

ART. XL.—*Some Tertiary Carnivora in the Marsh Collection, with Descriptions of New Forms*; by MALCOLM RUTHERFORD THORPE.

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INTRODUCTION.

The present paper is mainly descriptive of certain specimens of carnivores which furnish us with additional information regarding the geologic fauna of North America in the region between the Mississippi River and the Rocky Mountains. Moreover, it adds quite materially

to our knowledge of the time and space distribution of the forms herein described. Some of the specimens form the basis of new species, while others apparently afford evidence of transitional stages between certain well defined faunal landmarks. The majority of the genera are confined either to Oligocene or Miocene strata, but it is very probable that in some instances the Lower Pliocene has contributed a small quota of forms, as will be explained below.

The John Day carnivore material in the Marsh Collection has been described separately, while nearly all of the European specimens belong to well known genera and species. The drawings were made by Rudolf Weber.

The strata of Upper Miocene, and possibly some of Lower Pliocene age along the Niobrara River in the vicinity of Valentine are herein termed the Valentine beds, a name proposed by Barbour and Cook in 1917 for this horizon near Valentine, in Cherry County, Nebraska. These beds are probably somewhat lower than those on Snake Creek (not the Snake River of western Nebraska) or in the Devil's Gulch, and a list of the fauna, which has been found in the Valentine beds, given by Barbour and Cook, shows that it comes within the *Procamelus-Hipparion* zone as defined by Osborn in 1918.

There are at least fifteen other names which have been applied to this formation, some of which are faunal names, while others are preoccupied. Osborn¹ designated these beds as the Fort Niobrara formation, and the type locality is on the Niobrara River, near Fort Niobrara. Doctor W. D. Matthew has also adopted this usage. However, it seems to the writer that this name is not happily chosen, for the custom in the usage of geologic formation names is to shorten them when possible. It will be recalled that the Benton, Pierre, Bridger, and other formations were originally termed Fort Benton, Fort Pierre, Fort Bridger, etc. If the "Fort" should be dropped from Fort Niobrara, then the name of this Upper Miocene formation would necessarily have to be abandoned, as Niobrara formation is the name applied to a subdivision of the Cretaceous.

¹H. F. Osborn, *Equidæ of the Oligocene, Miocene and Pliocene of North America*, Iconographic type revision. Mem. Amer. Mus. Nat. Hist., new ser., 2, pt. 1, 23-24, 1918.

OLIGOCENE CANIDÆ.

Cynodictis Bravard and Pomel.

With one exception, all of the American forms of this genus are represented in the Yale Marsh Collection. Some of these species are based on slight but usually constant variations, although there may be some question as to specific rank for them.

Cynodictis angustidens (Marsh).

FIG. 1.

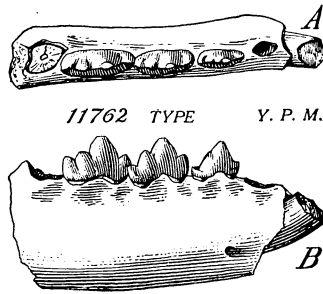


FIG. 1.—*Cynodictis angustidens* (Marsh). Holotype. $\times 3/2$. A, occlusal view of premolars; B, external view of right ramus.

In 1871, Professor Marsh described an “anterior portion of a right lower jaw, containing the last three premolars, and the canine” (p. 124), under the new specific name *Amphicyon angustidens*. This species is identical with Cope’s *Canis gregarius*, proposed in 1873, and, therefore, has precedence over the latter, since both belong within the genus *Cynodictis*.

The evidence, on which I base these conclusions, is derived from the types themselves and from the descriptions of them. Both types are lower jaws. Marsh’s *C. angustidens* and Cope’s *C. gregarius* are considerably smaller than the red fox; in both P_1 is one-rooted, P_4 has median and basal lobes, forming a cutting edge in line, the ramus is slender and deep, while the premolars are low and compressed, P_{2-4} have anterior basal tubercles, while P_{3-4} possess a posterior basal tubercle and cingulum.

Both the Marsh and Cope types were collected from the same geologic horizon, the former at Scott's Bluff, Nebraska, and the latter in northeastern Colorado.

The appended measurements fall well within the limits given by Cope, Scott, and Matthew for *C. gregarius*.

This species was by far the most abundant of the genus in America. It ranged from Colorado to South Dakota inclusive, and probably its habitat extended as far westward as the interior of Oregon. It is limited in time between the base of the Middle Oligocene and that of the Miocene. Scott (1898, p. 364) has described in detail the osteology of the species, his descriptions being based mainly, and probably wholly, on White River specimens. Wortman and Matthew (1899, p. 122) amplified Scott's description, so that this form is quite well known. The holotype, Cat. No. 11762, Y. P. M., was collected by Professor Marsh in 1870.

Besides the type, this species is represented by some very excellently preserved skulls and jaws, especially Cat. Nos. 10067 and 10068, Y. P. M.; by a large number of rami with dentition; and by certain skeletal elements. These are all typical and add nothing to our knowledge of this form.

Measurements.

	<i>C. angustidens</i>	<i>C. gregarius</i>
	Holotype	
	mm.	mm.
Length of premolar series.....	19.5	19*
Length of P ₄	6	6*
Depth of ramus at sectorial.....	10	10*
Transverse diameter of crown of P ₄ ...	2.6	2.5
Height of crown of P ₄	3.8	3.8
Width of jaw below P ₄	4.3	4.5
Depth of jaw below P ₄	10	9.6

* Measurements from holotype. Other measurements in this column are from Cope's drawings (1884) of specimens identified by him as *Galecynus gregarius*.

Wortman and Matthew (1899, p. 124) give the skull length as 76 mm. and the maximum width of the braincase as 29 mm. Cat. No. 12678, Y. P. M., collected by Mr. H. B. Sargent in 1870 at Scott's Bluff, is 2 mm. longer and 1 mm. wider in the same respective dimensions.

Scott (1898) shows in his table on page 373 that his specimens range in length from 86 to 92 mm. and in width of brain-case from 31 to 35 mm. Nearly all of the Yale specimens, as well as Cope's, are within the limits of Scott's table. This shows a difference of from 13 to 21 per cent in skull length, and yet the length of the superior and inferior tooth-rows, either premolar-molar series, or each individually, does not differ by more than 1 mm. in Y. P. M. Cat. No. 12678 (corresponding to Matthew's dimensions of No. 8774, A. M. N. H.) from the larger specimens which fall within the lower limits of Scott's table. I can detect no differences, other than size, between the smaller and the larger specimens, and the ratios seem to be uniform. These smaller individuals may represent a new variety, or they may be females. Y. P. M. No. 12678 is fully adult.

There are several Y. P. M. specimens in which M_3 possessed two roots, while others show but one root. Those having the two-rooted M_3 do not appear to be any more robust than the others. In fact, Y. P. M. No. 12691 has two roots on this molar and yet it is of the same slender proportions as the small skull and jaws bearing the number 12678. I fail to find any other marked distinctions between the two forms. Another specimen, No. 12687, from Scott's Bluff, Nebraska, shows very distinctly the alveolus of the double-rooted M_3 . A part of a ramus, No. 12689, possesses a small posterior cusp, together with the usual posterior and anterior basal tubercles on P_2 , a character possessed by *C. oregonensis* Merriam.

Cynodictis lippincottianus (Cope).

Syn.: *Canis lippincottianus* Cope 1873B, p. 9; *Galecyne lippincottianus* Cope 1884, p. 919; *Amphicyon gracilis* Leidy (non Pomel) 1856, p. 90 (nom. prec.); *Daphenus gracilis* Roger 1896, p. 44; *C. hylactor* Hay 1899, pp. 253-254.

This species, founded by Cope, was based on several rami from Colorado found in Middle Oligocene strata. Cope stated (1884, p. 920) that the "Dimensions [were] half as large again as in *C. gregarius*, as indicated by many specimens of the latter," while Wortman and Matthew (1899, p. 130) found from the type that the teeth were one fifth greater in lineal dimensions and

somewhat more robust. The Yale specimens agree with Matthew's determination and are represented by several fragments of rami, chiefly Y. P. M. Nos. 12684 and 12685, from Colorado. The skull is undescribed, unless Leidy's *Amphicyon gracilis* is considered synonymous. Matthew holds this view and I thoroughly agree with it.

Cynodictis paterculus Matthew.

This species is represented in the Marsh Collection by many specimens of rami, collected between and including Pawnee Buttes, Colorado, and Crow Buttes, South Dakota. The type, No. 9616, A. M. N. H., was collected in Montana. It apparently is not represented in the John Day fauna, but otherwise its distribution seems to be practically the same as that of *C. angustidens*. The type horizon is Lower Oligocene in the Titanotherium beds, but I consider that its vertical distribution must include a part of the Middle Oligocene (lower Brule). From the matrix and locality of the Yale specimens, it seems that the majority are from the lower Brule rather than from the Titanotherium beds.

Y. P. M. No. 12683 has a small posterior cusp on P_2 as in *C. oregonensis*. It corresponds to the type in other respects. One of the specimens has a double-rooted M_3 while the others have but the one. The specific characters, as outlined by Matthew, are constant, and thereby afford strong evidence for the validity of the species. However, I can not help feeling that this form may represent the male of *C. angustidens*. The main distinction between the two is that the former is somewhat more robust. The size of both is about the same.

Daphænus vetus Leidy.

Various localities in Nebraska and Colorado yielded remains of this species to the collectors working under Professor Marsh's direction. An especially well preserved skull and jaws (Cat. No. 10066, Y. P. M.), from Greeley, Colorado, was figured by J. L. Wortman in 1901 in this Journal. Another specimen, collected by Doctor E. L. Troxell in Sioux County, Nebraska, was purchased by Professor Charles Schuchert and by him presented to

the Peabody Museum. It consists of the major portion of the skeleton, as well as the skull, of which the basi-cranial area is very excellently preserved (Cat. No. 12771, Y. P. M.).

Daphænus hartshornianus (Cope).

Mandibular rami from Pawnee Buttes, Colorado, and from White River, Nebraska, represent this species in the Marsh Collection, but add little to our knowledge of it. The Nebraska form is, however, slightly smaller than the type, while the Colorado specimens are practically identical.

Both of the above species of *Daphænus* are Middle Oligocene (lower Brule) in age.

MIOCENE CANIDAE.

Mesocyon robustus Matthew.

A part of a lower jaw with two premolars agrees well with the type. It was collected at Gerry's ranch, Colorado, whereas the type locality is near the Rosebud reservation in South Dakota.

Nothocyon annectens Peterson.

This species is represented by rami collected at Scott's Bluff and south of Antelope Creek, both in Nebraska. That from the former locality is somewhat smaller than the type; the other locality shows specimens exceedingly close to the type. They, however, add nothing new to our knowledge of the species.

Nothocyon vulpinus Matthew.

In 1873, Professor Marsh collected specimens along the Niobrara River which are unquestionably referable to Matthew's species. The type locality is north of the Niobrara in southern South Dakota.

Nothocyon vulpinus coloradoënsis, mut. nov.

(Fig. 2.)

Holotype, Cat. No. 12812, Y. P. M. Lower Miocene, Pawnee Buttes, Colorado.

The holotype consists of part of a left ramus with P_3 , P_4 , M_1 ; and the alveolus of M_2 . It differs from *N. vulpinus*, its nearest ally, in having a relatively shorter jaw, larger sectorial, relatively smaller tubercular molar, premolars crowded, but with same individual antero-posterior diameter as in *N. vulpinus*, while their anterior cingulum is nearly obsolete. The sectorial has a small cusp between the protoconid and hypoconid, which is, I think, an individual variation.

FIG. 2.

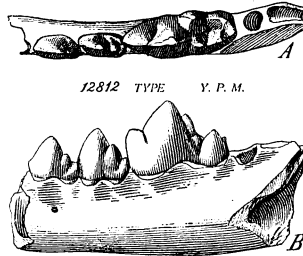


FIG. 2.—*Nothocyon vulpinus coloradoënsis*, mut nov. Holotype. Nat. size. A, occlusal view of premolars and first molar; B, external view of left ramus.

Measurements.

	<i>N. coloradoënsis</i> mm.	<i>N. vulpinus</i> mm.
Space occupied by P_3 , P_4 , and M_1	26.5	27.5*
Diameters of M_1 , transverse	5.5	4.8
Diameters of M_1 , ant.-post.	14	11.8
Maximum depth below M_1	13.5	11

* Taken from drawing.

Nothocyon latidens multicuspis, subsp. nov.

(Fig. 3.)

Holotype, Cat. No. 12801, Y. P. M. Miocene, near Antelope Creek, Nebraska. Collected in 1873 by Professor Marsh.

This specimen, consisting of part of a right ramus with M_1 , M_2 , alveolus of M_3 and part of that of P_4 , is somewhat

larger than *N. latidens*, but possesses the narrow tubercle on the external base of the protoconid which is a characteristic of that species. It, however, lacks the small tubercle just anterior to the base of the entoconid which is often present in specimens from the John Day Valley, Oregon, referred to Cope's species. The paraconid is the largest cusp of M_2 , with the protoconid and hypoconid of about equal dimensions. The entoconid is small. There is a small tubercle or cusp developed on the postero-external base of the protoconid. From this it will be seen that the tooth patterns of both M_1 and M_2 are quite similar in certain respects. M_3 was one-rooted.

FIG. 3.

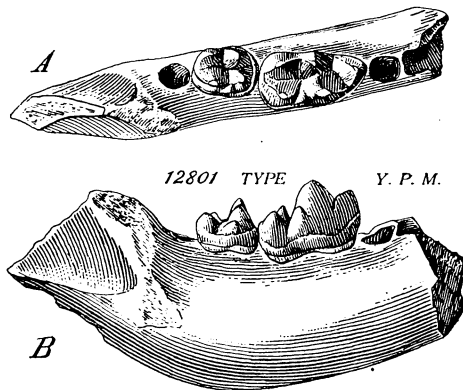


FIG. 3.—*Nothocyon latidens multicuspis*, subsp. nov. Holotype. $\times 3/2$.
A, Occlusal view of molars; B, external view of right ramus.

In 1907, Matthew called attention to a form "approaching *N. latidens* in size and characters" from the Lower Miocene of South Dakota, which he considered would prove to be a new species. The Yale specimen exceeds *N. latidens* in size, whereas I believe Matthew's specimen is smaller than the type of Cope's species.

The type locality for *N. latidens* is in the John Day Valley, Oregon, while this new subspecies is from Nebraska. Furthermore, Cope's species is Upper Oligocene (middle John Day) and the new form Lower or possibly Middle Miocene. Unfortunately we can not be positive either of its exact locality or geologic horizon. The reason for this is that the Yale College Scientific

Expedition of 1873 travelled from North Platte to Antelope Creek apparently without making any recorded collections. I am inclined to believe that whatever material was collected during the course of this long traverse was boxed at Antelope Creek, where the first collecting camp was established, and shipped east. Hence material from lower horizons came from the Antelope Creek camp, but was collected somewhere between there and North Platte (city), Nebraska.

Measurements of Holotypes.

	<i>N. multicuspis</i> mm.	<i>N. latidens</i> mm.
M ₁ , ant.-post. diameter	9.3	8
M ₁ , ant.-post. diameter of heel	4	3.5
M ₂ , ant.-post. diameter	5.2	
Depth below middle of sectorial	12	10.5

Nothocyon sp.

Cat. No. 12791, Y. P. M. Lower Miocene, near Scott's Bluff, Nebraska.

Both rami and part of a maxilla indicate a form of *Nothocyon* which does not readily fall within any of the known species. The length of the tooth-row is very close to that of *N. vulpinus*, but the depth of ramus below the alveolar parapet is nearly equal to that of *Mesocyon robustus*, that is, the mandible is considerably heavier and deeper than that of any other species of this genus. The depth below M₁ is 16 mm., the same as shown in the figure of *M. robustus*, although in the table of measurements for that species the depth is given as 6 mm., which is undoubtedly a typographical error. The antero-posterior diameter of M₂ is 1 mm. greater than that of *N. vulpinus*.

Harold Cook (1909) records a large form of *Nothocyon* discovered near the Agate Spring quarries in lower Harrison beds. His specimen is "somewhat larger and heavier than *N. geismarianus* Cope," and has a faint cingulum encompassing the anterior part of the sectorial. The Yale specimen also shows a slight cingulum in this position.

Measurements.

	mm.
Length of lower molar-premolar series.....	53
Length of lower premolar series	29
Breadth of skull at M ¹	52.5

Cynodesmus cuspidatus, sp. nov.

(Figs. 4-5.)

Holotype, Cat. No. 12788, Y. P. M. Upper Miocene (Valentine beds), Niobrara River below Rapid (now Minnechaduzza) Creek, Nebraska.

The holotype consists of parts of both maxillæ with molars, P³ and P⁴, the other premolars being represented by parts of the crowns or alveoli. A fragment of a jaw without teeth is provisionally referred to this species. These specimens were collected by O. Harger in 1873.

FIG. 4.

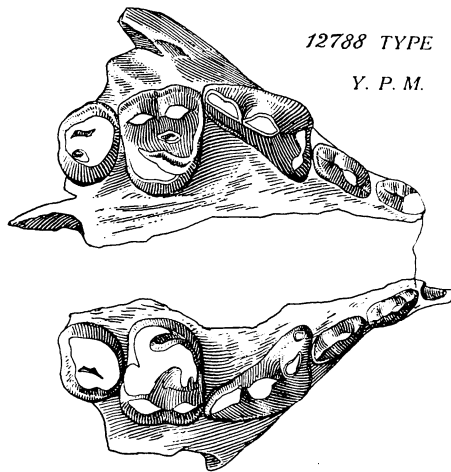


FIG. 4.—*Cynodesmus cuspidatus*, sp. nov. Holotype. Nat. size. Palatal view.

The species is intermediate in size between *C. thoöides* Scott and *C. thomsoni* Matthew, more closely resembling the former in size and the latter in dental characters, while the convexity above the anterior root of P⁴ is very much more prominent than in either of the described

species, and that above M^1 is weaker. The infra-orbital foramen is above the posterior part of P^3 as in *C. thoöides*, the type of the genus.

This form differs from the two species previously described in possessing an anterior tubercle on P^4 , as in *Ælurodon*. However, it does not appear to invalidate the generic reference, for *Canis familiaris* possesses a well defined anterior tubercle on P^4 , while *C. latrans* has not the least suggestion of one. P^2 possesses a posterior tubercle similar to that of *C. thomsoni*, and unlike the corresponding tooth in *C. thoöides*. The shear of the carnassial is not so transverse as in *C. thomsoni*, but approximately the same as in the genoholotype. The inner half of the superior molars is much broader than that shown in the type.

FIG. 5.

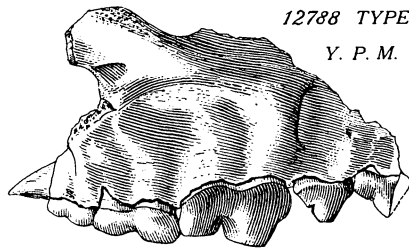


FIG. 5.—*Cynodesmus cuspidatus*, sp. nov. Holotype. Nat. size. Lateral view of right maxillary with teeth.

This new species is from a horizon higher than that of the others. From the similarity of tooth structure and the individual peculiarities of the teeth exhibited by both *C. thomsoni* and *C. cuspidatus*, sp. nov., I regard the latter as a derivative of the former. The type of the genus shows variations, which may be due to regional isolation, but whatever the cause, these seem to indicate an aberrant tendency on the part of the type. The South American canid, *C. cancrivorus*, probably shows the nearest approach, among modern Canidæ, to the genus *Cynodesmus*.

Measurements.

	<i>C. cuspidatus</i> Holotype	<i>C. thomsoni</i> *	<i>C. thöoides</i> †
	mm.	mm.	mm.
Upper molar series, length	19	16	18.2
Upper premolar series, length	38	31	40.5
P ¹ , ant.-post. diameter	3.5	4	4
P ¹ , transverse diameter	3	3	3
P ² , ant.-post. diameter	8	7.5	9
P ² , transverse diameter	4	4	4
P ³ , ant.-post. diameter	9	8	9.5
P ³ , transverse diameter	4.5	4.5	5.1
P ⁴ , ant.-post. diameter	16.5	16	15
P ⁴ , transverse diameter	9	10	11
M ¹ , ant.-post. diameter	11.8	10.5	11
M ¹ , transverse diameter	15	13.7	16
M ² , ant.-post. diameter	8	5	7
M ² , transverse diameter	11	6.4	10

* From Matthew 1907.

† From Scott 1894.

Tephrocyon hippophagus Matthew and Cook.

Typical specimens of this species were collected in Nebraska and Colorado. The skull is, however, not known, although it must possess characters very similar to that of *T. rurestris*. On this basis an individual M¹, Cat. No. 12789, Y. P. M., has been referred to this genus and species, as it is nearly the same size and shows the same characters as the John Day type of the genus. This superior molar was collected on the Niobrara River, between Antelope Creek and the mouth of Minnechadua Creek, Nebraska, by Capt. (later Brig.-Gen.) Mills, in 1873. Specimen No. 12833, Y. P. M., collected by Professor Lull, in "Quarry D," Ft. Niobrara Bird Reservation, on the Niobrara River, Nebraska, in 1914, has parts of both maxillæ. The axial length of P⁴, M¹, and M² is 33 mm. There is also, among other bones, a scapholunar which most probably belongs with the other parts. It is very similar in size and characters to *Canis latrans*.

Tephrocyon marshi, sp. nov.

(FIG. 6.)

Holotype, Cat. No. 12787, Y. P. M. Upper Miocene (Valentine beds), Cherry Co., Nebraska, along the Niobrara River, not far west of the mouth of Minnechaduza Creek. Collected by Professor Marsh in 1873.

This species is represented by a nearly complete left ramus with P_2 , P_3 , M_1 , and M_2 . It is nearly one half larger lineally than *T. hippophagus* and in its analogous parts seems to correspond most closely to the specimen recorded by Matthew and Cook (1909, p. 376) from the Snake Creek Pliocene. It differs, however, from all the other species of the genus in that it shows the beginning of a shortening of the ramus with a concomitant crowding, but not reduction, of the premolars, which overlap in each case. P_2 is placed obliquely with the anterior part outward, while P_1 was probably small, with a single root. M_3 was set in the ascending ramus of the jaw, and in this specimen is absent, with the alveolus partially closed, resembling a specimen of *Ælurodon haydeni* in the American Museum (No. 9744, Upper Miocene, Montana).

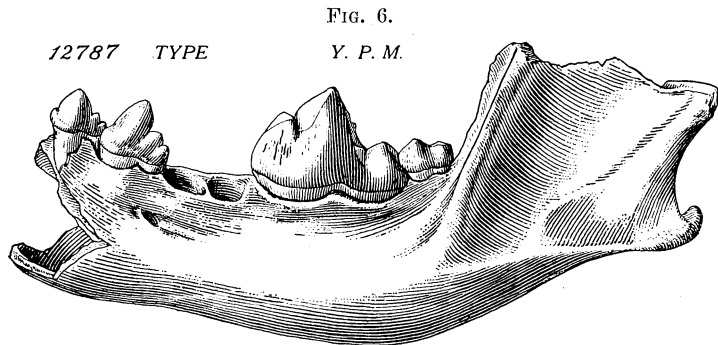


FIG. 6.—*Tephrocyon marshi*, sp. nov. Holotype. $\times 2/3$. External view of left ramus.

From *T. mortifer* this new species differs in being about one quarter smaller lineally, less robust, and in the crowding of the premolars.

If, as we are disposed to believe, *Tephrocyon* is approximately ancestral to *Canis* and *Ælurodon*, then this new species seems to be in the line from which *Ælurodon* developed, for here we have the robust sectorial showing

a slight increase in length and robustness with a jaw shortening. The premolar reduction might well result from this form in a few generations.

Measurements of Holotype.

	mm.
Lower dentition, P ₁ -M ₂	81.5
Lower premolars, P ₁ -P ₄	43.
Lower molars, M ₁ -M ₂	41.
P ₂ , ant.-post. diameter 11. ; transverse diameter	7.
P ₃ , ant.-post. diameter 13.2; transverse diameter	8.5
P ₄ , ant.-post. diameter 19. ; transverse diameter	10.
M ₁ , ant.-post. diameter 30.3; transverse diameter	12.1
M ₂ , ant.-post. diameter 11.2; transverse diameter	8.5
Depth of jaw beneath M ₂	30.7
Depth of jaw beneath P ₂	29.1

This species may be referable to the genus *Tomarctus* Cope 1873, and in fact it is possible that *Tephrocyon* may be synonymous with Cope's genus. The holotype of the type species, *Tomarctus brevirostris* Cope, was collected near Pawnee Buttes, Colorado, in the Middle Miocene Pawnee Creek beds. It consists of "an immature jaw, the carnassial about half emerged, and the anterior part of the jaw so broken that it is not at all certain that the premolars were, as Cope considered them, reduced in number" (Cope-Matthew 1915, pl. CXIXc).

This type retains only the carnassial, but if the drawing of this be correct, then it apparently bears a strong resemblance to the analogous tooth in *Tephrocyon*.

Leptocyon vafer (Leidy).

Several lower jaws, with teeth, in the Marsh Collection are referred to this slender-jawed genus. The premolars are compressed and not crowded, and the heel of M₁ shows the low entoconid crest obscurely divided into two cusps as stated by Matthew.

Amphicyon americanus Wortman.

The type of this species, Cat. No. 10061, Y. P. M., consists of a palatal portion of a skull with the teeth, except the incisors and first premolar. It was very fully described by J. L. Wortman in 1901.

Amphicyon sinapius Matthew.

(FIGS. 7, 8.)

In the collection there is a part of a right ramus with the base of P_3 , nearly complete P_4 , and complete M_1 and M_2 , a detached crown of a lower canine and a practically complete left superior canine. These bear the catalogue

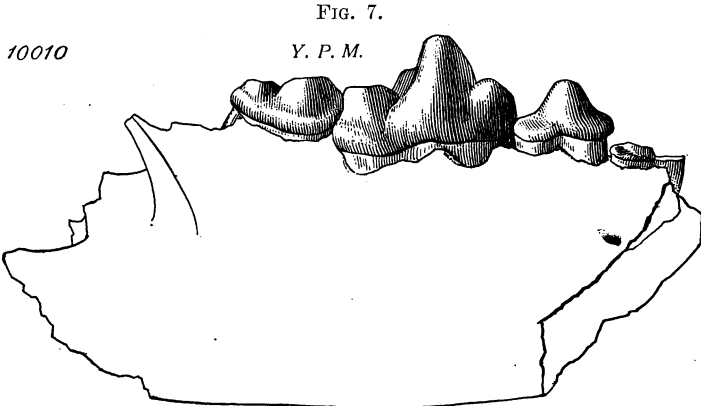


FIG. 7.—*Amphicyon sinapius* Matthew. $\times 2/3$. External view of part of right ramus.

number 10010, Y. P. M., and were collected on the Niobrara River in 1875. The superior canine has the same characters as that of the type of *A. americanus*.

There are three molars in the lower jaw, the first two of which are very robust, while the premolars are rela-

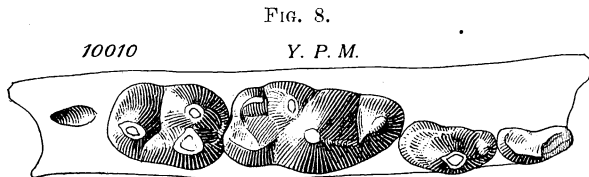


FIG. 8.—*Amphicyon sinapius* Matthew. $\times 2/3$. Occlusal view of molars and premolar.

tively considerably reduced as in the superior dentition. The paraconid of M_1 is reduced, while the protoconid and metaconid are robust and prominent. Of the heel, the hypoconid is by far the more prominent element, for the entoconid is marginal and much reduced. The robust M_2 is composed of a large protoconid, a smaller paraconid

and hypoconid. The entoconid is represented simply by a ridge.

An unworn M_1 , Cat. No. 12841, Y. P. M., collected on the Niobrara River, near the mouth of Minnechaduza Creek, exhibits nearly the same characters, except that the entoconid is composed of two small marginal cusps as in *Leptocyon* and the metaconid is a little smaller.

In size this species is probably about the same as the grizzly bear (*Ursus horribilis*).

Measurements.

	10010 Y. P. M. mm.	18258* A. M. N. H. mm.
P_3 , ant. post. diameter	15	
P_4 , ant.-post. diameter	19.5	
P_4 , transverse diameter	10	
M_1 , ant.-post. diameter	35.5	35
M_1 , transverse diameter	17	17.3
M_2 , ant.-post. diameter	23	25.1
M_2 , transverse diameter	16	17.6
Depth of ramus below middle of M_1	52	57.3
Length of inferior tooth row, P_3 - M_2 , incl.	91	92.8

* The author is indebted to Doctor W. D. Matthew for his kindness in sending these measurements to him.

Æluroidon savus (Leidy).

A left lower jaw with milk premolars, Cat. No. 12817, Y. P. M., is identified with this species. The first true molar was not erupted, but the external mandibular wall has been removed, thus exposing this tooth. The three deciduous premolars are similar in the main characters to those of *Canis*. The details of the crown of the fourth premolar closely resemble that of the permanent first lower molar, except in regard to size. All of the premolars are two-rooted.

Æluroidon near *wheelerianus* (Cope).

Cat. No. 10060, Y. P. M., consists of part of a left ramus with P_2 and P_3 and part of M_1 and M_2 with the canine, the alveolus of P_1 and part of that of I_3 , together with a part of the maxilla bearing P^1 and M^1 , and two loose teeth. It was collected on the Niobrara River, Nebraska.

The upper carnassial possesses a stout anterior tubercle

and the lower jaw corresponds most closely with the type of *A. wheelerianus*, except that both P_2 and P_3 are set obliquely, anterior end internal, in the mandible, and the two premolars preserved do not possess anterior basal cusps, as seen in No. 8307 (Cope Collection), A. M. N. H. The crowns of all teeth in the specimen (supposedly the type) figured by Cope in 1877 were broken away, so that the presence or absence of anterior basal cusps on the premolars can not be determined. Matthew and Gidley (1904) have definitely said that all of the superior and inferior premolars of this species had anterior basal cusps. Both the type and the Yale specimen are of Upper Miocene (Valentine beds) age.

Ælurodon taxoides lacks the anterior basal cusp on P_2 and P_3 , but differs in its much larger size, in which it approaches *A. haydeni*.

Another lower jaw, Cat. No. 12785, Y. P. M., was also collected on the Niobrara River. This right ramus is somewhat smaller and much more slender, possibly being that of a female. The differences, however, are not sufficiently great to invalidate the identification, in my opinion.

Ælurodon taxoides magnus, mut. nov.

(Figs. 9-11.)

Holotype, Cat. No. 10057, Y. P. M. Upper Miocene (Valentine beds), Niobrara River, a few miles east of the mouth of Antelope Creek, Nebraska. Collected by E. S. Lane in 1873.

The type material consists of both rami, with part of the right side of the face, with complete superior dental parapet, containing P^1 , P^2 , P^4 , and M^1 , all others being represented by alveoli, together with the distal half of the tibia and part of a cervical vertebra.

This new mutation is the nearest in size to *A. taxoides* Hatcher, but differs from it in possessing prominent anterior basal cusps on all of the premolars, both superior and inferior, with the possible exception of P^1 , the anterior part of which is broken away. The presence of these anterior basal cusps would seem to refer it to *A. wheelerianus*, but such is apparently not the case. Both *A. taxoides* and this new form are approximately 25 per cent larger. Moreover, in the latter the alveolar

parapet of the mandible rapidly ascends posterior to M_1 , so that a line from the posterior edge of the alveolus of M_3 to the base of the canine passes through the tip of the protoconid of the sectorial; in *A. taxoides* and *A. wheelerianus*, through the anterior base of the paraconid of M_1 .

FIG. 9.



FIG. 9.—*Elurodon taxoides magnus*, mut. nov. Holotype. $\times 1/2$. Right lateral view of part of maxillary and premaxillary with teeth.

This upward trend of the parapet is analogous to that in *A. ursinus*, which species has been referred to the Amphicyonine group. In other respects, however, this new individual is not like *Amphicyon*. Another differentiation lies in the fact that the length of the inferior pre-molar series of *A. wheelerianus* is less than that of the

FIG. 10.

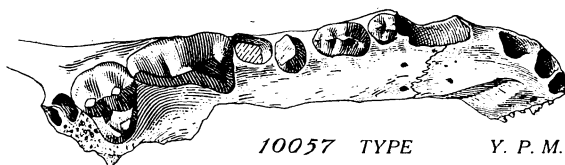


FIG. 10.—*Elurodon taxoides magnus*, mut. nov. Holotype. $\times 1/2$. Right palatal view.

molar series, while in both *A. taxoides* and the Yale specimen the premolar length exceeds the molar by one fifth.

The superior canine was large and, in cross-section, oval-shaped, and separated from the external incisor by a considerable diastema, while on the other side it was in

contact with P^1 . From the external incisor the incisive alveoli show a progressive reduction in transverse diameter. M^2 is considerably reduced in size. The parastyle on the upper carnassial is well developed.

The large infra-orbital foramen lies above the posterior part of P^3 . The anterior zygomatic pedicle is very heavy, measuring 41 mm. from the infra-orbital border to the alveolar parapet, directly beneath.

In some respects this new mutation is similar to *A. platyrhinus* Barbour and Cook, but the former differs in

FIG. 11.

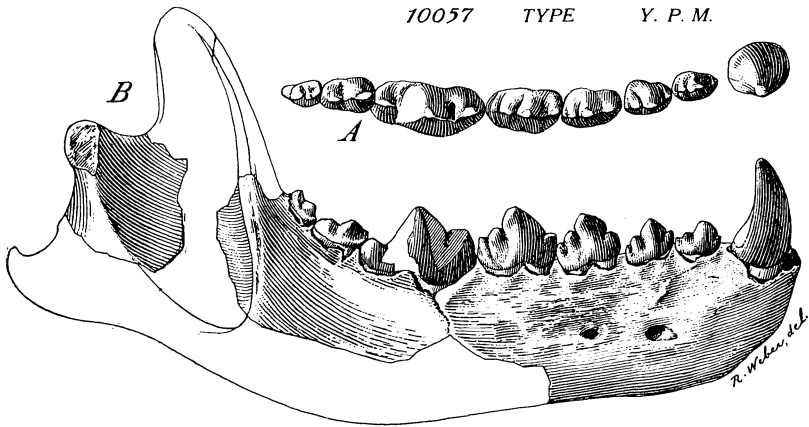


FIG. 11.—*Aelurodon taxoides magnus*, mut. nov. Holotype. $\times 1/2$. A, oclusal view of inferior dentition; B, external view of right ramus.

the following respects: (1) somewhat larger, (2) no crowding of the premolars except that there is no diastema between the first and the canine, (3) larger canine, (4) carnassial over one fifth greater in transverse diameter and M^1 smaller and of relatively less transverse diameter, and in still others, the number of which would undoubtedly be increased if we had more of the skull of the Yale specimen or the mandible of the Nebraska individual.

Measurements of Holotypes.

	<i>A. taxoides</i> mm.	<i>A. magnus</i> mm.	<i>A. wheelerianus</i> mm.
Length of inf. premolar series	62	63	46
Length of inf. molar series	53	53	49
Ant.-post. diameter of sectorial	34	32	28
Ant.-post. diameter of P ₄	22	21	15
Ant.-post. diameter of M ₂	12	14.5	12
Ant.-post. diameter of M ₃	8	9	6
Depth of ramus below P ₄	37	36	29.5
Length of sup. dental series, C-M ² inc.		113	
Length of sup. premolar series		74	
Length of sup. molar series		24	
Ant.-post. diameter of carnassial . .		27.3	

MUSTELIDÆ.

Brachypsalis pachycephalus Cope.

This genus and species is represented by the posterior part of a right ramus, except the coronoid process, possessing M₁ and M₂, somewhat damaged. It is Cat. No. 12780, Y. P. M., and it was collected near the mouth of Minnechaduza Creek on the Niobrara River, Nebraska. It is somewhat more slender than the type, in this respect approaching *B. modicus* Matthew, although in other essentials it is identifiable with Cope's species, representing a possible variety of the latter form.

Another specimen, a right ramus, Cat. No. 12803, Y. P. M., is more typical than No. 12780. Professor B. F. Mudge collected the jaw near Ellis, Kansas, in the Ogalalla formation, which is not later in age than Lower Pliocene and may well be of late Upper Miocene. This ramus shows characters intermediate between that of *B. modicus* and *B. obliquidens* Sinclair, although its modifications are much less extreme than those shown by Sinclair's species. The length of the tooth-row and of the individual teeth is a little greater than in the type of the genus.

Measurements.

	Cat. No. 12803 Y. P. M. mm.	Holotype mm.
Molar-premolar series, length	58	55
Premolar series, length	32	31
P ₂ , ant.-post. diameter	7	
P ₃ , ant.-post. diameter	9.5	
P ₄ , ant.-post. diameter	13*	
M ₁ , ant.-post. diameter	17.5*	14.5
M ₂ , ant.-post. diameter	9	
Depth of ramus at sectorial	25	25

*Alveolar measurements.

Potamotherium lycopotamicum (Cope).

The type of this species, from the Mascall beds of Oregon, has unfortunately been lost. It was based on a jaw broken away immediately behind the carnassial, and belonged to an animal about the size of a mink. The type was figured in 1915 (Cope-Matthew).

Two lower jaws, collected on the Niobrara River, are referred to this species. One, from "Quarry D," Ft. Niobrara Bird Reservation, Nebraska, Cat. No. 12834, Y. P. M., found by Professor Lull in 1914, has the carnassial unworn and intact, as well as the premolar alveolar parapet, with the ramus below intact. It also possesses the alveolus of M₂, the presence or absence of which in this species has not before been determined. All of the premolars are two-rooted except the first. The other

Measurements.

	Cat. No. 12834 Y. P. M. mm.	Cat. No. 12825 Y. P. M. mm.	Holotype mm.
Molar-premolar series, exclusive of M ₂ ..	22		22
M ₁ , ant.-post. diameter	7.1		6.6
M ₁ , transverse diameter	3.8		4
M ₁ , length of heel	2.4		2.4
P ₄ , ant.-post. diameter		4.2	4.5
P ₃ , ant.-post. diameter		3.8	
P ₂ , ant.-post. diameter		3.4	
Depth of ramus below sectorial		7	

specimen, Cat. No. 12825, Y. P. M., is one of the results of the Yale College Scientific Expedition of 1873, under the direction of Professor Marsh. It is a portion of the left ramus with P_2 , P_3 and P_4 , with the alveolus of P_1 and the canine. The fourth premolar has a low posterior cusp and prominent cingulum posteriorly. There is an alveolus for one incisor.

FELIDÆ.

Material referable to the cat family is extremely meagre in the Upper Miocene and Lower Pliocene, and it is with this in view that I desire to call attention to some of this material in the Yale collections.

Felis augustus Leidy.

The distal end of the humerus of a large felid was collected by Professor Lull on the Niobrara River, in Cherry County, Nebraska. It is a well preserved fragment, somewhat over 5 inches in length, bearing catalogue number 12809. The humerus exceeds in size that of *Felis leo* and is considerably more robust. *Felis augustus* must have been very close in size and probably in proportions to the Bengal tiger, which in turn is larger than the average male lion.

The lower half of another humerus, better preserved and 9 inches in its present length, was collected by F. W. Darby in Sheridan County, Nebraska, also near the Niobrara River. This humerus, Cat. No. 12810, Y. P. M., has practically the same dimensions as that of the type, while No. 12809 is about one twelfth smaller.

Felis sp.

A scapholunar and a median phalanx, from the Upper Miocene on the Niobrara River, near Fort Niobrara, Nebraska, indicate the presence of a felid or machærodont of about the size of *Daphænodon superbus* (Peterson). The scapholunar, Cat. No. 12838, is flatter and less oblong than that of *Felis leo* and the articular surfaces are in some cases slightly divergent. The resemblance, at any rate, is much closer to the cats, than to any of the other carnivores.

Pseudaelurus intrepidus Leidy.

Two specimens of this genus and species, found on the Niobrara River in Cherry County, Nebraska, exceed the type in size. The difference is not of specific value, but worthy of notice, as heretofore the type of the species has been regarded as representing the maximum size to which this genus attained in America. The posterior half of a left ramus, Cat. No. 12830, Y. P. M., was collected by Professor Lull in 1914. The other specimen, Cat. No. 12816, Y. P. M., consists of a third lower premolar, which is 2 mm. higher, 1.5 mm. wider, and 2 mm. greater in antero-posterior diameter than Leidy's type.

Pseudaelurus marshi, sp. nov.

(FIG. 12.)

Holotype, Cat. No. 12865, Y. P. M. Upper Miocene (Valentine beds), Niobrara River, near mouth of Minnechaduzza Creek, Cherry Co., Nebraska. Collected by Professor O. C. Marsh in 1873. Paratype, Cat. No. 12815, Y. P. M. Middle or Upper Miocene, northwestern Colorado.

The holotype consists of both lower jaws, partially restored, and the paratype of a left ramus with the alveolar parapet complete, as well as P_3 and P_4 . The new species is about the size of *Hoplophoneus primævus*, or one fourth smaller than *P. intrepidus* and hence considerably smaller than *P. intrepidus sinclairi* Matthew. The mandible is very much more slender than either of the above forms and does not exhibit so great depth below the tooth-row, although both the holo- and paratype are fully adult. The teeth are not crowded as in the above mentioned variety. Both types of the new species possessed a very diminutive P_2 , the antero-posterior diameter of which is not over 2 mm. The position of this premolar is inward from the true line of the tooth-row, as in Matthew's variety. The posterior basal tubercle of P_3 in the paratype is exceedingly small and that of the holotype is much reduced. The fourth premolar, in its component parts, most closely resembles the analogous tooth in *P. intrepidus sinclairi*, while the metaconid of M_1 has not suffered so great a reduction as in the latter variety. The paratype alone shows a distinct, but very small alveolus for M_2 , its antero-posterior diameter being 3 mm.

The mental foramina have approximately the same position as in Matthew's felid.

The European species *P. quadridentatus* (Blainville) is slightly longer than *P. intrepidus*, but is of approximately the same depth below the tooth-row. *Pseudaelurus*

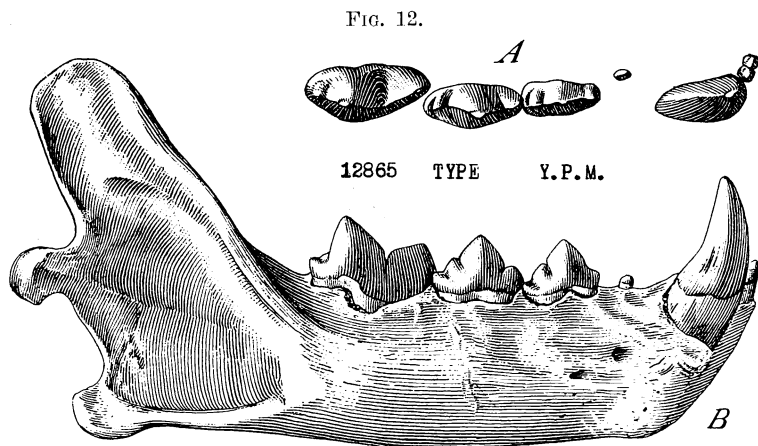


FIG. 12.—*Pseudaelurus marshi*, sp. nov. Holotype. Nat. size. A, occlusal view of inferior dentition; B, external view of right ramus.

marshi, sp. nov., in size corresponds more closely to *P. edwardsii* Filhol, although the latter is somewhat smaller. *Pseudaelurus intermedius* Filhol possesses a minute inner cusp on M_1 which is not found on any American form, so far as I am aware.

Measurements of Holotypes.

	<i>P. marshi</i> mm.	<i>P. intrepidus</i> mm.
Length, condyle to median incisor	97	122.7
Length of tooth series (M_1 , P_4 and P_3)	36	44.5
Length of diastema between C and P_3	8.6	14.8
Ant.-post. diameter of M_1	16	19.6
Ant.-post. diameter of P_4	12.5	14.8
Ant.-post. diameter of P_3	9.5	11.6
Width of jaw at sectorial	9	
Depth of jaw at P_4	17	23.2

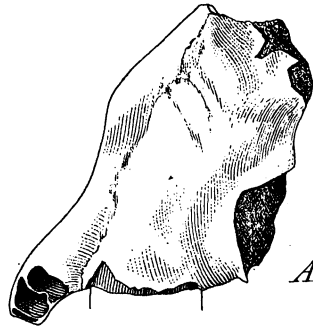
Machærodus niobrarensis, sp. nov.

(FIG. 13.)

Holotype, Cat. No. 12829, Y. P. M. Upper Miocene (Valentine beds), Niobrara River, Cherry Co., Nebraska.

The portion of a skull, anterior to P³, collected in 1873, is tentatively referred to *Machærodus*, in spite of the fact that no undoubted specimen of this genus has been hitherto found in North America. This specimen does not by any means dispel doubt as to the presence of this

FIG. 13.



12829 TYPE Y. P. M.

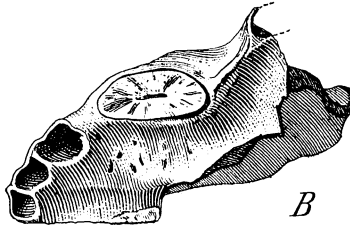


FIG. 13.—*Machærodus niobrarensis*, sp. nov. Holotype. $\times 3/4$. A, left lateral view of part of maxillary and premaxillary; B, palatal view of same.

genus in the New World, but it does show that there were forms present here which were more nearly allied to *Machærodus* than to any other genus of felids.

One of the outstanding and diagnostic characters of the specimen is seen in a cross-section of the canine, this tooth being very much compressed, and having an antero-posterior diameter of 21.5 mm. and a maximum transverse diameter of 8.8 mm.; measured at the alveolar

parapet. The ratio between the transverse and antero-posterior diameters, measured at the base of the crown, is as follows in the forms listed below: *Felis leo*, 1 to 1.4, *Pseudaelurus*, 1 to 1.7, in the true *Felis* line; while in the machærodont series, *M. necator* (based on Cope's figure), 1 to 2.2, *M. palmidens* (Blainville), 1 to 2.6, *M. niobrarenensis*, sp. nov., 1 to 2.4, and *Smilodon neogæus* Lund (from Burmeister's measurements), 1 to 2.33. *M. crassidens* may be nearer to the felines as indicated by the ratio of 1 to 1.65. Hence it is seen at once that the proportions of the canine in the felid and machærodont series are very different, and that this new machærodont is much closer to *Machærodus* than to any form in the feline series of equivalent or later geologic age.

Machærodus is very brachycephalic and this new species shows the same character. The anterior part of the alveolus of P³ is external to a plane, parallel to the sagittal plane, passing through the outermost part of the canine. In the Yale specimen the anterior part of this premolar is offset approximately 6 mm.; in *M. palmidens*, about 4 mm.

This new species differs from the typical *Machærodus*, in so far as we have comparable parts from which to judge, in that the incisors are a little more anterior to the canines, thereby making the muzzle slightly more pointed. Another divergence is seen in the incisor proportions, the external being larger and the amount of reduction from this one greater than in *M. palmidens*.

The skull of *M. palmidens* is a trifle greater than one half that of *Felis leo*, while this new species is probably about two thirds the size of the lion and hence smaller than any of the specimens hitherto referred to this genus from North America.

Measurements.

	<i>M. palmidens</i>	Cat. No. 12829
	mm.	Y. P. M. mm.
Width of palate at and including canines..	47	54
Width of palate at anterior part of P ³	60	73
Length of diastema between C and P ³	7	11.5
Length (axial) from prosthion to line through post. of canines	27	38

Felid, gen. et sp. indet.

Another specimen, Cat. No. 12839, Y. P. M., is that of an undoubted felid, but whether a member of the *Macharodus* or *Felis* line is not determined. As cat material from this horizon is so very scanty, in fact, largely unknown, it will not be out of place to give a brief description of certain bones of this skeleton. No skull is present, but several vertebræ, part of the pelvis, ribs, and the major part of the left femur are extant. It was discovered in 1914 by Professor Lull and collected by him, with the assistance of F. W. Darby, 5 miles east of Valentine, Nebraska. For comparison, an average-sized skeleton (Cat. No. 01050, Y. P. M.) of a male *Felis leo* was used. The geologic horizon is either Upper Miocene or possibly Lower Pliocene, as the specimen was found at approximately the same level as a 4-tusked mastodon, genus not yet determined, collected by the same party. The fossil skeleton, in the anterior portion of its anatomy, is apparently lighter than the lion, but in the posterior region it is fully as heavy, or possibly a little stouter and more robust.

The transverse processes of the atlas are slightly thicker, of less width, but greater posterior extent; the width of the dorsal surface is considerably greater; and the posterior opening of the passage for the vertebral artery is absolutely smaller than in the lion. The hypapophysial tubercle is apparently reduced, while the neural spine is very rudimentary. The alar canal is bridged over, and is not in the form of a notch as in *Felis leo*.

Measurements of Atlas.

	Cat. No. 12839 Y. P. M. mm.	Cat. No. 01050 Y. P. M. mm.
Max. width across wings	132	137.5
Ant.-post. diameter across articular surfaces	59	64
Ant.-post. diameter of neural arch, dorsal side	43	29
Ant.-post. diameter of neural arch, ventral side	17	24

The fifth and sixth cervicals, transversely, have a more nearly square outline to the neural canal; the walls of the neural arch are heavier; the vertebral canal is more elongate; the anterior and posterior faces of the centra are much more concave; the postzygapophyses stand at a slightly greater vertical angle than in the lion. The transverse processes are directed downward and outward; in *F. leo* outward and downward. The sixth lacks the upper transverse process of the lion. The seventh closely resembles that of the lion except that the costal facets are large and well defined in the fossil and the ends of the centrum are more concave.

Measurements of Cervicals.

	5th		6th		7th	
	12839	01050	12839	01050	12839	01050
	mm.		mm.		mm.	
Length of centrum	33	31	33	30	30	30
Width across prezygapophyses	43	74	52	66	52.3	66
Width across postzygapophyses	51	60	48	61		

Dorsals.—The first is very similar to that of *F. leo* except that it is slightly smaller and less robust; the fourth has a more oval (flattened from above downward) neural canal, less robust mammillary processes and is in general smaller and lighter than that of the lion. Its posterior articular surfaces extend but slightly beyond the centrum, while in *F. leo* they extend quite prominently. In the eleventh dorsal, the posterior articular surfaces are more vertical, with the superior section vertical, while in the lion the upper part bends outward, that is, has a more horizontal position. In the lion this vertebra has a vestigial spine, while the fossil possesses a relatively enormous one. The spine is wider, heavier, and longer in the twelfth; the centrum narrower, while the metapophyses of the prezygapophyses extend outward, are heavier and more robust, and the anapophyses extend to a line through the posterior margin of the postzygapophyses in the fossil. In the thirteenth, the metapophyses extend upward and outward; the anapophyses extend slightly beyond the posterior margin of the postzygapophyses; and the facets for the rib heads are deeper in this and the twelfth than in *Felis leo*.

Measurements of Dorsals.

	12839 mm.	01050 mm.
Length of centrum		
1st	28	30
4th	26.5	31
11th	30.5	37.5
12th	33	40
13th	35	43
Length of spine		
1st	65	76
4th	70	90
11th	55	16
12th	47.5	35
13th	46	34
Max. width across transverse processes		
1st	79	90
4th	68	67
Width across postzygapophyses		
11th	24	26
Width across anapophyses		
12th	44	51
13th	46.2	50
Width across metapophyses		
12th	51	44
13th	50	50

The first and second lumbar have heavier spines, their anapophyses extend slightly farther back and are situated a little farther down than in the lion.

Measurements of Lumbar:

	1st		2d	
	12839 mm.	01050 mm.	12839 mm.	01050 mm.
Length of centrum	39	46	40	48.5
Length of spine	46.1	38	50.5	43
Width across anapophyses	43	46	41*	45
Width across metapophyses	46	52	55	52

* Approximate.

The sacrum is but slightly smaller, while the spines are higher and a great deal more robust. The anterior articular facets lie in two planes, one outward and upward, and the second directly upward, while in *F. leo* they only have one—outward and upward. The rudiments of the zyga- and metapophyses are larger between the first and second segments and smaller between the second and third than in the lion. In *F. leo* the articular surfaces for the pelvis and the last lumbar are solidly united with each other and the centrum, but in the fossil they are widely separated and have no connection with each other. This fossil sacrum shows a pathological condition on the left side where there has been much exostosis, and the lateral mass is much closer to the centrum. The right side is normal. The maximum width across the lateral masses is 86 mm. in the fossil and 85 mm. in *F. leo*, while the combined length of the first two sacrals is the same in both, 62 mm.

The remaining part of the pelvis shows close similarity to *F. leo* in size and character. The tubercle for attachment of the rectus femoris muscle, in advance of the acetabulum, is slightly larger and more elevated, while the concavity above is smaller in the fossil, the ischiatic spine is a little less prominent, the ileo-pectineal eminence is more robust and less elevated, and situated a little more posteriorly. The maximum diameter of the acetabulum in both is 40 mm.

Of the femur, the great trochanter is not quite so heavy at the top, but extends a little farther down the shaft. The lesser trochanter is larger, the linea aspera more prominent, the trochanteric fossa deeper, and the bone somewhat heavier than in the lion.

Measurements of Femur.

	12839 mm.	01050 mm.
Max. transverse diam. at middle of lesser trochanter	50	49
Max. distance from inf. part of lesser trochanter to top of greater trochanter	76	69
Transverse diameter at middle of shaft.....	28.1	29

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