Contributions to the History of the Vertebrata of the Lower Eocene of Wyoming and New Mexico, made during 1881. By E. D. Cope.

(*Read before the American Philosophical Society, Dec. 16, 1881.*)

I. The Fauna of the Wasatch Beds of the Basin of the Big Horn River.

The basin of the Big Horn river contains the most northern area of the deposits of the Wasatch or Suessonian epoch known. In order to ascertain whether the fauna it contains differs in any way from that I discovered in the corresponding beds of New Mexico in 1874, I sent, during the past season, an expedition, under the direction of J. L. Wortman, already known from his successful exploration of the Wind River basin in 1880. The present paper gives a review of the results of the season's work, prefaced by an account of the geology furnished by Mr. Wortman. The species herein described are being engraved for the fourth volume of Dr. Hayden's report of the United States Geological Survey of the Territories, now passing through the press.

1. *The Geology of the Big-Horn Basin, by Jacob L. Wortman.*

As early as 1859 Dr. Hayden described in detail the Tertiary sediment occupying the upper drainage basin of the Big-Horn river, which he determined as belonging to the lower Eocene formation, and applied the name Wind River group, from its being exposed along the Wind river, a name given to the upper portion of the Big-Horn. From an extensive collection of vertebrate fossils made by the writer at this horizon, during the summer of last year, Prof. E. D. Cope, for whom the collection was made, has, in a bulletin, U. S. Geol. Surv. Terrs., F. V. Hayden, Vol. vi, No. 1, 1881, confirmed this determination, and discussed at length the faunal relations they bear both to the Bridger and Wasatch beds respectively. The conclusions reached are, that this series is intermediate to a certain degree, containing genera hitherto regarded as peculiar to each. This upper basin covers quite an extensive area, and is bounded upon every side by lofty mountains. The Owl Creek mountains, which afforded a barrier to the waters of this Eocene lake on the north, has subsequently been cleft by the Big-Horn, leaving a deep and rough cañon, through which it now flows in its course north to the Yellowstone. After passing the Owl Creek mountains it emerges into a second or lower basin, commonly called the Big-Horn basin proper. This one covers a much larger area than the upper, and like it is walled in by mountain ranges, and filled with a mass of sedimentary rock which is also referable to the lower Eocene series.

During the summer of the present year the writer has been engaged in further exploration of this interesting region, which resulted in the collection of a large number of extinct vertebrates, obtained exclusively from the lower Eocene horizon of the Big-Horn, and which have all been submitted to Prof. Cope, at whose instance the party was organized and equipped.

Dr. Hayden has made the observation that upon the eastern slope of the Wind River mountains all the corresponding strata are visible from the Silurian to the Cretaceous; this is also true of the northern slope of the Owl Creek mountains, while the southern side does not exhibit such continuity of structure. Upon entering the basin from the south, the older formations are seen to extend towards its centre for a distance of ten miles, inclining at an angle of 30° to the north, while the level of the Tertiary has been little or not at all disturbed since its deposition. That this basin contained a separate and isolated body of water, limited by its present boundaries, which were outlined about the beginning of the Wasatch epoch, there is every reason to believe. A section made by the Big-Horn at the southern extremity shows the Tertiary to rest unconformably upon a thick mass of buff colored sandstone, rather coarse in texture, somewhat laminated, and towards the bottom interspersed with thin layers of impure lignite varying from six inches to one foot in thickness. This sandstone most probably belongs to the Laramie series, but in the absence of fossils the determination is by no means satisfactory.

The Eocene sediment covers a large part of the basin, and cannot be less than 4000 feet in vertical depth. This mass, once continuous over a large area, has since been carved and weathered into many fantastic and remarkable forms, presenting at once a bold and striking appearance, a characteristic feature of the western Tertiary bad lands.

Beginning at the southern limit at a point opposite the mouth of Meyers creek, on the east side of the river, a series of low bad land bluffs, facing to the west and gradually becoming higher as they proceed, describe a gentle curve to the north, terminating at the river's edge 30 miles below. The character of the country between the river and these bluffs is a barren sage brush plain, while back of the bluffs a high mesa occupies the country for many miles. On the west side, numerous rivers, creeks, and their tributaries, putting down from the Sierra Shoshone range, have excavated the mass in every direction, leaving bold escarpments, high bad land buttes, elevated tables, with innumerable gulches and ravines. Country of this character stretches far away to the northern limit, near the Big Horn gap, presenting that desolate and sombre appearance, so often met with in bad land regions.

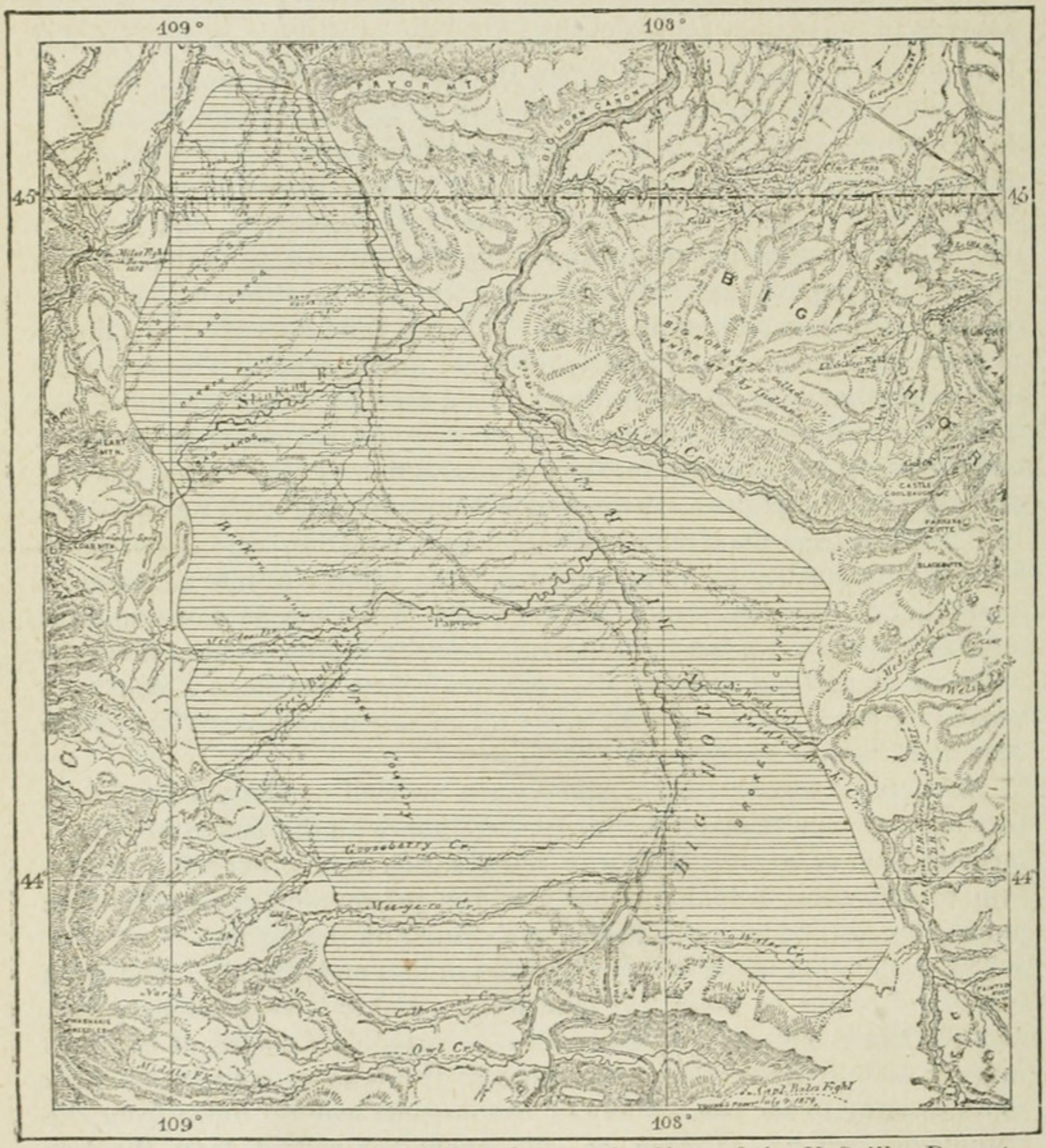
Its composition may be described as consisting of various colored clays alternating with layers of brown and blue sandstone, although that evenness of stratification by which a single layer of either, in one part, could be identified in another, does not exist. Those exposures, for example, on the east side of the Big-Horn are highly arenaceous, the clay and sand existing in almost equal proportions, while in the exposures along the Grey Bull river, and in the vicinity of Coryphodon butte, the quantity of sand is greatly diminished, and is found in separate layers. The preponderance of the red clay is a marked feature, and has called forth the remark from Dr. Hayden, relative to the sediment of the upper basin, "that they remind one of the Jura Trias red beds." This remark is forcibly illustrated by the character of the sediment found in the south-western part of the basin, near the head of Gooseberry creek, where the exposures consist largely of thick strata of the red clay, which gradually thin out to the north and east, blending with the pink, blue, and buff colors. In the northern part of the basin, and along Stinking river, the sediment consists almost exclusively of a pale yellow sandstone of a bluish tinge, from which few fossils were obtained.

The clays contain much lime in the form of small limestone nodules of a rusty brown appearance, in which the fossils are often found, having a thin and intensely hard layer of ferrous oxide investing them externally. In the red the fossils are always scarce and fragmentary, and when found are usually such parts as would, under the most favorable circumstances, be preserved. The blue seems to be the more productive, and to have offered better conditions for their preservation ; but, owing to the fact that lime forms the petrifying base, and being less able to withstand the heavy pressure than many other materials, the fossils from both the red and the blue are, as a general rule, greatly distorted and crushed. This fragmentary occurrence of fossils in the fine-grained clay, I am inclined to believe, is due, not to a scattering of the bones by currents, but rather to imperfect and unfavorable conditions for their preservation. That entire skulls and skeletons were deposited, where now nothing but the teeth remain, I am well satisfied from the circumstance that both superior and inferior series are not unfrequently found in proper position without a trace of ramus or cranium. In the sandstones, however, the fossils are in a magnificent state of preservation, but their extreme scarcity in this material gives the collector many long and fruitless searches. Two skeletons which have proven of considerable interest were all of any consequence that were obtained from the sandstones.

The general stratigraphical appearance, as well as the scattered and fragmentary condition of the fossils, together with the community of a large number of genera, refer it to the Wasatch epoch, but a full discussion of this point belongs properly to the paleontologist. A thorough elucidation will be found in Prof. Cope's paper on the fossils.

The exploration of this region is most arduous and difficult. The great scarcity of water in these bad land wastes, makes it very inconvenient, and renders it necessary to carry a water supply a distance of often 20 miles or more. Even when water does exist it is so strong with alkali as to be scarcely fit for use. Many of the streams coming down from the mountains dry up as soon as the snow has melted from the low foot hills in early spring, leaving large tracts entirely destitute of water, which frequently abound in fossiliferous exposures, and which it is the object of the explorer to examine. The broken and mountainous character of the country forbids the use of wagons to such an extent that pack animals are indispensable.

The accompanying map is intended to illustrate the exact position, as well as the extent of country covered by the Wasatch sediment at this point. Its topography is taken from a map made by Capt. J. Russell, Third Cavalry, U. S. A. (and published by the War Department), during a reconnoissance of that region in the summer of 1880, and to whom, as well as Dr. W. H. Corbusier, Col. J. W. Mason, and other officers stationed at Fort Washakie, I wish to express my deep sense of obligation for their very kind and courteous treatment.



Map of the Big-Horn Basin, reduced from the Map of the U. S. War Department.

2. *Synopsis of the Fauna.*

PISCES.

CLASTES sp.; not abundant.

PAPPICHTHYS sp. Vertebræ; not very common.

REPTILIA.

CROCODILUS sp. Allied to the *C. chamensis* and *C. heterodon*, but not represented by sufficiently well preserved specimens to permit of determination. There are numerous molariform teeth in the posterior parts of jaws, and the crowns of the longer teeth are grooved. Not uncommon.

EMYS sp. Rare ; one specimen of 220 mm. in length, of the type of *E. wyomingensis*, but not sufficiently well preserved for determination.

As the Eocene forms of this order are of unusual interest, I give an analysis of the extinct genera of the Cryptodire division of tortoises which have been found in North America up to the present time.

In the check-list of the North American *Batrachia* and *Reptilia*,* I enumerated nine families of this division of the *Testudinata*, three of which are extinct. Subsequently another extinct family, the Baënidæ, was added. I now define all of these families.

I. Plastron not articulated to the carapace, but presenting to it more or less open digitations. *Dactylosterna*.

Phalanges of anterior limb without condyles, and covered by a common integument ; eight pairs of costal bones.................. *Cheloniidæ*.

Phalanges of anterior limb without condyles ; nine or more costal bones, *Propleuridæ*.

Phalanges of anterior limb with condyles ; digits inclosed in distinct integuments ; eight costal bones ; sternal elements united by digitations and inclosing fontanelles ; caudal vertebræ procoelous. . . *Trionychidæ*.

Phalanges of anterior limbs with condyles ; digits distinct ; eight costal bones ; sternal elements united by suture and inclosing no fontanelles ; caudal vertebræ opisthocoelous.......................... *Chelydridæ*.

II. Plastron uniting with the costal bones of the carapace, by denticulate suture, and by ascending axillary and inguinal buttresses. (Feet ambulatory.) *Clidosterna*.

A. Intersternal bones present.

No intergular scuta.................................. *Pleurosternidæ*.†

Intergular scuta ; caudal vertebræ opisthocoelous................ *Baënidæ*.

AA. No intersternal bones.

a. Intergular scuta.

A mesosternal bone.................................. *Adocidæ*.

aa. No intergular scuta.

A mesosternal bone ; three series of phalanges.................. *Emydidæ*.

No mesosternal bone ; three series of phalanges............ *Cinosternidæ*.

A mesosternal bone ; two series of phalanges................ *Testudinidæ*.

* Bulletin U. S. National Museum, No. 1, 1875. p. 16.

† There are two genera of this family, neither of them yet found in America ; *Pleurosternum* Ow., with smooth shell, and *Helochelys* Myer, with sculptured shell.

III. Plastron uniting with the marginal bones of the carapace by straight contact only. (Feet ambulatory.) *Lysosterna.*

No intersternal bone nor intergular scutum ; a mesosternal bone and three series of phalanges.................................... *Cistudinidæ.*

The extinct species of the *Cryptodira* of this continent belong to eight of the above families. I give diagnoses of the genera to which they are referred. Names of existing genera are in Roman type.

CHELONIIDÆ.

Postabdominal bones distinct from each other............Chelonia Brong.

Postabdominal bones united with each other by suture..*Puppigerus* Cope.

PROPLEURIDÆ Cope.*

Transactions of American Philosophical Society, xiv., 1870, p. 235.

Ten costal bones ; first two marginals united with carapace by suture ; shell smooth, flattened............................ *Osteopygis* Cope.

Nine costal bones ; first two marginals united to carapace by suture ; shell sculptured (a high dorsal keel)..... ....*Peritresius* Cope.

Nine costal bones ; one marginal united with carapace by suture ; second by costal gomphosis ; shell not keeled nor sculptured .... *Propleura* Cope.

? Nine costal bones ; first united with carapace by suture ; second without costal gomphosis ; shell not sculptured.............*Catapleura* Cope.

? Nine costal bones ; marginals all free ; shell not sculptured............ *Lytoloma* Cope.

TRIONYCHIDÆ.

a. Surface of bones smooth.

Postabdominal suture digitate ....*Axestus* Cope.

aa. Surface of bones sculptured.

β. Sutures of plastron digitate.

A dermal flap protecting posterior legs below ; marginal bones............ Emyda Gray.

A dermal flap ; no marginal bones.................Cyclanosteus Peters.

No dermal flap nor marginal bones ; muzzle much abbreviated.......... Chitra Gray.

No dermal flap nor marginal bones ; muzzle elongate....Trionyx Geoffr.

ββ. Suture for postabdominal coarsely serrate.

Postabdominal recurved in front.........................*Plastomenus* Cope.

CHELYDRIDÆ.

a. Bridges of plastron wide ; ? caudal vertebræ.

One row of marginal scuta ; six pairs of scuta of the plastron........... *Idiochelys* Myr.

* *Palæochelys novemcostatus* Geoffr., belongs to this family, but not *Palæochelys* Myr.

One row of marginal scuta ; scuta of plastron ? not distinct............... *Hydropelta* * Myr.

aa. Bridges of plastron very narrow.

β. Carapace smooth, not sculptured.

Two rows of marginal scuta ; five pairs of scuta of the plastron........... Macrochelys Gray.

One row of marginals ; five pairs on plastron............Chelydra Schw.

One row of marginals ; four pairs of scuta on plastron....Claudius Cope.

ββ. Carapace sculptured.

One row of marginal scuta..... ....*Anostira* Leidy.

BAËNIDÆ.

Cope, Annual Report U. S. Geol. Surv. Terrs., 1872 (1873), p. 621.

Supramarginal scuta (Rütimeyer) ; no interhumerals.....*Platychelys* Myr.

No supramarginals nor interhumeral scuta........ ....*Baëna* Leidy.

No supramarginals ; interhumeral scuta present ......*Polythorax* † Cope.

ADOCIDÆ.

Cope, Proceedings American Philosophical Society, 1870, p. 559.

a. Vertebral bones and scuta normal.

One intergular scutum entirely separating the gulars ......*Adocus* Cope.

Either two intergulars, or the gulars meeting behind intergular.......... *Amphiemys* Cope.

aa. Vertebral bones wedge-shaped, widening upwards ; vertebral scuta not wider than the bones.

Elements of carpace early coössified................*Homorhophus* Cope.

EMYDIDÆ.

a. No scutal sutures.

Surface sculptured...................................*Apholidemys* Pom.

aa. Scuta including intermarginals and two anals.

Lobes of sternum narrow...........................Dermatemys Gray.

Lobes of sternum wide....... ....*Agomphus* Cope.

aaa. Scuta ; two anals, no intermarginals.

Surfaces of carapace sculptured ; plastron fixed......*Compsemys* Leidy.

Surfaces of carapace smooth ; plastron fixed ; recent *Emydidæ* and the genus.......................................Emys Brong.‡

Posterior lobe of plastron movable ; surface smooth....*Ptychogaster* Pom.

Anterior and posterior lobes of plastron movable ; surface smooth........ *Dithyrosternum* Pict. et Humb.

aaaa. Scuta ; one anal, no intermarginals.

Carapace smooth ....*Stylemys* Leidy.

* *Eurysternum* Wagn. (*Palæomedusa* et *Acichelys* Myr. (fide Rütimeyer) is nearly allied to *Hydropelta*.)

† Possibly one of the *Adocidæ*; see Proceed. Acad. Phila., Oct., 1876.

‡ Gray has distinguished several good genera among existing species on cranial characters.

TESTUDINIDÆ.

a. Two anal scuta.

Ten abdominal scuta....... ....*Hadrianus* Cope.

aa. One anal scutum.

Lower jaw with two cutting edges....................Xerobates Agass.

Lower jaw with one cutting edge.......................Testudo Linn.

RODENTIA.

PLESIARCTOMYS BUCCATUS Cope.

Two mandibular rami.

PLESIARCTOMYS DELICATIOR Leidy.

Mandibles of six individuals, some of them accompanied by bones of the skeleton.

BUNOTHERIA.

TÆNIODONTA.

Additional material gives the following results with regard to the affinities of this sub-order. There are three allied groups represented by the genera *Esthonyx, Tillotherium* and *Calamodon* of the American Eocenes, which are equally unlike each other. *Esthonyx,* as I long since showed, is related to the existing *Erinaceus;* very nearly indeed, if the dentition alone is considered. Its anterior incisor teeth are unusually developed, and have, as in *Erinaceus,* long roots. One pair at least in the lower jaw has enamel on the external face only, and enjoys a considerable period of growth. The genus *Tillotherium* is (fide Marsh) quite near to *Esthonyx.* Its molars and premolars are identical in character with those of that genus, the only important difference being found in the incisors. Here, one pair above, and one pair below, are faced with enamel in front only, and grow from persistent pulps as in the *Rodentia.* This character has been included by Marsh in those he ascribes to his "order" of *Tillodontia,* but as he includes *Esthonyx* in that order,* which does not possess the character, it is not very clear on what the supposed order reposes. The rodent character of the incisors is the only one that I know of which distinguishes *Tillotherium* from the *Inesctivora.* I have on this account retained the *Tillodonta* as a sub-order, and referred *Esthonyx* to the *Insectivora.*

The *Tæniodonta* agree with the *Tillodonta* in the possession of a pair of inferior incisors of rodent character, but it adds several remarkable peculiarities. Chief among these is the character of the inferior canines. In the *Tillodonta* they are either wanting, as in *Erinaceus,* according to the Cuvierian diagnosis, or they are insignificant. In *Calamodon* they are of large size, and though not as long-rooted as the second incisors, grow from presistent pulps. They have two enamel faces, the anterior and the posterior, the former like the corresponding face of the rodent incisors.

* Report of U. S. G. Survey 40th Parallel, by Clarance King; Vol. i, p. 377.

The function of the adult crown is that of a grinding tooth. This character distinguishes *Calamodon* as a form as different from *Tillotherium*, as the latter is from *Esthonyx*. There are, however, other characters. The external incisors, wanting in *Tillotherium*, are here largely developed, and though not growing from persistent pulps have but one. an external band-like enamel face. Their function is also that of grinders.

The fact that the rodent teeth in the lower jaw are the second incisors, renders it probable that those of the *Tillodonta* hold the same position in the jaw. This is to be anticipated from the arrangement in *Esthonyx*, where the second inferior incisors are much larger than the first and third. The superior dentition of the *Tæniodonta* is yet unknown.

Calamodon simplex Cope.

Report Vertebrate Foss., New Mexico, U. S. Geog. Surv. W. of 100th Mer. 1874, p. 5. Report of do. Capt. G. M. Wheeler, iv, ii, p. 166.

A nearly complete mandible of this species was found by Mr. Wortman, besides a series of unworn molar and canine teeth of a second individual, and fragments of some others. These furnish the correct dental formula as far as they go, as follows : I. 3 ; C. 1 ; M. 5. It appears that I correctly referred the long rodent teeth to the lower incisior series, but that the truncate two banded teeth so characteristic of the sub-order, are canines and not incisors, and that they belong to the lower as well as probably to the upper jaw.

The characters of the incisors are very peculiar. The first are small with short subcylindric crowns, and conic roots. The second incisors have been described ; as in *C. arcamœnus* they have a horizontal shoulder posterior to the base of the cutting portion. The third incisors increase in diameter upwards, and have a triangular section. The largest side of the triangle is interior, and the shortest the posterior, and neither possess any enamel. The anterior or enamel faced side is slightly convex. The grinding face is transverse and is in the plane of the corresponding face of the canine. The long diameter of the crown of the canine is at right angles to the anterior face of the third incisor, and diagonal to the long axis of the mandibular ramus. This, with the peculiarities of the other incisors, gives an irregular appearance to the anterior dentition.

The five molars are very similar in character, and even those with unworn crowns do not present any distinction into premolars and true molars. The enamel covers the summit of the crown, but on wearing, it is soon reduced to a cylindrical sheath. Further wear brings the grinding surface to the anterior and posterior surfaces which are covered with cementum instead of enamel.

Insectivora.

Esthonyx burmeisteri Cope.

Report Vertebrate Foss., New Mexico, 1874, p. 7. Report U. S. G. G. Surv. W. of 100th Mer. G. M. Wheeler, iv, ii, p. 156, pl. xi, fig. 26.

Two fractured crania exhibit the entire dentition of this species, and give the generic characters satisfactorily. The dental formula is, I. $\frac{2}{3}$; C. $\frac{1}{1}$; P-m. $\frac{?3}{3}$; M. $\frac{3}{3}$. The first superior incisor is large, and the crown is somewhat spoon-shaped. The second incisor is as robust as the first, but the crown is shorter. The second premolar has one external and one internal lobe, in the third (fourth) premolar these lobes are much enlarged, and the tooth is transverse. The true molars have two external cusps, which are flattened, close together, and well within the margin of the base of the crown. There is one internal lobe and a strong posterior ledge, as in the opossums. Of the inferior incisors, the median is large and half gliriform, while the first and third are small. The inferior, like the superior canines, are large. The first and second (third) premolars have no internal lobes, but the second (third) has a heel. The fourth is more or less like the first true molar.

The specimens show that my original determinations of the incisors based on loose teeth were correct. They also show that this genus is not far removed from the more rodent-like genus *Anchippodus* of Leidy.

There are several species of the genus, which I define as follows:

I. Fourth inferior premolar like first true molar.

Larger; third superior premolar larger; fourth premolar with the external cusp bilobate.......................................*E. acutidens.*

Medium; third superior premolar smaller; fourth premolar with external cusp simple; superior incisors wide; large inferior narrower........ *E. burmeisteri.*

Medium; superior incisors narrow; large inferior wider....*E. bisulcatus.*

II. Fourth inferior premolar with anterior V open and cutting.

Smallest; incisors unknown.................................*E. acer.*

A species of the size of *E. acer* has been named *E. spatularius*, but I cannot place it in the above key, as the premolar and incisor teeth are unknown. The section II, approximates nearer the genus *Conoryctes* than sect. I.

Mesodonta.

Hyopsodus lemoinianus, sp. nov.

This Mesodont is distinguished from the known species of the genus by its superior size, and the fully developed heel of the inferior third molar. The anterior inner cusps of the inferior molars are absolutely simple, and the same teeth have a weak external and no internal cingulum. The cusps are elevated and the enamel smooth.

The species of this genus known to me by their mandibles are four, and these differ chiefly in size. Their characters are as follows:

Length of true molars M. .0165; last molar elongate.....*H. lemoinianus.*

Length of true molars M. .0140; last molar longer than second........... *H. paulus.*

Size as last; last molar shorter than second................*H. miticulus.*
Length of true molars M. .0115; last molar elongate.........*H. vicarius.*

H. lemoinianus and *H. miticulus* have not been found out of the localities where they were discovered, while the other two species are distributed through most of the Eocene horizons, and have been found in many localities. Of the *H. lemoinianus* Mr. Wortman found nine more or less fragmentary mandibles.

Dedicated to my friend, Dr. Victor Lemoine of Reims, well-known for his brilliant discoveries in the vertebrate paleontology of the Lower Eocene beds near that city.

HYOPSODUS PAULUS Leidy.

Thirty-eight more or less broken mandibular rami.

HYOPSODUS VICARIUS Cope.

Eleven mandibular rami. A few specimens are intermediate between this species and the last in dimensions, the inferior true molars measuring M. .0120 and .0125 in length.

PANTOLESTES CHACENSIS Cope.

Four mandibular rami. This species has the fourth premolar more robust and less trenchant than in *P. secans*, and shorter than the last true molar. In *P. secans* it is longer than the last true molar.

PANTOLESTES METSIACUS sp. nov.

A small species of the size of the *P. longicaudus*, and distinguished by several peculiarities of dentition. The two cusps composing the anterior internal lobe of the molars are quite distinct but appressed. Each one is connected with the external anterior lobe by a transverse crest as is seen in *Esthonyx*, and these enclose between them a fossa. This fossa is closed internally by the appression of the anterior inner cusps. The fourth premolar is not so large as in *P. secans*, but resembles in proportions that of *P. chacensis*. It differs from that of *P. longicaudus* in its very short heel and its large anterior basal tubercle. The latter is double, consisting of two small cusps, one within and anterior to the other. The posterior heel is distinct on both sides of the ridge that marks the median line. The posterior external lobe is V-shaped, and the posterior inner is a small cone. Between the two is a minute median tubercle. The posterior tubercles are not so elevated as in the species of *Hyopsodus*. A weak external cingulum; enamel smooth.

Measurements.	M.
Length P-m. IV, with M. I, and II; (No. 1)...........	.0140
" P-m. IV....................................	.0048
" M. II.......................................	.0048

Measurements.	M.
Width M. II	.0040
Length M. III; (No. 2)	.0050
Width "	.0030
Depth ramus at P-m. IV; (No. 1)	.0060
" " M. III; (No. 2)	.0070

Portions of four mandibles preserved. No. 2 is a little smaller than No. 1, and No. 4 is a little larger than No. 1.

The species of *Pantolestes* may be distinguished as follows:

a. Fourth premolar trenchant everywhere, longer than second molar.

Length of true molars M. .0150; second molar with but one anterior inner cusp .... *P. secans.*

aa. Fourth premolar with blunt heel, not longer than second molar.

Length of true molars .0160; all with double cusps .... *P. chacensis.*

Length of true molars .0140; fourth premolar with minute anterior cusp, and long heel .... *P. longicaudus.*

Length of true molars .0130; fourth premolar with double anterior cusp, and short heel; molars with double cusps .... *P. metsiacus.*

Length of true molars .0105; fourth premolar small, .0035, without anterior cusps, and with two ridges on heel; true molars with double anterior inner cusps .... *P. nuptus.*

Pantolestes nuptus, sp. nov.

This is the last species of the genus, and is represented by a portion of a right mandibular ramus which supports three molars from the fourth to the sixth inclusive. Besides its small size, this species is distinguished by the relatively small dimensions of the fourth premolar, which is shorter than the first true molar instead of longer, as in all the other species. The well developed basin of its heel, which is bounded by a ridge on each side, distinguishes it at once also from *P. secans*, and is more distinct than in *P. chacensis*; from the latter and *P. metsiacus* the entire absence of anterior basal lobes separates it. The well developed pair of anterior inner tubercles of the true molars shows that it cannot be an abnormal *Hyopsodus vicarius*, with which it agrees in size. The first anterior tubercle is more widely separated from the second anterior than in any of the species of the genus, and is quite as in species of *Pelycodus*. It is smaller than the second anterior inner, which equals in size the anterior outer. The heel is wide, enclosing a basin, which is bounded externally by an angular ridge. Its posterior inner angle supports a cusp, which is separated by a deep notch from the anterior inner cusp. External to it on the posterior border of the crown is a small tubercle. No basal cingula.

Measurements.		M.
Length of three molars		.010
Diameters of M. i	anteroposterior	.004
	transverse	.003
Depth of ramus at P-m. IV		.007

Basin of the Big-Horn: J. L. Wortman.

PELYCODUS ANGULATUS Cope.

The species of this genus are, in the present state of our knowledge, best distinguished by their size.

Length of true molars on base	M. .024 ;	*P. pelvidens.**
" " " "	M. .019 ;	*P. jarrovii.*
" " " "	M. .017 ;	*P. tutus.*
" " " "	M. .015 ;	*P. frugivorus.*
" " " "	M. .012 ;	*P. angulatus.*

Remains of species of this genus are very common in the Wind River bad lands ; they were originally found in the Wasatch beds of New Mexico, and have not yet been announced from the Bridger formation.

The *P. angulatus,* heretofore only known from New Mexico, is represented in the Big-Horn collection by five mandibular rami, and a portion of a maxillary bone with teeth.

PELYCODUS FRUGIVORUS Cope.

Two mandibles and seven separate rami represent this Mesodont.

PELYCODUS TUTUS Cope.

Four rami display the typical length of the true molars, M. .017. Three are smaller, having the molars .016 in length, while one gives .018 for the same teeth. Other portions of the skeleton will be necessary to determine exactly the specific position of these specimens.

PROSIMIÆ.

CYNODONTOMYS LATIDENS, gen. et sp. nov.

Char. gen. Derived from mandibular rami. Dental formula I. ? 0 ; C. 1 ; P-m. 2 ; M. 3. The premolars are counted as two, on the supposition that the anterior one is two-rooted ; should it prove to be one-rooted, then the number will be three. The canines are very large and close to the symphysis, so that there do not appear to have been any incisors. The true molars have the frequently occuring three tubercles in front and a heel behind ; but the arrangement is peculiar in that the three tubercles are but little more elevated than the borders of the heel, and occupy a small part of the crown. The last molar is lost from both jaws, but the space for it is about as large as that occupied by the penultimate. The fourth premolar has but two anterior cusps, and these are more elevated than those of the true molars, and the heel is narrower. The mandibular rami are not coössified.

The dental characters of this genus resemble considerably those of *Anaptomorphus* and *Necrolemur,* but the large size of the inferior canine tooth distinguishes it from both. The double anterior cusps of the fourth premolar equally distinguish it from them.

Char. Specif. The inferior true molars are subquadrate in horizontal outline, somewhat narrowed anteriorly. The concave heel is the larger part of the crown ; it is only elevated into a low cusp at the posterior external angle. The anterior cusps are conic, and are in contact at the

* *Lipodectes pelvidens* Cope, Amer. Naturalist, Dec., 1881, p. 1019.

base. The external and posterior internal are of about the same size; the anterior inner is smaller and does not project so far inwards as the posterior. The fourth premolar has the posterior border of its heel serrate. The anterior cusps are elevated and moderately acute; the internal is a little less elevated than the external, and is separated from it by a deep notch. The alveoli for the anterior premolar are so close together, as to render it probable that they belong to but one tooth. They are placed somewhat obliquely to the long axis of the jaw. There is no diastema. The section of the base of the crown of the canine is a regular oval, the long diameter coinciding with the vertical diameter of the ramus.

The ramus is rather slender, but is shortened anteriorly. The boundaries of the masseteric fossa are well marked, the anterior ridge descending to below the middle line of the ramus. The mental foramen is large and is situated below the contact of the two premolars. The inferior edge of the ramus is rather thick.

Measurements.

		M.
Length of dental series including canine		.0240
" premolars		.0062
" molars		.0114
Long diameter base canine		.0036
Diameters P-m. IV	anteroposterior	.0038
	transverse	.0026
" " M. II.	anteroposterior	.0042
	transverse	.0038
Depth of ramus at P-m. I		.0060
" " " M. III		.0068

Anaptomorphus homunculus Cope, American Naturalist, 1882, Jan. (Dec. 30th, 1881), p. 73.

The genus *Anaptomorphus* was characterized by me in 1872,* from a mandibular ramus which exhibited the alveoli of all the teeth, three of them occupied by the teeth; viz.: the P-m. iv, and the M. i and M. ii. From the specimen the inferior dental formula was ascertained to be I. 2; C. 1; P-m. 2; M. 3. The Big-Horn collection contains a nearly entire cranium of what is probably a species of the same genus. From it the superior dentition, exclusive of the incisors, is determined to be: C. 1; P-m. 2; M. 3. The premaxillary bones are mostly broken off, but a part of the alveolus of the external incisor of one side remains.

The indications are that the external incisor was a small tooth, not exceeding the canine in size; and it was situated close to the latter. The canine is also small, and its simple crown is not more prominent than those of the premolars. The latter are separated from it by a very short diastema. The long diameter of their crowns is transverse to the long axis of the

* Proceedings American Philosophical Society, 1872, p. 554. Paleontological Bulletin, No. 8, p. 1, Oct. 12, 1872.

jaw ; and each one consists of a larger external, and smaller internal cusp. The true molars are also wider than long, and support two external and only one internal cusps.

The orbits are large and are entirely enclosed behind. The frontal bone does not send inwards to the alisphenoid a lamina to separate the orbit from the temporal fossa, as is seen in *Tarsius*. There is no sagittal crest, but the temporal ridges are distinct. The occipital region protrudes beyond the foramen magnum, or at least beyond the paroccipital process, which is preserved, the condyles being lost. The otic bulla is large, extending anteriorly to the glenoid cavity. The pterygoid fossa is large, the external pterygoid ala being well developed, and extending well upon the extero-anterior side of the bulla, as in *Tarsius*. As in that genus, the foramen ovale is situated on the external side of the bulla, just above the base of the external pterygoid ala. The carotid foramen, as I suppose it to be, is situated at the apex of the bulla. The lachrymal foramen is situated anterior to, and outside of the orbit as in *Lemuridæ* generally.

The cast of the anterior part of the left cerebral hemisphere is exposed. This projects as far anteriorly as the middle of the orbits, leaving but little room for the olfactory lobes. The relations of the latter as well as of other parts of the brain will be examined at a future time. The part exposed does not display fissures, and gentle undulations represent convolutions.

The characters of this genus now known, warrant us in thinking it one of the most interesting of Eocene Mammalia. Two special characters confirm the reference to the *Lemuridæ* which its physiognomy suggests. These are, the external position of the lachrymal foramen, and the unossified symphysis mandibuli. Among *Lemuridæ*, its dental formula agrees only with the *Indrisinæ*, which have, like *Anaptomorphus*, two premolars in each jaw. But no known *Lemuridæ* possess interior lobes and cusps of all the premolars, so that in this respect, as in the number of its teeth, this genus resembles the higher monkeys, the *Simiidæ* and *Hominidæ*,* more than any existing member of the family. Of these two groups the resemblance is to the *Hominidæ* in the small size of the canine teeth. It has, however, a number of resemblances to *Tarsius* which is perhaps its nearest ally among the lemurs, although that genus has three premolars. One of these points is the anterior extension of the otic bullæ, which is extensively overrun by the external pterygoid ala. A consequence of this arrangement is the external position of the foramen ovale, just as is seen in *Tarsius*. Another point is the probably inferior position of the foramen ovale. Though this part is broken away in the cranium of *Anaptomorphus homunculus*, the paroccipital process is preserved, and has the

* In an early description of *Anaptomorphus*, Proc. Amer. Philos. Soc., 1873, the types make me say " this genus * * might be referred decidedly to the *Lemuridæ*, were it not for the unossified symphysis." It is scarcely necessary to state that *Simiidæ* should be read in place of *Lemuridæ*.

position seen in *Tarsius*, as distinguished from the *Indrisinæ*, *Lemurinæ*, *Galaginæ*, etc. In this it also resembles the true *Quadrumana*.

When we remember that the lower *Quadrumana*, the *Hapalidæ* and the *Cebidæ*, have three premolar teeth, the resemblance to the higher members of that order is more evident. The brain and its hemispheres are not at all smaller than those of the *Tarsius*, or of the typical lemurs of the present period. This is important in view of the very small brains of the flesh-eating and ungulate Mammalia of the Eocene period so far as yet known. In conclusion, there is no doubt, but that the genus *Anaptomorphus* is the most simian lemur yet discovered, and probably represents the family from which the true monkeys and men were derived. Its discovery is an important addition to our knowledge of the phylogeny of man.

Char. specif. The specimen is distorted by pressure, but its form is normally nearly round, when viewed from above or below. The extremity of the muzzle is broken away, but the alveolus of the external incisor indicates that it is short, and not prolonged as in *Tarsius spectrum*. The mandibular ramus, already described, proves the same thing. The orbits are large, but not so much so as in *Tarsius spectrum* ; their long diameter equals the width of the jaws at the last superior molar teeth inclusive. The supra-orbital borders project a little above the level of the frontal bone, which is concave between their median and anterior parts. The cranium is wide at the postorbital region, in great contrast to its form in the *Adapidæ*, resembling the *Necrolemur antiquus* Filh. in this respect. The postfrontal processes are wide at the basal portion, and flat. From their posterior border the temporal ridges take their origin. These converge posteriorly and probably unite near the lambdoidal suture, but this part of the skull is injured. The anterior lobes of the cerebral hemispheres are indicated externally by a low boss on each frontal bone.

The paroccipital process is short and wide at the base, and it is directed downwards and forwards. The alisphenoid descends so as to form a strong wall on the anterior external side of the otic bulla. This is also the case in *Tarsius spectrum*, but in the extinct species the descending ala is more robust, and has a thickened margin. On the latter the external pterygoid ala rests by smooth contact of its thickened superior edge. This ala is twice as prominent as the internal pterygoid ala. The posterior nareal opening is not wide, and its anterior border is parallel with the posterior border of the last superior molar teeth. The palate is wide, and its dental borders form a regular arcade as in man, being quite different from the form usual in monkeys and lemurs, including *Tarsius*. Perhaps the form is most like that of *Microrhynchus laniger*. The proximal parts of the malar bone are prominent, and overhang the maxillary border, as in *Tarsius*.

The *foramina ovale* and *lachrymale* are rather large. There are two infraorbital canals, lying beside each other, and issuing by two foramina externa. The external appearance justified this conclusion, but the fact was demonstrated when I accidentally broke away the anterior border of one of the orbits. This displayed the two canals filled with matrix their entire length. The anterior foramen externum is anterior to and above the posterior, and both are above the first (third) premolar tooth. The lachrymal foramen is above the space between that tooth and the canine.

The crown of the canine tooth is a cone with a very oblique base, and a convex anterior face. The base rises behind, and the posterior face has on the median line a low angular edge. The internal cone of the third (first) premolar is not so prominent as that of the second, though large. The external cusps of both premolars rise directly from the external base. They are flattened cones, with anterior and posterior cutting edges. The crowns are a little contracted at the middle, so as to be narrower than the inner lobe of the tooth, which is narrower than the external portion. Both premolars have delicate anterior, posterior and external cingula. The external cusps of the true molars rise directly from the external base, and like those of the premolars, have a regularly lenticular section. At the internal base of each one is a small intermediate tubercle, which is connected by an angular ridge with the single internal cusps. There are delicate anterior, posterior, and external cingula, but no internal. The posterior cingulum shows a trace of enlargement at its inner part, which is well marked on the second molar, but it is not as prominent as in many Creodont genera. The posterior external cusp of the last true molar is reduced in size. Taking the molars together, the first true molar is the largest, and they diminish in size both anteriorly and posteriorly. The third true molar is a little smaller than the first (third) premolar. Enamel smooth.

Measurements.		M.
Length of cranium to occipital prominence above paroccipital process, and minus premaxillary bone		.0280
Total width at posterior border of orbit, below		.0240
Length of palate from front of canine tooth		.0116
Width of palate and peunltimate molars		.0125
Length of superior molar series		.0095
" " true molars		.0060
Diameters of crown of canine	anteroposterior	.0018
	vertical	.0018
Diameters crown of P-m. iii,	anteroposterior	.0020
	transverse	.0026
Diameters crown of P-m. iv,	anteroposterior	.0020
	transverse	.0035
Diameters M. ii,	anteroposterior	.0032
	transverse	.0040
Diameters M. iii,	anteroposterior	.0016
	transverse	.0028
Diameters of orbit	anteroposterior	.0110
	vertical (? depressed)	.0078
Interorbital width (least)		.0050

The *Anaptomorphus homunculus* was nocturnal in its habits, and its food was like that of the smaller lemurs of Madagascar and the Malaysian islands. Its size is a little less than that of the *Tarsius spectrum*. The typical specimen was found by Mr. J. L. Wortman in a calcareous nodule in the Wasatch formation of the Big-Horn basin, Wyoming Territory.

CREODONTA.

Shortly after the publication of my arrangement of the Creodonta in 1880*, I obtained a good deal of additional material, which enabled me to improve it in several respects. A number of genera have been added, and the characters which distinguish the *Miacidæ* and *Oxyænidæ* have been more fully brought out. The *Miacidæ* differ from all other families in having the fourth superior premolar sectorial as in the true *Carnivora*, while the true molars are tubercular. In *Oxyæna*, the fourth superior premolar displays no indication of sectorial structure, the first true molar assuming that character. In *Stypolophus* and allies, the second superior true molar is more or less sectorial, and the first true molar and even the fourth premolar in some of the genera, develop something of the same character. But there is every gradation between the triangular *Didelphys*-like, and the sub-sectorial *Pterodon*-like forms of the superior molars, in this group of genera.

The glenoid cavity of the squamosal bone presents differences in the various genera of this sub-order. In *Arctocyonidæ* (fide De Blainville), *Oxyænidæ*, and *Mesonychidæ*, it is bounded by a transverse crest anteriorly, as well as by the postglenoid posteriorly, while in the *Leptictidæ* it is plane and open anteriorly. In *Amblyctonidæ* its condition is unknown. In existing *Carnivora* this character is not very constant as a family definition ; it is best marked in the *Felidæ*, and least marked in the *Canidæ*. Nevertheless there is a group of genera allied to the *Oxyænidæ*, which are very marsupial in character, which have been called the *Leptictidæ*, and which differ so far as known from *Oxyæna* in the absence of the preglenoid crest. I suspect that these forms constitute a family by themselves, and for the present, until our knowledge of them is fuller, I define it by this character. The definitions of the families will then be as follows :

I. Ankle-joint plane transversely, or nearly so.

True molars above and below, tubercular ; last superior not transverse.... *Arctocyonidæ*.

Superior true molars, tubercular ; last superior premolar sectorial ; first inferior molar "tubercular sectorial"... ....*Miacidæ*.

Superior last molar transverse ; inferior molars tubercular-sectorial or with reduced anterior cusp ; no preglenoid crest................*Leptictidæ*.

Last superior molar trenchant, transverse ; first superior true molar sectorial ; inferior true molars tubercular-sectorial ; a preglenoid crest... *Oxyænidæ*.

* Proceedings Amer. Philos. Society, p. 76.

Last superior molar longitudinal ; inferior true molars without developed sectorial blade.................................... *Amblyctonidæ.*

II. Ankle-joint tongued and grooved, or trochlear.

Molar teeth in both jaws consisting of conic tubercles and heels ; none sectorial ; a preglenoid crest.......................... *Mesonychidæ.*

I now give the characters of the genera. All these are derived from examination of typical specimens. The opportunity of doing this I owe to the kindness of Messrs. Leidy, Gervais, Gaudry, Filhol, and Lemoine.

ARCTOCYONIDÆ.

Premolars, $\frac{4}{4}$; the first inferior one-rooted ; the last inferior well developed ; *Arctocyon* Blv.

Premolars below, 4, the first two-rooted, the last true molar much reduced ; (fide Lemoine)................................ *Hyodectes* Cope.

Premolars below, 3, first two-rooted ; true molars normal................ *Heteroborus* Cope.

MIACIDÆ.

Inferior tubercular molars two, premolars four............... *Miacis* Cope.

Inferior tubercular molars one, premolars four.......... *Didymictis* Cope.

LEPTICTIDÆ.

I. Superior molars sub-equilateral, without cutting heel posteriorly.

a. Fourth inferior true molar like the true molars, with three anterior cusps.

β. Third superior premolar with internal cusp ; anterior cusp of inferior molars small, median.

Third premolar with one external and one internal cusps. *Mesodectes* Cope.

Third premolar with two external and one internal cusps.... *Ictops* Leidy.

ββ. Third superior premolar without internal cusps ; anterior cusps of inferior molars present.

Cusps of superior molars marginal ; two superior incisors ; *Leptictis* Leidy.

Cusps of superior molars median in position ; anterior cusp of inferior molars well developed.......................... *Peratherium* Aym.

βββ. Anterior cusps of inferior molars wanting.

Fourth inferior premolar like true molars................ *Diacodon* Cope.

aa. Fourth inferior premolar different from true molars in a simpler constitution.

Last inferior molar tubercular ; cusps of other true molars well developed; three inferior premolars............................ *Lipodectes* Cope.

Inferior true molars alike, with anterior inner cusps little developed ; three premolars (?)................................. *Triisodon* Cope.

Inferior true molars alike, with cusps well developed ; four premolars.... *Deltatherium* Cope.

II. One or more superior molars, with the external heel produced into a blade.

a. Molars 4—3 ; three last inferior tubercular sectorial.

Premolars robust, conic.............................*Quercitherium* Filh.

Premolars compressed ; the fourth superior with a conic cusp and heel externally....................................*Stypolophus* Cope.

Premolars compressed ; fourth superior with a simple blade externally... *Proviverra* Rütim.

OXYÆNIDÆ.

I. Inferior molars without internal tubercles.

Molars, $\frac{4}{3}$ $\frac{3}{3}$; three sectorials in the lower jaw..............*Pterodon* Blv.

II. Inferior molars with internal cusps.

a. Posterior heel of one or more superior molars elongate and trenchant.

Last inferior molar truly sectorial, without internal tubercle ; second, tubercular-sectorial...............................*Protopsalis* Cope.

Molars, $\frac{4}{4}$ $\frac{2}{2}$; two last inferior molars tubercular-sectorial... *Oxyæna* Cope.

AMBLYCTONIDÆ.

Fourth inferior premolar with a broad heel supporting tubercles ; an anterior and no internal tubercles..................*Amblyctonus* Cope.

Inferior molars with tubercular heel, an anterior and an internal tubercle. *Periptychus* Cope.

Dental formula below, 3, 1, 3, 3. Fourth inferior premolar with a cutting edge on the heel ; both internal and anterior tubercles............... *Palæonyctis* Blv.

MESONYCHIDÆ.

a. Inferior molars seven ;

Cones of inferior and superior molars simple.....................*Mesonyx.*

Cones of last two inferior molars with lateral cusps..............*Dissacus.*

aa. Inferior molars ? six.

Internal lobes of penultimate superior molar v-shaped.....*Sarcothraustes.*

aa. Inferior molars five.

Inferior molars with strong anterior lobe.....................*Patriofelis.**

MIACIS CANAVUS Cope.

Bulletin U. S. Geol. Survey, Terrs., 1881, p. 189. One mandible.

MIACIS BREVIROSTRIS Cope, loc. cit. p. 190.

Parts of four mandibles.

DIDYMICTIS DAWKINSIANUS Cope, l. c., p. 191.

Six mandibular rami more or less complete.

Individuals of the genus *Didymictis* are abundant in the Wasatch beds

* Of uncertain reference to this family.

of the Big-Horn, and a good many of them do not coincide well in characters with the species already described. I define them as follows, premising that with other parts of the skeleton some changes may be found to be necessary. The large *D. altidens* was not obtained by Mr. Wortman in the Big-Horn country.

I. Inferior tubercular molar oval in outline, with a heel.

Length true molars .010 ; last three premolars .0135 ; last molar narrow. . *D. dawkinsianus.*

Length true molars .016—.018 ; last three premolars .028—.030 ; last molar narrow.................................*D. leptomylus.*

Length true molars .019—.020 ; last three premolars .036 ; last molar elongate...*D. protenus.*

Length true molars .025 ; last three premolars .035 ; last molar short..... *D. altidens.*

II. Inferior tubercular molar short, subquadrate in outline.

Length true molars .011 ; depth of ramus at sectorial .010............... *D. massetericus.*

Length true molars .018 ; depth of ramus at sectorial .017....*D. curtidens.*

DIDYMICTIS LEPTOMYLUS Cope.

American Naturalist, 1880, p. 908.

The specimens which I refer at present to this species belong to two varieties, which may perhaps be specifically distinct ; but this cannot be demonstrated at present. They differ in dimensions only. Thus the true molars of the type, which comes from the Big-Horn beds, measure M. .016 in length. Five specimens from the Big-Horn basin agree in having this dimension .018. The entire inferior molar series is only a little shorter than that of the smaller variety of the *D. protenus* from New Mexico (See my report to Capt. Wheeler, plate XXXIX).

DIDYMICTUS PROTENUS Cope.

Jaws more or less complete, of six individuals, are referable to this species. They agree closely in measurements and belong to the larger variety of the species figured on plate XXXIX of the report to Capt. Wheeler.

DIDYMICTIS MASSETERICUS, sp. nov.

This species is intermediate in size between the *D. leptomylus* and the *D. dawkinsianus*, and is characterized by the peculiar form of its tubercular molar, and the deeply excavated masseteric fossa. It appears to have been a rare species, as only one mandibular ramus was found by Mr. Wortman. This is broken off in front of the fourth premolar, and supports the last true molar teeth.

The tubercular molar is subquadrate in form, and consists of three low tubercles in front, and a wide heel behind, which has an elevated posterior border. The tubercular-sectorial has a short and narrow heel. Its anterior cusps are not very acute, and the two internal are equal, and a good deal shorter than the external. The fourth premolar is relatively shorter than in any other species of the genus, and the posterior marginal lobe is a mere thickening of the edge of the heel. There is a low anterior basal tubercle. The enamel is smooth.

The ramus is compressed and not deep. The angle is prominent, and is not inflected ; it does not extend so far posteriorly as the posterior border of the condyle. The inferior border of the masseteric fossa is an angular line, without abrupt excavation, but the face of the fossa descends rapidly. The anterior border of the fossa is abrupt and is formed by the usual sub-vertical ridge.

Measurements.	M.
Length between P-m. IV, and condyle inclusive	.0520
" of posterior three molars	.0170
" of tubercular-sectorial	.0070
Elevation of " "	.0070
Depth of ramus at sectorial	.0100

DIDYMICTIS CURTIDENS, sp. nov.

As in the case of the *D. massetericus* the present species is represented by a single fragmentary mandibular ramus. This supports a sectorial tooth of the size and form of that of the *D. protenus*, and is thus much larger than that of the species just named. This tooth is placed nearer to the base of the coronoid process than is seen in any other species, and only leaves space for a short tubercular tooth. This is lost from the specimen, but the alveolus shows pretty clearly its dimensions. The base of the fourth premolar remains, and it is evident that this tooth was like that of *D. protenus* in form and proportions. The base of the posterior marginal lobe is present. The ramus is deeper and larger than in the *D. massetericus*.

Measurements.	M.
Length of bases of last three molars	.0285
" " fourth premolar	.0120
" " sectorial on base	.012
Width " in front	.008
Depth of ramus at sectorial	.017

ICTOPS BICUSPIS Cope. Bull. U. S. Geolog. Surv., Terrs. 1881, p. 192.

This mammal was founded on a skull from the Wind River region. It is now represented by a mandibular ramus. The form of the fourth premolar being unknown, its reference to this species is provisional only. It may be remotely allied to *Stypolophus*, but the anterior inner cusp of the molars is small and does not reach the inner side of the crown, and the anterior external cusp is but little larger than the second anterior inner. The two cusps last named stand opposite to each other, and their apices are only separated from each other by an open notch. They, with the first anterior inner (here median), form a transverse narrow triangle. The posterior part of the crown is rather large and, though lower than the anterior part, is absolutely quite elevated above the alveolar border. Its summit presents a V externally, and there is a small posterior median angle. In the last true molar this angle is a little more prominent than in the others, and rises into a cusp. The external bases of the crowns are protuberant, but there are no cingula. Enamel smooth.

The ramus is rather compressed, and the masseteric fossa is well marked, and is bounded anteriorly by a prominent rib.

Measurements.		M.
Length of true molars		.0100
Diameters M. III	anteroposterior	.0035
	vertical	.0035
	transverse	.0030
Diameters M. I	anteroposterior	.0035
	transverse	.0028
Depth of ramus at M. II		.0070

This species is smaller in all dimensions than *I. didelphoides*, and the crowns of the molar teeth are shorter and more elevated than in that species.

Deltatherium absarokæ Cope. American Naturalist, 1881, p. 669.

A small species, represented by an imperfect cranium and lower jaw with nearly complete dentition.

Stypolophus aculeatus Cope.

Several fragmentary mandibles nearly coincide in measurements with this species. The molars are .0240 in length, and the ramus is .0140 in depth. The only difference in the measurements is that the true molars measure .0250 in *S. aculeatus*. The latter is, however, a species of the Bridger epoch, so that further comparison will be necessary before identification is made.

Stypolophus whitiæ, sp. nov.

Stypolophus strenuus Cope. Bulletin U. S. Geol. Survey, vi, 192; not of Report Capt. Wheeler, vol. iv, pt. ii.

The greater part of the skeleton, with skull and dentition of this species, were brought from the Big-Horn by Mr. Wortman. A part of a mandible of a second individual was also found. The species is, however, primarily based on a specimen from the Wind river. This is represented by a right mandibular ramus which supports all the molar teeth, and displays the alveolus of the canine, and lacks all posterior to the coronoid process; also by a portion of the frontal bone, two vertebræ, fragments of scapula, humerus, ulna, radius, ilium, and tibia, and the greater part of both tarsi. They represent a species larger than the Virginian opossum, and intermediate between the *S. brevicalcaratus* and *S. strenuus* in proportions. It has not the rudimental heels of the molars of the former species, nor the robustness of the latter.

The inferior outline of the mandible is gently curved from the canine to below the last molar. The anterior border of the masseteric fossa is well marked, but not the inferior border. The ramus is compressed and deep. The canines have stout roots and narrow curved crowns. The first premolar is separated by a short space from the canine and by a longer one from the second premolar. It has either a single compressed root or two roots confluent within the alveolus. The crown is truncated obliquely behind. The second premolar is two-rooted and the crown is elevated anteriorly and depressed posteriorly. The third premolar is more symmetrical, but the heel is produced. It is narrow and keeled medially. The fourth premolar is abruptly larger than the third. Its crown is simple, except a low tubercle at the anterior base and a short trenchant heel at the posterior base. Of the three tubercular-sectorials the first is the smaller. The heels of all three are rather narrowed and elongate. Their margin is raised all round, inclosing a basin ; a notch in the external margin cuts its anterior part into a tubercle. The two internal tubercles are rather obtuse, and are considerably shorter than the external cusp.

Measurements.	M.
Length from canine to end of last molar	.060
" " " first true molar	.037
" " " second premolar	.015
" of base of fourth premolar	.009
Elevation of fourth premolar	.007
Length of base of second true molar	.007
" heel " " "	.006
Elevation of second true molar	.009
Depth of ramus at third premolar	.015
Length of superior canine	.028
" crown of superior canine with enamel	.012

A portion of the frontal bone shows weak anterior temporal ridges uniting early into a sagittal crest, which is low as far as preserved. The parietal bones overlap the frontal as far forwards as the temporal ridges. Anterior to the latter the front is concave in transverse section. Viewed from below, the spaces for the olfactory lobes are large and entirely anterior to those which received the anterior lobes of the hemispheres ; each one is about as wide as long. In the small part of the cerebral chamber wall left, there is no indication of convolutions, which would be visible in a gyrencephalous brain ; two air-chambers in front of each olfactory lobe.

The base of the transverse process of the atlas is perforated from behind to the middle of its inferior side ; from the latter opening a foramen penetrates directly into the neural canal. A posterior dorsal vertebra has the centrum longer than wide and much depressed. Its inferior face is regularly convex in section. The proximal end of the scapula shows that its inner border is much thickened, and that the spine arises abruptly and near to the glenoid cavity. There appears to have been scarcely any coracoid ; the surface adjoining it is, however, injured. The humerus lacks the proximal portion and the inner half of the condyles with the epicondyles. The deltoid crest is not very prominent, so that the shaft is rather slender. The external distal marginal crest is thin, and is continued well up on the shaft. The external part of the condyle displays no intertrochlear ridge. Olecranar and coronoid fossæ well marked. The olecranon is robust and deep, and is truncate posteriorly and below. The head of the radius is a regular transverse stout oval.

A fragment of the ilium from near the acetabulum displays a prominent "anterior inferior spine." The best preserved tarsus includes calcaneum, astragalus, cuboid, and navicular bones. The tibial face of the astragalus is strongly convex antero-posteriorly and slightly concave transversely. The head is prolonged some distance beyond the distal extremity of the calcaneum, and presents a convex internal border and a concave external one. Its long axis is parallel to that of the tibial portion, but is not in the same axis, owing to its lateral position. The external face of the trochlear portion is vertical, and is interrupted by a deep fossa behind. The internal face is very oblique, and becomes the superior face of the head. The posterior face of the trochlea is grooved with a wide and shallow groove, which just reaches the superior face, terminating on the external side. The superior face is not grooved, but is shallowly concave in transverse section. The head is a transverse oval, and is convex ; it has a small facet for the cuboid on the outer side.

The heel of the calcaneum is large and expands distally, so as to be as wide as deep. The convex astragalar facet is very oblique to the long axis of the calcaneum ; the sustentaculum is rather small. Below the latter is a narrow tuberosity looking downwards and forwards. On the external side, close to the cuboid facet, is a depressed crest. The cuboid facet is as deep as wide. The cuboid bone is a little longer than wide proximally, and narrows distally. It has a narrow astragaline facet and a deep fossa below proximally. The hook inclosing the groove for the tendon of the flexor muscle is prominent. The navicular is rather small, and has three inferior facets, which diminish in size outwards. It has a strong posterior knob-like process, with a narrow neck.

When the tarsal bones are in position, and the tibia stands vertically on the astralagus, the cuboid bone is turned inferiorly. This indicates that this species walked on the outer edge of the hinder foot.

Broken metapodial bones are slender and straight. The proximal end of a metacarpal does not display the interlocking lateral articulation seen in *Protopsalis*. Two phalanges are depressed in form.

Measurements.		M.
Diameters of a dorsal centrum	anteroposterior	.0145
	vertical	.0075
	transverse	.0115
Diameters of glenoid cavity scapula	anteroposterior	.0145
	transverse	.0090

Measurements.			M.
Depth of olecranon			.0110
Width of head of radius			.0110
" neck of ilium anteroposteriorly			.0120
Diameter of shaft of tibia at middle			.0085
Diameters of astragalus	anteroposterior		.0180
	greatest		
	transverse.	of trochlea	.0140
		of head	.0100
Length of head			.0070
" calcaneum			.0300
Width of calcaneum at sustentaculum			.0140
" cuboid facet			.0066
Length of cuboid			.0120
Diameters	anteroposterior	distal	.0070
		proximal	.0075
	transverse proximal		.0098
Diameters of navicular	vertical		
	transverse	with tuberosity	.0100
		without tuberosity	0070
	anteroposterior		

As already remarked, it is probable that the semigrooved trochlea of the astragalus of this species is an indication that the genus *Prototomus* must be retained as distinct from *Stypolophus*, to which the present species probably truly belongs.

The specimen described, together with the mandibular ramus of another supporting the last two molar teeth, were found in the bad lands of Wind river, Wyoming, by J. L. Wortman. Dedicated to Frances Emily White M. D., of Philadelphia.

OXYÆNA FORCIPATA Cope.

Report Vert. Foss., New Mexico, 1874, p. 12. Report Capt. G. M. Wheeler, U. S. G. G., Expl. Surv. W. of 100th Mer. IV, ii, p. 105, 1877.

This formidable animal was abundant in Northern Wyoming, during the Wasatch epoch. At least ten individuals are represented in the collection. The following are the dimensions of the mandibles of the five best preserved.

	1	2	3	4	5
Length of dental series	.103	?	100	.100	.107
" premolar "	.042	.045	.044	.051	.054
Depth of ramus at M. III	.042	.039	.037	.042	.047

The measurement .035 for the length of the premolars given in my report to Capt. Wheeler, loc. cit., refers to the anterior three teeth, which were originally supposed to be the only premolars.

The claws of this species are moderately compressed, and they terminate abruptly and obtusely. The extremity is deeply fissured, and each of the two apices is rugose.

Mesonyx ossifragus Cope, American Naturalist, 1881, p. 1018.

Pachyæna ossifraga Cope. Report Capt. Wheeler, U. S. G. G. Surv. W. of 100th Mer. IV, ii, p. 94, 1877.

A series of specimens of this species demonstrates the following points : (1) *Pachyæna* was founded on a superior molar of *Mesonyx*, and must be suppressed. (2) *Mesonyx navajovius* Cope must be separated as a distinct genus, since the apices of the crowns of the last two molars have two cusps. I have called this genus *Dissacus* (American Naturalist, Dec., 1881). (4) It results that there are three species of *Mesonyx*: *M. ossifragus* Cope, *M. lanius* Cope, and *M. obtusidens* Cope.

M. ossifragus was the largest Creodont of the Eocene, equaling the largest grizzly bear in the size of its skull. In a cranium with lower jaw and almost complete dentition, the length to the premaxillary border from the postglenoid crest is M. .365 ; the largest *Ursus horribilis* in my collection gives .270 for the same length. This specimen has the dental formula I. $\frac{3}{2}$; C. $\frac{1}{1}$; P-m. $\frac{4}{4}$; M. $\frac{3}{3}$. The claws have the flattened form which I discovered in *M. lanius*, and the proximal phalanges have much the shape of those of a Perissodactyle. The astraglus has much the character of the animals of that order, and has the distal facets as I originally detected them in the *M. obtusidens*. The form of this bone is rather shorter and wider than in the latter species.

The inferior canine tooth of a large specimen has the following diameters at the base of the crown : anteroposterior .039 ; transverse .024.

AMBLYPODA.

Pantodonta.

The explorations in the bad lands of the Big-Horn river yielded several species of this sub-order, all which I refer at present to the *Coryphodontidæ*. They, however, represent several genera, two of which have not been previously known. I have distinguished these (American Naturalist, Jan., 1882), in the characters of the superior molar teeth as follows :

I. Last superior molar with two interior cusps.

All the superior molars with a well marked external posterior V......... *Manteodon.*

II. Last superior molar with but one inner cusp or angle.

a. Last superior molar with posterior external cusp.

Anterior two molars with posterior external V.................*Ectacodon.*

aa. Last superior molar without external posterior cusp.

† Anterior two molars with posterior external V.

Astralagus transverse, with internal hook.................... *Coryphodon.*

Astragalus subquadrate, without internal hook...............*Bathmodon.*

††First superior molar only with posterior external V.......*Metalophodon.*

The type of *Manteodon* is the *M. subquadratus*, which was about the size of an ox. The characters of its superior molars are more like those of Perissodactyles than are those of the other *Coryphodontidæ*. The type of *Ectacodon* is the *E. cinctus*, a species of about the dimensions of the last named. Its last superior molar is parallelogrammic, and has a cingulum all around it except on the external side.

MANTEODON SUBQUADRATUS, gen. et sp. nov.

Char. gen. These have been already pointed out in the key above given. They are a little more like those of the superior molar teeth of such *Perissodactyla* as *Limnohyus* and near allies, than those seen in the typical *Coryphodon*. The posterior transverse crest of that genus is here represented by a complete V, but the anterior lobe of that crest which represents the anterior V of the Perissodactyle, is only a lobe, as in *Coryphodon* The tooth in fact is much like the penultimate molar of the latter genus. The two internal cusps are unique in the family. The additional one is a growth of the inner extremity of the posterior cingulum, and is separated from the anterior inner cusp by a deep and wide notch. It is opposite to the posterior V, as the anterior inner cusp is opposite the anterior rudimental V. The premolar and incisor teeth are similar to those of *Coryphodon*. The skeleton is unknown.

Char. specif. These are learned from a series of teeth which were found together by Mr. Wortman free from admixture of others. They are not worn, excepting by moderate use of the animal when living.

The last superior molar is not of the oval form belonging to the species of *Coryphodon*, but is quadrate, with the internal side shorter and with rounded lateral angles. The first anterior cingulum, which represents the anterior basal cingulum of the *Lophiodontidæ*, is as elevated as in the species of *Coryphodon*. Externally it rises in a protuberance with sharp edge, which curves posteriorly and disappears on the external side of the crown. The inner extremity terminates abruptly, forming the anterior interior tubercle. The anterior external lobe is rather flat, and is not conical nor elevated above the anterior cingular lobe. It is not deeply separated from the latter, nor from the posterior V ; its edge is rough. The posterior V projects well inwards, and is rather narrow. Its posterior border extends as far outwards as the point of junction of its anterior border with the anterior external lobe, and terminates in a slight elevation of its border. The base of the crown extends external to the base of the V, and forms a strong posterior external protuberance. This causes the outline of the external base to be concave. This side of the crown has several small protuberances and rugosities. The posterior basal cingulum extends as far externally as the posterior V, and terminates internally in the posterior internal cusp. The second or basal anterior cingulum is well developed. There are no external nor internal cingula. The surface of the enamel is strongly and closely rugose where not worn.

The posterior inferior molar exhibits a transverse posterior crest, without any tubercle or ridge in the mouth of the posterior V-shaped valley. There is a strong posterior cingulum, amounting to a narrow heel. As in the case of the superior molar, the enamel where not worn is closely and strongly wrinkled. The first superior premolar is characterized by the very small development of its internal lobe, which is only a strong basal cingulum. The crown proper has a sub-triangular outline, and the external face is flat and not concave. No external cingulum; enamel wrinkled. An external incisor has a large transversely extended crown, without cingula. A low rib on the median line of the inner side. Enamel wrinkled. In this and in another incisor, the base of the crown is considerably expanded laterally.

Measurements.

		M.
Diameters of crown M. III, sup.	anteroposterior	.035
	transverse	.041
	vertical	.020
Width of M. III inferior, posteriorly		.022
Diameters P-m. I sup.	anteroposterior	.018
	transverse	.014
Diameter base crown I, II		.024
Length crown I, II		.019
Width base crown I, III		.026

ECTACODON CINCTUS, gen. et sp. nov.

Char. gen. In *Ectacodon* the last superior molar has more of the elements of a posterior external V than in *Coryphodon*, but not so much as in *Manteodon*. The posterior transverse crest, it is true, has no oblique posterior ridge joining it, to form with it more or less of a V. But the external posterior angle of the crown supports a cusp, homologous with the vertical rib found at the basal or external angles of the Vs in *Palæosyops* and allied genera, and indicating the outlines of a V which lacks its posterior side, in a manner not seen in *Coryphodon*. The penultimate and ante-penultimate superior molars are like those of the latter genus. Skeleton unknown. I have a single species of this genus.

Char. specif. Six superior molars of one skull represent this species. They belong to a large animal, one about the size of the *Manteodon subquadratus*. The last superior molar has a characteristic outline. It is not oval as in the species of *Coryphodon*, nor quadrate as in *Manteodon* sp., but sub-parallelogrammic. The transverse diameter exceeds the anteroposterior, and the anterior and posterior sides are parallel. The external outline is slightly oblique and slightly notched in the middle. The internal border is regularly rounded. The basal or second cingulum extends entirely round the tooth from the posterior external cusp, round the inner base to the anterior external base of the crown; being absent only from the external base. The first cingula both anterior and posterior are well developed as in the species of *Coryphodon*, and unite in the prominent internal angle. The posterior first cingulum joins the posterior basal cingulum at the middle of its length. The anterior first cingulum extends to the anterior external part of the crown, and then turns downwards and posteriorly and terminates at the middle of the external base. The posterior crest is not transverse, but quite oblique, sloping at an angle of 45° with the axis of the jaw. The part of the crest which represents the posterior V is a good deal larger than the part representing the anterior V, and is closely joined with it. The latter is well separated from the anterior first cingular ridge and its anterior exterior elevated portion. The enamel of this tooth is finely wrinkled, and is more readily worn smooth than in the *Manteodon subquadratus*.

The penultimate superior molar has the posterior V well developed, and its posterior basal or external angle is marked by a tubercle homologous with that which is so prominent on the last molar. The anterior V is a conic tubercle closely joined with the posterior V, and well separated from the anterior first cingular lobe. The basal cingula are well developed, but do not meet on the inner base of the crown. The first or superior cingula meet as usual in an interior angle, but there is a contraction of the anterior crest just before reaching this angle. The first true molar is smaller than the second and has the same general structure. Here, however, the anterior first cingulum is more prominent near the internal angle than the posterior. The characters of the premolars do not differ from the corresponding ones of species of *Coryphodon*. The enamel is delicately wrinkled. The first superior premolar is not preserved.

Measurements.

		M.
Diameters of crown of M. III	anteroposterior	.034
	transverse	.043
	vertical	.015
Diameters M. I	anteroposterior	.028
	transverse	.033
	vertical	.012
Diameters P-m. III	anteroposterior	.023
	transverse	.030

It is probable that this species was about the size of an ox.

Coryphodon anax, sp. nov.

Mr. Wortman sends me a number of teeth of probably two individuals, which exceed in size those of any species of *Coryphodon* yet known, and differ in certain details of form from all of them. The specimens consist of incisors, premolars and molars of both jaws of one animal, and an inferior canine, which from its separate wrapping, I suppose to have been derived from a different locality.

The incisors and premolars have the form usual in species of the genus, differing only in their large size. The same may be said of the premolars. A well preserved superior true molar is probably the third. It has the form usual in the genus, but exhibits two peculiarities. The posterior transverse crest is divided more deeply than usual by a deep notch which enters it from the transverse valley. The external portion is the shorter, and exhibits the peculiarity of being connected with external part of the anterior transverse crest. It is as closely connected with this crest, as it is with the internal portion of the posterior crest. The external connection does not exist in the other species of the genus, where the two crests are separated at their outer extremities by a deep valley. The posterior basal cingulum is obsolete, while the anterior is well developed. The enamel of this tooth where not worn, is wrinkled.

The posterior part of the last inferior molar is characteristic. The posterior transverse crest is short and very oblique, its inner extremity striking the posterior margin near the middle. Here it is elevated into a cusp, which rises above the surrounding parts in a characteristic manner. There is no ledge round its posterior base, but the border expands outwards at the base of the true crest. The additional inner marginal tubercle is low and compressed as in *C. lobatus*. A second inferior true molar is normal, with well developed anterior marginal ridge. The inferior canine mentioned is of large proportions, exceeding by one-half the dimensions of the inferior canine of *C. lobatus*. Its crown is curved outwards, and has a basal alate expansion of its internal ridge.

Measurements.		M.
Diameters of last superior molar	anteroposterior	.039
	transverse	.051
Diameters of second inferior true molar	anteroposterior	.039
	transverse	.028
Length of inferior canine		.160
" crown of "		.090
Diameters of base of crown of canine	vertical	.037
	transverse	.036

This species is nearest the *C. lobatus* in some respects. The short posterior crest of the last inferior molar with its cusp-like extremity, and the absence of posterior ledge on this tooth will readily distinguish it.

Bad lands of the Big-Horn river, Wyoming.

There are six individuals of this species in the collection which are mostly represented by fine specimens, which represent the entire dentition.

Eight other species of *Coryphodon* were obtained by the Big-Horn Expedition, and the material enables me to distinguish them better than heretofore. I present the following differential synopsis of their characters :

I. The last inferior molar with three posterior cusps, the internal sometimes represented by a ridge ; or the posterior inferior molars with an accessory cusp or tubercle on the inner side between the crests (*Coryphodon*, Owen) :

An internal tubercle ; last upper molar with the anterior cross crest and anterior external crest closely connected ; size largest.......... *C. anax.*

An internal conic cusp ; posterior crest oblique ; heel very small ; size medium.. *C. cuspidatus.*

An internal crest ; posterior crest oblique ; heel small ; size medium..... *C. obliquus.*

An internal tubercle ; posterior crest little oblique ; heel large ; size large. *C. lobatus.*

II. Posterior inferior molars with two posterior cusps ; without internal accessory tubercle :

a. Posterior inferior molars with small or no heel :

Large ; posterior superior molar oval, with distinct straight posterior crest ; inferior molars elongate ; symphysis mandibuli produced and narrowed ; premaxillary elongate........................ *C. latipes.*

Medium ; inferior molars nearly as wide as long ; premaxillary short..... *C. latidens.*

aa. Posterior inferior molars with prominent or wide heel :

Medium ; posterior superior molar with posterior angle, and angulate posterior crest ; inferior molars elongate ; symphysis mandibuli broad and short ; premaxillary elongate ; tusk trihedral.... *C. elephantopus.*

Smaller ; premaxillary bone short ; tusk trihedral................ *C. simus.*

Medium ; premaxillary elongate ; tusk compressed and grooved......... *C. molestus.*

Large ; last superior molar oval, with angulate posterior crest ; its anterior lobe connected with anterior cingular crest.............. *C. repandus.*

III. Last inferior molar with but one posterior cusp from which a curved crest extends round the posterior border of the crown.

Superior true molars narrow ; external incisors sharply angulate on external face.. *C. curvicristis.*

IV. Posterior inferior molar unknown.

Posterior superior molar oval ; posterior crest straight ; internal crest fissured (? normally) ; a complete internal cingulum... *C. marginatus.*

CORYPHODON CUSPIDATUS Cope.

This species was found in a single individual obtained in New Mexico ; a second one was discovered by Mr. Wortman in the Wind River basin, and a third has now been brought from the Big-Horn.

CORYPHODON LATIPES Cope.

I refer seven individuals provisionally to this species. Three of these are represented only by superior teeth, etc., and in four the last inferior molar is preserved. Of the latter, three have an angle, sometimes almost a crest, descending from the posterior inner tubercle, as in *C. obliquus,* but the specimens are all of superior size to that species, some of them very much exceeding it. It is also possible that this ridge is not a constant character. This species has the dentition which I have referred to the *Bathmodon radians,* but no astragalus of the species occurs in the collection. It may be the *C. latipes,* of which the teeth have not yet been identified. I hope soon to be able to decide this question.

CORYPHODON SIMUS Cope.

A broken mandible and maxillary bone, with several teeth represent this small species in the Big-Horn collection.

CORYPHODON ELEPHANTOPUS Cope.

Portions of the dentition of both jaws, including the last molar teeth of two individuals, prove that this species inhabited Wyoming in the early Eocene period. One of the individuals, represented only by the last molars of both jaws, is a little smaller than the typical specimen of which an entire cranium is figured in Capt. Wheeler's report (4to, 1877, Pl. LI–III), while a second specimen, which includes the entire superior molar series, is a little larger than the same.

This species is characterized by the obliquity of the edge of the posterior crest of the posterior superior molar backwards away from a transverse line ; and by the slope of the external side of this crest. In other words the inner half of the posterior crest nearly forms a V, like that of the penultimate molar. The posterior edge of the V is present, running outwards from the inner end of the posterior crest, which thus becomes the apex of the V. The *C. elephantopus* thus most nearly approaches the genus *Manteodon,* of all the species. To accommodate the obliquity of the crest the posterior outline of the last upper molar is strongly angulate, giving a sub-triangular outline. The heel of the last inferior molar is insignificant.

CORYPHODON REPANDUS, sp. nov.

This large species is known from the posterior portions of the dentition of both jaws, with an entire symphysis.

The last superior molars are intermediate in outline between the regular oval of the *C. radians,* and the sub-triangular form of the *C. elephantopus.* The peculiarities of the species are seen in the posterior crest. The two lobes of which this is composed, do not form a continuous line as in *C. latipes* and *C. simus,* but form an angle with each other as in *C. anax.* The anterior lobe is compressed, and its long axis is nearly that of the jaw ; the second lobe leaves it at a right-angle, but curves backwards as it extends inwards, giving a concave exteroposterior border. There is no ridge descending outwards from the inner extremity of the crest, to form a V, as in *C. elephantopus.* But the posterior basal cingulum extends to the external side of the tooth, which is not the case in any other species known to me excepting the *C. marginatus.* The anterior cusp is closely joined to the external elevation of the anterior first cingulum as in *C. anax ;* a character which separates it from all other species. A strong trace of a cingulum passes round the inner base of the crown. No external cingulum. The first true molar does not differ materially from that of other species. It is considerably smaller than the last. The apex of the premaxillary bone with the second incisor and alveolus of the first, is preserved. The bone is rather short. The crown of the incisor is regularly convex externally, and is not expanded at the base. There is a strong internal cingulum.

A fragment of the lower jaw supports the last two molars. The internal angle of the last one, is unfortunately broken. The posterior crest is, however, perfectly transverse, which is not the case with the species with three posterior tubercles. The preserved part of the posterior border shows a distinct, rather narrow heel. The anterior Vs are well developed and there are no lateral cingula. The symphysis is flattened out by pressure. The inferior canine is large. It is sub-triangular at base and has an anterior basal angular projection.

Measurements.

		M.
Diameters of superior M. III	transverse	.046
	longitudinal	.037
Diameters of superior M. I	transverse	.036
	longitudinal	.032
Diameters crown I. 2	vertical	.018
	transverse	.018
Diameters inferior M. III	transverse	.028
	anteroposterior	.040
	vertical in front (restored)	.024
Length of symphysis		.107
Depth of ramus at M. III		.056

The superior molars of this species might readily be taken for an under-sized individual of *C. anax*, but the last inferior molar is of a different type, and refers the species to a different section of the genus.

CORYPHODON CURVICRISTIS, sp. nov.

The fragments which represent this species belong to one individual. They include a considerable part of both mandibular rami with numerous molar teeth, and most of the inferior incisors loose. Also the second superior molar, some superior premolars, the canine, and three or four incisors, two of them in place in an incomplete premaxillary bone. None of the bones of the skeleton were obtained, so far as known.

The ramus of the mandible is both robust and deep. Its inferior border does not rise posteriorly so much as in some species, as *e. g.*, *C. latidens*, and the angle is well below the horizontal line of the dental alveoli. The dental foramen is just about in this line. The inferior premolars and molars do not differ from those of several other species, but the last molar has several peculiarities. The external cusp is the only one of the posterior pair which is present. It gives origin to two crests, both of them curved. The posterior represents the usual posterior transverse crest, but is gently convex backwards, and turns forwards on the inner side of the crown, only terminating at the external base of the anterior cross crest. The other curved crest is low, although higher than in most species, and extends to the middle of the base of the anterior cross crest. There is a distinct heel which is elevated at the middle and disappears gradually at each end, not being abruptly incurved as in *C. anax*. The anterior part of this tooth is as peculiar as the posterior. The external cusp gives origin to three crests, two of them the usual limbs of the anterior V ; while a third descends to the anterior border a little exterior to its middle. It encloses a deep groove with the anterior ridge of the anterior V. This arrangement is not seen in any other species.

The inferior canine is robust, and has its anterior angle prominent, but not alate. The crowns of the inferior incisors are regularly convex exteriorly, and have no cingula. They are regularly graded in dimensions.

The superior molar preserved is probably the penultimate. Its anterior portion is broken. The posterior external V is narrower than usual for a second molar, and resembles somewhat that of the last superior molar of the *Manteodon subquadratus*. A slight contact face on the posterior cingulum shows that this tooth is not the last molar. The said cingulum extends to the external base of the V; in rising to the internal cusp it forms a sigmoid curve. The cingulum below this, on the inner base of the crown, is rudimental. The superior canine has a long and robust crown, with a triangular section to the apex. The posterior face is a little wider than the other two, which are equal. The anterior is slightly concave in cross-section, and the posterior slightly convex transversely, although concave longitudinally. There is a weak ridge nearly parallel to and near the postero-external angle, and traces of others on the postero-external face of the crown in front of this one. The antero-internal angle is swollen at the base.

The superior incisors present characteristic features. The ridge of the external face, which is weakly developed in some of the species, and is wanting in others, is here represented by a strong longitudinal angle, which extends from the base of the crown to its apex, dividing the external face into two distinct planes. This character is most marked on the external incisor, where the planes are sub-equal, and concave. On the second the anterior plane is smaller, and on the first it is a good deal smaller. These incisors have a weak internal cingulum, but no external one.

Measurements.		M.
Length of ramus from P-M. IV inclusive		.257
" inferior true molars		.098
Diameters of M. I infer.	anteroposterior	.0275
	transverse	.020
Diameters of M. III infer.	anteroposterior	.036
	transverse	.029
Depth of ramus at M. III		.075
Diameters of M. II super.	anteroposterior	.0315
	transverse	.039
Diameters of crown of superior canine	longitudinal	.094
	anteroposterior	.022
	transverse	.034
Diameters of crown of I. iii	vertical	.022
	transverse	.024

The numerous characteristic marks, show that this species is one of the most distinct of the genus. It is also one of the largest, being second only to the *C. anax.*

CORYPHODON MARGINATUS, sp. nov.

This is one of the smaller species, having nearly the dimensions of the *C. molestus.* It is only represented by the superior canine, first inferior premolar, and last superior molar of one individual found together by Mr. Wortman. Their size, mineral condition and degree of wear, render it probable that all belong to one individual.

The superior molar is of the oval type, without posterior shoulder. The posterior crest is therefore straight, and parallel with the anterior crest. Its inner extremity does not display the least tendency to form a V, as is seen in *C. elephantopus.* Its exterior extremity is widely separated from the external prominence of the anterior crest (cingulum). The latter displays, at its inner extremity, the peculiarity of a deep fissure of the anterior side, which nearly divides the crest, and partially isolates the internal tubercle. Adjacent to the fissure its crest is tuberculate. The posterior upper cingulum descends from the inner cusp to the basal cingulum. The basal cingulum is well developed on the anterior and interior sides of the crown, and on the posterior as far as the base of the inner cusp of the posterior crest, where it gradually fades out. Enamel wrinkled.

The superior canine is remarkable for its small size. The posterior face is a little the widest, and its bounding edges are sharp, but not expanded. There are no prominent ridges of the enamel. The anterior face is moderately wide. The first inferior premolar presents no peculiarities.

Measurements.

		M.
Diameters of M. III superior	anteroposterior	.028
	transverse	.038
	vertical	.019
Diameters of P-m. I inferior	anteroposterior	.015
	transverse	.009
Diameters of C. superior	anteroposterior	.014
	transverse posterior	.018

The superior molar is but little worn, and shows that the animal was just adult. The canine is more worn than the molar.

There are several characters which mark this species as distinct from those previously known. It is the only member of the genus which has a complete internal cingulum. The fissure of the anterior crest, if normal, is peculiar to this species. The superior canine is disproportionately small.

Besides the *Coryphodons* already mentioned, a number of more or less complete skeletons were obtained, some of which can be identified by comparison with those which are accompanied by teeth, and which are enumerated in the preceding pages.

METALOPHODON TESTIS, sp. nov.

The genus *Metalophodon* was described by me in 1872.* Since that time it has remained without further illustration of importance, as no good specimens of it have been obtained by any of my expeditions up to the present year. Thy material now at hand consists of the entire superior molar series of the right side, and the superior molars of the left side, in beautiful preservation. These display the characters on which the genus was proposed, *i. e.*, the conversion of the posterior external V of the second true molar into a transverse crest similar to that of the last true molar. It follows that the first true molar is the only one which exhibits this V. It also follows that in this genus the peculiarities of the dentition of *Coryphodontidæ* are carried further than in *Coryphodon*, where two molars display the V, and one the crest; or than in *Manteodon*, where all three have a V, and none the crest. The genera then stand in the order of evolution, *Manteodon, Coryphodon, Metalophodon.*

Char. specif.—The first superior premolar has lost its crown. The other premolars do not display any marked peculiarities. The internal cusps are well developed, and are most prominent posterior to the line of the apex of the exterior crest. They connect with the posterior cingulum by a broad ledge, but do not connect with the anterior cingulum. The two cingula nearly connect round the inner base of the crown on the third premolar.

The first true molar is well worn. The base of the posterior external V can be seen, and the anterior and posterior cingula. There is no internal cingulum. The second true molar is the largest of the teeth. It is subtriangular in outline, its external side forming with the posterior, a right angle. Its general character is much like that of the Coryphodontes, but it presents the remarkable exception which constitutes the character of the genus *Metalophodon*. The posterior crest does not include a V, but is straight, and consists of the same elements as the posterior crest of the third true molars, but differently proportioned. The part representing the anterior V is a cone, much shorter than the part corresponding to the posterior V. As there is a postero-exterior angle of the crown there is an oblique surface rising to this part of the crest, which represents the external face of the V. There is also a small tubercle at the angle, where a similar one is found in the corresponding tooth of *Ectacodon cinctus.* Altogether this tooth is like the posterior molar of *Coryphodon elephantopus*, with a more prominent postero-external angle added. The anterior and posterior basal cingula are well developed, the latter being strong interiorly to the point where it sends a branch upwards to the internal cusp. There is no internal cingulum.

The last superior molar is a transverse oval, more regular than usual in the species of *Coryphodon*, since the diameters of the internal and external portions are about equal. The characters of the posterior crest differ from

* Proceedings American Philos. Soc., 1872, p. 542.

those seen in the genus named in that the internal portion is much smaller than the external, having a small conic apex, distinct from that of the exterior portion. Its postero-external face is nearly vertical, and it diverges a little posterior to parallel with the anterior crest. The latter (the first cingulum) is elevated, and is widely separated externally from the posterior crest, to whose base it descends on the external extremity of the crown. The basal cingulum is present all round the crown except at the base of the posterior crest, and externally. It is narrow on the inner extremity of the crown. It sends upwards a strong branch to the apex of the internal cusp. The enamel of all the molars is strongly wrinkled, but is worn smooth wherever rubbed.

Measurements.		M.
Length of superior molar series		.179
" premolar series		.085
Diameters P-m. II	anteroposterior	.019
	transverse	.025
Diameters M. I	anteroposterior	.029
	transverse	.032
Diameters M. II	anteroposterior	.036
	transverse	.042
Diameters M. III	anteroposterior	.0285
	transverse	.041
	vertical	.015

The *Metalophodon testis* differs from the *M. armatus*, in the more triangular form of its penultimate superior molar. Its form is quite different from that of the last molar, while in *M. armatus*, the two teeth resemble each other closely. The species are of about the same size.

The individual from which the above description is taken is rather aged.

Dinocerata.

Bathyopsis fissidens Cope.

Bulletin U. S. Geolog. Survey, Terrs., Feb. 1881, 194.

A considerable part of the dentition of the mandible of this species was found in the Big-Horn bad lands. This includes an incisor tooth, which is quite characteristic, and renders it probable that the anterior parts of the jaws differ considerably from those of other *Uintatheriidæ*. The root is sub-round. The crown resembles a good deal that of the species of *Coryphodontidæ*. It is higher than wide and has a subacute apex. One edge of the crown is convex, and the other concave. The external face is concave in both directions, and has no ridges nor cingulum. The inner face is concave longitudinally and convex transversely. The convexity is median and has a longitudinal concavity on each side of it. No internal cingulum except a trace at the base of the concave edge. The edges are obtuse even when unworn, and the enamel is obsoletely rugulose.

Measurements of incisor.		M.
Diameters of crown	anteroposterior	.012
	transverse	.020
	vertical	.020
Diameters of root	anteroposterior	.012
	transverse	.014

This incisor is very different from the kind seen in *Loxolophodon.* Mr. Osborne has shown that genus to have these teeth with compressed two-lobed crowns, a type unknown elsewhere among *Mammalia.**

PERISSODACTYLA.

In a paper on the "homologies and origin of the molar teeth of the Mammalia Educabilia," published in March, 1874,† I ventured the generalization that the primitive types of the Ungulata would be discovered to be characterized by the possession of five-toed plantigrade feet, and tubercular teeth. No Perissodactyle or Artiodactyle mammal was known at that time to possess such feet, nor was any Perissodactyle known to possess tubercular teeth. Shortly after advancing the above hypothesis, I discovered the foot structure of *Coryphodon,* which is five-toed and plantigrade, but the teeth are not of the tubercular type. For this and allied genera, I defined a new order, the *Amblypoda.* and I have published the confident anticipation that genera would be discovered which should possess tubercular (bunodont) teeth. This prediction has not yet been realized. I now, however, record a discovery, which goes far towards satisfying the generalization first mentioned, and indicates that the realization of the prophecy respecting the *Amblypoda,* is only a question of time.

In 1873,‖ I described from teeth alone, a genus under the name of *Phenacodus,* and although a good many specimens of the dentition have come into my possession since that date, I have never been able to assign the genus its true position in the mammalian class. The teeth resemble those of suilline Ungulates, but I have never had sufficient evidence to permit its reference to that group. Allied genera recently discovered by me, have been stated to have a hog-like dentition, but that their position could not be determined until the structure of the feet shall have been ascertained.§

In his recent explorations in the Wasatch Eocene of Wyoming, Mr. J. L. Wortman was fortunate enough to discover nearly entire skeletons of *Phenacodus primævus,* and *P. vortmani,* which present all the characters essential to a full determination of the place of *Phenacodus* in the system. The unexpected result is, that this genus must be referred to the order *Perissodactyla,* and that with its allies, it must form a special division of that order corresponding in the tubercular characters of its teeth with the

* A Memoir on *Loxolophodon* and *Uintatherium.* By H. Osborne.

† Journal of the Academy of Natural Sciences, Philadelphia.

‖ Palæontological Bulletin No. 17, Oct., 1873, p. 3; also, Report G. M. Wheeler, U. S. Engineers Expl. W. 100 Mer., iv, p. 174—1877.

§ Proceedings Amer. Philos. Society, 1881, p. 495.

bunodont or suilline division of the *Artiodactyla*. In this character, however, there is a closer gradation than in the case of the *Artiodactyla*, and it would scarcely be necessary to create such a group on that character alone. But the genus differs further from the *Perissodactyla* and approaches the *Proboscidia*, in the fact that the astragalus articulates with the navicular only, and by a universally convex surface, as in the Carnivora.

The astragalus resembles that of the latter order very closely, and differs from that of *Hyracotherium* and the nearest forms among the *Perissodactyla*. *Phenacodus* has moreover five well developed toes on all the feet, and was probably not entirely plantigrade. The cast of the brain case shows that the cerebral hemispheres were quite small and nearly smooth, and that the very large cerebellum and olfactory lobes were entirely uncovered by them. The bones of the two carpal rows alternate with each other, and there is a large third trochanter of the femur. The cervical vertebræ are opisthocœlous.

This group is then the ancestral type of the known *Perissodactyla*, that is of the horses, tapirs and rhinoceroses, and of the numerous extinct forms. Its systematic position may be schematically represented as follows:

Order PERISSODACTYLA ; ungulate ; digits of unequal lengths ; carpal bones alternating ; a postglenoid process. Astragalus with proximal trochlea, and without distal double ginglymus.

Suborder *Diplarthra ;* astragalus distally plane or concave in one direction, and uniting with both navicular and cuboid bones ; a third trochanter of the femur. The known families belong here.

Suborder *Condylarthra ;* astragalus convex in all directions distally, only uniting with navicular bone ; a third trochanter of femur.

Family *Phenacodontidæ*. Molar teeth tubercular ; the premolar teeth different from the molars ; five digits on all the feet.

Genera ; *Phenacodus* Cope, and very probably *Catathlæus*, *Anacodon* and *Protogonia* Cope, and perhaps also *Anisonchus* Cope. These genera include fifteen species, all from the lower Eocene beds. I gave a synopsis of their differential dental characters in the Proceedings of the Philosophical Society, 1881, p. 487, where I included also the genus *Mioclænus*. I omit the latter from the family at present, as I believe it to be Artiodactyle.

PHENACODUS PRIMÆVUS Cope.

Parts of a dozen individuals of this species were obtained, and one almost entire skeleton in a block of soft sandstone. This includes nearly all parts of the four extremities, as well as the skull, from which but small portions are wanting.

Species of this genus, so far as determinable from the dentition, are numerously represented in Mr. Wortman's collection. About fifty individuals are referable to eight species. These present a great range in size, and some diversities of structure. They may be distinguished as follows :

I. Last inferior molar with oval outline; heel small; anterior inner cusp simple.

Size medium ; length of true molars .025 ; depth of ramus at M. II, .018. *P. apternus.*

II. Last inferior molar wedge-shaped, with heel prominent; anterior inner cusp simple.

Large ; true molars .041 ; P-m. IV .014 ; depth of ramus at M. II, .027. *P. primævus.*

Medium ; true molars .027 ; depth at M. II .017 ; last molar smaller...... *P. vortmani.*

Smaller ; true molars .022 ; depth at M. II .013 ; last molar elongate ;.. *P. macropternus.*

Smaller ; last four molars .027 ; P-m. IV .007 ; depth at M. II .013 ; last molar with short heel............................*P. brachypternus.*

Smallest ; true molars .017 ; depth at M. II .012 ; heel long ; cusps elevated..*P. zuniensis.*

III. Last inferior molar wedge-shaped, with prominent heel ; anterior inner cusp double ;

Least ; last inferior molar .006 ; heel narrow ; true molars (superior) .016. *P. laticuneus.*

Two other species have been described, the *P. sulcatus*, and *P. omnivorus* Cope. The former I suspect belongs to another genus. I am not now sure of the distinctness of the latter from *P. primævus.*

Phenacodus hemiconus, sp. nov.

Represented by the posterior two superior molars of an individual intermediate in size between the *P. primævus* and *P. puercensis.* The posterior molar is peculiar in the very rudimental character of the posterior internal lobe, which is reduced to a mere wart on the cingulum. The posterior external tubercle is also rudimental, not exceeding the posterior inner in dimensions. The anterior tubercles, including the intermediate, are well developed, the internal exceeding the external. The cingulum is wide and crenate, and is only wanting on the external base of the crown. The penultimate molar does not differ so much from that of *P. primævus*, but the two internal cones are not so deeply separated at their base. The tubercles are all but little worn, and are conical in form, the external flattened on the external faces. Enamel wrinkled.

Measurements.

		M.
Diameters of M. II	anteroposterior	.009
	transverse	.012
Diameters of M. III	anteroposterior	.010
	transverse	.013

The size of this species precludes the possibility of its identity with any of the other species described here.

Phenacodus wortmani Cope. Bulletin U. S. Geol. Surv. Terrs. vi, 1881, p. 199. *Hyracotherium vortmani*, American Naturalist, 1880, p. 747.

Phenacodus puercensis Cope. Proceeds. Amer. Philos. Soc. 1881, p. 492.

An abundant species, represented by twelve mandibular rami in the collection, and by a nearly entire skeleton with perfect skull.

PHENACODUS APTERNUS, sp. nov.

Three rami, each of which supports the true molar teeth, indicate this species. The oval form of the posterior molar is due to the shortness of the heel, and the large size of the internal median tubercle, which projects inwards, giving a convex outline to the interior side of the crown. The external tubercles of all the true molars wear into crescents ; and the anterior inner is more robust than the posterior inner.

PHENACODUS MACROPTERNUS, sp. nov.

This species is apparently rare, being represented by only one mandibular ramus, which supports the posterior three molars, and a possible second ramus with molars iv and v. The first and second true molars are much like those of *P. vortmani*, but the third is relatively larger, and has an especially elongate heel. In *P. vortmani* the last molar is constricted, and narrower than the penultimate. In *P. macropternus* there is a weak external, and no internal cingulum. The tubercles of the last two molars are quite regularly conical, while the external pair of the first molar, wear into crescents. Smaller than the *P. vortmani.*

PHENACODUS BRACHYPTERNUS, sp. nov.

Three mandibular rami are the only specimens of this species found by Mr. Wortman in the Big-Horn region. They all display the fourth premolar, which has the characters of this genus, as distinguished from *Mioclænus.* The species is materially smaller than the *P. vortmani,* and its last inferior molar is intermediate between those of the latter and the *P. apternus,* in form. Both the internal and external intermediate tubercles are very full, and give the tooth posterior width. The posterior or fifth tubercle is large, and gives the posterior outline of the crown a trifoliate form. The posterior median tubercles of the M. II and I, are well marked. The molars gradually increase in size forwards, and the fourth premolar is longer than any of them, and rather narrow. The heel of the P-m. III is short and wide. On the true molars a weak external cingulum. Enamel slightly wrinkled.

PHENACODUS ZUNIENSIS Cope. Proceeds. Amer. Philosoph. Society, 1881, p. 462.

Mr. Wortman obtained eleven mandibular rami of this species, in only one of which are the premolars preserved. Excepting the *P. laticuneus,* this is the smallest species of the genus. The molars have much the appearance of those of the Mesodont genus *Hyopsodus,* but may be distinguished by the size of the posterior median tubercle. The second true molar is the widest tooth, and the last molar is rather elongate, and its cusps are not exactly opposite to each other. The cusps of the molars are more elevated than in the other species, and those of the external side all have a distinctly crescentic section. The anterior inner cusp is narrow and simple. There is no cingulum of any kind.

This species was originally described from New Mexican specimens.

Phenacodus laticuneus, sp. nov.

This is the least species, and is represented by six superior molars and the last inferior molar in a fragment of the lower jaw. The latter tooth exhibits peculiar characters already mentioned. The superior molars differ from those known to belong to the *P. primævus* and *P. puercensis* in having a vertical fissure of the inner side which separates the bases of the two internal tubercles. This gives them some resemblance to the superior molars of the species of *Anisonchus*, but the important difference remains in the separation of the anterior inner tubercle from the intermediate tubercles. The three are confluent into a V in the genus last mentioned.

The external cusps of the superior molars are rather acute, and lenticular in section, their external sides forming a convex rib. There is no rib between the external sides. There is a strong anterior cingulum, which terminates externally in a low angular cusp. There is no cingulum on any other part of the crown. The second, third and fourth premolars have two external cusps, and much resemble the corresponding teeth in *Hyracotherium*. The second is longer than wide, and has an internal ledge ; the third is as wide as long and has a wide internal ledge ; the fourth is wider than long and has an internal, and two intermediate cusps, and an anterior and posterior cingulum. They all have a weak external cingulum, of which a trace exists in the true molars.

The last inferior molar has a double anterior inner cusp as in some *Mesodonta*, and the external anterior cusp is robust. All the cusps are conical and with round section, and their bases are close together. The outline of the base of the crown is almost an isosceles triangle with rather wide base in front.

Measurements.		M.
Length of last six superior molars		.0350
" true molars		.0160
Diameters of M. II	anteroposterior	.0055
	transverse	.0080
Long diameter base of P-m. II		.0050
Diameters P-m. III	anteroposterior	.0060
	transverse	.0060

Anacodon ursidens, gen. et sp. nov.

Char. gen. Known only from mandibles supporting molar teeth. Probably family *Phenacodontidæ*. Last inferior molar with heel. Crowns of molars without distinct cusps, but with a superior surface consisting of two low transverse ridges separated by a shallow valley. Unworn grinding surface with shallow wrinkles. Perhaps only three premolars.

Char. specif. Broken mandibular rami of two individuals constitute the basis of my knowledge of this species. It is of the size of the *Phenacodus primævus*. The last inferior molar is wedge-shaped with the very obtuse apex posterior. It displays two slight transverse elevations anteriorly which represent the usual cusps. Grinding surface generally nearly flat. The posterior half of the crown of the penultimate molar is flat, and is separated from the anterior half by a transverse groove. Its surface is marked by shallow branching grooves.

The molar preceding this one in the broken specimen is probably the first. It is possible from its slightly worn condition that it is the fourth premolar, but the form is that of a true molar. The surface of the crown is marked by shallow grooves not very closely placed. The three premolar teeth in advance of this tooth are broken off. Their bases are narrow. There are no basal cingula on the molars.

Measurements.		M.
Length of posterior true molars		.033
Diameters of M. III	anteroposterior	.015
	transverse	.010
Diameters of M. ? I	anteroposterior	.015
	transverse	.011
Depth of ramus at M. II		.030

The characters of the teeth of this species are something like that of some of the *Palæochœri* of the Miocene, and resemble more those seen in some of the bears.

OLIGOTOMUS OSBORNIANUS, sp. nov.

Char. gen. Dental formula; I. ?, C. ?, P-m. ? $\frac{4}{4}$; M. $\frac{3}{3}$. External faces of external lobes of superior molars separated by a ridge; anterior external cusp of cingulum little developed. Premolars of superior series different from true molars, with only one internal lobe. Fourth inferior premolar similar to the true molars. Cusps of inferior molars connected by diagonal ridges forming Vs. A diastema in front of the second premolar.

This genus is a good deal like *Lambdotherium*, so far as known. Its superior molars are much like those of *Aeoëssus*, and their intermediate and internal tubercles are those of *Hyracotherium*.

The two or three species known to me are of small size.

Char. spec. The true molars of both maxillary bones, with the fourth premolar of one side are preserved more or less perfectly, with four inferior molars on two fragments of the lower jaw.

The external tubercles of the superior molars are nearly erect, and have a lenticular section. The rib which separates their external faces is prominent, and terminates in a free apex. The base of each face is marked by a strong cingulum, but the posterior one is very short. There is a strong anterior basal cingulum, but no posterior or internal one. The anterior inner tubercle is larger than the posterior. The intermediate tubercles are sub-round, and are anterior to the transverse line of the interior ones. They do not join the latter excepting after very considerable wear. The external anterior cingular cusp is rather more prominent on the first than on the second true molar. The fourth superior premolar has a well marked external anterior cingular cusp, which is, however, low ; and there is no ridge dividing the external faces of the external cusps. The single inner cusp is connected with the two external by two ridges, which diverge as they extend outwards. The anterior supports a tubercle close within the anterior external. There are strong anterior and posterior basal cingula and weak external and internal ones.

The third inferior premolar has a compressed ridge on the heel. The fourth premolar is like a true molar, with the anterior inner cusp well developed and elevated, and connected with the anterior and posterior external by oblique ridges. The inner posterior cusp is less conic in form than in the true molars, and the entire crown is somewhat contracted anteriorly. The true molars are characterized by the presence of a small median tubercle on the posterior border. There is a low external basal cingulum, which is wanting opposite the posterior cusp. Enamel generally smooth.

Measurements.		M.
Length of superior true molar series		.0210
Diameters of superior M. II	anteroposterior	.0080
	transverse	.0097
Diameters of P-m. IV	anteroposterior	.0085
	transverse	.0085
Length from inferior P-m. III to M. II inclusive		.0290
Diameters of P-m. IV	anteroposterior	.0080
	transverse	.0050
Diameters of inferior M. II	anteroposterior	.0075
	transverse	.0060
Depth of ramus between P-m. III and P-m. IV		.0150

As compared with the *O. cinctus,** this species differs in its superior dimensions. The anterior inner cusp of the inferior molars is probably single, though the slightly worn condition of those teeth renders this point a little uncertain. In *O. cinctus* some of them at least are double.

This species was, to judge from the size of its teeth, about the size of a red-fox. The specimens of it above described were found by Mr. J. L. Wortman in the bad lands of the Big-Horn river, Wyoming. It is dedicated to my friend, Henry L. Osborne, of Princeton College, New Jersey.

SYSTEMODON TAPIRINUS Cope. American Naturalist, 1881, p. 1018.

Hyracotherium tapirinum Cope. Systematic Catalogue of the Eocene Vertebrata of New Mexico, 1875, p. 20. Report U. S. Geol. Surv. W. of 100th mer. Capt. G. M. Wheeler, iv. ii. p. 263. Pl. lxvi. figs. 12–16.

This species was abundant in Wyoming during the Wasatch epoch, jaws and teeth of more than twenty individuals having been brought by

* Annual Rept. U. S. Geol. Survey Terrs. 1872, p. 607.

Mr. Wortman from the Big-Horn. From these I learn that the dental system is different from that characterizing the species of *Hyracotherium*. There is no diastema posterior to the superior canine, while in the latter genus there are two. Anterior to the canine there is a considerable one in the *Hyracotherium*. This part is not preserved in any of the specimens of *S. tapirinum*. The characters mentioned have induced me to separate the latter as type of a distinct genus, *Systemodon*. An examination of the figures and descriptions given by Dr. Lemoine of his *Pachynolophus gaudryi* found by him in the neighborhood of Reims, shows that it belongs to the genus *Hyracotherium*. It is therefore distinct from either of the species of *Systemodon*, and is to be compared with the *H. craspedotum* of the Wind River country, with which it agrees in size.

SYSTEMODON SEMIHIANS, sp. nov.

This species was also abundant in the Big-Horn region, jaws and teeth of sixteen individuals having been obtained. Its dimensions are a little smaller than those of the *S. tapirinus*, especially as to the premolar teeth. There is also a short postcanine diastema, which is not seen in the *S. tapirinus*.

The proportions of the maxillary series are represented by a left maxillary and premaxillary bone, with all the teeth in place, but the crowns lost from the first premolar anteriorly. The crowns of the true molars are somewhat worn, so I confine the description of these to the premolars. The third and fourth have considerable transverse extent, the latter being wider than long. The second has scarcely any internal tubercle, but only a low postero-internal heel. The internal tubercle of this tooth is large in *S. tapirinus*. The crown has two cusps, the posterior lower. The last two premolars have two external cusps close together. They have also an anterior external cingular lobe, as in the true molars. There is a posterior external basal lobe in the third premolar, but none or a rudiment on the fourth. No internal cingulum on the premolars. The superior true molars, although worn, show a prominent anterior external basal lobe, and no complete internal cingulum The base of the crown of the first premolar is narrow antero-posteriorly, and it has two roots as in *S. tapirinus*. It is in close contact with the second premolar, and is separated from the base of the canine by a space a little less than its own anteroposterior diameter, and less than the diameter of the canine. The base of the crown of the latter shows that it is not a large tooth, and has a wide lenticular section. The base of the external incisor is rather large, and is compressed.

Measurements of superior teeth..		M.
Total length of superior series		.0720
" " " molar "		.0310
" " " premolar "		.0250
Diameters base of canine	anteroposterior	.0055
	transverse	.0040

Measurements of superior teeth.

		M.
Length of base of P-m. I		.0040
Diameters P-m. III	anteroposterior	.0070
	transverse	.0078
Diameters P-m. IV	anteroposterior	.0070
	transverse	.0090
Diameters M. III	anteroposterior	.0100
	transverse	.0125

Some superior molars in better condition than those last described, exhibit the following characters. The intermediate tubercles are fused with the internal, forming a continuous cross crest, but their apices are distinguishable. The external cusps are subconical and are well separated. The anterior and posterior cingula are strong, the external is weaker, and it is wanting from the posterior part of the internal base of the crown.

A portion of a mandibular ramus, supporting six molars, presents the following characters. The teeth are a little smaller than those of *S. tapirinus*, the reduction being especially visible in the premolars. The cones of the crowns are more distinctly separated by notches than in that species, and are quite distinctly conic. The anterior ledge of the true molars is distinct, and there is a median posterior tubercle of the first two, which is represented by the wide crenate-edged heel of the third true molar. The anterior-internal cusps of the last two molars is double or bilobed ; that of the first is last. The anterior cones of the fourth premolar are subequal, and the posterior external cone is elevated. There is a trace of the posterior internal. There is also an anterior ledge. The heel of the third premolar rises to a median blade and posterior cusp. The anterior cusp is elevated and compressed, and supports a small internal lateral cusp. The base of the crown of the third premolar is elongate. All the teeth are rather compressed, and there is only a trace of an external cingulum.

The ramus is compressed and moderately deep. The dental foramen is large, and its superior border is on a level with the posterior base of the crown of the third true molar. Its inferior base is in line with the base of the crown of the second true molar.

Measurements of mandible..

		M.
Length of last six molars		.0530
" true molars		.0310
Diameters third premolar	anteroposterior	.0065
	transverse	.0040
	vertical	.0052
Diameters second true molar	anteroposterior	.0092
	transverse	.0060
	vertical	.0062
Diameters third true molars	anteroposterior	.0120
	transverse	.0060
Depth of ramus at P-m. III		.0170
Depth of ramus at front of M. III		.0220

The nearest ally of this species outside of the genus *Systemodon* is probably the *Hyracotherium craspedotum* Cope. This species was brought from the Wind River bad lands, and does not occur in the Big-Horn collection. It is about the size of the *S. semihians*, but is a true *Hyracotherium*, with a diastema behind the first premolar. The strong cingulum which characterizes it is not found in the *S. semihians*, and the inferior molars are wider and more robust.

HYRACOTHERIUM CRASPEDOTUM Cope.

Bulletin U. S. Geol. Survey, Terrs., 1881, p. 199. American Naturalist, 1880, 747.

The dentition of this species is in its dimensions and proportions intermediate between the two species of *Systemodon*. Its three premolars equal four of those of the *S. semihians*, while the molars of the two species are about equal.

A specimen having the proportions of the *H. craspedotum* was found by Mr. Wortman on the Big-Horn, but unfortunately it does not exhibit the characteristic cingula of the two dental series. The second superior premolar, like that of *Systemodon semihians* has no internal tubercle. It is not certain whether there is any diastema posterior to the first superior premolar. I therefore cannot yet ascertain whether this specimen represents an undescribed species of *Systemodon* or *Hyracotherium*, or a strong variety of the *H. craspedotum*. The accompanying inferior true molars are intermediate in size between those of the latter species and the *H. vasacciense*.

HYRACOTHERIUM VASACCIENSE Cope.

This species differs from the *H. venticolum* in its deep mandibular ramus. A single specimen from the Big-Horn presents the same proportions. The posterior inferior molar is rather short.

HYRACOTHERIUM VENTICOLUM Cope.

Bulletin U. S. Geol. Survey, Terrs., 1881, 198.

Fifteen individuals of this species are included in the collections.

HYRACOTHERIUM ANGUSTIDENS Cope.

This was a very abundant species. Mr. Wortman's collection contains jaws and teeth of twenty individuals sufficiently well preserved for identification, and a large number of other pieces of jaws, etc., which may be reasonably inferred to belong here.

In my report on the Wind River collection*, I noticed three varieties of this species, which differ in the depths of the ramus at the line of junction of the fourth and fifth molars. The numbers are 12, 14, and 15.5 mm. respectively. The lengths of the first true molar also vary from 7 to 6.5 and 7.5 mm. respectively. The last true molar measures in all 10.0 mm. The majority of the Big-Horn specimens agree with the second variety, but two others occur, one a little smaller, and the other a little larger than the average. The former measures ; length of last molar .0090 ; of

* Bulletin U. S. Geol. Survey Terrs. vi, 1881, p. 198.

first molar .0067 ; depth of ramus at M. I, .0120. The dimensions of the larger variety are : length of M. iii, .110 ; of M. i, .0067 ; depth ramus .0165. The New Mexican forms originally described, exhibit combinations of several of these measurements.

PACHYNOLOPHUS VENTORUM Cope.

Bulletin U. S. Geol. Surv. Terrs., 1881, p. 197. American Naturalist, 1880, p. 747.

One mandibular ramus.

PACHYNOLOPHUS POSTICUS, sp. nov.

Both rami of a mandible represent this large species. They are somewhat injured, and the crowns of five of the molars only can be distinctly seen. The latter display the characters seen in the *P. ventorum* and other species of the genus. The transverse crests are well characterized, and the valley between them uninterrupted. They are closed at the inner extremity by a low ridge nearly at right-angles with the cross crest posterior to them, as in the species of *Rhinocerus*. The anterior of these bounds an anterior ledge, which is quite large on the last true molar. The latter has a rather narrow, but prominent heel, which rises posteriorly. The fourth premolar has an anterior ledge, and wide heel with a diagonal crest which is median in front. The third premolar is similar, but smaller. The only cingulum is seen on the anterior part of the external side of all the true molars.

Measurements.		M.
Length of crowns of posterior six molars		.0700
" " true molars		.0440
Diameters P-m. iv	anteroposterior	.0095
	transverse	.0070
Diameters M. ii	anteroposterior	.0130
	transverse	.0095
Diameters M. iii	anteroposterior	.0180
	transverse anteriorly	.0092
Depth ramus at P-m. ii		.0280
" " M. ii		.0310

ARTIODACTYLA.

MIOCLÆNUS BRACHYSTOMUS, sp. nov.

Char. gen. The typical specimen of this species is represented by all the molar dentition of both jaws excepting the anterior three superior premolars. It also includes pelvis, femur, the distal parts of the tibia and fibula, the entire tarsus and the proximal portion of the metatarsus.

The dental characters conform precisely to those of the other species of *Mioclænus*. There is but one internal cusp of the superior true molars, and the intermediate tubercles are present. The fourth premolar has one external and one internal lobe. The inferior premolars have simple crowns without interior cusps or tubercles.

The characters of the tarsus are of much interest, and demonstrate that *Mioclænus* is the oldest type of artiodactyle yet discovered, and that it is not altogether primitive in some of its characters. Members of this order have been found by Cuvier in the upper Eocene (*Dichobune, Anoplotherium,* etc.), but none have been determined as yet from the Suessonian of America. A species represented by teeth from the Siderolithic beds of Switzerland have been referred to *Dichobune* (*C. campichii* Pict.); but dental characters alone are not sufficient to distinguish that genus from *Phenacodontidæ**. Dr. Lemoine found astragali of a small Artiodactyle in the Suessonian of Reims, and has referred them to his supposed Suilline *Lophiochœrus peroni.* I have reported an astragalus from the Wind River formation of Wyoming Territory, which is almost exactly similar to those found by Lemoine. The specimen now described, enables me to characterize with some degree of completeness this interesting form, which precedes in time all the known American *Artiodactyla.*

The characters of the tarsus are typically those of the order *Artiodactyla.* The astragalus exhibits a distal trochlea which is continuous with the sustentacular facet, and which articulates with both cuboid and navicular. The distal portion of the fibula is free from the tibia, and its shaft becomes very slender. It is possible that a more perfect specimen would display it as continuous. Its distal extremity articulates with the ascending tuberosity of the calcaneum. The cuboid facet of the latter is narrow. The cuboid and navicular bones are distinct from each other and from the cuneiforms. The mesocuneiform is shorter than the ectocuneiform, and *is coössified with it.* There are probably four metatarsals. The median pair are distinct, but appressed, their section together, sub-circular. The lateral metatarsals are slender, the external one is wanting, but its facet on the cuboid bone is very small.

These characters are in general similar to those of the genus *Dichobune,* but Cuvier† does not state whether the cuneiforms are coössified in that genus or not. They are united in Anoplotherium.‡ *Mioclænus* differs from *Dichobune* in the presence of but one internal tubercle of the superior molars, and in the single external tubercle of the superior premolars. Both genera are referable to a family to be distinguished from the *Anoplotheriidæ* by the presence of the external digits. This has been already named by Gill the *Dichobunidæ.*

Char. specif. The bones are about two thirds the size of those of the Javan musk-deer (*Tragulus javanicus*). The transverse extent of the superior true molars is greater than the anteroposterior. The composition of the last molar is like that of the others. The external tubercles are lenticular in section and the emargination which separates them is apparent on the external face of the crown. The intermediate tubercles are small, and are entirely distinct from the large external tubercle. There

* See American Naturalist, 1881, December.

† Ossemens Fossiles, v, p. 183.

‡ Gaudry Enchainements d. Regne Animal, p. 147.

is a distinct cingulum which is only wanting from the inner base of the crown. The fourth superior premolar has a trilobate outline of the base of the crown, the base of the inner lobe being contracted where it joins the external part of the crown. The internal tubercle is conic, with a prolongation outwards and forwards. Intermediate tubercle not distinct. External, anterior, and posterior cingula.

In the inferior true molars the external tubercles wear into crescents. The crowns increase in size posteriorly, which is the reverse of the order of enlargement in some of the other species of the genus. The fifth tubercle of the last molar is rather small, but is well distinguished from the other cusps. The internal median cusp is small, the external median. large. The premolars are not so much larger than the true molars in this as in the typical species of the genus. The second and third are more elongate on the base than the fourth. The latter is also less compressed than those that precede it. It has a short wide heel, and a small anterior basal tubercle. In the second and third premolars the posterior edge of the principal cusp is sharp, and descends gradually to the posterior base of the crown. Both have small acute anterior basal tubercles. The first inferior premolar is one-rooted, and has a simple crown directed somewhat forwards. It is separated from the second by a short space. The teeth anterior to this point are lost.

Measurements.		M.
Length posterior four superior molars		.0182
Diameters P-m. IV	anteroposterior	.0040
	transverse	.0042
Diameters M. II	anteroposterior	.0043
	transverse	.0060
Diameters M. III	anteroposterior	.0040
	transverse	.0060
Length of inferior molars		.0330
" " premolars		.0192
" " P-m. III		.0055
" " P-m. IV		.0045
Diameters M. I.	anteroposterior	.0040
	transverse	.0033
Diameters M. III	anteroposterior	.0052
	transverse	.0040
Depth of ramus at P-m. I		.0047
" " M. II		.0090
Length of astragalus		.0102
Width of trochlea behind		.0048
Diameters of cuboid	length	.0070
	width of middle	.0040

MIOCLÆNUS ETSAGICUS, sp. nov.

This, the largest species of the genus, is represented by the two rami of a mandible of an adult animal in good preservation. In their robust character the premolar teeth resemble those of the *M. turgidus*, but are not relatively so large, nor is the last true molar relatively so small, as in that species. The heel of the third premolar is obsolete, and that of the fourth is a wide cingulum. Neither exhibit an anterior basal tubercle, and in both the principal cusp is stout. The true molars widen posteriorly to the anterior part of the last molar. The latter contracts rapidly to a narrow heel. The tubercles are all subconic, and the median ones of the last molar are small. There are no cingula, and the enamel is smooth.

The ramus is not robust, and is of moderate depth. Its inferior border rises below the middle of the last molar tooth, and posteriorly. There is a "mental" foramen below the contact of the fourth premolar and first true molar.

Measurements.		M.
Length of bases of six posterior molars		.047
" " three premolars		.024
" " P-m. II		.009
" " P-m. IV		.008
" " P-m. IV		.005
Diameters basis of M. II	anteroposterior	.0075
	transverse	.0070
Diameter basis M. III	anteroposterior	.0084
	transverse	.0070
Depth of ramus at P-m. II		.0080
" " M. II		.0140

This species is named from the Crow Indian name of the Big-Horn river, *Etsagie*.

CONCLUDING REMARKS.

The paleontologist who has examined the preceeding list, will readily perceive that it represents fully the Wasatch fauna, with little admixture of earlier or later forms. The only genus which belongs to the Bridger or middle Eocene, which occurs in the Big-Horn basin, is *Pappichthys*, The characteristic Bridger genera *Hyrachyus*, *Palæosyops*, *Uintatherium*, and the *Tillodonta*, are absent, and their place is taken by *Phenacodus*, *Hyracotherium*, *Coryphodon* and *Tæniodonta*, as in New Mexico. Several genera are, as elsewhere, common to the two horizons, and two species cannot be distinguished in the parts preserved. Such as *Hyopsodus paulus* and *H. vicarius*. A closer comparison may be made with the Wind-River group, on which I published a report in the Bulletin of the U. S. Geological Survey of the Territories.* The following genera found in that formation have not been obtained from the Big-Horn. *Protopsalis*, *Lambdotherium*, *Palæosyops*, *Hyrachyus*.† Genera of the Big-Horn not obtained from the Wind-River: *Cynodontomys*, *Anaptomorphus*; *Mesonyx*,

*1881, Feb. p. 201.

† Since making my report on the Wind-River fauna, I have found the anterior part of the lower jaw of a species of this genus.

Deltatherium, Oxyæna ; Manteodon, Ectacodon, Metalophodon ; Anacodon, Oligotomus, Systemodon ; Mioclænus. Three of these genera have been found in the Bridger, and five have been obtained in the lower Eocene of New Mexico. Five of the genera are new to science.

An especial feature of the Big-Horn collection, as distinguishing it from those brought from other regions of the Wasatch formation, is the presence of numerous species of *Phenacodus,* and of new and rare species and genera of *Coryphodontidæ.*

II. The Fauna of the Catathlæus Beds or Lowest Eocene of New Mexico.

A number of new species and genera from this horizon were described in my Paleontological Bulletin No. 33. The present paper adds a few to this list. Up to the present time no species of *Coryphodon,* and but few specimens of *Hyracotherium* have been discovered in this formation, thus exhibiting a marked contrast to the Wasatch beds. The predominant genus is *Catathlæus,* which is represented by one very abundant species. The genera of *Creodonta* are mostly distinct from those of the Wasatch. The Diplarthrous Perissodactyla, so numerous in the Wasatch, are rare here. The genus which is well represented in both formations, is *Phenacodus ;* and *Mioclænus* occurs in both. *Mesodonta* are much less numerous than in the Wasatch, and *Amblypoda* have not yet certainly been found.

This is the only Tertiary formation where the Laramie genus *Champsosaurus* occurs. It is represented by three species.

Psittacotherium multifragum Cope.

American Naturalist, 1882, p. 156, Jan. 25th.

An interesting new form of this sub-order has been found in the *Catathlæus* beds (probably the Puerco formation) of New Mexico. It differs widely from the two genera hitherto known, *Anchippodus* and *Tillotherium.* Owing to the absence of the superior dental series, it is not possible to be sure which is the canine. The inferior dental formula may be therefore written, I. 2 ; C. 1 ; P-m. 3 ; M. 3 ; or I. 3 ; C. 0 ; P-m. 3 ; M. 3 ; or I. 3 ; C. 1 ; P-m. 2 ; M. 3. The first and second incisors are large and rodent-like, growing from persistent pulps ; the second are the larger. The third, or canines, are small and probably not gliriform. There is no diastema. The first premolar (or canine) has a compressed crown with two cusps placed transversely to the jaw axis, and has a complete enamel sheath, and probably two roots. The succeeding tooth is also transverse, and is two-rooted, judging from the alveolus. The first and second true molars are rooted, and the crown consists of two transverse separated crests, each partially divided into two tubercles. On wearing, the grinding surface of each assumes the form of a letter B with the convexities anterior. The last inferior molar is injured. The rami are short, and the symphysis deep and recurved.

Specific characters. The base of the coronoid process is opposite the junction of the second and third true molars. The ramus is deep and moderately stout. The enamel of the first incisor does not extend below the alveolar border, at the internal and external faces, and does not reach it at the sides. It has a few wrinkles on the anterior face. The anterior enamel face of the second incisor is thrown into shallow longitudinal grooves with more or less numerous irregularities from the low dividing ridges. There is a deeper groove on each side of the tooth, and there are about a dozen ridges between these on the anterior face. Both cusps of the first premolar are conic, and the external is the larger. The second true molar is a little smaller than the first. The enamel of the premolars and molars is smooth, and there are no cingula.

Probable length of dental series, .0750; diameters of I. I: anteroposterior, .0120, transverse; .0066; diameters I. 2: anteroposterior, .0160, transverse, .0115; diameters P-m. I: anteroposterior, .0072; transverse, .0130; diameters of M. ii. anteroposterior, .0090, transverse, .0090. Length of true molars, .0038; depth of ramus at M. ii, .0360.

The short deep jaws of this animal must have given it a very peculiar appearance, not unlike that of a parrot in outline.

PSITTACOTHERIUM ASPASIÆ, sp. nov.

Represented by two mandibular rami of two individuals, one adult, the other nearly so, but with the last inferior molar not fully protruded. The latter specimen must be used for description, as it presents two molar teeth, while the other specimen has lost them.

The most obvious difference from the *P. multifragum* is its inferior size, which can be readily perceived from the measurements given. The posterior crest of the molars appears to have less transverse extent than in the larger species. This crest in the last inferior molar has a curved crenate edge, with a small conic tubercle at its external extremity. The anterior crest consists of two conic tubercles, whose apices converge, but whose bases are closely appressed, and only distinguished by a superficial fissure. The valley between the crests is uninterrupted. The preceding molar is larger, and its posterior crest is like that of the lost molar. The apex of the anterior crest is broken off.

The ramus deepens rapidly forwards, and contains the enormous alveolus for the incisors. The coronoid process leaves the alveolar border at the line separating the last two molars, or, in the smaller specimen, a little anterior to this point, and is quite prominent. The masseteric fossa is well marked, but shallows gradually anteriorly and inferiorly.

Measurements.

No. 1.	M.
Depth of ramus at penultimate molar	.027
Width of last molar anteriorly	.008
Length of crown of do	.009
No. 2.	
Depth of ramus of penultimate molar	.029
" " at P-m. ii	.043
Length of five consecutive alveoli	.047

From the Puerco bed of N. W. New Mexico.

TRIÏSODON HEILPRINIANUS, sp. nov.

This species may be readily recognized as smaller than the *T. quivirensis*, and as having the anterior inner cusp of the inferior true molar of larger proportions than in the corresponding teeth of the latter species. It is only represented in my collection by a portion of a lower jaw, which supports only one well preserved molar. As the fourth premolar is not present, it is not positively ascertained that the species does not belong to *Ictops*.

The anterior cusp is very low, and is nearer the inside than the middle of the anterior border. The principal anterior cusps are opposite, and the external is a little the larger. The heel is larger than the basis of the anterior cusps, and has convex borders. Its internal border supports three tubercles, and the external border rises into a cutting lobe with lenticular section. Enamel smooth. No cingula, but the external base is injured.

Measurements.			M.
Diameters of inferior molar	vertical	of cusps	.0070
		of heel	.0052
	anteroposterior		.0110
	transverse		.0065

Puerco beds of New Mexico.

Dedicated to my friend, Professer Angelo Heilprin, of Philadelphia.

SARCOTHRAUSTES ANTIQUUS, gen. et sp. nov.

Char. gen. We have in evidence of the characters of this genus, the last two superior molars, the last one lacking the crown; and parts of both mandibular rami, which exhibit teeth as far posteriorly as the first true molar inclusive; all belonging to one individual. A part of a skeleton of a second individual, which includes a fragment of lower jaw, belongs probably to this species.

Sarcothraustes resembles both *Amblyctonus* and *Mesonyx*, but it is probably to the latter genus that it is allied. The last superior molar is transverse, much as in *Oxyæna*. The crown of the penultimate is subtriangular and transverse. It has two external subconic cusps and a single internal lobe, whose section on wearing is a V, each branch of the face extending to the base of the corresponding external tubercle. There are three small inferior incisors, and a large canine. There are probably only three inferior premolars, the first one-rooted. The crown of the second has no heel. The crown of the third has a short wide heel. The crown of the first true molar consists of an anterior elevated cone and a posterior heel. The latter is wide, having a posterior transverse, as well as a longitudinal median keel. The fragments of the supposed second individual include two large glenoid cavities with strong preglenoid crests, as in *Mesonyx*.

As compared with *Mesonyx*, this genus differs in the V-shaped crest of the penultimate superior molar; in *Mesonyx* it is represented by a simple cone. The last superior molar of *Mesonyx* is triangular and not transverse, but the composition of the crown of that tooth in *Sarcothraustes* must be known before the value of this character can be ascertained. If the view that *Sarcothraustes* has but three inferior premolars be correct, this character distinguishes it from *Mesonyx*, as do also the transversely expanded heels of the molars. The family *Mesonychidæ* may be for the present regarded as embracing the three genera of *Sarcothraustes*, *Mesonyx* and *Dissacus*.*

Char. Specif. The penultimate superior molar has a strong posterior cingulum which commences within the line of the internal bases of the external cusps, and rises into considerable importance behind the internal cusp. There is also an anterior cingulum which does not rise internally, and which is continuous with a strong external basal cingulum. The latter passes round the posterior base of the posterior cone, and runs into the posterior branch of the internal V. The posterior cone is smaller than the anterior cone, and its apex is well separated from the latter. The appearance of this tooth is something like that of a carnivorous marsupial.

The symphysis mandibuli slopes obliquely forwards, and is united by coarse suture. The ramus is stout and deep, as compared with the size of the molar teeth. The roots of the teeth are relatively large, especially those of the first two premolars. The crown of the canine is lost. The first premolar points forwards, nearly parallel with the canine, and divergent from the second premolar. The crown of the second premolar is small and subconic, and has a rudimental heel, and no anterior basal tubercle. The first true molar resembles considerably that of *Mesonyx*. There is a small anterior basal tubercle on the inner side of the principal cusp. The expansion of the heel is transverse only, there being no longitudinal lateral edges or tubercles. The enamel is obsoletely, rather coarsely wrinkled. There are two rather large mental foramina; the posterior below the anterior root of the first true molar, and the anterior below the posterior root of the second premolar.

Measurements.		M.
Diameters of superior M. ii	anteroposterior externally	.015
	transverse	.024
Anteroposterior diameter of base of M. iii		.0095
Anteroposterior diameter base of crown of inferior canine		.020
Length of bases of three inferior premolars		.038
Diameters inferior M. i.	anteroposterior	.019
	transverse	.0095
	vertical	.0110
Depth of ramus at P-m. iii		.0520
Width " "		.022

* American Naturalist, Dec., 1881.

CHAMPSOSAURUS PUERCENSIS, sp. nov.

I have already announced the discovery * of this Laramie genus in the Puerco beds of New Mexico, and described a species, *C. australis*, from that region. I now introduce two additional species from the same horizon. One of these is represented by a number of fragments which include three dorsal and four caudal vertebræ of apparently one individual. They represent an animal of larger size than any of those heretofore referred to *Champsosaurus*, excepting the *C. vaccinsulensis*. In all of the vertebræ the neural arch is more or less coössified with the centrum, and the animal had probably reached its full size.

One of the dorsal *centra* is split vertically and longitudinally, and shows the structure already figured by Leidy in the *Ischyrosaurus antiquus* † Leidy. The surface exposed displays two diagonal lines of fissure crossing each other at right angles. They indicate clearly the mode of origin of this amphiplatyan type of centrum. The centrum is first deeply amphicœlous as in the Theromorphous reptiles of the Permian. The conical cavities are filled by the ossification of the remaining portions of the notochord, forming a conical body which always remains distinct from the remainder of the centrum.

The articular faces of the dorsal centra are a little wider than deep, and the depth about equals the length of the body. They are not nearly so depressed as those of *C. australis*, and their outline is different. This is wider above and narrows below ; in both *C. australis* and *C. saponensis* the inferior outline is part of a circle. None of the dorsals preserved are keeled below. There is a fossa below the diapophysis which has a subvertical posterior boundary. The general surface (somewhat worn) does not display wrinkles near the articular faces. An anterior dorsal has a short compressed diapophysis with a narrow figure 8 articular surface, and its superior border is in line with the roof of the neural canal. The anterior caudals have subround articular faces ; the posterior are more oval and the bodies compressed. With greater compression, the length increases.

Measurements.		M.
Diameters of an anterior dorsal	anteroposterior	.025
	vertical	.025
	transverse	.030
Height of costal facet of do		.021
Diameters neural canal do.	vertical	.007
	transverse	.009
Diameters anterior caudal	anteroposterior	.024
	vertical	.021
	transverse	.021
Diameters posterior caudals	anteroposterior	.025
	vertical	.018
	transverse	.018

* American Naturalist, 1881. p. 669.

† Transac. Amer. Philos. Soc. 1860.

The typical specimen was found by Wm. Baldwin near the Puerco river, west of the Nacimiento mountain, New Mexico, in the typical locality of the Puerco formation.

CHAMPSOSAURUS SAPONENSIS, sp. nov.

Represented in my collection by six cervical and several dorsal vertebræ, one only of the latter with well preserved centrum, parts of ribs, and various other bones, whose reference is not yet certain.

The cervical vertebræ include the os dentatum or centrum of the atlas. This shows its streptostylicate character in its distinctness from both the centrum and the free hypapophysis of the axis. Nevertheless it is more Crocodilian than Lacertilian in form. Its anterior face is transverse, with a little lip carrying forwards the floor of the neural canal, below which the face is leveled posteriorly. The inferior surface is narrow and transverse, as though adapted for the anterior part of the hypapophysis of the axis. At each side it terminates in a prominent tuberosity, as though for the attachment of a cervical rib as in the Crocodilia. The anterior face is bounded posteriorly by a transverse groove which terminates in a fossa on each side. The posterior articular face of the os dentatum is wider than deep. The lateral angles of the superior face are rounded, and its median portion is concave.

The axis displays a large facet for the hypapophysis. Behind it the inferior middle line is not keeled, but is coarsely wrinkled longitudinally. The posterior edge of the hypapophysial facet is the most prominent part of the inferior surface. The posterior articular face is deeper than wide. This is true of the faces of all the cervical vertebræ. The latter gradually increase in size posteriorly, and the dorsals become larger. The articular faces of all the centra are regularly rounded and not contracted below. The five cervicals are strongly keeled below ; the keel of the third centrum being split up anteriorly into narrow ridges. On the sixth the keel is more prominent and acute. The dorsal is not keeled. A trace of the parapophysis appears low down on the fourth cervical ; it rises and becomes prominent as a round tuberosity on the fifth and sixth. It appears on the superior edge of the centrum of the dorsal vertebra, where it is connected with the diapophysis. It is near the middle of the length of the centrum, and not near the anterior border as in *C. australis*.

The surfaces of the vertebræ are very smooth excepting where thrown into coarse wrinkles near the borders of the articular faces and near the hypapophysis. The edges of the articular faces are somewhat revolute on the sides in the cervicals, but not on the dorsal. They are impressed in the centre to a point, most strongly so as we pass forwards in the series. There is a fossa below the space anterior to the parapophysis of the dorsal vertebra, which is abruptly bounded below by a horizontal angle. A separate neural spine perhaps of a cervical vertebra, has the following form. It is stout, and is contracted rather abruptly at the apex from behind forwards. The section is broadly lenticular, angulate in front, and truncate behind. The posterior face has several longitudinal wrinkles, including a median raised line, and there are some more irregular wrinkles on the sides.

Measurements of vertebræ.			M.
Anterior face of os dentatum	width		.025
	depth (oblique)		.012
Posterior face of os dentatum	width		.020
	depth		.018
Length os dentatum above			.014
Diameters axis	posterior face	depth	.022
		width	.020
	length		.0185
Hypapophysial facet os dentatum	depth		.008
	width		.014
Diameters fourth cervical	length		.022
	anterior	depth	.0225
		width	.022
Diameters sixth cervical	length		.0215
	anterior	depth	.0245
		width	.0235
Spaces between parapophysis and diapophysis of do.			.0040
Diameters of dorsal	length		.0265
	anterior	depth	.0260
		width	.0265
Height of neural spine of ?, from postzygapophysis			.0210
Anteroposterior width of do. at base			.0100

The portions of ribs are separated heads and shafts. The former are double and therefore cervical, and are quite large. If the shafts belong to them, the neck of this species must have been wide. The shafts are slender and are of dense bone. The section is oval at the middle, but towards the distal extremity becomes flattened and grooved and delicately line ridged on one side. The extremities of the long bones are without condyles but have concave surfaces like those of the ribs. The bodies are robust and angular. They may be abdominal ribs of unusual stoutness. From the Puerco beds, D. Baldwin.

Stated Meeting, January 6, 1882.

Present, 8 members.

President Fraley in the Chair.

Letters of acknowledgment were received from the Anthropological Institute of Great Britain and Ireland (XV, 3 ; 107, 108) ; and the Linnean Society, London (105, 106).