

**Article VII.—RESTORATION OF OXYÆNA LUPINA
COPE, WITH DESCRIPTIONS OF CERTAIN NEW
SPECIES OF EOCENE CREODONTS.**

By J. L. WORTMAN.

PLATE VII AND THREE TEXT FIGURES.

FAMILY OXYÆNIDÆ.

This family of the Creodonta was the most specialized in certain ways of any of the primitive flesh-eaters of Eocene times, and apparently occupied the same position with reference to the remainder of the fauna that the modern Felidæ do to the existing fauna. In the matter of dental equipment it is surprising to find that even as early as the Wasatch this family had developed a sectorial dentition almost if not quite as effective as that of the modern Cats. In other respects, however, they were far inferior; this is particularly seen in the small brain capacity, as well as the comparatively smaller, decidedly weaker limbs with shorter, more spreading feet, provided with flatter, fissured, non-retractile claws.

The origin of the family is completely unknown at the present. They begin with several species abruptly in the Wasatch deposits of both the San Juan and Big Horn beds without any known predecessors in the underlying Torrejon. For this reason there can be very little doubt that they represent migrants from another region, probably northern Asia, which came with the Coryphodonts, Artiodactyles, Perissodactyles, Primitive Dogs, as well as many other types whose existence begins so abruptly in the Wasatch beds of North America.

According to our present knowledge the family represents a perfectly natural grouping of the known species, and is easily distinguished from the other groups of typical Creodonts that had developed a more or less perfect sectorial dentition. A convenient distinction of these families may be made upon the enlargement of a special molar in the lower jaw; it is as follows:

1. Third lower molar enlarged,—HYÆNODONTIDÆ. Includes the genera *Palæosinopa*, *Sinopa*, *Proviverra*, *Cynohyænodon*, *Pterodon*, *Hyænodon*.

2. Second lower molar enlarged,—*OXYÆNIDÆ*. Includes the genera *Oxyæna*, *Patriofelis*, *Oxyænodon*.

3. First lower molar enlarged,—*PALÆONICTIDÆ*. Includes the genera *Palæonictis*, *Amblyctonus*, *Ælurotherium*.

Oxyæna lupina Cope.

By a fortunate circumstance I am now enabled to give a rather full account of the skeleton of this species, which has hitherto been only imperfectly known. At the time of my first trip into the Big Horn Basin in 1880 the country was a wild, uninhabited region, save for the occasional visits of roving bands of hostile Indians, and any explorations there by a small party were attended by no small amount of risk to one's personal safety. In fact, I was advised by the commander of Fort Washakie, at that time the base of our operations, that the trip was a hazardous one, and that he would not undertake to answer for our safe conduct. We went through, however, without serious inconvenience, but at the same time the collecting was not as thoroughly done as it probably would have been under less trying circumstances.

On this expedition, among other things, I secured a part of the skeleton of this species, which was erroneously referred to Cope's somewhat larger but closely allied species *O. forcipita*, in his volume 'Tertiary Vertebrata.' In 1891, I conducted another expedition into this same region for the American Museum, at which time, through a general settlement of the country, the former more hazardous conditions had been entirely removed and undertakings of this sort were not accompanied by the same risks of violence at the hands of savage Indians as formerly prevailed. Our knowledge of methods of collecting had, moreover, materially increased, and while the actual number of specimens secured was perhaps less, yet a somewhat greater success attended our efforts, especially in securing those parts which had already been washed out of the matrix in which they had been originally imbedded. In this category comes the present specimen, a portion of which had been collected by the expedition of 1880, and the remainder by the expedition of 1891.

During this latter expedition, a new method was employed for securing the missing parts which had been washed out and covered up again by the accumulating debris. Wherever possible

the loose dirt containing the fragments was gathered up and transferred to the nearest stream where it was washed out after the manner of the placer miner. In this way, wherever conditions were favorable, all the fragments were recovered, but in the case of the present skeleton, after every possible exertion, a large number of pieces necessary to complete the skeleton remained missing. When the Cope collection was purchased by the Museum and the two collections were brought together it was accidentally discovered by Dr. Matthew that the specimen of the Cope collection furnished the missing parts of one and the same individual of the Museum specimen collected in 1891; in this way an unusually complete skeleton for an Eocene fossil results and furnishes all the more important characters.

Skull.—All the details of the form of the skull cannot be accurately made out owing to the great amount of crushing and fracture which the specimen had sustained during the process of

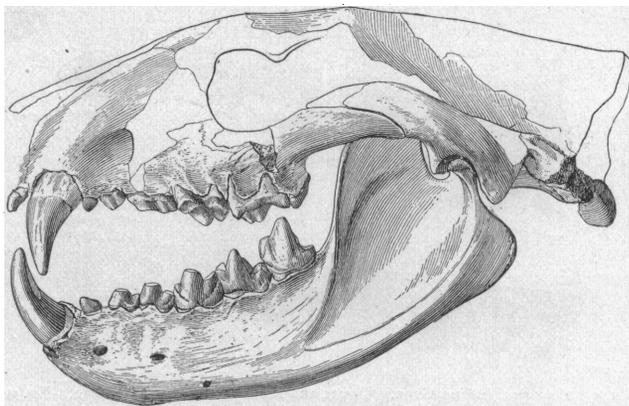


Fig. 1. *Oxyæna lupina* Cope. Skull and jaws, $\frac{3}{8}$ natural size. No. 107.

fossilization; but enough is preserved in an uninjured condition to indicate that the facial portion was very short and broad in proportion to the total length of the cranium. That part of the skull posterior to the orbits is proportionately much elongated and, owing to the small size of the brain-case, it appears to be unusually so. The sagittal crest is prominent and extended well forward; the zygomatic arches are wide and heavy, and the glenoid cavity has a distinct pre- and post-glenoid process. The

mastoid is prominent, and the paroccipital process has a more or less backward direction. The foramina of the base of the skull cannot be determined, but it appears probable that there was a distinct post-glenoid present.

The dentition, the formula of which is I. $\frac{3}{3}$, C. $\frac{1}{1}$, Pm. $\frac{4}{4}$, M. $\frac{3}{3}$, has been quite fully described and requires but a brief mention. It appears from the very perfect lower jaws that there were *three* incisors present upon each side, although this is not entirely demonstrable. In the upper jaw, the outer incisors are much larger than the two inner pairs, which are subequal. The canines are long and pointed, being slightly compressed at the base. The first premolar is small, single-rooted, and has a simple crown. The second is two-rooted and has a prominent posterior heel. The third is three-rooted with two external and one internal cusp. The fourth premolar, while possessing all the elements of

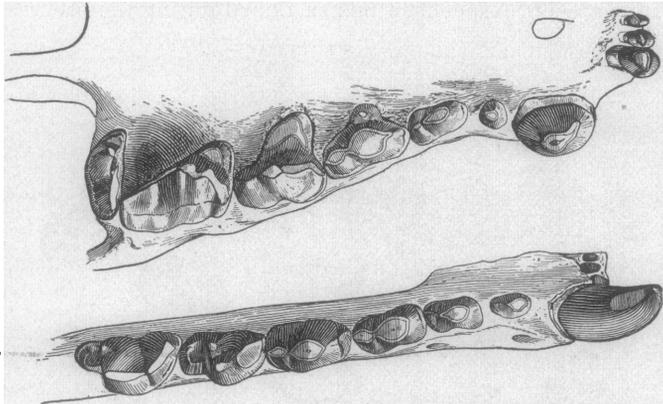


Fig. 2. *Oxyæna lupina* Cope. Upper and lower teeth, $\frac{3}{4}$ natural size. No. 107.

the superior sectorial of the typical Carnivora does not form a very perfect shear between the rudimental blade and that of the inferior first molar. The great shearing function was transferred to the first molar above and the second molar below; the first superior molar is curiously modified, in that the two original external cusps are placed very close together, and a large postero-external cusp added, which, in conjunction with the true postero-external cusp, form a very effective blade, the internal cusp being small. This is, at least, the interpretation which has

been placed upon the structure of this tooth, and the evidence in favor of such a view is found in the gradual assumption of a similar if not identical structure seen in *Hyænodon* from the more generalized pattern of the tooth exhibited by *Sinopa*. The last molar is transverse, and its crown consists of a single external cusp, with a great extension of the antero-external angle, together with a low, smaller internal cusp.

In the lower jaw the first premolar is small, the succeeding teeth gradually increasing in size to the last molar. Premolars two, three, and four have prominent heels, and the fourth has a small anterior basal cusp in addition. The molars have the typical sectorial pattern, with elevated trigon and a low, relatively small, basin-shaped heel. The internal cusp and heel are reduced in the last molar, foreshadowing its almost complete loss in *Patriofelis*.

Vertebrae.—The usual seven cervicals are present which, so far as the imperfect state of their preservation will permit one to judge, resemble closely those of *Patriofelis*. The atlas has rather wide, roomy cotyles for articulation with the occipital condyles and the transverse processes are perforated at the base quite as in *Patriofelis* and the modern Cats. The axis has a peg-like odontoid, a prominent inferior tubercle on the inferior posterior surface of the centrum, and distinct transverse processes, which are perforated at the base for the passage of the vertebral artery.

The spine is not preserved. The remaining cervicals have rather flattened centra and resemble those of *Patriofelis*.

The dorso-lumbar formula is 20, of which 13 are dorsals and 7 are lumbar. They increase in size gradually from before backwards, the posterior lumbar being the largest. The lumbar articulations are not so complex as those of *Patriofelis*, the convex postzygapophyses fitting into concave prezygapophyses with no evidence of the double, concavo-convex arrangement of certain of the other Creodonts. There are distinct anapophyses, but no metapophyses appear to have been developed. The sacrum is not preserved. Of the caudals enough are preserved to indicate that there was a long and powerful tail. The vertebrae resemble those of *Patriofelis* in all their details of structure.

Fore Limb.—Very little of the scapula is preserved, only the proximal portion of both bones being present. The glenoid cavity

has an oval form; the coracoid is prominent, and the relatively strong spine arises a short distance behind the glenoid border. There is evidence of a well developed acromion and metacromion, about as in *Patriofelis*. The humerus, like that of many of the Creodonts, has a powerful deltoid crest which occupies somewhat more than one half the entire length of the shaft. The head is pyriform, the tuberosities well developed, and the bicipital groove is deep. Distally the bone is broad, as in many of the modern Carnivores, especially the felines. There is a very prominent internal condyle; an entepicondylar foramen, and a somewhat reduced supinator ridge. The articular surface is very much as in the Cats. The ulna has a very prominent incurved olecranon, the shaft is straight, and the two distal articular facets are well separated as in the Cats. The head of the radius presents an oval outline with an unusually prominent tubercle. The lower end of the shaft is triangular in cross-section, and the scapho-lunar facet is concave. The fore foot has already been fully described,¹ and there is little of importance to add. The foot is relatively broad and spreading as in *Patriofelis*; the scaphoid, lunar, and centrale are free; the first phalanx of the thumb is relatively large, and all the claws are deeply fissured with the possible exception of the fifth. There is reason to believe that the habitual position of the foot was digitigrade, but there is no evidence of any retractility of the claws.

Hind Limb.—The pelvis is not very well preserved but enough is present to indicate that it was very similar to that of *Patriofelis*. The femur has a well-rounded head, a nearly straight shaft, and a small though distinct third trochanter. The tibia equals the humerus in length and has a slightly curved shaft; the cnemial crest is prominent, the internal malleolus is unusually thick and heavy, and the distal trochlea is directed obliquely inwards and is little excavated. The fibula is complete and comparatively little reduced. The hind foot is more slender than the fore foot. The tibial facet of the astragalus is but slightly grooved; the astragalar foramen is distinct, and the head of the bone is flattened from before backward, rounded and oblique; it articulates with both cuboid and navicular. The

¹ 'Fossil Mammals of the Wasatch and Wind River Beds.' Bull. Amer. Mus. Nat. Hist., Vol. IV, 1892, p. 108.

three cuneiforms have about the same relationship and arrangement as in the modern Cats. Of the metapodials there is a distinct interlocking, although the degree is much less than in the Felidæ. The third is the longest but the second is slightly the heaviest of the series. As in the fore foot, the claws are fissured and non-retractile.

Oxyænodon dysodus, gen. et sp. nov.

This genus is founded upon an unusually perfect half of a skull from the Uinta Eocene, collected by the writer in 1896. It indicates an animal of the size of a Gray Fox and is, therefore, if properly referred to the Oxyænidæ, the smallest member known. The dental formula is the same as that of *Oxyæna*, viz. : I. $\frac{3}{3}$, C. $\frac{1}{1}$, Pm. $\frac{4}{4}$, M. $\frac{2}{2}$, and the last superior molar is, moreover, transverse. The chief distinctions between the two are seen in the form of the skull and the character of the premolars, as well as the great enlargement of the symphysis in the Uinta genus. In *Oxyænodon* all the lower premolars are simple and have only rudimentary posterior heels, whereas in *Oxyæna* the heels of the

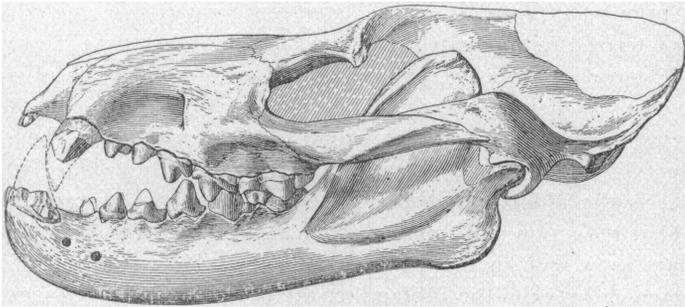


Fig. 3. *Oxyænodon dysodus*. Skull and jaw $\frac{3}{4}$ th natural size. Type specimen, No. 2515.

second, third, and fourth are large, and form important elements of the crown. In *Oxyænodon* the third superior premolar has no internal cusp, while in *Oxyæna* a well developed inner cusp is present. The heel of the last lower, as well as the internal cusp of the trigon, are more reduced in the Uinta genus than in *Oxyæna*. In *Oxyænodon* the mandibular symphysis is enlarged and extends back under the third premolar, the lower jaw being relatively shallow and thick, while in *Oxyæna* the mandibular

symphysis is of much less extent and the jaw is deeper. The facial portion of the skull in *Oxyænodon* is longer.

I have suggested¹ that this family has some affinities with the Seals. The skull *Oxyænodon* strengthens this view in certain particulars. The most important resemblances to the Sea Lion are seen in (1) the great postorbital construction of the skull; (2) the presence of a distinct lachrymal tubercle; (3) the exclusion of the frontal from any share in the anterior boundary of the orbit; (4) early union of lachrymal with maxillary; (5) forward extension of sagittal crest; (6) absence of anterior process of frontal between nasal and maxillary, and (7) an elongated mandibular symphysis. While the skull is not strikingly seal-like in its general appearance yet when we know the immediate ancestors of such a form as the Sea Lion it will not be surprising if it is found to connect with such a form as *Oxyænodon*.

FAMILY MESONYCHIDÆ.

The Mesonychidæ undoubtedly represent a distinct line of the primitive Carnivora whose later representatives came to be characterized by elongated and specialized limbs for a running habit, as well as by a peculiar reduction and simplification of certain cusps of the molar teeth. Somewhat contrary to the generally accepted arrangement of this group, I unite with them the so-called Triisodontidæ as a well marked subfamily. This latter series is the older and displays the same tendency towards the peculiar reduction and rounded, conical form of the cusps of the molars as is seen in the *Dissacus-Pachyæna-Mesonyx* line. The differences between the subfamilies are not great and, as observed by Matthew,² consist in the deep, heavy jaws with powerful symphysis, and the much wider, more distinctively tubercular character of the molars in the Triisodontidæ.

The single genus *Triisodon*, with three species, comes from the Puerco and is succeeded in the Torrejon by the two genera *Sarcothraustes* and *Goniacodon*. Matthew has pointed out that *Sarcothraustes antiquus* is without doubt the direct descendant of *Triisodon* and in this opinion I entirely agree. As noted by this

¹ 'Osteology of *Patriofelis*,' Bull. Amer. Mus. Nat. Hist., Vol. IV, 1894, p. 157.
Bull. Am. Mus. Nat. Hist., Vol. IX, 1897, p. 278.

author, the same cusp reduction and simplification is observed in this succession as occurs in the *Dissacus-Pachyæna-Mesonyx* series.

The second subfamily, Mesonychinæ, so far as at present known, finds its oldest representatives in the Torrejon beds in the single genus *Dissacus*, with two well marked species. It is, indeed, very doubtful, if not impossible, that any of the known species of *Triisodon* can be placed ancestral to the present genus, although it is not at all improbable that some slender jawed type in the Puerco having the cusp pattern of *Triisodon* will be found to have commenced an early modification of the teeth terminating in *Dissacus*. The evidence for the view that the inferior molar pattern in this genus is a degenerative one, is found in the fact that in the succeeding Wasatch *Pachyæna* the postero-internal cusp of the trigon is still more reduced than it is in *Dissacus*, while in the Bridger *Mesonyx* it exists as the merest vestige, the cusps of all the molars at the same time assuming a very rounded and characteristic conical form.

***Pachyæna intermedia*, sp. nov.**

It has been shown by Osborne and Earle¹ that neither of the known species of *Pachyæna* (*gigantea* and *ossifraga*) can stand directly in the line of descent leading to *Mesonyx* on account of the greater reduction of the last upper molar in the two species of *Dissacus* (*navajovius* and *saurognathus*) than in *Pachyæna*. Scott has shown² that *Mesonyx* has only two superior true molars, so that any species of *Pachyæna* which exhibits a less reduction of the last upper teeth than *Dissacus* cannot be placed ancestral to *Mesonyx*. Fortunately the collections of the Museum contain a specimen of a *Pachyæna* from the Big Horn, obtained by the expedition of 1896, which shows, proportionately, as great or a little greater reduction of the last upper molar than *Dissacus navajovius*. The specimen consists of the last two upper molars and bears the Museum number 2854. The teeth in question are somewhat smaller than the corresponding ones in *P. ossifraga* and exhibit a considerably greater reduction of the last molar in comparison with the tooth in advance than in this species. It

¹ 'Fossil Mammals of the Puerco,' Bull. Amer. Mus. Nat. Hist., Vol. VII, March, 1895, p. 39.

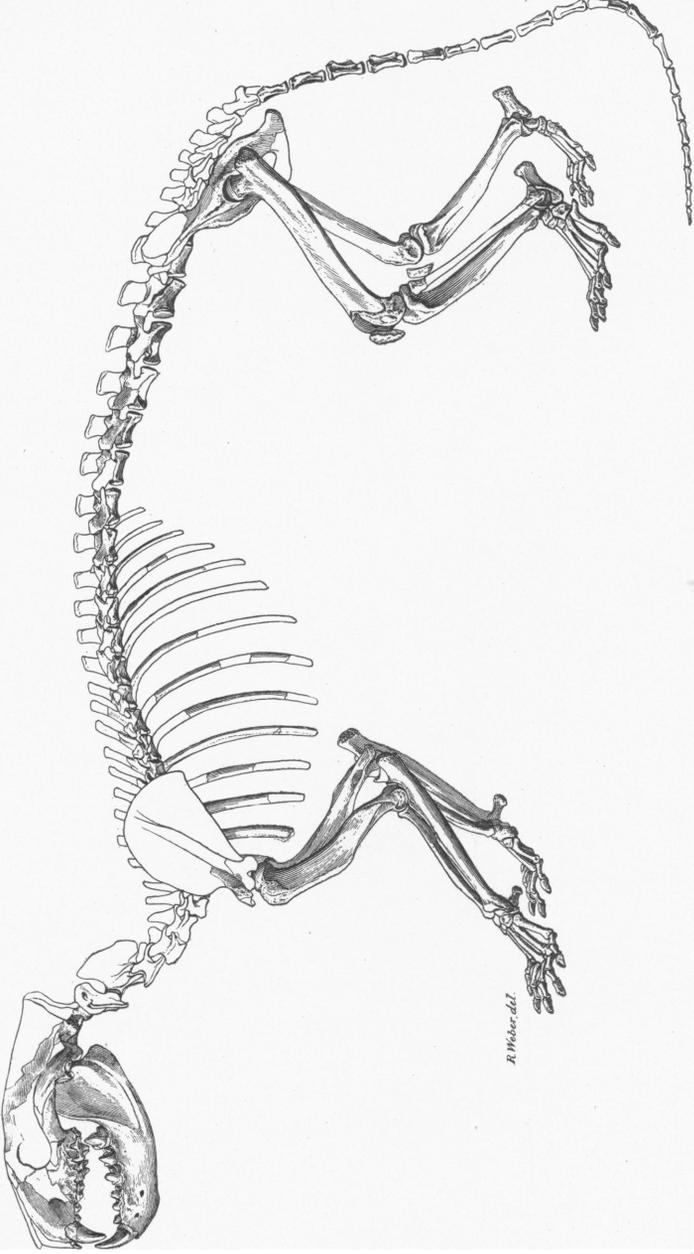
² 'Some New and Little Known Creodonts,' Jour. Philad. Acad. Nat. Sci., 1886, Vol. I.

may be that the specimen represents only a smaller variety of *P. ossifraga* and is not entitled to a specific rank, but in view of the fact that it furnishes just the character which, upon general grounds, one would be led to anticipate, I have thought fit to give it the above name.

This virtually completes the series of the *Dissacus-Pachyæna Mesonyx* phylum and establishes a closely connected specific descent reaching in time from the Torrejon to the White River without any important break. The Wind River representative of this series, however, yet remains to be discovered, but in accordance with what we already know its characters can be most accurately predicted.

EXPLANATION OF PLATE VII.

Oxyæna lupina, Cope. Skeleton, $\frac{1}{6}$ th natural size. No. 107, Am. Mus. Coll. The specimen described and figured as "No. 2" by Prof. Cope in 'Tertiary Vertebrata of the West,' (p. 319, pl. xxivc, figs. 12-15, and pl. xxivd, figs. 1-18) is a part of this individual.



OXYAENA LUPINA Cope.
One-sixth natural size.

