

THE GENERA AND SUBGENERA OF RACCOONS AND THEIR ALLIES.

By N. HOLLISTER,

Assistant Curator, Division of Mammals, United States National Museum.

The family Procyonidæ offers a remarkable instance of a group of mammal genera in which the differentiation in the structure of the teeth throughout the series is nearly uniform in degree from genus to genus, and strictly definite in direction from one extreme to the other. This condition is particularly interesting because of the wide difference between the teeth of genera from the extremes of the line, and because the widely diverse cranial and external characters show no special tendency toward serial grouping. Eliminating the very aberrant *Bassariscus*, which clearly does not belong in this series of genera, the superspecific groups remaining within the Procyonidæ, when based chiefly on dental characteristics, fall into as well-ordered a sequence of steps, connecting the Old-World *Ailurus* with the American *Potos*, as it would seem possible to find among living animals. (Plate 39.)

The one seemingly aberrant cranial feature in *Ailurus*,¹ the presence of the alisphenoid canal, can not in this case be considered a character of family or subfamily importance. The alisphenoid canal in other families of carnivores is known to be absent or present in different genera, in individuals of the same species, or even on the right and left side of the same individual. Of the American groups, *Euprocyon* is the nearest approach to *Ailurus*, but if the genera within the family are to be kept of fairly uniform value and degree of differentiation, *Euprocyon* is surely not more than a subgenus of *Procyon*. The small mountain forms of *coati mundis*, including *Nasua olivacea* Gray and its subspecies, differ so greatly from all the other members of the genus *Nasua* as to require generic separation. They show strong resemblances in several cranial and dental characters to *Bassaricyon*.

The *acomistles* (*Bassariscus*), while exhibiting many of the characters of the Procyonidæ differ so greatly in the nature of all the teeth that it seems impossible to retain them in the family. The

¹ For the loan of a skull of *Ailurus*, I am indebted to the Academy of Natural Sciences of Philadelphia, through Dr. Witmer Stone.

dog-like premolars and molars, the rounded canines, and the evident though small secondary lobes on the incisors (particularly noticeable in *B. sumichrasti*, which has been made the type of a separate subgenus "*Jentinkia*") all show unmistakable characters of the teeth of the Canidæ. It seems necessary, therefore, to place them in a separate family, as was done by Gray in 1869¹ and by Gill in 1872.²

The arrangement of the superspecific groups usually placed in the Procyonidæ would be then:

Family BASSARISCIDÆ.

1. BASSARISCUS Coues.

(syn., *Jentinkia* Trouessart.)

Family PROCYONIDÆ.

1. AILURUS Geoffroy and Cuvier.

2. PROCYON Storr.

a. EUPROCYON Gray.

b. PROCYON.

3. NASUA Storr.

4. NASUELLA, new.

5. BASSARICYON Allen.

6. POTOS Geoffroy and Cuvier.

The genera and subgenera of the family Procyonidæ may be diagnosed as follows:

Genus AILURUS Geoffroy and Cuvier.

1825. *Ailurus* GEOFFROY AND CUVIER, Hist. Nat. Mamm., vol. 5, livr. 50, text panda, p. 3. June.

1841. *Arctaelurus* GLOGER, Gemeinn. Hand- und Hilfsb. Naturg., vol. 1, pp., xxviii and 55 (1842).

1846. *Aelurus* AGASSIZ, Nomencl. Zool., Index, p. 9.

Type.—[*Ailurus*] *fulgens* Geoffroy and Cuvier.

Characters.—Face short, head roundish; ears large, erect, pointed; tail long, nonprehensile; claws semiretractile; sole of foot almost entirely haired; os penis small (23 mm. in length), not bilobed anteriorly.

Skull short, high, and rounded; rostrum short; braincase high and narrow, interorbital constriction comparatively great; zygomata without distinct postorbital processes; sagittal crest well developed. Palate highly arched, grooved medially, and extending only little beyond plane of last molar; vomer not attached to palatal bones; alisphenoid canal present; foramen ovale large; postglenoid process heavy, high, and greatly arched forward; audital bullæ very small, inflated only on inner side, the external auditory meatus a long and

¹ Bassaridæ, Gray, Cat. carn., pachyd., and edent. mamm., p. 246. 1869.

² Bassarididæ, Gill, Smiths. Misc. Coll., No. 230, p. 7, 59, 67. 1872.

narrow tube. Mandible short, greatly rounded; ascending ramus high, wide, and curved backward; condyles very large.

Dental formula.— $i \frac{3}{3} c \frac{1}{1} pm \frac{3}{4} m \frac{2}{2} = 38$.

Cheek-teeth large, maxillary row about one-third greatest length of skull; molariform teeth comparatively high crowned, multicuspoid; last upper premolar and upper molars much broader than long; pm^4 nonsectorial. Incisors weak. Canine ovate in section at cingulum, grooved on outer and inner surfaces. Each upper premolar with more than one cusp; pm^3 with well developed protocone and hypocone; pm^4 six-cusped, the protocone and hypocone with the prominent supplementary inner cusp forming more than one-half the tooth; pm_1 minute and deciduous; permanent lower premolars all long and narrow. Upper molars usually with numerous accessory cusplets on outside and on the strongly developed inner cingulum shelf; lower molars with numerous accessory cusplets. (Plate 39.)

Genus PROCYON Storr.

1780. *Procyon* STORR, Prodr. Meth. Mamm., p. 35.

(FULL SYNONYMY UNDER SUBGENERA.)

Type.—*Ursus lotor* Linnæus.

Characters.—Head broad behind, with pointed muzzle; ears fairly large, pointed; toes all free; claws nonretractile; tail shorter than body, nonprehensile; soles of feet entirely naked; os penis long and slender, about 100 mm. in length, bilobed anteriorly.

Skull more elongate (less rounded) than in *Ailurus*, shorter and broader than in *Nasua*; braincase broad and flat, with medium interorbital constriction; zygomata with distinct postorbital processes, but processes from frontals greatly reduced; sagittal crest moderate or absent. Palate flat or slightly concave, extending considerably beyond plane of last molar, and with barely noticeable lateral grooves; vomer attached to palatal bones; alisphenoid canal absent (as in all succeeding genera); foramen ovale small; postglenoid process small; audital bullæ large, greatly inflated on inner side, and not rising at sharp angle above the tube of the external auditory meatus. Mandible long, moderately rounded; ascending ramus low and extending backward without a highly arched curve; condyles small.

Dental formula: $i \frac{3}{3} c \frac{1}{1} pm \frac{4}{4} m \frac{2}{2} = 40$.

Teeth large (maxillary row about one-third greatest length of skull); molariform teeth comparatively high crowned, with heavy, conical cusps; last upper premolar and first upper molar subquadrate, only slightly broader than long, or both dimensions about equal; pm^4

subsectorial. Incisors heavy, normal, crowns slightly grooved in worn condition. Canine ovate at alveolus, slightly grooved on edges of outer surface and flattened on inner surface. First upper premolar single-rooted, second and third two-rooted, fourth three-rooted; pm^3 unicuspid, with well-developed cingulum shelf; pm^4 five-tuberculate, with only rarely an indication of supplementary inner cusplet; lower premolars more rounded, less lengthened, than in *Ailurus*. Upper molars usually without accessory cusplets, except on posterior border of inner cingulum shelf of m^1 , which is much less developed than in *Ailurus*; first lower molar large, with heavy conical cusps.

Subgenus **EUPROCYON** Gray.

1864. *Euprocyon* GRAY, Proc. Zool. Soc. London, 1864, p. 705.

1913. *Euprocyon* GOLDMAN, Smiths. Misc. Coll., vol. 60, no. 22, p. 16, February 28.

Type.—*Ursus cancrivorus* Cuvier.

Characters.—Pelage short; hair reversed from withers to between ears; claws heavier, straighter, broader, and more bluntly pointed than in true *Procyon*; os penis only slightly bowed, without sharply recurved distal end.

Skull essentially as in true *Procyon*, but with bony palate extending backward beyond plane of last molar a distance less than one-fourth the entire length of palate.

The teeth of *Euprocyon*, though obviously most resembling those of *Procyon* proper, show some tendencies of differentiation toward *Ailurus*. Third upper incisor with posterior fold little developed. The upper molariform teeth are broader, with better developed cingulum shelves and heavier, more rounded-coniform cusps; pm^4 has the deep valley between the paracone and hypocone not crossed by a connecting ridge, the hypocone standing as an isolated cusp; m^1 distinctly five-tuberculate (a well-developed protoconule present), with additional accessory cusplet on posterior border of inner cingulum. (Plate 39.)

Subgenus **PROCYON** Storr.

1780. *Procyon* STORR, Prodr. Meth. Mamm., p. 35.

1795. *Campsiurus* LINK, Beytr. Naturg., vol. 1, pt. 2, p. 87 (type, *Ursus lotor* Linnæus, now selected).

1795. *Lotor* GEOFFROY AND CUVIER, Mag. Enc., 1795, vol. 2, p. 187.

1816. *Loter* OKEN, Lehrb. Naturg., 3ter Theil., 2te Abth., p. 1080.

1899. *Mamprocyonius* HERRERA, Sin. Vulg. Cient. Vert. Mexicanos, p. 18.

Type.—*Ursus lotor* Linnæus.

Characters.—Pelage longer than in *Euprocyon*; hair of neck not reversed; claws lighter, strongly curved, and sharply pointed; os penis strongly bowed and sharply recurved at distal end.

The bony palate extends backward beyond plane of last molar a distance greater than one-fourth the entire length of palate, usually nearly one-third.

Posterior fold of third upper incisor commonly developing a small, independent cusp. Upper molariform teeth smaller and weaker than in *Euprocyon*, scarcely broader than long, with less developed cingulum shelves, and more sharply, less rounded, coniform cusps; paracone and hypocone of last upper premolar connected by a low ridge; m^1 four-tuberculate, the summit of protocone long, oblique, and not divided; and posterior border of cingulum shelf connected with crown of hypocone, without accessory cusplet. (Plate 39.)

Genus NASUA Storr.

1780. *Nasua* STORR, Prodr. Meth. Mamm., tab. A.

1799. *Coati* LACÉPÈDE, Tabl. Mamm., p. 7.

1845. *Nasica* SOUTH, Encycl. Metr., vol. 7, p. 383.

1872. *Cuati* LIAIS, Clim., Géol., Faune Brésil, p. 427.

1899. *Mammnasuaus* HERRERA, Sin. Vulg. Cient. Vert. Mexicanos, p. 26.

Type.—*Viverra nasua* Linnæus.

Characters.—Head long, rostral portion elongated, the snout upturned and mobile; ears rather short, rounded; tail very long, usually longer than body, nonprehensile; soles of feet naked; toes united for some distance from bases; front claws very long, slightly curved; hind claws strong, sharp, and well curved; os penis about 75–85 mm. long (according to Flower).

Skull long and comparatively narrow, the rostrum elongated and laterally compressed; braincase less flattened than in *Procyon*, with very little interorbital and considerable postorbital construction; zygomata with or without postorbital processes, frontals with distinct processes; sagittal crest well developed. Palate flat, or hollowed posteriorly, with distinct lateral grooves, and extending far beyond plane of last molar; palatine bones deeply notched on each side, with long processes extending laterally to the maxillary tuberosities; posterior root of last molar near line with center of orbit; vomer usually attached to palatal bones; foramen ovale small; audital bullæ small but smoothly rounded, and rising at sharp angle from tube of external auditory meatus. Mandible essentially as in *Procyon*, but ascending ramus comparatively small and low.

Dental formula: $i \frac{3}{3} c \frac{1}{1} pm \frac{4}{4} m \frac{2}{2} = 40$.

Teeth of medium size, much smaller than in *Procyon*, much larger than in *Nasuella* (maxillary row less than one-third the greatest length of skull, the uninterrupted series, $pm^2 - m^2$, usually more than one-fourth the greatest length, always more than one-fourth the occipito-nasal length); crowns comparatively high, with sharp, strong cusps; pm^4 slightly longer than broad; m^1 subquadrate, length and breadth about equal, or sometimes longer than broad;

pm^4 nonsectorial; molariform teeth with inner cingulum undeveloped and supplementary or accessory cusplets almost entirely wanting. Incisors lighter and weaker than in *Procyon*, the upper central pairs in line and in contact, the fronts of outer (i^3) back on level with posterior border of alveoli of middle incisors and separated from the middle pairs by a considerable diastema; lower incisors protruding forward. Canines much compressed laterally, the points turned outward. Premolars all two or three rooted; first three premolars single cusped, the middle two with wide cingulum shelf and heel; pm^4 with very well-developed hypocone. (Plates 38 and 39.)

NASUELLA, new genus.

Type.—*Nasua olivacea meridensis* Thomas.

Characters.—In general like *Nasua*, but smaller, with much shorter tail. Compared with *Nasua*, the skull of *Nasuella* is small and weak, the rostrum long and slender with the middle greatly constricted laterally. The palate extends still farther beyond plane of the last molar; the palatine bones are fan-shaped anteriorly and completely fill the space to the maxillary tuberosities; the molar-premolar row is so shortened that the posterior border of the last molar lies on a line with the most anterior border of orbit, leaving the maxillary tuberosity as a long shelf; audital bullæ small and flattened. Mandible lightly built, the ascending ramus short.

Dental formula: $i \frac{3}{3} c \frac{1}{1} pm \frac{4}{4} m \frac{2}{2} = 40$.

Teeth all greatly reduced in size and approaching in many characters the teeth of *Bassaricyon*; relatively and actually much smaller than in *Nasua*, *Bassaricyon*, and *Potos*; low crowned and sharply cusped, decidedly of a general insectivorous type; pm^4 nonsectorial; maxillary row, without the disconnected pm^1 , less than one-fifth the greatest length of skull; maxillary teeth all longer than broad; diastema between incisors and canine proportionally greater than in *Nasua*, between canine and pm^1 and between pm^1 and pm^2 very much greater; lower premolar series also much interrupted. Incisors as in *Nasua*, but outer (i^3) farther back from posterior alveolar plane of central four; and lower row much more protruding, the teeth almost horizontal, and on a line parallel with alveolar line of mandibular tooth row. Canines excessively flattened, saberlike, and outwardly bowed. First two upper premolars compressed cones, third with postero-internal shelf; fourth with three cusps only, the hypocone wanting. First upper molar subquadrate, four-cusped; very little larger than m^2 . Lower molars much compressed, of nearly equal size. (Plates 38 and 39.)

Genus BASSARICYON Allen.

1876. *Bassaricyon* ALLEN, Proc. Acad. Nat. Sci., Philadelphia, 1876, p. 20.

Type.—*Bassaricyon gabbii* Allen.

Characters.—Form elongated, head flattened, muzzle pointed; ears rather small, rounded; tail longer than head and body; posterior half of soles of feet furred; toes semipalmate; claws short, sharply curved and sharply pointed; os penis small, 32 mm. in length, slightly bowed, and much less distinctly bilobed anteriorly than in *Procyon* or *Euprocyon*. The general external appearance of the animal is remarkably like that of *Potos*. The best distinguishing external characters are the gray face and the less fully haired, less tapering, tail of *Bassaricyon*.

Skull short and broad; braincase much as in *Procyon*, but considerably smaller; rostral portion depressed as in *Nasua* and *Nasuella*, but much shorter; postorbital processes well developed from frontals and zygomata; orbits large; temporal ridges never forming a sagittal crest. Palate flat, with shallow lateral grooves, and extending well backward; vomer not attached to palatal bones; posterior half of audital bullæ greatly inflated, anterior half low and flattened; tube of external auditory meatus very short. Mandible light, the ascending ramus long and high.

Dental formula: $i \frac{3}{3} c \frac{1}{1} pm \frac{4}{4} m \frac{2}{2} = 40$.

Teeth somewhat larger than in *Nasuella*, the large cheek-teeth low crowned and only slightly cusped; teeth closely set, incisors all in contact and the upper cheek teeth uninterrupted from canine to m^2 . Lower incisors nearly normal, not produced forward as in *Nasuella*. Canines comparatively large, not excessively flattened; the upper pair nearly straight and not outwardly bowed. Premolars almost exactly as in *Nasuella*, but less compressed laterally. First upper molar somewhat larger than second; each with three low, rounded cusps, and well developed outer cingulum. (Plate 39.)

Genus POTOS Geoffroy and Cuvier.

1795. *Potos* GEOFFROY AND CUVIER, Mag. Enc., 1795, vol. 2, p. 187.

1799. *Kinkajou* LACÉPÈDE, Tabl. Mamm., p. 7.

1805. *Caudivolvulus* DUMERIL, Zool. Analyt., p. 14 (1806).

1811. *Cercoleptes* ILLIGER, Prodr. Syst. Mamm., p. 127.

1813. *Kinkaschu* FISCHER, Zoognosia., ed. 3, vol. 1, p. 14.

1815. *Aesurus* RAFINESQUE, Analyse Nat., p. 59.

1899. *Mamcercolepteus* HERRERA, Sin. Vulg. Cient. Vert. Mexicanos, p. 19.

Type.—*Viverra caudivolvula* Schreber.

Characters.—Form elongated; head rounded, muzzle pointed; tail very long, prehensile; ears short; posterior half of soles densely

furred; claws short, sharply pointed; fingers and toes partially webbed; limbs short.

Skull short, rounded, and highly arched; rostrum short and broad; braincase large, sharply constricted in the postorbital region (in fully adult skulls the postorbital constriction is greater than interorbital constriction); postorbital processes well developed from frontals, only slightly so from zygomata; sagittal crest usually developed on forward half of braincase. Palate flat, short, and extending posteriorly only short distance beyond plane of maxillary tuberosities; audital bullæ much flattened, about equally inflated anteriorly and posteriorly. Mandible heavy, the ascending ramus high, straight, and little produced backward.

$$\text{Dental formulæ: } i \frac{3}{3} c \frac{1}{1} pm \frac{3}{3} m \frac{2}{2} = 36.$$

Teeth, excepting m^2 , larger than in *Bassaricyon*, flatter, lower crowned, and still less tuberculated; entire row interrupted only by very short incisor-canine diastema. Incisors heavy, broad; the outer pair proportionately much larger and deeply emarginate over the posterior cingulum fold; lower incisors with chisel-shaped crowns, the central pair small. Canines large, much flattened, and emarginate on inner surfaces, and deeply grooved on outer sides; nearly straight. Premolars all large, the first two (pm^2 and pm^3) simple, with blade-like, crested crowns; pm^4 very broad, a long lateral shelf to the single internal, low and rounded cusp. First upper molar about twice the size of second, subquadrate, and almost flat except for outer raised rim; m^2 and both lower molars slightly sculptured and virtually without tubercles. (Plate 39.)

EXPLANATION OF PLATES.

PLATE 38.

Skulls of *Nasuella* and *Nasua* (natural size).

FIG. 1. *Nasuella olivacea meridensis*, Cat. No. 143658, U.S.N.M.

2. *Nasua nasua*, Cat. No. 61489, U.S.N.M.

PLATE 39.

Right upper tooth-rows of Procyonidæ.

(To facilitate comparison of the important features of the crown patterns, these tooth-rows are figured at same size, based on length of the three large molariform teeth.)

Fig. 1. *Ailurus*, Cat. No. 12426, Acad. Sci., Philadelphia.

2. *Euprocyon*, Cat. No. 172987, U.S.N.M.

3. *Procyon*, Cat. No. 6025, U.S.N.M.

4. *Nasua*, Cat. No. 61489, U.S.N.M.

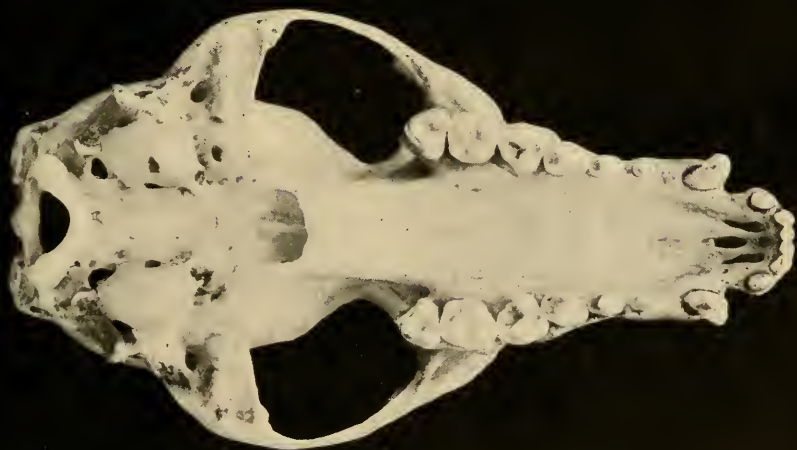
5. *Nasuella*, Cat. No. 143658, U.S.N.M.

6. *Bassaricyon*, Cat. No. 171138, U.S.N.M.

7. *Potos*, Cat. No. 74684, U.S.N.M.



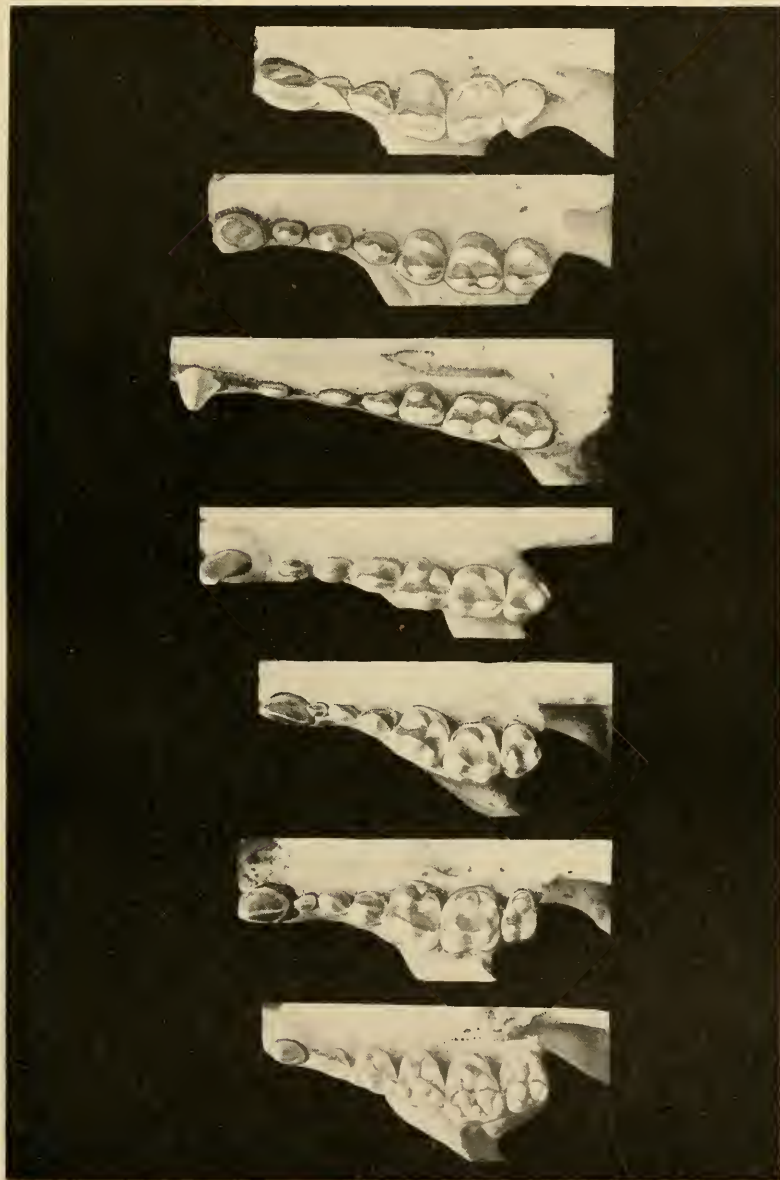
1



2

SKULLS OF NASUELLA (1) AND NASUA (2).

FOR EXPLANATION OF PLATE SEE PAGE 150.



Aiturus.

Euprocyon.

Procyon.

Nasua.

Nasuella.

Bassaricyon.

Potos.

TOOTH ROWS OF PROCYONIDÆ.

FOR EXPLANATION OF PLATE SEE PAGE 150.

