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THE TERTIARY OF MONTANA.

By Earl Douglass.

Introductory Remarks.

It has long been the wish of the writer, to prepare a memoir, complete as it is possible to make it, on the Tertiary formations of western Montana, the object being a restoration, so far as is practicable, of Tertiary times there, to accumulate data so that fairly accurate mental pictures of the conditions at the different periods may be obtained. It is not only interesting to thoroughly study the extinct mammals, which are the most abundant fossils, but to ascertain, as far as possible, what other animals lived at the same time, what plants flourished, and what were the physical conditions generally. Was it a land of mountain chains with intervening valleys as it is now, or was it a vast plain with the late Cretaceous mountains worn nearly down to the sea level? Was the climate dry and the land a dusty, windy waste, or was it a region of lowland forests, rich green uplands, great lakes and broad rivers? Was it a time of upheaval of the strata, of earthquakes, and of volcanic eruptions, that made streams of molten rock, charged the waters with debris, and made the sky gloomy with floating dust; or did each of these conditions prevail at some time during this long period? Was the climate mild and uniform, or were there cold winter storms; and was the land hidden in snow, and the waters imprisoned in ice, during a part of the year? What can we learn concerning the strange creatures of the times, whence they came, and whither they went? Were the forests, if there were any, the same as those we find there now, or have they, with the animals, changed? Can we throw any light on the past migration of plants and animals? What do these few fragmentary chapters teach us with regard to the transmutation of animal life?

These are all interesting questions, and we feel sure that by patient, careful study we may approach nearer and nearer the solution. In the inquiry we need an imagination broad enough to encompass all the possibilities; but the conclusions must be based on evidence alone. We must carefully avoid the accumulation of a chaos of facts on the one hand, and a glittering but frail structure of theories on the other. These problems furnish an ideal toward which to work. There are data bearing on nearly all; yet it is not expected that all can be completely solved here. It will require all the data available and all the talent of all the men working in this field of investigation to even approximately solve them; yet it is felt by the writer that certain aspects of the problems can be better seen by becoming more familiar with a certain area the boundaries of which are more or less definite, and where so many different horizons, with their several faunas, are represented.

The work done by the writer in this region has been primarily that of collecting, and there has not been time for an accurate survey of the extensive field; yet a large number of observations have been made, and many data have been collected from other sources bearing on the solutions of the problems here involved. As the data have accumulated, conceptions apparently more and more in harmony with the facts have gradually taken the place of ideas at first entertained.

It was originally intended to prepare the material and embody it in one comprehensive memoir, but this requires years of work, and it would too long defer the publication of interesting discoveries and results. It has been thought best, therefore, to issue it in parts uniform in style, so that if required, the parts can be bound together in one complete volume, after all have been issued.

To Dr. Wm. J. Holland, the Director of the Museum, and, since the death of Mr. J. B. Hatcher, the acting Curator of Vertebrate Paleontology, I am indebted for the free and unrestricted use of the material. The Montana fossils were collected by myself, or by expeditions in my charge. The drawings for this issue were made by Mr. Sydney Prentice, the draftsman for the Carnegie Museum.

PART I. A NEW MONOTREME-LIKE MAMMAL.

Xenotherium unicum gen. and sp. nov.

(Plate XXII., Figs. 13, 14, 15 and 16.)

One of the most interesting specimens from the Titanotherium Beds at McCarty's Mountain is a nearly perfect skull, which is unlike that of any Eutherian mammal with which I am acquainted; but in most of its characters is very much like the living Monotremes of the Australian region. The only essential skull

characters which distinguish it from modern Monotremes are (*a*) the possession of tympanic bullæ, and (*b*) distinct alveoli for cheek teeth, which appear to have been simple, one rooted, peg-shaped, and six in number on each side.

Among the fossils found near the same level were *Helodermoides*, *Ictops major*, *Ischyromys*, *Hyænodon*, *Agriochœrus*, *Limnenetes*, *Hyracodon*, and *Titanotherium*.

Principal Characters.

Characters of skull.—All the bones of the skull united into one piece, and the sutures, for the most part, obliterated; cranium short with nearly the form of a pear divided in half longitudinally, large and full in the occipital region, tapering rapidly forward to the rather short, low muzzle, broad and slightly convex on top; a large portion of the brain case behind the vertical lambdoid ridges; supraorbital ridges far apart and but faintly discernible; no post-orbital processes on the temporals; zygomatic arches complete, but slender; two infraorbital foramina; foramen magnum large with an extension upward in the occipital; tympanic bullæ present and well developed; pterygoids tending to arch over the space between the posterior portion of the palate, and the tympanic bullæ, but the arch not completed; premaxillaries extending beyond the anterior border of the palate, first diverging and then tending to converge again above.

There are on each side only six alveoli for teeth. These are arranged in longitudinal rows, and there were apparently only six simple, one-rooted teeth on each side. Only the last tooth is preserved and that is a minute peg, scarcely projecting below the palate but apparently covered with enamel. The lower surface is polished and slightly worn by attrition. The anterior tooth was much the largest, and its root evidently extended backward toward the orbit.

Measurements.

Length of skull	3.3 cm.
Width of skull at lambdoid ridges	2.3 "
Height of skull	1.33 "
Length of dental series	.9 "

Detailed Description.

Dentition.—There were apparently six teeth on each side of the upper jaw. The anterior alveolus by its size and the backward extension above and outside of the other teeth shows that this contained a one-rooted caniniform tooth. The posterior alveolus is small and still contains one minute, simple, peg-shaped tooth on each side. The other alveoli appear to have each held a one-rooted tooth. On one side the premaxillary is nearly complete and the one on the other side is less so. On these anterior projections of the maxillaries there is no vestige, or suggestion of in-

cisors, but on the anterior portion of the palate, it looks as though there might have been rudimentary teeth earlier in life.

The anterior alveolus is the largest, is nearly circular, and appears to have held a canine tooth. It extends backward and outward toward the orbit. Its position is indicated by a curved ridge on the maxillary. The second and third alveoli are nearly equal in size; but the fourth, fifth, and sixth diminish in size posteriorly, the last containing a minute tooth. The second, third, and fourth alveoli appear to be antero-internally and postero-externally oblique; and it appears on the outside of the maxillary that the roots of the second and third extend obliquely backward in the same direction as the supposed canine.

The last two teeth—one on each side—are the only ones preserved. They are small, simple, and cylindrical, with only a small blunt point projecting a trifle below the border of the alveolus and the palate. They appear to be covered with enamel as they are black and shiny. The lower surface of one is convex and roughened, with shallow pits and ridges, but I cannot make out any definite pattern. The other tooth is slightly worn or polished on the edge.

The Skull.

The bones of the skull are so thoroughly cemented together that it is difficult or impossible to make out many of the sutures. The muzzle is low and short, and at the canine alveolus twice as wide as high. The portion occupied by the nasals is convex. A curved convexity extends backward from the alveolus of the canine to near the orbits. If the portions anterior to the supposed canine are premaxillaries, then these bones unite below forming the anterior portion of the palate. The processes are separate above and diverge; but anteriorly there is a tendency, as in living Monotremes, to converge. Part of the anterior portions of the nasals are missing. The lines that appear to show the former position of the nasal and nasomaxillary sutures are fairly plain. The nasals are quite long and narrow, and are uniform in width as far as shown. The anterior border of the palate is slightly thickened, and an obscure lobing, with a suggestion of foramina, may indicate the former presence of rudimentary or deciduous incisors. The top of the skull is broad and nearly flat, yet somewhat convex antero-posteriorly and transversely. The most prominent portion (the greatest convexity) is near the middle of the upper surface of the cranium a little farther back than the orbits. The supra-temporal ridges are represented by faint (yet quite readily traceable) lines extending from the anterior portion of the orbito-temporal fossa upward, backward, and toward the middle line of the skull, then turning outward, making a quite regular curve, and ending at the

peculiar lambdoid ridges on the roof of the cranium. These faint supratemporal ridges never come near each other, so there is no sagittal crest; yet there is a faint line, or narrow longitudinal ridge, on the middle line of the skull. The post-orbital constriction is extremely slight as seen from above; but is more noticeable inside the orbito-temporal fossa. The former position of what were probably the fronto-parietal sutures may be faintly distinguished. Faint lines extend in a transverse direction on the skull at the post-orbital constriction, but near the middle line they turn backward and meet, thus forming a V-shaped figure.

The lambdoid ridges are continuous with the posterior portion of the zygoma. Just back of the auditory meatus they curve upward and ascend the brain-case vertically. Toward the top of the brain-case they trend slightly backward, and more so as they approach and meet each other at the upper portion of the occiput. These ridges are quite prominent on the sides, but become minute, low and narrow, on top. Here the skull is highest and widest.

The Occipital Region. — This region may be said to be divided into three lobes or convexities — a median inferior one, and two large lateral ones. The lateral ones are separated above by a thread-like median ridge continuous with the lambdoid ridges, and their lower portion by the median convexity. From the latter, they are separated by a shallow depression or concavity. The foramen magnum is large. The opening extends upward above the occipital condyles.

The occipital condyles are broad, and far apart above. The surfaces for the articulation with the atlas nearly meet below. Above each condyle is a small concavity. The basioccipital is partly hidden by the auditory bullæ, which are large and coössified with the exoccipitals, squamosals and pterygoids. They are somewhat flattened vertically — that is, they are not so nearly spherical as in some other mammals; though they are considerably inflated as seen from below. They are broadest internally, and narrow toward the external auditory meatus, which is short. They are three sided; two of the sides are convex; the anterior one is concave. There is a convexity on the middle of the lower surface and one on the inner border extending from the pterygoid backward nearly to the occipital condyle. The pterygoids partly arch over the space behind the posterior nares, but leave a slit between them, which is widest in front. This may, perhaps, be considered as a tendency toward a character seen in modern Monotremes, the moving backward of the posterior narial opening. The glenoid surface is comparatively large and flat, and is bounded posteriorly by the auditory bullæ. The palate is quite long and is longitudinally convex in the middle, with parallel convexities on each side between this and the alveoli.

Relationship.

The general appearance of the skull is strikingly like that of the Monotremes. In fact, with the exception of the presence of tympanic bullæ and rooted teeth, it differs in no essential particular from *Ornithorhynchus* or *Echidna*. The presence or absence of tympanic bullæ has little significance in this connection, as it has been independently developed in so many widely different mammals. The Monotremes have a tympanic ring. In some cases this may have developed into a bulla.

The teeth differ from those found in *Ornithorhynchus* in being peg-shaped, and in being set in quite deep and well-defined alveoli. The number is also greater than in the latter genus, there being, apparently, six in each side of the jaw instead of two or three. In the new genus, too, there was one tooth which was caniniform. In *Ornithorhynchus*, the teeth, which are low-crowned, appear to have small roots.

But when we consider the vast dissimilarity in the different teeth of some individuals—for example, in certain Multituberculates, Insectivores, Marsupials, etc.—to say nothing of the astonishing differences and variety in the structure of the teeth in the subclass Eutheria, we could hardly exclude this animal from the Monotremata on these grounds. In fact, they appear quite insignificant. That the Monotremes have had a long history, and that they developed into a considerable diversity of forms is made evident by the marked minor differences of the two or three existing genera.

But since the idea of development has taken possession of biologists there has been a great temptation to see relationship where none exists. There is a vast interval, both in time and space, between early White River times in the Rocky Mountains and the Australian region of to-day, and we have but a single skull by which to judge. Yet if we were looking for a Monotreme in these older beds we could hardly expect it to be so much like that of the living species as is the fossil.

The general appearance of the skull is most like that of *Echidna;* though in a few details it more resembles *Ornithorhynchus*. If we could take a skull of *Echidna*, shorten its muzzle, give it tympanic bullæ and simple cylindrical teeth, make the orbito-temporal fossa like that of the duckbill, and premaxillaries similar to those of the latter, but much shorter, we would have a skull similar in all its principal characters to the fossil.

If this is the skull of a Monotreme it certainly is of great interest. If not, it is perhaps even more so; as, so far as I can learn, there is nothing like it among the Eutheria.

PART II. LEPTICTIDÆ OF THE LOWER WHITE RIVER BEDS.

Nearly sixty years ago, a man who resided at one of the posts of the St. Louis Fur Company, on the Missouri River, sent to Dr. Hiram Prout, of St. Louis, a fragment of the lower jaw of a large and unknown animal. It was found in the Bad Lands of White River, about sixty miles east of the Black Hills. Dr. Prout described and figured this jaw — the last molar of which was complete — in the American Journal of Science (1847). From the resemblance of the last lower molar to that of *Palæotherium* of the European Tertiary, it was supposed to belong to that genus. This is what is now known as *Titanotherium*, and it was the first mammalian fossil described from the White River Beds of the West. Since then all the parts of the skeleton and hundreds of skulls of this animal have been found, and all from the lower horizon of the White River. Besides this, skulls and skeletons of the large *Elotherium*, *Metamynodon*, *Trigonias*, and other Rhinoceroses have been obtained; but aside from these, previous to the discoveries in Montana, almost nothing was known of the immediate precursors of the abundant and varied fauna, which had been so well preserved in the overlying Oreodon Beds.

In the year 1900 the present writer discovered, in three localities in Montana, remains of smaller mammals associated with *Titanotherium*. Of these about a dozen species were described.[1] The types were teeth, jaws, and portions of skulls. Among these, only one skull was nearly complete.

The American Museum Expedition to Western Montana in 1902, discovered nearly a dozen more species. These were all represented by jaw fragments with teeth. Twenty-three species and six new genera had now been described, principally from teeth and jaws. They were of much interest, as they represented a new fauna, and gave a better basis for comparison of the mammals of the Titanotherium Beds with those of the overlying Oreodon Beds. They were mostly small animals — marsupials, insectivores, rodents, and small ungulates.

In the summer of 1903, the Carnegie Museum Expedition in charge of the present writer, discovered a locality on the Bighole River, near McCarty's Mountain, north of Dillon, in Montana, which yielded far more complete specimens of this smaller fauna. In this collection there are many skulls of smaller animals — some almost complete — with portions of skeletons, also jaws with fuller teeth series, of larger animals.

These specimens, so far as they have been studied, do not appear to lessen the hiatus between the Titanotherium and Oreodon Beds, or the greater one between the former and the Uinta.

[1] *Trans. Am. Philos. Soc. N. S.*, Vol. XX., pp. 237–279. *Ann. Carnegie Mus.*, Vol. II., No. 2, pp. 145–150.

Among the fossils from the Titanotherium horizon in Montana are several specimens of *Ictops*. The best of these are from the beds near McCarty's Mountain, north of Dillon. Two species have been described by Dr. Matthew and myself from beds of the same age on Pipestone Creek in the vicinity of Whitehall. The latter were described from fragments of jaws with teeth. One imperfect skull was found near Three Forks associated with *Titanotherium*. From the deposits near McCarty's Mountain there are four specimens, all differing in size and in other particulars. All are represented by teeth, three by good parts of skulls, and two by skulls pretty nearly complete. Two were from near the same level; one was slightly, and another considerably, lower. There appear to be similar characters in the specimens from the Titanotherium Beds which distinguish them from those of the Oreodon Beds, yet the latter have not been prepared and thoroughly studied. We have in the Carnegie Museum some good portions of skulls from the Oreodon Beds of Sioux County, Nebraska; but they are either young, crushed, or injured in other ways, and are not in a condition for careful comparison. The specimens now under consideration are not distorted, and most of the teeth are beautifully preserved.

Though the specimens differ a good deal, they, perhaps, more resemble each other than they do the Leptictidæ of the Middle White River. Perhaps the most interesting thing about these little animals, at the present, is a study of their variations, and the light it throws, however little it may be, on the modes of change. It is evident that while the anatomical characters of some animals undergo local changes the other parts remain nearly the same; other animals are subject to slower and more evenly distributed transformations. There are analogies between biological and geological changes. When a "zone of weakness" or a region of greater strain—or whatever it may prove to be—is developed, there is more or less instability afterward, and these are the regions that are subject to greatest change while other portions remain relatively stable. So when the tendency to vary has begun in some portion of an animal there is no knowing where it will end. Other animals do not seem to have any very plastic parts, but changes progress more slowly and uniformly. It is evident that neither conservatism nor extreme plasticity preserve races from extinction.

So far as we know the Leptictidæ appear to be rather conservative, though varying considerably within certain limits. The present specimens differ so much, that it is more convenient to consider them as different species, which I think they really are. If all the intermediate varieties should be found, which is unlikely to happen, the species can be easily united.

The beds in which the fossils occur are more than 700 feet in thickness, and they

have a strong dip (20° or more) to the south and southwest. They are fine-grained with local bands and lenses of sand or small gravel. There are a few fair-sized pebbles. The deposit is light gray, with a buff tint when viewed from a little distance. A large portion of the material is volcanic dust. All through the formation, at intervals, are nodules, which are arranged in bands. In places this nodular material forms strata. The nodules, as a rule, are hard, and in them most of the fossils were found.

This interesting little area is situated north and a little east of Dillon, at a distance of about sixteen miles. It is north of the Bighole River, and forms a small portion of the bench, or foothill country, of the southeastern slope of McCarty's Mountain, where the bench borders the river valley. It is in Madison County. It is about a half-mile in length north and south and about one half that distance east and west. It is sharply distinguished, from the rocks which surround it on three sides, by its color and manner of weathering. On the north is an area of basalt perhaps about equal in area. This and the Tertiary deposits lie side by side at the same level, and there are fragments of basalt in the lower portion of the White River Beds. On the east, are the shales and sandstones of the Upper Cretaceous. On the south, is the river valley, and on the west, sand and gravel benches, which are probably of later date than the Lower White River.

The beds are imperfectly stratified — at least in some portions — though on the whole they are inclined to be rather massive. At a little distance the dip can be readily distinguished. As before stated, the greater portion of these beds is soft, and the product of their weathering is instructive, as it shows how material may be transported by water and deposited without regular assortment of material or stratification. The water which descends from this area at the time of heavy rains, or when snow is quickly melted, has formed a large alluvial cone immediately at the foot of the Tertiary hills. This is broadly spread out on the river bottom below, and by its peculiar color, its area can be readily distinguished at a distance.

The following, so far as determined, are the genera found in these beds: *Testudo*, *Helodermoides*, *Xenotherium*, *Peratherium*, *Ictops*, *Cylindrodon*, *Ischyromys*, *Palæolagus*, *Hyænodon*, *Limnenetes*, *Agriochœrus*, *Titanotherium*, *Colodon*, *Hyracodon*, and *Mesohippus*. Others are doubtful, or have not been sufficiently cleared from the matrix for certain determination.

About two miles west of here is a small exposure of a little different character of strata. From here only two specimens were obtained, a *Colodon* and an apparently new rodent.

Besides this especially favored locality other places have been found, which have yielded interesting White River fossils. Some of them have been mentioned in previous articles. Among the new localities found are those at (*a*) Cañon Ferry, near the Missouri River east of Helena, (*b*) between Prickly Pear Creek and the Missouri River northeast of Helena, and (*c*) near Dogtown Mine near the wagon road from Three Forks to Boulder. At Cañon Ferry the most of the fossils were from the Oreodon horizon; though the beds a little to the north and northeast probably belong in part to the Titanotherium horizon. With one or two exceptions, the fossils from the other localities above mentioned, belonged to the lower beds.

Ictops.

The type of *Ictops* is *I. dakotensis*. It was found in the Bad Lands of White River, Dakota, in 1866, and was described by Leidy in 1868. I quote from Leidy's description.

"*Ictops dakotensis*. This name is founded on a small fragment of a skull which was obtained with the preceding [*Leptictis haydeni*]. At first the specimen was supposed to belong to the same animal as the former. It clearly indicates a skull of nearly the same size and shape as that of *Leptictis*.

"The fragment consists of a portion of the face, containing the remains of most of the molar teeth. The face appears to have had nearly the same form and construction as in *Leptictis*, and the forehead exhibits traces of the two peculiar ridges defining the upper part of the temporal fossa in the latter.

"The remains of the molars consist of the posterior six. The second premolar appears to have been a two-fanged, conical crowned tooth, as in *Leptictis*. The third premolar has a trihedral crown, inserted by three fangs, whereas in *Leptictis*, as in the preceding tooth, it has a simple conical crown with a pair of fangs.

"The crown of the third premolar of *Ictops* is composed of three principal lobes, two external and the third internal. The four back molars have the same relative position and size as regards one another as in *Leptictis*, but they do not project abruptly beyond the premolars externally as in this. Their crowns, so far as can be ascertained, appear to have had the same construction as in the third premolar.

"The space occupied by the back six molars in *Ictops* is ten lines, being a little more than *Leptictis*."

Leidy called these two genera "insectivorous mammals, which appear to be peculiar, but related to the hedge-hogs."[1]

In his Extinct Mammalian Fauna, p. 351, Leidy describes *Ictops* a little more fully, and figures what is undoubtedly the type (Plate XXVI., Figs. 29 and 30).

[1] *Proc. Acad. Nat. Sci. Philad.*, 1868, p. 316.

In his Tertiary Vertebrata, p. 265, Cope, after the discovery of a skull and mandible of *Ictops* (*Palæictops*) *bicuspis* and a fragment of a mandible of *I. didelphoides*, gave the following generic characters. Dental formula $I\frac{3}{2}$, $C\frac{1}{1}$, $Pm\frac{4}{4}$, $M\frac{3}{3}$. "Third superior premolar tooth with two external and an internal cusp; fourth premolar like the true molar, with two external tubercles, an internal tubercle, and a posterior cingulum. Fourth inferior premolar with an internal and a well developed anterior tubercle; the anterior tubercle of the true molars median in position, and much smaller than the internal tubercle. Heels of molars with elevated cusps. Orbits not closed posteriorly. Coronoid process of mandible well developed. Inferior margin of mandible not inflected."

With regard to the systematic position Cope says, "*Ictops* agrees very closely with *Didelphys*. The fourth superior premolar has an internal cusp, which is wanting in *Didelphys*, and the inferior border of the mandible is not inflected. There are also but three superior incisors on each side. Under these circumstances I prefer to refer this genus to the *Bunotheria* rather than to the *Marsupalia*, but whether its proper place is in the Creodont or Insectivorous subdivisions I cannot yet determine."

On page 800 of the Tertiary Vertebrata Cope says that *Leptictis*, *Ictops*, and *Mesodectes* belong to a distinct division from *Peratherium* and *Domnina* and that this division is perhaps of ordinal value, but it remains uncertain on account of the incompleteness of the specimens.

Species of Ictops.

Ictops didelphoides Cope.

Bull. U. S. Geol. Surv. Ter., VI., p. 192. Figured in Cope's Tertiary Vertebrata, Pl. XXV*a*, fig. 9.

It is represented by a fragment of a lower jaw with three teeth. This may not be *Ictops* at all, and if so it is of very little use for our purpose.

Ictops acutidens Douglass.

This species was found in the Titanotherium Beds of Pipestone Springs, Montana, and described by Douglass.[1] It is represented by an upper jaw with the five posterior teeth, the lower jaws with the molar teeth and one premolar — the anterior portions of both rami absent — a lumbar vertebra, a femur, part of a tibia, an astragalus, and a calcaneum. It is a rather young individual, but probably nearly full grown. In my paper I gave a general description, but did not give a clear diagnosis of the distinguishing specific characters as they were not then known, the only species really

[1] Fossil Mammalia of the White River Beds of Montana, *Trans. Am. Phil. Soc.*, N. S., Vol. XX., p. 245. Reprint p. 9.

available for comparison being *Ictops dakotensis* of the Oreodon Beds of the plains.

Dr. Matthew found, in the same beds as the type, another specimen, which added a little to the features shown by the type. He gives more definitely the characters which are supposed to distinguish this from other known species.[1]

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

With regard to the last character, I would say that I have the type specimen before me as I write, and the last upper molar is much smaller than M^2, and much smaller than the one represented in Matthew's illustration, fig. 4, in the paper from which I quote.

Ictops Thompsoni Matthew.

Bull. Amer. Mus. Nat. Hist., Vol. XIX., 1903, p. 207, fig. 5.

This species was found in the same beds as *I. acutidens* at Pipestone Springs. According to Matthew it is distinguished by the following characters:

It is allied to *I. acutidens* but is smaller and has more compressed teeth. "The metacone on all the molars is decidedly smaller than the paracene; in *I. acutidens* they are nearly, and in other Leptictidæ quite, equal in size on M^{1-2}. The protocenes on P^4 and M^3 is more compressed antero-posteriorly, and the constriction between it and the outer cusps is more marked than in *I. acutidens*. The hypocene is smaller on M^1 and M^2 and absent on M^3 and P^4. The trittocene of P^4 is smaller than in *I. acutidens*. All of these distinctions are exaggerations of the differences between *I. acutidens* and the Leptictidæ of the Oreodon Beds."

Ictops montanus sp. nov.

(Plate XXII., Figs. 1, 2, 3 and 4.)

Carnegie Museum, No. 1020.

From the Titanotherium Beds near McCarty's Mountain, Montana.

This is a finely preserved skull. It lacks the end of the snout, a portion of the brain-case, and the zygomatic arch on one side.

Principal Characters. — *Skull quite broad and heavy behind with fairly large brain case. In front of the orbits a gradual constriction from all sides to form the rather*

[1] Bull. Amer. Mus. Nat. Hist., Vol. XIX., p. 205.

long muzzle. Zygomatic arches deep — broad as seen from the side. Post-glenoid process long and inclining forward toward the lower end. Squamosal extending downward in a broad mastoid process outside of the external auditory meatus. Depression at anterior portion of zygomatic arch rather deep. Anterior cusp of P^4 small and low.

General Description.

Dentition. — In this specimen the incisors and canines are not preserved; the premolars and molars on the right side are well preserved, also the last five teeth on the left side.

P^1 is a small, simple, laterally compressed, one-rooted tooth, slightly curving backward toward the point. The diastema behind this tooth is about three times the length of the tooth.

P^2 is a little larger, is two-rooted, has a sharply-pointed protocone and a minute posterior cusp.

P^3 is three-rooted, has a minute anterior cusp, a protocone larger than that in P^2, and a well developed posterior cusp which is, except at its point, connate with the higher protocone. This tooth has a well developed but not very large conical deuterocone. There is a trace of a cingulum on the exterior and posterior portions. On all the teeth posterior to P^2, the antero-external is higher than the postero-external cusp.

P^4 is nearly like the molars, is smaller than M^1 and M^2 but slightly larger than M^3. It has a small, low, anterior basal cusp which is only slightly above the alveolar border. The tritocone is separated from the protocone little if any more than in P^3, but is much nearer equal to it in size. The posterior cusp on the deuterocone is minute.

M^1 differs from P^4 in having a lower antero-external cusp, which is more separated from the postero-external one, in having a cingulum with minute outer anterior and posterior basal cusps, and in having a somewhat larger, yet small, postero-internal cusp. The tooth is also wider transversely than P^4.

M^2 differs very little from M^1.

M^3 is smaller, has a reduced postero-external cusp, and has no postero-internal one.

Description of Skull.

The occiput is broad, medially vertical, and sub-semicircular as seen from behind. The height is about four fifths the width — the exact proportions being 18 : 22 millimeters. The foramen magnum is large and has a heart-shaped outline. It is about one third the width of the occiput, and nearly half the

height. It extends for nearly half its height above the occipital condyles, so that the latter are far apart superiorly, but approach each other and are nearly or quite confluent below on the lower portion of the skull; thus, apparently indicating an angular position of the skull with reference to the cervicals. Above the foramen magnum, on the median line of the skull, a median ridge — the culmination of a median convexity — ascends to the crest of the occiput. Between this median convexity and the foramen magnum on the inside, and the lambdoid ridges on the outside, is a somewhat uneven depression. The lambdoid ridges are somewhat oblique, the lower portions being a little in advance of the foramen magnum. The posterior lower portions of the squamosal form a plate or long process outside of the periotic bones, both of which are preserved in the specimen. There are, in the collection, two skulls, which have the posterior lower portion well preserved. No tympanic bullæ are present but the form of the skull here makes it reasonably certain, I think, that the animal had large auditory bullæ. They may have been cartilaginous, or ossified but very thin, and have separated from the skull before its inhumation. The lower surface of the basioccipital is broadly convex just in front of the occipital condyles, and narrows anteriorly. This continues in a still narrowing convexity on the basisphenoid, and as a small narrow ridge on the presphenoid. The post-glenoid processes are rather long, projecting some distance below the zygzomatic arches and curving forward. The glenoid surface is triangular and slightly convex. The pterygoids have, at the posterior portion, two small triangular wing-like processes which are directed outward. The opening of the posterior nares is in a plane with the last molars. The palate ends on the median posterior border in a point or lobe. The border on each side of this is symmetrically rounded. There are foramina in the palatines just posterior and internal to the last molar. The anterior portion of the maxillo-palatine foramen is between the fourth premolars. The palate is slightly arched in the type specimen. The anterior part of the snout is broken off, but the first premolar tooth is present on one side.

The face is concave in front of and below the orbit, the depression invading the anterior portion of the zygomatic arch. In front of this the muzzle is nearly semicircular in section, and it tapers gradually forward. The nasals are long and narrow. They have a short contact with the frontals. The zygomatic arches are broad and are about equally made up of the malar and squamosal portions; though the former is a little broader vertically, than the latter. The posterior process of the malar extends to the glenoid surface. The lachrymals appear nearly circular as seen from the side. They are small and appear as a little narrow crescent outside the orbit. The fronto-maxillary sutures extend obliquely upward and forward from the orbit.

On the top of the skull on the anterior portions of the frontals are two oblong convexities extending backward from the anterior points of these bones and slightly diverging posteriorly. Between these along the frontal suture is a longitudinal concavity. The posterior portions of the frontals are flat or slightly concave. The greater portion of the parietals is broken away showing a cast of the brain-case. On the frontal the supra-temporal ridges are hardly distinguishable. On the posterior portion of the parietals they can be plainly seen. They are a considerable distance apart but converge slightly forward. The parieto-temporal suture is nearly horizontal. There are no post-orbital processes and the post-orbital constriction is slight.

Ictops intermedius sp. nov.

Carnegie Museum Collection, No. 1019.

This species is represented by the skull of an old individual with the lower jaw. The snout is gone, but it is in part restored in plaster from the impression on the rock. It was found in the same beds with *Ictops tenuis* to be described later, though at a little higher level, in the Titanotherium Beds of McCarty's Mountain, north of Dillon, in Montana.

Principal Characters. — *The skull is smaller than that of* Ictops montanus *and less robust. Though the skulls are similar throughout, yet there are differences, either slight or more pronounced in nearly every part. The most noticeable are the following: In* I. intermedius *the zygomatic arches are much more slender, the post-glenoid processes smaller and shorter, the mastoid process does not extend downward so far and is entirely different in form, the posterior portion of the skull is narrow, and the foramen magnum smaller. The teeth are shorter antero-posteriorly but fully as wide.*

Detailed Comparison.

The upper teeth are too much worn for accurate comparison.

The Skull. — Measuring from the anterior of $P^{\frac{1}{1}}$ to the occipital condyles this skull is 90 per cent. of the length of that of *I. montanus*. The width at the post-glenoid processes is 86 per cent. The width of the occiput nearly 82 per cent., the depth of the anterior portion of the zygomatic arch 71 per cent., and of the posterior 66 per cent. The occipital region besides being smaller was apparently more convex, but it is somewhat injured in the present specimen so one cannot be sure. The palate views of the skulls are much alike, except in the size of the different parts. The depression at the anterior portion of the zygomatic arch is much shallower than in *I. montanus*, or in *I. tenuis*, which are described in this paper. The zygomatic arch is slenderer than in any other specimen I have examined except, perhaps,

I. acutidens. This specimen has no convexities on the top of the skull above the orbits like those in *I. montanus.* The post-orbital constriction is slightly more noticeable than in the latter species. The post-glenoid process is small and short. The mastoid process of the squamosal is quite long antero-posteriorly but does not extend down so far and curve as much as it does in *I. montanus.*

The Mandible. — The lower jaw is fairly deep and heavy. All the teeth are preserved. There are three incisors on each side, of nearly equal size. They are semi-procumbent and their arrangement is nearly fore-and-aft parallel to the long axis of the jaw.

The canine is quite long, straight, and slender, and, like the incisors, is semi-procumbent, being directed more forward than upward. It is close to the third incisor; there being no space between them.

$P_{\frac{1}{1}}$ is small, apparently one-rooted, is directed forward, and is low crowned.

$P_{\frac{2}{2}}$ is much larger, more erect, yet directed slightly forward. It has a hint of a heel or small basal cusp.

$P^{\frac{3}{3}}$ is nearly erect, has a small posterior cusp and a rudimentary anterior one.

$P^{\frac{4}{4}}$ has a distinct anterior cusp and a well developed basal heel.

The molars are about equal in size but are so worn that the relative proportions of their various cusps cannot be determined with certainty.

The horizontal ramus of the mandible is moderately deep and heavy. It deepens gradually from the incisors backward to the last molar. The angle is injured. The masseteric fossa is deep and the anterior border of the edge of the ascending ramus is a narrow ridge.

Ictops tenuis sp. nov.

Carnegie Museum Collection, No. 1021.

An adult, but not old.

Found in Titanotherium Beds southeast of McCarty's Mountain near the same level as the type of *Ictops intermedius,* and somewhat higher than that of *I. montanus.* Of this specimen we have the anterior portion of the skull with the snout complete, the left ramus of the mandible lacking the top of the coronoid process, a radius, parts of the ulna and tibia, fragments of ribs, and other bones.

Principal Characters.—*This is larger than either of the specimens previously described. The most noticeable differences besides the greater size are the greater width of the palate between the teeth and the much greater width at the post-orbital constriction. The teeth are wider in proportion to the length than in* I. montanus. *The palate, though 40 per cent. wider at* $M^{\frac{2}{2}}$, *is nearly the same width at* $P^{\frac{1}{1}}$ *as that of* I. montanus. *The muzzle is*

slender in proportion to the size of the skull. The anterior portion of the zygomatic arch is proportionally more like that of I. intermedius. *The skull is one fifth broader than in the latter between the orbits and one third broader at the post-orbital constriction. Though the mandible is nearly one third longer, it is no deeper at the last molar.*

Detailed Description and Comparisons.

Dentition.—No upper incisors are preserved. On each side are alveoli for the third incisors, but it does not appear that there were functional first and second incisors. If there were, they were separated from $I^{\frac{3}{3}}$ by a diastema, and were not crowded like the corresponding lower teeth. The canine was small. Only the root is preserved. All the teeth on the right side anterior to $P^{\frac{3}{3}}$ are gone and appear to have been shed when the animal was young, as the alveoli are more or less nearly obliterated.

$P^{\frac{1}{1}}$ is larger than in *I. montanus* but it is a simple, one-rooted, laterally compressed tooth. The diastema between it and $P^{\frac{2}{2}}$ is the same. $P^{\frac{2}{2}}$ is about the same in both specimens. $P^{\frac{3}{3}}$ and $P^{\frac{4}{4}}$ are longer in the present specimen and $P^{\frac{4}{4}}$ is wider. As in *I. montanus* the anterior cusps of the molars are higher than the posterior ones. The molars have nearly the same antero-posterior diameter in the two species, but in *P. tenuis* the transverse diameter is much greater, and the inner portion of the tooth is very narrow. Taking Matthew's figure of *I. thompsoni* as a basis for measurement the teeth of the present specimen are even wider in proportion to the length than in that species. The last molar is absent from both sides.

The snout is very slender as compared with the size of the skull. The skull is very broad at the zygomatic arches, but narrows rapidly at their anterior portions and just in front of the orbit. The palate is broad behind and narrows gradually almost to a point in front. The posterior narial opening is in the plane of the last molars. There is a median point at the posterior portion of the palate. Though the skull was larger, the depth of the malar portion of the zygomatic arch is about the same as in *I. montanus*. The depression on the face at the anterior root of the arch has about the same depth but is smaller, leaving a heavier ridge between that and the orbit. The nasals are long and slender and are broadest at the anterior portions. The skull is broader on top than in any other specimen of *Ictops* that I have seen.

The Mandible.—The greater portion of the left side of the mandible is present. The coronoid process and the condyle are gone, and the angle is probably not quite complete.

Portions of the first incisors, canine, and second and third premolars are preserved. As in *I. intermedius* and *I. major* there are no diastemata in the lower jaw.

In the upper jaw there is a short interval between the canine and $P\frac{1}{-}$, a quite long one between $P\frac{1}{-}$ and $P\frac{2}{-}$, and a short one between $P\frac{2}{-}$ and $P\frac{3}{-}$. The mandible is deepest at $M_{\overline{1}}$. The anterior ridge of the ascending ramus is heavier and broader than in *I. intermedius*. All the mandibles of the different specimens have two mental foramina; but, as will be seen by the illustrations, they have a little different position in each.

Skeleton. — Nearly a whole ulna and the lower part of the radius are preserved They were apparently nearly equal in size. The radius is nearly 4 cm. in length. The olecranon is .8 cm. There is a longitudinal convexity on the shaft of the ulna giving the bone an angulate appearance.

One of the anterior dorsal vertebræ is preserved. It has a long spine, which is very much inclined backward.

ICTOPS.

Carnegie Museum specimen, No. 812.

This is the larger portion of a skull but it is much crushed and distorted so that but few of its characters can be definitely ascertained.

This skull was found in beds of sandy clay west of Three Forks, Montana, associated with *Titanotherium* and a little Oreodont. The beds are different lithologically from those of the same region in which *Limnenetes platyceps*, *L. anceps*, *Agriochœrus minimus*, *Trigenicus socialis*, *Mesohippus latidens* and associated *Titanotherium* remains were found. It is uncertain whether these beds are exactly contemporaneous with those containing the *Ictops* skull or not, but they must be nearly so. This skull is quite robust. The zygomatic arch is heavier than in any other specimen in the collection. The post-glenoid process is fairly long. The most noticeable feature is the wide interval which separated the supra-temporal ridges. They converge backward to within .6 cm. of the crest of the occiput and back of this diverge, becoming continuous with the lambdoid ridges. Where nearest they are 1 cm. apart. The occiput was broad, the nasals slender.

Ictops Major sp. nov.

Carnegie Museum specimen, No. 1022.

Of this specimen we have the upper dentition back of $P\frac{2}{-}$, a large portion of the mandible with all the lower teeth except $I_{\overline{1}}$, parts of the dorsal vertebræ, the sacrum, part of the pelvis, portions of the tibiæ, two caudal vertebræ, two phalanges, and other small fragments of the skeleton. The specimens were found in the Titanotherium Beds southeast of McCarty's Mountain, but at a lower level than the specimens above described. This represents the largest *Ictops* found in the beds at

this place. The inferior dental series is 32 per cent. (nearly $\frac{1}{3}$) larger than that of *I. intermedius* and 10 per cent. larger than *I. tenuis*.

Dentition.

Superior Dentition. — The width of $P^{\frac{3}{3}}$ is about two-thirds its length. In *I. tenuis* it is about one-half. The posterior cusp is more distinct from the protocone than in *I. montanus*. There is a cingulum on the posterior outer portion of the tooth.

$P^{\frac{4}{4}}$ has a low and minute but distinct anterior basal cusp, and a strong cingulum on the posterior outer portion. The protocone is a little higher than the cusp behind it. Both are lens-shaped in section and rather blunt pointed as seen from the side. The tooth has minute traces of anterior and posterior intermediate cusps. The posterior interior cusp appears as a cingulum-like ledge.

The molars have distinct cingula on the outside tending to form anterior and posterior outer basal cusps, except on the posterior of $M^{\frac{3}{3}}$. There is a minute cingulum on the anterior portion of the inner cusp in $M^{\frac{1}{1}}$ and the posterior inner cusp is small but well developed. $M^{\frac{2}{2}}$ has also an anterior cingulum but the posterior cusp is smaller than on $M^{\frac{1}{1}}$. $M^{\frac{3}{3}}$ is smaller than the other molars and its posterior outer cusp (metacone) is minute. It has a trace of the posterior inner cusp.

Inferior Dentition. — The first incisor is wanting. The other incisors and the canine are arranged in an antero-posterior row in line with the premolars and molars. $I_{\frac{2}{2}}$ and $I_{\frac{3}{3}}$ are spatulate, not much unlike the lower incisors of modern ruminants. $I_{\frac{2}{2}}$ is larger than $I_{\frac{3}{3}}$.

The canine has a higher crown than the incisors, but is narrow toward the top, instead of expanding like the incisors.

$P_{\frac{1}{1}}$ is one-rooted and it inclines forward, but less so than the canine.

$P_{\frac{2}{2}}$ is two-rooted and has a small heel. The protoconid is quite high and nearly erect.

$P_{\frac{3}{3}}$ has anterior and posterior cusps on the protoconid of nearly equal size and height, and a minute basal heel.

On $P_{\frac{4}{4}}$ the anterior cusp is larger than on $P_{\frac{3}{3}}$. The outer principal cusp is larger and higher than the inner one. On the heel the outer cusp is higher and larger than the inner one, and this in turn is larger than the median one.

$M_{\frac{1}{1}}$ differs from $P_{\frac{4}{4}}$ in having the anterior cusp higher and more confluent with the two principal cusps which are more nearly equal in size and height and are flatter behind, in the outer cusps of the heel being more nearly even, and in the median posterior cusp being larger. On $M_{\frac{3}{3}}$ the posterior cusp on the heel is higher than the other two.

Most of the fragments of the skeleton are too imperfectly preserved to admit of accurate description. Portions of five of the lumbar vertebræ are still united and in position. The centra are injured. Three of them are 2 cm. in length.

The tail was long and heavy judging by two vertebræ from near the anterior portion, and two others farther back. They are as broad as the lumbars and the two measure 2 cm. in length. Two other caudals are preserved; one 1.15 cm. in length, apparently from near the middle, and one 1 cm. in length from near the end.

A metacarpal was found at the same place, but it is not certain that it belongs to this specimen. One median and one ungual phalanx are also preserved. The latter has a short heel on the dorsal surface and a small one on the plantar portion.

The species of *Ictops* thus far secured from the Titanotherium Beds are:

Ictops thompsoni, *I. intermedius*, *I. montanus*, *I. acutidens*, *I. tenuis* and *I. major*.

The beds are in some places at least several hundred feet in thickness, being several times thicker than in the type locality, but as yet different faunal horizons have not been distinguished. At least three of the species have come from levels not differing greatly in height, probably less than 100 feet, yet of the lapse of time between their deposition we know nothing.

In size the species rank as follows: (1) *Ictops thompsoni*, smallest, (2) *I. intermedius*, (3) *I. montanus*, *I. acutidens*, (4) *I. tenuis* and (5) *I. major*.

SPECIES OF ICTOPS FROM MONTANA.

I. *Ictops acutidens.*	II. *Ictops montanus.*	III. *Ictops intermedius.*	IV. *Ictops tenuis.*	V. *Ictops major.*
P^3 has four distinct and separate cusps.	P^3 anterior cusp very small. Protocone and postero-external cusp connate.	P^3 cusps low and blunt; the anterior one hardly distinguished as a cusp.	P^3 protocone high; the three other cusps low and small.	P^3 much as in last but larger and cusps more massive and not so acute.
P^4 tritocone larger but not so high as protocone. Two small intermediate cusps between outer and inner ones. A strong outer cingulum, and anterior and posterior outer cingular cusps.	P^4 protocone much higher than tritocone; postero-external cusp small; cingulum weak and antero-external cusp smaller than in I.		P^4 protocone decidedly higher and larger than tritocone; antero-external basal cusp small. Cingulum on anterior and posterior outer portions of tooth.	P^4 anterior and posterior outer cusps small. Cingulum nearly surrounding tooth; protocone higher than tritocone.
M^1 strong postero-internal cusp, strong cingulum on outside. Length of tooth nearly equals width.	M^1 postero-external cusp not so large as in I.; cingulum not so strong; tooth wider in proportion to length.		M^1 postero-external cusp small; cingulum quite strong; tooth very wide in proportion to length.	
M^3 much smaller than M^2.	M^3 proportionally larger than in I.	M^3 proportionally larger than in I. or II.		M^1 about as in I.
Zygoma not heavy.	Zygoma heavy.	Zygoma comparatively slender.	Zygoma heavy.	
	Post glenoid processes large.	Post-glenoid processes much smaller than in II.		

MEASUREMENTS OF SPECIES OF ICTOPS.

	I. montanus. mm.	*I. intermedius.* mm.	*I. tenuis.* mm.	*I. acutidens.* mm.	*I. major.* mm.	*I. thompsoni.*[1] mm.	*I. dakotensis.*[1] mm.
Length of skull back of P^1	48.5	45					
Width of skull at P^2	8	6	7.6				
Width of skull at post-orbital constriction	13	12	16				
Width of occiput	20	18					
Width of occipital condyles	15	13					
Width of palate at P^2	5.5	6	6.5				
Width of skull at front of glenoid surface	25	24	33				
Length of molar-premolar series	23	22	28				
Length of premolar series	15.5	15.5	21				
Length of molar series	7.5	6.5	7		10		
Length of molars and P^3 and ^{4}	14	12	14		18	9.3	
Length of P^1	1.3		2				
Length of P^2	2.1		2.8				
Length of P^3	3.5	2.5	3.8	3.5	5		
Length of P^4	3	2.2	3.1	3.3	3.8		
Width of P^4	2.8	3.3	2.9	3.3	3.4		
Length of M^1	2.5	2.2	2.2	3	3.6	2.7	3.3
Width of M^1	3.5	3.5	4.2	3.8	4.3	3.9	4
Length of M^2	2.2	2.2	2.2	2.2	3.5		
Width of M^2	3.8	4	4	4.2	5		
Length of M^3	2	2		1.5	2	1.5	
Width of M^3	3	3		3	4	3.6	
Depth of mandible under M_3		5	5.2	4.5	5.7		
Length of lower dental series		25	29		32		
Length of lower molar series		7		8.5	10		
Length of M_1		2.5		2.5	4		
Length of M_3		3	3	2.5	3.2		
Length of femur					45		

[1] According to Matthew, *I. dakotensis* measured from Leidy's figure.

In width of molars in relation to length: (1) *I. tenuis*, widest in proportion to length, (2) *I. intermedius*, *I. thompsoni*, (3) *I. montanus*, (4) *I. major*, *I. acutidens*.

In development of cingulum on cheek teeth: (1) *I. intermedius?* least, (2) *I. tenuis*, (3) *I. montanus*, *I. acutidens*, *I. major*.

In robustness of zygomatic arch: (1) *I. acutidens* least, (2) *I. intermedius*, (3) *I. tenuis*, (4) *I. montanus*.

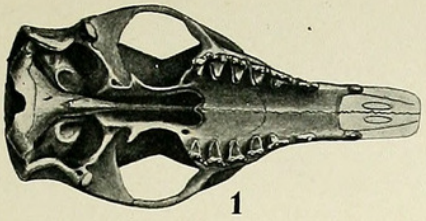
From what I have seen of the Leptictidæ of the Oreodon horizon I think that in all these species from the Titanotherium beds of Montana, unless it be *I. major*, the teeth are proportionately smaller.

Explanation of Plate XXII.

ALL FIGURES NATURAL SIZE.

Fig. 1. *Ictops montanus.* Skull, palate view.
Fig. 2. " " " side view.
Fig. 3. " " " top view.
Fig. 4. " " Upper teeth. Crown view.
Fig. 5. *Ictops tenuis.* " " " "
Fig. 6. *Ictops intermedius.* " " " "
Fig. 7. *Ictops acutidens.* " " " "
Fig. 8. *Ictops major.* " " " "
Fig. 9. " " Lower " " "
Fig. 10. *Ictops intermedius.* Skull, palate view.
Fig. 11. " " Skull and mandible, side view.
Fig. 12. " " Skull, top view.
Fig. 13. *Xenotherium unicum.* Skull, palate view.
Fig. 14. " " " top view.
Fig. 15. " " " side view.
Fig. 16. " " " rear view.
Fig. 17. *Ictops tenuis.* Anterior portion of skull, palate view.
Fig. 18. " " " " " " and mandible, side view.
Fig. 19. *Ictops major.* Right ramus of mandible.
Fig. 20. *Ictops tenuis.* Dorsal vertebra.
Fig. 21. *Ictops acutidens.* Lumbar vertebra.
Fig. 22. " " Left ramus of mandible, posterior portion (type specimen).
Fig. 23. *Ictops tenuis.* Ulna and part of radius.
Fig. 24. *Ictops major.* Lumbar vertebræ.
Fig. 25. " " (?). Metapodial.
Figs. 26 and 27. *Ictops major.* Caudal vertebræ.
Fig. 28. *Ictops major.* Anterior caudal vertebræ.
Fig. 29. " " Phalanx.
Fig. 30. " " Ungual phalanx.
Figs. 31 and 32. *Ictops acutidens.* Calcaneum, astragalus and part of tibia and fibula.
Figs. 33 and 34. " " Femur.

Ictops montanus. Figs. 1, 2, 3 and 4.
Ictops intermedius. Figs. 6, 10, 11 and 12.
Ictops tenuis. Figs. 5, 17, 18, 20 and 23.
Ictops acutidens. Figs. 7, 21, 22, 31, 32, 33 and 34.
Ictops major. Figs. 8, 9, 19, 24, 25, 26, 27, 28, 29 and 30.
Xenotherium unicum. Figs. 13, 14, 15 and 16.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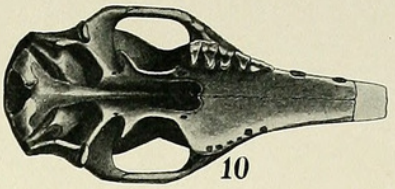
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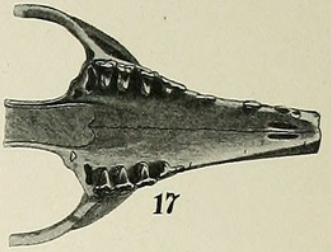
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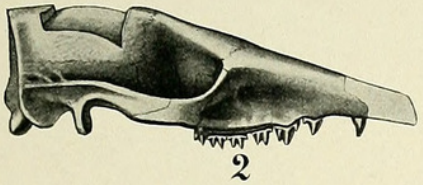
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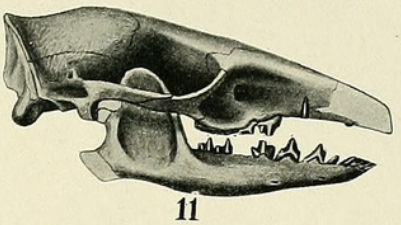
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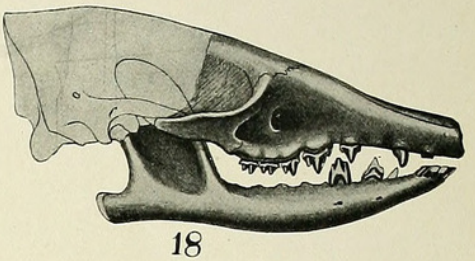
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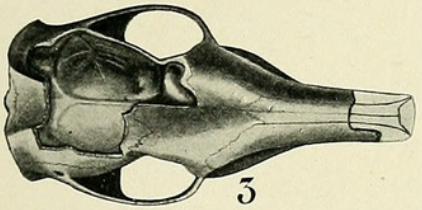
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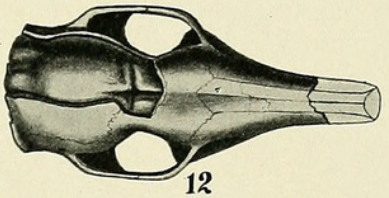
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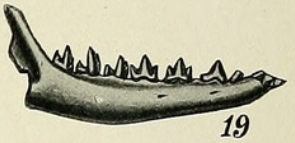
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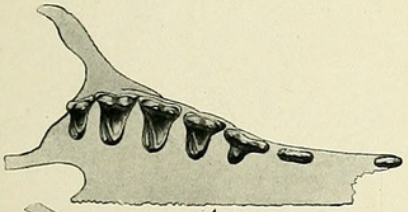
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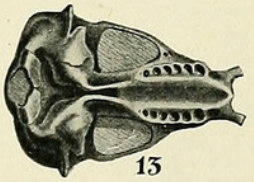
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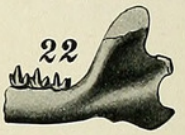
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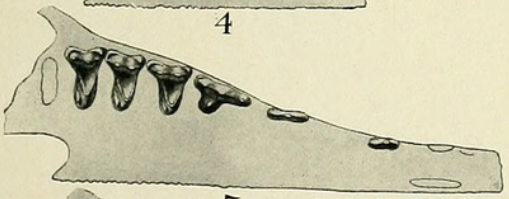
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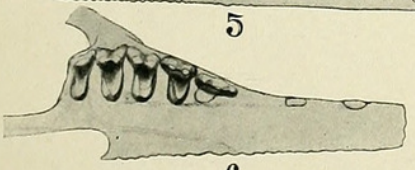
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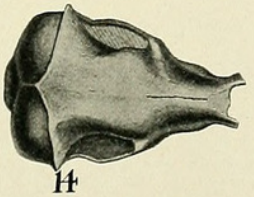
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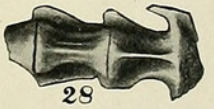
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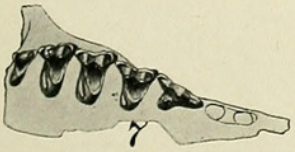
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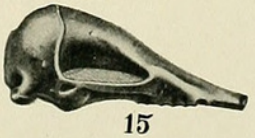
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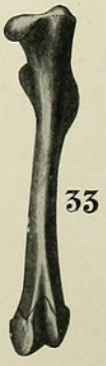
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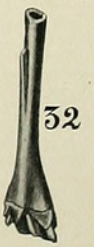
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Lower White River Mammals. *Ictops* and *Xenotherium*.