

ART. XVII. — *Studies of Eocene Mammalia in the Marsh Collection, Peabody Museum; by J. L. WORTMAN.* (With Plate VI.)

[Continued from p. 128.]

Limnocyon Marsh.

Limnocyon Marsh, this Journal, August, 1872, p. 6. Separata :
Thinocyon Marsh, this Journal, August, 1872, p. 12. Separata :
Oxyenodon Wortman, Bull. Amer. Mus. Nat. Hist., 1899, p. 145 :
Telmatocyon Marsh, this Journal, May, 1899, p. 397.

A group of small or medium-sized Creodonts ranging in time from the beginning of the Bridger to the close of the Uinta epoch, and, as far as known, having the following principal characters: Dental formula I. $\frac{3}{3}$ C. $\frac{1}{1}$ Pm. $\frac{4}{4}$ M. $\frac{2}{2}$; first upper and lower premolars two-rooted (except in *Limnocyon dysodus*); last superior molar transverse and little reduced; two subequal inferior molars with internal cusps and moderate-sized basin-shaped heels; fibula articulating with calcaneum; astragalus moderately grooved; femur with small third trochanter; deltoid crest of humerus reduced; distal end of humerus broad, with prominent supinator ridge and an entepicondylar foramen; metapodials of fore feet short and phalanges elongated; carpus unknown.

The genus *Limnocyon* was described by Professor Marsh in August, 1872, from a series of superior teeth which were not in place in the maxillary. A second species was proposed in the same paper upon a specimen consisting of both mandibular rami, one of which contains the last premolar and first molar, together with all the alveoli. In the same paper Professor Marsh proposed a second genus, *Thinocyon*, upon an entire left mandibular ramus, containing a few of the teeth in good condition and the alveoli and roots of all the others. In June, 1899, I proposed the genus *Oxyenodon* upon a well-preserved half of a skull, in which both the upper and lower teeth are present. In May, 1899, Professor Marsh, upon my advice, placed *Limnocyon verus* as synonymous with *Sinopa*, and proposed for the second species *L. riparius*, the generic name *Telmatocyon*. The reason for this advice was as follows: The type of the genus consists of the dissociated upper teeth, in which the superior molars are almost, if not quite, indistinguishable, in structure at least, from those of certain species of *Sinopa*, and as the number in this latter group is three and no two-molared type was at that time known, it was quite naturally supposed that the type specimen of *L. verus* was a *Sinopa*.

The type of *L. riparius*, having but two subequal lower molars, was otherwise unknown, and was regarded as a distinct genus. The relationship with *Oxyenodon* was entirely overlooked. The unstudied part of the collection affords much additional material, and it is now quite evident that the number of superior molars in *L. verus* is two instead of three. The association of upper and lower teeth in this material renders it clear, moreover, that the type of *L. riparius* is the lower jaw of *L. verus*, and on this account I do not hesitate to unite them. I also arrange *Thinocyon* and *Oxyenodon* in this genus, but, as already remarked, it may be found, with more complete information, that they represent distinctive generic modifications.

Limnocyon verus Marsh.

Limnocyon verus Marsh, this Journal, 1872, p. 6, Separata.

Originally established upon a superior series of teeth of the right side, figure 71, with the first premolar only, in place.

71

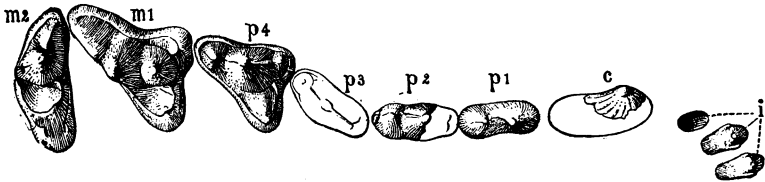


FIGURE 71.—Series of right superior teeth of *Limnocyon verus* Marsh; crown view; three halves natural size. (Type.)

The two middle incisors are present, but they do not present any characters of unusual importance; their roots are much compressed from side to side, like certain members of the Mustelidæ, and their crowns are obtusely pointed and rather narrow. The canine is represented by fragments only, but these are sufficient to indicate that it had the usual size and form of this tooth among the Carnivora; its surface is traversed by characteristic longitudinal grooves and ridges, much as in certain species of reptiles. There are apparently no traces of these grooves and ridges upon the canines of the other species of the genus (except very faint ones in *L. velox*), and it may be taken to be diagnostic.

The first premolar is two-rooted, with a conical, more or less recurved, principal cusp, and a rather extended heel bearing a small cusp; it is placed immediately behind the canine without the intervention of a diastema. The second premolar is only partially preserved in the type, but is present in many other specimens in the collection. The third premolar is missing in

the type, but in other specimens is similar to the first but larger. There is no internal cusp as in *Oxyaena*. The crown of the fourth is made up of the usual elements found in the typical sectorial premolar, although certain parts are little developed. There are two main external cusps, together with a small but distinct anterior basal cusp; to these is added a relatively large internal lobe, which is placed opposite or a little anterior to the large principal external cusp. The posterior external cusp is proportionally small, and the posterior

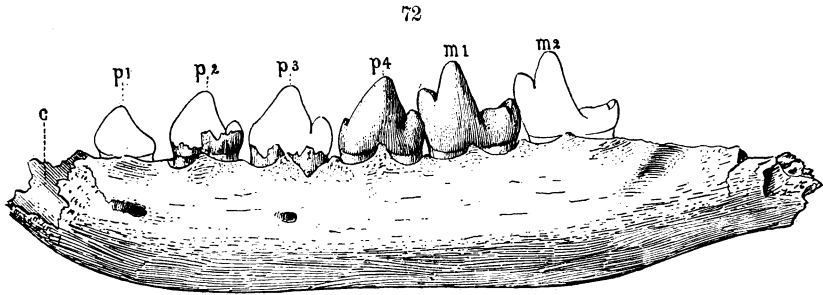


FIGURE 72.—Left mandibular ramus of *Limnocyon verus* Marsh (type of *Limnocyon riparius* Marsh): side view; three halves natural size.

border of the main cusp is little produced, so that the shear of this tooth cannot be said to be very perfectly developed. The first molar is the largest tooth of the series; its crown is composed of two principal external cusps, well separated, a strong blade-like postero-external spur, between which and the postero-external cusp is a deep vertical fissure, a basal antero-external ledge, and a large lunate internal cusp. The large postero-external spur, together with the postero-external cusp, furnish the principal shear, and constitute the chief sectorial organ of the superior series of teeth. The last molar is relatively large, three-rooted, and transverse; its crown is composed of one main external cusp, external to which, and separated by a slit-like fissure, is a sharp ridge, which has more or less of a sectorial function. The usual internal lunate cusp, together with distinct anterior and posterior intermediates, are present, but the postero-external cusp is vestigial or wanting.

The type of *Limnocyon riparius*, figures 72, 73, which I take to be the same as *L. verus*, consists of the greater part of both mandibular rami and a portion of a first superior molar. The specimen

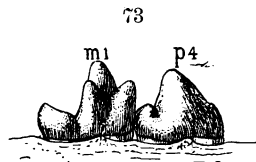


FIGURE 73.—First molar and fourth premolar of the preceding figure; inside view; three halves natural size.

does not exhibit very clearly the number of incisors, but in others which agree with it very closely, the number is three. The first premolar is two-rooted and is placed close behind the canine, without diastema. All the other premolars are likewise implanted by two roots, and are much crowded in the jaw. The fourth has a distinct posterior, but no anterior basal cusp. The crowns of all the premolars are rather thick from side to side, and the cusps are inclined to be obtuse and rounded. The two subequal molars, of which the first is preserved in the specimen, have the following characters: A moderately elevated trigon, with a large external and smaller internal and anterior cusps; a moderately well-developed shear, and blade-like modification of the external and anterior cusps; and a medium-sized basin-shaped heel. These two teeth are nearly equal in size, the last being a little the larger. The jaw is shallow vertically and thick from side to side. The symphysis is enlarged and extends to beneath the middle of the third premolar. There are two mental foramina, the larger of which issues beneath the anterior border of the second premolar. The coronoid is rather large and the angle is not inflected.

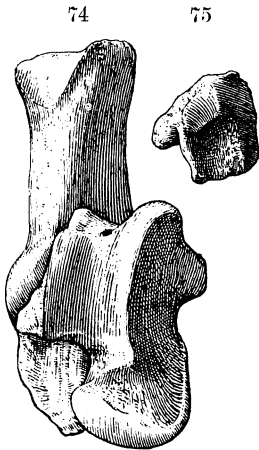


FIGURE 74.—Astragalus and calcaneum of *Limnocyon verus* Marsh; front view; three halves natural size.

FIGURE 75.—Fibula of *Limnocyon verus* Marsh; end view; showing articular surface for calcaneum; three halves natural size.

In one specimen a considerable part of the skull, Plate VI, together with certain parts of the skeleton, are preserved, from which the following characters may be stated: The face is rather short; the orbital cavity is relatively small; there is a distinct postorbital process and a sagittal crest of moderate proportions; there is apparently no anterior glenoid process, but a distinct postglenoid foramen; the mastoid is well exposed upon the postero-lateral wall of the skull, but the position of the stylomastoid foramen cannot be ascertained; the trochlear surface of the astragalus, figure 74, is moderately grooved and there is a distinct astragalar foramen, of about the same size and position as seen in that of the otter; the fibula is little reduced and has a considerable contact with the calcaneum, figure 75, as in the otter; the calcaneum has a moderately short tuber, a broad sustentaculum, and a prominent calcaneal

tubercle; there were apparently five toes in the hind foot, and the phalanges were elongated, being but little shorter than those of *Lutra*.

This species is the largest one of the genus thus far known, and the remains indicate an animal slightly larger than a raccoon, which it apparently resembled in its short limbs and heavy build. In one specimen the heel of the last molar is considerably larger than that of other individuals, and is very probably indicative of another species, but until better material is brought to light it is unwise to propose another name.

The principal measurements are as follows :

Type of *Limnocyon verus* :

Length of molar and premolar series	47·5 ^{mm}
Length of premolars	31·5
Length of molars	16·
Length (antero-posterior) of fourth premolar	9·2
Transverse diameter of fourth premolar (anterior border)	8·
Length of first molar (antero-posterior external)	11·5
Transverse diameter (anterior border)	9·5
Antero-posterior diameter of last molar (middle)	5·
Transverse diameter of last molar	13·

Type of *Limnocyon riparius* :

Length of molar and premolar series	46·5
Length of premolars	29·5
Length of molars	17·
Height of first molar	9·
Transverse diameter of first molar	5·
Depth of jaw at first molar	12·
Thickness of jaw at first molar	7·
Thickness of jaw at symphysis	8·

Measurements of other specimens :

Length of calcaneum	33·
Length of astragalus	21·5
Width of astragalus	16·
Length of a first phalanx of hind foot	19·
Length of a second phalanx of hind foot	12·5

The type specimen of *Limnocyon verus* was found by Mr. J. F. Quigley of the Yale party of 1871, at Grizzly Buttes, Bridger Basin, and the type specimen of *L. riparius* was found by Mr. Oscar Harger of the same party, at the same locality. Other specimens are from Henry's Fork.

Limnocyon velox Marsh.

Thinocyon velox Marsh, this Journal, August, 1872, p. 12, Separata.

The type of this species, figure 76, consists of an almost complete mandibular ramus, containing the canine and premolars more or less complete, as well as the roots of the molars and the alveoli for the incisors. The number of the latter cannot be determined with certainty. Professor Marsh stated them as two, but it is more than probable that there were three, with the middle one pushed back out of position. The canine

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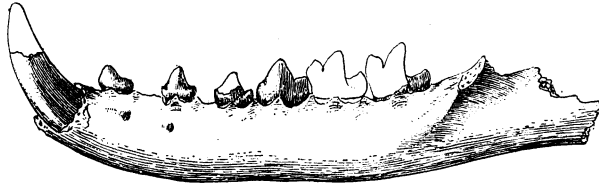


FIGURE 76.—Left mandibular ramus of *Limnocyon velox* Marsh (type of *Thinocyon velox* Marsh); side view; three halves natural size. (Type.)

is relatively large, recurved, and its surface exhibits very faint traces of the longitudinal grooving seen in *L. verus*. The first premolar is two-rooted, with an elongate heel as in this latter species. The remaining premolars resemble the corresponding teeth of *L. verus*, except that they are much smaller. The molars, of which only the heel of the last is preserved, have the same relative size and proportions as in the larger species. The jaw is unusually long and shallow, the symphysis enlarged, the inferior dental canal low in position, and the angle considerably inflected.

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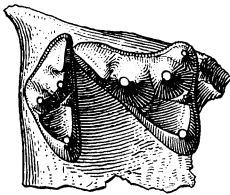


FIGURE 77. — Superior molars of *Limnocyon velox* Marsh; crown view; three times natural size.

From the numerous fragmentary specimens of this species in the collection, the following points in its structure may be stated: The last superior molar, figure 77, has two external cusps, and the antero-external basal cusp of the first upper molar is distinct and prominent; the occiput is low and broad, the sagittal crest weak, and the condyles large and divergent; there is no accessory condyloid foramen, and the stylomastoid foramen issues upon the inferior surface of the mastoid; the tympanic is not ossified into an otic bulla, and the base of the skull is broad, as in the Mustelidæ; the position of the posterior lacerated foramen is posterior and external to the periotic, as

in the Insectivora, and not postero-lateral, as in the Carnassidentia; the entocrotid enters the tympanic chamber and divides in a manner similar to that of the modern Insectivora, the main branch grooving the outer lateral aspect of the periotic, in front of, and below the *fenestra ovalis*, the other passing between the crura of the stapes and thence into the brain case; the foramen ovale is situated well within the basi-sphenoid and the paroccipital process projects outward and backward. There is no anterior glenoid process, but a distinct postglenoid foramen, and a deep groove in the position of the alisphenoid canal; the deltoid crest of the humerus, figure 78, is little developed, the shaft is much curved, and the distal end is broad, with an entepicondylar foramen; the ulna has a relatively short incurved olecranon, and the head of the radius is subcircular; there were five toes in the manus, the pollex, figure 79, unreduced, and the phalanges, figure 80, elongate as in *Lutra*; the femur has a strong second and a weak third trochanter; its distal end is characteristically broad, with little backward extension of the condyles, and a wide intercondylar groove; the pes is unknown.

The general facies of this species is not unlike that of certain of the otters, notably *Potamotherium* of the European Lower Miocene. The likeness is seen in the low broad occiput, the weak sagittal crest, the broad base of the skull, the probable absence of the alisphenoid canal, the character of the humerus, ulna, radius, femur, and the elongated phalanges, together with probable contact between fibula and calcaneum. The character of the lower jaw and teeth, however, precludes the possibility of its being ancestral to this group. The fundamental differences are seen in the structure of the first molar, which has,

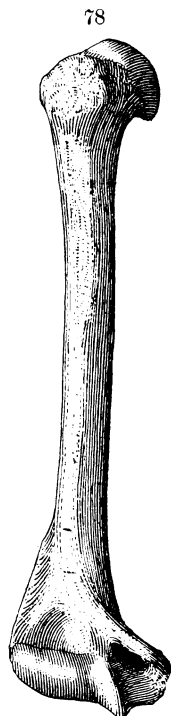


FIGURE 78. — Humerus of *Limnocyon velox* Marsh: front view: two and one-fourth times natural size.

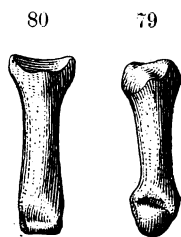


FIGURE 79. — Metacarpal of the pollex of *Limnocyon velox* Marsh: front view: three halves natural size.

FIGURE 80. — Phalanx of *Limnocyon velox* Marsh: front view: three halves natural size.

like all the Creodonts, the postero-external angle enlarged and produced into a cutting blade. It is upon this tooth that the sectorial specialization has centered, whereas in the otters it is the fourth premolar. The superficial likeness to the aquatic mustelines is very evident, however, and I do not hesitate to venture the opinion that this species was aquatic or partially so in its habits. The resemblances to the Insectivora seen in the base of the skull are very marked, and there is a possibility that the entire group may belong to this order instead of to the Creodonta.

The measurements of the species are as follows :

Type of *Limnocyon velox* :

Length of molar and premolar series	30·5 ^{mm}
Full length of jaw (estimated)	53·
Length of molars	11·
Depth of jaw at last molar	8·

Other specimens :

Height of occiput above base of condyles	12·
Width of condyles	15·
Width of occiput	15·5
Width of base of skull between mastoids (outside)	22·
Length of two superior molars	7·3
Width of first molar (in front)	4·8
Width of last molar	5·4
Length of humerus	40·5
Antero-posterior diameter of head of humerus	7·5
Transverse diameter of distal end of humerus	9·5
Length of olecranon of ulna	5·
Length of metapodial of pollex	7·5
Length of a first phalanx of manus	8·

The type specimen was found by Professor Marsh at Grizzly Buttes, in the Bridger Basin, and others were collected at Millersville. The horizon for the species is therefore near the base of the deposits.

Limnocyon medius, sp. nov.

Numerous remains of a species intermediate in size between *L. verus* and *L. velox* are contained in the collection, but unfortunately they are for the most part rather fragmentary. One specimen, figures 81, 82, which I select as the type, consists of the greater part of both lower jaws, associated with the upper molars and a part of the premolar dentition. The principal differences, besides those of size, are seen in the superior molars. In *L. verus* and *L. velox* the two external cusps of

the first superior molar are well separated, whereas in the present species these cusps are much closer together. In *L. velox*, again, the last superior molar has two external cusps, and in *L. medius* and *L. verus* there is only one. The last two

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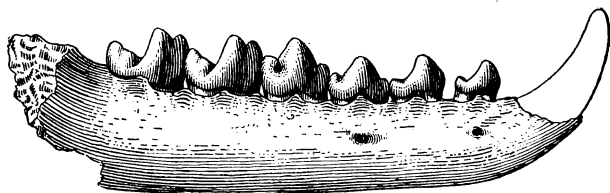


FIGURE 81.—Lower jaw of *Limnocyon medius* Wortman; side view; three halves natural size. (Type.)

species differ in the last molar, in that there is a very distinct internal cingulum in the latter, which is absent in the former.

Various parts of the skeleton are represented in the specimens, and, these apparently agree very closely with those of *L. velox*. Some parts of lumbar vertebræ are preserved in one specimen, and these show that the double tongue and groove articulations were present, as in *Patriofelis*. The deltoid crest of the humerus is reduced, the distal end is broad, and there is an entepicondylar foramen. The trochlear surface of the astragalus is little grooved, and there is a considerable contact between the fibula and calcaneum. The remains indicate an animal somewhat smaller than a Grey Fox. The measurements are as follows:

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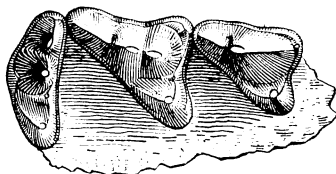


FIGURE 82.—Fourth premolar and first and second superior molars of *Limnocyon medius* Wortman; crown view; two and one-fourth times natural size. (Type.)

Length of fourth premolar and two superior molars	17· mm
Length of superior molars	10·
Width of first molar (in front)	6·5
Width of last molar	8·
Length of lower molar and premolar series	35·
Length of lower molars	13·
Depth of jaw at last molar	10·
Full length of jaw	80·
Length of humerus	65·
Antero-posterior diameter of head of humerus	13·5
Transverse diameter of distal end of humerus	13·5

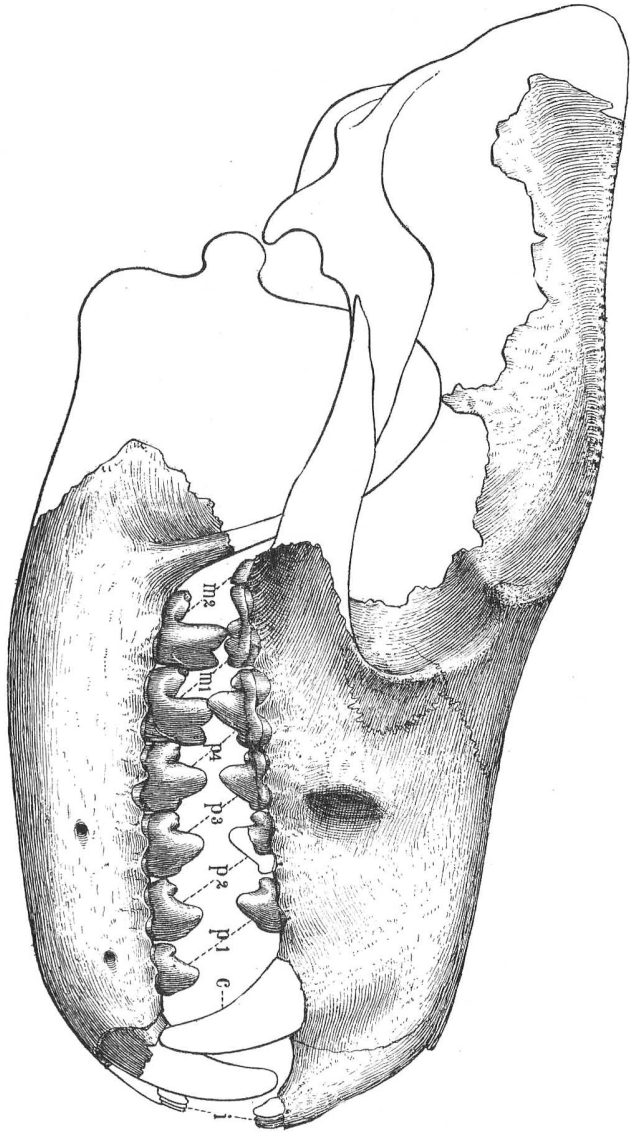
The type specimen of this species is from near Henry's Fork, Bridger Basin, but others were found in the lower part of the deposits.

Limnocyon dysodus Wortman.

Oxyenodon dysodus Wortman, Bull. Amer. Mus. Nat. Hist., June, 1899, p. 145.

The Uinta representative of this genus, as far as known, while differing from the Bridger forms in rather strongly marked specific characters, had, nevertheless, not departed sufficiently from the general type to warrant the establishment of a separate genus for its reception. It may well be that the skeleton, when more fully known, will show characters which will necessitate its removal from *Limnocyon*, but upon present evidence, I choose to regard these characters as of no more than specific importance. That it exhibits a distinct advance in structure over the Bridger species, is shown by the fact that the first lower premolar has become single-rooted, the two external cusps of the first superior molar have been more closely approximated, and the last upper molar is considerably reduced in size. It would appear that this form is a direct descendant of *L. medius*, which is the most abundant species in the upper horizon of the Bridger, and that it was very probably also the forerunner of *Thereutherium*.

[To be continued.]



EXPLANATION OF PLATE VI.

Skull of *Limnocyon vevus* Marsh; side view; one and one-eighth natural size.