

**Article VII.—FOSSIL MAMMALS OF THE LOWER  
MIOCENE WHITE RIVER BEDS. COLLECTION  
OF 1892.**

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With two Plates and eight figures in Text.

INTRODUCTORY NOTE.

The reports from the Department of Mammalian Palæontology in the American Museum are published in two series. The *Faunal series* includes at present the *Wahsatch Fossil Mammals*, the *Cretaceous Fossil Mammals*, and the present *Lower Miocene Fossil Mammals*, Part I. This series is designed to cover the entire Museum collections from certain horizons, and not only to include descriptions of new forms, but to serve as a descriptive guide to the collection for the use of specialists. The *Special series* includes preliminary notices of important types which it is advisable to publish promptly. In the latter series four papers have already been devoted to the Lower Miocene Collection of 1892, namely: upon *Protoceras*;<sup>1</sup> upon *Artionyx*,<sup>2</sup> which Scott has now shown to be identical with *Agriochærus* Leidy; upon the *Divisions of the Lower Miocene*;<sup>3</sup> upon *Aceratherium tridactylum*;<sup>4</sup> and upon *Ancestors of the Tapir*.<sup>5</sup>

The present is the first part of a report belonging to the 'faunal series,' and covers part of the fossils collected in 1892. More recent collections and the remainder of this will be treated in a second part. These collections were made by Dr. Wortman, assisted by Mr. Peterson and Mr. Gidley.

The most novel points in the present paper are:

1. New characters of the Lower Miocene Rhinoceroses, including two new types, *A. trigonodum* and *A. platycephalum*.
2. The osteology of *Metamynodon*.

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<sup>1</sup> Osborn and Wortman, Bull. Am. Mus. Nat. Hist., Vol. IV, Dec. 30, 1892.

<sup>2</sup> Loc. cit., Vol. V, Osborn and Wortman, February, 1893.

<sup>3</sup> Loc. cit., Wortman, June 27, 1893.

<sup>4</sup> Loc. cit., Osborn, April 29, 1893.

<sup>5</sup> Loc. cit., Wortman and Earle, August 18, 1893.

SUCCESSION OF SPECIES IN THE WHITE RIVER MIOCENE.

Approximate estimate of the thickness of the Beds.	General Character of Rock.	Types appearing for Last Time, Italicized.
100 feet. PROTOCERAS BEDS.	Leptauchenia Layer : nodule-bearing, pink-colored clays.  Coarse sandstones, not continuous.	Pogonodon sp. ? Eporodon major, Leptauchenia sp., Aceratherium tridactylum, <i>Hyracodon</i> , <i>Hyænodon</i> ? <i>Hyracodon</i> sp., Aceratherium tridactylum, Aceratherium platycephalum, Diceratherium proavium, Protapirus obliquidens, <i>Mesohippus bairdii</i> , Mesohippus sp., Elotherium imperator, Thinohyus sp., Anthracotherium karense, Hypotamius brachyrhynchus, Protoceras celer, Agriocherus gaudryi, Pogonodon sp. (?)
BARREN CLAYS. 100 feet.	Light-colored clays. Nodulous clay stratum. Bones white.	A few scattered mammalian remains. <i>Oreodon bullatus</i> , <i>Hyænodon crucians</i> , <i>H. cruentus</i> , Dapheus, Palæolagus haydeni, Ischyromys typus, Leptictis haydeni, <i>Metamynodon</i> , Leptomeryx evansi, <i>Hyracodon</i> , Pœbrotherium wilsonii, <i>Aceratherium occidentale</i> , Dinictis felina, Hoplophoneus primævus.
75 to 100 feet.	Sandstones and clays. Bones rusty colored.	Aceratherium occidentale, Mesohippus bairdii, <i>Hyracodon</i> sp., Elotherium imperator, <i>E. mortoni</i> .
OREODON BEDS.	Oreodon Layer : nodule-bearing. Bones with scale of ferruginous oxide. 'Red layer.'	<i>Hyracodon</i> sp., Aceratherium mite, Aceratherium occidentale, Mesohippus bairdii, Colodon luxatus, Protapirus simplex, Elotherium mortoni, Elotherium imperator, Anthracotherium occidentale, Hypotamius americanus, Pœbrotherium wilsonii, Leptomeryx evansi, <i>Oreodon culbertsonii</i> , <i>Oreodon gracile</i> , Hoplophoneus primævus, Hoplophoneus occidentalis, <i>Hyænodon horridus</i> , <i>Hyænodon paucidens</i> , <i>Hyænodon crucians</i> , <i>Hyænodon cruentus</i> , Dapheus, Ischyromys sp., Palæolagus haydeni.
50 feet.	Metamynodon Layer : sandstones and clays. Bones rusty. Reddish gritty clay. Bones white.	<i>Hyracodon</i> sp., <i>Aceratherium mite</i> , Metamynodon planiceps, <i>Oreodon culbertsonii</i> , Mesohippus bairdii, Hoplophoneus primævus, Elotherium mortoni, Elotherium imperator.
TITANOTHERIUM BEDS. (Total thickness, 180 feet.)	Mingled remains of Titanotherium, Aceratherium, Mesohippus.	<i>Aceratherium trigonotam</i> , Mesohippus bairdii, Anthracotherium occidentale, Elotherium mortoni (?), <i>Oreodon culbertsonii</i> (?), <i>Titanotherium</i> .

3. The basi-occipital characters of *Oreodon* as developed in successive horizons.
4. The determination of two species of *Anthracotherium*. Additional characters of the American *Hyopotamus*.

The section upon the Perissodactyla was mainly written by myself ; that upon the Artiodactyla and Carnivora by Dr. Wortman. Authors, in citing this paper, are requested to kindly recognize the names of both contributors.—H. F. O.

#### FAUNAL SUCCESSION IN THE LOWER MIOCENE.

One of the most important features of the field work of the Expedition of 1892 was a very careful survey of the complete section of the Lower Miocene beds in South Dakota. Wortman has already published a preliminary table of the succession of strata,<sup>1</sup> and we now add a preliminary list of the succession of species. This will naturally be subject to revision ; some species will be found to occur upon higher or lower levels, and the list characteristic of each level will be greatly increased. In the meantime the following list will furnish the basis for definite criticism and revision, and taken together with the admirable work of Scott upon the Deep River beds, and of Hatcher upon the lower section or Titanotherium beds, is a step towards the still more exact stratigraphical and faunal work of the future.

### Suborder PERISSODACTYLA

#### Family RHINOCEROTIDÆ.

#### *Aceratherium trigonodum*, sp. nov.

#### PLATE II, A.

This species is the oldest of the series, and is named from the strictly triangular form of the last upper premolar. The best specimen is a nearly perfect skull (No. 529) with one jaw found

<sup>1</sup> 'On the Divisions of the White River or Lower Miocene of Dakota,' Bull. Am. Mus. Nat. Hist., V, pp. 95-106, June 27, 1893.



in the uppermost 'Titanotherium layer.' The type specimen (No. 528) is a perfect set of upper grinders of both sides, only partly worn.

The specific characters are : Dentition,  $\frac{1}{1}$ ,  $\frac{1}{1}$ ,  $\frac{4}{3}$ ,  $\frac{3}{3}$ . (a) *Upper canine* apparently persistent and well developed. (b) *Upper premolars* subtriangular ; third premolar with an incipient postero-internal cusp, well developed towards the base ; fourth premolar with a feeble or incipient postero-internal spur and a somewhat prominent elevation of the postero-internal cingulum, which presents the appearance of a 'cingule' when worn. (c) *Upper molars* with well-developed internal cingulum upon protoloph ; cingulum feeble or absent on metaloph ; incipient 'antecrochet' at base of metaloph becoming apparent upon wear. (d) *Skull* (No. 529) fairly elevated ; sagittal crest low ; nasals rather short, not notched ; postglenoid and posttympanic processes widely separated.

The canine associated with specimen No. 529 was not found *in situ*, and is therefore open to some question ; it is larger than

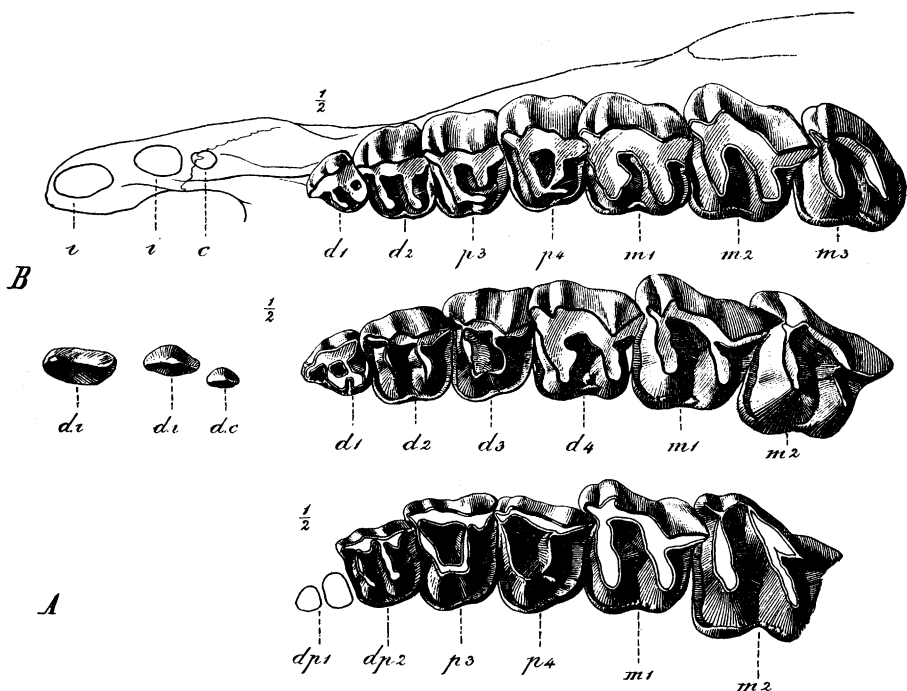


Fig. 1. Upper dentition of the left side of : A, *Aceratherium trigonodum*, type (No. 528). B, *Aceratherium mite*, showing immature dentition (No. 521). *Aceratherium mite*, showing mature dentition (No. 522). One-half natural size.

that of *A. mite*. The lower jaw is long and slender ; it lacks any trace of the first premolar ; the lower canines differ from those of *A. occidentale* in being fully procumbent. The nasals are relatively shorter and more obtuse than in *A. mite* ; the sagittal crest is less sharply defined. The postglenoid processes extend more widely behind the glenoid fossa than in the later types.

### ***Aceratherium* (*Cænopus*) *mite* Cope.**

PLATE II, B.

This species has been hitherto known chiefly in its teeth and skeletal characters, from the descriptions<sup>2</sup> of Cope. It is represented by three beautifully preserved skulls, one containing the complete milk dentition (No. 521), the others containing the adult dentition in two stages of wear (Nos. 522, 524). Found at the base of the 'Oreodon Beds' (Nos. 521, 522), and in the 'Metamynodon layer' (No. 524).

The specific distinctions of the skull region are : Dentition, <sup>2</sup>, <sup>1-0</sup>, <sup>4</sup>, <sup>2</sup>. (a) Small *upper canines* present in milk series, and temporary or absent in permanent dentition. (b) *Upper premolars* : third premolar subtriangular with a small but well-defined postero-internal cusp (tetartocone), and a short posterior crest ; fourth premolar subtriangular with a somewhat feebler tetartocone. (c) *Upper molars* with more or less well-defined internal cingula, especially upon the protoloph, 'antecrochet' usually distinct upon first molar and feeble or absent upon second and third molars ; third molar with ectoloph and meta-*loph* completely confluent. (d) *Skull* rather broad and low ; sagittal crest well-defined posteriorly ; occiput of medium height ; frontals broad and somewhat rugose above postorbital processes ; nasals notched laterally and sharply pointed ; postglenoid and postsympanic processes separate.

These skulls are small and delicate, about 17 inches in length. The general impression one receives is of considerable lateral and moderate vertical extension. The premaxillaries are not overhung by the nasals, and are completely separated in the median line. Seen from above, the nasals, pointed at the tip, widen suddenly as in *Hyrachyus*, with which generic type *A. mite* presents many striking resemblances. The skull gradually broadens to a point above and slightly behind the orbits, then contracts into the rather broad, low cranium. The premaxillaries are almost in contact with the nasals.

The younger individual (No. 521) shows all the upper premolars of the *first series* in place. The first premolar has a long ectoloph and two irregular transverse crests. The second premolar has two perfect transverse crests. The third premolar has two crests which are confluent internally; it is more triangular in form and less progressive than the second premolar. The fourth premolar is on the other hand more progressive than the molars,

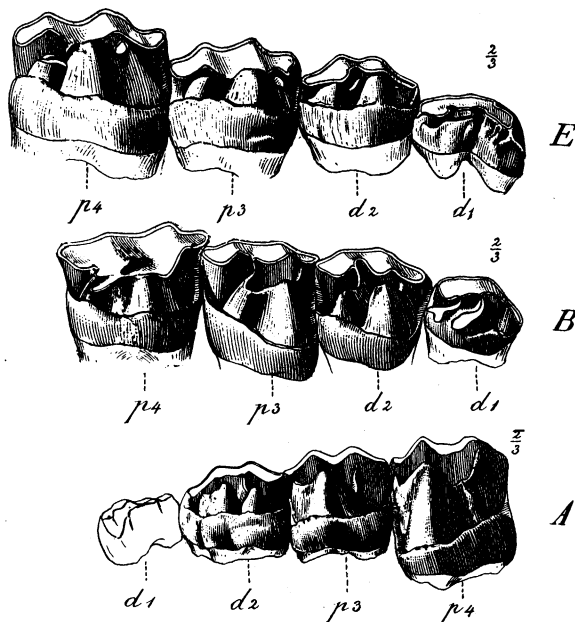


FIG. 2. Adult Upper Premolars of the First and Second Series. A, *Aceratherium trigonodum*, type (No. 528). B, *Aceratherium mile* (No. 522). E, *Aceratherium platycephalum* (No. 540). Showing by the internal view the persistence and unchanged form of the two 'milk' teeth, D. 1 and D. 2, and the evolution of the postero-internal lobe in the third and fourth premolars, P. 3, P. 4. Two-thirds natural size.

with protoloph and metaloph, an antecrochet and a tubercle at the entrance of the median valley. It is somewhat doubtful whether the incisors and the canine belong to the first or second series.

### ***Aceratherium occidentale* (Leidy).**

PLATE II, C.

This classic species is represented by numerous specimens, including three fairly well-preserved adult skulls (Nos. 532, 535,

537), and one perfect baby skull and jaws (No. 534). It seems to occur chiefly above the 'Metamynodon layer' in the middle and upper divisions of the 'Oreodon Beds.'

The specific distinctions are: Dentition,  $\frac{3}{2}$ ,  $\frac{0}{1}$ ,  $\frac{4-5}{3}$ ,  $\frac{3}{3}$ . (a) *Upper canines* wanting in deciduous and permanent series; lower canines with crowns of medium length, semiprocumbent. (b) *Upper premolars*: third premolar subquadrate, with strong tetartocone and posterior crest not quite in contact in the unworn condition; fourth premolar transitional to subquadrate with feeble development of tetartocone and posterior crest. (c) *Upper molars*: internal cingula fairly well defined, especially upon protolph; 'antecrochet' well developed upon first and second molars, and sometimes present upon third molar; third molar with ectoloph and metaloph completely confluent. (d) *Skull* rather high and narrow; nasals long, well developed and slightly notched; sagittal crest flattening out except in posterior region of cranium; postglenoid and posttympenic processes approximated but not actually in contact; occiput elevated; paroccipital processes very long and slender.

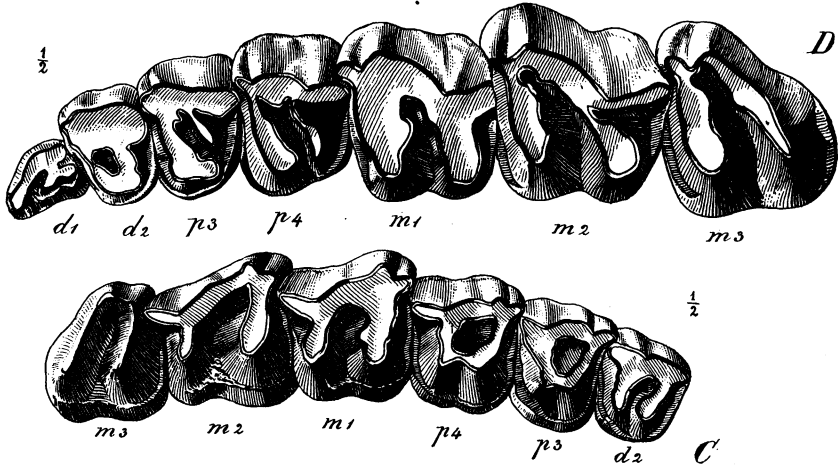


Fig. 3. Adult Upper Dentition of *C. Aceratherium occidentale* (Leidy) (No. 535), and of *D, Aceratherium platycephalum*, type (No. 545). One-half natural size.

The immature skull (No. 534) is doubtfully referred to this species. In contrast with the young *A. mite* it exhibits a feeble pair of upper incisors, and no trace of the upper canines. The four deciduous premolars are the only grinding teeth present; they are all completely molariform, with two complete crests, except D. P. 1, which exhibits a strong postero-internal cusp and a very feeble posterior crest. There is a 'crista' upon D. P. 2.

***Aceratherium platycephalum*, sp. nov.**

PLATE II, E.

The type of this species is a skull and lower jaw (No. 545) from the coarse sandstones or lower section of the 'Protoceras Beds,' on the same level with *A. tridactylum*. Belonging to the same species is a perfect set of upper premolars and molars of the right side (No. 540).

The specific distinctions are as follows: Dentition,  $\frac{1}{2}, 0, \frac{4}{3}, \frac{3}{3}$ . (a) Third and fourth *upper premolars* with prominent postero-internal cusps (tetartocones) which when unworn are quite separate from the delicate posterior crests; third premolar quadrate; fourth premolar subquadrate. (b) Internal cingula upon true *upper molars* wanting; first molar exhibits an 'antecrochet'; third molar exhibits a depression on the posterior face at the junction of the ectoloph and metaloph. (c) Large procumbent lower canines, with a small median pair of incisors. (d) *Skull* flattened, obtuse nasals, slight postglenoid-posttympenic contact; broad, low occiput; sagittal crest wanting and represented merely by two low, divergent *linea aspera* about one inch apart.

Both specimens (Nos. 545, 540) belong to a large animal. The skull is about 25 inches in length, and is wholly different in its

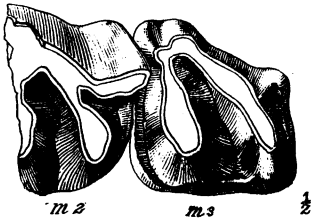


Fig. 4. Second and third upper molars of *Aceratherium simplicidens* Cope, type. One-half natural size.

proportions from that of the contemporary *A. tridactylum*, which is of the high narrow type, and about 20 inches in length. The prominent bosses above the post-orbital processes, the short obtuse nasals, the very large horizontal lower incisors, or canines, the flattened upper surface of the cranium, are all characters which

immediately distinguish this type. The proportions of the skull suggest that this species may have succeeded the *A. mite* Cope.

The last upper molar is somewhat similar in form to that of *A. simplicidens* Cope.

***Aceratherium tridactylum* Osborn.<sup>1</sup>**

PLATE II, E, AND PLATE III.

This species was founded upon the remarkably complete skeleton represented in Plate III. Other remains are a fine skull

<sup>1</sup> Bull. Am. Mus. Nat. Hist., Vol. V, April 29, 1893, p. 85.



(No. 541), and many fragmentary portions of the skeleton. Found in the coarse sandstones or lower division of the 'Protoceras Beds.'

The specific distinctions are : Dentition,  $\frac{2}{3}$ ,  $\frac{0}{3}$ ,  $\frac{4}{3}$ ,  $\frac{3}{3}$ . (a) The *upper premolars* cannot be clearly defined at present, owing to the adult wear. (b) Internal cingula upon *upper molars* faintly developed or wanting ; first, second and third molars with strong 'antecrochet.' (c) Semiprocumbent lower canines. (d) *Skull* elevated, elongate nasals, broad postglenoid-posttympanic contact, high occiput, powerful sagittal crest.

The following paragraph is from the original description of the type specimen :<sup>1</sup> "The skeleton measures seven feet nine inches in length, and four feet in height to the top of the lumbar vertebral spines. There are nineteen dorsal, five lumbar and three sacral vertebræ. The pelvis is long and rather slender, and the limbs are of an intermediate type, heavier than in *A. occidentale* and much longer than in the Upper Miocene *A. fossiger*. There are only three digits in the manus, hence the name *tridactylum*, there being no trace of the fifth digit, which is so characteristic of the Lower Miocene Rhinoceroses of America and Europe, with the possible exception of *A. mite* Cope."

In the type the nasals are perfectly smooth, but in another skull (No. 541) the nasals exhibit a pair of rugosities which at once suggest the possession of a pair of horns, and Mr. Hatcher<sup>2</sup> has recently shown that this species is followed by another, related to the John Day genus *Diceratherium* Marsh. The distinctive features of the skull are the high, narrow occiput, and powerful sagittal crest, the arching and rugose nasals overhanging the premaxillaries, the posterior lateral projections of the zygomatic arches, the widely united postglenoid and posttympanic processes. The dentition is characterized by the medium sized semiprocumbent lower canines, and by the strong 'antecrochet' upon the upper molars.

#### GENERAL FEATURES OF THE LOWER MIOCENE RHINOCEROSSES.

##### PLATES II AND III.

From these observations it appears that there was a very rapid evolution both in form and in size among the Lower Miocene

<sup>1</sup> Loc. cit.

<sup>2</sup> American Geologist, May, 1894, p. 360.

Rhinoceroses, also that there was considerable variety and a number of parallel lines of species. The succession in *time* is : *A. trigonodum*, *A. mite*, *A. occidentale*, *A. tridactylum*, and *A. platycephalum*. The relative appearance in time of *A. simplicidens* Cope and *A. pumilum* Cope has not been ascertained, nor do we understand as yet the phyletic succession of any of these species.

The transformation of the upper premolars is particularly interesting : first, in the retention of the D. P. 1 and D. P. 2 as permanent teeth, the latter exhibiting fully molariform transverse crests ; second, in the more rapid evolution of the third premolar than of the fourth premolar. Quite the reverse of this is the case in the horses, where the fourth premolar is more progressive than the third.

The discovery of *A. tridactylum* and of *A. platycephalum* was quite unexpected. The former may connect with *Diceratherium* through the *D. proavium* of Hatcher. The latter is an altogether unique form, as it resembles none of the later Miocene types thus far discovered. The distinctive features of the skull evolution are well shown in Plate II.

### Family AMYNODONTIDÆ S. & O.

In this family of aberrant Rhinoceroses are included the genera *Amynodon*, *Metamyndon*, and possibly *Cadurcotherium*, a European form which presents many analogies to the American Amynodonts. The previous family definition given by Osborn may now be amended as follows :

Large upper and lower canines. Upper and lower incisors reduced in number, and of a uniformly small size. Premolar series in both jaws greatly reduced. Last upper molar with a complete ectoloph. Skull with a short facial region and powerful sagittal crest. Functional digits 4-3. Lunar wedge-shaped distally.

We are now enabled to fully compare these animals with the Rhinocerotidæ, the most striking differences being in the peculiar form of the skull, the great canine tusks, and the four functional toes in front. Very numerous minor differences run throughout

the dentition and skeleton, and indicate ancient divergence from the Rhinoceros stem.

*Restoration.*—The most complete individual, which we refer to *M. planifrons*, gives us all the proportions of the body. The adult was about 9½ feet long and 4½ feet high at the shoulders, with a low, compactly built body, muscular limbs and deep chest. The vertebral spines were not elevated. Thus the general appearance of the animal, with its low, broad skull, widely spreading zygomatic arches and tusks, was widely different from the contemporary *Aceratherium* with its light build, feeble canine tusks and high, narrow skull.

### **Metamynodon planifrons** S. & O.

All the specimens in the collection (Nos. 546-554) are provisionally referred to this species. The variations in size and dental formulæ do not afford the basis for specific separation from the type at present.

The material collected in 1892 embraces remains of nine individuals, as follows: *A*, from *Metamynodon stratum*: No. 546, greater part of skeleton, fragments of skull, lower jaw complete, lacking pelvis and lumbar; No. 547, skull; No. 549, lower jaw; No. 550, lower jaw of young individual, with milk teeth; No. 551, jaws of young individual; No. 552, fragmentary lower jaw; No. 553, complete lower jaw. *B*, from *Upper Oreodon stratum*: No. 548, fore limb; No. 696, lower jaw.

#### SKULL AND LOWER JAWS.

The osteology of the skull has already been fully described; the lower jaws are long and not very deep; the condyle is elevated, with great transverse and slight antero-posterior section. The coronoid is slender; the border of the angle is thickened as in *Rhinoceros*. The symphysis is long and horizontal with a single mental foramen.

*Dentition.*—The dental formula as given by Scott and Osborn requires modification, as there is evidence that the number of incisors is less than stated by them. In skull No. 555 there are three upper incisors upon one side and two upon the other. Of  
[July, 1894.]

the lower jaws, Nos. 551 and 546 present two incisors upon each side, while No. 555 has but a single incisor upon each side. There are three upper premolars and two lower premolars as a number constant in all the specimens. The dental formula should therefore be written I.  $\frac{3-2}{2-1}$ , C.  $\frac{1}{1}$ , Pm.  $\frac{3}{2}$ , M.  $\frac{3}{3}$ . The *incisors* are sub-functional, being better developed than appeared in the Harvard College type skull. The most exceptional feature is the large *canine* tusks, which are  $3\frac{1}{2}$  inches in length in the lower jaw, and 2 inches in length in the upper jaw. The lower canines are strongly recurved, trihedral in section, with posterior faces worn flat by close friction with the anterior faces of the upper canines. Both pairs of tusks diverge, and are outwardly curved like those of the wild boar. The *premolars* are characterized by extreme reduction in size, the antero-posterior diameter of the entire premolar series being less than that of the second true molar. They also show a limited assumption of the molar pattern, as has been already pointed out. The *upper molars* are distinguished by the flattened external face of the ectoloph, which in M. 3 is carried well beyond the metaloph, a feature which is very rare in the true Rhinoceroses. There is a trace of the 'crista' in M. 2 in one specimen (No. 547.) There is no internal cingulum, and the transverse crests are devoid of either the crochet or antecrochet.

The *lower molars* are remarkable for their extremely high, elongate and laterally compressed crowns, which exhibit a tendency to a prismatic or hypsodont structure. The anterior crest is strongly and sharply incurved. In the molars of Nos. 550, 555, 546 a prominent tubercle appears at the entrance of the posterior valley. The third molar has only two lobes, as in the true Rhinoceroses.

#### THE SKELETON.

*Vertebrae*.—The following description refers exclusively to No. 546, unless otherwise specified. The atlas indicates powerful transverse processes; the suboccipital foramen perforates the anterior part of the arch. The axis is rather elongate, and exhibits an obtuse odontoid process. The remaining cervicals have strongly opisthocœlous centra, with oval faces, the greatest diameter being transverse; the zygapophyses are large and slightly oblique; the neural spines are not preserved; the seventh cervical is im-

perforate, and its centrum shows a facet for the first rib. Fifteen *dorsals* are preserved. The first dorsal has a broad descending lamella from the transverse process with a facet for the tuberculum of the first rib; the capitulum of the first rib articulates at the anterior base of the process. The succeeding dorsals lack the lamella; the adjacent facets for the capitulum of the rib become confluent between the third and fourth dorsals; the capitulum is supported on adjacent facets between each pair of vertebræ as far back as the 15th dorsal. The tubercular facet is also exhibited upon the 15th dorsal, the last one completely preserved. The zygapophyses are very small, and are horizontal in position from the first to the 11th dorsal, when they begin to take an oblique position; in the 15th they are considerably rounded and obliquely placed. The dorsal spines are not very elevated in the mid-dorsal region, and they sink rapidly towards the posterior end of the series; they have a trihedral section; they are keeled anteriorly, and deeply excavated posteriorly from D. 3 to D. 12, where the upper portion of the spine assumes the broad flattened form characteristic of the lumbar. No vertebræ are preserved behind the 15th dorsal except five of the caudals.

*Ribs*.—Fourteen ribs of the right and six of the left side are preserved, indicating that there was a deep, rather narrow chest. The first rib has an oval section above and is flattened below. The 2d to the 7th ribs have flattened shafts; the ribs from the 8th to the 14th pass from a trihedral to a rounded section. From the length of the ribs it is estimated that the depth of the chest was about 35 inches.

*Scapula*.—Of the scapula only the lower portion is preserved. It exhibits a shallow glenoid fossa, a low rugose corocoid process.

*Humerus*.—The humerus is massive, with prominent greater and lesser tuberosities, a rugose deltoid crest slightly retroverted, but not hooked, extending half-way down the shaft. The ectepicondyle is very prominent, and there is a supratrochlear foramen. The internal condyle is perfectly flat. The relative measurements of the humerus and the radius are 16 in. to 13 in.

*Radius*.—The radius has a characteristic pit on its front face just above the insertion of the *brachialis anticus*; the shaft is

flattened, and distally presents a very strongly concavo-convex face for the scaphoid, and slightly concave face for the lunar.

*Ulna.*—The ulna has a short olecranon, a trihedral shaft and a prominent rugosity on the median external face; distally there is a deep groove upon the anterior face for the passage of the extensor tendon; it rests partly upon the lunar as well as upon the cuneiform.

The *pelvis* is wanting.

*Hind Limbs.*—The hind limbs are characterized by the great length of the femur in proportion to the tibia—the ratio being femur, 19 inches; tibia, 11 inches. The head of the *femur* has a large pit for the *ligamentum teres*, a prominent rugose great trochanter which does not rise above the head; a shallow digital fossa; the lesser and third trochanters are low and placed well down upon the shaft; the rotular groove faces obliquely downwards, indicating that the knee was carried well up; the external and internal tuberosities are equal; the external condyle is the largest. The *tibia* has a double spine, a broad cnemial crest, which exhibits a deep median superior depression; the internal malleolus is not prominent, and the astragalar trochlear, as in *Aphelops*, is shallow. The *fibula* is complete although reduced, with an expanded distal extremity; the shaft is trihedral in section and not laterally compressed.

*Manus.*—The manus exhibits the articulations and relations invariably associated with tetradactylism, viz.: the lunar is wedge-shaped distally, and is supported equally upon the magnum and unciform instead of mainly upon the unciform, as in the *Rhinoceros* and in tridactyl types generally. The bones of the proximal row are in other respects similar to those in *Rhinoceros*. The distal row shows a small trapezium; the second digit being supported by the trapezoid and abutting against the magnum; the third and fourth digits articulate with the magnum and unciform in the usual manner, and the fifth is well developed, as indicated by a broad horizontal unciform facet. The larger specimen (No. 548) from the “upper *Oreodon stratum*” exhibits a third digit and a large fifth digit fully as functional as in *Titanotherium*, and more strongly developed than in the *Tapir*.

*Pes*.—The pes is remarkable especially for the form of the tuber calcis, which is elongate, flattened, expanded distally, and has its long axis placed nearly transversely instead of antero-posteriorly. The cuboid has a larger astragalus than calcaneal facet, while the astragalus itself is very short. The middle metapodial abuts against the cuboid. As a whole the pes is very short.

In addition to the points above noted, *Metamynodon* is distinguished from the modern Rhinoceros by a lesser development of the humeral tuberosity and of the third femoral trochanter, by the elongated neck for the head of the femur, and by the shortness of the astragalus. Upon the whole, however, it is much more advanced and specialized in the direction of the modern Rhinoceros type than the contemporary *Aceratherium occidentale*.

## Family EQUIDÆ.

### Subfamily ANCHITHERIINÆ.

#### CHARACTERS OF THE LOWER MIOCENE SPECIES OF HORSES.

The typical form, *Meshippus bairdii*, extends apparently unmodified in form and very slightly increasing in size from the lowest to the highest beds, while just above the Oreodon strata a distinct and much larger form appears, and in the highest strata (Protoceras Beds) a second larger type appears transitional to the John Day *Anchitherium*. We thus observe the *persistence of primitive species of Horses contemporary with divergent progressive species* as a characteristic of the evolution of the Horses. This is in accord with the previous observations of Marsh, confirmed by Scott and Osborn, that a form ? *Anchitherium parvulus*, which is very slightly removed in dental characters from *Meshippus*, occurs even in the top of the Miocene (Loup Fork);<sup>1</sup> also with Scott's recent observations upon the polyphyletic series of the upper Miocene (Deep River) Horses of North America.

#### **Meshippus bairdii** (*Leidy*).

This well-known species is represented by remains of sixteen individuals—Nos. 664-677, 712, 713—chiefly from the 'Oreodon'

<sup>1</sup> See Scott and Osborn, Bull. Mus. Comp. Zool., 1890, p. 89.

and 'Metamynodon' strata, including all parts of the skeleton and of the dentition excepting the incisor teeth. Among the most valuable specimens for morphological study is the nearly complete skeleton of a young individual, No. 685.

#### INCERTÆ SEDIS.

#### ? *Meshippus longipes*, sp. nov.

The type of this species is a complete hind limb (No. 684), found just above the 'nodular layer' in the sandstones and clays of the upper 'Oreodon beds.'

It presents certain points of likeness with the hind limb of *Hyracodon nebrascense*, as well as with that of the *Miohippus annectens*, recently described by Scott from the 'Deep River Beds' of Montana, which lie at the base of the Loup Fork or Upper Miocene.<sup>1</sup> In other words, if really a Horse it is a much larger and more modernized type than the *M. bairdii*. The animal stood about 31 inches high at the hip, while *M. bairdii* stood 21 inches high.

The pelvis is similar to that of *M. bairdii*, so far as we can determine from the small portion preserved. The femur has a deep pit for the *ligamentum teres*; the great trochanter is missing; the third trochanter is placed higher upon the shaft than the second. The tibia has a greatly elevated cnemial crest. The fibula is reduced to a continuous extremely slender shaft closely applied to the side of the tibia. The calcaneum has a long tuber calcis, and displays a small fibular facet; the ectal superior calcaneo-astragalar facet is separate, while the ental and inferior facets are continuous, thus differing widely from the separate facets of *M. bairdii*, and resembling those of *H. nebrascense*. On the other hand the astragalo-tibial grooves of the ankle joint are much sharper than in any known species of *Hyracodon* and resemble those of the Horses. The cuboid articulates with the astragalus by a very narrow facet as in both the Horses and *Hyracodons*. The navicular displays a deep postero-external facet for the cuboid. The ectocuneiform is very deep with an

<sup>1</sup> 'The Mammalia of the Deep River Beds,' Trans. Am. Phil. Soc., Vol. XVII, May, 1894, p. 80.



external facet for metatarsal IV. The mesocuneiform is short. The entocuneiform has a small navicular facet.

The toes spread distally; the lateral pair are relatively larger and more oval in section than in *M. bairdii*. The proximal phalanges are much longer relatively than in the typical Horses. Altogether it is very doubtful where this animal belongs. It is widely distinct from both the known lower Miocene Horses and Hyracodons.

The specific characters are: (a) Metatarsals 3, long and slender, slightly spreading distally. (b) Sustentacular and inferior calcaneo-astragalar facets continuous. (c) Astragalo-tibial grooves sharp. (d) Fibula complete, but greatly reduced and closely applied to tibia.

## Suborder ARTIODACTYLA.

### Family OREODONTIDÆ.

An unusually fine series of skulls of the Oreodonts from all levels of the White River formation enables us to add something to the knowledge of the vertical distribution of the species. It has been stated at various times that remains of Oreodonts occur in the lower Titanotherium Beds, but careful search in the region explored by our party, viz.: the divide between the White and Cheyenne Rivers, has failed to bring to light a single specimen of the group from these underlying strata. All the specimens in our collection were found in the Oreodon and Protoceras Beds, or middle and upper divisions.

#### *Oreodon culbertsonii* Leidy.

Remains of this species are exceedingly abundant in the lower 'nodular layer' of the 'Oreodon Beds'; it is from their relative abundance in this stratum that this primary division of the White River sediments takes its name. The typical nodular layer, in which their remains are especially numerous, lies within fifteen or twenty feet of the top of the Titanotherium strata, and it is not an unfrequent occurrence to find them also in the clays immediately overlying the Titanotherium Beds; in fact it is highly

probable that the species has been found in the extreme uppermost layers of the Titanotherium Bed proper.

So far as our collection shows, the vertical range of *O. culbertsonii* does not exceed thirty feet, extending from the top of the Titanotherium Beds, upwards some distance above the lower nodular or 'red layer.' It is probable, however, that more extensive collections will increase this limit considerably both above and below.

The principal characters of this species are seen in the very small, uninflated tympanic bullæ, the form of the paroccipital processes, and the presence of a distinct and separate foramen rotundum. In the absence of any accurate description of this region of the skull, it is here treated in some detail for purposes of comparison with later types. The specimen described and figured is No. 595. The bullæ are small and rugged in contradistinction to the large, smooth, rounded form found in the later species. The paroccipital processes are rather elongated, more or less triangular in section, especially at the base, and connected with the posterior portion of the bullæ by prominent ridges. At the base of the paroccipital process, on the side looking towards the postglenoid, are seen two fossæ, separated from each other by a well-marked lamina of bone extending out from the paroccipital; in the anterior of these fossæ is found the point of articulation of the tympanohyal element of the hyoid arch, while in the posterior fossa is seen the external opening of the stylomastoid foramen.

At the posterior termination of the pterygoid plate of the sphenoid, and immediately in advance of the bulla, is situated the *foramen ovale*, while upon the outer side of the root of the pterygoid, in advance of, and a little internal to the foramen ovale, is seen another distinct, though smaller, foramen, which is in all probability the *foramen rotundum*. In front of this again come the large sphenoidal fissure and the optic foramen.

#### **Oreodon gracilis** *Leidy.*

This species, of which there are a number of skulls in our collection, has practically the same vertical distribution as *O. culbertsonii*. It is readily distinguished by its smaller size, by the

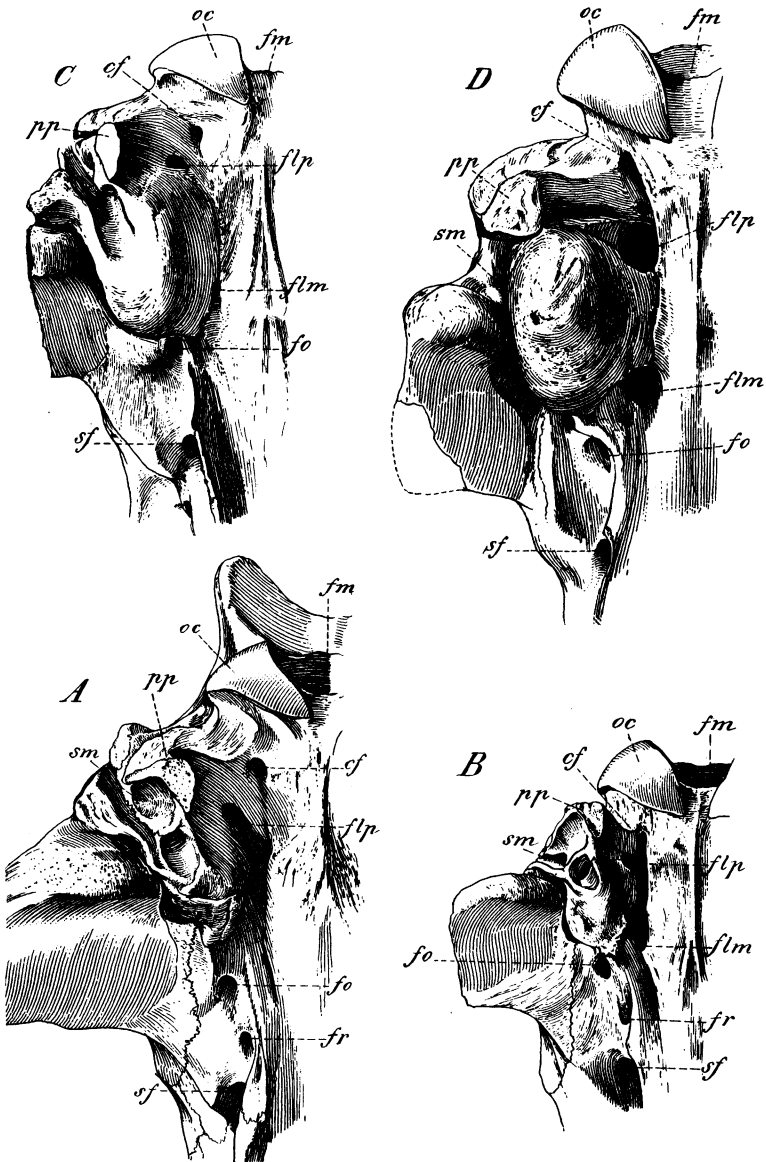


Fig. 5. Evolution of the Basi-occipital Region in Oreodon. C, *Oreodon bullatus* (No. 611). D, *Eporceodon major* (No. 1038). A, *Oreodon culbertsonii* (No. 595). B, *Oreodon gracilis* (No. 596). Natural size.

somewhat greater inflation of the bullæ, and by the less distinct double fossa at the base of the paroccipital. It has, however, a distinct and relatively large foramen rotundum. Fig. 5 *B* (No. 596).

### **Oreodon bullatus** *Leidy*.

There is a single skull of this species in our collection (No. 611) which was obtained from the second 'nodular layer,' from seventy-five to a hundred feet above the 'red layer' of the 'Oreodon Bed.' It is a matter of much interest to note that the bullæ are much more inflated than in either *O. culbertsonii* or *O. gracilis*. They are, moreover, extended backwards and are largely in contact with the paroccipitals, which are, however, not flattened from before backwards to any appreciable extent. The posterior fossa at the base of the paroccipital is but faintly represented, the anterior being large and distinct.

The *foramen rotundum* is represented by two very minute vestigial foraminæ at the sides of the pterygoid plate, between the sphenoidal fissure and the 'foramen ovale.' It is more than probable that these will be found wanting in many specimens of this species. In our specimen they certainly could not have been functional, and there can be little doubt that the superior maxillary nerve made its exit through the sphenoidal fissure. The foramen rotundum therefore may be said to be practically absent.

### **Eporeodon major** (*Leidy*).

In the overlying Protoceras Beds Oreodons are very numerous. They are found principally in a nodular layer just as in the lower beds. So far as our collection shows, all the species of this upper horizon exhibit greatly inflated bullæ (see No. 1038); the paroccipital is flattened at its base and applied closely to the bullæ; there is no posterior fossa at the base of the paroccipital, and the foramen rotundum is entirely wanting. The crowns of the teeth are more elongated, and the species are slightly larger.

It is stated by Scott<sup>1</sup> upon the authority of Marsh,<sup>2</sup> that in the Oreodons from the John Day horizon the thumb is absent and

<sup>1</sup> *Morpholog. Jahrbuch*, Vol. XVI, p. 339.

<sup>2</sup> 'Notice of New Tertiary Mammals,' *Amer. Jour. Sci.*, Vol. IX, p. 239-250.

that the bullæ are inflated. This character of the absence of the thumb is regarded by Scott as sufficient ground for the separation of these species into a distinct genus (*Eporeodon*). He does not apparently regard the species with the inflated bullæ from the White River formation as belonging to this genus, and criticises Marsh for proposing the genus upon the ground of the inflation of the bullæ. He remarks further that the forms with the large bullæ occur together with those of the uninflated bullæ in the same strata. This is not borne out by our observations. As regards the presence or absence of the thumb in the species from the Protoceras Beds very little is known at present, but it is a fact, abundantly demonstrated by our collection, that the greatly inflated bulla type, with flattened paroccipitals and lacking the foramen rotundum, comes *only from the upper or Protoceras Beds*. In a like manner those species in which the bullæ are little or not at all inflated, the paroccipitals are not flattened and the foramen rotundum is present, are confined to the lower part of the Oreodon Beds. The single example of the transitional form, *O. bullatus*, has a position exactly intermediate, in respect to its vertical distribution. These facts are significant, and seem to demonstrate very conclusively that the range in time corresponds with the evolution of the bullæ.

### Family ANTHRACOTHERIIDÆ.

The expedition was fortunate in securing a number of specimens of *Hypotamus*, including several more or less complete skulls and lower jaws, and of still greater interest the first remains of *Anthrocotherium* found in this country, proving that the Anthrocotheriidæ were represented by both the characteristic European genera.

#### ***Hypotamus americanus* Leidy.**

This species, which has hitherto been known only from isolated teeth, is represented by the anterior portion of the skull (No. 575) and other remains. The molar teeth agree precisely with Leidy's type, and enable us to characterize this species more fully. It is of precisely the same size as the *H. velaunus* from Ronzon, as

figured by Filhol. It also resembles this European species closely in the greater elongated, narrow muzzle, but differs from it in the absence of the first superior premolar. The skull, so far as preserved, does not present any further differences.

The locality is the 'Metamynodon stratum,' in which the remains of several individuals were found. Among them is a series of three upper molars (No. 576) which are of considerably larger size; also some lower jaws with milk teeth.

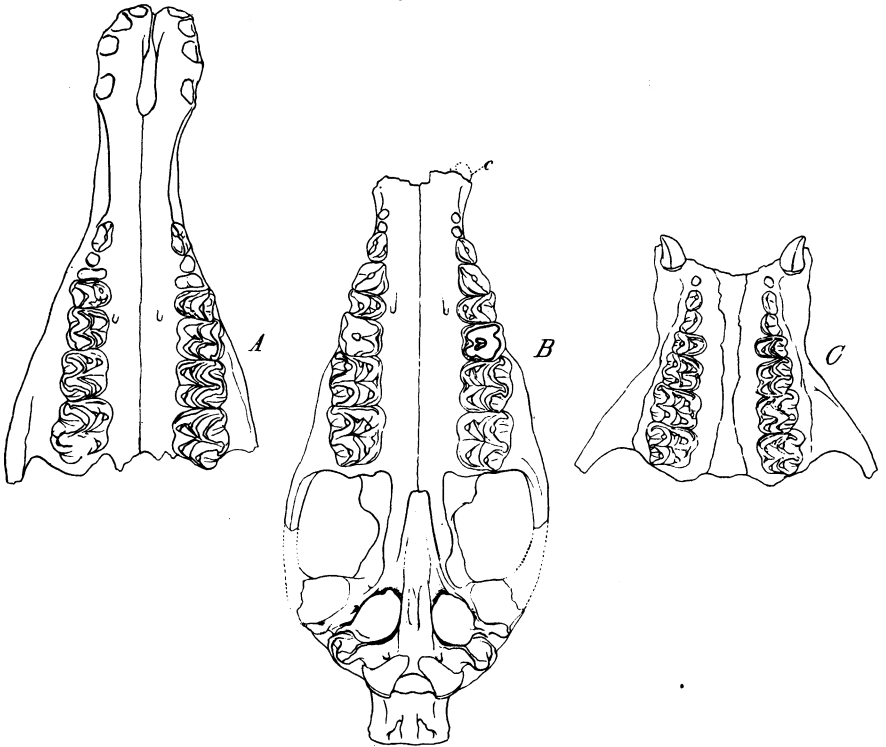


Fig. 6. Palatal Views of Skulls of Anthracotheres. A, *Hyopotamus americanus* Leidy (No. 575). B, *Hyopotamus brachyrhynchus*, type (No. 582). C, *Anthracotherium curtum*. One-fourth natural size.

### ***Hyopotamus brachyrhynchus*, sp. nov.**

The type of this species is a skull (No. 582) from the overlying Protoceras Beds; it is well distinguished by the shortness of the muzzle, as the specific name indicates. The interval between

the base of the canine and the second premolar is but one-half as great as in *H. americanus*. There is also a well-developed bifanged first premolar.

## METAMYNODON BEDS.

*H. americanus*.

I.<sup>3</sup>, C.<sup>1</sup>, P.<sup>3</sup>, M.<sup>3</sup>. Muzzle elongated, C. to P.<sup>2</sup>=70 mm. Second upper premolar with feeble internal cingulum.

## PROTOCERAS BEDS.

*H. brachyrhynchus*.

I.—, C.<sup>1</sup>, P.<sup>4</sup>, M.<sup>3</sup>. Muzzle short, C. to P.<sup>2</sup>=36 mm. Second upper premolar with strong internal cingulum. Molar cingula and styles strongly developed.

The type skull of *H. brachyrhynchus* is shorter than that referred to *H. americanus*, but otherwise is of the same proportions. The principal characters are as follows: Orbits open posteriorly; a sagittal crest; occiput compressed laterally, as in *H. aymardi*; paroccipital process prominent and separated from the postglenoid by the tubular portion of the tympanic. The tympanic bullæ are well inflated as in the Peccary, but are lower, more rounded, and more elongated antero-posteriorly.



Fig. 7. Superior Dentition of *Anthracotherium? curtum* Marsh.  
Two-thirds natural size.

***Anthracotherium curtum* Marsh.**

The specimen referred to this species is part of a skull (No. 1039) containing the canine, and the complete premolar-molar series of the left side, and the fourth premolar and three molars of the right side. In size it resembles the smaller European species. There is absolutely no diastema.

*Upper dentition.*—The canine is vertically placed and more triangular in form than in the European species, and exhibits a sharply worn anterior face. Pm. 1 is missing; it is single-fanged. Pm. 2 has traces of the cingulum at the

outer angles and upon the inner face. In Pm. 3 these features are strengthened, and this tooth exhibits a postero-internal shelf. Pm. 4 has a well-developed internal cusp (deuterocone) surrounded by a basal cingulum; the protocone is subrescendent. The molars exhibit rather low obtuse cusps of crescentic form, with the characteristic protoconule; the parastyle and mesostyle are low and obtuse; the metastyle is rudimentary or incipient except in M. 3; the internal cingulum is not very prominent. In general these teeth are of the low selenodont type found in the European forms.

The locality is the 'Metamynodon stratum' of the Oredon Beds. The description of this specimen was completed when a communication was published by Professor Marsh<sup>1</sup> of a new species, *Heptacodon curtus*, founded upon a single molar tooth, and said to be "apparently allied to *Hyopotamus*." The type of *H. curtus* is slightly smaller than the specimen here described. The author does not recognize the relationship to *Anthracotherium*.

#### **Anthracotherium karence, sp. nov.**

This is a larger form from the Protoceras Beds, and is represented by the last two upper molars of the left side (No. 1040). It is well distinguished by the very strong development of the

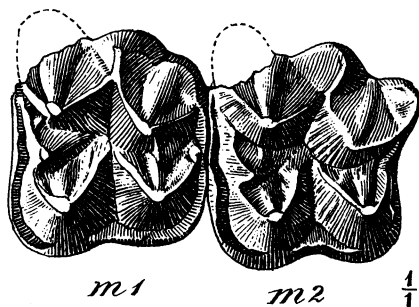


Fig. 8. First and Second Upper Molars of *Anthracotherium karence*, type. Natural size.

mesostyle upon M. 2 and M. 3, and by the prominent metastyle upon M. 3. The molars are of larger size than in *A. occidentale*, the cusps are more elevated and more sharply crescentic, the in-

<sup>1</sup> 'A New Miocene Mammal,' Am. Jour. Sc., May, 1894, p. 409.



ternal cingulum is also much more prominent. In general these teeth approach more nearly the *Hyopotamus* type, excepting of course in the form of the mesostyle.

This species is named after one of the prominent peaks in the Black Hills—*Inyan Kara*.

## METAMYNODON BEDS.

*A. occidentale.*

C.<sup>1</sup>, P.<sup>4</sup>, M.<sup>3</sup>. Molars with low cusps semibunodont. Feeble metastyle on M.3. Internal cingulum not prominent. *Measurements*: M.2-3, 40 mm. Width M.3, 23 mm.

## PROTOCERAS BEDS.

*A. karense.*

Formula unknown. Cusps of molars elevated and crescentic. Mesostyle a prominent crested spur. Metastyle very prominent in M.3. *Measurements*: M.2-3, 54 mm. Width, M. 3, 27 mm.

## Order CREODONTA.

## Family HYÆNODONTIDÆ.

*Hyænodon paucidens*, sp. nov.

This species is based upon an unusually perfect skull and lower jaw. The most striking characters in which it differs from all other *Hyænodons* hitherto discovered, is the absence of the first premolar in the upper jaw. The dental formula therefore is I.  $\frac{3}{3}$  C.  $\frac{1}{1}$ , Pm.  $\frac{3}{4}$ , M.  $\frac{2}{3}$ , instead of I.  $\frac{3}{3}$ , C.  $\frac{1}{1}$ , Pm.  $\frac{4}{4}$ , M.  $\frac{2}{3}$ , as it is in all other species of this genus so far known. It has generally been the practice among palæontologists to regard a character of this importance as of generic value, and there are doubtless few who would hesitate to propose a new genus for its reception, but the skull in every other respect is so very like that of the other species of *Hyænodon* that it is deemed inadvisable to pursue such a course.

Careful examination shows that the absence of this tooth is not an accidental variation. In the first place the space which the first premolar should occupy is relatively shorter than in the nearest ally, *H. crucians*, being only 10 mm., whereas in *H. crucians* it is 15 mm. The entire length of the tooth line measuring from the posterior border of the upper canine to the posterior border

of the last molar is 80 mm. in *H. crucians*, and 70 mm. in *H. paucidens*. The third premolars in both the upper and lower jaws have a more oblique position, and the teeth are more crowded than in *H. crucians*. The skull is slightly smaller, the muzzle narrower and the canines longer and more robust than in *H. crucians*. The palatal region agrees very closely with that of *H. crucians* in having the palatines in contact throughout their entire length, and the pterygoid plates of the alisphenoid separate in the median line. In this respect both species differ markedly from the species described by Scott,<sup>1</sup> *H. leptcephalus*, in which the pterygoid plates are in contact for a long distance. The interorbital constriction in the skull of *H. paucidens* is placed at the fronto-parietal suture, where the two diverging branches of the sagittal crest meet, as in the larger species *H. horridus* and *H. cruentus*. In *H. crucians* both are situated in advance of the interorbital constriction.

A synopsis of the American species of the genus may now be given as follows:<sup>2</sup>

- I. *Superior Premolars 4.*  
 A. Posterior nares opening between posterior part of palatines; pterygoid plates of alisphenoid not in contact below.  
 a. Cranial constriction in advance of fronto-parietal suture.....*H. crucians*.  
 b. Cranial constriction at fronto-parietal suture.  
 aa. Face very deep; an external buttress on anterior lobe of last lower molar....*H. horridus*.  
 bb. Face shallower; buttress absent.....*H. cruentus*.  
 II. *Superior Premolars 3*.....*H. paucidens*.  
 B. Palatines in contact throughout; pterygoid plates of alisphenoids meeting below.....*H. leptcephalus*.

### *Hyænodon crucians* Leidy.

A tolerably well-preserved skull of this species is represented in the collection, together with some few fragments of the skeleton. The skull is already well known, and does not call for any further mention. A fragment of the atlas shows that the transverse processes are pierced by the vertebral canal quite in the ordinary way. Two lumbar vertebræ exhibit the usual characters

<sup>1</sup> Journal Acad. Nat. Sci. Philad., Ser. 2, Vol. IX, No. 2.

<sup>2</sup> See Scott, Journal Acad. Nat. Sci., Vol. IX, p. 175.

of the Creodonts in the complex mode of articulation of their zygapophyses. Their centra are strongly keeled below, and there are small though distinct anapophyses present. A fragment of the pelvis, including a part of the acetabulum and the ilium, is interesting as showing the relatively prominent tubercle for the origin of the *rectus femoris*, as well as the absence of the pubic spine. The ilium is apparently little expanded, and there is a distinct cotyloid notch. The proximal end of the femur shows a well rounded globular head, placed upon a constricted and rather elongated neck; the head is marked by a distinct pit for the *ligamentum teres*. The digital fossa is of moderate size, and there is a small though distinct third trochanter. Only the shaft of the tibia is preserved, which indicates a moderately stout bone with considerable lateral compression and a prominent cnemial crest, as in the dog. A fragment of the shaft of the fibula shows that it was much reduced in size, and was slender and delicate. The calcaneum has a moderately elongated tuber; a large facet for the fibula, a prominent external tubercle, and a very oblique facet for the cuboid.

#### THE MILK DENTITION OF HYÆNODON.

A rather complete lower jaw of a young Hyænodon, pertaining to a small species (presumably *H. crucians*) contained in the collection, renders it possible to give a description of the milk dentition of the inferior series. Filhol has described<sup>1</sup> the inferior milk dentition of *Hyænodon cayluxi*, and considered the important fact of their supposed relationship with the Marsupials. Our specimen is more complete than Filhol's, and includes the canines and incisors in addition to the molars and premolars. The roots of two incisors upon the left side are preserved in position, which, together with an alveolus for the third tooth, enables me to state that there were three incisors upon each side. Just as in the permanent dentition, the second or median incisor is crowded back out of position; their crowns are missing. The canines are small, much curved and sharp pointed, very much as they are in the dog. The root is compressed later-

<sup>1</sup> 'Mammifères Fossiles des Phosphorites,' Paris, 1877.

ally, the enamel is extended down much lower upon the outside than upon the inside of the tooth, and there is a faint indication of a cingulum well up towards the point upon the inside.

As regards the milk molars, our specimen shows that the first tooth situated behind the canine did not develop a successor, and, as in the dog and so many other diphodonts, is a *persistent milk tooth*. The second deciduous molar is missing, having already been shed; a fragment of a root on the left side, however, indicates that it had been present. The third milk molar is still retained in position, and would have been, judging from the advanced state of eruption of the permanent tooth immediately beneath, the next one to be discarded. Its general form is like that of the corresponding permanent tooth destined to succeed it, with some few trifling exceptions; it is, however, notably smaller and weaker in every way. The crown is made up of a principal cusp, to which is added in front a very weak and indistinct basal cusp, together with a somewhat stronger cusp and cingulum behind. The fourth deciduous molar is slightly larger than the preceding one. Its structure is very similar to the first permanent molar, which lies immediately behind it, with which it also agrees very well in size. The crown consists of three cusps, the two anterior of which form a rather imperfect though distinct pair of sectorial beads; the third cusp is basal and makes up the weak heel or talon. Its structure is more complex than that of its permanent successor, as is so universally the case among the Carnivora.

It is proper to speak in this connection of the peculiar character of the first lower true molar of the Hyænodonts in general, since our specimen seems to throw some light upon this question. If the adult, permanent dentition of any of either the European or American species of *Hyænodon* be examined, the *small weak first lower molar* is a very noticeable and constant feature. The great disparity in size between it and the tooth immediately in advance, as well as the one immediately behind it, is very marked. It is, moreover, always much more worn, lighter in color, and has all the characteristic marks of a persistent milk tooth. I am now able to state from the condition of wear that *it was protruded early with the milk set*, and not after the lapse of a considerable period,

as is always the case among other diphyodonts. If therefore we are to judge of it by its size, date of appearance, as well as its general structure, it will be necessary to classify it with the first series in the time of its eruption.<sup>1</sup> If this be true it points to a condition among the ancestors of the Creodonts wherein there were five instead of four teeth protruded together.

This peculiarity of the first lower molar is not confined to *Hyænodon*, but is also seen in *Pterodon* and many species of *Stypolophus* as well, although perhaps not so distinctly. It is perhaps another fact suggesting the lineal descent of *Hyænodon* from *Stypolophus*.

## Order CARNIVORA.

### Family NIMRAVIDÆ.

#### Genus *Hoplophoneus* Cope.

This type is represented by two species, the smaller of which, *H. primævus*, is the most abundantly represented. Both species appear to be confined to the 'Oreodon Beds.' Although fragmentary feline remains were also found in the upper 'Protoceras Beds,' they cannot be identified with certainty, and it is probable that they do not pertain to the *Hoplophoneus* type, insasmuch as they indicate an animal of much larger proportions.

#### *Hoplophoneus occidentalis* Leidy.

This species is represented in the collection by two individuals, in one of which the skull and nearly all the vertebræ are preserved, and in the other the limbs and vertebræ in excellent condition, thus rendering it possible to give a complete restoration of the animal.

The chief distinction between the two known White River species is found in the superior premolar formula. In *H. primævus* there are three premolars above, whereas in *H. occidentalis* there are only two. There is another very constant and important

<sup>1</sup> See Wortman, 'American System of Dentistry,' p. 500.



difference between the two species in the matter of size. A comparative statement of the measurements of some of the more important bones brings this fact out very clearly.

	<i>H. occidentalis.</i>	<i>H. primævus.</i>
Length of Humerus.....	200 mm.	170 mm.
“ Ulna.....	212	163
“ Radius.....	160	132
“ Femur.....	250	195
“ Tibia.....	188	160
“ Sacrum.....	100	73

In the numerous specimens of both species in our collection, the astragalus shows a remarkably flat trochlea, as in the *Creodonts*, and the astragalar foramen is present and well developed. In the carpus the scaphoid, lunar and centrale are united, but the suture between the two first-mentioned bones is always visible even in old individuals.



EXPLANATION OF PLATE II.

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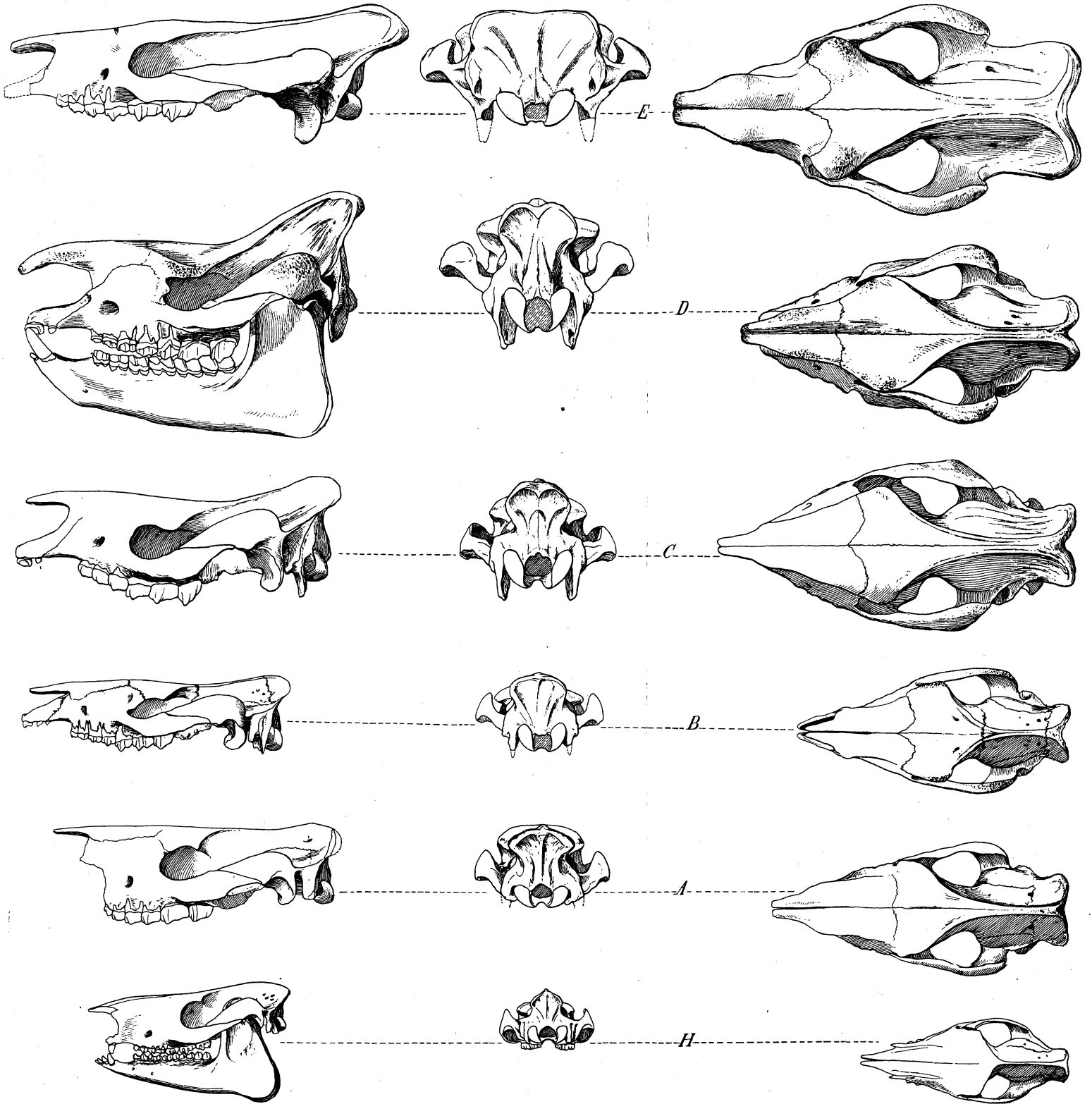
THE LOWER MIOCENE RHINOCEROSES.

*Evolution of the Skull.*

Figures one-eighth natural size.

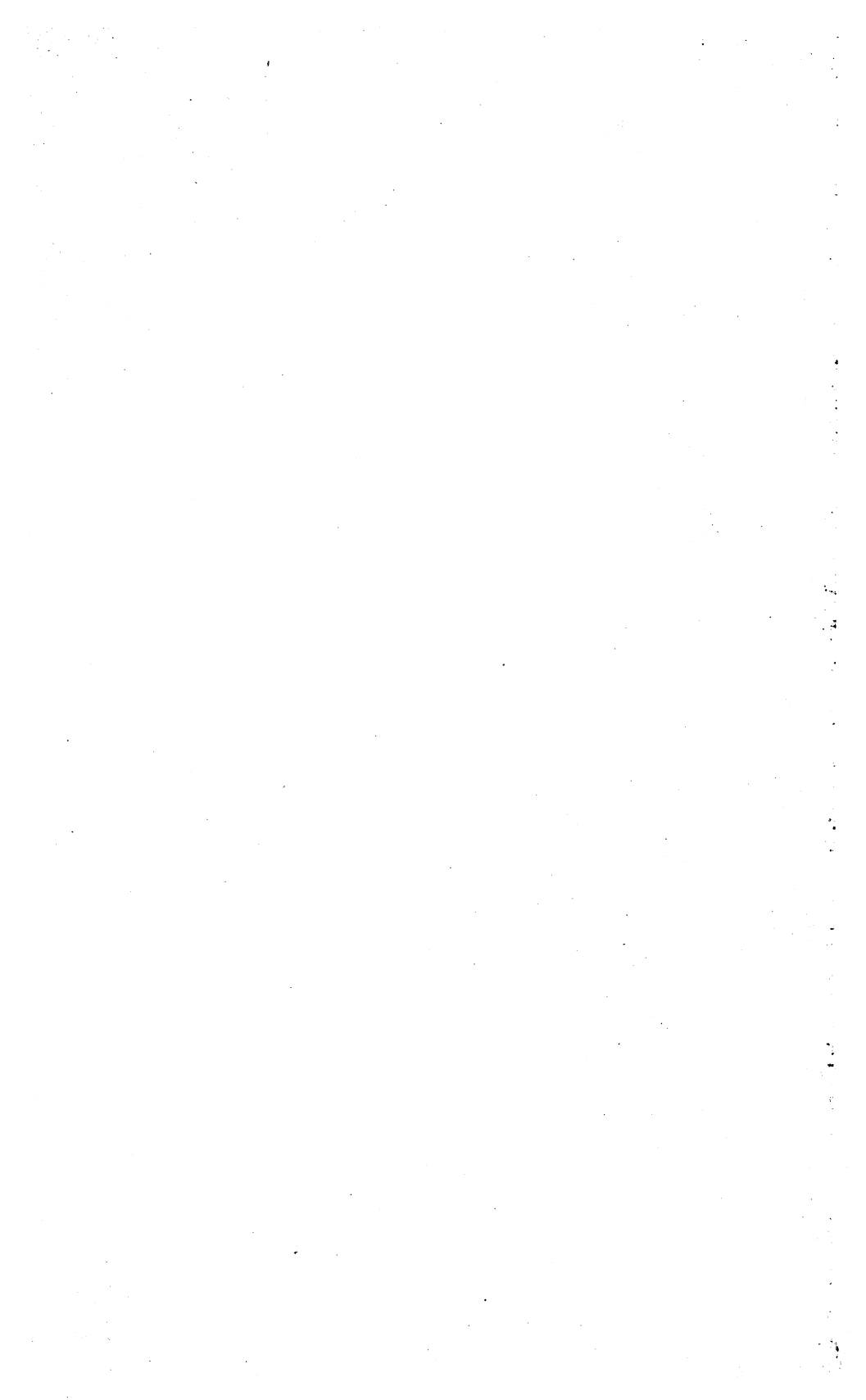
- E.* Aceratherium platycephalum.
- D.* Aceratherium tridactylum.
- C.* Aceratherium occidentale.
- B.* Aceratherium mite.
- A.* Aceratherium trigonodum.
- II.* Hyrachyus agrarius (from the Middle Eocene,  
Bridger Formation).





LOWER MIOCENE RHINOCEROSSES.





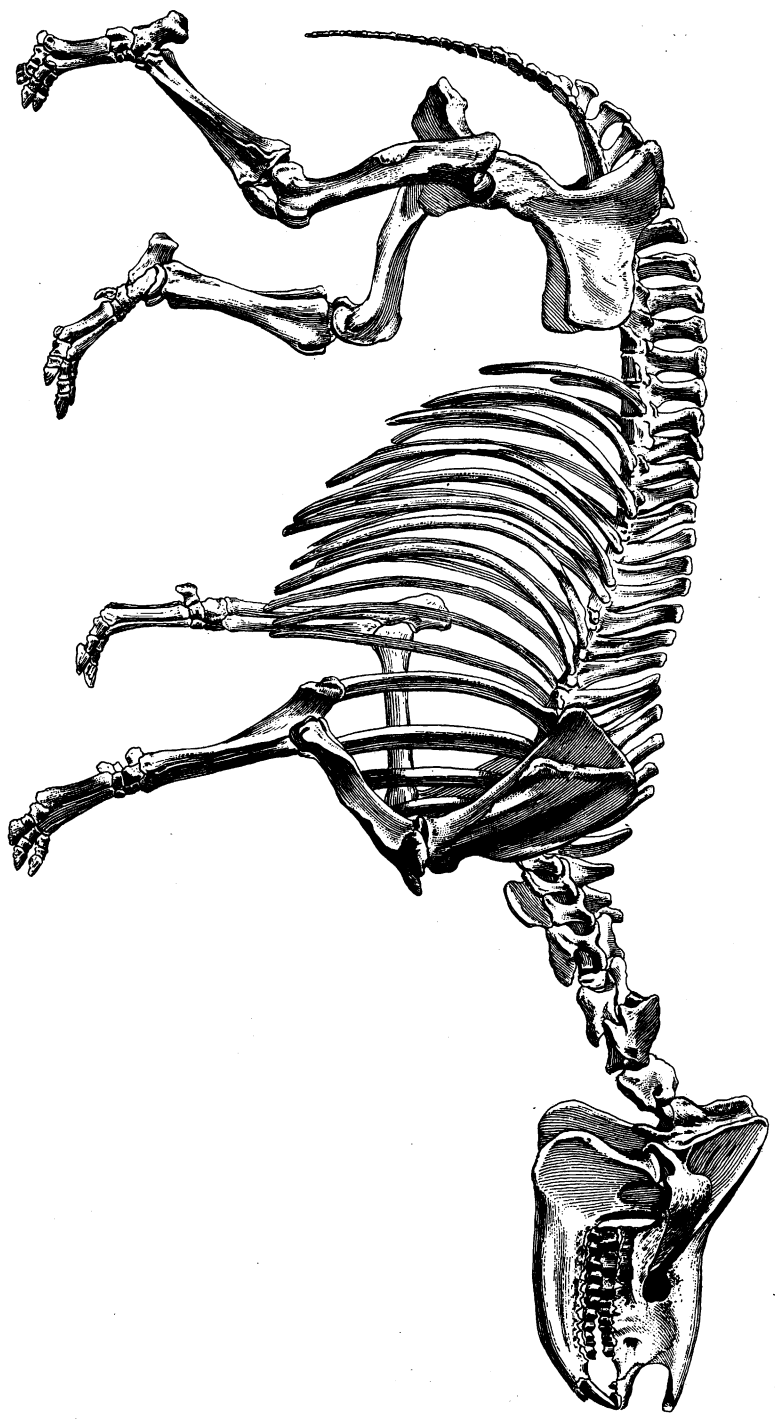
EXPLANATION OF PLATE III.

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SKELETON OF ACERATHERIUM TRIDACTYLUM.

One-tenth natural size.

All parts are preserved and mounted as here represented, excepting : the left fore limb, which is restored from the right side, the great trochanter of the femur, and one or two caudals.



ACERATHERIUM TRIDACTYLIUM.

One-tenth natural size.

