

V. MERYCOCHÆRUS AND A NEW GENUS OF MERY-
COIDODONTS, WITH SOME NOTES ON OTHER
AGRIOCHÆRIDÆ.

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(PLATE XXI.)

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I. A HISTORY OF THE GENERIC NAME MERYCOCHÆRUS.

In the year 1857 Dr. F. V. Hayden, while on an exploring expedition, discovered opposite Fort Laramie in a stratum of "dull reddish brown indurated grit" (bed "D" of Hayden's section of the Miocene formations), portions of skulls and mandibles of a new genus of Merycoidodonts. In 1858 these were described by Joseph Leidy under the name of *Merycochærus proprius*.¹ The genus was based on several portions of the upper and lower jaws.

Previous to this time only four species of Merycoidodonts (*Oreodonts auctorum*) had been described, *Merycoidodon culbertsoni* Leidy, in 1848, *Eucrotaphus jacksoni* Leidy, in 1850, *Oreodon gracilis* Leidy, in 1851, and *Oreodon major* Leidy, in 1854. These, with the exception of *Eucrotaphus jacksoni*, were represented, so far as the skulls and dentition are concerned, by good material enabling satisfactory comparisons to be made.

In the same paper in which *Merycochærus proprius* was described Leidy established the genus *Merychyus* with three species, *Merychyus elegans*, *Merychyus major*, and *Merychyus medius*. In this same paper Dr. Leidy gave a few of the characters which distinguish *Merycochærus* from the Merycoidodonts then known.

¹ *Proc. Acad. Nat. Sci. Phila.*, 1858, p. 24.

In his *Extinct Mammalian Fauna of Dakota and Nebraska*, published in 1869, Leidy described and figured part of a skull and a lower jaw, which are designated as the type of *Merycochærus proprius*. They are now in the Academy of Natural Sciences in Philadelphia, and I have recently examined them. The skull is represented by portions of both upper jaws, the left the more complete, including portions of the premaxillaries, maxillaries, and malars. The teeth are represented by a third incisor and all the teeth posterior to it. Unfortunately the upper portion of the premaxillary is gone, so that it cannot be ascertained how far the premaxillaries were coössified. It seems a little doubtful, as Mr. Peterson has suggested to me, whether the mandible marked as part of the type belongs to the same individual, as the upper jaw does not quite fit, though this may be due to the defective mending of the mandible.

In the *Extinct Mammalian Fauna of Dakota and Nebraska* Leidy gives, among others, the following characters, which serve to distinguish this genus from those previously described : Size a third larger than that of *Eucrotaphus*? (*Oreodon*) *major*; the infraorbital arch is remarkable for its great absolute and relative depth, is two and one half times that of *Eucrotaphus major*, and is directed much more inward to the face than in *Oreodon*. The anterior origin of this arch is at the anterior portion of the second molar tooth and is not continued forward in a ridge to the middle of the premolar series as in *Oreodon*. This causes the face to be abruptly narrowed at the interval of the first and second molars. The side of the face “forms a wide unbroken, transverse concavity from the supraorbital arch to the canine alveolus.” The infraorbital foramen is large and situated above the interval of the first and second molars. On account of the depth of the malar the orbit is more elevated than in *Merycoidodon*, and its anterior border is on a line with the interval between the first and second molar. The lachrymal bone appears not to have possessed the depression known as the lachrymal fossa.

The next species to be included in the genus was *Merycochærus rusticus*. The specimen which is marked as the type is the property of the United States National Museum at Washington. It consists of nearly the same portions as the type of *Merycochærus proprius*. It has, however, more of the anterior portion of the muzzle (including the premaxillaries, but none of the nasals) and the symphyseal portion of the mandible. These specimens were collected by Dr. F. V. Hayden

on the Sweetwater River, eighteen miles west of "The Devil's Gate in Wyoming."

In the original description of *Merycochærus rusticus*² Dr. Leidy gave some of the principal characteristics as revealed by the type. They are the following: The skull is a little more than two thirds the diameter of that of *Merycochærus proprius*. The infraorbital arch is deep; the face has the same abrupt narrowing in front of the orbits as in *M. proprius*, and the infraorbital foramen occupies a corresponding position. In *Oreodon* (*Merycoidodon*) the face narrows more gradually anteriorly, and the infraorbital foramen is situated farther forward.

Leidy suspected from examining these specimens that the remains from the region of the Niobrara River which he had described under the name of *Merychys medius* belong to the same species as the type of *Merycochærus rusticus*, and that *Merychys major* belonged with *Merycochærus proprius*.

In his *Extinct Vertebrate Fauna of the Western Territories* (1873), Leidy figured (Pl. III.) what is considered as the type of *Merycochærus rusticus*, and gave further particulars concerning the small collection from the valley of the Sweetwater River in Wyoming. He here points out differences between the teeth of *Merycochærus* and *Oreodon* (*Merycoidodon*) which he had not done before.³

In *Merycochærus* the crowns of the molars are higher than in *Oreodon* (*Merycoidodon*) and when the anterior molar is protruded, the posterior molars, though functional, are partly buried in the jaw and advance as they are worn away. Before the last tooth is fully protruded "the anatomical character of the triturating surface of the first molar is totally obliterated, and that of the second molar somewhat destroyed." He also says that the highest points of the crowns of the premolars, especially the upper ones, are in advance of the middle of the crowns, even after they are much worn. In *Oreodon* (*Merycoidodon*) the highest point is median.

At this time Leidy was under the impression that *Oreodon* (*Merycoidodon*) and *Merycochærus* were distinct though closely related genera, the latter from a later geological horizon and the successor by evolution of the former; but that *Merycochærus* is the same as *Merychys* and from the same geological horizon. Yet in this same discussion he gave separate definitions to these genera.

²"Remarks on a Collection of Fossils from the Western Territories." *Proc. Acad. Nat. Sci. Phila.*, 1870, pp. 109-110.

³Leidy's "Extinct Vertebrate Fauna of the Western Territories," p. 199.

In his definition of *Merycochærus* he includes both *M. proprius* and *M. rusticus*. The latter may belong to a different genus, as will be seen later.

One thing in Leidy's discussion of *Merycochærus* is very interesting. He says: "The mental foramen, like the infraorbital foramen is proportionately larger than in *Oreodon* (*Merycoidodon*). Perhaps this difference in the size of the foramina, together with the other peculiarities of the face, may indicate that *Merycochærus* was provided with large prehensile lips, or probably a short proboscis." (Page 203.)

Just following the paper in which Leidy first described the type of *Merycochærus rusticus* is one by the same author entitled *Remarks on a Collection of Fossils from Dallas City, Oregon*.⁴

This collection consisted of remains of mammals obtained by Rev. Thomas Condon from the Valley of Bridge Creek, a tributary of the John Day's River. "The greater number and more striking specimens belong apparently to a species of *Oreodon*, larger than any previously described, and equaling in size *Merycochærus proprius*. Indeed so far as we are familiar with the skull of both, the two are so nearly alike that one may be regarded as only a variety of the other, or at most may be viewed as distinct species of the same genus. I am, however, disposed to view one as the offspring by selection of the other, and regard them as corresponding species of two genera, which existed probably in different times or localities.

"The species, which I propose to distinguish under the name *Oreodon superbus*, is indicated by a mutilated skull, together with mutilated crania and portions of jaws with and without teeth, of half a dozen or more individuals."

What we should undoubtedly consider as the type of this species is the skull represented in Fig. 1, Plate I., of Leidy's *Extinct Vertebrate Fauna*.

In his *Synopsis of the Species of Oreodontidæ*⁵ Cope included this species in the genus *Merycochærus* with other forms from Oregon and Montana which did not belong there, and included Bettany's *Merycochærus temporalis* in the species (*l. c.*, pp. 521-523). Cope says (p. 522): "Of this fine species I have nine crania extracted from the matrix, and a good many not yet cleaned." If these are identical with the type, the characters of this species ought now to be capable

⁴ *Proc. Acad. Nat. Sci. Phila.*, 1870, pp. 111-113.

⁵ *Proc. Amer. Philos. Soc.*, 1884.

of careful definition. This is important as the species was made the type of *Promerycochærus*,⁶ when that genus was separated from *Merycochærus*.

When Cope wrote his *Synopsis of the Oreodontidæ*, he was unable to give real distinguishing characters to the genus *Merycochærus* as he employed the name. In his key to the species, however, he made some divisions which are interesting. He divided the group into three sections.

In section I. the infraorbital foramen is above the middle of the fourth superior premolar, the posterior part of the zygoma is expanded, and the palate is moderately produced posteriorly. Species: "*Merycochærus superbus*, *M. leidy*, and *M. chelydra*."

Sec. II. Infraorbital foramen above first true molar; palate greatly produced posteriorly. "*Merycochærus macrostegus*? and *M. montanus*."

Sec. III. Infraorbital foramen above the anterior border of the second true molars. "*Merycochærus rusticus* and *M. proprius*."

The two latter are distinguished as follows:

In *Merycochærus rusticus* the zygoma originates above the second molar; size large; incisors small.

In *Merycochærus proprius* the zygomatic arch originates above the third true molar; size larger; incisors large.

On page 535 of the same paper, Cope gives some of the distinguishing characters of *Merycochærus proprius* and *Merycochærus rusticus*. Of the former he says:

"This large species represents the extreme form of the genus in the anterior position of its dental series as compared with the brain-case. The zygomatic arch and infraorbital foramen are therefore more posteriorly placed than in any other species. The premaxillary bone is more prominent than in any other, and the incisor teeth have relatively larger dimensions. The size is about that of *M. superbus*. I have not seen any other than the typical specimen."

Of *Merycochærus rusticus* he says:

"The smallest species, characterized among other things by the closure of that part of the narial fissure which separates the premaxillary bones below. According to Leidy's figure above quoted, the depth of the middle line of the undivided premaxillary is greater than the width of the bone, a state of things not approached by any of the

⁶ *Amer. Jour. Sci.*, Vol. XI., 1901, p. 82. See also Matthew's "Fossil Mammals of Colorado," *Mem. Amer. Mus. Nat. Hist.*, Vol. VII., p. 398.

species of this genus described in the preceding pages. The pre-maxillary in *M. proprius* is not described."

Of the seven species enumerated and characterized in Cope's paper above quoted three — "*Merycochærus*" *macrostegus*, "*Merycochærus*" *chelydra*, and "*Merycochærus*" *montanus* were described for the first time. The types of *Merycochærus* *superbus*, *leidyi*, *macrostegus* and *chelydra* all came from the John Day beds of Oregon. With little doubt, the first three, and perhaps all, came from Bridge Creek. *Merycochærus* *montanus* was found in the Ticholeptus or Deep River Beds of Montana.

In 1890 Prof. W. B. Scott⁷ described a foot of a Merycoidodont from the Miocene of Nebraska under the name of *Merycochærus* *cænopus*.

In his *Mammalia of the Deep River Beds*⁸ (1893) Scott described nearly the entire skeleton of what he supposed to be *Merycochærus* *montanus*.

While collecting fossils in the Loup Fork horizon in the Lower Madison Valley in Montana (1894-1896) Earl Douglass discovered several portions of mandibles of Merycoidodonts. Three of these were remarkable for the depth of the horizontal ramus of the mandible and the shortening and crowding of the premolar series. In one of these afterward named *Merycochærus* *altiramus*,⁹ the mandible was surprisingly deep, especially at the angle.

In 1899, in the Flint Creek Beds (Upper Miocene) near New Chicago, Montana, Douglass found a nearly complete skull, including the mandible, of an extremely peculiar Merycoidodont which had a remarkably deep mandible like some of the specimens from the Madison Valley. The most peculiar characters were the extreme shortening of the nasals and several modifications of the skull, making it as clear as the structure of the skull could do, that the animal possessed a large upper lip or proboscis.

Mr. Douglass described the above specimens in the paper above quoted,¹⁰ under the generic name *Merycochærus*. In Part II., p. 82, he says:

⁷ *Beiträge zur Kenntniss der Oreodontide*, p. 346, Pl. XVI., Figs. 33 and 34.

⁸ *Proc. Am. Philos. Soc.*, Vol. XXI., p. 151.

⁹ "New Species of *Merycochærus* in Montana," *Am. Jour. Sci.*, Vol. XI., part II., Jan., 1901, p. 73.

¹⁰ *Am. Jour. Sci.*, Vol. X., pp. 428-438 and Vol. XI., pp. 73-83.

"As previously stated, the discovery of a complete skull of *Merycochærus* shows that those previously described under that name must be divided into two genera, though at present the generic limits cannot be definitely defined. I include provisionally under the genus *Merycochærus*, of which *M. proprius* is the type, *M. rusticus*, *M. laticeps*, *M. madisonius*, *M. elrodi*, and perhaps *M. compressidens* and *M. obliquidens*. Were the skulls of all these found, the genus might have to be divided again."

In this paper *Promerycochærus* was proposed provisionally for the other species which had been included in the genus *Merycochærus*, calling them *Promerycochærus superbus*, *leidy*, etc.

"Between these two groups as I have divided them there is an easily recognizable difference in the inferior dentition. In *P. montanus* and *macrostegus*, and, judging by the upper dentition in *P. superbus* and *chelydra*, the length of the premolar series nearly or quite equals that of the molar series. . . . In *Merycochærus proprius*, *rusticus*, *laticeps*, *compressidens*, *altiramus*, and *madisonius*, the premolar series equals or is slightly less than the length of the first two molars and the anterior lobe of M_3 . In the first species it is a trifle more, and they decrease in about the order mentioned. . . .

"In all of these there is more or less crowding of the first three premolars, and P_2 is placed obliquely in the jaw. In other respects the mandibles vary so much that we may expect that further discoveries will show that they do not all belong to the same genus."

In 1898, forty years after the type of *Merycochærus* was described by Dr. Leidy, an expedition from the American Museum of Natural History in charge of Dr. W. D. Matthew, secured, among other extremely interesting fossils, almost complete skulls and skeletons of *Merycochæri*. This was an interesting discovery and it showed that widely divergent lines had been included in the same genus. These fossils were described by Dr. Matthew in his splendid memoir, *Fossil Mammals of the Tertiary of Colorado*.¹¹ While there may be a little doubt that the one described as *Merycochærus proprius* should be included in the same species as the one described by Leidy, yet there appears to be little doubt that we have here the true *Merycochærus*.

Dr. Matthew describes, from higher beds, other similar fossils which he thinks may belong to a different genus.

¹¹ *Memoirs Amer. Mus. of Nat. Hist.*, Vol. I., part VII.

II. THE LATER TERTIARY FORMATIONS OF THE WEST.

The geological position of these fossils is of as much interest, perhaps, as their anatomical structure, and we cannot study the evolution of the different forms without knowing the sequence of the different horizons. I, therefore, take some space to discuss this matter.

Dr. Matthew states that *Merycochærus proprius* is found "near the top of the White River formation (horizon C)." ¹² This seems in harmony with Hayden's table in Leidy's "Extinct Mammalian Fauna," yet I believe that to those who have not had time to look up the matter with some care, there is apt to be a misunderstanding here, and Dr. Matthew's use of the term "White River" may give a wrong conception; nevertheless if one carefully reads the memoir, his meaning is very plain.

In 1862 Meek and Hayden ¹³ applied the names "*White River*" and "*Loup River*" (the latter overlying the former) to two divisions of the Tertiary in Nebraska and what is now South Dakota.

The *Loup River Beds*, were defined as follows:

"Fine loose sand, with some layers of sandstone, contains bones of *Canis*, *Felis*, *Castor*, *Equus*, *Mastodon*, *Testudo*, etc., some of which are scarcely distinguishable from living species. All fresh water and land types."

"On the Loup Fork of Platte River extending to an unknown distance beyond the Platte."

Thickness 300 to 400 feet. Referred to Pliocene.

The *White River* was defined as follows:

"White and light drab clays, with some beds of sandstone, and local layers of limestone. Fossils, *Oreodon*, *Titanotherium*, *Chæropotamus*, *Rhinoceros*, *Anchitherium*, *Hyænodon*, *Machærodus*, *Trionyx*, *Testudo*, *Helix*, *Planorbis*, *Limnæa*, Petrified wood, etc. All extinct. No brackish water or marine remains."

"Bad lands of White River under Loup River Beds, on Niobrara and across the country to the Platte."

Thickness 1,000 feet or more. Referred to Miocene.

In 1877 Cope ¹⁴ called Hayden's Santa Fe marls of New Mexico, *Loup Fork*, and originated the term *Loup Fork Epoch*, which included the *Loup River* beds of the Nebraska and Dakota region, beds of similar age in Colorado, and the Santa Fe Marls.

¹² "Fossil Mammals from Colorado," p. 401.

¹³ *Proc. Acad. Nat. Sci., Phila.*, Vol. XIII., pp. 433, 434.

¹⁴ *U. S. Geol. Surv. West of 100th Meridian*, Vol. IV., part II., pp. 20, 361.

There have been since then, two general names for the Tertiary of the western plains, but an attempt to more closely correlate the American with the European horizons has gradually led to the placing of the Loup Fork in the Miocene and the White River in the Oligocene — at least the portions of them that contained the greatest number of fossils — though there are beds in this region above the rich fossil-bearing beds of the White River and beneath the typical Loup River which, until recent years, have not yielded many fossils.

Nearly parallel with the development of our knowledge of the Tertiary of the region of the western plains, there has progressed, though on a less extended scale, the study of the John Day beds and their interesting faunæ and floræ. Though undoubtedly the lower beds in the John Day region are contemporaneous with portions of the White River, and are Oligocene in age, yet part of the fauna of the former has appeared to be of later date and earlier than the typical Loup River — earlier, even, than the Loup Fork in its extended sense. So in tables of the Tertiary strata of the western interior region about the following succession has come into current use :

Miocene..	{	Loup Fork Formation..	{	Nebraska beds,
			{	Deep River beds.
	{	John Day Formation....	{	Upper,
			{	Middle,
			{	Lower.
Oligocene {	{	White River Formation	{	Protoceras beds,
			{	Oreodon beds,
			{	Titanotherium beds.

Dr. J. C. Merriam,¹⁶ in 1901, divided the John Day series into lower, middle, and upper. In the lower division no good fossils were found. Among the fossils in the middle division are *Diceratherium* and *Eporeodon*. The latter is much like some of the Merycoidodonts of the Protoceras beds (Upper White River). The upper beds of the John Day series are those from which were obtained the large Merycoidodonts which have been referred to *Merycochaerus*, but which are now known as *Promerycochaerus*.

In the valleys of Montana several formations have been found, which, as the fossils were such that they could not be exactly correlated with other horizons, have been given various local names until their position could be determined. They range from Lower Oligocene

¹⁶ "A Contribution to the Geology of the John Day Basin," *Bull. Dept. of Geol., University of Cal.*, Vol. 2, No. 9, p. 293.

to Upper Miocene, yet the lists of species never precisely coincide with those of other regions.

In the three regions above mentioned, the plains, Oregon, and Montana, it is a question how much the dissimilarities of the faunæ in these different localities are due to difference in time and how much due to geographic distribution. Undoubtedly both are important factors. Personally I am more and more impressed with the idea that only at long intervals have conditions in any one region been favorable for the preservation of vertebrate fossils, and these favorable local conditions may not have occurred at the same time in widely separated localities, though evidently a great similarity of conditions existed over a vast region during the deposition of the Lower White River beds.

It is evident that in the region in Colorado, which was studied by Matthew, the upper strata of what he calls the White River are the only representatives there of a long period of time during which fossil-bearing deposits accumulated in Nebraska, Oregon, and Montana.

I give a quotation which shows Dr. Matthew's views on the subject:

“The equivalence of the Titanotherium Beds and Oreodon Clays with the corresponding horizons in South Dakota scarcely needs discussion, as the faunæ are largely identical. The equivalence of the Leptauchenia assise with the Protoceras sandstones is more difficult to show, as the two have almost nothing in common. The Leptauchenia clays of South Dakota, in the localities examined by Wortman¹⁷ *overlie* the Protoceras sandstones; but others have found them interbedded and almost certainly contemporaneous. The uppermost levels of the South Dakota clays, which no doubt are considerably above the sandstones, are said to be barren; and in Colorado we found fossils scarce in horizon C, but, when discovered, of much interest. They appear to indicate that these comparatively barren upper clays are considerably later than any of the more richly fossiliferous beds, and that the building up of the White River formation was continued into the Uppermost Oligocene or Lower Miocene. For in the top levels we found genera and even species hardly separable from those which occur in the Loup Fork formation above, in company with the known Loup Fork fauna, viz.: *Merycochærus proprius*, *Anchippus texanus*, *Blasto-*

¹⁷ “On the Division of the White River or Lower Miocene of Dakota,” *Bull. Amer. Mus. Nat. Hist.*, Vol V., p. 95.

meryx, and others that indicate much more modernization than is apparent in the typical White River." ¹⁸

It is evident, then, that Dr. Matthew uses the "White River" as the name of a formation which includes several beds belonging to several different horizons. Its upper member according to the usage of Dr. Matthew extends into the Miocene where it contains genera and species, hardly separable from the Loup Fork immediately overlying it, and these species are much more modernized than is apparent in the typical White River. *Merycochærus*, then, probably is not a form belonging to the White River beds as these are commonly understood to be located in the geological series. So far as my observation and study go *Merycochærus* does not occur below the Middle Miocene. With regard to Hayden's list in Leidy's "Extinct Mammalian Fauna," there is not space to discuss it here, only to say that few of the specimens enumerated in column "D" as contemporaneous with *Merycochærus proprius* can be pointed to as definitely marking horizons, when it is considered that in those early days of discovery, fragments of jaws, etc., were very misleading. Then, too, in collecting from deposits, which are undoubtedly in part of stream origin, it would be strange if there were not some specimens put in the wrong list.

The typical *Merycochærus* is probably older than the specimens from Montana which, in part at least, have been wrongly put in that genus.

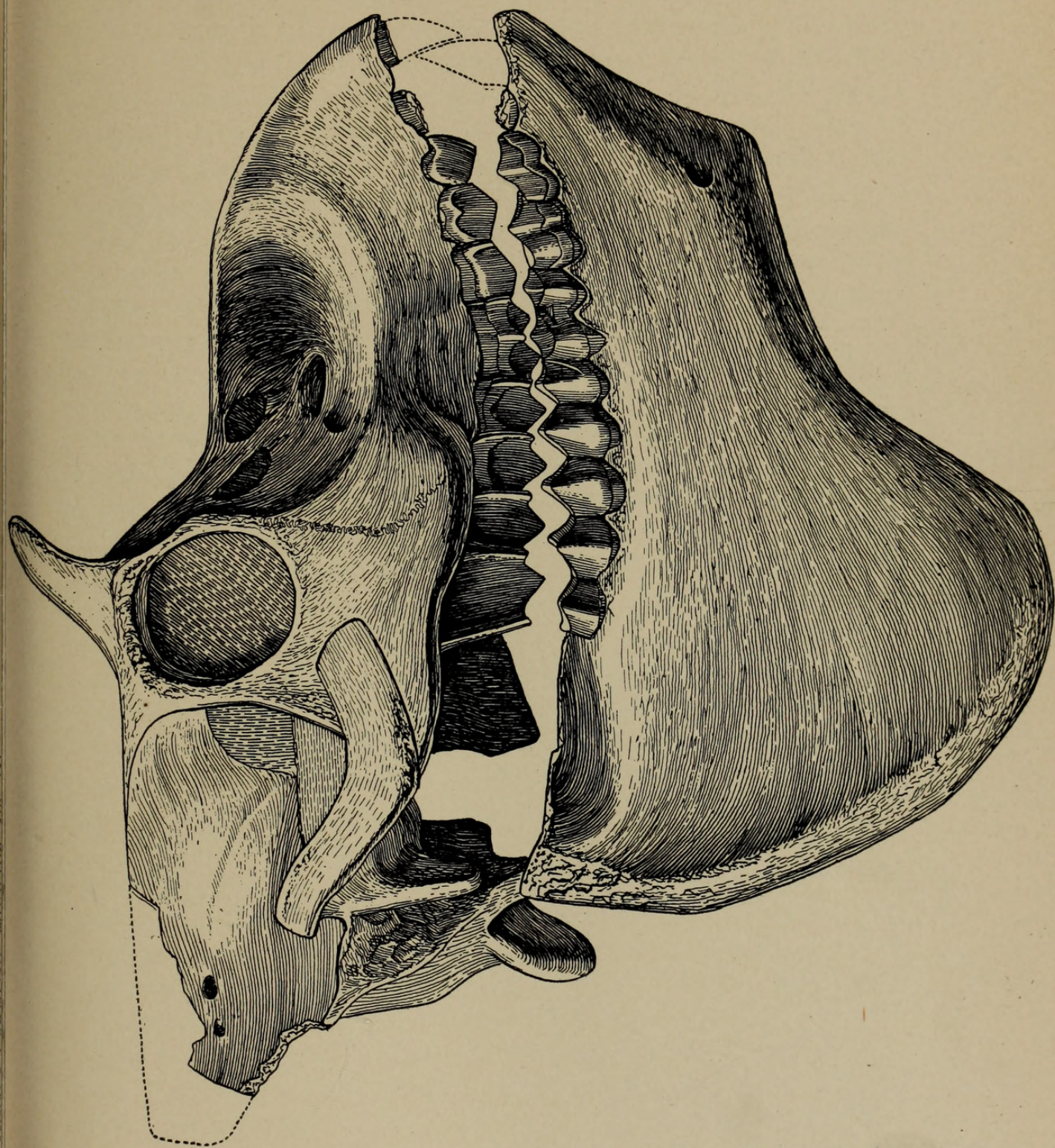
III. *Pronomotherium* gen. nov.

I propose this name for a new genus, the type of which is a nearly complete skull with the mandible (Carnegie Museum Catalogue of Vertebrate Fossils No. 796) formerly described as *Merycochærus laticeps* Douglass. ¹⁹ This specimen was very fully described in the paper cited. I am now better able to give the characters which distinguish it from the genus in which it was wrongly placed.

GENERIC CHARACTERS. — *Skull extremely short, brachycephalic, broad and low. Posterior portion reduced in length more than the anterior portion. Brain case small. Inclination of basi-cranial to basi-facial axis extreme. Anterior narial opening of two portions, one opening a little anterior to the orbits, the other a long slit between the*

¹⁸ "Fossil Mammals from Colorado," p. 372. See also pages 401 and 402.

¹⁹ "New Species of *Merycochærus* in Montana," *Amer. Jour. Sci.*, Vol. X., Dec., 1900, p. 428.



Skull of *Pronomotherium laticeps* Douglass, $\frac{1}{2}$.

upper borders of the maxillaries and opening upward. Premaxillaries united for a long distance and forming a spout-shaped depression which is concave transversely and convex longitudinally. Sides of face concave below horizontal portion of posterior nares. Malar below orbit very deep but squamosal portion of zygomatic arch light. Mandible heavy and angle extremely large and deep. Both the mandible and sides of the face, especially the malar portion, fitted for the attachment of heavy muscles. Premolar series of teeth shortened and crowded. Molar series increasingly hypsodont. Incisors small.

It will not be necessary to redescribe the skull, but I have made comparisons with the types of *Merycochærus proprius*, *Merycochærus ? rusticus*, and skulls of *Merycochærus* collected by Mr. O. A. Peterson in the Harrison or upper Monroe Creek beds in Nebraska.

COMPARISON WITH MERYCOCHÆRUS PROPRIUS.

In *Pronomotherium laticeps* the premaxillaries, as seen from in front, are narrower and more concave, are trough-shaped, not simply having a narrow median channel near the alveolar border as in *Merycochærus proprius*; the anterior palatine foramina are not so large; themalmaxillary ridge is more prominent, the face not so nearly flat, but is much more deeply concave above the ridge just mentioned; the infra-orbital foramen is on the nearly horizontal shelf above this ridge instead of opening on the nearly vertical portion of the face; the incisive border is much narrower, so it is evident that the incisors were smaller. The first premolar is oblique, and there is no space between this and the second premolar. The space in front of P^1 is much shorter than in *Merycochærus proprius*. There are but faint traces of cingula on the teeth posterior to P^1 , while in the type of *Merycochærus proprius* they are strong and heavy. The teeth are all narrower, P^2 is shorter and P^3 has not the peculiar pattern of the type of *Merycochærus proprius* as it apparently had only two pits. P^4 is of the same length but is narrower, giving it a quite different appearance. This is also true of M^1 . The second and third premolars are not such broad and heavy teeth, and the ridges and buttresses are not so heavy. The posterior outer lobe of M^3 is much narrower and is directed outward, not extending much behind the posterior horn of the posterior inner crescent; the posterior half of the tooth is much narrower, and there are no median ridges on the outer surfaces of the outer crescents in the molars.

The mandible associated with the type of *Merycochærus proprius* is very different in form from the type of *Pronomotherium laticeps* which is not quite so old an individual. The depth of the jaws is nearly the same at the chin, but in the last named specimen the lower border of the jaw begins to drop beneath $M_{\frac{2}{2}}$, and under the posterior portion of $M_{\frac{3}{3}}$ it becomes exceedingly deep. The incisors and canine are far less robust. The proportional length of the premolar to the molar series is apparently somewhat less. The molars and premolars have about the same pattern, but in the present type are more hypsodont. In nearly all respects the specimen of *Pronomotherium* has a more advanced or specialized appearance.

COMPARISON WITH MERYCOCHÆRUS? RUSTICUS.

The specimen of *Pronomotherium* is apparently much more like *Merycochærus* (?) *rusticus* than *Merycochærus proprius*. The symphysis of the premaxillaries, the concavities of the sides of the face, the way the infraorbital foramen opens, the sudden widening of the skull at the anterior portion of the zygomatic arches, the reduction in the size of the incisors, and the form of the chin and other portions of the mandible are much the same in both, yet there are slight differences in all of these.

Pronomotherium laticeps is considerably larger than *Merycochærus* (?) *rusticus*, the anterior palatine foramina are smaller; the shelf at the bottom of the facial concavity—the top of the malo-maxillary ridge—is flatter and more horizontal; the malo-maxillary ridge is narrower and more angulate, not broadly and evenly convex as in *Merycochærus* (?) *rusticus*. Premolars one and two do not incline backward and become much more worn on the posterior edges as in *Merychys*. The fourth premolar has a larger inner cingulum, and molars one and two have more prominent buttresses.

It may be that *Merycochærus rusticus* belongs in the same genus as *Pronomotherium laticeps*, but it is still very doubtful, as the type of the former is so incomplete, and Dr. Matthew refers the specimens from Colorado²⁰ to this species, with some doubt.

I have made detailed comparisons of *Pronomotherium laticeps* with specimens obtained by O. A. Peterson in the Loup Fork (Upper Monroe Creek or Harrison beds) of Nebraska. These are much like the specimens which Dr. Matthew refers to *Merycochærus proprius* but

²⁰ "Extinct Mammals from Colorado," p. 412.

I defer these comparisons for my more complete memoir on the *Agriochæridæ* of Montana. It is sufficient to say here that this specimen differs in nearly every detail from the specimens from Nebraska.

THE SO-CALLED MERYCOCHÆRI FROM THE LOWER MADISON VALLEY, MONTANA.

With regard to part of these specimens nothing final can be said until the skulls or portions of them are found. The specimen named *Merycochærus madisonius*²¹ looks very much like the mandible of *Pronomotherium laticeps*. The associated upper jaw²² is more like *Merycochærus* in having the anterior inferior origin of the zygomatic arch farther forward than in the former.

"*Merycochærus compressidens*"²³ in the form of the jaw more resembles that of the type of *Merycochærus*, but it may be something else.

The so-called *Merycochærus altiramus*²⁴ should be put in the genus *Pronomotherium* as a skull in the American Museum of Natural History shows no generic distinction from the type of *Pronomotherium*.

Cope's *Merycochærus obliquidens*²⁵ evidently does not belong to either of these genera.

IV. AFFINITIES OF PRONOMOTHERIUM.

I do not know of anything very closely related to *Pronomotherium laticeps* except *Pronomotherium altiramus* and "*Merycochærus*" *rusticus*. It may be from beds later than *Merycochærus proprius* but probably not a direct descendant. It is doubtful if it is a descendant of "*Merycochærus*" *rusticus*, but it was probably more nearly contemporaneous with the latter, than with the former. I know of nothing in lower horizons which is likely to prove ancestral to any of these.

Pronomotherium was an extremely aberrant artiodactyl. The upper lip and snout were certainly greatly modified to correspond with the extreme modification of the bones of the head. The character of the skull could hardly tell in a plainer manner, that the possessor

²¹ "New Species of *Merycochærus*," *Am. Jour. Sci.*, Vol. XI., 1900, p. 75, Fig. 2.

²² *Ibid.*, p. 77.

²³ *Ibid.*, p. 79, Fig. 4.

²⁴ *Ibid.*, p. 73, Fig. 1.

²⁵ "The Vertebrate Fauna of the Ticholeptus Beds," *Amer. Nat.*, XX., p. 368.

had a large lengthened snout or proboscis. How long it was of course is not known but it was probably quite long. The position of the condyles and the extremely heavy mandible indicates that the head was carried with the facial axis in approximately a vertical position or approaching a right angle to the vertebræ of the neck.

If we may judge by what appears to be its nearest known relatives, and by what few fragments of bone are preserved, this animal was short limbed, like most of the later *Merycoidodonts*; but we must await the discovery of more complete skeletons.

V. AGE OF THE FLINT CREEK AND MADISON VALLEY BEDS.

These beds both belong to the Loup Fork Epoch as it is usually understood. Either they are not quite contemporaneous or else they represent a somewhat different ecological condition, at least there is a different assemblage of fossils. This will be thoroughly discussed later after a revision of the fauna has been made. *Mylagaulidæ*, but perhaps of different genera, occur in both formations, *Pronomotherium* appears in the Flint Creek Beds and a related form *Pronomotherium altiramus* in the Madison Valley Beds. *Palæomeryx* ? appears in both beds but of smaller size in the latter. *Procamelus* of large size occurs in both.

On the other hand *Mylagaulus* is found in the Flint Creek and Deep River beds. *Ticholeptus* occurs in the latter, and perhaps in the former, as the specimen, *Merychys smithi* is much more like *Ticholeptus*. *Palæomeryx* ? *borealis* occurs in the Deep River beds, and what appears to be the same species, in the Flint Creek beds.

It appears most probable, from the evidence, that the Flint Creek beds are in some ways intermediate between the Deep River and Madison Valley formations, yet some things in the first seem more modernized or specialized than in the last, yet we cannot judge by this, for there have been very highly specialized mammals all along the line, and some characters that were supposed to be modern are quite ancient. A careful study of the Horses, Camels, and other fossils of these beds may furnish a better basis for correlation.

Matthew ²⁶ thinks that the Pawnee Creek Loup Fork holds a position distinctly lower than that of the Niobrara, Santa Fe, and the Republican River Basin. "It seems most nearly equivalent to the upper beds of Smith Creek, Montana (Deep River substage)."

²⁶ "Fossil Mammals of Colorado," pp. 373-4.



Douglass, Earl. 1907. "Merycochoerus and a new genus of Merycoidodonts, with some notes on other Agriochoeridae." *Annals of the Carnegie Museum* 4(2), 84–98. <https://doi.org/10.5962/p.328719>.

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