter of last molar,	10
Transverse diameter of "	10¾
Depth of lower jaw below first true molar,	19
Length of lower premolar series, including lower canine,	23
Length of lower premolar series, excluding "	17
Breadth of first premolar,	5½
Breadth of second "	6
Breadth of third "	6½
Breadth of first molar,	6½
Breadth of crown of lower canine,	6½

On several remarkable specimens of skulls not readily referable to the preceding species of Oreodon.

Three specimens of skulls, exhibiting remarkable deviation in character from those pertaining to the preceding species of *Oreodon*, probably represent as many distinct species. I was at first inclined to consider them as representing accidental varieties, pertaining to *O. gracilis* and *O. major*, though they partake of the character of the other species. One of the skulls approximates in size that of *O. Culbertsoni*, but presents more of the anatomical peculiarities of *O. gracilis*. I have suspected that it might belong to a hybrid of these species, but now view it as distinct, with the name of *Oreodon affinis*.

Another skull indicates an animal as large as *Oreodon major*, with teeth as large as those of *O. Culbertsoni*, but with other characters approaching it to *O. gracilis*. This I have also considered to be a hybrid variety, and have named it *Oreodon hybridus*. The third skull resembles that of *O. Culbertsoni* in every respect, except that it is provided with auditory capsules proportionately as large as those of *O. major*. To this variety I have given the name of *Oreodon bullatus*.

Dr. Hayden reports these three skulls to have been derived from the lowest bed of the tertiary deposit of the Mauvaises Terres of White River, or bed A of his table, as indicated on page 20. Their associates are the remains of *Titanotherium Prouti*, *Hyopotamus americanus*, *Lophiodon occidentalis* and *Rhinoceros occidentalis*. No remains of *Oreodon Culbertsoni*, *O. gracilis* and *O. major* were found with them. *Rhinoceros occidentalis* is common to the beds containing the latter and the former. *Hyopotamus* and *Lophiodon* are found in the eocene formations of Europe. These facts indicate *Oreodon affinis*, *O. hybridus* and *O. bullatus* to be species which preceded the others in time, and were perhaps their ancestors, from one or another of which they may have been derived, according to the doctrine of natural selection.

Oreodon affinis.

The specimen now referred to a species with the above name, was previously noticed under No. 10, page 96, as a variety belonging to *Oreodon gracilis*. It is represented in figure 3, plate IX, and consists of the facial portion of a skull, which in size is as large as the corresponding portion of some skulls of *Oreodon Culbertsoni*, but which exhibits more of the peculiarities of *Oreodon gracilis*. As in this and differing from the former, the orbits are proportionately small and the lachrymal fossæ shallow. Likewise, the posterior ends of the nasals together form a half-ellipse, as in *O. gracilis*, but even more blunt than usual in this species. The teeth, though larger than is commonly the case in the latter, are yet smaller than in some specimens.

Oreodon hybridus.

Figure 4, plate IX, represents a specimen nearly corresponding with the former one, but which in its proportions approaches *Oreodon major*, while the teeth are no larger than usual in *Oreodon Culbertsoni*. The face above is more convex transversely than in the adult skull of *O. major*, or is less abruptly vertical at the sides. The orbits have the same proportions as in the latter, but the lachrymal fossæ are less deep and resemble more those of *O. gracilis*. The nasal bones are narrower than in the specimens referred to *O. major*, and terminate posteriorly as in a young skull of the latter and nearly as is usual in *O. gracilis*, but their lateral borders, between the very blunt angular processes of the frontals, are sigmoid. The molar teeth indicate an old animal, as their crowns are much worn. Their size, as before mentioned, is not greater than is usual in *O. Culbertsoni*.

Measurements of the two preceding specimens, in comparison with corresponding parts of *O. gracilis*, *O. Culbertsoni* and *O. major*, are as follows:

OREODON.	*Measurements in lines.*				
	AFFINIS	HYBRIDUS	GRACILIS.	CULBERT'I.	MAJOR.
Breadth at post-orbital arches,	36	48	26	36	48
Breadth at ant-orbital margins,	28	36	21	27	38
Breadth at infra-orbital foramina,	15½	22	12	17	21
Breadth above last molars,	28	38	21	30	40
Breadth of hard palate between first true molars,	11½	17	9	15	18
Breadth of nasals above infra-orbital foramina,	9	10½	8	7½	14½
Breadth of nasals at ends of frontal processes,	10½	11	8	7½	14
Length of nasals back of " "	8	10	7	10½	18
Height of orbits,	11	16	9	15	15
Distance between supra-orbital foramina,	6½	8½	5	4	7
Length of upper true molar series,	18	22	15	22	26

OREODON BULLATUS.

The collection of fossils obtained in the Mauvaises Terres, in Dr. Hayden's expedition of the summer of 1866, has afforded me the opportunity of examining a multitude of additional specimens of skulls and fragments of others, with teeth, of *Oreodon Culbertsoni.* Besides those which present the ordinary individual variations, there is one specimen which exhibits a most remarkable and unexpected deviation of character. The specimen consists of a mature skull, much fractured, and having one side of the face broken away. The other side retains the molars, with part of the corresponding canine tooth.

The skull agrees in general form, size and details of structure with that ordinarily of *Oreodon Culbertsoni,* except that it possesses inflated auditory bullæ proportionately as large and nearly of the form of those of *Oreodon major.* In *O. Culbertsoni* the auditory bullæ are proportionately less well developed than in *O. gracilis,* so that I was totally unprepared to see a skull, which otherwise would have been referred without hesitation to *O. Culbertsoni,* with bullæ approaching in size those of *O. major.* Had the cranium alone of this singular specimen been found, it would have been viewed as pertaining to *Agriochœrus,* because in its form, size, construction, and possession of large inflated auditory bullæ, it agrees with that of the latter genus, but then it has the face and teeth of *Oreodon Culbertsoni.* The discovery of this specimen throws doubt on a previous determination of some isolated crania which were referred to *Agriochœrus,* and in part at an earlier period, or before an entire skull of the latter had been obtained, to a supposed distinct genus named *Eucrotaphus.*

Measurements of the above skull are given, in comparison with those of *O. Culbertsoni,* as specimen number 18, page 92.

Of other portions of the Skeleton of Oreodon.

The various collections of fossils from the Mauvaises Terres which I have had the opportunity of examining, contain a great multitude of fragments of the skeleton of two species of *Oreodon*, the *O. Culbertsoni* and *O. gracilis*, but by far the greater number belong to the former species. The fragments chiefly consist of portions of the long bones of the extremities, for the most part the articular ends, while vertebræ are comparatively rare. The specimens are almost always isolated, and only in a few instances have they been preserved in contiguity, or in their proper relative position in masses of the rock to which they belong. Nearly all the mammalian fossils from Dakota and Nebraska, which form the subject of the present work, are specimens which have been picked up from the surface of the locality in which they were found, and they mostly consist of single bones or fragments, weathered from the neighboring cliffs. Rarely do the specimens consist of several bones, except in the case of the skulls, held together in their proper relative position. None of the fossils have as yet been quarried from the rocks in which they abound. Hence, notwithstanding the enormous quantity of remains of *Oreodon* which have been obtained, we have not procured sufficient material to build up an entire skeleton.

Vertebræ.—I have had the opportunity of examining two specimens, consisting of the cervical series of vertebræ of *Oreodon Culbertsoni*. These are partially imbedded together, with portions of the skulls in masses of matrix, but the exposed parts are much broken. The more perfect of the two series is seven and a quarter inches long, and the individual vertebræ, so far as can be ascertained in their imperfect state, in shape are much like those in ordinary ruminants in general, or like those in the Hog and Peccary. The atlas measures two inches ten lines transversely, and three-fourths of an inch between the articular processes in front and behind. The transverse processes are obliquely convex at the lateral border, as in the Deer, but are relatively not so much prolonged posteriorly.

The bodies of the succeeding five vertebræ are strongly carinated inferiorly, as in living ruminants. The spinous processes successively increase in length from the third to the last. The axis measures an inch and a half in length, from the summit of its odontoid process, and an inch and a third transversely between the anterior articular processes. Its spinous process is broad and strong, and shaped as in recent ruminants.

A series of the bodies of the anterior eight dorsal vertebræ, partially imbedded in the mass of matrix in contiguity with the less perfect cervical series above mentioned, is six and three-quarter inches in length, the body of the eighth being nine and a half lines long. Their form and construction, so far as can be seen, are not different from what they are in recent ruminants and suilline animals.

A series of three bodies of anterior lumbar vertebræ of *O. Culbertsoni*, adhering to a portion of matrix, measures three inches and a third in length, each vertebral body being a little over an inch long and three-fourths of an inch transversely at the posterior articular face. Another series of three lumbar vertebræ, partially imbedded in the rock and of the same length as the preceding, retain portions of the spinous processes, measuring an inch in width. A last lumbar vertebra attached, with a portion of the sacrum, to a fragment of rock, has the body a little over an inch in length and ten lines in width transversely at its posterior articular surface. Its costal processes are transverse, of robust proportions, an inch in length and half an inch in width.

The portion of sacrum above mentioned measures nearly three inches in width at the tips of the alæ, and its articular surface for the lumbar vertebra is ten lines wide.

Anterior extremities.—Fragments of several scapulæ of *Oreodon Culbertsoni* indicate a bone nearly like that of recent ruminants, but with the dorsum more equally divided by the spine. The glenoid articulation, in a specimen, from the summit of the coronoid process measures fourteen lines, and transversely nine and a half lines.

Fragments of humeri of *O. Culbertsoni* are numerous, and similar ones of *O. gracilis* are not unfrequent. The form of the bone and its proportions are nearly as in the Peccary. In the former species its estimated length is about six inches; a specimen of the latter species measures a little over four inches. The longer diameter of the head is transverse, and terminated by the lesser tuberosity. The distal articulation presents a construction like that of recent ruminant and suilline animals.

Various specimens of the humerus of *O. Culbertsoni* and *O. gracilis* exhibit the following extremes of measurement:

	Largest. Lines.	Smallest. Lines.
Circumference at the middle of the shaft in O. Culbertsoni,	22	18
" " " O. gracilis,	14	11
Diameter of head with greater tuberosity in O. Culbertsoni,	21	15
" " " O. gracilis,	12	8
Transverse diameter of distal articulation in O. Culbertsoni,	10	
" " " O. gracilis,	7	

Fragments of the bones of the fore-arm of *Oreodon* are comparatively few. Several specimens, consisting of portions of both bones held in juxtaposition by matrix, indicate the radius and ulna to be distinct, and relatively to each other as well developed as in the Hog, but proportionately more slender or longer in relation with the thickness.

Measurements derived from several specimens of the fore-arm bones of *O. Culbertsoni* and *O. gracilis* are as follows:

	O. Culbert'i. Lines.	O. gracilis. Lines.
Breadth of the two bones in conjunction near the middle,	10	
Length of olecranon,	12	7½
Breadth "	10	6
Breadth of head of radius,	9½	6½
Breadth of lower end of do.,	9½	6½
Breadth of lower end of the ulna,	4½	
Greatest width of radius near middle,	5	
Greatest width of ulna " "	6	

In conjunction with a specimen of the lower portion of the fore-arm bones of *O. Culbertsoni*, a carpus and metacarpus are preserved. The former consists of seven bones, as in the Hog.

The metacarpus likewise consists of four bones as in the latter animal, and are quite as well developed, but are proportionately longer and narrower. The lateral pair are even better developed in relation with the intermediate ones than in the Hog, and the first of the series is longer and larger than the last one, the reverse of the condition in the Hog. Of the intermediate pair, the second not only extends higher than the third one, but also lower. A specimen of the greater portion of a fore foot of *Oreodon gracilis* exhibits the same construction of the metacarpus as in *O. Culbertsoni*.

Measurements of the metacarpals are as follows :

	O. Culbert'i. Lines.	O. gracilis. Lines.
Length of first metacarpal,	21	16
" second "	28	21
" third "	24½	19
" fourth "	19	15

Posterior extremities.—A fragment of the iliac portion of a hip bone, attached to one of the specimens of the sacrum of *O. Culbertsoni* before mentioned, exhibits a greater relative breadth and degree of flatness than in ordinary ruminants, the Hog and the Peccary. Another specimen of the portion of a hip bone, partially imbedded in a mass of rock, together with the skull, several vertebræ, and other bones of the extremities of a young animal, has the ischio-pubic portion an inch and a half in width.

Numerous fragments of the femur of *Oreodon* indicate this bone to have nearly the form and proportions of that of the Peccary. Measurements derived from specimens of the species *O. Culbertsoni* and *O. gracilis* are as follows :

	O. Culbertsoni.	O. gracilis.
Circumference of shaft of femur at middle, . . .	24 lines.	
Diameter of head of femur at middle, ...	10 "	6 lines.
Breadth of head together with great trochanter, . .	22 "	12 "
Breadth of distal end, ...	17 "	

The tibia and fibula of *Oreodon* appear to have held the same relations of development and form in comparison with those of the Hog as in the bones of the fore-arm.

The breadth of the head of the tibia in different specimens pertaining to *O. Culbertsoni* ranges from fifteen to twenty lines. The breadth of the lower end in several specimens, about ten and a half lines; in a specimen belonging apparently to *O. gracilis*, eight lines.

The patella, calcaneum and astralagus of *Oreodon* are almost repetitions in form of those of the Peccary.

Of other bones of the hind foot of *Oreodon*, I have not had the opportunity of inspecting any, but we may safely infer that they bear the same resemblance to those of the Hog that those of the fore foot do.

The relative lengths of the bones of the metacarpus referred to *Oreodon* resemble in some respects the condition in the Tapir more than in the Hog. Thus, as in the former, the first is longer and more robust than the fourth, and the second is prolonged inferiorly beyond the third as well as above it, but these intermediate bones are more nearly equal in size, as in the Hog. Probably these specimens do not belong to *Oreodon*, isolated as they were; it remains for future discovery to determine the question positively.

MERYCOCHŒRUS.

This genus belongs to the same family as *Oreodon*, and indeed is so closely related to the latter that there would be no impropriety in regarding it as the same. The number, relative position, form and constitution of the teeth are alike in both, though the skull of the only known species upon which the name of *Merycochœrus* was suggested, exhibits peculiarities which I have regarded as sufficient to characterize the animal as belonging to a genus distinct from *Oreodon*.

Merycochœrus proprius.

This animal was larger than any of the described species of *Oreodon*, having exceeded *O. major* more than a third, or it was about twice the size of *O. Culbertsoni*. Its remains, consisting of fragments of jaws with teeth, were obtained by Dr. Hayden during Warren's Expedition of 1857, on the head-waters of the Niobrara River, opposite Fort Laramie. They were discovered in a stratum of "dull reddish-brown indurated grit," or bed D of Dr. Hayden's section of the miocene formation, as indicated on pages 17, 20.

The chief differences between *Merycochœrus proprius* and the species of *Oreodon* observed in comparing the specimens of the former with the corresponding portions of the skulls of the latter, are briefly as follows:

In *Merycochœrus* the infra-orbital arch, as formed by the malar bone and its conjunctions, is remarkable for its great absolute and relative depth, being double that in the Hog, and two and a half times as great as in *O. major*. It is directed much more abruptly inward to the face than in *Oreodon*. The external surface of its anterior abutment, formed by the malar and maxillary bones, constitutes a deep vertical plane, sloping with a gentle curve inwardly and subsiding entirely on a line with the fore-part of the second molar tooth.

In *Oreodon* the fore part of the infra-orbital arch forms a convex ridge proceeding forward and inward and gradually subsiding over the position of the middle premolars.

In consequence of the comparatively abrupt termination of the infra-orbital arch, the face appears abruptly narrowed at the position of the interval of the first and second molars, compared with its condition in *Oreodon*. The face appears also relatively more prolonged, giving it a narrow snout-like appearance as in the Hog. From the interval of the first and second molars it gradually narrows to the position of the third premolar, and then widens to the position of the canine alveolus, from whence it is abruptly rounded upon the incisive border. The side of the face appears to be relatively higher than in *Oreodon*, and it forms a wide unbroken, transverse concavity from the infra-orbital arch to the position of the canine alveolus.

The infra-orbital foramen is situated above the interval of the first and second molars, and is as large as in the Hog. In all the species of *Oreodon* it is situated above the third premolar, and is comparatively small.

In consequence of the great relative depth of the infra-orbital arch, the orbit is more elevated in position than in *Oreodon*. Its anterior border is on a line with the interval of the second and third molars. In *Oreodon* it is on a line with the fore-part of the second molar.

From a remaining fragment of the lachrymal bone, its facial surface appears to have been relatively much smaller and narrower than in *Oreodon*, and appears not to have been depressed into a deep lachrymal fossa, though it does appear to have contributed, together with the maxillary, to form a broad concave fossa, nearly as in the Hog. The suture, between the lachrymal, malar, and maxillary, descends at first almost vertically and curves backward at its lower part. In *Oreodon* it proceeds more obliquely backward and downward.

The incisive border of the jaw is of great relative depth, whether compared with its condition in *Oreodon*, the ruminants generally, or the suilline animals. It recalls to mind the corresponding deep convexity of the fore-part of the upper jaw in the Horse and Tapir, though it projects comparatively little in advance of the canines. Within the position of the incisive portion of the premaxillaries, in conjunction with the contiguous portion of the maxillaries, the bone is excavated with a broad concavity, which appears to be part of a basin-like expansion from the incisive foramina. This expansion has been at least an inch in diameter, whereas in *Oreodon* the incisive foramina are two small elliptical apertures opening directly on a level with the hard palate. The premaxillaries appear to have been completely co-ossified in the adult state.

The lower jaw has the same form nearly as the corresponding portion of that of *Oreodon*. The symphysial portion or fore-part is relatively wider and deeper, apparently in accordance with a more robust character of the canines and incisors. A ridge, descending in the course of the canine alveolus, sweeps backward and gradually subsides along the base of the jaw. The presence of the ridge produces a concave condition of the surface below the anterior molar teeth. In *Oreodon* the corresponding portion of the jaw forms a continuous convexity with that of the symphysis. The mental foramen is situated below the interval of the second and third premolars.

As before mentioned, the teeth of *Merycochœrus* are like those of *Oreodon*, but they, together with the jaws, are proportionately more robust in comparison with the size of the skull than in the latter.

The differences indicated between the fossils referred to *Merycochœrus* and the corresponding parts of *Oreodon* may by other naturalists be considered as insufficient to separate the former from the latter otherwise than specifically. Under such a view the remains would indicate a well-marked fourth species, with the name of *Oreodon proprius*.

In comparing the remains of *Merycochœrus proprius* with those of *Oreodon major*, it would appear as if one might readily have been derived from the other on the Darwinian theory of selection.

The fossil specimens of *Merycochœrus proprius* which I have had the opportunity of examining are as follows:

1. The greater portions of the upper and lower jaws, with nearly all the teeth. Those of the left side, partially restored from those of the right, are represented, two-thirds the natural size, in figures 1, 2, plate X. The triturating surfaces of the teeth are represented of the natural size in figures 3, 4 of the same plate.

The molar teeth are about half worn away, and are repetitions in form of those of *Oreodon*.

The back abutment of the last upper true molar is relatively more robust than in the latter, and forms a process of such strength as to wear away a distinct slope upon the hinder lobe of the corresponding tooth of the lower jaw.

The first upper premolar is more isolated in its position than in *Oreodon*, being separated by a comparatively wide interval from the seco[illegible] series, as well as from the canine.

The crowns of the first and second upper premolars are narrower in proportion with their length and breadth than in *Oreodon*. In the crown of the third premolar the postero-internal lobe, as it exists in the latter genus, is degraded to the condition of a festooned basal ridge enclosing a pair of mammillary tubercles.

The first inferior premolar is more crowded in its position than in *Oreodon*, being inserted obliquely across the alveolar border, so that one-half of its crown is situated internally to the canine, and a third is exterior to the second premolar.

The canines are of robust proportions, the inferior being much more so than the superior. Their crown is half worn away. The crown of the superior canine is trihedral, the external surface being invested with enamel. The antero-internal surface is a triangular plane worn by contact with the inferior lateral incisor, and the postero-internal surface forms part of a lozenge-shaped plane worn by contact with the inferior canine. The latter is a trihedral column, with a trihedral pointed summit forming the remainder of the crown, which is worn off at its fore part into a broad sloping plane by contact with the superior canine.

The measurements of the specimens, compared with corresponding ones of *Oreodon major*, are as follow:

	M. proprius. Lines.	O. major. Lines.
Length of the upper alveolar border,	88	61
Length of the lower " "	83	
Depth of infra-orbital arch,	23	9
Distance of infra-orbital margin from the alveolar margin,	29	14
Distance of infra-orbital foramen from the alveolar margin,	15	7½
Distance from infra-orbital foramen to front of incisive alveoli,	56	28
Depth of lower jaw at fore part of last molar,	27	
Length of symphysis,	38	
Length of upper molar series,	74	48
Length of lower molar series,	69	
Length of upper true molar series,	43	25½
Length of lower " " "	45	
Antero-posterior diameter of last upper molar,	21	10¼
Transverse " " "	16½	11

	M. proprius. Lines.	O. major. Lines.
Antero-posterior diameter of second upper molar,	14	9½
Transverse " " "	14½	10½
Antero-posterior diameter of first upper molar,	9	7½
Transverse " " "	11	9
Antero-posterior diameter of last upper premolar,	7¼	5½
Transverse " " "	9½	8½
Antero-posterior diameter of third upper premolar,	8	6
Transverse " " "	8	6
Antero-posterior diameter of second upper premolar,	8½	6
Transverse " " "	6	5
Antero-posterior diameter of first upper premolar,	7	5½
Transverse " " "	3½	3
Antero-posterior diameter of upper canine,	6½	
Transverse " " "	7¾	
Antero-posterior diameter of last lower molar,	23½	
Transverse " " "	10	
Antero-posterior diameter of second lower molar,	13	
Transverse " " "	9½	
Antero-posterior diameter of first lower molar,	9	
Transverse " " "	8	
Antero-posterior diameter of last lower premolar,	8½	
Transverse " " "	6	
Antero-posterior diameter of second lower premolar,	9	
Transverse " " "	5½	
Antero-posterior diameter of first lower premolar,	9	
Transverse " " "	3¼	
Antero-posterior diameter of lower canine,	9½	
Transverse " " "	7½	
Antero-posterior diameter of lower lateral incisor,	5	
Transverse " " "	9	

2. Small portions of the facial part of a skull, with teeth, from an individual of rather more robust proportions and greater age than that of the preceding specimens. They consist of small fragments of the maxillæ with teeth, some isolated teeth, the fragment of a malar, and one of a nasal bone.

The last superior molar tooth in one of the specimens, represented in figure 5, plate X, is remarkable for its proportionate narrowness and the greater size of its posterior column or buttress, in comparison with those previously described. The tooth, indeed, looks as if it might pertain to a distinct genus, though I rather incline to believe its peculiarity is an extreme variation of an individual character.

An accompanying fragment of the maxilla, containing the premolars and the greater part of the first true molar, exhibits these teeth of the same form as those of the preceding specimens, but more worn.

An upper canine presents a more robust character than those of the first-described specimens. Just above the limit of its posterior worn surface it measures eight lines from before backward and nine lines from side to side.

An inferior lateral incisor is represented in figures 6 and 7, plate X. Its summit is worn from contact with the incisor above, and its postero-internal border by contact with the upper canine. Its internal face is bounded by a strong basal ridge. The length of the crown, in its present worn, blunted condition, is nine lines; its transverse diameter at base ten lines; and from without inwardly it is four and a half lines.

The fragment of a malar bone below the infra-orbital margin is nearly two inches in depth.

The fragment of a nasal bone, consisting of the anterior portion, presents this terminating in a blunt point, relatively much shorter than in *Oreodon*. Its breadth is eleven lines.

3. A pair of slightly worn premolars and an incisor from a third individual younger than either of those to which the preceding specimens belonged. The former teeth, represented in figure 9, are the second and third premolars of the right side. The incisor, figure 8, is the upper lateral one of the same side.

MERYCHYUS.

The extinct genus *Merychyus* is indicated by specimens discovered by Dr. Hayden, during Warren's Expedition of 1857. They were found in the sands of the Niobrara River, are well preserved, and have no adherent matrix. They are regarded by Dr. Hayden as belonging to the pliocene formation, or bed F of his section, as indicated on pages 16 and 20.

Merychyus is closely related to *Oreodon* and *Merycochœrus*, though distinguished from both by well-marked characters. The number, relative position and general form of the teeth are the same as in those genera. See plate XI.

The true molars are constructed on the same plan as those of all other ruminants, recent and extinct, and are intermediate in their character with those which have short crowns as in the Deer and *Oreodon*, and those which have long crowns as in the Camel and Sheep. See figures 1, 2, 12, 13, 15, plate XI.

In comparison with the true molars of *Oreodon* the crowns are considerably longer in proportion to their breadth, and are also rather narrower in proportion to their diameter antero-posteriorly, especially in the case of the last of the series.

In *Oreodon* the crowns of the true molars protruded so as to be inserted alone by the fangs at a comparatively early period, as in the Deer. In *Merychyus* they successively protruded to the same extent at a much later period, as in the Camel.

When the crown of the last upper molar was yet involved one-third in the jaw, in *Merychyus*, the usual interspaces separating the inner and outer lobes of the first molar and the anterior interspace of the second molar had become obliterated. See figure 4, plate XI. In *Oreodon* the corresponding interspaces were retained long after the complete protrusion of the crowns of all the molars.

In *Merychyus* the outer and inner constituent lobes of the upper true molars are closer, and the crescentic interspaces more contracted than in *Oreodon*. The external faces of the outer lobes are larger, less sloping, and more uniformly concave in the transverse direction. They are slightly convex longitudinally, and generally undivided by a median ridge. The internal surfaces of the inner lobes are more concave vertically.

In the unworn upper true molars of *Merychyus* the crescentic interspaces or pits are widely gaping, but rapidly narrow to a vertical fissure. The external face of the inner lobes, bounding the pits internally, is convex downward and concave transversely. The internal face of the outer lobes, bounding the pits externally, is nearly vertical. In *Oreodon* the corresponding interspaces are more expanded, less deep, and gradually slope to the bottom. The external face of the inner lobes, bounding the pits internally, is concave longitudinally and transversely, and the internal face of the outer lobes, bounding the pits externally, is somewhat sloping. (Compare figures 3, 4, 16, plate XI, with figure 1, plate VII.)

The buttresses bounding the outer lobes externally of the upper true molars of *Merychyus* are much longer than, but do not expand in the same robust manner at bottom as in *Oreodon*. (Compare figures 1, 15, plate XI, with figures 1, 2, plate VI, and figure 1, plate VIII.)

The posterior horn of the antero-internal lobe enters the angular interval of the outer lobes, and is joined just before its termination by the contiguous horn of the postero-internal lobe. In *Oreodon* the anterior horn of the latter lobe enters the angular interval of the outer lobes, and the contiguous horn of the antero-internal lobe is bent parallel with the former horn towards the postero-internal face of the antero-external lobe. (Compare figure 16, plate XI, of the present work, with figure 1, plate iii, of The Ancient Fauna of Nebraska.)*

* The difference is not well represented in the figures of the present work, in consequence of inattention on the part of the artist.

The lower true molars of *Merychyus* are not only longer and slightly narrower relatively than in *Oreodon*, but are remarkable for the comparative shallowness of the interspaces separating the inner and outer constituent lobes. Indeed, before the last molar is fully protruded, the interspaces of its lobes are obliterated, as well as those of the molars in advance. Before the teeth are half worn away, the lower true molars appear composed of an antero-posterior pair of three-sided prisms, with the addition of the usual back lobe to the last of the series. (See figures 5, 6, 14, plate XI.)

The inner surface of the crowns of the lower true molars is a nearly vertical plane, as in the Camel, interrupted only by feeble ridges at the division of the lobes. In *Oreodon* the corresponding surface presents a similar appearance to that in the Deer. (Compare figures 7, 13, plate XI, of the present work, with figure 3, plate iii, and figure 9, plate vi, of The Ancient Fauna of Nebraska.) The outer surfaces of the crowns resemble those in *Oreodon*, except in their greater relative length, more vertical character, and in appearing more concave longitudinally.

The crowns of the premolars of *Merychyus* are also longer and narrower in proportion to their breadth than in *Oreodon*.

The fourth upper premolar is nearly like that of *Oreodon*. Its outer face, besides being larger, is devoid of the slight median ridge, and is more convex longitudinally. The interspace separating its lobes does not become so contracted as in the true molars, its inner surface gradually shelving towards the bottom as in *Oreodon*.

The anterior three upper premolars are constructed on the same plan as those of *Oreodon*. The first one is smaller in its relation with those behind than in the latter, and it is obliquely inserted across the alveolar border.

Viewed externally, the anterior three upper premolars appear relatively larger than in *Oreodon*, and less cordiform in appearance. They also exhibit a backward curve not evident in *Oreodon*. They are further convex downward and transversely. Their points are in advance of the middle, arising in part from a narrowing of the front portion of the crown in relation with the back portion, and in the case of the anterior two premolars, from the edge of the crown in advance having an inward direction. In *Oreodon* the points of the premolars are median. (Compare figures 1, 15, plate XI, with figures 1, 2, plate VI, and figure 1, plate VIII.)

The internal portion of the crowns of the anterior three upper premolars present the same ridges, sub-lobes and fossæ as in *Oreodon*.

The lower premolars are longer and slightly narrower in relation with their breadth than in *Oreodon*, but otherwise closely resemble those of the latter. The anterior pair, as in *Merycochœrus*, are obliquely inserted across the alveolar border, and more crowded in position than in *Oreodon*. (Compare figures 2, 5—8, plate XI, with figures 1, 2, plate VI.)

The canines and incisors, in form, position and relative size, closely resemble those of *Oreodon.* (Compare figures 1—11, plate XI, with figures 1, 2, plate VI, figure 1, plate VII, and figure 1, plate VIII.)

If one can judge from the jaws, the general form and construction of the skull of *Merychyus* is the same as in *Oreodon.*

The alveolar portion of the upper jaw, as seen in figure 1, plate XI, has the same form as in the latter, but at the border is more convex antero-posteriorly. The infra-orbital foramen occupies a position above the fourth premolar; in *Oreodon* it is placed above the third premolar, and in *Merycochœrus* above the interval of the first and second true molars.

The lower jaw, as represented in figure 2, plate XI, has the same form as in *Oreodon,* except that its alveolar border is more sloping from behind, and it is more convex obliquely across the back portion.

It may be supposed that the genus *Merychyus* is an offspring of the earlier genus *Oreodon,* and would appear to be a striking example of the theory of natural selection of the eminently philosophic Darwin.

There appear to be three distinct species of *Merychyus* indicated by the fossils, and mainly distinguished by their size.

Merychyus elegans.

The smallest species of *Merychyus,* to which the above name has been given, is founded on several halves of upper and lower jaws, containing admirably preserved series of teeth of two different individuals. Some of the specimens, with different views of the teeth, are represented in figures 1 to 11, plate XI. They indicate an animal intermediate in size to *Oreodon gracilis* and *O. Culbertsoni.*

The measurements of the specimens are as follows:

	Lines.
Distance from maxillary tuberosity back of alveolar border to incisive alveoli,	44
Breadth at infra-orbital foramina,	17
Breadth of hard palate between first true molars,	14
Depth of lower jaw at back of last molar,	17
Depth of lower jaw below last premolar,	10
Length of symphysis,	17
Length of upper molar series,	36
Length of lower " "	35
Length of upper true molar series,	22
Length of lower " "	24
Antero-posterior diameter of last upper true molar,	10
Transverse " " "	8

	Lines.
Antero-posterior diameter of second upper true molar,	6¾
Transverse " " "	6¾
Antero-posterior diameter of first upper true molar,	6
Transverse " " "	5¾
Antero-posterior diameter of last upper premolar,	4
Transverse " " "	5
Antero-posterior diameter of third upper premolar,	4¼
Transverse " " "	4
Antero-posterior diameter of second upper premolar,	4
Transverse " " "	3½
Antero-posterior diameter of first upper premolar,	3
Transverse " " "	2
Antero.posterior diameter of superior canine,	3
Transverse " " "	3½
Antero-posterior diameter of last lower molar,	11½
Transverse " " "	4¾
Antero-posterior diameter of second lower molar,	7
Transverse " " "	5
Antero-posterior diameter of first lower molar,	5¼
Transverse " " "	4¼
Antero-posterior diameter of last lower premolar,	5
Transverse " " "	3½
Antero-posterior diameter of second lower premolar,	3¾
Transverse " " "	2½
Antero-posterior diameter of first lower premolar,	3¼
Transverse " " "	1¾
Antero-posterior diameter of lower canine,	3¾
Transverse " " "	2¾

Merychyus medius.

A second species of *Merychyus*, to which the above name is given, is founded upon a fragment of a lower jaw containing the true molars, and an isolated upper last molar tooth. The specimens indicate an animal one-half larger in diameter than *M. elegans*, and intermediate in size to the Lama and Camel.

The fragment of a lower jaw, with different views of the contained teeth, is represented in figures 12—14, plate XI.

The first true molar has the crown nearly worn to its base. The last had not entirely protruded. The interspaces, separating the inner and outer lobes in a younger condition, have been completely obliterated in all the teeth, except traces in the posterior two divisions of the last molar, as seen in figure 14. The inner surfaces of the crowns, figure 13, exhibit ridges bounding the lobes with the intervening spaces concave and smooth. A tubercle, an element of a basal ridge, exists only between the bottoms of the outer lobes.

The measurements of the specimen are as follows:

	Lines.
Length of the true molar series, ...	34
Antero-posterior diameter of last molar, ...	17
Transverse " "	7½
Antero-posterior diameter of second molar, ...	9½
Transverse " " "	7
Antero-posterior diameter of first molar, ...	7½
Transverse " "	6¼

The isolated upper last true molar does not differ in form from the corresponding tooth of the smaller species. Its antero-posterior diameter is fourteen and a half lines; its transverse diameter ten and a half lines.

Fragments of a skull of a young animal, apparently belonging to this species, exhibit the following characters.

The cranium with the same general form as in *Oreodon*, but with a relatively shorter sagittal crest separating the temporal fossæ. The crest divides into the diverging temporal ridges some distance back of the deeply notched anterior border of the parietal. The forehead is relatively longer and more convex. The orbits are closed by a post-orbital arch stronger than in *Oreodon*. The infra-orbital arch is relatively deeper than in the latter. Lachrymal fossæ exist in front of the orbits. The infra-orbital foramen is situated above the back part of the last temporary premolar. In *Oreodon* at the same age it is above the interval of the latter and the premolar in advance. The frontals are abruptly depressed approaching the root of the nose, where the nasals, with parallel borders, are abruptly truncated. The supra-orbital foramina are comparatively distant. The post-glenoid tubercle is very flat antero-posteriorly, quite linguaform in comparison with that of *Oreodon*.

The teeth, preserved in one side of the jaw, consist of the three temporary molars, the first and second permanent true molars, the first premolar and the canine.

Merychyus major.

The largest species of *Merychyus*, distinguished by the above name, is indicated by fragments of jaws with teeth, from several different individuals. The specimens indicate an animal approximating in size *Merycochœrus*.

An upper jaw fragment, containing the third and fourth premolars and the succeeding two true molars, is represented in figures 15, 16, plate XI. The teeth are surrounded by a well-marked, though thin basal ridge, which is feebly developed only at a few points in the smallest species. In the second premolar a large pointed tubercle assumes the position of the acute ridge, situated antero-internally in the corresponding tooth of the smallest species and in that of *Oreodon*.

A singular peculiarity in the teeth of this specimen is the apparent absence of enamel in certain positions in which it ordinarily exists before it is removed by attrition. Thus it appears to be absent on the external surfaces of the inner lobes of the true molars. The enamel on the internal surfaces of the outer lobes thins away and appears to cease at their lateral borders, or turns for a short distance over the contiguous edges of the external surfaces of the inner lobes. The enamel also appears absent on the external surface of the inner lobe of the last premolar, and for some distance at the sides of the internal surface of the outer lobe. In the third premolar the enamel appears absent on the external surface of the postero-internal sub-lobe, and the greater extent of surface bounding the interspace externally between the sub-lobe and the principal lobe. Where the enamel appears to be absent, it is no doubt present in a much thinned condition, so as not to be obvious under ordinary inspection.

The measurements of the specimen are as follow :

	Lines.
Antero-posterior diameter of the second true molar,	16
Transverse " " "	13½
Antero-posterior diameter of first true molar,	12½
Transverse " " "	11
Antero-posterior diameter of fourth premolar,	8¼
Transverse " " "	9¼
Antero-posterior diameter of third premolar,	8½
Transverse " " "	7¾

A fragment of a lower jaw of another individual, containing the last molar with the crown half worn away, presents, as the measurements of the tooth, an antero-posterior diameter of twenty-one lines, and a transverse diameter of eight and three-quarter lines.

Another fragment, containing the true molars much worn and mutilated, proves the jaw to be of less depth and more slender proportions than in *Merycochœrus proprius*. Below the middle of the last molar the bone is twenty-two lines deep.

Small fragments of the anterior ends of both jaws, containing fangs of teeth, indicate the same arrangement of these organs as in the smallest species.

In comparing the fossil specimens referred to *Merychyus major* with those of *Merycochœrus proprius*, they may be observed to be so much alike that, making allowance for difference due to age, or the difference in degree of attrition to which the teeth have been subjected, they may be suspected to belong to the same animal. The anatomical peculiarities already indicated appear to be sufficient to separate the two animals, of which one belongs to the miocene, the other to the pliocene formation. (Compare figures 15, 16, plate XI, with the figures of plate X.)

LEPTAUCHENIA.

Leptauchenia is an extinct genus of ruminants founded on some fossil remains discovered by Dr. Hayden in 1855, on one of the tributaries of White River, near Eagle Nest Butte, in a formation attributed by him to bed D of the miocene, as indicated in the section page 17. The fossils are more fractured and crushed, and more friable than those of the *Oreodons* and their associates from the Mauvaises Terres. The matrix is also somewhat different from that of most of the latter, and resembles that attached to the remains of *Oreodon major*, and approaches that adherent to the remains of *Merycochœrus*.

The genus is closely allied to *Merychyus*, so far as can be ascertained from a comparison of the corresponding parts, and, like the latter, it is related to *Oreodon* and *Merycochœrus*.

The characters observed in the specimens of *Leptauchenia* distinguishing the genus from *Merychyus*, though apparently slight, nevertheless appeared to me sufficient to separate them, and to be in evidence that other and more striking characters would probably be found in more complete ones.

The number, relative position, general form and construction of the teeth agree with those of *Merychyus*. (Compare figures 2—5, plate XII, with figures 1—5, plate XI.)

The upper true molars have nearly the same form and proportions as in the latter, but the back pair are more uniform in the relation of their transverse and fore and aft diameters, especially in the case of the last one. (Compare figures 5, 8, 12, plate XII, with figures 3, 4, 16, plate XI.)

The outer buttresses of the crown are relatively more prominent and stronger or thicker, especially the median ones. The latter divide the crown to the fangs more completely than in *Merychyus*, and their thickened base projects forward so as to fold over the surface of the lobe in advance, instead of expanding into the base of the crown as in the last-named genus. The intervening outer faces of the external lobes are more oblique, or are directed more outward and backward than in *Merychyus*. (Compare figures 4, 6, 7, 11, plate XII, with figures 1, 15, plate XI.)

The interspaces separating the inner and outer lobes of the upper true molars of *Leptauchenia* appear, in the unworn condition of the teeth, even to have been proportionately less capacious than in those of *Merychyus*. From their gaping mouths they more rapidly narrowed, so as to be reduced to a fine vertical fissure approaching the bottoms of the crescentic pits. In consequence of this arrangement, from attrition of the teeth, the gaping mouths of the pits early disappeared, leaving the molars with broad surfaces of exposed dentine bordered by enamel, and provided each with a pair of median crescentic enamel bars, bounding an almost imperceptible trace of a fissure, the remnant of the interlobular spaces. Figures 5, 8, 12, plate XII.

The inferior true molars likewise closely resemble those of *Merychyus*. As in this, they are also remarkable for the early obliteration of the interspaces of the inner and outer lobes. (See figures 3, 14, 17, 20.) From those of *Merychyus* they usually differ in the decided separation internally of the inner lobes, by means of a narrow fold or well-defined and slightly overlapping ridge extending to the bottom of the crown. (Compare figures 16, 19, plate XII, with figures 7, 13, plate XI.)

Some additional and more complete remains of *Leptauchenia*, including those of another species, were obtained by Dr. Hayden in his expedition of the summer of 1866, on White Earth Creek, a tributary of White River. The fossils and pertaining matrix have the same general appearance as those from Eagle Nest Butte, and like them were derived from bed D of the miocene, as indicated on pages 17 and 20.

The fossil specimens of *Leptauchenia*, though far less well preserved than those of *Merychyus*, are more complete in extent, though more mutilated and crushed.

The cranium of *Leptauchenia* has the general form and construction of that of *Oreodon*. Large temporal fossæ are separated by a well-developed sagittal crest. The auditory bullæ are of enormous proportions. The forehead is broad and nearly flat. The orbits are closed by a post-orbital arch. The infra-orbital arches are strong. Lachrymal fossæ exist in front of the orbits. The infra-orbital foramina are situated above the third premolars.

Large unossified spaces exist in advance of the frontals above the fore part of the orbits, extending forward, over and in advance of the lachrymals. These unossified spaces, proportionately much larger but similar to those existing in the Deer, Lama, and some other living ruminants, are entirely absent in *Oreodon*. The fossils referred to *Merycochœrus* and *Merychyus* do not retain the part of the skull in which the unossified spaces are present in the specimens of *Leptauchenia*, so that their existence in the former remains a question to be solved by future discovery.

Notwithstanding the differences existing, and which I have attempted to indicate, since I have had the opportunity of inspecting the additional specimens of *Leptauchenia* above referred to, I have suspected that this genus may prove to be the same as *Merychyus*. At any rate the latter is next of kin to the former, and represented it at a later period. *Oreodon, Merycochœrus* and *Leptauchenia* were cotemporaries, their remains being derived from the same stratum of the miocene formation, bed D of Dr. Hayden's section. The remains of *Merychyus* belong to the pliocene formation of the Niobrara, or bed F of Dr. Hayden's section. The latter is the pliocene *Leptauchenia*, and was probably a direct offspring of the miocene *Leptauchenia*.

The fossil specimens referred to the latter apparently indicate three species, all of which were comparatively small.

Leptauchenia major.

The largest species of *Leptauchenia*, distinguished by the above name, was originally founded on specimens consisting of one side of an upper jaw, with all the molars and the canine tooth, and several fragments of lower jaws with teeth. The last collection of Dr. Hayden contains a nearly complete skull, which, however, is partially crushed, much fractured and otherwise mutilated.

The skull indicates an animal about the size of the smallest species of *Merychyus*, and is intermediate in size to *Oreodon Culbertsoni* and *O. gracilis*. In comparing the specimens of jaws and teeth of *Merychyus elegans* with the corresponding parts of the skull of *Leptauchenia major*, the resemblance appeared so great that I could not avoid the suspicion that the discovery of additional material might prove them to be the same, though I think it hardly probable that the differences which have been indicated as of generic value can be due only to individual peculiarity.

The specimen of *Leptauchenia major*, consisting of a portion of the upper jaw with teeth, is represented in figure 4, plate XII. It belongs to the left side and is half an inch shorter than the corresponding portion of *Merychyus elegans*. The bone is much mutilated, but its form is observed to be nearly as in the latter. The infra-orbital foramen is above the back part of the third premolar; in *M. elegans* it is above the fourth. The alveolar border, with the teeth, is more convex, both downward and outwardly. It is also nearly uniformly convex in the former direction, while in *M. elegans* it is sigmoid, or convex downward in the position of the true molars, and concave in that of the premolars.

The external buttresses of the true molars are strikingly prominent in comparison with those of *M. elegans;* and from the greater obliquity of the intervening surfaces of the outer lobes the buttresses have a more overlapping or imbricated appearance. (Compare figures 4, 5, plate XII, with figures 1, 3, 4, plate XI.)

The triturating surfaces of the same teeth, figure 5, present broad dentinal tracts, bounded by a more deeply sinuous border externally than in *M. elegans.* (Compare with figures 3, 4, plate XI.)

On the triturating surface of the first molar, figure 5, a crescentoid enamel islet, including a narrow depression, occupies an intermediate position to the posterior pair of lobes. On the triturating surfaces of the last two molars there is seen a pair of median angular crescentoid bars. These are sections of the remaining enamel investment of the inner faces of the external constituent lobes of the crown, and are nearly as thick as the enamel at the outer border of the latter, but they thin out to nothing at the extremities, before and behind. The bars appear to come in direct contact with the dentine of the inner lobes, as there is no visible separation, but most probably there intervenes an imperceptibly thin layer of enamel, the remains of the investment of the outer faces of the internal lobes.

The fourth premolar is like that of *Merychyus elegans*, excepting that it exhibits upon the triturating surface a central bar of enamel, as in the back true molars, instead of a conspicuous crescentic enamel pit.

The third premolar also resembles that of *M. elegans*, except that the postero-internal fossa extends more deeply into the crown and is more open at the bottom antero-internally. Nearly the same difference exists in the second premolar of the two animals. The first premolar is alike in both.

The upper canine has the same form as in *M. elegans*, but like the other teeth is smaller.

The specimen of the nearly complete, but much fractured skull above mentioned, in a perfect condition, independently of the lower jaw, appears as if it had been proportionately more depressed and wider than in *Oreodon.* An upper view of one-half the specimen is represented in figure 1, plate XII, but the side view is too much mutilated to exhibit any of the important characters of the skull, except the lower jaw, which is represented in figure 2.

The cranium, in its present condition, appears of great breadth and proportionate shallowness, compared with that of *Oreodon.* The difference, I suspect, is at least partially due to the specimen having been crushed downwardly and spread outwardly, though the appearance of such crushing and spreading is not very obvious. The face likewise appears proportionately low to the cranium, and it is broader posteriorly and more tapering anteriorly than in *Oreodon.*

The sides of the cranium are occupied, as in the latter, by large temporal fossæ, separated by a prominent sagittal crest. The anterior temporal ridges are more divergent than in *Oreodon.*

The forehead is broad and generally flat, compared with that of the genus just mentioned. It is slightly elevated along the middle, and feebly depressed between the latter position and the temporal and supra-orbital borders. The supra-orbital foramina occupy a position about half way between the median line and the post-orbital process. The frontals are separate, as in *Oreodon*.

Large vacuities or unossified spaces encroach deeply on each side of the forehead, extending about half the width of the orbit, posterior to the ant-orbital margin. The vacuities are separated by a prolongation of the frontals, about half an inch in length and five lines wide, extending forward to articulate with the nasals, which are lost in the specimen. Laterally the vacuities are bounded by the ant-orbital process, articulating with the upper angle of the facial plate of the lachrymal. In advance of the process just mentioned, the vacuities are narrowed, and extend forward above and then in advance of the lachrymals. The facial plate of the latter is large, nearly square and deeply impressed with an ant-orbital fossa.

A prominent ridge appears to extend across the face, extending from the infra-orbital arch, below the lachrymal fossa, to the fore-part of the maxilla where it articulated with the nasal.

The infra-orbital foramen, as in the upper jaw fragment previously described, is situated above the third premolar tooth.

The hard palate is constructed like that of *Oreodon*. The auditory bullæ are of enormous proportions. They abut posteriorly against broad and strong paroccipitals. They are antero-posteriorly oval and measure in this direction about an inch, and are about eight lines in depth and seven in width.

The lower jaw is like that of *Oreodon* and *Merychyus*, as represented in figure 2, plate XII. Below the position of the molars it is more convex, both externally and at the base, than in the specimens of *Merychyus elegans*. The mental foramen is situated below the interval of the first and second premolars, as in the latter and *Oreodon*.

The lower jaw, figure 2, contains a full series of teeth, consisting of six molars, a canine, and four incisors, as in *Oreodon* and *Merychyus*. In the upper jaw the teeth are all broken, but sufficient of them remains to determine that the formula is the same as in the two genera just named.

The inferior true molars, figures 2, 3, as observed in the lower jaw just mentioned, and in some fragments of others, closely resemble in character those of *Merychyus elegans*, except that in the case of the first and second of the series the inner constituent lobes of the crown are well defined internally by a well-marked fold or narrow buttress, which is obsolete in *Merychyus*. In a corresponding position of the last molar the buttress is not so well developed as in those in advance.

In all the specimens under investigation the crowns of the lower true molars appear as if made up of simple trilateral prisms, laid side by side. The triturating surfaces exhibit triangular dentinal depressions bordered by enamel, without any trace of the separation originally existing between the outer and inner constituent lobes.

The last premolar nearly resembles that of *Merychyus* and *Oreodon*, but differs in the internal median ridge, which is simple and extends obliquely backward, and does not project an offset forward as in the former genera. The anterior premolars resemble those of the latter genus, in a less well-developed condition.

The crown of the canine is proportionately thicker in comparison with its breadth than in *Merychyus* or *Oreodon*, and the internal ridge is more prominent, so as to make the crown appear more decidedly trihedral than in the latter genera. The incisors are like those of the latter.

Leptauchenia decora.

The species distinguished by the above name was the first noticed, and that upon which the genus was originally proposed. It was established before the discovery of *Merycochœrus* and *Merychyus*, and was indicated by some small fragments of jaws with molar teeth, which, from their resemblance to those of the *Auchenia* or Lama, gave rise to the name of *Leptauchenia*. A number of additional fragments, including a mutilated skull, all from near Eagle Nest Butte, on the White River, serve to give us a better acquaintance with the anatomical characters of the species.

Leptauchenia decora was rather smaller than *Oreodon gracilis*. The skull, judging from a crushed and somewhat distorted specimen, represented in figure 6, plate XII, has a rather more compact form than that of the latter, being proportionately broader, shorter, and, independently of the mandible, lower.

The cranium is like that of *Leptauchenia major*, but appears proportionately to have been deeper and less wide. The face appears to have been proportionately shorter and broader, and its fore part appears to have been remarkably shortened.

The forehead is like that of *L. major*. The vacuities of the face did not extend so deeply into the frontals as in the latter, and the prolongation of the forehead separating them was proportionately much shorter. The ant-orbital processes articulating with the lachrymals are wider than in *L. major*. Large lachrymal fossæ exist as in the latter, and the infra-orbital foramen occupies a corresponding position above the third premolar. The supra-orbital foramen occupies a corresponding position to those in *L. major*.

The infra-orbital arch as formed by the malar is of remarkable robustness. It projects more outwardly and is more than half as deep again than in the larger *Oreodon gracilis*.

The lower part of the face, if the condition in the specimen is not the accidental result of crushing, is of remarkable breadth and is proportionately short. The sides of the upper jaw are unusually convex outwardly, and the teeth appear crowded in position. The upper true molars form a strong convexity downwardly, while the premolars in advance present a concavity in the same direction.

The auditory bullæ are equally huge with those of *L. major* in proportion to the size of the species. They form oval capsules, ten and a half lines fore and aft, seven and a half lines wide, and seven lines deep.

The lower jaw has the general construction and form of that of *Oreodon*, but it is proportionately short at its fore part in relation with the shortness of the upper jaw, and its posterior part is of much greater proportionate depth. Indeed, the disproportion between the back and front portions is so great as to remind one of the condition of the lower jaw in the Howling Monkeys.

The coronoid process is proportionately shorter and broader than in *Oreodon*. The fossa below is rather deeper. The base, as partially seen, below the position of the molars is rapidly ascending forward.

The molar teeth of *Leptauchenia decora*, as exhibited in the specimen of the skull from which the above description is given, and in a number of additional fragments of jaws, figures 6—20, are like those of the larger species *L. major*.

Figures 7—10, plate XII, represent two fragments, apparently from the same upper jaw, the one containing the last two true molars, the other the last three premolars.

The true molars, figures 7, 8, are moderately worn; the last had not entirely protruded, and the triturating surface had not been sufficiently worn to expose a continuous tract of dentine throughout all its lobes.

In the second molar, figure 8, the exposed dentine is continuous on the summits of all the lobes, and encloses a median pair of bent vertical plates of enamel belonging to the inner faces of the outer lobes. The exposed dentine of the inner lobes, approaching the bottom of the plates just indicated, appears to be separated from them only by a narrow fissure, without perceptible enamel bounding the inner face of the latter.

In the last molar, figure 8, the exposed dentine of the summits of the anterior pair of lobes includes a narrow crescentoid enamel pit, bounded externally by a comparatively deep wall consisting of the inner enamel layer of the antero-external lobe. A narrow tract of dentine is exposed, from attrition, on the fore part of the summit of the postero-external lobe of the same tooth, and is continuous with the exposed dentine of the anterior pair of lobes. The outer inclined face of the postero-internal lobe, when closely examined, appears unworn, and yet its dentine appears to be exposed. The enamel on the exterior of this lobe appears to cease with its triturating border. The apparently unenamelled surface of the postero-internal lobe is continuous with a similar patch on the postero-internal surface of the postero-external lobe.

The premolars, figures 9, 10, agree with those of *L. major*, except that the central enamel pit of the last of the series is more open, as in *Merychyus elegans*.

The lower molars, represented in figures 13—20, agree closely with those of *L.*

major, excepting that in the specimens under observation, the inner lobes of the last molar are better defined from each other internally, as in the case of the true molars in advance.

Leptauchenia nitida.

A third species of *Leptauchenia*, smaller than the others, is founded on a mutilated skull, which, together with a number of bones and fragments of other parts of the skeleton, is imbedded in a mass of matrix similar to that adhering to and enveloping the fossils of the other species. The specimen was obtained in Dr. Hayden's expedition of 1866, on White Earth Creek, a tributary of White River.

The skull, represented in figure 21, plate XII, is about the size of that of the Musk Deer, and nearly resembles that of *L. major* in its form and proportions.

The cranium nearly resembles that of the last-named species, but apparently is proportionately less depressed. The forehead is proportionately as large, but is less prominent in the middle and more elevated at the supra-orbital margins. The vacuities of the face do not encroach upon it so much as in *L. major* or *L. decora*, and appear not to have extended quite so far back on a line with the ant-orbital margins. Comparatively they but slightly notch the frontals, and the prolongation of these to articulate with the nasals is short. As in the other species, the vacuities appear to extend above and in advance of the lachrymals.

The orbits appear to be formed as in *Oreodon*. Large concave fossæ impress the facial surface of the lachrymals.

The supra-orbital foramina are situated back of the middle of the position of the orbits, and rather nearer the supra-orbital margin than the median frontal suture. The infra-orbital foramen is situated above the fourth premolar, as in *Merychyus elegans*.

The face in advance of the orbits appears to be proportionately much narrower than in *L. decora*. It was quite as narrow as that of the Musk Deer, or even narrower between the position of the jaw and nose.

The auditory bullæ agree in their proportions with those of the preceding species.

The glenoid cavity resembles that of *Oreodon*, but the post-glenoid tubercle is proportionately very small. In *Oreodon* it is a process of the squamosal, but in *Leptauchenia nitida* it appears to receive a considerable contribution from the tympanic.

The lower jaw, as may be seen by a fragment retaining the condyle and coronoid process, together with an impress of the remainder of the ascending ramus on the matrix, figure 21, resembles in its construction the corresponding part in *Oreodon*.

The molar teeth of the upper jaw are partially retained on one side of the specimen, but are too much mutilated to determine their characters. So far as can be ascertained, they resemble in their order and form those of the preceding species of *Leptauchenia.*

As indicated in the preceding pages, the fossils of *Leptauchenia* are too much mutilated and otherwise imperfect to obtain accurate measurements in all cases, so that the following comparative list of those species must be regarded as approximative only:

	L. major. Lines.	L. decora. Lines.	L. nitida. Lines.
Estimated length of skull from summit of inion to upper incisive alveoli,	69	48	42
Estimated breadth at post-orbital arches,	30	24	18
Estimated breadth at infra-orbital arches,	35	30	22
Breadth of forehead between the orbits,	23	19	11
Length of do. in median line,	21	14	13
Breadth of face at last molar alveoli,	27	22	15
Breadth of face at infra-orbital foramina,	14½	13	7
Breadth at canine alveoli,	14	8	5
Length of upper alveolar border,	38	25	21
Depth of lower jaw below middle of last molar,	15		
Depth at second premolar,	12		
Depth at condyle,			19
Length of upper molar series,	31		17½
Length of lower molar series,	30		

The following list of measurements is taken in the case of the two larger species from well-preserved specimens belonging to different individuals:

	L. major.		L. decora.		L. nitida.
	Lines.	Lines.	Lines.	Lines.	Lines.
Length of the upper molar series,	32	31	22		17
Length of upper true molar series,	20	19	15	14	9½
Antero-post. diameter of last upper molar,	8½		7¼	6½	4
Transverse " " "	7½		6½	5½	
Antero-post. diameter of second upper molar,	7½		6	5¾	3½
Transverse " " "	7		5¾	5½	
Antero-post. diameter of first upper molar,	5½		4½		2½
Transverse " " "	6¾		4¾		
Antero-post. diameter of last upper premolar,	3½	3½		2¾	
Transverse " " "	5			3½	
Antero-post. diameter of third upper premolar,	4	4		2¾	
Ant.-post. diameter of second upper premolar,	3½	3½		2½	

	L. major.		L. decora.	
	Lines.	Lines.	Lines.	Lines.
Antero-post. diameter first upper premolar, .	2½	3		
Length of lower molar series, . .		30		
Length of lower true molar series, . .		21		15½
Antero-post. diameter last lower molar, .	9½	9	7	7½
Antero-post. diameter second lower molar, .	5½	6	5	4¼
Antero-post. diameter first lower molar, .	5	5	4¼	4
Antero-post. diameter last lower premolar, .		4¼	3½	
Ant.-post. diameter second lower premolar, .		3	3	
Antero-post. diameter first lower premolar, .		2½	2½	

AGRIOCHŒRIDÆ.

A peculiar and extinct family of ruminants of the most aberrant character, but allied to the *Oreodonts*, is indicated by the remains of a single genus,—*Agriochœrus*,—of which three species appear to be distinguishable. The remains were obtained from bed B of Dr. Hayden's section of the miocene formation, on the Mauvaises Terres of White River, and they are of comparatively rare occurrence.

The principal distinctive features of the family as seen in the skull of *Agriochœrus*, are briefly as follow: The skull has the general form and construction as in *Oreodonts*, but the orbits are open behind as in the representative of the ruminants of the early tertiary period, the *Anoplotherium*. No lachrymal fossæ exist in front of the orbits. The formula of dentition is the same as in the *Oreodonts*. The true molars, though constructed after the ruminant type, are remarkable for their transversely spreading character, or the shallowness and breadth of their crowns. The fourth upper premolar departs from the usual ruminant character in the possession of three demiconoidal lobes to the crown, two externally and one internally. The third lower premolar is nearly like the succeeding pair of true molars.

The two extinct families of the *Oreodonts* and *Agriochœrids* which I have attempted to characterize evidently hold an intermediate position between the ruminants and suilline pachyderms. Notwithstanding their equally close relationship with the latter, I have preferred classifying them with the former, on account of the construction of their true molar teeth, so eminently characteristic among living animals of that remarkable habit, the rumination of food.

AGRIOCHŒRUS.

Agriochœrus is a remarkable genus of extinct ruminants, more aberrant from existing members of the order than any of those previously described. It was originally characterized on fossil remains of a species from the Mauvaises Terres of Dakota, presented to this Academy by Dr. Hiram A. Prout, of St. Louis.

Agriochœrus antiquus.

The remains on which the species was founded distinguished by the above name, consist of the greater portion of the anterior part of a skull, including portions of both jaws with most of the molar teeth, and small fragments of jaws with teeth of a second individual. The former specimens, much mutilated, are represented in figures 5, 6, plate i, of The Ancient Fauna of Nebraska. Several of the latter, in a better state of preservation, are represented in figures 9, 10, of the same plate.

The specimens indicate an animal with the skull approximating in size that of *Oreodon Culbertsoni.*

The face appears to have been shorter and of less depth in relation with its breadth than in the latter. The forehead had nearly the same form but is flatter, and is somewhat abruptly depressed on each side above the position of the post-orbital processes.

The frontals posteriorly, though broken away, are readily observed to have been convergent and received into a notch of the parietal as in *Oreodon.* Anteriorly they are too much broken to judge of their arrangement.

The supra-orbital foramina are small, and quite near the inter-frontal suture.

The orbits are sub-rotund, relatively about as large as in *Oreodon,* but with rather more obliquity upward. They are open behind, as in *Anoplotherium,* the carnivora generally, etc., and in this respect differ widely from those of ordinary ruminants. The post-orbital processes of the frontal and malar bones are conoidal, of nearly equal size, and are about half an inch apart at their ends.

No lachrymal fossa exists in front of the orbit, the facial surface of the lachrymal bone contributing to the general convexity of the side and upper part of the face.

The infra-orbital arch is proportionately almost as deep as that of *Oreodon.* It has nearly the same form, but has its external face more vertical. Between it and the alveolar border the face is less depressed than in *Oreodon.*

The infra-orbital foramen occupies a position above the interval of the posterior two premolars.

The hard palate, for the greater extent obscured in the specimen by a remaining portion of matrix, at its fore part is deeply inclined at the sides.

The alveolar border accommodating the molar teeth is less convex antero-posteriorly than in *Oreodon*.

The portions of the lower jaw, accompanying the specimen just described, corresponding with the position of the molar teeth, resemble the same portions in *Oreodon*.

The number of teeth possessed by *Agriochœrus* cannot be ascertained from the specimens; it may, however, be suspected, from the evident affinity of the genus to *Oreodon* and its allies, that it had an equal number.

In one of the specimens (figure 6, plate i, Anc. Fauna of Neb.) there are preserved on one side of the upper jaw a series of six molar teeth, the true molars and three premolars in advance. In the accompanying portions of the lower jaw five molars are retained,—the true molars and the adjacent two premolars.

The true molars of *Agriochœrus* are evidently of the ruminant type, though very peculiar compared with those of recent ruminants or other extinct members of the order.

The upper true molars are remarkable for the wide-spreading character of their crowns. They bear a striking resemblance to those of the extinct *Hyopotamus* in form and proportions, except that they do not possess the odd or fifth lobe situated between the anterior pair of usual lobes. In comparison with those of *Oreodon* they are proportionately of less depth and greater breadth. The constituent lobes have nearly the same form and relative proportions, but are lower, more expanded, and separated by wider and shallower interspaces. Their external buttresses are of the robust hemispherical character of those of *Hyopotamus*, and are not laterally compressed in descending from the base as in *Oreodon*.

The upper last premolar resembles the teeth behind, with the postero-internal lobe reduced to a rudimentary condition, and with the external buttresses of the crown also much reduced in their proportions.

The penultimate premolar has a three-sided pyramidal crown, with a comparatively small three-sided lobe situated postero-internally. The principal lobe is considerably larger than those of the succeeding tooth, and has its broader external surface rather convex transversely and provided with three slight vertical ridges at its back half.

The antepenultimate premolar is a reduced form of the succeeding one.

The lower true molars nearly resemble those of *Oreodon* in form and proportions, but their constituent lobes are rather smaller, more contracted towards the summit, and their interspaces are wider or more excavated in appearance. The inner sides of the crowns resemble those of *Oreodon* or of the Deer, except that the lobes are less oblique, and do not overlap one another where contiguous. The posterior lobe also is provided with a recurved buttress-like process contiguous to that of the anterior lobe.

The descending crescentoid summits of the outer lobes terminate differently from those of *Oreodon*. The anterior horn of the outer front lobe ends at the base of the corresponding inner lobe. The posterior horn turns up to the posterior side of the latter. The anterior horn of the outer back lobe joins the contiguous horn of the lobe in advance below and before its termination The posterior horn ends in two branches, one joining the posterior face of the inner back lobe, the other joining its base posteriorly. In the last molar the latter branch does not exist, and the former is joined by the contiguous horn of the horse-shoe-like summit of the fifth lobe.

The lower last premolar is like the true molars, except that the front outer lobe is relatively better developed than in the succeeding tooth, and is continued by a strong process inward at the fore part of the crown. The inner lobes also, in comparison with those of the true molars, are much reduced in size, and occupy the hinder two-thirds of the inner side of the crown. See fig. 4, pl. XIII.

The lower penultimate premolar has a single lobed crown larger than those of the tooth behind. It is pointed, convex externally, sloping antero-internally, and provided with an ovoidal cul-de-sac postero-internally. See fig. 4.

Several mutilated cranial portions of skulls, originally referred to a genus under the name of *Eucrotaphus*, of which two species were distinguished, from a difference in size of the specimens and a variation in size and form of the auditory bullæ, under the names of *E. Jacksoni* and *E. auritus*, I supposed to belong to *Agriochœrus*.

The specimens are described on page 56 of The Ancient Fauna of Nebraska, and represented in plate vii of that work. They have nearly the size, proportions, form and constitution of the cranium of *Oreodon Culbertsoni*, but are more abruptly narrowed in advance of the squamosals than is usual in the latter, and the auditory bullæ are proportionately as large as in *Oreodon major*.

In the smaller of the two specimens, supposed to belong to *Agriochœrus antiquus*, the auditory bullæ are mammillaform, with little difference in the diameters. In a better preserved cranial specimen, brought from the Mauvaises Terres by Dr. Hayden, but with the auditory bullæ broken away, the cranium is somewhat narrow at its fore part. In most of its details it agrees with the cranium of *Oreodon Culbertsoni*. The sagittal crest is thirty-four lines in length from the inion, and at its bifurcation receives the angular summit of the frontals.

For the comparative measurements of the facial specimen of *Agriochœrus antiquus*, see the table following the account of *A. latifrons*.

Agriochœrus major.

A small fragment of a lower jaw containing a second true molar tooth, and a specimen consisting of the greater part of a mutilated cranium, brought from the Mauvaises Terres of White River by Dr. Hayden in 1855, were supposed to indicate a different and larger species of *Agriochœrus* than the former, to which the above name has been given.

The cranial specimen nearly agrees in size, form and proportions with that originally ascribed to *Eucrotaphus auritus*, described in The Ancient Fauna of Nebraska, and represented in figures 1 to 3, plate vii, of that work. Both specimens possess large inflated auditory bullæ, which differ from those in the cranium referred to *E. Jacksoni*, and since to *Agriochœrus antiquus*, in their larger size and oval form, but they also differ in some measure from each other, both in exact form and size. In the specimen originally referred to *E. auritus* they are the larger, and their base posteriorly is prolonged to articulate with the base of the paramastoid process. In the other specimen they are without the prolongation, and rest directly against the latter process. In both specimens the basi-occipital is deeply carinated.

The inferior second true molar above mentioned is like the corresponding tooth of *A. antiquus*, but measures $8\frac{1}{2}$ lines fore and aft and 6 lines transversely, while that of the latter measures 7 lines by $5\frac{1}{2}$ lines.

Agriochœrus latifrons.

The last collection of Dr. Hayden from the Mauvaises Terres contains a specimen, consisting of a nearly complete skull, including the lower jaw and teeth, which I at first viewed as pertaining to *Agriochœrus antiquus*. It sufficiently approximates the corresponding portions of the latter, both in size and constitution, to belong to it, but yet in some points presents such wide differences that I shall describe it as of a distinct species, under the above name, though I think it may only prove to be a sexual variety of the former, and perhaps belongs to the male.

The skull of *Agriochœrus latifrons*, represented in figure 1, plate XIII, has lost the anterior extremity and upper part of the face, including a portion of the forehead, both zygomata, and the summit of the inion. It is much fissured and is otherwise somewhat mutilated, and is yet partially imbedded in its rocky matrix. It contains most of the molar teeth, part of one canine, and traces of the lower incisors.

The skull is almost the size of those of the larger, more robust, apparently male skulls of *Oreodon Culbertsoni*, nearly agreeing with them in size, proportions and constitution.

The cranium might readily be mistaken for that of the latter animal were it not for the large auditory bullæ, of which one is exposed through an accidental fracture of the specimen. The bullæ are nearly of the form and size of those of the cranial specimen formerly attributed to *Eucrotaphus auritus*, as represented in figure 3, plate vii, of The Ancient Fauna of Nebraska.

The cranium of *A. latifrons* is proportionately longer than in *Oreodon Culbertsoni*. The sagittal crest is long, high and strong, and extends from the broad summit of the inion to the forehead, as formed by the frontals. Its bifurcation anteriorly is acute and remarkably prominent, but the diverging temporal ridges gradually subside approaching the post-orbital processes.

The fronto-parietal suture is more advanced in position than is usual in *Oreodon Culbertsoni*. Commencing at the bottom of the notch formed by the bifurcation of the sagittal crest, it curves forward and outward, crosses the temporal ridge just back of its middle, descends a short distance at the side of the cranium about midway between its narrowest part and the post-orbital process, and then curves backward and downward to the alisphenoid.

Both the squamosals and parietals are rather wider, fore and aft, than in *Oreodon Culbertsoni*, and the back part of the latter above the former are more depressed than is usual in the animal just named.

The inion appears to have been proportionately wider and lower, and to have had a wider summit than in *Oreodon Culbertsoni*. The sides of the inion in the latter incline outwardly to the acute border formed by the squamosal. In the skull of *A. latifrons* the outer part of these lateral surfaces presents a long, deep and wide fossa, bounded in front by the acute border of the squamosal, and behind by the prominent sub-acute border of the ex-occipital. The bottom of the fossa is occupied by the mastoid, which is more exposed than in *Oreodon Culbertsoni*, and appears as a clavate surface widest above, narrowing below, and terminating in a somewhat wider extremity constituting the mastoid process, which is also thicker, though not more prominent inferiorly, than in *O. Culbertsoni*. In the latter the margin of the ex-occipital is not prominent, and the mastoid continues on the same inclined plane with it to the border of the squamosal, so that the large conspicuous fossa at the side of the inion of *A. latifrons* is not existent in *O. Culbertsoni*. A smaller fossa, however, exists in a nearly corresponding position between the upper end of the mastoid and the ex- and supra-occipitals.

The paramastoids or par-occipitals are long, strong, and curved tapering processes, resting at their base against the auditory bullæ.

The post-auditory process of the squamosal is much thicker than in *Oreodon*, and projects more inferiorly than the mastoid process.

The post-glenoid tubercle has the same form and robust character as in *Oreodon*, and the glenoid articulation likewise appears to have the same form and construction.

The auditory bulla is fore and aft oval, and measures an inch in that direction, about eight lines in depth, and about seven in width. The back part of its base turns outwardly to articulate with the base of the par-occipital.

The space between the post-glenoid tubercle and the par-occipital is relatively much wider than in *Oreodon*, mainly to accommodate the more robust post-auditory and mastoid processes.

The face is both higher and wider than in *Agriochærus antiquus*, and in these respects resembles more in its proportions that of robust or male individuals of *Oreodon Culbertsoni*. It is, however, proportionately shorter than in the latter.

The forehead between the post-orbital processes is about an inch wider than in *A. antiquus*, nor is it so abruptly depressed upon these processes as in the latter. Posteriorly it is deeply depressed at the bifurcation of the sagittal crest. The frontals are separate, and form together posteriorly an acute angle, received between the co-ossified parietals. The fore part of the forehead is destroyed.

The orbits are open behind, but appear rather less oblique at their outlet than in *A. antiquus*.

No lachrymal fossa, so conspicuous a feature in *Oreodon*, exists in front of the orbit.

The palate, exposed in the specimen through an accidental fracture, is almost absolutely flat. In *Agriochœrus antiquus*, where it is exposed between the position of the premolars, it is comparatively narrow, and the two sides incline in an unusual degree, the angle being about 30°. In a transverse section the sides appear sigmoid, ascending more abruptly near the median palate suture and descending more abruptly near the alveolar border.

The lower jaw is identical in form and proportions with that of *Oreodon Culbertsoni*, except that the rami are more extended or produced backward of the line of the condyles. The dentary portion is relatively of somewhat greater depth than in the jaw fragments of *A. antiquus*.

The fossil confirms the suspicion that the formula of dentition of *Agriochœrus* is the same as that of *Oreodon*. On the left side of the specimen the molar series is preserved complete, with the teeth all entire, seven in the upper and six in the lower jaw. (Figure 1, plate XIII.) They are altogether slightly smaller than in the first described specimens of *Agriochœrus antiquus*, notwithstanding the face is somewhat larger than in this.

The molars hold the same relative position with one another as in *Oreodon*, and in a lateral view present a strong resemblance to them, save in the difference of the abutment-like ridges of the upper true molars. (See figure 1, plate XIII.)

The lower molars are separated from the canine teeth by a comparatively large interval, which is nearly half an inch. In *Oreodon Culbertsoni* the first premolar succeeds closely upon the canine. In *Agriochœrus latifrons* the edge of the jaw at the hiatus is thin and concave, and exhibits no trace of having accommodated an additional tooth.

In the upper jaw the incisors and canines, with the corresponding part of the face, are broken off and lost close upon the position of the molar series.

The first upper premolar (figure 2), not existing in the first-described specimens of *A. antiquus*, is considerably smaller than the succeeding tooth, and its homologue in *O. Culbertsoni.* It is a reduced representative of the second premolar, but its crown is simpler in not having the strong basal ridge at the postero-internal face.

The succeeding premolars and the true molars are like those of *A. antiquus.* (Compare figures 1, 2, plate XIII, of this work, with figures 5, 6, 10, plate i, of the Ancient Fauna of Nebraska.)

The first lower premolar, not existing in the first-described specimens of the latter, has a crown like that of the corresponding tooth of *Oreodon Culbertsoni.* (Figures 1, 3, plate XIII.)

The second lower premolar resembles that of *Oreodon Culbertsoni,* but is proportionately smaller. The likeness is greater than in the case of the corresponding tooth of *A. antiquus.* In this the crown of the tooth forms a broad cone with the outer convex surface separated from the inner sloping and slightly concave surface by an acute border and summit. The posterior border forms a wide festoon, enclosing a cup-like fossa directed inwardly. In *A. latifrons,* as in *O. Culbertsoni,* the crown of the tooth is more trihedral. From near its middle internally there projects a ridge obliquely backward and expanding in the base of the crown. The posterior border of the latter turns inwardly at the base, joins the median ridge, and encloses a lozenge-shaped fossa.

The last lower premolar (figure 3) resembles the succeeding true molars to such a degree that I at first suspected it was the last of the temporary series of teeth. This, however, appears not to be the case; all the permanent teeth occupy their functional position, and the last premolar, or what might be supposed to be the last temporary molar, is less worn than the first true molar. In *A. antiquus* the corresponding tooth (figure 4) departs more from a likeness to the true molars, in the internal lobes of the crown being proportionately less well-developed, so that they permit the fore part of the antero-external lobe to be extended inwardly in advance of the antero-internal lobe.

The lower true molars are identical with those of *A. antiquus.* (Compare figures 1, 3, plate XIII, of this work, with figures 5, 7, 8, 9, plate I, of the Ancient Fauna of Nebraska.)

The fang of the left inferior canine, retained in the specimen, apparently indicates the tooth to have had the same form and relative position as in *Oreodon.*

The incisive alveolar border of the lower jaw is nearly all lost, but a portion remaining on the left side with traces of several alveoli appear to indicate the same number of incisive teeth in *Agriochœrus* as exist in *Oreodon.*

In comparing the cranial specimens originally referred to *Eucrotaphus* (see Ancient Fauna of Nebraska, page 56, plate vii), and subsequently to *Agriochœrus antiquus* and *A. major* (see pages 134, 135), with that of *A. latifrons,* they are observed to bear a nearer resemblance to that of *Oreodon Culbertsoni,* save in the possession of largely inflated tympanics.

In one specimen, retaining part of the forehead, the fronto-parietal suture commences within the division of the sagittal crest, as in *A. latifrons,* which is exceptionally the case in *O. Culbertsoni.* In two specimens, retaining the inion, neither possess the large lateral fossæ noticed as present in *A. latifrons.* In one of these the inion is identical with the ordinary form of that of *O. Culbertsoni;* in the other the sides are depressed rather peculiarly, so as to produce nearly vertical planes. In none of the specimens is the interval between the post-glenoid tubercle and the paramastoid so wide as it is in *A. latifrons,* and in this respect they agree with *O. Culbertsoni.*

There are three additional specimens of mutilated crania, with large auditory bullæ and otherwise resembling those above indicated, which accompanied the skull of *Agriochœrus latifrons* in Dr. Hayden's last collection. These specimens, like the former, resemble the cranium of *Oreodon* more than they do that pertaining to the skull of *A. latifrons.* They differ more or less from one another in the same manner as the former cranial specimens. The auditory bullæ differ remarkably in size; in one being nearly double the volume they are in a second, and being intermediate in size in the third.

All the isolated cranial specimens,—resembling the cranium of *O. Culbertsoni* in its form, proportions and construction, but having the tympanics much inflated,—I was led to suppose belonged to *Agriochœrus,* and from the difference observed between them and that of *A. latifrons,* considered them as pertaining to the other two species indicated. Since the discovery of the specimen of a skull which presents all the characters previously attributed to *Oreodon Culbertsoni,* except in the possession of large auditory bullæ, described under the caption of *O. bullatus,* the determination is rendered doubtful. As the isolated cranial specimens, independently of the presence of the greatly inflated tympanics, resemble the cranium of the ordinary forms of *Oreodon Culbertsoni* more than they do that pertaining to the skull of *Agriochœrus latifrons,* they may be inferred to belong to the same category as the skull referred to *O. bullatus.*

Dr. Hayden's last Mauvaises Terres collection further contains fragments of the jaws with teeth of several different individuals of *Agriochœrus,* which agree in their anatomical characters with the corresponding parts of the specimens previously described, except that they vary slightly in size. A fragment of the lower jaw containing the last two molars has a greater depth, and the teeth are larger than in the specimens referred to *A. antiquus* and *A. latifrons,* but the second molar tooth is intermediate in size to that of these species and that referred to *A. major.*

Notwithstanding I have been led to distinguish three species of *Agriochœrus,* I am inclined to suspect that all the specimens really pertain to a single one, and the differences which have been indicated are perhaps partly sexual, and in part of the character of individual variation.

The following are comparative measurements of the skull of *A. latifrons* and the corresponding parts of *A. antiquus:*

	A. latifrons. Lines.	A. antiquus. Lines.
Estimated length of skull from occipital condyles to incisors,	102	
Estimated length of cranium from inion to fore part of sagittal crest,	40	
Estimated breadth between the zygomata,	60	
Greatest breadth of cranium at the convexity of the squamosals,	30	
Breadth at narrowest part of the cranium,	15	
Vertical diameter of the orbits,	13	
Breadth of forehead at post-orbital processes,	40	28
Breadth of face at middle of last molars,	44	34
Breadth of face at infra-orbital foramina,	27	18
Breadth of face at ant-orbital margins,	42	29
Height of forehead from alveolar border,	30	23
Length of lower jaw, partially estimated,	84	
Breadth of ramus obliquely, back of the last molar,	34	
Depth of jaw at condyle,	37	
Depth of jaw at coronoid process,	46	
Depth below fore part of last molar,	19	17
Depth below second premolar,	14	11½
Estimated length of symphysis,	23	
Length of upper molar series of seven,	39	
" " " except first,	35	36
Length of lower molar series of six,	38	
" " except first,	34	36
Length of upper true molar series,	22	22½
Length of lower true molar series,	24	25

The following are comparative measurements of molar teeth of *Agriochœrus:*

	Measurements in lines.					
	A. latifrons.	A. antiquus.	Agrioc.	Agrioc.	Agrioc.	A. major.
Series upper true molars, ...	22	22½	22½	22¾		
Antero-posterior diameter of last true molar,* .	9	9	8¾	9¼	9½	
Transverse " " " .	9½	10½	9¾	10½	10¼	
Antero-posterior diameter of second true molar,	8¼	8	8¼	8½	8½	
Transverse " " "	9	9	9	10	9¼	
Antero-posterior diameter of first true molar, .	6½	6½	7	7½		
Transverse " " " .	7	7½	7½	8		
Antero-posterior diameter of last premolar, .	5½	6	5½	6		
Transverse " " " .	6½	6½	6½	6¼		
Series lower true molars, ...	24	25				
Antero-posterior diameter of last true molar, .	11¼	12	11½	12¾	13½	
Transverse " " " .	6	6	6	6½	6½	
Antero-posterior diameter of second true molar,	7	7		7½	8	8½
Transverse " " " .	5½	5½		5¾	6	6
Antero-posterior diameter of first true molar, .	5½	6½				
Transverse " " " .	5	5				
Antero-posterior diameter of last premolar, .	5½	6½				

CAMELIDÆ.

This family, represented in the recent fauna of the earth by the Camel and Lama, contained many more representatives in former geological eras. In the fauna under investigation it appears to have been well represented. The remains viewed as belonging to it have been referred to six extinct genera, comprising eight species.

Two of the genera are of the miocene period; the remains of one—*Pœbrotherium*—having been obtained from bed B of Dr. Hayden's section, in association with remains of *Oreodon Culbertsoni*, etc. The fossil upon which the genus *Protomeryx* was founded was obtained from bed D of the same section. The other genera belonged to the pliocene period,—the remains of three species of *Procamelus*, and those of *Homocamelus*, *Megalomeryx* and *Merycodus* having been obtained from bed F of Dr. Hayden's section.

PŒBROTHERIUM.

The name *Pœbrotherium* is applied to an extinct genus of ruminating animals, apparently most nearly allied to the Camel and Lama among existing animals.

Pœbrotherium Wilsoni.

A unique species, to which the above name was given, was established on a specimen consisting of the facial portion of a skull from the Mauvaises Terres of White

* The antero-posterior diameter is taken between the most prominent points externally in the case of the upper teeth, internally in the lower teeth. The transverse diameter is taken between the most prominent points anteriorly.

River, presented to the Academy of Natural Sciences in 1846 by Mr. Alexander Culbertson, a gentleman engaged in the western fur trade. It was the first of the mammalian fossils brought to the notice of the author from the great bone depositories of Dakota. Notwithstanding the rich yield of fossils from the same region, but few remains of the same species have since been obtained that have come under my inspection.

The specimen was first described in the Proceedings of the Academy, in 1847, and subsequently in "The Ancient Fauna of Nebraska," in which it is well represented, together with the teeth, in figures 1—4, plate i.

The fossil retains the greater part of both jaws, the intermediate portion of the face, portions of the orbits, and part of the base of the cranium, together with the auditory bullæ. It belonged to an individual which had not yet reached maturity, for though all the permanent true molars had protruded, the temporary molars had not been shed.

The upper portion of the face, including the forehead and nasals, is broken away, as is also the case with the premaxillaries and the anterior extremity of the lower jaw.

The remaining portion of the face in the fossil is long, narrow and tapering. From the anterior margin of the orbit it slopes forward and inward without being impressed by a lachrymal fossa. Near its middle, however, above the prominent alveolar border, and below the position occupied by the nasals, it is deeply depressed into a fore-and-aft oval concavity, the bottom of which reaches within a couple of lines of that of the opposite side. The depression to some degree may be the result of accident, though it has not that appearance in the fossil. At its fore part is a rather abrupt bulge, extending forward to the broken end of the specimen, which apparently is due to the existence of a canine alveolus like that of the male Musk Deer.

The orbit appears to have possessed the usual large size observed in recent ruminants. Its anterior margin, somewhat everted, is on a line with the middle of the anterior half of the second upper true molar tooth. The inferior margin, directed obliquely downward and forward, is slightly everted, while the malar surface beneath is almost vertical instead of being strongly inclined downward, as in recent ruminants generally.

The zygoma pursues an oblique course downward and forward to the face. Its outer surface is comparatively deep in proportion to the size of the skull.

The infra-orbital foramen opens about an inch in advance of the orbit, over the position of the fore part of the last temporary molar tooth.

The facial surface of the lachrymal is oblong-square, and contributes to the general slope of the contiguous portion of the face. At the orbital margin it is produced into an angularly bent ridge or lachrymal process, within the position of which there is situated the orifice of the lachrymo-nasal duct.

The only parts visible of the base of the cranium are the auditory bullæ, which appear of enormous size. They extend nearly half the depth of the back part of the lower jaw, reach outwardly several lines beyond the general plane of the external surface of the latter, and internally are within five lines of each other. Postero-internally they abutted against the paramastoids, and anteriorly they project within the position of the lower jaw. They are about an inch in breadth fore-and-aft, three-fourths of an inch in thickness behind, and about eleven lines in length. Their inner surface is nearly flat and parallel; their outer surface is more convex, and directed forward. They are most convex and narrowest anteriorly, are thick and convex beneath, and are prominently convex postero-externally. Their back part appears doubled so as to enclose a vertical gutter ending below in a pit, with a process for the conjunction of the styloid bone.

The external auditory meatus has the appearance of a small loop, suspending the auditory bulla like a bag behind the glenoid articulation. In its present condition in the fossil, which, however, appears to be perfect, it is very short and does not reach outwardly within a couple of lines of the external prominence of the auditory bulla. It opens outwardly with a feeble inclination downward and backward.

The lower jaw approaches nearest in form that of the Camel among living ruminants. The base is nearly horizontal as in the Camel, but is rather more flexuose. The downward convex production of the extremities and middle nearly reach the same plane. The alveolar border at the back part makes a steep downward and forward sweep, but rises again from the position of the first true molar to the beginning of the closed row of molars, when it again descends along the hiatus to the first premolar.

The body of the lower jaw is thickest and most convex at the middle, and most vertical at the back part and below the premolars. The posterior portion of the jaw extending from the alveolar border obliquely backward and downward is of great comparative breadth. The posterior border forms a hook-like process as in the Camel family. The end of the hook is just below the middle of the depth of the jaw from the condyle. The margin below is convex and continuous with the base of the bone. The margin above forms a semi-circle, occupied by the outwardly projecting portion of the auditory bulla.

The condyle, so far as it is visible, appears to resemble that of the Lama. The coronoid process rises nearly as in the latter, but appears not to have been so long. Below the process externally there is a comparatively deep fossa, as in the Niobrara genus *Procamelus*.

The mental foramen is situated below the back part of the first premolar tooth, corresponding also with the back part of the articulation of the symphysis.

Dentition.—The fossil contains the permanent true molars, and the temporary molars except the first premolar of the lower jaw. The molar series of both jaws are represented in figures 5, 6, plate XIII. Canines appear to have existed in the upper jaw, and they, as well as incisors, probably belonged to the lower jaw.

A premolar in the upper jaw occupies an advanced position from the others, separated from them by a hiatus of four lines (figure 5). It has a crown twice the breadth of the length inserted by a pair of widely separated and somewhat divergent fangs. The crown is fore-and-aft oblong, with a trenchant lower border becoming slightly more prominent towards the middle. It is worn off internally in a sloping manner from attrition of an opposed tooth below. The latter is lost in the fossil.

The second and third premolars of both jaws possess great proportionate breadth, and are inserted by widely separated and somewhat divergent fangs. These teeth remind us of the corresponding ones of the eocene *Dichobune cuspidatus.*

The temporary true molars in form and construction hold the same relation to those of the permanent series as in living ruminants.

The permanent true molars of both jaws have the ordinary constitution of those of ruminants generally.

The second upper premolar has an oblong crown four times the breadth of its length and thickness. It is thickest posteriorly, and is feebly trilobate externally. The lower border is trenchant and most prominent at the middle. Internally it is worn by attrition in a sloping manner.

The third upper premolar has an oblong crown three times the breadth of its length. It is trilobate externally, the posterior lobe forming a transverse angular ridge at the triturating border, and the anterior pair together forming an angular cusp. Internally the crown appears rather trilobed, which, structurally, is really the condition of the crown. The triturating surface is wide clavate in outline, with the back part widest. It presents an exposed tract of dentine crossed by a transverse angular valley, separating the angular ridge behind from the cusp in front.

The upper temporary true molar is a reduced representative of the teeth behind. It is so worn that the enamel of the triturating surface is obliterated except a small crescentic islet intermediate to the posterior pair of constituent lobes.

The upper permanent true molars have crowns with the breadth of their base a little exceeding the width and length. The first and second of the fossil are fully protruded, and are inserted in the usual manner. The last has almost entirely protruded, and is slightly worn.

The crowns have nearly the relative proportions of those in the Camel, though their width at base appears somewhat greater. Their outer surfaces are more oblique in relation with one another than in the Camel.

As in the latter, the outer surfaces of the external lobes of the upper true molars are nearly vertical planes, with narrow median ridges and bounded anteriorly by prominent narrow ridges. The inner surfaces slope moderately and become rather abruptly prominent along the middle. The outer surfaces of the internal lobes are strongly concave; the inner surfaces prominent, strongly sloping, and feebly concave in their length.

Of the worn crescentic summits of the inner lobes of the upper true molars, the anterior horn of the posterior crescent is continuous with the conjoined horns of the external crescents; and the posterior horn of the anterior crescent is directed towards the postero-internal face of the antero-external lobe.

The second lower premolar has a crown nearly three times the breadth of the length and thickness. It is feebly trilobate externally, and has a trenchant border rising towards the middle. Its posterior thicker extremity extends a short distance external to the fore part of the succeeding tooth.

The third lower premolar has the crown more than three times the breadth of the length. It is feebly trilobate externally, but more decidedly so internally from the presence of a notch separating the anterior two divisions. It widens moderately from before backward. The triturating border presents a zig-zag tract of dentine, widening posteriorly.

The lower temporary true molar is so worn that the crown appears composed of three simple prismatic columns of dentine, enveloped in enamel, successively enlarging posteriorly.

The lower permanent true molars approach in form those of the Camel. Their inner surfaces are quite as simple, forming nearly vertical planes, with slight median and marginal elevation of the constituent lobes. The outer surfaces exhibit more angular prominences of the external lobes. The outer surfaces of the internal lobes are remarkable for being almost flat. The inner surfaces of the external lobes are angularly concave.

The worn triturating surfaces of the true molars exhibit narrow tracts of dentine, continuous everywhere upon the constituent lobes, and enclosing wide, three-sided enamel pits.

The last molar has a fifth lobe, which is comparatively thin and has an acute biting border, unworn in the fossil.

The species *Pœbrotherium Wilsoni* was named in honor of Dr. Thomas B. Wilson, of Philadelphia, a distinguished patron of natural history.

Measurements derived from the fossil are as follow :

	Lines.
Distance from auditory meatus to fore part of first premolar,	57
Distance from auditory meatus to ant-orbital margin,	28
Breadth outside auditory bullæ,	25
Breadth at auditory meatus,	21
" malar bones midway below orbits,	28
" infra-orbital foramina,	14
" above first premolar,	7½
" above middle true molar,	22
Height of orbit from base of lower jaw,	20
Breadth of orbit,	14
Height of lower jaw at condyle,	23
" " middle true molar,	7
" " second premolar,	7
" " angular apophysis,	10
Length of upper molar series exclusive of the isolated premolar,	30
Length of lower " " " "	32

		Lines.		
Diameter of first upper premolar,	antero-posterior,	3½ ;	transverse,	1
" second " "	"	4¼	"	1
" third " "	"	4¾	"	3
" temporary true molar,	"	4½	"	3¾
" first permanent upper true molar,	"	5½	"	5
" second " " "	"	6½	"	5¾
" third " " "	"	7	"	6
" second lower premolar,	"	4¼	"	1
" third " "	"	4¾	"	1½
" temporary true molar,	"	6	"	2½
" first permanent lower true molar,	"	5	"	3½
" second " " "	"	6½	"	3¾
" third " " "	"	8½	"	3½

In Dr. Hayden's expedition to the Mauvaises Terres of White River, in 1866, he obtained a number of small fragments of jaws with molar teeth of *Pœbrotherium Wilsoni*. One of the specimens consists of a fragment of the upper jaw of an adult individual, containing the back two premolars on both sides, portions of the second one, and on the left side portions of the succeeding two true molars.

The back two premolars are represented in figure 7, plate XII. They are of rather less width than the teeth they replace, as compared with those contained in the skull above described.

The last premolar resembles the ordinary form in other ruminants, the crown consisting of a transverse pair of lobes separated by a crescentic interspace. The penultimate premolar has a broader crown than the former, but is not so broad as its predecessor. It corresponds in form with the outer lobe of the tooth behind, in an expanded condition, but with less depth. Small offsets, projecting inwardly from the two extremities, may be viewed as rudiments of the internal lobe of the last premolar. The premolar in advance appears to have been nearly of the same size and form.

In front of the latter tooth in the specimen commences the hiatus, as in the young skull above described. The infra-orbital foramen is situated over the last premolar.

The measurements of the premolars are as follow:

	Lines.
Antero-posterior diameter of second premolar, ...	$4\frac{1}{2}$
Antero-posterior diameter of third premolar, ...	$4\frac{1}{2}$
Antero-posterior diameter of fourth premolar, ...	$4\frac{1}{4}$
Transverse " " "	$3\frac{1}{4}$

PROCAMELUS.

The genus *Procamelus* was established on a number of fossil fragments of jaws with teeth of several different species, discovered by Dr. Hayden on the Niobrara River. The fossils belong to the pliocene formation, or bed F of Dr. Hayden's section, as indicated on pages 16, 20, 21. The specimens generally belonged to old animals, as proved by the much worn condition of the teeth, and they are mostly much mutilated.

In anatomical character the fragments exhibit a nearer affinity with the corresponding parts of the existing Camel family than they do with those of any other ruminants.

As far as can be ascertained and inferred from the imperfect specimens, the formula of dentition appears to have been as follows:

$$\text{True molars } \frac{3}{3}, \text{ premolars } \frac{4?}{4}, \text{ canines } \frac{1?}{1}, \text{ incisors } \frac{?}{3}$$

Thus, in comparison with the permanent or adult series of teeth of the Camel, *Procamelus* is distinguished by the possession of an additional premolar to the upper series, and two additional ones to the lower series. In its dentition it would thus appear that *Procamelus*, in its relation with the living members of its family, represents their earlier or less mature condition, or that before they have shed those premolars which reduce the number to that observed in their adult condition.

The true molars and premolars, excepting the first of the latter, form unbroken rows, as in the smaller number of the corresponding teeth in the recent members of the Camel family.

The inferior true molars have the same form and constitution as in the Camel, but are rather smaller in proportion with the size of the jaw. The superior true molars, so far as can be judged from the generally much mutilated specimens, likewise hold the same relations with those of the Camel.

The fourth premolar in both jaws also closely resembles that of the latter animal.

The third upper premolar is much better developed than the corresponding tooth of the Camel, and the second one is in excess of the number existing in the permanent series of that animal and the Lama.

The third and second premolars of the lower jaw are in excess of the number observed in the adult series of the Camel and Lama.

The first lower premolar is separated from the others, and is caniniform, as in the corresponding tooth of the Camel. The separation is less than in the latter, in consequence apparently of the presence of the additional premolars occupying part of the interval. The corresponding tooth is absent in the permanent series of the Lama.

The lower jaw is of more robust proportions in relation with the size of the contained teeth than in the Camel and Lama. Its fore part is relatively deeper, and the symphysis much shorter; the back part is relatively of greater breadth, and the ascending ramus shorter.

Procamelus agrees with the recent Camel family in the possession of a post-coronoid process to the lower jaw. The ascending ramus exhibits a well-marked external concavity or fossa, which is comparatively feebly developed in the Lama, and does not exist in the Camel and ordinary ruminants.

PROCAMELUS ROBUSTUS.

The largest species of *Procamelus*, distinguished by the above name, is indicated by a portion of the right side of a lower jaw, represented in figure 1, plate XV, two-thirds the size of nature. It contains the premolars, except the third (which has been introduced in the figure from another specimen), and the first and last true molars. The specimen indicates an animal which apparently was about the size of the existing Camel. The teeth are rather smaller than the corresponding ones of the latter, but this difference is more than compensated by the greater number of molars, the row of which is absolutely longer than in the Camel, and the jaw fragment is deeper and thicker or more robust than its homologue in that animal.

The jaw fragment bears a nearer resemblance of form and proportions to the same portion in the Lama than the Camel. It is of more uniform depth than in the latter, in which it rapidly decreases forward.

Below the molars externally the jaw is as convex as in the Camel, and of little greater depth. Below the premolars, and above the thickened convex base, it is comparatively flat, and is one-fourth greater in depth than in the Camel. In advance of the premolars it is about as thick as in the latter, but still holds the same relative depth as beneath the premolars.

Internally the alveolar portion of the jaw is as convex posteriorly as in the Camel, but is much less so anteriorly. Below the alveolar portion, along the position of the base, the bone is depressed, especially at the back part. The portion of the jaw accommodating the premolars, in comparison with that in the Camel, is much thinner.

The base of the jaw is nearly as thick as in the Camel, but its line approaching the symphysis is more sigmoid. In advance of the premolars the base retains its thickness, but the bone above is thinner and rises towards the hiatus of the teeth in a more carinate manner, as in the Lama.

The symphysial portion of the jaw appears to have been much shorter than in the Camel. The symphysis terminates posteriorly below the position of the crown of the caniniform premolar, whereas in the former animal it reaches far back of this position.

The mental foramen occupies a similar position to that in the Camel,—that is, below the caniniform premolar. A second foramen occupies a position not quite so far back as its homologue in the Camel and Lama, being situated below the last premolar, instead of the first true molar as in those animals.

As before intimated, the molar series, though composed of smaller teeth than in the Camel, from their greater number occupies a greater extent of space along the alveolar border of the jaw. Thus in a lower jaw of the Camel, in which the four molar teeth occupy a space of five inches and a half, in the fossil the six teeth occupy a space of six inches and a quarter.

The true molars, as seen in figures 1, 2, *e*, *g*, plate XV, are almost the counterpart of those of the Camel. In the first one, in the fossil, the crescentoid intervals, which separate the inner and outer lobes in unworn teeth, are completely obliterated, leaving a yoke-shaped triturating surface of dentine bordered by enamel internally and externally, as represented in figure 2, *e*.

The last molar yet retains the crescentic pits intervening between the anterior pairs of lobes. The pits appear to be as contracted and their sides as vertical as in the Camel. The worn triturating surface of this tooth, represented the size of nature in figure 2, *g*, is almost an exact likeness of its homologue in the latter animal at the same stage of abrasion. The tooth exhibits a single important difference from that of the Camel in the greater degree of distinction of the internal lobes internally through a more strongly folded condition of their posterior border.

The fourth or last premolar, figures 1, 2, *d*, has the crown much worn, nevertheless it appears to have been proportionately shorter, about as wide and thinner than in the Camel, but has nearly the same form. The triturating surface presents a minute islet at its back part, the remains of the pit seen in a similar position in the less worn tooth of the Camel or Lama.

The third premolar, not existing in the adult state of the latter animals, in the specimen has lost the greater part of its crown. In figure 1, *c*, it is represented as restored from older or more worn teeth of another species. The crown appears to have been a reduced form of that of the last premolar just described.

The second premolar has a remarkable appearance. It is represented in figures 1, 2, *b*, —, in the latter of the natural size, in the former reduced one-third. From its condition, it appears to have protruded at a comparatively late period. The crown is laterally compressed conical, with trenchant borders and pointed summit, and with the sides impressed approaching the borders. It is only slightly worn,—just below the apex, about half the length of the posterior border. The tooth is inserted by a pair of confluent, somewhat gibbous fangs, more robust than those of the succeeding premolar.

The first or caniniform premolar, figure 1, *a*, is situated nearly in the same relative position as in the Camel, that is to say, nearly the same distance from the corresponding tooth,—the last premolar. The crown is much worn, but appears to have been as well developed and to have had the same form as in the Camel—curved conical, laterally compressed, with trenchant borders, and the sides impressed near the latter. The fang is large and gibbous, and curves downward and backward.

About eight lines in advance of the caniniform premolar the fossil presents part of a large curved alveolus, which was sufficient to accommodate a canine tooth like that of the Camel. All traces of incisive alveoli are lost in the specimen.

The measurements of the fossil in comparison with those of a lower jaw of a recent adult Camel are as follow:

	P. robustus.		Camel.	
	Inch.	Lin.	Inch.	Lin.
Distance from canine alveolus to back of last molar, . .	8	6	9	2
Space occupied by closed row of six molars, . . .	6	2		
Space occupied by true molars and last premolar, . .	5		5	6
Space from caniniform premolar to last premolar, . .	2	2	2	5
Length of hiatus back of first premolar, . . .	1	1	2	5
Length of hiatus in front of do. . . .		8		6
Space occupied by true molars, ...	4	3	4	7
Space occupied by back three premolars, . . .	1	10		10
Depth of jaw at fore part of last molar, . . .	2	3	2	2
Depth of jaw at last premolar, ...	2		1	5
Depth of jaw at caniniform premolar, . . .	1	8	1	4
Depth of jaw at hiatus back of latter, . . .	1	7	1	3
Thickness of jaw below last molar, ...	1	4	1	4
Thickness of base below do.		9	1	
Thickness of base below last premolar, . . .		9		11

	P. robustus.		Camel.	
	Inch.	Lin.	Inch.	Lin.
Thickness of alveolar portion below last premolar, . .		8	1	
Thickness at middle of hiatus back of first premolar, .		10		10
Antero-posterior diameter of last molar, . . .	1	11	2	
Antero-posterior diameter of first molar, . . .	1		1	1
Antero-posterior diameter of last premolar, . . .		9		9
Antero-posterior diameter second premolar, . . .		6½		
Height of crown of do. . .		5		

An isolated specimen of a well preserved upper true molar, probably the first one, represented in figures 3, 4, plate XV, perhaps belongs to *Procamelus robustus.* It bears a near resemblance to the corresponding tooth of the Camel. It measures fifteen and a half lines antero-posteriorly at the outer part of the triturating surface and eight lines wide at the prominent points of the anterior lobes. Near the base of the crown it is about as wide from before backward as at the triturating surface, but at the anterior lobes from without inwardly is eleven lines wide.

Procamelus occidentalis.

Most of the fossil remains of *Procamelus* under examination are referable to a smaller species than the preceding, to which the above name has been given. It is estimated that the animal was about two-thirds the size of the existing Camel.

The specimens on which the species is founded consists of fragments of jaws, with teeth, of several different individuals, mostly of old animals, and much mutilated. The best preserved specimens are as follow :

1. The greater portion of the right side of the lower jaw, containing the last premolar and the succeeding molars. It is represented in figure 5, plate XV, two-thirds the diameter of nature and with the caniniform premolar and the succeeding two premolars ideally restored from other specimens. The side of the jaw has lost its symphysial portion, the greater portion of its base, and the coronoid process.

The construction of the jaw clearly resembles that in the Camel and Lama more than in any other ruminant, but is nearer that of the latter animal than of the former one.

The body or dental portion of the bone nearly resembles in its form and proportions that of the Lama, but back of this the jaw is relatively broader. The ascending portion is also relatively wider and shorter than in the Lama, but still bears a nearer resemblance to its condition in this animal than in the Camel. As in the former it is furnished with an external concavity or masseteric fossa, but much better developed.

The post-coronoid process springs from a relatively wider lamina than in the Camel or Lama. It is not situated so high as in either of the latter; its point, which is thick, strong, and somewhat bent inwardly, rising but little above the level of the masticating surfaces of the teeth.

The condyle is situated at a lower level than in the Camel or Lama, and in its form resembles that of the latter, but differs from that of either in its anterior portion having a strong inclination inwardly and its posterior portion being quite vertical.

The entrance of the dental canal is about opposite the general level of the alveolar border, and is about half way between the posterior molar tooth and the post-condyloid notch.

The molars and last premolar, figures 5, 6, *d* to *g*, closely resemble those of the preceding species, as they do likewise the corresponding teeth of the Camel and Lama.

The second and third molars retain the remains of the enameled intervals of the external and internal lobes, seen as crescentoid and ellipsoid pits upon the worn triturating surfaces, figure 6, *f*, *g*. In the first molar and the premolar in advance the triturating surfaces present broad surfaces of dentine bordered with enamel, figure 6, *d*, *e*.

In advance of the last premolar the jaw fragment retains the pair of sockets of the third premolar.

The measurements of the specimen compared with those of the Lama and Camel are as follow:

	P. occid's.		Lama.		Camel.	
	Inch.	Lin.	Inch.	Lin.	Inch.	Lin.
Depth of lower jaw below last molar, ...	2		1	6	2	3
Thickness of jaw below "	1	½		8	1	4
Breadth from last molar obliquely to technical angle, . .	3	7	2	5		
Height from level of base to end of post-coronoid process, . .	3	4	3			
Height from base to condyle, ...	4	8	4	4		
Distance from last molar to end of post-coronoid process, . .	4		3		4	4
Breadth of ramus on level with bottom of post-condyloid notch, .	2	10	1	9	2	4
Breadth of condyle, ...	1	2		8	1	8
Length of series of true molars and last premolar, . .	4	1	2	7	5	6
Length of series of true molars, ...	3	5	2	2½	4	7
Antero-posterior diameter of last premolar, . . .		7½		5		9
" " first molar, ...		10½		6½	1	1
" " second do.	1	1		8	1	7
" " last do.	1	6	1	½	2	

2. A fragment of the fore part of the left side of a lower jaw, containing the last premolar entire, with portions of the other premolars and the first molar, and a portion of the alveolus for a canine tooth.

The specimen belonged to an individual not quite so aged as the former, as indicated by the less worn condition of the last premolar tooth. The jaw fragment is of less proportionate depth than the corresponding part of the former appears to have been. It resembles in form that of the Lama, but is relatively of less depth, approaching in this respect more the condition in the Camel.

The base presents a stronger and shorter curve approaching the symphysis than in the latter.

The back part of the symphysis terminates, as in *P. robustus*, below the fore part of the caniniform premolar. A vasculo-neural foramen, communicating with the dental canal, is situated below the fore part of the last premolar. The mental foramen is placed below the hiatus just in advance of the position of the caniniform premolar, and a small foramen is situated just below the latter.

The only perfect tooth in the fossil, the last premolar, is somewhat larger than in the preceding specimen. From its less worn condition, it presents at the back part of the triturating surface an elliptical enamel pit. The second premolar was provided with a pair of fangs inserted into distinct sockets.

The first or caniniform premolar occupies the same relative position as in *P. robustus*, and it appears to have had the same form. In advance of it, in the specimen, there exists a portion of a large canine alveolus.

The measurements of the fossil are as follow:

	Lines.
Depth of jaw below fore part of last premolar,	16
Depth at hiatus in advance of premolars,	10½
Depth at back part of symphysis,	13
Space occupied by premolars,	20
From canine alveolus to fore part of last premolar,	36
Hiatus between canine and first premolar,	10
Hiatus between latter and second premolar,	10
Antero-posterior diameter of last premolar,	8

3. An alveolar fragment of the left side of a lower jaw, containing all the molars except the caniniform premolar. It belonged to an aged animal, the first molar having its crown worn away to the fangs, and all the others worn in a proportionate manner. In its worn condition, the crown of the third premolar, as represented in figure 6, *c* (in which it has been introduced from this specimen), repeats the form of that of the succeeding tooth in the same condition of abrasion.

The fangs of the second premolar are confluent and not gibbous. The tooth has lost the fore part of its crown.

The last molar retains a crescentic enamel pit in the middle division of the tooth, but in the other molars the corresponding pits are completely obliterated.

The length of space occupied by the molar series, independent of the caniniform premolar, is within a couple of lines of five inches, of which the included premolars occupied a space of an inch and a half.

20

4. A small fragment of the right side of a lower jaw, containing three premolars and the first molar. It belonged to a more aged, but apparently more robust individual than any of the preceding specimens. The crowns of all the teeth, except that of the second premolar, are nearly worn to their fangs. The second premolar, represented and introduced in the series, figure 6, *b*, plate XV, has its crown worn off about one-half, in an oblique manner posteriorly. It has widely divergent, robust gibbous fangs.

The space occupied by the four teeth in the fossil measures two inches and a half, of which the premolars occupy twenty lines.

5. A last premolar and the succeeding pair of molars of the right side of the lower jaw. They belonged to a younger animal than any of the preceding specimens, and agree in form with the corresponding fossil teeth previously described or indicated, and also with those of the Camel. Upon the triturating surfaces of the premolar and the anterior division of the first molar a small oval enamel pit is observable; on the posterior division of the latter tooth, and on both divisions of the succeeding molar, central crescentoid pits still remain.

The measurements of the teeth at the triturating surfaces are as follow:

	Lines.
Antero-posterior diameter of last premolar, ...	8
Transverse diameter posteriorly, ...	4
Antero-posterior diameter of first molar, ...	10
Antero-posterior diameter of second molar, ...	14

6. The alveolar portion of both upper maxillæ, with part of the hard palate, and containing most of the molar teeth much mutilated.

The more perfect or left side of the specimen is represented in figure 7, plate XV, with three premolars restored from the teeth of both sides, and the molars ideally restored in outline.

The roof of the mouth, as composed of the palatine plates of the maxillary and palate bones, has nearly the same character as in the Camel. A large palatine foramen likewise holds the same relative position between the corresponding premolars. The alveolar portion of the bones externally has the same form as in the Camel, and the infra-orbital foramen holds the same relative position, being situated above the last premolar.

The molar series form a closed row of six, independent of a caniniform premolar which may have existed in the jaw.

The true molars, so far as can be judged from their much mutilated condition in the fossil, appear to have had the same constitution and form as in the Camel and Lama.

The last premolar, figure 7, *c*, has the same form as that of the latter animals in the same condition of abrasion.

The third premolar, figure 7, *b*, resembles that just mentioned, with its internal lobe thinned and deeply parted or notched in the middle.

The second premolar, figure 7, *a*, in excess of the number in the Lama and Camel, resembles the first of the former animal in the shape of its crown. This is laterally compressed conical, and feebly trilobate. The tooth is inserted by a pair of robust fangs.

The measurements of the fossil, in comparison with those of the Camel, are as follow:

	P. occid's.		Camel.	
	Inch.	Lin.	Inch.	Lin.
Breadth of face in advance of the premolars, . .	1	6	1	8
Breadth of face at the last molar alveoli, . . .	4		5	5
Breadth of face at infra-orbital foramina, . . .	2	6	3	3
Breadth of palate between last molars, . . .	2	3	2	10
Breadth of palate between second premolars, . .	1	4	1	6
Length of closed series of upper molars, . . .	4	8	5	9
Length of series of upper true molars, . . .	3		4	3

7. Two imperfect specimens of upper true molars probably belong to *Procamelus occidentalis*. They are the second and last of the series, and are moderately worn. Apparently they belonged to the same individual, and bear a near resemblance to those of the Camel. The last molar measures 13 lines antero-posterierly at the outer part of the triturating surface, and 11 lines transversely at the base of the anterior lobes.

8. Two isolated incisors, from different individuals,—the first and second of the series from the canine,—probably belong to this species. They closely resemble the corresponding teeth of the Camel.

Procamelus gracilis.

Among the Niobrara fossils there are several isolated teeth and small fragments of jaws with single teeth, which have been suspected to indicate a third species of *Procamelus*, distinguished by the above name.

One of the specimens, an isolated inferior last premolar, is represented in figure 15, *a*, plate XIV. It resembles in form the corresponding tooth of *Procamelus robustus* and *P. occidentalis*, but is much smaller. The worn triturating surface exhibits at its back part an elliptical enamel pit, as that of the other species would at the same stage of abrasion, and also as in the Camel and Lama.

The remaining specimens have the appearance as if they had been derived from one individual, but there is no positive means of determining whether they belonged to the same species as the premolar just described. They bear a due degree of relationship in size to that tooth, and even a form which approximates them.

One of the specimens, an isolated tooth, represented in figure 15 *b*, plate XIV, is apparently a third premolar of the lower jaw. It is slightly worn, and nearly resembles in shape the fourth premolar above described. The form is a modification of that of the lower premolar of the Camel. The crown is proportionately shorter and wider, the width greatly exceeding the height. Viewed laterally it is oblong, with the outer side moderately sloping, and the inner side presenting four ridges. The back pair of the latter are separated by a short oblique valley; the anterior by vertical concave depressions. The tooth is trilobate, with the middle lobe largest and highest, and the posterior lobe thickest and divided by the short oblique valley just mentioned.

Two of the specimens, of which one is represented in figure 15, *c*, plate XIV, are second premolars of the right and left sides, and are inserted into small fragments of the jaw by robust pairs of fangs. The crown of these teeth is oblong, wider than high, convex externally, slightly trilobate internally, and with an acute biting edge rising in a point in advance of its middle.

The remaining specimen appears to be a caniniform premolar, and is inserted into a small fragment of the lower jaw by a pair of strong fangs, in the same relative position as the caniniform premolar in *Procamelus occidentalis*. The crown is compressed conical, wider than high, and has acute borders descending from a feebly worn point.

The tooth last described renders it probable that it and its companions, except the fourth premolar belonging to a different individual, may pertain to the same genus, as some fossils referred to *Homocamelus caninus*, hereafter described.

The measurements of the specimens are as follow:

	Lines.
Antero-posterior diameter of fourth premolar,	6
Antero-posterior diameter of third premolar,	5
Antero-posterior diameter of second premolar,	3½
Height of do.,	2¾
Antero-posterior diameter of caniniform premolar,	3
Height of do.,	2½
Thickness of do.,	1½

The collection of fossils obtained in Dr. Hayden's trip to Dakota in 1866 contains several small fragments of jaws, with teeth, of *Procamelus*, from Little White River, or the South Fork of the Makisi-ta-Wakpa. These were found together with numerous remains of solipeds and other animals in loose sand belonging to a formation like that of the Niobrara River, which has yielded so many fossils. The fragments alluded to are apparently intermediate in proportions with those referred to *Procamelus robustus* and *P. occidentalis*, leading me to suspect that these are really of the same species, the more robust remains probably pertaining to the male, the other to the female.

The specimens consist of the following:

1. A small fragment of the lower jaw, containing the second premolar, or the first of the continuous series. The tooth is like that of *Procamelus robustus*, represented in figure 1, *b*, plate XV, but is smaller, the crown measuring 4¾ lines long and 5¼ lines broad.

2. A small fragment of the right side of a lower jaw, containing the third premolar. The tooth has the same form as that in *P. robustus* and *P. occidentalis*, represented in figure 1, 6, *c*, plate XV. Its breadth is 8 lines, its thickness posteriorly 3¼ lines.

3. The symphysial portion of a lower jaw, containing the canines on both sides, the median pair of incisors and one lateral incisor. This specimen, represented in figure 5, plate IX, is interesting, as it proves that the anterior extremity of the lower jaw, and the form, number and relation of incisor and canine teeth of *Procamelus* are the same as in the existing Camel. The canines are proportionately not quite so well developed as in the latter. In the specimen, the teeth are all considerably worn, including the apices of the canines. The breadth of the latter at the base of the crown is 7 lines, the thickness 4½ lines. The distance between the outer part of the bases of the crowns of the canines is 23 lines.

Accompanying the jaw fragments from Little White River, there are several specimens of first phalanges, resembling in form those of the Camel, but longer in proportion with their breadth, which probably belong to *Procamelus*. Two specimens of the same form present the following measurements:

	Lines.	Lines.
Length through the axis,	45	40
Breadth of upper articulating surface,	16	13
Width of do. from before backward at the middle,	12	10
Breadth of distal articular surface behind,	13	12

HOMOCAMELUS.

HOMOCAMELUS CANINUS.

An extinct animal belonging to the Camel family, apparently distinct from any of those previously indicated, is represented by several fragments of jaws, with teeth, contained in Dr. Hayden's Niobrara collection of fossils.

The specimens, derived from the same individual, consist of a portion of the right maxilla, containing three premolars; a portion of the right intermaxilla, with a caniniform incisor; and a third specimen, consisting of portions of the left maxilla and intermaxilla, with the caniniform incisor, the canine tooth and three premolars.

A series of these teeth, with the corresponding portions of the maxillary and intermaxillary bones are represented in figure 17, plate XIV, as recomposed of the fragments from the two sides of the face.

The portions of the maxillary and intermaxillary bones of the fossils have nearly the same form as the corresponding portion of the upper jaw in the Camel. The fore part of the face, as in this animal, was produced in a narrow snout-like prolongation. The breadth of the face outside the canine alveoli measured about seventeen lines, opposite the first premolars about fifteen lines, and opposite the middle of the second premolars about nineteen lines. The hard palate was more deeply vaulted than in the Camel. No palatine foramen exists in the fossils in advance of the posterior broken border, which is on a line with the middle of the position of the third premolar.

The caniniform incisor, the canine, and the first premolar, as represented in figure 17, were all separated from each other and from the succeeding continuous row of premolars and true molars by wide arching intervals.

The second and third premolars, figures 16, 17, forming the advanced pair of teeth of the closed molar series, differ from those occupying the jaw fragments ascribed to *Procamelus occidentalis*, both in shape and relative position to each other. In *P. occidentalis* the antero-posterior diameter of the two teeth mentioned extends along the same line, and this is parallel with the alveolar border. In the present fossil the two teeth have their antero-posterior diameter directed obliquely, so that the back part of the first premolar is external to the fore part of the second. Both teeth are inserted by distinct pairs of fangs.

The crown of the second premolar, figures 16, 17, *d*, slightly worn, is moderately compressed conical, with its posterior portion curving outward and backward in a wing-like expansion. Internally it is bounded by a crescentoid basal ridge.

The crown of the third premolar, figures 16, 17, *e*, is a more developed form of that of the preceding tooth. The internal basal ridge is produced into a thick fold or process before and behind, extending towards the triturating border. It has nearly the constitution of the crown of the corresponding tooth, or first premolar, of the Camel, but is relatively shorter and wider, and has the antero-internal fold relatively better developed. The worn triturating border exhibits a reniform surface of dentine, with the notch outward.

In advance of the premolars there is a hiatus, sharp bordered, but less arched or straighter than in the Camel, and measuring about an inch and a quarter in length.

The first premolar, figure 17, *c*, holds nearly the same relative position to the other teeth as in the Camel, but otherwise is different. It is directed slightly forward in its course downward, and is inserted into the jaw by a pair of robust divergent fangs. The crown is compressed conical, nearly as broad as long, and with the point slightly curved inward. The inner and outer surfaces are defined by subacute borders, slightly indented along their course.

In advance of the tooth just described there is an arching hiatus about an inch in length.

The canine tooth, figure 17, *b*, holds the same relative position as in the Camel and Lama, and presents nearly the same proportions and direction of curvature. The crown, however, is relatively narrower or less compressed than in the Camel, and bears more resemblance to that of an ordinary carnivorous animal. The inner and outer surfaces are defined by two feeble, slightly indented ridges, occupying more the internal aspect of the crown as is usual in canine teeth generally.

In advance of the canine tooth a narrow, arched hiatus exists, about half an inch in length.

The caniniform incisor, figure 17, *a*, is a repetition in form and size of the tooth just described, and it occupies the same relative position as in the Camel.

The measurements of the teeth pertaining to the specimens above described are as follow:

	Lines.
Antero-posterior diameter of second premolar,	6
Antero-posterior diameter of first premolar,	$4\frac{1}{2}$
Antero-posterior diameter of caniniform premolar,	4
Length of crown of caniniform premolar,	$4\frac{1}{2}$
Length of crown of canine tooth,	9
Antero-posterior diameter of do.	$4\frac{1}{2}$
Transverse diameter of do.	4
Length of crown of caniniform incisor,	9
Antero-posterior diameter of do.	$4\frac{1}{2}$
Transverse diameter of do.	$4\frac{1}{4}$

PROTOMERYX.

Protomeryx Halli.

A fossil obtained by Dr. Hayden at Bear Creek, a tributary of White River, in the Mauvaises Terres, indicates an extinct animal, apparently a member of the Camel family, and different from any other described. The fossil belongs to the miocene formation, represented by bed D of Dr. Hayden's section, as indicated on pages 17, 21.

The specimen, represented in figures 8, 9, plate XV, consists of the fore part of the left side of a lower jaw, with the greater part of the symphysis, three incisive alveoli, the canine tooth, part of a caniniform premolar, and two other premolars.

In comparison with the corresponding portion of the jaw of the Camel or Lama, it is of relatively greater depth, less convex externally, and has the symphysis shorter and more oblique.

The alveolar portion of the jaw, sustaining the back premolars, is vertical and flat, but below, the bone is more convex. The symphysis forms an angle of about 35°, and when entire has approximated an inch and a half in length. It terminates posteriorly below and back of the middle of the hiatus behind the caniniform premolar.

The mental foramen is situated about midway below the middle of the hiatus just mentioned. A minute foramen, of the same character as the former, is situated below the back part of the canine tooth.

The hiatus between the caniniform premolar and the other premolars is a concave space about four and a half lines wide. That between the canine tooth and the caniniform premolar is scarcely two lines, and a third, hardly a line in extent, intervenes between the canine tooth and lateral incisor.

The depth of the jaw below the middle of the second premolar is ten lines; below the hiatus in advance, eight lines and a quarter.

Of the three incisive alveoli, the two lateral contain portions of the fangs.

The canine tooth, figures 8, 9, *b*, holds nearly the same relative position as in the Camel. It curves upward, forward, and slightly outward. Its fang is robust and somewhat gibbous. The crown is much worn, and appears to have been laterally compressed conical.

The caniniform premolar, figures 8, 9, *c*, likewise appears to have held the same relative position as in the Camel. Its crown is broken away in the specimen.

The two succeeding premolars, figures 8, 9, *d*, *e*, are nearly alike in size and form, the first being rather smaller and less well-developed. The crowns are twice the width of the height, are laterally compressed conoidal, and feebly trilobate. The second is slightly worn; the third considerably.

The second premolar is 4 lines wide and two lines high, which was nearly its original size. The third premolar is four and three-quarter lines wide, and two lines high in its present worn condition.

It may be inferred that *Protomeryx*, in addition to the number of teeth indicated in the fossil above described, possessed a fourth premolar and three molars. The formula of dentition therefore was the same as in *Procamelus*, at least for the lower jaw; that is to say, 3 incisors, 1 canine, 4 premolars and 3 molars.

In the jaw fragment of *Protomeryx* the symphysis extends further back in relation with the corresponding teeth than in *Procamelus robustus* or *P. occidentalis*. The mental foramen also occupies a more posterior position than in the latter, and the second and third premolars are wider in relation with their height, as well as different in their form.

I at first attributed the fossil to *Leptauchenia*, but specimens of the latter subsequently obtained indicate that it belongs to a different genus.

The species is named in honor of Prof. James Hall, the eminent palæontologist of Albany, New York, to whom I am indebted for the examination and loan of many interesting fossils, which partly form the subjects of the present work.

MEGALOMERYX.

Megalomeryx niobrarensis.

The above name was employed to distinguish a large extinct ruminant, supposed to belong to the Camel family, and assumed to be of a different genus from *Procamelus* or any other one previously noticed, though the grounds of its distinction are of a meagre character. It was proposed upon two fossils in Dr. Hayden's Niobrara collection, consisting of inferior molar teeth, one of which is inserted into a small fragment of the jaw. The teeth indicate an animal about as large as the great extinct ruminant, the *Merycotherium sibericum*, supposed to belong to the Camel family, and likewise founded upon a few molar teeth, which were obtained in Siberia.

One of the specimens, represented in figure 14, plate XIV, appears to be a first true molar, with the crown between a half and two-thirds worn away, and with a pair of strong fangs inserted into a fragment of the jaw. In form and construction the tooth resembles the corresponding one of the Camel, Lama and Sheep, at the same stage of attrition. The inner side presents a vertical concave groove separating the lobes, and no prominent ridges. The triturating surface presents a yoke-like outline, and a small reniform enamel islet just back of the centre of the hinder division of the crown. The antero-posterior diameter of the crown measures about twenty-one lines, the transverse diameter eleven and a half lines, and the length externally nine lines.

The jaw fragment is an inch and a quarter thick. Like most of its associate fossils it is thoroughly petrified, and exhibits the marks of having been gnawed before it became a fossil.

The second specimen is an isolated first or second inferior molar, slightly worn, and represented in figures 12, 13, plate XIV. In form and construction it closely resembles the corresponding teeth of the Camel. Its length is about three inches and a third; the antero-posterior diameter at the triturating surface two inches, and just above the developing fangs an inch and a half. At the same stage of abrasion it would have been of the same form as the preceding specimen, and nearly the same size, though not quite so large in its transverse diameter.

I have latterly suspected that the teeth referred to the above genus may belong to a large species of *Procamelus.*

MERYCODUS.

Merycodus necatus.

The above-named genus and species were originally proposed on a small fragment of a lower jaw, containing the last premolar and the first true molar of an extinct ruminating animal. The specimen was found at Bijou Hill, east of the Missouri River, and accompanied a large collection of fossil vertebrate remains, from the Mauvaises Terres of White River, obtained for Prof. James Hall, of Albany, by Mr. Meek and Dr. Hayden in the summer of 1853.

The Niobrara collection of fossils subsequently obtained by Dr. Hayden contains a number of specimens, mainly consisting of fragments of lower jaws with teeth, referable to the same extinct animal.

The most characteristic specimen consists of a portion of the right side of the lower jaw, containing the true molars, the two premolars in advance, and the sockets of the first premolar. It is represented in figure 9, plate XIV, with the addition of a first premolar from another specimen.

The several fossil fragments of the lower jaw indicate this bone, in advance of the ascending portion, to have nearly the same form and proportions as in the Deer.

Externally the bone is moderately convex, is deep below the position of the molars, and in advance of them is slender. The base forms a convex line beneath the teeth just mentioned, and turns down toward the symphysis. A long hiatus, as in the Deer, separated the molar teeth from those at the front of the jaw. The margin of the hiatus descends from the premolars in its direction forward. Two foramina occupy the same relative position of the jaw externally as in the Deer.

Six molar teeth form a closed row in the side of the lower jaw of *Merycodus*, as in ordinary recent ruminants, and as represented in figures 9, 10, plate XIV.

The unworn molars were furnished with long crowns, inserted into the jaw as in the Sheep, and they protruded in the same manner as in this animal gradually as they were worn away. The form and construction of the true molars is almost identical with those of the Sheep, excepting that they are not provided with the well-marked fold extending inwardly at the fore part of the corresponding teeth of the latter.

In the last molar the internal lobes are not defined by ridges as in the Sheep, and the posterior division of the crown is fuller, less acute, or is even obtusely rounded at its back part, and the two constituent lobes include a more capacious and deeper interval or pit.

The crowns of the hinder pair of premolars are intermediate in appearance to those of the Sheep and Deer. They are comparatively long, thin, and straight externally as in the former, but their constitution more nearly resembles that of the second premolar of the latter.

The third premolar externally is nearly square, and presents a vertical groove at the back part, as in the corresponding tooth of the Sheep. Internally it presents a succession of five ridges or processes as seen in the second premolar of the Deer, and these processes have nearly the same form and relationship with one another as in the latter. The triturating surface, relatively narrower at its back part than in the Deer, is also worn off in a more blunt or less pointed manner.

The second premolar is a diminished likeness of that just described, but a wider and feebler depression occupies the position of the external groove of the former.

The first premolar was inserted by a pair of distinct fangs, and appears to have been separated from the teeth occupying the front of the jaw by a hiatus almost as great relatively as in the Deer.

In the specimen described, the crown of the last molar, worn upon all its lobes, had not yet protruded one-half its length from the jaw. The second molar had protruded about half the present length of its crown. The crowns of the first molar and the premolars had entirely protruded.

A second fossil specimen belonging to *Merycodus necatus* consists of the left side of the lower jaw of a young animal, containing in the functional series of molar teeth the three temporary molars and the first and second true molars of the permanent series. The last permanent true molar had not yet commenced to protrude from the jaw.

The back temporary molar presents the usual form in its relation with the permanent teeth behind as in all other ruminants. The second temporary premolar resembles in its constitution the second and third of the permanent series. The first temporary premolar is a diminished representative in form of the one behind it.

A permanent first premolar removed from a fragment of another jaw, containing besides the other unprotruded permanent premolars, together with the protruded permanent true molars, exhibits a form which is a less developed and reduced one of the other premolars.

Another fossil specimen, consisting of a fragment of the right side of a lower jaw, contains the last premolar and the true molars very much worn. The premolar in its much worn condition has assumed much the appearance of that of the second premolar of the Sheep in a similar stage of abrasion. The enamel pits are obliterated on the triturating surface of the first molar, and appear as minute oval rings on the second molar. The last molar preserves its anterior two pits, and is inserted into the jaw by fangs.

Several other, but less perfect fragments of lower jaws, and a few isolated inferior molar teeth, exhibit the same characters as those already given.

There were no fragments of upper jaws or teeth in the Niobrara or other collections of fossils, which could with any probability be referred to *Merycodus necatus.*

Two astragali and a metacarpal bone of some small ruminant, in the Niobrara collection of fossils, may belong to *Merycodus necatus.*

One astragalus measures three-fourths of an inch in length and five lines in breadth. The other specimen, somewhat imperfect, is rather larger than the former.

The metacarpal bone measures four inches and a half in length, and is seven and a half lines wide at the articular extremities.

The measurements of the lower jaw and inferior molar teeth of *Merycodus necatus* are as follow:

	Lines.
Depth of lower jaw at first premolar,	6
Depth of do. at middle of first true molar,	6¾
Length of series of six molar teeth,	25
Length of series of true molars,	16
Length of crown of the less than half protruded and moderately worn last true molar,	8
Antero-posterior diameter of do. at middle,	7½
Antero-posterior diameter of second true molar,	5
" " first true molar,	4
" " last premolar,	3½
" " second premolar,	3
" " first premolar,	2½
Length of hiatus from first premolar to back border of the mental foramen,	10
Depth of jaw below hiatus where narrowest,	4

The collection of fossils obtained by Dr. Hayden in his trip to Dakota in 1866 contains portions of lower jaws and teeth of *Merycodus necatus,* obtained on Little White River, or the South Fork of the main stream. A jaw fragment agrees in character with the Niobrara River specimens, except that it is rather more robust in its proportions, the difference being apparently due to difference in age. Its measurements, in comparison with the Niobrara specimens, are as follow:

Specimens from	L. White R.	Niobrara R.	
	Lines.	Lines.	Lines.
Depth of jaw at first premolar,	6½	6	
Depth at middle of first true molar,	7½	7	7½
Depth at middle of last true molar,	10		8
Depth one-third of an inch in advance of the molars,	4½	4	
Space occupied by six molars,	25	25	
Space occupied by true molars,	16	16	15
Space occupied by last two premolars,	6	6	
Breadth of second true molar,	5¾	5	4½
Breadth of last true molar, above,		7	7

MOSCHIDÆ.

This family is represented in the Mauvaises Terres miocene formation by the remains of an extinct genus, to which I have given the name of *Leptomeryx.* Its remains were obtained from beds B and D of Dr. Hayden's section.

LEPTOMERYX.

The genus distinguished by the above name is founded upon the fossil remains of a small ruminant, allied to the recent Musks, discovered in association with remains of *Oreodon Culbertsoni, O. gracilis, Anchitherium Bairdii,* &c., in the miocene tertiary deposits of Dakota. The skull of *Leptomeryx* has the general conformation of that of the Musks, is unprovided with antlers, and has no ant-orbital lachrymal fossæ. The jaws are provided with continuous rows of six molars on both sides, as in most recent ruminants.

Leptomeryx Evansi.

The species and genus above named was first characterized by a specimen, consisting of a mutilated skull, accompanied with a portion of the lower jaw, discovered by Dr. John Evans in the Mauvaises Terres of White River, Dakota. Subsequently Dr. Hayden obtained portions of several less well-preserved skulls, together with a multitude of fragments of jaws with teeth, and some portions of other bones of the skeleton, partly from the same region, and partly from Bear Creek, a tributary of the

Sheyenne River. According to Dr. Hayden, the remains of *Leptomeryx Evansi* belong to beds B and D of his section of the tertiary formations of Dakota and Nebraska.

The skull in size and form approaches most that of the living Musks. The best preserved specimen under examination, represented in figures 1—4, plate XIV, has the intermediate portion of the cranium and the anterior extremity of the face destroyed.

Lateral view of the skull, figure 1, *plate* XIV.—The cranium back of the orbits is proportionately longer and wider, but lower than in the Musks. The temporal fossæ are proportionately longer, and their long diameter is antero-posterior as in the Deer, instead of oblique as in the former. As in these, they are separated posteriorly by a short sagittal crest, though proportionately longer than in them. Their anterior boundary is more vertical, and even inclines slightly backward in its descent, instead of forward as in the Musks. Posteriorly they are defined from the inion by an acute ridge, more oblique from the perpendicular than in the latter. See figures 1, 2, plate XIV.

The zygoma is much stronger than in the Musks, and indeed is proportionately more so than in existing ruminants generally.

The temporal fossa of *Leptomeryx* is about twice the length of the depth. It presents a uniform convex surface, becoming concave only in approaching the superior and posterior defining ridges.

The zygomatic fossa is proportionately more capacious than in the Musks. The zygoma starts directly outward from its posterior root about the middle of the position of the temporal fossa. It is then directed very abruptly forward, more like in the Hog and Peccary than in recent ruminants, and proceeds gently downward to the face. It is constructed as in the Musks and Deer, and presents a wide, external vertical face two and a half lines in depth.

The orbits are proportionately rather smaller than in the Musks, and occupy nearly the same relative position as in these, the ant-orbital margin being on a line with the fore part of the first true molar tooth. The orbital entrance is quadrately oval, with the transverse diameter rather greater than the vertical, but it is more oblique, with both a greater upper and forward inclination than in the Musks.

Two specimens under examination appear to indicate that the post-orbital arch is interrupted for a short distance. The frontal contributes a longer process to the arch than the malar, and both processes end in roughened points about a line apart inwardly, and widening outwardly to about twice that distance. See figure 1, plate XIV.

The ant-orbital margin presents a strong lachrymal process, proportionately much more conspicuous than in the Musks and Deer. The entrance to the lachrymo-nasal duct is internal to the position of the process, as in the former animals.

No ant-orbital lachrymal fossa exists, the facial surface of the lachrymals being nearly as even a plane as in the living Musks.

The face below the orbit and its alveolar portion resemble the condition in the latter animals.

In advance of the lachrymal a vacancy exists, as in the Deer, apparently bounded by the same bones.

The maxillaries resemble those of the Deer. The infra-orbital foramen is likewise situated as in this and the Musks, above the first of the closed row of molars.

Upper view of the skull, figure 1, *plate* XIV.—In the upper view of the skull, the cranium appears a well-formed oval, and is not narrowed immediately back of the post-orbital arches.

The forehead stretches backward, in a much narrower triangle than in the Musks, to the sagittal crest, and to within about three-fourths of an inch of the summit of the inion. The bounding temporal ridges at first diverge comparatively gradually, and then at their fore part more abruptly curve outwardly.

From the position of the post-orbital arches, the forehead forms a broad sloping plane, directed forward as in the Musks; but it appears more depressed between the position of the orbits, from a greater elevation of the supra-orbital borders.

A pair of supra-orbital foramina, opening into a groove, occupy the same relative position on each side of the forehead as in the Musks and Deer.

The nose is broken away in all the specimens of *Leptomeryx* I have had the opportunity of inspecting, but judging from its contiguous parts it appears to have had the same form as in the Musks or Deer.

Posterior view of the skull, figure 3, *plate* XIV.—The inion is triangular, as in the Musks; is proportionately wider and lower than in these, but not so prominent posteriorly. With the exception of the comparatively acute condition of its summit, it resembles more that of the Deer in its appearance. From the median prominence it inclines on each side obliquely outward to the lateral acute borders separating it from the temporal fossæ.

The occipital foramen and condyles nearly resemble those of the Musks in their form, proportions and relations, and the same is the case with the paramastoid processes.

Inferior view of the skull, figure 4, *plate* XIV.—The basal axis of the cranium is proportionately wider and flatter than in the Musks, and in these respects resembles more that in the Deer.

The tympanics, in their proportions and relations, likewise bear a nearer resemblance with those of the Virginia Deer than with those of the Musks. They are flask-like, with the auditory bulla compressed spheroidal, and with the meatus auditorius directed obliquely outward, backward and upward. The orifice of the meatus is directed much more posteriorly than in either the Musks or Deer.

The styloid process and stylo-mastoid foramen occupy the same relative position as in the latter. The inner part of the auditory bulla is likewise separated, as in the Deer, from the basi-occipital by a large reniform foramen, within which a portion of the petrosal is visible.

The condyloid foramen is large, and occupies the same relative position as in the Deer.

The oval and rotund foramina are distinct from each other, and nearly equal in size. The large spheno-orbital foramen occupies the same relative position as in the Deer and Musks.

The glenoid articulation resembles more those of the former than of the latter, but varies from both. Its fore part is nearly straight transversely, and inclines slightly outward from its inner extremity, and slopes convexly backward and outward into a comparatively deep concavity, bounded behind by a post-glenoid tubercle proportionately stronger than that in the Deer. A comparatively small foramen occupies the interval of the tubercle just mentioned and the tympanic.

The region of the posterior nares is destroyed in the specimens under examination, and the contiguous portion of the hard palate is too much broken to judge accurately of its character. The palatines appear not to have been prolonged into a canal as in the Deer, but to have been separated by a deeper notch, more as in the Musks. The lateral palatine notch advanced as far as the position of the middle of the last molar tooth.

The portion of the hard palate between the molars has nearly the same form as in the Deer. The posterior palatine foramina are on a line with the fore part of the second true molars.

Form, relations and connections of the bones of the skull.—The supra-occipital advances on the top of the cranium as in the Deer, but laterally to a greater extent proportionately. The lateral occipitals, paroccipitals, mastoids and squamosals hold about the same relationship with one another as in the animal just mentioned, and such is likewise the case with the bones forming the axis of the base of the cranium.

The squamosal contributes rather more than one-third to the extent of the temporal surface. It is pierced just above the zygomatic root with a venous foramen as in the Deer.

The co-ossified parietals are large, and the sutures of conjunction with the squamosals pursue the same course as in the Deer. Their anterior portion is too much broken in the specimens under examination to judge accurately of their connection with the frontals. The truncated summits of the latter appear together to have been received into a notch of the parietals, and the intervening suture then advanced along the temporal ridges to the bases of the post-orbital processes when it descended posterior to the latter, as in the Musks.

The upper back portion of the parietals is pierced with a large venous foramen, and one or two small ones.

The frontals are separated by a comparatively straight suture, as in the Musks. Their fore part terminates as in the latter, nearly on a line with the anterior border of the lachrymals.

The malar is of greater proportionate depth beneath the orbit than in the Deer and Musks, and the process it contributes to the zygoma is much stronger. The suture of conjunction with the maxillary advances to about a line with the middle of the second true molar, when it obliquely ascends to the anterior border of the lachrymal. The facial surface of the latter is proportionately small, and is higher than wide.

Mandible.—The lower jaw is of much greater proportionate breadth at its back part, as represented in figure 1, plate XIV, than in the Musks and Deer. It is also much more produced backward and to a greater depth than in the latter. The border of the produced portion is bent inwardly, and its convex edge is continuous with the base of the jaw. The latter ascends forward almost without interruption, compared with its condition in the Deer.

The ascending ramus has a forward inclination, and at the upper part is outwardly impressed with a broad shallow concavity. The condyle has nearly the same form and relative position as in the Deer and Musks. The coronoid process is broken off in the specimens.

The fore part of the lower jaw of *Leptomeryx* has not yet been found.

Dentition.—The only teeth of *Leptomeryx* I have had the opportunity of examining are those of the molar series. As previously indicated, these are of the same number and hold the same relative position as in most living ruminants.

Figure 5 represents the triturating surfaces of the upper, and figure 6 part of the lower molar series of *Leptomeryx*, magnified two diameters.

The true molars are composed in the usual manner among ruminants, the crown consisting of two pairs of crescentoid pyramidal lobes, except the last one below, which in *Leptomeryx* has an additional pair. They resemble most those of the Deer and Musks, and, as in these when completely occupying the functional position, are inserted into the jaws by distinct fangs. See figure 1, plate XIV.

The upper true molars of *Leptomeryx* are almost miniature resemblances of those of the Deer, except that the inner lobes of the crown send no accessory processes into the interspaces separating them from the outer lobes. The external faces of the latter exhibit, in the same manner, series of prominent, narrow, buttress-like ridges, and from the base of the postero-internal lobe anteriorly there springs a strong tubercle. This is variable in the degree of its development in different individuals, but generally is proportionately better developed than in the Deer. See figure 5, plate XIV.

The last upper premolar has a bi-lobed crown, with the lobes like those of the true molars, but proportionately longer, as usual in all the upper premolars of most living ruminants. The inner lobe exhibits a slight disposition to the formation of a process, projecting into the interspace of the lobes, as in the Deer.

The anterior two upper premolars have a crown which is a modification in form of that of the last premolar. The outer lobe appears like that of the latter extended in breadth, while the inner lobe is proportionately reduced to a median cone connected by basal ridges with the sides of the outer lobe. The first premolar differs from the second only in being less well-developed.

The inferior true molars, figure 6, resemble those of the Musks more than those of the Deer, from the circumstance that the lateral buttress-like ridges internally of the inner lobes are less prominent than in the latter, and the median ridge is more obtuse.

The last of the series of lower molars has the usual accessory lobe of this tooth in ruminants divided into a distinct pair, less well-developed than those in advance, and the inner one less well-developed than the outer one.

The last inferior premolar, figure 6, has a broad crown, narrowing anteriorly and rising in a prominent median point. Internally it is trilobate, or exhibits three conoidal prominences separated by a pair of vertical gutters. At the back part of the crown a narrow pit extends deeply from the triturating surface.

The second lower premolar, figures 7, 8, is a reduced form of the last one; and the first premolar is still less well-developed, and is without the posterior pit of the crown.

The worn triturating surface of the lower premolars presents an elongated tract of dentine, trilobate internally, and bilobate posteriorly except in the first one.

The last lower temporary molar has three pairs of lobes to the crown, as usual among ruminants.

The last upper temporary premolar has a broad crown, composed of three lobes externally and a single lobe postero-internally, connected with the fore part of the tooth by a long basal ridge.

The other temporary premolars above and below appear to resemble the anterior premolars of the permanent series in a less well-developed condition.

Measurements taken from three specimens of *Leptomeryx Evansi* are as follow:

	Lines.	Lines.
Length from occipital condyle to ant-orbital foramen, . .	32	
Length from summit of inion to ant-orbital foramen, . .	38	
Length of sagittal crest, ...	9	
Length of forehead from do. to naso-frontal suture, . .		21
Breadth of forehead at ends of post-angular processes, . .	20	20
Breadth of do. between middle of orbits, ...	13	13
Breadth of cranium at middle, ...	15	15
Length of temporal fossa along the middle, . . .	19	
Breadth of inion at base of paramastoids, ...	14	
Height of do. to inferior margin of occipital foramen, . .	12	
Vertical diameter of occipital foramen, ...	5½	
Transverse " "	5½	
Vertical diameter of occipital condyles, ...	5½	6½
Transverse " "	3	3½
Breadth of skull at middle of zygomata, ...	23	
Breadth of face at ant-orbital margins, ...	14½	15
Breadth of face at ant-orbital foramina, ...	8	
Vertical diameter of orbits, ...	9	
Transverse diameter of orbits, ...	9½	
Length of tympanic bulla, ...	6	
Antero-posterior diameter of tympanic bulla, . . .	4	
Transverse diameter of glenoid articulation, . . .	6	
Antero-posterior diameter of do., ...	4	
Height of facial surface of lachrymal, ...	5	
Breadth of facial surface of lachrymal, ...	3	
Length of the upper molar series, ...	17	
Length of the upper true molar series, ...	9½	9½
Breadth obliquely of lower jaw back of last molar, . .		12
Height of lower jaw at condyle, ...		17
Height of lower jaw at back of last molar, . . .		7
Height of lower jaw at middle of last premolar, . . .		4½
Length of lower true molar series, ...		11
Breadth of last upper true molar, ...	3	
Width " "	3½	
Breadth of second upper true molar, ...	3½	
Width " " "	4	
Breadth of last upper premolar, ...	2½	
Width " "	3	

	Lines.	Lines.
Breadth of second upper premolar, ...	3¼	
Width " " "	2½	
Breadth of last lower true molar, ...		4½
Breadth of second lower true molar, ...		3½
Breadth of last lower premolar, ...		3

CERVIDÆ.

This family is represented in the pliocene fauna of the Niobrara River by a species of *Cervus*, the only one of all the ruminants described which does not belong to an extinct genus.

CERVUS.

Cervus Warreni.

Among the Niobrara fossils collected by Dr. Hayden there are several specimens referable to the genus *Cervus*, but whether to the same species is uncertain.

One of the specimens consists of a small antler, represented, of the natural size, in figure 12, plate XXVII. It differs in appearance from the antlers of any species of recent American deer that I have had the opportunity of observing, which led me to refer it to an extinct species. The frontal process is cylindroid, and after rising about half an inch expands in a mushroom-like manner into an annular burr, which is comparatively smooth or devoid of nodular processes. The burr actually looks as if it belonged to and was the termination of the frontal process, and the antler appears to spring from its interior. The antler, after ascending from the burr in a compressed cylindroid manner for about an inch, divides into a pair of diverging fangs or snags. One of these, cylindroid at base, is broken off; the other is conical, and about two inches and a quarter long.

A second specimen, with no evidence that it belonged to the same animal as the antler, consists of a jaw fragment containing the lower three molars and the last premolar. The teeth agree in form and size with those of the common Deer, *Cervus virginianus*, and may belong to this or to some other recent species. Found as an associate of remains of undoubted extinct animals, I have regarded the lower jaw fragment and the antler as representing a peculiar species, for which the name of *Cervus Warreni* has been proposed, in honor of General G. K. Warren, U. S. A., commander of the expedition in which the collection of Niobrara fossils was made.

ANTILOPIDÆ.

COSORYX.

Cosoryx furcatus.

A small ruminant animal, apparently intermediate in character to the family of the Deer and that of the Antelope, is indicated by several fossils obtained by Dr. Hayden on the Niobrara River, Nebraska. The specimens are portions of several antlers, or perhaps horn cores, of which the better preserved one is represented in figure 8, plate XXVIII, of the natural size. It bears a resemblance to a similar but larger fossil described by Gervais in the Zoologie et Paléontologie Francaises, page 78, and represented in figure 4, plate xxiii, of that work. Gervais refers the fossil to a species with the name of *Antilope dichotoma*, but it is more probable that all the fossils noticed represent a genus differing from either *Antilope* or *Cervus*. The fossils have no burr or crown at the base as in the latter, and they bifurcate at the upper extremity, which is not the case in any known Antelope, not even in the Prong Horn, *Antilocapra americana*, in which the forking of the horn does not extend to its core.

The fossil, as represented in our figure, is about two and a half inches long from the fragment of the frontal bone to the broken ends of the prongs above. The shaft is straight and cylindroid, and only slightly striated longitudinally. In the second specimen the shaft is more cylindrical than in the former. The upper extremity becomes gradually more flattened and expanded, and divides, as already intimated, into a pair of prongs.

ARTIODACTYLA.

The above term, first employed by Prof. Owen of London, I have adopted as the name of an order including the even-toed animals of the order of Pachydermata of Cuvier, and excluding the Ruminantia of the Pachydermata Artiodactyla of Owen. As thus restricted, the order is represented in the tertiary formations of Dakota and Nebraska by eight species of seven genera, all of which are extinct except one,—the genus *Dicotyles*. Two of the genera, *Hyopotamus* and *Titanotherium*, belong to the lowest bed of the miocene formation of the Mauvaises Terres of White River, Dakota, indicated as bed A in Dr. Hayden's table, page 21. The other genera, *Elotherium*, &c., belong to intermediate beds of the same formation and locality, indicated as beds B and D in Dr. Hayden's table. The species of *Dicotyles* is represented by a single tooth from the sands of the Niobrara River, Nebraska, the position being indicated as bed F of the pliocene formation in Dr. Hayden's tables, pages 16 and 21.

SUIDÆ.

ELOTHERIUM.

Elotherium is an extinct genus of remarkable animals belonging to the family of suilline pachyderms. It was first indicated in 1847 by M. Pomel, from some remains found in the Department of the Gironde, France. The following year it was more completely characterized, under the name of *Entelodon*, by M. Aymard, from remains discovered together with others of *Hyænodon*, *Hyopotamus*, &c., in a formation at Rongon, in the Department of the Haute-Loire. Its allies among extinct genera are *Chæropotamus*, *Palæochœrus*, *Anthracotherium*, etc.; among recent animals, the Hog, Peccary and Hippopotamus.

A species, apparently of the same genus, was characterized in 1850 in the Proceedings of this Academy, under the name of *Archæotherium Mortoni*. It was proposed on a specimen consisting of a fragment of an upper jaw containing two premolars, obtained in the Mauvaises Terres and presented to the Academy by Mr. Alexander Culbertson.

The original descriptions of *Elotherium* by M. Pomel, and *Entelodon* by M. Aymard, I have not had the opportunity of seeing, nor had I seen any account of them at the time of publishing a notice of *Archæotherium*.

From the various collections of fossils subsequently brought from the Mauvaises Terres of White River, and submitted to my inspection, I have had the opportunity of examining a number of specimens pertaining to different individuals of several species of *Elotherium*, sufficient altogether to give us a knowledge of nearly the whole skull, including the dentition. Of other parts of the skeleton only a few fragments have been identified.

From the many fragments of skulls of *Elotherium* I have attempted the restoration of a complete one, as represented in plate XVI. Though perhaps not entirely accurate in all its proportions, as the specimens vary considerably in size and exact details of form, apparently from differences of age, sex, and individual peculiarity, yet the restoration gives a fair idea of the form of the skull, and the parts, as taken from different specimens, are anatomically correct.

In comparison with the figures and description of the dentition of the European *Elotherium*, as given in Gervais' Paléontologie Française and Pictet's Traité de Paléontologie, that of the American *Elotherium* appears to agree in all essential characters.

Elotherium Mortoni.

Of this species I have had the opportunity of examining portions of the skull of about fifteen different individuals. One of the best preserved specimens consists of the greater part of a skull of an animal which had not yet reached adult age, and which is represented in plates viii, ix, figures 1, 2, of the Ancient Fauna of Nebraska.

The restored skull of *E. Mortoni* is represented in plate XVI, about two-thirds the diameter of nature. The parts *a*, *b*, *c* are derived from the particular specimen above indicated, except portions of the nasal and frontal on the part *b*. The anterior extremity of the face, marked *d*, is derived from a well-preserved adult specimen, except the nasal bone, which is introduced from another individual. The portions of the lower jaw marked *e*, *f*, are derived mainly from a fourth individual, but perfected from a fifth one.

The skull of *E. Mortoni* in its adult condition was about the size of that of the Wild Boar, and was about a third less in size than that of the *Entelodon magnum*, Aymard, or *Elotherium Aymardi* of Pomel.

In a side view the skull bears some resemblance to that of the Hog, but it is less elevated posteriorly, so that its upper part does not slant so much. The cranium is longer and lower, and is surmounted by a high sagittal crest. The temporal fossa is far more capacious, and the zygomatic arches extend more outwardly. The orbit is more advanced in position, and it has a complete bony rim and a more forward direction The side of the face is cylindroid, and converges regularly to the snout. The nasals project but slightly. The ascending ramus of the lower jaw is short, and its back border more vertical. The outline of the base is interrupted by a pair of bony knobs, and the symphysis is less slanting. The canine teeth do not project internally, and resemble more those of the carnivores than those of living suilline animals.

In the upper view of the skull of *Elotherium Mortoni* it actually bears more resemblance to that of the great felines, the Lion or Tiger, than to that of its natural ally, the Hog. The cranium is proportionately shorter, narrower posteriorly, and much less capacious than in the Lion, but its sides occupied by the capacious temporal fossæ, separated by the high sagittal crest, and defined below by the wide outstretching zygomatic arches, give it a wonderful resemblance to that of the latter animal. The face is proportionately much longer than in the Lion, both in relation with its breadth and height, and with the length of the cranium. The forehead is much wider and longer, and the orbits are more vertical and much less directed forward.

In some respects the skull of *Elotherium Mortoni* resembles that of the Hippopotamus more than it does that of the Hog. Thus *E. Mortoni* resembles Hippopotamus in the separation of the temporal fossæ by a sagittal crest, in the wide expanse of its zygomatic arches, in its more cylindroid face, and in the short termination of the nasals.

Lateral view of the skull.—The upper outline of the skull, as seen from its side, represented in plate XVI, presents a moderate and almost uninterrupted slope from the rounded summit of the inion to the end of the nose. The occipital outline is nearly like that of the Hog, prominently convex above and concave below, ending nearly perpendicularly with the condyles. The muzzle is pointed, but the slope of the nose is oblique as in the Hippopotamus or the Bear, and the slope of the mandibular symphysis is not very different from that of the latter animal.

The temporal fossa has a capacity in its proportions and form more resembling that of carnivores than that of the ordinary suillines. Among the latter it is most like that of the Hippopotamus, especially of *Chœrodes*, or the small Hippopotamus of St. Paul's River, Western Africa. Besides being of greater capacity than in the latter, it is proportionately longer and not quite so deep.

The temporal surface rises upon a strong sagittal crest, which is not greatly exceeded in its proportions by that of the Hyæna. Posteriorly it forms a broad slope outwardly to the acute margin of the inion and the deep posterior root of the zygoma. Its long diameter is fore and aft, instead of being obliquely downward and forward as in the Hog.

The zygoma at its posterior root projects directly outward to a greater extent than in the Hog. Bending abruptly forward, as in the latter animal, it then ascends inwardly towards the face as in the Hippopotamus. It is remarkable for its great depth, which exceeds that in the Hog. Its fore part, however, beneath the position of the orbit, is as remarkably narrow compared with its condition in a similar position in relation to the orbit in the Hog. This comparative weakness of the connection of the zygoma with the side of the face is duly compensated for in the additional abutment to the zygoma, in the strong post-orbital arch. The outer surface of the zygoma, rather less vertical posteriorly than in the Hog, at its anterior part slopes from the orbital margin downward, outward and backward.

The posterior root of the zygoma, in association with the mastoid and paramastoid, forms a comparatively high, wide and deep arch, communicating at its inner part with the orifice of the external auditory meatus. The anterior surface of the arch is a broad deep slope contributing to the temporal fossa.

The entrance of the orbit is more advanced in position than in the Hog, and holds nearly the same relative position as in the Hippopotamus, but is not elevated as in the latter, being below the level of the forehead as in *Chœrodes*, the Hog and the Peccary. Its ant-orbital margin is on a line with the second true molar tooth. It is entire, as in ruminants and ordinary solipeds, and as is also rarely the case in the Hippopotamus. Posteriorly it is formed by a strong arch, to which the frontal and malar contribute nearly equally. It is vertically ovoid, with the narrower part above; and it is larger than in the Hog, and rather more directed forward.

The orbital cavity has a more forward and less upward direction than in the Hog. It is directed obliquely forward, comparatively slightly upward, and approaching the entrance is rather more abruptly directed outward.

The supra-orbital margin is prominent, and at its fore part everted. The ant-orbital margin presents a strong median, mammillary eminence of the lachrymal bone, defined above and below by notches.

The lachrymal orifice is single, longitudinally oval, and is situated within the orbit internal in position to the lower of the notches just mentioned.

The face is long and cylindroid as in the Hippopotamus, but is not encroached upon by bony excrescences of the canine alveoli, as exist in the latter and other suilline animals. In the corresponding position the face presents the convex swell of the canine alveoli as observed in ordinary carnivora, like the Lion and Bear.

The premaxillary projects forward nearly as much as in the Hog. Its lateral surface is more convex both fore and aft and from above downward.

The facial surface of the lachrymal is large and square, and contributes to the general slope from the forehead and ant-orbital margin to the side of the face. There is no disposition to the formation of an ant-orbital fossa or depression such as exists in the Hog and Peccary.

The infra-orbital foramen is as large as in the Hog, and is situated above the position of the third premolar tooth. In an old adult specimen there exists a second considerable sized foramen behind the position of the former. In another adult specimen, from a large individual, the infra-orbital foramen is divided into an upper larger and a lower smaller portion.

Superior view.—In examining the skull of *Elotherium Mortoni* from above, in absence of other evidence one might suppose it belonged to a large carnivorous animal. The cranium, with its capacious temporal fossæ, high sagittal crest, and wide arching zygomata, especially exhibits an approach to the carnivorous type of construction, but its comparative shortness, together with the proportionately long face, betray its suilline character.

The cranium is cylindroid in the parietal region, but slightly narrows forward, and becomes rather more abruptly narrowed immediately in advance of the sides of the parietals and on a line with the bifurcation of the sagittal crest. Its sides slope backward and outward to the acute lateral border of the inion and the anterior surface of the posterior root of the zygoma; they gradually rise on the high sagittal crest and the broad, biallated summit of the inion, and in front they curve outwardly upon the post-orbital arches.

The sagittal crest is absolutely as long as in the much larger Hippopotamus. Converging from the biallated summit of the inion it increases in strength anteriorly. Its bifurcation is thick and prominent, and receives the pointed summit of the frontal.

The spaces included by the zygomata resemble those of the Hippopotamus. They are widest posteriorly and converge most externally.

The forehead is broad and convex, but is rather deeply depressed in the middle, especially posteriorly in the angle of bifurcation of the sagittal crest. The temporal ridges are about as long as the latter, and curve from it at an angle of divergence of about 45°. At first quite prominent, they gradually subside, and at the outer part of their course are obtusely rounded.

The supra-orbital foramina, of which one alone is preserved in a single specimen, appear to be small, and are situated near the median line almost opposite the post-orbital arches.

The face above is cylindro-conical in form. From the position of the zygomata it gradually narrows, less abruptly in advance of the orbits, to about the position of the infra-orbital foramina or the middle of the face, when it again widens to accommodate the canines, and afterwards is narrowed and rounded off to the front of the muzzle. From side to side, in front of the orbits, the face forms a uniform convexity.

The nasals continue the transverse arch of the face. Together they are coffin-shaped, and are widest between the ends of the angular processes of the frontal. Their anterior extremity is notched, and the contiguous processes form a short angular point, projecting above the nasal aperture as in *Chœrodes*.

Posterior view.—The inion is less deep than in the Hog, and in its proportions is more like that of the Hippopotamus. Its summit, narrower than in the Hog, presents, as in this animal, a pair of wing-like plates, less divergent and proportionately more prominent posteriorly. The concave surface between the wing-like processes, though much smaller, is proportionately deeper than in the Hog. Lower down the surface appears to have been transversely convex, being broken in the only specimen in which it is partially preserved.

The lateral border of the inion forms an acute edge, descending obliquely from the summit and curving outwardly and slightly upward to the top of the archway enclosing the external auditory meatus.

The sides of the inion are deeply depressed, and form a deep concavity between the upper part of the ex-occipital, the supra-occipital, and the edge of the squamosal. The lower border of the ex-occipitals curve outwardly and downward from the condyles to the external part of the archway leading to the auditory meatus, where they terminate in the paramastoids.

The occipital foramen is transversely oval, and is larger and looks more downward than in the Hog.

The condyles are less sessile than in the latter, and resemble more those of the Hippopotamus and *Chœrodes.* Their upper border is nearly horizontal, and they are separated at their lower extremities by a wide notch, part of the occipital foramen.

The paramastoid processes, or par-occipitals, hold a much more external position in relation with the condyles than in any of the living suilline animals. They are too much broken in the specimens under examination to determine their character, but they appear not to have been better developed proportionately than in the Peccary and Hippopotamus. Their base, in association with the less well-developed mastoid process, forms the posterior wall of the archway leading to the external auditory meatus.

Inferior view.—The base of the skull is proportionately broader than in the Hog, and bears more resemblance to that of the Hippopotamus.

The basi-occipital is more convex than in any of the recent suilline animals. It is proportionately long and thick. Narrowing anteriorly in conjunction with the basi-sphenoid, it forms a pair of tuberosities for muscular attachment. The basi-sphenoid, narrower than the former, ascends from it forward to a comparatively large aperture above the position of the internal pterygoids, which are suturally connected in an arching manner across the position of the pre-sphenoids.

The anterior condyloid foramen occupies a corresponding position with that in the Hippopotamus. The glenoid cavity is remarkable for its extreme outward position. It resembles more that of the Peccary than that of the Hog or Hippopotamus. It is not so low relatively as in the former, being only a little below the level and on a line with the basi-sphenoid. It is concave fore and aft, straight and horizontal transversely, and is nearly equal in diameter in those two directions. Its borders in front and behind are prominent, and constitute ant- and post-glenoid tubercles.

From the glenoid cavity the zygoma is directed forward, with a slight curvature outward, and then inwardly to the face. The inner surface of the zygoma is directed downward and outward, especially at its lower anterior portion.

The posterior root of the zygoma inferiorly is exhibited in the form of a long, transverse, strong and convex ridge, in a line with the spheno-occipital conjunction. Posteriorly on the same line, but a little higher in position, is another long convex ridge, less strong than the former, formed by the inferior border of the ex-occipital extending to the par-occipital.

Between the two ridges just indicated is situated the tympanic bone. The inner part of this forms a broad depressed convex bulla, but feebly developed compared with its condition in the recent suilline animals, being proportionately smaller even than in the Hippopotamus. The outer part of the tympanic bone forms a shelving plate directed straight outward between the two ridges previously indicated, and bounding inferiorly the auditory meatus. The direction of the latter and of its external orifice is outward, with only a slight direction upward and backward, and the orifice is within the position of the paramastoid process. From the fore part of the auditory capsule a strong conical eustachian process is directed downward and forward.

The foramen lacerum is a crescentoid space between the auditory bulla and the basi- and ex-occipitals. The oval foramen is situated exterior to the root of the pterygoid process, in front of the ali-sphenoid as it turns outwardly to contribute to the fore part of the zygomatic root.

The spheno-orbital foramen occupies the bottom of the orbital fossa, rather less than an inch in advance of the oval foramina. About the fourth of an inch in front, and internally to the position of the spheno-orbital, the optic foramen is situated.

The stylal pit and the contiguous foramen appear to have their position just external to the back part of the auditory capsule.

The middle palatine notch, like that of the extinct *Chœropotamus*, is much longer than in recent suilline animals. It extends as far forward as the fore part of the second true molars. It is somewhat ellipsoidal in form, and the included space is a deep concave gutter continuous with the nasal cavities.

The hard palate is long, and proportionately wider than in the Hog. It is moderately arched both transversely and fore-and-aft. Its sides, as in living suilline animals, are nearly parallel.

The palatine plates of the palate bones are comparatively small, in consequence of the large size of the palatine notch. The posterior palatine foramina are large, and occupy the position of the suture between the palate and maxillary bones.

The anterior palatine foramina greatly exceed in size those of recent suilline animals. As far as can be ascertained from their imperfect condition in the specimens under examination, they appear together even to be larger than the corresponding foramen in the Tapir.

Form, relations, and connections of the bones of the skull.—The parietal bones are fused at the sagittal crest, in which they are widest. They narrow in their descent, and at the bottom of the temporal fossæ join the ali-sphenoids.

The supra-occipital advances on the sides of the summit of the cranium more than in the Hog, and in that position forms an angular plate between the posterior extremity of the parietal and the upper extremity of the squamosal.

The latter contributes but little surface to the side of the cranial cavity compared with that of the Hog, and in this respect approaches the condition in the Hippopotamus, especially the *Chœrodes*. The squamosal is much extended outwardly, and forms the large contribution to the temporal surface in front of the posterior root of the zygoma.

The suture defining the squamosal above descends very obliquely, but with a moderate curvature forward, from the lateral border of the inion to the bottom of the temporal fossa just in advance of the position of the oval foramen, when it curves backward externally to the latter and crosses the zygomatic root.

The frontal is single, and it contributes more than a fourth to the extent of the temporal surface.

The fronto-parietal suture, commencing in the notch of the sagittal crest, curves forward a short distance upon the temporal ridge upon each side, and then turns rather abruptly downward and backward on the temporal surface to about its middle, when it again abruptly turns forward and downward to the ali-sphenoid bone.

Anteriorly the frontal terminates in two long angular processes, including the posterior extremites of the nasals, and separating them from the lachrymals.

The post-orbital process of the frontal is strong and long, and is directed downward, outward and backward to join the corresponding process of the malar.

The latter bone enters almost entirely into the formation of the zygoma. Its comparatively feeble connection with the maxillary and lachrymal is compensated in its additional strong connection with the frontal in the post-orbital arch. The malar is a deeper bone than in the Hog, and its posterior portion in the same manner gives support to the zygomatic process of the temporal.

The facial and orbital surfaces of the lachrymal form two sides of an irregular cuboid. The facial surface forms a large square inclined plane. The suture from the fore part of the lachrymal descends obliquely backward between the malar and maxillary.

The premaxillaries extend upward and backward between the nasals and maxillaries to a point ending above the position of the second premolar.

Mandible.—The posterior portion of the lower jaw is remarkable for its shallowness, resembling in this respect more nearly the condition in the Peccary than the Hog. Its outer surface is depressed into a broad shallow concavity, as in *Chœrodes,* extending from beneath the condyle nearly to the base of the bone.

The angle of the jaw is obtusely angular, and is produced to about the same extent both backward and downward. The posterior border of the jaw is vertically concave.

The condyle is mutilated, and the coronoid broken away in the specimen under examination, but the former appears to have been a transverse convexity as in the Peccary, while the latter was also probably broad and short as in this animal.

The chin in its breadth resembles the condition in recent suilline animals, but most resembles the corresponding part in the Peccary. It is especially remarkable for the possession, on each side, of a large mammillary protuberance, curving outwardly from the base. It is transversely convex above, but becomes concave below, between the position of the mental protuberances. The slope of the chin is about 45°.

The outer surface of the horizontal ramus of the jaw is slightly convex below the position of the molars, but is rather concave anteriorly.

From the thick rounded base of the lower jaw, beneath the position of the third and fourth premolars, there projects another strong mammillary protuberance, like that of the chin, but smaller. A similar process occupies a corresponding position in the extinct *Anthracotherium.*

The principal mental foramen occupies a position just above the base of the mental protuberance.

Dentition.—The teeth of *Elotherium* appear to have been as many and to have held nearly the same relative position with one another as in the Hog. Such is certainly the case in the specimens which we have referred to this genus.

The upper true molars have cuboidal crowns, with convex sides and rounded borders. The lower half of the crowns, forming the triturating surfaces, are composed of two rows each of three conical lobes, bounded anteriorly by a thick terrace-like basal ridge.

The last of the upper true molars is the smallest, and its crown is less cuboidal and more ovoidal than in the others. Its posterior lobes are more rudimental and broken, and of the anterior lobes the intermediate one is feebly developed.

The second upper true molar is the largest of the series. Of its six lobes the external pair and that antero-internally are the best developed and nearly equal, and the intermediate ones of the two transverse rows are least developed. Posteriorly an oblique ridge ascends from the summit of the postero-internal lobe to the base of that postero-externally.

The first true molar resembles the former, excepting that it has an additional ridge festooning the outer side of the base of the postero-external lobe.

As the conical lobes of the upper true molars do not extend more than half the depth of the crown, they are obliterated when trituration has extended so far, leaving broad exposed dentinal surfaces bordered with enamel.

Of the lower true molars the intermediate one is the largest, and the others are nearly equal. Their crowns in outline are antero-posteriorly oblong oval and constricted at the middle, as in the anterior pair of corresponding teeth of the Hog and Peccary. The upper half of the crowns, forming the triturating surface in the unworn teeth, is composed of two transverse pairs of conical lobes, confluent at base and better developed than those of the upper molars. Posteriorly the crown is bounded by a tubercle, intermediate to the back pair of lobes, and in front is bounded by a narrow basal ridge. Portions of a basal ridge likewise diverge from the posterior tubercle of the crowns of the anterior molars. In the last molar the posterior tubercle is not better developed than in the teeth in advance, a condition one would not have expected in an animal of such strong suilline character.

A marked peculiarity in the lower true molars is observed in the tendency of the antero-internal lobe to divide, as indicated by the cleft or grooved summit, or in other words this lobe appears to be a connate pair.

Of the upper premolars the first is the smallest, the third is the longest and widest, and the fourth is the thickest.

The fourth upper premolar, smaller than the succeeding tooth, but longer, has a three-sided crown, composed of a transverse pair of conical and basaly connate lobes. These are like the corresponding ones of the true molars behind, but very much larger and the outer lobe is about a third larger than the inner one. Posteriorly the base of the lobes is embraced by a stout ridge, and one of less strength festoons the base of the outer lobe in front, extending to the inner lobe.

The anterior three upper premolars have simple, laterally compressed, conical crowns, with a slight posterior curvature. Their front and back borders form subacute indented ridges. The fore-part of the third, or largest of the premolars, is more obtuse, or exhibits the indented ridge only towards the base of the crown, where this likewise presents traces of a basal ridge, proceeding from the former one.

The fourth premolar is close to the succeeding true molars, and the third is separated from it by a narrow interval. The others are separated from the latter and each other by rather wide intervals. The first one is situated obliquely in the jaw, as is frequently the case in the Hog, close behind the canine tooth.

In a young unworn first upper premolar, contained in a fragment of an upper jaw, the crown is strongly curved, and its posterior and antero-internal subacute indented ridges give it a decidedly carnivorous reptilian look.

Of the lower premolars the first is the smallest and the third the largest. All four have crowns resembling the anterior three upper ones, except that the last of the series has the base of its crown extended into a broad heel, festooned by a narrow basal ridge. The same tooth has a similar ridge at its fore-part, and feebler ridges of the same character festoon the fore and back part of the bases of the teeth in advance.

The fourth lower premolar is close to the succeeding true molar, the third is close to the former or separated by a narrow interval; the others are separated from the latter and each other, and from the lower canine by more or less wide intervals.

The canine teeth of *Elotherium Mortoni* resemble much more those of carnivorous animals than of any existing pachyderms. They especially resemble those of the Bear. Their crown is long, conical and curved. They end in an obtuse point and posteriorly present a subacute ridge, separating the outer and inner surfaces. Antero-internally also they present a less prominent, shorter and more obtuse ridge. The fangs pursue the same course, as in the Bear, and have the same conical gibbous character.

The upper and lower canines are nearly equal in size, but the excess is in favor of the former.

The incisors, three in number, on each side, above and below, increase in size in succession from first to last. They are separated from one another by considerable intervals, and those above are separated from the contiguous canine by a larger interval, to accommodate the point of the canine below.

The fangs of the incisors curve from their sockets in the same manner as those of the canines. The crowns are curved conical, and have their outer more convex surface defined from that within by lateral subacute ridges, most prominent at the base of the crowns.

When the jaws are closed the lobes of the true molars, above and below, alternate with one another, the latter holding the advanced position. The crowns of the lower premolars and the lower canine are situated in advance, and interlock with those above. The incisors of the two sides together form semicircular rows.

The enamel on all the teeth is thick and strongly corrugated, but is especially rugged upon the true molars. The ridges of the crowns, wherever they exist, are more or less indented.

Temporary dentition.—The number of temporary teeth and the order of succession of the permanent series, appears to have been the same in *Elotherium Mortoni* as in the Hog.

The upper deciduous true molar resembles the permanent true molars, but with the inner part of its crown proportionately less well-developed.

The upper last deciduous premolar has a fore and aft elongated trihedral crown, with a transverse pair of conical lobes posteriorly and a single larger pyramidal lobe anteriorly.

The lower deciduous true molar, as in the corresponding tooth of recent suilline animals, differs from the permanent true molars in the possession of an additional transverse pair of lobes to the crown.

The enamel of the deciduous teeth is thinner and smoother than that of the permanent set.

Notice of specimens forming the basis of the above description.—1. The greater part of the skull, including portions of the lower jaw, of a young animal. The specimen formed part of the collection of Dr. David Dale Owen, from the Mauvaises Terres, and is now preserved in the Museum of the Smithsonian Institution. It is represented in plates viii, ix, figures 1, 2, and plate x, figures 1—7, of the Ancient Fauna of Nebraska.

The upper jaw of the specimen contains in functional position the last deciduous premolar, the true molar of the same series, and the following two permanent molars. Concealed within the jaw are the last two permanent premolars and the last permanent true molar. Portions of the lower jaw contain in functional position the last temporary molar and the following two permanent true molars. Concealed within the same fragments are the last permanent premolar and the last permanent true molar.

The supra-occipital and the ex-occipitals are yet separate, but the latter and the basi-occipital are co-ossified. The latter, and the basi- and pre-sphenoids, are also separated.

Measurements of the specimen are as follow :

	Inches.
Estimated length of the skull, about	16
Estimated length of the lower jaw, about	12
Length of sagittal crest, partially estimated,	4
Length of temporal fossa along the middle,	4¾
Greatest breadth of cranium at the parietals,	2¾
Breadth of skull at back part of the zygomata,	8¾
Length of zygomatic fossa,	3¼
Breadth of zygomatic fossa posteriorly,	2¾
Depth of zygoma just back of the orbit,	2¼
Breadth of forehead at fronto-malar sutures,	6¾

	Lines.
Breadth of forehead at middle of orbits,	54
Breadth at ant-orbital prominence,	40
Breadth at infra-orbital foramen,	28
Breadth above second true molars,	40
Height of orbital entrance,	24
Transverse diameter of do.,	21
Breadth of occipital foramen,	20
Breadth at outer part of glenoid cavities,	90
Breadth of palate between first true molars,	17
Length of upper true molar series,	33
Antero-posterior diameter of first true molar,	10½
Transverse " " "	10¼
Antero-posterior diameter of second true molar,	11½
Transverse " " "	11½
Antero-posterior diameter of last true molar,	9½
Transverse " " "	9½
Antero-posterior diameter of upper temporary true molar,	10
Transverse " " " "	8
Antero-posterior diameter of last temporary premolar,	11
Transverse " " " posteriorly,	7½
Depth of posterior border of lower jaw,	44
Depth of jaw below first permanent true molar,	23
Length of series of lower true molars,	33
Antero-posterior diameter of last true molar,	11½
Transverse " "	7½
Antero-posterior diameter of second true molar,	12¼
Transverse " " "	8¼
Antero-posterior diameter of first true molar,	10½
Transverse " " "	7
Antero-posterior diameter of last permanent premolar,	12½
Transverse " " " "	6
Length of crown of last permanent premolar,	8½

2. A much mutilated and fractured specimen, consisting of the upper jaw, or facial portion of a skull, without the orbits and anterior extremity, from an old individual in which the lobes of the true molars are obliterated from attrition. The specimen belonged to Dr. Evans' Mauvaises Terres collection, and is now in the Smithsonian Institution.

Its measurements are as follow:

	Inches.
Length of nasal bones from the widest part, between the points of the frontal angular processes, and their anterior extremity,	$4\frac{3}{4}$
Greatest width of jaw outside of the second true molars,	4
Narrowest part of the jaw above the second premolars,	$2\frac{1}{2}$
Width of jaw outside of the canine alveoli,	$3\frac{1}{3}$
Length of space occupied by the molars and canines,	8
Length of space occupied by the true molars,	$2\frac{1}{2}$

3. A much mutilated specimen consisting of portions of both jaws, with teeth, of a middle-aged adult, from the same collection as the preceding. In the upper jaw on the two sides together it contains a full series of premolars; in the lower jaw, a series of the back three premolars and the first true molar. On one side the third lower premolar had been lost at an early period, and one of its sockets is obliterated. The concave interspace between the second and fourth premolars measures an inch and a half. The last two premolars and the true molars are close together.

Measurements from the specimen are as follow :

	Lines.
Length of crown of first upper premolar (blunted),	6
Antero-posterior diameter of do.,	$7\frac{1}{2}$
Length of crown of third upper premolar (blunted),	$9\frac{1}{2}$
Antero-posterior diameter of do.,	11
Length of crown of upper fourth premolar,	$7\frac{1}{2}$
Antero-posterior diameter of do.,	$8\frac{1}{2}$
Length of crown of last lower premolar,	9
Antero-posterior diameter of do.,	$12\frac{1}{2}$

4. A specimen from Dr. Owen's collection, consisting of a portion of the upper jaw of an adult individual. It contains on both sides the anterior two true molars, and the fangs of the premolar in advance and of the true molar behind. The retained true molars are slightly worn at the summit of the lobes. The specimen is represented in figure 1, plate xi, of Dr. D. D. Owen's Geological Survey of Wisconsin, &c.

The measurements are as follow :

	Lines.
Width of face above the second true molars,	44
Height on the same line from the hard palate,	42
Space occupied by the upper true molars,	32
Antero-posterior diameter of first true molar,	10
Transverse " " "	10
Antero-posterior diameter of second true molar,	11
Transverse " " "	11

5. A fragment of the upper jaw, containing the left hinder pair of premolars and the sockets of the first succeeding true molar. The specimen is from an adult of rather advanced age, and is represented in figures 3, 4, plate ix, of the Ancient Fauna of Nebraska. The three teeth mentioned were close together. The separation between the pair of constituent lobes of the crown of the fourth premolar is completely obliterated by wearing, as represented in figure 4 of the plate just mentioned.

The measurements of the specimen are as follow:

	Lines.
Width of nose between the frontal angular processes,	12½
Space occupied by the third and fourth premolars,	24

6. Anterior extremity of the upper jaw, retaining the greater part of both premaxillaries, and containing on both sides the sockets and fangs of the anterior two premolars, the greater part of both canines, and on one side the lateral two incisors and the fang of the inner one. It belonged to an adult, but not an old individual, of more robust proportions than the preceding specimens. It may probably belong to the species hereafter indicated under the name of *Entelodon ingens*. It is represented as forming the fore part of the muzzle in the restored figure, at *d*, plate XVI.

Its measurements are as follow:

	Lines.
Space included by the anterior two premolars,	31
Interval between them,	8
Length of crown of canine,	24
Antero-posterior diameter of base of crown,	10½
Transverse " "	8½
Antero-posterior diameter of fang of canine at mouth of alveolus,	13
Transverse " " " "	9
Space between canine and lateral incisor,	8½
Space between lateral and second incisor,	4
Length of crown of lateral incisor (blunted),	10
Breadth at base of do.,	7
Thickness at base of do.,	6
Length of crown of second incisor (blunted),	9
Breadth at base of do.,	6½
Thickness at base of do.,	4½
Width of incisive foramina together,	13
Breadth of jaw at canine alveoli,	44

7. A portion of a cranium of a young individual.

8. A fragment of the upper jaw of an adult individual, containing the last premolar and the following pair of true molars of the left side.

The measurements of the teeth are as follow:

	Lines.
Antero-posterior diameter of crown of last upper premolar,	9
Transverse " " " "	10
Antero-posterior diameter of first upper true molar,	10
Transverse " " "	10
Antero-posterior diameter of second upper true molar,	11
Transverse " " "	11

9. Three fragments of a lower jaw, consisting of the symphysial portion and portions of the two sides. They contain the anterior pair of true molars and the last premolar on both sides, the fangs of the third premolars, part of the alveoli of the second and those of the first premolars, the fangs of the canines and those of the incisors. The mental and the other basal protuberances are broken off. The first true molar is considerably worn, and the summits of the teeth in front and behind are slightly blunted.

Measurements from the fragments and teeth are as follow:

	Lines.
Depth of lower jaw below first true molar,	24
Width outside of canine alveoli,	33
Length of symphysis,	40
Antero-posterior diameter of last premolar,	14
Transverse " "	6½
Length of crown of last premolar,	9
Antero-posterior diameter of first true molar,	11
Transverse " "	7¾
Antero-posterior diameter of second true molar,	13
Transverse " " "	9
Breadth at base of third premolar,	15
Breadth at base of crown of canine,	11½
Width or transverse diameter of do.,	9½

10. A number of small fragments of jaws, with and without teeth, from more than half a dozen different individuals of different ages. A fragment of the lower jaw retains one of the mental protuberances entire. Another retains the greater part of the second basal protuberance, and a third, from a very young animal, retains it entire.

In two fragments of the upper jaw from the same individual, rather advanced in age, each contains the last two true molars, which have the following measurements:

	Lines.
Antero-posterior diameter of second true molar, ...	12
Transverse " " "	12½
Antero-posterior diameter of last true molar, ...	10½
Transverse " " "	10½

11. A number of isolated teeth and fragments. A last superior molar presents two large conical tubercles or lobes at the fore part of its crown, and at its back part two quite small ones. It measures ten lines antero-posteriorly and eleven lines transversely.

Of two last upper premolars, one is comparatively small. Their measurements are as follow:

	Lines.	Lines.
Antero-posterior diameter of last upper premolar, . . .	10½	9
Transverse " " " . . .	10½	9

The crown of one unworn canine measures 22 lines in length, 13 lines in breadth at base, and 9½ in width.

12. Fragments of several teeth, comparatively large, represented in figures 8—13, plate x, of the Ancient Fauna of Nebraska, formerly attributed to another species under the name of *Archæotherium robustum.* These probably belonged to a male or larger individual of *Elotherium Mortoni.*

Other remains referable to Elotherium Mortoni.—Of other parts of the skeleton referable to this animal I have the opportunity of examining an axis, and fragments of several bones of the extremities, in the collections of Drs. Owens and Evans.

The axis supposed to belong to *Elotherium Mortoni* bears a resemblance to that of the Peccary, though presenting some differences. The body inferiorly presents a strong median keel, expanding posteriorly and separating a pair of broad deep concavities. The posterior articular surface is a little wider than high, and is concave. The odontoid process is strong, and marked below by the articular surface of the atlas continuous with those of the anterior zygapophyses. The latter are wider than high, and form an angle with the odontoid process of about 45°. They are nearly flat transversely or obliquely, and convex from above downward. The transverse process is feebly developed, and is pierced above from behind forward by the foramen for the vertebral artery. The spinal canal, viewed in front, is obcordate.

The measurements of the specimen are as follow:

	Lines.
Length of axis inferiorly, including odontoid process,	45
Width at the anterior articular processes,	41
Breadth of abutments of the vertebral arch,	15
Breadth of arch at root of spinous process,	24
Width at posterior articular processes,	26
Width at posterior articular surface of body,	19
Height of do. exclusive of the hypapophysis,	17
Height of spinal canal in front,	11
Width of spinal canal in front,	13

The fragments of bones of the limbs, apparently from two different individuals, are supposed to belong to *Elotherium Mortoni* from their relative size and their approach in anatomical character to those of recent suilline animals. They consist of a mutilated proximal extremity of the humerus, two distal ends of that bone, two proximal ends of the conjoined ulna and radius, two distal ends of femora, the proximal end of a tibia and two distal extremities of the same, one of which has a portion of the fibula co-ossified.

The humeral fragments nearly resemble in form the corresponding portions in the Peccary. The outer portion of the articular surface of the external condyle forms a sloping plane backward, instead of a groove as in the animal just mentioned.

The ulna and radius are closely conjoined, but are separable in the specimens. It would appear as if in advancing years they became co-ossified as in the Peccary, though perhaps not so completely. The ulna in its relative size with the radius is about as well developed as in the Hog.

The lower end of the femur has its shaft more flattened laterally than in the Hog or Peccary. Above the trochlea for the patella there is a deep concavity, and above the external condyle a well-marked roughened impression for muscular attachment. The articular surface of the external condyle is disconnected with that of the trochlea, and the articular surface of the internal condyle joins it by a narrow isthmus.

The extremities of the tibia, and that below of the fibula, pretty closely resemble the same parts in the Hog and Peccary. The articulation of the ankle joint is nearly equally divided into fore and aft oblique concavities by an intervening ridge of the tibia, as in other suilline animals.

Measurements of the fragments above indicated are as follow:

	Lines.
Antero-posterior diameter of humerus at head,	31
Circumference of shaft 4¼ inches below the head,	34

	Lines.
Breadth of distal extremity,	22
Greatest width of the ante-brachial articulation,	17
Breadth of fore-arm bones together, at middle,	15
Breadth of middle of radius,	10
Breadth of middle of ulna,	$7\frac{1}{2}$
Breadth of head of radius,	17
Circumference of femur $4\frac{1}{2}$ inches above distal end,	41
Breadth at condyles of femur,	24
Breadth of head of tibia,	25
Breadth of distal end of tibia and fibula,	31

Elotherium ingens.

The fragments of teeth originally described under the name of *Archæotherium robustum* were supposed to indicate a different species from *Elotherium Mortoni*, on account of their size exceeding that in the specimens referred at the same time to the latter. The subsequent examination of additional specimens of *E. Mortoni*, from the observed variability in size of corresponding parts of different individuals, have led me to consider those referred to *A. robustum* as belonging to larger individuals, perhaps of the male, of the same animal. The collections of Dr. Hayden contain fragments of jaws and teeth, found in association with the fossils of *Elotherium Mortoni* in the Mauvaises Terres, which appear too large to belong to this species, even making allowance for a considerable range in size. These I have referred to a different species under the name heading the present chapter, though I am prepared to admit that these larger fossil remains may have pertained to robust males of *Elotherium Mortoni*. The species was about a third larger than *E. Mortoni*, and was about the size of the *Elotherium Aymardi* of France.

The specimens referable to *Elotherium ingens* are as follow:

1. The fore part of the lower jaw, in advance of the second premolars. An anterior view is represented, one-half the natural size, in figure 10, plate XXVII. It contains the fangs of the first premolars, canines and incisors. It also contains one of the mental protuberances nearly entire, and the greater part of the opposite one. The measurements of the specimen are as follow:

	Inches.
Height of symphysis,	4
Breadth of jaw outside of canine alveoli,	$3\frac{3}{4}$
Breadth between ends of mental protuberances,	$4\frac{3}{4}$
Depth of jaw below first premolar,	$2\frac{3}{4}$

2. The crown of an inferior molar tooth, represented in figures 8, 9, plate XXVII, and the greater portion of another specimen of larger size. The comparative measurements of the two specimens are as follow:

	Lines.	Lines.
Antero-posterior diameter,	15	16½
Transverse diameter,	12	14

3. The greater portion of the crown of a third upper premolar, and the last lower premolar which is represented in figure 11, plate XXVII. These teeth appear not to have been protruded from the jaw, as they are not only unworn, but the crowns are hollow, with thin walls.

The upper premolar has the crown about sixteen lines long, has been about an inch and a half wide at base, and in this position is three-fourths of an inch thick. The lower premolar has the crown fourteen lines long at the middle externally, with the base twenty lines wide, and ten lines thick just back of its middle.

4. A portion of the upper jaw, containing on one side the fangs of the posterior two premolars and the true molars, and on the opposite side those of the same premolars and of the first true molar. The measurements of the specimen are as follow:

	Lines.
Space occupied by the true molars, about	42
Breadth of face above second true molars,	52
Breadth of face at ant-orbital foramina,	30
Breadth of nasals at frontal angular processes,	20

5. Fragments of the upper jaw of a young animal. One contains the first premolar unworn, in which condition the crown is seven lines long, nine broad, and five thick. Another fragment contains the last temporary premolar, the temporary true molar, and the first permanent true molar. The measurements of the teeth are as follow:

	Lines.
Antero-posterior diameter of permanent true molar,	14
Transverse " " "	14
Antero-posterior diameter of temporary true molar,	12
Transverse " " "	11
Antero-posterior diameter of last temporary premolar,	13
Transverse " " "	9

Some additional specimens, apparently belonging to *Elotherium ingens*, obtained by Dr. Hayden in the Mauvaises Terres in the summer of 1866, are as follow:

The middle portion of the face, considerably mutilated and without any portion of the lower jaw. It contains on one side the remains of the fangs of the true molars, and those of the two premolars in advance. The upper part and sides of the face together form rather more than a half-cylinder, widening somewhat conically behind. Measurements derived from the specimen are as follow:

	Lines.
Length of space occupied by the closed row of teeth, consisting of the true molars and the two premolars in advance, about . . .	68
Space occupied by true molars, about	40
Height of face at middle on line of interval between last two molars, .	40
Distance between infra-orbital foramina, ...	32

An upper canine tooth, broken at the ends and worn off in front, at the conjunction of the crown and fang, into a vertical elliptical plane an inch and a half long and seven lines wide, also apparently belongs to the larger *Elotherium*.. The fang is somewhat gibbous at its widest part antero-posteriorly, measuring sixteen lines fore and aft and eleven lines transversely. The length of the tooth in its perfect state, along the anterior curve, has been about six inches; the crown alone about two and a half inches.

A still larger species of *Elotherium* than either of the preceding is perhaps indicated by the greater portion of a canine tooth, obtained by Dr. Hayden with the preceding specimens. It appears to have belonged to the left side of the lower jaw. Both ends of the tooth and the inner side of the crown are broken away. The remaining portion of the crown exhibits the effects of attrition of the opposed teeth both before and behind. The gibbous fang is an inch and a half in diameter antero-posteriorly, and rather less than an inch and a quarter transversely. In the perfect condition the tooth has probably measured about seven inches in length along its anterior curvature.

The difference of size between certain specimens of *Elotherium* is so great as to leave little doubt that they indicate at least two distinct species, but between the extreme sizes there are many gradations, which probably relate to different sexes. The tooth just described may have been that of an old male of *E. ingens*, or, as above intimated, it may indicate a third species of the genus.

PERCHŒRUS.

PERCHŒRUS PROBUS.

Among the fossils of the Mauvaises Terres collections there are a few small fragments of jaws with teeth and isolated teeth of suilline animals, which, especially from the paucity of material, are of uncertain reference. I have referred them to two new genera, the one above named and that of the succeeding chapter, though I am not positive that the remains of the former may not belong to the genus *Palæochœrus*, or some of its allies, previously characterized from remains found in the miocene tertiary of Europe. The indistinctness of detail with which many of the latter fossils are depicted renders it often impracticable from the figures to make comparisons essential to the determination of characters.

Of the specimens referred to the genus and species above named, two consist of fragments of lower jaws with teeth, and were formerly referred to the genus *Palæochœrus*, with the name of *P. probus*.

One of the jaw fragments, represented in figure 20, plate XXI, contains a portion of the last temporary molar, and the succeeding pair of permanent true molars with the crowns fully protruded and almost unworn. From beneath the temporary molar the fully developed crown of the last permanent premolar was removed, and is represented in figures 22 and 23. These teeth bear a general resemblance in form, construction and size to those of the recent Peccary, *Dicotyles torquatus*. They also resemble those of *Palæochœrus* and *Hyotherium*, and perhaps to the exclusion of some of the accompanying specimens may really belong to one of these genera.

The first and second permanent true molars, figure 21, viewed from above appear oblong-oval, with a moderate median constriction. From a continuous basis spring four conical lobes, forming the triturating surface. The lobes are nearly equal in size, and have moderately wrinkled sides. A strong basal ridge half the depth of the crown is situated at its back part, and connects the bases of the contiguous lobes. A thin ridge exists also at the fore part of the crown, and a festooned element of the same occupies the interval of the outer lobes externally. A short distance below the summits of the anterior lobes they are associated by a festooned ridge in front and behind. Similar ridges descend from the postero-external lobe, of which the front one ceases abruptly in the transverse valley of the crown, and the other joins a median prominence of the posterior basal ridge.

The unworn crown of the last permanent premolar, figures 22, 23, bears some resemblance to the corresponding tooth of the Peccary, but is rather simpler in form, and is less well-developed at the back part. The crown is broader than long, and about half the thickness of the breadth. The principal pair of lobes are more closely confluent than those corresponding to them in the Peccary, and form together a cone, crossed antero-posteriorly by a shallow groove. At the base of the crown antero-internally there is situated a comparatively large mammary tubercle, which is scarcely represented by a basal ridge in the Peccary. Posteriorly a pair of mammillary eminences form the base of the crown, of which the outer is almost twice the size of the inner one. A thin basal ridge descends behind, from just below the summit of the larger eminence, externally and internally.

A second jaw fragment, figure 27, from another young animal, but apparently the same species, contains the entire last temporary molar and the first permanent molar.

The latter has the same shape and constitution as the corresponding tooth of the former jaw fragment, but it is slightly less robust, smoother, and has the intervals of the lobes more open. Differences of the same kind are observed between teeth of different individuals of recent species of Peccary.

The temporary true molar has the usual construction, modified from that of the permanent true molars, as observed in suilline animals generally. The crown is formed of three pairs of lobes, of the same character but less well-developed than those of the tooth behind.

The measurements of the two lower jaw fragments and teeth are as follow :

	Lines.	Lines.
Thickness of jaw below second true molar, . . .	8½	
Thickness of jaw below first true molar, ...	7½	7
Antero-posterior diameter of second true molar, . . .	7	
Transverse " " " . . .	5½	
Antero-posterior diameter of first true molar, . . .	6	6½
Transverse " " " . . .	4¾	4½
Antero-posterior diameter of last temporary molar, . .		7½
Transverse " " " . .	4	3¾
Antero-posterior diameter of last permanent premolar, . .	6	
Transverse " " " . .	3½	

Two specimens, consisting of the isolated crowns of molar teeth, apparently the last of the upper series, probably belong to the same species as the jaw fragments above indicated. One of the crowns is imperfect; the other is represented in figure 26, and resembles in general appearance the last superior molar of the Peccary.

The crown is low, and nearly as wide at its fore part as it is broad, but is abruptly narrowed back of the middle. Viewed above it is trapezoidal in outline, with rounded angles. It is surrounded by a basal ridge, thick in front and behind, thin elsewhere, and interrupted a short distance at the bases of the internal lobes and the postero-external lobe. All the lobes, tubercles, and ridges of the triturating surface are strongly and vertically wrinkled. The anterior pair of lobes of the crown are the best developed and most distinct. They appear as two conical hills with furrowed sides, separated by a lower crescentoid ridge expanding in front of the former, and embracing the antero-external hill. The crescentoid ridge is continuous behind, with an oblique ridge crossing the transverse valley of the crown and becoming associated with the posterior lobes. The latter are less well-developed than the corresponding elements in the Peccary, and are separated by a higher eminence.

Behind the posterior lobes, the basal ridge extending from each side and meeting at the middle, then appears to turn forward and double upon itself.

The measurements of the specimen are as follow: antero-posterior diameter of last superior molar, 8 lines; transverse diameter, 7½ lines; length or depth of crown, 4 lines.

An isolated upper true molar, apparently the first of the series, represented in figures 24, 25, may belong to the same animal as the teeth just described, though it appears hardly broad enough in its proportions, and its lobes appear to be too smooth. Probably it may belong to the same species as the lower jaw fragments, to the exclusion of the other specimens of upper molars above noticed, or it may have belonged to a species distinct from either.

The crown is more square than in the Peccary, or the transverse and antero-posterior diameters are nearly equal, agreeing in this respect with that of the corresponding teeth of the extinct *Palæochœrus*, *Chœropotamus*, *Hyotherium* and *Hyracotherium*. The tooth indeed bears considerable resemblance to an upper true molar of the latter animal, both in form and construction, and is of more complex character than the corresponding teeth in the former genera. A dentated or crimped basal ridge encloses the crown except on the inner side, though even here a constituent element of the ridge occupies the bottom of the interval of the inner pair of lobes. Of the lobes of the crown the outer are the largest and most distinct, and they form four-sided pyramids. The inner pair of lobes are conical, and complicated by confluence with lobes intervening between them and the outer ones. The antero-median lobe is as large as the contiguous inner one, and almost completely connate with it. The postero-median lobe is larger than the contiguous inner one, or it appears to be a larger sub-division of the latter, and separated from it by a narrow antero-posterior groove. In front, this postero-median lobe joins a mammillary eminence at the middle of the transverse valley of the crown, and behind is continuous with an angular median prominence of the basal ridge. The sides of all the lobes of the crown are comparatively smooth or devoid of wrinkles.

The measurements of the specimen are as follow: antero-posterior diameter, 6¼ lines; transverse diameter, 6 lines; greatest depth of crown, 3½ lines.

LEPTOCHŒRUS.

Leptochœrus spectabilis.

Among the specimens of rather uncertain reference noticed at the commencement of the previous chapter, is a small alveolar fragment of a lower jaw containing the first and second true molar teeth, discovered by Dr. Hayden in the Mauvaises Terres of White River.

The fossil evidently indicates a small suilline animal, for which the above name has been proposed. It was about the size of its ancestral relations of the same family, the *Hyracotherium cuniculus* and *Microchœrus erinaceus*, of the English eocene formation.

The molar teeth of the fossil resemble in form the corresponding ones of the Peccary, being oblong-square viewed laterally, and oblong-square, with rounded angles and a median constriction, when viewed above. A basal ridge exactly as in the Peccary holds the same relation with the crown.

Figure 16, plate XXI, represents an upper view of the first molar, magnified three diameters. The second molar has the same form, but is smaller,—an unusual condition among the known suilline animals. The teeth belong to the left side, so that the left portion of the figure is the anterior of the tooth, and the upper portion the inner side of the same. The crown, viewed from the inner and outer side, exhibits the antero-internal division of the crown as the largest, the contiguous outer division next in size, and the postero-internal division as the smallest. Viewed from the triturating surface, the postero-external eminence or lobe with its divergent arms appears the largest, though corresponding with the division of the crown which is third in size. A basal ridge exists in front and behind the crown, and an element of the same occupies the bottom of the interval of the external eminences. The lobes of the crown are conoidal, and the external ones have crescentoid summits. Those of the back lobe diverge in a V-like manner to the inner lobes; those of the fore lobe curve inwardly to join the antero-internal lobe. The sides of the crown are, relatively with the size, strongly corrugated.

The specimen above described is the only one which could with any degree of certainty be referred to *Leptochœrus spectabilis*. Its measurements are as follow:

	Lines.
Thickness of jaw below first true molar,	$3\frac{1}{4}$
Antero-posterior diameter of do.,	$2\frac{3}{4}$
Transverse diameter of do.,	$2\frac{1}{2}$
Antero-posterior diameter of second true molar,	$2\frac{1}{2}$
Transverse " " "	2

Dr. Hayden's collection of the summer of 1866 contains two additional specimens from the Mauvaises Terres of White River, which appear to be referable to *Leptochœrus spectabilis*. One of them consists of a fragment of the right side of the lower jaw, containing the second and third premolars, a portion of the fourth one, and the first true molar. The other specimen is a fragment of the same side of the upper jaw, containing the last premolar and the following pair of true molars.

The specimen of the lower jaw is represented in figure 17, plate XXI, of the natural size; an upper view of the teeth, twice the size of nature, is given in figures 18, 19. The portion of the bone resembles the corresponding part in a Wolf more than in any of the recent suilline animals. The first true molar (figures 17, *c*, 19), retained in the fossil, is like those already described.

The premolars (figures 17, 18, *a*, *b*) appear successively to have increased in size. They have laterally compressed crowns, encircled by a basal ridge strongly developed in front and behind, especially in the latter position, and moderately so at the sides. The inner and outer surfaces are defined posteriorly by a sub-acute border descending from the point, and dividing or splitting up towards the base. The front border is more rounded.

The surfaces of the crowns are strongly corrugated in relation with their size.

The third premolar is wider in relation with its height than the second, and is also proportionately thicker posteriorly.

The fragment of an upper jaw with three teeth is represented in figure 15, twice the natural size. A view of the triturating surfaces of the teeth is given in figure 14, twice the size of nature. Of the three teeth the last premolar is larger than the succeeding true molars, and of these the first is the larger.

The upper true molars (figure 14, *b*, *c*) have transversely trihedral crowns, and are widest in this direction. The outer part of the crown is composed of a pair of simple and regular conical eminences or lobes, festooned by a strong basal ridge. The inner part of the crown is composed of a single conical lobe much larger than those externally, and it has a crescentoid ridge diverging from its summit on the sides outwardly. It is festooned in front and behind by a basal ridge continuous with that on the outer part of the crown. Between the larger internal lobe and the outer ones there is a pair of much smaller eminences, one placed at the fore, the other at the back part of the crown.

The crown of the last premolar (figure 14, *a*) consists of a transverse pair of lobes resembling those of the true molars, but larger. They are enclosed by a basal ridge, proportionately less well-developed than in the true molars, and, as in these, interrupted internally. The inner and outer faces of the lobes are defined by sub-acute ridges, ascending from the summit with an outward inclination. The basal ridge develops a tubercle in front of the base of the outer lobe.

The enamel of the upper teeth, as in the lower ones, is strongly corrugated or wrinkled, in which respect, as well as in general appearance, the teeth of *Leptochœrus* present some resemblance to those of *Pliolophus*, of the eocene formation of England.

The measurements of the specimens are as follow:

	Lines.
Antero-posterior diameter of second upper true molar,	2½
Transverse " " "	3½
Antero-posterior diameter of first upper true molar,	2¾
Transverse " " "	3½
Anntero-posterior diameter of last upper premolar,	2¾
Transverse " " "	3¾
Antero-posterior diameter of first lower true molar,	2½
Transverse " " "	2¼
Antero-posterior diameter of last lower premolar,	3½
Transverse " " "	2½
Antero-posterior diameter of third lower premolar,	3¾
Transverse " " "	2
Height of crown of third lower premolar,	2¼
Antero-posterior diameter of second lower premolar,	3
Transverse " " "	1½
Height of crown of second lower premolar,	2¼
Depth of jaw below last true molar,	5
Depth of jaw below second premolar,	3¾

DICOTYLES.

Dr. Hayden's collection of Niobrara fossils contains a specimen of an upper canine tooth of a Peccary, represented in figure 3, plate XXVIII. It is much worn, and is nearly the size that the corresponding tooth of *Platygonus compressus* would appear to be under the same circumstances. It presents a longitudinal median groove both externally and internally. Its reference to any particular species is uncertain.

NANOHYUS.

Nanohyus porcinus.

In the expedition of Dr. F. V. Hayden, in the summer of 1866, to the Mauvaises Terres of White River, Dakota, among the fossil vertebrate remains previously noticed or described, he discovered a fragment of the left ramus of the lower jaw of a small mammal, supposed to be nearly allied if not belonging to the suilline family.

The teeth in the fragment consist of the last temporary molar, the succeeding two permanent molars in functional position, and the anterior portion of the third molar partially protruded. The interior of the jaw beneath the temporary molar is occupied by the crown of the last premolar, which, judging from the appearance of the exposed outer part, has the same form and size as the molars behind.

The temporary molar is inserted by a pair of widely separated fangs, and its crown presents the usual greater breadth than the succeeding pair of those of the teeth behind, as in pachyderms generally. The crown is trilobate externally and internally, and this condition probably corresponds with three constituent pairs of lobes, the distinction of which is for the most part obliterated by wearing. The median division of the crown is largest, and that in advance is the smallest. The abraded summit of the former presents an irregularly transverse quadrate surface of exposed dentine, continuous with a smaller subreniform tract upon the anterior division. The posterior division of the crown still exhibits the distinction of a transverse pair of lobes, of which the outer one is much the larger. This presents on its abraded summit a crescentoid surface of exposed dentine, and the inner one a minute circular islet of the same substance, and both are considerably below the level of the worn surfaces of the divisions of the crown in front.

The two permanent true molars, preserved in the specimen, are alike in form and size, and the anterior portion of the last molar agrees in character with the corresponding portion of the teeth in advance.

The crown of the first and second true molars is composed of two transverse pair of conical lobes, of which the anterior are about a third higher than the posterior, and are separated from them by a deep transverse valley. The inner and outer lobes are separated by a valley about half the depth of the former, closed at the fore and back part of the crown by a small tubercle. The front tubercle is most conspicuous, and receives a feeble offset or ridge from the antero-external lobe. A similar offset from the postero-external lobe ends in the middle of the transverse valley of the crown. A basal ridge exists nowhere except at the fore part of the crown, where it is most conspicuous externally, and is there associated with the tubercle closing the front of the fore and aft valley of the tooth. A minute circular islet of exposed dentine occupies the summits of the anterior lobes of the crown of the first true molar.

The breadth of the crown of the last temporary molar is $2\frac{1}{4}$ lines. The breadth of the crown of the second unworn permanent true molar is $1\frac{3}{4}$ lines, and its height at the anterior division is the same.

The depth of the jaw fragment below the first permanent true molar is one-fourth of an inch. The base is moderately convex fore and aft.

Though I have found it difficult to ascertain, by comparison with figures, how far the fossil described differs from the corresponding portion of other known animals, it nevertheless appears to me to do so sufficiently to refer it to a distinct genus and species.

ANTHRACOTHERIDÆ.

This extinct family, whose types are the genera *Anthracotherium* and *Chœropotamus* of the early and medial tertiary formations of Europe, is represented in the tertiary deposits of the Mauvaises Terres by a species of *Hyopotamus,* also a European genus. Its remains were derived from the lowest stratum of the miocene formation, marked as bed A by Dr. Hayden, especially distinguished by the abundance of remains of a huge associate, hereafter to be described under the name of *Titanotherium.*

HYOPOTAMUS.

The genus *Hyopotamus** was established by Prof. Owen on some remains found in the eocene formation of the Isle of Wight, though it appears to have been previously noticed by M. Pomel under the name of *Ancodus,* from some remains found in a deposit of the same age in France.

The dental formula of the animal was probably the same as in the Hog and the extinct *Anthracotherium;* that is to say, it possessed three incisors, a canine, four premolars and three true molars on each side of both jaws.

Hyopotamus americanus.

Among the most interesting fossils obtained by Dr. Hayden in the Mauvaises Terres of White River are the remains of a species of *Hyopotamus,* to which the above name has been given. They belong to a single individual of adult age, and consist of upper molar teeth with small portions of the jaw attached to them, and part of a lower molar.

The upper teeth are the true molars of the left side, the anterior two of the opposite side, and what I take to be, in comparison with the teeth of *Anthracotherium magnum,* the second premolar of the left side and the second and third of the right side. A series of the teeth is represented in figures 1, 3, plate XXI. The portion of a lower molar belongs to the last of the series, and consists of the crown without its hinder lobe, represented in figures 5, 6, plate XXI.

The teeth of *Hyopotamus americanus* are about the same size as those of *H. bovinus* of the European tertiary formation, and the corresponding ones are so much alike, that Prof. Owen's description of the upper true molars of the latter applies nearly equally well to those of the former.

The crowns of the upper true molars, figure 1, are quadrate, with the transverse

* In furnishing the list of extinct mammals of Dakota and Nebraska for the table of Dr. Hayden, pages 20, 21, I inadvertently placed this genus and the next among the *Perissodactyla.*

diameter exceeding that fore and aft, and with the height about half the former measurement. In the unworn condition (figure 1, *c*) they are composed of five pyramidal lobes, four of which hold the same relative position as their homologues in living ruminants; the fifth lobe intervenes between the anterior pair as existing in the latter. The outer sides of the lobes are concave, but interrupted by a median elevation; the inner sides are angularly convex, and separated from the former by an acute ridge diverging from the summits of the lobes outwardly towards their bottom. The outer lobes are longer than the inner ones, which partially embrace the bases of the former.

The front and back of the crowns of the upper true molars are embraced by a thick angular basal ridge, which is more or less indented. The bases of the external pair of lobes where contiguous bulge outwardly, and conjoin in the formation of a remarkably broad and convex buttress as in *Agriochœrus*. The fore part of the base of the antero-external lobe in like manner bulges outwardly and forms a similar buttress, which is continuous with the anterior basal ridge of the crown. A much reduced buttress of the same kind also occupies the back part of the base of the postero-external lobe, continuous with the posterior basal ridge of the crown. The presence of these prominent convex buttresses to the crown renders the depth of the concavity of the outer faces of the external lobes greater than in the internal lobes. See figures 1, 2.

The median transverse valley is deeper than that antero-posteriorly. It is especially deep at its outer part, where its bottom is closed by the conjunction of the outer lobes. The fore and back part of the lobes, or the sides of the transverse valleys of the crown, are more or less strongly corrugated.

The upper true molars are inserted by three fangs,—two external, and a broad internal one involving a connate pair. These teeth strongly resemble the corresponding ones of *Agriochœrus*, with the introduction of a fifth lobe between the anterior pair.

In the specimens, the last true molar, figure 1, *c*, is unworn. In the second true molar, figure 1, *b*, the postero-external lobe is worn along its acute borders so as to expose narrow lines of dentine; the summits of the anterior lobes are nearly worn to a level, and exhibit exposed crescentoid dentinal tracts, of which those of the antero-internal and median lobe are continuous through a narrow isthmus. In the first molar, figure 1, *a*, the separation of the anterior three lobes is obliterated, leaving a broad concave tract of dentine bordered by enamel. The separation of the posterior pair of lobes is yet indicated by the remains of the crescentoid interspace.

The teeth represented in figure 3, plate XXI, which I suppose, from their resemblance to the corresponding ones of *Anthracotherium magnum*, to be the second and third premolars, are contained, in apposition together, in a small fragment of the jaw.

This also retains part of an alveolus of the tooth in advance, indicating it to have been in apposition with the others. If the reference of the two premolars is correct, it follows that the molar series of *Hyopotamus* form a continuous row, differing in this respect from *Anthracotherium*, in which the first premolar is removed from the others by a considerable interval. It is further probable, under these circumstances, that the fourth or last permanent premolar of *Hyopotamus* is like the third, as in *Anthracotherium*. On the other hand, if the teeth we have supposed to be the second and third premolars be viewed as the third and fourth, it would then appear as if the second would resemble the third, and both be like the second one of *Anthracotherium*. We have not the means of positively determining this question, for the most complete of the specimens upon which Prof. Owen founded the genus *Hyopotamus* was the jaw of a young animal, containing in series the permanent true molars and two temporary molars in advance.

The third upper premolar tooth of *Hyopotamus americanus*, represented in figures 3, 4, to the left, is inserted by two fangs, one internal to the other. The crown is half as wide again transversely as it is antero-posteriorly or longitudinally. It is composed of a transverse pair of lobes, as in the posterior pair of premolars of *Anthracotherium*, and as is the case in the upper premolars of ordinary ruminants. The external lobe resembles the corresponding ones of the true molars, but is slightly less in size, and it has its basal angles proportionately less prominent externally. It is worn at the summit and along the anterior border, so as to exhibit a narrow tract of exposed dentine. The internal lobe is considerably smaller and more regularly conical than the other, and is slightly more anterior than posterior in its relation with it. It presents a sub-acute ridge antero-externally joining the base of the outer lobe, and a similar ridge postero-internally continuous as a basal ridge, joining the contiguous portion of the base of the outer lobe. A thick, acute-edged basal ridge bounds the front of the crown and associates the two lobes. The summit of the internal lobe is worn so as to exhibit a central circular spot of dentine.

The second upper premolar, represented in figures 3, 4, to the right, resembles the corresponding tooth of *Anthracotherium magnum*. It is inserted in the jaw by three fangs,—two externally, and one postero-internally. The crown is widest in an opposite direction to the former teeth, being greatest antero-posteriorly, and is least in the length. It is trihedral, and is mainly composed of a broad conical lobe, situated obliquely fore and aft in relation with the tooth behind. The broad surfaces are separated by acute ridges, of which the anterior is slightly inflected, and the posterior is reflected and ends at the summit of an abutment formed by the projecting base of the lobe postero-externally. The outer surface of the crown is convex anteriorly and concave posteriorly, with the base prominent and longitudinally corrugated. Internally the crown is bounded by a basal ridge forming a right angle, and including within the rounded angle postero-internally a moderately large tubercle. In front of the latter the basal ridge is more or less tuberculate; behind, it is more even and continuous, and has an acute edge. The inner slope of the crown is most prominent just in advance of the middle, and in front is somewhat depressed. The summit and posterior border of the crown are slightly worn.

The lower jaw of *Hyopotamus bovinus* possesses a continuous row of six molars, and has the first premolar removed from the others by a wide interval. The specimens above described would appear to indicate that the first premolar was not separated from the others in the animal to which they belonged. This fact, coupled with the one that the only specimen of an inferior molar we have the opportunity of examining presents slight difference from the corresponding tooth of *H. bovinus*, may indicate the American animal as pertaining to a genus different from either *Hyopotamus* or *Anthracotherium*.

The specimen of an inferior molar, figures 5, 6, consists of the crown of the last of the series, without its hinder or fifth lobe. It nearly resembles the corresponding portion of the same tooth in *Hyopotamus bovinus*. It is composed of two transverse pairs of pyramidal lobes, of which those external are considerably the larger, and they embrace the internal ones. The latter are comparatively narrow, convex externally, and devoid of all trace of a basal ridge. They present an antero-external subacute ridge descending to the interspace separating them from the external lobes. The ridge of the postero-internal lobe is the more prominent, and is more external. The antero-internal lobe presents another sub-acute ridge posteriorly, the correspondent of which is undeveloped in the lobe behind. The external lobes of the crown are angularly convex outwardly, slightly depressed in front and behind, and deeply separated by the intervening valley. From their summit acute ridges diverge outwardly, and embrace the bases of the internal lobes. The anterior ridge of the antero-external lobe descends in front of the base of the contiguous internal lobe, and there appears to have ended in a prominent tubercle, which is broken off in the specimen. The posterior ridge of the former lobe produces a transverse festoon between its summit and that of the latter one. The anterior ridge of the postero-external lobe descends to the interval of the internal lobes, and then bends forward, outward and upward to the festooned ridge between the anterior pair of lobes. The posterior ridge of the same lobe descends behind the base of the postero-internal lobe, and there appears to have become continuous with the ridge of the posterior lobe, which is lost in the specimen. A thick indented basal ridge occupies the fore part of the crown, but not elsewhere, except as a tubercle at the exit of the transverse valley.

The measurements of the specimens referred to *Hyopotamus americanus* are as follow:

	Lines.
Length of the upper true molar series,	35
Antero-posterior diameter of last true molar,	13½
Transverse " " "	15
Length of crown,	7½
Antero-posterior diameter of second true molar,	13
Transverse " " "	14
Antero-posterior diameter of first true molar,	10
Transverse " " "	11
Antero-posterior diameter of third premolar,	6
Transverse " " "	9
Antero-posterior diameter of second premolar,	10
Transverse " " "	8½
Antero-posterior diameter of last lower molar, estimated,	17
Transverse " " "	8

ANOPLOTHERIDÆ.

To this ancient and extinct family, typified by the curious *Anoplotherium* of the eocene formations of Europe, I have referred the genus *Titanotherium*, a huge animal whose remains are characteristic of the lowest bed of the tertiary deposits of the Mauvaises Terres. The remains are associated with those of *Hyopotamus*, *Lophiodon*, and *Rhinoceros occidentalis*, and the bed in which they are found, marked A in Dr. Hayden's tables, immediately overlies the cretaceous formation of Dakota.

TITANOTHERIUM.

This extinct genus appears to be nearly allied with *Chalicotherium*, and, like it, approximates the even-toed pachyderms, or Artiodactyla, as previously defined, with the Ruminantia. From the form of its lower true molars, which were first discovered, it was supposed to be more nearly allied with the *Palæotherium*, and was hence placed among the uneven-toed pachyderms, or *Perissodactyla*, but the nearly complete dentition of both jaws, since discovered, appear to indicate its position to be as above stated.

Titanotherium Prouti.

The animal thus named was of comparatively huge proportions, and larger than any of those with which its remains are found associated in the miocene deposits of Dakota. A notice of the great extinct pachyderm was first published by Dr. Hiram A. Prout, of St. Louis, who described a fragment of the lower jaw as pertaining to a large species of *Palæotherium*. The specimen was the first of the mammalian fossils brought to the knowledge of naturalists from the great cemeteries of Dakota and Nebraska.

Besides the specimen described by Dr. Prout, I have had the opportunity of examining many others derived from the same locality, in collections subsequently made by different explorers. The specimens consist of fragments of jaws with teeth, isolated teeth and fragments of others, together with portions of bones of other parts of the skeleton. They are usually much fractured, and are pervaded by fissures in all directions, the result of pressure whilst imbedded in the strata to which they belong. The fragments are generally retained in their original position, cemented together by portions of the imbedding matrix, or they are but slightly displaced. If it were not for this coherence of the fragments, the specimens would be crumbled into a multitude of particles.

The most characteristic specimen of *Titanotherium Prouti* I have had the opportunity of inspecting consists of alveolar portions of the upper jaw, including the intermaxillaries, and containing nearly all the molar teeth, with the sockets of the others. It was obtained, together with several additional molars, a fragment of a lower jaw, and portions of other bones, by Messrs. Meek and Hayden, and belongs to the collection of Prof. James Hall, of Albany, N. Y., by whom it was loaned to me for examination. A complete series of the molar teeth, as restored from the two sides, together with the fore part of the jaw, is represented in figures 1, 2, plate XXIV, three-fourths the size of nature.

Other important specimens consist of portions of lower jaws with teeth, previously described in the Ancient Fauna of Nebraska, and a number of isolated molar teeth since obtained by Drs. Hayden and Evans.

The corresponding teeth from different individuals vary considerably in size and in the degree of development of a basal ridge. The variation is probably due to a difference in sex,—the more robust belonging to the male, the others to the female.

The formula of dentition of *Titanotherium* can be ascertained with certainty from the different fossil specimens, except as concerns the number of inferior incisors. The upper jaw specimen of Prof. Hall's collection, above mentioned, indicates the following series:

$$\text{In. } 2\text{—}2,\ \text{c. } 1\text{—}1,\ \text{p. m. } 4\text{—}4,\ \text{m. } 3\text{—}3 = 20.$$

Fragments of lower jaws exhibit the same number of molar and canine teeth, and probably there existed also the same number of incisors as in the upper jaw.

The upper molar teeth form a continuous row, successively increasing in size from first to last. The true molars are constituted alike after the same pattern, and they are related in position with one another as in *Palæotherium*, *Anoplotherium*, *Rhinoceros* and the ruminants. The outer sides are oblique, with the antero-external border projecting outwardly and a little in advance of the back part of the contiguous tooth. The upper premolars appear as contracted or less well-developed forms after the pattern of the true molars. Their outer sides are placed together nearly on the same line.

The upper canines are separated from the molars by a comparatively short hiatus.

The upper incisors follow close upon the canines, and those of the two sides are separated by a concave notch, about half an inch in width, in the fossil under examination.

The lower molar teeth form a continuous row, and are also separated from the canines by a small hiatus.

Thus it appears that the teeth of *Titanotherium* form rows in each jaw almost as close as in *Anoplotherium*, small intervals existing between the canines and molars, and between the incisors of the two sides, in consequence of the absence of the first of the usual number of these latter teeth as existing in *Anoplotherium* and many other animals.

Superior true molars.—The upper true molars of *Titanotherium*, figures 1, 5, 6, 7, plate XXIV, have broad square crowns, which successively increase in size from first to last. In the first the transverse diameter exceeds the antero-posterior, in the second the diameters are nearly equal, and in the third the antero-posterior exceeds the transverse.

The crowns are composed of four principal lobes, as in *Chalicotherium*. The outer pair of lobes resemble in their general form and relationship the corresponding ones of the last-named genus, those of *Anoplotherium*, of the recent Deer, &c. Externally they present a pair of inclined planes sloping downward and inward, and ending at the triturating border in angular points. Laterally these planes are bounded by thick, convex, buttress-like ridges, which expand in an arching manner at the base of the lobes. The posterior buttress is less well-developed than the others, especially in the first and second true molars. (See figures 1, 2, 5, 6, 7.) The anterior of the two planes just mentioned presents a comparatively feeble median longitudinal ridge, which is absent in the posterior plane. The base of the outer lobes externally is somewhat thickened, and in most of the true molars under examination is devoid of a distinct basal ridge. In some specimens, however, a conspicuous basal ridge exists, as in the first and second molars represented in figures 5 and 6, and as well seen in the fragments represented in figures 11—13, plate xvii, of the Ancient Fauna of Nebraska.

In the unworn teeth the inner surfaces of the outer lobes are transversely convex, and slope from their bottom with a feeble concavity towards the triturating border.

Of the inner lobes of the crown the anterior is rather the larger, and is nearly median in position. It is in the form of a broad cone projecting from a concave basin, except where it contributes to the swollen base of the crown internally. See figures 1, 5, 6, 7

The posterior of the inner lobes resembles that in advance, as seen in the first and second molars represented in figures 5 and 6, or in other specimens it assumes more or less the form of a three-sided pyramid, as represented in figures 1, 7. In the latter condition the three sides are bounded by as many ridges, of which two contribute to the posterior and internal borders of the crown. The third ridge proceeds obliquely from the point of the pyramidal lobe outward and forward to terminate opposite the middle of the base of the postero-external lobe of the crown. The inner face of the pyramid is vertical and convex; the other two faces, directed forward and outward, are convex in the first true molar, sloping planes in the second, and concave in the last molar.

In advance of the antero-internal lobe a thick ridge curves from its base to the fore part of the antero-external lobe. This ridge, a constituent element of a basal ridge, successively enlarges in passing from the first to the last of the true molars, occupying the angular interval between the anterior two lobes of the crown. In the second and third molars it almost assumes the importance of an additional lobe. Though holding nearly the position of the anterior of the three internal lobes in the true molars of *Anoplotherium*, it appears not to be homologous with it, but with the element of a basal ridge at the bottom of that lobe. It corresponds with a similar thick ridge in the same relative position in the true molars of *Chalicotherium*.

The antero-posterior valley of the crown of the upper true molars of *Titanotherium* follows the zig-zag course of the base of the inner sides of the outer lobes, and communicates with that surrounding the base of the antero-internal lobe. Its bottom is rather irregular, being more or less interrupted by pits and tubercular processes. A deep pit occupies the valley at the bottom of the postero-internal face of the antero-external lobe, and a shallower and less distinct one is situated in a corresponding position in relation with the postero-external lobe.

In the trituration to which the upper true molars of *Titanotherium* were subjected in mastication, the acute crescentic summits of the outer lobes were first worn away. As the enamel was removed, W-shaped tracts of dentine were exposed, bordered by the former substance. The dentinal tracts gradually widened and extended to the bottom of the antero-posterior valley of the crown, and the inner enameled sides of the outer lobes were thus obliterated. (See figures $1_{5,6,7}$, 5, 6, 7, plate XXIV.) It was not until about this stage of wearing that the dentine began to be exposed at the apices of the inner pair of lobes, and it was only after the enamel had been worn away from the outer lobes and across the antero-posterior valley of the crown that considerable circular or ovoidal islets of dentine became apparent by the abrasion of the inner lobes, as seen in the first true molar, represented in figures 1, 5, plate XXIV. In this condition the anterior deep pit of the antero-posterior valley appears with its lining of enamel surrounded with dentine, and connected with the enamel of the base of the antero-internal lobe by a narrow isthmus, as seen in the first and second true molars represented in figures 1, 5, 6.

An isolated upper last molar, represented in figure 7, plate XXIV, two-thirds the size of nature, less worn than in the complete series above indicated, also exhibits a less proportionate degree of development of the back part of its crown.

Superior premolars.—The first upper premolar, figure $1, _1$, plate XXIV, of *Titanotherium,* in the upper jaw specimen of Prof. Hall's collection, is a small tooth about a fourth the size of the succeeding one. The crown in its present condition is trilateral, and is worn on the triturating surface so as to leave a broad exposed tract of dentine sloping in a somewhat convex manner inward and forward to the base. The external surface of enamel presents an indentation, indicating a pair of lobes as having entered into the composition of the outer portion of the crown, as in the better developed succeeding teeth. The triturating surface also at its back part presents a triangular process of enamel dividing off the inner portion of the crown, which in the unworn condition formed a rudimental lobe.

The succeeding three premolars, figure $1, _{3, 4, 5}$, of the same specimen, successively increase in size, and have quadrate crowns with the transverse diameter exceeding that from before backward, the disproportion successively increasing. In some specimens the disproportion is greater than in others, as represented in figures 3, 4, in comparison with the corresponding teeth in figure 1.

The crowns of these premolars are constituted of four lobes as in the case of the true molars, but they are less distinctly or separately developed. Indeed, the crowns of the premolars appear like those of the true molars, reduced in proportions and conjoined antero-posteriorly in such a manner that the inner and outer pairs of lobes appear connate as a result.

Externally the outer lobes are not separated by a prominent median buttress, as in the true molars, but present a broad surface more resembling the condition of the corresponding surface in the upper molars of *Rhinoceros.* The base and lateral borders are somewhat swollen, and in some specimens a basal ridge exists. The lobes terminate at the triturating border in angular points blunted by attrition. A convexity or ridge, varying in the degree of prominence, descends to each point, and an intervening depression defines the lobes. The internal faces of the outer lobes form convex buttress-like prominences, separated from the inner lobes by an antero-posterior zig-zag valley as in the true molars.

The inner pair of lobes of the crown are more or less completely connate. The anterior lobe is much larger than the posterior. Together they form an oblong conoidal eminence, gradually narrowing from before backward, but rather abruptly enlarging at the posterior extremity. The inner lobes are enclosed by a stout basal ridge, as represented in figures 3, 4, plate XXIV, and also in figures 1—7, plate xvii, of the Ancient Fauna of Nebraska, or the ridge may be interrupted internally as seen in figure 1, $_{2, 3, 4}$, plate XXIV.

The antero-posterior valley of the crowns of the three premolars under consideration resembles that of the true molars, and, like it, is interrupted by two pits, occupying the same relative position. The posterior pit is much deeper than the corresponding one in the true molars, and approaches in this respect the anterior pit.

In the trituration to which the premolars were subjected in mastication they passed through the same steps as the true molars. As the outer lobes wore away, gradually widening W-like tracts of dentine encroached upon the antero-posterior valley. As the inner connate lobes were worn away, a clavate tract of dentine became exposed, which, gradually widening from abrasion, became continuous by its anterior broader end with the dentinal tract of the antero-external lobe across the antero-posterior valley.

The upper true molars of *Titanotherium* bear a near resemblance to those of *Chalicotherium,* but the premolars are much better developed in their relation with the former than in this genus.

Inferior true molars.—Of lower true molars of *Titanotherium* the specimens already described in the Ancient Fauna of Nebraska are the best preserved I have had the opportunity of examining. (See figures 1, 2, 3, 8, 9, 10, plate xvi, and figures 8, 9, 10, plate xvii, of the Ancient Fauna of Nebraska.)

The lower true molars of *Titanotherium* are constructed upon the same pattern as those of *Palæotherium, Anoplotherium, Chalicotherium* and *Anchitherium.* The crowns of the first and second are each composed of a pair of lobes; that of the last possesses an additional less well-developed lobe.

The inner side of the crown of the true molars forms a vertical, somewhat uneven plane, divided towards the triturating border into angular points separated by angular notches. In the first and second molars there are three of these points, with two intervening notches; in the last one, four points and three notches.

The constituent lobes of the crown are demi-conoidal and confluent internally and at the base. Externally they are sloping and transversely convex, and are separated by deep angular valleys. In this position they are bounded by a basal ridge, usually continuous, but sometimes nearly interrupted where the lobes are most prominent. In the unworn teeth the summits of the lobes are acute and angularly crescentoid, and they ascend to a median point externally and terminate in the angular points of the crown externally. Between the points mentioned the lobes embrace concave valleys opening in an angular manner internally.

As the lower true molars were worn (see figure 3, plate xvi, figures 8, 9, plate xvii, Anc. Fauna of Neb.), crescentic tracts of dentine became exposed upon the abraded summits of the lobes. These tracts gradually widened, and those of the contiguous lobes became conjoined. The abrasion continuing, the internal concave valleys of the lobes became gradually obliterated, leaving upon the crown a broad yoke-shaped tract of dentine bordered by thick enamel.

Premolars.—A fragment of a lower jaw belonging to the collection of Prof. Hall indicates the existence of four premolars, but none of the teeth have been preserved in the specimen.

An isolated, much worn premolar, apparently a third, is represented in figures 8—10, plate xvi, of the Ancient Fauna of Nebraska. It has a bi-lobed crown of the same form as in the true molars, but is much smaller. The worn triturating surface exhibits a broad yoke-like tract of dentine bordered by enamel.

Figures 9—12, plate XXIV, represent two isolated premolars, probably the second and first. They have likewise bi-lobed crowns constructed after the pattern of those of the true molars, but much reduced in size, and in a more rudimental condition of development.

Figure 8 represents the crown of an isolated superior premolar, probably the second of the temporary series. The anterior extremity is worn off apparently by the lateral pressure of a first lower premolar. The specimen differs from the permanent premolars not only in the prolongation of its fore part, but also in the greater distinction of the constituent lobes, the inner ones being separated as much as in the upper permanent true molars. The tooth may probably belong to an animal quite distinct from *Titanotherium*.

Canines.—The canine teeth of *Titanotherium* are of moderate proportions, and are situated but a short distance in advance of the molar series.

In the upper jaw specimen, figs. 1, 2, plate XXIV, of Prof. Hall's collection, the sockets for the canines are curved conical, and measure at their exit rather more than an inch in diameter.

The figures 11, 12, of plate xvi, of the Ancient Fauna of Nebraska, represent the crown of a canine tooth supposed to have belonged to the lower jaw represented in figure 2 of the same plate. It is curved conical, with the inner smaller and less convex surface defined from the outer by rather obtuse or sub-acute ridges. It is provided with a basal ridge, which is more strongly developed internally. The apex of the crown is worn off, and the wearing extends downward a short distance externally so as to exhibit there an oval tract of exposed dentine. The length of the crown is over an inch and a half; its diameter from before backward at the base an inch.

An additional specimen, of about the same size as the preceding, but more blunt at the apex from abrasion, has the same form, but has the basal ridge undeveloped externally.

Another specimen, consisting of the crown of a canine tooth, is supposed to belong to the upper jaw of *Titanotherium.* It is larger than the crown of the supposed lower canines, and is devoid of a basal ridge. It further differs in the course of the subacute ridges defining the inner and outer surfaces, which descend nearly straight from the apex in the lower canines, but in the upper one curve inward and towards each other approaching the base. The apex of the specimen is worn off horizontally, and presents a lenticular excavation of the dentine bordered by enamel. The length of the specimen in its present condition externally, where greatest, is seventeen and a half lines; the antero-posterior diameter of the crown is fifteen lines, and the transverse diameter thirteen and a half lines.

An additional specimen consists of the greater portion of an unworn crown of a canine tooth of the same shape as the former, but of less size. Its length externally is sixteen and a half lines.

Incisors.—As previously indicated, the upper jaw specimen of *Titanotherium,* figure 1, plate XXIV, in Prof. Hall's collection, proves the existence of a pair of incisor teeth on each side, but, with the exception of a single fang, the alveoli only are preserved. The alveoli are close to the canines, and those of the two sides are separated by a transverse concave notch about half an inch in width. The alveoli are antero-posteriorly oval, and nearly equal in size.

Structure of the teeth.—The teeth appear devoid of coronal cementum. The enamel is from the fourth of a line to a line and a half in thickness, and, taking into view the size of the teeth, is comparatively smooth. Upon the outer sides of the molars it is more or less finely corrugated, and marked by contour lines of growth. Moderate abrasion or friction appears comparatively early to have made the surfaces smooth and highly polished. In the fossils the enamel is stained steel-gray, and in many positions exhibits a high polish.

Upper maxillary and intermaxillary bones.—The upper jaw specimen of *Titanotherium,* of Prof. Hall's collection, consists of small fragments of the alveolar portions of the maxillaries and the greater portion of both intermaxillaries. The latter are co-ossified with the former, and the course of the intervening suture is obliterated.

The intermaxillaries project but little in advance of the position of the canine alveoli. The front of the snout, in advance of the lateral convex prominences produced by the latter, presents a broad slope about four inches in width and three in depth below the inferior concave nasal border. The nasal orifice was about three inches in width.

The hard palate between the position of the canine and incisive alveoli is deeply arched. The anterior palatine foramina are comparatively small, about the third of an inch in diameter, and lead into defined grooves descending internal to the position of the first incisors.

Inferior maxilla.—Small fragments of the lower jaw, with mutilated condyles, present these as having nearly the same relative position and shape as in *Rhinoceros.* They are transverse, clavate convexities, with the narrow extremity internal. The coronoid process, broken away in the specimens, starts at its root about an inch in advance of the condyle. The notch separating the two is broad and shallow.

The specimens under examination are too imperfect to determine the form of the back part of the lower jaw. The posterior border appears as if it had curved upward from the base as in *Rhinoceros.*

The outer vertical sides of Dr. Prout's specimens, described in the Ancient Fauna of Nebraska (figure 1, plate xvi of that work), measure below the middle of the last molar five and a half inches in depth; and the convex base of the same, below the first true molar, is two and a quarter inches in thickness.

A fragment of a lower jaw, belonging to Prof. Hall's collection, has a depth of five inches below the first true molar, and a thickness of two and a half inches.

The base of the jaw is antero-posteriorly convex, as in *Anoplotherium* and *Rhinoceros.* The chin presents a broad sloping surface as in the latter genus. Two mental foramina are situated below the position of the second premolar tooth.

Measurements of the jaws and teeth of *Titanotherium* derived from different specimens are as follow:

1. Measurements of the upper jaw and teeth from the specimen in Prof. Hall's collection; one series of the teeth being represented in figures 1, 2, plate XXIV:

	Inch.	Lin.
Width of space between canines occupied by incisors, . . .	2	3
From incisive alveoli to entrance of nasal orifice, . . .	3	4
Width of face outside of canine alveoli, ...	4	2
Distance from incisive alveoli to back of last molar, . . .	17	
Length of series of the molar teeth, ...	14	
Length of true molar series, ...	9	

		Inch.	Lin.		Inch.	Lin.
Diameter of last true molar,	antero-posteriorly,	3	10;	transversely,	3	5
Diameter of second "	"	3	3	"	3	5
Diameter of first "	"	2	4	"	2	10
Diameter of last premolar,	"	1	7	"	2	5

	Inch.	Lin.		Inch.	Lin.
Diameter of third premolar, antero-posteriorly,	1	5;	transversely,	1	11
Diameter of second " "	1	2	"	1	7
Diameter of first " "		10	"		9

2. Measurements of three specimens of second upper true molars:

	Inch.	Lin.	Inch.	Lin.	Inch.	Lin.
Diameter antero-posteriorly, . . .	4		3	7	3	6
Diameter transversely	3	4	3	4	3	4

3. Measurements of two specimens of first upper true molars:

	Inch.	Lin.	Inch.	Lin.
Diameter antero-posteriorly, ...	2	11	2	8
Diameter transversely, ...	3	1	2	9

4. Measurements of four specimens of third or fourth upper premolars:

	Inch.	Lin.	Inch.	Lin.	Inch.	Lin.	Inch.	Lin.
Diameter antero-posteriorly, .	1	11	1	11	1	10	1	10
Diameter transversely, . .	2	7	2	5	2	7	2	7

5. Measurements of two specimens of second or third upper premolars:

	Inch.	Lin.	Inch.	Lin.
Diameter antero-posteriorly, ...	1	8	1	6
Diameter transversely, ...	2	1	2	

6. Measurements from a fragment of a lower jaw in Dr. Owen's collection:

	Inch.	Lin.
Depth of lower jaw back of last molar, ...	6	3
Length of true molar series, ...	9	4
Diameter of last true molar, antero-posteriorly, ...	4	
Diameter of second " "	3	
Diameter of first " "	2	3
Diameter of last premolar, "	1	9
Diameter of third " "	1	4

7. Measurements from two fragments of a lower jaw in Dr. Prout's collection:

	Inch.	Lin.
Depth of lower jaw back of last molar, ...	7	6
Length of series of true molars, ...	10	9
Diameter of last true molar, antero-posteriorly, . . .	4	6
Diameter of second " "	3	3
Diameter of first " "	2	8

8. Measurements from a fragment of a lower jaw in Prof. Hall's collection:

	Inch.	Lin.
Length of premolar series, ...	7	
Depth of lower jaw back of last premolar, ...	4	8

9. Measurements of isolated lower true molars:

	Inch.	Lin.	Inch.	Lin.
Diameter of last true molars, antero-posteriorly, . .	4		4	4
Diameter of second " " . .	2	9	3	

Occipital condyle.—An occipital condyle of *Titanotherium*, in Dr. Evans' collection, appears less bent than in *Rhinoceros*. It measures four inches four lines in its long diameter, and nearly three inches in its short diameter.

The different collections of fossils, from the Mauvaises Terres of White River, submitted to my examination, contain a large quantity of fragments of huge bones, which appear to be entirely referable to *Titanotherium*, though most of them are so mutilated and weather-worn as to have their characteristic markings obliterated. Among the better preserved specimens, corresponding ones differ so much in size as to lead to the suspicion that they belong to two different species. The evidence at present appears to me to be insufficient to justify a separation, and I have therefore viewed the fossils as pertaining to different-sized individuals and sexes of a single species.

An enigmatic specimen, among the fossil bones attributed to *Titanotherium*, resembles the horn core of the hollow-horned ruminants, nor have I been able to make anything else of it. It is a comparatively short, stout, slightly curved cone, rather more compressed or wider in one direction than the other. The apex is blunt and roughened. The constitution of the specimen strongly resembles that of the horn core of an Ox. The base exhibits a coarser cellular structure, and the largest cell of the specimen was occupied by a crystal of calcite about an inch in diameter. The length of the specimen is six inches; the breadth within a couple of inches of the broken base is about four inches one way and three inches the other. Should this peculiar specimen really belong to *Titanotherium*, it would place the animal in nearer relationship with the ruminants than I had suspected.

Vertebræ.—Of portions of two specimens of the second cervical vertebra, the more perfect measures about five inches in length from the summit of the odontoid process to the posterior margin of the body. Posteriorly the latter is strongly concave.

An isolated body of a posterior cervical vertebra is short in comparison with its breadth, and is convex anteriorly and concave posteriorly. It measures about two inches in length, and anteriorly about four inches in breadth. The spinal canal, between the roots of the vertebral arch, is two and a half inches in width. Another cervical vertebra has the same length as the preceding, but is less equal in its breadth, the transverse diameter being an inch less than the vertical. The depth of its posterior concavity is half an inch.

Besides a number of fragments, together with several entire dorso-vertebral bodies with detached epiphyses, of young animals, there are under examination five adult specimens of bodies of dorsal vertebræ. These are convex anteriorly and concave posteriorly, and are short in comparison with their width, though not to the same degree as in the proboscidean pachyderms. The largest of the specimens is two and a half inches in length by about four inches in breadth, with the spinal canal about two inches in width. The smallest specimen is two and a quarter inches long, and three and three-quarter inches in breadth. The articular facets for the ribs, as in the Elephant, are sustained on strong lateral processes, and are deeply concave.

Several isolated heads of ribs present a spheroidal form, and have their facets separated by wide sub-angular fossæ. They measure from an inch and a half to an inch and three-fourths in diameter.

Anterior extremities.—An isolated head of a right humerus is a segment of a sphere with an ellipsoidal outline, and measures five and a half inches in its long diameter. A specimen consisting of the upper extremity of a right humerus, with the head about the same size as that just indicated, though too much mutilated to determine its exact form, when perfect appears to have measured about a foot in circumference ten inches below the head. Another specimen, consisting of the upper extremity of a left humerus, has the head about five and a half inches in its long diameter, and the short diameter about an inch less. The greatest breadth of the head and external trochanter together has been over eight and a half inches.

Six specimens, considerably mutilated, of distal ends of the humerus, exhibit a radio-ulnar articulation nearly like that of the *Rhinoceros*. The largest specimen measures about nine and a half inches in breadth at the tuberosities of the condyles, and the radio-ulnar articulation is five inches in width.

The bones of the fore-arm were as well developed in relation with each other as in the *Rhinoceros*.

The upper extremity of an ulna exhibits some resemblance to the corresponding part in the latter animal. The bone, back of the articulation, is comparatively broad and thin. The two sides are concave. The olecranon rises over seven inches above the summit of the articulation, and is about five and a half inches wide near its middle. Its summit, inclining downward and outwardly towards the posterior border, is thick, tuberous, and deeply impressed by the insertion of the tendon of the extensor cubiti. The articulation is divided into two unequal parts by a deep notch externally, narrowing into a groove conducting inwardly and downward to a deep irregular fossa, on the front aspect of the bone, separating the two sides of the radial articulation. The upper division is trapezoidal in outline, about six inches, in its long diameter, obliquely crossing the fore part of the bone from without inwardly and downward. The smaller division is sub-oval and about an inch and a half in diameter; and it articulated with the inferior part of the external condyle of the humerus. Both divisions of the humeral articulation are extended downward for the articulation of the radius. The breadth of the two divisions together of the radial articulation is about five and three-quarter inches.

Two mutilated specimens of the upper extremity of the radius have nearly the same form as in the *Rhinoceros*. The smaller specimen is five and a quarter inches wide and three inches from before backward.

Two specimens of the distal extremity of the radius measure severally six, and seven and a half inches at their widest part. The carpal articular surface of the smaller specimen in its perfect condition has been about five inches wide and two and a half inches from before backward.

Posterior extremities.—A small fragment of a hip bone has an acetabulum five inches in diameter.

Three mutilated upper extremities of the femur have the head averaging about four and three-fourths of an inch in diameter. Another specimen has the head five inches in diameter. In all, the head exhibits a large fossa for the attachment of a terete ligament.

A specimen of the lower end of a femur, nearly two feet in length, in the collection of Prof. Hall, has a cylindroid shaft, somewhat compressed antero-posteriorly and measuring at its narrowest part about nine inches in circumference. The shaft exhibits no trace of a third trochanter, such as exists in many pachyderms. The lower end of the bone measures about seven inches in breadth.

An imperfect patella indicates a length of about five inches and a breadth of three inches. Its form is ovoid, with the narrow end downward. The trochlear surface is nearly equally divided by the usual carina, and the lateral facets are concave.

Of three mutilated specimens of the proximal end of the tibia, the best preserved exhibits a breadth of about six inches posteriorly, and the thickness, including the tubercle for the ligament of the patella, is nearly as great. The two articular surfaces are bounded behind by a wide shallow concavity. The outer one is trapezoidal in outline, slightly concave transversely and convex antero-posteriorly. The inner one is sub-oval and slightly concave.

Of four specimens of the distal end of the tibia, the most perfect is four and a half inches broad, and nearly resembles the corresponding part in the *Rhinoceros*.

The number of toes possessed by *Titanotherium* I have not been able to ascertain.

PERISSODACTYLA.

Under this name, originally employed by Professor Owen, I distinguish an order including all the uneven-toed animals of the order of Pachydermata of Cuvier, but excluding the Solidungula, which are included by the former authority. Thus restricted, the order is represented in the tertiary fauna of Dakota and Nebraska by half a dozen species, mostly of extinct genera.

The genus *Lophiodon* is indicated by remains, found in association with those of *Hyopotamus* and the much more abundant ones of *Titanotherium*, in the lowest stratum of the Mauvaises Terres tertiary deposits of White River. The stratum, marked as bed A in Dr. Hayden's tables, immediately overlies the formation of cretaceous age of the region.

Remains of *Rhinoceros*, in comparative abundance, are found throughout the whole series of strata of the miocene formation of White River. Those of another genus of the same family—*Hyracodon*—are found in the same series of strata except the first one, or that designated as bed A by Dr. Hayden.

Three species of as many genera—*Rhinoceros*, *Elephas* and *Mastodon*—belong to the pliocene formation of the Niobrara River, occupying bed F of Dr. Hayden's tables.

Included in the account of this order there are noticed two additional species of *Rhinoceros*, from the tertiary formations of Texas and California, and probably of miocene age.

RHINOCEROTIDÆ.

Among the most interesting and unexpected palæontological discoveries in America is that of the former existence of the Rhinoceros family upon this continent. The remains of five distinct species have been brought to my notice from the States of Dakota, Nebraska, Texas and California. Numerous remains of two of the species have been collected, by different explorers, in the Mauvaises Terres of White River, Dakota. These belong to the miocene formation. One of the species was probably a hornless Rhinoceros of the sub-genus *Aceratherium*. The other has been referred to a new sub-genus, with the name of *Hyracodon*. It was a small hornless animal, provided with a full series of incisors and canines, as well as of molars.

A third species larger than either of the preceding, distinguished under the name of

Rhinoceros crassus, is indicated by a few remains discovered by Dr. Hayden on the L'eau-qui-court, or Niobrara River, Nebraska. It is of pliocene age, and belongs to bed F of Dr. Hayden's sections.

A fourth species, named *Rhinoceros meridianus*, is indicated by the fragment of a tooth obtained from a tertiary deposit of Washington county, Texas, and submitted to the author for examination by Dr. B. F. Shumard.

The remaining species, named *Rhinoceros hesperius*, is indicated by portions of a lower jaw from Calaveras county, California, submitted to my inspection by Professor J. D. Whitney.

RHINOCEROS.

Rhinoceros occidentalis.

The species to which the above name has been appropriated has been previously described in Dr. D. D. Owen's Geological Report of Wisconsin, &c., and subsequently more fully in the Ancient Fauna of Nebraska, and is represented in plates xii and xiii of that work.

The species was between a half and three-fourths the size of the living Indian *Rhinoceros*, and is indicated by a comparative abundance of remains. The collection of every explorer of the Mauvaises Terres submitted to my inspection contains specimens consisting of much mutilated skulls, fragments of others, portions of jaws with teeth, isolated teeth, and bones of other parts of the skeleton. The greater portions of three skulls, as far as their anatomical characters can be compared, agree with one another in size, proportions, and details of form, as much as usual among the different individuals of a species.

The best specimen of the skull of *R. occidentalis* I have had the opportunity of examining is that from the collection of Dr. Owen, already described in the Ancient Fauna of Nebraska, and represented in plate xii, and figure 1, plate xiii, of that work, and reproduced in plate XXII of the present work. It is an adult specimen, and is nearly three-fourths the size of that of the Indian *Rhinoceros*. It is unaccompanied by the lower jaw, and has lost a great portion of the right side and the end of the snout. To make up for the loss of the lower jaw, I have the opportunity of examining one containing a full series of teeth, in the collection of Prof. James Hall, besides several other specimens containing the molar teeth.

Side view of the skull.—In outline, the side view of the skull, plate XXII, figure 2, of *R. occidentalis*, presents the form of an irregular transversely oblong square, pointed at the fore part. In comparison with the skull of the Indian *Rhinoceros* it appears as if it had the two extremities pressed above from each other so as to be rendered nearly horizontal the greater part of its length.

The temporal fossa is proportionately longer, but of less depth than in the Indian *Rhinoceros.* Anteriorly it is better defined from the orbit, from the greater prominence outwardly of the supra-orbital boundary and of the ridges converging to the latter from the sagittal crest and from the vicinity of the spheno-orbital foramen. Behind, it extends upon a wide everted border separating it from the inion.

The temporal fossæ are separated from each other at the upper back part of the cranium by a short thick sagittal crest, which is longitudinally grooved and early divided into the temporal ridges. These are long and prominent, and diverge at a very acute angle in a curvilinear manner.

The temporal surface inclines more than in the Indian *Rhinoceros,* both at the side of the cranium and upon the root of the zygoma. The latter springs from near the middle of the lower part of the temporal region.

The side of the face forms a nearly vertical plane sloping inwardly and forward, and is rather abruptly defined from the upper part. In front of the orbit it is of greater width fore and aft proportionately than in the Indian *Rhinoceros.*

The orbit is less advanced in position relatively than in the latter, its anterior margin corresponding in position with the interval of the fifth and sixth molars. The orbital entrance forms about three-fourths of a circle, with a diameter of about two inches and a quarter. Its plane is nearly vertical, but has a feeble inclination downward and a slightly stronger one forward. It is bounded above by a thick, convex, roughened supra-orbital prominence forming part of the lateral boundary of the forehead. The floor of the orbit is more deeply excavated, and the roof is more extensive proportionately than in the Indian *Rhinoceros.*

The facial surface of the lachrymal is about as large proportionately as in the latter, and is somewhat depressed beneath the extension forward of the supra-orbital prominence. At the orbital margin it is produced in a roughened process, within which there appear to be two lachrymal foramina, one above the other.

The naso-maxillary suture descends obliquely for two and a quarter inches, and at its lower part is not more than the fourth of an inch distant from the upper end of the premaxillary bone. The latter extends higher than in the Indian *Rhinoceros,* and is connected with the contiguous maxillary bone by a strong serrated suture.

The infra-orbital foramen is situated about an inch and a half above the interval of the second and third molar teeth.

The forehead and upper fore part of the face together form a long, lozenge-shaped, nearly horizontal plane. The forehead extends backward in a long somewhat acuminate triangle between the temporal ridges, and appears depressed from the prominence of the latter. Where the temporal ridges at their fore part begin to turn downward they lose their upward prominence, and the forehead intermediately appears nearly level. On each side it forms the supra-orbital prominences before mentioned, which extend forward towards the upper lateral border of the snout. Between the supra-orbital prominences the forehead is transversely concave, and is narrowed towards the nasals. The back parts of the latter are broad and incline towards each other, but laterally turn downward upon the side of the face. The fronto-nasal suture forms a double crescent, with the contiguous horns directed into the internasal suture, which remains open.

The occipital region is much mutilated in all the skulls under examination. It appears to have been proportionately more prominent over the position of the occipital foramen than in the Indian *Rhinoceros*.

The occipital foramen is rather ovoid or sub-pyriform, and is about sixteen lines in diameter. The occipital condyles have their long diameter but little inclined from a vertical line.

The paramastoid process is less well-developed than in the Indian *Rhinoceros*, while the mastoid process is proportionately quite as large. The latter is directed obliquely forward, and has its apex nearly reaching the middle of the post-glenoid tubercle.

The entrance to the auditory meatus is a high archway between the mastoid and post-glenoid tubercles, narrowing below and expanding outwardly.

Base of the skull. Plate XXII, figure 1.—The glenoid cavity is directed more outwardly than in the Indian *Rhinoceros*, and is of greater proportionate breadth fore and aft. The post-glenoid tubercle is more compressed, and proportionately broader and shorter.

The inferior cranial axis is straighter than in the Indian *Rhinoceros*.

The basi-occipital is deeply and sharply carinated in the median line.

The condyloid foramen occupies a deep concavity midway between the occipital foramen and the paramastoid process, and a little over an inch from that of the opposite side.

The foramen lacerum holds the same relative position as in the Indian *Rhinoceros*, but is proportionately smaller. The foramen ovale is distinct from the former, and about half an inch obliquely in advance of it.

The remaining characteristic foramina of the sphenoid hold the same relative position as in the Indian *Rhinoceros*.

The palatine gutter has nearly the same proportions and form as in the latter, but does not extend quite so far forward.

The hard palate is remarkable for its deep, narrow-arched form. The molar series on each side in nearly straight lines converge anteriorly, so that the first pair of teeth are within three-fourths of an inch of each other, while the last pair are nearly two inches apart.

Lower jaw.—The specimen of the lower jaw of *Rhinoceros occidentalis*, in Professor Hall's collection, has lost the portion back of the teeth. It contains the full molar series and all the incisors.

The body of the jaw containing the molars is of more uniform depth than in the Indian *Rhinoceros*, and the base is less convex fore and aft. The chin does not present the broad sloping plane of the species just mentioned, but is comparatively narrow and convex, and recalls to mind the condition of that of the Tapir. The symphysis measures thirty-five lines in length.

Dentition.—The formula of dentition of *R. occidentalis* appears to be the same as in the existing unicorn *Rhinoceroses*,—that is to say, two incisors and seven molars, on each side of the face, in both jaws.

The upper molar teeth generally of the genus *Rhinoceros* have cuboidal crowns composed of an outer pair of connate lobes, with a pair of pyramidal lobes or folds extending from them inwardly. The bottom of the crown is furnished with a basal ridge, variable in its degree of development. A transverse valley separates the inner lobes, and expands inwardly. A valley of secondary importance is constituted by the interval between the postero-internal lobe and the back portion of the basal ridge. Accessory folds or prominences, in different species, extend from the principal lobes into the principal valley. The first molar is much smaller than the others, and is rudimental in its form. The succeeding three molars present sufficient distinction of structure from those behind to be recognized as premolars. In the last true molar the postero-internal lobe is usually obsolete. In the unworn teeth the constituent lobes of the crown present more or less continuous acutely enamelled summits. These are rapidly blunted by attrition in the process of mastication, and tracts of dentine become exposed and gradually widen as trituration proceeds. From the union or confluence of parts or processes of the lobes towards their base, when their summits are worn away to the level of the points of confluence, portions of the valleys become pits, and appear as such upon the broad exposed dentinal tracts of the masticating surfaces.

The upper molar teeth of *R. occidentalis*, plate XXII, figures 1, 2, bear a close resemblance to a series represented in De Blainville's Osteographie, G. *Rhinoceros*, plate xii, as belonging to *R. incisivus*, from Auvergne, France. They, however, do not bear the same resemblance to those of *Aceratherium incisivum*, which De Blainville considered the same as the former, as represented in tab. xiv of Kaup's Ossemens Fossiles.

The upper true molars are provided with a thin basal ridge, which is obsolete on the inner side of the internal lobes and is best developed in front and back of these and between them. The principal valley deepens inwardly, but is shallowest just external to the middle of its course, and successively deepens in the three molars at its outer closed extremity. The antero-internal lobe bulges about its middle into the principal valley, but the bulging successively declines in the series from first to last.

The last true molar is totally devoid of a postero-internal lobe, its position being occupied by the increased obliquity of the outer portion of the crown.

In the three large upper premolars of *R. occidentalis* the basal ridge is better developed than in the true molars. It is, however, obsolete at the bottom of the antero-external lobe. It is continuous around the inner half of the crown, and is thickest at the inner back part of the postero-internal lobe. The internal lobes of the three teeth under consideration are confluent at their inner expanded extremities, but least so in the first of the series. In consequence of this confluence, in the third and fourth premolars, of the specimen under examination, trituration has converted the principal valley into an enamelled pit, opening upon the masticating surface.

In the first premolar of the specimen the internal lobes of the crown are distinct, and the principal valley remains open.

The inferior molar teeth of *R. occidentalis* are like those of all other species of the genus. They have oblong quadrilateral crowns, composed of a pair of cuboidal lobes excavated in a gouge-like manner antero-internally, and having, in the unworn condition, acute, somewhat rectangular, crescentoid summits. In the process of trituration, the acute summits of the lobes are worn away and tracts of dentine become exposed, which gradually widen and become confluent on each pair of lobes composing the crown of a tooth.

Constituent portions of a basal ridge festoon the lower molars of *R. occidentalis*, and are best developed on the premolars.

In the specimen of the lower jaw of Prof. Hall's collection there are no traces of the existence of a first premolar, but in another specimen of Dr. Evans' collection, belonging to a younger and considerably larger individual, a connate pair of fangs, of a small tooth, are preserved.

Of incisor teeth of *Rhinoceros occidentalis*, the lower jaw of Prof. Hall's collection contains those of both sides, as represented in plate XXI, figure 34. They are four in number as in the Indian *Rhinoceros*, are comparatively small, but resemble those of the latter animal in form.

The lower lateral incisor has a compressed cylindrical fang with a pyramidal crown, measuring at the base seven and a half lines wide and five and a quarter lines thick. Externally the crown is convex, broad and flattened in front, and internally is worn off in a sloping manner to the base.

The lower internal incisor has a rather ovoidal crown, strongly convex in front, slightly so behind, and is bounded by a basal ridge forming a single festoon. The crown is only four and a half lines wide transversely and three and a half fore and aft.

No superior incisors of *R. occidentalis* are preserved with any of the specimens of jaws we have had an opportunity of examining. An isolated upper lateral incisor is supposed to belong to this species, as it holds about the same relation of size and form to the opposed tooth of the lower jaw in Prof. Hall's collection, that the corresponding tooth in the Indian *Rhinoceros* does to the lower lateral incisor. It has a compressed cylindroid fang nearly an inch and a half long, with an oblong crown ten and a half lines wide and five lines thick. Internally the crown is worn away, in a shelving, somewhat concave manner, to the base posteriorly.

Several fragments of jaws with molar teeth apparently indicate considerable range in the size of individuals of *R. occidentalis*. It is not improbable that the largest specimens may pertain to another species, but, so far as characters have been preserved, a variation in size is the only important difference observed.

Figure 1, plate XXIII, represents an imperfect tooth, a sixth upper molar, considerably larger than the corresponding tooth in the skull of Dr. Owen's collection. It measures twenty-one lines fore and aft, and twenty-two and a half lines transversely, while the other measures nineteen lines fore and aft and twenty lines transversely.

A much mutilated jaw in Dr. Evan's collection has the series of six molars nearly eight inches in length, while the same series in the specimen of Prof. Hall measures a little over six inches. Another fragmentary specimen exhibits the same series about six and a half inches in length.

Figures 2, 3, plate XXIII, represent the crowns of two lower lateral incisors, having the same form as the corresponding teeth in the lower jaw of Prof. Hall's collection, but much larger. These specimens measure at base ten and a half lines wide and six lines thick.

Another isolated specimen of the crown of a lower lateral incisor is a little larger than those in the jaw just indicated, as it measures eight and a quarter lines wide and five and a quarter thick.

The collection of Prof. Hall contains specimens of the posterior two upper molars of the temporary series, and fragments of the lower jaw with the last temporary molar and the first permanent true molar. The upper temporary molars differ from their permanent successors in having the inner lobes more equally developed and separated internally to their base, in having several accessory folds projecting into the bottom of the principal valley, and in not having the basal ridge continuous internally nor strong.

Whether *Rhinoceros occidentalis* possessed a horn cannot with certainty be ascertained from the specimens we have had the opportunity of examining. There is no process, prominence, or roughness upon the forehead indicating the existence of a frontal horn, and the comparatively depressed condition of the face approaching the end of the snout leads to the suspicion that a nasal weapon of the same kind was also absent.

Measurements derived from the skull of *R. occidentalis* of Dr. Owen's collection are as follow:

	Inches.
Estimated length of the skull when entire, about	18
Estimated breadth of the inion at the mastoids,	5
Length from occiput to front of first molar,	16¼
Breadth at zygomatic arches,	8
Distance between tips of post-glenoid processes,	3½
Length of temporal fossa, fore and aft,	8½
Depth " " "	4
Greatest breadth at supra-orbital processes,	7
Distance from ant-orbital margin to lateral nasal notch,	4½
Breadth of face at last molar alveoli,	5
Breadth of face at first molar alveoli,	2¼
Length of upper molar series,	7¼
Length of series of the three upper true molars,	4

Diameters of molars:

		Lines.		Lines.
First premolar,	antero-posterior,	9½;	transverse,	9½
Second "	"	11½	"	12½
Third "	"	12½	"	16
Fourth "	"	13½	"	17½
First true molar,	"	16½	"	18
Second "	"	19	"	20
Last "	"	19½	"	19

Measurements derived from three specimens of lower jaws of *R. occidentalis*, including that of Prof. Hall's collection, are as follow:

	Lines.	Lines.	Lines.
From back of last molar to front of incisors,	108		
Depth of jaw below middle of last molar,	25	32	28
Hiatus between molars and incisors,	22		
Length of molar series of six,	73	78	92
Breadth of incisive space of both sides,	20		
Depth of symphysis,	34		
Breadth of chin below hiatus of the teeth midway,	18		
Breadth of first lower molar,	9		11½

	Lines.	Lines.	Lines.
Breadth of second lower molar,	11	10¼	13
Breadth of third "	11¼	12	14
Breadth of fourth "	12	12½	15½
Breadth of fifth "	14½	15½	18
Breadth of sixth "	16½	16½	18

From the measurements given of the lower jaws with their teeth, it will be observed that they are quite disproportionate in comparing the size of the teeth with the depth of the bones. The differences are to a great extent due to a difference in age. Thus the first two specimens belonged to individuals of nearly the same age. The teeth are much worn away, and the fore and aft measurements considerably reduced from their more juvenile condition, due to their closer approximation and the disappearance of the intervening enamel. In the second specimen the jaw is rendered deeper than the others, from the higher extension of the alveolar processes intervening between the fangs of the teeth. In the third specimen the teeth are comparatively little worn, well separated, and have the intervening enamel nearly of its original thickness.

Of other bones of *Rhinoceros occidentalis* the different Mauvaises Terres collections contain many fragments, chiefly of the larger bones of the extremities. They repeat the form of the corresponding bones of the living *Rhinoceroses*.

The collection of Dr. Hayden contains an entire humerus, together with the radius and ulna, imbedded in a mass of matrix, apparently referable to *R. occidentalis*. The measurements of the bones are as follow:

	Inches.
Length of the humerus,	12½
Breadth of proximal end, fore and aft,	5¼
Breadth of proximal end, transversely,	3½
Diameter of head, fore and aft,	2½
Breadth of distal end,	3¼
Breadth of ante-brachial articulation,	2
Length of fore-arm from head of radius,	10½
Breadth of distal end of fore-arm,	3
Breadth of middle of fore-arm,	2¼

Several proximal ends of femurs considered to belong to the same species have the following measurements: breadth of femur transversely, including the head and trochanters, five inches; width of trochanters fore and aft, three and a half inches; diameter of head transversely, two and a quarter inches.

A specimen of the distal end of a femur has the following measurements: breadth at condyles, five inches; breadth of articular surface of condyles, four inches; breadth of trochlea for the patella, two inches.

The head of a tibia, from the collection of Dr. Evans, has the following measurements: breadth of head of tibia, four inches; width fore and aft and internally, three and a half inches.

Rhinoceros crassus.

Some fossil remains, consisting of small fragments of jaws with portions of teeth and several isolated teeth, discovered by Dr. Hayden in the sands of the L'eau-qui-court, or Niobrara River, have been referred to a species of *Rhinoceros* with the above name, though it is uncertain whether all the specimens belong to the same species.

The more characteristic specimens consist of a fragment of the upper jaw containing the greater portion of a last molar tooth, and an isolated upper lateral incisor. These appear to indicate a species of about the same size, and having the same formula of dentition as the existing Indian *Rhinoceros*.

The portion of the upper molar tooth, represented in figure 8, plate XXIII, is of the right side, and exhibits the modification of form from the other true molars which is usual in living species of the genus. The specimen nearly agrees in size and construction with the corresponding portion of the same tooth in the Indian *Rhinoceros*. The crown is about a third worn away, and when perfect has measured fore and aft internally about two inches, and its oblique diameter postero-externally has been about half an inch more. From the corresponding tooth of *R. occidentalis* it not only differs greatly in size, but the posterior lobe of the crown presents an offset projecting into the transverse valley, opposite the similar but lesser offset or bulge of the anterior lobe. A prominence occupies the bottom of the inner half of the transverse valley.

The isolated upper lateral incisor, represented in figures 6, 7, is of the left side, and nearly agrees in its proportions and size with the corresponding tooth of the Indian *Rhinoceros*. The crown is much worn away, the abrasion having extended nearly to the base externally, and beyond or above it internally. The worn surface, figure 7, is a long ellipse, measuring two and a third inches fore and aft, and three-fourths of an inch transversely.

The remaining specimens attributed, with less certainty, to *R. crassus*, consist of a fragment of a lower jaw with the first large temporary molar, and the isolated crown of an upper temporary premolar.

The first mentioned specimen is represented in figure 9; and nearly agrees in its form with the corresponding portion of the lower jaw of a young Indian *Rhinoceros*, though the contained tooth is relatively larger. The anterior end retains the bottom of a lateral incisive alveolus, and leaves sufficient space to have been occupied by a small internal incisor. The mental foramen is situated beneath the back half of the molar tooth.

The crown of the upper deciduous molar, represented in figures 4, 5, appears to belong to the third or fourth of the series of the right side. It is moderately worn, a continuous tract of dentine being exposed along the summits of all the lobes.

The outer part of the crown forms a thick wall, with the inner surface sloping inwardly, and with the outer surface convex downward and divided near its middle by an obtuse ridge. From the outer wall of the crown there extend inwardly a pair of transverse lobes, embraced at bottom by a well-developed and deep basal ridge extending from one extremity of the outer wall of the crown to the other. The internal lobes expand inwardly and towards their base. The anterior of the two lobes curves backward in its course inward. A deep valley separates the internal lobes, and shallower ones bound them in front and behind. From the outer wall, two narrow folds or processes project into the wide outer extremity of the middle valley. One of the processes joins a thicker process or offset projecting at right angles from the posterior transverse lobe, and thus contributes to convert a portion of the middle valley into a deep pit. The anterior and posterior valleys, of which the latter is the deeper and longer, are bounded opposite the lobes by the basal ridge.

The fore-and-aft diameter of the specimen is nineteen lines; its transverse diameter anteriorly sixteen lines, posteriorly nineteen lines.

RHINOCEROS MERIDIANUS.

The species to which the above name has been applied is indicated by the greater and more characteristic portion of the crown of an upper molar tooth, submitted to the examination of the writer by Dr. Benjamin F. Shumard, of St. Louis. It was derived from a tertiary deposit in Washington county, Texas, and presents much the general aspect of the Mauvaises Terres fossils of White River, Dakota, with which it is probably of cotemporary age.

The specimen is represented in figure 10, plate XXIII, and appears to belong to the penultimate molar of the right side. It evidently indicates a species different from *R. occidentalis* and *R. crassus*, and was intermediate in size to them.

The estimated measurements of the tooth in a restored condition are two inches fore. and aft externally, twenty-two lines wide in front, and eighteen lines wide behind. The median valley of the crown is strongly sigmoid in its course, arising from the inner lobes being each provided with an oblique offset alternating and extending into the valley in a parallel manner, as seen in the figure.

Rhinoceros hesperius.

The remarkable discovery of remains of several species of *Rhinoceros* in Dakota, Nebraska and Texas—a genus which previously was supposed to have been peculiar to the eastern hemisphere—has been followed by the further discovery of the remains of a species, apparently different from any of the preceding, west of the Rocky Mountains. Prof. J. D. Whitney, engaged in a geological survey of California, has submitted to my inspection a portion of the lower jaw of a *Rhinoceros*, derived from a tertiary deposit of Chili Gulch, Calaveras Co., California.

The specimen so closely resembles in its general aspect and state of petrifaction the Mauvaises Terres fossils of White River, Dakota, that it would have been viewed as one, if the locality from which it was obtained were not known. It consists of the right side of the lower jaw, without the ascending portion, and with the symphysial portion of the opposite side. It contains the true molars, the fangs of four premolars, one lateral incisor and the fang of the other, and the alveoli of the internal incisors. The specimen is represented, reduced one-half, in figures 11, 12, plate XXIII.

The form of the jaw is nearly like the corresponding portion in the Indian *Rhinoceros,* and the formula of dentition is the same as in this species. It indicates a species nearly the size of *Rhinoceros occidentalis.* Compared with the lower jaw of the latter, its body has a considerably greater depth in relation with the size of the contained molar teeth, and the chin is of much more robust proportions, in accordance with a greater degree of development of the incisors. The symphysis is fifty-two lines in length; the width of the chin at the middle twenty-nine lines. The hiatus separating the molars and incisors has a prominent acute edge, and measures two and a half inches in length.

The molar teeth undergo a more rapid reduction in size, advancing through the series, than in *R. occidentalis.* While the true molars average the size of those of the latter, or are intermediate in size to those of two specimens of the lower jaw of *R. occidentalis,* the premolars are proportionately much smaller.

The whole series of six large molars in the California *Rhinoceros* measures seventy-eight lines in length, and the average depth of the jaw below those teeth is about thirty-two lines. In two lower jaws of *R. occidentalis* the corresponding molar series measures in one case seventy-three lines long, and in the other ninety lines, and the average depth of both jaws below these teeth is twenty-four lines.

The true molar series in the California *Rhinoceros* occupy a space of forty-eight lines; the three large premolars a space of thirty lines. Of the two jaws of *R. occidentalis,* in one case the true molars occupy a space of forty-two lines, the premolars thirty-one lines; in the other case the true molars occupy a space of fifty-two lines and the premolars forty-one lines. Thus in the California *Rhinoceros* the premolars occupy an inch and a half less space than the true molars; in the *R. occidentalis,* eleven lines less.

The lateral incisors have a different shape from those of *R. occidentalis,* and are proportionately better developed than in the Indian *Rhinoceros.* The fang a little below the base of the crown is cylindrical, and about ten lines in diameter. The crown is conical, and is worn off internally in a long triangular slope. In its present condition it measures an inch and a half in length, by ten lines in width fore and aft at the base, and eight and a half lines transversely.

The sockets for the internal incisors indicate their occupants to have held about the same relation in size to the lateral incisors as in the Indian *Rhinoceros.*

The size of the jaw of the California *Rhinoceros* appears to be too small to belong either to *R. crassus* or *R. meridianus,* and it is therefore inferred to be a distinct species, for which the name of *R. hesperius* has been proposed.

Measurements derived from the lower jaw, in comparison with those of Professor Hall's specimen of the lower jaw of *R. occidentalis,* are as follow:

	R. hesperius. Lines.	R. occidentalis. Lines.
From back of last molar to incisive alveoli,	132	108
Depth below last molar,	34	26
Depth below second premolar,	30	22
Depth of symphysis,	52	34
Breadth of chin outside of canines,	32	20
Length of series of six large molars,	78	73
Length of true molar series,	48	42
Length of premolar series, exclusive of the first tooth,	30	31
Length of hiatus in advance of molars,	30	22
Breadth of last molar,	17	16
Breadth of second molar,	16	15
Breadth of first molar,	14	11½

Quite recently (Feb., 1869) Prof. Whitney submitted to my examination a number of fragments of upper molar teeth, together with the entire unworn crown of one, probably belonging to *R. hesperius.* They are reported to have been discovered in association with human and equine remains in Calaveras Co., California.

The teeth evidently pertained to a species approaching nearly in size the *R. occidentalis,* of Dakota. The entire unworn crown above mentioned is that of a last molar from the left side of the upper jaw, and closely approaches both in size and form the corresponding tooth of *R. occidentalis,* as represented in plate XXII. It differs, however, in having the anterior lobe much more strongly constricted near its base, and in the posterior lobe being provided near its middle with a prominent crest projecting forward into the transverse valley of the crown. An isolated antero-internal lobe of a tooth in advance, as in the preceding case, also presents a deeper constriction than in the corresponding teeth of *R. occidentalis.* The antero-postero diameter of the perfect crown of the last molar measures fifteen and a half lines; the transverse diameter eighteen lines.

HYRACODON.

The genus *Hyracodon* is founded on fossil remains formerly referred to a species of *Rhinoceros,* with the name of *R. nebrascensis.* It is characterized by having molar teeth constituted like those of *Rhinoceros, Hyrax,* and the extinct *Aceratherium,* but is further provided with canine teeth and a full series of incisors in both jaws. As in the last-named genera, it is also destitute of horns.

Hyracodon nebrascensis.

Many fossil specimens of this species have been brought from the Mauvaises Terres of White River, Dakota, where they appear to be equally abundant with the remains of *Rhinoceros occidentalis.* The animal was about two-thirds the size of the latter, and less than half that of the living Indian *Rhinoceros.*

Besides numerous fragments of jaws with teeth, I have had the opportunity of examining the greater portions of six mutilated skulls, from which I am enabled to give a nearly complete account of the most characteristic part of the skeleton.

The perfect skull of *Hyracodon nebrascensis* has nearly the same form as that of *R. occidentalis,* and, as in this, its upper outline is nearly straight, though sloping moderately in front.

Views of the greater portions of several skulls, including the molar dentition, of *Hyracodon nebrascensis,* are given in plates xiv and xv of the Ancient Fauna of Nebraska, but want of sufficient means has prevented the representation of additional and in some instances better specimens in the present work.

Lateral view of the skull.—The temporal fossa of *Hyracodon nebrascensis* appears proportionately not so long as in *Rhinoceros occidentalis,* though it extends a greater distance along and near the median line of the cranium. The temporal surface is convex, and rises upon a sagittal crest extending two-thirds of its length. Posteriorly it exhibits several large venous foramina.

The zygoma pursues nearly the same course as in the Indian *Rhinoceros.* Its hinder root springs from about the middle of the lower boundary of the temporal fossa, and has its upper surface convex fore and aft.

The orbit has nearly the form and proportions of that of *R. occidentalis*, but has its entrance less vertical, from its being less overhung by the supra-orbital prominence of the forehead, so that it has a slight upward direction. The post-orbital process of the frontal does not extend so far back, and therefore the orbit appears more open or less contracted behind than in *R. occidentalis*. The ant-orbital margin is on a line with the back part of the ante-penultimate molar. It exhibits a compressed conical lachrymal process, within the position of which there are two foramina, one above the other. The orbital entrance is about an inch and a half in diameter, and is situated nearly midway between the upper outline of the forehead and the alveolar margin.

The face in advance of the orbits is proportionately somewhat shorter than in *R. occidentalis*. It also appears less vertical at the sides, but in all the specimens is too much fractured to judge accurately of its original form and details.

The infra-orbital foramen is situated an inch above the interval of the second and third premolars.

Upper view of the skull.—Above, the cranium appears ovoid, expanded towards the summit and lateral borders of the inion, and prolonged in front to expand into the forehead.

The sagittal crest is long and narrow, proportionately much longer than in *R. occidentalis*. The temporal ridges diverge from its fore part at a less acute angle than in the latter.

The forehead has the same form nearly as in *R. occidentalis*, but is proportionately neither so long nor broad. It is more convex between the supra-orbital margins, but is quite as much, if not more depressed along the middle. The frontal suture remains open.

The fronto-nasal suture, extending nearly the breadth of the forehead, has its outer extremities descending to the lachrymals on a line with the ant-orbital margin. It is in the form of a pair of crescents, between which extend the internal angular processes of the frontals. The suture is much less advanced in position than in *R. occidentalis*.

The snout or upper fore part of the face is somewhat tapering. The nasals are flat above and incline towards each other; at the sides they are convex. Their posterior broad scroll-like extremities articulate with the frontals and lachrymals, and receive between them the obtusely angular processes of the former bones. Anteriorly they are deeply notched, each terminating in a pair of long processes.

The intermaxillary at the side of the face forms a narrow plate, slightly widening in its ascent, and articulating with the nasal bone. The width of its upper end where it joins the latter is ten lines, but at the middle it measures but half that width. A similar articulation of the intermaxillary with the nasal bone exists in the allied recent genus *Hyrax*, but not in the true *Rhinoceroses.*

The nasals, even in aged specimens of *Hyracodon nebrascensis,* remain separated. Their anterior free ends appear to have projected about an inch beyond their articulation with the intermaxillaries.

There are no evidences whatever in favor of *Hyracodon* having possessed either a frontal or a nasal horn. The surface of the forehead is smooth, and presents no prominence adapted to the support of a horn. The nasal bones become narrow and comparatively weak in front, and appear totally unadapted to sustain a weapon like the nasal horn of existing *Rhinoceroses.*

Posterior view of the skull.—The inion forms a nearly equilateral triangle, of which the mastoid processes form the basal angles. The occiput is proportionately more bulging in the median line than in the Indian *Rhinoceros,* but is less so than appears to be the case in *R. occidentalis.* The condyles have their long diameter more nearly vertical than in the former, but less so than in the latter. They are prolonged beneath in a scroll-like manner on the basilar process, and approach in this position at the distance of a line from each other.

The occipital foramen is low pyriform, and about ten lines in diameter. It has its upper margin considerably posterior to the position of the lower one.

Base of the skull.—The co-ossified basi-occipital and sphenoidal resemble those of the Indian *Rhinoceros,* becoming narrower and more prominent and convex anteriorly.

The paramastoid process is longer than the mastoid and post-glenoid processes. The mastoid is shorter than the last named process, and is separated from it by a wide interval.

The condyloid foramina are situated just to the outside of the lower ends of the occipital condyles, and are ten lines apart.

The foramen lacerum is a large reniform vacuity, about an inch fore and aft and the third of an inch wide. In advance of it a short distance is the foramen ovale. Half an inch from this, to the outside of the root of the pterygoids, is a foramen or short canal communicating with the spheno-orbital foramen. The latter occupies a position at the apex of the orbital cavity, internal to a pointed process terminating the orbito-temporal ridge.

The optic foramen is situated about an inch in advance of the spheno-orbital foramen.

The glenoid articular fossa forms a deep concavity opening outwardly and backward on the posterior root of the zygoma. It is deeper than in the Indian *Rhinoceros,* and directed more backward at its outer part. The post-glenoid process is comparatively short, thick and tuberous.

The hard palate of *Hyracodon nebrascensis* is strongly arched, though not to the same extent it is in *Rhinoceros occidentalis*. It is proportionately much broader and less convergent anteriorly than it appears to be in the latter. The inter-palatine notch extends as far forward as the posterior third of the penultimate molar tooth.

Lower jaw.—The lower jaw of *Hyracodon nebrascensis* presents intermediate characters to that of the *Rhinoceroses* and Tapirs.

The body of the lower jaw and its base, corresponding with the position of the molar series, resemble the same part in the Indian *Rhinoceros*. The anterior extremity of the jaw resembles the corresponding portion of that of the Tapir. The chin presents a similar mode of construction, and likewise the alveolar border for the reception of an unbroken arch of canines and incisors. The symphysis is two inches in length. There appear to exist usually three mental foramina, in a row in advance of the fourth premolar tooth, extending as far as the hiatus in front of the molar series.

The back part of the jaw is comparatively high. The coronoid process is proportionately longer and wider than in the Indian *Rhinoceros*, and its apex is elevated above the base of the jaw a distance exceeding two-thirds the length of the latter. The fossa on the outer surface of the ramus, below the coronoid process, is a much larger and deeper depression relatively than in *R. occidentalis*. The notch back of the coronoid process is not so wide as in the latter.

Dentition.—The usual number of teeth in the unicorn *Rhinoceroses* is seven molars and two incisors on each side of both jaws. The two-horned *Rhinoceroses* in the adult condition have no incisors. The extinct genus *Aceratherium* possessed the same number of teeth as the unicorn *Rhinoceroses*, but the incisors were larger. *Hyrax*, in the adult condition, has one incisor above and two below on each side.

The dental formula of *Hyracodon nebrascensis* is as follows:

$$\text{Incisors } \frac{3-3}{3-3};\ \text{c. } \frac{1-1}{1-1};\ \text{p. m. } \frac{4-4}{4-4};\ \text{t. m. } \frac{3-3}{3-3}=44.$$

Prof. Owen observes in his Odontography, p. 589, that Dr. Falconer informed him that there are six incisors in both jaws of one of the extinct species of *Rhinoceros* from the Himalayas, but he makes no reference to canine teeth, so that it is probable none existed.

Hyracodon therefore, while possessing the usual number of molars of *Rhinoceros*, etc., together with the unusual number of incisors of an extinct Himalayan species, in addition also had canines, thus presenting a dental formula like that of the Tapir, *Palæotherium*, etc.

The molar teeth in both jaws have the same relative position and general constitution as in recent species of *Rhinoceros*. The canines and incisors together in both jaws form unbroken arches, of which that of the lower jaw is the smaller. The arches are about two inches in length.

The hiatus separating the upper molars from the canines forms a concave notch, with an acute edge, and varies from half an inch to an inch in extent. That of the lower jaw is of the same character and extent.

The superior molars of *Hyracodon nebrascensis* so closely resemble those of *Rhinoceros occidentalis* that a description would apply nearly equally well for both species. The last tooth of the series in the former, however, differs strikingly in exhibiting a decided tendency to the formation of a posterior valley to the crown, or to the distinction of a pair of inner lobes from the outer portion of the crown. (Compare figure 13, plate xiv, and figure 3, plate xv, with figure 1, plate xii, of the Ancient Fauna of Nebraska.)

The inferior molars also agree in form with those of *R. occidentalis,* but have the basal ridge relatively better developed. In a specimen of the lower jaw of an adult individual, a portion of a small first premolar is preserved, sufficient to indicate that seven lower molars belong to the series.

In all the specimens under examination the crowns of the incisors and canines have been lost except in the case of a single incisor,—the last of the upper series. The crown of this tooth is simply conical and pointed, and is four lines long. A small remaining fragment of the contiguous canine appears to indicate that this was also conical, and I suspect that all the incisors and canines of both jaws had simple conical crowns.

Judging from the fangs preserved in an upper jaw, the incisors appear slightly to have diminished in size from first to last, while the canine was a little larger than the contiguous incisor, though not more so than the first one.

In two fragments of lower jaws, in which the fangs of the incisors and canines are preserved, the former teeth appear to have slightly and successively increased in size from the first of the series, but the canine more abruptly enlarged.

The temporary molars of the upper jaw of *Hyracodon* differ from their permanent successors in having the internal lobes of the crown more equally developed, and in being separated from each other to the base internally. The last inferior temporary molar exhibits a disposition to form a third lobe situated in advance of the usual pair of lobes.

Measurements derived from a skull of *Hyracodon nebrascensis* are as follow:

	Inches.
Length of skull from occipital condyle to incisive alveoli,	10¼
Breadth of inion at mastoid processes,	3
Breadth at zygomata,	5½
Distance between tips of post-glenoid processes,	3

	Inches.
Length of temporal fossa,	5
Depth " "	2½
Height of face on a line with ant-orbital margin,	3¼
Greatest breadth of forehead,	3½
From ant-orbital margin to lateral nasal notch,	2¾
Breadth of face at last molar alveoli,	3¼
Breadth of face at first molar alveoli,	2
Length of upper molar series,	4¾

Measurements derived from a specimen including both jaws with the teeth are as follow:

	Lines.
Length of the upper molar series,	57
Length of the lower molar series,	54
Length of the upper true molar series,	29
Length of the lower true molar series,	29

		Lines.		Lines.
Diameter of first upper molar,	antero-posterior,	6;	transverse,	6
Diameter of second "	"	7¼	"	9¼
Diameter of third "	"	8½	"	10½
Diameter of fourth "	"	9	"	11½
Diameter of fifth "	"	9½	"	11
Diameter of sixth "	"	11	"	11½
Diameter of seventh "	"	9½	"	10½
Depth of lower jaw below middle of last molar,				20
Depth of lower jaw below middle of first molar,				14
Antero-posterior diameter of second lower molar,				7
Antero-posterior diameter of third " "				8½
Antero-posterior diameter of fourth " "				8½
Antero-posterior diameter of fifth " "				8
Antero-posterior diameter of sixth " "				10
Antero-posterior diameter of seventh " "				10½

Of other bones of *Hyracodon nebrascensis,* a number of fragments are preserved in the various collections of Mauvaises Terres fossils I have had the opportunity of examining. In general, they resemble in form the corresponding parts in the Indian *Rhinoceros,* and they present some variation in size.

An atlas, apparently referable to *Hyracodon,* differs from that of the animal just named in being proportionately longer, and apparently in having shorter transverse processes, which are pierced fore and aft for the passage of the vertebral blood-vessels.

Its breadth is a little over two inches, and its length or fore and aft measurement at the sides is about the same extent. In the median line it is little over an inch fore and aft, and its depth is twenty-two lines.

Several distal ends of humeri resemble the corresponding parts in the Indian *Rhinoceros*, but have the process on the outer condyle proportionately less well-developed. They measure about two and a half inches in width, with the articular surface an inch and three-fourths wide.

The proximal ends of a radius and ulna are like those of the Indian *Rhinoceros*. The breadth of the fore-arm bones together on a level with the head of the radius is two and a quarter inches.

The distal extremity of a femur is three and a quarter inches in breadth, with the articular surface of the condyles two and three-quarter inches wide, and that of the trochlea an inch and a half wide.

An entire tibia, in Dr. Owen's collection, has the same form as that of the Indian *Rhinoceros*. Its length is eleven and a half inches; the width of the head three and one-third inches, and of the distal end two and one-sixth inches.

Among a collection of fossils obtained in Colorado Territory by Dr. E. T. Berthoud, recently sent to me by the Smithsonian Institution for examination, there are fragments of two lower jaws, apparently of *Hyracodon nebrascensis*, labelled "Currant Creek, West Fork, lat. 40° 55′, long. 109° 34′." In one of the specimens, containing the fangs of the last three molars, the series occupied a space of thirty-four lines, and the depth of the jaw at the middle of the last tooth is twenty-one lines. The other specimen, containing the last two molars and portions of the two in advance, has the series of the last three occupying a space of twenty-nine lines, indicating a smaller individual than the former.

TAPIRIDÆ.

The family of the Tapirs is represented in the miocene deposit of the Mauvaises Terres of Dakota by a species of *Lophiodon*, an extinct genus characterized by Cuvier from remains of several species found in formations of the same age in Europe. The only specimen, though a perfectly characteristic one, indicating the former existence of an American *Lophiodon*, consists of a single tooth, discovered by Dr. Hayden and attributed by him to the *Titanotherium* bed, or bed A, of his section of the tertiary deposits of Dakota.

LOPHIODON.

Lophiodon occidentalis.

This species is founded upon a specimen consisting of a last inferior molar tooth inserted in a small fragment of the jaw, and obtained by Dr. Hayden in the Mauvaises Terres of White River, in his trip of 1866. The specimen is represented in figures 28—30, plate XXI, and is the only fossil referable to *Lophiodon* which has been noticed in all the collections from Dakota or Nebraska.

Characters derived from a tooth cannot always be depended on to determine the genus of animals to which it belonged, and the future discovery of additional material may prove the fossil under consideration to belong to a very different animal from *Lophiodon*. Under present circumstances, however, the specimen can only be appropriately referred to the latter.

The crown is composed of a pair of transverse hill-like lobes, as in the lower molars of the Tapir, with the addition of a well-developed posterior conoidal talon. The principal lobes have sub-acute summits, slightly concave transversely. Their posterior surface is sloping, their anterior concave, and their exterior sides are convex. The talon is about half the height of the principal lobes, convex posteriorly, and with the anterior surface inclining from the middle on each side. The crown is bounded in front by a basal ridge.

The diameter of the crown antero-posteriorly is nine and three-quarter lines; transversely six and a half lines.

PROBOSCIDEÆ.

The family of the great proboscideans is represented in the pliocene fauna of the Niobrara River of Nebraska by a species of Mastodon, strikingly distinct from that of a later period, whose remains have been found so abundantly distributed throughout the North American continent. Associated with it there have been discovered the remains of an Elephant, which, especially on account of its relative age, but also from its comparative size, I have suspected to be a distinct species from its American congener of the quaternary period, usually regarded as the *Elephas primigenius*.

The remains of the Niobrara Mastodon and Elephant occupy the uppermost of the beds of the tertiary formations of Nebraska, marked in Prof. Hayden's tables as bed F.

In the chapters on the Mastodon and Elephant I have introduced some remarks on remains of these genera occurring throughout North America, and have presented strong evidence that at least three, and perhaps four distinct species of the former inhabited this continent at different periods.

MASTODON.

Remains of the Mastodon which have come under the inspection of the author apparently indicate four distinct species as having once inhabited North America. One of the species, the well known *Mastodon ohioticus*, or *M. americanus* as I shall hereafter call it, appears to have roamed throughout the continent during the quaternary period. A second species, perhaps the *Mastodon andium*, is indicated by a molar tooth, obtained at Tambla, Honduras, by Capt. J. M. Dow, and presented by him to the Academy. A third species seems to be represented by a few remains purporting to have been derived from the miocene formations on the Atlantic border of the United States. The remains of a fourth species, *Mastodon mirificus*, were discovered by Dr. Hayden in the pliocene fossiliferous sands of the Niobrara River, in association with a multitude of other fossils described or mentioned in this work.

Mastodon americanus.—In this species the molar series consists of six teeth to each side of both jaws. They successively increase in size from first to last. The anterior three widen posteriorly, the succeeding pair are of nearly uniform breadth, and the last one narrows posteriorly.

The crown of the first tooth presents two principal transverse divisions or ridges; that of the second tooth two principal ridges and a third rudimental one; the crowns of the succeeding three teeth each three ridges; and the crown of the last tooth four principal ridges and a fifth elementary one more or less reduced to the condition of a heel.

The divisions or ridges of the crown form wide hills, with sub-acute summits, separated by transverse angular valleys. The latter are slightly shallower at the middle of their course, but are not interrupted by accessory eminences as in the European *Mastodon angustidens* and some other species.

Constituent elements of a basal ridge, more or less well-developed, occupy the bottom of the crown, usually in front and behind and at the outlets of the transverse valleys, and more rarely at the bottoms of the ridges internally and externally.

The transverse ridges of the crown are sub-divided by a median wide notch, narrowing to a vertical cleft, into a pair of pyramidal lobes, which are connate from the base for three-fourths of their length. The sub-acute summits are prolonged towards each other, and occasionally are somewhat denticulated. The exterior sides of the lobes are convex and sloping. The anterior and posterior surfaces are broad and sloping planes, often slightly convex or concave, and they form the sides of the transverse valleys. They are nearly even, but often present longitudinal rugose ridges separated by irregular grooves, especially towards the bottoms of the valleys.

The outer lobes of the inferior molars, and the inner ones of the superior molars, have their exterior sides more sloping and their summits usually narrower than the other lobes. These have usually longer and wider summits, and generally present a notch and groove more or less distinct, apparently indicating a tendency to subdivision into a pair of lobules, or, in other words, the inner lobes of the lower molars and the outer lobes of the upper molars appear to be composed of a connate pair of lobules more or less evident.

The outer lobes of the lower molars, and the inner ones of the teeth above, present a buttress-like sub-acute ridge in front and behind, extending from the summit to the bottom of the intervening valleys. The lobes just indicated rather obscurely exhibit an apparent composition of a connate pair of lobules. Sometimes the included lobule presents ridges apparently corresponding with the buttress-like ridges of the embracing lobule. Likewise among the longitudinal ridges, frequently occupying the sloping surfaces of the other lobes, a pair may often be observed corresponding with the buttress-like pair of the former lobes.

The third division of the crown of the second molar is constituted like the others, but is more or less rudimental. Its external lobe in the lower tooth, and internal one in the upper tooth, are the least developed and sometimes appear nearly obsolete.

The heel of the last molar, usually less pronounced in the upper than the lower tooth, consists of the thick contiguous element of the basal ridge, sometimes alone, but oftener compounded with one or more conical eminences more or less well-developed, and approaching in character a fifth ridge or division to the crown.

As the molars of *M. americanus* are worn away, more or less lozenge-shaped tracts of dentine appear at the summits of the inner lobes of the teeth above and the outer lobes of those below; and transversely oval or clavate tracts, occasionally slightly lozenge-shaped, appear on the other lobes.

Considerable difference exists between the corresponding teeth of different individuals of *M. americanus*. They vary in size, in proportions, in degree of development of constituent elements of a basal ridge at the outlets of the transverse valleys of the crown, in smoothness of the enamel, etc. Lateral constituents of the basal ridge may be obsolete, moderately developed and smooth, or well marked and rugged. Difference in degree of development of the buttresses of the inner lobes of the upper teeth, and of the outer lobes of the lower teeth, produce a variation in the freedom of obstruction to the course of the transverse valleys. The last molar tooth is especially of a variable character, differing much in size and in the proportion of its diameters. Generally possessing four transverse ridges and a heel to the crown, occasionally there are five ridges with or without a heel, and sometimes the number is reduced to four without a heel. With a diminution in the number of ridges the teeth usually are of more uniform width; with the increase there is usually a proportionate degree of narrowing of the crown posteriorly.

Among a large number of molars from different parts of the United States, preserved in the Museum of the Academy of Natural Sciences, two varieties may be observed, but with all shades of gradation between those which appear most distinct.

Smooth variety of teeth are distinguished by the comparatively regular transverse angular lobes of the crown, separated by as regular transverse angular valleys, hardly obstructed in their course by any projection from the bounding lobes. The sides of the latter slope regularly and smoothly, but the outer lobes of the lower teeth, and the inner ones of the upper teeth, present a more or less well-developed buttress-like ridge, projecting fore and aft into the transverse valleys. The enamel is comparatively smooth; the basal ridge slightly developed.

In the rugged variety of teeth the lobes of the crown are more rounded or less sharply angular, and the transverse valleys are more or less obstructed by a greater degree of development of the buttress-like projections of the outer lobes of the lower teeth, and of the inner ones in the upper teeth. The sloping sides of the valleys are more or less strongly wrinkled and tuberculate, looking like the slopes of hills washed into grooves by rains. The enamel is generally more or less rugose, and the basal ridge well developed and rugged.

In the smoother variety of teeth the last molars are more uniform in transverse diameter than in the other variety. In this they appear to have a greater tendency to prolongation and narrowing behind, as well also as to have a disposition to increase in the number of transverse lobes.

The rugged variety of teeth approach more nearly than the others those of *Mastodon andium*.

Mastodon ————?—The Mastodon tooth, previously mentioned as having been obtained at Tambla, Honduras, is a nearly perfect last upper molar of the left side. Tambla is a village in one of the passes leading from the plain of Comayagua to the Pacific. In the same locality Dr. Le Conte detected remains of a species of *Bos* and *Equus*.* Fragments of teeth of the latter, presented to the Academy, indicate an animal about the size of the Ass, but are too imperfect to characterize the species to which they pertain.

The Tambla Mastodon tooth, represented in figure 14, plate XXVII, resembles so nearly a corresponding one from Tarija, Bolivia, described and figured by M. Gervais in his Recherches sur les Mammiferes Fossiles de l'Amerique Meridionale,† page 20, plate 5, figure 3, and referred by him to the *Mastodon andium*, that the specimen may be viewed as belonging to the same species. It is smaller, as Gervais gives eighteen centimetres for the breadth fore and aft, and nine centimetres for the width in front

* Proc. Acad. Nat. Sci. 1858, 7.

† Forming part of the Zoologie de l'Expedition dans les parties centrales de l'Amerique du Sud de M. le Comte F. de Castelnau.

of the sixth upper molar of the Tarija Mastodon, while that of the Tambla Mastodon measures scarcely fifteen centimetres fore and aft, and less than eight centimetres in width at the fore part.

The crown of the Tambla Mastodon tooth, figure 14, plate XXVII, presents four divisions or ridges composed of transverse pairs of lobes. The summits of the latter are all worn, and, with the exception of the outer lobe of the last pair, exhibit exposed tracts of dentine.

The outer lobes of the crown are smaller and of simpler form than the inner ones. They are conical, wider transversely than fore and aft, convex and nearly vertical externally, and sloping and depressed towards the middle in front and behind. Their worn summits present transverse ellipses of dentine, of which the anterior one had just joined that of the corresponding inner lobe. The third outer lobe is abnormally undeveloped, is less in size than the one behind it, and appears simply as an additional offset to the third inner lobe. The fourth outer lobe is a simple cone, worn at the summit posteriorly in a sloping manner, but not so as to expose the dentine.

The inner lobes of the crown at their internal semi-diameter are transversely convex. They expand in the median line of the crown, contiguous to the outer lobes, and form thick convex buttresses, which obstruct the middle of the transverse valleys. In the anterior two of the inner lobes the summits are worn into broad and deeply concave pits of dentine, bordered by thick enamel. The third inner lobe is connate with the abnormally but partially developed outer lobe, and together at the worn summit they exhibit a cruciform tract of exposed dentine. The fourth inner lobe presents a minute cruciform tract of dentine on its summit.

The contiguous buttresses of the second and third inner lobes, less worn than the others, appear compounded in part with an intervening pair of mammillary accessory lobules. From the less degree of development of the contiguous buttresses of the third and fourth inner lobes, the posterior valley is less obstructed than the others. The posterior buttress of the fourth inner lobe is larger than the anterior, and it, together with an element of the basal ridge externally, forms a posterior convex prominence or heel to the crown. The basal ridge was best developed at the fore part of the crown, but thick elements of the same exist at the inner outlets of the anterior two transverse valleys.

The tooth is provided with three distinct fangs, of which the antero-external one measures six and a half inches in length, following the curvature of its fore part.

In a recent visit to Washington (May, 1869), in the Museum of the Smithsonian Institution, I observed a molar tooth, from Nicaragua, Central America, presented by Capt. Dow, which appears not to have pertained to the same species as the former, but to the *M. americanus.* The tooth I took to be a fifth of the upper jaw, agreeing with the corresponding tooth of the species just named in size and constitution, and differing only in a greater degree of development than usual of the abutments of the inner lobes, by which the valleys of the crown are in a proportionate degree obstructed.

Mastodon ————?—In 1858 Dr. Richard Harlan, a son of the late American naturalist of that name, desired me to inspect a collection of natural history specimens which had belonged to his father, and which had been stowed away in the garret of a warehouse upwards of twenty years previously, where they had remained untouched until the time the subject was mentioned to me. In the collection I observed the plaster cast of a Mastodon tooth, which struck me from its resemblance to a certain tooth of somewhat enigmatic character preserved in the Museum of this Academy. My suspicion that it was a cast of the latter tooth appeared to be confirmed on turning over the cast, and finding within the hollow of the crown an attached label, inscribed "*Mastodon longirostris*, Miocene, Maryland." Notwithstanding an extraordinary likeness, subsequent examination and comparison proved that the cast was derived from a different specimen.

The original of the cast is lost, and appears to be that referred to in a paragraph, page 38 of vol. iv, 1843 to 1845, of the Proceedings of the Geological Society of London, which reads as follows: "In the Museum of Baltimore Mr. Lyell was shown the grinder of a Mastodon, distinct from *M. giganteum*, and which had been recognized and labelled by Mr. Charlesworth as *M. longirostris*, Kaup. It was found at the depth of fifteen feet from the surface in a bed of marl near Greensburgh, Caroline Co., Maryland, and is considered by Mr. Lyell as a miocene fossil."

The original is also referred to by Dr. Warren, in his work on the *Mastodon giganteus* of North America, under the article headed "The Baltimore Tooth," page 78. He observes: "Dr. Ducatel, of Baltimore, being engaged as geological surveyor of the State of Maryland anterior to 1840, noticed a spot in Caroline county, near the banks of a small river, where he thought some valuable fossils might be discovered. From this place a Mastodon tooth was obtained, which remained in the possession of Dr. Ducatel for some time without attracting much attention. Mr. Charlesworth, when travelling in this country, pronounced it to be a grinder of the *Mastodon longirostris*. Some time after, being seen by Sir Charles Lyell, he gave for opinion that it was the tooth of a species distinct from the *Mastodon giganteum*. Dr. Hays and Dr. Harlan were of the same opinion. The specimen belonged at the time to a collection in the Academy at Baltimore, where it was permanently deposited." Dr. Warren continues: "In the year 1843 a statement was made by Mr. Lyell on the miocene deposits of the United States, in which he noticed this tooth. Having a curiosity to see it, being at Baltimore in 1848, I applied for an opportunity of examining this fossil, but on inquiry ascertained that the collection was dispersed, and the tooth had disappeared. Dr. Hays joined in the search and shared with me the disappointment I experienced, as he had known the tooth."

The cast, represented in figure 13, plate XXVII, is that of a last inferior molar of the left side, and indicates the tooth to have been intermediate in character with the corresponding teeth of *M. americanus* and *M. angustidens*. Fore and aft it is about the size of small specimens of teeth of the former species, but is proportionately narrower, and agrees better in this respect with those of the latter species.

The crown presents four divisions or ridges and a heel, each of the former being composed in the usual manner of a transverse pair of lobes. The anterior two ridges are considerably worn, and the first one is broken away at its fore part. They bear some resemblance to those of the Tambla tooth, and the neighboring transverse valleys are obstructed at the middle in the same manner. Likewise the anterior two inner lobes, from trituration, have exposed trefoil tracts of dentine. The third ridge of the crown is but slightly worn, and, though constructed on the same plan as those in advance, exhibits the distinctive features more clearly. The outer lobe appears to be composed of a connate pair of lobules, of which the included one is much the smaller, and has springing from it in advance and occupying the second valley of the crown a large mammillary eminence. The corresponding inner lobe exhibits a pair of fore and aft prominent buttresses obstructing the transverse valleys, and in addition an offset connate with the included lobule of the outer lobe. The fourth division of the crown is less well-developed than those in advance, which are of nearly uniform size. Its lobes are each composed of a distinct pair of lobules, of which the included ones are smaller, contiguous, and situated somewhat in advance of the exterior lobules, so that they contribute to obstruct the middle of the third transverse valley of the tooth. The heel of the crown is composed of a pair of small mammillary eminences, a rudiment of an additional ridge to the tooth.

The fore and aft diameter of the cast in its present condition is sixty-eight lines, and when perfect is estimated to have been about six and one-third inches. Its width at the base of the second ridge of the crown is thirty-two lines. The height of the third nearly unworn ridge is twenty-five lines from the base of the crown; that of the fourth ridge twenty-two lines.

The cast exhibits so remarkable a resemblance in every respect with the representation of a tooth described by Prof. Owen in his History of British Fossil Mammalia, that it might readily be taken for a copy of the latter tooth. This is described, on page 280, as a penultimate upper molar of *Mastodon angustidens*, from the fluvio-marine crag of Norfolk, England, and is represented in figure 98. On comparing the latter with our representation of the cast, figure 13, plate XXVII, one cannot fail to be struck with the apparently accidental resemblance of the specimens in form, size, and mutilation. The two certainly resemble each other so much that one would do as well as the other to represent the species.

The tooth of enigmatic character, above referred to, preserved in the Museum of the Academy, to which the cast just described bears a resemblance, was purchased in London, as an American fossil, through Mr. Edward Charlesworth, and sent to Dr. T. B. Wilson, by whom it was presented to this Institution. By a wonderful coincidence of circumstances, it was mistaken for the original of the cast above described, and was without dissent believed to be such until the discovery of the cast in Dr. Harlan's collection proved it to be otherwise. In comparing the specimen with the cast above described, it is observed that the two teeth nearly resembled each other in general construction, proportions, size, accidental color and fracture, and position in the series. When we add to these characters of resemblance that both specimens were of reputed American origin, were different from the corresponding teeth of the *M. americanus*, and were the only ones of the kind discovered, it is not to be wondered that the tooth under consideration was unhesitatingly admitted to be the original of the cast. It is the tooth figured by Dr. Warren in his work on the *Mastodon giganteus*, marked *Mastodon angustidens?*, and is referred to on page 79 under the head of "the Baltimore tooth." Dr. Warren remarks that while examining the Mastodon teeth in the collection of the Academy of Natural Sciences, "Dr. Hays, fixing on one, immediately said: 'This is the Baltimore tooth we were looking for, or it is so like it as not to be distinguished from it.'" It was also to this specimen that the extract from Mr. Charlesworth's letter refers, in Appendix C, page 176, of the same work. Mr. Charlesworth wrote: "Some time in 1847 or 8 I was passing through an obscure alley connecting Lincoln's Inn Fields with Temple Bar, when my attention was arrested by a Mastodon tooth in a shop window, which seemed to me a fac-simile of the one I had examined with so much interest in the Baltimore Museum. The proprietor of the shop told me he had bought the tooth as American at one of Steven's sales, the well-known natural history auctioneer at Covent Garden. We struck a bargain for the fossil, and I shortly afterwards sent it to Dr. Wilson, with a statement of its remarkable resemblance to the tooth which I supposed still to be safe in the Baltimore Museum."

The tooth, represented in figure 14, plate XXVII, is a last lower molar of the left side, rather smaller than the plaster cast, but presenting about the same proportions of breadth fore and aft to the width.

The crown exhibits four principal divisions or ridges, together with a heel consisting of a rudimental fifth division, separated by four transverse valleys. The middle of the latter is occupied by accessory eminences, and a thick basal ridge completed the fore part of the crown.

The four principal divisions of the crown are of nearly uniform development, and are proportionately longer or deeper and more cylindrico-conical or mammilliform than in the plaster cast. They are also more deeply separated by the transverse valleys, which are more contracted and angular, and at their outlet approach more nearly the base of the crown.

The anterior three divisions of the crown incline forward, and are worn so as to exhibit tracts of dentine at the summits of their component lobes. The fourth division and the rudimental one slightly diverge from those in advance, or have a backward inclination. In the cast, and also in the corresponding tooth of *M. americanus*, all the divisions of the crown have a forward inclination.

All the divisions of the crown are separated by a well-marked vertical fissure into the usual pairs of lobes. Each lobe is further sub-divided by a distinct fissure into a pair of lobules. The exterior lobules are the larger, prominently mammilliform, and nearly alike, but the inner ones are more vertical than the outer ones. The intervening lobules are contiguous, and appear compressed between the fore part of the exterior lobules.

In the anterior two divisions of the crown, the exposed dentinal tract of each lobe or connate pair of lobules has an irregular dumb bell, or figure-of-eight outline. In the third division, each lobule presents a minute dentinal pit at its worn summit. The fourth division of the crown is composed like those in advance, and is proportionately much better developed than the corresponding division in the plaster cast and in the tooth of *M. americanus*. The heel or fifth lesser division of the crown is composed of a pair of mammilliform lobes, about half the size of the exterior lobules of the lobes in advance.

The transverse valleys are narrower, deeper, and more angular than in the plaster cast. The accessory eminences occupying and obstructing their middle are in transverse pairs, and are mammilliform. The first pair are nearly equal, the inner being the smaller, and their worn summits, with a central dentinal pit, reach the level of the contiguous pair of divisions of the crown. Of the remaining pairs of accessory eminences, the inner one in each is very small, while the larger ones successively diminish in size.

The anterior basal ridge is partly broken away, together with a portion of the internal lobule of the first division of the crown. The remaining portion of the former is worn off very obliquely, and exhibits part of an interior tract of exposed dentine.

The fore and aft diameter of the crown is five and a half inches; the greatest width, which is at the bottom of the third ridge or division, is thirty-one lines. The height of the unworn fourth division of the crown externally is thirty-two lines.

Since writing the above, I have received for examination, from the Smithsonian Institution, two fragments of Mastodon teeth found at Tarboro, North Carolina. One is the posterior half of a last inferior molar, and is represented in figure 16, plate

XXVII. In its form, constitution, condition of preservation, and color, it sufficiently resembles the corresponding portion of the enigmatic tooth purchased in London as to render it more probable than ever that the latter is really American. The fragment, while approximating most the corresponding part of the enigmatic tooth, also approaches that of the cast, so as to be intermediate in character.

The accompanying fragment of a tooth consists of a middle portion of the crown, which in the arrangement of its constituent elements sufficiently resembles the other specimen to belong to the same species, if not the same individual.

Two additional specimens in the Museum of the Academy may perhaps belong to the same species as the foregoing. One of these consists of the fragment of a Mastodon molar from the collection of the American Philosophical Society. It is represented in figures 3, 4, plate xxii, accompanying Dr. Hays' "Descriptions of Inferior Maxillary Bones of Mastodons," in the fourth volume of the Transactions of that Society. Is is indicated in the reference to the plate as belonging to a peculiar species, and is dedicated to Dr. Chapman, from which it is usually referred to under the name of *M. Chapmani*. Nothing is known in regard to the locality from whence the specimen was obtained. Apparently it consists of the fore part, comprising three divisions, of the last upper molar of the right side. It is much worn, and the embracing enamel of the first division of the crown, together with the greater part of the outer lobe of the second division, are broken away.

In the anterior two divisions of the crown the exposed dentine extended in single broad tracts from side to side. In the less worn third division the lobes yet remain distinct, and appear to alternate with each other in relative position. The inner lobe, worn, like those in advance, nearly to the bottom of the intervening portion of the transverse valleys, occupies nearly two-thirds of the masticating surface of the third division of the crown. Its exposed dentinal tract is transversely dumb-bell formed, with the interior portion festooned. The outer lobe, posterior and external in position to the inner lobe, is bounded in front and behind by the deep outlets of the contiguous transverse valleys. A groove indicates it to be composed of a connate pair of lobules, the summits of which together exhibit a transverse dumb-bell-like tract of dentine, much smaller than that of the inner lobe. Behind the latter, in the middle of the third valley there is an accessory eminence, worn to the level of the lobes in advance, and exhibiting on its summit a small oval islet of dentine.

The remaining specimen above referred to consists of the fragment of a Mastodon tooth from the excavation of the Brunswick Canal, Darien, Georgia, where it was found in association with remains of *Elephas Columbi, Megatherium mirabile, Equus fraternus, Bison latifrons*, etc.

The fragment apparently consists of the posterior two divisions of the crown of a fifth molar, and resembles in general form the corresponding portion of the same tooth in *M. americanus*. The summits of the lobes in each division of the crown approach more nearly or incline more towards each other, the bottoms of the valleys are more concave, and their middle is obstructed by comparatively small accessory eminences, associated with the buttress-like ridges of the more inclined lobes. The posterior basal ridge is produced into a single median conical eminence. The summits of the anterior lobes of the specimen are worn at their fore part, but not sufficiently to expose the dentine. The posterior lobes are unworn.

The width of the specimen at the base of the posterior division of the crown is forty lines, and at the base of the division in advance thirty-eight lines.

Mastodon mirificus.

Among the most interesting discoveries of Dr. Hayden in Nebraska are the remains of a species of Mastodon, unquestionably distinct from those which had been so long familiar to naturalists as pertaining to the *M. americanus*.

The most characteristic specimen of the newly discovered species of Mastodon, distinguished by the above name, consists of the greater part of both rami of the lower jaw, each containing the last molar tooth. It was found on the Loup Fork of the Platte River, though remains, apparently of the same species, were observed by Dr. Hayden on the Niobrara River. The left ramus of the specimen is represented in figures 1, 2, plate XXV.

The lower jaw of *M. mirificus* is smaller than that of *M. ohioticus*, being both shorter and of less depth, but is proportionately of rather greater breadth posteriorly. The form is nearly the same, but the rami are more convex externally, and the alveolar border slopes backward.

The specimen exhibits no trace of having been provided with incisor tusks.

A single tooth on each side, the last of the molar series, occupies the alveolar border of the jaw, and it has so completely replaced those which preceded it in functional position that hardly a trace of their sockets is left. In advance of the molar the border forms a prominent carina-like ridge, pursuing a sigmoid course to the elongated chin.

The crown of the sixth molar of *M. mirificus* exhibits six divisions or ridges, separated by comparatively narrow valleys, and composed, in the usual manner, of transverse pairs of lobes.

A slight disproportion exists between the two teeth in the specimen; that of the right side measures eight and a half inches fore and aft and forty-one lines wide at the base of the third division; that of the left side measures eight and three-quarter inches fore and aft, and has measured about thirty-eight lines wide at the base of the third division.

The anterior four divisions of the crown are nearly of uniform size; the others undergo a successive reduction, and rather more so in the right than in the left tooth. The former divisions of the crown are all worn so as to expose large tracts of dentine bordered by thick festooned bands of enamel. In the anterior two divisions the dentinal tracts extend completely across, in the others they are confined to their respective lobes. The latter present the relative complexity of those of the teeth of *Mastodon Humboldtii.* The exterior portion of the lobes are simply robust conical; their interior portion appears to be composed of a connate group of lobules or offsets from the main lobes.

The fifth division of the crown presents a reduced and more simple condition compared with those in advance, and the last division is composed of a transverse pair of cones, of which the outer larger one, in the right tooth, is sub-divided. The posterior two valleys contain the remains of a thin layer of cementum.

Dr. Falconer has grouped all the Mastodons into two subgenera, *Trilophodon* and *Tetralophodon,* based upon the intermediate teeth of the molar series possessing three or four transverse divisions or ridges to the crown. The formulæ he gives for the ridged condition of the molar teeth in the two subgenera are as follow:

	1st molar.	2d.	3d.	4th.	5th.	6th.
Trilophodon, . .	1	2	3	3	3	4
Tetralophodon, . .	2	3	4	4	4	5

The *Mastodon americanus* and the *M. angustidens* of Europe, according to the formula, are placed by the author in the subgenus *Trilophodon.* The *Mastodon longirostris* of Europe is placed in the subgenus *Tetralophodon.* Of the two South American species, *M. andium* and *M. Humboldtii,* the former was viewed as belonging to *Tetralophodon,** the latter to *Trilophodon;* but more recently Dr. Falconer has placed them both in the last-named subgenus.†

According to the formula, *Mastodon mirificus* would appear to belong to the subgenus *Tetralophodon.*

The measurements of the lower jaw of *M. mirificus* are as follow:

	Inches.
Greatest breadth outside the position of the molars, and opposite the penultimate or fifth ridge of the crown, ...	16¼
Length from prolongation of chin to back of last molar, obliquely, .	17
Length from do. in the median line to the back of the last molars, .	16½
Length of the symphysial gutter from the posterior line of the symphysis, .	4¾

Dr. Hayden observed many other remains of Mastodon, probably belonging to this

* On the Species of Mastodon, etc. Quar. Jour. Geol. Soc. London, 1857, xiii, 307.

† On the American Fossil Elephant, etc. Nat. Hist. Review, London, 1863, 99.

species, in association with those of *Hipparion* and *Elephas*, at the head of the Loup Fork branch of the Platte River, between that point and the Niobrara River, and in the course of the latter. The remains of *Mastodon mirificus* are attributed by Dr. Hayden to the uppermost bed of the pliocene tertiary, or bed F of his section of the tertiary deposits of Nebraska and Dakota.

ELEPHAS.

Fossil remains of Elephants have been discovered throughout the continent of North America, frequently in association with those of *Mastodon americanus*. They are much less abundant than those of the latter, less complete, and generally less well-preserved. The Elephant, though a cotemporary of the Mastodon, probably preceded it in time, and probably ceased to exist long before the latter. Indeed, the remains of the North American Elephant which have been discovered, with a few exceptions, consist of teeth, and, while many complete skeletons of the Mastodon have been found, to this day we know but little of the skeleton of our Elephant.

From the character of the molar teeth, most naturalists of authority have regarded the remains of the North American Elephant as having belonged to the same species as the Mammoth, or *Elephas primigenius* of Northern Asia and Europe.

Among the fossil teeth of the American Elephant two varieties have been observed; the ordinary one, in which the constituent divisions or lobes are comparatively thin and numerous; and the other, in which the lobes are coarser, less numerous, with thicker and more crimped enamel, and more widely separated by cementum. Dr. Harlan thought it probable that these two varieties of teeth indicated different species,* and this opinion is more decidedly expressed by Dr. Falconer, who had more favorable opportunities for investigating the characters of the great proboscideans, both living and extinct, than any other naturalist. Dr. Falconer regards the thin-lobed variety of fossil teeth of this continent as belonging to *Elephas primigenius*, while the coarser-lobed variety he has referred to a different species, with the name of *Elephas Columbi*.

Though it is not improbable that the *Elephas primigenius* may have ranged through the high northern latitudes of America and Asia including its peninsula Europe, and may even have extended southwardly throughout the continent of North America, such a wide range of distribution of a species of mammal is unusual. While I am disposed to view the remains of the Elephant found in the frozen cliffs of Escholtz Bay in northern Alaska, and bordering closely on Asia, as those of *Elephas primigenius*, I hold the opinion that most of the remains found throughout North America, and usually referred by authors to the latter, really pertain to a peculiar

*Jour. Ac. Nat. Sci. iii, 1823, 67; Med. Phys. Res. 1835, 361.

species. This opinion I think is sustained by sufficient anatomical evidence. Dr. Falconer observes that "there is one peculiarity in the molars of the North American Mammoth, which is so constant that I believe in most instances, by means of it, they can be discriminated in a mixed collection of European, Asiatic and American specimens,—namely, that the ridges and their constituent elements are more attenuated and condensed."* He however adds: "But I do not regard it as indicating more than a slight geographical variety, as the other characters, such as the form of the lower jaw, &c., remain constant to the true Mammoth type."

The anterior portion of a lower jaw, found at Jackson, Ohio, and described and figured by an anonymous writer in the American Journal of Science, vol. xxxiv, for 1838, and corresponding portions of two jaws found at Burlington Heights, near Hamilton, at the western extremity of Lake Ontario, described and figured by E. Billings in the Canadian Naturalist, vol. viii, for 1863, exhibit decided peculiarities distinguishing them from their homologues in *Elephas primigenius*. In comparing the figures of the front part of the lower jaws, in the works just mentioned, with those of *E. primigenius* in Cuvier's plates of the Ossemens Fossiles, we are struck with the differences. The converging rami of the lower jaw, in the specimens above indicated, with the prolonged narrow symphysis, and the deep narrow symphysial gutter, would rather lead one to suppose our Elephant was the same as the living Asiatic species than the extinct *E. primigenius* of Asia and Europe.

Viewing the North American Elephant as distinct, I had adopted for it the name, first proposed by Dekay, of *Elephas americanus*, before I had noticed the account of the lower jaw from Jackson, Ohio, which the author, for convenience in comparison, refers to under the name of *Elephas Jacksoni*, and which Mr. Billings has since called *Euelephas Jacksoni*, attributing the name to Briggs and Foster.

It is not improbable that the teeth referred by Dr. Falconer to *E. Columbi* may indicate a distinct species from the former, though at present I am not prepared to view it as such, for the many specimens of fossil Elephant teeth I have had the opportunity of examining appear to exhibit every gradation of character between the extreme varieties. Nearly the same characters assigned to the teeth referred to *E. Columbi* I had recognized in the fragment of a molar from the Niobrara River, before I had seen the account of the former, which induced me to refer the Niobrara fossil to a species with the name of *E. imperator*. This, from its belonging to a special geological fauna, may prove to be distinct, but, awaiting future discovery, I am inclined to view it, together with *E. Columbi*, as belonging to the *E. americanus*.

The gradation of characters assigned to the American variety of teeth of *E. primigenius* and *E. Columbi* is illustrated by the following list of specimens preserved in the Museum of the Academy:

* On the Am. Fos. Elephant, in Nat. Hist. Rev. 1863, 66.

1. An inferior last molar, from Madison, Indiana. It is worn throughout the entire breadth, and measures fore and aft nine and three-quarter inches. It contains twenty ridges, with a worn heel in front and behind, each of half an inch in thickness. The widest ridge measures three inches.

This specimen contains a greater number of ridges in the same space than any other fossil Elephant tooth in the collection of the Academy. The crown is nearly worn to its fangs, and yet the plates of dentine are thin. The plates of cementum are still thinner, and the thin laminæ of enamel are moderately crimped.

It resembles very much a cast in plaster, in the Museum of the Academy, of a last inferior molar of *Elephas primigenius*, the original of which, from the Canal de l'Ourcq, near Paris, is represented in figure 6*a*, plate x, G. *Elephas*, of De Blainville's Osteographie. The cast measures ten inches in breadth, and contains twenty-one and a half ridges, with a prominence behind apparently composed of two more rudimental ridges. The widest ridge measures three and a half inches.

2. A superior last molar, nearly perfect, locality unknown, but with the aspect of the Big-bone-lick specimens, measures thirteen inches in breadth, little more than half of which is worn. It contains twenty-seven and a half ridges, of which the widest is four and a half inches. The first unworn ridge or lobe is about eight inches in length.

3. A lower last molar with the anterior extremity broken off, of unknown locality, but probably from Big-bone-lick. The triturating surface extends nearly the breadth of the specimen, which is about eleven inches. It contains twenty-two divisions or lobes, of which the widest is about three and a half inches.

4. A lower last molar from Big-bone-lick. It is worn its entire breadth, and measures ten and three-quarter inches. It contains twenty and a half ridges, of which the widest is little over four inches.

5. An upper last molar, probably from Big-bone-lick, a foot in breadth, which is rather more than one-third worn. It contains twenty-five ridges, besides which it has lost several of the more rudimental ones posteriorly.

6. An upper last molar from Big-bone-lick, worn about two-thirds its breadth, and broken at its fore part. The remainder measures ten and a half inches in breadth, and contains seventeen ridges, of which the widest is four and a half inches.

7. The anterior part of a molar, probably about half its original extent, from Benton Co., Misssouri. It measures seven and three-quarter inches in breadth, and contains twelve and a half divisions.

8. An upper molar, from Willamette Valley, Oregon, worn rather more than half

its breadth, which is eleven and a half inches. It contains eighteen and a half ridges, of which the widest is four and a half inches.

9. An inferior molar of the variety referred to *Elephas Columbi*, from Brunswick Canal, Darien, Georgia. It has lost a small portion anteriorly, and is worn its entire breadth, which is eight and three-quarter inches. It contains twelve and a half ridges, and a back heel of cement of about half an inch in thickness.

Besides the gradual transition of character in the relative thickness of the constituent plates of the molars of the North American Elephant, referred by Falconer to two species, specimens likewise exhibit a gradation in the degree of crimping of the enamel, and also in the mode of wearing, from the more level condition of the triturating surface of such teeth as have been referred to *E. primigenius*, to the terraced condition viewed as a character of those referred to *E. Columbi*.

Since writing the above, I have received for examination from the Smithsonian Institution five Elephant molars, which possess some interest. Four of them are from the Yukon River, Alaska; the remaining specimen is from Petite Anse Salt Mine, Louisiana.

Of the Yukon specimens, three are much mutilated, and present the ordinary type of structure. The fourth one resembles those referred by Dr. Falconer to *Elephas Columbi*. It is from an intermediate position in the series, and is probably a third or fourth. It exhibits as great a degree of coarseness of its constituent plates as the section of the tooth of *E. Columbi*, from Georgia, represented in plate 1 of Dr. Falconer's admirable paper on the American Fossil Elephant, published in the Natural History Review for 1862. The back three plates are unworn in the specimen; the anterior five are worn off in the usual manner. The eight plates together at their base occupy a space of six and three-quarter inches; ascending they converge, both from in front and behind, so as to occupy at the triturating surface about a line less than four inches. The back unworn plates are about four and a quarter inches long; the first worn plate is three inches long. The greatest thickness or width of the tooth, at the middle of the fourth plate, is forty lines. Perhaps these Yukon specimens may belong to *Elephas primigenius*.

The Petite Anse tooth is most decidedly of the character of those referred to *E. Columbi*. The specimen consists of the greater portion of a much worn last inferior molar. The triturating surface in all its details resembles those of the Elephant teeth from Brunswick Canal, Georgia.

The fragment of a molar tooth originally referred to a species with the name of *Elephas imperator* was obtained by Prof. Hayden on the Loup Fork of the Platte River. I was led to refer it to a species different from the more ordinary American

Elephant, from its greater size, the comparative coarseness of the constituent elements, together with the fact that it appeared to be a member of a peculiar fauna, an associate of the *Mastodon mirificus*, as the ordinary *E. americanus* was of the *M. americanus*. The notice of *E. imperator* was published in a short "Notice of Remains of Extinct Vertebrata from the Niobrara River," in the Proceedings of this Academy for 1848, and before I had seen Dr. Falconer's paper "On the Species of Mastodon and Elephant," published the previous year in the Quarterly Journal of the Geological Society of London.

The specimen assigned to *E. imperator* is represented in figure 3, plate XXV, one-third the diameter of nature. It exhibits the characters attributed by Dr. Falconer to *E. Columbi*, compared with the supposed American variety of *E. primigenius*.

The specimen is the fore part of an upper molar, probably the fifth. The triturating surface, extending the breadth of the fragment, is nearly five inches at its widest part. The breadth on the less broken side is about seven and a half inches, and contains only as many ridges,—that is to say, one ridge to an inch of breadth. There is, however, a thick talon in front, and the ridges curve considerably backward on the less broken side of the tooth. The four more perfect ridges of the specimen at the middle of the triturating surface occupy a space of a little over three inches, including the three intermediate plates of cementum. The widest ridges measure four and a half inches. The enamel is thick and strongly crimped, and the dentinal tracts are slightly dilated at their middle.

Elephas imperator, if not regarded as a peculiar species of a peculiar fauna, may be viewed, together with those teeth which have been referred to *E. Columbi*, as belonging to the *Elephas americanus*.

Other remains of Elephants, as Dr. Hayden supposes them to be, he observed in association with those of *Mastodon mirificus*, *Equus excelsus*, and *Hipparion*, at the head of the Loup Fork branch of the Platte River, also between this point and the Niobrara River, and on the latter.

In a recent visit to Washington, I observed in the Geological Cabinet of the General Land Office a penultimate inferior molar of an Elephant, obtained by Dr. Hayden in Johnson Co., Nebraska. The tooth is of the coarse-plated variety, and its breadth was about one foot. The triturating surface had an extent of eight inches, and exhibited nine worn lobes. Behind the latter there were four unworn lobes and a rudiment of another.

More recently I have had the opportunity of inspecting some remains of an Elephant from Talbot Co., Maryland, in the possession of Prof. E. D. Cope. They indicate an animal approaching mature age. Among the remains are four molars, apparently the last of the temporary series from both jaws. They are well worn down, and exhibit about a dozen ridges to the crown. The tusks have been about five feet in length, and about a foot in circumference at their exit from the alveoli. The latter, preserved among the specimens, are long, as in *Elephas primigenius*, but they appear more divergent than is represented to be the case in the outline figure of the skull of that species, in Falconer's plates. The premaxillary gutter is deep. The maxillo-premaxillary suture descends obliquely near the middle of the outer side of the incisive alveolus. The breadth of the jaw at the exit of the tusks is fourteen inches; just in advance of the position of the infra-orbital foramen twelve inches; at the middle of the incisive alveoli about eleven inches.

SOLIDUNGULA.

The *Solidungula* or *Solipedia*, an order whose sole existing representative is the genus *Equus*, during the medial and later tertiary period down to the present epoch appears to have been much richer in genera. According to the researches of the author it was composed of two families, the *Equidæ* or true Horses, and the *Anchitheridæ*, and was represented by no less than eight distinct genera, inhabiting the country of the United States. Of the eight genera, three only have heretofore been observed in Europe and Asia, including the existing one,—namely, *Equus*, *Hipparion*, and *Anchitherium*. The additional genera have been named *Protohippus*, *Merychippus*, *Hypohippus*, *Anchippus*, and *Parahippus*.

The Niobrara collection of fossils contains a multitude of well-preserved remains of solipeds, consisting of teeth and bones and fragments of others, clear from matrix, but very generally isolated and mingled pell mell in the utmost confusion, so that in many cases I have found it impossible to refer them to any distinct species or genus. Even some of those which have been referred to species, after much labor and comparison, may prove to have been incorrectly done. The separation of solipedal remains under such circumstances is peculiarly difficult, on account of the close resemblance between the bones and teeth of different species, as is exemplified in the comparison of the bones and teeth of the different existing species of *Equus*.

EQUIDÆ.

The *Equidæ* are represented in the present condition of the earth by a single genus, *Equus*,—at least so far as equine genera are distinguishable through characters derived from the teeth.

The superior molars of the *Equidæ* have long square columnar crowns, which are gradually abraded in the course of protrusion, and are inserted into the jaws by fangs only after they are nearly worn out. The crowns are composed of six pairs of columns with the intervals occupied with cementum, so that when the summits of the columns are worn away the crown presents a broad masticating surface traversed by lines of enamel, with alternating tracts of dentine and cementum.

The external and median columns of the upper molars are the principal or larger ones, are of uniform size, and crescentoid in transverse section, with the contiguous horns conjoined; and the median pair embrace the external pair. The internal columns are smaller, cylindroid, and of secondary importance.

In the first large upper molar an additional secondary column is developed at the fore part of the crown, and rarely a pair may be found in place of the one. In the last molar the postero-internal column generally remains undeveloped.

The inferior molars, as in the case of the upper ones, have long columnar crowns, which are gradually worn away in the course of protrusion, and become inserted into the jaw by fangs only after they are nearly worn out. The crowns are oblong-square, and are composed of an external pair of crescentoid columns and an internal pair of twin-cylindroid columns. The intervals of the columns are filled with cementum.

The anterior horn of the foremost crescentoid column extends as a wall in a rectangular manner across the front of the crown. The contiguous horns of the crescentoid columns conjoin each other and the anterior twin-cylindroid column. The posterior twin column, smaller than that in advance, and has its back division less well-developed, apparently from its contracted position. In the last molar, where the division of the column just mentioned has more room for development, it is as large as the anterior division. In like manner, from a greater provision of space in the first large lower molar, the anterior extension of the front crescentoid lobe becomes developed into a column almost equal to the parent column.

To the family of *Equidæ* belong the genera *Equus, Protohippus, Hipparion* and *Merychippus.*

EQUUS.

In the superior molar teeth of the genus *Equus* the antero-internal column conjoins the antero-median column throughout the length of the crown, except at its unworn summit. In the permanent series, except the first tooth, it is double the size of the postero-internal column, expanding before as well as behind its connection with the antero-median column; and in transverse section, as seen on the worn triturating surface, it is broadly elliptical. Examples: *Equus caballus,* and other recent species of the genus, *Equus fossilis* of Europe, etc.

The genus *Equus* is represented at the present period by half a dozen species, which are all indigenous to the eastern hemisphere. At the time of the discovery of America by Europeans no living member of the genus existed in either continent, though conditions proved to be so favorable that the domesticated species, the Horse and the Ass, subsequently introduced, became widely distributed. The former especially has reproduced to such an extent that it is perhaps as abundant in America as it is elsewhere in the world. It has even also assumed the savage state, in which it is often seen in thrifty herds, having the appearance as if it were indigenous to the soil. These facts appear the more remarkable in view of the circumstance that several species of *Equus*, and species of closely allied genera, existed in America during former geological periods, and became subsequently extinct.

Fossil remains, referred to several species of *Equus*, have been discovered in the post-tertiary deposits of South America.

Mr. Darwin, in his Journal of the Voyage of the Adventure and Beagle, vol. iii, pp. 96, 149, 1839, gives an account of his discovery of two fossil teeth of a species of *Equus* in Bahia Blanca and Entre Rios. These specimens, found in the same formation as remains of extinct Edentata, of *Toxodon* and *Mastodon*, and in the same condition of preservation, were subsequently described by Prof. Owen, in the Zoology of the Voyage of the Beagle, Fossil Mammalia, page 108, 1840. Of one of them he observes: "Every point of comparison that could be established proved it to differ from the tooth of the common *Equus caballus* only in a slight inferiority of size." Of the other, which is represented in figures 13, 14, of plate xxxii, accompanying the work, by the comparison of which with the teeth of the Horse, the author remarks: "The anatomist can judge of its close correspondence with a middle molar of the left side of the upper jaw." Later, in the Catalogue of the Fossils of the Museum of the Royal College of Surgeons, page 236, 1845, Prof. Owen refers the two fossil teeth to an extinct species, under the name of *Equus curvidens*, and of the specimen, figured in the work before quoted, he observes: "It has a greater relative antero-posterior diameter than in the recent Horse, but differs more especially in the greater degree of incurvation of the entire tooth."

Dr. Lund, in a letter from Brazil, April 1, 1840, to the Editors of the Annales des Sciences Naturelles, 2d series, vol. 13, p. 319, 1840, stated that he had found the metatarsal bone of a species of *Equus* in the midst of an osseous breccia, including bones of the extinct *Canis troglodytes*, *Dasypus punctatus*, and *Chlamydotherium Humboldtii.* He says, "the bone is broader and more flat than those of the living Horses with which he had the opportunity of comparing it," and refers it to an extinct species with the name of *Equus neogæus.*

In the Transactions of the Royal Danish Academy of Sciences, vol. 12, pp. 89, 93, plate xlix, 1840, Dr. Lund indicates and figures five teeth, from bone-caverns of Brazil, which are referred to three species of *Equus*, including that last designated; the additional ones being named *Equus principalis* and *Equus caballus.*

According to M. Gervais, Weddell, in his Voyage dans la Bolivie, page 204, which work I have not seen, indicates remains of an extinct Horse, which he refers to a species with the name of *Equus macrognathus.* M. Gervais himself, in Gay's Historia de Chile, Zoologia, vol. 1, p. 146, plate viii, figure 7, 1847, describes and figures an inferior molar of robust proportions, which he refers to a species with the name of

Equus Americanus. The same author, in his Recherches sur les Mammiferes Fossiles de l'Amerique Meridionale, page 33, plate vii, 1855, describes and figures a number of equine remains which he refers to two species, under the names of *Equus neogæus* and *Equus Devillei.*

Under the head of *Equus neogæus* M. Gervais places *E. principalis,* Lund; *E. macrognathus,* Weddell; *E. Americanus,* Gervais; and *E. curvidens,* Owen. Under the head of *Equus Devillei* he places *E. principalis* with a note of interrogation, and he observes "that slight differences in the form of the lower molars and a less size are the only characters that can yet be assigned to distinguish it from *E. neogæus.*"

In the upper molar teeth of *Equus principalis* and *E. neogæus,* as represented by Dr. Lund in the work above mentioned, the central lakes of the worn triturating surface are comparatively of extreme simplicity. The internal median fold of enamel, from its isthmus of connection with the antero-median column of the tooth, is reflected backward only, and it forms a short ellipse. In *E. principalis* this ellipse, as is also the case with that formed by the enamel fold just behind, is oblique; in *E. neogæus* the corresponding ellipses have their long diameter antero-posterior, which difference is favor of the distinction of the two species.

In comparing M. Gervais' figure 1, plate vii, of the work above mentioned, representing the posterior four upper molars much worn, and which are referred by the author to *E. neogæus* or *E. macrognathus,* they will be observed in the characters above stated to agree with the tooth of *E. principalis* as represented by Dr. Lund.

In the upper molar of *E. curvidens,* as represented by Prof. Owen, the internal median fold of the triturating surface is reflected forward as well as backward of its isthmus, forming a comparatively long ellipse with the long diameter antero-posterior. The same arrangement exists in the upper molars of the recent Horse, except in the first one and in those of the temporary series. No extent of wearing in the teeth of this animal will give rise to such an appearance of the internal median fold as that represented in M. Gervais' figure just mentioned, so that the difference is not one of age.

The two isolated upper molars represented in M. Gervais' figures 2, 3, plate vii, likewise referred to *Equus neogæus* or *E. macrognathus,* agree in the arrangement of the internal median fold of the triturating surface with *E. curvidens,* Owen, but the enamel enclosing the central lakes is rather more complexly folded.

From an examination of the figures and the descriptions of the fossil upper molar teeth above mentioned, I am led to suspect their reference to species as follows:

1. Equus curvidens, Owen: Zool. Voy. Beagle, pl. xxxii, figs. 13, 14. *E. neogæus* or *E. macrognathus.* Gervais: Rech. Mam. Fos. Am. Merid. pl. vii, figs. 2, 3.
2. Equus neogæus. Lund: Dansk. Viden. Selsk. Afh. xii, pl. xlix, fig. 3.

3. Equus principalis. Lund: Ibidem, fig. 1. *E. neogæus* or *E. macrognathus.* Gervais: Rech. Mam. Fos. Am. Mer. pl. vii, figs. 2, 3.

Fossil equine remains have been found throughout the length and breadth of North America.

Buckland, in Beechy's Voyage to the Pacific, Appendix, page 595, 1851, and Sir John Richardson, in the Zoology of the Voyage of the Herald, p. 17, 1854, have both described equine remains discovered in association with those of an extinct Elephant, the Moose, the Reindeer, Musk Ox, etc., in the frozen cliffs of Eschscholtz Bay, Arctic America. They are referred to *Equus fossilis*,—a name applied to the species to which belong the ordinary fossil remains of a Horse found in Europe, by most palæontologists considered to have been the same as, or at least the progenitor of, the existing *Equus caballus.*

Dr. S. L. Mitchell, in a published Catalogue of Organic Remains presented to the Lyceum of Natural History of New York, pp. 7, 8, 1826, was the first to announce the existence of fossil equine remains in the United States. He indicates the discovery of a vertebra and teeth of a Horse in association with remains of Mastodon, etc., from near Neversink Hills, New Jersey.

Dr. Richard Harlan, in his Medical and Physical Researches, p. 267, 1835, refers to equine remains from the valley of the Ohio or Mississippi River, from the excavation of the Chesapeake Canal near Georgetown, District of Columbia, from gravel banks on the north branch of the Susquehanna River, and from the shore of Neuse River below Newbern, North Carolina. The fossils are attributed by the author to *Equus caballus.*

Dr. W. M. Carpenter, in the American Journal of Science, vol. xxxiv, page 201, 1838, describes and figures an upper molar tooth, of robust proportions, of a Horse, found with remains of the Mastodon, in the parish of West Feliciana, Louisiana.

Dr. Dekay, in the Zoology of New York, pt. 1, Mammalia, p. 108, 1842, in speaking of fossil equine remains of the United States, remarks that they resemble those of the common Horse, but from their size apparently belonged to a larger animal, and he refers them to an extinct species with the name of *Equus major.*

Dr. R. W. Gibbes, in the Proceedings of the American Association for the Advancement of Science, page 66, 1850, notices fossil equine teeth from Missouri, South Carolina, Skidaway Island, Georgia, and the Potomac River; and refers the fossils to *Equus curvidens*, Owen, *E. americanus*, Leidy, and to a peculiar species.

Prof. F. S. Holmes, in a pamphlet entitled Remains of Domestic Animals discovered among Post-pliocene Fossils in South Carolina, 1858, notices remains, mingled with those of *Mastodon*, *Megatherium*, and other extinct genera, which he regards as having belonged to the same species as the Domestic Horse, Hog, Sheep and Ox.

Prof. Emmons, in the North Carolina Geological Survey, 1858, p. 196, describes and figures several teeth which he views as fossils of the miocene formation, and attributes to the *Equus caballus*.

The author of the present work has previously published several notices on remains of extinct horses belonging to North America. In the Proceedings of the Academy of Natural Sciences of Philadelphia for 1847, p. 262, fossil teeth found in the United States were attributed to two species under the names of *Equus curvidens* and *E. americanus*. Subsequently, in Holmes' Post-pliocene Fossils of South Carolina, 1858, p. 100, fossil remains, undistinguishable in size and anatomical character from the bones and teeth of the recent Horse, were viewed as indicating an extinct species, for which the name of *Equus fraternus* was proposed Other remains reputed to be of unusual size, though they do not exceed in this respect the bones and teeth of the largest variety of the Domestic Horse, from the more complex folding of the enamel in the superior molars than in either the latter or the former, were referred to a species with the name of *Equus complicatus*. This name is, however, synonymous with the above *E. americanus*, and was substituted in consequence of the latter having been employed the same year by M. Gervais to designate a species supposed to be indicated by an inferior molar from Chili, South America.

The various equine fossils of the United States to which reference has been made have been attributed to different divisions of the tertiary period, but the weight of evidence is in favor of their all belonging to the post-tertiary epoch. Some of them perhaps are even remains of the Domestic Horse, not true fossils, or not properly belonging to the formations in which they have been found, but accidental occupants.

Besides a number of teeth, with little doubt belonging to the recent Horse, though obtained from deposits of an earlier period, the Museum of the Academy of Natural Sciences contains the following fossil specimens:

An upper and a lower molar, well preserved, found in association with remains of *Mastodon americanus* in a stratum, according to the accompanying label, "full of bones," on the shore of the Susquehanna River, Luzerne Co., Pennsylvania. The teeth are rather larger than the corresponding ones of the ordinary Horse, and the upper one, which appears to be a fourth or fifth of the series, exhibits a more complexly folded condition of the enamel on the triturating surface than at least is usual in the recent Horse. The cementum on both teeth is uncommonly thick.

The upper molar, independent of the investing cementum, measures at the triturating surface antero-posteriorly thirteen and a half lines, transversely thirteen lines.

The lower molar, the second or third of the series, measures antero-posteriorly fourteen and a half lines, transversely eight lines, or, with the investing cementum, eleven and a half lines.

An inferior molar, found in association with remains of *Elephas*, *Mastodon americanus*, *Megatherium mirabile*, &c., in the excavation of the Brunswick Canal, near Darien, Georgia. It is a second or third of the series, and is not distinguishable in size or anatomical character from the corresponding tooth of the ordinary Horse.

A number of upper and lower molars, and a tibia, found in association with remains of *Mastodon americanus*, *Elephas americanus*, *Megalonyx Jeffersonii*, *Mylodon Harlani*, *Felis atrox*, &c., in the vicinity of Natchez, Mississippi. Some of the teeth are of large size, and exhibit a highly complex folding of the enamel on the triturating surface; others are of the ordinary size and anatomical character.

An axis or second cervical vertebra, a calcaneum, a metacarpal, a metatarsal, three pasterns and a coffin-bone, from the great fossil ossuary of Big-bone-lick, Kentucky.

Several molar teeth formerly attributed to the latter locality, and referred by the writer to *Equus curvidens*, and subsequently to the recent Horse. Being found without label in a collection of fossils from Big-bone-lick in the Museum of the Academy, they were supposed to be from the same locality, but they are now suspected to be the specimens referred to by Dr. Harlan as being in the possession of the Academy, and derived from the valley of the Ohio or Mississippi.

A coronary bone, found in association with remains of *Bootherium cavifrons* and a great abundance of remains of *Mastodon americanus* in Benton Co., Missouri.

The author has further had the opportunity of inspecting numerous specimens of fossil teeth from the post-pliocene deposits in the vicinity of Charleston, South Carolina, a first upper molar from Illinois Bluffs, Missouri, a similar tooth from Texas, and likewise the specimens from North Carolina described by Prof. Emmons.

Nearly all the equine remains above indicated have been described and illustrated in the work of Prof. Holmes, entitled Post-pliocene Fossils of South Carolina, published in Charleston in 1860.

The associates of these equine remains in the various localities from whence they were obtained are the *Mastodon americanus*, *Elephas americanus*, *E. Columbi*, *Tapirus americanus fossilis*, *Tapirus Haysii*, *Hipparion venustum*, *Bison latifrons*, *Bootherium cavifrons*, *Megatherium mirabile*, *Megalonyx Jeffersonii*, *M. dissimilis*, *Mylodon Harlani*, *Ereptodon priscus*, *Felis atrox*, *Canis dirus*, *Ursus amplidens*, *Castoroides ohioensis*, *Hydrochœrus Æsopi*, etc.

The weight of evidence is certainly in favor of most of the equine remains above noticed, being true fossils and belonging to the deposits in which they were discovered. Many are undistinguishable in anatomical character from corresponding bones and teeth of the recent Horse, and some of them perhaps have really belonged to the latter, and are not true fossils, but accidental occupants of the formation in which they were found; that is to say, they may have been buried in the formation long subsequent to its deposit, and have thence derived certain of the characters, such as coloring and petrifaction, of the true fossils of the formation. Other teeth, usually of comparatively large size, exhibit a degree of complexity in the plication of the enamel upon the triturating surface that they are readily distinguished by this character from those of the recent Horse.

The two varieties of teeth indicated are related to each other much in the same manner as are those of *Equus fossilis* and *Equus plicidens* of Europe, and the palæontologist who is disposed to place no value upon a wide separation of locality in the attempt to determine a species, might consider the two varieties of equine fossils of the United States the same as the European ones just named.

It is true that between the usually smaller and more simple, and the larger and more complex varieties of fossil equine teeth of the United States, there are intermediate forms, which entirely preclude a well-defined grouping of the specimens so as to represent two distinct species.

I nevertheless suspect that the fossils represent two different species, according to the ordinary comprehension of a species among living equine animals, and with this view I have distinguished them by the names of *Equus fraternus* and *E. complicatus.* The latter name, substituted for that of *E. americanus,* is most probably synonymous with the *E. major* of Dr. Dekay, who, as previously mentioned, in alluding to the discovery of fossil teeth of a Horse in America, remarks that they resemble those of the common Horse, but from their size apparently belonged to a larger animal.

The reference of the fossil remains to two distinct species I think receives support from the circumstance that if teeth of several existing members of the genus *Equus* were commingled they would be even less readily distinguishable from one another.

The existing species of *Equus* are mainly distinguished by external characters, such as coloration and ornamentation of the hair, and variation in the size of the animals or their parts. If bones and teeth of the Domestic Horse, the Mule, the Ass, the Dziggetai, the Hemione, the Quagga, the Dauw and the Zebra were commingled, they might readily be considered as belonging to varieties of a single species. Though I have no opportunity of making the comparison, I suspect that the bones and teeth of the three last-named species are so nearly alike that, had they been found in a fossil state in Southern Africa, instead of the living animals, they would have been unhesitatingly considered as pertaining to a single species.

Cuvier observes: "J'ai comparé avec soin les squelettes de plusieurs variétés de chevaux, ceux de mulet, d'ane, de zebre, et de couayga, sans pouvoir leur trouver de caractere assez fixe pour que j'osasse hasarder de prononcer sur aucune de ces especes, d'apres un os isolé; la taille meme ne fournit que dés moyens incomplets de distinction, les cheveux et les anes variant beaucoup a cet égard, a cause de leur état de domesticité; leurs différences pouvant presque aller du simple au double, et quoique je n'aie pu encore me procurer le squelette de l'hemione ou dzigguetai, je ne doute point qu'il ne ressemble autant â toutes les autres especes qu'elles se ressemblent entre elles." In referring to the common *Equus fossilis* of Europe, the same authority remarks: "La meme resemblance paroit avoir eu lieu de l'espece fossile aux especes vivantes."*

In confirmation of Cuvier's remarks, Hensel observes: "Auch mir ist es nicht gelungen in den oberen Backenzähnen bestimmte Charaktere für die einzelnen Species aufzufinden, obgleich ich mit Ausnahme des *Equus montanus* alle derselben vergleichen konnte."† This observation is the more important from the fact that the extinct species of horses that have been indicated have been mainly distinguished from differences in the upper molar teeth.

Under the circumstances above considered, I repeat that I cannot avoid the suspicion that the fossil remains of horses indicated as having been discovered in the United States really represent two distinct species,—one about the size of the ordinary varieties of the Domestic Horse, with the bones and teeth, so far as we are acquainted with them, undistinguishable from those of the latter; and a second of comparatively large size (about the size of the English Dray Horse), with molar teeth, but especially the upper ones, presenting on the triturating surface an unusually complex folding of the enamel. To the former belongs the name of *Equus fraternus*, to the latter that of *E. complicatus*, or *E. major* of Dekay.

If the remains referred to *E. fraternus* be regarded as belonging to the same species as the existing *E. caballus*, it follows that the latter was indigenous to this continent at a former geological period, then became extinct, and ages subsequently was reintroduced from Europe. Or, going a step further, if we are to consider *E. fraternus* of the United States, *E. curvidens* of South America, and *E. fossilis* of Europe and Arctic America the same as *E. caballus* of the present period, we have presented to us a remarkable instance of the distribution of a species through time and space, the like of which I believe has no known parallel case among mammals.

* Ossemens Fossiles, 4 ed., t.iii, p. 217.

† Physikal. Abhandl. d. K. Akad. d. Wissenschaften zu Berlin, 1860, page 85.

Equus excelsus.

Dr. Hayden's Niobrara collection of fossils contains a number of bones and teeth closely like those of the ordinary Domestic Horse, both in size and anatomical character. Similar fossils also were obtained by the same indefatigable explorer from the Pawnee Loup branch of the Platte or Nebraska River. The fossils present a variable degree of alteration from their original condition. While nearly all are well preserved,—that is to say, are neither crushed or water-worn,—some are but little changed, while others apparently exhibit a considerable amount of siliceous infiltration. It is not improbable that part of the specimens looked upon as fossils may be remains of the Mustang or recent wild Horse of our western wilderness, but most of them appear to be true fossils indigenous to the locality in which they were found.

Although the fossil equine remains above indicated are so nearly like the bones and teeth of the recent Horse, I am inclined to view them as having belonged to another extinct species of the genus, and that species distinct too from *Equus fraternus*. This I did originally on the ground that they belonged to a peculiar fauna. But later I have observed the fact that the superior molars differ from those of *E caballus* and *E. fraternus* in the same manner that the corresponding teeth usually do from those of the Ass, as pointed out by Hensel, who remarks: "Das einzige Merkmal, durch welches sich die oberen Backenzähne des Esels von denen des Pferdes zu unterscheiden scheinen, is der Mangel der kleinen Falte, welche im Grunde der grossen Zahnbeinfurche auf der Innenseite des Zahnes bei dem Pferde vorkommt."*

In the same manner, the small inward fold of enamel, very generally observable in the upper molars of *Equus caballus* and *E. fraternus*, near the bottom of the deep valley between the median- and posterior internal folds, is usually absent in the corresponding teeth of *Equus excelsus*, the extinct Horse of Nebraska, as in the recent Ass.

In the summer of 1865 I received from Professor J. D. Whitney, engaged in the geological survey of California, some remains of Horses from that State. Most of the remains, among them an entire skull, are recent in appearance, and neither differ in anatomical character or size from the corresponding parts of the Mustang, or recent Indian Horse of the west, and, though sometimes taken from auriferous gravel at considerable depths, are probably of the existing species. Among the specimens are several upper molar teeth which have more the usual appearance of fossils. One was obtained from auriferous clay at a depth of thirty feet from the surface, in Tuolumne Co., and is slightly colored with oxide of iron; another was obtained from a bed of asphaltum, near Buena Vista Lake, and is impregnated with bitumen. These teeth, about the same size as the corresponding ones of the recent Horse, from the compara-

* Phys. Abh. K. Akad Wissens. Berlin, 1860, p. 86.

tive simplicity of arrangement of the enamel on their triturating surface I suspected to indicate an extinct species different from those of the eastern part of the continent, and proposed for it the name of *Equus occidentalis*.*

Subsequently the Academy received a portion of an upper jaw containing the anterior three large molars and several isolated molars of the same Horse from the Asphaltum bed or spring, near Buena Vista Lake, California. The specimens are thoroughly infiltrated with bitumen, and were presented by Dr. George H. Horn. Shortly after, I received for examination from Prof. Whitney portions of both upper and lower jaws, containing most of the teeth, from several individual Horses. These specimens were from the same locality as the former, and, like them, in a most remarkable manner permeated with bitumen.

All the parts of these fossils agree in size and proportions with the corresponding parts of the living Horse, but the superior molars all agree in the comparatively simple arrangement of the enamel upon their triturating surface. But the point most worthy of remark is that all these teeth referred to *E. occidentalis* resemble the corresponding teeth of the Ass in the absence of the little fold of enamel generally observable in the teeth of *E. caballus* and *E. fraternus*, and, I may add, in the more complex teeth of *E. complicatus*, near the bottom of the deep valley between the median- and posterior internal folds of the triturating surface. In this, which appears to be a somewhat important character, as well as in the simplicity of arrangement of the enamel generally, the California Horse agrees with the Nebraska Horse, and after all, therefore, the former was probably the same species as the latter.

As an interesting coincidence, nearly at the same time that I had the opportunity of examining the specimens from California just indicated, I received for examination from Messrs. D. G. Elliot and George N. Lawrence, of New York, a small collection of fossil bones, taken from an Asphaltum bed and from a stratum of blue clay beneath, in Harden Co., Texas. Most of the specimens are thoroughly imbued with bitumen, like the California Horse remains above mentioned. They consist of fragments of several turtle shells, the portion of a molar tooth of a giant Sloth, *Megalonyx validus*, several remarkable phalanges of two different animals, undetermined, the upper sectorial tooth of a large carnivore, *Trucifelis fatalis*, a small fragment of a Mastodon molar, and several Horse teeth. The latter consist of a first and last upper molar of the permanent series, the fragment of a fourth or fifth molar, and a second or third upper temporary molar. These teeth, in their proportions, complexity of arrangement of the enamel, and the presence of the little fold at the bottom of the deep internal valley of the triturating surface, agree with *Equus complicatus*. The last molar is remarkable for its excessive curvature.

In conclusion, I think there is evidence in favor of the probability of there formerly

* Proc. Ac. Nat. Sci. 1865, 94.

having existed at least three distinct species of Horse during the pliocene and post-pliocene period of North America,—viz.: *Equus fraternus*, *E. complicatus*, and *E. excelsus*, and probably *E. fossilis* or *E. caballus* may have existed in the extreme north-west of the continent extending from Asia.

The remains of *Equus excelsus* in Dr. Hayden's collection from Nebraska consist of fragments of jaws with teeth, isolated teeth, and bones of the extremities, as follow:

1. A fragment of the right side of the upper jaw, containing the back four molars, from the Pawnee Loup branch of the Platte or Nebraska River. The jaw fragment agrees in size and form with the corresponding portion in the recent Horse. The teeth are but moderately worn, and at the triturating surface together occupy a space of about four and a quarter inches from before backward. As seen in figure 31, plate XXI, the enamel folding surrounding the central lakes of the triturating surfaces is of the simplest character. The absence also of the small inward folds above alluded to, and usually observed in the recent Horse at the bottom of the deep oblique valley on the inner side of the teeth, may be noticed, except in the last of the series, where it exists. The measurements of the teeth are as follow:*

	Length. Inches.	Ant.-post. diam. Lines.	Trans. diam. Lines.
Third molar, ...	3¼	13	14
Fourth molar, ...	2¾	12½	14
Fifth molar, ...	3½	12	13
Sixth molar, ...	3¼	12	10½

2. A fragment of an upper left molar, a third or fourth of the series, from the same locality. It nearly agrees with that of the fossil just described.

3. Two inferior molars, from the same locality. They are the fifth and the last of the series, and are but little worn. They are represented in figure 39, plate XIX, and exhibit no characteristic difference from those of the recent Horse. Their measurements are as follow:

	Length. Inches.	Ant.-post. diam. Lines.	Trans. diam. Lines.
Fifth molar, ...	3¾	13	9
Sixth molar, ...	3¼	14½	8

4. Seven lower molars, from the same individual, from the Niobrara River. They consist of the second to the last inclusive of one side, and the posterior two of the

* In the measurements of the teeth of equine animals in the succeeding pages, unless otherwise mentioned, the following plan is pursued:

In the upper molars the length is measured along the external median ridge of the crown, or when it is mentioned internally, along the median column of the crown. In the lower molars, the length is measured along the middle of the crown internally.

other side, and are moderately worn. They are rather smaller than those above described, especially the last one. The series from the second to the sixth, at their triturating surfaces, together occupy a space of about six inches from before backward. Measurements of two of the specimens, independent of the investing cementum, are as follow:

	Length of crown.	Ant.-post. diam.	Trans. diam.
	Lines.	Lines.	Lines.
Second molar,	31	14¼	7
Last molar,	22	13	5

5. Two inferior first molars, one from Pawnee Loup River, the other from the Niobrara. They are between a third and a half worn, and agree closely in character with the corresponding teeth of the recent Horse. Their measurements are as follow:

	Lines.	Lines.
Length of the crown at the middle internally,	19	22
Antero-postero diameter of the triturating surface,	16	15
Transverse do. independent of the cementum,	7	7½

6. Six inferior molars, one from Pawnee Loup, the others from the Niobrara River. Three are the third, fifth and sixth of the series, and are two-thirds worn down. The others are less worn, and of different ages. They all agree in character with those of the recent Horse.

7. A series of three lower temporary molars, from the Niobrara River. The first is but little worn; the others belonged to a different individual, and are more worn. The measurements of the specimens at or near the triturating surface, as defined by the exterior enamel, are as follow:

	Ant.-post. diam.	Trans. diam.
	Lines.	Lines.
First temporary molar,	16½	5
Second " "	15	6
Third " "	16½	5½

8. Four symphysial fragments of as many lower jaws, from the Niobrara River. They agree in form with the corresponding portion of the lower jaw of the recent Horse. One of them retains the bottoms of the six incisive alveoli, and the contiguous canine alveoli.

9. An unworn and a much worn incisor, from the Niobrara, agreeing with corresponding teeth of the recent Horse.

10. The greater part of a mutilated occiput, about the size and form of that of the ordinary Horse, from the Niobrara River. The breadth of the specimen at the paramastoid processes is estimated to have been about four and a quarter inches. The occipital foramen is about seventeen lines in diameter transversely about the middle,

and about fifteen lines in height. The longest diameter of the posterior part of the condyles is twenty-two lines, which is also the length of the inferior part. The latter extends upon the basilar process an inch in advance of the anterior edge of the occipital foramen.

11. The lower extremity of a humerus, from the Niobrara River. The specimen comparatively of moderate proportions. Its measurements are as follow:

	Inch.	Lin.
Circumference of the shaft four inches above the inferior lateral edge of the articular surface,	4	8
Breadth of the articular surface,	2	6
Width, from before backward, of the internal condyle,	3	
Width of the external condyle,	1	10

12. The lower extremity of a radius, agreeing in size and proportions with the same portion of the bone in the ordinary Domestic Horse. From Pawnee Loup River. Its measurements are as follow:

	Inch.	Lin.
Circumference of the shaft three inches above the inferior lateral edge of the articular surface,	5	5
Breadth of shaft at same position,	2	
Thickness, before backward, at same position,	1	2
Breadth at lateral tuberosities for ligaments of the carpal articulation,	3	
Breadth of carpal articular surface,	2	6

13. The lower extremity of a tibia, about the size of the corresponding portion of the same bone in the common Horse. From the Niobrara River. Its measurements are as follow:

	Inch.	Lin.
Circumference of shaft five inches above apex of the pyramidal process,	5	4
Breadth, from side to side, at the same position,	1	10
Thickness, before backward, at the same position,	1	4
Breadth at the lateral tuberosities of the ankle,	3	3
Width from before backward and obliquely between the two median pyramidal processes,	2	6
Width of the articular end internally,	2	1
Width of the articular end externally,	1	7

14. A patella, of the same size as in the ordinary Horse, from the Niobrara River. It measures three inches in breadth and depth, and the articular surface is thirty-four lines in breadth and twenty-seven lines in depth.

15. Seven astragali from the sands of the Niobrara River, of the same form but

varying in size. The largest are about the same size as in the recent Horse; the smallest perhaps may belong to some of the larger *Hipparions* hereafter to be indicated. Their measurements are as follow:

	Lin.	Lin.	Lin.	Lin.	Lin.	Lin.	Lin.
Greatest breadth of articular surface of condyles,	29	26	25	25	24	22	22
Width, from before backward, of inner condyle, .	35	31	30	29	28	28	
Width of outer condyle, ...	33	28	28			27	25
Breadth of base, ...	31	28	29	26	26	26	26
Breadth of scaphoid articular surface, . .	29	27	26	24	23		23
Greatest depth of do., ...	21	18	18		16		16

16. Four calcanei from the Niobrara River, varying in size as follows:

	Lines.	Lines.	Lines.	Lines.
Extreme length, ...	57	56	54	50
Depth at middle of tuberosity, . . ,	25	22	22	20
Width at middle of tuberosity, . . .	11	10	11	10
Depth of extremity of tuberosity, . . .	27	23	22	22
Thickness of extremity of tuberosity, . .	18	16	16	15
Depth of articular extremity, . . .		28	27	24
Breadth of articular extremity, . . .		26	29	23

17. A fragment of a calcaneum and an astragalus, picked up by Dr. Hayden on the surface of the ground near Fort Pierre, on the Missouri River, therefore in a locality remote from where the preceding specimens were obtained. The bones appear to be thoroughly petrified or infiltrated with siliceous matter, and have spots of lichens on the surface. They correspond in form and size with the same bones in smaller varieties of the recent Horse. The measurements of the astragalus agree pretty closely with those of the above specimens, indicated in the second and third rows.

18. A scaphoid bone, from the Niobrara River, about the size and proportions of those of the common Horse. It measures twenty-eight lines from side to side, twenty-two lines from before backward, and six lines in thickness.

19. A series of four bones, together comprising a complete foot, from the Niobrara River. Though all probably derived from different individuals, they hold the same proportion to one another and agree in size with the corresponding bones of the ordinary Horse. They consist of the left median metatarsal bone and the succeeding phalanges. The entire foot measures nineteen inches in length.

The metatarsal bone is twelve and a half inches long; its circumference at middle four and three-quarters inches; the breadth of its proximal end twenty-nine lines, and the antero-posterior diameter twenty-four lines; the breadth of the distal extremity is twenty-five lines, and the antero-posterior diameter twenty lines.

The first phalanx is three and a half inches long; the breadth of its proximal end is thirty lines, and that of its distal end twenty-five lines.

The second phalanx, from the centre of its opposite articular surfaces, is an inch and a half long; the breadth of the proximal end is twenty-eight lines, and that of its distal end twenty-five lines.

The third phalanx, broken on one side, has about the same form and proportions as in the ordinary Horse. Along the anterior slope it measures two and a half inches, and its extreme breadth has been about four and one-third inches. The width of the articular surface has been about two and a quarter inches; and the diameter from before backward is one and a quarter inches.

20. The upper end of a metacarpal and seven lower extremities of metacarpals and metatarsals, like those of the common Horse, from the Niobrara River. They vary slightly in relation of size. The carpal articular surface of the upper metacarpal fragment measures twenty-six lines in width, and sixteen lines from before backward. The phalangial articular surface of the largest of the lower fragments measures two inches wide and twenty lines from before backward on the median trochlear ridge; of the smallest of the lower fragments, twenty-one lines wide and seventeen lines from before backward.

21. Two pastern, three coronet, and two coffin bones, from the Niobrara River.

The pasterns are somewhat mutilated, and one is devoid of its upper epiphysis. They are rather smaller than that of the reconstructed foot, but are otherwise like it. Their comparative measurements with that of the latter are as follow:

	Lines.	Lines.	Lines.
Length in the axis, ...	39	37	
Breadth of proximal end, ...	29		
Breadth of distal end, ...	24½		23½
Breadth of shaft at middle, ...	19	18½	17½
Breadth of proximal articulation, . . .	26		

The coronets are considerably smaller than that of the reconstructed foot, and may probably have pertained to one or other of the larger *Hipparions* hereafter to be indicated. They differ slightly in size and relations of diameter among themselves. One of them closely corresponds in form with that of the common Horse, and that of the reconstructed foot; the other pair are more transversely convex in front. Their comparative measurements, together with that of the reconstructed foot are as follow:

	Lines.	Lines.	Lines.	Lines.
Length through the axis, . . .	18	17	16	15
Breadth between the upper lateral tubercles, .	28	23	24	23
Breadth of proximal articular surface, .	25	20	22	21
Breadth of distal articular surface, . .	25	20	22	21

The two coffin bones have nearly the same form and size, and differ from that of the reconstructed foot in spreading less, or having a much less expanded base in relation with their height. Their comparative measurements, together with that of the reconstructed foot, are as follow :

	Lines.	Lines.	Lines.
Height of anterior slope, ...	30	27	25
Breadth of lateral spread, ...	51	36	36
Extent of spread antero-posteriorly, . . .	36	32	31
Breadth of articular surface, ...	27	24	22
Projection of angles laterally beyond the articular surface,	12	7	8

22. A pastern and coronary bone, apparently from the same individual, from the Niobrara River.

The pastern, somewhat smaller than the preceding, is not so wide in relation with its thickness or antero-posterior diameter, and exhibits a rather greater disproportion between the extremities. Its length, in the axis of the bone, is thirty-three lines; the breadth between the lateral tubercles, proximally, twenty-five lines; the breadth of the shaft at the middle is sixteen lines; and the breadth of the distal end is nineteen lines.

The coronet differs but slightly from the smaller of the preceding specimens. Its length in the axis is sixteen lines; its breadth, between the upper lateral tubercles, twenty-two lines; the breadth of the proximal articular surface is twenty lines; and the breadth of the distal articular surface is nineteen lines.

23. The lower extremity of a tibia much smaller than the corresponding portion of the same bone of the Horse, and approaching in size that of the Ass. The specimen is from the Niobrara River, and presents the following measurements :

	Lines.
Breadth of lower end, ...	30
Antero-posterior diameter internally, ...	19
Antero-posterior diameter externally, ...	14
Antero-posterior diameter between the middle pyramidal eminences, and obliquely, ...	21
Breadth of articular surface, ...	22

24. A median metatarsal bone, from the Niobrara River, intermediate in size to that of the recent Horse and the Ass, and probably pertaining to a *Hipparion*. It is both longer and proportionately narrower than the corresponding bone of *Hipparion gracile* of Europe. It has the same form as in the recent Horse. Its measurements are as follow :

	Inches.	Lines.
Length in front, from the edge of the carpal articular surface to the bottom of the distal median ridge,	10	7
Breadth of carpal articular surface,		22
Diameter of carpal articular surface from before backward,		18
Circumference of shaft at middle,		48
Transverse diameter of shaft at middle,		16
Antero-posterior diameter of shaft at middle,		14
Breadth of the phalangial articular surface,		20
Antero-posterior diameter of phalangial do. at the median ridge,		17

25. A mutilated pastern, from the Niobrara River. It is nearly as long as in the recent Horse but of more slender form. It probably belonged to a *Hipparion*. Its measurements are given in the account of the succeeding specimen.

26. A pastern and coronet bone, apparently from the same individual, from the Niobrara River.

The pastern nearly agrees in size and proportions with the preceding specimen, being slightly shorter and narrower. The comparative measurements of the two pasterns are as follow:

	Lines.	Lines.
Length, in the axis,	35	34
Width of proximal end,	23	21
Width of distal end,	18	18
Width of shaft at middle,	15	13½
Thickness of shaft at middle,	11½	12

The coronet bone is nearly of the size and proportions of the specimen last described. It measures sixteen lines long, twenty lines in width at the proximal end, and nineteen lines at the distal end.

27. A coronet and coffin bone, apparently from the same individual, from the Niobrara River.

The coronet is longer than in any of the preceding specimens except that of the reconstructed foot, which it approaches very nearly in form as well as size. The coffin bone, on the other hand, is much smaller than in any of the preceding specimens, though its articular surface accords in size with that of the coronet just indicated. It is further remarkable from the small extent of its lateral angles, which only project slightly beyond the articular border. The length of the coronet is eighteen lines, the breadth of the proximal end twenty-five lines, and of the distal end twenty-four lines.

The measurements of the coffin bone are as follow:

	Lines.
Height of anterior slope,	23
Breadth of lateral spread,	26
Extent of spread antero-posteriorly,	24
Breadth of articular surface,	24
Projection of angles laterally beyond the latter,	3

PROTOHIPPUS.

In this genus, as in *Equus*, the superior molar teeth have their antero-internal column associated with the antero-median column throughout the length of the crown. It is, however, very little larger than the postero-internal column,—extending only backward of its connection with the antero-median column, as in the first upper permanent molar of *Equus* and as in the temporary series of this genus. The correspondence in the character mentioned between the upper permanent molars of *Protohippus* and the corresponding first tooth, together with the temporary molars of *Equus*, indicates an earlier or more primitive condition of the former genus. The arrangement of the enamel in *Protohippus* is even less complex than usual in *Equus*.

Protohippus perditus.

Dr. Hayden's Niobrara collection of fossils contains an interesting specimen, consisting of a fragment of the skull of an equine animal, smaller than the Ass, to which the above name has been given. The fragment is composed of the back portion of the right maxillary bone, with the greater portion of the contiguous malar and a small portion of the lachrymal bone, and it contains the back four molar teeth. The infra-orbital margin and part of the infra-orbital foramen are preserved.

The specimen, represented in figure 1, plate XVII, closely resembles in form and construction the corresponding part in the Domestic Horse. As in this, the malar ridge of the maxillary terminates above the position of the antepenultimate molar, and the infra-orbital foramen is situated above the tooth in advance. The only important difference observable in the fossil as compared with the skull of the Horse, is in having the orbit a little more anterior in position, as in the Ass,—its front border being on a line with the fore part of the last molar tooth.

The teeth, consisting of the back four molars, are but moderately worn, and are more curved in relation with their length than in the Horse. The anterior tooth, exposed to view at the fore part, presents an external curvature the radius of which is about twenty lines; the internal curvature is the segment of a relatively smaller circle. Its crown measures eighteen lines along the former curvature and nine lines along the latter.

The general construction of the teeth,—that is to say, the arrangement of the enamel in its relation with the other elements,—as seen in the abraded surfaces, represented in figure 2, plate XVII, is nearly the same as in the Horse. The median lakes are more gaping or relatively more capacious than in the latter, even at the same stage of attrition, and the enamel border is rather simpler in its course or less folded.

The most important differences observable in the teeth of the fossil from those of the Horse and Ass,—those, indeed, upon which I have looked as of generic value,—are found in the arrangement of the internal columns of the crown. In the genus *Equus* the antero-internal column expands both before and behind its connection with the antero-median column, and in transverse section, as observed in the triturating surface, presents an elongated antero-posterior ellipse. In *Protohippus*, the new genus to which the fossil has been referred, the antero-internal column of the crown extends only backward from its connection with the antero-median column, and in section presents a short oblique ellipse, much as is the case in the upper temporary molars of the Horse.

In the latter, the postero-internal column of the upper molars preserves its distinctness from the one in advance and from the postero-median column, until the crown is nearly worn away to the fangs. In *Protohippus* the fold or inflection separating the postero-internal and postero-median columns extends but a comparatively short distance in the length of the crown, so that it becomes early obliterated; just previously leaving a small elliptical ring on the triturating surface.

Dr. Lund's figures 1 and 3, plate xlix, of the Royal Danish Academy of Sciences, representing upper molars of *Equus principalis* and *E. neogœus*, and M. Gervais' figure 1, plate vii, of the Researches on the Fossil Mammals of South America, representing upper molars of *E. neogœus* or *E. macrognathus*, but to which I have previously referred as probably pertaining to *E. principalis*, exhibit the same peculiarity of arrangement in the enamel on the triturating surface, and therefore likewise pertain to the genus *Protohippus*.

Measurements of the fossil in question, in comparison with those of the corresponding part of the recent Horse and Ass, are as follow:

	P. perditus.	E. asinus.	E. caballus.
	Lines.	Lines.	Lines.
Length of space occupied by back four molars, .	38	43	51
Antero-posterior diameter of third molar, . .	10	12½	13
Transverse do. (independent of cement), . .	10	11	13
Antero-posterior diameter of last molar, . .	9½	10¼	15
Transverse " " . . .	8¼	8	11
Distance from alveolar edge to infra-orbital margin at back of last molar, ...	20	29	42

	P. perditus. Lines.	E. asinus. Lines.	E. caballus. Lines.
Distance from alveolar edge to infra-orbital foramen above third molar, ...	18	23	33
Distance from infra-orbital foramen to anterior orbital margin, ...	26	38	54

Among the multitude of equine remains in the Niobrara and other collections, there are no others which can be referred with any certainty to *Protohippus perditus.*

Protohippus placidus.

Among many isolated upper molars of equine animals from the Niobrara River, mostly of uncertain reference, there are several sufficiently resembling those of *Protohippus perditus* to lead to the suspicion that they may belong to another and smaller species of the same genus. The teeth alluded to are not only smaller, but are less curved in relation with their length than in *P. perditus.* With the impression that they represent a distinct species, they may be referred to under the name of *Protohippus placidus.* The specimens apparently referable to it are as follow:

1. A first upper molar tooth about half worn away. The masticating surface, represented in figure 40, plate XVIII, presents extreme simplicity in the arrangement of the enamel, compared with its condition generally in equine animals. The central lakes appear wide and gaping, as in the more posterior teeth of *Protohippus perditus.* No trace of a posterior valley or enamel inflection of the crown exists. In this character the tooth approaches those of *P. perditus,* for although the inflection is present in the molars belonging to the fossil of the latter, it evidently extends but little depth in the length of the crown. In the fourth molar of the fossil just mentioned the inflection has been nearly obliterated, its remains being visible as a small ring in the postero-internal corner of the triturating surface; and at a little later period in the progress of attrition, the inflection would likewise have disappeared. The measurements of the specimen are as follow:

	Lines.
Length externally of the first upper molar, ...	9 to 10
Length along the internal column, ...	7
Antero-posterior diameter of triturating surface, ...	$9\frac{1}{2}$
Transverse " " "	$7\frac{1}{2}$

2. Two upper molars, seconds or thirds, or one of each of the series, very much worn. One of the specimens, the triturating surface of which is represented in figure 47, is about half worn away. It exhibits the same simplicity of arrangement of the enamel as in the preceding specimen and in the teeth of *P. perditus.* The other spe-

cimen, represented in figure 46, is four-fifths worn away. Its central lakes appear narrow in comparison with those of the former specimen, in consequence of their being nearly worn to the bottom.

In both teeth no trace of a posterior valley to the crown exists, as it had apparently long been obliterated. In the half-worn tooth the internal column of the crown appears associated by a very contracted isthmus with the antero-median column; in the more worn specimen the isthmus alluded to is wide comparatively. The measurements of the teeth are as follow:

	Lines.	Lines.
Length externally, ...	9½	4½
Length internally, ...	6½	3
Antero-posterior diameter, ...	8	7¾
Transverse diameter, ...	9	9

3. Three upper molars, apparently a fourth, and a right and left fifth of the series. The former, represented in figure 45, is nearly half worn away; the latter, represented in figures 43, 44, are hardly a fourth worn away.

In the fourth molar, the central lakes of the triturating surface in their wide gaping character resemble closely those of the less worn of the two preceding specimens described. The anterior lake is almost devoid of cementum, which appears not to be the result of accident after the death of the animal to which the tooth belonged. No trace of a posterior valley to the crown exists.

The little worn fifth molars likewise exhibit the usual simplicity of arrangement of enamel on the triturating surfaces, figures 43, 44, and the central lakes appear capacious. In both specimens the posterior valley is seen to exist, but in neither does it extend more than one-third the length of the crown, so that by the time the teeth were half worn away it would have been obliterated, as in the preceding specimens. In the less worn of the two teeth, the posterior median lake opens into the posterior valley of the tooth. The measurements of the specimens are as follow:

	4th superior molar.	5th.	5th.
	Lines.	Lines.	Lines.
Length externally, ...	10	14½	17
Length internally, ...	6½	11½	13½
Antero-posterior diameter, ...	7	7½	8
Transverse diameter, ...	8½	7	8

4. A last superior molar, apparently two-thirds worn away, and represented in figure 39. It agrees with the preceding, and the corresponding tooth of *P. perditus*, in the simplicity of arrangement of the enamel, and the gaping character of the central lakes of the triturating surface. Its measurements are as follow:

	Lines.
Length externally,	8
Length internally,	5
Antero-posterior diameter,	8
Transverse diameter,	7

Three additional specimens may be described under the present head, though I am doubtful as to the propriety of their association, nor can I with less uncertainty refer them to *Hipparion gratum*, hereafter to be described. They are as follow:

A first superior molar, four-fifths worn away, and represented in figure 41. Its proportions are greater than the corresponding tooth above described would have been at the same stage of attrition. The central lakes of the triturating surface are of a different shape, less gaping, and present, even in their much worn condition, evidences of having been more complex in the arrangement of their surrounding enamel. Remains of a posterior valley of the crown exist as a small reniform islet in the postero-internal corner of the masticating surface. The internal column is nearly circular in transverse section, and is associated with the antero-median column by a wide isthmus.

A first superior molar, of greater proportions, but more worn than the preceding specimen. It is represented in figure 42, and more nearly resembles the latter than it does the first-described tooth referred to *P. placidus*. On the triturating surface all traces of the distinction of internal columns have disappeared, so that from the specimen alone it would be very uncertain whether to refer it to *Protohippus* or *Hipparion*.

A second or third superior molar, four-fifths worn away, and represented in figure 48. It accords in proportions and size with the teeth above referred to *P. placidus* generally. The central lakes of the triturating surface are still capacious, and in the specimen are both nearly devoid of cementum. The remains of a posterior valley exist as a small circular ring in the back internal corner of the masticating surface. The internal column is associated with the antero-median column by a very narrow isthmus. The tooth I have suspected to belong to a *Hipparion*, so much worn away that, having nearly reached the bottom of the crown, the two columns, usually observed separated, have become conjoined.

The measurements of the three specimens are as follow:

	1st superior molar. Lines.	1st. Lines.	2d. Lines.
Length externally,	3½ to 6	3 to 4½	4
Length internally,	2½	1½	3
Antero-posterior diameter,	10	11	9
Transverse diameter,	8	8	8

HIPPARION.

Hipparion, or *Hippotherium*, is an extinct equine genus, the remains of several species of which have been discovered in the middle and later tertiary deposits of Europe and Asia.

The skeleton of *Hipparion* was constructed on the same general plan as that of the Horse, or of the genus *Equus*. The extremities were supported on a single toe as in the latter, but an additional pair of toes were provided for each foot, though they were not sufficiently developed to reach the ground.

The superior molar teeth, which are the most characteristic of these organs in equine animals, in *Hipparion* present a striking difference from those of *Equus*. The difference mainly depends on the extent of separation of the antero-internal column of the crown from the antero-median column. In *Equus* the separation exists only at the summits of the columns in the unworn teeth. As these are worn away by attrition, the antero-internal column early appears on the masticating surface, in section as an ellipse of enamel enclosing dentine, and conjoined by an isthmus with the antero-median column. In *Hipparion* the separation of the two columns indicated extends to near the bottom of the crown, so that, as the teeth are worn away, for a long time there is observed on the inner side of the masticating surface an isolated ring or ellipse of enamel, which does not join the antero-median column, as in *Equus*, until the teeth are nearly worn out. Usually also the arrangement or course of the enamel, as seen on the masticating surface of the superior molars, especially that surrounding the median crescentoid lakes, is more complex in *Hipparion* than in *Equus*.

In the inferior molars, the prolongation in front of the anterior crescentoid column is extended in a short transverse fold outwardly, the merest trace of which is to be detected in the corresponding teeth of *Equus* towards the bottom of the crown.

The remains of a small species of *Hipparion* were discovered by Prof. F. S. Holmes and Capt. A. H. Bowman, U. S. A., in a supposed post-pliocene formation on the Ashley River, in the vicinity of Charleston, South Carolina. They consisted of two upper molar teeth, and are described and figured, under the name of *Hipparion venustum*, in Holmes' Post-pliocene Fossils of South Carolina, page 105, figures 32, 33, plate xvi.

Since the discovery of the *Hipparion venustum*, numerous remains of other species have been discovered in Nebraska by Dr. F. V. Hayden. As shown by the existing species of *Equus*, we may have different extinct species represented by remains of the same anatomical character, and therefore unrecognizable. The Nebraska *Hipparion* remains, however, do exhibit differences sufficient to justify their reference to several distinct species, until the discovery of more abundant material may prove otherwise.

HIPPARION OCCIDENTALE.

In the rich collection of fossils obtained by Dr. Hayden from the Mauvaises Terres of White River, Dakota, and now in possession of this Academy, there are five teeth of a species of *Hipparion*, which has been distinguished by the above name. The specimens are black, and well preserved. They have no adherent matrix, and are very different in appearance from the ordinary Mauvaises Terres fossils. According to Dr. Hayden, they belong to the superficial portion of the tertiary deposits, or bed F of the section, as indicated on page 16, and which is more fully developed on the Niobrara River and at Bijou Hill.

The teeth consist of four upper molars of the right, and one of the left side, and are represented in figures 1—5, plate XVIII. They were accompanied by a fragment of a last upper molar and a lower molar, apparently of another equine animal.

The specimens are between a third and a half worn away, and exhibit on their triturating surface the characters usually ascribed to the genus. They indicate a much larger animal than the *Hipparion venustum* of South Carolina, and approach in size those of *H. gracile* of Europe. They have nearly the size, proportions, and curvature of the teeth of the Ass.

In the upper molars, the course of the enamel, as seen on the masticating surfaces, figures 1—5, is not so complex as in *H. gracile* or *H. mediterraneum*, but is sufficiently so to exhibit an evident relationship.

The antero-internal column of the crown is of uniform width throughout its length, except in the first molar (4), in which it feebly widens near the bottom. In transverse section, in the anterior molars, it is reniform; in the fourth (2) and fifth (1) molars elliptical. The external buttress-like ridges of the crown in the anterior molars are as robust as in the Ass, and the concave intervals are comparatively deep. The posterior valley, or inflection of enamel, extends to near the bottom of the crown.

The enamel is observed on the masticating surface to be complexly folded at the sides of the central lakes, except along the back border of the posterior lake. The median fold of the inner enamel border of the crown, extending towards the isolated reniform lake, is trilobate in the first molar (4) and the third (5) of the left side, but it is bilobate in the second (3) of the right side; and in both the latter it is deeply inflected at its back part, so as even to reach the centre of the masticating surface. In the fourth (2) and fifth (1) molars the median fold just mentioned is comparatively simple.

The measurements of the specimens of superior molars are as follow:

	1st. Lines.	2d. Lines.	4th. Lines.	5th. Lines.
Antero-posterior diameter of triturating surface, .	15	13	11½	10¾
Transverse do. (independent of the cement), .	11	11½	11½	10½
Length of crown externally, . . .	10½ to 14.	17		19
Breadth of internal column at the triturating surface, from before backward, . . .	3¾	4¾	4½	4
Breadth of do. at bottom of the crown, . .	4¼	4¾		4

Hipparion speciosum.

Shortly after the discovery of the teeth of *Hipparion occidentale* on White River, Dr. Hayden obtained several specimens of equine molars at Bijou Hill, situated east of the Missouri River, below the outlet of the White River. In a notice of these fossils in the Proceedings of the Academy for 1856, page 311, they were referred to a species under the name of *Hipparion speciosum*. Several of the specimens ascribed to the latter apparently belong to a distinct equine genus, *Merychippus*, hereafter to be described. The others consist of an unworn upper molar, a second partially worn, and two imperfect specimens.

The unworn molar, a fourth or fifth of the series, is smaller and more curved than the corresponding teeth of *H. occidentale*. It also decreases in diameter towards the bottom of the crown more rapidly than in the latter, and the internal column is of less uniform diameter.

The second specimen, belonging to the same position in the series as the former one, resembles it in size, proportions and curvature. It is about a fourth worn, and exhibits the characteristic relation of the constituent elements on the masticating surface, as represented in figure 16, plate XVIII. The arrangement of the enamel around the median crescentoid lakes is not more complex than in the Ass, and therefore less than has been described to be the case in other known species of the genus *Hipparion*. The internal column of the crown is relatively narrower than in *H. occidentale*, and in section is oval. The measurements of the specimen are as follow:

	Lines.
Antero-posterior diameter, ...	9
Transverse diameter, ...	8½
Length externally, ...	17
Length internally, ...	10
Breadth of internal column, ...	3

The imperfect specimens likewise belong to the fourth and fifth of the upper molar series, and accord in their construction, size, proportions and curvature, with the preceding. Their triturating surface, represented in figures 18, 19, exhibits nearly the same arrangement of the enamel as in the former specimen. The less imperfect tooth, probably a fourth molar, measures sixteen lines along the median ridge externally, and ten lines along the internal column. The antero-posterior diameter of the triturating surface is nine and three-fourths lines, and the transverse diameter nine and a half lines. The remaining specimen, a mere fragment, belonged to a smaller tooth, probably a fifth of the series.

Another specimen, probably belonging to *H. speciosum*, is the outer portion of an upper molar tooth, also a fourth or fifth of the series, which is of especial interest from its having been discovered in Washington Co., Texas,—a locality remote from that in which the former specimens were obtained. It was submitted to my examination by Dr. B. F. Shumard, of St. Louis, Missouri, who informed me that it was obtained, in digging a well, from a white calcareous sandstone of medial tertiary age, at the depth of forty feet below the surface.

The fragment bears a sufficiently near resemblance to the corresponding portion of the teeth above described in size, proportions, and appearance of the triturating surface, as represented in figure 17, to render it probable that it belonged to the same species of *Hipparion*.

From the Niobrara River, Dr. Hayden obtained the following specimens, which probably belong to *Hipparion speciosum*, although they present considerable variation of character among themselves.

1. Three isolated molars, belonging to the fourth and fifth of the series. They are between a fourth and a third worn away, and have their masticating surfaces represented in figures 13, 14, 15. They approximate the specimens above described sufficiently to be viewed as pertaining to the same species, and do not vary from them more than they do among themselves.

The three specimens differ a little in proportions, degree of curvature, and complexity of arrangement of the enamel. The smallest one, figure 15, probably a fifth of the series, approaches most closely the Bijou Hill and Texas specimens in its proportions and degree of curvature, but is more complex in the arrangement of its enamel around the islets of the masticating surface, as it is also in comparison with its companions. In this respect it most nearly resembles the fragment of a molar among the Bijou Hill specimens.

A second specimen, probably the fourth of the molar series, figure 14, is larger, less curved, and not quite so complex in the arrangement of the enamel around the central lakes of the masticating surface as in the former. The remaining specimen, figure 13, likewise a fourth molar, is much larger than the others, and the simplest in the arrangement of its enamel foldings.

The measurements of the three specimens, in comparison with the most perfect Bijou Hill specimen, are as follow:

	4th superior molar.	4th.	5th.	5th Bijou.
	Lines.	Lines.	Lines.	Lines.
Antero-posterior diameter,	10½	9½	9½	9
Transverse diameter,	9½	9	8½	8½
Length externally,	17	14	16	17
Length internally,	9	10½	10	10
Breadth of internal column,	3	3½	3	3

2. Three upper molars, apparently from the same individual, consisting of an imperfect first, a second, and a fourth or fifth of the series. Their triturating surfaces, represented in figures 6, 11, 12, plate XVIII, exhibit an arrangement of the enamel which has led me to suspect that they belong to the same species as the preceding specimens.

The fourth or fifth molar (12), the only tooth corresponding with any of the above specimens (13, 14), approximates them in the folding of the enamel. In comparison with them it appears proportionately too large for a fifth molar, and agrees better in this respect with the fourth molars. In relation with its two companions, however, judging from its proportionate length, it appears rather to be the fifth of the series. It is less worn than any of the worn specimens above described, and is therefore longer and slightly broader on the masticating surface.

In the three specimens under consideration, as observed on the masticating surfaces, the arrangement of the enamel is simple in comparison with its condition in previously recognized species of *Hipparion*, and indeed is nearly as simple as in the Horse and Ass. A comparison between the specimens and those of *H. occidentale* exhibits a striking difference, rendering it improbable that they should belong to the same species.

The internal column of the crown is narrow and rather lozenge-like ellipsoidal in transverse section.

In what may be considered to be the fifth molar (12), the fold of enamel, at the inner side of the triturating surface, extending towards the ellipsoidal islet, is simple; and in the second molar (11) is bi-lobed.

In the first molar (6), which has lost its outer portion, the two central lakes of the masticating surface communicate by their contiguous arms, and the anterior one opens into the interval bordering on the internal ellipsoidal lake or islet.

The measurements of the specimens are as follow:

	1st superior molar. Lines.	2d. Lines.	5th. Lines.
Antero-posterior diameter,	11½	11½	10
Transverse diameter,		11	10
Length externally,		18	20
Length internally,	11½	14	15
Breadth of internal column,	2¾	3½	2¾

3. Five upper molars, apparently from the same individual, consisting of the first, third, and fourth, of the left side, and the second and last of the right side. The specimens are somewhat weather-worn; the fourth is mutilated, and the sixth, which had not long protruded, has lost its outer portion. A series, from the first to the fourth inclusive, is represented in figures 7—10.

They are less worn than the preceding specimens, but independently of this circumstance the first molar is proportionately larger, while the others nearly agree in proportions. The internal column of the crown is rather wider towards the bottom, and partakes less of the lozenge-shaped character, or is more elliptical in transverse section.

The arrangement of the enamel, as seen on the triturating surface of the first molar, figure 7, is almost exactly like that of the preceding specimen, figure 6. In the second molar, figure 8, the enamel is more folded on the contiguous sides of the median lakes than in the corresponding tooth, figure 11, above described, but not in a remarkable degree. In the third molar the triturating surface, figure 9, nearly resembles that of the second, but the section of its internal column appears reniform instead of elliptical. The fourth molar, figure 10, agrees in its characters with the corresponding teeth above described sufficiently to refer it to the same species.

In most all the *Hipparion* teeth previously described to the specimens under consideration, the internal column of the crown is of pretty uniform diameter, but in these it is narrow at the triturating surface, and gradually but slightly widens towards the bottom.

By comparing the views of the triturating surfaces (figures 7—10) of these teeth with those (figures 1—5) of *Hipparion occidentale,* they will be observed to be different in appearance,—too much so to render it probable that they should belong to the same species.

The measurements of the specimens are as follow:

	1st superior molar. Lines.	2d. Lines.	3d. Lines.	4th. Lines.	6th. Lines.
Antero-posterior diameter,	13	11½	11	10½	9
Transverse diameter,	10	10½	10	10	
Length externally,	17 to 20	21	23		
Length internally,	13	16	17	14	17
Breadth of internal column,	3	3	3½	3¾	3
Breadth of do. at bottom,	4	4	4½	4½	4

Hipparion affine.

Among the collection of equine teeth from the Niobrara River, there are a number of specimens larger than those referred to *Hipparion speciosum,* but having about the same size and proportions as those of *H. occidentale,* or of the existing Ass. They however differ from those of *H. occidentale* in the simplicity of arrangement of the enamel, which is not more folded than in the Horse. The internal enamel column is also not only proportionately very much wider than in *H. speciosum,* but also absolutely wider than in *H. occidentale.* As well-marked anatomical characters appear to distinguish these teeth from those of the two species of *Hipparion* above indicated, I have referred them to another species under the name of *H. affine.*

The specimens belonging to this category are as follow:

1. Five upper molars, apparently from the same individual, consisting of the second and third of the right side, and the third, fourth and fifth of the left side. A series, exhibiting the triturating surfaces, from the second to the fifth inclusive, is represented in figures 20—23.

The teeth are much younger than those of *H. occidentale,* and are comparatively but little worn. They are just at that age when the third permanent molar had assumed its position in the functional series, but is not sufficiently worn to exhibit the entire course of the characteristic lines of enamel on the triturating surface.

The triturating surfaces exhibit an extreme simplicity in the arrangement of the enamel, compared with the condition observable in recognized species of *Hipparion,* and is only equalled by the arrangement in the Horse and Ass. From the young condition of the teeth, I at first supposed the simplicity was in a great measure due to this circumstance, but on cutting through the second molar near its middle, I found that the surfaces thus exposed still retained the simplicity of arrangement of the masticating surface.

The internal column of the crown is comparatively wide, and of uniform breadth throughout its length. In transverse section on the triturating surface it is reniform.

The measurements of the specimens are as follow:

	2d superior molar.	3d.	4th.	5th.
	Lines.	Lines.	Lines.	Lines.
Antero-posterior diameter,	12½	12	11	11½
Transverse diameter,	11	10½	10½	9
Length externally,	22	24	22	25
Length internally,	16	19	14½	18
Breadth of internal column,	5	5½	5	5
Breadth of do. at bottom,	5	5½	5	5

2. A water-rolled specimen of a last upper molar tooth, one of the few fossils in the Niobrara collection presenting that condition. It is between a third and one-half worn away, and the triturating surface, as represented in figure 24, accords in the simplicity of its constitution with that of the preceding specimens.

The measurements of the tooth, making some allowance for accidental attrition, are as follow:

	Lines.
Length externally,	15 to 19
Antero-posterior diameter,	11½
Transverse diameter,	9½
Length of internal column,	10
Breadth of do. throughout,	4

Hipparion gratum.

A number of comparatively small equine teeth, in the Niobrara collection, apparently indicate a different species of *Hipparion* from those represented by the specimens previously described. I am, however, not only in some doubt as to the specific distinction of the teeth in question from the other *Hipparion* teeth, but am in an equal state of uncertainty as to whether they may not belong to the same category as those referred to *Protohippus placidus*. The specimens have almost the same size, usually nearly the same proportions as in the latter, and some of them in a similar stage of attrition exhibit nearly as much simplicity in the arrangement of the enamel. They further approach in character in the extent to which the posterior enamel inflection reaches in the length of the crown. In the teeth of *Hipparion* previously described, the inflection just mentioned nearly reaches the bottom of the crown, as in the upper molars of the Horse and Ass.

An apparently important difference between the teeth under consideration and those referred to *Protohippus placidus* is in the extent of separation of the internal column of the crown from the antero-median column. In the attrition to which the teeth were subjected in mastication, in *Protohippus*, as in the Horse, the two columns just mentioned became early associated by an isthmus on the triturating surface.

In the specimens under examination, the columns mentioned are separated a considerable depth of the crown, as in the recognized species of *Hipparion*, and they appear not to have become conjoined on the triturating surface until the teeth were much worn away, in which condition they are hardly distinguishable from those referred to *Protohippus placidus*.

The specimens in question are as follow:

1. Three molars of such an age, proportions, and general appearance as to render

it probable they belonged to the same individual. They consist of the first, fifth and sixth of the series, and are perhaps not more than a third worn.

The first of the series, represented in figure 25, plate XVIII, resembles the corresponding tooth of the first series ascribed to *Protohippus placidus* in size, form and proportions. The internal column appears on the triturating surface isolated, as in *Hipparion*, but it is a question whether at the same stage of attrition it would not have been associated with the antero-median column, as it appears in the tooth of *Protohippus placidus.* The central lakes are observed to be less gaping than in the latter, and their surrounding enamel is rather more folded. The remnant of the posterior enamel inflection of the crown is seen as a small circular islet occupying the inner back corner of the triturating surface.

The fifth and sixth molars, of which the latter is represented in figure 26, plate XVIII, exhibit rather more complexity in the folding of the enamel surrounding the central lakes of the triturating surface, than in the first of the series, but otherwise hold an intimate relationship of character with it. The outer part of the fifth tooth is lost, and the remnant of the posterior valley is observed as an oval islet on the masticating surface.

The measurements of the specimens are as follow:

	1st superior molar. Lines.	5th. Lines.	6th. Lines.
Antero-posterior diameter,	10½	8	8
Transverse diameter,	8½		6½
Length externally,	15		15
Length internally,	12	13	12
Breadth of internal column,	2½	3	3½

2. A second or third molar, worn just sufficiently to exhibit the characteristic arrangement of the enamel on the triturating surface, as represented in figure 27, plate XVIII. The posterior enamel inflection of the crown, as usually existing in *Hipparion* and *Equus*, already appears in the masticating surface as an irregularly circular islet. The internal elliptical islet, or section of the internal column, is wide, and exhibits an anterior prolongation towards the anterior median column, as if about to establish an intercommunication as in *Protohippus.* The measurements of the specimen are as follow:

	Lines.
Diameter of triturating surface antero-posteriorly and externally,	9½
Diameter of crown at bottom antero-posteriorly and externally,	6½
Diameter of triturating surface transversely,	8½
Length of crown along external median ridge,	21

	Lines.
Length of crown along internal column, ...	17½
Breadth of internal column at triturating surface, ...	4
Breadth of internal column at middle of crown, ...	3½

3. A fourth or fifth molar, from a third to one-half worn, represented in figure 30, plate XVIII. It accords in character with the less complete fifth molar of the foregoing series, described previously to the last specimen. Its measurements are as follow:

	Lines.
Antero-posterior diameter, ...	8
Transverse diameter, ...	8
Length externally, ...	15
Length internally, ...	9
Breadth of internal column, ...	3

4. Two last molars but little worn, represented in figures 28, 29, plate XVIII. The measurements of the specimens are as follow:

	Shorter one. Lines.	Longer one. Lines.
Antero-posterior diameter just above the rounded triturating extremity, ...	8	7½
Transverse do. including cementum, ...	7	6
Antero-posterior diameter at bottom of crown, . .	9	8½
Transverse " " " . . .	8	7
Breadth of internal column, ...	2½	3½
Length externally, ...	17	18½
Length internally, ...	14	15½

Hipparion-like upper molar teeth of uncertain reference.

The Niobrara collection contains a number of *Hipparion*-like molar teeth, both permanent and temporary, of the upper jaw, which I have been unable to refer to the foregoing species with any degree of certainty, nor do I feel more satisfied that they belong to other species. The specimens are as follow:

1. Three isolated upper molars, belonging to the second and third of the series. They are from about a fourth to a third worn away, and are represented in figures 31, 32, 33, plate XVIII. Their proportions are somewhat less than the White River specimens of *Hipparion occidentale,* but their triturating surface exhibits as much complexity in the arrangement of the enamel. Their internal column is of variable diameter and shape. In one it is like that most usual in the teeth referred to *H. speciosum;* in another it is as broad as in *H. occidentale;* and in the third specimen it is of intermediate size.

These teeth appear as intermediate varieties between those referred to *H. speciosum* and *H. occidentale*, and favor an impression that all the specimens together belong to the same species. Their measurements are as follow:

	2d superior molar. Lines.	2d. Lines.	3d. Lines.
Antero-posterior diameter,		11	11½
Transverse diameter,		10	11
Length externally,		19	15
Length internally,	15	15	
Width of internal column,	4	3½	4½
Width of do. at bottom,	4	4	

2. A first superior molar tooth, apparently belonging to a different species of *Hipparion* from any before indicated. It is about half worn away, and is represented in figure 34. The triturating surface bears a near resemblance to that of the corresponding tooth (4) of *H. occidentale*, but the tooth is of much smaller proportions, being intermediate in size to the former and that of *H. gratum*. The central lakes of the triturating surface are almost as complex; and the internal column is reniform in transverse section, as in *H. occidentale*. The measurements of the specimen are as follow:

	Lines.
Length externally,	7
Length internally,	4½
Antero-posterior diameter,	12½
Transverse diameter,	9
Breadth of internal column,	3½

3. A second or third superior molar, probably of the temporary set, though of this latter point I feel uncertain. Its proportions are nearly as great as in *Hipparion occidentale*, and the arrangement of the enamel, as seen on the triturating surface represented in figure 35, is quite as complex as in that species. The tooth also bears some resemblance to the temporary molars of *Merychippus mirabilis*, hereafter to be described. I suspect it to be the third temporary molar of *Hipparion speciosum*. The measurements of the specimen are as follow:

	Lines.
Length externally,	8
Length internally,	6½
Antero-posterior diameter,	12½
Transverse diameter,	7½
Breadth of internal column,	2½

4. A first superior temporary molar, nearly as large as the preceding specimen, and sufficiently resembling it to render it probable that it may belong to the same species. It is apparently about one-third worn away, and is represented in figure 36. The triturating surface presents nearly as much complexity of arrangement of the enamel as in the preceding specimen. The central lakes are deficient in cementum at their centre. The internal column is elliptical in transverse section. The measurements of the specimen are as follow:

	Lines.
Length externally,	$6\frac{1}{2}$
Length internally,	$4\frac{1}{2}$
Antero-posterior diameter,	12
Transverse diameter,	$7\frac{1}{2}$
Breadth of internal column,	$2\frac{1}{2}$

5. A first superior temporary molar, remarkable for its narrowness transversely compared with its breadth antero-posteriorly. It is represented in figure 37, and is so peculiar in appearance as to suggest the idea that it may belong to an unknown equine genus. The central lakes of the triturating surface partake of the proportionate breadth of the tooth, and are unoccupied with cementum centrally. The surrounding enamel is delicate, and folded with a medium degree of complexity. The fore part of the tooth is extended by a pair of accessory columns, instead of one as usual in *Equus* and *Hipparion*. The inner of the two accessory columns, in section, as seen on the triturating surface, is uncinate. The internal column of the crown increases in breadth towards the bottom, and is ellipsoid in section on the triturating surface, with a small beak directed towards the antero-median column. The measurements of the specimen are as follow:

	Lines.
Length externally,	$6\frac{1}{2}$
Length internally,	4
Antero-posterior diameter,	16
Transverse diameter,	8
Breadth of internal column,	$2\frac{1}{2}$

5. Two isolated temporary molars, slightly water-worn. They are sufficiently alike in size and construction to be the second and third of the same individual. They likewise bear sufficient resemblance to the specimen last described, notwithstanding the great difference in antero-posterior measurement, as to lead to the suspicion that they may belong together.

The teeth are considerably wider from before backward than from side to side. The central lakes of the triturating surface, as represented in figure 38, are of comparatively simple construction. The internal column is elliptical in section, and presents a beak or process at the fore part, as if indicating an approaching association of the column with the antero-median column. The measurements of both specimens are as follow:

	Lines.
Length externally,	8
Length internally,	5
Antero-posterior diameter,	10
Transverse diameter,	6
Breadth of internal column,	3

MERYCHIPPUS.

So far as can be ascertained from the material at command, the molar teeth of this genus are characterized in the same manner as those of *Protohippus;* but while the latter has the face in advance of the orbit constructed on the same plan as in *Equus*, in *Merychippus* it exhibits in a corresponding position a remarkable depression or fossa. In comparison with the temporary molars of *Equus*, those of *Merychippus* approach more nearly in their appearance the teeth of the second family of the Solidungula,—that is to say, the *Anchitheridæ*.

The genus *Merychippus* was originally proposed in the Proceedings of this Academy for 1856, page 311, on a small fragment of an upper jaw containing two teeth, of a supposed equine animal, discovered by Dr. Hayden at Bijou Hill.

The teeth, represented in figures 3, 4, plate XVII, consist of the first and second superior molars, apparently of the temporary series, though the jaw fragment filled with a calcareous matrix, in its present condition, shows no evident signs of occupancy by permanent successors. In their mode of insertion and general appearance they bear some resemblance to the upper true molars of the Deer, but depart from them in many important anatomical characters.

In general form, proportions, and mode of insertion, the teeth also resemble those of *Anchitherium*, with which *Merychippus* was nearly allied. The crowns are composed of six lobes, as in *Anchitherium*, and the intervals in the fossil are nearly devoid of cementum, which was supposed to be the natural condition of the teeth, until the discovery of other specimens led to a different conclusion. The fossil is somewhat weathered, and appears to have accidentally lost its cementum, though small portions still remain in the narrowest interspaces of the lobes, and in the second molar it fills up the vacuity between the postero-median and postero-internal lobe. The summits of the lobes are worn so as to exhibit nearly continuous tracts of dentine, as represented in figure 4. The fore part of the anterior molar has been lost, but otherwise the teeth are nearly perfect.

The external lobes of the crown of the molars in question have the same form, proportions, and relation with each other as in *Anchitherium aurelianense*, with which they also nearly agree in size. The internal lobes, compared with their condition in the latter animal, are much reduced in size, while the median lobes are enlarged in a proportionate degree. In *Anchitherium* the external and internal lobes are the principal ones, while the median lobes appear to be of secondary importance. In *Merychippus* the external and median lobes, like the corresponding columns in the upper molars of the Horse, are the principal ones, and the internal lobes are of secondary importance, likewise as in the Horse.

In *Anchitherium* the median lobes of the crown of the upper molars curve inward and backward, and abruptly cease by becoming continuous with the internal lobes. They appear to be arrested in their course or backward sweep by a comparatively excessive development of the internal lobes. In *Merychippus* the median lobes are crescentoid demicones like the internal ones in the true molars of the Deer, and they hold the same relation to the external lobes as the latter do in the Deer. A comparative reduction in development of the internal lobes has allowed a full sweep of the median lobes, so as to include in their embrace the external lobes. The internal lobes of the crown are simple cones springing from the inner side and base posteriorly of the median lobes.

The antero-median lobe in transverse section in the second molar forms a simple crescent. In the first molar its anterior horn is complicated with several minute folds or processes. The postero-median lobes in both teeth have their horns complicated by conspicuous offsets or diverging processes.

At the back part of the crown of the upper molars of *Anchitherium* there is a conspicuous tubercle, apparently an offset from the basal ridge. In *Merychippus* the corresponding process is associated as a constituent portion of the postero-median lobe, and appears as its complex posterior horn.

The processes complicating the horns of the median lobes of the crown, in the teeth of *Merychippus*, evidently correspond with the folds observed in a similar position upon the median columns of the upper molars in the Horse, which become conspicuous as tortuous enamel lines bounding the sides of the central lakes of the worn triturating surfaces in that animal.

The measurements of the teeth in the Bijou fossil are as follow:

	1st superior molar.	2d.
	Lines.	Lines.
Length externally at the middle of the lobes, . . .	4½	5½
Length externally at the intermediate ridge, . . .	4	4½
Antero-posterior diameter, ...	11	9½
Transverse diameter, ...	8¼	9

Fifteen months subsequently to the notice of the fossil above described, Dr.

Hayden's rich collection from the Niobrara River was submitted to my examination. In the collection there are a number of fossils which appear to me to belong to *Merychippus*, though I am not positive of the correctness of my view, but feel that the matter must be left to more acute powers of observation, or to the discovery of new material, to determine the question.

One of the fossils of the Niobrara collection, represented in figure 10, plate XVII, and apparently referable to the same genus as the Bijou fossil above described, consists of a portion of the right side of the upper jaw of a young equine animal, containing in functional position the second and third temporary molars, and within the jaw the corresponding teeth of the permanent series.

The triturating surfaces of the temporary teeth, represented in figure 11, plate XVII, are much more worn than in the Bijou fossil, but on comparing the corresponding tooth—that is to say, the second molar—in both specimens, it will be observed that in a more worn condition the tooth of the Bijou fossil would have assumed a strong likeness to that of the Niobrara fossil. The difference between the two appears greater from a difference in size, and from the presence of cementum in the Niobrara fossil and its absence in the other. The similarity in the two teeth indicated appeared to me to be sufficiently great to refer the fossils to the same genus; the difference in size, apparently confirmed by other specimens, has led me to refer them to different species. Notwithstanding this determination, I feel prepared to find through more accurate observation or further discovery that my view is erroneous.

For the smaller species, first indicated by the Bijou fossil, the name of *Merychippus insignis* has been proposed; for the larger one, to which the Niobrara fossil belongs, that of *Merychippus mirabilis.*

The temporary molars in the latter fossil, as before intimated, are provided with cementum, from which circumstance they present a more striking resemblance to the corresponding teeth of the Horse than those of the Bijou fossil. In the second molar, however, the cementum appears to have been somewhat scanty, as it only partially fills the central lakes of the crown, adhering to their parietes. The third temporary molar, from the presence of the cementum and the greater proportionate length of the crown, bears less resemblance to the molars of *Anchitherium* than the tooth in advance.

Both temporary teeth of the Niobrara fossil are inserted by fangs, and the crowns of both are much more worn than in the Bijou fossil. The worn triturating surfaces bear a near resemblance to those of the Horse in the same condition. The course of the enamel surrounding the central lakes, as also that at the periphery of the crown, is as simple as in the Horse.

The anterior lake of the triturating surface of the second molar, in the Niobrara fossil, has an outlet into the oblique valley between the median and internal lobes, as in the first and second molars of the Bijou fossil, but both lakes are closed in the third molar.

The antero-internal lobes are conoid, and their worn summits exhibit a nearly circular section, continuous with the antero-median lobe, as in *Protohippus*, and as is also the case in the temporary molars of the Horse.

The permanent molars preserved in the interior of the Niobrara jaw fragment consist of the second, and of the third imperfect at its posterior part. The jaw fragment also retains part of the cavities for the first and fourth molars. The latter tooth had protruded, and appears to have been about the size of the teeth of the Ass, or those in the preceding pages referred to *Hipparion affine* or *H. occidentale.*

The permanent teeth preserved in the fossil, as represented by the second one in figures 12, 13, plate XVII, are in the condition of thin dentinal shells, thinly invested with fissile enamel and devoid of cementum. They are constructed on the same plan as the teeth of the Horse, resembling them in the same condition of development, except that they present the character assigned to *Protohippus*,—namely, the antero-internal column is narrow, and does not expand in advance of its conjunction with the antero-median column, which, as repeatedly stated, is likewise the condition in the temporary molars of the Horse.

Had these teeth been observed as isolated specimens in a more advanced stage of development, mingled with the other equine teeth of the Niobrara collection, they would have been referred to *Protohippus*, but important differences in the character of the jaw fragment in which they belong establish their distinction. This circumstance appears less remarkable from the fact that we have a number of distinct species of *Equus*, without correspondent differences in the teeth or parts of the skeleton.

The portion of the upper jaw of *Protohippus perditus*, figure 1, plate XVII, previously described, was stated to be the counterpart in form of the corresponding portion of the face in the Horse.

In the Niobrara fossil referred to *Merychippus mirabilis*, fortunately for comparison, nearly the corresponding portion of the jaw has been preserved, figure 10, as in *Protohippus perditus*. The malar ridge of the maxillary bone ceases above the position of the last temporary molar tooth. Immediately above the ridge, including its upper surface, the bone is impressed with a remarkable fossa, broad and deep, and recalling to mind the lachrymal depression of the Deer. A similar ant-orbital depression, though situated higher in its relation with the malar ridge, existed in the more nearly related *Hipparion mediterraneum*, as seen in a well-preserved skull, from Greece, described and represented by Dr. A. Wagner in the fifth volume of the Transactions of the Royal Bavarian Academy of Sciences, page 338, plate ix.

The ant-orbital maxillary depression in the fossil under examination is encroached upon outwardly by the position of the fourth molar tooth, and would have been rendered deeper after further protrusion of the latter. The orifice of the infra-orbital canal opens just in advance of the ant-orbital fossa, over the position of the fore part of the last temporary molar tooth.

At the upper angle of the premaxillary fossa the lachrymal suture is observable, and in advance of this the upper border of the specimen, to its anterior extremity, is defined by the nasal suture.

Having thus attempted to establish the generic identity of the Bijou and Niobrara fossils above described, I shall proceed to give an account of additional fossils, apparently referable to the two species of *Merychippus*, under the respective head of each of the latter.

Merychippus insignis.

As stated in the notice of the genus, the species *Merychippus insignis* was first indicated by a fragment of a jaw containing two teeth, from Bijou Hill. The Niobrara collection of fossils contains a number of specimens apparently referable to the same species, as follow:

1. An entire series of superior permanent molar teeth, contained in an alveolar fragment of the jaw. The teeth appear to be about two-thirds worn away, and are inserted into the jaw by the fangs alone. The triturating surfaces, represented in figure 5, plate XVII, have much such an appearance as would be exhibited in the teeth of *Protohippus perditus* at the same age or condition of abrasion.

The transverse diameter of the teeth is greater than that from before backward, except in the first of the series, but this disproportion is mainly due to their much worn condition. The central crescentoid lakes of the triturating surfaces are of simple character, contracted, and have their contiguous horns in general much prolonged outwardly in comparison with the distal ones. The inner columns of the crown are circular in transverse section, and they join the median lobes by wide isthmi.

In all except the back two teeth, the postero-internal column has lost its distinct character by an obliteration of the posterior inflection or valley of the crown. The bottom of the valley remains in the first molar as a small circular islet, and in the third molar as a minute ring. It is totally obliterated in the second and fourth molars.

In the fourth molar, the antero-internal column in some degree has lost its distinctness by closure of the outlet of the valley between it and the column behind. The bottom of the valley is left on the triturating surface as an oblique ellipsoidal islet. The other molars present an appearance indicating that they would have assumed the same condition as that just described, at a later stage of abrasion.

In the first molar, the anterior central lake of the triturating surface opens into the oblique valley between the median and internal columns, as was described to be the case in the anterior two temporary molars of both species of *Merychippus*. The lakes of the anterior two molars are only partially filled with cementum.

The length of the space occupied by the six molar teeth is four inches and one line. The measurements of the individual teeth are as follow:

	1st superior molar	2d	3d	4th	5th	6th
	Lin.	Lin.	Lin.	Lin.	Lin.	Lin.
Length externally, . . .	4	4	4	3¼	4½	5
Length internally, . . .	3	2½	2½	2¼	2¼	2¼
Antero-posterior diameter, . .	10½	8½	8	7½	7	8
Transverse diameter, . . .	9½	10½	10	10	9½	8½

2. Two superior molar teeth, apparently a fourth and the last of the series, from the same individual. They are comparatively but little worn, and are represented in figures 49, 50, plate XVIII. They are smaller than the corresponding teeth of *Protohippus perditus*, more robust, shorter, and more curved than those referred to *P. placidus*, and have about the same proportions as in the full series of *Merychippus insignis* above described, from the same locality. The worn triturating surfaces present about as much simplicity in the arrangement of the constituent dental elements as in the Horse, but rather more complexity than in the specimens of *Protohippus*. The antero-internal column appears isolated, but presents a conspicuous process, which at a later stage of abrasion of the teeth would evidently have become an isthmus of conjunction with the antero-median column.

The measurements of the specimens are as follow:

	4th superior molar.	6th.
	Lines.	Lines.
Length externally, ...	12	13
Length internally, ...	4½	7
Antero-posterior diameter, ...	9	8
Transverse diameter, ...	8½	6
Antero-posterior diameter on same level as the more worn series above described, ...	8	8½
Transverse do., ...	9½	8½

While the transverse diameter of the two teeth is the same as that of the corresponding teeth of the full series at the same level of the latter, the antero-posterior diameter is greater. In the progress of protrusion of the crowns of the teeth in equine animals, the antero-posterior diameter of the crown decreases, from disappearance of the contiguous enamel due to pressure and friction of the teeth against one another, while the transverse diameter remains unchanged. Hence, at a later age, the two teeth in question would have had about the same antero-posterior diameter as in the full and older series.

2. Figures 6, 7, plate XVII, represent two mutilated upper molars from Bijou Hill, originally supposed to belong to *Hipparion speciosum*, but, from comparison with additional material, are now viewed as pertaining to *Merychippus insignis*. They apparently belonged to the same individual, and agree in proportions with the corresponding teeth above described, but are less worn than those of the full series from the Niobrara River.

One of the specimens, figure 6, a first molar, has the central lakes conjoined, and both are filled with cementum, unlike the condition observed in the Niobrara fossil. The anterior lake, as in the latter, opens into the internal oblique valley of the crown. The other specimen, figure 7, a fourth or fifth molar, is irregularly worn, as is not unfrequently observed in old Horses in the domestic state. The inner columns, in this tooth, have lost their distinctive characters, and the bottoms of the valleys defining them appear on the triturating surface as islets.

The measurements of the specimens, partially estimated, are as follow:

	1st superior molar.	4th.
	Lines.	Lines.
Length externally,	5½	5½
Length internally,	3	2
Antero-posterior diameter,	11	8½
Transverse diameter,	9	9½

The late Dr. Samuel Moore submitted to my inspection three specimens of isolated upper molar teeth, from Washington Co., Texas, which appear to be referable to *Merychippus insignis*. The locality was previously mentioned as one from which a molar tooth of *Hipparion speciosum* was obtained. The specimens were picked up from the surface of the ground, and have no adherent matrix. Two appear somewhat smoothly water-worn at the root; the other has minute lichens attached. They are as follow:

1. A first superior molar, about half worn, and broken at its fore part. It is represented in figure 53, plate XVIII, and agrees closely in proportions and anatomical character with that of the entire series above described, except that its central lakes are filled with cementum.

2. A second or third superior molar, but slightly worn, represented in figure 52. It agrees in its proportions with the corresponding teeth of the above described series. A narrow tract of dentine has become exposed almost continuously along the summits of the constituent lobes, including the internal ones.

3. The remaining specimen is a last superior molar, about a fourth worn. The length of the tooth appears too great in comparison with the others referred to this species, though its short diameters hold the same proportions. The triturating surface, represented in figure 51, resembles that of the corresponding teeth referred to *Protohippus*, to which the specimen may belong.

The measurements of the Texas specimens are as follow :

	1st superior molar. Lines.	2d. Lines.	6th. Lines.
Antero-posterior diameter,	11	9½	8½
Transverse diameter,	9	8	7½
Length externally,	5½	10½	12
Length internally,	3	6½	8

Merychippus mirabilis.

A second species of *Merychippus*, with the above name and larger than the former, was inferred to have existed, from a fragment of an upper jaw of a young animal, containing the second and third temporary molars, and, concealed within the jaw, their permanent successors. The specimen, from the Niobrara River, is represented in figures 10—13, plate XVII, and is particularly described in an account of the genus, in which the attempt was made to establish its generic identity with the fossil from Bijou Hill, referred to *Merychippus insignis.*

Additional specimens from the Niobrara River, apparently referable to *Merychippus mirabilis*, are as follow:

1. Two temporary molars, the first and second of the series, represented in figure 14, plate A. They are more worn than the temporary teeth of the above mentioned fragment, being only half their length. The second tooth agrees with that of the latter in its proportions and anatomical structure. In the case of the first molar, absent in the jaw fragment, there is a near resemblance in anatomical constitution with the corresponding tooth of the Bijou fossil referred to *M. insignis*, the only differences observable being readily accounted for in the difference of age. The specimen is provided with cementum on its inner side, but this substance is absent in the central lakes, and appears to have been scant externally. In the second molar the central lakes are partially occupied by cementum, and a moderate quantity exists both externally and internally. In both teeth the anterior lake has an outlet into the oblique valley between the middle and internal lobes.

It would appear from the remains of *Merychippus* thus far examined, that it is the usual condition for the first and second temporary molars to have the anterior lake of their triturating surface communicating with the oblique valley between the median and internal lobes; but in the permanent series the same arrangement is confined to the first molar tooth. It further appears to be the ordinary condition for the central lakes of the first temporary molar to be devoid of cementum, while those of the second are partially filled, and those of the third possess the usual amount observed in equine animals generally. In the first and second permanent molars the lakes appear to have been partially occupied with cementum.

The measurements of the teeth are as follow:

	1st superior temporary molar. Lines.	2d. Lines.
Length externally,	4	$2\frac{1}{2}$
Length internally,	$1\frac{1}{2}$	1
Antero-posterior diameter,	14, estimated.	11
Transverse diameter,	$8\frac{1}{2}$	10

2. A superior temporary molar, most nearly resembling the third of the jaw fragment above mentioned, but less worn and of slightly less proportions. The triturating surface is represented in figure 54, plate XVIII, and is not sufficiently worn at its back part to exhibit the usual enamel lines, nor at the inner part to associate the internal and median columns. It evidently presents a likeness to that of the third molar in the jaw fragment before mentioned, as seen by comparing it with the corresponding tooth in figure 11, plate XVII. The length of the tooth along the external median ridge is six and a half lines; along the internal column four lines. The antero-posterior diameter of the triturating surface is twelve and a half lines; the transverse diameter nine lines.

3. A first superior permanent molar, apparently referable to *Merychippus mirabilis.* The tooth is much curved, the curvature of the outer side being double the length of the inner curvature. It appears about a third worn, its triturating surface being represented in figure 15, plate XVII. The central lakes have comparatively simple outlines, are capacious, and filled with cementum. The anterior lake, as in the corresponding tooth of the entire series of *Merychippus insignis,* figure 5, communicates with the oblique valley between the median and internal columns of the tooth.

The measurements of the specimen are as follow: Length following the curvature of the external principal ridge, sixteen lines; following that of the internal column, seven and a half lines. Antero-posterior diameter of the triturating surface, thirteen and a half lines; transverse diameter, ten and a half lines.

4. The fragment of an upper jaw containing the back four molar teeth, represented in figures 8, 9, plate XVII. It belonged to an individual of nearly the same age as that of the complete series of molars referred to *Merychippus insignis,* as indicated by the wear of the teeth.

The triturating surfaces (figure 9) of the teeth in the specimen bear a near resemblance to the corresponding ones of the series (figure 5) just mentioned. The central lakes are of extreme simplicity, and crescentoid. Except in the last molar, their contiguous arms are much prolonged beyond the line of the distal arms. The lakes of the last molar are more capacious than in the others, and partake of the gaping character seen in the teeth referred to *Protohippus*.

In the third and last molars the anterior internal column still preserves its distinctness. In the two intermediate teeth it has lost its distinct character, and the bottom of the oblique valley which separated it originally from the postero-median column appears on the triturating surface as an ellipsoidal lake or islet. The distinction of the postero-internal column is entirely obliterated in all the teeth.

The amount of cementum on the exterior of the teeth appears scanty. It is thin on the outer sides, and that of the central lakes is worn into deep hollows, except in the posterior valley of the last tooth.

The jaw fragment of the fossil is remarkably different in anatomical character from the corresponding part of the maxillary bone of the Horse.

The malar ridge terminates above the position of the fourth molar tooth (figure 8), as in *Protohippus* (figure 1), and therefore does not advance as far as in the jaw fragment (figure 10) of the young *Merychippus*, in which it terminates above the third temporary molar. A similar difference is observed between the young and adult Horse.

Above the malar ridge, in the fossil under consideration, the maxillary bone is depressed in so wonderful a manner that at first view it appears as if the orbit was advanced far beyond the position it holds in *Protohippus*, *Equus*, or *Hipparion*. The portion of the depression remaining in the specimen actually forms a horizontal concavity, looking like the fore part of the floor of an orbit, and measures from without inwardly (from the broken end of the malar process to the broken edge of the bone where it ascended to articulate with the lachrymal bone) sixteen lines. The depression evidently corresponds with that existing in the jaw fragment (figure 10) of the young *Merychippus* described in an account of the genus. A depression apparently of the same nature existed likewise in *Hipparion mediterraneum*, as before mentioned, and in *Anchitherium Bairdi* of White River. Among extinct ruminants, such antorbital depressions have been noticed in *Oreodon* and *Bootherium;* in recent ones they are conspicuous in the Deer.

The fore part of the maxillary antrum, as existing in the Horse and *Protohippus*, appears to have been entirely replaced by the maxillary depression in *Merychippus*.

The outer edge of the infra-orbital foramen, preserved in the specimen, indicates it to be situated above the interval of the third and fourth molars. In the young jaw fragment referred to *Merychippus* it holds a more advanced position, being placed above the fore part of the third temporary molar.

The measurements of the teeth contained in the specimen are as follow:

	3d superior molar. Lines.	4th. Lines.	5th. Lines.	6th. Lines.
Length externally,	6	5	5	5½
Length internally,	2	2	1½	2½
Antero-posterior diameter,	10½	9	9½	11½
Transverse diameter,	12½	11½	12	11

5. Two last superior molars. One of them is worn about as much as that of the fossil last described, and presents nearly the same proportions and appearance, as represented in figure 56, plate XVIII. It is six lines externally along its median ridge, and three lines along the internal column. Its antero-posterior diameter is twelve lines, and its transverse diameter ten and a half lines.

The other specimen is much less worn, and is of larger proportions. The triturating surface, as represented in figure 55, plate XVIII, resembles in its anatomical character the two corresponding teeth above described. Its length externally is thirteen lines; internally eight lines. Its antero-posterior diameter at the triturating surface is twelve and a half lines; the transverse diameter eleven lines. On the same level as the corresponding tooth in the jaw fragment above described, it is nearly thirteen lines in antero-posterior diameter, and twelve lines in transverse diameter.

6. The outer portion of a last superior molar, from White River. This was found in association with the teeth of *Hipparion occidentale*, from the same locality, and at first was suspected to belong to that animal, notwithstanding the comparative simplicity in its construction. It is very much less worn than in any of the corresponding teeth referred to *Merychippus*, but resembles them in the character of its triturating surface. At the same age it would have had nearly the same proportions and appearance as the last molar in the jaw fragment of *Merychippus mirabilis*. The length of the tooth following the curve of the antero-external ridge is twenty-two lines; along the external median ridge, nineteen lines. The antero-posterior diameter of the triturating surface is ten lines; at the bottom of the crown eleven lines.

ANCHITHERIDÆ.

The *Anchitheridæ*, an extinct family of solipeds, has for its type the genus *Anchitherium*, first established on the remains of a species, the *A. aurelianense*, from the medial tertiary deposits of France.

The *Anchitheridæ* have six large molar teeth on each side of both jaws, besides a small premolar, as in the Horse.

The superior molars have short square crowns, devoid of cementum, and are inserted into the jaw, when functionally used, by fangs. The crowns are composed of an external pair of demi-conoidal lobes, an internal pair of conical lobes, and a median pair of smaller lobes, which usually appear as prominent folds continuous with the inner lobes and curving outwardly in advance of the external lobes. At the back part of the crown, in the interval of the contiguous internal and external lobes, there exists a large crescentoid tubercle springing from the basal ridge, which with slight interruptions surrounds the crown.

The inferior molars, as in the case of the upper ones, have short crowns, devoid of cementum, and are inserted into the jaw by fangs. The crowns are oblong-square, and are composed of an external pair of crescentoid demi-conoidal lobes, and an internal pair of smaller conoidal lobes, which present more or less disposition to become twin lobes, and which are homologous with the inner twin columns in the lower molars of the *Equidæ*. In the first molar an additional lobe is developed at the fore part of the tooth, and is attended with a reduction in size of the antero-external lobe. In the last molar there is an additional posterior lobe homologous with the crescentoid demi-conoidal lobes in advance.

To the family of *Anchitheridæ* belong the genera *Anchitherium*, *Hypohippus*, *Anchippus*, and *Parahippus*.

ANCHITHERIUM.

In the superior molars of this genus the external lobes are the best developed, and the median ones the least. The median lobes appear as thick ridges bulging slightly at their inner part, where they are continuous with the internal conical lobes. The latter are somewhat compressed from before backward, so that their transverse diameter is greater than the antero-posterior. In the inferior molars the antero-internal conical lobe, developed at and conjoining the contiguous horns of the external lobes, is feebly indented at the summit.

Anchitherium Bairdi.

The remains of a species of *Anchitherium*, to which the above name has been applied, are rather abundant in the Mauvaises Terres miocene deposits of White River, Dakota, belonging to the intermediate beds B, C, D, of Dr. Hayden's section. The greater portion of half a dozen skulls, together with many fragments of jaws with teeth, isolated teeth, and fragments of other bones, are contained in the different collections of fossils I have had the opportunity of examining.

The best specimen of a skull is represented in plate XX of the present memoir, and different views of another, together with views of series of molar teeth, are given in figures 14—21, plate x, and plate xi, of the Ancient Fauna of Nebraska.

The specimens indicate a species about three-fifths the size of the *Anchitherium aurelianense* of Europe.

The skull of *A. Bairdi* bears a near resemblance to that of the Horse and Ass.

The cranium is almost identical in form, proportions, and construction, with that of the latter animals. The inion, including the occipital foramen and condyles, are the same. The base of the cranium presents the same features in detail, so far as these are preserved in the fossil and can be compared.

The temporal fossæ have the same form and constitution as in the Horse. They are separated by a sagittal crest extending less than half their length. The squamosals contribute a proportionately greater extent of surface in their construction.

The face appears short in comparison with that of the Horse, mainly in consequence of the proportionately larger size and advanced position of the orbits. It is relatively much shallower, in consequence of the less degree of development of the alveolar portion in accordance with the comparatively short crowned molar teeth. The proportionate breadth of the face is somewhat greater.

The forehead has the same outline of form as in the Horse, but is much less prominent. It is almost flat between the orbits, being feebly elevated laterally and slightly depressed at the middle; but farther back, between the acutely diverging temporal ridges, it is somewhat convex.

The frontal suture remains open in adult skulls, and the interparietal suture extends through the triangle which the parietals contribute to the forehead, or as far back as the sagittal crest, as seen in figure 2.

The orbital entrance is proportionately larger than in the Horse, and occupies a more anterior position in the face. It has a nearly circular form, but is interrupted posteriorly by a wide interval of communication with the temporal fossa. Instead of the strong post-orbital arch of the Horse, *A. Bairdi* possesses merely a long, curved, pyramidal post-orbital process to the frontal bone, as represented in figures 1, 2.

The acute supra-orbital margin is situated but slightly below the general level of the forehead. The anterior orbital margin is prominently everted and acute, and it occupies a position on a line with the middle of the antepenultimate molar tooth.

The infra-orbital arch is relatively about as well developed as in the Horse, but the masseteric ridge extends but a comparatively short distance from it upon the maxillary bone, as seen in figure 1.

The face in advance of the orbits is proportionately smaller and more rapidly tapering than in the Horse.

A lachrymal depression, about like that of the Sheep, occupies the lower two-thirds of the facial surface of the lachrymal bone, and extends forward upon the maxillary between the position of the nasals and the infra-orbital foramen. A similar but deeper fossa is represented as occupying the side of the maxillary bone in advance of the position of the lachrymal, in *Hipparion gracile*.*

The facial surface of the lachrymal bone is of more uniform width, and proportionately narrower than in the Horse. The maxillo-malar suture preserves an oblique course backward from the lachrymal, instead of a vertical one as in the latter animal.

The infra-orbital foramen occupies a position about half an inch above the middle of the third molar tooth, and about an inch from the orbit. A smaller foramen, apparently an offshoot from the former, is situated below it, in all the specimens under observation.

The fore part of the face is destroyed in all the specimens under consideration. The upper part of the face has the same form as in the Horse, as is also the case with the back part of the nasals and their mode of articulation with the frontals, lachrymals and maxillaries.

The back part of the hard palate is proportionately wider and more arched than in the Horse, but otherwise has the same form. The interpalatine notch likewise has the same shape, but is more narrowed posteriorly between the pterygoids. It reaches as far forward as the middle of the antepenultimate molars. The palate plates of the palatines have a greater proportionate width fore and aft than in the Horse.

The lower jaw, as in the case of the upper, is of much less proportionate depth than in the Horse, in accordance with the less development of the alveoli. The back portion of the jaw is of less proportionate depth in comparison with its breadth, but is greater in relation with the length of the whole jaw.

The body of the lower jaw is of more uniform depth than in the Horse, and is more convex and less vertical at the outer side. The posterior convex border is rather abruptly prominent about an inch below the condyle. The base is slightly flexuose in its course.

The coronoid process is more curved than in the Horse, and the maxillary depression below is deeper and better defined. The condyle and notch in advance are the same as in the latter animal.

The mental foramen appears to be irregular in character. In two specimens there are several small ones extending in a row along the fore part of the jaw, varying in each specimen and on the two sides.

The end of the lower jaw in advance of the molars tapers much in the same manner as in the Horse. The hiatus in advance of the teeth has an acute edge, and the symphysis extends nearly as far back as the commencement of the molar series.

The dentition of *Anchitherium* is expressed by the following formula:

*Abhandl. d. K. Bayerisch. Akad. d. Wissens. Band V, Tab. ix.

$$\text{In. } \frac{3-3}{3-3}; \text{ can. } \frac{1-1}{1-1}; \text{ mol. } \frac{7-7}{7-7} = 44 \text{ teeth.}$$

None of the specimens of *A. Bairdi* under examination have retained the incisors or canines, but a number with full series of molars, of different ages, have been preserved.

The molar teeth of *A. Bairdi* are absolutely identical in form with those of *Anchitherium aurelianense*, as represented by De Blainville in his Osteographie, under the name of *Palæotherium hippoides*, in plate vii of the genus *Palæotherium*. Well preserved specimens of series of molars of the latter species, from Sansan, Gers, France, contained in the collection of this Academy, on comparison exhibit the same character.

The molar teeth of *Anchitherium* exhibit so wide a difference from those of the Horse, and comparatively so near a resemblance to those of *Palæotherium*, that it is not at all surprising that its remains were originally referred to the latter genus. Notwithstanding the difference, attention once directed to the subject, an equine character is distinctly traceable in these teeth. They have short crowns without cementum, and are inserted into the jaws by distinct fangs during the whole period of their functional existence. In the Horse, the corresponding teeth have long columnar crowns, in the constitution of which cementum enters as an important constituent. The crowns are gradually protruded from the jaws as they are abraded in the process of mastication, and it is only when aged, and the crowns are nearly worn out, that these teeth come to be inserted by distinct fangs.

Of the upper molar teeth of *Anchitherium Bairdi*, the first of the series, as usual, in comparison with the others is small, but is proportionately large in comparison with that of the Horse. It has a simple conical crown, compressed on the inner side, and measuring three and a quarter lines fore and aft and two and a half transversely. It is inserted by a pair of fangs, appears to retain its position in company with the large molars to the latest period, and is worn away together with them.

The six large upper molars, as in all other equine animals, are nearly alike in form and size. They have square crowns with the width exceeding the breadth, and with both these measurements considerably greater than the length. They are inserted by four fangs, of which the outer ones are vertical and widely separated, and the inner are confluent and divergent from the others. The crowns are composed of three pairs of lobes, of which the inner and outer are the principal ones, and the median lobes are the smaller and of secondary importance.

The outer lobes are demi-conoidal, and resemble those of *Palæotherium*. They form at their conjunction a narrow buttress externally; and a stronger buttress bounds the fore part of the anterior of the two lobes. A tendency to the development of a buttress is seen also at the back part of the posterior of these lobes. The buttresses expand and are conjoined at the bottom of the crown, forming together a pair of arches bounding the external surfaces of the outer lobes. These surfaces are nearly flat, and are divided by a conspicuous median ridge. The internal surfaces of the outer lobes are prominently or almost angularly convex.

The inner lobes of the crown are simply conical, wider transversely than fore and aft, and with the anterior slightly larger than the posterior.

The median lobes are not more than half the size of the principal ones, and appear as prominent folds curving from the inner lobes outwardly to the anterior face of the outer lobes. They are bulging near their commencement, so that the summit in the worn condition presents a curved clavate form.

Constituent elements of a basal ridge exist at the fore and back parts of the crown, and at the outlet of the valley separating the inner lobes.

In the interval posteriorly between the back inner and outer lobes there exists a tubercle, which, in association with the contiguous portion of the basal ridge, assumes the dignity of a sub-lobe.

In the first large molar of the upper series, the anterior buttress is more distinct or separate than in the others, though it is not so large.

In comparing the upper molars of *A. Bairdi* with those of a series of *A. aurelianense*, the differences observable are of the slightest character. The inner lobes are slightly wider in relation to their fore and aft diameter; the external median ridge of the outer lobes is proportionately better developed; and the element of the basal ridge at the outlet of the valley between the inner lobes is larger.

In the process of mastication, from attrition, tracts of dentine become exposed at the summits of all the lobes. These at first form a pair of crescents on the outer lobes, oval islets on the inner lobes, and clavate ones on the median lobes. As abrasion continues, the dentinal tracts widen and become continuous. When the crowns are about half worn away they exhibit broad surfaces of dentine, with small, median, crescentic, shallow enamel lakes, with long curving, narrow, enamel outlets between the remains of the inner lobes internally. Subsequently the narrow enamel outlets are obliterated and then follow the median enamel lakes, leaving broad expanses of dentine bordered by enamel.

Of the lower molars, the first is a small tooth inserted by a single fang. It is lost in all the specimens under examination, though its alveolus is retained in several.

The six large lower molars have oblong quadrate crowns, with the breadth about twice the transverse width, and about a third greater than the length. They are composed of an outer fore and aft pair of principal lobes, with an inner pair of secondary lobes, connate with the former. The last of the series has an additional less well developed principal lobe. Each tooth has two fangs, of which the back one in the last molar is a connate pair. The principal lobes of the crown are slightly oblique in their relative position, angularly convex and sloping externally, concavely excavated internally, and are acutely crescentoid at the summit. Of the inner secondary lobes, the anterior is much the larger, and is pyramidal in form, with a twin pointed summit. It springs from the crown at the conjunction of the principal lobes, and is continuous with their contiguous horns. The posterior of the secondary lobes is conical, and springs from the crown in conjunction with the back horn of the posterior principal lobe. The front horn of the anterior principal lobe curves inward, downward and backward to the base internally of the anterior secondary lobe.

A basal ridge, nearly continuous, bounds the crowns of the lower molars externally, in front, and behind. In the latter position it rises inwardly, and terminates in a tubercle springing from the conjunction of the posterior principal and secondary lobes.

In comparing the lower molars with those of the Horse, it is evident that the principal lobes of the crown correspond with the external crescentoid columns in the latter, the anterior secondary lobe with the anterior internal twin column in the Horse, and the posterior secondary lobe, with its contiguous tubercle terminating the basal ridge, corresponds with the posterior twin column in the teeth of the Horse.

The hinder lobe of the last molar tooth resembles the principal lobe in advance, reduced in size. The anterior large molar is smaller than the others, and is narrowed at its fore part.

As the lower molars are worn, crescentic tracts of dentine appear at the summits of the principal lobes, and minute islets on those of the secondary lobes. The dentinal tracts gradually widen and become continuous throughout on the summits of all the lobes. When the teeth are about one-third worn away, the enamel lines on the masticating surface pursue a general course approaching in appearance the characteristic arrangement observed on the worn teeth of the Horse.

The temporary dentition of *Anchitherium* is most probably like that of the Horse. Specimens of jaws of *A. Bairdi* exhibit three temporary molars in both jaws, corresponding with the anterior three of the permanent series, which they exactly resemble in form. The first one above and below has a greater breadth in proportion with the width than in their permanent successors, and their fore part is better developed.

Since writing the above. I have had the opportunity of examining several specimens of mutilated skulls of *Anchitherium Bairdi*, obtained by Dr. Hayden in his last trip to Dakota, which retain the anterior extremity of the face in a state of preservation sufficiently well to indicate its conformation to be the same as in the Horse.

The premaxillaries extend upward and backward to articulate by their upper end with the nasals. The ends of the latter project as in the Horse, but retain a proportionately greater breadth and terminate in a more obtuse manner.

The symphysial extremity of the lower jaw is constructed as in the Horse, but the intermediate portion is more cylindroid in its form.

None of the fore teeth are preserved in the specimens, but the retained alveoli indicate the same number of incisors and canines as in the Horse.

The upper canines projected from the maxillaries quite near the suture of the premaxillaries, and were separated from the incisors by a space little more than a line wide. The lower canines were close to the incisors.

The first small premolar, retained in the lower jaw of one of the specimens, is much smaller than the corresponding upper tooth. It is inserted by a single fang, and has a laterally compressed conoidal crown with a posterior heel.

The length of the skull of *Anchitherium Bairdi* from the summit of the inion to the fore part of the upper jaw is seven and a quarter inches; the length of the lower jaw is six inches.

Measurements derived from several of the best preserved specimens are as follow:

	Lines.	Lines.	Lines.	Lines.	Lines.
Length from occipital condyles to front of upper jaw,	82				
Length from inion to fronto-nasal suture, . .	53*	53	53		
Length of sagittal crest from inion, . .	15½	15	17		
Length of forehead, ...	41*	39	39	41	
Breadth of do. at post-orbital processes, . .	32			28	
Breadth of do. at middle of orbits, . . .	23			20	
Breadth of cranium about middle, . . .	24	25	22		
Length of temporal fossa along middle, . .	33				
Height of do. at zygomatic root, . . .	18		19		
Breadth of inion at par-occipitals, . . .	21		21		
Height of do., ...			21		
Breadth of face at middle of infra-orbital arches, .	36		38		
Breadth at ant-orbital processes, . . .	26	26	25*	24	
Breadth at infra-orbital foramina, . . .	18	19	18	18	
Breadth at canine alveoli, ...	10				
Length of nasals at middle, . . .					34
Breadth of do. at fronto-nasal suture, together, .	19	19		17	20
Breadth of do. at upper ends of premaxillaries, .					10
Height of orbit, ...	15			15½	
Width of orbit, ...	16½			15	
Length of lower jaw, ...		72			
Height of do. at condyle, ...			29*		
Height of do. at coronoid process, . . .			40*		

* Estimated.

	Lines.	Lines.	Lines.
Height of do. at back of last molar, . .			14½
Height of do. at first small premolar, . .	8	7½	8
Breadth of alveolar portion of symphysis, . .	7	7	
Breadth of symphysis where narrowest, . .	4	4½	
Length of symphysis, ...	12	12	
Length of series of seven upper molars, . .	34½		34
Hiatus between do. and the canine, . .	8		
Length of series of seven lower molars, . .	34½		34
Hiatus between do. and the canine, . .	10		

Measurements of molar teeth derived from several of the more perfectly preserved series are as follow:

	Adult.	Adult.	Aged.	Milk.	Milk.	Adult. Large individual.
	Lin.	Lin.	Lin.	Lin.	Lin.	Lin.
Length of upper series of seven molars, . .	34½		33½			
Length of upper series of six large molars, .	31½	31½	31½			
Length of upper series of three back molars, .	16	16	16¼			
Length of lower series of seven molars, . .	35					
Length of lower series of six large molars, .	33	33				
Length of lower series of three back molars, .	17½	17½	16¾			
Ant.-post. diameter upper small premolar, .	3¾		3½			
Transverse " " " .			2½			
Ant.-post. diameter lower small premolar, .	1¾					
Ant.-post. diameter upper first large molar, .	6	6	6	6¾	6¾	6¾
Transverse " " " .		6	6¼	5¾	5	7
Ant.-post. diameter upper second large molar, .	6	5¾	5¾	6¼	6	7
Transverse " " " .		6¼	6½	6¼	5¾	7¾
Ant.-post. diameter upper third large molar, .	6	5¾	5¾	6¾	6	7
Transverse " " " .		6½	7	6¾	6	8
Ant.-post. diameter upper last molar, . .	5½	5½	5¾			
Transverse " " " . .		6½	6½			
Ant.-post. diameter lower first large molar, .	5½	5¼				
Transverse " " " .		3¼				
Ant.-post. diameter lower third large molar, .	6	5½	5			
Transverse " " " .		4½	4½			
Ant.-post. diameter lower last large molar, .	6½	7½	7			
Transverse " " " .		3½	3½			

HYPOHIPPUS.

Regarding the characters of this genus as distinct from the former, so far as they are derived from a single upper molar tooth, they are as follow: The external lobes have the same form as in *Anchitherium*, but in the specimen their outer face is transversely concave, without a trace of median ridge. The internal lobes form regular cones, the transverse and antero-posterior diameters being equal.

Hypohippus affinis.

The above name has been applied to a genus and species of a supposed solipedal animal, allied to *Anchitherium*, and inferred to have existed from a single fossil tooth, in the Niobrara collection. The specimen consists of a well-preserved crown of an upper molar, and is represented in figures 11, 12, plate XXI. From its hollowness, together with its worn condition, I suspect the tooth to be the second or third of the temporary series.

The crown has the same anatomical construction as in *Anchitherium*, being composed of three pairs of lobes having the same relative position with one another, and about the same proportions as in that genus.

The tooth is larger than those of *Anchitherium aurelianense*, and is equal in size to those of *Palæotherium medium*, with which it also bears a general resemblance. It has been inserted into the jaw by fangs, as in the two latter animals, and appears to have been equally devoid of cementum. It is worn so as to exhibit wide tracts of dentine along the summits of its constituent lobes.

The external lobes of the crown have the same form as in *Anchitherium*, and are sustained by equally robust buttress-like ridges, but their outer face is uniformly concave, and not interrupted by a median ridge. The internal lobes are regularly conical, the diameter from before backward being equal to the transverse, whereas in *Anchitherium* the latter exceeds the former, thus giving the internal lobes in this genus the appearance of compressed cones. The antero-internal lobe is considerably larger than the one behind. The median lobes are even less dilated at their inner part than in *Anchitherium*. The outer extremity of the postero-median lobe is continuous with the conjunction of the external lobes, and just before its termination, in front and behind, exhibits a small process or tubercle, apparently the rudiment of the complex folds, in a corresponding position of the teeth of the *Equidæ*. A crescentoid tubercle occupies the interval at the back of the crown, and constituent portions of a basal ridge are situated around the tooth exactly as in *Anchitherium*.

The measurements of the specimen are as follow:

	Lines.
Length of the crown at the median buttress, ...	5½
Length of the antero-external lobe, ...	7½
Antero-posterior diameter externally, ...	14
Transverse diameter, ...	13

ANCHIPPUS.

The distinctive characters of this genus, as determined from a fragment of a superior molar tooth, are as follow: The median lobes are better developed than in the former two genera, and the internal lobes are in a proportionate degree diminished. The postero-median lobe in its course gives off a process, which approaches, without reaching, the inner extremity of the median lobe in advance. Likewise the posterior crescentoid tubercle of the crown gives off a process, which approaches the inner extremity of the neighboring median lobe, but stops short and connects itself with the contiguous internal lobe. In other words, the median lobes and posterior tubercle, with their offsets, exhibit a tendency to conjoin, and thus form a pair of crescentoid lobes embracing the external ones, as do the corresponding columns in the *Equidæ.*

Anchippus Texanus.

Dr. B. F. Shumard submitted to my examination the greater part of an upper molar tooth of an animal, apparently allied to *Anchitherium,* from Washington Co., Texas. The specimen was obtained from "Hutchin's Well," fifty feet below the surface, from a yellow sandstone, supposed to be of miocene age.

The tooth, represented in figure 13, plate XXI, has lost the outer portion of the external lobes, but is otherwise sufficiently perfect to exhibit its peculiar characters. Its size is nearly the same as in the teeth of *Anchitherium aurelianense,* with which it also agrees in general proportions and construction.

Six pairs of lobes compose the crown, holding the same relative position with one another as in *Anchitherium;* but they, and the intervening valleys, appear proportionately somewhat deeper.

The external lobes appear to have had the same form as in *Anchitherium.* The internal lobes also have the same form, but are longer and less robust, while the median lobes are proportionately more robust, or, in other words, the internal and median lobes approach nearer to equality than in *Anchitherium.* The postero-median lobe pursues the same course as in the latter genus, and outwardly joins the external lobes at their angle of conjunction. From near the middle of its course it gives off a process, which is directed towards the inner thicker portion of the antero-median lobe, but ceases a short distance from it. The process approaches the antero-median lobe with the appearance of having a disposition to conjoin it, and thus form together a crescentoid lobe embracing the antero-external lobe, as in the corresponding columns of the *Equidæ*. No similar arrangement exists in the true *Anchitherium*. A crescentoid tubercle, as in the latter genus, occupying the interval at the back of the crown, gives off a process, which joins the contiguous internal lobe near the starting outwardly of the postero-median lobe. In other words, the crescentoid tubercle exhibits a disposition to join the latter, thus together to form a crescentoid lobe, embracing the postero-external lobe as in the corresponding columns of the *Equidæ*. Constituent portions of a basal ridge exist anteriorly and posteriorly as in *Anchitherium*.

In the specimen, the summits of all the lobes are worn so as to exhibit tracts of dentine. The tracts upon the summit of the internal lobes form ellipses with their long diameter oblique, and in the direction of the median lobes. In *Anchitherium* the corresponding exposed tract on the summit of the antero-internal lobe has its longer diameter transverse.

The tooth, from its structure, is evidently intermediate to those of *Merychippus* as a representative of the *Equidæ*, and those of *Anchitherium*.

In its perfect condition the tooth has been about ten lines in its antero-posterior diameter, and eleven in its transverse diameter.

PARAHIPPUS.

In this genus, as defined from three upper molar teeth and a single inferior molar, apparently of the temporary series, the following peculiarities are observed: The external lobes of the crown of the upper molars on their outer surface swell into a strongly marked median ridge. The median lobes are as well developed in proportion with the inner lobes as in the preceding genus. The postero-median lobe divides at its outer extremity into two widely diverging processes, each of which sub-divides. The teeth show a nearer approach to those of the *Equidæ*, through the genus *Merychippus*, than in any of the preceding genera. In other words, there is not only an increase in the size of the median lobes and a corresponding reduction of the internal ones, as compared with *Anchitherium* and *Hypohippus*, but there is exhibited a disposition to union of the median lobes and posterior tubercle of the crown, as in *Anchippus*, and in addition we have the anterior or outer extremity of the postero-median lobe complicated with additional processes as in *Merychippus*. In the inferior molar, the internal conical lobes as seen in *Anchitherium* are developed into twin cones, corresponding with the internal twin columns of the lower molar teeth of the Horse.

Parahippus cognatus.

The Niobrara collection of fossils contains four specimens of molar teeth, apparently of a solipedal animal of the family of *Anchitheridæ*, differing from any of the preceding. The above name has been proposed for it, and, from the construction of the teeth, it appears to have been more closely related to the *Equidæ* than any other of its family.

The teeth all belonged to the same individual, and appear to pertain to the temporary series. They are but slightly worn, are devoid of cementum, and have rugose enamel,—much more so, indeed, than in any of the previously described fossils belonging to the same family. In form, mode of insertion, and general constitution, they bear a near resemblance to those of *Anchitherium aurelianense*, with which they also agree in size.

The specimens consist of the upper molar teeth of the left side and the first lower molar of the right side.

The superior molar teeth, represented in figure 7, plate XXI, have external demi-conoidal lobes as in *Anchitherium*, but their outer face swells more gradually into a thicker and more prominent median ridge. The median lobes are proportionately more robust, and approach more equally in size the internal conical lobes. The median lobes are also thicker and more prominent at their inner extremity, and therefore less ridge-like and more conoidal than in *Anchitherium*. The outer extremity of the postero-median lobe divides into a pair of widely divergent processes, each of which sub-divides into a pair of smaller ones. These processes appear to correspond with the folds springing from the anterior horn of the postero-median column of the upper molars of the Horse, or those which complicate the contiguous borders of the central lakes of the worn triturating surface. The antero-internal lobe of the crown is more perfectly conical than in *Anchitherium*, and is proportionately somewhat smaller. The postero-internal lobe, relatively to that in advance, is rather larger than in the genus just mentioned.

The first upper molar has its antero-posterior diameter proportionately greater than the transverse diameter in comparison with the corresponding temporary tooth of *Anchitherium*, arising principally from the greater degree of development of the antero-median lobe and the anterior accessory demi-conoidal lobe. The internal lobes are more nearly equal in size than in the succeeding teeth.

The first inferior molar, represented in figures 9, 10, plate XXI, resembles that of *Anchitherium aurelianense* in form and size, except that the internal median conical lobe is larger, deeply notched, and cleft nearly to its base on the inner side. The posterior tubercle springing from the basal ridge is also better developed.

In the constitution of the teeth of *Parahippus*, they are clearly intermediate to those of *Anchippus* of the same family and *Merychippus* of the equine family.

The length of the series of upper molar teeth is thirty-one lines. The measurements of the individual teeth are as follow :

	1st superior molar. Lines.	2d. Lines.	3d. Lines.
Length of crown along median ridge of outer lobes, .	6	6	6½
Length of crown along prominent ridge at junction of do.,	4½	4½	4½
Antero-posterior diameter, ...	12	10	10
Transverse diameter, ...	9	9	9½
Length of crown of first inferior molar at the middle twin conoidal lobe, ...			3½
Antero-posterior diameter of do., ...			11
Transverse diameter, ...			6

Remains of Solipeds of uncertain reference.

Dr. Hayden's collection of fossils from the Niobrara River contains many specimens pertaining to equine animals, but to which of those I have attempted to characterize in the preceding pages I have been unable to determine. They consist of fragments of lower jaws with and without teeth, numerous inferior molars for the most part isolated, a few incisors, and many bones and fragments of others of the limbs. They were picked up here and there in the loose sands of the Niobrara, in association with the more characteristic specimens already described, together with many other of the fossils noticed in this work.

The more complete series of inferior molars, and most of the others exhibiting any peculiarity, are represented in plate XIX, with views of the triturating surfaces. Those not represented nor described are so nearly like the former as to render it unnecessary to give a particular account of them.

The more important specimens are as follow :

1. The greater portion of the right side of the lower jaw of an old animal. It contains the third, fifth and sixth molars, with the fangs of the others. The specimen holds a due relationship in size to that referred to *Protohippus perditus*, and may perhaps belong to the same animal. The portion of the jaw resembles the corresponding portion in the Ass, and the mental foramen holds the same relative position.

The teeth retained in the specimen have their crowns worn to such an extent as to be inserted alone by lengthened fangs. The triturating surfaces appear of a highly simple character, as represented in figures 13, 14, plate XIX. No trace remains in the jaw of the early existence of a small premolar.

The measurements of the specimen are as follow:

	Lines.
Space occupied by the molars,	55
Space occupied by the three back molars,	28
Breadth of third molar,	8¼
Breadth of fifth molar,	8½
Breadth of sixth molar,	11
Depth of jaw below third molar,	20
Depth immediately in advance of molars,	14

2. A portion of the lower jaw, nearly corresponding with the last, but retaining none of the symphysis. From a young animal. As in the Horse, there appears to have been no canine accompanying the deciduous dentition. The functional series of molars consisted of the temporary molars and the following or fourth one of the permanent series. The fifth molar has protruded to a degree to have commenced trituration. Within the jaw are seen the anterior three permanent molars, fully developed.

A socket exists in front of the larger teeth, from which a small premolar has been lost. The anterior pair of temporary molars are retained in the specimen; the third has been broken away. The former have their crowns nearly worn out, and their triturating surfaces, represented in figure 17, present as much simplicity as in the back permanent molars of the preceding specimen. A tubercle, with its summit worn off, appears at the entrance of the median transverse valley externally.

The permanent molars have the long crowns characteristic of the true *Equidæ*. The worn triturating surface of the fourth of the series is represented in figure 16.

The jaw is larger in its proportions than in the preceding specimen, though its greater depth is in a measure due to the accommodation of the long teeth included within the bone. The portion in advance of the molars has been somewhat longer.

The measurements of the specimen are as follow:

	Lines.
Space occupied by the premolars and following two permanent molars,	52
Depth of jaw below back of first temporary molar,	23
Distance from first molar to back of symphysis,	14
Distance from first molar to lateral incisor,	24
Width of the constriction of the fore part of the jaw,	11
Breadth of first temporary molar,	11
Breadth of second temporary molar,	10½
Length of crown internally of second permanent molar,	20
Length of crown internally of fourth permanent molar,	18
Breadth of fourth permanent molar at triturating surface,	10

3. Fragment of the right side of a lower jaw, containing the last two molars about

half worn away. The teeth are larger in their proportions than in the preceding specimens, and would appear to be even simpler in their constitution at the same stage of abrasion, as represented in the view of the triturating surfaces in figure 18, plate XIX.

The measurements of the teeth are as follow:

	Lines.
Length of crown at fore part externally of fifth molar, . . .	7
Breadth of fifth molar, ...	9
Length of crown at fore part externally of last molar, . . .	7
Breadth of sixth molar, ...	13

4. Three symphysial portions of as many jaws, having the same general form as the corresponding part in the Ass. They belonged to animals of nearly the same size, but vary among one another in their relative proportions. One contains the fangs of all the incisors and canines. The latter appear to have been of robust character, and they formed a continuous semi-circle with the former. The other two specimens, slightly less constricted and flatter below than in the preceding, were devoid of canines.

5. A number of isolated incisors and several canines, resembling in constitution those of living equine animals.

6. A series of lower molars of the right side, except the first one. They are well preserved, and less than half worn. Though isolated and mingled with a multitude of other specimens, they are supposed to belong together from their agreement in all essential characters. Their triturating surfaces, with the addition of that of a specimen of a first molar from another animal, probably of the same species, is represented in figure 3. This series of molars I suspect to belong to one of the species of *Hipparion*,—probably *H. affine*, or perhaps *H. occidentale.*

The measurements of the teeth are as follow:

	Lines.
Length of series of six molars, ...	68
Length of series of back three molars, ...	33
First molar, breadth, ...	12
Second molar, "	11
Third molar, "	11
Fourth molar, "	10
Fifth molar, "	10½
Sixth molar, "	12½
Second molar, length of crown, ...	11
Fourth molar, " "	14
Sixth molar, " "	15

7. A complete series of molars of the right side, represented in figure 4. The anterior three are attached by a fragment of the jaw; the others, though isolated, appear to have belonged to the same individual, as indicated by their relative fitness with the former and with one another. The animal had just reached adult age, as proved by the state of the last molar, which had not been worn the entire breadth. The teeth are smaller than in the former, but the difference is not so great as it appears to be in the figures, for at the same age or stage of abrasion they would have been more nearly alike in their proportions.

In general appearance, such as relative size and proportions, age, accidental staining and weather-worn condition, these specimens look as if they may have belonged to the same individual as the upper molars represented in figures 7—10, plate XVIII, and referred to *Hipparion speciosum.*

The measurements of the teeth are as follow:

	Lines.
Length of series of six molars,	65
Length of series of back three molars,	31
Length of crown of first molar,	13
Length of crown of third molar,	21
First molar, breadth at triturating surface,	11
Second molar, " "	11
Third molar, " "	10½
Fourth molar, " "	10½
Fifth molar, " "	10½
Sixth molar, " "	11½

8. A series of right lower molars except the last one, about the same age as the preceding series, but considerably smaller. They were all isolated specimens mingled with many others, but fit well together, and in other respects appear as if they had been derived from the same individual. Their worn triturating surfaces are represented in figure 6, and sufficiently nearly resemble those of the preceding series to belong to the same species. Judging from their smaller size, they may belong to *Hipparion gratum*, or perhaps to *Protohippus placidus.*

The measurements of the teeth are as follow:

	Lines.
Length of series of five molars,	45
First molar, length of crown,	13
Third molar, " "	21
Fifth molar, " "	21
First molar, breadth of crown,	8¾
Second molar, " "	8¾

		Lines.
Third molar, breadth of crown,		9
Fourth molar, " "		8½
Fifth molar, " "		10
Fifth molar, " "	near middle,	9

9. A number of molars, fitting in pairs, from different individuals and ages, probably belong to the same species as the preceding series. Figure 7 represents the triturating surface of the posterior two of the series; figure 8, the fourth and fifth of another series; figure 9, the second and third of a series, which are contained in a fragment of the jaw; and figure 10 an anterior pair. Figure 2 also represents a last molar, probably of the same species.

10. A series of the back three molars, apparently belonging together, and represented in figure 5. They appear to be less than half worn away, and nearly agree in size and proportions with the teeth above described. The arrangement of the enamel on the triturating surface differs in an important manner, and they probably belong to a different animal,—probably *Protohippus perditus*. In the teeth previously described, at the fore part of the crown externally there is a narrow longitudinal fold with a more or less free summit. When the teeth were slightly worn, the latter appeared on the triturating surface as an islet, but soon became an outward extension of the more important fold directed inwardly. In the teeth under inspection, the external fold at the fore part of the crown is rudimental, or substituted by a ridge of enamel as in the Horse, and does not appear on the triturating surface, as an outer extension of the large internal enamel fold, in any stage of abrasion.

The measurements of the teeth are as follow:

	Lines.
Space occupied by the three molars,	29
Breadth of fourth molar,	9
Breadth of last molar,	11
Length of crown of fourth molar externally,	11
Length of crown of last molar externally,	11

11. A series of the back three molars, apparently from the same animal, which had scarcely reached adult age, as the last tooth is unworn. Their triturating surfaces are represented in figure 11, and nearly resemble those of the series last described, but are even simpler in the arrangement of the enamel folds internally.

The measurements of the teeth are as follow:

	Lines.
Space occupied by the three molars,	31
Breadth of fourth molar at triturating surface,	10
Breadth of fourth molar near bottom,	7½

	Lines.
Breadth of last molar,	10½
Length of fourth molar externally,	16½
Length of fifth molar externally,	19

12. A series of the anterior four molars, inserted in a portion of the jaw. The teeth appear to be about a third worn away, and they nearly agree in proportions with those previously described. Their triturating surfaces are represented in figure 12, and are intermediate in character with those of the last two series described and the previous ones. The narrow external fold or ridge at the fore part of the crown is rather better developed than in the last two series indicated, but not so well as in the others.

The measurements of the teeth are as follow:

	Lines.
Space occupied by the four molars,	36½
Space occupied by the anterior three molars,	28½
Breadth of first molar,	9½
Breadth of do. near bottom,	8
Length of do.,	9
Breadth of third molar,	9
Breadth of do. near bottom,	8
Length of do.,	14
Breadth of fourth molar,	8½
Breadth of do. near bottom,	7½
Length of do.,	12

13. A last molar of the left side, narrow in proportion to its length in relation with the corresponding teeth previously described. Its triturating surface is represented in figure 15, and is nine lines in breadth, while the length of the crown at the middle externally is twenty lines.

14. A fourth or fifth molar of the right side, from Bijou Hill. The triturating surface is represented in figure 1, and resembles in the arrangement of its enamel the series of figure 5, supposed to belong to *Protohippus*. At the lower four-fifths of the specimen, however, the narrow external fold at the fore part of the crown is as well developed as in the teeth supposed to belong to *Hipparion*, and, as in them, at a later stage of attrition would have exhibited itself on the triturating surface.

It is this specimen which is among the number mentioned under the head of *Hipparion* (*Hippodon*) *speciosum*, in the Proceedings of the Academy for 1856, p. 311.

15. A number of isolated molars, represented in figures 19—23 The specimen of the last figure is from Bijou Hill, and appeared so peculiar that when first seen it was

viewed as indicating a new species, and was described in the Proceedings of the Academy for 1854, page 90, under the name of *Hippodon speciosus*. The specimens of the former figures look so much like the latter as to render it probable that they belonged to the same animal.

16. A fragment of the left side of the lower jaw, containing the supposed third molar. This is inserted by fangs, and its triturating surface is represented in figure 24. The breadth of the surface is ten and a half lines; its thickness, independent of the cementum, six lines.

17. Three isolated molars, represented in figures 25—27. The specimen of figure 25 is a first temporary tooth of the left side. The others held an intermediate position in the permanent series; that of figure 26 is nearly half worn away; that of figure 27 is comparatively but little worn. These display a peculiar arrangement of the enamel on the triturating surface, quite different from that of any of the teeth previously mentioned, but they are sufficiently alike among themselves to render it probable that they belong to the same species.

18. A series of the anterior three molars, apparently belonging together. Their triturating surfaces are represented in figure 28, and approach in character those of the last mentioned specimens as to render it probable that they belonged to the same species. The specimen of figure 27 probably held the same relationship of a fourth tooth to this series, and that of figure 26 probably is a fifth molar.

The measurements of the three teeth are as follow:

	Lines.
Space occupied by the three molars,	32
Breadth of first molar,	10½
Length externally at middle,	12½
Breadth of second molar,	10½
Length of do.,	17
Breadth of third molar,	10½
Length of do.,	20½

This series of teeth bears such a near resemblance in general appearance, relative age, and proportionate size, to the back series represented in figure 11, that, were it not for the striking difference in the arrangement of the enamel on the triturating surface, I should have referred them to the same individual.

19. A lower molar, probably the second or third of the left side, represented in figure 29. It is much worn, and apparently belonged to a larger animal than any of the preceding specimens. It accompanied the upper molars of *Hipparion occidentale*, from White River, represented in figures 1—5, plate XVIII, and was, when first seen,

supposed to belong to the same animal. The length of the crown at the middle externally is about an inch; the breadth of the triturating surface eleven and a half lines; its thickness seven lines.

20. A half-dozen isolated molars, of various ages, and positions intermediate in the permanent series. They are represented in figures 30—36, and, with the last described specimen, are of larger proportions than any of the others, being about the size of those of the Ass. They probably belong to one or more species of *Hipparion.*

21. Four temporary molars, represented in figures 37, 38, 41. The two represented in the last figure are contained together in a fragment of the lower jaw, and appear to be the second and third of the left side.

22. An inferior molar, probably a second or third of the permanent series, represented in figure 40.

23. A series of bones together composing a complete fore foot, about the size of that of the Ass, in the Niobrara collection. The median metacarpal and succeeding two phalanges have every appearance of having belonged to the same individual; and the coffin bone, though probably from a different skeleton, accords in its proportions with the preceding bones.

The median metacarpal bone is roughened, at the sides posteriorly, the entire length of the shaft, as if for the conjunction of lateral metacarpals, as has been recognized to be the case in the genus *Hipparion,* to which these fossils also probably belong. The measurements of the metacarpal are as follow:

	Inch.	Lin.
Length in the axis of the bone,	8	6
Width of the carpal articular surface,		18
Diameter of the same from before backward,		13
Breadth of the shaft at the middle,		14
Circumference of the same,		41
Breadth of the phalangial articulation,		18

The measurements of the pastern bone are as follow:

	Lines.
Length in the axis,	27
Breadth of the proximal end,	19
Breadth of the shaft at middle,	13
Breadth of the distal articular surface,	17

The measurements of the coronary bone are as follow:

	Lines.
Length,	14
Breadth of proximal end,	20
Breadth of distal end,	20

The measurements of the coffin bone are as follow :

	Lines.
Height of anterior slope,	23
Breadth of lateral spread,	24
Extent of spread antero-posteriorly,	24
Breadth of articular surface,	20
Projection of angles laterally beyond the same,	4

24. Five lower extremities of humeri, pertaining to equine animals smaller than the Ass, from the Niobrara River. They agree in form with the corresponding portion of the humerus of the Horse. Their comparative measurements are as follow :

	Lines.	Lines.	Lines.	Lines.	Lines.
Breadth of the articular surface,	23	21	20	19	15
Width of the internal condyle,	26	23	22	21	18
Width of the external condyle,	16	14	13	12	10

25. Six lower ends of tibiæ of small equine animals, from the Niobrara River. They are about one-half the diameter of the corresponding portion of the same bone of the Horse, and they differ but slightly among themselves in size and proportions. The measurements of the specimens are as follow:

	Lin.	Lin.	Lin.	Lin.	Lin.	Lin.
Breadth of the articular end,	20	20	19	19	18	18
Width of do. internally,	14	14	14	13	13	12
Width of do. externally,	11	10	9	9	11	9
Circumference of shaft two inches and a quarter above the lower end,		37	37	35		32

26. A patella of a small equine animal, from the Niobrara, not quite so broad in relation with its depth as in the Horse. Its measurements are as follow: breadth twenty-one lines; depth twenty-three lines; breadth of articular surface twenty lines; depth sixteen lines.

27. Twelve astragali of equine animals, from the Niobrara River. The largest is little more than half the diameter of that of the Horse, and from this they exhibit a series decreasing to little more than one-third the diameter of that of the Horse. In anatomical detail of form they agree with that of the latter. The measurements of two of the largest, two of intermediate size, and two of the smallest, are as follow:

	Lines.	Lines.	Lines.	Lines.	Lines.	Lines.
Greatest breadth of articular surface of the condyles, . . .	18	15	16	14	12	11
Width of inner condyle, . .	22	20		17	16	14
Width of outer condyle, . .	18	17	16	14	13	12½
Breadth of base, . . .		16½	16	15	12	11
Breadth of scaphoid surface, . .	15	15	14	12	11	10
Depth of the same, . . .	13	12	10	10	8½	8½

28. Six calcanea, from the same locality, agreeing in proportions with the bones just described. The measurements of three of the specimens are as follow:

	Lines.	Lines.	Lines.
Extreme length, ...	40	35	32
Depth at middle of tuberosity, , . . .	14	13	11½
Width " "	5	4½	4½
Depth of extremity of tuberosity, . . .	16	14	12
Thickness " "	11	10	8
Depth of articular end, ...	15	15	13
Breadth " "	18	16	12½

29. Four bones together, of due proportions, recomposing a hind foot, of an equine animal remarkable for its small size and slender form. The bones apparently belonged to different individuals, and all came from the Niobrara River except the coronet bone, which was obtained at Bijou Hill. The entire foot measures ten and a half inches in length.

The metatarsal bone is longer in comparison with its thickness, or is proportionately of more slender form than in the Horse or Ass. Its measurements are as follow:

	Inches.	Lines.
Length, ...	7	2
Circumference at middle, ...		24
Transverse diameter at middle, ...		8
Antero-posterior diameter at middle, ...		9
Breadth of proximal extremity, ...		12
Antero-posterior diameter of do., ...		10
Breadth of distal articulation, ...		11
Antero-posterior diameter of its median ridge, ...		9

The pastern is nineteen lines long; the breadth of its proximal extremity is eleven and a half lines, and of its distal end nine and a half lines.

The coronet bone is ten lines long, thirteen lines broad at the upper end, and twelve lines at the lower end.

The coffin bone has its base more angular in outline than in the Horse, arising chiefly from its anterior part being prolonged. The apex of the prolongation presents the peculiarity of being deeply notched. The body of the bone appears also more angular, than semi-circular as it is in the Horse, arising from its being more prominent forward. The bone at its lower part is comparatively rugose and perforated. Its measurements are as follow:

	Lines.
Height of anterior slope,	17
Breadth of the spreading base,	17
Antero-posterior extent of the base,	18
Breadth of articular surface,	12
Projection of angles laterally beyond the latter,	3

30. A metatarsal bone, smaller than that last described, from the Niobrara River. Its length is six inches and seven lines; the breadth of its proximal end is eleven lines, and of its distal end ten lines.

31. Two upper fragments and eleven lower fragments of metatarsals, from the Niobrara River. One of the upper fragments is considerably larger than the corresponding portion of either of the whole bones last described, and the other fragment is slightly smaller than either. The breadth of the proximal articulation of the larger one is fifteen lines; of the smaller one ten lines. Of the lower fragments the largest has its articular surface fifteen lines in breadth; a second measures thirteen lines; a third twelve lines, and the smallest measures eleven lines.

32. Thirteen pasterns, from the Niobrara, exhibit a variety in size, as indicated by the following measurements of half a dozen of them:

	Lines.	Lines.	Lines.	Lines.	Lines.	Lines.
Length,	23	22	20	17½	17½	15
Breadth of proximal end,	14	12	14	12	12	12
Breadth of distal end,	12½	10½	11	9½	8	8½
Breadth of middle of shaft,	10	8	9	8½	7½	8½

33. Four small coronets, of which one is from Loup Fork, the others from the Niobrara. They present the following dimensions:

	Lines.	Lines.	Lines.	Lines.
Length,	12	11	11	10
Breadth proximally,	15	14	13	15
Breadth distally,	14½	13½	11	13½

Additional remains of equine animals from Little White River, or the South Fork of the main stream of Makisi-ta Wakpa, or White River.

The collection of Prof. Hayden, obtained in his expedition in the summer of 1866 at Dakota, contains a number of remains of equine animals, which were found in association with a few others of *Procamelus occidentalis*, *Merycodus necatus*, etc. They were discovered on Little White River, in loose sand belonging to the same formation as that on the Niobrara River, which has yielded such an abundance of similar fossils. Unfortunately the specimens throw no further light on the determination of the species I have attempted to characterize in the preceding pages. The more important ones are as follow:

1. A pair of upper molars, contained together in a fragment of the jaw. They are apparently the second and third of the series, belong to the left side, and are represented in figure 2, plate XXVII. The teeth more nearly resemble those of *Hipparion occidentale,* from White River, represented in figures 1—5, plate XVIII, on which the species was originally characterized, than any of those subsequently described from the Niobrara River or other locality. They are nearly alike in size and complexity of arrangement of the enamel, but the internal median column of the crown is proportionately somewhat narrower.

The measurements of the teeth are as follow:

	Lines.
Length of crown of second molar externally,	19
Breadth of triturating surface,	12½
Width of triturating surface,	12½
Length of crown of third molar,	21
Breadth of triturating surface,	12
Width of triturating surface,	12

2. An isolated superior molar, apparently a fifth of the series. It has nearly the size, proportions and structure of the corresponding tooth of *H. occidentale,* represented in figure 1, plate XVIII, except that the inner median column of the crown is rather narrower. Its measurements are as follow:

	Lines.
Length externally at the middle,	15
Breadth,	10½
Width (transversely),	11¼
Breadth of internal column,	3¼

3. Three isolated molars, from intermediate positions in the series, resembling in size, proportions and structure those referred to *Hipparion gratum,* and represented in figures 25—30, plate XVIII. Their measurements are as follow:

	Lines.	Lines.	Lines.
Length at the middle externally,	11	16	19
Breadth of triturating surface,	9	9½	9
Breadth below,	7	7½	7
Width of triturating surface,	10	8½	8
Breadth of internal column,	3	3½	3¾

4. Portions of a number of upper molars, together with a perfect one, having the general aspect as if they had belonged to the same animal. A full series is represented in figure 1, plate XXVII, in a restored condition. They bear a strong likeness to those of *Protohippus perditus*, represented in figure 2, plate XVII, and may belong to that species. The teeth are, however, larger than those in the specimen referred to *P. perditus*, and have their internal columns more cylindrical, or circular in transverse section, as is the case in *Merychippus*. It is probable they may belong to this genus, which, in the upper molar teeth, is apparently only distinguishable from *Protohippus* in having the internal columns of the crown for the most part regularly cylindrical instead of compressed cylindroidal. The apparent greater difference observed in the interior lakes of the triturating surfaces in figures 5 and 9, plate XVII, of *Merychippus*, and figure 2 of *Protohippus*, depends simply on a difference in the degree of abrasion of the teeth. In the comparatively little worn specimens of *Protohippus*, figure 2, the lakes appear wide and gaping. As these lakes contract towards the bottom of the crown, when this is much worn they would appear narrow, as in the specimens of *Merychippus*, figures 5 and 9.

The teeth under consideration approach in size and proportions those of *Merychippus mirabilis*, and probably belong to this species. The measurements derived from the imperfect specimens are as follow:

	Lines.
Length of first molar externally at middle,	14½
Breadth of do.,	13½
Width from external median ridge to internal median column,	10
Breadth of second molar (partially estimated,)	12
Breadth of third molar, " "	12¾
Length of fourth molar externally,	18
Breadth of fourth molar, "	11
Breadth of fifth molar, "	11½
Breadth of sixth molar, "	11

5. An isolated molar, apparently the fourth of a series, represented in figure 5, plate XXVII. It bears a near resemblance to the corresponding tooth of *Protohippus perditus*, in the specimen represented in figure 2, plate XVII, and probably belongs to the same species. Its measurements are as follow:

	Lines.
Length of crown externally at middle,	18
Breadth at triturating surface,	10
Breadth near fangs,	8
Width, transversely,	10

6. Two first upper molars, from animals about the same size but of slightly different ages. The specimens, represented in figures 6, 7, plate XXVII, are sufficiently different in appearance to belong to different species, and approach most nearly in character those referred to *Protohippus placidus*, represented in figures 40, 41, 42, plate XVIII. Their measurements are as follow:

	Lines.	Lines.
Length at middle externally,	11½	13½
Breadth,	9½	10
Width obliquely across the middle,	8	7½

7. Three isolated upper molars, larger than any of the above from the same locality. One of them is an unworn first molar, which had not yet protruded from the jaw. Its length antero-externally is nearly two inches; its breadth is thirteen lines; its width ten and a half lines. The other two specimens, from intermediate positions in the series, are represented in figures 3, 4, plate XXVII. In structure they bear a resemblance to those of *Protohippus perditus* more than to those of any of the other equine species indicated, but they are much larger, and probably belong to another species of the genus. In one of the specimens, figure 4, comparatively but little worn, the section of the internal median column on the triturating surface appears isolated as in *Hipparion*, but a prolongation exists at its fore part, indicating an early conjunction with the antero-median column of the tooth, as in *Protohippus* and *Equus*. Though I am apprehensive of having fallen into the error of multiplying species on insufficient grounds, I feel persuaded that the specimens just described indicate a larger species of *Protohippus* than those previously named, and therefore propose to distinguish it with the name of *Protohippus supremus*.

The measurements of the two worn molars are as follow:

	Lines.	Lines.
Length at middle externally,	22	26
Breadth at triturating surface,	12	13½
Breadth near fangs,	9	10
Width at middle of triturating surface,	12	11

8. A portion of the left side of a lower jaw of a young animal, containing the three temporary molars in functional position, and about one-half worn. The fourth permanent molar was yet entirely concealed within the jaw. In advance of the teeth there exists a minute conical socket, from which a small premolar has been shed. The measurements of the specimen are as follow:

	Lines.
Space occupied by the temporary molars,	40
Breadth of first molar,	13½
Breadth of second molar,	12½
Breadth of third molar,	14
Depth of jaw at back of last molar,	23
Depth of jaw at front of first molar,	16
Depth of jaw on a line with the mental foramen,	12½

9. A fragment of a lower jaw of the left side of an adult animal, probably belonging to the same species as the last specimen. It contains the posterior two molars. These teeth, though worn down the greater part of their extent, exhibit no transverse fold projecting outwardly at the fore part of the crown, as is usually the case in *Hipparion*.

Probably this and the preceding specimen belong to *Protohippus*.

The space occupied by the two teeth is an inch and a half; the breadth of the fifth molar is eight and a quarter lines; of the sixth molar, ten lines.

10. A fragment of the right side of a lower jaw, containing the posterior three molars of the permanent series. It belonged to a rather larger animal than the preceding specimen, and one of about the same age, but evidently to a different species, as indicated by the difference in arrangement of the enamel on the worn triturating surfaces. The teeth of this fossil are of the character of those of *Hipparion*, as indicated by the presence of the antero-external fold of the crown. The measurements of the teeth are as follow:

	Lines.
Space occupied by the three molars,	29
Breadth of fourth molar,	8
Breadth of fifth molar,	8½
Breadth of sixth molar,	11

11. Several dozen isolated inferior molars, of various ages, sizes, and belonging to several different species and genera, but none differing in an important degree from those already indicated, from the Niobrara River. Among them is an inferior molar of *Equus excelsus*.

12. Two symphysial fragments of lower jaws, both having the same general form and construction as in the corresponding portion of the jaw of the Horse. One is much narrower in its proportions than the other, and it contains the alveoli of a continuous semicircle of six incisors and a pair of canines. The other, more robust in its proportions and belonging to a larger animal, contains the remains of the same

number of teeth holding the same relation. The breadth at the narrowest portion of the smaller specimen is scarcely ten lines; that of the other is nearly fifteen lines.

13. The lower extremity of a radius, the articular surface of which measures twenty-one lines in breadth.

14. Four astragali, of which the largest and smallest present the following measurements:

	Lines.	Lines.
Greatest breadth of articular surface of the condyles, . .	15	13
Width of inner condyle, ...	20	17
Width of outer condyle, ...	18	14½
Breadth of base, ...	16	14
Breadth of scaphoid surface, ...	15	12
Depth of scaphoid surface, ...	11	9

15. Four distal ends of metacarpals and metatarsals, the articular surfaces of which measure the following breadths: fifteen, twelve, eleven, and ten lines.

16. Five first phalanges or pasterns, of which three present the following measurements, the others being of intermediate proportions:

	Lines.	Lines.	Lines.
Length in the axis, ...	22½	18½	18½
Breadth of proximal end, ...	14½	13½	11
Breadth of distal articulation, ...	12	10½	8½
Breadth at middle of shaft, ...	9	9½	7

17. Four second phalanges or coronets, with the following dimensions:

	Lines.	Lines.	Lines.	Lines.
Length in the axis, ...	16½	13	11½	11
Breadth proximally, ...	22	15½	15	14
Breadth distally, ...	21	13	14½	12½

RODENTIA.

This order is represented by six species of as many genera, in the tertiary deposits of the Mauvaises Terres of White River, and those of the Niobrara River. Four of the genera are extinct, and belong to the miocene formation; the others apparently are referrable to *Castor* and *Hystrix,* and belong to the pliocene formation. They represent five families, all still in existence: the *Leporidæ, Sciuridæ, Castoridæ, Muridæ,* and the *Hystricidæ.*

LEPORIDÆ.

The Hare family is represented in the miocene fauna of the Mauvaises Terres by a peculiar genus, which has been named as follows:

PALÆOLAGUS.

PALÆOLAGUS HAYDENI.

The genus and species are founded upon a number of fragments of upper and lower jaws with teeth. The specimens were discovered by Dr. Hayden at the head of Bear Creek, a tributary of the Sheyenne River, Dakota. They are considered by Dr. Hayden to be of miocene age, and belong to bed C of his vertical section of the tertiary deposits of Dakota and Nebraska.

The specimens indicate *Palæolagus* to have had the same number of molar teeth as the existing Hares or Rabbits,—six to the upper and five to the lower series. The constitution of the teeth likewise is of the same character as in the latter animals. In *Palæolagus,* however, the first inferior molar is composed of a double column as in the others, whereas in the Hare it is a triple column.

The bottoms of the inferior incisors, seen in several of the fossils, are noticed extending further back than in the Hare, reaching partly beneath and partly internal to the anterior three molars, while in the Hare they stop short of the position of the first molar.

From the recent genus *Lagomys,* and the extinct genus *Titanomys* of the miocene deposits of France and Germany, *Palæolagus* differs, as does the Hare, in the possession of a greater number of molar teeth.

The fossils indicate a species rather less in size than the Gray Rabbit, *Lepus syl-*

vaticus. They vary among themselves in size and robustness, but independently of what may be considered as individual peculiarities, the differences appear to depend mainly on difference of age.

In regard to the form of the jaw fragments, consisting merely of the portions containing the molar teeth, they agree nearly with the corresponding portions in the Rabbit, except that they appear proportionately rather more robust. In a corresponding position of the lower jaw there does not exist, in the fossils, the reticular foramina observed in the vicinity of the mental foramen in the Rabbit.

Three specimens, consisting of portions of as many upper jaws, contain molar teeth, as represented in figures 14—16, plate XXVI, magnified three diameters. The teeth of the different specimens exhibit considerable variation in size, form, and apparent constitution; nevertheless they are suspected all to have belonged to the same species, and the differences are supposed to be due to difference of age.

The teeth of the youngest specimen, figure 14, are the smallest of the three series, and consist of all the molars except the last one, part of the alveolus of which is also retained by the specimen. The anterior three teeth belong to the deciduous set, and are inserted into the jaw by fangs, or at least an unenamelled portion of the crown.

The first tooth of the series is the smallest, and resembles that of the Rabbit. The crown is divided by an anterior valley into a pair of lateral lobes. The succeeding two temporary teeth have their triturating surface bordered by enamel, except on the outer part. The second tooth exhibits a short internal valley, and a small central islet. The fourth molar tooth, almost as large as that in advance, is bordered by enamel except externally. It possesses an internal transverse fold or valley and a central islet. The fifth molar, about the size of the second, is bordered by enamel, and possesses a short internal valley.

The teeth of the second specimen, larger than those of the former one, consist of the second to the fifth, or of the four intermediate ones, figure 15, and belong to the permanent series. They are oblong-square curved columns, with cordiform triturating surfaces, the outer border of which is devoid of enamel. A transverse fold or valley extends from the inner side in all of them, and each presents a central islet, which is crescentoid in the anterior pair of teeth, and minute and round in the posterior pair. The specimen also retains parts of the first and sixth alveoli.

The teeth of the third specimen, figure 16, are so much larger, and appear so different from those of the other specimens, that they might be supposed to belong at least to another species of the genus. They are teeth of a comparatively aged animal, and consist of the second to the fifth inclusive of the series. The triturating surfaces are transversely quadrate ellipsoidal, and bordered by enamel, except on the outer side. All traces of the internal transverse fold or valley have been completely obliterated.

The remaining specimens, seven in number, consist of portions of lower jaws with teeth, which exhibit differences equal to those of the upper jaw specimens, as seen in figures 17—20 of the same plate, representing teeth of four of the fossils of different sizes and ages, magnified three diameters.

The youngest specimen exhibits a full series of five inferior molars, as represented in figure 17. Of these, the anterior four bear a near resemblance in form and constitution with the corresponding series of *Titanomys visenoviensis*, as represented in plate 46 of Gervais' Paléontologie Francaise.

The first molar forms a double column, with a triturating surface consisting of the ellipses conjoined by a median isthmus. The succeeding pair of molars are the largest of the series, and each is composed of a pair of columns, which on the triturating surface are only united by cement. The anterior column is the broader, and transversely ellipsoidal; the posterior column is somewhat pyriform in transverse section. The fourth tooth is about the size of the first, and formed like the second and third. The fifth and last tooth, the smallest of the series, is in excess of the number existing in *Titanomys*. In form it resembles that of the Rabbit, and the first one of its own series.

A second specimen, of more advanced age than the preceding, contains the anterior four molars, as represented in figure 18, together with the alveolus for a fifth tooth. The columns, composing the molars, on the triturating surfaces are seen to be united internally by a narrow isthmus. In addition, the first molar exhibits its median isthmus.

A third specimen contains the anterior three molars, as represented in figure 19. The teeth are intermediate in appearance to those of the preceding two specimens. On the triturating surfaces the columns of each tooth, except the first, appear united only by cementum.

A fourth specimen contains the anterior three molars, as represented in figure 20. The jaw fragment is of more robust proportions than any of the other corresponding specimens. The teeth indicate an aged animal, and in general appearance hold a near resemblance with those of an upper jaw fragment, the teeth of which are represented in figure 16. The crowns are very much worn away, and are inserted into the jaw by fangs. The crowns are mutilated internally, but appear to have been devoid of enamel in that position. The triturating surface of the first molar exhibits no transverse valleys, and is bordered by enamel only externally. The succeeding teeth exhibit an external valley, and are bordered by enamel externally and partly at the sides.

If all the specimens above described really belong to the same species, as is supposed, the changes which take place in the teeth in the advance of age appear briefly to be as follow:

The upper molars are double columns, which are at first separated by an internal transverse fold or valley, except in the first tooth, in which the fold is anterior. In the progress of wearing, the transverse valley is shortened, and its somewhat widened and deepened bottom is at first isolated as a central islet to the triturating surface. The islet is subsequently obliterated; the transverse valley continues to be reduced, and is finally obliterated. The teeth increase in breadth as they advance in age, and the enamel is obliterated externally long before it approaches its termination internally. The steps of this process of change may be readily traced in the series of figures from 14 and 15 to 16.

In the lower jaw the molars are likewise composed of double columns, which in the first and last teeth, from an early period, appear on the triturating surface united only by cementum, as represented in figures 17, 19. As the teeth are worn away, the columns become associated by an internal isthmus, and are then separated by a deep transverse valley, as represented in figure 18. Later the internal isthmus gradually widens, and the transverse valley is proportionately shortened and is finally obliterated, as represented in figure 20.

As in the case of the upper molars, the lower ones, as they wear down, are reproduced, and grow of greater breadth. The extent of increase, however, may not be so great as represented between what are viewed as aged and young specimens above described, for the teeth of the latter at the bottom of the crown exceed very little the diameter at the triturating surface. It would therefore follow, either that the crowns as existing in the young specimens would be completely worn away and replaced by other and broader but continuous ones, or that the older and larger specimens belong to a larger species from the younger and smaller ones.

The measurements of the specimens are as follow:

	1st spec. Lines.	2d sp. Lines.	3d sp. Lines.
Space occupied by six superior molars,	$4\frac{1}{2}$		
Space occupied by five anterior superior molars,	4		
Space occupied by four intermediate molars,	$3\frac{1}{4}$	4	$4\frac{1}{4}$
Transverse diameter third upper molar,	$1\frac{1}{2}$	$1\frac{3}{4}$	$2\frac{1}{4}$

	1st sp. Lines.	2d sp. Lines.	3d sp. Lines.	4th sp. Lines.
Depth of lower jaw below second molar,	$3\frac{1}{4}$	$3\frac{1}{2}$	$3\frac{1}{2}$	$4\frac{3}{4}$
Space occupied by six lower molars,	$4\frac{3}{4}$			
Space occupied by anterior three lower molars,	3	$3\frac{1}{2}$	$3\frac{1}{2}$	4
Antero-posterior diameter of third lower molar,	1	1	1	$1\frac{1}{2}$
Transverse " " "	1	$1\frac{1}{5}$	$1\frac{1}{6}$	$1\frac{1}{2}$

Dr. Hayden's last collection of fossils from the Mauvaises Terres contains a few additional fragments of jaws with teeth of *Palæolagus Haydeni*. The specimens exhibit nothing peculiar from those already described, and are only of especial interest from the fact of their having been derived from a different locality.

SCIURIDÆ.

This family is represented in the miocene fauna of the Mauvaises Terres by a peculiar genus, to which the following name has been given.

ISCHYROMYS.

Ischyromys typus.

Another rodent animal, distinguished by the above name, and belonging to the family of the Squirrels and Marmots, is indicated by the greater portion of a skull and two fragments of lower jaws, discovered by Dr. Hayden at the head of Bear Creek, in association with the remains of *Palæolagus Haydeni.*

The skull, represented in figures 1, 2, plate XXVI, was about the size of that of a Muskrat, *Fiber zibethicus,* and also approached it in form, though differing from it and the skulls of all recent rodents in many important points. Its form approaches more that of the Beaver than that of the Muskrat, but bears a nearer resemblance to that of the extinct *Steneofiber viciacensis,* as represented in plate 48 of Gervais' Paléontologie Francaise, than with any other form of rodent skull with which the writer is familiar.

The occipital region, much mutilated in the fossil, was vertical as in the Beaver. In the upper view, the cranium appears proportionately neither so broad nor capacious as in the latter animal, and its sides incline more laterally. In the interparietal region it is of less breadth and capacity than in the Muskrat, and in the frontal region is wider and more capacious.

A narrow sagittal crest separates the temporal fossæ, and extends from the inion to near the middle of the frontal bone, and to the most constricted portion of the cranium, before it bifurcates to define the lateral borders of the forehead. The temporal surface is extensive, and reaches forward upon the side of the frontal bone in advance of its middle.

The interparietal bone is shield-shaped in outline, nearly straight behind, subangular and without prolongation in front, and slightly incurved at the sides.

The interparietal suture appears as a fissure dividing the sagittal crest.

The temporal bone contributes but a small proportion of surface to the temporal fossa. The temporo-parietal suture pursues an irregularly horizontal course backward to the boundary of the inion. The upper border of the temporal bone is pierced by a foramen, in the line of the temporo-parietal suture, as large as that existing in the Muskrat.

The frontal bone, in the specimen, is divided by a median fissure, apparently a continuation of the sagittal suture. A portion of the bone on one side is broken away, and the apparent suture may have been accidental. The forehead is broader than in the Muskrat, and is transversely convex, but slightly depressed at the middle. The posterior extremity of the frontal is received into a deep notch of the parietals. The anterior border pursues nearly a similar course across the face as in the Beaver.

The face appears to have been nearly as broad proportionately as in the Beaver. The infra-orbital foramen appears to have been as large as in the Muskrat.

The hard palate is wider and not so deep as in the latter animal. The incisive foramina extended as far back as the maxillo-intermaxillary suture. The palate plates of the palate bones together form an isosceles triangle reaching as far forward as the position of the second molar teeth.

The basi-occipital is much narrower than in the Muskrat, and, as in this, presents a median keel. The basi-sphenoid is of more uniform breadth, and forms a narrow inclined plane.

The auditory bulla is large and oval.

The fossil contains on one side all the molar teeth, five in number, and upon the opposite side all except the last one.

The fragments of lower jaws, attributed to the same species as the skull, consist of alveolar portions, of which one contains a portion of an incisor, the second molar, the socket and fangs of the first, and portions of the sockets for the third and fourth molars; and the other specimens contain the second and third molars and portions of the sockets of the first and fourth.

The fossils would indicate the dental formula to consist of the usual number of incisors, and five molars to each side of the upper jaw, and four to each side of the lower jaw.

The upper molars of the fossil, represented in figure 4, plate XXVI, three times the diameter of nature, belong to the permanent set, and are constructed after the plan of those of the Squirrel family. They have rounded cuboidal, tuberculated crowns invested with thick enamel and devoid of obvious cementum, and they are inserted by well-developed fangs.

The lower molars bear a near resemblance to those generally of the upper jaw in a reversed position.

The first upper molar is the smallest of the series, and appears to be inserted by a single fang. Its crown is barrel-shaped, with the triturating extremity impressed by a crescentic fossa, which separates an antero-external conical eminence from an internal crescentic ridge.

The succeeding three superior molars are the largest, and nearly of uniform size. The fifth molar is slightly less than those immediately in advance.

The back four upper molars bear some resemblance to those of the Marmot, *Arcto-*

mys monax, or of the Squirrel, *Sciurus carolinensis*, and mainly differ in the distinct development of a pair of lobes to the crown internally, instead of one as in the former animals.

As before intimated, the crowns of the lower molars resemble those of the upper ones in a reversed position.

In the second upper molar, or premolar, the bilobed character of the inner part of the crown is less distinct than in the true molars, in consequence of feeble development in the postero-internal lobe.

The moderately worn triturating surfaces of the upper molars, except the first or small one, in the fossil skull, exhibit crescentoid tracts upon the summits of the inner lobes, with transverse prolongations from their concavities along the summits of the outer lobes, and narrow prolongations outwardly from their distal horns. The specimens of inferior molars exhibit similar worn surfaces in a reversed position.

The measurements of the specimens are as follow:

	Lines.
Distance from inion to fronto-nasal suture,	21½
Width of cranium at the root of the zygomatic process,	11½
Width where narrowest, in the frontal region,	4½
Width of forehead at fronto-maxillary suture,	10
Length of sagittal crest,	16
Length of parietals along the latter,	7
Length of frontals along the middle,	9½
Distance from posterior nares to incisive foramina,	9
Breadth of hard palate between middle molars,	3½
Length of superior molar series,	7½
Antero-posterior diameter of third molar,	2
Transverse " " "	1¾
Antero-posterior diameter of second lower molar,	2
Transverse " " "	1¾

Dr. Hayden's last collection of Mauvaises Terres fossils contains a number of fragments of jaws of *Ischyromys typus*, which are the first specimens I have seen from that locality, the previous ones having been derived from Bear Creek. Among them are the greater portions of four halves of lower jaws, all containing full series of molars, while others of the upper and lower jaw contain from two to four. These afford us an opportunity of rendering our knowledge of the permanent dentition of the animal complete.

One of the best preserved specimens of the lower jaw, represented in figure 3, plate XXVI, nearly agrees in form with the corresponding portion in the Squirrel, but the impression of the masseter is comparatively feeble, and only reaches as far forward as the position of back part of the second molar tooth.

Of the inferior molar teeth, two complete series, viewed on their triturating surface, and magnified three diameters, are represented in figures 5 and 6. The former figure represents those of the left side considerably worn; the latter represents those of the right side still more worn.

These teeth are four in number, and more uniform in appearance among themselves than those above, of which they resemble the third and fourth in a reversed condition. The anterior transverse ridge of the triturating surface in the two upper teeth just indicated, in the lower molars occupies a position at the back of the crown. When much worn, the teeth viewed on their triturating surfaces, as seen in figure 6, appear to have the crown trilobed internally and bilobed externally.

Measurements derived from several of the specimens are as follow:

	Lines.	Lines.	Lines.	Lines.
Length of the lower molar series,	7	7	7½	7
Depth of lower jaw below second molar,	5½	5		
Depth of lower jaw in advance of the molars,	5	4½		

CASTORIDÆ.

The family of the Beaver is represented both in the miocene fauna of the Mauvaises Terres and the pliocene fauna of the Niobrara River.

PALÆOCASTOR.

Palæocastor nebrascensis.

A rodent of the Beaver family, and about half the size of the existing Beaver, is indicated by several specimens contained in Dr. Hayden's collection of fossils from the Mauvaises Terres of White River.

One of the specimens, represented in figures 7, 8, plate XXVI, consists of a much mutilated skull, with the fragments retained nearly in their original position by a mass of included calcareous matrix. The greater part of the cranium is destroyed, as is also the nose and parts of the jaws, though all the teeth are preserved. A second specimen consists of portions of both jaws of an aged individual, badly mutilated and imbedded in a mass of matrix. The remaining specimens, from a third individual, consist of portions of both sides of the lower jaw and one side of the upper jaw, containing all the molar teeth, and freed from investing matrix.

So far as any conception can be had of the form and construction of the skull from the mutilated specimen above mentioned, it appears to have resembled that of the closely allied animal *Steneofiber viciacensis*, an extinct rodent from the lower pliocene formation of Saint-Gerand-le-Puy, France, represented in plate 48 of Gervais' Paléontologie Francaise. The teeth also of the Nebraska specimens bear a near resemblance to those of the animal just named.

From these resemblances the Nebraska fossils were referred to a species of *Steneofiber*, about two-thirds the size of *S. viciacensis*. *Steneofiber* has been viewed by Dr. Bronn, in the Lethæa Geognostica, as synonymous with *Chalicomys*, of which the type is *C. Jägeri*, indicated by the portion of a lower jaw and teeth, from the miocene formation of Germany. The lower jaw of *Steneofiber viciacensis* remains unknown; if, however, it should prove to possess a form such as that of *Chalicomys Jägeri*, as represented in figure 19, plate xxv, of Kaup's Ossemens Fossiles, it would appear to be different from that in the Nebraska rodent under examination. In the lower jaw of the latter, the base pursues the course of that in the Beaver, but in *Chalicomys Jägeri* it possesses a comparatively strong, downward convexity. Under the circumstances, I have preferred placing the Nebraska fossils under consideration in a new genus, distinguished by the name heading the present chapter.

In the mutilated skull, small fragments of the cranium held in position by the included mass of matrix exhibit the following details in comparison with the figures of the skull of *Steneofiber viciacensis*, represented in Gervais' Paléontologie Francaise, plate 48.

The forehead presents the same triangular form and proportionate size. The temporal fossæ appear to have had the same form and proportionate capacity. They were separated in the same manner by a long sagittal crest, extending forward upon the frontal bone. The cranium, just back of the forehead, was equally constricted. The external auditory passage formed a short oblique canal, with its orifice directed outward and backward in the same manner. The palatal region likewise had the same form and construction, and the infra-orbital foramina held the same relation of size and position as in *Steneofiber viciacensis*.

The incisors in both jaws are proportionately as long and strong as in the Beaver, and they have the same form.

The lower jaw, figures 8, 9, is strong, and approaches in form that of the Beaver. The fore part from the ascending ramus closely resembles the corresponding portion in the latter. The base also pursues the same course. In the lower jaw of *Chalicomys Jägeri*, as previously stated, the base forms a comparatively deep convexity, in advance of the position of the angle. The latter, in the Nebraska fossil, is of less proportionate breadth than in the Beaver, and is much bent inwardly. The condyle is relatively higher or at a proportionately longer distance from the base. It forms a single superior convexity as in the Muskrat, but proportionately less wide antero-posteriorly, and it does not extend downward externally as in the Beaver. The posterior border of the jaw, a little below the condyle, forms a 3-like double curvature, as seen in figure 8. The greater portion of the ramus forming the coronoid process is lost, but from its remains it appears to have been peculiar. The border of the ramus in the rodent jaw, and indeed in that of most animals, descending from the front of the condyle to form the notch between it and the coronoid process, in the fossil under examination proceeds downward and outward from the neck of the jaw externally, as seen in figure 8.

The mental foramen occupies the ordinary position below the fore part of the first molar.

The molar teeth in all the fossils under examination belonged to the permanent series, and had advanced to an age at which they had all become inserted by the fangs only. They are four in number, and have the same constitution as in the Beaver, Agouti, *Steneofiber*, *Chalicomys*, etc.

In the specimens consisting of detached portions of jaws, in which the teeth are best preserved, they present the following characters:

In the upper molars the crowns successively decrease in size from the first to the last, as in the Beaver. The crowns are cuboidal with rounded lateral borders, but they have not so much of an outward curvature as in the Beaver. The worn triturating surfaces represented in figure 10, magnified two diameters, present a lateral valley on each side as in the Beaver; the inner one directed outward, the outer one inward and backward. The anterior division of the crown exhibits an elliptical islet in the course of the inner valley, and usually an additional minute islet. The posterior division of the crown exhibits from three to four minute islets included in the bend of the external valley.

In the lower molars, the crowns of the anterior three differ slightly in size; the first is the largest, the fourth the smallest of the series. Upon the worn triturating surfaces, represented in figure 11, magnified two diameters, in the first tooth the internal valley divides the crown transversely, but in the other teeth it is converted into an islet. The external valley extends obliquely backward. In advance of the valleys the triturating surface usually presents an elliptical islet, but in the first molar two small ones are substituted. Back of the valleys in the intermediate pair of teeth there is a single transverse elliptical islet. In the first tooth there is an additional small round one; and in the last tooth there are one or two small round ones.

In the other specimens the teeth present slight differences, mainly dependent on their more worn condition, one result of which has been the obliteration of most of the smaller islets of the triturating surfaces.

Measurements of the specimens of *Palæocastor nebrascensis* are as follow:

	Lines.
Length of upper molar series, ...	$6\frac{3}{4}$
Length of lower molar series, ...	$7\frac{3}{4}$

	Lines.
Width of palate between first molars,	2½
Length of hiatus from first molar to incisives,	11½
Width of narrowest portion of cranium,	4¼
Depth of lower jaw at first molar,	6
Height of condyle from base at angle,	11½
Length of lower jaw from condyle to front of incisive alveoli,	21½
Breadth of jaw from prominence of posterior border to fore part of molar alveoli,	14¼
Diameter of incisors,	1¾
Diameter first upper molar,	1¾
Antero-posterior diameter of last upper molar,	1¼
Antero-posterior diameter of first lower molar,	2
Transverse " " "	1½
Antero-posterior diameter of last lower molar,	1½

CASTOR.

Castor tortus.

A specimen indicating the former existence of a species of Beaver, about half the size of the recent one, was discovered by Dr. Hayden in the loose sands of the Niobrara River. Dr. Hayden considers the fossil as belonging to the pliocene period, and attributes it to bed F of his vertical section of the tertiary formations of Nebraska and Dakota. The specimen represented in figure 21, plate XXVI, consists of the greater portion of an upper jaw, containing on both sides the anterior three molars and portions of the incisors. It belonged to a quite aged animal, as indicated by the condition of the molar teeth, which are nearly worn away to the fangs.

The portion of the jaw consists of the under parts of both maxillary and intermaxillary bones, which together are the diminished counterpart in form of the corresponding parts of the recent Beaver.

The incisor teeth likewise have the same relative proportions and form as in the latter animal.

Of the molar teeth, represented in figures 21, 22, the first is less worn than the others, in consequence of a part of its functions having been performed by a predecessor. It bears a near resemblance in its construction and enamel folding to that of the existing Beaver. The succeeding pair of molars appear different from the corresponding teeth which I have had the opportunity of examining in skulls of the recent Beaver, but the differences appear to me to be due to difference of age. These teeth have their crowns nearly worn out, and appear to have undergone such a change that what was their inner side has become posterior, as seen in figures 21, 22. I may be in error in supposing such a change possible, and have not had the opportunity of examining skulls of equally aged individuals of the existing Beaver, to ascertain whether any change of the kind really occurs. In their present condition, the width of the crown greatly exceeds the antero-posterior diameter, especially in the second molar, and the lines of enamel on the triturating surfaces proceed in oblique curves from without inward and backward. What is the internal valley, as ordinarily seen in the corresponding teeth of the recent Beaver, in the fossil opens at the back of the crown.

Comparative measurements of the fossil with the corresponding portion of the skull of a recent Beaver, are as follow:

	C. tortus. Lines.	C. fiber. Lines.
Length of space occupied by four molars,	6¼	13
Length of hiatus from first molar to incisors,	12¾	21
Breadth of face opposite first molars,	7	14
Breadth of face in advance of infra-orbital foramina,	5½	11
Width of palate between first molars,	1	3¼
Width of palate between last molar alveoli,	4	7½
Antero-posterior diameter of first molar,	2	3¾
Transverse " "	2½	3½
Antero-posterior diameter of second molar,	1¼	3
Transverse " "	2	3¼
Antero-posterior diameter of third molar,	1½	3
Transverse " "	2	3¼
Diameter of incisors,	2	3½

MURIDÆ.

This family is represented in the miocene fauna of the Mauvaises Terres by a genus to which I have given the following name:

EUMYS.

Eumys elegans.

A specimen discovered by Dr. Hayden at the head of Bear Creek indicates a rodent of the Rat family. It was found in what Dr. Hayden has named "the Turtle and Oreodon bed," or bed B of his vertical section of the Dakota and Nebraska tertiary deposits. The specimen, represented in figure 12, plate XXVI, twice the natural size, consists of a portion of the left side of a lower jaw, and belonged to an animal approaching in size the Brown Rat, *Mus decumanus.* The species has been distinguished by the name at the head of the chapter.

The jaw fragment, consisting of the intermediate portion, agrees in form and constitution with the corresponding portion in the Rat. The inserted portion of the incisor, retained in the specimen, projects as far back and in the same manner as in the Rat.

The side of the jaw was provided with three molar teeth as in the latter animal, but the intermediate one alone is preserved in the specimen, together with the alveoli and fangs of the others.

The entire molar has an oblong-square crown, inserted into the jaw by fangs as in the Rat. The triturating surface, represented in figure 13, magnified four diameters, exhibits four principal lobes entering into the constitution of the crown. The summits of the lobes are worn so as to exhibit a continuous tract of dentine bordered by enamel, but unprovided with intervening cementum. The worn surfaces of the ovoidal lobes alternate with each other internally and externally. Those of the anterior pair of lobes conjoin by a narrow tract in front, extending into a point inwardly and outwardly. Those of the internal lobes are separated by a pointed tract extending into the valley separating the latter. Those of the outer lobes are separated by the external transverse valley. The worn surface of the postero-external lobe extends in a pointed tract back of the postero-internal lobe.

The measurements of the specimen are as follow:

	Lines.
Depth of jaw below second molar, ...	3
Space occupied by three molars, ...	3½
Antero-posterior diameter of second molar, ...	1

HYSTRICIDÆ.

The family of the Porcupines is represented by a species of *Hystrix,* in the pliocene fauna of the Niobrara River.

HYSTRIX.

Hystrix venustus.

Two isolated molar teeth of a rodent animal, differing from any of the preceding, were discovered by Dr. Hayden in company with the specimen of *Castor tortus.* They apparently indicate a species of Porcupine, but in structure are unlike those of the recent American Porcupine, *Erethizon dorsatus,* and exhibit a more evident relationship with those of the crested Porcupine, *Hystrix cristata,* of Europe.

One of the teeth, represented in figure 23, plate XXVI, magnified one and a half diameters, corresponds with the first upper molar of the right side in the latter animal, and closely approaches it in constitution, form, and size. It appears to have been about one-fourth worn, and was furnished with a pair of short fangs. The crown is six and a half lines long antero-internally, and four and a half lines antero-externally. It curves backward and outward to about the same extent as in the Crested Porcupine, and, as in this, presents a pair of lateral enamel folds dividing the crown into two portions. The triturating surface measures four lines and a quarter antero-posteriorly, and three and a quarter transversely at the anterior division of the crown. At the base of the latter it measures four lines transversely. The anterior division of the triturating surface exhibits a transverse bow-like islet, and the posterior a transverse boot-shaped islet, together with a minute circular one.

The second specimen consisted of the crown of an unworn tooth, which presents less resemblance to any of the teeth of the Crested Porcupine than the former, and may perhaps belong to a different animal from it.

Compared with the left upper molars of the Crested Porcupine, which it most resembles, it is more square in transverse section, or its antero-posterior diameter is proportionately less. The outer and posterior surfaces form vertical planes, the anterior surface is convex, and the inner one alone forms an enamel fold penetrating the crown. A section of the specimen near the triturating surface, as represented in figure 24, magnified one and a half diameters, exhibits three transverse, elongated, elliptical enamel islets, with the internal transverse valley projecting between the inner ends of the anterior pair of islets.

The length of the specimen, before a section was made, was nearly half an inch anteriorly. Its antero-posterior diameter is three lines; its transverse diameter three lines and a half.

INSECTIVORA.

This order, in the extinct mammalian fauna under consideration, is represented by the remains of two genera, which were discovered by Dr. Hayden in his last trip to the Mauvaises Terres, in the summer of 1866. The fossils belong to bed B of the miocene formation of Dr. Hayden's sections. Both genera indicated by the fossils are extinct, and have been named *Leptictis* and *Ictops*. Both are nearly allied, and belong to a peculiar family related with that of the Hedgehogs.

LEPTICTIS.

Leptictis Haydeni.

The animal for which this name has been proposed is indicated by an almost complete skull, obtained near the mouth of one of the small tributaries of White River, in the Mauvaises Terres. It apparently belongs to an animal of the insectivorous order, but exhibits sufficient resemblance to the skulls of the Opossums to lead to the suspicion that it may possibly pertain to a member of the Marsupialia. Among the Carnivora it exhibits more affinity to the canine family than any others, and appears more nearly related to the Viverrine than the Musteline family.

The skull is without the lower jaw, and was imbedded in the soft silico-calcareous rock of the tertiary beds of White River. The matrix adhered the more intimately to the fossil through the intermediation of a thin layer of more ferruginous character.

The skull belonged to an animal past maturity, as indicated by the blunted or worn condition of the teeth; it nevertheless retains most of the sutures as distinctly as in the Opossums.

The specimen, represented in figures 25, 26, 27, plate XXVI, is less in size than that of the Mink, and its shape is more Canine than Musteline. It bears some resemblance in form to that of the insectivorous genus *Glisorex*, or to that of the viverrine genus *Eupleres*.

The cranium is remarkable for the possession of a pair of prominent ridges defining the upper part of the temporal fossæ, as in a fossil cranium represented by De Blainville (Osteographie, Mustela, plate xiv) under the name of *Mustela plesictis* from Auvergne, and by Gervais (Paléontologie Francaise, plate xxviii, figure 2) under the name of *Mustela angustifrons.* Similar ridges, relatively less well developed, exist in the Gray Fox.

The orbits are as little distinct from the temporal fossæ as in the Skunk or the European Hedgehog. The fossil retains most of the teeth, figures 25, 26, the number of which on each side consists of seven molars, the canine, and two incisors. Of the molars, the back four have broad trilateral crowns, with a number of points or tubercles as in the Opossums and Hedgehogs, or the back two in the Dog. The anterior three molars have simple laterally compressed conical crowns. The canines are comparatively small.

Whether the animal possessed a greater number of incisors in the upper jaw than appears to be indicated in the fossil is somewhat uncertain, for although the specimen is imperfect at the end of the snout, yet the alveolar border looks as if it were entire, and even if it is not, the portion lost would appear to be too small to accommodate an additional pair of teeth.

Upper view of the skull. (Figure 27, plate XXVI.)—The cranium back of the orbital spaces is conoidal and wider than high; is feebly contracted back of the zygomatic arches, and then expanded to the acute border of the inion. It is narrowest immediately back of the post-orbital prominences, but is relatively not so much constricted as in the Mink or Fox, but more so than in the Skunk and European Hedgehog.

The ridges defining the upper part of the temporal fossæ are prominent, thick, linear and obtuse. They are nearly parallel, and extend from the inion to the forehead, where they swell in the lateral prominences common to the latter and the post-orbital eminences. The extremities of the ridges are moderately divergent. The intervening space forms a wide and nearly flat gutter from two and three-quarter lines where narrowest to about four lines towards the ends.

The forehead is of moderate width, prominently convex at the sides and depressed at the middle. Laterally it is defined by the short, obtuse supra-orbital margin ending in the post-orbital eminence.

The face is long, and tapers evenly to the end of the snout. The nasals are long, and of nearly uniform breadth. They commence together in a short obtuse angle. Their anterior extremities are lost in the fossil.

Lateral view. (Figure 25, plate XXVI.)—The upper outline of the skull forms an almost unbroken curve. It slopes slightly downward at the posterior third, and strongly and evenly so in front to the end of the face. The lateral border of the inion inclines as little as in the Opossum. The occipital condyles project but slightly beyond it.

The temporal fossa is small compared with its extent in most Carnivora, and has about the same proportions as in the European Hedgehog. The zygoma is relatively about as strong as in the latter, and is arched to nearly the same degree. It has no upward rise in its course forward, but inclines downward from its posterior root to its junction with the face. It possesses no post-orbital process.

A moderately deep fossa occupies a position both in front and behind the zygomatic arch. The anterior fossa impresses the maxillary just in advance of the malar bone, and beneath the orbit. The posterior fossa impresses the squamosal over the auditory archway, and extends from upon the back of the zygoma to the border of the inion.

A foramen occupies the bottom of the posterior fossa of the zygoma, and three others pierce the squamosal just above the fossa.

The orbital space is defined from the temporal fossa only by the smooth convex post-orbital eminence. A small foramen pierces the summit of the latter.

The ant-orbital margin from the position of the lachrymal bone is acute, and curves downward and backward upon the zygoma. Its most anterior part is above the position of the antepenultimate molar.

The infra-orbital foramen is situated a short distance in advance of the orbit, above the interval of the fourth and fifth molars. It is oval, nearly as wide as high, and about a line in diameter.

Posterior view.—The inion presents a wide, horizontal summit, emarginate at the middle. The sides are convex, and end below in the post-auditory processes of the temporals.

A prominent median ridge descends from the upper border of the inion, and expands above the occipital foramen. The lateral surfaces are depressed, and are most prominent approaching the latter. A deeper depression on each side is formed upon the pars mastoidea of the temporal.

The occipital foramen is sub-pyriform, three and three-quarter lines high and four and a quarter lines wide. The occipital condyles are comparatively but moderately prominent, and are quite sessile. They project more inferiorly than posteriorly.

Inferior view. (Figure 26, plate XXVI.)—The basi-occipital is of moderate width, and but feebly carinated. It rapidly narrows to the conjunction of the basi-sphenoid, which is slightly ascending. The articulation of the two is the most prominent portion of the basilar surface.

The paramastoid process is rudimental, and the mastoid process is but little better developed. The contiguous post-auditory process of the squamosal is better developed than either of the former.

The auditory bulla on one side is broken away, but upon the other appears to be entire and of remarkable form. It is comparatively small, and is in the form of a triangular scroll descending by its base from the side of the basi-sphenoid and basi-occipital, and curving outwardly to terminate in a free point. It reminds one of the process developed from the alisphenoid, enclosing the front of the tympanic cavity, in the Opossum. No auditory canal extends from the bulla in the fossil, but an open archway communicates with its interior from between the post-glenoid and post-auditory processes, as in the Opossum.

The glenoid fossa forms a nearly level plane above, and behind descends almost at a right angle upon a comparatively long, robust post-glenoid tubercle. This is vertical and hooked inwardly. At its base internally there is a vascular foramen.

The optic foramen holds a rather more advanced position than usual in its relation with the spheno-orbital foramen. The latter, a short vidian canal, and the oval foramina, hold the same relative position with one another as in the Dog.

The position of the eustachian communication with the tympanic cavity and the carotid canal appear to be at the fore and outer part of the scroll-like auditory bulla.

The condyloid, jugular, and stylo-mastoid foramina hold the usual relative position with one another.

The palate is long, narrow, and moderately arched fore and aft and transversely. No large perforations exist in it as in the Opossum.

The palate plates of the palate bones together form a triangle with zig-zag sides and a notched apex, which reaches as far forward as the fourth molars.

The palatine notch resembles that of the Fox, being of considerable capacity and extending as far forward as the interval between the last pair of molar teeth. It there forms a double festoon with a prominent median palate spine.

The posterior palatine foramen, about a line long, occupies the narrow triangle between the last molar tooth and the bottom of the palatine notch. Two other foramina, quite small, occupy the vicinity of the lateral suture between the palate plates of the palate and maxillary bones.

The incisive foramina are small, not being quite a line in length. They are situated between the position of the pair of incisors retained on each side.

Forms and connections of the bones of the skull.—The supra-occipital extends a short distance forward on the top of the cranium, and is defined by an anterior produced convex border. The occipito-parietal suture from the top of the cranium curves outward, backward, and downward, turns over the lateral edge of the inion to its posterior surface, and descends to the pars mastoidea of the temporal.

The pars mastoidea contributes a large surface to the lateral depression of the inion, and is interposed between the supra-occipital and parietal above and the ex-occipital and squamosal below.

The supero-lateral margin of the inion is formed in succession by the supra-occipital, parietal, and the squamosal, ending below in the post-auditory process. Between the latter and the sessile occipital condyle a thick but slightly prominent mastoid process and the rudimental paramastoid process are interposed.

The basi-occipital and basi-sphenoid are co-ossified on a line with the posterior surface of the glenoid cavities.

The squamosal is nearly three times the length of its height. The suture formed between it and the parietal proceeds in a nearly horizontal line from the lateral border of the inion to the top of the alisphenoid.

The co-ossified parietals are large, and cover in two-thirds of the top and sides of the cranium. Together they are quadrate in outline, divergent postero-laterally and convergent anteriorly. Their posterior border is concavely notched to join the supra-occipital. In the median line the parietals are ten lines long, laterally thirteen lines.

The fronto-parietal suture forms a transverse, zig-zag semicircle extending between the summits of the alisphenoids, and situated just posterior to the narrowest portion of the cranium.

The frontals remain separated, and measure seven lines along the median suture. The forehead occupies about half their length, and the post-orbital eminences are about their middle laterally. The angular processes are acuminate, and the notch between them is four lines in depth by two and a third wide between their points.

The fronto-maxillary suture curves backward and outward to the lachrymal bone, the facial surface of which is a narrow triangle at the ant-orbital margin.

The premaxillaries are as wide at the sides as they are high, and are not prolonged at their upper extremity beyond the position of the canine teeth.

The malar bone enters entirely into the constitution of the zygoma. About its middle it forms a horizontal suture slanting between it and the end of the zygomatic process. Its anterior extremity is deeply notched at the articulation with the maxillary bone.

Dentition. (Figures 25, 26, plate XXVI.)—As previously mentioned, the teeth in the fossil consist of two incisors, a canine, and seven molars on each side. The first incisor of the left side and the second of the right, together with the third, fifth and sixth molars of the same side, were lost in the recent condition of the animal, the remaining sockets being filled with stone matrix.

The incisors are small, and quite lateral in their position, being nearly in the same line as the other teeth. They are separated from each other and the canine by short intervals, and the anterior pair of the two sides are a line and a quarter apart.

One of the remaining incisors, the second of the left side, has lost its crown. The first incisor of the right side has the crown broken; the portion preserved is compressed from without inwardly, and is worn off to a sharp edge and in a sloping manner internally.

The canine teeth are quite small, but hold the usual position and direction. Their crown is in greater part lost, but the remaining portion indicates that it was laterally compressed and conical. The fang produces comparatively slight prominence of its alveolus on the side of the face.

Substitute a pair of tubercular molars for the sectorial tooth of the Dog, and we would have almost a likeness of the molar series of *Leptictis.*

The first premolar is separated from the canine by an interval of about a line, and an interval of less than half that extent separates it from the second. This and the third are close together, but a small interval separates the latter from the fourth.

The anterior three premolars, of which the third one is represented magnified three diameters, in figure 28^3, plate XXVI, successively increase in size and are inserted by two fangs. Their crown is laterally compressed conical, with the base somewhat extended behind. The third one has its base posteriorly relatively thicker than the others. These teeth have their apex blunted or worn, and they are also worn off posteriorly.

The four posterior molars are close together, and appear to be inserted by a pair of fangs externally and a larger one internally. Their crowns are nearly alike in form, and the anterior three in size, the last one being the smallest. In the specimen the remaining fifth and the sixth molars of one side are mutilated, and the others are blunted from wearing.

The crowns of the four posterior molars, of which the first is represented three times the diameter of nature, in figure 28^4, resemble in shape those of the tubercular molars of the Dog, and in form and constitution the penultimate tubercular molar of the Ichneumon. They are broader transversely than fore and aft, and project externally beyond the line of the premolars in advance, than which they are also shorter. They are trilateral, and are composed externally of a pair of conical tubercles or lobes bounded by a feeble basal ridge, and internally of a broad crescentoid lobe bounded by a strong basal ridge posteriorly and a feeble one anteriorly. Between the inner and outer lobes the surface is concave, and devoid of the pair of intermediate tubercles existing in the tubercular molars of the Dog and the posterior molars of the Opossum.

The species of *Leptictis* is named in honor of Professor F. V. Hayden, who has so zealously explored a great part of the region of the Upper Missouri, and has so efficiently investigated its geology and palæontology.

The measurements of the skull of *Leptictis Haydeni* are as follow:

	Lines.
Estimated length of the skull from the occipital foramen to the fore part of the incisive alveoli,	29
Length of cranium from summit of the inion to the fronto-nasal suture,	18½
Length of skull from lateral border of inion to maxillo-premaxillary suture,	29
Distance from inion laterally to ant-orbital margin,	18½
Height of inion,	8½
Breadth of inion,	13
Breadth at zygomata,	17½
Breadth of cranium above roots of zygomatic processes,	11½
Breadth at narrowest portion of cranium,	7
Breadth at post-orbital eminences,	8
Breadth at ant-orbital margins,	10½
Breadth at infra-orbital foramina,	7
Length of face from ant-orbital margin, estimated,	14
Breadth at alveolar border where greatest, being opposite the ante-penultimate molars,	9
Breadth at canine alveoli,	4½
Length of palate,	15½
Greatest width of do. posteriorly,	4½
Length of the molar series,	11
Length of the series of the back four molars,	5½

ICTOPS.

Ictops Dakotensis.

Accompanying the skull of *Leptictis*, described in the preceding chapter, in Dr. Hayden's last collection from the Mauvaises Terres, there is a fragment of a skull, which on first view I supposed to belong to the same animal, but which on more attentive examination proved to be part of another animal. The specimen, somewhat mutilated and distorted, is represented in figure 30, plate XXVI. It retains portions of the frontals, nasals, and maxillaries, and further contains the remains of most of the molar teeth of both sides.

The fragment nearly agrees in form and size with the corresponding portion of the skull of *Leptictis Haydeni*. Upon the sides of the forehead there are prominences appearing like the anterior terminations of the temporal ridges of the latter, leading to the supposition that these also existed in this animal. The anterior termination of the frontals and the form of the nasals likewise resemble the corresponding parts in *Leptictis*.

The remains of the molar teeth in the specimen alone serve to distinguish this fossil from *Leptictis.* They also apparently indicate the insectivorous nature of the animal. The portions of teeth remaining are those of the back six molars on one side and five on the other, except the last one.

The second premolar is two-fanged as in *Leptictis*, and its crown, which is lost, appears to have had the same form as in the latter.

The third premolar in *Leptictis* has the same form and construction as that in advance, but in *Ictops*, the name by which we designate the genus to which we have referred the fossil under examination, it is very different. In this it is inserted by three fangs, two external and one internal. The crown, as represented in the magnified view, figure 29[3], is trihedral, and about as wide transversely as antero-posteriorly. It is composed of three principal lobes, two external, the third internal. The outer pair of lobes are laterally compressed conical and connate, with perhaps the exception of the apices, which are broken away in the specimen. In front of the base of the anterior lobe there projects a small pointed tubercle. The inner lobe is a trihedral pyramid nearly median in position in its relation with the outer pair, which it conjoins at base. The outer surface is concave, and separated from the inner ones by acute ridges diverging from the pointed summit. A narrow basal ridge bounds the internal lobe posteriorly.

The four back molars of *Ictops* have the same relative position and size as regards one another as in *Leptictis.* They, however, do not project abruptly beyond the premolars externally as in the latter, as noticed by comparing the relative position of the molars and third premolar of the two animals in figures 28 and 29.

In the first and best preserved of the four back molars of *Ictops*, figure 29[4], the outer part of the crown is constructed like that in the premolar in advance, but is slightly more robust, though not quite so wide fore and aft. The pointed tubercle in front is also rather larger, and a more marked basal ridge exists behind. The inner part of the crown is formed of a three-sided pyramidal lobe, proportionately much larger than that of the tooth in advance. The acute borders of this lobe near the middle of their course project into a pair of cusps, which appear as the summits of rudimental lobes springing from the former. Posteriorly the internal lobe of the crown is bounded by a low accessory lobe, which corresponds with the narrow basal ridge in the tooth in advance. A feeble basal ridge also exists at the fore part of the internal lobe of the crown.

The succeeding tooth, represented in figure 29[5], appears to have had nearly the same form as the one just described, but the basal ridge in front of the internal lobe is much better developed.

The remaining inner part of the crowns of the last two molars apparently indicate these teeth to have had the same character as the one just described.

The first two teeth noticed, representing in the series the third and fourth premolars, are unworn. In the first of the true molar series the summit and posterior acute border of the principal internal lobe are worn so as to exhibit an exposed tract of dentine, which is also exposed upon the anterior rudimental lobe of its anterior acute border.

The space occupied by the back six molars of *Ictops* is ten lines, being a little more than in *Leptictis*. The measurements of the teeth are as follow :

	Lines.
Antero-posterior diameter of third molar,	$2\frac{1}{5}$
Transverse " "	$1\frac{4}{5}$
Antero-posterior diameter of fourth molar,	2
Transverse " "	$2\frac{1}{4}$
Antero-posterior diameter of fifth molar (estimated,	2
Transverse " " "	$2\frac{1}{2}$
Antero-posterior diameter of sixth molar (estimated),	$1\frac{3}{4}$
Transverse " " "	$2\frac{1}{4}$
Antero-posterior diameter of seventh molar (estimated),	$1\frac{1}{2}$
Transverse " " "	$1\frac{3}{4}$

Concluding Remarks.

In a retrospect of the tertiary faunæ of Dakota and Nebraska, exemplified by the fossil remains described in the preceding pages, amid the rich evidences of mammalian life one cannot but be struck with the extreme deficiency in other forms. With the exception of one or two species of turtles, and a single terrestrial mollusk, no representative of any other Class or Order has been discovered in immediate association with the extinct mammals.

The geological constitution of the localities concerned make it appear that the formations in which the mammalian fossils occur are the deposits of ancient lakes, or of the estuaries of streams communicating with the latter. In this view of the formations we are led to inquire why they exhibit no traces of fishes or aquatic mollusca mingled with the multitude of relics of terrestrial mammals. Even remains of the latter of decided aquatic habit are absent. With the exception of the marsh-loving Rhinoceros and the Beaver, no amphibious mammals have been discovered, not even the Hippopotamus, whose remains are frequent in cotemporaneous formations of Europe and Asia.

The constitution of the skeletons of most fresh-water fishes, though comparatively unfavorable to their preservation as fossils, can hardly be admitted as a sufficient reason for the total absence of their remains in the formations in question. The conditions during which the formations of the Mauvaises Terres were deposited would appear to have been especially favorable for the preservation of the most delicate structures. The mammalian fossils, in the perfect preservation of their original sharpness of outline without the slightest trace of erosion, and the character of their containing matrix, indicate quiet water with a soft muddy bottom. The chemical constitution, too, of the matrix and fossils, indicate a petrifying quality in the mud and water favorable to the preservation of any animal skeleton.

The absence of remains of fishes and aquatic mollusks in association with the mammalian fossils, both in the Niobrara and Nebraska formations, may be accounted for by supposing that the lakes in which were formed the deposits containing the fossils may have been periodically subjected to admissions of salt water from the ocean, thus inducing a condition unfavorable to life in the lake waters.

The turtle shells mingled in profusion with the mammalian fossils, though exhibiting in some respects the constitution of land turtles, in others partake of the character of the emydeans, so as to suggest the probability of amphibious habits.

It is remarkable that among the multitude of remains of mammals and turtles, there are none of Crocodiles. Where were these creatures, when the shores of the ancient Dakotean and Nebraskan waters teemed with such an abundant provision of savory ruminating hogs?

The tertiary mammals of Dakota and Nebraska, the subjects of consideration in the preceding pages, are not remarkable for large size, compared with those of later periods including the existing one. Indeed, the White River miocene fauna is rather remarkable for the reverse character, most of the animals having been of comparatively small size. Among the carnivora there was a single large one, the *Hyænodon horridus*, which was about equal to a full-grown Black Bear. The feline animals were small. Among the vegetable feeders there was only one animal of comparatively large size, the *Titanotherium Prouti*, which approached in bulk the living Elephants. In the pliocene fauna of the Niobrara there were a greater number of large animals than in the former. Besides a Horse as large as the domestic species, it contained a Rhinoceros about the size of the living Indian species; a large ruminant, *Megalomeryx;* a Mastodon; and an Elephant, as large as any elsewhere discovered. The other remains generally indicate animals of small size compared with later congeneric species, both extinct and recent.

An interesting fact, which, however, might have been anticipated in view of the theory of the origin of species through successional development, is the nearer approach to uniformity in the general physiognomy of the animals of the various orders of both of the extinct faunæ which have been the subjects of consideration, than in animals of corresponding relationships in later faunæ. In the general form of the skull, especially in the shape and construction of the cranium, with temporal fossæ separated alone by a sagittal crest, in the absence of horns or horn-like appendages, and in the number, kind, and arrangement of the teeth, the tertiary mammals of Nebraska and Dakota exhibit a decidedly nearer relationship with one another than the mammals of corresponding or allied families of later epochs.

The White and Niobrara River faunæ are clearly consecutive, the former being older than the latter. In view of the apparent relationship of the animals, I have considered the faunæ to be successively of miocene and pliocene age, though it has not been positively ascertained that they were actually cotemporaneous with these epochs, as recognized elsewhere.

The better known miocene and pliocene formations of other localities in North America are almost entirely marine in character, and, though rich in the evidences of animal life, have yielded but few remains of terrestrial mammals, so that we are unable to make comparisons between their faunæ and those above mentioned.

The following table exhibits comparative lists of the terrestrial mammalian faunæ of the miocene, pliocene, and quaternary periods of North America. The mammals of the two former periods are almost all represented by the remains from Dakota and Nebraska, which form the main material of the preceding pages. Representatives from other localities are specially noted. In the list of quaternary mammals some are named which are still living, but remains of them, found in association with those of extinct species, render it probable that they were also cotemporaneous.

Miocene.	Pliocene.	Quaternary.
	CARNIVORA.	
Canidæ.	*Canidæ.*	*Canidæ.*
Amphicyon vetus.	Canis sævus.	Canis occidentalis.
" gracilis.	" temerarius.	" latrans.
	" vafer.	" virginianus.
	" Haydeni.	" primævus.
Hyænodontidæ.		
Hyænodon horridus.		
" cruentus.		
" crucians.		
Felidæ.	*Felidæ.*	*Felidæ.*
Drepanodon primævus.	Pseudælurus intrepidus.	Felis atrox.
" occidentalis.	Ælurodon ferox.	" fatalis.
Dinictis felina.		
	Ursidæ.	*Ursidæ.*
	Leptarctus primus.	Procyon lotor.
		" priscus.
		Ursus americanus.
		" amplidens.
		Arctodon pristinus.
		Mustelidæ.
		Galera macrodon.
	RUMINANTIA.	
Oreodontidæ.	*Oreodontidæ.*	
Oreodon Culbertsoni.	Merychyus elegans.	
" gracilis.	" medius.	
" major.	" major.	
" affinis.		
" hybridus.		
" bullatus.		
Merycochœrus proprius.		
Leptauchenia major.		
" decora.		
" nitida.		
Agriochœridæ.		
Agriochœrus antiquus.		
" major.		
" latifrons.		
Camelidæ.	*Camelidæ.*	*Camelidæ.*
Pœbrotherium Wilsoni.	Procamelus robustus.	Camelops kansanus.
Protomeryx Halli.	" occidentalis.	
	" gracilis.	
	Homocamelus caninus.	
	Megalomeryx niobrarensis.	
	Merycodus necatus.	

Miocene.	Pliocene.	Quaternary.
	RUMINANTIA.	
Moschidæ.		
Leptomeryx Evansi.		
	Cervidæ.	*Cervidæ.*
	Cervus Warreni.	Cervus virginianus.
		" canadensis.
		" tarandus.
		" americanus.
	Antilopidæ.	
	Cosoryx furcatus.	
		Capridæ.
		Ovis mammilaris.
		Ovibus moschatus.
		" bombifrons.
		" cavifrons.
		Bovidæ.
		Bison americanus.
		" latifrons.
		" antiquus.
		" priscus.
	ARTIODACTYLA.	
Suidæ.	*Suidæ.*	*Suidæ.*
Elotherium Mortoni.	Dicotyles.	Dicotyles.
" ingens.		" nasutus.
" superbum, California.		Platygonus compressus.
" Leidyanum, N. Jersey.		
Perchœrus probus.		
Leptochœrus spectabilis.		
Nanohyus porcinus.		
Anthracotheridæ.		
Hyopotamus americanus.		
Anoplotheridæ.		
Titanotherium Prouti.		
	PERISSODACTYLA.	
Rhinocerotidæ.	*Rhinocerotidæ.*	
Rhinoceros occidentalis.	Rhinoceros crassus.	
" meridianus, Texas.		
" hesperius, California.		
Hyracodon nebrascensis.		
Tapiridæ.		*Tapiridæ.*
Lophiodon occidentalis.		Tapirus americanus.
		" Haysii.
	Proboscideæ.	*Proboscideæ.*
	Mastodon mirificus.	Mastodon americanus.
	Elephas imperator.	" ———
		" ———
		Elephas americanus.
		" primigenius.

Miocene.	Pliocene.	Quaternary.
	SOLIDUNGULA.	
Anchitheridæ.		
Anchitherium Bairdi.		
Anchippus texanus, Texas.		
Hypohippus affinis.		
Parahippus cognatus.		
Anchippodus riparius, New Jersey.		
	Equidæ.	*Equidæ.*
	Hipparion occidentale.	Hipparion venustum.
	" speciosum.	Equus major.
	" affine.	" fraternus.
	" gratum.	" pacificus.
	Protohippus perditus.	" conversidens.
	" placidus.	" tau.
	" supremus.	" fossilis.
	Merychippus insignis.	
	" mirabilis.	
	Equus excelsus.	
	RODENTIA.	
Leporidæ.		*Leporidæ.*
Palæolagus Haydeni.		Lepus sylvaticus.
Sciuridæ,		*Sciuridæ.*
Ischyromys typus.		Arctomys monax.
		Sciurus.
Castoridæ.	*Castoridæ.*	*Castoridæ.*
Palæocastor nebrascensis.	Castor tortus.	Castor canadensis.
		Castoroides ohioensis.
	Hystricidæ.	
	Hystrix venustus.	
		Cavidæ.
		Hydrochœrus Æsopi.
		Chinchillidæ.
		Amblyrhiza inundata.
Muridæ.		*Muridæ.*
Eumys elegans.		Neotoma magister.
	INSECTIVORA.	
Erinacidæ.		
Leptictis Haydeni.		
Ictops dakotensis.		
? Omomys Carteri, Wyoming.		
		Fam. ?
		Anomodon Snyderi.
	MARSUPIALIA.	
		Didelphis virginiana.
	EDENTATA.	
		Gravigrada.
		Megatherium mirabile.
		Megalonyx Jeffersoni.
		" dissimilis.
		" validus.
		Megalocnus rodens.
		Ereptodon priscus.
		Mylodon Harlani.

In comparing the two lists representing the North American tertiary mammals, mainly from the States of Dakota and Nebraska, with the third list representing the quaternary mammals of the same continent, a remarkable dissimilarity is observed, and there is also noticed a greater resemblance of the former with the tertiary and quaternary mammals of the old world.

Of thirty-two genera of miocene terrestrial mammals, chiefly from the Mauvaises Terres of Dakota, not one occurs in the quaternary formations of North America; and of twenty-one genera of pliocene terrestrial mammals, chiefly from the Niobrara River of Nebraska, only eight are common to the quaternary formations of North America, and of these eight, three are absent in the existing fauna of the continent.

The eight genera alluded to as common to the pliocene tertiary and the quaternary formations are *Canis*, *Cervus*, *Dicotyles*, *Mastodon*, *Elephas*, *Equus*, *Hipparion*, and *Castor*.

It is uncertain how far the species of *Canis* attributed to the Niobrara pliocene formation are peculiar to it. Part of the fossils may be quaternary, or perhaps even recent remains. Of *Cervus*, part of the specimens referred to it may be of a recent species, while the antler viewed as pertaining to the same may represent a peculiar genus subsequently extinguished. The only remains indicative of *Dicotyles* was an upper canine tooth, which may really have belonged to a quaternary or perhaps a recent species. The remains of the pliocene *Mastodon* pertain to the subgenus *Tetralophodon*, while those of the quaternary period belong to the subgenus *Trilophodon*. The remains of *Elephas* probably indicate a species distinct from the quaternary *E. americanus*, though it is not positively ascertained. The remains of *Equus* appear to be different from those of the later *E. fraternus*. The genus *Hipparion* is clearly common to both the pliocene and quaternary periods, but the species are different. *Protohippus*, one of the solipedal genera of the Niobrara pliocene, appears also to have existed during the quaternary period in Chili, S. A. A small species of *Castor*, of the Niobrara pliocene, is represented by the larger quaternary and still existing Beaver.

The quaternary fauna of both American continents was especially distinguished by the presence of those wonderful creatures, the giant Sloths, no trace of which has been detected in the tertiary formations of North America. This appears the more remarkable from the circumstance that remains of several edentate genera have been discovered in the miocene formations of Europe.

The presence, in the quaternary fauna of North America, of the great Sloths, together with other ordinal and generic forms, which likewise existed, and in part still continue to exist, in South America, leads to the impression that the North American continent during the quaternary period was peopled by the extension of life from the south. The greater similitude of the miocene and pliocene faunæ, which we have investigated in the present work, with the cotemporaneous faunæ of the old world, suggests the probability that the North American continent was peopled during the tertiary period from the west. Perhaps this latter extension occurred from a continent, whose area now forms the bottom of the great Pacific Ocean, and whose tertiary fauna is now represented east and west by the fossil remains of tertiary age in America on the one hand, and Asia, with its peninsula Europe, on the other.

In comparing the miocene and pliocene faunæ with each other, as represented mainly by the remains from the Mauvaises Terres and the Niobrara River, we observe the remarkable fact that in upwards of fifty genera belonging to the two faunæ together, scarcely a genus is common to both. In view of the consecutive order and close approximation in position of the two formations and faunæ, such an exclusiveness would hardly have been suspected. The circumstance may in some measure appear exaggerated, from the fact that certain genera which I have considered as distinct would by other naturalists be viewed as the same. Thus, for instance, the pliocene *Merychyus* may be regarded as identical generically with the miocene *Oreodon*, but after all these are the only ones which could be looked upon as the same, unless perhaps *Rhinoceros* is included. In this case, however, the miocene *Rhinoceros occidentalis* appears to have been an *Aceratherium*, while that of the pliocene formation was probably a true or horned *Rhinoceros*.

Of all other known faunæ, extinct and recent, those of Dakota and Nebraska under consideration appear to approximate most in their relationship with the tertiary faunæ of Europe.

Of the carnivora of the former localities, comprising eight genera and fifteen species, five of the genera, or more than one-half, are found in the European tertiaries, as, for instance, *Canis*, *Amphicyon*, *Hyænodon*, *Pseudælurus*, and *Drepanodon*. The feline *Dinictis* of the Dakota miocene has not elsewhere been discovered. The remaining two carnivorous genera are too imperfectly known for comparison.

It is truly wonderful that of the numerous ruminantia, comprising fourteen genera and nearly double that number of species, none excepting the genus *Cervus* belongs to any other known fauna, extinct or recent. Even in the case of the excepted genus, it is probable that part of the remains attributed to it may belong to a peculiar subgenus, while others may be of a recent species.

When we compare the family relationships of the North American tertiary and quaternary ruminants, we find remarkable differences. A peculiar family, the *Oreodontidæ*, is represented both in the miocene and pliocene; in the former by three genera and many species, in the latter by a single genus. This family has nowhere else been discovered, neither in the American quaternary, nor the foreign tertiary equivalents.

Another family, the *Agriochœridæ*, nearly allied to the former, is peculiar to the miocene of the Mauvaises Terres.

The *Camelidæ* are represented in the North American miocene, pliocene, and quaternary deposits, but particularly in the miocene, and they are yet represented in the existing fauna of South America.

The *Moschidæ* are represented by the genus *Leptomeryx* in the Dakota miocene, but not in the later formations of North America.

The *Cervidæ* are represented in the pliocene and succeeding epochs of North America.

The *Antilopidæ* are represented by a genus in the Niobrara pliocene.

The *Capridæ* and *Bovidæ* are not represented in North America prior to the quaternary period.

Of *Artiodactyla*, exclusive of the *Ruminantia*, the remains of seven species of six genera belong to the Dakota miocene, of which two genera, *Elotherium* and *Hyopotamus*, are common to the European tertiary. The remaining genera, in part but imperfectly known, appear to be peculiar. The Niobrara pliocene presents us with traces of a Peccary, but this probably may belong to a later period.

One of the artiodactyle genera of the Dakota miocene, the huge *Titanotherium*, was represented by the nearly allied *Chalicotherium* of the European and Himmalayan miocene period.

Of uneven-toed pachyderms, or *Perissodactyla*, the Dakota miocene presents an *Aceratherium*, a peculiar genus of the same family, the *Hyracodon*, and a species of *Lophiodon*. The former and latter are both European tertiary forms. Another member of the Rhinoceros family, *R. hesperius* as it has been named, from California, was probably an *Aceratherium* of miocene age. *R. meridianus*, of Texas, was probably likewise of the same category as the latter.

The Niobrara pliocene presents us with three genera—Rhinoceros, Mastodon and Elephant. The former, apparently a true Rhinoceros, has not been found in the American quaternary formations, though abundant in the European equivalent, and continuing to exist in Asia and Africa. The Mastodon belonged to the subgenus *Tetralophodon*, while that of the quaternary period was a *Trilophodon*. Elephants of other species were nearly cosmopolite during the quaternary period; but two species now alone live in Asia and Africa.

Five genera of solipeds appear to have lived in North America during the miocene period. Three of them are peculiar, and appear not to have been discovered elsewhere. They have been named *Anchippus*, from Texas, *Hypohippus*, from the Niobrara River, and *Anchippodus*, from New Jersey. The remaining genus, *Anchitherium*, characterized by an abundance of remains from the Mauvaises Terres, belongs also to the European miocene.

The pliocene formation of the Niobrara is remarkable for the abundance of its equine remains, which have been referred to five genera, of which *Merychippus* and *Parahippus* are peculiar, and *Protohippus* has been discovered elsewhere only in South America. The remaining genera, *Hipparion* and *Equus*, belong also to the North American quaternary and likewise to the European tertiary and quaternary formations.

The miocene rodents of the Mauvaises Terres belong to four peculiar genera, of as many still existing families. One of the genera, however, *Palæocastor*, may be identical with the European *Steneofiber*, or *Chalicomys*, of cotemporaneous age.

The pliocene rodents of the Niobrara appear to belong to the still existing genera, *Castor* and *Hystrix*, but the latter now exists only in the old world.

Of the few discovered quaternary rodents of North America, one genus, *Hydrochœrus*, now absent on this continent, still lives in South America.

The miocene *Insectivora* of North America belong to three genera, not discovered elsewhere.

SYNOPSIS

OF

EXTINCT MAMMALIA OF NORTH AMERICA.

The present synopsis includes the synonymy and references to the principal authorities, but in many cases does not refer to copied notices. Though mainly a Synopsis of Extinct Mammalia, as expressed in the title, it also includes notices of certain mammals still in existence, but whose remains have been found in association with those of extinct species.

PRIMATES.

BIMANA.

HOMO.

Fossil human skeleton from Guadaloupe, Konig: Philos. Trans. Roy. Soc. London, 1814, 107, Pl. III. Cuvier: Ossem. Fos. 3d Ed. I, 1825, 66; 4th Ed. I, 1834, 213. *A second skeleton from the same formation,* Cuvier: Os. Fos. 3d Ed. I, 1825, 67, Pl. I; 4th Ed. I, 1834, 215, Pl. I. *Portions of the former skeleton,* Moultrie and Shepard: Am. Jour. Sc. XXXII, 1837, 361.

Evidences of the cotemporaneous existence of Man with Mastodon, in Missouri, Koch: in Philadelphia Presbyterian, Jan. 12, 1839, copied into Am. Jour. Sc. XXXVI, 1839, 199; Mantell's Fossils of the British Museum, 1851, 473; Trans. Ac. Sci. of St. Louis, I, 1856–60, 61.

Os innominatum of a Man from a stratum of blue clay, below the skeleton of the Megalonyx, etc., from the vicinity of Natchez, Mississippi, Dickeson: Proc. Ac. Nat. Sc. Phil. 1846, 107.

Skeleton of a Man in an excavation at New Orleans, La., Dowler: Tableaux of New Orleans, 1852; quoted by Usher in Nott and Gliddon's Types of Mankind, 1854, 338.

Jaws, with teeth, and portions of a foot of Man in a conglomerate of rotten coral-reef limestone and shells in a bluff upon the shores of Lake Monroe, Florida, Agassiz: Mobile Daily Tribune, April 14, 1853; quoted by Usher in Nott and Gliddon's Types of Mankind, 1854, 352.

Evidences of the existence of Man with Mastodon, etc., in the post-pliocene formation in the vicinity of Charleston, S. C., Holmes: Proc. Ac. Nat. Sc. 1859, 179; Ibidem 1867, 125.

Remains of Man found with those of Mastodon and Elephant in California, Whitney: Am. Jour. Sci. XXXVIII, 1864, 264. *Ancient human skull in California,* Ibidem XLII, 1866, 424; XLIII, 1867, 265.

Remains of Man in a guano deposit in Orchilla, W. I., Leidy: Proc. Ac. Nat. Sc. 1865, 181.

Evidences of cotemporaneousness of Man and Elephant at Petit Anse, Louisiana, Leidy and Clew: Proc. Ac. Nat. Sc., 1866, 109.

Human skeleton found in gravel in Kansas, Berthoud: Proc. Ac. Nat. Sc. 1866, 342.

Recent observations appear to have proved that the genus *Homo* existed in Europe not only prior to the historic period, but even extended to the tertiary epoch, cotemporaneously with many extinct animals of the quaternary period. It is, however, questionable how far we can say the same of Man in America, though we are quite prepared to admit the evidence of undoubted facts bearing on the subject. There are many notices on record of the discovery of the remains of Man upon this continent, both of bones and rude works of art, which are supposed to antedate the period usually assigned for the appearance of the animal, but none are clear of doubt. None of the accounts are sufficiently clear to bring conviction that Man was cotemporaneous with any of the well-known extinct animals of the preglacial, or even of the postglacial period distinguished from the present one. Even the traditions, which are reported to have prevailed among certain of our Indian tribes, referring to the coexistence of Man and Mastodon, want weight. For, admitting that there were such traditions, these in general too often bear upon their face the appearance of having been invented, perhaps in many cases insensibly, and by gradual accession, to explain notions or conceptions of extraordinary facts and phenomena. Thus most probably originated the tradition, so commonly believed, of the former existence of giants, from the frequent discovery of the huge bones of the Mammoth and Mastodon, almost everywhere strewn over the earth.

One of the apparently most authentic instances of the cotemporaneous association of human remains, with those of extinct animals in North America, is that of a human innominate bone reported to have been discovered with bones of *Megalonyx, Mylodon,* etc., near Natchez, Mississippi. The specimen, with its reputed associates, are preserved in the Museum of our Academy, and all present the same appearance of preservation and color. They are not petrified, but have preserved their original consistence and composition with little change, other than being stained chocolate-brown from ferruginous infiltration.

The human bone consists of about half an ilium, together with the back part of the ischium to where its tuber begins to turn forward. The ilium is broken at its border, except at the ischiatic notch and about an inch and a half of the crest where this is thickest anteriorly. The bone is mature, and exhibits no trace of epiphysial separation, as has been stated. Placed in correspondence with an ilium of recent Man it presents no distinctive character. The specimen may have been cotemporary with the remains of extinct animals, with which it is said to have been found, though it appears to me equally if not more probable that it may have fallen into the formation, from an Indian grave above, at a comparatively recent date, and became stained like the true fossils, from ferruginous infiltration.

Prof. Whitney has lately given notice of the discovery of human remains with those of extinct animals in California, but the notices are too brief to allow judgment to be passed on the facts.

Homo, or Man, is the only known genus of its family which has been recognized or discovered. Consisting of a number of existing races and their varieties, as they are usually distinguished, (or of species and their varieties, as they would appear to be, parallel with many of the accepted species of other genera,) they probably originated not the one from the other, but probably all originated or diverged from a common primæval form, which yet remains to be discovered. Whether this will be recognized as a distinct species of the same genus, or of another and closely allied genus, we leave the future to tell. Up to the present time, in no part of the world have remains been discovered which can be positively referred to an extinct species of *Homo;* and in this continent, to the present time, no remains of Man have been discovered which, with positive assurance, we can say were cotemporaneous with any of the undoubted extinct species of other mammals.

No remains of extinct quadrumanous animals, belonging to another branch of the primate order, have been discovered in North America.

We may also add that no fossil remains of Bats, or of the order of *Cheiroptera,* have been found on this continent.

CARNIVORA.

FELIDÆ.

FELIS.

Felis atrox.

Leidy: Proc. Amer. Phil. Soc, 1852, V, 261; Trans. do. 1852, X, 322, Pl. 34; Waile's Rep. Agric. and Geol. Mississippi, 1854, 286.

An extinct species, as large as the Lion, indicated by the ramus of a lower jaw, containing the canine and molar teeth, found in association with remains of *Mastodon americanus,* etc., near Natchez, Mississippi. Quaternary.

TRUCIFELIS.

Trucifelis fatalis.

See Plate XXVIII, Figs. 10, 11.

Felis (Trucifelis) fatalis, Leidy: Proc. Ac. Nat. Sc. 1868, 175.

An extinct feline animal, approaching in size the Lion or Bengal Tiger, which I have distinguished by this name, is indicated by the specimen represented in figures 10, 11, plate XXVIII. It consists of a small fragment of the upper maxilla, containing the sectorial tooth and the socket for the succeeding small tubercular tooth.

The specimen, together with teeth of Horses, the tooth of a large Sloth, a number of Turtle.bones and a small fragment of a Mastodon tooth, have been submitted to my inspection by the New York Lyceum of Natural History, through the kind office of Messrs. D. G. Elliott and Geo. N. Lawrence. They are all more or less black or brown, and most of them are thoroughly imbued with soft bitumen or petroleum, having been obtained from a petroleum bed in Hardin County, Texas.

The sectorial molar resembles that of the ordinary feline animals, but in general its crown is considerably longer in proportion with its breadth and thickness.

The breadth of the crown is a little less than in the Lion and Tiger, but the principal cusp and the anterior lobe are longer, while the posterior lobe, though not deeper or longer at its fore-part, is of more uniform depth. The proportionate thickness is nearly the same as in the Lion or Tiger. The anterior lobe of the crown differs from that of other Cats, not only in its proportionately greater length, but in its distinct division into two sublobes, of which the anterior one extends more than half the depth of the other. In feline animals generally there is an apparent tendency to the production of a sublobe at the base of the anterior lobe of the crown, especially in the Tiger, but in them it is a production of the basal ridge, which is not the case in the fossil tooth under inspection. In the division of the front lobe of the crown, the fossil tooth exhibits more likeness to the corresponding temporary tooth of the Lion or Tiger than to that of their permanent series, thus indicating a more primitive character in the animal to which it belonged. The buttress at the fore-third of the crown internally is rounded at base, without forming a conspicuous tubercle as in the Cats.

From the approximation in size of the upper sectorial molar to that of the lower sectorial molar of *Felis atrox*, I at first suspected it to belong to the same animal, but when we consider the facts that the tooth just mentioned of *F. atrox* agrees in its form and proportions with that of the ordinary Cats, while the former tooth differs so much, it is rendered improbable that it should belong to the same.

In comparison with the upper sectorial molars of *Drepanodon* or *Machairodus*, that of our fossil differs as much from them as from those of other known Cats.

The fragment of maxilla in the fossil indicates a depth below the infra-orbital foramen about as great as in the Lion.

The socket for the the tubercular molar holds about the same relative position as in ordinary Cats, and indicates a tooth about as large as that of the Lion.

The fossa of the palate, in advance of the alveolus just mentioned, is about as deep as in the Tiger.

The measurements of the specimen, in comparison with those of the Lion and Tiger, are as follow:

		Lion.	Tiger.
	Lines.	Lines.	Lines.
Depth from infra-orbital foramen to base of crown of sectorial molar,	15	14	14
Breadth of crown of sectorial molar, ...	15¾	16	16½
Thickness at the position of the inner buttress, . . .	7½	8¼	7½
Thickness of the crown at the posterior lobe, . . .	4½	5¾	4½
Depth of principal cusp, ...	9	7¾	7¾
Depth of anterior lobe, ...	7	6	6¼
Depth of posterior lobe at fore-part, ...	6½	6½	6
Depth of posterior lobe at back part, ...	5	4½	4½

PSEUDÆLURUS.

Pseudælurus intrepidus.

See page 52, Pl. I, Fig. 8.

Felis (Pseudælurus) intrepidus, Leidy: Proc. Ac. Nat. Sc. 1858, 22.

Sands of the Niobrara River, Nebraska. Pliocene.

ÆLURODON.

Ælurodon ferox.

See page 68, Pl. I, Figs. 13, 14.

Leidy: Proc. Ac. Nat. Sc. 1858, 22.

Sands of the Niobrara River, Nebraska. Pliocene.

DREPANODON.

Drepanodon primævus.

See page 54, Pl. IV.

Machairodus primævus, Leidy and Owen: Proc. Ac. Nat. Sc. 1851, 329; 1853, 392; 1857, 90; Owen's Rep. Geol. Surv. Wisc. &c. 1852, 564; Anc. Fauna Neb. 1853, 95.

Drepanodon primævus, Leidy: Proc. Ac. Nat. Sc. 1857, 176.

Mauvaises Terres of White River, Dakota. Miocene.

Drepanodon occidentalis.

See page 63, Pl. V, Fig. 5.

Drepanodon or *Machairodus occidentalis*, Leidy: Proc. Ac. Nat. Sc. 1866, 345.

Mauvaises Terres of White River, Dakota. Miocene.

DINICTIS.

Dinictis felina.

See page 64, pl. V, Figs. 1–4.

Leidy: Proc. Ac. Nat. Sc. 1854, 127; 1856, 91; 1857, 90.

Mauvaises Terres of White River, Dakota. Miocene.

CANIDÆ.

CANIS.

Canis indianensis.

Canis primævus,* Leidy: Proc. Ac. Nat. Sc. 1854, 200; Jour. Ac. Nat. Sc. 1856, III, 167, Pl. XVII, Figs. 11, 12.

An upper maxillary bone with teeth, found in association with remains of *Megalonyx*, etc., in the banks of the Ohio River, near Evansville, Indiana. Quaternary.

Canis sævus.

See page 28, Pl. I, Fig. 9.

Leidy: Proc. Ac. Nat. Sc. 1858, 21.

Sands of the Niobrara River, Nebraska. Pliocene.

Canis temerarius.

See page 29, Pl. I, Fig. 12.

Leidy: Proc. Ac. Nat. Sc. 1858, 21.

Sands of the Niobrara River, Nebraska. Pliocene.

Canis vafer.

See page 29, Pl. I, Fig. 11.

Leidy: Proc. Ac. Nat. Sc. 1858, 21.

Sands of the Niobrara River, Nebraska. Pliocene.

Canis Haydeni.

See page 30, Pl. I, Fig. 10.

Canis (*Epicyon*) *Haydeni*, Leidy: Proc. Ac. Nat. Sc. 1858, 21.

Sands of the Niobrara River, Nebraska. Pliocene.

Canis virginianus.

An upper canine tooth, referrable to this species, was found in association with remains of *Dicotyles*, etc., in the crevices of the lead-bearing rocks near Galena, Illinois. Quaternary and recent.

Canis occidentalis.

Wyman: Hall and Whitney's Rep. Geol. Surv. Wisconsin, and Whitney's do. Upper Mississippi Lead Region, 1862, 422, 423. Leidy: Proc. Ac. Nat. Sc. 1868, 176.

Quaternary and recent.

* This name I find was previously employed for the Wild Dog of Nepal. Hodgson: Proc. Zool. Soc. Lond. 1833, 111.

Canis latrans.

Wyman: Hall and Whitney's Rep. Geol. Surv. Wisconsin, and Whitney's do. Upper Mississippi Lead Region, 1862, 422, 423.

Quaternary and recent.

AMPHICYON.

Amphicyon vetus.

See page 32, Pl. I, Figs. 1–6.

Daphœnus vetus, Proc. Ac. Nat. Sc. 1853, 393.

Amphicyon vetus, Leidy: Proc. Ac. Nat. Sc. 1854, 157; 1857, 90.

Mauvaises Terres of White River, Dakota. Miocene.

Amphicyon gracilis.

See page 36, Pl. I, Fig. 7, Pl. V, Figs. 6–9.

Leidy: Proc. Ac. Nat. Sc. 1856, 90; 1857, 90.

Mauvaises Terres of White River, Dakota. Miocene.

HYÆNODONTIDÆ.

HYÆNODON.

Hyænodon horridus.

See page 39, Pl. III.

Leidy: Proc. Ac. Nat. Sc. 1853, 392; 1857, 90.

Mauvaises Terres of White River, Dakota. Miocene.

Hyænodon cruentus.

See page 47, Pl. V, Figs. 10, 11.

Leidy: Proc. Ac. Nat. Sc. 1853, 393.

Mauvaises Terres of White River, Dakota. Miocene.

Hyænodon crucians.

See page 48, Pl. II.

Leidy: Proc. Ac. Nat. Sc. 1853, 93.

Mauvaises Terres of White River, Dakota. Miocene.

MUSTELIDÆ.

GALERA.

Galera macrodon.

Cope: Proc. Ac. Nat. Sc. 1867, 138, 155.

Founded upon a portion of a lower jaw with teeth, probably from a post-pliocene formation of Charles County, Md.

URSIDÆ.

URSUS.

Ursus americanus.

Harlan: Jour. Ac. Nat. Sc. VI, 1830, 269; Med. Phys. Res. 1835, 329. Pictet: Traité de Paléont. 1853, I, 189. Leidy: Proc. Ac. Nat. Sc. 1859, 111.

Ursus, Leidy: Proc. Ac. Nat. Sc. 1853, 303.
Ursus americanus fossilis, Leidy: Waile's Rep. Agric. and Geol. Missisippi, 1854, 286; Jour. Ac. Nat. Sc. III, 1856, 169.

Found with remains of *Megalonyx*, etc. Quaternary.

Ursus amplidens.

Leidy: Proc. Ac. Nat. Sc. 1853, 303; Waile's Rep. &c. Mississippi, 1854, 286; Jour. Ac. Nat. Sc. 1856, III, 168, Pl. XVII, 13–16. Cope: Proc. Ac. Nat. Sc. 1869, 3.

Founded on the fragment of a lower jaw with the last molar tooth, from near Natchez, Mississippi. Prof. Cope has recently discovered remains of this species in a bone breccia, mingled with remains of the Tapir, Horse, Peccary, etc., in Wythe County, Virginia. Post-pliocene.

ARCTODUS.

Arctodus pristinus.

Leidy: Proc. Ac. Nat. Sc. 1854, 90; Holmes' Post-pliocene Fossils of South Carolina, 1860, 115, Pl. XXIII, figs. 3, 4.

Indicated by the crown of a molar tooth of peculiar character, but most nearly resembling the penultimate lower molar of the Black Bear. It was found in the post-pliocene formation of the Ashley River, near Charleston, South Carolina.

LEPTARCTUS.

Leptarctus primus.

See page 70, Pl. I, Figs. 15, 16.

Leidy: Proc. Ac. Nat. Sc. 1856, 311; 1857, 90.

From Bijou Hill, below the mouth of White River. Pliocene.

PROCYON.

Procyon lotor.

Leidy: Holmes' Post-pliocene Fossils of South Carolina, 1860, 115, Pl. XXIII, Fig. 1.

A few traces in the post-pliocene deposit of Ashley River, South Carolina.

Procyon priscus.

Le Conte: Am. Jour. Sc. 1848, V, 106. Leidy: Jour. Ac. Nat. Sc. 1856, III, 169, Pl. XVII, Figs. 17–24; Hall and Whitney's Rep. Geol. Surv. Wisconsin, and Whitney's do. Upper Mississippi Lead Region, 1862, 424.
Procyon, Le Conte: Mem. Am. Acad. Arts, &c. 1848, III, 258.

Remains found in crevices of the limestone, in the vicinity of Galena, Illinois. Post-pliocene.

RUMINANTIA.

BOVIDÆ.

BISON.

Bison americanus.

Buffalo, Cooper: Month. Am. Jour. Geol. 1831, 174, 207. Knight: Am. Jour. Sc. 1835, XXVII, 166. Lyell: Proc. Geol. Soc. London, 1843, IV, 36.

Bos americanus, Cooper, etc.: Month. Am. Jour. Geol. 1831, 43; Am. Jour. Sc. 1831, XX, 371; Edinb. New Phil. Jour, 1831, XI, 353.

Oxen, Rafinesque: Month. Am. Jour. Geol. 1831-2, 355.

Bison americanus, Dekay: Nat. Hist. New York, Zool. Pt. I, 1842, 110. Leidy: Proc. Ac. Nat. Sc. 1854, 200, 210.

Bos, Wyman: Hall and Whitney's Rep. Geol. Surv. Wisconsin, and Whitney's do. Upper Mississippi Lead Region, 1862, 421.

Remains have been found at Big-bone-lick, Kentucky, and elsewhere, in association with remains of *Mastodon*. Quaternary and recent.

Bison priscus.

Urus, Buckland: Appendix to Beechey's Nar. Voy. to the Pacific, 1831, 595, in part; Ox, 597, Pl. III, in part.

Bison priscus, Richardson: Zool. Voy. Herald, 1854, 33, Pl. VI, Figs. 5, 6; VII, Fig. 1; X; XIII, Fig. 3. Leidy: Proc. Ac. Nat, Sc. 1854, 210.

Remains from the frozen mud cliffs of Eschscholtz Bay; may probably pertain to the same species as the *Bison priscus* of Northern Europe. Quaternary.

Bison latifrons.

Great Indian Buffalo, Peale: Philos. Mag. 1803, 325, Pl. VI; Hist. Disq. on the Mammoth, 1803, 84.

Aurochs, Cuvier: An. du Mus. 1808, 382, Pl. 34, Fig. 2; Ossem. Fos. 1812, IV, 50, Pl. III, Fig. 2; Ed. 2d, 1824; Ed. 3d, 1825, 143, Pl. XII, Fig. 2; Ed. 4, 1835, VI, 287, Pl. CLXXIII, Fig. 2.

Bos latifrons, Harlan: Fauna Americana, 1825, 273; Med. and Phys. Res. 1835, 276; Trans. Geol. Soc. Pennsylvania, 1835, 71; Edinb. New Philos. Jour. 1834, XVII, 359. Rafinesque: Ac. of some remark. Nat. ob. Philadelphia, Nov. 1831. Cooper: Month. Am. Jour. Geol. 1831, 174. Dekay: An. Lyc. Nat. Hist. New York, 1828, 286; New York Fauna, Zool. Pt. I, 1842, 10. Pictet: Paléont. 1844, I, 310; 1853, I, 366.

Urus, Bojanus: Nov. Act. Ac. Nat. Cur. 1826, 427. Buckland: Append. to Beechey's Voy. Pacific, 1831, 595.

Great Fossil Ox, sp. *latifrons*, Godman: Am. Nat. Hist. 1828, III, 243, Pl.

Bos urus, Buckland: Ap. Beechey's Voy. 1831, 597, Pl. III, Fig. 1.

Taurus latifrons, Rafinesque: Enumer. remark. Nat. Obj. Philadelphia, Nov. 1831; Atlantic Jour. 1832-3, 28.

Taurus gigas, Ibidem.

Bison priscus, Meyer: Palæologica, 1832, 96 in part. Rütimeyer: Verhand. Naturf. Gesells. in Basel, 1866, 339.

Bos priscus, Meyer: Nov. Act. Ac. Nat. Cur. 1835, XVII, 141. Geinitz: Verstein. 1846, 55. Giebel: Fauna d. Vorwelt. 1847, I, 153. Gervais: Zool. Pal. Fr. 1848, I, 188.

Bos, Bison, or Ox, Harlan: Am. Jour. Sc. 1842, XLIII, 143. Couper: Proc. Ac. Nat. Sc. 1842, 190, 216. Owen: Proc. Geol. Soc. London, 1842, III, 693; Proc. Ac. Nat. Sc. 1846, 93. Gibbes: Proc. Am. Assoc. Adv. Sc. 1850, III, 66.

Fossil Ox, Perkins: Am. Jour. Sc. 1842, XLII, 137. Carpenter: Ib. 1846, I, 245, Figs. 1, 2.

Sus americana, Harlan: Am. Jour. Sc. 1842, XLIII, 143, Pl. III, Fig. 1. Couper: Proc. Ac. Nat. Sc. 1842, 190, 216.

Sus americanus, Pictet: Traité de Paléont. 1844, I, 256.

Lophiodon bathygnathus, Owen: Cat. Fos. Mam. &c., Mus. Col. Surg. 1845, 198.

Harlanus americanus, Owen: Proc. Ac. Nat. Sc. 1846, 96; Jour. do. 1847, I, 18, Pl. VI; Am. Jour. Sc. 1847, III, 125. Pictet: Traité d. Paléont. 1853, I, 303.

Bison latifrons, Leidy: Proc. Ac. Nat. Sc. 1852, 117; 1854, 89, 210; 1867, 85; Mem. Ext. Sp. Amer. Ox in Smith. Contrib. 1852, 8, Pls. I, II; Waile's Rep. Agric. &c. Mississippi, 1854, 286; Holmes' Post-plio. Fos. South Carolina, 1860, 109, Pl. XVII, Figs. 15, 16. Falconer: On the Amer. Eleph. in Nat. Hist. Review, 1863, 53; Palæont. Mem. 1868, II, 223.

Bison antiquus, Leidy: Proc. Ac. Nat. Sc. 1852, 117; 1854, 210; 1867, 85; Mem. Ext. Sp. Am. Ox, 1852, 11, Pl. II, Fig. 1.

Bison crassicornis, Richardson: Zool. Voy. Herald, 1852–4, 40, 139, Pl. IX, XI, Fig. 6; XII, Figs. 1–4; XIII. Figs. 1–2; XV, Figs. 1–4. Leidy: Proc. Ac. Nat. Sc. 1854, 210.

Harlanius, Bronn: Leth. Geog. 1856, III, 846.

This extinct species was first indicated by a portion of a huge skull, which was found in the bed of a creek falling into the Ohio River, a dozen or more miles north of Big-bone-lick, Kentucky. The specimen is now preserved in the Museum of the Academy.

Dr. Carpenter described a portion of a skull and a molar tooth of the same species from the banks of the Brazos River, near San Felipe, Texas; and Dr. Falconer reports the existence of a fine skull from the same locality, preserved in the British Museum.

Other remains referrable to *Bison latifrons* have been obtained from the excavation of the Brunswick Canal, near Darien, Georgia, from Big-bone-lick, Kentucky, Natchez, Mississippi, and the shore of the Ashley River, South Carolina.

In my memoir on the extinct species of American Ox, page 12, I suggested the probability that the fossil attributed to *Bison antiquus* might belong to the female of *B. latifrons,* and with this view, in the present synopsis, I have considered the former as synonymous with the latter, though future discoveries may prove the two to be distinct.

Prof. Rütimeyer, in his Beiträge, page 41, views *B. antiquus* as the male and *B. latifrons* as the female of the same species as the European *Bison priscus.* So far as the sex is concerned this appears to be reversing the usual order of things, for the more characteristic fossil first referred to *B latifrons* is of much greater proportions than that referred to *B. antiquus.*

Recently a fine specimen, consisting of the cranial portion of a skull, together with both horn cores, of a large extinct Ox, has been presented to the Academy by Walter Brown, of San Francisco, California, through William M. Gabb, of the California Geological Survey. The fossil was obtained from Santa Clara County, California.

In size and proportions it is nearly related with the specimen originally referred to *Bison antiquus.* It also sufficiently resembles the fossil from Eschscholtz Bay, described by Buckland and Richardson, and referred by the latter to an extinct species, with the name of *Bison crassicornis,* to render it probable that this may have belonged to the same.

In some respects the California fossil differs from either of the others mentioned. The horn cores are proportionately less robust in comparison with their length, and less abruptly tapering than in the original specimen of *B. antiquus;* and they are directed transversely outward instead of obliquely outward and backward, as is represented to be the case in *B. crassicornis.*

Comparative measurements of the fossil originally referred to *Bison latifrons,* (1), that to *B. antiquus* (2), and the fossil *Bison* from California (3), with the measurements of *B. crassicornis* (4), given by Richardson, in the Zoology of the Voyage of the Herald, are as follow:

	1 Inches.	2 Inches.	3 Inches.	4 Inches.
Distance between tips of horn cores, ...			36	
Distance between bases of horn cores, ...	16		15	11½
Circumference at base of horn cores, ...	21	15	14½	12½
Length of horn core along upper curvature, . .			9½	
Breadth of forehead in front of cores where narrowest, .			13	10½
Length of forehead from inion to fronto-nasal suture, .			13½	9·7
Height of inion from lower margin of occipital foramen,	8		7	6
Breadth of inion, ...			13	
Breadth of space occupied by condyles, ...	7		6	5·7

CAPRIDÆ.

OVIBOS.

Ovibos moschatus.

Bos grunniens, Fabricius: Fauna Grœnlandica, 1780, 28.

Musk Ox, Pennant: Arctic Zoology, 1792, 12. Buckland: Appendix to Beechey's Voyage, 1831, 595, 606. Hayes: Open Polar Sea, 1867, 390.

Ovibos moschatus, Richardson: Zool. Voy. Herald, 1854, 22. Leidy: Proc. Ac. Nat. Sc. 1854, 210.

Remains at Eschscholtz Bay and Greenland.

There are portions of four skulls of this species in the Museum of the Academy, obtained by Dr. I. I. Hayes at Port Foulke, Greenland. All the specimens appear recent, though they may be the remains of animals which had been imbedded in ice for ages. One is a cranium with both horn cores, accompanied by a ramus of the lower jaw, much weather-worn and covered with lichens. A second is a cranium, and a third the upper portion of one, both with the bases of the horn cores, and both weather-worn. The remaining specimen consists of a portion of one side of the cranium, with the horn core and enveloping horn nearly perfect.

Ovibos bombifrons.

Animal allied to the Bison, Wistar : Trans. Am. Philos. Soc. 1818, 379, Pl. XI, Figs. 10, 11.

Bos bombifrons, Harlan : Fauna Amer. 1825, 271 ; Edinb. New Philos. Jour. 1834, XVII, 359 ; Med. Phys. Res. 1835, 275 ; Trans. Geol. Soc. Pennsylvania, 1835, 71. Cooper, Smith and DeKay : Am. Jour. Sc. 1831, XX, 370 ; Edinb. New Phil. Jour. 1831, XI, 353. Cooper : Month. Am. Jour. Geol. 1831, 43, 173, 206. DeKay : An. Lyc. Nat. Hist. New York, 1838, 286 ; Nat. Hist. New York, Pt. I ; Zool. 1842, 110. Meyer : Nov. Act. Ac. Nat. Cur. 1835, 143. Pictet : Traité d. Paléont. 1844, I, 310 ; 1853, I, 366.

Wistar's Fossil Ox, Godman : Am. Nat. Hist. 1828, III, 243, Pl.

Bos (Bison?) bombifrons, Meyer : Palæologica, 1832, 97.

Ovibos bombifrons, Leidy : Proc. Ac. Nat Sc. 1852, 71.

Bootherium bombifrons, Leidy : Proc. Ac. Nat. Sc. 1852, 71 ; 1854, 210 ; Mem. Ext. Sp. Am. Ox, in Smith. Contrib. 1852, 17, Pl. IV, Fig. 2, Pl. V.

Bos (Bootherium) bombifrons, Bronn : Leth. Geog. 1856, 981, Pl. LV, Fig. 9.

Ovibos priscus, Rütimeyer : Verh. Naturf. Gesells. in Basel, 1866, 328.

Indicated by an imperfect skull found at Big-bone-lick, Kentucky, the only fossil characteristic of the species which has yet been discovered. The specimen in form bears considerable resemblance with the corresponding portion of the skull of a Musk Bull, sixteen months old, represented in figure 2, plate IV, of the Zoology of the Voyage of the Herald. It is, however, of mature age, as the interfrontal, fronto-parietal and occipito-parietal sutures are completely obliterated. Quaternary.

Ovibos cavifrons.

Bos pallasii, in part of DeKay : An. Lyc. Nat. Hist. New York, 1828, II, 291, Pl. VI ; Edinb. New Phil. Jour. 1828, V, 327 ; Nat. Hist. New York, Pt. I ; Zool. 1842, 10. Cooper : Month. Am. Jour. Geol. 1831, 173, 206. Harlan : Edinb. New Philos. Jour. 1834, XVII, 359 ; Med. Phys. Res. 1835, 276 ; Trans. Geol. Soc. Pennsylvania, 1835, 72 in part. Meyer : Palæologica, 1832, 97 ; Nov. Act. Ac. Nat. Cur. 1835, 155 in part. Geinitz : Versteinerungskunde, 1846, 55 pt. Giebel : Fauna d. Vorwelt, I, 1847, 154. Pictet : Traité d. Paléont. I, 1853, 366.

Bos bombifrons, Agassiz : Proc. Am. Assoc. Cincinnati, 1851, V, 179. John : Ibidem, 235.

Ovibos cavifrons, Leidy : Proc. Ac. Nat. Sc. 1852, 71.

Bootherium cavifrons, Leidy : Proc. Ac. Nat. Sc. 1852,* 71 ; 1854, 209, 210 ; Mem. Ext. Sp. Amer. Ox, in Smith. Contrib. 1853, 12 ; Waile's Rep. on the Agric. and Geol. Mississippi, 1854, 286.

Ovibos maximus, Richardson : Zool. Voy. Herald, 1854,† 25, Pl. XI, Figs. 2–4. Leidy : Pr. Ac. Nat. Sc. 1854, 210.

Ovibos priscus, Rütimeyer : Verh. Naturf. Gesells. in Basel, 1866, 328.

* Proceedings, May 4th, 1852. The number for May and June, distributed in July.

† Page 120 remarks, "first part of Zoology Voy. Herald came out October, 1852."

Remains of this species are comparatively abundant. They have been found near Fort Gibson, on the Arkansas River; at New Madrid, on the Mississippi River; at Big-bone-lick and on the Kentucky River, Kentucky; in Trumbull County, Ohio; in Benton County, Missouri; and Prof. Englemann informs me that the great part of a skeleton had been recently discovered in excavating for the foundation of a building in St. Louis. Probably the remains found in the frozen cliffs of Eschscholtz Bay, referred by Richardson to *Ovibos maximus*, belong to the same species.

At the time of preparing my memoir on the extinct species of American Ox, I had neither seen a recent Musk Ox skull nor characteristic representations of one. Subsequently, in comparing the fossils referred to *Bootherium* with Richardson's plates of the Musk Ox skull, in the Zoology of the Voyage of the Herald, my opinion that they might belong to the genus *Ovibos* appeared to be confirmed, though of this I am not yet quite positive. In the fossils the lachrymal fossæ are of remarkable comparative depth; in the Musk Ox, as represented in Richardson's plates, they appear not to be more conspicuous than in the Sheep, nor does Richardson mention them in the description of the lachrymal bones. Rütimeyer says distinct lachrymal fossæ exist in *Ovibos*, and considers the fossils as belonging to this genus.

The latter author further views the remains of *O. cavifrons* as those of the male, and the specimen of *O. bombifrons* as of the female of the same species, which he names *Ovibos priscus*. In the adult skull of the Musk Cow, represented in Richardson's figure 1, plate IV, the bases of the horn cores extend over the frontals to within a short distance of each other, nearly as in the adult Bull. In the aged specimen of *Ovibos bombifrons*, the horn cores project laterally from the frontals, far removed from each other, as is represented to be the case in Richardson's figure 2, plate IV, of a Musk Bull sixteen months old. From this resemblance it may be inferred that the fossil referred to *O. bombifrons* represents the male of a species of more primitive character than the *Ovibos moschatus*. These facts further throw doubt on the view of Rütimeyer, that *O. bombifrons* is the female of *O. cavifrons*.

OVIS.

Ovis mammilaris.

Sheep, Hildreth: Am. Jour. Sc. 1836, XXIX, 146.

Ovis mammilaris, Anon.: Am. Jour. Sc. 1837, XXXI, 82, Figs. 19. DeKay: Nat. Hist. New York, Zool. 1842, I, 112. Leidy: Anc. Fauna Neb. 1853, 9.

Indicated by the greater part of a skull found in Licking County, Ohio. Quaternary.

CERVIDÆ.

CERVUS.

Cervus virginianus.

Cooper: Month. Am. Jour. Geol. 1831, 207. Leidy: Proc. Ac. Nat. Sc. 1854, 200; Waile's Rep. Agric. &c. Missis. 1854, 286; Holmes' Post-pliocene Fos. S. Carol. 1860, 109. Emmons: North Carol. Geol. Surv. 1858, 200. Wyman: Hall & Whitney's Geol. Surv. Wisc. and Whitney's do. Up. Missis. Lead Reg. 1862, 421.

Mazama Salinaria, Rafinesque: Enum. and Ac. of some remark. Nat. Obj., Philad. 1831; Atlantic Journal 1832–33, 112, 509.

Panallodon Tumularium, Rafinesque: Ibidem.

Odocoileus speleus, Rafinesque: Atlantic Journal 1832—33, 109, with figure; The Good Book 1840, 67.

Deer, Hildreth: Am. Jour. Sc. 1836, XXIX, 147. Harlan: Ibid. 1842, XLIII, 143. Hall: Geol. of New York, Pt. IV, 1843, 364, 367; Bost. Jour. Nat. Hist. 1847, 390. Baird: Proc. Am. Assoc. 1850, 350. Holmes: Proc. Amer. Assoc. 1850, III, 203. Winchell: Am. Jour. Sc. 1864, XXXVIII, 223–24.

Cooper refers to remains of this species at Big-bone-lick, Kentucky. Hall mentions remains found in association with those of Mastodon, in Cattaraugus and Green Co., New York.

The Museum of the Academy contains a number of specimens consisting of bones, teeth, and fragments of antlers, some found in association with remains of Mastodon, or in similar positions and with those of other recent animals. The specimens are from near Natchez, Mississippi; from the banks of the Ohio River, near Evansville, Indiana; from loess in the valley of the Vermilion, Illinois; from a railroad cutting near Aberdeen, Munroe Co., Mississippi; and from Burlington and Monmouth Counties, New Jersey.

Baird speaks of large numbers of remains of the Deer found with those mostly of other living animals, in a cave near Carlisle, Cumberland Co., Pa. The Academy also possesses similar remains from Durham Cave, Bucks Co., Pa.

Emmons mentions the fragment of an antler of the Deer found in a miocene bed in North Carolina, and views it as a fossil of the age of the bed. This view is certainly incorrect. Several of the specimens in the Museum of the Academy were taken from the marl beds of cretaceous age in New Jersey, but evidently are to be considered as accidental occupants of the formation in which they were found.

The *Odocoileus speleus* of Rafinesque is based upon an upper premolar of the Deer from Carlisle Cave, and the *Mazama Salinaria* on the prong of an antler of the same animal from Kentucky. His *Panallodon* also appears to have been founded on a portion of the lower jaw of the Deer.

Cervus canadensis.

American Elk, Mitchell: Cat. Org. Rem. 1826, 32. Winchell: Am. Jour. Sc. 1864, XXXVIII, 223–24.

Cervus canadensis, Cooper: Month. Am. Jour. Geol. 1831, 207. Briggs and Foster: Geolog. Surv. of Canada, 1863, 914.

Elaphus americanus, Dekay: Nat. Hist. N. York, Zool. I, 1842, 120, Pl. XXIX, Fig. 2.

Elk, or *Stag,* Harlan: Am. Jour. Sc. 1842, XLIII, 143. Hall: Nat. Hist. N. Y., Geology, Pt. IV, 1843, 364, 367.

Elaphus Canadensis, Hall: Bost. Jour. Nat. Hist. 1847, 391.

Cervus ——, Leidy: Anc. Fauna Nebraska, 1853, 9.

Harlan refers to remains found with those of extinct animals at Newbern, N. C. Mr. Cooper, in "Notices of Big-bone-lick," speaks of remains found in that locality. Hall refers to remains found in similar positions to those of Mastodon, near New Hudson, Alleghany Co., and in Chautauque Co., New York.

The description and figure of a fragment of a skull, given by Dr. Dekay, from near the mouth of Racket River, New York, appear to apply to this species.

Portions of two antlers in the Museum of the Academy were obtained in the earth just above the cretaceous green sand near Deal, Monmouth Co., New Jersey.

Cervus alces.

Cooper: Month. Am. Jour. Geol. 1831, 207.

Remains at Big-bone-lick, Kentucky. Quaternary and recent.

Cervus tarandus.

Reindeer, Mitchell: Cat. Org. Rem. N. Y. 1826, 26. Buckland: Append. to Beechey's Voyage, 1831, 595, 597, 605, Pl. III, Figs. 11—13. Leidy: Proc. Acad. Nat. Sc. 1858, 179. Fisher: Proc. Acad. Nat. Sc. 1859, 194.

Cervus tarandus, Cooper: Month. Am. Jour. Geol. 1831, 207. Richardson: Zoology Voyage Herald, 1854, 20.

Remains at Eschscholtz Bay, Alaska; Racket River, and Sing Sing, New York; near Vincentown, New Jersey; and Big-bone-lick, Kentucky.

An antler of a Reindeer, perhaps of an extinct species, preserved in the Museum of the Academy, is represented in figure 9, plate XXVIII. It was presented by Mr. Carlton Moore, and was found near Vincentown, Burlington Co., New Jersey, at a depth of four feet from the surface, in the stratum of earth overlying the green sand.

The specimen, apparently of the right side, has its upper extremity broken off, and in the present condition is about two feet in length. It is not petrified, but is somewhat friable, and is in the usual condition of preservation of the remains of *Cervus virginianus, C. canadensis,* the Beaver, the Muskrat, and the Mastodon, found in similar positions in New Jersey.

The antler bears a nearer resemblance to those of the Barren Ground Reindeer than it does to those of the Woodland Reindeer, but differs in some respects from the antlers of both of those varieties or species. The specimen has no brow branch, but in its usual position immediately above the almost obsolete burr there is a slight conical eminence. The first branch projects about six inches above the base of the antler, and extends forward and outward to about the same distance, when it appears to have expanded in a palmate extremity, the greater part of which is lost. The course of the main trunk is sigmoid, flattened on the inner side, and convex on the outer side. It gives off no other branch than the one mentioned, to the broken end of the specimen. A few inches below the latter posteriorly the border of the antler is extended into a narrow heel-like expansion. Near the base the antler is four and a quarter inches in circumference, and is nearly the same at the remote broken end. The anterior branch is flattened cylindrical, and a little over three inches in circumference at the middle.

The fossil may perhaps be viewed as the antler of a Reindeer in which the brow branch is obsolete, and the first branch is unusually high in its origin.

Cervus americanus.

Cervus, Wistar: Trans. Am. Phil. Soc. 1818, 377, Pl. X, Figs. 4, 5. Owen: Pr. Geol. Soc. Lond. 1842, III, 693.

Cervus americanus, Harlan: Fauna Amer. 1825, 245; Edinb. New Phil. Jour. 1834, XVII, 358; Trans. Geol. Soc. Penn. 1835, 70. Cooper: Month. Am. Jour. Geol. 1831, 174, 206. Leidy: Anc. Fauna Neb. 1853, 8.

Cervus resembling C. Alces, Cooper, etc.: Am. Jour. Sc. 1831, XX, 370; Month. Am. Jour. Geol. 1831, 207; Edinb. New Phil. Jour. 1831, XI, 353.

Elk, Croom: Am. Jour. Sc. 1835, XXVII, 170.

Elaphus americanus, In part of Dekay: Nat. Hist. N. York; Zool. 1842, I, 120.

Cervus americanus fossilis, Meyer: Palæologica 1832, 92. Mantell: Medals of Creation 1844, 375. Pictet: Traité d. Paléon. 1844, I, 305; 1853, I, 359.

The remains upon which this species was first indicated consists of a mutilated cranial portion of a skull with the roots of the antlers, described and figured by Dr. Wistar. The specimen was found, according to this author, at Big-bone-lick, Kentucky, and formed part of a collection of fossil bones presented to the American Philosophical Society by Thomas Jefferson. It presents a more chalky aspect and friable condition than is observed among the fossils from Big-bone-lick, which leads me to suspect it was found elsewhere. Accompanying the cranial specimen there are portions with the roots of the antlers of another, and two metacarpals, undescribed by Dr. Wistar, all in the same friable and abraded condition.

The fossils certainly indicate an extinct species, and one which approximated, if it did not exceed in size, the great Irish Deer.

The roots of the antlers projected directly outwards, almost on a level with the intervening frontals, as in the Moose. In one of the specimens, the broken end of the antler, nine inches from the interfrontal suture, is a little below the level of the frontals. No brow branch appears to have existed.

The two metacarpals differ a little in length, and the longer and more perfect one exceeds in length those of the great Irish Deer, but is proportionately less robust, indicating a less bulky but taller and more graceful animal.

Measurements of the specimens are as follow :

	Inch.	Lin.
Breadth of the inion,	7	
Height of do.,	4	10
Distance between the burrs of the antlers,	8	10
Diameter of occipital foramen transversely,	1	6
Diameter of occipital foramen vertically,	1	10
Circumference of antler nine inches from the interfrontal suture,	7	
Length of metacarpal bone,	14	6
Breadth of upper extremity of do.,	2	4
Breadth of lower extremity of do.,	2	9
Circumference of middle of shaft of do.,	5	10

Cervus Warreni.

See page 172, Pl. XXVII, Fig. 12.

Leidy: Proc. Acad. N. Sc. 1858, 23.

Sands of the Niobrara River, Nebraska. Pliocene.

OREODONTIDÆ.

OREODON.

Oreodon Culbertsoni.

See page 86, Pl. VI, Fig. 1; VII, Fig. 2; IX, Figs. 1, 2.

Merycoidodon Culbertsonii, Leidy: Proc. Ac. Nat. Sc. 1848, 47, Pl. II; 1850, 121; 1851, 239.

Oreodon priscum, Leidy: Proc. Ac. Nat. Sc. 1851, 238.

Cotylops speciosa, Ibidem, 239.

Oreodon robustum, Ibidem, 276.

Oreodon Culbertsoni, Leidy: Owen's Rep. Geol. Surv. 1852, 548, Pl. X, Figs. 4—6, XIII, Figs. 3—4; Anc. Fauna Neb. 1853, 45, Pl. II, III, IV, Figs. 1—5, V, Figs. 1, 2, VI, Figs. 8—11; Proc. Ac. Nat. Sc. 1853, 392; 1854, 35, 157; 1857, 89. Bronn: Leth. Geog. 1856, 930.

Mauvaises Terres of White River. Dakota. Miocene.

Oreodon gracilis.

See page 94, Pl. VI, Figs. 2, 3.

Leidy: Proc. Ac. Nat. Sc. 1851, 239; 1853, 392; 1854, 157; 1857, 89; Owen's Rep. Geol. Surv. 1852, 550, Pl. XI, Figs. 2, 3, XIII, Figs. 5, 6; Anc. Fauna Neb. 1853, 53, Pl. V, Figs. 3, 4, VI, Figs. 1—7.

Oreodon gracile, Leidy: Proc. Ac. Nat. Sc. 1851, 239.

Mauvaises Terres of White River, Dakota. Miocene.

Oreodon major.

See page 99, Pl. VII, Fig. 1; VIII,

Leidy: Anc. Fauna Neb. 1853, 55, Pl. IV, Fig. 6; Proc. Ac. Nat. Sc. 1853, 398; 1856, 164; 1857, 89.

Mauvaises Terres of White River, Dakota. Miocene.

Oreodon affinis.

See page 105, Pl. IX, Fig. 3.

Oreodon hybridus.

See page 105, Pl. IX, Fig. 4.

Oreodon bullatus.

See page 106.

MERYCOCHŒRUS.

Merycochœrus proprius.

See page 110, Pl. X.

Leidy: Proc. Ac. Nat. Sc. 1858, 24.

From a calcareous grit on the head-waters of the Niobrara, opposite Fort Laramie. Miocene.

MERYCHYUS.

Merychyus elegans.

See page 118, Pl. XI, Figs. 1—11.

Leidy: Proc. Ac. Nat. Sc. 1858, 24.

Sands of the Niobrara River, Nebraska. Pliocene.

Merychyus medius.

See page 119, Pl. XI, Figs. 12—14.

Leidy: Proc. Ac. Nat. Sc. 1858, 25.

Sands of the Niobrara River, Nebraska. Pliocene.

Merychyus major.

See page 121, Pl. XI, Figs. 15, 16.

Leidy: Proc. Ac. Nat. Sc. 1858, 26.

Sands of the Niobrara River, Nebraska. Pliocene.

LEPTAUCHENIA.

Leptauchenia major.

See page 124, Pl. XII, Figs. 1—5.

Leidy: Proc. Ac. Nat. Sc. 1856, 163; 1857, 89.

From a tributary of White River, in the Mauvaises Terres, near Eagle Nest Butte, and from White Earth Creek, another tributary of White River. Miocene.

Leptauchenia decora.

See page 127, Pl. XII, Figs. 6—20.

Leidy: Proc. Ac. Nat. Sc. 1856, 88; 1857, 89.

From the same localities as the former species. Miocene.

Leptauchenia nitida.

See page 129, Pl. XII, Figs. 21, 22.

From White Earth Creek, Dakota. Miocene.

AGRIOCHŒRIDÆ.

AGRIOCHŒRUS.

Agriochœrus antiquus.

See page 132, Pl. XIII, Fig. 4.

Leidy: Proc. Ac. Nat. Sc. 1850, 121; 1853, 392; 1854, 157; 1857, 89; Anc. Fauna Neb. 1853, 24, Pl. I, Figs. 5—10. Bronn: Leth. Geog. 1856, 933.

? *Eucrotaphus Jacksoni*, Leidy: Proc. Ac. Nat. Sc. 1850, 90; Anc. Fauna Neb. 1853, 56, Pl. VII, Figs. 4—6. Bronn: Leth. Geog. 1856, 931.

Mauvaises Terres of White River, Dakota. Miocene.

Agriochœrus major.

See page 134.

Leidy: Proc. Ac. Nat. Sc. 1856, 164; 1857, 89.

? *Eucrotaphus auritus*, Leidy: Owen's Rep. Geol. Surv. 1852, 563, Pl. XV, Figs. 1, 2; Anc. Fauna Neb. 1853, 56, Pl. VII, Figs. 1—3. Bronn: Leth. Geog. 1856, 931.

Mauvaises Terres of White River, Dakota. Miocene.

Agriochœrus latifrons.

See page 135, Pl. XIII, Figs. 1—3.

Leidy: Proc. Ac. Nat. Sc. 1867, 32.

Mauvaises Terres of White River, Dakota. Miocene.

CAMELIDÆ.

PŒBROTHERIUM.

Pœbrotherium Wilsoni.

See page 141, Pl. XIII, Figs. 5—7.

Leidy: Proc. Ac. Nat. Sc. 1847, 322, Pl. Figs. 1—4; 1853, 392; 1854, 157; 1857, 89; Owen's, Rep. Geol. Surv. 1852, 571; Anc. Fauna Neb. 1853, 19, Pl. I, Figs. 1—4. Pictet: Traité de Paléont. 1853, I, 350. Bronn: Leth. Geog. 1856, 956.

Mauvaises Terres of White River, Dakota. Miocene.

PROCAMELUS.

Procamelus robustus.

See page 148, Pl. XV, Figs. 1—4.

Leidy: Proc. Ac. Nat. Sc. 1858, 89.

Sands of the Niobrara River, Nebraska. Pliocene.

Procamelus occidentalis.

See page 151, Pl. IX, Fig. 5, XV, Figs. 5—7.

Leidy: Proc. Ac. Nat. Sc. 1858, 23, 89.

Sands of the Niobrara River, and Little White River. Pliocene.

Procamelus gracilis.

See page 155, Pl. XIV, Fig. 15.

Leidy: Proc. Ac. Nat. Sc. 1858, 89.

Sands of the Niobrara River, Nebraska. Pliocene.

HOMOCAMELUS.

Homocamelus caninus.

See page 158, Pl. XIV, Figs. 16, 17.

Sands of the Niobrara River, Nebraska. Pliocene.

PROTOMERYX.

Protomeryx Halli.

See page 160, Pl. XV, Figs. 8, 9.

Leidy: Proc. Ac. Nat. Sc. 1856, 164; 1857, 89.

From Bear Creek, a tributary of White River, Dakota. Miocene.

MEGALOMERYX.

Megalomeryx niobrarensis.

See page 161, Pl. XIV, Figs. 12—14.

Leidy: Proc. Ac. Nat. Sc. 1858, 24.

Sands of the Niobrara River, Nebraska. Pliocene.

MERYCODUS.

Merycodus necatus.

See page 162, Pl. XIV, Figs. 9, 10.

Leidy: Proc. Ac. Nat. Sc. 1854, 90, 157; 1857, 89; 1858, 23.

From Bijou Hill, Little White River, and the Niobrara River. Pliocene.

CAMELOPS.

Camelops Kansanus.

Leidy: Proc. Ac. Nat. Sc. 1854, 172; Jour. Ac. Nat. Sc. 1856, III, 166, Pl. 17, Figs. 8—10.

Indicated by a small fragment of an upper jaw, found in the gravel drift of Kansas. Post-pliocene.

Corresponding parts are not in our possession to ascertain the case, but it is not improbable that this genus may on future discovery prove to be the same as *Procamelus.*

MOSCHIDÆ.

LEPTOMERYX.

Leptomeryx Evansi.

See page 165, Pl. XIV, Figs. 1—8.

Leidy: Proc. Ac. Nat. Sc. 1853, 394; 1854, 157; 1857, 89.

Dorcatherium Evansi, Leidy: Proc. Ac. Nat. Sc. 1857, 176.

Mauvaises Terres of White River, Dakota. Miocene.

ANTILOPIDÆ.

COSORYX.

Cosoryx furcatus.

See page 173, Pl. XXVIII, Fig. 8.

Sands of the Niobrara River, Nebraska. Pliocene.

ARTIODACTYLA.

SUIDÆ.

PLATYGONUS.

Platygonus compressus.

Large species of Sus, Brown: Barton's Med. Phys. Jour. 1806, II, Pt. 2, 158.

Sus tajassu, Nuttall: Trav. in Arkansas 1821, 155.

Recent Pecari, Harlan: Fauna Americana 1825, 222.

Platygonus compressus, Le Conte: Am. Jour. Sc. 1848, V, 103, Figs. 1, 2; Mem. Am. Acad. Arts and Sc. 1848, III, 257, Pls. I—IV; Proc. Ac. Nat. Sc. 1852, 57. Leidy: Trans. Am. Phil. Soc. 1852, X, 323, Pl. 37, Figs. 9—16, Pl. 38, Figs. 2, 3; Anc. Fauna Neb. 1853, 9. Pictet: Paléont. 1853, I, 303. Bronn: Leth. Geog. 1856, III, 846.

Hyops depressifrons, Le Conte: Am. Jour. Sc. 1848, V, 104; Mem. Am. Acad. 1848, III, 258; Proc. Ac. Nat. Sc. 1852, 57.

Protochœrus prismaticus, Le Conte: Am. Jour. Sc. 1848, V, 105; Proc. Acad. Nat. Sc. 1852, 5. Leidy: Trans. Am. Phil. Soc. 1852, X, 323, Pl. XXXVII, Fig. 18; Anc. Fauna Neb. 1853, 9. Pictet: Paléont. 1853, I, 335. Bronn: Leth. Geog. 1856, III, 901.

Dicotyles depressifrons, Le Conte: Proc. Ac. Nat. Sc. 1852, 3. Leidy: Trans. Am. Phil. Soc. 1852, X, 323, Pl. 38, Fig. 1; Anc. Fauna Neb. 1853, 9.

Dicotyles costatus, Le Conte: Proc. Ac. Nat. Sc. 1852, 5.

Euchœrus macrops, Leidy: Trans. Am. Phil. Soc. 1852, X, 323, Pls. XXXV—XXXVII, Figs. 5—8, 17, 19; Anc. Fauna Neb. 1853, 9.

Dicotyles torquatus (fossilis), Leidy: Anc. Fauna Neb. 1853, 9.

Pachyderm, new genus, Le Conte: Proc. Ac. Nat. Sc. 1854, 69.

Dicotyles compressus, Leidy: Proc. Ac. Nat. Sc. 1856, 140; 1868, 231; Trans. Am. Phil. Soc. 1857, XI, 18, Pl. VI, Figs. 2—7; Hall & Whitney's Rep. Geol. Wisc., and Whitney's do. Up. Missis. Lead Region 1862, 424.

Hyops, Bronn: Leth. Geog. 1856, III, 895.

Dicotyles, Wyman: Hall & Whitney's Rep. Geol. Wisc., and Whitney's do. Up. Mis. Lead Reg. 1862, 422.

All the fossil remains of Peccaries which have been described under the above names, including the synonyma, I have considered as representing a genus distinct from *Dicotyles,* founded upon differences in the degree of development of the constituent elements of the crown of the molar teeth.

In *Platygonus* the principal lobes of the crown of the molar teeth are relatively better developed than in *Dicotyles.* They are proportionately longer, less corrugated at the sides, and approach somewhat in character the constituent lobes of the crown of the corresponding teeth of the cervine family, while those of *Dicotyles* appear more truly suilline in appearance. In other words, in comparing the molar teeth of *Platygonus* with those of the living Peccaries, the Deer and the Hog, it will be observed that the molars of the former resemble those of the Deer more than do the molars of the Peccaries, while the latter resemble those of the Hog more than do the molars of *Platygonus.*

In the upper premolars of *Platygonus,* the crown is composed of a single pair of transverse lobes, resembling those of the true molars, bounded by a basal ridge which is especially thick in front and behind. In the corresponding teeth of *Dicotyles* the crowns are composed of four lobes, as in the true molars, but the posterior pair are relatively less well developed, more especially the postero-internal one.

Differences of the same character are observed in the lower premolars. In *Platygonus* the crowns are composed of a transverse pair of principal lobes, bounded by a narrow basal ridge in front, and a broad one behind. In *Dicotyles* the principal lobes of the crown are less distinct, and in the last premolar the posterior basal ridge assumes the character of an additional but less well developed pair of lobes, which are not obvious in *Platygonus.* Quaternary.

DICOTYLES.

Dicotyles lenis.

Dicotyles fossilis, Leidy: Holmes' Post-pliocene Fossils of South Carolina, 1860, 108, Pl. XVII, Figs. 13, 14.

Dicotyles torquatus, Wyman: Whitney's Rep. Geol. Surv. Up. Missis. Lead Region, 1862, 422. Cope: Proc. Ac. Nat. Sc. 1867, 138, 155; 1868, 185.

Squalodon protervus, in part of Cope: Proc. Ac. Nat. Sc. 1867, 151.

Cynorca, in part of Cope: Proc. Ac. Nat. Sc. 1867, 151, 152.

Remains of a Peccary, probably distinct from the living *Dicotyles torquatus,* have been found in the post-pliocene formation of Ashley River, South Carolina, and in Wisconsin. Recently Prof. Cope has announced the discovery of remains of a Peccary, with those of *Ursus amplidens, Equus, Tapirus, Cervus,* etc., in a hard breccia in Wythe Co., Virginia.

The same author has also indicated the discovery of remains of a Peccary, found together with those of an extinct species of *Galera,* in Charles County, Maryland. A tooth described by him from the same locality, and referred to a cetacean with the name of *Squalodon protervus* or *Cynorca proterva,* is clearly an upper canine of the same animal. The canine is smaller than the corresponding tooth of any recent or extinct Peccary I have hitherto seen. The enamel is worn at the fore part of the crown, exposing a wide band of dentine extending the entire length, In its perfect condition the crown has been about three-fourths of an inch in length by about four and a half lines in breadth at base; and in this position is three lines in thickness.

Of the specimens from Charles County, Md., referred by Prof. Cope to *D. torquatus,* one is an inferior canine, probably belonging to the same individual as the former tooth. The enamel is completely worn off to the base posteriorly. In its present condition the crown is 10 lines long, 4 lines broad and $3\frac{1}{4}$ lines thick at base, which measurements are nearly those of the unworn tooth.

Another specimen, accompanying those just noticed, is a portion of the left ramus of the lower jaw of a young animal, containing in functional position the last temporary molar and the succeeding first true molar, the former but little worn, the latter inappreciably so. A second specimen of a first true molar appears to have belonged to the opposite side of the same individual.

The two specimens of first true molars resemble the corresponding teeth of *Dicotyles torquatus,* but unlike those we have seen, are devoid of any trace of tubercles between the principal lobes of the crown, externally as well as internally. The teeth are smaller than in most skulls of the *D. torquatus* to which I have access, but are larger than in one of them. The antero-posterior diameter of the fossil teeth is $5\frac{1}{2}$ lines, the transverse diameter $4\frac{1}{4}$ lines. In the small recent skull of *D. torquatus* alluded to, the corresponding tooth measures $4\frac{3}{4}$ by $3\frac{3}{4}$ lines. A similar tooth from the shores of Ashley River, South Carolina, also devoid of a tubercle between the lobes of the crown externally as well as internally, measures 7 by $5\frac{3}{4}$ lines.

The condyle of the young fossil jaw fragment differs from that in specimens of the adult jaw of *D. torquatus* in its greater extent fore and aft, compared with its breadth, and in its less degree of convexity.

Dicotyles nasutus.

See plate XXVIII, Figs. 1. 2.

Extinct Peccary, Leidy: Proc. Ac. Nat. Sc. 1860, 416.

Dicotyles nasutus, Leidy: Proc. Ac. Nat. Sc. 1868, 230. Cope: Ibid. 1869, 3.

An extinct species of Peccary, certainly different from *Platygonus compressus,* is indicated by a specimen submitted to my examination by the late Dr. David Dale Owen. It was found at the depth of between thirty and forty feet below the surface, in digging a well, in Gibson County, Indiana. It is represented in figures 1, 2, plate XXVIII, and consists of the fore-part of the upper jaw, containing on one side the canine and anterior two molar teeth. It also retains the socket for the other canine and those of the incisors, one of which is likewise preserved.

The specimen indicates a rather larger animal than the largest living Peccary, or than *Platygonus compressus*. The face in advance of the molars is prolonged to a greater degree than in either of those animals, but is proportionately narrower.

The two premolars retained in the specimen are blunted from wear. They are constructed more nearly after the pattern of those of the living Peccaries than after those of *Platygonus*.

The crown of the second premolar is composed of four principal conical tubercles, which alternate in position with a median, fore and aft row of lesser tubercles. The anterior and posterior of the latter replace the basal ridge in a corresponding position in the living Peccaries and in *Platygonus*.

The crown of the first premolar is constructed on the same plan as the second, but is more rudimental in character.

The incisors hold the same relative position as in *Platygonus* and the recent Peccaries, but as indicated by the alveoli, appear to have been comparatively feeble organs. The alveoli are circular, and the anterior pair are but little larger than the posterior ones.

The upper canine tooth has the same form and mode of insertion as in *Platygonus* and the recent Peccaries, but is smaller, absolutely and relatively.

The arching ridge of the canine alveolus, extending upon the premaxillary and bounding a recess for the accommodation of the inferior canine, is almost as high as in *Dicotyles labiatus*.

The bones entering into the constitution of the fossil fragment, the maxillaries, premaxillaries, the vomer and a small portion of the nasals are all completely co-ossified.

The anterior ends of the co-ossified premaxillaries project to a much greater degree in advance of the incisors than in *Platygonus* and the recent *Dicotyles*. They are also more truncate, and on each side of the intermaxillary notch are impressed with a conspicuous pit, apparently for the attachment of a pair of muscles, intended for a more mobile and longer snout than is possessed by the living Peccaries, or than existed in *Platygonus*.

The incisive foramen holds the same relative position as in the latter animals. The palatine canals open into a groove within the position of the second premolar, and the groove continuing forward becomes hardly perceptible within the position of the canines.

The hard palate, as in *Platygonus*, is not so rough as in the living *Dicotyles*, but is widely and rather deeply grooved along the middle, extending from the position of the molar teeth to the incisive foramina.

The upper part of the nose appears not to have been quite so broad as in *Dicotyles labiatus*, but the nasals appear to have been prolonged at their fore-part, as in that species.

The measurements of the specimen, compared with those of *Platygonus* and the two living Peccaries, are as follow:

	D. nasatus. Lines.	D. torquatus. Lines.	D. labiatus. Lines.	Platygonus. Lines.
From first premolar to front of premaxillaries, .	58	31	41	46
From first premolar to canine alveolus, . .	30	8	14	23
Length of jaw in front of canines, . . .	24	17	20	19
Breadth outside of lateral incisors, . . .	15	14	17	17
Breadth outside of canine alveoli, . . .	28	26	31	29
Narrowest part of interval back of canines, . .	14	13	17	13
Height from palate back of incisive foramina to upper part of nasals, ...	16	17	18	
Height of arch of canine alveoli, . . .	11	10	11	16
Ant.-post. diameter first premolar, . . .	$4\frac{1}{2}$	$4\frac{1}{4}$	5	$4\frac{3}{4}$
Transverse " "	4	$3\frac{3}{4}$	$4\frac{1}{2}$	$4\frac{1}{2}$
Ant.-post. diameter second premolar, . . .	$5\frac{1}{2}$	$4\frac{1}{4}$	5	5
Transverse " "	$5\frac{1}{2}$	$4\frac{1}{4}$	5	$5\frac{1}{4}$
Ant.-post. diameter at base of crown of canine, .	$5\frac{3}{4}$	6	8	$6\frac{1}{2}$
Transverse " " " . .	$3\frac{1}{2}$	$4\frac{1}{2}$	5	$4\frac{1}{4}$
Transverse diameter ant. incisive alveoli, . .	$2\frac{1}{2}$	$3\frac{3}{4}$	4	4
Transverse diameter post. " . .	2	$2\frac{1}{2}$	3	$2\frac{1}{4}$

Mr. Timothy Conrad has recently submitted to my inspection the crown of a second molar tooth obtained by Dr. P. Knieskern, from a supposed miocene formation of Shark River, Monmouth County, New Jersey.

The molar bears nearly the proper relation of size with the premolars in the specimen above described of *Dicotyles nasutus* to belong to the same animal The crown has a strong basal ridge, hardly interrupted at the most prominent portion of the lobes externally and internally. The lobes present the same form and relative position as in *D. labiatus*. They are considerably worn, exhibiting on their summits exposed tracts of dentine; nearly circular on those external, and larger and irregularly reniform on those internal. The measurements of the tooth, in comparison with the corresponding tooth of other species, are as follow:

		Lines.		Lines.
Fossil tooth, ...	ant. post. diam.	$9\frac{1}{4}$	trans.	$8\frac{1}{4}$
Dicotyles labiatus, ...	" "	7	"	$6\frac{3}{4}$
Dicotyles torquatus, ...	" "	$6\frac{1}{2}$	"	$5\frac{1}{2}$
Platygonus compressus, ...	" "	$7\frac{3}{4}$	"	$6\frac{3}{4}$

Dicotyles ——

See page 200, Pl. XXVIII, Fig. 3.

Sands of the Niobrara River. Pliocene?

ELOTHERIUM.

Elotherium Mortoni.

See page 175, Pl. XVI.

Archæotherium Mortoni, Leidy : Proc. Ac. Nat. Sc. 1850, 90 ; Owen's Rep. Geol. Surv. Wisc., &c. 1852, 558 ; Anc. Fauna Neb. 1853, 57, Pl. VIII, IX, X, Figs. 1—7. Bronn : Leth. Geog. 1856, 905.

Arctodon, Leidy : Proc. Ac. Nat. Sc. 1851, 278.

Archæotherium (Entelodon) Mortoni, Leidy : Owen's Rep. Geol. Surv. Wisc., &c. 1852, Ref. to Tab. X, Figs. 1—3, XI, 1, XIII, 1, 2.

Archæotherium robustum, Leidy : Owen's Rep. etc. 572 ; Anc. Fauna Neb. 1853, 122, Pl. X, Figs. 8—13. Bronn : Leth. Geog. 1856, 905.

Rhinoceros americanus, Leidy : Proc. Ac. Nat. Sc. 1852, 2.

Archæotherium (Entelodon) robustum, Leidy : Anc. Fauna Neb. 1853, 66.

Entelodon Mortoni, Leidy : Proc. Ac. Nat. Sc. 1853, 392 ; 1854, 157 ; 1857, 175.

Archæotherium, Greene : Proc. Ac. Nat. Sc. 1853, 292.

Elotherium Mortoni, Leidy : Proc. Ac. Nat. Sc. 1857, 175.

Mauvaises Terres of Dakota. Miocene.

Elotherium ingens.

See page 192, Pl. XXVII, Figs. 8—11.

Entelodon ingens, Leidy : Proc. Ac. Nat. Sc. 1856, 164 ; 1857, 89.

Elotherium ingens, Ibidem, 1857, 175.

Mauvaises Terres of Dakota. Miocene.

Elotherium Leidyanum.

Marsh :

Cope : Cook's Geol. N. Jersey 1868, 740.

The largest American species, from Squankum, Monmouth Co., N. J. Most probably of miocene age.

Elotherium superbum.

Leidy : Proc. Ac. Nat. Sc. 1868, 177.

A species indicated by an incisor tooth, obtained by Prof. Whitney from Douglas Flat, Calaveras Co., California. It was derived from a stratum of the same age as that from which a lower jaw of *Rhinoceros hesperius* was taken. The tooth appears to me to be the right upper lateral incisor of a species of *Elotherium*, perhaps the same as *E. ingens* of the Mauvaises Terres of White River, Dakota, though it would appear to belong to a larger individual than the remains referred to the latter, if not to a yet larger species. The crown of the tooth is conical, compressed from within outwardly, and subacute laterally. The apex is rounded ; the base somewhat expanded, and at its fore part produced in a short embracing ridge. The fang is conical and curved. The measurements of the specimen are as follow :

Length of tooth in straight line twenty-nine and a half lines ; length of crown thirteen lines ; breadth nine lines ; thickness six and a half lines.

PERCHŒRUS.

Perchœrus probus.

See page 194, Pl. XXI, Figs. 20—27.

Palæochœrus probus, Leidy: Proc. Ac. Nat. Sc. 1856, 165; 1857, 89.

From the Mauvaises Terres of White River, Dakota. Miocene.

LEPTOCHŒRUS.

Leptochœrus spectabilis.

See page 197, Pl. XXI, Figs. 14—19.

Leidy: Proc. Ac. Nat. Sc. 1856, 88; 1857 ,89.

From the Mauvaises Terres of White River, Dakota. Miocene.

NANOHYUS.

Nanohyus porcinus.

See page 200, Pl. XXIX, Figs. 11, 12.

Leidy: Proc. Ac. Nat. Sc. 1869, 65.

From the Mauvaises Terres of White River, Dakota. Miocene.

ANTHRACOTHERIDÆ.

HYOPOTAMUS.

Hyopotamus americanus.

See page 202, Pl. XXI, Figs. 1—6.

Leidy: Proc. Ac. Nat, Sc. 1856, 59.

Chœropotamus (Hyopotamus) americanus, Leidy: Proc. Ac. Nat. Sc. 1857, 89.

From the Mauvaises Terres of White River, Dakota. Found in association with *Titanotherium* in the lowest bed of the tertiary formation.

TITANOTHERIUM.

Titanotherium Prouti.

See page 206, Pl. XXIV.

Palæotherium, Prout: Am. Jour. Sc. 1846, II, 288, Fig. 1; 1847, III, 248, figures. Pictet: Traité de Paléont. 1853, 1, 311.

Palæotherium ? Proutii, Owen, Norwood and Evans: Proc. Ac. Nat. Sc. 1850, 66. Leidy: Ibid. 122; Ibid. 1851, 170; Owen's Rep. Geol. Surv. Wisc. &c. 1852, 551.

Palæotherium (Titanotherium) Proutii, Leidy: Owen's Rep. Geol. Surv. Wisc. 1852, Tab. IX, Figs. 2, 3; XII B, Figs. 3, 4, 6, 7, 8.

Rhinoceros ? Americanus, Leidy: Proc. Ac. Nat. Sc. 1852, 2.

Palæotherium maximum, Leidy: Owen's Rep. etc. Ref. to Tab. XII B, Figs. 3, 4.

Titanotherium Proutii, Leidy: Anc. Fauna Neb. 1853, 72, Pl. XVI, XVII; Proc. Acad. Nat. Sc. 1853, 392; 1854, 35, 157; 1856, 92; 1857, 89. Bronn: Leth. Geog. 1856, III, 864.

Palæotherium giganteum, Leidy: Anc. Fauna Neb. 1853, 78, Pl. XVII.
Palæotherium ? giganteum, Gervais: Zool. Pal. Fr. 1848—1852, I, 187.*
Titanotherium, Greene: Proc. Ac. Nat. Sc. 1853, 292.
Eotherium americanum, Leidy: Proc. Ac. Nat. Sc. 1853, 392.
Leidyotherium, Prout: Trans. Ac. St. Louis, 1860, 699.

From the lowest stratum of the tertiary deposits of the Mauvaises Terres of White River, Dakota. The tooth supposed to be characteristic of *Leidyotherium*, and reported to have been obtained near Abingdon, Virginia, is a fossil from the Mauvaises Terres of White River, Dakota. Miocene.

PERISSODACTYLA.

RHINOCEROTIDÆ.

ACERATHERIUM.

Aceratherium occidentale.

See page 220, Pl. XXI, Fig. 34; XXII; XXIII, Figs. 1–3.

Rhinoceros occidentalis, Leidy: Proc. Ac. Nat. Sc. 1850, 119, 276; 1853, 392; 1857, 89; 1865, 176; Owen's Rep. Geol. Surv. Wisconsin, &c. 1852, 552, Tab. IX, Figs. 1, 2, XIV, XV, Fig. 4; Anc. Fauna Neb. 1853, 81, Pl. XII, XIII; the present work, 220.
Acerotherium, Leidy: Proc. Ac. Nat. Sc. 1851, 331.
Aceratherium occidentale, Leidy: Proc. Ac. Nat. Sc. 1854, 157.

Mauvaises Terres of White River, Dakota. Miocene.

RHINOCEROS.

Rhinoceros crassus.

See page 228, Pl. XXIII, Figs. 4–9.

Leidy: Proc. Ac. Nat. Sc. 1858, 28; 1865, 176.

Sands of the Niobrara River, Nebraska. Pliocene.

Rhinoceros meridianus.

See page 229, Pl. XXIII, Fig. 10.

Leidy: Proc. Ac. Nat. Sc. 1865, 176.

From Washington County, Texas. Miocene?

Rhinoceros hesperius.

See page 230, Pl. XXIII, Figs. 11, 12.

Leidy: Proe. Ac. Nat. Sc. 1865, 176.

From Calaveras County, California. Miocene?

* Gervais in a note observes that "the animal indicated under this name by Prout is viewed by M. Pomel as the type of a new genus, which he calls *Menodus*." I have not been able to find M. Pomel's notice in any of the works to which I have access. His name probably antedates that of *Titanotherium*.

HYRACODON.

Hyracodon nebrascensis.

See page 232.

Rhinoceros Nebrascensis, Leidy: Proc. Ac. Nat. Sc. 1850, 121; 1853, 392; 1857, 89. Owen's Rep. etc. 1852, 556, Tab. XII A, Fig. 6, XII B, 5, XV, 3. Anc. Fauna Neb. 1853, 81, Pl. XIV, XV.

Aceratherium Nebrascensis, Leidy: Proc. Ac. Nat. Sc. 1851, 331; 1854, 157.

Hyracodon nebrascensis, Leidy: Proc. Ac. Nat. Sc. 1856, 92; 1857, 89; 1865, 176.

Mauvaises Terres of White River, Dakota. Miocene.

TAPIRIDÆ.

TAPIRUS.

Tapirus americanus.

Tapir, Carpenter: Am. Jour. Sci. 1842, XLII, 390; 1846, I, 247. Stuff: L'Institut, 1846, XIV, 396, fide Jahrb. f. Mineralogie, 1848, 127. Tuomey; Rep. Geol. South Carolina, 1848, 165, 166, 208. Cope: Proc. Ac. Nat. Sc. 1867, 138. Blake: Am. Jour. Sc. 1868, XLV, 381.

? *Palæotheria*, Tuomey: Rep. Geol. South Carolina, 1848, 203.

Tapirus Americanus fossilis, Leidy: Proc. Ac. Nat. Sc. 1849, 180; 1854, 199; Waile's Rep. Agric. &c. Mississippi, 1854, 280; Holmes' Post-pliocene Fos. South Carolina, 1860, 106, Pl. XVII, Figs. 1–3, 6, 11, 12.

Pachyderm, Agassiz: Proc. Am. Assoc. Adv. Sc. 1851, V, 179.

Remains, mostly of teeth and jaw fragments, undistinguishable from the corresponding parts of the living *Tapirus terrestris*, have been found in Texas, Louisiana, Mississippi, South Carolina, Virginia, Ohio, Illinois, California and elsewhere. Seeing that different known species of Tapirs exhibit but little or no differences in the parts corresponding to the fossil specimens just indicated, it is not improbable that these really belong to an extinct species. Quaternary in North America.

Tapirus Haysii.

Tapir, Hays: Proc. Ac. Nat. Sc. 1852, 53.

Tapirus Haysii, Leidy: Proc. Ac. Nat. Sc. 1852, 106, 148; 1854, 200; Anc. Fauna. Neb. 1853, 9; Waile's Rep. Agric. &c. Mississippi, 1854, 286; Holmes' Post-pliocene Fos. South Carolina, 1860, 106, Pl. XVII, Figs. 4, 5, 7–10. Cope, Proc. Ac. Nat. Sc. 1869, 3.

Remains, consisting of teeth and jaw fragments, from Kentucky, Indiana and Mississippi, apparently indicate a more robust species than the former one. Quaternary.

LOPHIODON.

Lophiodon occidentalis.

See page 239, Pl. XXI, Figs. 28–30.

Leidy: Proc. Ac. Nat. Sc. 1868, 232.

From the Mauvaises Terres of White River, Dakota; supposed to be derived from the lowest stratum of the tertiary deposit of that locality. Miocene.

Of uncertain reference.

Lophiodon, Owen: Pr. Geol. Soc. London, 1842, III, 693.

PROBOSCIDEÆ.

MASTODON.

Mastodon americanus.

Giants, Cotton Mather: In a letter to Dr. Woodward, in the Philos. Trans. London, 1717, XXIX, 62.

———, Guetard: Mem. Acad. Sc. 1752, XLIX, 349. Camper: Acta Petrop. 1777, Pt. II, 219; Nov. Act. Petrop. 1788, II, 252. Annan: Mem. Am. Acad. 1785, 160. Edwards: Ib. 164. Anon: Columb. Mag. Philada. 1786, 104, Pl. Figs. 1–3. Drayton: View South Carolina, &c., 1802, 39, Pl. Figs. 1, 4, 6, 7, 8.

Elephant, Elephas, Daubenton: Mem. Acad. Sc. 1762, 206. Buffon: Hist. Nat. 1754, XI, 169–172. Collinson: Phil. Trans. London, 1768, LVII, Pt. I, for 1767, 464. 468. Barton: Tilloch's Philos. Mag. 1805, XXII, 97.

Hippopotamus, Daubenton and Buffon as above. Couper: Proc. Ac. Nat. Sc. 1842, 189, 216; Proc. Geol. Soc. London, 1843, 33. Harlan: Am. Jour. Sc. 1842, XLIII, 143.

Pseudelephant, W. Hunter: Phil. Trans. London, 1769, LVIII, for 1768, 34, Pl. IV, Figs. 1, 3, 5.

Animal incognitum, Incognitum, W. Hunter: Ibidem. Camper: Act. Acad. Sc. Imp. Petrop. 1778, Pt. II, 219. Turner: Trans. Am. Phil. Soc. 1799, IV, 510. Ashe: Mem. of Mammoth, Liverpool, 1806.

American Elephant, Pennant: Synop. Quadr. 1771, 91; Hist. Quadr. 1781, I, 160; Ed. 2d, 1793, I, 174. Barton: Med. and Phys. Jour. 1804, I, 158; Suppl. 1806, 22. Madison: Barton's Med. Phys. Jour. 1806, II, 58.

Mammoth, Jefferson: Notes on Virginia, 1782, 69, 73; Ed. 1829, 39. Turner: Trans. Am. Philos. Soc. 1799, IV, 510. R. Peale: Ac. of the Skeleton, &c. London, 1802; Tilloch's Philos. Mag. 1802, XIV, 162, 225, Pl. V, Fig. 1; Hist. Disq. etc. 1803. Barton: Med. and Phys. Jour. 1804, I, 157; Suppl. 1806, 22. Madison: Barton's Med. and Phys. Jour. 1806, II, 58. Ashe: Mem. of Mammoth, 1806. Anon.: Am. Jour. Sc. 1819, I, 239. Stewart: Ib. 1828, XIV, 188. *Mamoth,* C. W. Peale: Catal. Peale's Mus. Philadelphia, 1796, 19. *Mammouth,* Barton: Suppl. to Med. and Phys. Jour. 1806, 22.

Mamonteum, Camper: Nov. Act. Ac. Sc. Imp. Petrop. 1788, 252, Pls. VIII. IX.

Ohio-Incognitum, Blumenbach: Abbild. Naturh. Gegenst. 1797, No. 19, according to DeBlainville's Osteog. Gen. Elephas, 245; Ibidem Göttingen, 1810, No. 19, Pl. 19 A.

*Elephas americanus,** Cuvier: Tabl. Elem. Hist. Nat. (an 6) 1798, 149; Mem. Inst. Nat. Sci. (An VII) 19, 21. Barton: Med. and Phys. Jour. 1806, II, 157; Suppl. 1807, 168.

Mammut ohioticum,† Blumenbach: Naturges. 6th Ed. 1799, 698; 8th Ed. 1807, 730, quoted from

* Cuvier, in the works quoted, and DeBlainville, in his Osteog. Gen. Elephants, 237, 245, attribute this name to Pennant. Falconer and Cautley, in the Fauna Antiq. Sival., 17, also observe, "that Pennant first ventured in 1793 to designate the American fossil animal, in a systematic work, as a species of Elephant by the name of *E. americanus.*" I have been unable to find the name thus expressed in any of the works of Pennant, nearer than the words "American Elephant," which occur in the Synopsis of Quadrupeds of 1771 and in both editions of the History of Quadrupeds, that of 1781 and 1793. Systematically expressed, the name of *Elephas americanus* appears to have been first employed by Cuvier, in attributing it to Pennant.

† The name is first employed by Blumenbach in the sixth edition of the Handb. d. Naturgeschichte, published in Göttingen in 1799. In the fifth edition, published in 1797, page 703, under the head of Incognita, he calls the Mastodon "das famose Land-Ungeheuer der Vorwelt, der *vulgo* so genannte fleischfressende Elephant, dessen Gebeine besonders am Ohio in Nordamerica in Menge ausgegraben werden" Falconer incorrectly attributes the name to the edition of 1797, Palæont. Mem. 1868, I, Note 4 to page 55.

Bronn's Leth. Geog. 1853–6, 823. *Mammout ohioticum*, Man. d'hist. Nat. trad. p. Artaud, 1803, II, 408, Pl. Fig. A. *Mammontheum ohioticum*, imputed to Blumenbach by DeBlainville: Ost. Gen. 1845, Elephas, 237.

Great American Incognitum, R. Peale: Hist. Disq. on the Mammoth, London, 1803.

Elephas macrocephalus, Camper: Desc. Anat. d'un éléphant male, avant. prop. Note p. 10, on authority of Falconer in Palæont. Mem. 1868, 1, 56.

Mastodonte, Cuvier: An. Mus. 1806, VIII, 272; Os. Fos. 1812, II, Gr. Mast. 3; 2d Ed. 1821, I, 208; 3d Ed. 1825, 208; 4th Ed. 1834, II, 252. Ware: Bost. Jour. Philos. 1824, I, 257, 391.

Grand Mastodonte, Cuvier: An. Mus. 1806, VIII, 270; Os. Fos. 1812, II, 1, 42, Pls. I–VIII; 2d Ed. 1821, I, 206, 249; 3d Ed. 1825, I, 206, 249, Pls. 1–VII; V. Pt. 2, 527; 4th Ed. 1834, II, 249; X, 478, Pls. XIX–XXV; Regne Animal, 1817, I, 233. Blainville: Osteog. Gen., Eleph., 1845, 245, 261.

Mastodonte de l'Ohio, Cuvier: An. Mus. 1806, VIII, 412; Ossem. Fos. 1812, II. Div. Mast. 1–12; 2d Ed. 1821, I, 266, 268; 3d Ed. 1825, I, 266, 268; 4th Ed. 1834, II, 368.

Animal de l'Ohio, Cuvier: An. Mus. 1806, VIII, 311; Ossem. Fos. 1812, II, Gr. Mast. 1, 42; 3d Ed. 1825, I, 249; 4th Ed. 1834, II, 324.

Ohio Mammoth, Barton: Suppl. to Med. and Phys. Jour. 1807, 168.

Harpagmotherium Canadense, Fischer: Programme d' invitation, 1808, 19.

Mastodon giganteum,* Cuvier: Regne Animal, 1817, I, 233; 2d Ed. 1829, I, 241; Edit. by Griffith, London, 1827, III, 328; Edit. pub. by Fortin, etc. Paris, —— I, 282. DeKay, etc. An. Lyc. Nat. Hist. New York, 1824, I, 143. Harlan: Fauna. Amer. 1825, 211; Edinb. New Phil. Jour. 1834, XVII, 343; Trans. Geol. Soc. Penna. 1835, I, 47; Med. Phys. Res. 1835, 254. Rensselaer: Am. Jour. Sc. 1826, XI, 246; 1828, XIV, 33. Godman: Am. Nat. Hist. 1826, II, 205, 3 Pls. Hayes: Trans. Am. Phil. Soc. 1834, IV, 317; Proc. do. 1841, II, 103. Croom: Am. Jour. Sc. 1835, XXVII, 169, 170. Couper: Proc. Acad. Nat. Sc. 1842, 189, 216; Proc. Geol. Soc. London, 1843, IV, 33. Owen: Proc. Geol. Soc. Lond. 1842, III, 690. Grant: Ibid. 771. Nasmyth: Ib. 776. Lyell: Ib. 1843, IV, 36; Am. Jour. Sc. 1844, XLVI, 320, 322. Bailey; Ibid. XLVII, 119. Pictet: Traité de Paléont. 1844, I, 245; 2d Ed. 1853, I, 287. Dickeson: Proc. Ac. Nat. Sc. 1846, 106. Giebel: Fauna d.Vorwelt, 1847, I, 201. Wyman: Am. Jour. Sc. 1850, X, 57.

Mastodon, Atwater: Am. Jour. Sc. 1820, II, 345, Pl. 2. Hayden: Geol. Essays 1820, 121. Godman: Jour. Acad. Nat. Sc. Phil. 1825, IV, 73. Rensselaer: Am. Jour. Sc. 1827, XII, 380. Stewart: Ib. 1828, XIV, 187. Gazley: Ib. 1830, XVIII, 139. Guernsey: Ib. 1831, XIX, 358. Cooper, Smith, and Dekay: Ib. 1831, XX, 371; Month. Am. Jour. Geol. 1831, 43; Edinb. New Phil. Jour. 1831, XI, 352. Rafinesque: Month. Am. Jour. Geol. 1831, 355. Troost: Tr. Geol. Soc. Penn. 1834, I, 139, 236. Anon.: Am. Jour. Sc. 1834, XXV, 256; 1835, XXVII, 165. Hildreth: Ib. 1836, XXIX, 146. Miller: Ib. 1837, XXI, 171. Briggs: Sec. An. Rep. Geol. Surv. Ohio 1838, 127. Carpenter: Am. Jour. Sc. 1838, XXXIV, 201; 1839, XXXV, 344; 1846, I, 244, 249. Koch: Ib. 1839, XXXVI, 198; XXXVII, 191; Pr. Geol. Soc. Lond. 1842, III, 714; Trans. Ac. Sc. St. Louis 1856–60, 61, 116, 117. Horner: Pr. Am. Phil. Soc. 1840, I, 279, 307; Trans. do. 1843, VIII, 53. Goddard: Proc. Ac. Nat.

* The earliest date at which I have been able to find the name of *Mastodon* systematically expressed, is in the work here quoted. Previously, Cuvier appears only to have used the gallicized term of Mastodonte. Bronn, in the 3d edition of the Lethæa Geognostica, page 820, credits *Mastodon* to Cuvier as early as 1805, but does not give the reference.

Sc. 1841, 115. Hays: Proc. Am. Phil. Soc. 1841, 103. Plummer: Am. Jour. Sc. 1841, XL, 149. Harlan: Ib. 1842, XLIII, 143; 1843, XLV, 208. Horner and Hays: Trans. Am. Phil. Soc. 1843, VIII, 37, Pls. I—IV. Hays: Proc. Am. Phil. Soc. 1843, III, 45; 1844, IV, 43; 1846, IV, 269. Chaloner: Proc. Ac. Nat. Sc. 1843, 321. Haymond: Am. Jour. Sc. 1844, XLVI, 294. Whipple: Proc. Am. Phil. Soc. 1844, IV, 35. Maxwell: Ib. 118, 127. Gray: Proc. Bost. Nat. Hist. Soc. 1846, 92; Am. Jour. Sc. 1847, III, 436. Hallowell: Proc. Ac. Nat. Sc. 1847, 117, 130. Smith: Am. Quar. Jour. Agric. 1846, III, 19. Adams: Rep. Geol. Vermont 1846, 87, Fig. 5. Anon.: Am. Jour. Sc. 1846, I, 268. Woolworth: Am. Quar. Jour. Agric. 1847, VI, 34, Fig. 2. Whittlesey: Ib. 1848, V, 215. Tuomey: Ib. 1849, VIII, 71. Gibbes: Proc. Am. Assoc. Adv. Sc. 1850, III, 66. Holmes: Ib. 203. Lathrop: Am. Jour. Sc. 1851, XIII, 439. Cottle: Ib. 1853, XV, 282. Blake: Ib. 1855, XIX, 133. Brevoort: Proc. Am. Assoc. Adv. Sc. 1859, XII, 232. Shumard: Trans. Ac. Sc. St. Louis 1860, 678. Wyman: Hall & Whitney's Rep. Geol. Surv. Wisc., and Whitney's Rep. Geol. Surv. Up. Missis. Lead Reg. 1862, 421. Winchell: Am. Jour. Sc. 1864, XXXVIII, 223, 224. Hayden: Proc. Ac. Nat. Sc. 1866, 316. Worthen: Geol. Surv. Illinois, 1866, 315.

Ohio-Elephant, Pander and D'Alton: Skel. d. Pachyd. 1821.

Mastodon maximus, Cuvier: Ossem. Fos., 2d ed. 1824, V, Pt. 2, 527; 3d ed. 1824, V, Pt. 2, 527; 4th ed. 1836, X, 477. Cooper: Month. Am. Jour. Geol. 1831, 160, 206. Meyer: Palæologica 1832, 70. Harlan: Edinb. New Phil. Jour. 1834, XVII, 343; Trans. Geol. Soc. Penn. 1835, I, 47; Med. Phys. Res. 1835, 254. Foster: Sec. An. Rep. Geol. Surv. Ohio 1838, 79. DeKay: Nat. Hist. N. York, Zool. 1842, I, 102. Tuomey: Rep. Geol. S. Carol. 1848, 180, 205. Bronn: Index Pal. 1848, I, 706.

*Mastodon angustidens.** Harlan: Fauna Amer. 1825, 214.

Tapirus mastodontoides, Harlan: Fauna Amer. 1825, 224; Edinb. New Phil. Jour. 1834, XVII, 351; Trans. Geol. Soc. Penn. 1835, I, 59; Med. Phys. Res. 1835, 265. Pictet: Paléont. 1853, I, 302. *Tapir mastodontoides*, Pictet: Paléont. 1844, I, 268.

Tetracaulodon mastodontoideum, Godman: Trans. Am. Philos. Soc. 1830, III, 478, 484, Pls. XVII, XVIII; Jahrb. f. Min. 1831, 120. Meyer: Palæologica 1832, 13.

Mastodon Ohioticum, Jahrb. Min. 1832, 355. Gervais: Zool. Pal. Francaises 1848—52, I, 187.

Tetracaulodon brevirostre, Kaup: Isis 1832, XXV, 630; Jahrb. Min. 1833, 224.

Mastodon giganteus, Kaup: Ossem. Fos. 1832–9, 66, Atlas, Pl. XX. Eichwald: Isis 1834, 682. Bronn: Leth. Geog. 1838, 1235. Owen: Odontog. 1840–5, 616; Brit. Fos. Mam. 1846, 273—278, Fig. 102; Proc. Ac. Nat. Sc. 1846, 93; Anat. of Vertebrates 1866, II, 441. Mantell: Medals of Creation 1844, 832. Anon.: Am. Jour. Sc. 1846, II, 131. Geinitz: Versteinerungskunde 1846, 35. Gibbes: Pr. Am. As. Adv. Sc. 1850, 95. Warren: Mastodon Gigant. 1852; 2d ed. 1855; Am. Jour. Sc. 1855, XIX, 349. Wyman: Am. Jour. Sc. 1853, XV, 48. Leidy: Waile's Rep. Agric. and Geol. Mississippi 1854, 286. Editors: Am. Jour. Sc. 1862, XXXIV. Dawson: Acadian Geology 1868, 83.

Mastodon Cuvieri, Hays: Trans. Am. Phil. Soc. Phila. 1834, IV, 334. Grant: Proc. Geol. Soc. Lond. 1842, 771. Koch: Riesenthiere d. Urwelt 1845.

Mastodon Jeffersoni, Hays: Ibidem. Grant: Ibidem.

* The tooth supposed by Dr. Harlan to belong to this species, and which he states is in the possession of Mr. Wagner, I have seen, and am satisfied that it pertains to *M. americanus*. It is rather smaller than usual, but the transverse angular hills, with the angular unobstructed valleys, are quite characteristic of the latter.

Tetracaulodon Collinsii, Hays: Ibidem. Grant: Ibidem.

Tetracaulodon Godmani, Hays: Ibidem. Koch: Desc. of the Missourium, Lond. 1841, 3; Proc. Geol. Soc. Lond. 1842, III, 715; Riesenth. d. Urwelt. 1845. Grant: Proc. Geol. Soc. Lond. 1842, III, 771. Geinitz: Versteinerungskunde 1846, 36.

Mastotherium, Fischer: Bibliog. Palæont. 1834, 148.

Mastodon tapiroides, Harlan: Med. Phys. Res. 1835, 262.

Missourian, Missurium, Missourium, Koch: Am. Jour. Sc. 1839, XXXVII, 192; Fror. N. Notitz. 1840, 104—106; Jahrb. Min. 1840, 736; Riesenth. d. Urwelt; Desc. of the Missourium, St. Louis 1841; Ibidem, London, 1841. Nasmyth: Proc. Geol. Soc. Lond. 1842, 779.

Tetracaulodon, Hays: Proc. Am. Phil. Soc. 1840, I, 383; 1841, 102, 106; 1842, II, 183, 264; 1843, III, 46; 1845, IV, 269. Owen: Proc. Geol. Soc. Lond. 1842, III, 690. *Tetracauledon*, Horner: Proc. Amer. Phil. Soc. 1840, I, 308.

Leviathan Missourii, Koch: Desc. of the Missourium, 1841, 13; Ibidem, London, 1841, 17.

Tetracaulodon Tapyroides, Koch: Desc. Missourium, Lond. 1841.

Tetracaulodon Osagii, Koch: Ibidem.

Tetracaulodon Kochii, Koch: Pr. Geol. Soc. Lond. 1842, III, 715, 716; Riesenth. d. Urwelt Berlin 1845. Grant: Pr. Geol. Soc. Lond. 1842, III, 771. Nasmyth: Ib. 776, 778. Geinitz: Versteinerungskunde 1846, 37.

Tetracaulodon Tapiroides, Koch: Ibidem.

Tetracaulodon Haysii, Grant: Pr. Geol. Soc. Lond. 1842, III, 771, Koch: Riesenth. d. Urwelt 1845. Geinitz: Verstein. 1846, 37.

Tetracaulodon Bucklandi, Grant: Ibidem. Koch: Ibidem.

Mastodon Collinsii, Kaup: Archiv f. Naturges. 1843, 174. Giebel: Fauna d. Vorwelt 1847, I, Pt. I, 207.

Missourium Theristocaulodon, Koch: Riesenth. d. Urwelt 1845. Geinitz: Verstein. 1846, 39.

Mastodon rugatum, Koch: Ibidem.

Elephas Ohioticus, Blainville: Ost. Gen., Elephas, 1845, 261, 306.

Mastodon Ohioticus, Falconer and Cautley: Fauna Ant. Sivalensis, 1846, 16, Pl. III, Fig. 9; Pls. XLII–XLV, 4. Bronn: Leth. Geog. 1853–6, III, 823, Pl. XLIV, Fig. 6. Kaup: Beitr. Urwelt. Sæugeth. 1857, I, 25. Editors: Canad. Jour. Ind. &c. 1858, III, 356. Owen: Palæontology, 1859, 353. Leidy: Holmes' Post-pliocene Fos. South Carolina, 1860, 108, Pl. XIX, Figs. 1, 2, 3; Proc. Ac. Nat. Sc. 1866, 290. Falconer: Quar. Jour. Geol. Soc. Lond. 1865, XXI, 253; Palæont. Mem. 1868, I, 55, 84, 87, 424, Pl. 7, Fig. 2; II, Pl. I, Fig. 2, Pl. II, Fig. 2.

Dinotherium, Carpenter: Am. Jour. Sc. 1846, I, 249, 250. Holmes: Am. Jour. Sc. 1849, VII, 197; Proc. Am. As. Adv. Sc. 1850, III, 203.

Elephas Rupertianus, Richardson: Zool. Voy. Herald, 1854, 101; Referred to *Mastodon*, 141; Am. Jour. Sc. 1855, XIX, 131.

Mastodon (Trilophodon) Ohioticus, Falconer: Quar. Jour. Geol. Soc. London, 1857, 312–321; Palæont. Mem. 1868, I, 87; II, 6–19.

Mastodon Americanus, Leidy: Proc. Ac. Nat. Sc. 1868, 175.

Trilophodon Ohioticus, Falconer: Palæont. Mem. 1868, II, 176, 204. *T. ohiaticus*, Cope: Cook's Geol. N. Jersey, 1868, 740.

Remains of the ordinary American *Mastodon* have been found throughout the continent of North America. From their size and frequency they are the most familiar of fossils. They are those upon which the name of "Mastodonte" was first applied by Cuvier. Systematically expressed the term of *Mastodon* has become so familiar in ordinary language, that it would be useless to attempt to substitute the earlier, but less agreeable names of *Mamonteum, Mammut* or *Harpagmotherium*. Of specific names, systematically expressed, that of *americanus* is the earliest I have been able to discover, and being peculiarly appropriate is the one I have adopted.

Mastodon mirificus.

See page 249, Pl. XXV, Figs. 1, 2.

Leidy: Proc. Ac. Nat Sc. 1858, 10.
Mastodon (Tetralophodon) mirificus, Leidy: Ibidem, 28.

From the Loup Fork of the Platte River, and also reported to occur on the Niobrara River. Pliocene.

Mastodon obscurus.

See page 244, Pl. XXVII, Figs. 13, 15, 16.

Mastodon angustidens, Meyer: Palæolog. 1832, 71 in part. ? Croom: Am. Jour. Sc. 1835, XXVII, 170. Warren: Proc. Am. Assoc. Adv. Sc. 1850, 93; Desc. Skel. Mast. 1852, Pl. XXVI. Gibbes; Pr. Am. As. Adv. Sc. 1850, III, 69.

Mastodon longirostris, Harlan: Am. Jour. Sc. 1842, XLIII, 143. Charlesworth: Lyell, in Proc. Geol. Soc. Lond. 1843, IV, 38; Am. Jour. Sc. 1844, XLVI, 322. Charlesworth and Harlan: In Lyell, on the Miocene, &c., Quart. Jour. Geol. Soc. Lond. 1845, I, 427.

Mastodon longirostris, s. angustidens, Charlesworth: In Warren on the Mastodon, 1852, Append. 175; 2d Ed. 1855, Ap. 203.

The Baltimore Tooth, Warren: Desc. Skel. Mastodon, 1852, 78; 2d Ed. 1855, 92.

Cast of Mastodon Tooth, Leidy: Proc. Ac. Nat. Sc. 1858, 12; this work, 245, Pl. XXVII, Fig. 13.

Fragments of Mastodon Teeth from Tarboro, N. C., Leidy: This work, p. 247, Pl. XXVII, Fig. 16.

? *Mastodon giganteus*, Emmons: Rep. N. Carolina Geol. Surv. 1858, 198, Fig. 23.

Mastodon of the Miocene, Emmons: Man. Geol. 1860, 216, 218, 237, Figs. 186, 205.

Tetralophodon, Emmons: Man. Geol. 1860, 237, Fig. 205.

Mastodon ——— ? Leidy: The present work, p. 245, Pl. XXVII, Figs. 13, 15, 16.

Apparently a species distinct from the preceding, indicated by specimens from North Carolina and Georgia. Other specimens, from unknown localities, supposed, however, to be American, probably belong to the same. One of the latter was referred to a species by Dr. Hays under the name of *M. Chapmani*,* but Dr. Hays expresses the opinion to me that this is distinct from the former. Under the circumstances I propose to distinguish the species represented by the undoubted American specimens by the name heading this article. The species has been suspected to be of miocene age. I have included it in the catalogue of quaternary mammals on page 357.

* See page 248.

Mastodon andium?

See page 242, Pl. XXVII, Fig. 14.

? *Mastodon resembling M. angustidens*, Meyer: Jahrb. f. Min. 1840, 581.

Mastodon giganteus, LeConte: Proc. Ac. Nat. Sc. 1858, 7.

Mastodon ohioticus, Leidy: Proc. Ac. Nat. Sc. 1859, 91.

Tambla Mastodon, Leidy: The present work, page 242, Pl. XXVII, Fig. 14.

? *Rhyncotherium*, Falconer's Palæont. Mem. 1868, II, 75.

A tooth from Tambla, Honduras, probably belongs to this species. Quaternary.

Undetermined.

Mastodon, from Bahama: Edinb. New Phil. Jour. 1826, I, 395.

ELEPHAS.

Elephas primigenius.

? *Mammoth*, from Hudson's Bay: Edinb. New Phil. Jour. 1826, I, 395.

Elephant, Buckland: Appendix to Beechey's Nar. of a Voyage to the Pacific, 1831, 594–5, Pls. I, II.

Elephas primigenius, Richardson: Zool. Voy. Herald, 1854, 11.

Remains in the ice-cliffs of Eschscholtz Bay, Alaska, probably belong to the same species as the Mammoth of Northern Europe and Asia, which we view as distinct from the more southern American Elephant. Quaternary.

Elephas americanus.

Elephant, or *Elephas*, Catesby: Nat. Hist. Carolina, 1731, I; Account of Carolina p. VII; Ibid. of 1771. Drayton: View of South Carolina, &c. 1802, 40, 41, Pl. Fig. 5. Peale: Hist. Disq. Mammoth, Lond. 1803, 68. Barton: Philos. Mag. Lond. 1805, XXXII, 98. Cuvier: An. d. Mus. 1806, 129. Mitchell: Obs. on Geol. N. Amer. 1818, 362, 384, 394, 401, 429, Pl. VI, Figs. 2, 3, 5, 6; Catal. Org. Rem. N. York 1826, 10. Rensselaer: Am. Jour. Sc. 1828, XIV, 31. Gazley: Ib. 1830, XVIII, 139. Cooper, Smith and Dekay: Ib. 1831, XX, 371; Month. Am. Jour. Geol. 1831, 43; Edinb. New Phil. Jour. 1831, XI, 353. Long: Month. Am. Jour. Geol. 1831, 2, 565. Anon.: Am. Jour. Sc. 1834, XXV, 256. Harlan: Med. Phys. Res. 1835, 359, Pl.; Amer. Jour. Sc. 1842, XLIII, 143. Hildreth: Proc. Am. Jour. Sc. 1836, XXIX, 146. Briggs: First An. Rep. Geol. Surv. Ohio 1838, 96. Foster: Amer. Jour. Sc. 1839, XXXVI, 190; Pr. Am. Assoc. Adv. Sc. 1857, X, 148. Horner: Proc. Am. Phil. Soc. 1840, I, 279. Meyer: Jahrb. f. Min. 1840, 581. Perkins: Am. Jour. Sc. 1842, XLII, 137. Phillips: Pr. Geol. Soc. Lond. 1842, III, 705. Chaloner: Proc. Ac. Nat. Sc. 1843, 321. Hays: Pr. Am. Phil. Soc. 1844, IV, 43. Lyell: Pr. Geol. Soc. Lond. 1843, IV, 36; Am. Jour. Sc. 1844, XLVI, 320; 1847, III, 37. Carpenter: Ib. 1846, I, 249. Whittlesey: Ib. 1848, V, 215. Thompson: Ib. 1850, IX, 256. Agassiz: Pr. Am. Assoc. Adv. Sc. 1850, II, 100. Holmes: Ib. 203. Gibbes: Ib. III, 69. Anon.: Am. Jour. Sc. 1853, XV, 146. Wyman: Ibid. 1857, X, 148. Anon.: Ib. 1858, XXV, 283. Shumard: Trans. Ac. Sc. St. Louis 1856—60, 678. Clew and Leidy: Proc. Ac. Nat. Sc. 1866, 109.

Second Incognitum, Ashe: Mem. of Mammoth, Liverpool 1806, 18.

Elephas primigenius, Barton: Med. Phys. Jour. 1806, II, 157; Suppl. 1807, 168. Cuvier: Os. Fos. II, 1812, 55—57, 135; 3d ed. I, 1825, 153—158, 199; 4th ed. II, 1834, 236, Pl. XV, Figs. 9—11. Cooper: Am. Month. Jour. Geol. 1831, 168, 206. Anon.: Am. Jour. Sc. 1837, XXXII, 377. Meyer: Palæologica 1832, 64, in part. Dekay: Nat. Hist. N. York, Zool. I, 1842, 100. Owen: Pr. Geol. Soc. Lond. 1842, III, 693; Brit. Fos. Mam. 1846, 238, 261. De Blainville: Ost. Gen., Eleph. 1845, 357, Pl. VIII, 6d. Geinitz: Versteinerungskunde 1846, 33 in part. Giebel: In part, Fauna d. Vorwelt I, 1847, 208. Gervais: Zool. Pal. Fran. 1848—52, I, 187. Agassiz: Proc. Amer. Assoc. Adv. Sc. 1850, 69. Cottle: An. Mag. Nat. Hist. 1852, X, 396; Amer. Jour. Sc. 1853, XV, 282. Pictet: Traité Paléont. 1853, I, 284. Bronn: Leth. Geog. 1853—1856, III, 814. Richardson: Zool. Voy. Herald 1854, 11, 142. Anon.: Am. Jour. Sc. 1855, XIX, 132. Blake: Ib. 132. Warren: Mastodon giganteus 1855, 158, Pl. 28. Falconer, in part: Quart. Jour. Geol. Soc. Lond. 1857, XIII, 307; 1858, XIV, 84; 1865, XXI, 253; Nat. Hist. Rev. 1863, 43, in part. *E. primogenius*, Harlan: Fauna Amer. 1825, 207; Edinb. New Philos. Jour. 1834, XVII, 350; Med. Phys. Res. 1835, 263; Tr. Geol. Soc. Pa. 1835, I, 57. Godman: Am. Nat. Hist. 1826, II, 255. Foster: Second An. Rep. Geol. Surv. Ohio 1838, 79. Couper: Proc. Acad. Nat. Sc. 1842, 189. Wylie: Amer. Jour. Sc. 1859, XXVIII, 283. *Elaphus primagenius*, Troost: Tr. Geol. Soc. Pa. 1835, I, 143. *Elephus primigenius*, Leidy: Waile's Rep. Agric. and Geol. Mississippi, 1854, 286.

Elephas Mammonteus, Barton: Med. Phys. Jour. 1806, II, 157; Suppl. 1807, 168.

Asiatick Elephant, Hayden: Geol. Essays 1820, 121.

Mammoth, Briggs: First An. Rep. Geol. Surv. Ohio 1838, 96. Couper: Pr. Ac. Nat. Sc. 1842, 189, 217; Pr. Geol. Soc. Lond, 1843, IV, 33.

Elephas Jacksoni, Anon.: Am. Jour. Sc. 1838, XXXIV, 358, 363, Fig. *a*. Mitchell: Ibid. 1864, XXXVIII, 223. Falconer: Palæont. Mem. 1868, II, 239.

Elephas Americanus, Dekay: Nat. Hist. N. York, Zool. 1842, I, 101, Pl. XXXII, Fig. 2. Woolworth: Amer. Quar. Jour. Agric. 1847, VI, 31, Fig. 1. Leidy: Anc. Fauna Neb. 1853, 9; Holmes' Post-plioc. Fos. S. Carolina 1860, 108, Pl. XVIII.

Megatherium, Haymond: Am. Jour. Sc. 1844, XLVI, 294.

Elephas (Euelephas) Columbi, Falconer: Quart. Jour. Geol. Soc. 1857, XIII, 319; 1858, XIV, 84; Nat. Hist. Rev. 1863, 43, Pls. I, II; Palæont. Mem. 1868, II, 14, 214, Pl. X, Figs. 1, 2.

Elephas (Euelephas) primigenius, Falconer: Quart. Jour. Geol. Soc. 1857, XIII, 319 in part; Palæont. Mem. 1868, I, II, 14, 158—254 in pt.

Elephas Texianus, Owen: Rep. Brit. Assoc. Leeds 1858, Address, p. 84; Palæontology, 2d ed., 1861, 395. Blake: Geologist, 1861, IV, 470; 1862, V, 57.

Elephas imperator, Leidy: Proc. Ac. Nat. Sc. 1858, 10.

Elephas (Euelephas) imperator, Leidy: Ib. 29.

Euelephas Jacksoni (Briggs and Foster), Billings: Canad. Nat. and Geol. 1863, VIII, 135, 147, Figs. 1—5; Geol. Surv. Canada 1863, 914, 966, 967, Figs. 495—8.

Euelephas Columbi, Falconer: Palæont. Mem. 1868, II, 211—234.

Elephas Columbi, Falconer: Ibid. 212—234.

Remains, generally consisting of the least perishable part,—that is to say, teeth,—have been found throughout the continent of North America. Not unfrequently found in association with the more numerous and better preserved remains of the *Mastodon americanus*. The animal was probably of earlier origin, and became earlier extinct than the latter. Pliocene? and post-pliocene. For the species I have adopted DeKay's name of *E. americanus*. The earlier one, *E. Jacksoni*, applied to a specimen by an anonymous writer, as he observes, for convenience from the place near which it was found, if adopted, to be correct, should be *E. Jacksonensis*.

In a recent visit to New Haven, Conn., in the Museum of Yale College I saw the fragment of a lower molar of an Elephant, from near Real del Monte, sixty miles north of the city of Mexico. The tooth is of the coarse-plated variety, and presented seven double plates and a single plate in a space of four and three-quarter inches.

SOLIDUNGULA.

EQUIDÆ.

EQUUS.

Equus fossilis.

Horse, Buckland: Beechey's Nar. Voy. Pacific 1831, Appendix, 595, Pl. III, Figs.
Equus fossilis, Richardson: Zool. Voy. Herald 1854, 17.

Remains found in the frozen cliffs of Eschscholtz Bay, Alaska, may probably belong to the same species as the *Equus fossilis* of Europe, the probable ancestor of the Domestic Horse of to-day. Quaternary.

Equus major.

Horse, Equus, Mitchell: Cat. Org. Rem., N. York 1826, 7, 8. Cooper: Month. Am. Jour. Geol. 1831, 207; Am. Jour. Sc. 1831, XX, 371; Edinb. New Phil. Jour. 1831, XI, 353. Carpenter: Am. Jour. Sc. 1838, XXXIV, 201, Figs. 1—3. Dickerson: Proc. Acad. Nat. Sc. 1846, 106. Leidy: Proc. Acad. Nat. Sci. 1847, 328, Pl. Fig. 6, *supposed new species.* In part of Tuomey: Rep. Geol. S. Carolina 1848, 165, 166, 208. Gibbes: Pr. Am. As. Adv. Sc. 1849, II, 193, *resembling E. plicidens*; 1850, III, 66, *supposed new species.* Holmes: Ibid. 68.
Equus major, DeKay: Nat. Hist. New York, Zool. I, 1842, 108. Leidy: The present work, p. 265.
Equus Americanus, Leidy: Pr. Ac. Nat. Sc. 1847, 265, Pl. II, 328; 1851, 140; 1853, 241; 1854, 200. Gibbes: Pr. Amer. Assoc. Adv. Sc. 1849, II, 194; 1850, III, 66. Pictet: Traité de Paléont. 1853, I, 318.
Equus complicatus, Leidy: Pr. Ac. Nat. Sc. 1858, 11; 1868, 175; Holmes' Post-pli. Fos. S. Carol. 1860, 100, Pl. XV, Figs. 2—5, 7, 9, 11—15, XVI, Figs. 19—22, 24—26, 30, 31; The present work, page 265.

Remains of an extinct species, about as large as the corresponding parts of the largest living varieties of the Domestic Horse, found in association with remains of *Mastodon americanus*, *Megalonyx Jeffersoni*, etc. Molar teeth generally distinguishable by the comparatively complex course of the enamel lines on the triturating surfaces.

For the species I have adopted the name of DeKay, as it was evidently to this one he refers, although he gave no distinctive character other than size. Quaternary.

Equus fraternus.

Horse, Equus, Cooper, etc.: Am. Jour. Sc. 1881, XX, 370. Hildreth: Ibid. 1836, XXIX, 146. Harlan: Ibid. 1842, XLIII, 143. Couper: Proc. Ac. Nat. Sc. 1842, 189, 216; Proc. Geol. Sc. Lond. 1843, IV, 33. Lyell: Ibid. 36–39. Owen: Am. Jour. Sc. 1844, XLVI, 323; Pr. Ac. Nat. Sc. 1846, 93; Jour. Ac. Nat. Sc. 1847, 18. Holmes: Pr. Am. As. Adv. Sc. 1850, III, 203.

Equus caballus, Harlan: Edinb. New Phil. Jour. 1834, XVII, 352; Med. Phys. Res. 1835, 267; Trans. Geol. Soc. Penn. 1835, I, 61.

Equus curvidens, Leidy: Proc. Ac. Nat. Sc. 1847, 263. Gibbes: Pr. Am. As. Adv. Sc. 1849, II, 193; 1850, III, 66. Pictet: Traité de Paléon. 1853, I, 318, in part.

Equus fraternus, Leidy: Proc. Ac. Nat. Sc. 1858, 11; Holmes' Post-plio. Fos. S. Carolina, 1860, 100, Pl. XV, Figs. 6, 8, 16–18; XVI, Figs. 23, 27–29; the present work, page 265.

Remains of a Horse found in association with the former, but undistinguishable anatomically from the corresponding parts of ordinary varieties of the Domestic Horse, have been supposed to indicate a peculiar species, distinguished by the above name. Quaternary.

Equus excelsus.

See page 266, Pl. XIX, Fig. 39; XXI, Fig. 31.

Leidy: Proc. Ac. Nat. Sc. 1868, 26.

Equus occidentalis, Leidy: Proc. Ac. Nat. Sc. 1865, 94.

Remains from the Pawnee Loup branch of the Platte or Nebraska River, and from the sands of the Niobrara River, Nebraska. They agree in size with corresponding parts of the ordinary Domestic Horse. Similar remains from California probably belong to the same species. Quaternary.

Equus pacificus.

Leidy: Proc. Acad. Nat. Sc. 1868, 195,

Indicated by teeth from Martinez, Contra Costa County, California. A large species, with extreme simplicity in the folding of the enamel in the upper molars. Quaternary.

Equus parvulus.

Equus, Leidy: Proc. Ac. Nat. Sc. 1868, 195.

Equus parvulus, Marsh: Am. Jour. Sc. 1868, XLVI, 374; An. Mag. Nat. Hist. 1869, III, 95.

Remains from a tertiary deposit at Antelope Station, Nebraska, 450 miles west of Omaha. Pliocene?

The remains probably belong to the same species as some of the abundant solipedal fossils of the Niobrara sands.

Equus conversidens.

Owen: Pr. Roy. Soc. Lond. 1869, XVII, 267.

Remains from the newer tertiary deposits of the valley of Mexico.

Equus tau.

Owen: Pr. Roy. Soc. Lond. 1869, XVII, 267.

Remains from the same locality as the preceding.

Of uncertain reference.

Equus, LeConte: Proc. Ac. Nat. Sc. 1858, 7.

Remains from Tambla, Honduras.

Caballo, DeCastro: De la Exist. de grandes Mam. Fos. en la Isla de Cuba, Habana, 1865, 5.

Remains in Cuba.

PROTOHIPPUS.

Protohippus perditus.

See page 275, 327, Pl. XVII, Figs. 1, 2; XXVII, Fig. 5.

Equus (Protohippus) perditus, Leidy: Proc. Ac. Nat. Sc. 1858, 26.

Remains from the Niobrara River, Nebraska, and Little White River, Dakota. Pliocene.

Protohippus placidus.

See pages 277, 328, Pl. XVIII, Figs. 39–48; XXVII, Figs. 6, 7.

Remains from the Niobrara River, Nebraska, and Little White River, Dakota. Pliocene.

Protohippus supremus.

See page 328, Pl. XXVII, Figs. 3, 4.

Remains from Little White River, Dakota. Pliocene.

HIPPARION.

Hipparion venustum.

Leidy: Proc. Ac. Nat. Sc. 1853, 241.

Hippotherium venustum, Leidy: Holmes' Post-pliocene Fossils South Carolina, 1860, 105, Pl. XVI, Figs. 32, 33.

From the post-pliocene formation near Charleston, South Carolina.

Hipparion occidentale.

See pages 281, 326, Pl. XVIII, Figs. 1–5; XXVII, Fig. 2.

Leidy: Proc. Ac. Nat. Sc. 1856, 59; 1857, 89; 1858, 27.

Hippotherium occidentale, Leidy: Proc. Ac. Nat. Sc. 1858, 27.

From a superficial layer of the tertiary deposits of the Mauvaises Terres of White River and from Little White River, Dakota. Pliocene.

Hipparion speciosum.

See page 282, Pl. XVIII, Figs. 6–19.

Hippodon speciosus, Leidy: Proc. Ac. Nat. Sc. 1854, 90.

Hipparion (Hippodon) speciosum, Leidy: Proc. Ac. Nat. Sc. 1856, 311; 1857, 89; 1858, 27.

Hipparion speciosum, Leidy: Proc. Ac. Nat. Sc. 1858, 27.

From Bijou Hill, Dakota, the Niobrara River, Nebraska, and Washington County, Texas. Pliocene.

Hipparion affine.

See page 286, Pl. XVIII, Figs. 20–24.

Remains from the Niobrara River. Pliocene.

Hipparion gratum.

See pages 287, 326, Pl. XVIII, Figs. 25—30.

Remains from the Niobrara River, Nebraska, and Little White River, Dakota. Pliocene.

MERYCHIPPUS.

Merychippus insignis.

See page 296, Pl. XVII, Fig. 3—7.

Leidy: Proc. Ac. Nat. Sc. 1856, 311; 1857, 89; 1858, 27.

From Bijou Hill, Dakota, the Niobrara River, Nebraska, and from Washington Co., Texas. Pliocene.

Merychippus mirabilis.

See page 299, 327, Pl. XVII, Figs. 8—15; XXVII, Fig. 1.

Leidy: Proc. Ac. Nat. Sc. 1858, 27.

From the Niobrara River, Nebraska. Pliocene.

ANCHITHERIDÆ.

ANCHITHERIUM.

Anchitherium Bairdi.

See page 303, Pl. XX.

Palæotherium Bairdii, Leidy: Proc. Ac. Nat. Sc. 1850, 122.

Anchitherium Bairdii, Leidy: Owen's Rep. Geol. Surv. &c. 1852, 572; Anc. Fauna Neb. 1853, 67, Pl. X, Figs. 14—21, XI; Proc. Ac. Nat. Sc. 1853, 392; 1857, 89.

Remains from the Mauvaises Terres of White River, Dakota. Miocene.

HYPOHIPPUS.

Hypohippus affinis.

See page 311, Pl. XXI, Figs. 11—12.

Anchitherium (*Hypohippus*) *affinis,* Leidy: Proc. Ac. Nat. Sc. 1858, 26.

From the sands of the Niobrara River, Nebraska. Pliocene.

PARAHIPPUS.

Parahippus cognatus.

See page 314, Pl. XXI, Figs. 7—10.

Anchitherium Parahippus) cognatus, Leidy: Proc. Ac. Nat. Sc. 1858, 26.

From the sands of the Niobrara River, Nebraska. Pliocene.

ANCHIPPUS.

Anchippus texanus.

See page 312, Pl. XXI, Fig. 13.

Leidy: Proc. Ac. Nat. Sc. 1868, 231.

From the tertiary of Washington Co., Texas. Miocene?

ANCHIPPODUS.

Anchippodus riparius.

Leidy: Proc. Ac. Nat. Sc. 1868, 232.

Indicated by a tooth from a tertiary formation, probably miocene, of Shark River, Monmouth Co., New Jersey.

The tooth, represented in figs. 45, 46, plate XXX, would appear to correspond with a first or second lower true molar of a ruminant, or with any of the series between the first and last molars in *Palæotherium* or *Anchitherium*. The crown is much worn, even so as to obliterate some of its distinctive features. It is composed of a pair of demi-conoidal lobes, one before the other, the plane side internally, the convex and sloping side externally. From each lobe descends a fang in the usual manner. No fold, and only a feeble basal tubercle occupies the deep external angular interval between the lobes. The worn triturating surface presents, on the anterior lobe, a wide crescentoid tract of exposed dentine, slightly concave and bordered with thick enamel. The anterior arm of the crescent is obtuse; the posterior extends less inwardly and is acute. The posterior lobe exhibits a half ellipsoidal tract of dentine, nearly straight at its inner margin, and bordered with enamel, except behind, where it has all disappeared. The dentinal tracts of the two lobes are connected by a narrow isthmus. The enamel is thick, black and shining, and though it appears to have been originally more or less rough, yet it is now nearly smooth. The measurements of the specimen in its present condition are as follow:

Fore and aft diameter of the crown, ten lines; breadth of posterior lobe obliquely at base of the enamelled crown, nine and a half lines; breadth of anterior lobe in same position, eight and a quarter lines; breadth of worn triturating surface of posterior lobe, six lines; breadth of do. on anterior lobe, five and a half lines.

RODENTIA.

LEPORIDÆ.

LEPUS.

Lepus sylvaticus.

Leidy: Trans. Am. Phil. Soc. 1857, XI, 18; Holmes' Post-pliocene Fossils of South Carolina, 1860, 113; Hall and Whitney's Rep. Geol. Sur. Wisc. and Whitney's do. Up. Missis. Lead Region, 1862, 424.

Remains, associated with those of *Platygonus,* found in the crevices of the lead-bearing rocks near Galena, Illinois. Also in the post-pliocene deposit of Ashley River, near Charleston, South Carolina.

PALÆOLAGUS.

Palæolagus Haydeni.

See page 331, Pl. XXVI, Figs. 14–20.

Leidy: Proc. Ac. Nat. Sc. 1856, 89; 1857, 89.

From Bear Creek, a tributary of the Sheyenne River, and from the Mauvaises Terres of White River, Dakota. Miocene.

SCIURIDÆ.

SCIURUS.

Sciurus panolius.

Cope: Proc. Ac. Nat. Sc. 1869, 3.

Remains found in a limestone breccia, in association with those of *Megalonyx,* etc., in Wythe County, Virginia. Quaternary.

TAMIAS.

Tamias lævidens.

Cope: Proc. Ac. Nat. Sc. 1869, 3.

Remains found in association with the preceding.

ARCTOMYS.

Arctom s monax.

Leidy: Trans. Am. Phil. Soc. 1857, XI, 18; Hall and Whitney's Rep. Geol. Surv. Wisc. and Whitney's do. Up. Missis. Lead Region, 1862, 424.

Teeth found in association with remains of *Platygonus* in crevices of the lead-bearing rocks near Galena, Illinois. Quaternary and recent.

? Arctomys ——.

Stereodectes tortus, Cope: Proc. Ac. Nat. Sc. 1869, 3.

Based on an incisor tooth, from a bone breccia, from Wythe County, Virginia. The characters upon which both species and genus are founded appear to me abnormal. The distortion and unusual solidity indicated by Prof. Cope are probably due to growth unopposed by the corresponding tooth of the other jaw, which had been lost. Such a condition is not unfrequently observed in the *Arctomys monax,* etc.

ISCHYROMYS.

Ischyromys typus.

See page 335, Pl. XXVI, Figs. 1–6.

Leidy: Proc. Ac. Nat. Sc. 1856, 89; 1857, 89.

Bear Creek, a tributary of the Sheyenne River, and Mauvaises Terres of White River. Miocene.

CASTORIDÆ.

CASTOR.

Castor canadensis.

Beaver, Hall: Nat. Hist. N. York, Geol. Pt. IV, 1843, 367.

Castor fiber, americanus, Wyman: Am. Jour. Sc. 1850, X, 61, Fig. 4.

Castor canadensis, Leidy: Holmes' Post-pliocene Fossils South Carolina, 1860, III, Pl. XXI, Fig. 2.

Remains have been found in association with those of *Mastodon* and other extinct animals, or in similar positions. They have been reported from Memphis, Tennessee; Ashley River, South Carolina; from New York and New Jersey.

Castor tortus.

See page 341, Pl. XXVI, Figs. 21, 22.

Castor (Eucastor) tortus, Leidy: Proc. Ac. Nat. Sc. 1858, 23.

From the sands of the Niobrara River, Nebraska. Pliocene.

CASTOROIDES.

Castoroides ohioensis.

Foster: Am. Jour. Sc. 1837, XXXI, 80–83, Figs. 15–17; Second Rep. Geol. Surv. Ohio, 1838, 80. Hall and Wyman: Boston Jour. Nat. Hist. 1847, V, 385, Pls. XXXVII–XXXIX. Whittlesey: Am. Jour. Sc. 1848, V, 215. Wyman: Am. Jour. Sc. 1850, X, 63, Fig. 5. Agassiz: Proc. Am. Assoc. Cincin. 1851, V, 179. LeConte: Proc. Ac. Nat. Sc. 1852, 53. Pictet: Traité de Paléont. 1853, I, 253. Leidy: Holmes' Post-pliocene Fossils S. Carolina, 1860, 114, Pl. XXII, Figs. 5–8; Proc. Ac. Nat. Sc. 1857, 97. Bronn: Leth. Geog. 1856, 1046, Pl. LIX, Fig. 8.

Extinct animal of the order Rodentia, Am. Jour. Sc. 1837, 80, Figs. 15, 17. Harlan: Bul. Soc. Geol. de France, 1839, X, 89.

Castor (Trogontherium?) ohioense, DeKay: Nat. Hist. N. York; Zool. I, 1842, 75, Pl. XIX, Fig. 3.

An entire skull found near Clyde, Wayne County, New York; two rami of lower jaws and a radius, near Nashport, Licking County, Ohio; the ramus of a lower jaw, at Memphis, Tennessee; two molars, an upper incisor and two petrous bones, near Shawneetown, Illinois; and fragments of teeth on the shore of the Ashley River, South Carolina.

Hall (Bost. Jour. Nat. Hist. 1847, 391,) and Wyman (Am. Jour. Sc. 1850, 64,) also report the discovery of remains near Natchez, Mississippi, and in Louisiana.

Recently a skull was submitted to the inspection of the author which was found in ploughing a field near Charleston, Coles County, Illinois. Quaternary.

PALÆOCASTOR.

Palæocastor nebrascensis.

See page 338, Pl. XXVI, Figs. 7–11.

Steneofiber Nebrascensis, Leidy: Proc. Ac. Nat. Sc. 1856, 89; 1857, 89.

Chalicomys Nebrascensis, Leidy: Proc. Ac. Nat. Sc. 1857, 176.

From the Mauvaises Terres of White River, Dakota. Miocene.

PSEUDOSTOMIDÆ.

GEOMYS.

Geomys bursarius.

Pseudostoma bursarius, Leidy: Trans. Am. Phil. Soc. 1857, XI, 18; in Hall and Whitney's Rep. Geol. Surv. Wisc. and Whitney's do. Up. Missis. Lead Region, 1862, 424.

Geomys bursarius, Leidy: Proc. Ac. Nat. Sc. 1867, 97.

Teeth found in association with remains of *Platygonus* in crevices of the lead-bearing rocks near Galena, Illinois. An entire skull, thoroughly petrified, found in association with remains of *Mastodon* and Elephant in the loess at the mouth of the Platte River, Nebraska.

ARVICOLIDÆ.

ARVICOLA.

Arvicola riparia?

Arvicola, Leidy: Trans. Am. Phil. Soc. 1857, XI, 18; Hall and Whitney's Rep. Geol. Wisconsin and Whitney's do. Up. Missis. Lead Region, 1862, 424.

Teeth of an *Arvicola* about the size of those of the living *A. riparia* were found in association with remains of *Platygonus*, in the same condition of preservation, in crevices of the lead-bearing rocks near Galena, Illinois.

FIBER.

Fiber zibethicus.

Muskrat, Holmes: Proc. Am. As. Adv. Sc. 1850, III, 201.

Fiber zibethicus, Leidy: Holmes' Post-pliocene Fossils of South Carolina, 1860, 113, Pl. XXII, Figs. 2–4.

Remains found in association with those of *Mastodon* and other extinct animals in the post-pliocene formation on the Ashley River, near Charleston, South Carolina. Also found with *Mastodon* remains in New Jersey.

MURIDÆ.

NEOTOMA.

Neotoma magister.
Baird: U. S. Pacific R. R. Expl. etc. VIII, 1857, 498, Pl. LIII, Fig. 4.

The species is based by Prof. Baird on specimens of lower jaws, found with other animal remains, in caves near Carlisle, Pennsylvania.

The Museum of the Academy contains the greater part of a skull and the ramus of a lower jaw of a *Neotoma* about the size of those of *N. floridana*, found with a multitude of other bones, mostly of living species, in Durham Cave, Bucks Co., Pa.

EUMYS.

Eumys elegans.
See page 342, Pl. XXVI, Figs. 12, 13.
Leidy: Proc. Ac. Nat. Sc. 1856, 90; 1857, 89.

Bear Creek, a tributary of the Sheyenne River, Dakota. Miocene.

CHINCHILLIDÆ.

AMBLYRHIZA.

Amblyrhiza inundata.
Cope: Proc. Ac. Nat. Sc. 1868, 313.

Indicated by remains of a large rodent from the cave deposits of Anguilla, W. I. Post-pliocene.

LOXOMYLUS.

Loxomylus longidens.
Cope: MS. Proc. Ac. Nat. Sc. May 4, 1869.

Remains found in association with the preceding.

HYSTRICIDÆ.

HYSTRIX.

Hystrix venustus.
See page 343, Pl. XXVI, Figs. 23, 24.
Hystrix (Hystricops) venustus, Leidy: Proc. Ac. Nat. Sc. 1858, 22.

Sands of the Niobrara River. Pliocene.

CAVYIDÆ.

HYDROCHŒRUS.

Hydrochœrus Æsopi.
Oromys Æsopi, Leidy; Proc. Acad. Nat. Sci. 1853, 241. Bronn: Leth. Geog. 1856, III, 1050.

Hydrochœrus Æsopi, Leidy: Proc. Ac. Nat. Sc. 1856, 165; Holmes' Post-pliocene Fossils of South Carolina, 1860, 112, Pl. XXI, Figs. 3—6.

Teeth found in the post-pliocene deposit on the Ashley River, near Charleston, South Carolina.

INSECTIVORA.

LEPTICTIS.

Leptictis Haydeni.

See page 345, Pl. XXVI, Figs. 25—28.

Leidy: Proc. Ac. Nat. Sc. 1868, 315.

Mauvaises Terres of White River, Dakota. Miocene.

ICTOPS.

Ictops dakotensis.

See page 351, Pl. XXVI, Figs. 29, 30.

Leidy: Proc. Ac. Nat. Sc. 1868, 316.

From same locality with former.

ANOMODON.

Anomodon Snyderi.

Le Conte: Am. Jour. Sc. 1848, V, 106, Fig. Pictet: Traité de Paléont. 1853, I, 179. Leidy: Jour. Ac. Nat. Sc. 1856, 171, Pl. 17, Figs. 25, 26. Bronn: Leth. Geog. 1856, III, 1064.

Indicated by an isolated tooth, supposed to be a canine, of peculiar character. It was found in association with remains of *Platygonus*, &c., in the crevices of the lead-bearing rocks in the vicinity of Galena, Illinois. Post-pliocene. The genus is of uncertain reference, and is only suspected to be that of a large insectivorous animal.

OMOMYS.

Omomys Carteri.

Leidy: Proc. Ac. Nat. Sc. 1869, 63.

Indicated by portions of a skull, together with the greater portion of a ramus of the lower jaw, discovered by Mr. J. Van A. Carter in a tertiary formation near Fort Bridger, Wyoming. The skull was reduced to useless fragments; the ramus of the lower jaw with teeth was the only characteristic part preserved. This specimen is represented in figures 13, 14, plate XXIX, magnified four diameters. It indicates an insectivorous animal allied to, if not belonging to the family of the Hedge-hogs. Among living Insectivora, described and figured by DeBlainville, Gervais, Peters, Mivart, and others, the jaw fragment approaches most nearly in size and form the corresponding portion in the representations of *Tupaia ferruginea*, of Java and neighboring isles. It likewise nearly resembles in size and form the corresponding portion of a fossil jaw, found in a miocene formation of Sansan, France, and referred to an insectivorous animal with the name of *Galerix viveroides*. The extremities of the ramus are lost, and the remaining portion contains four molar teeth. The depth of the jaw below the position of the latter measures about two lines, and is nearly uniform. The base is but slightly convex fore and aft, below the position of the teeth. Back of these to the broken end of the specimen it is slightly concave. The mental foramen is below the position of the second premolar, and the symphysial articulation reached as far back as the third. The masseteric impression is well marked, and well defined about two lines back of the position of the second true molar.

Seven molar teeth, in an unbroken series, appear to have occupied the side of the jaw. Four appear to have been double-fanged premolars, with laterally compressed conical crowns. Only the third and fourth of the latter are preserved. The alveoli of the second are retained, and also the inner side of what appears to be a pair for the first premolar.

The last true molar, which has lost its crown in the specimen, appears to have been a double-fanged tooth, constructed like those in advance.

The teeth in the specimen from the third premolar to the second true molar successively, and after the former, gradually decline in height or prominence.

The third and fourth premolars nearly resemble in general form and proportions the second and third premolars of the Opossums. The true molars are constructed on the same general pattern as those of the genera *Sorex*, *Erinaceus*, *Gymnura*, *Potomogale*, *Galeopithecus*, and the Opossums. All the teeth are provided externally with a basal cingulum or ridge, nowhere elevated into points or cusps.

The crown of the third premolar, more prominent than in any other tooth, is triangular, longer than broad, pointed, and thicker posteriorly. Its anterior border is acute and slightly convex in the length; the posterior outline, formed by the back part of the outer convex surface, is slightly concave. The inner surface, narrower than the outer, presents at its fore part below a narrow ledge, feebly continuous forward, as an element of the basal cingulum. This is best developed as a talon at the back of the crown, and least externally and postero-internally. The outer surface of the crown, convex transversely, is continuous posteriorly.

The fourth premolar has nearly the same form as the preceding tooth, but its crown is lower and wider. The basal cingulum is rather better developed externally and less so antero-internally. The inner surface is sensibly concave, and the ridge defining it from the postero-external surface exhibits a feeble tendency to form an accessory point.

The crowns of the two succeeding true molars, retained in the specimen, are nearly alike in size and form, though the first is in a trifling degree wider and higher. They are bounded by a well marked basal cingulum externally, nearly half their depth, reaching across the median valley and also anteriorly, but ceasing and becoming obsolete behind.

Two cusps or lobes project at the outer part of the crown of the true molars, and three smaller ones internally. Of the outer cusps the anterior is the higher and narrower. Of the inner ones the posterior two are nearly equal, and the anterior is the smallest; most so in the second molar. They are all three-sided pyramids, each with one face directed inwardly and two outwardly. Their height is not greater than their width, nor are they very sharply pointed. The borders defining the inner surface of the antero-external cusps conjoin the antero-internal two cusps, including a small depression. Of the borders defining the inner concave surface of the postero-external cusp, the front one joins the posterior surface of the antero-external cusp, while the back one joins the postero-internal cusp.

The space occupied by the molar series was about six and a half lines. The length of the crown of the third premolar is one and one-fifth lines; the breadth one line. Length of crown of second premolar five-sixths of a line; breadth one and one-fifth lines. Breadth of first true molar one and one-fourth lines.

DROMATHERIUM.

Dromatherium silvestre.

Emmons: Am. Geol. 1857, 93, Fig. 66; Manual Geol. 1860, 171, Fig. 152. Leidy: Proc. Ac. Nat. Sc. 1857, 150; 1859, 162. Owen: Palæontology, 1860, 302. Dana: Manual of Geology 1863, 429, Fig. 650.

Insectivorous mammal, Emmons: Pr. Am. As. Adv. Sc. 1858, 78.

Indicated by two halves of lower jaws, of different individuals, discovered by Prof. E. Emmons in the coal of Chatham Co., N. C. One of the specimens is preserved in the Museum of the Academy. The oldest known mammal yet found in America. Triassic.

MARSUPIALIA.

DIDELPHYS.

Didelphys virginiana.

Holmes: Post-plioc. Fos. S. Carol. 1860, II, 116, Pl. XXIII, Fig. 2.

Quaternary ? and recent.

EDENTATA.

GRAVIGRADA.

MEGATHERIUM.

Megatherium mirabile.

Megatherium, Mitchell: An. Lyc. Nat. Hist. 1824, I, 58, Pl. VI, Figs. 12, 13. Cooper: Ib. 114, Pl. VIII; 1828, II, 267; Edinb. New Phil. Jour. 1828, V, 327. Cuvier: Ossem. Fos. 1836, VIII, 338. Anon.: Am. Jour. Sc. 1839, XXXV, 380. Couper: Proc. Ac. Nat. Sc. 1842, 189, 216; Pr. Geol. Soc. Lond. 1843, IV, 33. Harlan: Am. Jour. Sc. 1842, XLIII, 143; 1843, XLIV, 70. Lyell: Proc. Geol. Soc. Lond. 1843, IV, 36; Am. Jour. Sc. 1844, XLVI, 323. Tuomey: Rep. Geol. S. Carolina 1848, 203. Holmes: Am. Jour. Sc. 1849, VII, 197; Pr. Am. As. Adv. Sc. 1850, II, 203.

Megatherium Cuvieri, Harlan: Fauna Amer. 1825, 201; Edinb. New Phil. Jour. 1834, XVII, 355; Trans. Geol. Soc. Penn. 1835, 63; Med. Phys. Res. 1835, 269, in part. Meyer: Palæologica, 1832, 62, in part. Hodgson: Mem. on the Megatherium, 1846. DeKay: Nat. Hist. New York, Zool. 1842, I, 98.

Megatherium mirabile, Leidy: Proc. Ac. Nat. Sc. 1852, 117; Anc. Fauna Neb. 1853, 10; Mem. Ext. Sloth Tribe, 1855, 49, 59, Pl. XV; Holmes' Post-pliocene Fos. S. Carol. 1860, 111, Pl. XX, Fig. 8. Bronn: Leth. Geog. 1853–6, III, 1003.

Remains of the North American *Megatherium*, all referable to this species, have thus far been discovered only in the States of Georgia and South Carolina. Quaternary.

Of uncertain reference.

Megatherium, Harlan: Am. Jour. Sc. 1828, XIV, 187.

Remains found in New Jersey, nine miles south-east of Philadelphia. No further notice was given of the discovery. Probably only Mastodon.

MEGALONYX.

Megalonyx Jeffersoni.

Megalonyx, Jefferson: Trans. Am. Philos. Soc. 1799, IV, 246. Cuvier: Ossem. Fos. 3d Ed. 1825, V, Pt. I, 160, Pl. XV, except Fig. 13; 4th Ed. 1836, VIII, 304, Pl. CCXVI, except Fig. 13. Cooper, etc.: Am. Jour. Sc. 1831, XX, 370; Month. Am. Jour. Geol. 1831, 171. Cooper: An. Lyc. Nat. Hist. N. York, 1833, III, 166. Lyell: Proc. Geol. Soc. Lond. 1843, IV, 36; Am. Jour. Sc. 1844, XLVI, 323. Wyman: Hall and Whitney's Rep. Geol. Surv. Wisconsin and Whitney's do. Up. Missis. Lead Region, 1862, 422. *Megalonix*, Wistar: Trans. Am. Phil. Soc. 1799, IV, 526, Pls. I, II. Barton: Med. Phys. Jour. 1804, I, 153; Tilloch's Phil. Mag. 1805, 99. Cuvier: An. du Mus. 1804, V, 358, Pl. XXIII, except Fig. 13; Ossem. Fos. 1812, IV, Megal. 1–18, Pl.

Megatherium Jeffersonii, Desmarest: Mammalogie, 1820, 366.

Megatherium boreale, Oken: Krüg. Urwelt. Naturg. 1825, II, 29, on authority of Bronn's Leth. Geog. 1856, III, 1009.

Megalonyx Jeffersonii, Harlan: Fauna Amer. 1825, 201; Edinb. New Phil. Jour. 1834, XVII, 355; Trans. Geol. Soc. Penn. 1835, I, 65; Med. Phys. Res. 1835, 347. Cooper: Month. Am. Jour.

Geol. 1831, 206. Meyer: Palæologica, 1832, 63. Troost: Trans. Geol. Soc. Penn. 1835, I, 144, 336, 347. Dekay: Nat. Hist. N. York, Zool. 1842, Pt. 1, 99. Owen: Am. Jour. Sc. 1843, XLIV, 341. Pictet: Traité de Paléont. 1844, I, 223. Geinitz: Verstein. 1846, 26; 2d Ed. 1853, I, 269. Dickerson: Proc. Ac. Nat. Sc. 1846, 106. Leidy: Proc. Ac. Nat. Sc. 1852, 117; 1854, 200; Anc. Fauna Neb. 1853, 9; Waile's Rep. &c. Mississippi, 1854, 286; Mem. Ext. Sloth Tribe, in Smith. Contrib. 1855, 3, 57, Pls. I–XIII, Figs, 1–7, 9–14, 16, 17; Trans. Am. Phil. Soc. 1860, XI, 107, Pl. VI, Fig. 1. Bronn: Leth. Geog. 1856, III, 1009, Pl. XLV, Fig. 10. Wyman: Hall and Whitney's Rep. Geol. Wisc. and Whitney's do. Up. Missis. Lead Region, 1862, 422.

Megalonyx laqueatus, Harlan: Jour. Ac. Nat. Sc. 1830, VI, 269, Pls. XII–XIV; Month. Am. Jour. Geol. 1831, I, 45, 74, Pl. III, Figs. 4–6; Edinb. New Phil. Jour. 1834, XVII, 357; Med. Phys. Res. 1835, 273, 319, Pls. XII–XIV, XV, Figs. 5–7; Trans. Geol. Soc. Penn. 1835, 67, 347, Pl. XXI; Am. Jour. Sc. 1843, XLV, 208. Wyman: Ibid. 1850, 58, Figs. 1, 2. Leidy: Proc. Ac. Nat. Sc. 1852, 117.

Aulaxodon s. Pleurodon, Harlan: Jour. Ac. Nat. Sc. 1830, 284; Med. Phys. Res. 1835, 330.

Aulaxodon speleum, Rafinesque: Atlantic Journal, 1832–3, 28.

Megatherium, Rafinesque: Ibidem.

Onychotherium, Fischer: Sur la Turquoise, 40; Bibl. Pal. 1834, 135, on authority of Bronn's Leth. Geog. 1856, III, 1010.

Megalonyx potens, Leidy: Proc. Ac. Nat. Sc. 1852, 117.

Remains discovered in Virginia, Kentucky, Tennessee, Mississippi and Alabama. Quaternary.

Megalonyx dissimilis.

Megalonix, or *Megalonyx*, Cuvier: An. du Mus. 1804, V, Pl. XXIII, Fig. 13; Ossem. Fos. 1812, IV, Pl. Megal. Fig. 13; 4th Ed. 1836, Pl. 216, Fig. 13.

Megalonyx laqueatus, Owen: Odontography, 1840–5, II, 21, Pl. 80, Fig. 6.

Megalonyx dissimilis, Leidy: Proc. Ac. Nat. Sc. 1852, 117; Anc. Fauna Neb. 1853, 9; Waile's Rep. &c. Geol. Missis. 1854, 286; Mem. Extinct Sloth Tribe, 1855, 45, 57, Pl. XIV, Figs. 4–8; XVI, Figs. 8, 15.

Indicated by teeth from near Natchez, Mississippi. Quaternary.

Megalonyx validus.

Leidy: Proc. Ac. Nat. Sc. 1868, 175.

This species is indicated by the fragment of a tooth from Harden County, Texas, and was obtained, together with remains of *Mastodon*, etc., from a bed of clay and sand beneath a bed of bitumen, with which most of the fossils were more or less imbued. The tooth fragment, of which the triturating surface is represented in figure 6, plate XXX, resembles most in form the second upper tooth of the *Megalonyx Jeffersoni*, but is much larger than in the mature individuals of that species. The transverse diameter is fifteen and one-fourth lines; the antero-posterior eleven and one-half lines. The transverse section is quadrate. The anterior surface is nearly a transverse plane; the posterior surface forms a plane inclining outward; the inner surface is nearly a plane inclining forward; the outer surface forms, with those in front and behind, a semicircle. The triturating surface is comparatively slightly concave, and inclines postero-internally. Its anterior border is the most prominent; the posterior being comparatively so little prominent as not strikingly to interfere with the slope of the surface. The specimen is thoroughly impregnated with bitumen.

MEGALOCNUS.

Megalocnus rodens.

Megalonyx, De Castro: De la Exist. de grandes Mamif. Fos. en la Isla de Cuba, Habana, 1865, 13, Pl. Figs. 3, 4.

Megalonyx rodens, Leidy: Proc. Ac. Nat. Sc. June, 1868, 180.

Megalocnus rodens, Leidy: Ibidem, June, 1868, 180.

Myomorphus cubensis, Pomel: Comptes Rendus, September 28, 1868, LXVII, 665–668, fide An. Mag. Nat. Hist. 1868, II, 457.

Megalonyx (Myomorphus) cubensis, Pomel: Ibidem.

Indicated by a portion of a lower jaw found at Ciego Montero, Cienfuegos, Cuba. Quaternary.

EREPTODON.

Ereptodon priscus.

Leidy: Proc. Ac. Nat. Sc. 1853, 241; Anc. Fauna. Neb. 1853, 10; Mem. Extinct Sloth Tribe, 1855, 46, 58, Pl. XIV, Figs. 9–11, XVI, Fig. 18. Bronn: Leth. Geog. III, 1853–6, 1011. *Ereptedon priscus*, Leidy: Waile's Rep. &c. Mississippi, 1854, 286.

Indicated by a molar tooth found near Natchez, Mississippi. Quaternary.

MYLODON.

Mylodon Harlani.

Megalonyx laqueatus, Harlan: Month. Am. Jour. Geol. 1831, 74, Pl. III, Figs. 1—3; Edinb. New Phil. Jour. 1834, XVII, 358; Med. Phys. Res. 1835, 334, Pl. XV, Figs. 2—4; Trans. Geol. Soc. Penn. 1835, 67; Am. Jour. Sc. 1842, XLIII, 142; 1843, XLIV, 72; XLV, 208.

Megalonyx, Cooper: Month. Am. Jour. Geol. 1831, 172; An. Lyc. Nat. Hist. N. York 1833, III, 166. Perkins: Am. Jour. Sc. 1842, XLII, 136. Lyell: Pr. Geol. Soc. Lond. 1843, IV, 36; Am. Jour. Sc. 1844, XLVI, 323.

Mylodon Harlani, Owen: Zool. Voy. Beagle, Fos. Mam. 1840, 68; Odontography, 1840–5, 335; Mem. on Mylodon, 1842, 15; Proc. Geol. Soc. Lond. 1842, III, 693; Amer. Jour. Sc. 1843, XLIV, 341. Pictet: Traité de Paléont. 1844, I, 225; 1853, I, 270. Geinitz: Versteinerungskunde, 1846, 27. Leidy: Anc. Fauna Neb. 1853, 10; Waile's Rep. Geol. Missis. 1854, 286; Mem. on Sloth Tribe, 1855, 47, 58, Pl. XIV, Figs. 1—3, XVI, Figs. 19, 20; Holmes' Post-plioc. Fos. S. Carol. 1860, 111, Pl. XX, Fig. 7. Bronn: Leth. Geog. 1853–6, III, 1013.

Orycterotherium Missouriense, Harlan: Pr. Am. Phil. Soc. 1841, II, 111, 119; Am. Jour. Sc. 1842, XLIII, 142; 1843, XLIV, 69, 79, Pls. I—III; XLV, 210. *O. Missouriensis*, Perkins: Bost. Jour. Nat. Hist. 1844, IV, 135.

Mylodon, Perkins: Am. Jour. Sc. 1842, XLII, 136, Figs. 1—4.

Orycterotherium, Harlan: Am. Jour. Sc. 1842, XLII, 392. Carpenter: Amer. Jour. Sci. 1846, I, 249?

Orycterotherium Oregonensis, Perkins: Am. Jour. Sc. 1842, XLII, 392; 1843, XLIV, note to 80; Bost. Jour. Nat. Hist. 1844, IV, 135.

Aulaxodon s. Pleurodon, in part of Harlan: Am. Jour. Sc. 1842, XLIII, 141.
Eubradys antiquus, Leidy: Proc. Ac. Nat. Sc. 1852, 117; 1853, 241.

All the remains of *Mylodon* heretofore discovered in North America appear to belong to this species. Quaternary.

Of uncertain reference.
Extinct genus of the Edentate order, Hale: Am. Jour. Sc. 1848, VI, 357.

Skull from Claiborne Bluff, Alabama. Eocene. Probably a squalodont?

SIRENIA.

MANATUS.

Manatus antiquus.
Manatus, Tuomey: Rep. Geol. S. Carol. 1848, 165, 166, 208. Gibbes: Pr. Am. Assoc. 1849, II, 193; 1850, III, 66. Pictet: Traité de Paléont. 1853, I, 372.
Manatus antiquus, Leidy: Proc. Ac. Nat. Sc. 1856, 165; Holmes' Post-plioc. Fos. S. Carol. 1860, 117, Pl. XXIV, Figs. 5—7.

Indicated by remains in the post-pliocene formation of Ashley River, South Carolina.

Remains of uncertain reference.
Manatus, Harlan: Jour. Acad. Nat. Sc. 1825, 236; Edinb. New Phil. Jour. 1834, XVII, 361; Trans. Geol. Soc. Penn. 1835, 73; Med. Phys. Res. 1835, 278, 385. Meyer: Palæologica, 1832, 98. Smith: Am. Jour. Sc. 1844, XLVII, 116. Allen: Ibid. 1846, I, 41. Leidy: Anc. Fauna Neb. 1853, 10. Cope: Proc. Ac. Nat. Sc. 1867, 138.
Manatus giganteus, DeKay: Nat. Hist. N. York, Zool. 1842, I, 123.
Manatus americanus fossilis, Harlan: fide Pictet's Traité de Paléont. 1853, I, 372.

Harlan mentions two vertebræ of a gigantic species from the western shore of Maryland, and also a rib from the same locality. I have seen fragments of ribs and vertebræ of a *Manatus* from the miocene and later formations of New Jersey, Virginia, North Carolina, and Florida. Prof. Cope recently noticed remains from the post-pliocene formation of Charles Co., Maryland.

PRORASTOMUS.

Prorastomus sirenoides.
Owen: Quart. Jour. Geol. Soc. Lond. 1855, XI, 541, Pl. XV.

Remains found in the Island of Jamaica. Tertiary.

Ischyrotherium antiquum.
Ischyrotherium antiquus, Leidy: Proc. Acad. Nat. Sc. 1856, 89. *I. antiquum*, Leidy: Trans. Am. Phil. Soc. 1859, XI, 150, Pl. XX, Figs. 8–17.
Ischyrosaurus antiquus, Cope: Trans. Am. Phil. Soc. 1869, XIV, 38, 39.

The remains originally referred to a sirenian with the above name, but at the same time suspected to belong to a reptile, I have not introduced into the synopsis of mammals, as I have latterly viewed them as reptilian. The anatomical characters of the specimens, for the most part, are peculiar, but are more related with those of reptiles than of mammals.

PINNIPEDIA.

PHOCIDÆ.

PHOCA.

Phoca groenlandica?

Bones of a Seal, Jackson: Final Rep. Geol. and Min. New Hampshire, 1844, 94. Wyman: Am. Jour. Sc. 1850, X, note to 230.

Remains of a species of Seal, Leidy: Proc. Ac. Nat. Sc. 1856, 90, Pl. III.

Phoca groenlandica, Billings: Geol. Surv. of Canada, 1863, 920, 965, Figs. 493, a, b.

Remains from quaternary formations of Maine and Canada.

Phoca Wymani.

Animal belonging to the Phocidæ, Wyman: Am. Jour. Sc. 1850, X, 229, Figs. 1–3.

Phoca Wymani, Leidy: Anc. Faun. Neb. 1853, 8.

Remains found in a miocene formation at Richmond, Virginia.

Phoca debilis.

Leidy: Proc. Ac. Nat. Sc. 1856, 265.

Squalodon debilis, Cope: Proc. Ac. Nat. Sc. 1867, 144.

A supposed species of Seal, indicated by three teeth, from the sands of the Ashley River, South Carolina. They are all mutilated and somewhat water-worn. The two larger and better specimens are represented in figures 12, 13, plate XXVIII, of the present work. The crowns are short, compressed conical, with the back border tuberculate, and with an internal and anterior basal ridge. The fang is single, long and gibbous.

Prof. Cope suspects the teeth to belong to a *Squalodon,* which may be the case, or perhaps they may belong to a Dolphin.

Phoca modesta.

Figure 14, plate XXVIII, represents a small tooth, in the collection of the Academy, from the Ashley River deposits, South Carolina. The crown is compressed conical, about as wide as it is high, with the apex blunt and feebly curved inwardly, with the borders subacute and with a tubercle at base, the hinder tubercle being unequally divided. The inner and outer surfaces are strongly grooved from summit to base. The fangs are a connate pair, of which one is prolonged beyond the other. Total length of the specimen five and one-half lines. The little tooth is referred to a Seal, though it is not improbable it may belong to a Squalodont.

LOBODON.

Lobodon vetus.

Stenorhynchus vetus, Leidy: Proc. Ac. Nat. Sc. 1853, 377.

An apparently extinct species of Seal, indicated by a molar tooth, found in the vicinity of Burlington, New Jersey. The specimen purports to have been derived from the green sand, but is probably of miocene age and accidental in its position in relation with the preceding formation.

The original of the tooth I have not seen, but it was in possession of Timothy Conrad, the well-known naturalist, who made an outline drawing of it the size of nature, which is represented in a wood-cut, of the same size, on page 377 of the Proceedings of this Academy for 1853. The specimen has been lost. The drawing of it so nearly resembles the representations of the molar teeth of the Crab-eating Seal, *Lobodon carcinophaga* of Gray, or the *Stenorhynchus serridens* of Owen, that it may be regarded as an indication of an extinct species of the same genus.

Of uncertain reference.

Seal allied to Cystophora proboscidea, Owen: Am. Jour. Sc. 1844, XLVI, 319.

From Martha's Vineyard, Massachusetts.

Seal from Newbern, N. C., Harlan: Am. Jour. Sc. 1842, XLIII, 143.

TRICHECHIDÆ.

TRICHECHUS.

Trichechus rosmarus.

Barton: Philos. Mag. London, 1805. XXXII, 98. Mitchell, etc.: Edinb. New Phil. Jour. 1828, V, 325. Harlan: Edinb. New Phil. Jour. 1834, XVII, 360; Trans. Geol. Soc. Penn. 1835, I, 72; Med. Phys. Res. 1835, 277. Leidy: Trans. Am. Phil. Soc. 1857, XI, Pls. IV, V, Fig. 1.

Morse, or *Walrus*, Mitchell, etc.: An. Lyc. Nat. Hist. New York, 1828, II, 271. Lyell: Am. Jour. Sc. 1844, XLVI, 319. *Different from existing species*, Owen: Proc. Geol. Soc. London, 1843, IV, 32; Am. Jour. Sc. 1844, XLVI, 319. Pictet: Paléont. 1844, I, 189; 1853, I, 233. Agassiz: Proc. Am. As. Adv. Sc. 1851, 251, 348.

Trichecus, Meyer: Palæologica, 1832, 55, in part.

Trichecus Virginianus, Dekay: Nat. Hist. New York, Zool. 1842, I, 56, Pl. XIX, Figs. 1 *a*, *b*.

Remains of the Walrus, not characteristically distinct from the corresponding parts of the existing animal have been found in superficial deposits of Martha's Vineyard, Massachusetts, Monmouth County, New Jersey, and Accomac County, Virginia.

ZEUGLODONTES.

SQUALODON.

Squalodon atlanticus.

Macrophoca atlantica, Leidy: Proc. Ac. Nat. Sc. 1856, 220.

Squalodon atlanticus, Leidy: Cope's Ad. to the Verteb. Fauna of the Mioc. Per., Proc. Acad. Nat. Sc. 1867, 132, 144, 151, 153.

A species indicated by three molar teeth, represented in figs. 4—7, plate XXVIII, of the present work, from the miocene marl of Shiloh, Cumberland Co., New Jersey. From the teeth of *Basilosaurus*, and others of the same family that I have had the opportunity of inspecting, they differ in the remarkably rugose character of their crown.

The crowns of the teeth are broader than long, and nearly half as thick as the breadth. They are compressed conical, with subacute borders and convex sides somewhat impressed at the middle towards the base. The enamel, except at the summit, is remarkably rugose longitudinally, especially towards the base, where the rugæ becomes more or less interrupted, but finally subside at the verge of the fangs. In one specimen, figure 6, the anterior border is simply subacute and roughened; the posterior border forms a series of three large conical tubercles, and perhaps possessed a fourth. In the other specimens, figures 4, 5, the anterior border presents two tubercles, and the traces of a third at the base; the posterior border possesses a series of four tubercles. These tubercles partake of the general character of the crown, having subacute and denticulate borders. The teeth possess a pair of fangs, connate about half their length, and with their free portions having a more or less backward direction.

The teeth above described bear a resemblance in size and general form and construction with the true molars of *Squalodon antverpiensis*, described by Van Beneden, page 70 of the Mem. de l'Acad. Roy. d. Sc. de Belg. 1865, and represented in plate I; and indeed it was the view of this plate which led me to assign the New Jersey fossils to the same genus. They, however, differ in well marked characters from those of *S. antverpiensis*. The crowns of the teeth of *S. atlanticus* are broader in relation with their length, are provided with accessory denticles on the anterior as well as the posterior border, and have the enamel wrinkled in a remarkable degree. In *S. antverpiensis* the external surfaces of the crowns of the molars appear more regularly longitudinally striated, or perhaps are rather subdivided into narrow planes or shallow grooves separated by narrower longitudinal ridges, with comparatively little or no intervening wrinkling. In one of the teeth above described, the outer surface, or that opposed to the one represented in figure 6, is feebly subdivided into narrow planes, and the wrinkling is not so strong as on the internal surface.

The measurements of the three teeth are as follow:

	Lines.	Lines.	Lines.
Length of crown at middle,		9½	9
Breadth of crown at base,	12	12½	12
Thickness of crown in advance of middle,	5½	6	5½
Length of fangs from crown,	20	18½	13½

Since writing the foregoing, Prof. Cope has described some remains, apparently of

Squalodon atlanticus, from the miocene formation of Charles Co., Maryland. Two of the specimens consist of portions of both maxillary bones, each containing three teeth nearly like those above described. They belonged to a younger animal, as they appear unworn. The crowns are rather longer in relation with their breadth than in two of the teeth from New Jersey, but approach in this respect the third of the latter. The enamel is less strongly wrinkled than in the New Jersey teeth; but the differences mentioned are probably not of specific value.

The jaw fragments are about seven inches in length, and in the space of six inches were provided with five double-fanged molar teeth. The back ones are obliquely inserted, so that the fore part of those behind is overlapped by the base of those in front, and only the anterior teeth were more widely separated with appreciable intervals.

A caniniform tooth, from the same locality as the preceding, probably pertains to the same species. When perfect, following its curve it has measured four inches in length. The crown has measured an inch and a half, with the diameter at base nine lines fore and aft and six lines transversely. The inner and outer surfaces, defined by sub-acute ridges, are subdivided into narrow planes or shallow grooves, and are feebly roughened except near the base, where they are strongly wrinkled.

Figure 18, plate XXX, represents one of the jaw fragments above mentioned, with the first tooth of the series introduced from the opposite side.

Squalodon Holmesii.

Colophonodon Holmesii, Leidy: Proc. Ac. Nat. Sc. 1853, 377.
Squalodon Holmesii, Leidy: Cope in Proc. Ac. Nat. Sc. 1867, 151, 153.

Specimens of long, narrow, fusiform teeth, slightly curved and nearly straight, from the eocene formation of the Ashley River, South Carolina, which have been referred to a peculiar genus under the name of *Colophonodon*, by comparison with Beneden's plates of Squalodonts* are seen to be incisors of a similar animal.

A nearly perfect specimen is represented in figure 15, plate XXVIII. The crown is a narrow cone, subdivided by a pair of acute linear ridges, in the position of which it is of slightly greater diameter. The point of the crown is broken off. The enamel is generally smooth and shining, and presents a few slight linear wrinkles near the middle of the two surfaces of the crown. It extends farther down on the inner side of the tooth, and at the base of the crown appears worn off irregularly. The fang is more than double the length of the crown, moderately curved, fusiform, and gibbous. The gibbosity on the convex part of the fang is grooved. The tooth appears solid throughout, and when perfect has measured over three inches long. Its crown has been about an inch long, by three and a quarter and three and a half lines in diame-

* Recherches sur les Squalodons. Mem. de l'Acad. Roy. de Belg. 1865, XXXIV, Pls. I, III, and 1867, XXXVII, Plate.

ter at base. The fang has been about two and a quarter inches long, with its swollen part four and a half lines in diameter.

Figure 16, of the same plate, represents the greater portion of a more anterior, somewhat larger, and a nearly straight tooth. In its perfect condition it has approximated four inches in length, and in transverse section in any position appears to be of almost uniform diameter. The enamel of the base of the crown, though fissured in the specimen, appears smooth, but it exhibits portions of the linear acute ridges defining two surfaces.

Figure 17 represents the greater portion of the crown of a tooth of more robust proportions than in the preceding. It is long, straight, conical, and invested throughout with enamel, which is strongly wrinkled. In its present state, with broken apex and base, it is twenty lines long. Its diameter above the broken part of the base, between the acute linear ridges separating the two surfaces of the crown, is five lines; the opposite diameter is four and a half lines.

Another specimen, with part of the crown nearly like that in the latter specimen, but less wrinkled, and with part of the fang, has had nearly the form of the specimen represented in figure 16. The diameter of the crown at base is five lines by four and a half lines. When perfect, it has been about two inches in length.

Another specimen, consisting of the crown and part of the fang of the tooth, is intermediate in its proportions and form with that first described and represented in figure 15, and the others. The crown when perfect has measured about sixteen lines long, by four and three and a half lines in diameter at base. The enamel is strongly wrinkled longitudinally.

All the specimens above described are solid or nearly so, but that represented in figure 17 has a small pit at the base, communicating with the apparently fractured surface, but which really looks like that seen on shed teeth in the position of contact with the successional teeth. I have not been able to determine to my own satisfaction whether these teeth belong to one or two distinct species, or to any of those indicated by other remains.

A specimen, also from the Ashley River, represented in figure 9, plate XXIX, perhaps is a canine or anterior premolar of the same animal. The crown is slightly curved, conical, and acute, and has its faintly wrinkled surfaces separated by prominent acute borders. The length of the crown is from eleven to twelve lines; and it is from five to six lines in diameter at base. The fang is hollow, and when perfect has probably approximated two inches in length. The unworn crown and hollow condition of the tooth indicate a young condition.

I have suspected that these teeth might belong to *Squalodon atlanticus*, but in comparison with those in the jaws of *S. antverpiensis*, as represented by Van Beneden (Mem. Acad. Roy. Sc. Belgique, XXXV, Pl. I), they are much too small in relation with the molar teeth. In their comparative smoothness and size they bear a nearer relation with the representation of a molar tooth of *Squalodon pygmæus*, and perhaps belong to that species.

Squalodon pelagius.

A small species, indicated by the fragment of a jaw, from Ashley River, near Charleston, South Carolina. The specimen was obtained by Prof. F. S. Holmes, who attributes it to the eocene formation.

The fragment represented in figure 1, plate XXIX, is from the intermediate portion of the jaw, and contains a molar tooth, two alveoli and part of another. The first alveolus of the specimen is fore and aft oval, four lines by three lines, and contained the last of the premolars, or a transitional tooth with connate fangs. The succeeding alveolus accommodated a tooth with a distinct pair of fangs. The tooth remaining in the specimen occupied the next alveolus. It has a laterally compressed conical crown, with the breadth greater than the length and the thickness less than half the former measurement. The borders are trenchant and devoid of denticles. The surfaces are longitudinally rugose near the base, especially internally, and externally there is a feeble tendency to the production of a basal ridge. The fangs are distinct. The molars were separated by interspaces rather greater in breadth than the teeth, and the outer part of the intervals exhibit moderately deep concave fossæ, for the accommodation of the opposed teeth when the jaws are closed.

The length of the fragment, corresponding with the position of four teeth, is about three and one-half inches. The crown of the remaining tooth has been about four and one-half lines long and its width is five lines.

Squalodon pygmæus.

Zeuglodon, Tuomey: Proc. Ac. Nat. Sc. 1847, III, 151; Jour. Ac. Nat. Sc. 1847, I, 16; Am. Jour. Sc. 1847, IV, 283; Rep. Geol. South Carolina, 1848, 166; 1849, VIII, 69. Gibbes: Jour. Ac. Nat. Sc. 1847, I, 8. Holmes: Am. Jour. Sc. 1849, VII.

Basilosaurus, Tuomey: Jour. Acad. Nat. Sc. 1847, I, 16, Pl. V. Holmes: Am. Jour. Sc. 1849, VII.

Zeuglodon pygmæus, Müller: Monatsb. Ak. d. Wis. Berlin, 1851, 242; Zeuglodonten v. Nordamerika, 1849, 29, Pl. XXXIII, Figs. 1, 2. Bronn: Leth. Geog. 1853–6, III, 771.

Basilosaurus pygmæus, Leidy: Anc. Fauna Neb. 1853, 8.

Doryodon pygmæus, Cope: Proc. Ac. Nat. Sc. 1867, 155.

Doryodon, Cope: Proc. Ac. Nat. Sc. 1868, 186.

Phocodon Holmesii, Agassiz: In an unpublished Plate.

This species was established upon a mutilated skull, obtained by Profs. F. S. Holmes and L. R. Gibbes from the eocene formation of Ashley River, about ten miles from Charleston, South Carolina. A brief description, accompanied by a rude sketch of the specimen, was published by Mr. Tuomey in the Proceedings and Journal of this Academy, as above indicated. Mr. Tuomey referred the fossil to the genus *Zeu-*

glodon, or *Basilosaurus*, and his description and figure, repeated by Müller, constitute the basis of his *Zeuglodon pygmæus*.

Prof. Holmes, to whom the specimen now belongs, has recently submitted it to my examination. It indicates a species intermediate in size to *Squalodon atlanticus* and *S. pelagius*. It is represented in figures 7, 8, plate XXIX, reduced one-half.

In general form the skull of *S. pygmæus* is much like that of the European species *Squalodon Ehrlichii*, as represented by Van Beneden in his "Recherches sur les Squalodons, Bruxelles, 1865, Plate II."

The skull is intermediate in form with that of the living Dolphins and that of *Dorudon*, as represented in the nearly complete skull represented in plate XXVI, of Müllers work on the Zeuglodonts, under the name of *Zeuglodon brachyspondylus*.*

The skull of *Squalodon pygmæus*, in comparison with that of the Porpoise, exhibits a proportionately greater degree of compactness and contraction, much greater strength and decidedly a more carnivorous aspect. The cranium is less voluminous, of much less capacity as concerns the cerebral cavity, is depressed behind instead of being protuberant, and is strongly constricted at the middle. The bones of the skull of the living Dolphins may be said to be comparatively light and laminar; those of *Squalodon pygmæus* are decidedly ponderous. The cranial axis in the former is comparatively thin, in the latter it is proportionately several times as thick. Everything indeed in the skull of *Squalodon* would appear to indicate the power of contending with and securing stronger prey than the modern Dolphins are able to do.

The inion of *Squalodon pygmæus* is proportionately not so great as in the Porpoise and is depressed or moderately concave instead of being decidedly convex. Its summit relatively does not reach so far forward, but is separated by a comparatively long interval from the forehead, though relatively not to the same extent as in *Basilosaurus*.

The temporal fossæ are of greater capacity than in the Dolphins, and approach within a fourth of the distance at their upper part, though this is much less than in *Dorudon*, in which they are only separated by a sagittal crest.

The outline of the inion, formed entirely by the occipital, has the form of a longitudinal section of a blunt cone. The surface is moderately concave, the supra-occipital portion being bent forward. The ex-occipitals present a posterior vertical plane ending in a broad, strong paramastoid process. The condyles, nearly like those in the Porpoise, project from the lower part of the inion by a more abrupt and constricted neck than in the latter. The occipital foramen is transversely oval.

The temporal fossæ are much wider fore and aft than from above downward, being the reverse of the condition in the Porpoise. They are separated at the vertex by an interval between the inion and the forehead, about an inch and three-fourths wide.

*Ueber d. fos. Reste d. Zeuglodonten v. Nordamerica, Berlin, 1849.

The bottom is deeply concave, and, though more extensive than in the Porpoise, is constituted in the same manner by portions of the parietals, frontal, and squamosal. Posteriorly they are bounded by a prominent crest separating them from the inion. Anteriorly they are also bounded by a prominent crest, formed by the frontal.

The vertex or top of the skull forms a short plane between the inion and forehead, constituted by the conjoined parietals. On each side, the plane of the vertex forms with the top of the temporal fossa a rounded margin, from which the parietal descends into the fossa to meet the squamosal, the alisphenoid at bottom, and the frontal in advance.

The forehead, as composed by the frontals, continues the plane of the vertex forward, and narrows outwardly in a ridge forming the anterior boundary of the temporal fossa. In the fossil, the fore part of the frontals where they conjoin the nasals and ethmoid, together with these, is broken away. In the median suture the frontals are separated by a deep elliptical pit, with sutured sides, which probably accommodated a supernumerary bone.

The supra-orbital portion of the frontals, with its post-orbital process, presents very much the same form and relations as in the Porpoise. The ant-orbital portion of the frontals is lost in the fossil.

The basi-occipital and basi-sphenoid are co-ossified in the specimen. They are proportionately narrow and very thick in comparison with their condition in the Porpoise. As in the latter, the basi-occipital on each side extends downward and outward into a large alary process, which, together with the paramastoid posteriorly, and the mastoid externally, as in the Dolphins, bounds a large, though comparatively wider and shallower recess, to accommodate the petro-tympanic bone.

The zygomatic process of the temporal, in accordance with the comparatively powerful mandible which articulated with its glenoid recess, is very much more robust than in the Porpoise, though nearly like it in form. The glenoid articulation is a broad concave surface, bounded behind by a strong post-glenoid tubercle.

The mastoid process is far better developed than in the Porpoise, and projects nearly as much as the paramastoid. Between it and the post-glenoid tubercle a narrow arch is prolonged inward, corresponding with the position of the auditory passage. A large rugged recess occupies the back part of the zygomatic root, extending below on the mastoid process.

A large jugular foramen, and that for the hypoglossal nerve, occupy the same relative position as in the Dolphins.

The pre-, ali-, and orbito-sphenoids, together with the pterygoids, palatines, and vomer, are all lost in the fossil.

The maxillæ and intermaxillæ are very Dolphin-like in their forms and relations, but, as in other parts of the skull, differ strikingly in their great proportionate strength.

A tooth retained in the left maxilla is now lost, but is represented in three views, together with three views of the skull in an unpublished plate by Professor Agassiz. The tooth, a double-fanged molar, is intermediate in size and character with the corresponding ones of *Squalodon atlanticus* and *S. pelagius*. The crown is compressed conical, longer than broad, and has both its acute borders serrated. The enamel presents a row of rugosities near the base externally, but appears generally to have been nearly smooth. According to Mr. Tuomey, the length of the crown was seven-eighths of an inch; the breadth five-eighths of an inch.

In its present condition the skull measures about fifteen inches, but when perfect has approximated two feet in length. Other measurements derived from the specimen are as follow:

Height from inferior margin of occipital foramen to summit of inion,			5 in. 2 l.
Breadth of inion at paramastoids,			7 in.
Breadth of occipital foramen,	1 in. 4 l.	Height of do.,	1 in. 1 l.
Vertical diameter of condyles,	1 in. 7 l.	Transverse do.,	1 in.
Width fore and aft of temporal fossa,			4 in. 7 l.
Height of do. obliquely from zygoma,			3 in. 7 l.
Breadth of vertex at boundaries of temporal fossæ,			1 in. 6 l.
Breadth of cranium just below vertex,			2 in. 1 l.
Distance from summit of inion to fronto-parietal suture,			1 in. 1 l.
Breadth of skull at mastoids,			8 in. 4 l.
Breadth of skull at post-orbitals,			7 in.

Squalodon protervus.

Cynorca proterva, Cope: Proc. Acad. Nat. Sc. 1867, 144, 151; 1868, 185.
Squalodon protervus, in part of Cope: Proc. Acad. Nat. Sc. 1867, 151.
Cynorca, In part of Cope: Ibidem, 152.

Four isolated teeth, from Ashley River, South Carolina, apparently indicate a small species of *Squalodon*, which may perhaps be the same as that described under the name of *S. pelagius*. Two of the teeth represented in figures 18, 19, plate XXVIII, together with the canine tooth of a Peccary, are the specimens upon which Prof. Cope founded the distinctive characters of his *Cynorca proterva* or *Squalodon protervus*. He was unaware, he informs me, that I had already described and had had figured the former teeth in preparation for the present synopsis.

One of the teeth, a molar, represented in figure 19, approaches in form and size that of the jaw fragment referred to *S. pelagius*. The crown is, however, longer, narrower and thinner; the length being greater than the breadth. It is also less straight or more curved inwardly and is comparatively smooth externally, and less rugose internally. Its surfaces also are more evenly convex or not impressed approaching the acute borders. The fangs, partially connate, indicate a more anterior position for the tooth than that contained in the jaw fragment. The length of the crown is about five lines; the breadth scarcely four lines.

Two teeth appear as premolars in relation with the former. They have longer and narrower crowns than the preceding, but otherwise have the same character. The single fang is long, curved and gibbous. The best preserved of the two specimens, when perfect, has had its crown about half an inch long; its breadth at base is three lines and three-fourths.

Another tooth of more robust character than the preceding, represented in figure 18, probably holds the relative position of a canine to them, though perhaps it does not belong to the same animal. The crown is stouter than in the other teeth, but like them is smooth externally and rugose, except near the apex internally. The fang, about half as long again as the crown, is conic and oblique, but feebly curved. The length of the crown is half an inch; the breadth three lines and three-fourths; the thickness two lines and three-fourths.

DELPHINODON.

Delphinodon mento.

Squalodon mento, Cope: Proc. Ac. Nat. Sc. 1867, 132, 144, 152.

Several isolated teeth, from the miocene formation of Charles County, Maryland, ascribed by Prof. Cope to the genus *Squalodon*, I suspect belong to a different genus. The most characteristic tooth, represented in figures 7, 8, plate XXX, supposed to be a premolar, is very unlike the corresponding teeth, so far as we are acquainted with them, in the distinct species of *Squalodon*. The crown of this tooth is subtrihedral conical, as broad as it is long, ovoid in section at base, and with a slight twist inwardly. The inner and outer surfaces are very unequal, and separated by linear, rugulose ridges. The back of the crown forms, at its basal half, a thick convex tubercle, crossed by the posterior dividing ridge, and bounded near the base by a short embracing ridge. The anterior dividing ridge of the crown pursues a sigmoid course from the summit postero-internally to the base antero-externally. The inner and outer surfaces of the crown are conspicuously wrinkled and the former, in addition, exhibits an irregular curved ridge, terminating in a basal tubercle and dividing off the anterior more wrinkled third of the inner surface of the crown, from the posterior two-thirds of the same surface. The fang is more than three times the length of the crown, strongly curved backward, slightly gibbous near the crown and compressed near the point. The measurements of the specimen are as follow:

Length of the crown, 6 lines; breadth, 6 lines; thickness, $4\frac{3}{4}$ lines.
Length of the fang, 19 lines; greatest breadth, $5\frac{1}{2}$ lines.
Length of the tooth along its anterior curvature, 30 lines.

A second tooth, figure 9, plate XXX, longer and with a more robust fang and a differently shaped crown, may belong to the same animal, though of this there is no more certain evidence than association and general relation of size and form. The crown is longer and narrower than in the preceding specimen, and forms a simple cone, slightly compressed and curved. Ridges defining the inner and outer surfaces are almost obsolete, but the enamel is wrinkled nearly in the same manner as in the preceding tooth. The fang is strongly curved and gibbous. The measurements of the specimen are as follow :

Length of the crown, 7 lines ; breadth, 5 lines ; thickness, 4 lines.
Length of the fang, 22 lines ; greatest breadth, 6 lines.
Length of the tooth along the anterior curvature, 33 lines.

A third tooth, accompanying the former specimens, in its perfect condition, had about the same length as the second tooth, but was of more robust proportions. If it belonged to the same animal it held a more posterior position in the jaw than the others. The summit of the crown is broken off and it is eroded at the conjunction of the fang. The crown is conical, curved and oval in section at base. It presents no trace of ridges defining the inner and outer surfaces. The enamel appears less corrugated than in the former specimens, but is probably worn. Postero-internally it is longitudinally grooved. The fang is less curved and less tapering than in the preceding specimens, and it presents a median longitudinal groove internally. The measurements of the specimen are as follow :

Length of crown restored, $7\frac{1}{2}$ lines ; breadth, $6\frac{1}{2}$ lines ; thickness, $4\frac{3}{4}$ lines.
Length of fang, 16 lines ; breadth, $6\frac{1}{2}$ lines.

Delphinodon Wymani.

Phoca Wymani, Leidy : Proc. Ac. Nat. Sc. 1856, 265.
Squalodon Wymani, Cope : Proc. Ac. Nat. Sc. 1867, 132, 151, 152.

Three teeth, from the miocene formation of Charles County, Maryland, ascribed by Prof. Cope to a species of *Squalodon*, appear to me, at least in part, to belong to a smaller species of *Delphinodon*.

One of the teeth, figure 10, plate XXX, bears a resemblance to that first described of the larger species. Its crown is proportionately longer, and the posterior tubercle and internal curved ridge of the crown are rudimental, but it has the same general form, with the abrupt curvature and slight twist of the summit backward and inward. The ridges defining the inner and outer surfaces of the crown are alike in their course, and the enamel is likewise wrinkled. The fang has also the same form, but is comparatively less curved. The measurements of the specimen are as follow :

Length of the crown, 5 lines ; breadth, $3\frac{3}{4}$ lines ; thickness, 3 lines.
Length of the fang, restored, $10\frac{1}{2}$ lines ; breadth, $3\frac{1}{2}$ lines.
Length of the entire tooth restored, 14 lines.

A tooth, figure 12, plate XXX, from the miocene formation of Virginia, originally ascribed by me to the same species as the remains of a Seal described by Prof. Wyman, is very like the one above indicated. The crown is proportionately somewhat narrower, but otherwise the tooth might be viewed as having belonged to the same animal. Its measurements are as follow:

Length of the crown, 5 lines; breadth, 3½ lines; thickness, 2½ lines.
Length of the fang, 10½ lines; breadth, 3 lines; length of the entire tooth, 14 lines.

The remaining two teeth from Charles County, ascribed by Prof. Cope to *Squalodon Wymani*, are different from the preceding, and it is uncertain whether they belong to the same animal. They have more the usual appearance of the teeth of the Dolphins. Their crown is robust conical, hardly compressed, abruptly curved backward, and without ridges defining the inner and outer surfaces, except a feeble one postero-internally. The enamel is comparatively smooth. In one specimen, figure 11, plate XXX, the crown abruptly curves a short distance from the base; in the other from near its middle. The fang is long, simple, and rather abruptly curved postero-internally towards the end. The measurements of the specimens are as follow:

	Lines.	Lines.
Length of the crown,	5½	5½
Breadth of the crown,	3½	3½
Thickness of the crown,	3½	3
Length of the fang,	12	13½
Breadth of the fang,	3½	3½
Entire length of the tooth,	16	18

PHOCAGENEUS.

Phocageneus venustus.

Phocodon, Agassiz: in Wyman's Notice Rem. Verteb. An., Amer. Jour. Sc. 1850, X, 230, Fig. 4.
Squalodon mento, in part of Cope: Proc. Ac. Nat. Sc. 1867, 152.

If *Phocodon* is the same as *Squalodon*, the tooth represented in figure 4 accompanying Prof. Wyman's Notice of Remains of Vertebrated Animals found at Richmond, Va., is surely very unlike any of those more certainly ascribed to the latter. Having requested Prof. Wyman to allow me to inspect the tooth, he sent me a specimen which he observed was either the original of the figure or pertained to the same animal. If such is the case, the figure is an unfaithful representation of it. The specimen is represented in figure 10, plate XXIX, of the present work.

The crown is conical, compressed, oval in section at base, and moderately curved. It forms an acute ridge before and behind, and has an acute point. The base is conspicuously swollen internally, and contracts all around towards the neck. The anterior acute border of the crown expands in a triangular surface of the swollen base.

The posterior border is embraced by an attempt to form a basal cingulum. The enamel of the crown is nearly uniformly corrugated, and the wrinkles are much interrupted. The fang, broken at its point, has been about twice the length of the crown, is conical, slightly curved, and feebly gibbous.

The tooth bears some resemblance to the corresponding ones of the Californian Seal, *Arctocephalus monteriensis*, and may perhaps belong to a Seal. It approximates in appearance one of the specimens (figure 9, plate XXX) from Charles Co., Md., referred by Prof. Cope to *Squalodon mento*. It differs, however, in the proportionately greater breadth of the crown, and in possessing acute borders, and an internal swollen base. The enamel is also generally more strongly corrugated. The fang is much shorter, and very much less gibbous. Side by side the two teeth do not appear to belong to the same animal.

The measurements of the specimen are as follow :

Length of the crown, 6 lines ; breadth, 5 lines ; thickness, 4 lines.
Length of the fang restored, 14 lines ; breadth, 4½ lines.
Length of the tooth restored, 19 lines.

BASILOSAURUS.

Basilosaurus cetoides.

Gigantic bones, Logan : Proc. Geol. Soc. Lond. (1827, 8) 1834, I, 85.

Basilosaurus, Harlan : Bul. Soc. Geol. de France (1833), 1835, IV, 124 ; Trans. Amer. Phil. Soc. 1834, IV, 397, Pl. XX, Figs. 1, 2 ; Edinb. New Philos. Jour. 1834, XVIII, 29 ; Trans. Geol. Soc. Penn. 1835, I, 77, 348, Pl. XXII—XXIV ; Med. Phys. Res. 1835, 337, 349, Pls. XXVI—XXVIII ; Pr. Geol. Soc. Lond. (1839) 1842, III, 23 ; Bul. Soc. Geol. de France, 1839, X, 89 ; Lond. and Edinb. Philos. Mag. 1839, XIV, 302 ; Trans. Geol. Soc. Lond. (1839) 1842, VI, 67. Owen : Pr. Geol. Soc. Lond. (1839) 1842, III, 24 ; Lond. and Edinb. Philos. Mag. 1839, XIV, 302. Wailes : Rep. &c. Geol. of Missis. 1854, 277.

Zeuglodon, Owen : Proc. Geol. Soc. Lond. (1839) 1842, III, 24; Lond. and Edinb. Philos. Mag. 1839, XIV, 302. Conrad : Am. Jour. Sc. 1840, XXXVIII, 381. Anon. : Amer. Jour. Sc. 1845, XLIX, 218. Meyer : Jahrb. f. Min. 1847, 669. Hale : Am. Jour. Sc. 1848, VI, 361.

Zeuglodon cetoides, Owen : Lond. Edinb. Philos. Mag. 1839, XIV, 302 ; Trans. Geol. Soc. Lond. 1841, VI, 69, Pls. VII—IX ; Palæontology, 1859, 345 ; Pictet's Traité de Paléout. 1844, 317. Mantell : Medals of Creation, 1844, 826. Emmons : Am. Quar. Jour. Agric. 1845, II, 59, 366 ; 1846, III, 223, Pls. I, II. Buckley : Am. Jour. Sc. 1846, II, 125, Figs. 1, 2. Geinitz : Versteinerungskunde 1846, 56. Müller : Monatsb. d. Akad. Wissens. Berlin 1847, 103. Archiv f. Anatomie, 1847, XIV, 363, 377, 378. Carus : Nov. Act. Acad. Nat. Cur. 1850, XXII, 381.

Zeuglodon Harlani, Dekay : Nat. Hist. New York, Zool. 1842, 123. Wailes : Rep. &c. Geol. Missis. 1854, 278.

Zygodon, Buckley : Am. Jour. Sc. 1843, XLIV, 409 ; Edinb. New Phil. Jour. 1843, XXXV, 77. Koch : Jahrb. Min. 1845, 676, in part.

Hydrarchus Harlani, in part of Koch : Kurze Beschreib. d. Hydr. Harl. 1846 ; Jahrb. f. Min.

1847, 47. In part of Carus, etc.: Resultate geol. anat. u. zool. Untersuchungen ueber Hydrarchos, 1847, 5.

Hydrarchus v. *Hydrarchos*, in part of Koch: as above; Jahrb. f. Min. 1847, 717. Do. of Carus, etc.: as above. Müller: Archiv. f. Anat. 1847, XIV, 363.

Basilosaurus cetoides, Gibbes: Jour. Ac. Nat. Sc. 1847, I, 15, Pl. I, Figs. 1—4, 8. Geinitz: Result. geol. etc. Hydrarchos, 1847, 1. Reichenbach: Ibid. 13.

Zeuglodon macrospondylus, Müller: Monatsb. d. Akad. Wissens. Berlin, 1847, 103; Archiv f. Anat. 1847, XIV, 388; Ueber d. Zeuglodonten v. Nordamerika, 1849, Pl. I, Fig. 1 in part; II?; V, Figs. 2—5?; VI?; VII?; VIII, Figs. 1, 2, 4—8; IX, X, XI?; XII, Figs. 1—10; XIII, Figs. 3, 4?; XIV—XVII; XIX, Fig. 6; XX, series I; XXII; XXIII, Figs. 3—5. In part of Koch: Naturw. Abh. v. Haidinger, 1851, IV, 53. Pictet: Paléont. 1853, I, 378. Bronn: Leth. Geog. 1853–6, 769.

Phocodon s. *Squalodon*, in part of Agassiz: Am. Jour. Sc. 1847, IV, 421.

Hydrarchus macrospondylus, in part of Koch: Naturw. Abh. v. Haidinger, 1851, IV, 60, Pl. VII.

Zeuglodon trachyspondylus, Koch: Naturw. Abh. v. Haidinger, 1851, IV, 57.

Zeuglodon Hydrarchus, s. *Hydrarchos*, in part of Koch: Ibidem, Pl. VII.

Remains of the great *Basilosaurus* have been found in Alabama, Louisiana, Mississippi, and Arkansas. Eocene.

DORUDON.

Dorudon serratus.

Gibbes: Proc. Ac. Nat. Sc. 1845, II, 254, Pl. I.

Dorudon, Gibbes: Am. Jour. Sc. 1845, XLIX, 216; Proc. Ac. Nat. Sc. 1848, 57. Agassiz: Proc. Ac. Nat. Sc. 1848, 4.

Basilosaurus serratus, Gibbes: Jour. Ac. Nat. Sc. 1847, I, 15, Pl. III, Figs. 1–3? Pl. IV.

Zygodon, Koch: Jahrb. Min. 1845, 676 in part.

Zeuglodon, Owen: Proc. Ac. Nat. Sc. 1846; III, 15. Meyer: Jahrb. f. Min. 1847, 669. Tuomey: Rep. Geol. South Carolina, 1848, 156, 208.

Bear, Owen: Jour. Ac. Nat. Sc. 1847, I, 10.

Hydrarchus Harlani, in part of Koch: Kurze Beschreib. d. H. Harlani, Dresden, 1847; Jahrb. f. Min. 1847, 47. Carus: Resultate, etc. Hydrarchos.

Basilosaurus cetoides, in part of Gibbes; Jour. Ac. Nat. Sc. 1847, I, 5, Pl. II, Figs. 1–8; III, Figs. 4–6; Proc. Am. Assoc. 1849, II, 193.

Basilosaurus Kochii, Reichenbach: in Carus' Resultate geol. etc. Hydrarchos, 1847, 13.

Zeuglodon brachyspondylus, Müller: Monatsb. d. Akad. Wissens. Berlin, 1847, 103; Archiv f. Anatomie, 1847, XIV, 388; Ueber d. Zeuglodonten v. Nordamerika, 1849, Pls. I, Fig. 1, in part, Figs. 2, 3; III–V, Fig. 1; VIII, Figs. 3, 9, 10; XII, Fig. 11? XIII, Figs. 1, 2, 6, 7; XVIII; XIX, Figs. 1–5; XX, series II and III; XXI; XXIII, Fig. 4; XXVI; XXVII, Figs. 1, 2, 6. Bronn: Leth. Geog. 1853–6, III, 770.

Zeuglodon pygmæus? in part of Müller: Ueber d. Zeuglodonten v. Nordamerika, 1849, page 29, Pl. XIX, Figs. 1–5.

Zegulodon Hydrarchus, Carus: Nov. Act. Acad. Nat. Cur. 1850, XXII, 369, Pl. XXXIX A, Figs. 1–3; XXXIX B. In part of Koch: Naturw. Abh. v. Haidinger, 1851, IV, 57, Pl. VII.

Pontogeneus priscus, Leidy: Proc. Ac. Nat. Sc. 1852, 52.

Doryodon serratus, Cope: Proc. Ac. Nat. Sc. 1867, 155.

Delphinoid, Cope: Proc. Ac. Nat. Sc., 1868, 186; 1869, 6.

It is by no means certain that the remains from the eocene formations of South Carolina, described by Gibbes under the name of *Dorudon* and *Basilosaurus serratus*, belong to the same animal, as the vertebræ from Alabama, referred by Müller together with the former remains, to *Zeuglodon brachyspondylus*. Admitting, however, that they are the same, the comparatively short vertebræ of the latter would separate the genus from *Zeuglodon*, or *Basilosaurus* as I prefer to call it, and I therefore have adopted the generic together with the earlier specific name of Dr. Gibbes.

Eocene of South Carolina, Alabama and Louisiana.

Four comparatively well preserved and isolated teeth, sent to me for examination by Prof. F. S. Holmes, of Charleston, and obtained by the late M. Tuomey from the eocene formation of Alabama, appear to belong to the *Zeuglodon brachyspondylus* of Müller, which I have viewed with him as synonymous with the *Dorudon serratus* of Gibbes.

The teeth, represented in figures 2–5, plate XXIX, consist of a canine, a premolar with connate fangs and two molars with separate fangs.

The canine tooth, represented in figure 2, has nearly the form and size of that described and figured by Dr. Gibbes as pertaining to *Dorudon*, or *Basilosaurus serratus*. The crown bears a close resemblance to that of the canine of a Bear. In the specimen it is unworn, is compressed conical, with a rather blunt apex and with the borders acute. The enamel is strongly wrinkled on both surfaces. The fang forms a rather abrupt angle with the crown, and is less robust than in the specimen represented in figure 3, plate IV, of Dr. Gibbes' plate. It is moderately tapering, compressed and solid; the broken end exhibiting nothing but a minute orifice of the dental canal.

The premolar, represented in figure 3, is a less robust tooth than the preceding. It has the summit of the crown worn blunt so as to expose the dentine, and the ends of the fangs are broken off. The crown is considerably shorter and more compressed than that of the canine, but is rather broader. The enamel is wrinkled, though not quite so strongly as in the canine. The fangs are connate throughout as well as solid, exhibiting no trace of dental canals.

The molar, represented in figure 4, from an intermediate position in the series, nearly corresponds in size with those referred by Dr. Gibbes to *Dorudon serratus*, but in appearance resembles more those of *Basilosaurus cetoides* than it does the figures of the former represented in Dr. Gibbes' plate IV. In Dr. Gibbes' figures the enamel investment of the molars is represented as of remarkable shallowness, probably due to an attempt at perspective drawing by the artist. Dr. Gibbes states that the enamel in the teeth extends an inch in depth from the summit, whereas in the figures it is represented to be from seven to nine and one-half lines. In a plaster cast of the specimen, represented in Dr. Gibbes' figure 4, the enamel is indicated to be about the same depth as in the tooth about to be described.

The crown is nearly a third wider than high at the middle, and has its borders provided each with three denticles, of which the posterior are much the larger and extend nearer the summit. The enamel is strongly wrinkled internally, less so externally, but in some positions is nearly smooth. Dr. Gibbes describes and represents the enamel in the teeth of his *Dorudon* to be uniformly smooth. The fangs united in the body of the tooth, but separated the greater part of their length, extend nearly straight or slightly convergent from the crown. As in the other teeth they are solid.

The molar, represented in figure 5, from the back of the series, is a diminished likeness of the corresponding tooth of *Basilosaurus cetoides*, represented in Prof. Emmons' figure 3, plate II, of Vol. III, of the Amer. Jour. of Agriculture, and copied in Müller's work, "Ueber der Zeuglodonten," figure 5, plate XXIII.

The crown is much broader than the length, and is thickest on a line with the middle of its anterior narrower fang. The anterior border is acute, and impressed at the sides, especially externally, but it presents no conspicuous denticle except a rudimental one at the base. The posterior, longer, more sloping border forms, together with the summit of the crown, a series of six denticles. The fangs project nearly straight from the crown, and, as in the preceding teeth, are solid.

The measurements of the teeth are as follow:

	Canine. Lines.	Premolar. Lines.	Molar. Lines.	Molar. Lines.
Length of crown, ...	$15\frac{1}{2}$	$9\frac{1}{2}$	14	10
Breadth of crown, ...	10	$10\frac{3}{4}$	19	16
Thickness of crown, ...	7	$5\frac{1}{2}$	$6\frac{1}{4}$	$5\frac{3}{4}$
Length of fangs, when entire, ...	26	20	22	18

A specimen of a much mutilated premolar tooth, represented in figure 6, plate XXIX, from the Ashley River, South Carolina, in its size and appearance looks as if it might pertain to the same animal as the preceding. The specimen, loaned by Prof. Holmes, was probably derived from the eocene formation.

The crown is compressed conical, slightly curved and defined by acute ridges, of which the entire one behind presents, near the base, a clasping tubercle. When perfect, it has measured about ten lines long. The enamel is wrinkled as in the teeth above described. The fangs were connate through the greater part of their length, and they are gibbous and solid.

A cervical vertebra from the Washita River, Louisiana, originally referred to a cetacean with the name of *Pontogeneus priscus*, appears to agree nearly in size, form, and construction with the cervicals described by Müller as those of *Zeuglodon brachyspondylus*. The specimen has the body three inches in breadth, with nearly the same depth, and a length of one inch and a quarter below and one inch at the side. The articular surfaces are moderately concave. The breadth of the spinal canal between the abutments of the neural arch is one inch and seven lines. The roots of the transverse processes project from the lower part of the sides of the body.

Another cervical vertebra, from the eocene formation of Alabama, presented to the Academy by Dr. Clanton, has nearly the same construction as the former, but is larger and more biconcave. The breadth of the body is four inches, the depth three inches, and the length below an inch and a half. The width of the spinal canal is two inches. The stout roots of the transverse processes project from the lower part of the body obliquely.

CETOPHIS.

Cetophis heteroclitus.

Cope: Proc. Ac. Nat. Sc. 1868, 185.

Founded on caudal vertebræ from the miocene of Charles Co., Maryland.

SAUROCETUS.

Saurocetus Gibbesii.

Agassiz: Proc. Ac. Nat. Sc. 1848, 4.

Saurocetus, Gibbes: Ibidem, 57.

Founded on a tooth from the eocene of South Carolina.

CETACEA.*

DELPHINIDÆ.

DELPHINUS.

Delphinus occiduus.

Leidy: Proc. Ac. Nat. Sc. 1868, 197.

An extinct species is indicated by a fossil derived from the upper miocene formation of Half-moon Bay, California, submitted to my examination by Prof. J. D. Whitney. The specimen consists of an intermediate portion of the upper jaw, devoid of teeth, and encrusted with selenite. It measures along the more perfect lateral border five inches, and in this extent is occupied with nineteen closely set, circular alveoli, rather over two lines in diameter. At the back of the fragment the jaw has measured a little more than two inches wide. From this position it gradually tapers for half its length, and then proceeds with parallel sides to the fore end, where it is ten and one-half lines wide. The palate behind is nearly plane or slightly convex; at its fore

* Most of the Cetaceans indicated in the present synopsis are accepted on the authority of Prof. Cope, who has devoted much attention to the study of the order. With few exceptions, I have not yet had time nor opportunity to review the materials of his researches.

part it presents a deep median groove, closed by the apposition of the maxillaries, and this groove is separated only by a narrow ridge from the alveoli. The sides of the maxillaries are slightly concave longitudinally, convex transversely. The intermaxillaries are broken away, leaving a wide, angular gutter between the remains of the maxillaries.

Delphinus ——?

Cetacean, Wyman: Am. Jour. Sc. 1850, X, 231, Figs. 7a, 7b, 7c.
Squalodon mento, in part of Cope: Proc. Ac. Nat. Sc. 1867, 152.

In a Notice of Remains of Vertebrated Animals found at Richmond, Virginia, Prof. Wyman describes the fragment of a jaw and several isolated teeth which he regards as belonging to an animal of the same species, a Cetacean resembling in the corresponding parts the genus *Delphinus*.

Of the two teeth, represented in figures 7*b*, 7*c*, accompanying the notice, which Prof. Wyman has submitted to my inspection, that of 7*b* evidently belongs to an animal of the Dolphin family.

The crown is conical, compressed fore and aft, curved inwardly, smooth, and furnished in front and behind with an indistinct linear ridge defining the inner and outer parts. The fang is somewhat quadrate and gibbous, and much thickened by cementum, which is partly broken away in the specimen. From the oval obtuse bottom of the fang a circular aperture communicates with the pulp cavity.

The tooth represented in figure 7*c* may belong to the posterior part of the same series. It is smaller than the preceding, and has not the crown compressed fore and aft. The fang is fusiform, gibbous, and curved backward.

The tooth represented in figure 7*a* appears to have been lost, so that I have not had an opportunity of inspecting it. It may have belonged to the same animal.

The measurements of the two teeth represented by figures 7*b* and 7*c* are as follow:

	Lines.	Lines.
Length of crown,	6	5
Breadth do. fore and aft,	$2\frac{1}{2}$	$2\frac{3}{4}$
Thicknesss do.,	$3\frac{1}{2}$	$2\frac{3}{4}$
Length of fang,	8	8
Thickness of fang,	$4\frac{1}{2}$	4

Three teeth from the miocene of North Carolina bear a resemblance to those just described. One of them nearly repeats the form of that first noticed, but is considerably smaller. The others have the same shaped crown as in the second described specimen, but are stouter and longer, though the fangs are not so gibbous.

PRISCODELPHINUS.

Priscodelphinus Harlani.

Plesiosaurus, Harlan: Jour. Acad. Nat. Sc. 1825, 232, Pl. XIV, Fig. 1; Edinb. New Phil. Jour. 1834, XVIII, 29; Trans. Geol. Soc. Penn. 1835, I, 77; Med. Phys. Res. 1835, 281.

Priscodelphinus Harlani, Leidy: Pr. Ac. Nat. Sc. 1851, 327; 1853, 377; Anc. Fauna Neb. 1853, 8; Cret. Rept. United States in Smiths. Trans. 1861, 1, note. Dana: Man. Geology, 1863, 478. Cope: Proc. Ac. Nat. Sc. 1867, 144; 1868, 188.

Priscodelphinus, Lyell: Principles of Geol. 1854, 145; Man. Elem. Geol. 1855, 256.

The species is indicated by an isolated vertebra, originally described and figured by Dr. Harlan as pertaining to a *Plesiosaurus* from the cretaceous green sand of New Jersey. Recognizing its cetacean character, from its reported origin I supposed it to be the first evidence of the existence of cetaceans during the cretaceous period. Later researches prove the fossil to belong to the middle tertiary period. The specimen is a vertebra of mature age, and was obtained at Mullica Hill, Gloucester County, New Jersey. The length of the body is a little over two inches; the posterior articular surface is twenty lines wide and seventeen in depth. The spinal arch is lost. The width of the spinal canal just within its fore part is nine lines. The length of a transverse process, with an articular facet for a rib, is seventeen lines.

A less complete dorsal vertebra and four caudals, from their relative proportions supposed to belong to the same species, are from the miocene deposit of Shiloh, Cumberland Co., New Jersey, and are preserved in the Museum of the Academy.

Priscodelphinus Conradi.

Delphinus Conradi, Leidy: Proc. Ac. Nat. Sc. 1852, 35. Cope: Ibidem, 1867, 144.

Priscodelphinus Conradi, Cope: Proc. Ac. Nat. Sc. 1868, 188.

Founded on vertebræ from the miocene of Virginia, and Charles Co., Maryland.

Priscodelphinus acutidens.

Cope: Proc. Ac. Nat. Sc. 1867, 144, 146.

Founded on a single tooth from the miocene of Charles Co., Maryland.

Priscodelphinus spinosus.

Cope: Proc. Ac. Nat. Sc. 1868, 187.

Indicated by vertebræ from the miocene formation of Charles Co., Md.

Priscodelphinus atropius.

Cope: Proc. Acad. Nat. Sci. 1868, 187, 188.

Indicated by vertebræ from the miocene formation of Charles Co., Md.

Priscodelphinus stenus.

Cope: Proc. Ac. Nat. Sc. 1868, 188.

Indicated by vertebræ found with the above.

TRETOSPHYS.

Tretosphys grandævus.

Priscodelphinus grandævus, Leidy: Proc. Acad. Nat. Sc. 1851, 327; 1853, 377; Anc. Fauna Neb. 1853, 8; Cret. Rept. U.S., in Smiths. Trans. 1865, 1, note. Dana: Man. Geology, 1863, 478. Cope: Proc. Ac. Nat. Sc. 1867, 144.

Delphinapterus grandævus, Cope: Proc. Ac. Nat. Sc. 1868, 191.

T. grandævus, Cope: Proc. Ac. Nat. Sc. 1868, 191.

Tretosphys grandævus, Cope: Proc. Ac. Nat. Sc. 1869, 6, 7, 8.

This species was originally indicated by two vertebræ from the miocene marl beds of Shiloh, Cumberland Co., N. J. The specimens are without epiphyses, and appear related to a larger dorsal vertebra than that referred to *Priscodelphinus Harlani*, and were therefore supposed to indicate a different species. There is no positive evidence that they belonged to the same genus, their reference in this respect having been made on their general relation in length and on the supposition that they belonged, together with the vertebra of *P. Harlani*, to the cretaceous green sand.

Mature specimens of vertebræ, apparently of the same species, have since been obtained from the same locality. The body of an adult lumbar vertebra measures two and three-quarter inches in length, and at the articular ends rather less than two and a quarter inches in breadth.

The fragment of an upper jaw accompanying two of the vertebral specimens is suspected to belong to the same animal, and indicates it to have possessed a long, narrow muzzle. The fragment is about a foot in length; at the back part is twenty-three lines wide and thirteen and a half lines in depth; at the fore part it is fifteen lines wide and nine lines in depth. A fissure divides it in the median line, widening into a narrow angular groove below, and closed at its fore part above. The under surface is transversely convex, and impressed into a shallow groove along the line of the sockets of the teeth, which are twenty-two in number in the space of a foot. The upper part is prominently convex, declining anteriorly and strongly impressed at the sides. No teeth remain in the specimen.

Tretosphys lacertosus.

Delphinapterus lacertosus, Cope: Proc. Ac. Nat. Sc. 1868, 190.

T. lacertosus, Cope: Proc. Ac. Nat. Sc. 1868, 189.

Tretosphys, Cope: Proc. Ac. Nat. Sc. 1868, 190.

Delphinapterus Hawkinsii, Cope: Ibidem.

Tretosphys lacertosus, Cope: Proc. Ac. Nat. Sc. 1869, 7.

Remains from the miocene of Charles Co., Md.

Tretosphys Gabbii.

Delphinapterus Gabbii, Cope: Proc. Ac. Nat. Sc. 1868, 191.

T. Gabbii, Cope: Ibidem.

Tretosphys Gabbii, Cope: Proc. Ac. Nat. Sc. 1869, 7, 8.

Founded on a caudal vertebra from the miocene of Charles Co., Md.

Tretosphys uræus.

Cope: Proc. Ac. Nat. Sc. 1869, 7, 8.

Founded on a lumbar vertebra from Shiloh, Cumberland Co., N. J., and a caudal from near the mouth of the Patuxent, Maryland.

Tretosphys Ruschenbergeri.

Delphinapterus Ruschenbergeri, Cope: Proc. Ac. Nat. Sc. 1868, 189.

Tretosphys Ruschenbergeri, Cope: Proc. Ac. Nat. Sc. 1869, 7, 9.

Founded on a caudal and a lumbar vertebra, from the miocene of Charles Co., Md.

ZARHACHIS.

Zarhachis flagellator.

Cope: Proc. Acad. Nat. Sc. 1868, 189, in part; 1869, 9.

Founded on a caudal vertebra from the miocene of Charles Co., Md.

Zarhachis Tysoni.

Zarhachis flagellator, in part of Cope: Proc. Ac. Nat. Sc. 1868, 189.

Zarhachis Tysonii, Cope: Proc. Ac. Nat. Sc. 1869, 9.

Founded on a lumbar vertebra from the miocene of the Patuxent, Maryland.

Zarhachis velox.

Zarhachis flagellator, in part of Cope: Proc. Ac. Nat. Sc. 1868, 189.

Zarhachis velox, Cope: Proc. Ac. Nat. Sc. 1869, 10.

Founded on a lumbar vertebra from the miocene of Shiloh, Cumberland Co., N. J.

LOPHOCETUS.

Lophocetus calvertensis.

Delphinus Calvertensis, Harlan: Pr. Nat. Inst. Washington, 1842, 195, accom. with 3 pls. Dekay: Nat. Hist. New York, Zool. Pt. I, 1842, 136. Markoe: L'Institut, 1842, X, 384; Jahrb. f. Mineralogie, 1843, 238.

Pontoporia calvertensis, Cope: Proc. Ac. Nat. Sc. 1866, 297.

Lophocetus calvertensis, Cope: Proc. Ac. Nat. Sc. 1867, 144, 146.

Indicated by a skull from the miocene of Calvert cliffs, Maryland.

RHABDOSTEUS.

Rhabdosteus latiradix.

Cope: Proc. Ac. Nat. Sc. 1867, 132, 144, 145.

Founded on fragments of jaws and teeth from the miocene of Charles Co., Md.

IXACANTHUS.

Ixacanthus cœlospondylus.

Cope: Proc. Ac. Nat. Sc. 1868, 159, 187.

Founded on vertebræ from the miocene of Charles Co., Md.

ANOPLONASSA.

Anoplonassa forcipata.

Cope: Pr. Am. Phil. Soc. 1869, 188, 189, Pl. V, Fig. 5.

Indicated by a jaw fragment, from near Savannah, Georgia.

BELUGA.

Beluga vermontana.

Delphinus Vermontanus, Thompson: Amer. Jour. Sci. 1850, IX, 257, Figs. 1—13. Leidy: Anc. Fauna Neb. 1853, 10. Pictet: Traité de Paléont. 1853, I, 382.

Beluga Vermontana, Thompson: Hist. of Vermont, 1853, Append. 15, Figs. 1—13. Briggs and Foster: Geol. Surv. of Canada, 1863, 919. Cope: Proc. Ac. Nat. Sc. 1867, 144.

Indicated by the greater part of a skeleton found at Charlotte, Chittenden Co., Vermont. According to Mr. Thompson, probably also by some remains found at Montreal, Canada. Post-tertiary.

CATODON.

Catodon vetus.

Cetacea resembling Physeter macrocephalus, Gibbes: Jour. Ac. Nat. Sc. 1847, I, 11.

Physeter, Gibbes: Pr. Am. Assoc. 1849, II, 193, 194.

Physeter antiquus,* Leidy: Proc. Ac, Nat. Sc. 1853, 378; Holmes' Post-plioc. Fos. S. Carol. 1860, 117, Pl. XXIV, Figs. 8, 9. Emmons: Rep. N. Carol. Geol. Surv. 1858, 212, Fig. 34; Man. Geol. 1860, 213, Fig. 181. Cope: Proc. Ac. Nat. Sc. 1867, 144; 1859, 162.

Two teeth resembling those of the Sperm Whale are described on page 117, and represented in figures 8, 9, plate XXIV, of Holmes' Post-pliocene Fossils of South Carolina; one from the post-pliocene deposit of Ashley River, the other, recent in appearance, obtained from an excavation in Charleston. A somewhat larger and straighter tooth is described and figured on page 213 of Emmons' North Carolina Geological Survey, from Craven Co., North Carolina, and is attributed to the eocene formation.

The collection of the Academy contains four teeth and a vertebra, together with some fragments of bones of a Sperm Whale from the miocene formation of Virginia. The teeth are small, and the vertebra is devoid of epiphyses, indicating a young animal. The teeth are much decomposed, friable, and broken. The best preserved in its perfect condition has been about four and a half inches long, and is fourteen and a half lines in diameter antero-posteriorly at the middle.

ORYCTEROCETUS.

Orycterocetus quadratidens.

Leidy: Proc. Ac. Nat. Sc. 1853, 378. Emmons: N. Car. Geol. Surv. 1858, 210, Fig. 32.

Orycterocetus cornutidens, in part of Leidy: Proc. Ac. Nat. Sc. 1856, 255. Cope: Ib. 1867, 144.

The remains originally referred to *Orycterocetus* by the author consist of two teeth

* This name was previously employed by Gervais, Comptes Rendus, 1849, xxviii, 646.

together with small fragments of a jaw from the miocene formation of Virginia, presented to the Academy by Prof. Holmes, of Charleston.

The teeth, represented in figures 16, 17, plate XXX, two-thirds the natural size, in their general appearance remind one more of the tusks of a Boar than they do those of the Sperm Whale, with which *Orycterocetus* may have been related. They are long and conical, one being nearly straight, the other strongly curved. Near the apex they are rather ovoidal in transverse section, but towards the base assume a more quadrate character. They are finely ridged longitudinally, and strongly marked with annular lines of growth. The apex is worn on opposite sides in the straight tooth; all around in the curved one. The base presents a funnel-like pulp cavity defined by the thin edge at the outer periphery of the base of the teeth, as in the incomplete teeth of the Sperm Whales, and as in the teeth of the Crocodiles. The teeth exhibit no distinction of crown and fang, no signs of enamel investment, but are composed wholly of dentine, except that the straight specimen on one side at the base presents a thin patch of cementum, apparently the remains of a more extended covering.

The curved tooth in its perfect condition along the convexity has been about five inches in length; the diameter at base about eleven lines laterally and ten lines from before backward. The straight tooth has been about the third of an inch shorter, and slightly less in diameter at base.

A fragment of the upper jaw accompanying the teeth, about eight inches long, accommodated as many teeth. The alveoli were separated by thin partitions, and their bottom was separated from the dental canal by a thick layer of porous bone. Two alveoli, perfect at their outer parapet, are an inch and three-fourths deep by an inch in diameter. The outer part of the jaw at the side of these alveoli is three and a quarter inches deep.

Prof. Emmons has described and figured a tooth which he refers to *Orycterocetus quadratidens*. The specimen was obtained from Pitt Co., North Carolina, and is probably of miocene age. The tooth is of more robust proportions, more curved, and more obtuse at the summit than in those above described. "It is somewhat quadrate or angular; its transverse section is rather ovate, with the anterior part flattened. Its base has a short conical pulp cavity less than an inch in depth." The length of the tooth as represented in Prof. Emmons' figure is about six inches; its diameter at middle over fourteen lines.

Orycterocetus cornutidens.

Leidy: Proc. Acad. Nat. Sc. 1856, 255. Emmons: Rep. N. Car. Geol. Surv. 1858, 211, Fig. 33. Cope: Proc. Ac. Nat. Sc. 1867, 144.

Orycterocetus crocodilinus, Cope: Proc. Ac. Nat. Sc. 1867, 144.

This species was first characterized from an isolated tooth found in the miocene formation of North Carolina. The specimen belonged to Prof. Emmons, and is represented in figure 33 of his Report of the North Carolina Geological Survey.

The tooth bears a miniature resemblance to a cow horn, being conical, strongly curved, and proportionately much broader approaching the base than in the preceding species; nor does it assume a quadrate appearance, but is nearly circular or ovoidal in transverse section. The deep conical pulp cavity is defined by a sharp edge at the periphery of the base. The length of the tooth is about the same as that of the curved tooth of *O. quadratidens*, but its diameter at base is an inch, by an inch and two lines.

Recently Prof. Cope has described a tooth from the miocene of Charles Co., Md., which he refers to a species distinct from the preceding. The specimen, however, agrees so nearly in its form and proportions with an equal length of the summit of the tooth of *O. cornutidens*, that I suspect it belongs to a younger individual of the same, or a different part of the jaw in the adult. The specimen is two inches five lines in length, and about eight in breadth.

We know nothing of other remains of *Orycterocetus* than those indicated. When we observe the variety in the form and size of the teeth in the Sperm Whale, we are led to suspect that probably all the specimens referred to the several species of *Orycterocetus* belong to one.

HOPLOCETUS.

Hoplocetus obesus.

Leidy: Proc. Ac. Nat. Sc. 1868, 196.

Founded on specimens consisting of a tooth and the fragment of another, obtained by Prof. Holmes from the post-pliocene deposit of Ashley River, in the vicinity of Charleston, South Carolina.

The nearly entire tooth, represented in figure 13, plate XXX, two-thirds the diameter of the specimen, has a portion of the crown and the end of the fang broken away. The crown was much worn, leaving on the summit a broad, flat, discoidal surface. The enamel, where it remains, forms a band encircling about one-third of the crown, about three lines in depth, and one-fourth of a line thick. It appears to have been rugose longitudinally. The fang, a striking character in the teeth referred to *Hoplocetus*, is fusiform, remarkably robust, and large in proportion to the crown. It is straight at the bottom two-thirds, but curved towards the crown, so that this appears to be obliquely implanted upon it. The interior of the fang is pervaded by a narrow pulp cavity of irregular diameter, from the existence at its sides of nodosities. The part constituting the technical neck of the tooth is feebly constricted. The measurements of the specimen are as follow:

	Lines.
Length in present condition in a straight line,	44
Estimated length of fang restored,	52
Greater diameter of fang,	19
Lesser diameter of fang,	16½
Estimated diameter of crown at base,	8

The fang of this tooth appears to consist of an axis of dentine about equal in diameter to the crown, and its great accession of bulk appears to be due to the cemental layer.

The second specimen consists of the fragment of a tooth devoid of crown. The tooth has been of little greater bulk than the preceding, as the diameter of the remaining portion of the fang is twenty and one-half lines.

The more perfect tooth bears a near resemblance to that of *Hoplocetus crassidens*, represented in figure 10, plate XX, of Gervais' Paléontologie Francaise.

Another tooth referable to the same genus, and perhaps to a different species, is represented in figures 14, 15, plate XXX, two-thirds the natural diameter. It was sent to me for examination by Prof. Wyman, of Cambridge, and was derived from the miocene formation in the vicinity of Richmond, Virginia. It is much larger and straighter than the better preserved of the two specimens above described.

The crown is worn off in a blunt manner or somewhat convex disk, about nine lines in diameter, and is encircled by a more or less worn and broken band of longitudinally rugose enamel, varying in depth from three to five lines, and one-third of a line in thickness. The fang is broken at its end, and exhibits a long conical pulp cavity, large enough to introduce the end of the middle finger for an inch or more. The fang in shape is fusiform, exceedingly robust, straight, and somewhat quadrate. As in the other specimens, it is composed of a dentinal axis near the diameter of the crown, enveloped in a huge accumulation of cementum. The length of the specimen in a straight line, in its present condition, is fifty-five lines. The fang in a restored condition is estimated to have been five inches long. The diameter of the fang is twenty and twenty-one and a half lines.

In the large proportion of cementum to the dentinal axis of the teeth of *Hoplocetus* they bear such a resemblance to the fragments found in the Red Crag of England, and referred by Prof. Owen to a genus under the name of *Balænodon*, as to render it probable the former is the same as the latter.

The relations of *Hoplocetus* or *Balænodon* are conjectural; though associated with the cetaceans, the teeth upon which the genus is founded remind one quite as much, if not more, of the canines of certain Seals.

ONTOCETUS.

Ontocetus Emmonsi.

Leidy: Proc. Ac. Nat. Sc. 1859, 162. Emmons: Man. Geol. Phila. 1860, 219, with Fig. of a tooth half the natural size. Cope: Proc. Ac. Nat. Sc. 1867, 144.

Indicated by a mutilated tooth remarkable for its shape and size. It is curved conical, laterally compressed and fluted. In its perfect condition it has been upwards of ten inches in length by about four inches in its greater diameter from before backward and two and a half inches transversely. It is composed of dentine with an exterior comparatively thin layer of cementum, and an interior comparatively large amount of osteo-dentine. The lower extremity of the fang is solid. The specimen is eroded in several positions, apparently as if the detached tooth had lain some time at the bottom of the sea, exposed to the boring action of some molluscous or other animal.

The specimen, half the size of nature, is represented on page 219, of Emmons' Manual of Geology, published in Philadelphia in 1860. It was obtained from the miocene formation of North Carolina, but the exact locality is not mentioned by Prof. Emmons. The relations of the animal to which the specimen belonged are uncertain. It may have pertained to a cetacean like the Sperm Whale; perhaps to a Walrus-like animal.

HEMICAULODON.

Hemicaulodon effodiens.

Cope: Proc. Am. Phil. Soc. 1869, 191, Pl. V, Fig. 6.

Of the same uncertain reference as the specimen indicated in the preceding notice of *Ontocetus*, is the fragment of a tooth, from Monmouth Co., New Jersey, described by Prof. Cope under the above name, and suspected by him to belong to a sirenian.

BALÆNIDÆ.

BALÆNA.

Balæna mysticetoides.

Emmons: Rep. North Carolina Geol. Surv. 1858, 204, 205, Fig. 26.

Founded on an otolite from the miocene of North Carolina.

PROTOBALÆNA.

Protobalæna palæatlantica.

Balæna palæatlantica, Leidy: Proc. Ac. Nat. Sc. 1851, 308; Anc. Fauna Neb. 1853, 8. Cope: Proc. Ac. Nat. Sc. 1867, 132, 144, 147.

Balænoptera palæatlantica, Cope: Proc. Ac. Nat Sc. 1868, 192, 193.

Founded on a jaw fragment, accompanied by several vertebræ, from the miocene formation of City Point, Virginia. The form and construction of the portion of jaw appears to indicate a genus different from any of those now living. The jaw fragment is about nine inches long, straight and ovate in cross section. The basal portion is demi-cylindroid; the upper portion presents a sub-acute gingival border, with an internal row of large and nearly equidistant neuro-vascular canals, directed upward and moderately forward. The outer side is strongly convex, and near its upper border presents two neuro-vascular canals, larger than those nearer the edge internally and directed more obliquely forward. All the neuro-vascular canals communicate with a longitudinal canal, of the form of the jaw fragment, and fourteen lines in its longer and eleven lines in its shorter diameter. The inner surface of the fossil, less convex than the outer, at its lower part presents a deep and proportionately wide fissure, extending the length of the specimen, for the accommodation of the Meckelian cartilage. The depth of the fragment anteriorly is forty-three lines; posteriorly fifty-one lines. The transverse diameter anteriorly is thirty-four lines; posteriorly thirty-three lines.

Of two vertebræ accompanying the jaw fragment, judging from the general appearance, either, if alone, would have been viewed as belonging to the same individual, but one is mature while the other is devoid of epiphyses. Both are from the lumbar region, and are proportionately longer than the corresponding bones of *Balæna* or *Protobalæna*. The sides of the body, below the transverse processes, are deeply depressed or concave, so as to produce a prominent median carina inferiorly. The measurements of the specimens are as follow:

	Adult. Inches.	Young. Inches.
Length of body inferiorly,	7	6
Depth of body anteriorly,	$5\frac{1}{2}$	$5\frac{1}{2}$
Breadth of body anteriorly,	6	$6\frac{1}{2}$
Width of spinal canal at middle,	$2\frac{1}{4}$	$1\frac{3}{4}$

ESCHRICHTIUS.

Eschrichtius priscus.

Balæna prisca, Leidy: Proc. Acad. Nat. Sc. 1851, 308; Anc. Fauna Nebr. 1853, 8. Cope: Proc. Ac. Nat. Sc. 1867, 132.

Balænoptera prisca, Cope: Proc. Acad. Nat. Sc. 1867, 144, 147; 1868, 192.

Eschrichtius priscus, Cope: Proc. Ac. Nat. Sc. 1869, 11.

Founded on a jaw fragment, accompanied by a mature caudal vertebra, from the miocene formation of Westmoreland County, Virginia.

The jaw fragment is about fourteen inches in length and is of slender proportions. It is demi-cylindroid, feebly convex internally and slightly curved downward as well as inward. It is of nearly uniform depth and thickness. The base forms an obtuse or rounded ridge at the boundary of the inner and outer surfaces. The upper margin defining the inner surface is sub-acute. Below the upper margin internally there exists a row of small gingival foramina, directed forward. Rather more than half an inch from the same margin there exists a row of large vasculo-neural foramina directed obliquely forward. The canal within the bone throughout its length is divided by a partition. The measurements of the specimen are as follow:

Depth posteriorly, 34 lines; anteriorly 34 lines.
Thickness posteriorly, 24 lines; anteriorly, 22 lines.

The caudal vertebra, from the anterior part of the series, is slightly longer than the breadth, and its articular extremities are nearly circular and convex. The posterior abutments of the chevrons extend nearly half the length of the body. The transverse processes projected from near the middle of the latter about an inch and three-fourths back of the edge of the anterior articulation. The spinal canal is narrow, not more than seven lines in width. The measurements of the specimen are as follow:

Length of body inferiorly,	67 lines;	superiorly, 67 lines.
Length of body laterally,	77 "	in the axis, 82 "
Breadth of anterior articular extremity,		77 "
Depth " " "		74 "
Breadth of posterior " "		78 "
Depth " " "		74 "
Breadth of neural arch,		42 "
Breadth of transverse processes,		48 "

Eschrichtius cephalus.

Cope: Proc. Ac.Nat. Sc. 1867, 131, 144, 148; 1868, 184, 193; 1869, 10, 11.

Remains comprising a considerable portion of the skeleton, from the miocene formation of Charles Co., Md.

Eschrichtius leptocentrus.

Cope: Proc. Ac. Nat. Sc. 1867, 144, 147; 1868, 193; 1869, 10, 11.

Founded on an isolated cervical vertebra, devoid of epiphyses, from the miocene formation of Virginia.

Eschrichtius expansus.

Megaptera expansa, Cope: Proc. Ac. Nat. Sc. 1868, 193.
Eschrichtius expansus, Cope: Proc. Acad. Nat. Sc. 1869, 11.

Founded on vertebræ from the miocene of Westmoreland Co., Virginia, and Charles Co., Maryland.

Eschrichtius pusillus.

Cope: Proc. Ac. Nat. Sc. 1868, 191, 193; 1859, 11.
Balænoptera pusilla, Cope: Proc. Ac. Nat. Sc. 1868, 159.
? Delphinapterus tyrannus, Cope: Proc. Ac. Nat. Sc. 1868, 190; 1869, 7.

Remains from the miocene of Maryland, and from the vicinity of Charleston, S. C.

Of uncertain reference.

Vertebræ of Cetaceans, Hitchcock: Rep. Geol. Massachusetts, 1833, 193, Pl. XII, Figs. 23—25, 28.

Cetacean from Newbern, N. C., Harlan: Am. Jour. Sc. 1842, XLIII, 143.

Whale from Brunswick Canal, Georgia, Harlan: Am. Jour. Sc. 1842, XLIII, 143.

Whale-bone Whales and Bottle-nosed Whales (Hyperoodon), Owen: Amer. Jour. Sc. 1844, XLVI, 319.

Founded on vertebræ from Martha's Vineyard. Miocene.

Vertebræ like those of the porpoise, Emmons: Rep. N. Carol. Geol. Surv. 1858, 201.

Caudal vertebra of a whale, Emmons: Ibidem, 201, 202, Fig. 25.

Balæna, Emmons: Ibidem, 202.

Fragments of jaws and vertebræ from the Meherrin River, near Murfreesborough, North Carolina. Miocene.

Otolites of whales, Emmons: Ibidem, 205, Figs. 27, 28.

Of two species, from the miocene of North Carolina.

Otolite resembling that of Balæna Mysticetus, Emmons: Ibidem, 208.

From the miocene of Craven Co., North Carolina.

Cetacean ear bones, Emmons: Ibidem, 208, 209, Figs. 28—31.

Of four species, from the miocene of Tar River, N. C.

? Cetacean, Carpenter: Am. Jour. Sc. 1846, I, 249.

Fragment of a skull from the quaternary of Texas.

Cetaceans, Wyman: Am. Jour. Sc. 1850, X, 233.

Fragments of bones from the miocene of Richmond, Va.

Cetacean, Dana: U. S. Expl. Exped., Geol. 722, Pl. XVI, Fig. 1.

Vertebræ and fragments of other bones in argillaceous sandstone, Astoria, Oregon.

The Museum of the Academy contains a mature sacro-lumbar vertebra from the same locality. Length of centrum thirty-eight lines; width in front thirty-three lines, height twenty-eight lines; width of spinal canal one inch.

Doubtful Fossils.

Sus scrofa.

Aper, Aper pecari?, Rafinesque: Enumeration and account of some remarkable natural objects, Philad., Nov. 1831.

Sus scrofa, De Blainville: Osteographie Generale, article Sus, 192, 204, Pl. IX, Sus scrofa, Texas.

Hog, Holmes: Proc. Amer. Assoc. Adv. Sc. 1850, 203.

Bos bovis.

Cow, Holmes: Pr. Am. Assoc. Adv. Sc. 1850, 203.

Cœlogenys paca.

Osteopera platycephala, Harlan: Fauna Americana, 1825, 126. Meyer: Palæologica, 1832, 58. Pictet: Paléont. 1853, I, 254. Bronn: Leth. Geog. 1856, 1047.

Physeter macrocephalus.

Recent Spermaceti Whale, on the authority of Harlan: Am. Jour. Sc. 1828, XIV, 186; Edinb. New Phil. Jour. 1834, XVII, 361; Med. Phys. Res. 1835, 278.

Megistosaurus, Godman, according to Harlan: Am. Jour. Sc. 1828, XIV, 186; Edinb. New Phil. Jour. 1834, XVII, 361; Med. Phys. Res. 1835, 279; Trans. Geol. Soc. Penn. 1835, I, 47.

Nephrosteon, Rafinesque: Atlantic Journal, 1833, 12. See Harlan as just quoted. Pictet: Traité de Paléont. 1853, I, 386. Giebel: Fauna d. Vorwelt, 1847, I, 236.

Of uncertain reference.

Rorqualis australis, or *Balænoptera*, De Kay: Nat. Hist. N. York, Pt. I, Zool., 1842, 131, 132, Pl. 33, Fig. 4.

A skull, fifteen feet long, dug up near Balize, Louisiana, probably of a recent animal, was supposed by Dr. De Kay to be the same as the Rorqual of the Cape of Good Hope. The figure given by Dr. De Kay, if correct, certainly indicates a different animal from the Rorqual. It represents the roof of the mouth or palate decidedly arched, which is not the case in the latter. The arching is slight compared with the condition in the Right Whales, indicating the possession of a short baleen as in the Finners, but to which of these it belongs the means of information are too meagre to ascertain. Probably the skull belongs to an undescribed species now living in the Gulf of Mexico.

Fictitious Fossil.

Rhinoceroïdes Alleghaniensis, Featherstonehaugh: Month. Am. Jour. Geol. 1831, 10, Pl. Harlan: Edinb. New Phil. Jour. 1834, XVII, 353.

Rhinoceros Alleghanensis, De Blainville: Ost. Gen., Rhin. 172.

Tropodon, Rafinesque: Atlantic Journal, 1832–3, 114.

Founded on a fragment of sandstone rock with several projecting pebbles, which were mistaken for incisor teeth. According to De Blainville, who says "c'est sans doute une piece artificielle," the specimen is preserved in the Museum at Paris. Ost. Gen., Rhin., 173.

Additional notice of Remains of Mammals.

The remains of a number of mammals have recently been described by Prof. Cope, in the Proceedings of the American Philosophical Society, but the publication of them was not made in time to be noticed in their proper place in the foregoing Synopsis.

The following remains of huge Rodentia, from the island of Anguilla, W. I., are indicated on page 407 of the Synopsis:

Amblyrhiza inundata, Cope: Proc. Am. Phil. Soc. 1869, 183, Pl. IV, with figures representing an incisor, molar teeth, and fragments of the femur.

Loxomylus longidens, Cope: Ibidem, 187, Pl. V, Figs. 2, 3.

Leptomylus longidens, Cope: Ibidem, 192.

Leptomylus Amblyrhiza, Cope: Ibidem, 192.

The accompanying figures represent a pair of upper incisors, molars, and a phalanx which appears to be the intermediate or proximal one of the series.

The following were all found in association in a limestone breccia, the remnant of a cave, in Wythe County, Virginia. Age, quaternary.

CARNIVORA

Galera perdicida.

Cope: Proc. Am. Phil. Soc. 1869, 177, Pl. III, Fig. 1.

Hemiacis perdicida, Cope: Proc. Ac. Nat. Sc. 1869, 3.

Indicated by the ramus of a jaw with teeth.

Ursus amplidens, Cope: Ibidem, 176. See page 370 of this work.

Procyon lotor, Cope: Ibidem, 176. See page 370.

Myxophagus spelæus.

Cope: Proc. Ac. Nat. Sc. 1869, 3; Proc. Am. Phil. Soc. 1869, 176, Pl. III, Figs. 2.

Based on the fragment of a tooth, apparently the heel of a sectorial molar or portion of a tubercular molar of a carnivore.

RUMINANTIA.

Cariacus virginianus, Proc. Am. Phil. Soc. 1869, 176. See page 376 of this work, Cervus virginianus.

Bos? antiquus, Cope: Ibidem, 176. See page 362, synonymous with Bison antiquus.

ARTIODACTYLA.

Dicotyles nasutus, Cope: Ibidem, 176. See page 385.

PERISSODACTYLA.

Tapirus Haysii, Cope: Ibidem, 176. See page 391.

SOLIDUNGULA.

Equus? complicatus, Cope: Ibidem, 176. See page 399.

RODENTIA.

Lepus sylvaticus, Cope: Ibidem, 175. See page 403.

Tamias lævidens, Cope: Ibidem, 174, Pl. III, Figs. 4. See page 404.

Sciurus panolius, Cope: Ibidem, 174, Pl. III, Figs. 5. See page 404.

Arctomys monax, Cope: Ibidem, 173. See page 404.

Stereodectes tortus, Cope: Ibidem, 172, Pl. III, Figs. 3. See page 404.

The figures appear to me to represent a deformed incisor of the preceding.

Neotoma ? floridanum, Cope: Ibidem, 173.

Hesperomys ? leucopus, Cope: Ibidem, 173.

Castor fiber, Cope: Ibidem, 173. See page 405.

INSECTIVORA.

Blarina, Cope: Ibidem, 175.

EDENTATA.

Megalonyx Jeffersonii, Cope: Ibidem, 172. See page 411.

CHEIROPTERA.

Vespertilio, Cope: Ibidem, 176.

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[Synonymes are in Italic.]

REFERENCES TO THE PLATES.

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Fig. 2. Portion of the left ramus of the lower jaw, containing the heel of the sectorial tooth, and the succeeding pair of tubercular molars.

Fig. 3. Inner view of a right sectorial tooth of the lower jaw.

Fig. 4. Fragment of the left side of a lower jaw with the sectorial molar, viewed externally.

Fig. 5. Series of the three upper tubercular molars of the left side, viewed on their triturating surfaces. *a*, last molar ; *b*, penultimate molar ; *c*, ante-penultimate molar.

Fig. 6. Series of the upper sectorial and the succeeding two tubercular molars of the right side, from a smaller and younger individual. *b*, penultimate molar ; *c*, ante-penultimate molar ; *d*, sectorial tooth.

Fig. 7. Amphicyon gracilis. See page 36.

Fragment of the left side of a lower jaw, containing the last premolar and the sectorial tooth, viewed externally.

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Left ramus of the lower jaw. *a*, position of an alveolus for a premolar.

Fig. 9. Canis sævus. See page 28.

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Fig. 10. Canis Haydeni. See page 30.

Fragment of the right ramus of the lower jaw, containing the sectorial molar and the preceding pair of premolars much worn. *a*, pair of alveoli for the last molar; *b*, pair of alveoli for the penultimate molar.

Fig. 11. Canis vafer. See page 29.

Greater portion of the right ramus of the lower jaw, containing all the teeth except the incisors.

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Fig. 13. Outer view of the right sectorial tooth. Fig. 14. Inner view.

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PLATE II.

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Fig. 1. View of the right side of a skull, with both of the jaws containing full series of molar teeth.

Fig. 2. Upper view of the greater portion of a skull, from another specimen.

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PLATE III.

HYÆNODON HORRIDUS. See page 39.

View of the left side of a skull, with the jaws containing nearly all the teeth. Of the natural size.

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DREPANODON PRIMÆVUS. See page 54. Figures of the natural size.

Fig. 1. View of the right side of a skull, without the lower jaw. It contains all the teeth except one incisor and the first premolar.

Figs. 2–4. From a young but mature individual.

Fig. 2. Series of the upper molars of the right side, unworn.

Fig. 3. View of the triturating surface of the last or tubercular molar.

Fig. 4. Portion of the right ramus of the lower jaw, containing all the molar teeth unworn.

Fig. 5. Nearly complete skull of an old individual, as conspicuously indicated by the much worn condition of the upper sectorial tooth.

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Figs. 1–4. DINICTIS FELINA. See page 64.

Fig. 1. View of the right side of a nearly complete skull, containing all the molars and the lower canine perfect.

Fig. 2. Portion of the right ramus of the lower jaw, from another specimen, exhibiting a complete series of molars.

Fig. 3. Inferior view of the right upper sectorial and tubercular teeth.

Fig. 4. Posterior view of the right upper tubercular tooth.

Fig. 5. DREPANODON OCCIDENTALIS. See page 63.

Fragment of the left ramus of a lower jaw, containing the second premolar, and the fangs of the molars before and behind. (Erroneously indicated as in Plate IV, on page 63.)

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Right lateral and upper views of a remarkably well preserved skull.

The originals of these figures are nearly as perfect as represented; several salient points alone being lost, and a comparatively few fractures existing.

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Upper view of the left half of a remarkably well preserved skull, but slightly restored from other specimens.

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Upper view of the facial portion of a skull.

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Symphysial fragment of a lower jaw. The original contains both canines, the median incisors, and the left lateral one. In the figure a second lateral incisor is introduced from an isolated specimen belonging to another individual.

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MERYCOCHŒRUS PROPRIUS. See page 110.

Figures 1, 2, about two-thirds the diameter of nature; the remainder of the natural size.

Fig. 1. Left side of the upper jaw, consisting of the greater part of the maxilla, the premaxilla, and parts of the malar and lachrymal. It contains a full series of teeth, but the lateral incisor, the first

premolar, the first true molar, and portions of those succeeding, are restored from the specimen of the right side of the jaw.

Fig. 2. Portion of the lower jaw, belonging to the same individual as the preceding. It contains a full series of teeth, but the incisors have been introduced from the specimen of the opposite side.

Fig. 3. View of the triturating surfaces of the upper teeth, mostly from the same specimen as figure 1, but partly from that of the opposite side. All are observed to be much worn; the incisors are blunted; the canine is most worn off posteriorly, and all the molars exhibit exposed tracts of dentine; least in the first premolar; in the first true molar extending the entire breadth of the crown.

Fig. 4. View of the triturating surfaces of the lower teeth, mainly from the same specimen as figure 2.

Fig. 5. Last upper molar of the left side, from a different individual than the preceding. It varies from the corresponding tooth of the latter, as seen in figure 3, in being proportionately narrower and in having a stronger posterior column.

Figs. 6, 7. Inferior lateral incisor of the left side, from the same individual as the preceding specimen. Fig. 6. Outer view. Fig. 7. Inner view, in which is observed the exposed dentine of the worn summit and postero-external border.

Fig. 8. An upper lateral incisor of the right side. From a comparatively young animal, the tooth being unworn. Outer view. The figure, inadvertently, has been drawn in a reversed position.

Fig. 9. The upper second and third premolars of the right side, apparently from the same individual as the specimen of Fig. 8. *a*, second premolar; *b*, third premolar. In the latter tooth, the postero-internal fossa of the crown and its included tubercles are not so well defined as in the corresponding tooth of the specimen of Fig. 3.

PLATE XI.

All the figures are of the natural size.

Figs. 1–11. Merychyus elegans. See page 118.

Fig. 1. View of the upper jaw and teeth. Taken from a specimen of the left side, reversed in the figure to correspond with the next.

Fig. 2. View of the right side of the lower jaw, from the same individual as the last. The canine and first premolar are introduced from the opposite side.

Fig. 3. View of the triturating surfaces of a series of upper molars of the right side, including the canine tooth.

Fig. 4. Similar view of the teeth, which are more worn, taken from the same specimen as Fig. 1.

Fig. 5. View of the triturating surfaces of the lower molars of the left side, from the same individual as those of Figs. 1, 2 and 4.

Fig. 6. View of the triturating surfaces of the lower molars, except the last one, of the canine and the lateral pair of incisors, of the left side, from the same individual as Fig. 3.

Fig. 7. Inner view of the lower molars and canine of the right side, from the same specimen as Fig. 2.

Fig. 8. Outer view of the canine and premolars, from the same individual as Figs. 3 and 6.

Fig. 9. Front view of the canine and incisors of the same specimen as the last.

Fig. 10. Similar view of the canine and contiguous pair of incisors from the opposite side of the same individual. The points of the incisors are less worn than in those of the other side.

Fig. 11. Front view of the upper canines and incisors, from the same specimen as Fig. 1.

Figs. 12–14. Merychyus medius. See page 119.

Fragment of the left side of the lower jaw, containing the true molars.

Fig. 12. Outer view. Fig. 13. Inner view.

Fig. 14. View of the triturating surfaces of the molars.

Figs. 15, 16. MERYCHYUS MAJOR. See page 121.

Fragment of the right side of the upper jaw, containing the third and fourth premolars and the first and second true molars.

Fig. 15. Outer view. Fig. 16. Triturating surfaces of the teeth.

PLATE XII.

All the figures are of the natural size.

Figs. 1–5. LEPTAUCHENIA MAJOR. See page 124.

Fig. 1. Upper view of the right side of a much mutilated skull.

Fig. 2. Greater portion of the left ramus of the lower jaw, containing a complete series of teeth, from the same specimen as the former.

Fig. 3. View of the triturating surfaces of the molars of the series just mentioned.

Fig. 4. Left upper jaw, from another individual, containing a complete series of molars and the canine tooth.

Fig. 5. View of the triturating surfaces of the same teeth.

Figs. 6–20. LEPTAUCHENIA DECORA. See page 127.

Fig. 6. Left side of a much mutilated skull.

Fig. 7. Posterior fragment of the right maxilla, containing the last pair of molars.

Fig. 8. Inferior view of the same specimen.

Fig. 9. Anterior fragment of the right maxilla, apparently from the same individual as the former, containing the premolars except the first one.

Fig. 10. Inferior view of the same specimen.

Fig. 11. Fragment of a left upper maxilla, containing the last premolar and the true molars.

Fig. 12. View of the triturating surfaces of the same teeth.

Fig. 13. Fragment of the left side of a lower jaw, containing the last two molars.

Fig. 14. Triturating surfaces of the same teeth.

Figs. 15–17. Views of the outer, inner and triturating surfaces of a second true molar of the right side of the lower jaw.

Figs. 18–20. Similar views of a more worn tooth.

Figs. 21, 22. LEPTAUCHENIA NITIDA. See page 129.

Fig. 21. View of the remains of the right side of a skull imbedded in matrix. The outline of the posterior portion of the lower jaw is preserved upon the matrix.

Fig. 22. Upper view of the left side of the same skull, partially restored, from the opposite side.

PLATE XIII.

All the figures are of the natural size.

Figs. 1–3. AGRIOCHŒRUS LATIFRONS. See page 135.

Fig. 1. View of the left side of an almost complete skull, from the Mauvaises Terres of White River, Dakota. Discovered by Dr. Hayden during his expedition in the summer of 1866.

Fig. 2. View of the triturating surfaces of the upper molars, from the same specimen.

Fig. 3. View of the triturating surfaces of the lower molars, likewise from the same specimen.

Fig. 4. View of the triturating surfaces of the second and third or last lower premolars of *Agriochœrus antiquus*, represented for comparison with the corresponding teeth of Fig. 3.

Figs. 5–7. Pœbrotherium Wilsoni. See page 141.

Fig. 5. View of the triturating surfaces of the right upper molars of the skull represented in Fig. 1, Pl. I, of the Ancient Fauna of Nebraska. The first premolar is situated far in advance of the others; the succeeding three teeth belong to the temporary dentition, the three following to the permanent series.

Fig. 6. View of the triturating surfaces of the right lower molars, from the same specimen as the preceding. The anterior three teeth belong to the temporary series; those behind to the permanent series.

Fig. 7. The third and fourth right upper premolars of the permanent series, from a small specimen obtained by Dr. Hayden in his trip to the Mauvaises Terres in 1866.

PLATE XIV.

All the figures of the natural size, except 5, 6, 7, 8 and 10.

Figs. 1–8. Leptomeryx Evansi. See page 165.

Fig. 1. Left lateral view of a skull; the upper jaw with a complete series of molars; the lower jaw, with the last premolar and the true molars, from another specimen.

Fig. 2. Upper view of the left side of the same skull.

Fig. 3. Occipital view of the same.

Fig. 4. Inferior view of the left side of the base of the same skull.

Fig. 5. Triturating surfaces of a complete series of molar teeth of the left side, from the same skull, magnified two diameters.

Fig. 6. Triturating surfaces of a last premolar and the succeeding true molars of the right side, contained in a fragment of the lower jaw, magnified two diameters.

Fig. 7. Triturating surface of the lower first and second temporary premolars of the right side, magnified two diameters.

Fig. 8. The same teeth, from another and little worn specimen, also magnified two diameters.

Figs. 9, 10. Merycodus necatus. See page 162.

Fig. 9. Portion of the right ramus of a lower jaw, containing a complete series of molars; the first being restored from another specimen.

Fig. 10. Triturating surfaces of the same teeth, magnified two diameters.

Fig. 11. Oreodon Culbertsoni.

Upper view of a natural cast of the cranial cavity.*

* The cast would appear to indicate that the brain was as simple in its construction as in the Coney, (*Hyrax*,) or as in living rodents. The cerebrum, in comparison with that of ordinary living ruminants and suilline animals, is of greater simplicity, as regards the number and arrangement of its convolutions, and the cerebellum is more symmetrical. It resembles more in character that of the Musks than of other familiar ruminants. The cerebrum is pyriform, compressed from above downward. Its fore part is broken off in the specimen. The position of the interhemispheral or great longitudinal fissure, in the cast, is occupied by a ridge expanding at the extremities. Each cerebral hemisphere, in the cast, exhibits, from the position of the interhemispheral fissure to that of the sylvian fissure, four distinct ridges corresponding with cerebral convolutions. These, in comparison with Prof. Owen's figures, (Anatomy of Vertebrates, Vol. III, London, 1868,) appear to agree in succession with the medial, medilateral, supersylvian and sylvian convolutions, of which the former three are visible in the upper view of the cast. The medial convolution, hardly separated from the frontal, together with it, extends the length of the hemisphere. Posteriorly it doubles forward to become continuous with the medilateral convolution, which extends forward about two-thirds the length of the hemisphere; and in the same manner the frontal bends backward to become continuous with the supersylvian convolution. The supersylvian and medilateral fissures form sigmoid grooves, extending the length of the hemisphere; and the medial

Figs. 12–14. Megalomeryx niobrarensis. See page 161.

Fig. 12. A first or second lower true molar, moderately worn.

Fig. 13. Triturating surface of the same tooth.

Fig. 14. Triturating surface of a much worn first lower true molar.

Fig. 15. Procamelus gracilis. See page 155.

Triturating surfaces of three premolars of the left side. *a.* A last premolar, but probably a penultimate of *P. occidentalis.* *b, c.* Penultimate and antepenultimate premolars, from a different individual than the preceding, and probably belonging to a species of the succeeding genus.

Figs. 16, 17. Homocamelus caninus. See page 158.

Fig. 16. Fragment of the right maxilla, with the second and third premolars, *d, e,* viewed from beneath.

Fig. 17. Representation of a portion of the left upper jaw, reconstructed from fragments belonging to the two sides. *a,* caniniform incisor; *b,* canine tooth; *c,* caniniform premolar; *d, e,* second and third premolars.

PLATE XV.

Figs. 1–4. Procamelus robustus. See page 148.

Fig. 1. Portion of the right ramus of the lower jaw, two-thirds the diameter of nature. *a.* Caniniform or first premolar, the crown blunted by attrition; *b,* second premolar, nearly unworn; *c,* third premolar, partially restored from another specimen; *d,* last premolar; *e,* first true molar; *f,* sockets for the second true molar; *g,* last true molar.

Fig. 2. Teeth, from the same specimen as the preceding, seen on their triturating surfaces, of the natural size. *b,* second premolar; *d,* last premolar; *e, g,* the first and last true molars.

Fig. 3. Outer view of an upper true molar, probably the first of the right side, of the natural size.

Fig. 4. View of the triturating surface of the same specimen as the last.

Figs. 5–7. Procamelus occidentalis. See page 151.

Fig. 5. Portion of the right side of the lower jaw, two-thirds the diameter of nature. *a,* first or caniniform premolar, ideally introduced; *b, c,* the second and third premolars, introduced from other specimens; *d,* last premolar; *e, f, g,* true molars, parts of which are restored.

Fig. 6. View of the triturating surfaces of the lower molar teeth, partly from the preceding specimen and partly from others, of the natural size. *b, c,* the second and third premolars, belonging to a different specimen from the teeth behind; *d,* last premolar, from the same specimen as fig. 5; *e, f, g,* true molars from the same as the latter, partially restored.

Fig. 7. Inferior view of the left side of a mutilated specimen of the upper jaw, of the natural size. *a, b, c,* second, third and fourth premolars, restored from the teeth on both sides of the specimen. The true molars are ideally restored in outline, a portion of the crown only of the first molar being retained in the fossil.

Figs. 8, 9. Protomeryx Halli. See page 160.

Fig. 8. Anterior portion of the left side of the lower jaw, of the natural size.

and medilateral convolutions are separated by a well-marked fissure, as in the Hog. In the cast the lamdoidal convolution is not very distinct from the material occupying the position of the interhemispheral fissure. The postsylvian convolution forms a well-marked lobe, separated from the anterior cerebral lobe. The cerebellar cast, viewed above, appears nearly half the size of that of the cerebrum, but its bulk is actually hardly a third of that of the latter. Its median or vermiform lobe projects above nearly as much as the cerebrum, and forms a prominent convex, semicircular ridge. The lateral lobes or hemispheres are small compared with the former.

Fig. 9. Upper view of the same specimen. *a*, position of the incisors; *b*, canine; *c*, first premolar; *d*, *e*, second and third premolars.

PLATE XVI.

Elotherium Mortoni. See page 175.

View of the restored skull, represented from a number of fragments belonging to individuals of different ages and sizes. Two-thirds the diameter of nature.

The fragments *a*, *b*, *c* are from the same individual, which had not yet reached maturity. The specimens are represented in Pl. VIII, Fig. 1, Pl. IX, Figs. 1, 2, and Pl. X, Figs. 6, 7, of the Ancient Fauna of Nebraska. The upper portion of *b* is restored from another specimen. The fragment *d* is from a third specimen, and has the end of the nasals restored from the same one as the upper portion of *b*. The fragments *e f* are from a fourth individual, and are partially restored from specimens belonging to two other individuals.

PLATE XVII.

All the figures are of the natural size.

Figs. 1, 2. Protohippus perditus. See page 275.

Fig. 1. Portion of the right maxilla, containing the posterior four molars.

Fig. 2. Triturating surfaces of these teeth.

Figs. 3–7. Merychippus insignis. See page 296.

Fig. 3. Fragment of the right maxilla, containing the first and second temporary molars.

Fig. 4. View of the triturating surfaces of the same teeth.

Fig. 5. Triturating surfaces of a series of upper permanent molars of the right side.

Fig. 6. A first upper molar of the left side of the permanent set.

Fig. 7. A fourth or fifth molar of the same side.

Figs. 8–15. Merychippus mirabilis. See page 299.

Fig. 8. Portion of the right maxilla, with the posterior four molars.

Fig. 9. Triturating surfaces of the same teeth.

Fig. 10. Portion of the right maxilla, containing the second and third temporary molars.

Fig. 11. Triturating surfaces of the latter teeth.

Fig. 12. Second permanent molar from the interior of the specimen represented in fig. 10.

Fig. 13. Outer view of the same tooth.

Fig. 14. (Inadvertently indicated as being in plate A, on page 299.) Triturating surfaces of the first and second right upper molars of the temporary series.

Fig. 15. A first upper permanent molar of the right side.

PLATE XVIII.

Views of the triturating surface of upper molar teeth of various equine animals. Figures all of the natural size. Specimens from the Niobrara River except when mentioned otherwise.

Figs. 1–5. Hipparion occidentale. See page 281. All the teeth from the same individual. Specimens from the Mauvaises Terres of White River.

Fig. 1. Fifth molar of the right side.

Fig. 2. Fourth do. The specimen imperfect, and represented as restored.

Figs. 3, 4. Second and first molars.

Fig. 5. Third molar of the left side, of the same individual.

Figs. 6–19. Hipparion speciosum. See page 282.

Fig. 6. First molar of the left side.

Figs. 7–10. The specimens apparently from the same individual: Figs. 7, 9, 10, the first, third and fourth molars of the left side; Fig. 8, the second molar of the right side.

Fig. 11. Second molar of the left side. Fig. 12. Fourth molar of the left side.

Fig. 13. Fourth molar of the right side. Figs. 14, 15. Fourths, or fifths, of the right side.

Fig. 16. Fourth or fifth of the left side. Specimen from Bijou Hill.

Fig. 17. Fourth molar of the right side, the inner part restored. Specimen from Washington Co., Texas.

Figs. 18, 19. Fourth and fifth molars of the right side, both partially restored. Specimens from Bijou Hill.

Figs. 20–24. Hipparion affine. See page 286. The specimens, except the last one, appear to have been derived from the same individual.

Fig. 20. Second molar of the right side. Figs. 21–23. Third, fourth and fifth molars of the left side.

Fig. 24. Last molar of the left side.

Figs. 25–30. Hipparion gratum. See page 287.

Fig. 25. First molar of the right side. Fig. 26. Last molar of the right side.

Fig. 27. Second or third molar of the right side.

Figs. 28, 29. Last molars of the right and left sides, with the triturating surfaces only partially worn across.

Fig. 30. Fifth molar of the right side.

Figs. 31–38. Hipparion, undetermined species. See page 289.

Figs. 31, 32. Second and third molars of the right side.

Fig. 33. Second molar of the left side.

Fig. 34. First molar of the right side, apparently of the temporary series.

Fig. 35. Second or third temporary molar of the right side.

Fig. 36. First temporary molar of the right side.

Figs. 37, 38. First and third temporary molars of the left side, apparently from the same individual.

Figs. 39–48. Protohippus placidus. See page 277.

Fig. 39. Last molar of the left side. Fig. 40. First molar of the left side.

Fig. 41. First molar of the right side, apparently of the temporary series.

Fig. 42. First molar of the left side, apparently temporary, and much worn.

Figs. 43–45. Fourth or fifth molars of the right and left sides.

Fig. 46. Second or third right molar, apparently temporary, and much worn.

Fig. 47. Second or third right molar.

Fig. 48. Second or third left molar, apparently temporary.

Figs. 49–53. Merychippus insignis. See page 296.

Fig. 49. Fourth molar of the right side. Fig. 50. Last molar, slightly worn, of the same side.

Figs. 51–53. Specimens from Washington Co., Texas.

Fig. 51. Sixth molar of the left side.

Fig. 52. Slightly worn second or third right molar.

Fig. 53. First molar of the right side.

Figs. 54–56. Merychippus mirabilis. See page 299.

Fig. 54. Third temporary molar of the right side.

Figs. 55, 56. Last molars of the right and left sides.

PLATE XIX.

Views of the triturating surfaces of inferior molar teeth, mostly of undetermined species of equine animals, all of the natural size. In referring to the relative position of the teeth the small or rudimental premolar is excluded from the enumeration. See page 315.

Fig. 1. Fifth molar of the right side. Specimen from Bijou Hill. Length externally 15 lines; breadth at the triturating surface 9½ lines; thickness without the cementum 3½ lines; breadth near bottom 8 lines.

Fig. 2. Sixth or last molar of the right side. Length antero-externally 16 lines; breadth of triturating surface 9 lines; thickness 3½ lines; breadth near bottom 9 lines.

Fig. 3. A complete series of molars of the right side, all of which belonged together except the first one.

Fig. 4. A complete series of molars of the right side.

Fig. 5. A series of the back three molars of the right side.

Fig. 6. A series of the anterior five molars of the right side.

Fig. 7. Last two molars of the right side. Length of fifth 18 lines; breadth at triturating surface 10 lines; near bottom 7 lines; thickness in former position 3¾ lines; in latter 4½ lines. Length of sixth molar 19½ lines; breadth 11 lines; thickness above 3¾ lines, below 4 lines.

Fig. 8. Fourth and fifth molars of right side. Length of fourth 17½ lines; breadth above 9 lines, below 6 lines; thickness above 3½ lines, below 4 lines.

Fig. 9. Second and third molars of right side.

Fig. 10. First and second molars of right side. Length of first 12 lines; breadth above 8 lines, below 7 lines; thickness above 4 lines, below 4½ lines.

Fig. 11. Posterior three molars of the right side.

Fig. 12. Anterior four molars of the left side.

Figs. 13, 14. Sixth, fifth, and third molars of the right side; contained in a portion of the jaw of an old animal.

Fig. 15. Last molar of the left side. Length 20 lines; breadth 9 lines; thickness 3½ lines.

Fig. 16. Fourth molar of the right side. Length 19 lines; breadth above 10½ lines, below 7½ lines; thickness above 3¾ lines, below 5 lines.

Fig. 17. Anterior two temporary molars, from the same specimen as the preceding.

Fig. 18. Last two molars of the right side, contained in a fragment of a jaw of an old animal.

Fig. 19. An intermediate molar of the left side. Length 9 lines; breadth above 8 lines, below 7 lines; thickness above 4 lines, below 4¼ lines.

Fig. 20. A specimen nearly like the preceding. Length 8 lines; breadth above 8 lines, below 7½ lines; thickness above 4 lines, below 5 lines.

Fig. 21. Another specimen nearly like the preceding, from the right side. Length 10½ lines; breadth above 9 lines, below 8½ lines; thickness above 4 lines, below 5½ lines.

Fig. 22. An intermediate molar of the left side. Length 11½ lines; breadth above 9 lines, below 8½ lines.

Fig. 23. Molar of the right side. Length 9 lines; breadth above 8 lines, below 7 lines; thickness above 4 lines, below 5 lines. Specimen from Bijou Hill.

Fig. 24. Third molar of left side, contained in a jaw fragment.

Fig. 25. First temporary molar of the left side.

Fig. 26. Molar of the left side. Length 11 lines; breadth above 8½ lines, below 7½ lines; thickness above 4 lines, below 5½ lines.

Fig. 27. Molar of the right side, probably the fourth. Length 18 lines; breadth above $10\frac{1}{2}$ lines, below 8 lines; thickness above $4\frac{1}{4}$ lines, below 5 lines.

Fig. 28. A series of the anterior three molars of the right side. Length of third molar 20 lines: breadth above 11 lines, below 9 lines; thickness above 5 lines, below 6 lines.

Fig. 29. Second or third molar of the left side. From the Mauvaises Terres of White River.

Fig. 30. Intermediate molar, probably the third of the left side. Length 2 inches; breadth above 1 inch, below $9\frac{1}{2}$ lines; thickness above 6 lines, below 6 lines.

Fig. 31. Intermediate molar, probably the third of the left side. Length 20 lines; breadth above 11 lines, below 10 lines; thickness above 5 lines.

Fig. 32. An intermediate molar, probably the third of the right side. The specimen is contained in a fragment of the jaw, and is about half worn away. The breadth of its triturating surface is 1 inch; its thickness, independent of the cement, 7 lines, with the latter 8 lines.

Fig. 33. An intermediate molar of the left side, about half worn down. Length 14 lines; breadth at triturating surface 13 lines; thickness 7 lines.

Fig. 34. An intermediate molar of the right side, moderately worn. Length 22 lines; breadth above $13\frac{1}{2}$ lines, below 9 lines.

Fig. 35. An intermediate molar of the right side. Length 22 lines; breadth above 14 lines, below 10 lines; thickness above 5 lines, below 6 lines.

Fig. 36. An intermediate molar of the left side. Length 22 lines; breadth 11 lines.

Fig. 37. Second temporary molar of the right side. Length at central axis 11 lines; breadth of triturating surface $13\frac{1}{2}$ lines.

Fig. 38. Third temporary molar of the left side. Breadth of masticating surface $13\frac{1}{2}$ lines. Specimen contained in a fragment of the jaw.

Fig. 39. Posterior two molars of the right side of *Equus excelsus*.

Fig. 40. An intermediate molar of the right side. Breadth of triturating surface 1 inch; thickness $4\frac{1}{2}$ lines.

Fig. 41. Second and third temporary molars of the left side. The specimens are contained together in a fragment of the jaw.

PLATE XX.

ANCHITHERIUM BAIRDI. See page 303.

Of the natural size.

Fig. 1. View of the left side of a skull, containing in both jaws all the molar teeth except the small anterior first lower premolar.

Fig. 2. Upper view of the skull, from the same specimen.

PLATE XXI.

All the figures are of the natural size except 14, 15, 16, 18, 19.

Figs. 1–6. HYOPOTAMUS AMERICANUS. See page 202.

Fig. 1. Upper true molars of the left side, viewed on their triturating surfaces. *a*, *b*, *c*, first, second and third.

Fig. 2. Outer view of the posterior pair of the series. *b*, second, *c*, third molar.

Fig. 3. Second and third premolars of the left side, viewed on their triturating surfaces.

Fig. 4. Outer view of the same teeth, contained in a fragment of the jaw.

Fig. 5. Last lower true molar without its hinder lobe, from the left side.

Fig. 6. Outer view of the same tooth.

Fig. 7–10. Parahippus cognatus. See page 314.

Fig. 7. Three upper molars of the left side, apparently of the temporary series, viewed on their triturating surfaces.

Fig. 8. The second of the series, viewed externally.

Fig. 9. The first lower temporary molar of the right side, viewed upon its triturating surface.

Fig. 10. The same tooth, viewed externally.

Figs. 11, 12. Hypohippus affinis. See page 311.

Fig. 11. A second or third left upper molar of the temporary series, viewed on its triturating surface.

Fig. 12. The same tooth, viewed externally.

Fig. 13. Anchippus texanus. See page 312.

Greater portion of an upper left molar tooth, viewed on its triturating surface.

Figs. 14–19. Leptochœrus spectabilis. See page 197.

The figures twice the diameter of nature, except 16, 17.

Fig. 14. The last premolar and the succeeding two true molars, of the upper right side. *a*, premolar; *b*, *c*, true molars.

Fig. 15. The same teeth, contained in a fragment of the jaw, viewed externally.

Fig. 16. An inferior true molar, apparently the first of the left side, viewed on its triturating surface, and magnified three diameters.

Fig. 17. Portion of the right side of a lower jaw, containing the last two premolars and the second true molar, of the natural size. *a*, *b*, premolars; *c*, second true molar.

Fig. 18. The same premolars, viewed from above and magnified two diameters.

Fig. 19. The second true molar, from the same jaw fragment, viewed on its triturating surface and magnified two diameters.

Figs. 20–27. Perchœrus probus. See page 194.

Fig. 20. Fragment of the left side of a lower jaw, containing a portion of the last temporary molar and the succeeding two permanent true molars.

Fig. 21. Triturating surfaces of the latter two teeth.

Fig. 22. Last permanent premolar, inner view, removed from beneath the last temporary molar of the specimen represented by figure 20.

Fig. 23. The same tooth viewed from above.

Fig. 24. An upper left true molar, probably of the same animal, reversed and viewed externally.

Fig. 25. Triturating surface of the same tooth.

Fig. 26. A last upper molar, probably of the same animal, viewed on the triturating surface.

Fig. 27. Fragment of a lower jaw, right side, of the same animal, containing the last temporary molar and the succeeding permanent true molar.

Figs. 28–30. Lophiodon occidentalis. See page 239.

Three views of a last inferior molar of the right side.

Fig. 28. External view. Fig. 29. Internal view.

Fig. 30. View of the triturating surface.

Fig. 31. Equus excelsus. See page 266.

Fragment of the right side of the upper jaw, containing the back four molars.

Figs. 32, 33. Merychippus mirabilis?

Fig. 32. An inferior temporary molar, viewed on the triturating surface.

Fig. 33. The same tooth viewed externally.

Fig. 34. RHINOCEROS OCCIDENTALIS. See page 224.

Anterior extremity of the lower jaw, containing the incisors, viewed in front.

PLATE XXII.

RHINOCEROS OCCIDENTALIS. See page 220.

Figures one-half the size of nature. Repetition of plate XII, of the "Ancient Fauna of Nebraska."

Fig. 1. Inferior view of the skull.

Fig. 2. View of the left side of the same specimen.

PLATE XXIII.

All the figures of the natural size, except 11, 12.

Figs. 1–3. RHINOCEROS OCCIDENTALIS? See page 225.

Portion of a sixth upper molar, apparently of a large individual of the species.

Figs. 2, 3. Crowns of two lower lateral incisors, apparently from large individuals of the species.

Figs. 4–9. RHINOCEROS CRASSUS. See page 228.

Fig. 4. A right upper molar of the deciduous series, the third or fourth, outer view.

Fig. 5. View of the triturating surface of the same tooth.

Fig. 6. An upper left lateral incisor tooth, viewed externally.

Fig. 7. The same tooth, viewed on its triturating surface.

Fig. 8. Portion of a last upper molar of the right side, viewed on the triturating surface.

Fig. 9. Fragment of a lower jaw of a young animal, containing the first large temporary molar.

Fig. 10. RHINOCEROS MERIDIANUS. See page 229.

Portion of the upper penultimate molar of the right side, viewed on its triturating surface.

Figs. 11, 12. RHINOCEROS HESPERIUS. See page 230. One-half the diameter.

Fig. 11. Greater portion of the right ramus of the lower jaw, containing the lateral incisor and the true molars.

Fig. 12. Triturating surfaces of the latter teeth.

PLATE XXIV.

TITANOTHERIUM PROUTI. See page 206.

All the figures three-fourths the diameter of nature, except 7, which is two-thirds the diameter, and 8 to 12, which are of the natural size.

Fig. 1. A complete series of molars of the upper left side, together with the corresponding fore part of the jaw, viewed from beneath.

Fig. 2. The same viewed externally.

Figs. 3, 4. Two isolated third or fourth upper premolars of the left side, viewed on their triturating surfaces.

Figs. 5, 6. The second and third upper left true molars, belonging to the same individual, viewed on their triturating surfaces.

Fig. 7. An upper last true molar of the left side, less worn than in Fig. 1. The specimen further differs from that of Fig. 1 in the less proportionate degree of development of the back portion of its crown. It was carelessly drawn by the artist on a different scale from the preceding, being represented two-thirds the diameter of nature.

Fig. 8. A supposed second upper temporary premolar of the right side, of the natural size.

Figs. 9, 10. External oblique and upper views of the crown of an inferior premolar, apparently the second, of the natural size.

Figs. 11, 12. Similar views of an inferior premolar, apparently the first, of the natural size.

PLATE XXV.

Figs. 1, 2. MASTODON MIRIFICUS. See page 249. Figures one-half the diameter of nature.

Fig. 1. Outer view of the greater portion of the left side of the lower jaw, containing a single molar tooth.

Fig. 2. Upper view of the same specimen.

Fig. 3. ELEPHAS IMPERATOR. See page 255. One-third the diameter.

Fragment of a molar tooth, viewed on the triturating surface.

PLATE XXVI.

Figs. 1–6. ISCHYROMYS TYPUS. See page 335.

Figs. 1–3. The natural size.

Fig. 1. Upper view of the skull. It exhibits the supra-occipital, part of the squamosals pierced at their upper part by a large foramen (*a*), the frontals, the parietals, on each side of the latter the alveolar border of the maxillaries, and in front part of the latter and the outline of the back ends of the nasals. The frontal of the left side has been restored from the right of the specimen.

Fig. 2. View of the right side of the same specimen, partially restored from the left side.

Fig. 3. Right side of the lower jaw from a different individual. The specimen, of this figure, was obtained from the Mauvaises Terres of White River; the specimen, of the preceding figures, was derived from Bear Creek, a tributary of the Sheyenne River.

Figs. 4–6. Three times the diameter of nature.

Fig. 4. View of the triturating surfaces of the upper molars of the left side, from the same specimen as Figs. 1, 2. They count from left to right.

Fig. 5. View of the triturating surfaces of the lower molars of the left side, from a specimen accompanying that of Fig. 3.

Fig. 6. Similar view of the molars of the right side, from an older specimen than the preceding, which it accompanied.

Figs. 7–11. PALÆOCASTOR NEBRASCENSIS. See page 338.

Figs. 7–9. Of the natural size.

Fig. 7. Upper view of a much mutilated skull. Fig. 8. View of the right side of the same.

Fig. 9. View of the left side of the lower jaw, from another specimen.

Figs. 10, 11. Twice the diameter of nature.

Fig. 10. View of the triturating surfaces of the upper molars of the right side. They count from right to left. From a different specimen than the preceding.

Fig. 11. View of the triturating surfaces of the lower molars of the right side. They count from right to left. From a different specimen than the preceding.

Figs. 12, 13. EUMYS ELEGANS. See page 342.

Fig. 12. View of the left side of the lower jaw, twice the diameter of nature. The outline is completed from the jaw of the Rat.

Fig. 13. View of the triturating surface of the tooth contained in the specimen of the preceding figure, magnified four diameters. The tooth is the left inferior median molar.

Figs. 14–20. PALÆOLAGUS HAYDENI. See page 331. Triturating surfaces of the upper and lower molar teeth, all magnified three diameters.

Figs. 14–16. Upper molar teeth.

Fig. 14. From a young specimen, containing the temporary teeth 1, 2, 3, and the following two permanent teeth, 4, 5, of the left side. The temporary molars were nearly ready to be displaced, their crowns being much worn and inserted alone by fangs.

Fig. 15. From an adult specimen, containing the four intermediate permanent teeth, 2–5, of the right side.

Fig. 16. The four intermediate molars, 2–5, of the right side, from an old animal.

Figs. 17–20. Lower molar teeth.

Fig. 17. A full series of molars of the right side, from a young adult specimen.

Fig. 18. The anterior four molars of the left side, from an older specimen than the preceding.

Fig. 19. The anterior three molars of the right side, from another specimen.

Fig. 20. The anterior three molars of the left side, from an old animal.

Figs. 21, 22. CASTOR TORTUS. See page 341.

Fig. 21. Under view of the upper jaw, containing the anterior three molars on both sides and part of the incisors, the natural size.

Fig. 22. Inferior view of the molars of the right side, from the same specimen as the last, twice the diameter of nature.

Figs. 23, 24. HYSTRIX VENUSTUS. See page 343. One and a half times the diameter of nature.

Fig. 23. First upper molar of the right side.

Fig. 24. Section near the triturating surface of an unworn molar, probably from the same animal.

Figs. 25–28. LEPTICTIS HAYDENI. See page 345. All the figures of the natural size except the last one.

Fig. 25. View of the left side of the skull. Fig. 26. Inferior view of the left half of the skull. Fig. 27. Superior view of the skull.

Fig. 28. Inferior view of the third and fourth premolars of the right side, magnified three diameters.

Figs. 29, 30. ICTOPS DAKOTENSIS. See page 351.

Fig. 29. Inferior view of the third, fourth and fifth molars, magnified three diameters.

Fig. 30. Superior view of the facial portion of a skull, of the natural size.

PLATE XXVII.

All the figures are of the natural size except Figs. 10, 13–16, which are one-half the diameter.

Fig. 1. MERYCHIPPUS MIRABILIS? See page 327. Series of upper molars of the left side, partially restored.

Fig. 2. HIPPARION OCCIDENTALE. See page 326. Triturating surfaces of the second and third upper molars of the left side.

Figs. 3, 4. PROTOHIPPUS SUPREMUS. See page 328. Triturating surfaces of left upper molars, from an intermediate position of the series.

Fig. 5. PROTOHIPPUS PERDITUS. See page 327. An upper fourth molar of the left side.

Figs. 6, 7. PROTOHIPPUS PLACIDUS? See page 328. Two upper first molars of the right and left side, from different individuals, perhaps different species.

Figs. 8–11. ELOTHERIUM INGENS. See page 192.

Figs. 8, 9. Crown of an inferior true molar of the right side. Fig. 8. External view. Fig. 9. View of the triturating surface. Of the natural size.

Fig. 10. Front view of the lower jaw. One-half the natural size.

Fig. 11. Last lower premolar of the right side, viewed externally. Of the natural size.

Fig. 12. Cervus Warreni. See page 172.

An antler. Of the natural size.

Fig. 13. Mastodon obscurus. See page 245.

View of the triturating surface of a last inferior molar tooth of the left side, purporting to have been derived from a miocene formation of Caroline Co., Maryland. Taken from a cast in plaster. Half the natural size.

Fig. 14. Mastodon andium? See page 242.

View of the triturating surface of a last superior molar of the left side. From Tambla, Honduras. Half the natural size.

Fig. 15. Mastodon ——? See page 246 (in error indicated as Fig. 14.) Half the natural size.

View of the triturating surface of a last lower molar of the left side, from a specimen purchased in London, and supposed to have been originally derived from the United States.

Fig. 16. Mastodon obscurus. See page 247.

View of the triturating surface of the back part of a last inferior molar. From Tarboro, North Carolina. Half the natural size.

PLATE XXVIII.

All the figures are of the natural size, except Fig 9.

Figs. 1, 2. Dicotyles nasutus. See page 385.

Fore part of the upper jaw.

Fig. 1. Inferior view. Fig. 2. View of the right side. In both views the left anterior incisor and the right canine and anterior two molars are seen.

Fig. 3. Dicotyles ——. See pages 200, 387.

An upper canine tooth, with the crown much worn in front.

Figs. 4–7. Squalodon atlanticus. See page 416.

Figs. 5–6. Apparently all internal views of three molars. Fig. 7. Anterior view of the same specimen as Fig. 6.

Fig. 8. Cosoryx furcatus. See page 173.

The greater portion of an antler, or horn core, attached to a fragment of the frontal bone.

Fig. 9. Cervus tarandus? See page 377. One-fourth the diameter of nature.

An antler. From Burlington Co., New Jersey.

Figs. 10, 11. Trucifelis fatalis. See page 366.

Upper sectorial molar tooth, inserted in a portion of the maxilla of the right side.

Fig. 10. Outer view. Fig. 11. Inner view.

Figs. 12, 13. Phoca debilis. See page 415.

Teeth. From the sands of Ashley River, South Carolina.

Fig. 14. Phoca modesta. See page 415.

Tooth found with the preceding.

Figs. 15–17. Squalodon Holmesii. See page 418.

Teeth. From the eocene formation of Ashley River, South Carolina.

Figs. 18, 19. Squalodon protervus. See page 423.

Teeth. From the Ashley River deposits, South Carolina.

PLATE XXIX.

Figures all of the natural size, except 7, 8, 11–14.

Fig. 1. Squalodon pelagius. See page 420.

Fragment of an intermediate portion of the left maxilla, reversed in position. From the eocene formation of Ashley River, South Carolina. Besides a true molar it exhibits the sockets of a premolar and two other molars, and intervening depressions externally to accommodate the teeth of the opposed jaw when at rest.

Figs. 2–5. Dorudon serratus. See page 428.

Teeth. From the eocene of Alabama.

Fig. 2. Outer view of a canine tooth.

Fig. 3. Outer view of a premolar.

Fig. 4. Outer view of a true molar.

Fig. 5. Outer view of a posterior true molar.

Fig. 6. Dorudon serratus. See page 430.

A mutilated premolar tooth. From the eocene formation of Ashley River, South Carolina.

Figs. 7–8. Squalodon pygmæus. See page 420.

Figures one-half the diameter of nature.

Fig. 7. View of the right side of the skull. The intermaxillary bone has been introduced from the left side of the specimen, which is otherwise not so well preserved.

Fig. 8. Upper view of the skull.

Fig. 9. Squalodon Holmesii? See page 419.

A canine tooth. From the eocene of Ashley River, South Carolina.

Fig. 10. Phocageneus venustus. See page 426.

Tooth. From the miocene formation of Virginia.

Figs. 11, 12. Nanohyus porcinus. See pages 200, 389.

Figures three times the diameter of nature.

Fig. 11. External view of a fragment of the right side of the lower jaw, exhibiting in functional position the last temporary molar and succeeding two permanent molars, and within the jaw the crown of the last permanent premolar.

Fig. 12. View of the triturating surfaces of the teeth.

Figs. 13, 14. Omomys Carteri. See page 408. Figures four times the diameter of nature.

Fig. 13. Portion of the right side of the lower jaw, containing the last two premolars and the succeeding two true molars, viewed externally.

Fig. 14. View of the triturating surface of the second true molar, reversed in position, the fore part being to the left, or the outside upward.

PLATE XXX.

Figs. 1–12, and 18, of the size of nature; 13–17, two-thirds the diameter.

Figs. 1–3. Galera macrodon. See page 369.

Fig. 1. Portion of the right side of the lower jaw, containing two premolars and the sectorial molar.

Figs. 2, 3. Outer and lower views of the upper sectorial molar of the left side. From Charles County, Maryland.

Figs. 45, 46. Anchippodus riparius. See page 403. Figures of the natural size.

Fig. 45. View of the triturating surface of an inferior molar.

Fig. 46. Outer view of the same tooth.

Fig. 6. MEGALONYX VALIDUS. See page 412 for description.

Triturating surface of a molar tooth.

Figs. 7–9. DELPHINODON MENTO. See page 424.

Figs. 7, 8. Inner and outer views of a tooth.

View of another tooth.

Figs. 10–12. DELPHINODON WYMANI. See page 425.

Fig. 10. View of a tooth. From Charles Co., Md.

Fig. 11. View of another tooth, found with the former.

Fig. 12. A tooth similar to that of Fig. 10. From Virginia.

Figs. 13–15. HOPLOCETUS OBESUS. See page 438.

Fig. 13. Lateral view of a tooth. From Ashley River, South Carolina.

Figs. 14, 15. Two views of a tooth. From the miocene, in the vicinity of Richmond, Va.

Figs. 16, 17. ORYCTEROCETUS QUADRATIDENS. See page 436.

Fig. 16. View of a straight tooth. Fig. 17. A curved tooth.

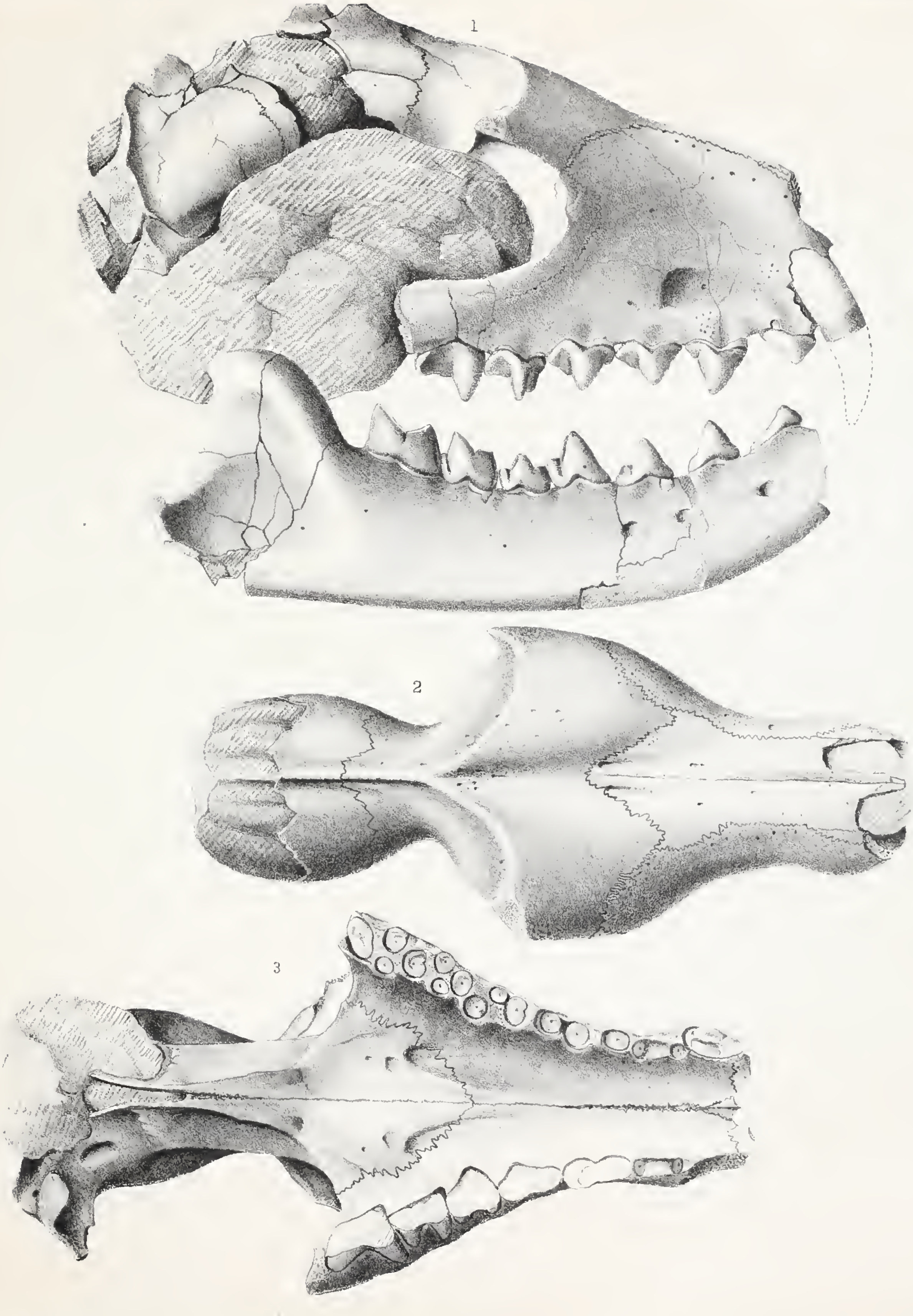
Fig. 18. SQUALODON ATLANTICUS.. See page 416.

Portion of the right side of a jaw, containing three teeth. The anterior tooth of the series of four is introduced from the opposite side.

A. J. Ibbotson, del

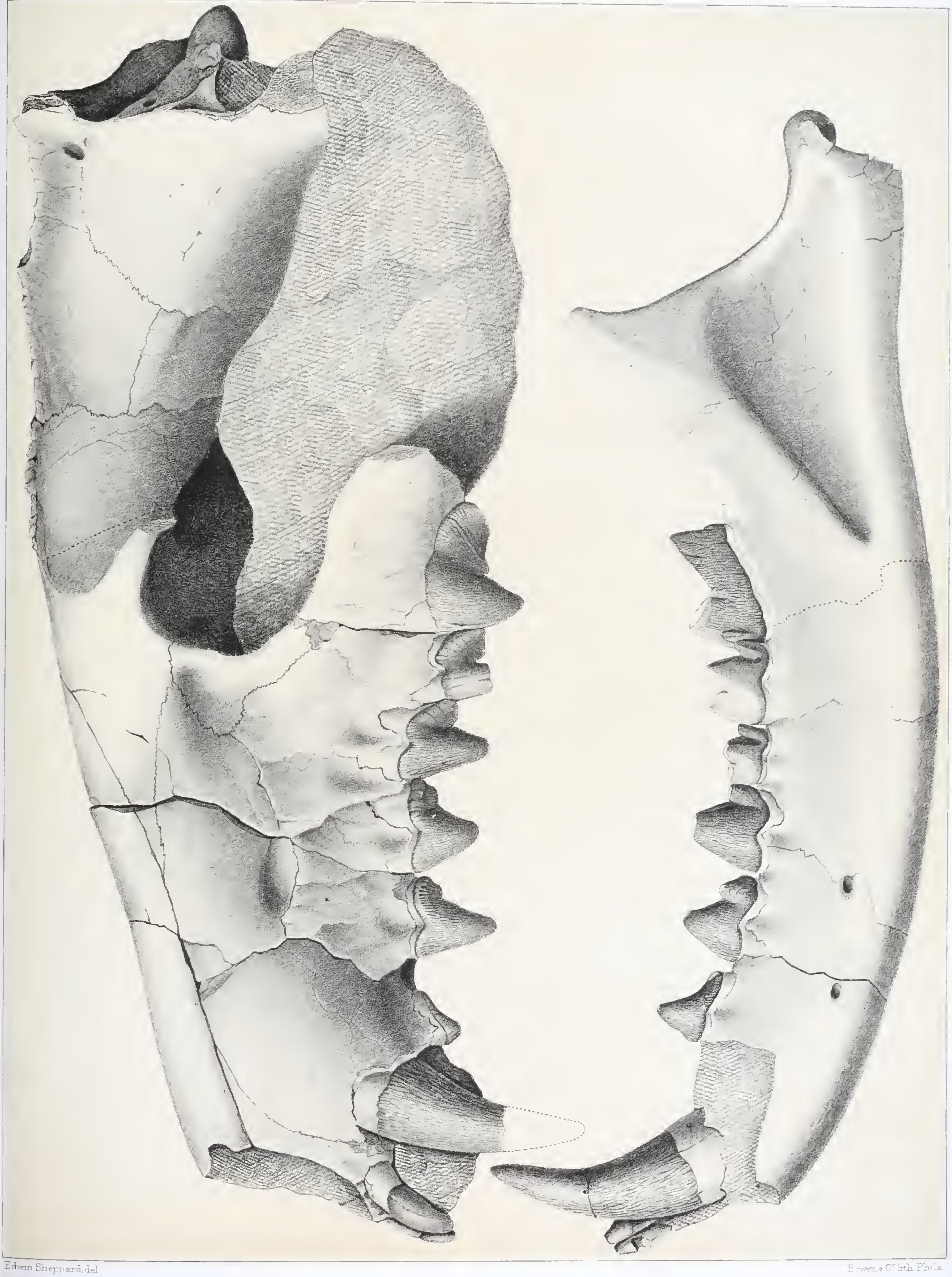
1-6 AMPHICYON VETUS. 7 A. GRACILIS. 8 PSEUDAELURUS INTREPIDUS
9. CANIS SAEVUS. 10. C. HAYDENI. 11 C. VAFER. 12 C. TEMERARIUS.
13,14. AELURODON FEROX. 15,16. LEPTARCTUS PRIMUS.

Plate II



Edwin Sheppard, del.

HYAENODON CRUCIANS

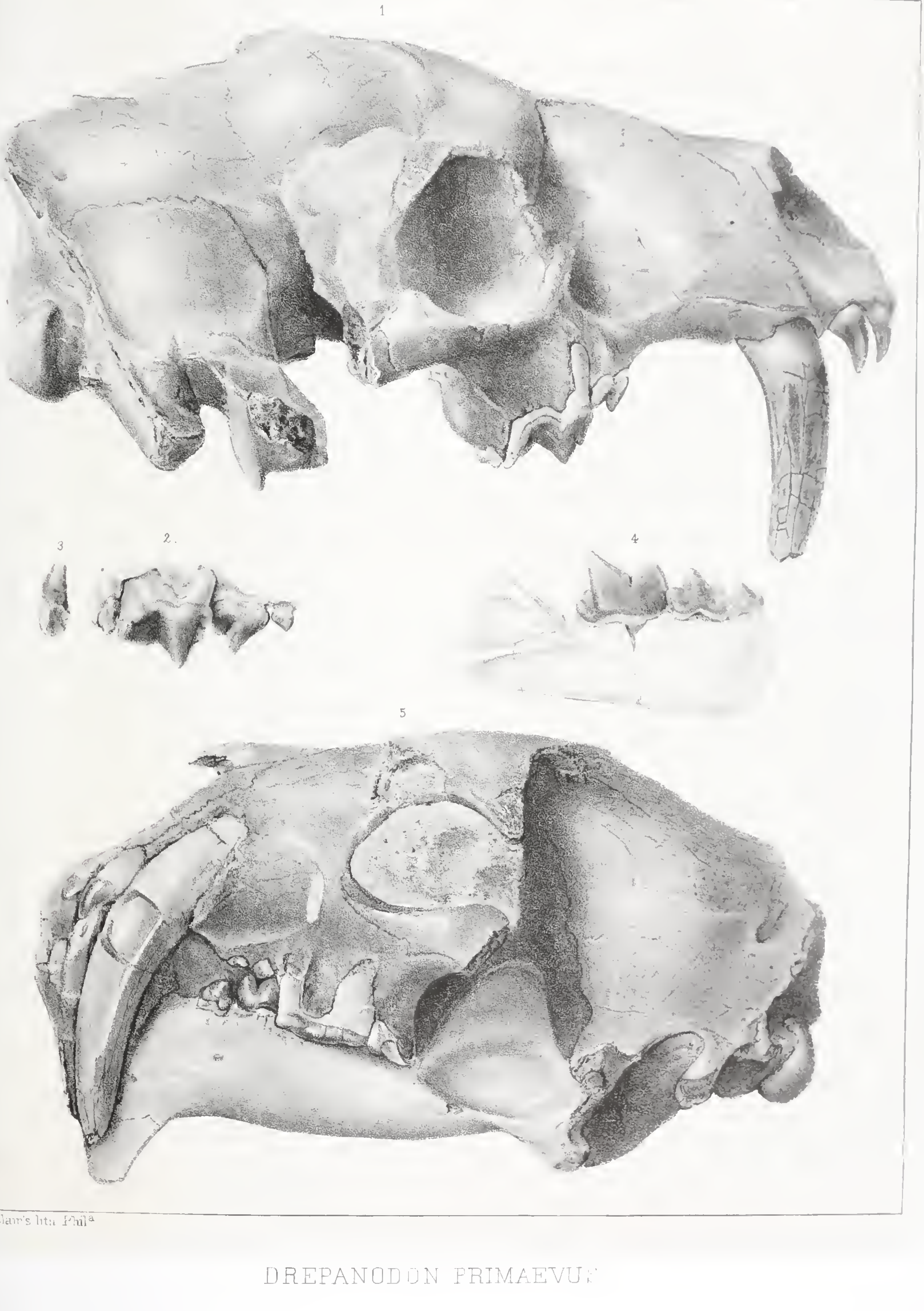


Edwin Sheppard del

Bowen & Co lith Phila

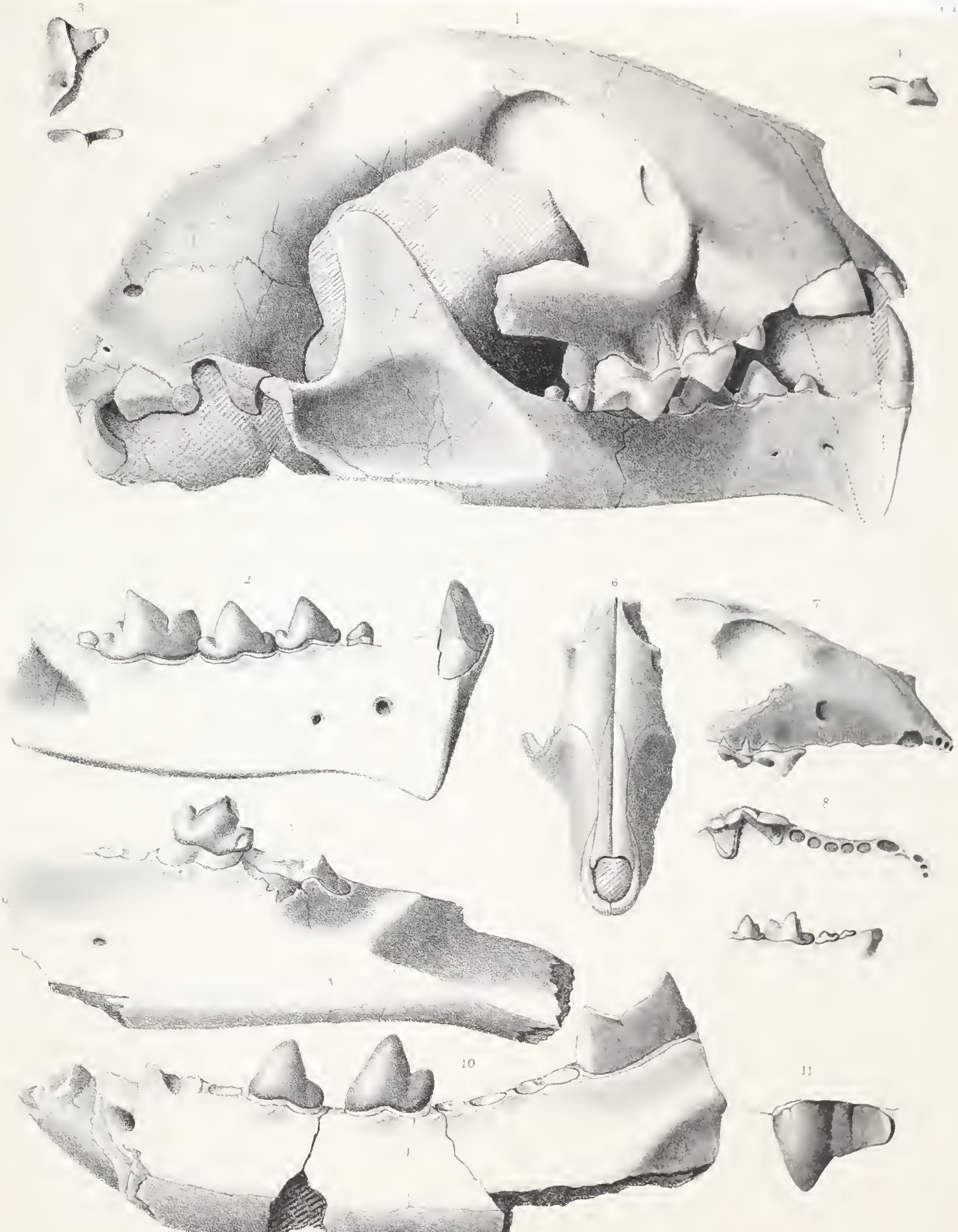
HYAENODON HORRIDUS.

Plate IV

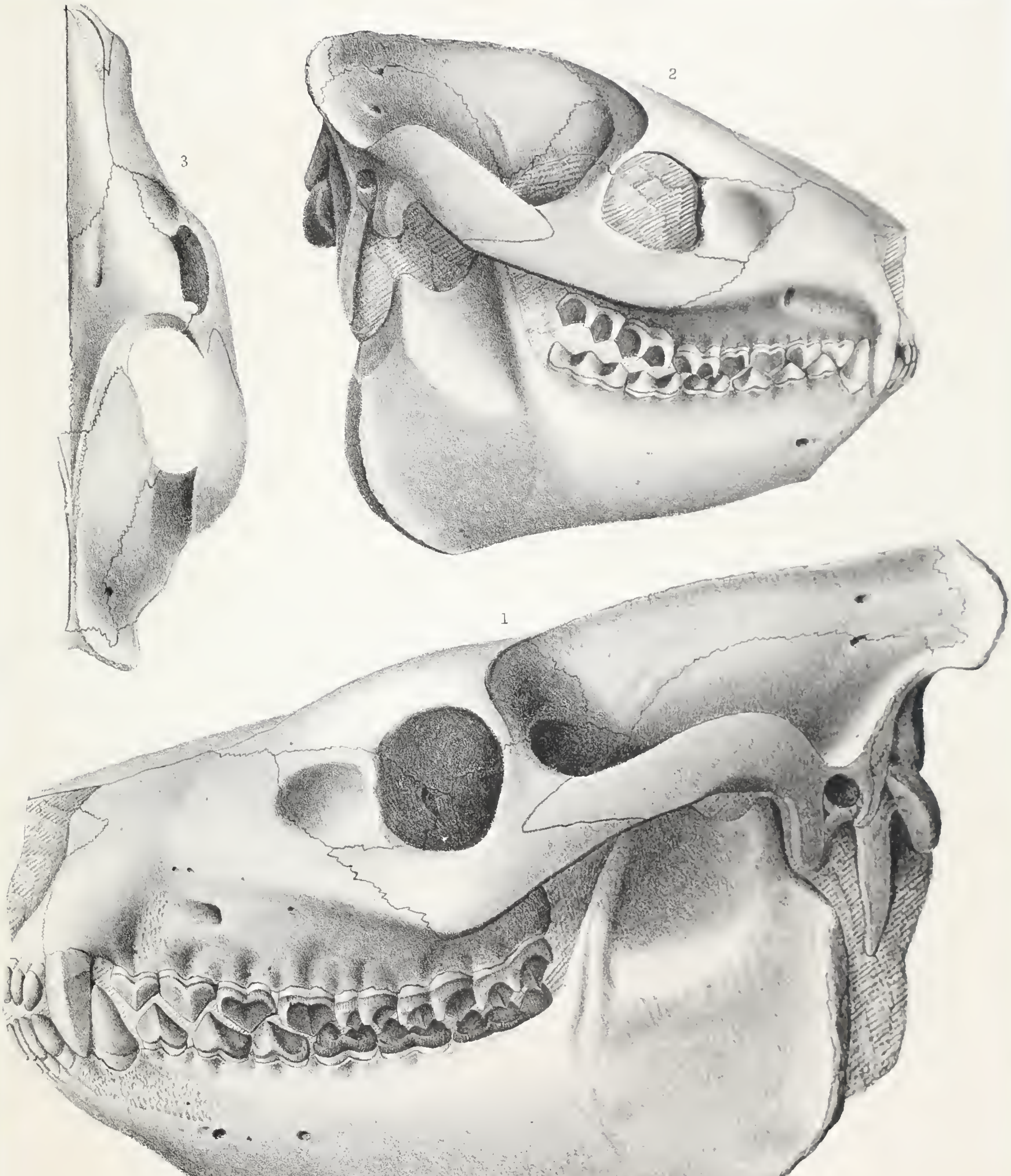


T. Sinclair's lith. Phil[a]

DREPANODON PRIMAEVUS



1-4 DINICTIS FELINA. [illegible] ANCTODON OCCIDENTALIS [illegible] AMPHICYON GRACILIS.
10, 11 HYAENODON CRUENTUS.



Edwin Sheppard, del.

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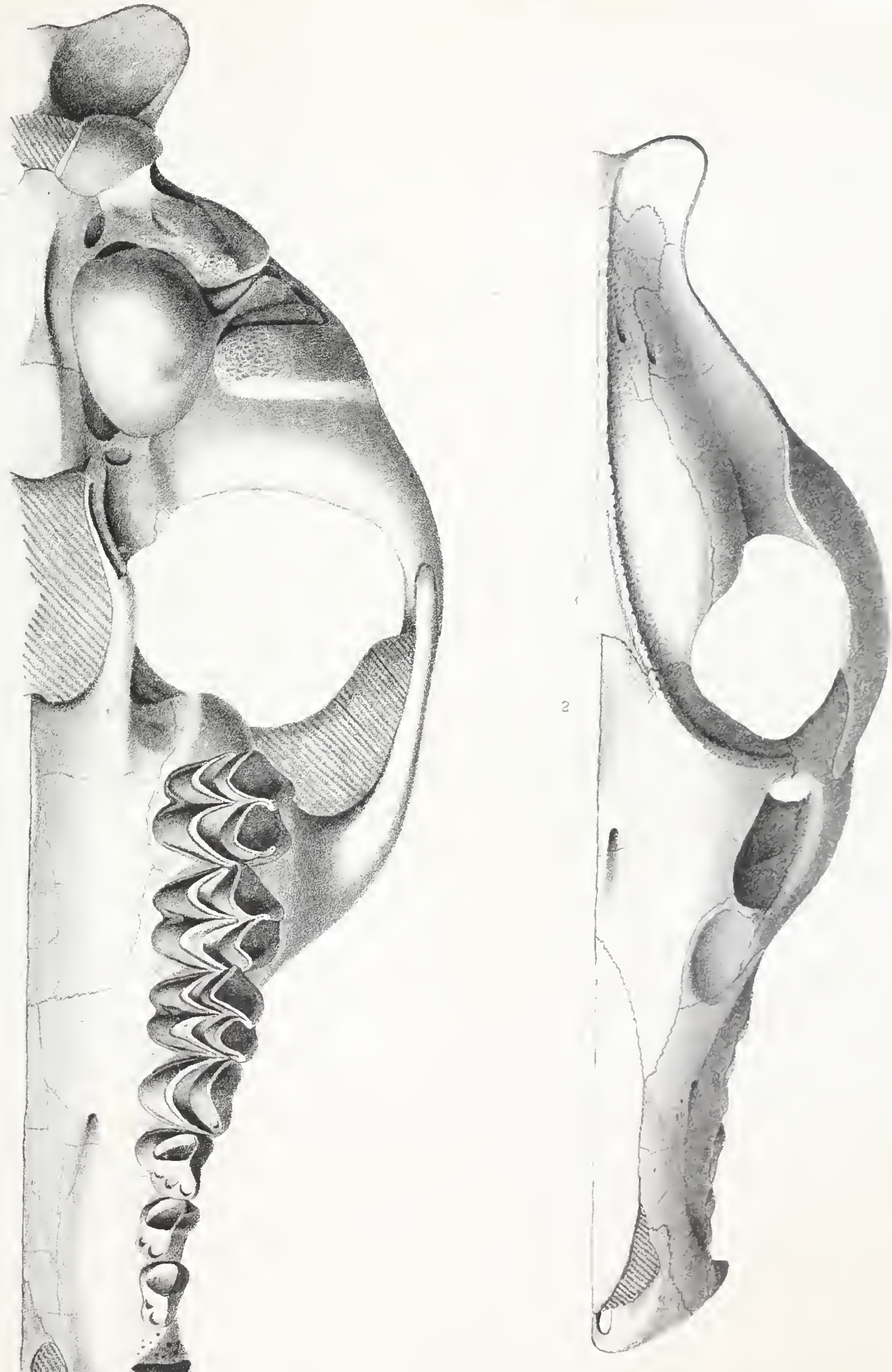

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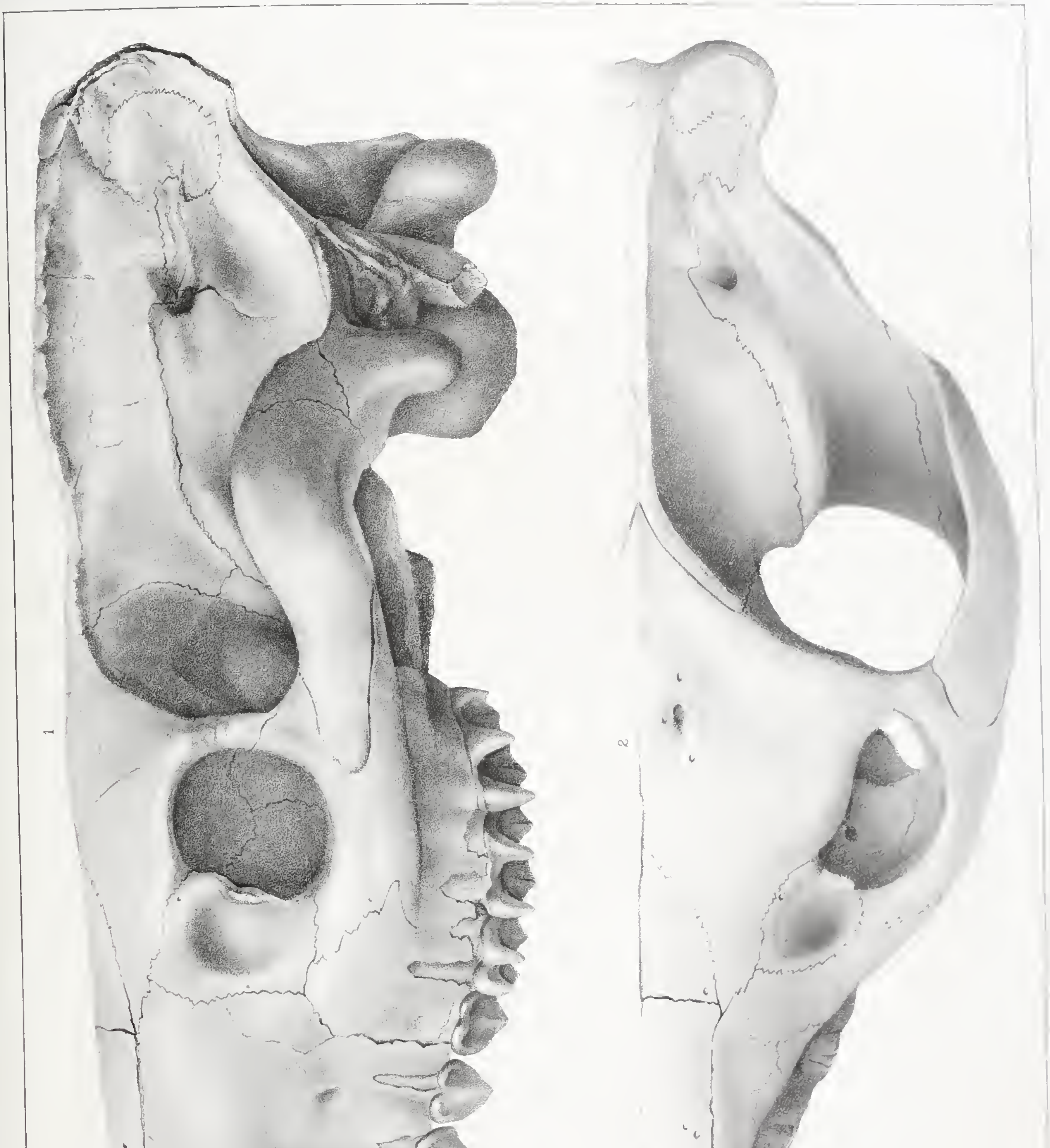
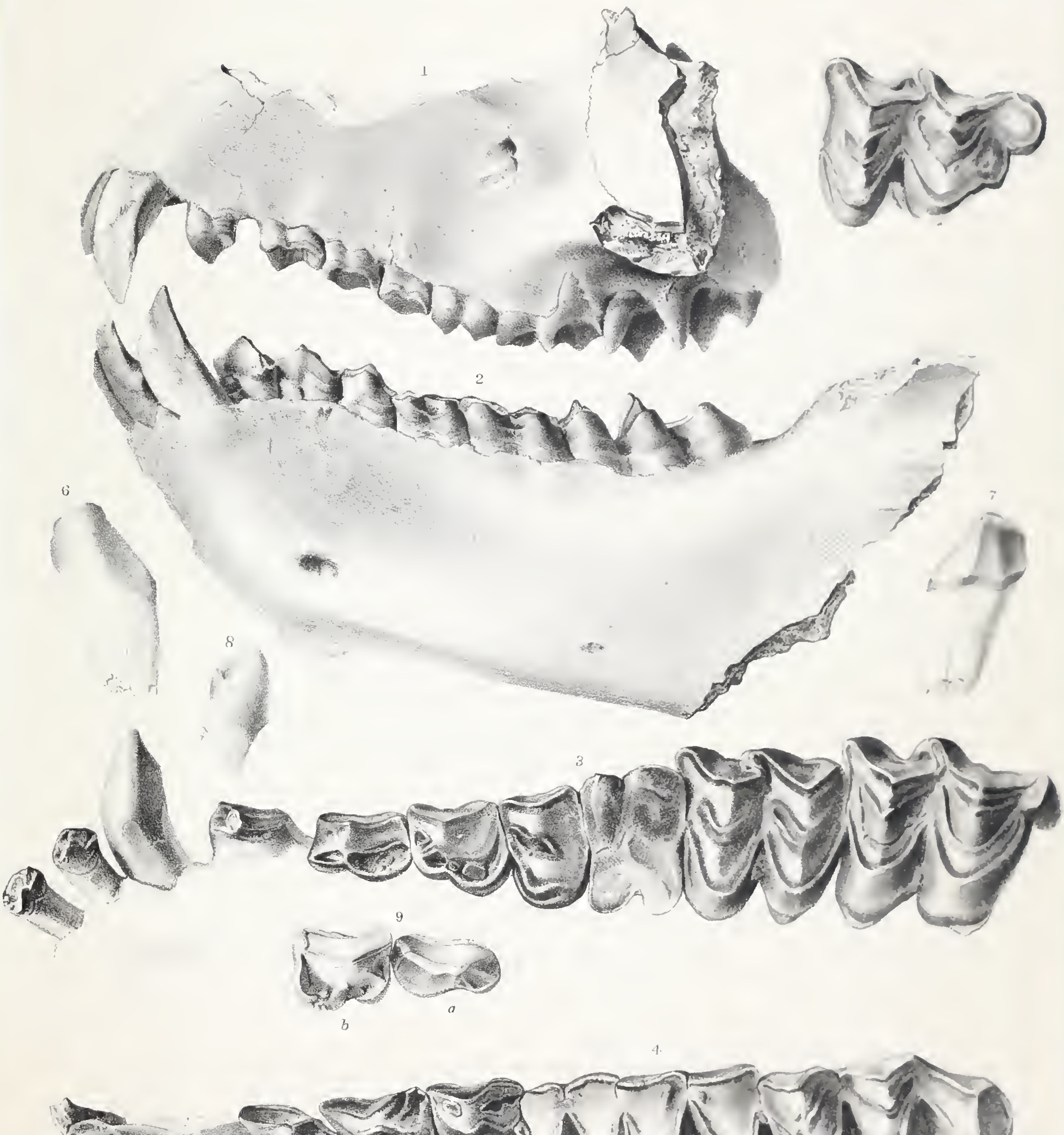


T Sinclair's lith Phila

OREODON MAJOR

1. [illegible]REODON CULBERTSONI [illegible] GRACILIS [illegible] MAJOR [illegible]

Plate X



A. [illegible] del.

MERYCOCHOERUS [illegible]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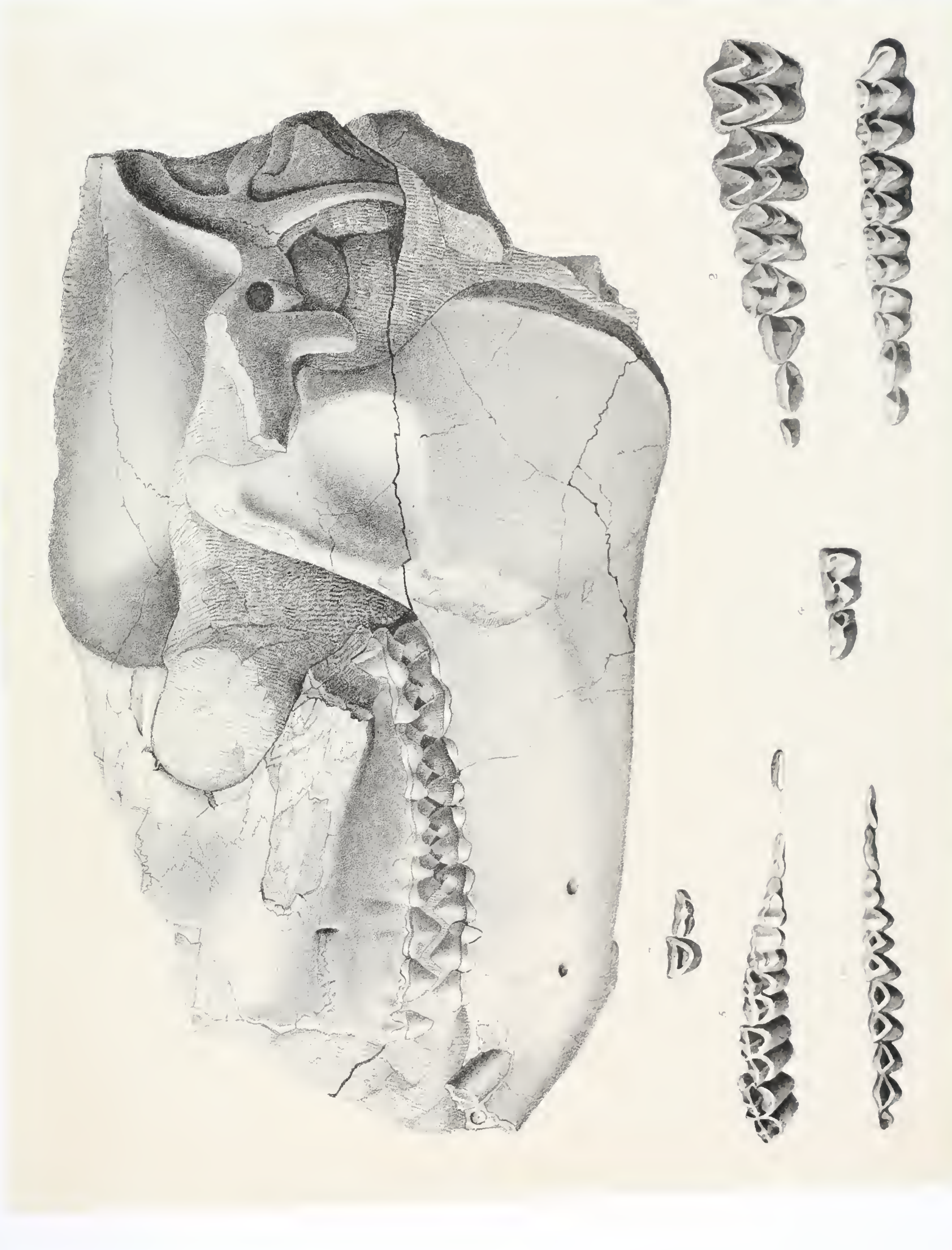
LEPTAUCHENIA MAJOR



1-5 LEPTOMERYX EVAN[illegible]

[illegible]-14 MEGALOMERYX [illegible]

[illegible]-17 HOMOCAMELUS [illegible]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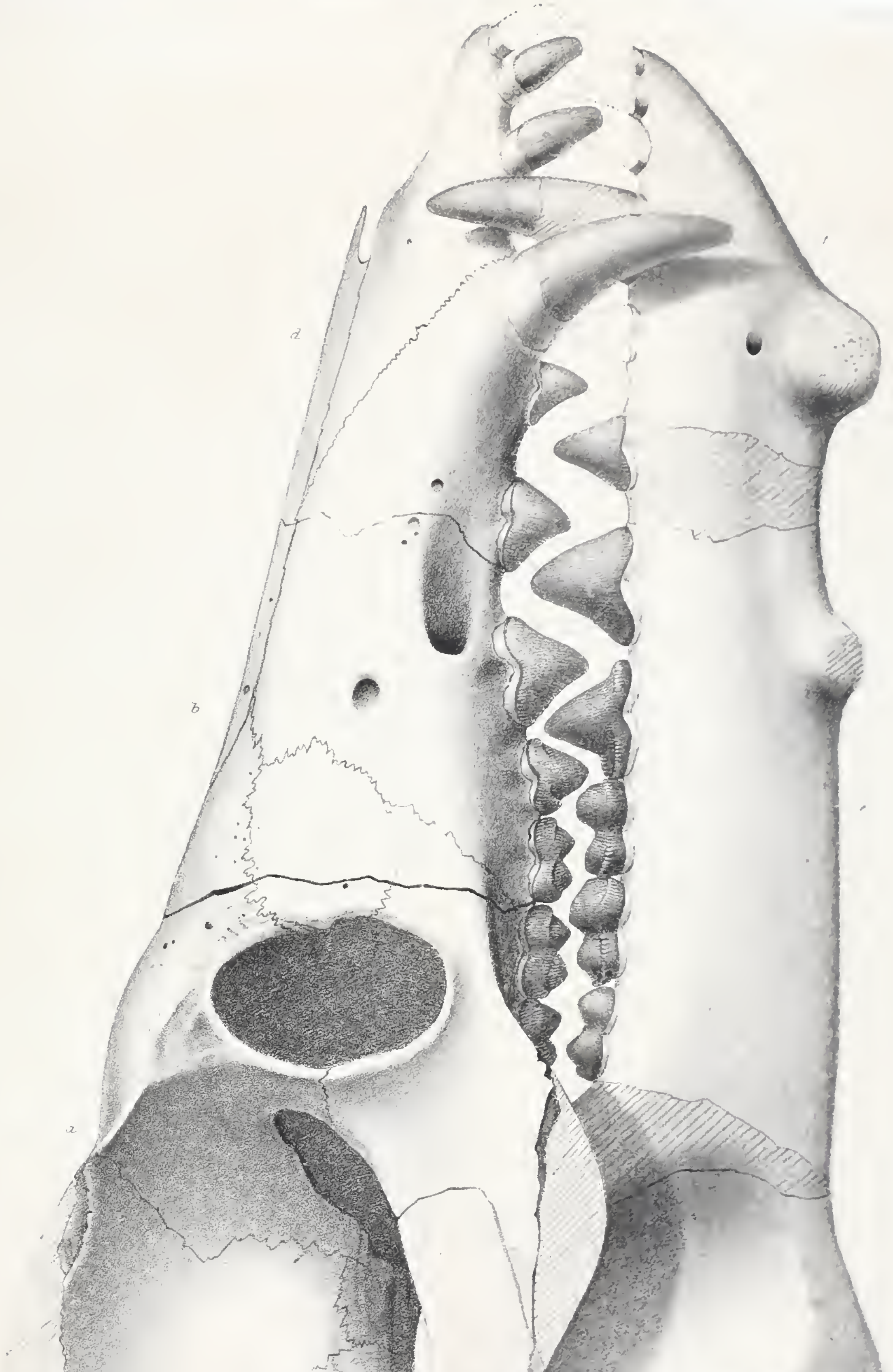
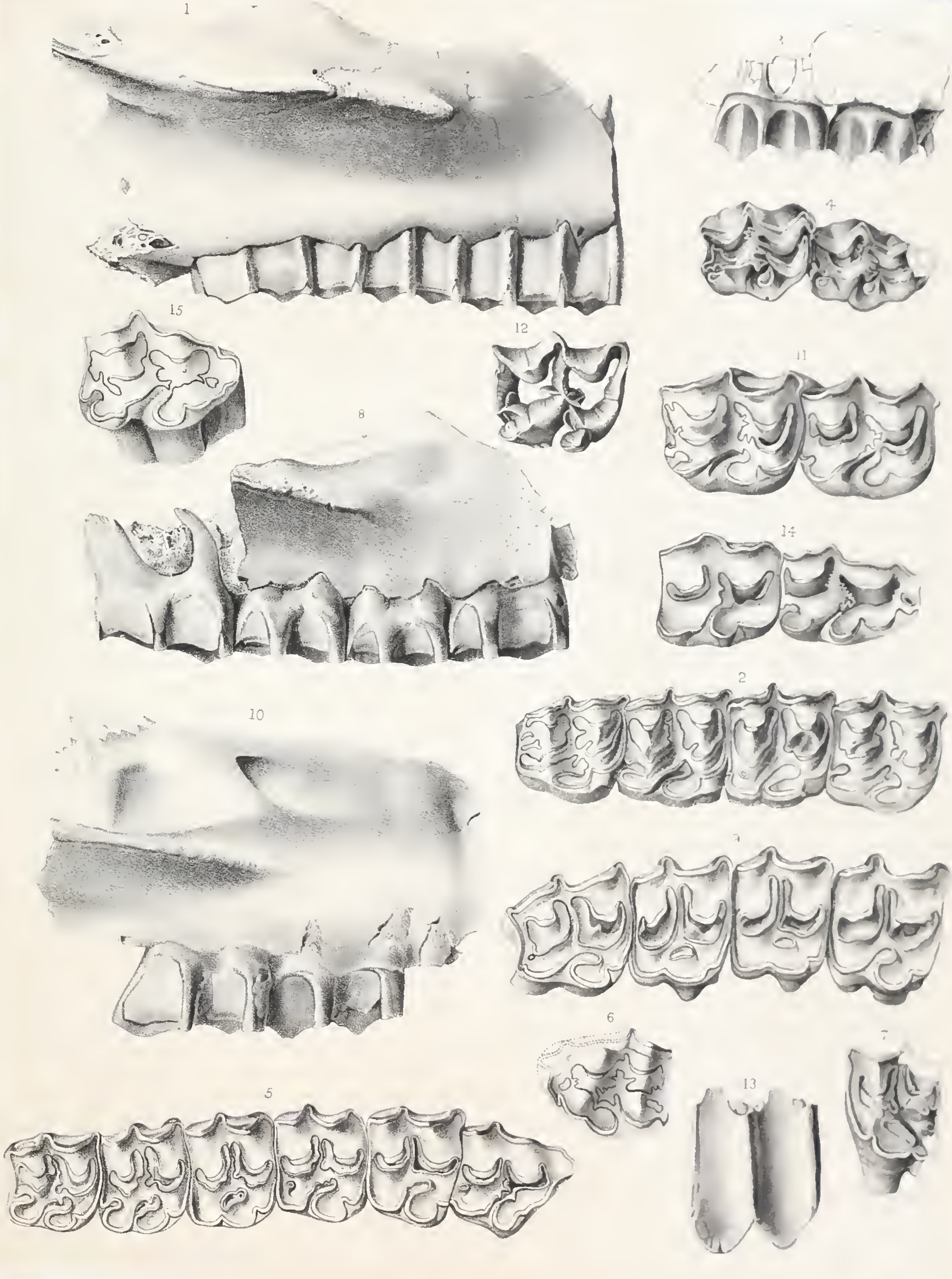
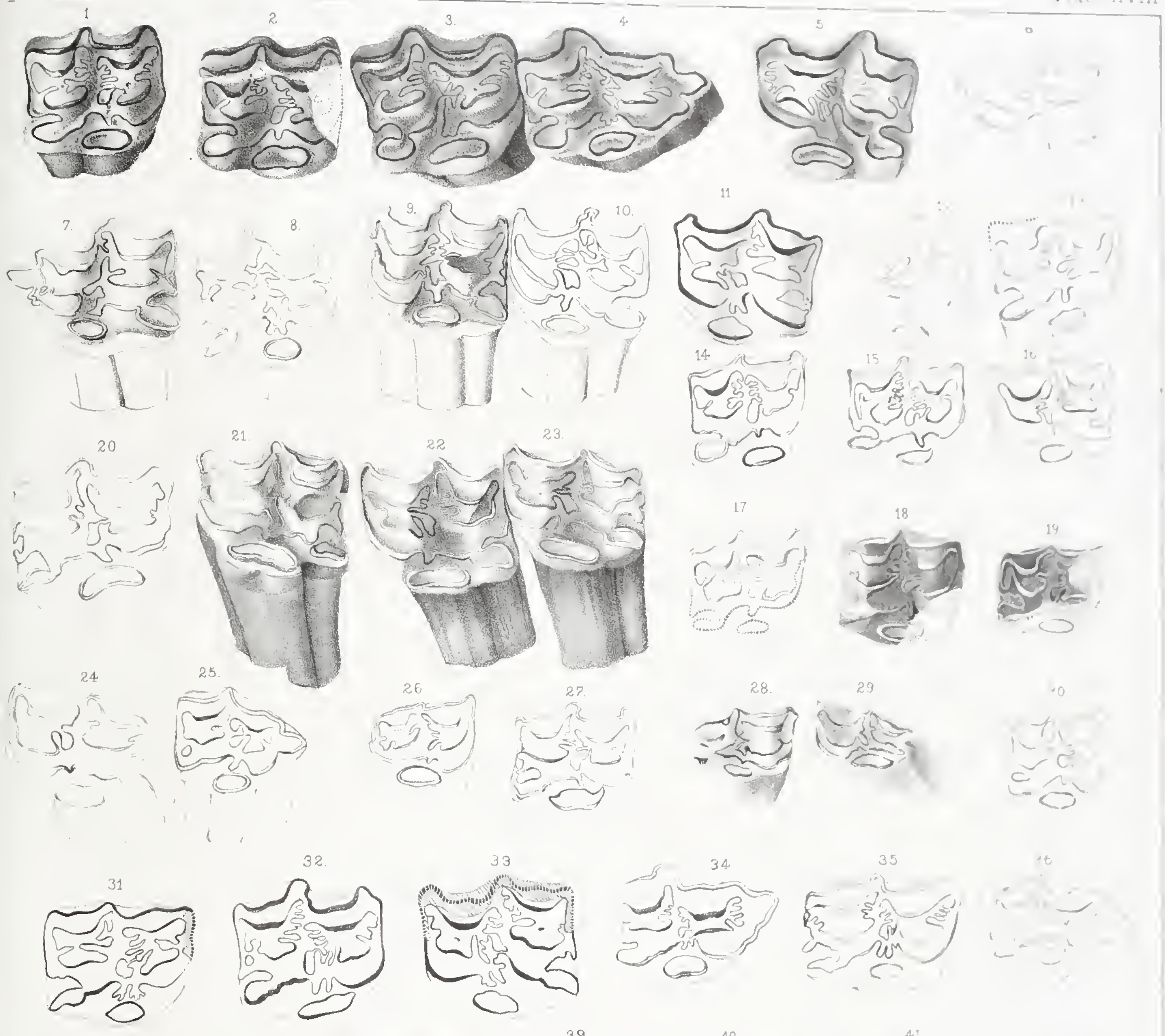


ELOTHERIUM MORTONI

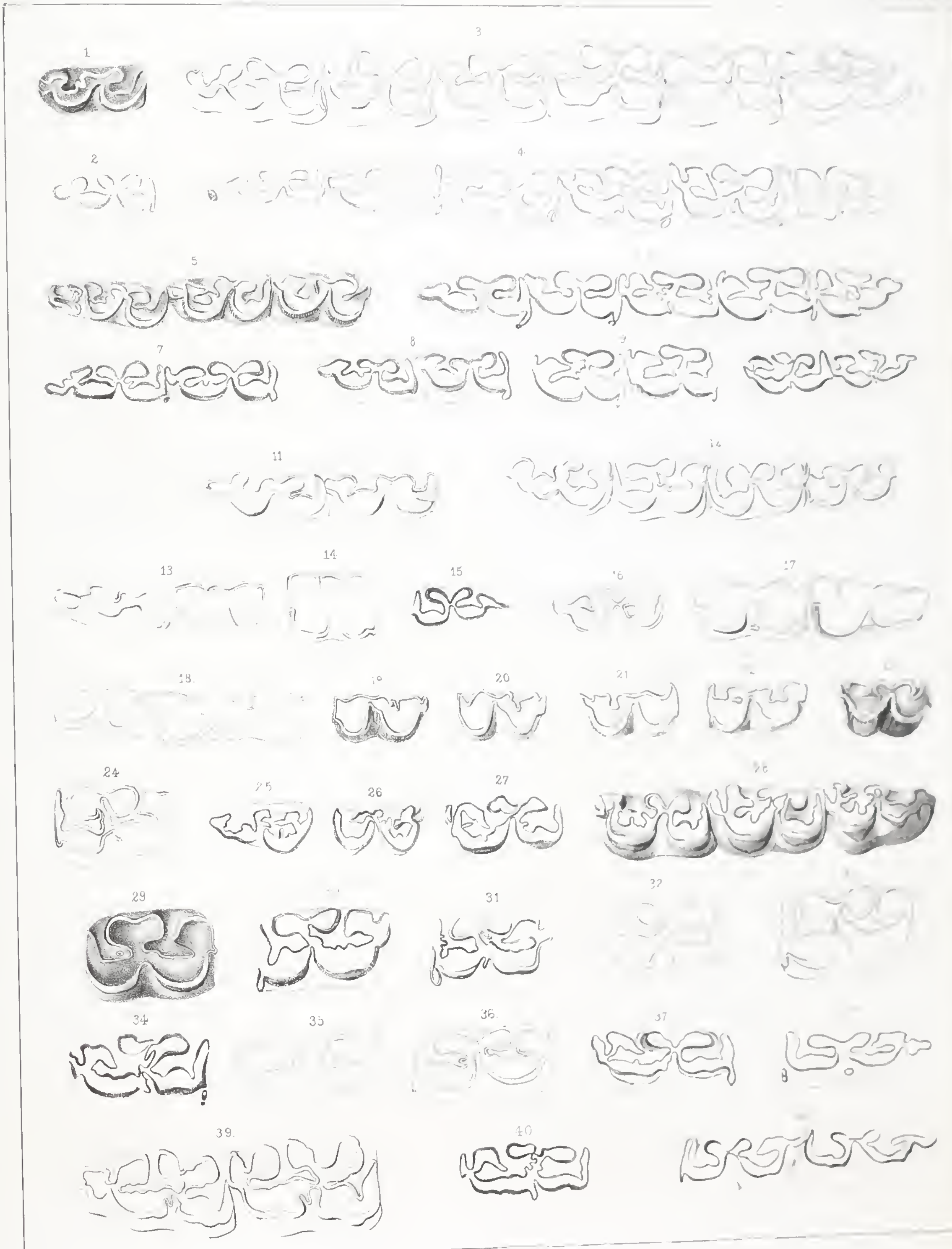


A. Ibbetson, del.

1-3 PROTOHIPPUS PERDITUS. 4-7 MERYCHIPPUS INSIGNIS. 8-15 M. MIRABILIS.



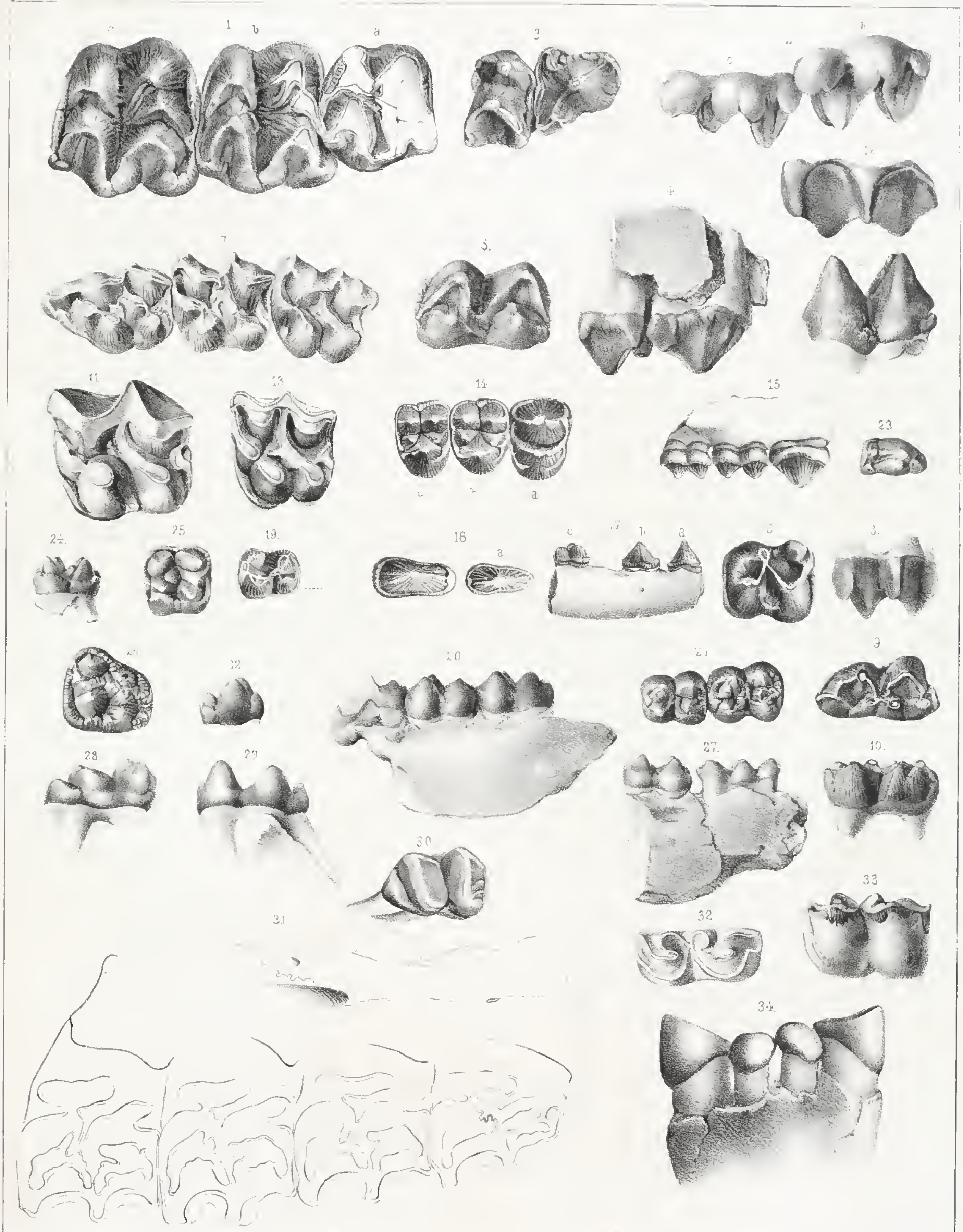
T. Sinclair's lith. Phil^{a}



T. Sinclair's lith Phil[a]

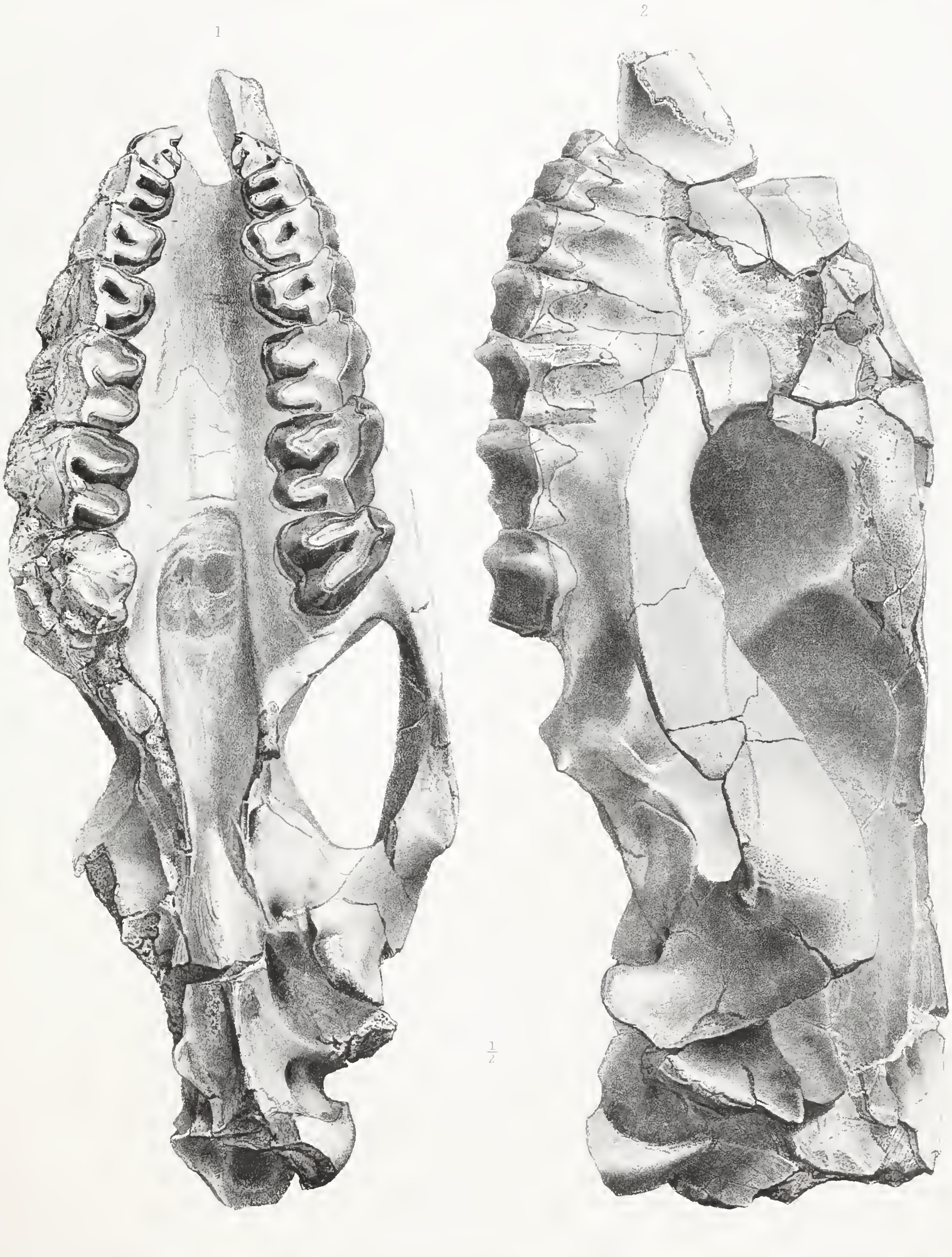
T. Sinclair's lith, Phil^a

ANCHITHERIUM BAIRDI



T Sinclair's lith Phil

1_6 HYOPOTAMUS 7_10 PARAHIPPUS 11,12 HYPOHIPPUS. 13 ANCHIPPUS
14_19 LEPTOCHOERUS 20_27 PERCHOERUS. 28_30 LOPHIODON
31 EQUUS 32,33 MERYCHIPPUS. 34 RHINOCEROS.



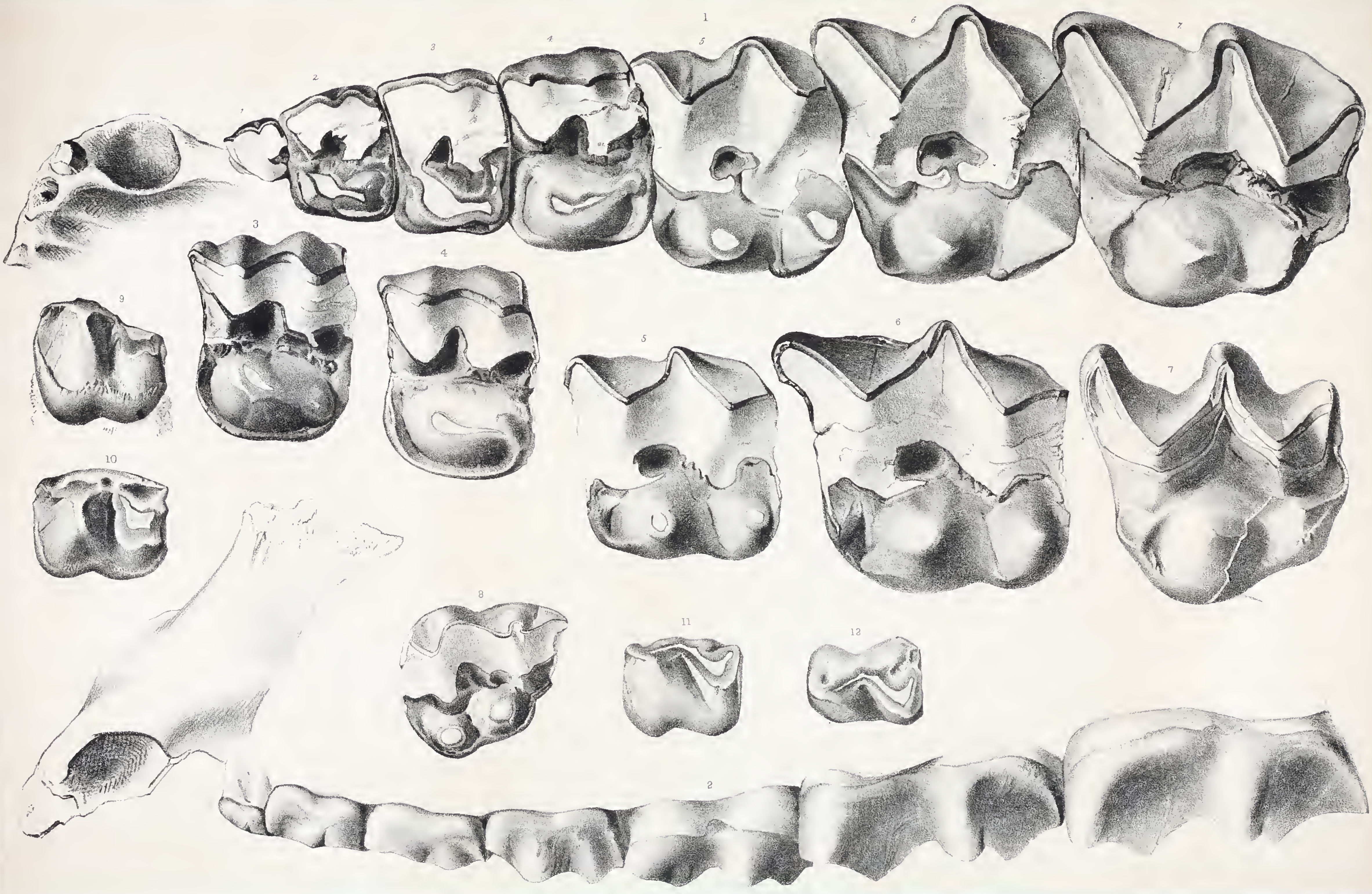
A. J. Ibbotson Del.

T. Sinclair's lith. Phila.

RHINOCEROS OCCIDENTALIS, Leidy

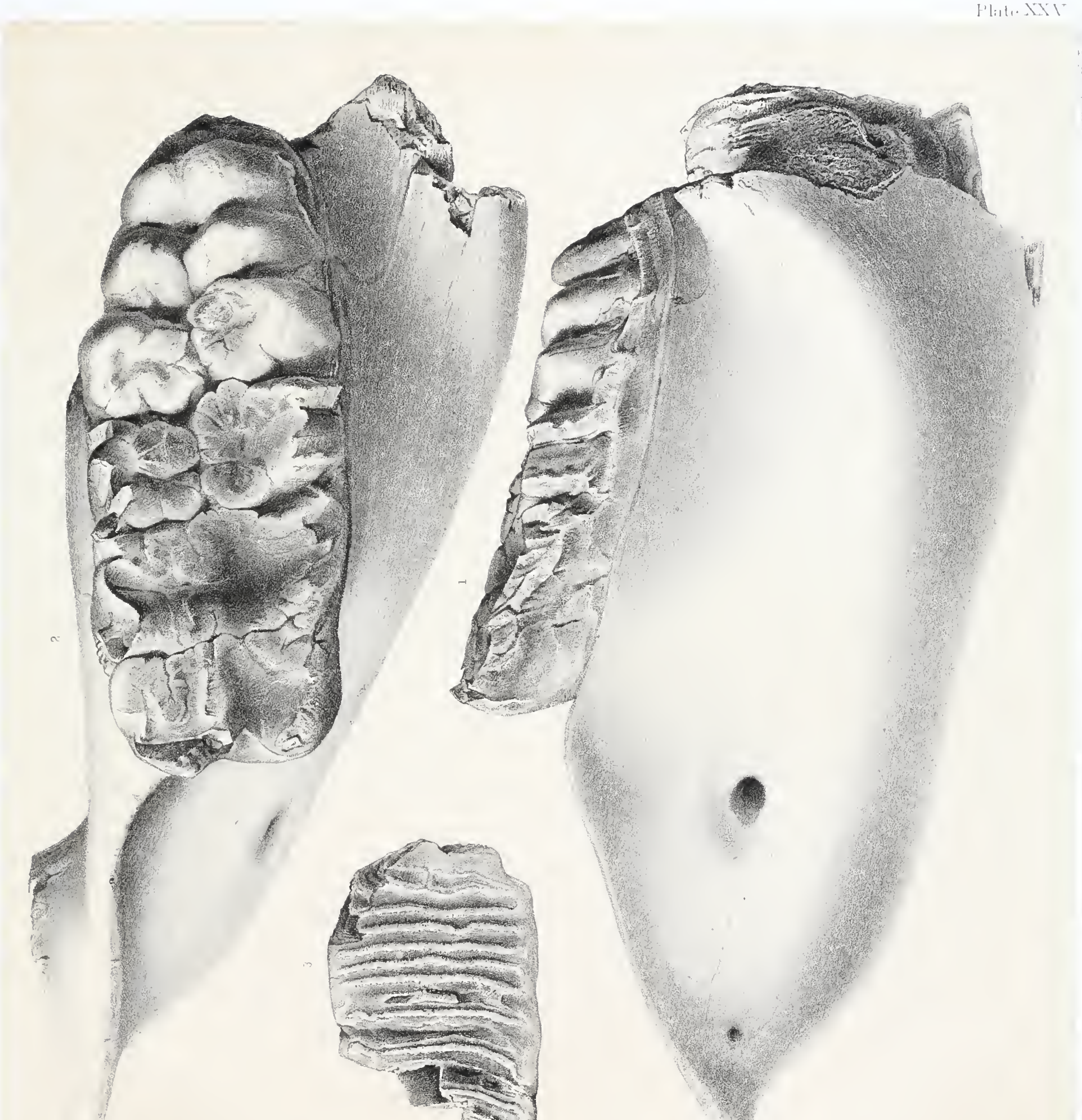
A.J. Ibbotson, del.

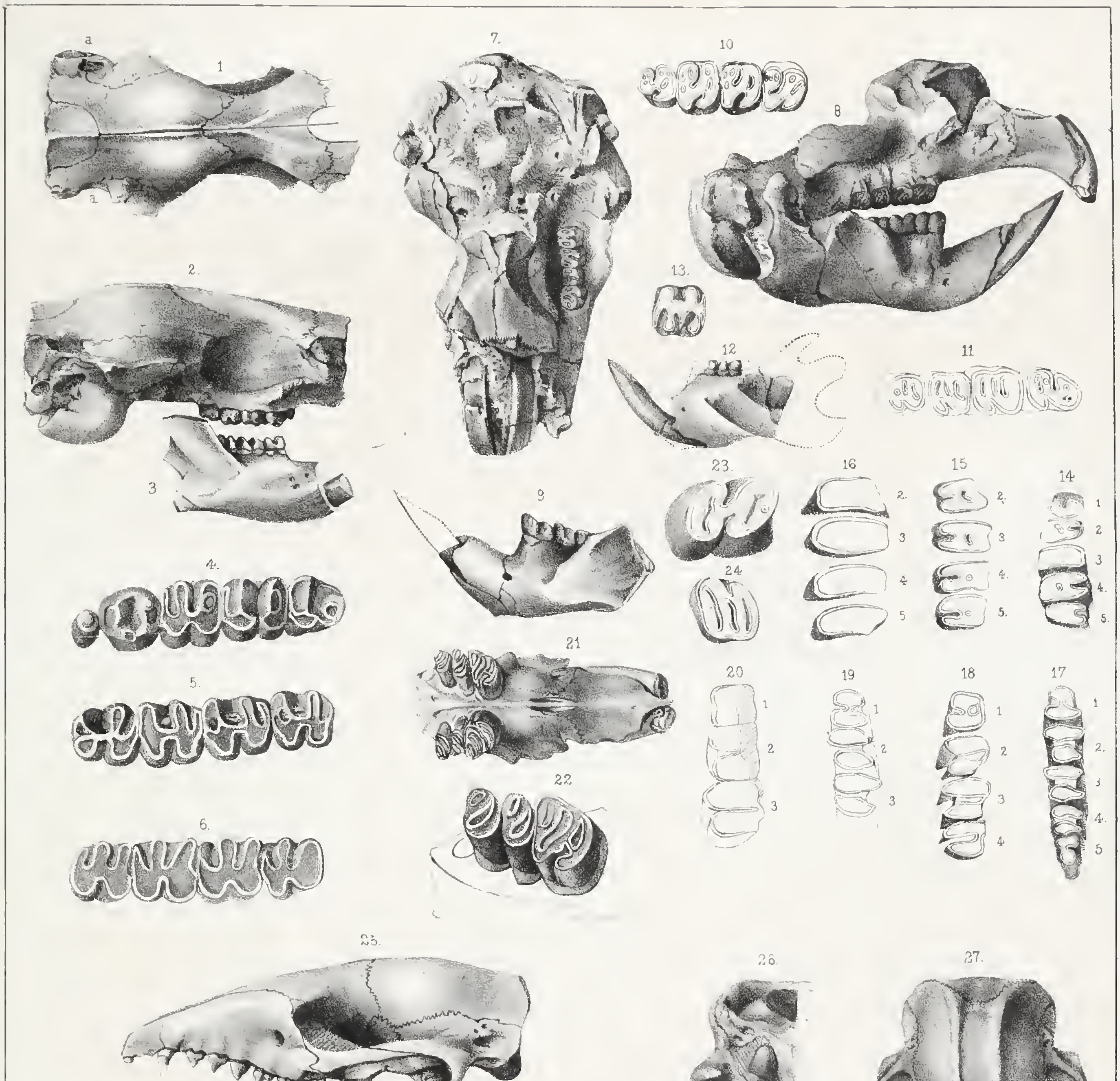
1-3 RHINOCEROS OCCIDENTALIS. 4-9 R. CRASSUS. 10 R. MERIDIANUS. 11,12 R. HESPERIUS.



J.Ibbotson, del.

Plate XXV

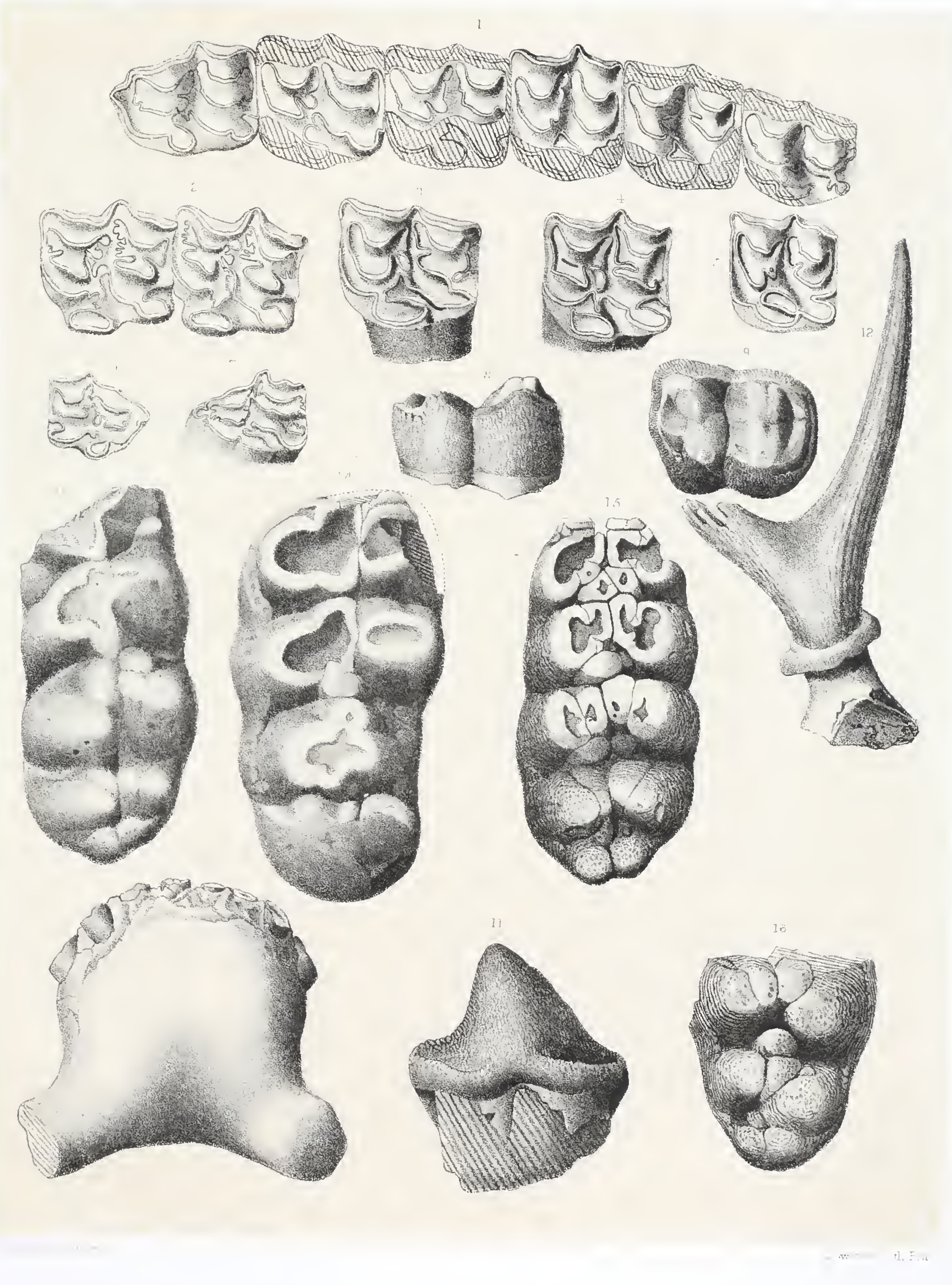


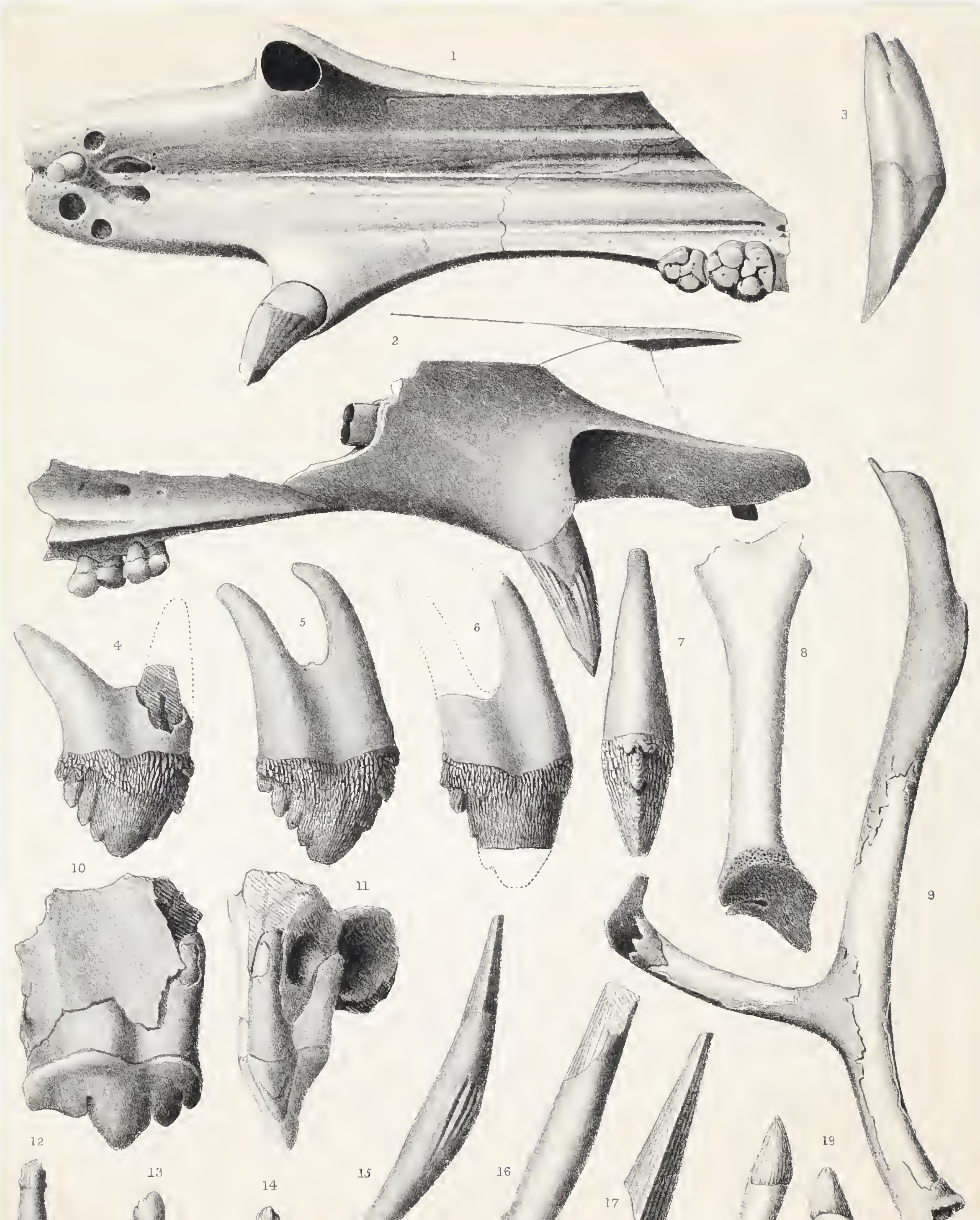


T. Sinclair's lith, Phil^a

1_6 ISCHYROMYS TYPUS. 7_11 PALAEOCASTOR NEBRASCENSIS. 12_13 EUMYS ELEGANS
14_20 PALAEOLAGUS HAYDENI. 21_22 CASTOR TORTUS. 23_24 HYSTRIX VENUSTUS
25_28 LEPTICTIS HAYDENI. 29_30 ICTOPS DAKOTENSIS.

Plate XXVII

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T Sinclair's lith

T Sinclair's lith