# XVII

# ON THE SYSTEMATIC POSITION OF *ÆLUROPUS MELANOLEUCUS*

BY

K. S. BARDENFLETH

In the year 1869 A. Milne Edwards received a letter[1]) from the traveller Père A. David, dealing with several new mammals collected by him in the Eastern Thibet, and among these was a kind of bear found in the province Moupin which he named *Ursus melanoleucus* and of the exterior of which he gave a short description. He added:

"Je n'ai point observé dans les cabinets d'Europe cette espèce qui est bien la plus jolie du genre que je connaisse; puisse-t-elle constituer une nouveauté pour la science!"

This wish was sufficiently fulfilled; the zoologists have played at battle-door and shuttle-cock with the animal, from the Ursidæ to the Procyonidæ and back again.

In March of the following year Milne Edwards shortly wrote about it[2]): ". . . Par sa forme extérieure, il ressemble en effet beaucoup à un Ours, mais les caractères ostéologiques et le système dentaire l'en distinguent nettement et le rapprochent des Pandas et des Ratons. Il doit constituer un genre nouveau que j'ai appelé *Ailuropoda.*"

But this name being preoccupied in another sense, P. Gervais[3]) after examining a plaster cast of its cranial cavity named it *Pandarctos*, considering it as an aberrant Ursid with some Panda-like features.

At the same time A. Milne Edwards altered the name to *Ailuropus* which is used by A. David in his "Rapport"[4]) 1871 (15, December) where he writes: "M. A. Milne Edwards a créé pour lui le genre *Ailuropus.*" He also resumes the words of Milne Edwards about its systematic relation cited above.

The first detailed description of its exterior, its skull and its teeth was given

[1]) Nouvelles Archives du Muséum t. V, 1869, Bull. pag. 13.

[2]) A. Milne Edwards: Sur quelques Mammifères du Thibet oriental. (Annales des Sciences naturelles, Tome XIII, série 5, 1870.)

[3]) P. Gervais: Mémoire sur les formes cérébrales des Carnivores. (Nouvelles Archives du Muséum, Tome VI, 1870.)

[4]) A. David: Rapport présenté a l'assemblée de MM. les professeurs-administrateurs du Mus. d'Hist. nat. (Nouv. Arch. du Mus., Tome VII, Bulletin, 1871. Pp. 88 and 92.)

by A. Milne Edwards in 1874[1]). From this description he concludes as follows: "L'ensemble de faits que je viens de passer en revue prouve que l'Ailurope ne peut être rapporté à aucun des types génériques précédemment connus. Il appartient indubitablement à la famille des Carnassiers arctoides, dont les Ours sont les principaux réprésentants, et il ressemble beaucoup à ces animaux; mais il tient encore plus peut-être des Pandas, et il présente un singulier mélange des caractères ostéologiques. Ainsi, par le mode d'articulation de la mâchoire inférieure, l'énorme developpement des arcades zygomatiques, il ressemble aux Félins les plus robustes, et quelques naturalistes le comparent à l'Hyène; mais la conformation de ses dents mâchelières indique que c'est en réalité un animal moins carnivore que ne le sont les Ours. Par leur forme générale, ses grosses molaires tuberculeuses ressemblent beaucoup à celle de l'Urside fossile désigné sous le nom d'*Arctotherium bonariense*, par M. P. Gervais. — Par la disposition de la couronne, le penultième molaire a beaucoup d'analogie avec les molaires de divers Pachydermes fossiles, notamment du *Choeropotamus parisiensis*, et l'on aurait trouvé cette dent isolée, qu'on l'aurait rapportée à un herbivore pachyderme. Néanmoins c'est entre les Ours et les Pandas que l'Ailurope doit prendre place dans nos classifications méthodiques, et la division qui la renferme, me paraît avoir une valeur zoologique plus considérable que celle de la plupart des genres dont se compose l'ordre des Carnassiers" (pag. 335—6). — This decision of the position of the animal among the Arctoidea is far less definite than the former of the same author; it is interpreted as an intermediate form between the two families Ursidæ and Procyonidæ.

A description — unfortunately rather cursory — of the skeleton was given by P. Gervais in 1875[2]). About the relationship of the animal he writes: "Cette étude m'a conduit à le rapporter aussi à la famille des Ursides, dans laquelle il occupe toutefois une place à part, ce que l'on pourrait rappeler en en faisant une tribu distincte parmi ces animaux". (Pag. 78). In short, it is to him an aberrant member of Ursidæ, but not of Procyonidæ.

In his article "Mammalia" in the British Encyclopædia[3]) W. H. Flower regarded it as a true representative of the Ursidæ, but connecting them with *Ælurus* (which to him formed a distinct family) and with several extinct genera.

The same place is occupied by *Æluropus* in W. H. Flower and R. Lydekker: "Mammals"[4]), where it is said: "In the large size and complex crowns of the upper

[1]) A. Milne Edwards: Recherches pour servir à l'histoire naturelle des Mammifères. Paris 1868—74, pp. 321–38.

[2]) P. Gervais: De l'Ursus melanoleucus. (Journal de zoologie, tome IV, 1895.)

[3]) Brit. Encyclopæd. Ed. 9., vol. XV, 1883.

[4]) W. H. Flower & R. Lydekker: An introduction to the study of Mammals, living and extinct. London 1891.

premolars this genus differs very markedly from the true Bears. The fourth upper premolar (carnassial) makes no approach to the markedly sectorial type presented by the corresponding tooth of *Hyænarctus*, its structure being, on the whole, more like that of *Ælurus*." (pag. 561).

H. Winge[1]) places still more exclusively *Æluropus* among Ursidæ as a very near relative of the *Hyænarctus*, these two forming together a branch of the Ursine stem, whereas *Ælurus* belongs to the Procyonine stem of Procyonidæ whose root is *Bassaris*. A true relationship between the two species is thus out of the question.

But *Æluropus* was not allowed to stay among the Bears; in 1901 E. Ray Lankester and R. Lydekker[2]) asserted, after a careful comparison between its skeleton, especially the limb-bones, and that of *Ælurus* and *Ursus*, that it must be closely associated with Ælurus, and should be named the "Greater Panda", not the "Particoloured Bear": "In spite of the difference in their dental formula, it appears reasonable that if *Ælurus* be included in the Procyonidæ, *Æluropus* should likewise find a place in the same family. The two may indeed be regarded as the representatives of a subfamily of the Procyonidæ — the Ælurinæ." (p. 171).

In 1904 Max Weber[3]) following Winge's views placed *Æluropus* near *Hyænarctus* among the Ursidæ, and 1913 the present writer[4]) shortly treated the form of the upper carnassial of carnivorous mammals and among those also that of *Æluropus*. By examination of the position of the roots he tried to prove Winge's assertion that the inner cusps of the carnassial of *Æluropus* were homologous with those of *Ursus*, not with those of *Ælurus*, the anterior one being not the sixth cusp (Winge's indication, = protocone Osborn), but a strongly developed cingulum-cusp. He added: "The other resemblances between *Æluropus* and *Ælurus* seem to me to be mostly analogous features due to the adaptation to the same habits" (p. 106). Of this the present short paper will try to give fuller proofs.

In the following list I have paralleled some of the characters of *Ælurus*, *Æluropus* and *Ursus*.

| Ælurus. | Æluropus. | Ursus. |
|---|---|---|
| Back reddish brown, belly black, face brighter with white | Colour yellowish white, with rings round the eyes, the ears, | Colour of several species black, with a white crescentic |

[1]) H. Winge: Jordfundne og nulevende Rovdyr (Carnivora) fra Lagoa Santa etc. E Museo Lundii 2 bd. 2. halvbd. København 1895—96.

[2]) E. Ray Lankester & R. Lydekker: On the affinities of *Æluropus melanoleucus*. (Transact. Linn. Soc. London, ser. 2, vol. VIII).

[3]) Max Weber: Die Säugetiere. Jena 1904.

[4]) K. S. Bardenfleth: Notes on the form of the Carnassial Tooth of Carnivorous Mammals (Vidensk. Meddelelser fra den Naturh. Foren. i København bd. 65).

snout, eye-brows, cheeks and ears. — Tail long, annulated, with long hairs; ears large, pointed; feet sub-plantigrade.

the fore limbs (together with an uniting band over the shoulders and back) and the hind limbs (except the thighs) black-brown. — Tail nearly invisible; ears small, round; feet (according to the authors) sub-plantigrade.

spot under the throat; *U. maritimus* yellowish white all over the body. — Tail almost invisible; ears small, rounded; feet plantigrade (with hairy soles in *U. maritimus*.)

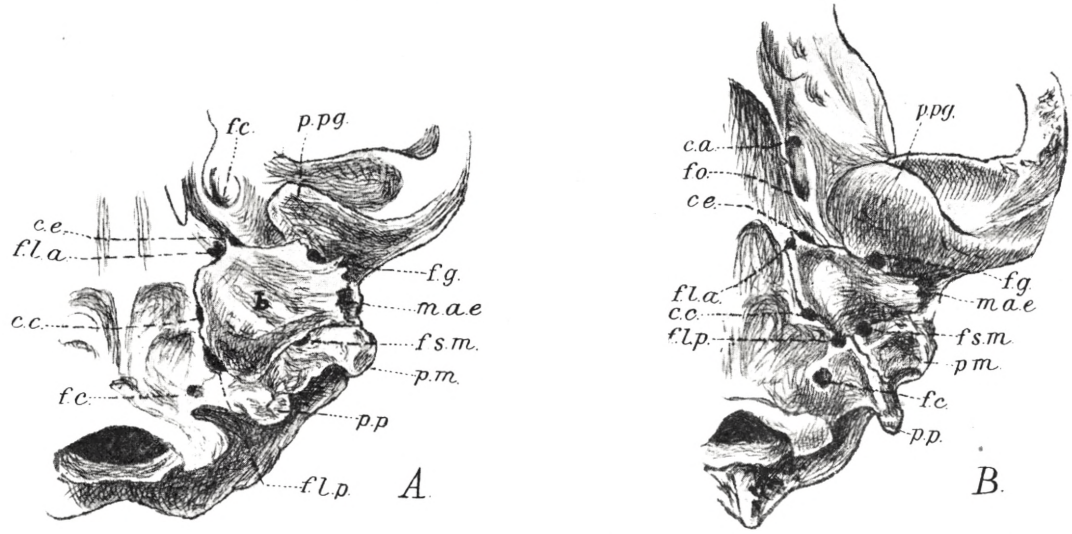



Fig. 1. Basis cranii of A. *Procyon lotor*, B. *Ælurus fulgens*. b = bulla, c. a. = alisphenoid canal, c. c. = carotid canal, c. e. = Eustachian canal, f. c. = condylar foramen, f. g. = glenoid foramen, f. l. a., f. l. p. = anterior and posterior foramen lacerum, f. o. = oval foramen, f. s. m. = stylo-mastoid foramen, m. a. e. = meatus acusticus externus, p. m. = mastoid process, p. p. = paroccipital process, p. p g = postglenoid process.
(The specimens are from the Copenhagen museum. Natural size.)

Skull short, rounded.

Orbits with distinct post-orbital processes from the frontals only.

Zygomatic arches very wide. Crista sagittalis rather high.

Anterior border of nostrils somewhat backward sloping.

Skull short, rounded.

Orbits with no postorbital processes.

Zygomatic arches extremely wide. Crista sagittalis very high.

Anterior border of nostrils nearly vertical.

Skull rather elongated in some species (e. g. *U. arctos*, *U. maritimus*), short in others (e. g. *U. ornatus*, *U. malayanus*.)

Orbits often with distinct postorbital processes from the frontals (not in *Melursus*) and the zygomata.

Zygomatic arches moderately wide. Crista sagittalis not high.

Anterior border of nostrils very sloping only in the species with long skull.

| | | |
|---|---|---|
| Bony palate prolonged considerably behind the posterior border of the last molar. | Bony palate not reaching the posterior border of the last molar. | Bony palate prolonged considerably behind the last molar. |
| Alisphenoid canal present (absent in the other Procyonidæ[1]). | Alisphenoid canal only indicated by a small depression. | Alisphenoid canal present. |

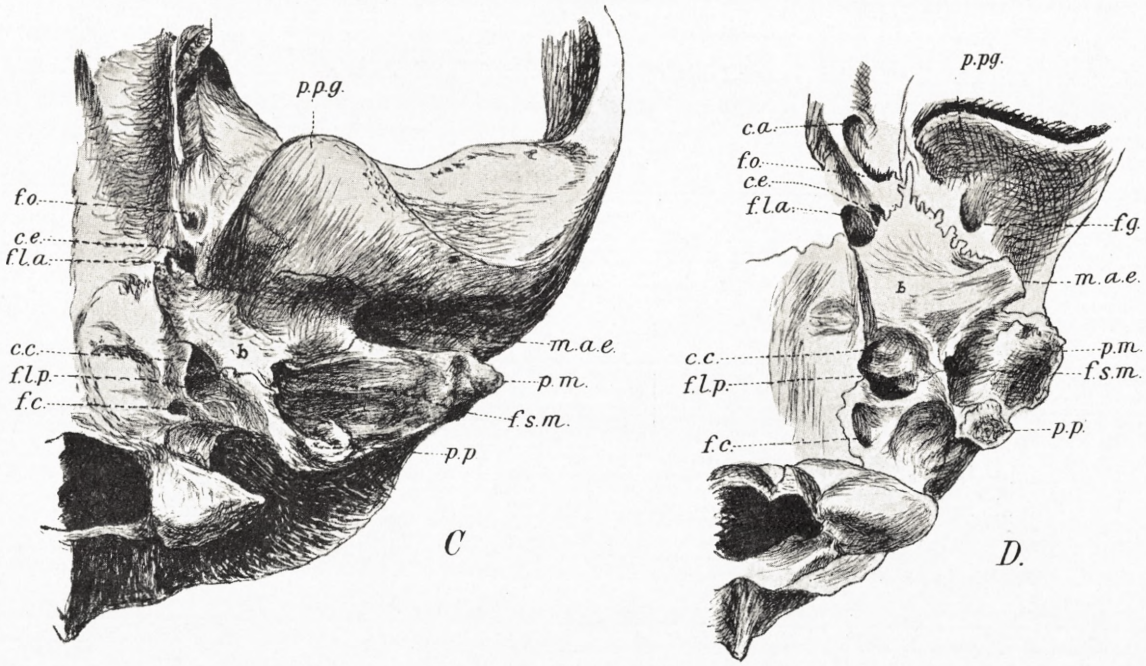



Fig. 2. Basis cranii of C. *Æluropus melanoleucus*, D. *Ursus arctos*. (The letters as in fig. 1. — C is drawn from a photograph taken in the British museum; the skull is viewed somewhat from behind to show the large postglenoid process. D is drawn from a specimen in the Copenhagen museum. About $^5/_7$.)

| | | |
|---|---|---|
| Foramen condyloideum quite separated from the foramen lacerum posterius. | Foramen condyloideum placed very near the foramen lacer. post., only separated from it by a thin bony wall. | Foramen condyloideum widely separated from the for. lacer. post., but with a shallow groove leading towards it. |
| Foramen ovale and the opening of the Eustachian canal rather near each other. | Foramen ovale and the opening of the Eustachian canal very near each other. | Foramen ovale and the opening of the Eustachian canal widely separated from each other. |
| No Steno's fissure. (Lankester & Lyd. pl. I.) | No Steno's fissure. | Steno's fissure present. |
| Basioccipitale moderately broad. | Basioccipitale narrow. | Basioccipitale broad. |
| The space between the posterior ends of palate bones and | The space between the posterior ends of palates and ptery- | The space between the posterior ends of palates and ptery- |

[1]) For the characters of the basis cranii vide fig. 1 and 2.

the hamular processes of the pterygoids most narrow between the palates.

Fossa glenoidea rather expanded transversely.

Processus postglenoideus very high, separated from the anterior part of the bulla by a very narrow space.

Bulla bottle-shaped, inflated in its inner half.

Meatus acusticus externus long, cylindrical, not pressed between proc. postglenoid. and proc. mastoid.

Processus mastoideus small, short, separated from the rather long and slender processus paroccipitalis.

The condyle of the mandible very extended in lateral direction, its upper face concave, the ends cut obliquely downwards and inwards, the outer end more oblique than the inner.

Ascending ramus of mandible very high, rather slender, with rather great backward curvature of the pointed top. The space for attachment of muscles on its outer side very large.

Processus angularis rather large, not inflected.

Horizontal ramus of mandible equally thick in both ends, its inferior border convexe. Symphysis rather long, not anchylosed.

goids most narrow between pterygoids.

Fossa glenoidea very expanded transversely.

Processus postglenoideus extremely high, abuts against the anterior part of the bulla and is coalesced with it.

Bulla irregularly shaped, not inflated.

Meatus acusticus externus short, placed at the bottom of a deep groove between proc. postglenoid. and proc. mastoid.

Processus mastoideus long, compressed in antero-posterior direction, united with the long processus paroccipitalis by a low, concave ridge.

The condyle of the mandible very extended in lateral direction, its upper face convex, the ends cut obliquely, the outer end much more so than the inner.

Ascending ramus of mandible very high, slender, with very great backward curvature of the pointed top. The space for attachement of muscles very large.

Processus angularis small, inflected.

Horizontal ramus of mandible very strong, much higher at the hind end than at the fore end, its inferior border somewhat concave. Symphysis long, anchylosed.

goids most narrow between pterygoids.

Fossa glenoidea not very expanded transversely.

Processus postglenoideus rather low, widely separated from the bulla.

Bulla almost triangular, not inflated.

Meatus acusticus externus rather short, but with a long spout-like process from its floor. Proc. postglen. and proc. mastoid. widely separated.

Processus mastoideus long, stout, blunt, the ridge between it and the strong processus paroccipitalis indistinct.

The condyle of the mandible not very extended in lateral direction, the inner end nearly vertical.

Ascending ramus of mandible not very high, broad, with blunt top which is not very bent; the space for attachment of muscles moderate.

Processus angularis rather large, not inflected.

Horizontal ramus of mandible strong, varying in thickness, but often thicker in its posterior end; inferior border varying in form.

Tooth formula: $\frac{123}{123}\,\frac{1}{1}\,\frac{.23456}{123456.}$ [1])

Teeth (except $p_1$) broad, stout, cusps strong, conical, cingulum well developed on the upper teeth, with tendency to form accessory cusplets.

$m^2$ broader than long, shorter than $m^1$.

$m_3$ absent.

$p^3$ quinque-cuspid, with a special root supporting the two inner cusps.

$p^4$ as large as $m^1$, the two inner cusps (6—7 Winge, pr. and hy. Osborn) form more than $^1/_2$ of the tooth, they are supported by a very strong root which is placed mainly under the anterior cusp.

$p_3$ strong, with one rather blunt cusp.

$p_4$ quinque-cuspid.

Number of vertebræ 7 c., 14 d., 6 l., 3 s., 18 caud.

Scapula small, the supra-scapular border almost not extending beyond the ridge running along the glenoid border. Glenoid and coracoid border somewhat diverging.

Head of humerus rather

[1]) For the teeth cfr. pl. I.

Tooth formula: $\frac{123}{123}\,\frac{1}{1}\,\frac{123456}{\cdot\,234567.}$

Teeth (except $i\frac{1-2}{1-2}$ and $p^1$) broad, extremely stout, cusps very strong. There is a great tendency to form not only cingulum cusps, but also accessory cusplets in the valleys between the ordinary cusps.

$m^2$ elongated, longer than $m^1$.

$m_3$ only a little reduced.

$p^3$ quinque-cuspid, but the two inner cusps are widely separated cingulum-cusps with no special root.

$p^4$ smaller than $m^1$, the inner cusps form only $^1/_3$ of the tooth, only the posterior one is supported by the weak root and is thus the true "heel-cusp" (Winge l. c.), the anterior is a cingulum-cusp with no root. (Bardenfleth l. c.)

$p_3$ strong, with three sharp cusps.

$p_4$ tri-cuspid, with sharp edges.

Number of vertebræ: 7 c., 13 d., 4 l., 6 s., 7 caud. (at least) (according to Gervais).

The supra-scapular border of the scapula forms a very small area behind the upper $^1/_5$ of the ridge running along the glenoid border. Glenoid and coracoid border somewhat diverging.

Head of humerus rather

Tooth formula: $\frac{123}{123}\,\frac{1}{1}\,\frac{1(2)(3)456}{1(2)(3)4567.}$

Premolars reduced, $p\,\frac{2-3}{2-3}$ often wanting, molars stout, somewhat broadened, especially $m^{2-3}$ and $m_{2-3}$, which show a tendency to form cingulum cusps and accessory cusplets and folds between the ordinary cusps.

$m^2$ elongated, longer than $m^1$.

$m_3$ somewhat reduced.

$p^3$ rudimentary, with one or three small cusps, often absent in adult animals.

$p^4$ reduced, much smaller than $m^1$; the "heel-cusp" is placed far back, but connected with the anterior outer cusp (5 Winge) by a cingulum ridge which sometimes develops a small cusp. (c in pl. I 9.).

$p_3$ reduced, often absent.

$p_4$ reduced, with 1—3 irregular cusps.

Number of vertebræ: 7 c., 14—15 d., 6—5 l., 4—6 s., 9—10 caud.

The supra-scapular border forms (in some species) a prominent area behind the ridge running along the glenoid border, this area occupying the upper half of the glenoid border (it is rather small in *U. ornatus*, *Melursus* a.o.). Glenoid and coracoid border often nearly parallel.

Head not rather heavy.

heavy. Upper face of tuberculum majus (external tuberosity) somewhat oblique.

Entepicondylar foramen present.

Deltoid ridge feeble, but forming a straight line.

Front surface of humerus regularly, but slightly, curved.

Supinatur ridge not very prominent.

Entepicondyle flat, somewhat expanded.

Inner crest of trochlea (surface for ulna) very little prominent.

Trochlear fossa shallow.

The fore-arm shorter than humerus.

Olecranon relatively high.

Preaxial malleolus of radius forms a short point.

The radial sesamoid small, articulated with radiale-intermedium and metacarpale I (very minute in the other Procyonidæ).

Metacarpals rather short.

Bony protecting sheath of claws well developed.

Femur rather long and slender.

Trochlear surface (for patella) nearly symmetrical.

Area between the head and the trochanters (of femur) rather flat.

heavy. The general form of the upper end is nearly intermediate between *Ælurus* and *Ursus*.

Entepicondylar foramen present.

Deltoid ridge distinct, forming a straight line.

Front surface of humerus regularly, but slightly, curved.

Supinator ridge prominent.

Entepicondyle flat, very expanded, but seems to be more of the form of that of *Ursus* than of *Ælurus*, seen in front.

Inner crest of trochlea prominent.

Trochlear fossa shallow.

The fore-arm shorter than humerus.

Olecranon relatively high.

Preaxial malleolus of radius forms a rounded surface.

The radial sesamoid extremely long ("præ-hallux"), articulated with radiale-intermedium and metacarpale I.

Metacarpals short.

Bony sheath of claws well developed.

Ilia longer than in *Ursus*, so that the form of the pelvis is somewhat different.

Femur short, stout.

Trochlear surface nearly symmetrical.

Area between head and trochanters rather flat, wide.

Tuberculum majus nearly horizontal.

Entepicondylar foramen generally absent.

Deltoid ridge broad, ending with a marked tuberosity.

Front surface of humerus angulated at the prominent tuberosity.

Supinator ridge prominent.

Entepicondyle thick, expanded.

Inner crest of trochlea prominent.

Trochlear fossa rather deep.

Ulna longer than humerus.

Olecranon relatively short.

Preaxial malleolus of radius forms a prominent point.

The radial sesamoid very small, articulated with radiale-intermedium only.

Metacarpals rather short.

Bony sheath of claws less developed.

Femur longer, more slender.

Trochlear surface somewhat obliquely placed.

Area between head and trochanters uneven, narrow.

| | | |
|---|---|---|
| The two distal condyles of femur reach nearly equally far behind. | The two distal condyles reach nearly equally far behind. | The inner condyle reaches somewhat behind the outer one. |
| The groove on the distal end of the tibia for articulation with the astragalus shallow. | The groove on the distal end of the tibia shallow. | The groove on the distal end of the tibia not very shallow. |
| Fibula greatly expanded at the two extremities. | Fibula greatly expanded at the two extremities. | Fibula not greatly expanded at the two extremities. |
| Tarsale IV—V antero-posteriorly elongated (also in *Procyon.*) | Tarsale IV—V antero-posteriorly elongated. | Tarsale IV—V transversely elongated. |
| A very large pointed sesamoid is articulated to the inner side of the centrale (absent in *Procyon.*) | A large somewhat pointed sesamoid is articulated to the inner side of the centrale. | Tibial sesamoid (not always?) present, nearly as large as in *Æluropus* (cfr. fig. 3). |
| Metatarsals long, slender (also in *Procyon*). | Metatarsals rather short and stout. | Metatarsals rather long and slender. |

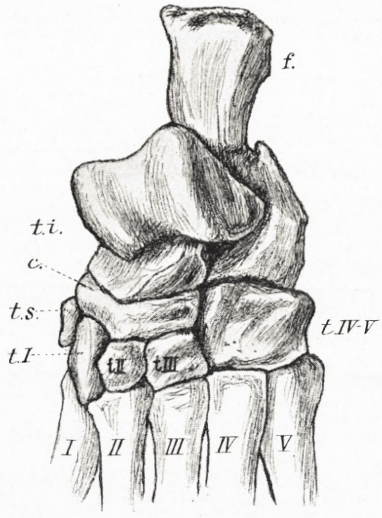



Fig. 3. Tarsus of *Ursus arctos.* (1/2). c = centrale, f = fibulare (calcaneus), t. i. = tibiale-intermedium (astragalus), t.s. = tibial sesamoid, t I—V = 1st to 5th tarsal, I—V = 1st to 5th metatarsal.

| | | |
|---|---|---|
| No rhomboid area visible in the front region of the brain. | A distinct rhomboid area present. | A distinct rhomboid area present. |
| General form of the brain mostly procyonoid. | General form mostly arctoid. | The arctoid form of the brain very different from the procyonoid one. |
| Lobi olfactorii short. | Lobi olfactorii extremely long. | Lobi olfactorii short. |
| Cerebellum mostly overlapped by cerebrum. | Cerebellum mostly free. | Cerebellum somewhat concealed. |

This synopsis of the characters of *Æluropus* shows us an animal with several *Ælurus*-like, and several original characters. But if we not only count them, but also weigh them, we can certainly reach a more decisive result.

The coloration gives us no hold. It is unique in *Æluropus*, but it is almost so also in *Ælurus*, though the brown colour of the latter reminds us of the colour of *Nasua*, the annulated tail and the stripes on the snout of some of the other Procyonidæ. — Mammals with the belly darker than the back are rather rare; among the Carnivora they are found among Canidæ *(Canis vulpes var. melanogaster* and perhaps other varieties, *Nyctereutes procyonoides*, *Icticyon venaticus)*, among Mustelidæ *(Gulo borealis*, the *Foetorius*-group, *Vison*, *Mellivora*, *Mephitis*, *Thiosmus*, *Meles*, *Ictidonyx*, *Poecilogale*, *Galictis barbara)*, among Procyonidæ only *Ælurus*. — The capricious coloration of *Æluropus* may perhaps be interpreted as a case of partial albinism, in adaptation to the cold snow-covered mountains where it lives, like the total albinism of *Ursus maritimus*, *Canis lupus var. albus* and other mammals in the ever-white polar regions.

The skull is very peculiar; P. Gervais compares it with that of *Hyæna*. The most characteristic feature, and the starting-point for understanding it, is the immensely developed dentition. And the origin of this is to be sought in the food of the animal. But unfortunately its biology is very little known. Milne Edwards says (1874, pag. 336) that it feeds principally on roots, young bamboos and other vegetables, and A. David writes as follows about the same subject (1871 pag. 89): "Il . . . paraît avoir un régime végétal; mais pourtant l'on dit qu'il ne refuse point le chair quand s'en présente; et même je pense que c'est sa nourriture principale en hiver, saison dans laquelle il n'est pas sujet à rester endormi". — That *Æluropus* does eat meat, seems very likely, judging from the sharp-edged anterior premolars, but it must have been hard and tough vegetables which have developed the peculiar molars, which almost resemble the teeth of some Suidæ.

As in animals with very strong teeth the muzzle is very short, in order that the teeth may act with the greatest possible force, but the teeth being all in activity (except $p\,\frac{1}{1}$) they cannot become shortened and must consequently be very crowded. But nevertheless $m_3$ can hardly be called rudimentary, not even so much as in *Ursus;* that means no doubt that this tooth is still of importance to the animal and, therefore, not indifferent in systematic respect. *Ælurus* has lost it, but as a kind of compensation $m_2$ has a large backward elongation.

To move the immense lower jaw with force very strong muscles are required; they give the brain-case with its strong crests the peculiar and characteristic *Hyæna*-like form. And they press the zygomatic arches outwards in order to get the necessary space. The articulation of the lower jaw needs sufficient fixedness;

consequently the condyle and the glenoid cavity become very enlarged, and the temporal root of the zygoma is more heavy than in any other Carnivore.

The exceedingly strong processus postglenoideus abuts against the flat, *Ursus*-like bulla; and as the heavy head — which is made still more heavy by the great specific gravity of the bones, which is, I think, only exceeded by the specific gravity of the bones of the Sirenia — requires very powerful neck-muscles for supporting and fixing it, the occiput becomes very broad. This in connection with the large postglenoid process gives a peculiar antero-posteriorly compressed appearance to the basis cranii. That explains the form of the bulla, the short distance between the glenoid cavity and the mastoid process, the extraordinary place of the meatus acusticus externus and the nearness of the foramina to each other. — The systematic importance of the alisphenoid canal seems somewhat doubtful. It is absent in Felidæ, present in Viverridæ (except in *Viverricula*, *Cynogale* [according to Flower, absent according to Mivart], *Galidictinæ*, *Eupleres*, *Proteles*), absent in Hyænidæ, present in Ursidæ, absent in *Æluropus*, absent in Procyonidæ (except *Ælurus*), absent in Mustelidæ. — Steno's fissure is absent in Procyonidæ, present in *Ælurus*, absent in Ursidæ, present in *Æluropus*.

The resemblance between the skull of *Æluropus* and that of *Ælurus* is due to a convergent development of the teeth. According to Flower & Lydekker (l. c. pag. 562) it feeds chiefly on fruits and other vegetable substances; David says (1871, pag. 89): "Du reste, le petit panda, *Ailurus fulgens*, . . . . tâche aussi de varier, avec de la viande, ses repas, qui d'ordinaire consistent en végétaux, fruits, feuilles, bourgeons, pousses de bambous sauvages, selon la saison". Evidently the food of the two animals is nearly similar and must have the same effect on the teeth, and these again on the form of the head: the short muzzle, the large and crowded multicuspid teeth, the wide zygomatic arches, the expanded glenoid cavity and large processus postglenoideus, — all is due to the same cause. The obliquely cut ends of the mandibular condyles are not unique among the Carnivores; they seem to be characteristic of animals with strong articulation and large processus postglenoidei, they are e. g. very conspicuous in *Meles*, also to be seen in *Hyæna* and others. The strong muscles which require a large area for attachment, dilate the processus coronoidei and give them their peculiar form. But as the brain-case is relatively larger in *Ælurus* than in *Æluropus*, the muscles get sufficient space on it without transforming it as in *Æluropus*, and the smaller and lighter head requires not so strong neck-muscles, therefore the basis cranii is not so much transformed as in *Æluropus*, and the typical *Procyon*-like bulla is not altered.

The Bears are omnivorous animals; young European bears feed chiefly on soft fruits, young sprouts and other soft vegetables, even the polar bear is said to eat

grass in the summer (Flower & Lydekker pag. 558). Therefore the crowns of their molars are more flat; they do not require so much force for crushing and cutting their food; the molars are reduced, $p\frac{2-3}{2-3}$ often disappeared, the muzzle often rather long, the muscles not very strong. And consequently the zygomatic arches are not wide, the sagittal crest low, the mandibular articulation not so expanded, processus postglenoideus rather low, the neck-muscles do not cause an antero-posterior compression of the hind part of the brain-case, etc.

Thus we are entitled to say that the resemblances between the skull of *Æluropus* and *Ælurus* can all be derived from the convergent development of their teeth which are adapted to crush tough vegetables; but the resemblance between *Æluropus* and *Ursus* — the form of the bulla, the presence of $m_3$, the construction of $p^4$, the form of the space between the pterygoids etc. — is due to real generic connection.

As to the limbs, at the first glance they seem to be more Panda-like than Bear-like; but if the head of *Æluropus* is a modified bear-head, the resemblance between the limbs of *Æluropus* and *Ælurus* must also be of adaptive nature. But unfortunately we are not sufficiently acquainted with its life-habits to give a full explanation of the features of the limbs, nor are the muscles known. But as a general rule we may say that the limb-bones of *Æluropus* differ from those of *Ursus* and resemble those of *Ælurus* in being shorter, stouter, more expanded at the ends than in *Ursus*, and the ridges and other parts of the bones where the muscles are inserted, are formed more like those of *Ælurus*. That seems to me to indicate that the two animals move in the same manner; no doubt *Ælurus* climbs trees, the larger *Æluropus* perhaps climbs on the rocks.

The presence of an entepicondylar foramen is of no great significance, being generally absent in *Ursus*, but often present in *U. ornatus* and according to Gervais (1875, pag. 86) also in *Arctotherium bonariense* and *Hyænarctos*. Its appearance in the other carnivorous families is also somewhat irregular like the appearance of the foramen alisphenoideum. According to W. K. Gregory[1]) its presence may be a primitive feature. — The form and size of the radial sesamoid on the carpus is quite unique among Carnivora, it suggests to us the "os falciforme" of *Talpa* (though the latter is articulated with the distal end of radius); in *Castor* we find a sesamoid with the same position and nearly the same size as that of *Æluropus*[2]). Also in the foetal carpus of *Didelphys* (W. K. Gregory l. c. pag. 440 fig. 9) and in some climbing rodents we find a similar bone. Thus its presence may indicate

[1]) Will. K. Gregory: The orders of Mammals. (Bulletin of the Amer. Mus. of Nat. Hist. vol. XXVII, 1910, pag. 436).

[2]) Flower: Osteology of the Mammalia, London 1885, fig. 96.

either burrowing or climbing habits[1]); it seems to me to be a confirmation of the view that *Æluropus* is a climbing animal. It is no doubt connected with the tendon of musc. abduc. magnus pollicis and musc. abduc. curtus poll. (Gervais 1875 p. 86). — The large and heavy animal needs strong muscles, this may be the reason why the bone is so extraordinarily large. — The elongation of the tarsale IV—V in *Ælurus* and *Æluropus* may be due to their supposed semiplantigrade gait (though this is somewhat doubtful in *Æluropus*); it is also elongated in dog and cat. — When Lankester & Lydekker say (l. c. pag. 170): "I cannot find evidence of the existence of [the] tibial sesamoid in either *Procyon* or *Ursus*", this must be founded upon a mistake or upon a defective skeleton, the sesamoid is present, at least in *Ursus*, and nearly as large as that of *Æluropus* (cfr. fig. 3).

If Gervais is right in his indication about the number of the vertebræ, *Æluropus* has the fewest number of dorsals of any Carnivore, the least otherwise known being *Mellivora indica* with 14 dorsal and 4 lumbar vertebræ (Flower: Osteology, pag. 81); but the highest number, 16 and 6, being also found among Mustelidæ *(Mephitis)* much stress cannot be laid on this number in systematical relation. The vertebræ of *Æluropus* seem to be mostly arctoid, those of *Ælurus* are procyonoid[2]).

Unfortunately the soft parts of *Æluropus* are unknown except the brain, but this organ shows, according to Gervais (1870, pag. 136—7 and 141), less resemblance to that of *Ælurus* than do the other parts of its body; it differs only in more unimportant characters from that of *Ursus*.

We may thus say that *Æluropus* is a true member of the Ursidæ, but developed in another direction than *Ursus*, no doubt from a form related to *Hyænarctus* and indicating on certain accounts a culminating-point of that branch of Ursidæ, whereas *Ælurus* is the culminating-point of the *Procyon-Nasua* series of Procyonidæ. The two forms are converging branches of the same general stem, Arctoidea, but with different points of origin on it. They can thus by no means form connecting links between Ursidæ and Procyonidæ; this link may (according to Winge) be sought in a primitive, *Cynodictis*-like form.

[1]) H. Winge: Jordfundne og nulevende Gnavere fra Lagoa Santa etc. (E Museo Lundii, Bd. I, København 1888, pag. 170 or 200).

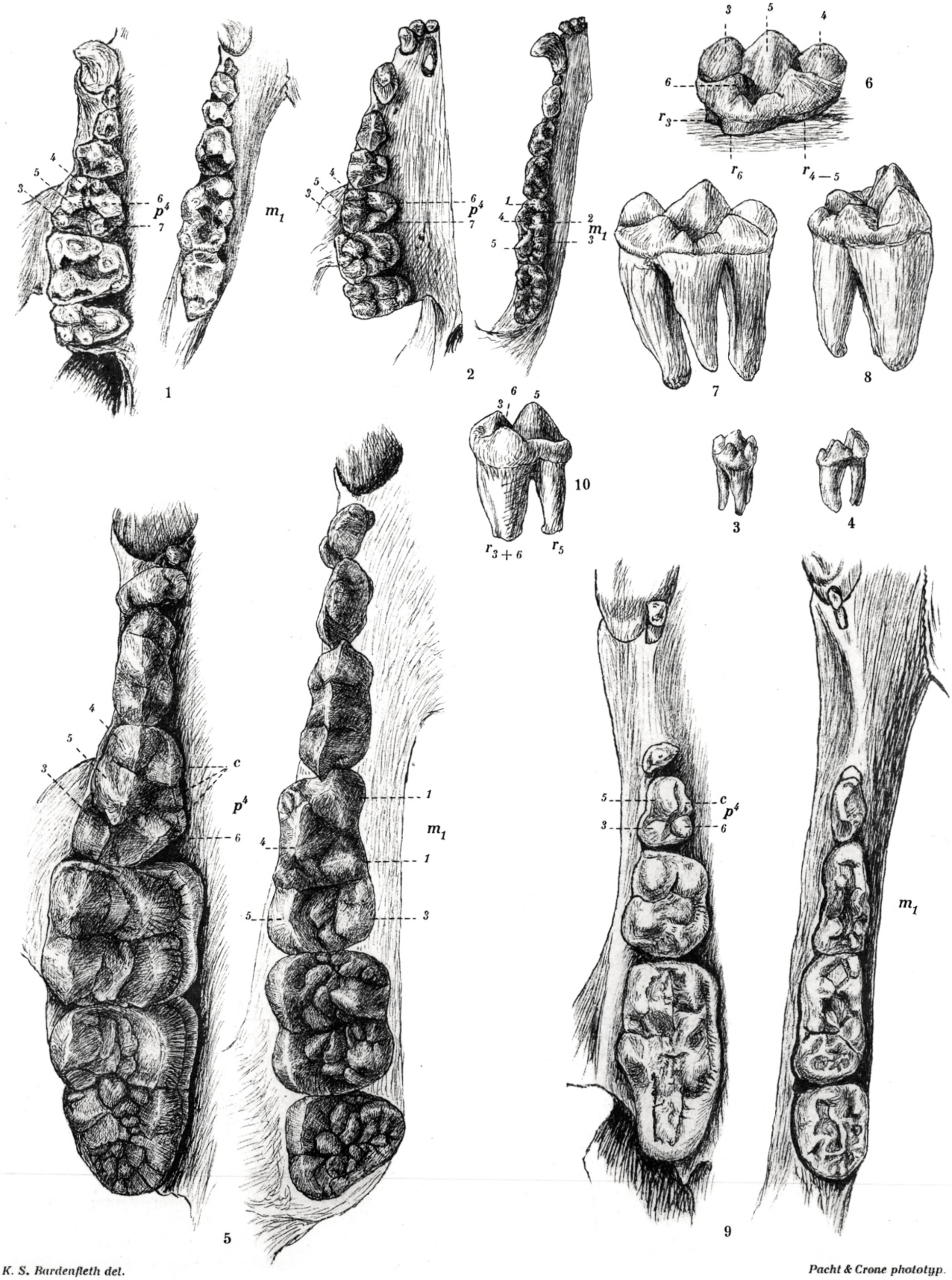
[2]) E. Stromer: Die Wirbel der Landraubtieren. (Zoologica, 1902, pag. 135).

## Explication of pl. I.

1. Teeth of *Procyon cancrivorus.*
2. ,, ,, *Ælurus fulgens.*
3—4. $p^4$ ,, ,, ,, isolated.
5. Teeth of *Æluropus melanoleucus.*
6—8. $p^4$ ,, ,, ,, isolated.
9. Teeth of *Ursus arctos.*
10. $p^4$ ,, ,, ,, isolated.

The numbers 1—7 of $p^4$ and $m_1$ are Winge's symbols; $r_3$ and $r_6$ the roots supporting the cusps 3 and 6, $r_{3+6}$ these roots coalesced, $r_{4-5}$ and $r_5$ the root supporting the front part of $p^4$, c = cingulum cusps.

Fig. 1 and 9—10 from specimens in the Copenhagen museum, fig. 2—8 from British museum. All natural size.




*K. S. Bardenfleth del.*

*Pacht & Crone phototyp.*