

*Hyæna* and probably many other phyla, the Middle Siwalik stage has a somewhat more primitive *representative* type in the Pikermi fauna, but a directly *ancestral* type (so far as appears) in the Chinji. This does not prove that India was the center of dispersal of these types, but that it was accessible to them both in Chinji and Dhok Pathan, more so, one would judge, than Western Europe, and less so than the present Ægæan region.

### III. PRELIMINARY REVIEW OF SIWALIK COLLECTIONS IN INDIAN MUSEUM, CALCUTTA

PROBOSCIDEA.—*Dinotherium*, skull. Palmer, 1924, Pal. Ind., N.S., VII, No. 4. Partial skull coll. Pilgrim, 1912, Lower Chinji.

All that is saved is the basicranial region and set of teeth. Basicranial agrees so far as stated with Eppelsheim skull. No condyloid foramen. An alisphenoid foramen. Postglenoid and posttympanic processes unite, enclosing a "false meatus" better developed than in *Elephas*, *D. indicum* and *D. pentapotamix*.

Type of *D. indicum* is part of a molar identified by Lydekker as hinder part of  $m^1$ . It is, according to Palmer, front part of  $m^2$ . Probably is from Lower Siwalik beds of Dera Ghazi Khan.

Type of *D. pentapotamix*,  $p^3$ , probably Lower Siwalik, near Attock. Agrees rather closely with corresponding tooth of Palmer's skull, which is intermediate in size between Lydekker's type and *D. giganteum*. Such differences as there are may be regarded as indicating one rather variable species. Specimens of  $p^4$ ,  $m^1$  and  $m^2$  from the Chinji beds also show much variability in the characters used by Lydekker to distinguish *pentapotamix* from *giganteum*.

Type of *D. naricum* Pilgrim from Gaj was subsequently referred by its author to *D. indicum* as only a variant. It was described as an "upper true molar, probably the last," but is  $m^2$ . Does not differ materially from *D. giganteum*.

CARNIVORA.—*Pterodon bugtiensis*. Gigantic jaw, front complete, 2 molars; front teeth are broken off but alveoli complete. Also a part lower jaw with  $m_2$ -3. Doubtful  $p_4$ .

If correctly restored, jaw is nearly two feet long. Probably exaggerated, as jaw of this genus is short and deep.

Also one upper molar in jaw fragments,  $m^2$ . *Pterodon* sp.

*Dissopsalis*. Pretty fair upper jaw,  $p^3$ - $m^2$ . Upper jaw  $p^2$ -4; upper jaw  $m^2$  and part  $m^1$ ; several separate teeth.

Nothing in this that shows different from our specimen, but the upper jaw should be figured for comparison.

*Amphicyon shahbazi*. Jaw fragment  $m_2$ ,  $m_1$ , with trigonid broken off, alveolus of  $m_3$ . Peculiar species. Figured Pal. Ind., IV, Mem. 2, Pl. III, Fig. 2.

*Amphicyon palæindicus*. Upper molar. Medium size, rather smaller than *giganteus*, compares with our Lower Sheep Creek species in size.

Rest of *Amphicyon* removed by Dr. Pilgrim.

*Canis cauleyi*. \*Maxilla,  $p^4$ - $m^2$ . Upper Siwaliks. Pretty fair *Canis*. Should be carefully refigured. Figured in Pal. Ind. (X) II, Pl. xxxii, Fig. 3.

No other *Canis* in this collection.

*Hyænarctos palæindicus*. \*Upper jaw. Middle Siwaliks.  $P^4$ - $m^2$ . The  $m^2$  is sub-square; needs figuring.  $M^1$  still somewhat trigonal.

*H. punjabiensis*. Upper jaw. Middle Siwaliks. Slightly elongate  $m^2$ , more squared  $m^1$ . Apparently belongs with mandible. The  $m^2$  is on a referred specimen, probably of *palæindicus*; the type  $m^2$  of *Indarctos* belongs to this species.

*H. punjabiensis*. Mandible. Appears to be correctly referred to the species.

*H. sivalensis*. Cast of cranium (original in B.M.), also of femur, radius and ulna.

*Indarctos salmonianus*. Middle Siwaliks, Hasnot. Much elongate  $m^2$ .

*Melursus theobaldi*. Skull. Upper Siwaliks. Teeth appear to be battered off, but skull is pretty good. Figured in Pal. Ind., (X) II, Pl. xxviii, Figs. 1, 2.

*Ursus namadicus*. Cast of upper jaw from Narbada.

*Mellivora*. Cast of cranium. Also casts of skulls of *Enhydriodon*, *Lutra* and *Viverra*. Originals in B.M.

*Herpestes*, etc., Karnul Caves. Some at least of this material is very recent. Other specimens appear to be older. With a supposed atelodine rhinoceros; but I am a bit skeptical of absence of tusks being normal.

*Palhyæna* cf. *hipparionum* and *indicus*. \* 3 lower jaws. Middle Siwaliks.

*Lycyæna macrostoma*. Skull. Middle Siwaliks. Figured Pal. Ind., (X) II, Pls. xxxvi and xxxvii. Lower jaw,  $p_4$ - $m_1$  and roots of remaining teeth also figured in following plate.

Rest of *Palhyæna* removed by Pilgrim.



Fig. 2. *Conohyus indicus*.  $P_{3-4}$  and  $m_3$ . Siwalik specimen in Indian Museum, Calcutta.

*Hyæna colvini*. \*Skull, also \*palate and \*left maxilla. All from Upper Siwaliks. Should be drawn. All figured.

\*Left mandibular ramus. Upper Siwaliks.

*Hyæna felina*. Left lower jaw. Uppermost Siwaliks. Jamu. Right lower jaw. Upper Siwaliks. All figured.

*Æluropsis annectens*. Lower jaw,  $p_4$ . Figured by Lydekker.

*Sivalurus chinjiensis*. Fine upper jaw, lower jaw doubtfully referred. Figured by Pilgrim.

*Sivalurus sivalensis*. Good lower jaw. Figured by Pilgrim.

*Paramachærodus* cf. *schlosseri*. Two lower jaws. Figured by Pilgrim.

These genera fall into the same groups as our "*Pseudæluurus*" and "*Heterofelis*."

*Machærodus*. Very clearly distinct by the reduced  $p_3$ .  $M_1$  practically heelless, a very minute rudiment only to represent the ?metaconid.

*M. sivalensis*. Lower jaw. Upper Siwaliks. Rurki Mus. Coll.

*Felis cristata* is a species about size of tiger. Casts of two skulls, the originals in B.M. One marked *F. palæotigris*, the other *F. cristata*. A third cast is of an imperfect skull, palate mostly gone.

*Felis rubiginosa*. Upper and lower jaws from Karnul caves. Look pretty modern. Size of small domestic cat.

SUIDÆ.—*Conohyus*. Upper and lower jaws figured of *chinjiensis* (small sp.), Chinji zone; of *indicus* (larger sp.), Nagri zone; *sindiensis*. Premolars are somewhat enlarged in fashion of *Tetraconodon*, but by no means extreme.

*Tetraconodon*. Exaggerated premolar enlargement. The molars when unworn are quite of suid type.

*T. minor* from Burma, Irawaddy series. Has  $p^4$  very little enlarged, smaller than molars, but of same general form, with protocone and deutocone of subequal size. Lower jaw fragment shows much enlarged premolars (but no molars). I do not see how these lower premolars can belong to the same species as the upper jaw.

*Sivachærus*. Large robust type, premolars not inflated, but molars relatively stout. Comes from Hasnot and from Siwaliks and Burma (Pakokku, ?Irawaddy series). Also Tatrot zone.

*Propotamochoærus* is more normal pig,  $p^4$  has strong triticocone,  $p^3$  is broadened at posterior end with three roots, small postero-internal heel. Lower premolars are all rather compressed.

*Lophochærus*, a diminutive animal with simple cusps, little or no extra cuspsules, slight tendency to transverse crestring, very small heel on  $m_3$ .

*Listriodon* has strong transverse crestring, large simple heel on  $m_3$ ;  $p_4$  has very distinct metaconid.  $P^4$  has distinct triticocone and posterior cingulum enlarged internad into a rudimentary hypocone;  $p^3$  a heavy postero-internal cusp.

*Dicoryphochoærus*.  $P^4$  and molars have strong tendency to polybunty, otherwise not so unlike *Propotamochoærus*.

*Dicoryphochoærus titan*. Fine big skull and jaws. The middle pair of incisors large, long, spatulate teeth. Lower canines are rather large, but not in proportion to size of skull; back of skull notably high.

Several other parts of skull with heavily worn teeth may belong to this or smaller Suidæ.

Some species of *Dicoryphochoærus* are large and massive. Lower jaw B539 has stout incisors, small canines; rather short diastema is between  $p_1$  and  $p_2$ ,  $p_3$  has anterior and posterior cusps,  $p_4$  also has a strong internal cusp. Molars suggest a preliminary stage to *Phacochoærus* in the numerous highish cusps, especially on  $m_3$ . This is *Sus titan* of Lydekker. Metacarpals associated here are separate, moderate length, massive, strong keels extending over upper surface. Fine skull and jaws in wall case.

*Sus falconeri* carries the above characters a little further, the crown of molars  $\frac{3}{8}$  being higher, also polybunous. This is Upper Siwalik. *Sus indicus* of smaller size, with narrower teeth, is from Pleistocene.

*Sanitherium* is very small, with narrow molars, rather simple and shorter crowned, only lower molars known. Lower Siwalik, etc.

*Sivahyus* is also very small; narrow molars, higher crowned and compressed cusps suggest ancestry of *Hippohyus*.

*Hippohyus* larger, size of domestic pig, polybunous, with high, laterally compressed cusps. Lower premolars quite trenchant; upper premolars have several pockets.

These come mostly from Tatrot zone, some from Dhok Pathan zone at Hasnot.

*Bugthitherium*. Possibly related to *Entelodon*, but not determinable in absence of crowns of any teeth and any trace of molars.

"TRAGULIDÆ."—"Tragulus" *sivalensis*. Upper molar from Hasnot, Middle Siwaliks. This has some resemblance to *Mennina*, none to *Tragulus*, but there is no

evidence that it is a tragulid. A lower  $p_4$  and  $m_3$  also placed here; they do not belong together, neither belongs to "*T.*" *sivalensis*, and the premolar is certainly not tragulid; the molar is peculiar, not like known tragulines. Also three jaw fragments with molars only, molars rather high-crowned, rugose enamel, simple heel.

*Dorcatherium majus* seems to be somewhat of an aggregate of several different animals. Premolars on one jaw from Middle Siwaliks,  $p_4$  has double posterior crest like ?*Leptotragulus*. Heel of  $m_3$  has large external crescent, enfolding a small basal cusp, the latter absent in some other specimens. Moderately high crowns. Middle and Lower Siwalik.

*Dorcabune* has much the same construction in bunodont, thick-enameled teeth, short-crowned, rugose enamel. Larger size than "*Dorcatherium*," comes from Lower Siwalik, some also from Middle Siwalik.

*Prodremotherium* and *Gelocus* from Gaj, only  $m_{2-3}$  known. Both I think are the same genus, but it is not *Prodremotherium* or *Gelocus*. Strong looped heel on  $m_3$ .

GIRAFFIDÆ.—*Propalæomeryx*.  $M_{2-3}$  from Gaj of "*P.*" *exigua*;  $m_3$  of *P. sivalensis* from Lower Siwaliks. The latter has a heavy basal external cusp between 2nd and 3rd lobes, transverse pitch of anterior inner crescent exaggerated, size larger and broader.

*Giraffa punjabiensis* from Middle Siwaliks,  $p^3$ - $m^2$ ,  $m^2$ - $m^3$ , etc. These are typical giraffid teeth, whatever their generic position.

*G. sivalensis* is much the same.

*Giraffokeryx* is smaller, with narrower molars, less specialized, but similar.

*Hydaspitherium*. Skull. Middle Siwaliks, Hasnot. This is one of the most perfect skulls of this group. Smaller and less massive than *Sivatherium* and lacks the anterior pair of horns. The posterior pair is postorbital but quite clear of the lateral angles of occipital crest. Elongated anteroposteriorly in a form much like *Bramatherium* skull cast, but the horns are broken off close to base so that their form and separation are not preserved.

The angles of occipital crest project but do not form a rounded horn as in *Bramatherium*; however, the occiput is quite wide. This specimen has not been restored at all, but it is not completely cleaned around arches. It is by no means so high and short as *Sivatherium*, much nearer the giraffine proportions. Palate nearly in line with condyles.

*Hydaspitherium megacephalum*. Lower jaw,  $p_2$ - $m_3$ , Jabi, Punjab.  $P_4$  has complete, full-sized inner and outer crescent in anterior half; the posterior half reduced and obliquely set but completely formed pair of crescents.  $P_3$  has three major and two smaller cross crests, inner crests on  $p_2$  also well formed. Molars have strong overlap of anterior on posterior inner crescent; also on  $m_3$  the posterior inner crescent has a crest on outer side that goes forward to meet the posterior margin of anterior exterior crescent. Heel consists of main cusp large and much curled around, and a couple of subsidiary inner cusps in front of it.

*H. magnum*. Upper jaw,  $P^3$ - $m^3$ . Middle Siwaliks. Complete inner and outer crescents on  $p^3$  and  $p^4$ ; inner crescent has an accessory crest in its posterior half directed postero-externad.

Various upper and lower teeth identified as *Hydaspitherium*.

Cervical vertebræ quite short, bovid proportions.

Metapodials and foot bones about proportions of *Samotherium*, but larger.

*Sivatherium*. Larger size than *Hydaspitherium*. Appears to be characteristic of Upper Siwaliks as *Hydaspitherium* is of Middle.  $P_4$  has relatively smaller and less

perfect posterior crescents, the tooth as a whole wider. Cervicals short, with bovid proportions, but gigantic; ball of centrum about  $2\frac{1}{2} \times 3$  inches, arches 8 inches wide. Limb bones size of *Mastodon productus* or larger.

EQUIDÆ.—*Hipparion punjabiense*. Fine palate  $p^2$ - $m^3$  r. and l. This is a little larger than *H. occidentale*, the protocone is more or less lenticular except on  $p_2$  in which it is oval; highly complex enamel foldings.

*H. theobaldi*. Fine palate,  $dp^2$ - $m^2$  and  $p^1$  r.

*H. theobaldi*. Upper jaw,  $p^4$ - $m^3$  l., upper jaw,  $dp^{2-4}$ .

I cannot see any serious differences between these species not accounted for by difference in age and wear of teeth. Specimens referred to *theobaldi* show the stout metapodials and large lateral digits same as Brown's. Skull has rather deep lacrymal pit, well forward of orbit (2 inches). Practically all material is Middle Siwalik.

*Equus sivalensis*. Much elongate protocone in one maxilla, but a skull shows relatively short protocones.

Other maxillæ with more or less intermediate characters.

RHINOCEROSSES.—*R. unicornis, deccanensis, carnuliensis*. Pleistocene and recent. These are represented by fragmentary material and do not appear to be separable from the ordinary Indian rhinoceros. A jaw of *R. carnuliensis* has a little of the symphysis preserved, which draws in anteriorly as though incisor were small or absent; but not enough is preserved to be sure on this point. But premolars are little reduced, alveolus of  $p_2$  shows two large roots,  $p_3$  is large and  $p_4$  almost size of  $m_1$ . This is an old animal.

*R. palæindicus* certainly has large lower tusks; casts also show small median pair of incisors. Broad, heavy, flat symphysis, ?procumbent tusks. Isolated median incisor from Lehri Punjab.

*R. sivalensis*. Lower jaws, one showing alveoli of tusks, closer together than *palæindicus* and no incisor apparently. Also  $p_2$  is large and two-rooted, with imperfect anterior but complete posterior molariform loph. Upper molars with fairly strong straight crochet, no trace of crista or antecrochet, prominent external pillar. This holds of a number of separate teeth. Referred milk molars have long crochet, strong antecrochet, only a trace of crista.

"*Teleoceras*" *blanfordi* from Gaj. Weak crochet, strong antecrochet,  $p^3$  with moderate crochet, double crista, no antecrochet;  $p_4$  with weaker crochet and crista. Also from Middle Siwaliks.

*T. fatehjangensis* does not appear particularly different, allowing for age and individual difference. The type is a palate with  $p^4$ - $m^2$  well worn, badly preserved and not cleaned.

"*Diceratherium*" *shahbazi* from Gaj. Smaller and more brachydont than the preceding species, with weak crochet and antecrochet, strong external pillar, somewhat quadrate  $m^3$ ,  $p^{2-4}$  molariform, unreduced.

These have nothing to do with *Diceratherium* or *Teleoceras* of America. A lower jaw of "*T.*" *blanfordi* from Gaj has  $p_{3-4}$ ,  $m_1$  complete,  $m_2$  broken off,  $m_3$  not yet erupted. Alveoli for good-sized tusks (but possibly these are milk molars 2-4).

*Aceratherium perimense*. Gigantic species with rather short-crowned teeth, lower molars narrow and compressed, almost metamynodont. Very large lower tusks, not procumbent;  $p_2$  small, triangular,  $p_3$  large, but reduced anteriorly;  $p_4$  molariform, nearly as large as  $m_1$ . Upper tusk also very large. Weak to strong crochet and weak antecrochet on molars, strong external pillar, moderately high-crowned upper molars,

flat-surfaced behind the pillar. Heavy cingulum around inner and anterior face of protocone in some upper molars. Mostly from Lower Siwaliks.

*Aceratherium lydekkeri*. Maxilla from Middle Siwaliks,  $p^1$ - $m^2$ . Does not seem very different from *A. perimense*; crochet perhaps stronger and a crista present on  $m^2$ .  $P^{2-4}$  have the cross crests complete and well developed;  $p^1$  is non-molariform. Minor crests almost absent on  $P^{2-4}$ , only rudiment of crista on  $p^3$  and of crochet on  $p^4$ ; cingulum around protocone prominent.

"*Aceratherium*" *bugtiense* from Gaj. This is *Paraceratherium* and quite distinct in the imperfectly molarized premolars; larger size molars lack the minor crests, shorter crowns, lower molars not compressed laterally ("metamynodont"), conical lower incisor.

"*Aceratherium blanfordi* var. *minus*." Lower Siwaliks. This seems to be the same as "*Diceratherium*" *shahbazi*. Good series of upper teeth. It is from Gandvi in Bugti hills.

*Cadurcotherium indicum*. Size of *Metamynodon* and closely resembles it. Upper jaw  $p^4$ - $m^3$ , lower jaw  $m_1$ - $3$ . Lateral compression of molars strongly accentuated on  $m_3^3$ ;  $p^4$  relatively small, with something of a median pocket.

*Dicerorhinus deccanensis*. Lower jaw apparently complete, has no tusks. Premolars unreduced. Molars are rather brachydont.

"*Dicerorhinus*" *platyrhinus*. Cast of skull, Upper Siwaliks. The teeth are rather closely related to *Celodonta* and *Ceratotherium*, not to *Dicerorhinus*. Large anterior and small posterior horn core, no supporting septum in nasals.

*Rhinoceros sivalensis*. Middle Siwaliks. Top of skull only, no teeth. Anterior horn core rather small, not terminal. No trace of second horn core. Occiput elevated, the top of cranium strongly concave.

*Aceratherium lydekkeri*. Skull. Flat top, rather broad frontal region, nasals withdrawn, reduced, and rounded in cross-section. Size gigantic, corresponding to teeth noted on another page. The occiput does not appear to rise in the usual rhinoceros way, but to carry on backward in line with top of flat frontal region.

*Metamynodon birmanicus* and *M. cotteri*. Upper Eocene, Burma. Quite small, about the size of *Amyrnodon* and molars scarcely any more compressed. Inner crescents of upper molars undivided. This is in all respects much nearer to *Amyrnodon* than to *Metamynodon*. Incisors, however, are reduced to  $\frac{1}{2}$  of fairly large size. Canines large, vertical, the lower recurving and worn to a flat surface against anterior face of upper canines. Quite a long diastema and long muzzle pinched in between canines and premolars. Might stand as a separate genus near to *Amyrnodon*.

*Sivatitanops* and *Eotitanotherium*. These are too fragmentary for generic determination. The best specimens are two or three complete teeth, three premolars and one true molar (upper). They are titanotheres, however, safely enough.

*Indolophus guptai* and *Chasmotherium birmanicum*. Probably closely related to *Teleolophus*, or perhaps partly intermediate between *Indolophus* and *Deperetella*.

*Chalicotherium*. The only Siwalik material referred is two or three lower teeth. Quite a small animal, the size of *C. sivalense*.

*Phyllotillon* is larger, about the size of *Moropus*; fair upper jaws, parts of lower jaws and individual teeth preserved. Molars have continuous anterior and posterior crests, the former curving sharply around at inner end and rising to a prominent protocone behind it.

PRIMATES.—\**Palaeopithecus sivalensis*. Palate,  $p^4$ - $m^3$  r., well preserved. Middle Siwaliks.

\**Sivapithecus indicus*. Lower jaw,  $p_4-m_2$  preserved. Comes close to *Dryopithecus cautleyi* jaw, allowing for its being more worn. Lower Siwaliks.

*Dryopithecus punjabicus*.  $M_2$  and  $m_3$  on jaw fragments, distinctly smaller and less inflated cusps. Upper jaw  $p^3-m^2$  r. from Middle Siwaliks also seems a bit too small. Lower Siwaliks.

*Sivapithecus indicus*. Jaw symphysis, left half, from Middle Siwaliks. I should doubt this going with the jaw from Lower Siwaliks. Too big and heavy. Might go with *Palæopithecus sivalensis* palate from Middle Siwaliks.

*Cercopithecus hasnoti* and *Macacus sivalensis*. Upper teeth and jaw fragments. Middle Siwaliks. These are macaques, but need careful identification.

ANTHRACOTHERES.—*Merycopotamus*. Two fronts of skulls, several upper jaw fragments, parts of lower jaws, foot bones, etc. This is *Ancodus* with the mesostyle loop farther widened out, the fifth cusp lost and crowns of teeth somewhat lowered, and enlarged flaring canine tusks. Specimens from Upper Siwaliks are larger, canines heavier, but are referred to same species as "males."

*Hemimeryx* (*Chæromeryx* incl.). Differs from *Merycopotamus* in somewhat smaller size, less separation of mesostyle loop, inner crescents less concave and anterior one (protocone) incomplete posteriorly.

*Chæromeryx*. Represented only by a poor milk tooth, cast of two others. Look like milk teeth of one of the other genera.

*Telmatodon*. Bugti (Gaj). Large, brachydont, no distinct trace of 5th cusp on molars, but appears to be an anthracothere. The mesostyle loop is narrow and angulate, even more than in *Hemimeryx*; the posterior flange of protocone similarly incomplete, splitting into two divergent branches; the hypocone posteriorly has an outer flange replacing the posterior wing. Premolars are the normal anthracothere type, jaw elongate, with canine and large incisors making a rather flaring front.

*Gonotelma*. Has same construction, but a distinct trace of fifth cusp on anterior wing of protocone. Smaller size. Also from Gaj.

*Hyboöps*. Mostly Lower Siwaliks. Has more distinct 5th cusp and posterior wings of inner crescents complete.

*Merycops*. Gaj beds. Has stronger 5th cusp, and tooth is of less transverse width, posterior wing of hypocone normal, that of protocone divided, somewhat as in *Gonotelma* and *Telmatodon*.

*Brachyodus* "*africanus*" from Gaj. The fifth cusp is well distinguished; crown short, mesostyle loop fairly wide, outer cusps are conic, with crests coming up their sides from the styles, the inner cusps also robust, *hy* (*ml*) with something of the completed crescent, but only anterior wing on 5th cusp, and protocone with hardly any crescentic form.

*B. hypotamoides*. Larger, with somewhat lower crown and more robust cusps, the molars increasing a good deal from first to third,  $p^4$  hardly any larger than *B. africanus*.

*B. giganteus*. Very similar in teeth. Wider heel on  $m_3$ . Larger size of skull.

"*Anthracotherium*" *siliistrense*. Upper molars have very slight parastyle, almost vestigial mesostyle, no metastyle, five cusps, the paraconule strong, crescentic, protocone imperfectly so. Metaconule crescentic, but with extra crest anterior and slightly inward. Moderately low crown. Lower molars show a corresponding degree of crescentic and crested structure. Pilgrim refers this to *Microbunodon*, but it is remarkably selenodont for an anthracotheriine, as much so as *Brachyodus*, etc. These are Lower Siwalik. A smaller species, *A. mus*, in Gaj, doubtfully related.

*Anthracotherium bugtiense*. A gigantic (true?) anthracothere with mesostyle well developed, crested, not split,  $pa^1$  strong and well separated, strong para- and meta-styles, heavy cingula on upper molars, the cusps not much crescentic, robust and rounded, especially when worn. Premolars simple, almost entelodontoid when worn. Gaj horizon.

*Anthracotherium crassum* and *pangan* from Eocene are even shorter-crowned, but with weak or vestigial styles, cusps more bunodont.

*Anthracohyus rubricæ* is very like the above; *A. chæroides* is distinctly more conic bunodont in form of cusps and the styles are wholly absent. Also from Eocene.

*Anthracokeryx* has more angulate cusps, but small and low, the styles weak, the paraconule less clearly separate, tending to form a transverse crest with the protocone. Eocene, Burma.

BOVIDÆ.—*Tragocerus perimensis*. Horns and adjacent part of skull. Lower Siwaliks.

*T. punjabicus*. Back of skull, l. horn, no palate or muzzle.

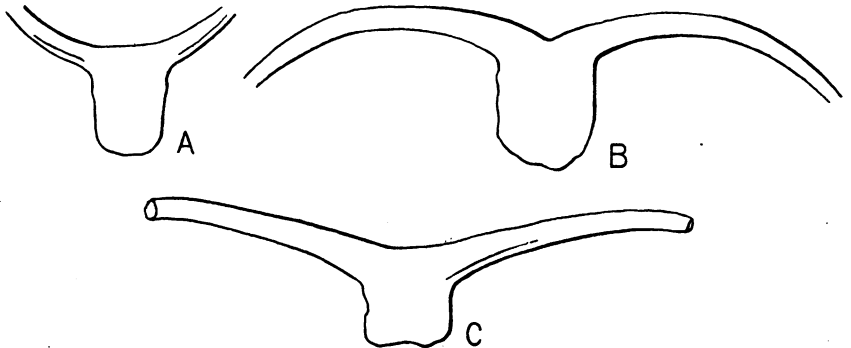


Fig. 3. Horn-cores of bovids. A—*Bubalis platycerus*; B—*Bos acutifrons*; C—*Bos planifrons*. Siwalik specimens in Indian Museum, Calcutta.

*T. punjabicus*. Upper jaw. Middle Siwaliks. Upper teeth short-crowned, moderately rugose enamel, simple structure, anterior exterior rib stronger, posterior exterior rib rather weak.  $P^2$  and  $p^3$  almost oreodontoid, but only  $p^4$  with crescents complete. Horns are much like the Samos species, so far as I can judge, but perhaps heavier, straighter, shorter.

*Bubalis palæindicus*. Upper Siwaliks. Two skulls. Horns round, straight, little divergent. Teeth narrow, hypsodont, enamel smooth,  $p^{3-4}$  with complete inner crescents,  $p^2$  smaller, ?? similar structure. Skull moderately arched, muzzle rather long, occiput shorter than *Tragocerus*.

*Cobus patulicornis*. Upper Siwaliks. Only proximal ends of horns preserved with fragment of skull. Seems rather inadequate for identification.

*Gazella porrecticornis*. Middle Siwaliks. Fragmentary horn-cores, lower jaws. Premolars not molariform, enamel smooth, moderately high crowns.  $P_2$  is somewhat reduced, has median and posterior inner crests.



*Hippotragus sivalensis*. Upper Siwaliks. Skull, with bases of horns. Horn-bases round-oval in cross-section, muzzle short and concave, with broad antorbital fossæ. Skull strongly arched, back longer than *Bubalis*, more as in *Tragocerus*. Very little of the teeth preserved in this specimen; another skull ? taken by Pilgrim.

*Boselaphus lydekkeri*. Jaws and teeth. Middle Siwaliks. Nearly size of small cattle. Hypsodont teeth, smooth enamel, no cement, basal pillars between inner crescents of upper molars and between outer crescents of lower molars, but not so heavy as in Bovinæ. External ribs moderately convex, styles prominent, narrow. Heel of  $m_3$  simple.

*B. palæindicus*. Lower jaw. Niki, Punjab.  $P_4$  has median and two posterior internal crests, the anterior blade straight, simple, somewhat reduced.

*B. namadicus*. Back of skull, Pleistocene. Horn bases are wide apart and seem to point laterally. Other specimens (jaws, etc.) missing.

*Taurotragus*. Upper jaw,  $p^3-m^2$ ; upper teeth. Middle Siwaliks. Very like *Boselaphus lydekkeri*; I cannot see the difference. Skull borrowed out (by ? Pilgrim).

*Strepsiceros falconeri*. Punjab. Upper molars. Much like *Taurotragus* and *Boselaphus*, but ? shorter crown and ? weaker inner pillar.

*Bubalis platycerus*, with flat-topped horns concave backward. (Fig. 3A).

*Bos acutifrons*, with round horns concave forward. (Fig. 3B).

*B. acutifrons*. Skull. Slight median sagittal crest between the horns, part preserved has spread of about 8 feet.

*B. planifrons*. Skull has horns straighter in basal portion. Very little upward curve in either this or the preceding. (Fig. 3C).

*Bos namadicus*. Pleistocene. Differs from the two preceding in a strong upward curve in horns, especially toward tip. Cf. *Urus*.

Two or more other fine gaur skulls near to *Bubalis platycerus*.

CHELONIA.—*Emyda*. Various fragments showing strongly pustulate sculpture, prominent pustules all over carapace, especially on nuchal, marginal and costal plates, more or less flattened out on plastron.

*Trionyx*. Incomplete carapace and various fragments showing the usual pitted sculpture. Some very massive and large, indicate a giant species ? 3 feet long.

*Colossochelys*. Episternal and one or two other fragments. "Gen. non det." Another giant tortoise indicated by fragments of episternal lacking the great wing processes of *Colossochelys*.

*Caulleya*. Part of marginal plate only.

*Testudo*. A few poor fragments, episternals and hyposternals. Neither this nor the preceding seems very well demonstrated.

*Clemmys*. A half dozen good shells, four alleged species 4"×6". None of them have the three crests of *C. palæindica*, which are prominent in the casts of both young and adult shells of that species.

*Pangshura*, with one strong median crest, two good carapaces.

*Batagur*. Fine cranium, part of a much smaller carapace, separate plates, large animals.

Other fine specimens in wall case not yet examined.

IV. CRITICAL NOTES ON SIWALIK CARNIVORA IN THE BRITISH MUSEUM

**MUSTELIDÆ**

**MELLIVORA and MELLIVORODON**

*Mellivora* is represented by two fine skulls from the Upper Siwaliks, one in the British Museum collections, No. 40184, the other in the Science and Art Museum in Dublin; the latter has a lower jaw associated, supposed to be same individual.

Originally figured and described as *Gulo* (then including *Mellivora*) by Baker and Durand, 1836, Jour. Asiat. Soc. Beng., V, p. 581, Figs. 4-8, but not named, though regarded as a species allied to, but distinct from, the Indian ratel, *Mellivora indica*.

No. 40184 is figured in Faun. Ant. Siv., unpublished plate q (Brit. Mus., Nat. Hist.), plate description under name of *Ursitaxus sivalensis* in the Desc. Plates Faun. Ant. Siv., p. 553 of Volume I of Falconer's Memoirs, 1868.

Refigured by Lydekker, Pal. Ind., (X) II, Pl. xxvi (B.M. No. 40184) and p. 182, Fig. 1 (part of Dublin skull) under name of *Mellivora sivalensis*.

Lydekker states that  $p^2$  and  $p^3$  are slightly larger, and the inner half of  $m^1$  less expanded in *sivalensis* than in *indica*; correspondingly  $p_3$  is larger, while  $m_1$  is smaller.

There seems to be no doubt that these belong properly to the existing genus and are rather close to the existing species; the difference about what one would expect with a Lower Pleistocene form.

*Mellivora sivalensis* resembles Zdansky's *Eomellivora* in the character of  $p^4$  and  $m^1$ ; but not in the skull characters, according to Zdansky's account of them (his figure does not indicate the excessive shortness of skull specified in his description). *Eomellivora* also retains  $p_1^1$ , lost in *M. sivalensis* as in the modern *Mellivora*.

I do not see any adequate basis for Zdansky's attempt to set apart *Mellivora*, *Mellivorodon* and *Eomellivora* as a separate group descended from *Palæogale* and *Bunælorus* independently of the rest of the Mustelidæ. As to *Mellivorodon*, it is quite as likely to be a cat as a mustelid. *Mellivora*, *Eomellivora* and *Gulo* would form a possible group, along with *Ælurocyon* and *Megalictis*; but the gap between them and *Bunælorus* is still pretty wide, and *Oligobunis* would come into nearer association. *Bunælorus* may, so far as the evidence goes, be a common ancestral type for this group, the putoriines and some others; but also it may be a side twig from a common mustelid ancestor of the Middle Oligocene.

**Mellivora sivalensis**

(Fig. 4). The type differs much more from *M. indica* and *capensis* than these do from each other. Teeth are very distinctly more primitive.  $M^1$  much less expanded internally, the inner half about  $\frac{1}{2}$  width of outer half, whereas in both modern species it is about twice as wide (a.-p.). The transverse width of  $m^1$  about the same.  $P^4$  is much more carnassiform, the blades longer and more compressed, antero-external angle of tooth more angulate, not rounded off as in the modern species, the protocone (deuterocone) much smaller and narrower, projecting equally far inward, but more anteriorly set. The premolars, especially  $p^3$ , are more compressed. The front teeth

do not show any marked differences. The palate does not extend so far backward behind the molars (6 mm. as against 12.5–16 mm.).

Skull is heavy posteriorly, carries a considerable raised sagittal area bounded by postorbital crests near together towards anterior part, widening out posteriorly to enclose a triangular plateau. Posttympanic process prominent, (lateral to bulla), lambdoid and occipital crests strong. These cranial characters are probably all male characters; the two modern skulls especially compared being female, and an incomplete male resembling the fossil skull.

The tooth characters, however, are important.

*Mellivora punjabiensis* is known only from a fragment of lower jaw showing  $p_3-4$  much worn, and somewhat battered roots of front teeth and carnassial. It may be, and very likely is, a distinct species from *sivalensis*, but the type does not prove it; the differences in the premolars may be

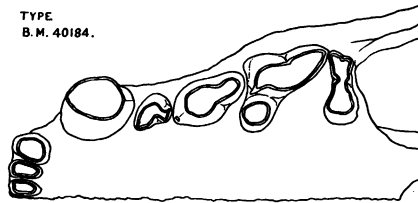


Fig. 4. *Mellivora sivalensis*. Upper teeth, crown view, natural size. From the type skull in the British Museum. Upper Siwaliks.

largely due to wear, as compared with the little-worn teeth of *sivalensis*; the difference in line of tooth row is partly because the drawings are not taken in exactly the same vertical plane, and is not of much importance; the size of canine is a highly variable individual character, as is the overlap of  $p_4$  on  $m_1$ .

#### MELLIVORODON

Based upon two jaw fragments of very doubtful status. The type looks more like a cat than a mustelid. Whether the second specimen referred to it by Lydekker (it is not a paratype) belongs to the same species, genus or family appears to me to be wholly indeterminable. But Lydekker's type figure agrees with the cats and differs from the larger mustelids in the following particulars:

1. Only two premolars, large, subequal, somewhat spaced.
2. Premolars compressed and elongate.
3. Molar carnassial narrow and long, as for the compressed shearing flanges of a cat, unlike the massive carnassials of *Gulo*, *Mellivora* or other larger mustelids.

4. Straightness of the lower border and slight angulation at the symphysis.
5. Arrangement of mental foramina. Cf. Pilgrim, 1915, Rec. Geol. Soc. Ind., Pl. v, Fig. 2.

The only point carrying doubt as to felid relationship is the apparent lack of posterior accessory cusp and heels on  $p_4$ , and this may be due to wear or battering. They are not always strongly developed in Felidæ, though their absence is a good distinction of Mustelidæ if demonstrated.

If the second specimen really belongs, it would prove that the genus belongs to the *Ælurictis* group of Felidæ.

This type of *Mellivorodon* shows some points of resemblance to a specimen figured by Pilgrim in 1915<sup>1</sup> under the name *Paramachærodus* cf. *schlosseri*, although the diastema behind the canine is much less

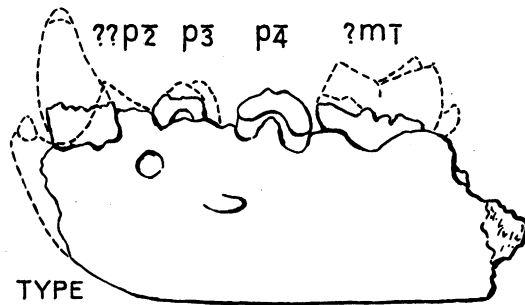


Fig. 5. *Mellivorodon palæindicus*. Sketch of type lower jaw, natural size, external view. Ind. Mus. No. D21. Middle Siwalik beds.

(perhaps in part due to the battering that has destroyed the alveolar border of the canine). If there really was a  $p_2$  as Lydekker states, the felid resemblance would still be of possible significance, as this tooth does sometimes occur in late Tertiary Felidæ.

Although resembling both Felidæ and Mustelidæ, it is not impossible that this jaw might represent an aberrant (short-jawed) canid or viverrid (cf. *Cynodon* group). As there is no evidence that the second jaw fragment attributed to *Mellivorodon* belongs to it or is in any way related to or resembling it, save for the quite uncharacteristic features of being about the same size and having about the same width of *blade* in the carnassial (a character repeated in numerous genera of several

<sup>1</sup>Rec. Geol. Sur. Ind., XLV, Pl. v, Fig. 2.

I find it difficult to understand from Pilgrim's figures how the specimens of "*Paramachærodus* cf. *schlosseri*" can belong to the same species. The upper one appears to me a fairly typical machærodont, the lower a true felid. As to Pilgrim's remarks on my failure to indicate the detailed phyletic evolution of each of the two groups of the Felidæ, I did not do so because I do not think it practicable.

families), it seems to be quite indeterminate. No additional and more characteristic specimens having been referred to the species or genus, it appears that both should be suppressed.

### *Lutra palæindica*

Two described species from the Siwaliks, *L. palæindica* Falconer and Cautley, based on a skull and part of mandible in the British Museum; and *L. bathygnathus* Lydekker.

It appears doubtful, in view of the difference in size, in robustness of the carnassial and character of its heel, whether *L. bathygnathus* belongs to the same genus as *palæindica*, which is pretty closely allied to the modern otters. *Palæindica* is from the Upper Siwaliks (Pleistocene), *bathygnathus* from the Middle Siwaliks of the Punjab.

Compared with *L. vulgaris* the skull of *palæindica* is smaller, decidedly narrower throughout, with much weaker crests, the occipital crest very slight, the lambdoid



Fig. 6

Fig. 6. *Lutra palæindica*. Upper teeth, crown view, natural size. Type specimen, Upper Siwalik.



Fig. 7

Fig. 7. *Lutra palæindica*. Lower teeth of the type specimen, crown view, natural size.

crest almost obsolete, and no sagittal crest distinguishable. Muzzle narrower, and infraorbital foramen appears to have been much less enlarged. It is nearer throughout to *L. sumatrensis*.

Condyles relatively small. Basicranium broad, but bullæ not so much flattened, standing out somewhat more prominently on the base of the cranium. Palate is not so wide as in *vulgaris*, its backward extension about the same.

TEETH.— $M^1$  has much the proportions of *vulgaris*, but metacone is less prominent postero-externally, giving a more oblique set to the outer part of the tooth.  $P^4$  is decidedly longer, the protocone (deuterocone) set more anteriorly and smaller and more compressed; the angle between exterior lines of  $p^4$  and  $m^1$  is much greater in *palæindica* than in *vulgaris*. The antero-external angle of  $p^4$  is somewhat more prominent, and the cusp (parastyle) more distinct. The alveoli of the anterior premolars appear to agree with those of *vulgaris*, somewhat smaller as would be expected. Canine and incisors appear from their alveoli to have been of about the same size as in *vulgaris*, but the canines considerably less wide apart, the diastema separating  $i^3$  and  $c^1$  much smaller, and the  $c^1$  less external to  $i^3$ , more behind it.

Fig. 7. In the lower jaw the carnassial is distinguished from that of *vulgaris* by considerably larger trigonid, the talonid being of nearly the same size and construction. Alveoli of other teeth do not show any marked differences. Jaw is somewhat smaller, much shallower and weaker. Pohle<sup>1</sup> puts the species into the *sumatrana* group.

**"Lutra" bathygnathus** Lydekker

**TYPE.**—(Fig. 8.) A lower jaw fragment, Ind. Mus. D33, with damaged  $p_4$ ,  $m_1$  and alveoli of front teeth.  $M_2$  was probably present but concealed by matrix, teste Lydekker.

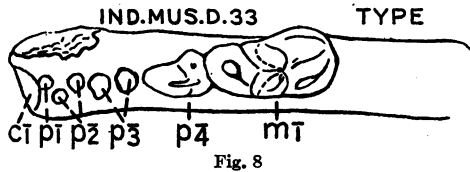


Fig. 8

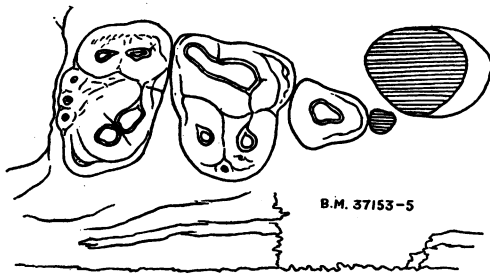


Fig. 9

Fig. 8. "*Lutra*" *bathygnathus*. Sketch figure of type lower jaw, natural size. Middle Siwalik beds. Probably not *Lutra*, but its real affinities uncertain. Compare *Brachypsalis*.

Fig. 9. *Enhydriodon sivalensis*. Upper teeth, crown view, natural size. Composite drawing from three co-type skulls, B. M. Nos. 371 53-5. Upper Siwalik.

ker. The describer refers to this species a second jaw fragment, showing alveolus of  $m^2$  but nothing of the teeth in advance of it. This reference appears to me too doubtful to have any weight in determining the character of  $m_2$  in the type. Pohle (*loc. cit.*, p. 26) refers the species to *Potamotherium*, on the formal basis of its retaining all the premolars. It might compare better with *Brachypsalis*; but until the character of  $m_2$  is known it is too uncertain for generic reference. The crown of  $p_4$  in the type is broken off, the protoconid of  $m_1$  chipped and the metaconid broken. In view of the imperfection of the type and doubtful status of the species, such statements as that it is especially related to the Cape otters are quite unwarranted by evidence. It is "such stuff as (palæogeographic) dreams are made of."

<sup>1</sup>Pohle, 1919, *Archiv. f. Naturgesch. (A)*, Vol. IX, pp. 1-246.

### ENHYDRIODON

*Amyxodon* FALCONER AND CAUTLEY, 1836, Jour. Asiat. Soc. Bengal, IV, p. 707 (*nom. nud.*); ROYLE, 1839, Illustr. Bot. Himal., I, p. 31 (*nom. nud.*).

*Enhydriondon* FALCONER, 1868, Palæont. Mem., I, p. 331, Pl. xxvii, Figs. 1-5; and of later authors generally.

= *Lutra* LYDEKKER, 1884, Pal. Ind., (X) II, p. 195.

TYPE.—(Fig. 9.) *E. sivalensis* Falconer, 1868, *loc. cit.*, based upon a skull and two anterior parts of skulls, Nos. 37153-55, British Museum Collection, of which No. 37153, complete skull, is selected as type.

Although reduced by Lydekker to the rank of a sub-genus at most, *Enhydriondon* has generally been accepted as a distinct and well marked genus. It differs from all the otters and skunks, and resembles the badger group, in the well developed tetartocone (hypocone) on  $p^4$ ; and the skull and teeth present no apparent characters to associate it with otters rather than badgers. Pohle, in his review of the Lutrinæ<sup>1</sup>, recognized the peculiar characters of the premolar, and accepts the genus as valid, but does not doubt its pertinence to the otters.



Fig. 10. *Enhydriondon campani*. Upper teeth, crown view, natural size. From cast of the type specimen in the British Museum. Original from Monte Bamboli, Italy.

### *Enhydriondon sivalensis* Falconer, 1868

*Enhydriondon sivalensis* FALCONER, 1868, Palæont. Mem., I, Pl. xxvii, Figs. 1-5. *E. ferox*, *ibid.*, p. 552 (Faun. Ant. Sival. plate descriptions).

*Enhydriondon ferox* FALCONER AND CAUTLEY, Faun. Ant. Sival., unpublished plates, Pl. P, Figs. 4-6. In British Museum, Natural History.

This is a very large animal, one of the largest known Mustelidæ. The construction of  $m^1$  is lutrine, but in  $p^4$  the protocone has a quite different position and form, and the large hypocone has no analogy in the Lutrinæ; it occurs only in Melinæ among Mustelidæ.

*Enhydriondon campani* of Monte Bamboli is notably different, though apparently related, and much more primitive. While in *sivalensis*  $p^4$  has attained a full quadrate form (cf. *Procyon* among Procyonidæ), in *E. campani* it retains much of the primitive construction, the protocone (deuterocone) anterior, the hypocone (tetartocone) added on as a heavy ridge, still partly crested, though nothing like so much as in Lydekker's drawing; and the tooth has an irregularly trapezoidal form. In  $m^1$  the protocone shows no trace of the twinning apparent in *sivalensis*. And  $p^2$  is a functional tooth instead of a vestigial remnant, the jaw much longer. The relations of these two are

<sup>1</sup>Pohle, 1919, *loc. cit.*

about what one would expect from an early Pliocene and an early Pleistocene type. *E. bamboli* should, however, be made a distinct genus on the above differences in teeth. Neither probably has anything to do with the otters; they are separately descended from some primitive type allied perhaps to *Megalictis* and other Lower Miocene genera, —not to *Potamotherium*, which is the ancestral type for otters.

*Lutra aönychooides* Zdansky of the Chinese Pliocene is in some respects the type from which *Enhydriodon campani* might be derived. The  $p^4$  appears to show a semi-separate cingulo-cusp that might develop into the postero-internal cusp of *E. campani*; and while  $m^1$  is rather wide anteroposteriorly on the inner side, its form somewhat approaches that of *E. campani*. Zdansky's remark that *L. sivalensis* and *L. campani* are "in der Richtung gegen *Enhydra* zu spezialisiert, kommt daher hier nicht weiter in Betracht"—seems to me misleading; it does not appear that the specialization of *Enhydriodon* is in the direction of *Enhydra*, nor was it so considered by Falconer.

### Enhydriodon sp.

Fig. 11. Falconer in his notes intimates that he recognized a second and smaller species of the genus, apparently upon the evidence of an upper carnassial which should have been in the British Museum collection but could not be found when Lydekker catalogued it. The tooth here figured is probably the missing carnassial, and as may be seen differs enough from the typical *Enhydriodon* to suggest a second species smaller and more primitive. If this tooth, now bearing the museum number M4847, is from the Middle Siwalik bed, it is very likely the species reported by Pilgrim from that horizon.



Fig. 11. *Enhydriodon* sp. Upper carnassial  $p^4$ , left side; crown view, natural size. Siwalik beds.

### URSIDÆ

#### URSUS

#### *Ursus theobaldi* Lydekker

*Ursus theobaldi* LYDEKKER, 1884, Pal. Ind., (X) II, p. 211, Pl. XXVIII.

TYPE.—Ind. Mus. D17, a skull, badly battered and showing only part of the roots of the teeth.

The distinctive characters as indicated by Lydekker are the strong vaulting of the palate and its extension farther backward behind  $m^2$  than in any other bear, *U. labiatus* approaching most nearly. But the anterior cheek teeth are less reduced apparently than in *labiatus*.

HORIZON.—Boulder Conglomerate zone, Upper Siwaliks.

LOCALITY.—Kangra.

Additional material of this species which would make it possible to determine the tooth construction, etc., would be very desirable. Provisionally at least it may be regarded as a species of *Melursus* distinguished from *labiatus* by the points cited by Lydekker. It may, as Lydekker insists, have been a direct ancestor of the modern sloth-bear, but I should want better evidence to really prove it.



**Ursus namadicus** Falconer and Cautley<sup>1</sup>

*Ursus namadicus* CAUTLEY AND FALCONER, Palæont. Mem., I, p. 321, footnote, Pl. xxvi, Fig. 5, p. 552 (Faun. Ant. Sival. Plate Descriptions); LYDEKKER, 1884, Pal. Ind., (X) II, p. 216, Pl. xxviii, Fig. 3.

The type is figured in one of the unpublished plates of the Faun. Ant. Sival., in the British Museum (Nat. Hist.), designated Pl. o, and referred to as such in the Faun. Ant. Sival. plate descriptions. Lydekker's figure and the one in Falconer's Memoirs appear to have been copied from the figure. It is Fig. 8 of the unpublished

B. M. 32916.

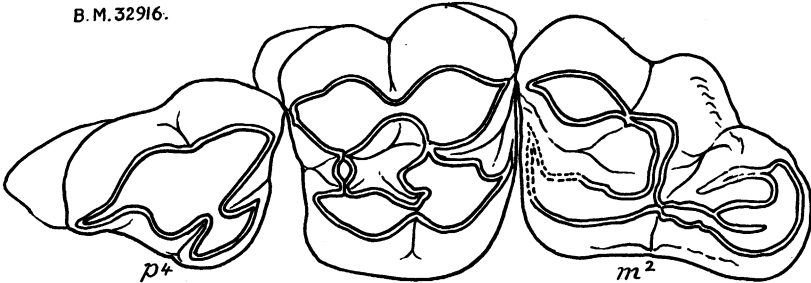


Fig. 12. *Arctotherium bonærense*. Upper cheek teeth, crown view, natural size. From the skeleton in the British Museum.

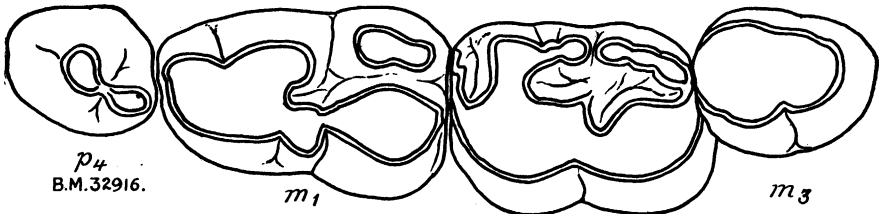


Fig. 13. *Arctotherium bonærense*. Lower cheek teeth, crown view, natural size. Same specimen as Fig. 12.

plate; Fig. 9, a referred tibia, also figured by Lydekker, *loc. cit.*, Pl. xxix, Fig. 3 (copy reversed from Faun. Ant. Sival.), does not belong to a bear.

Lydekker, after careful comparisons, concludes that the species is nearest to *U. 'torquatus'* (= *tibetanus*). It seems a rather primitive species with some points of affinity to *etruscus* and *arvernensis*, and like them belongs among the species of true *Ursus*.

**ARCTOTHERIUM, PARARCTOTHERIUM, INDARCTOS, HYÆNARCTOS**

Skull and jaws of *A. bonærense* in British Museum, No. 32916, with large part of skeleton. Cast of type skull of *Pararctotherium*.

<sup>1</sup>Ascribed to the joint authorship in the type reference p. 552.

*Arctotherium* is surprisingly different from the true bears. *A. simum* probably does not belong to this genus,<sup>1</sup> and is provisionally separable as *Tremarctotherium* Kraglievich.

The true *Arctotherium* is much closer to *Hyænarctos*, the distinctions being in less specialized characters, listed under *Hyænarctos*. *Pararctotherium* is near to *Arctotherium*, but smaller and more specialized ursid in the rugosity of enamel on inner half of molar, squaring up of  $m^1$ , reduction of  $p^4$  with disappearance of its inner and reduction of its posterior cusp.

*Indarctos* is more like *Arctotherium* and *Pararctotherium* in  $m^2$ , but heel of  $m^2$  is less differentiated.  $M^1$  is narrower than in *Arctotherium* or *Pararctotherium*, approaching the true bears to some degree.

#### HYÆNARCTOS = AGRIOTHERIUM<sup>2</sup>

*Agriotherium* WAGNER, 1837, Gelehrte. Anzeig. k. bay. Akad., V, p. 335.

*Sivalarctos* DE BLAINVILLE, 1841, Compt. Rend., XIII, p. 165.

*Amphiarctos* DE BLAINVILLE, 1841, Ostéographie, II, *Subursus*, p. 96.

*Hyænarctos* FALCONER AND CAUTLEY, in Owen, 1840-45, Odontography, p. 505, Pl. CXXXI (subgenus); GERVAIS, 1859, Zoöl. et Paléont. Franç., 2<sup>e</sup> Éd., p. 208 (genus); CAUTLEY AND FALCONER, in Falconer, 1868, Pal. Mem., I, p. 321, Pl. XXVI (subgenus); LYDEKKER, 1884, Pal. Ind., (X) II, p. 219, Pls. XXX, XXXI.

TYPE.—(Of all the above), *Ursus sivalensis* Falconer and Cautley, 1836.

*Hyænarctos* is clearly related to *Arctotherium*, and separated by:—

1. Lack of any posterior extension of  $m^2$ , which is either quadrate as in the type, or the posterior half reduced in transverse width as in *H. palæindicus*, but not extended backward as it is in *Indarctos*, *Arctotherium*, *Pararctotherium* and the various modern bears.
2.  $P^4$  less reduced, the parastyle prominent (weak in *H. punjabiensis*), notch between blades strong and deep, the whole tooth retaining much more its primitive carnassial character.
3. Anterior premolars less crowded.
4. Zygoma from opposite  $m^2$  instead of from between  $m^1$  and  $m^2$ .
5. Postorbital process much further backward, opposite posterior nares instead of opposite  $m^2$ .
6. Considerable sagittal crest; brain-case not so large and the skull as a whole less shortened.

<sup>1</sup>V. Kraglievich, 1926, Anal. Mus. Nac. Buen. Air., XXXIV, pp. 1-16, September 28. But I had come to this conclusion independently on seeing the *A. bonariense* skull before knowing of Kraglievich's article.

<sup>2</sup>It is generally admitted (see Gervais, *loc. cit. infra*, Lydekker, *loc. cit. infra*) that Wagner's name has priority over *Hyænarctos* and those proposed by de Blainville. *Hyænarctos* has been generally used in spite of that well known fact, much as *Oreodon*, *Mastodon* and numerous other names have been retained. The 'strict constructionists' of modern nomenclature apparently are under the impression that they have discovered a lapse of priority usage not known to their predecessors; but it is not so; and in fact most of their revivals of obsolete names are or might have been copied from Leidy, Lydekker and other writers, although they make no acknowledgment of such indebtedness. Wagner specifies as reasons for separating *U. sivalensis* that the teeth indicate a more carnivorous adaptation, nearer to the normal carnivore dentition.

*H. punjabiensis* comes nearer to *Indarctos*, and appears to be a species of that genus rather than *Hyænarctos* proper.

*H. palæindicus* is more primitive than *H. sivalensis*.

### *Hyænarctos sivalensis* Falconer and Cautley, 1836

*Ursus sivalensis* FALCONER AND CAUTLEY, 1836, *Asiat. Research.*, XIX, p. 193. (*Agriotherium*) WAGNER, 1837, *loc. cit. Sup.*; (*Sivalarctos*) DE BLAINVILLE, 1841, *Compt. Rend.*, XIII, p. 165; (*Amphiarctos*) DE BLAINVILLE, 1841, *Osteog.*, II, p. 96; (*Hyænarctos*) OWEN, 1841-45, *Sup.*, Pl. CXXXI; GERVAIS, 1859, *loc. cit. Sup.*; CAUTLEY AND FALCONER, 1868, *loc. cit. Sup.*; LYDEKKER, 1884, *loc. cit. Sup.*, p. 220, Pl. XXX, Fig. 5 (copied from unpublished figure in *Faun. Ant. Sival.*, Pl. o, Fig. 1c); PILGRIM, 1914, *Rec. Geol. Sur. Ind.*, XLIV, p. 225 et seq.

TYPE.—B. M. No. 39721, a damaged skull, and 39722, lower jaw, from the Siwalik Hills. Placed by Pilgrim as Upper Siwalik, but of uncertain horizon. As all other specimens of *Hyænarctos* come from the Middle Siwaliks it seems probable that the type was from low down in the Upper Siwalik series, not from the Boulder Con-

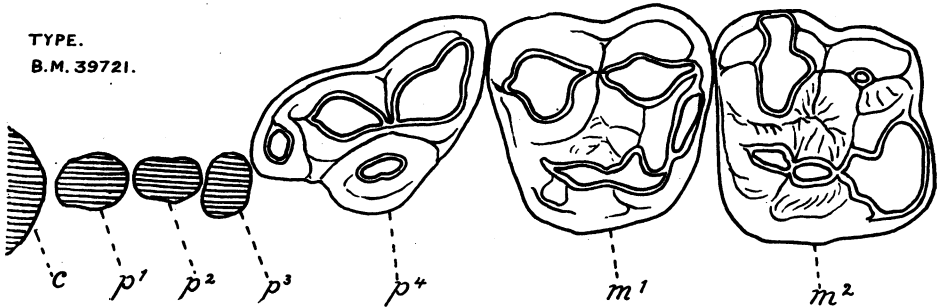


Fig. 14. *Hyænarctos* (= *Agriotherium*) *sivalensis*. Upper teeth, crown view, natural size. From the type skull in the British Museum.

glomerate zone. There is no indication that skull and jaw belong together; Falconer speaks of the jaw as having been found first and the skull subsequently; however, under the conditions of collecting in India, especially in the earlier days, this would not preclude their belonging to the same individual.

The matrix of the type skull is a uniform gray sandstone, moderately hard, the bone and teeth of a rather light chocolate brown, not black, but dark brown in places where weathered or otherwise altered. The jaw is similar but weathered on outer side to a puce-color and the teeth a lighter brown on weathered side. Jaw a good deal collapsed by crushing; teeth not perceptibly broken in crushing, but must be considerably changed in transverse diameters. They appear to be quite uncrushed.

Identification of the upper teeth as  $p^1, 2, 3$ , each single-rooted, is on analogy with *Arctotherium* and *Pararctotherium*, in which this is certainly the interpretation of the alveoli, as a one-rooted  $p^3$  is preserved on *Pararctotherium* (type), and a one-rooted  $p^1$  on the British Museum *Arctotherium* skull, the relationships of the alveoli being identical in *Pararctotherium* and *Arctotherium*. In the *Hyænarctos sivalensis* skull the premolars are not crowded or displaced, and a suggestion of two roots is observable.

$P^4$  is of about the same length as in *A. bonærense*, but less breadth; postero-external shear less reduced, parastyle a stout, prominent cusp, absent in *Arctotherium*. Notch between the blades deep, almost to level of valley separating protocone (deuterocone), whereas in *Arctotherium* and *Pararctotherium* it is obsolete and shallow. Internal cusp (protocone, =deuterocone) is larger than in *Arctotherium*, less posterior in position, centering a little in advance of the inter-blade notch. The inner cusp wholly absent in *Pararctotherium*, and tooth much smaller.

$M^1$  smaller than *Arctotherium*, size of *Pararctotherium*, but inner half smaller than outer half, instead of quadrate as in *Pararctotherium*; *Arctotherium* is intermediate, but nearer *Pararctotherium*. Inner half of tooth less flattened than *Arctotherium*, lacks the rugosities of *Pararctotherium*, the two inner cusps less separate than in *Arctotherium*.

$M^2$  is nearly square, with the external side drawn in moderately so as to make rather a trapezoid. Metacone, however, is very nearly as large and high as paracone. Protocone twinned, hypocone separate and a posterior cingulum behind it, broad, low inner cingulum obscure, anterior and narrow external cingulum. All cusps are broad and low, and the unworn enamel appears to indicate some rugosity, but not noticeable.

Proportions of skull and palate appear to be about as in *Arctotherium*, except for less extreme shortening, probably smaller brain-case and well developed sagittal crest. Palate appears more excavated, but this may be due to crushing; but it is of the same broad type, a little extended behind, heavy short canines and large stout incisors (alveoli only, which indicate teeth as large as in *Arctotherium*).

Position of postorbital process considerably further back than in *Arctotherium* and *Pararctotherium*; the zygomatic arch springs from opposite  $m^2$  instead of between  $m^1$  and  $m^2$  as in *Arctotherium* and *Pararctotherium*.

Zdansky, in his description of *Indarctos* from China, makes the remark in a footnote (v. Zdansky, *loc. cit. infra*, p. 17) that Dames "kam zu seinen richtigen Ergebniss durch die irrige Annahme dass  $p^1$ - $p^3$  einwurzelig gewesen waren." Dames, however, was quite right so far as I can judge from the alveoli of the type skull, and Zdansky's supposed anterior alveolus for  $p^3$  observed in Lydekker's drawing<sup>1</sup> is really only a slight depression in the palate. Lydekker's drawing is not at all accurate in representation of any of the premolar alveoli.

### ***Hyænarctos palæindicus***

*Hyænarctos palæindicus* LYDEKKER, 1878, Rec. Geol. Sur. Ind., XI, p. 103; 1884, Pal. Ind., (X) II, p. 232, Pl. xxx, Figs. 1 and ? 3, Pl. xxxi, Figs. 2 and 3; PILGRIM, 1914, Rec. Geol. Sur. Ind., XLIV, p. 228.

TYPE.—Ind. Mus. No. D16, upper jaw  $p^4$ - $m^2$  r.

LOCALITY AND HORIZON.—"Siwaliks of the Punjab," Middle Siwalik, probably Hasnot or Niki.

Differs from *sivalensis* in the more trihedral form of  $p^4$ , with stronger protocone (deuterocone) and shorter outer crest, more evenly divided by the inter-blade notch, owing to less proportionate development of paracone (protocone). Also, and more notably, in the reduction of the metacone and postero-external angle of  $m^2$ . The closer setting of inner and outer rows of cusps on  $m^1$  and  $m^2$  noted by Lydekker is partly or

<sup>1</sup>Zdansky, 1924, Pal. Sin., (Ser. C), II, Fasc. II, p. 18.

wholly due to difference of wear. The species shows some approach to *Dinocyon* (not to "*Amphicyon* and the dogs," as has been repeatedly stated); but not enough to cast doubt on its generic reference.

The lower jaw associated with this species by Lydekker is stated to have no evidence of  $m_2$ . Whether this is due to individual difference or accident or to the jaw fragment being broken off too low down to show the root of  $m_2$  (which lay probably partly on the ascending ramus, as the last molar frequently does in most Carnivora, and with a root that curves strongly backward and does not penetrate deep into the horizontal ramus), is not important to determine. In any case it is quite unlikely that  $m_2$  was normally absent in this or any other species of *Hyænarctos*.

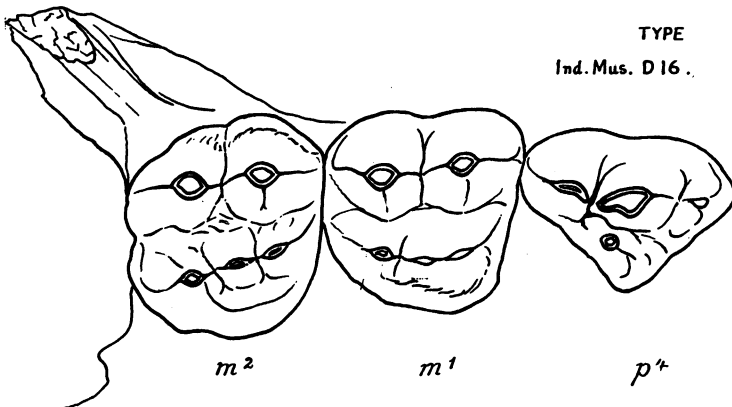


Fig. 15. *Hyænarctos* (= *Agriotherium*) *palæindicus*. Upper teeth, crown view, natural size. Type specimen, Indian Museum.

But it is wholly uncertain whether this lower jaw really belongs to *Hyænarctos* rather than to *Indarctos*. Pilgrim's acceptance of Lydekker's view has, I think, led him astray in some other matters (vide *H. punjabiensis* notes). In fact no carnivore with that much extension of posterior molars above and of heel of  $m_1$  below is in the least likely to lose  $m_2$  normally. Compare *Hemicyon*, *Cephalogale*, *Procyonidæ*, etc. The upper dentition of *H. palæindicus* and *sivalensis* demands an  $m_2$  of about the size of that in the supposed lower jaw of the type of *sivalensis* in order to correspond to the upper teeth. The  $m_2$  in *H. palæindicus* ought to be more oval but scarcely shorter than in *sivalensis*; that of *Indarctos salmontanus* ought to be oval, rather longer than in *Hyænarctos sivalensis* and to some slight extent approaching the type of  $m_2$  in *Ursus*. The lower jaw of *punjabiensis* fits it very well.

I think it likely that the lower jaw attributed by Lydekker to *palæindicus* belongs more probably to *Indarctos punjabiensis*, but that the  $m_2$  was not normally absent in the species and probably was present in this specimen, but tooth and root broken away.

### INDARCTOS

This genus is in many respects rather close to *Arctotherium* and *Pararctotherium*. As based upon the type specimens (or specimen) of *I. punjabiensis* and *salmontanus* it differs from them in:

1.  $P^4$  little reduced.
2. Molar cusps, especially the inner ones, tending to definite a.-p. ridges as in the true bears, more than they do in either *Arctotherium* or *Pararctotherium*.

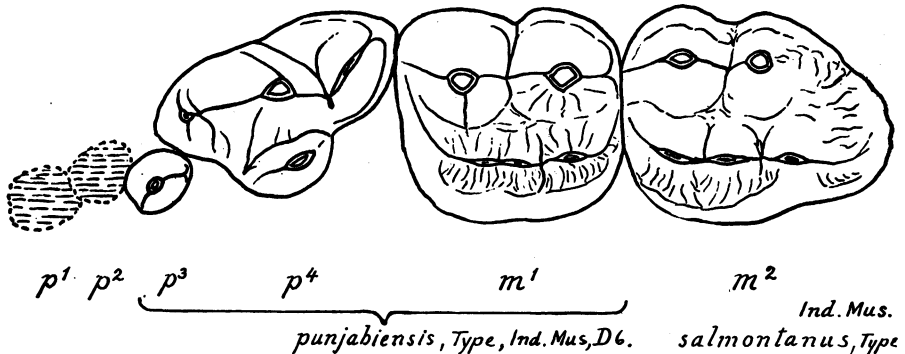


Fig. 16. *Indarctos punjabiensis*. Upper teeth, crown view, natural size. Type specimen, Indian Museum. The second molar from the type of *I. salmontanus* Pilgrim, which is believed to be the same individual.

3. Heel of  $m^2$  less differentiated from the rest of the tooth.
4.  $M^1$  somewhat narrower transversely.

It agrees with them and differs from *Hyænarctos* in:

1. Large heel on  $m^2$ .
2.  $M^1$  more quadrate, inner half as wide antero-posteriorly as outer half.
3. Reduction of parastyle on  $p^4$  (absent in *Arctotherium* and *Pararctotherium*).
4. Zygomatic arch springs from anterior part of  $m^2$  and from  $m^1$  (from posterior part of  $m^2$  in *Hyænarctos*; in *Arctotherium* and *Pararctotherium*, between  $m^1$  and  $m^2$  and forward on  $m^1$ ).
5. If the lower jaw ascribed to *H. sivalensis* belongs really there, and the teeth are uncrushed, there is a notable difference in the transverse width of the lower teeth, much broader in *Indarctos* than in *Hyænarctos*, proportioned as in *Arctotherium*.

**Indarctos (*Hyænarctos*) punjabiensis** Lydekker, 1884

SYNONYM.—*Indarctos salmontanus* Pilgrim.

*Hyænarctos punjabiensis* LYDEKKER, 1884, Pal. Ind., (X) II, p. 226, Pl. xxx, Fig. 2; PILGRIM, 1914, Rec. Geol. Sur. Ind., XLIV, p. 228 et seq.

?*Indarctos salmontanus* PILGRIM, 1914, *loc. cit.*, p. 225, Pl. xx.

\*TYPE.—Ind. Mus. No. D6, crowns of upper teeth  $p^4$ - $m^1$  r. and l., ?  $p^2$  l.; doubtfully part of type, a lower jaw, c, and  $m_{1-3}$  r. and l. complete, Ind. Mus. No. D8. Both from the Middle Siwaliks of Hasnot, but stated to have been collected in different years.

Type of *I. salmontanus*, upper jaw fragment,  $m^2$  and root of  $m^1$  l., also from Middle Siwaliks of Hasnot, and may be, in my opinion, a part of the same individual as Lydekker's type. Whether it is or not could be decided by finding whether  $m^1$  l. of Lydekker's type is a tooth with roots or merely a crown; and if the latter, whether it does not fit on the root of Pilgrim's type. If not the same individual, it is pretty certain that they are the same species, as the characters of  $m^1$  and  $m^2$  correspond, and the proportions of teeth are the same.<sup>1</sup>

*Indarctos lagrelii* Zdansky<sup>2</sup> from the lower Pliocene of North China is quite nearly related to *I. punjabiensis*, but more primitive in a number of particulars. It is a smaller species, and the premolar reduction has not gone so far;  $p_3$  is still two-rooted but in *I. punjabiensis* it is one-rooted;  $p^3$  is two-rooted, but in *I. punjabiensis* the roots are more closely connate, and in *Hyænarctos sivalensis* they are united into one, the tooth turned completely transverse, whereas in *Indarctos lagrelii* it is at an angle of 45° to the fore-and-aft line. The relative size of the premolars is greater throughout in *I. lagrelii*, which would stand very well as a direct ancestor of *I. salmontanus* and, so far as I have compared them, of *I. oregonensis*.

As this Chinese fauna appears to be correlated rather closely with the Pontian, this would suggest a somewhat post-Pontian age for the Dhok Pathan zone of the Siwaliks, and equally for the Rattlesnake beds of Oregon, both more or less equidistant from the supposed palæarctic center of dispersal of the Ursidæ.

***Hyænarctos anthracites*** Schlosser, 1890

*Amphicyon laurillardi* (in part?) MENEGHINI, 1862, Atti. Soc. Ital. Sci. Nat., IV, Pl. II. Not *A. laurillardi* POMEL, Cat. Meth. Vert. Foss., p. 72, from Sansan, which is a synonym of *A. major* Blainville, auct. Lydekker, Pal. Ind., (X) II, p. 248.

*Hyænarctos* GERVAIS, 1875, Zoöl. et Pal. Gen., (II), p. 22; LYDEKKER, 1884, Pal. Ind., (X) II, p. 248.

*Hyænarctos anthracites* SCHLOSSER, 1890, Beit. z. Pal. Oest. Ung., VIII, p. 81.

TYPE.—A lower jaw from Pliocene of Monte Bamboli, Italy, cast in British Museum (Natural History).

<sup>1</sup>Doctor Pilgrim has kindly examined the original specimens in Calcutta since the above was written, and informs me that the two specimens cannot be the same individual, as there is a certain amount of duplication in the teeth.

<sup>2</sup>*Indarctos lagrelii* Zdansky, 1924, Palæont. Sin., (Ser. C) II, Fasc. I, p. 16, Pl. iv, Figs. 1-4.

## PHYLOGENY OF THE URSIDÆ (PROVISIONAL)

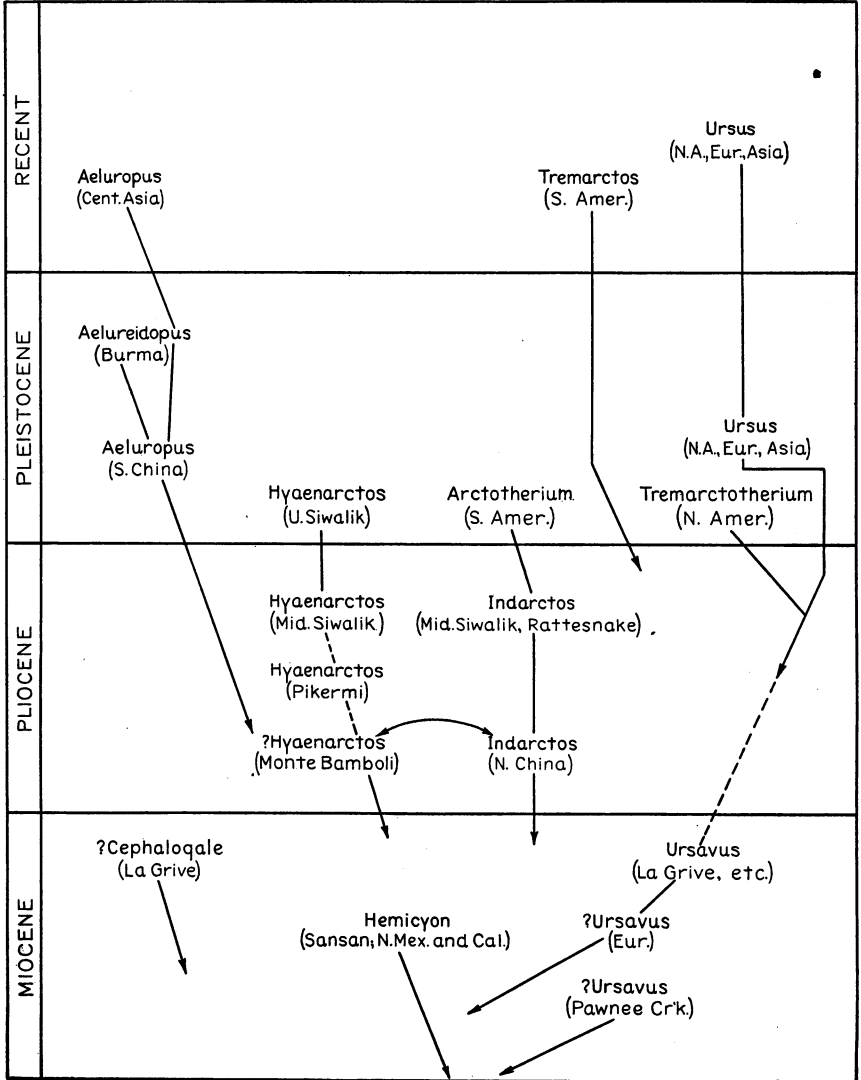


Fig. 17. Phylogeny of the Ursidæ.



This is a small species which makes quite an approach to *Ursus boeckhi* Schlosser, with which it should be compared. Relations of this species to *Indarctos* and to the more primitive species of modern bears require revision.

The horizon of Monte Bamboli is regarded as between Pikermi and La Grive, but there is very little faunal evidence to go on.

## CANIDÆ

### AMPHICYON Lartet, 1836

Chien gigantesque d'Avary près de Beaugency, CUVIER, Ossemens Fossiles.

*Canis giganteus* SCHINZ, 1825, in Cuv. Thierreich, IV, p. 342.

*Amphicyon* LARTET, 1836, Bull. Soc. Géol. Franç., VII, p. 219.

*Amphicyon giganteus* LAURILLARD, 1843, Dict. Univ. Hist. Nat., III, p. 567.

TYPE.—*Amphicyon major* Blainville, 1841, Ostéog., Subursus, Pls. xiv-xv, upper jaw and other materials from Sansan. Blainville states that Lartet founded the genus upon Sansan material. I have not seen the type reference.

*A. giganteus* Laurillard, 1843, is probably Cuvier's "chien gigantesque de Beaugency," which in Schinz's German translation of Cuvier had already been named *Canis giganteus*. This species name should therefore date from 1825, based on an upper molar tooth.

Cuvier, Ossemens Fossiles, p. 466, IV of 1823 ed.

Measurements given of the upper molar as .043 and .032.

Associated with bones of mastodon, rhinoceros and "gigantic tapirs" = *Dinotherium*.

*Amphicyon major* as represented by the upper jaw, etc., figured by Blainville (cast in British Museum, also in American Museum) is considerably smaller, though still larger than Lydekker's species. Teeth more quadrate.

The numerous species referred by European and early American writers to *Amphicyon* belong mostly in other genera.

*A. giganteus* is quite as likely to be *Pliocyon*, but its generic position is uncertain, lacking topotypes or a more careful study of the type.

*A. lemanensis* should be compared with *Daphænodon*.

*A. ambiguus*, etc., of the Phosphorites need comparison with *Daphænus* and *Daphænodon*; they are pretty surely not *Amphicyon*.

*Agnotherium* Kaup, 1833,<sup>1</sup> is cited by Lydekker as a synonym of *Amphicyon*, admitting that it is the older name. Kaup's description shows that Fig. 4 of his plate, a lower carnassial, is the type. What this carnassial may be is not very clear, but it does not agree well with *Amphicyon*, even allowing for pretty bad figuring. It is fairly safe to say that *Agnotherium* is more or less indeterminate, but not a synonym of *Amphicyon*.

### *Amphicyon lydekkeri* Pilgrim, 1910

*Amphicyon lydekkeri* PILGRIM, 1910, Rec. Geol. Sur. Ind., XL, p. 64; *ibid.*, p. 199.

TYPE.—"M<sub>1</sub>" (cast is actually m<sup>2</sup>) from Middle Siwaliks of Padhri (stated as Hasnot on p. 199; and cast stated to be type has that locality on label).

Distinguished by Pilgrim from *A. palæindicus* by its greater size and squareness.

<sup>1</sup>Kaup, 1833, Oss. Foss. Darmst., Carn. Foss., p. 28, Pl. 1, Figs. 3-4.

Compared with *A. major*, the  $m^2$  is rather near, but distinguished by more symmetrical and lower crown, the paracone smaller and lower and less skewed around in a postero-external direction. Crown lower and more flattened as a whole, size and proportions much the same otherwise.

This is a species with more flattened and ursoid molar than *A. major*, but nothing can be said positively of its affinities without more evidence as to other teeth. Its position in the genus is provisional; it might be a *Pliocyon*. Does not fit well in *Dinocyon*, but should also be compared with that genus.

### *Amphicyon palæindicus*

*Amphicyon*, sp. innom., FALCONER, 1868, Pal. Mem., I, p. 416.

(*Amphicyon palæindicus* FALCONER, on label of type specimen).

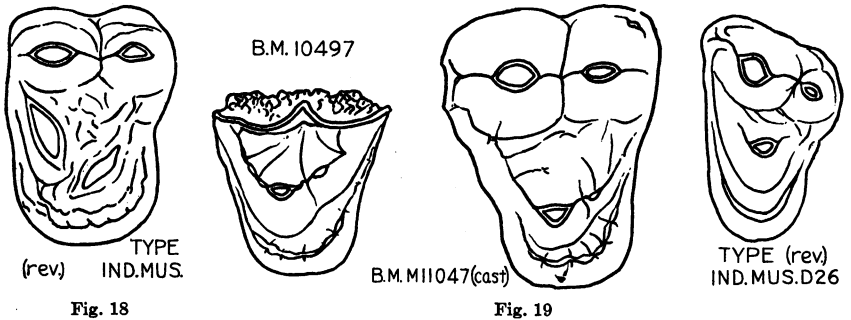


Fig. 18

Fig. 19

Fig. 18. '*Amphicyon*' *lydekkeri* Pilgrim. Upper molar, crown view, natural size. Middle Siwalik beds, Hasnot. Doubtful whether this species belongs to the genus.

Fig. 19. Upper molars of *Amphicyons*: B. M. No. 10497, an incomplete upper molar,  $m^1$ , from the Gaj formation, Bugti Hills; B.M. No. 11047, cast of a similar molar from the Lower Siwaliks, original in Indian Museum; Ind. Mus. D26, type of *Amphicyon palæindicus*,  $m^2$  reversed in figure for comparison with No. 11047, which is probably the type of tooth compared by Pilgrim with *A. giganteus*. Both may well represent the same species.

*Amphicyon palæindicus* LYDEKKER, 1876, Pal. Ind., (X) I, p. 66, Pl. VII, Figs. 5, 8, 12; 1884, *ibid.*, II, p. 248, Pl. XXXII, Figs. 4, 5, 8.

TYPE.—Upper molar tooth,  $m^2$ , Ind. Mus. D26, from "Middle" Siwaliks, Kushalghai, Punjab. Paratype, a lower jaw fragment, Ind. Mus. D23, from Nurpur, with  $dp_4-m_1$ . Both are Lower Siwalik, auct. Pilgrim.

The species is near to the size of *A. major*, but distinguished by the less quadrate teeth, higher hypoconid crest and low, small entoconid crest. Inner part of carnassial has the surface pitched obliquely, not sub-parallel to palate. (In these features it approaches type of *A. frendens* of Snake Creek beds—and probably various other species.)

The above from Lydekker's description. Comparing the type tooth with *A. major* it is very notably different, so that I would be rather doubtful of its belonging to the genus. The tooth is decidedly smaller, the inner half less expanded, the metacone much smaller in proportion, and the tooth is considerably 'broken-backed.' The protocone is much reduced and not so distinctly crescentic, its wings having nearly disappeared.

Two additional specimens may throw light on affinities.

1. M11047 of British Museum collection, plaster cast of  $m^1$  from Chinji beds, Lower Siwaliks. Original in Indian Museum (No.  $\frac{K992}{13} = D155$  Ind. Mus.).

This is a very large tooth, larger than  $m^1$  of *A. major*, considerably smaller than *giganteus*, and differs from *major* and, to a less extent, from *giganteus* in higher and more conical paracone and metacone. The inner half of the tooth is a good deal like that of *giganteus*, but the outer half much smaller. The tooth is somewhat broken-backed, as is *giganteus*, unlike *major*. In *A. major* the inner half has cingulum less developed and more limited to postero-internal side, and the outer cusps are smaller and lower.

2. M1557 of British Museum collection, plaster cast of  $dp_4-m_1$  from Nurpur—Lower Siwaliks in Pilgrim's correlation.<sup>1</sup> Original in Indian Museum.

This is about the size of *A. major*, but differs in more compressed trigonid, higher and equally wide talonid, the entoconid much more reduced, the hypoconid more of a median crest.

The characters of all these teeth rather suggest *A. frendens* and similar species; in some points like *Dinocyon*, but with much smaller tubercular teeth. The  $m^1$  is very large compared to the  $m^2$ , but this would conform to the rapid reduction in size of outer cusps in  $m^2$  from front to back, so that they may belong to the same species despite the apparent incongruity. On the other hand, the lower carnassial trigonid seems small for the large  $m^1$  (although it registers well enough). This may, in short, be a species trending from the *A. frendens* type towards such types as *Hyæncyon*. But until associated material has been found, no conclusions can be safely drawn as to its affinities.

### ***Amphicyon shahbazi* Pilgrim**

*Cephalogale shahbazi* PILGRIM, 1910, Rec. Geol. Sur. Ind., XL, p. 199 (no description); 1912, Pal. Ind., (N. S.) IV, Part 2, p. 11, Pl. III, Figs. 1, 2; *Amphicyon*, 1913, Rec. Geol. Sur. Ind., XLIII, p. 74.

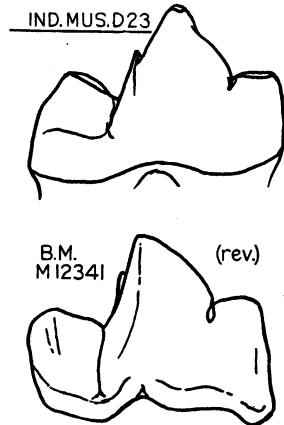


Fig. 20. Lower carnassials of *Amphicyon*; the upper figure from the jaw fragment, Ind. Mus. No. D23, figured by Lydekker, Lower Siwalik beds; the lower a specimen in the British Museum, No. 12341, discovered and described by Forster Cooper from the Bugti beds (reversed in figure).

<sup>1</sup>Pilgrim, 1910, Rec. Geol. Sur. Ind., XL.

Four specimens of '*Amphicyon*' in the British Museum collection, from the Bugti Hills, of which one, M12341, figured by Cooper, 1923 (Ann. Mag. Nat. Hist., (IX) XII, p. 260, Fig. 1B), is referred to *palæindicus*. Differs from the paratype of *palæindicus* in broader, more robust trigonid, slightly smaller metaconid, rather larger entoconid shelf, and hypoconid not quite so high. On the whole, a more 'normal,' less specialized tooth, but rather near, and might be listed as *Amphicyon* aff. *palæindicus*?



B.M. 12339.

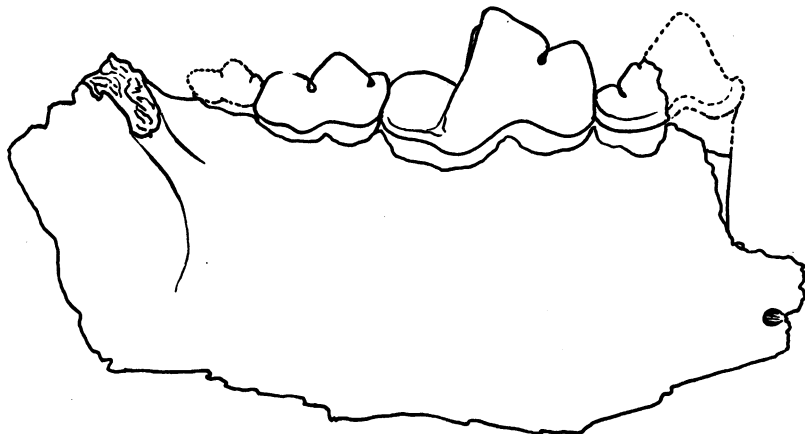


Fig. 21. *Amphicyon shahbazi* lower jaw from Dera Bugti, Baluchistan, British Museum No. 12339, figured by Forster Cooper in 1923. Natural size, external view, and crown view of teeth. Gaj horizon.

A second lower carnassial, B. M. No. 12340, about the same size, is referred to *A. shahbazi*. This may be the specimen referred to by Pilgrim in 1913, *loc. cit.*, p. 74. If so, it would differentiate *shahbazi* from *palæindicus* by slightly smaller size, reduced metaconid, lower hypoconid. It is also figured by Cooper<sup>1</sup> who refers it to *shahbazi*.

A third specimen, M12339, is a lower jaw with  $m_{1-2}$  complete, part of  $p_4$  and alveolus of  $m_3$ . This also is figured by Cooper in 1923.<sup>2</sup> The carnassial is decidedly smaller than any of the preceding, the metaconid somewhat stronger relatively, and the

<sup>1</sup>Cooper, 1923, *loc. cit.*, pp. 261-262, Fig. 1B.

<sup>2</sup>Cooper, 1923, *loc. cit.*, pp. 261-262, Fig. 7C.

entoconid shelf better developed, the hypoconid rather lower and more external. The external face of the trigonid is more uniformly convex, lacking the flattening that distinguishes the preceding in progressive degree from 12341 to 1557. I hardly think this is likely to be the same species as 12340, if 12340 is held to be distinct from 12341 and 1557. But they are all rather nearly related, I should judge, the Bugti Hills specimens in various ways and in varying degree more primitive.

The second lower molar of this jaw (12339) differs from that of *A. major* in much smaller size, both absolutely and proportionately; it has a fairly distinct paraconid, absent in *A. major*, the metastylid is an unimportant rudiment in place of the closely connate flanking cusp of *A. major*, the heel is more definitely basined, with a marginal entoconid crest instead of a shelf, the hypoconid decidedly higher and more crested. The fourth premolar is both relatively and absolutely larger than in *A. major*, appears to have had a much higher principal cusp, and a higher but smaller accessory cusp, closely twinned to the posterior border of the main cusp.

Alveolus of  $m_3$  is shorter and more rounded than in *A. major*.

A fourth specimen, M10497 of the British Museum collection, from the Bugti Hills, is the inner part of an upper molar,  $m^1$ . Agrees rather closely with upper molar cast, M11047, from Chinji, and registers quite well with lower carnassial M12341 from Dera Bugti referred to *A. palæindicus*. Not enough of it to have any significance. This also is from Bugti Hills; has not been figured.

All the above Bugti and Lower Siwalik material referred to *palæindicus* and *shahbazi* may well belong to one group of *Amphicyon*s, related to *frendens* and *giganteus*. There seems to be no evidence that these really are *Amphicyon* rather than *Pliocyon*. I cannot believe that the lower jaw belongs to the same species as the larger specimens, and think it very doubtful whether the so-called *palæindicus* belongs to that species rather than *A. shahbazi*.

The jaw is of wholly different type from *A. lemanensis*. It is a short, deep, stout, *Ælurodon*-like jaw, quite distinct from the long, shallow, thin jaw of *A. lemanensis*; as the upper teeth in all this group differ in aspect from the flat-crowned, low-cusped, subequal upper molars of *A. lemanensis*. Suggests again affinities to *Hyæncyon*. (But these are hardly tenable as phyletic relations.)

### ***Canis curvipalatus***

*Canis ? vulpes* BAKER AND DURAND, 1836, Jour. Asiat. Soc. Beng., V, p. 581 et seq., Figs. 9, 10. Republished 1868, FALCONER, Pal. Mem., I, p. 341.

*Canis curvipalatus* BOSE, 1879, Quar. Jour. G. S., XXXVI, pp. 134-6; LYDEKKEER, 1884, Pal. Ind., (X) II, p. 254, Pl. XXXII, Figs. 1, 1A.

TYPE.—B. M. No. 37149, skull and lower jaws from the "typical Siwalik Hills."<sup>1</sup>

This is a finely preserved skull; the teeth have been nearly complete, but two or three have been broken off since the specimen was found.

Described and discussed in detail by Lydekker, who saw in it a link between *Otocyon* and the foxes. Has a good many *Otocyon* characters, and even a curious shelf behind  $m^2$  that suggests an  $m^3$  (apparently no real alveolus for it; and certainly no trace of alveolus for  $m_4$ ).

<sup>1</sup>The matrix and preservation are peculiar—a light brown sand, the bone cream-white, the teeth mostly light brown shaded in places into a darker brown and more rarely into a light bluish gray. The matrix is a very fine-grained loessic sand, and the bone chalky in texture; neither is very hard.

A true *Canis* in disappearance of paraconid on  $m_2$ . Large molars and small premolars, carnassial with short blades and large, well separated inner cusp;  $m^2$  about same size as  $p^4$ . Canines very small. Bullæ large; anteriorly they reach forward to or slightly in advance of back of glenoid fossæ; posteriorly closely united with vertical (and long ?) paroccipital process. Wide condyles, broad, low occiput, somewhat indistinct lyrate area, not reaching back quite to occiput.

The skull is somewhat flattened by crushing, and to this probably is also due the broad angle made by the basicranial to basifacial axis which Bose considered to be specific and named the species from it.

As compared with *C. bengalensis*, the tooth-row is shorter, the molars and  $p^4$  larger, the premolars less compressed. Protocone of  $p^4$  considerably larger and more offset, and the blades more massive.  $M^1$  and  $m^2$  have considerably greater transverse width, and  $m^2$  is somewhat larger relatively, with less reduction of metacone. The difference in basifacial-basicranial angle is probably due to crushing, and perhaps the greater width and distance apart of the bullæ are exaggerated by it, but the larger,

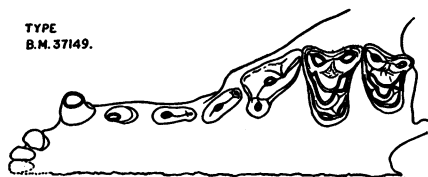


Fig. 22

Fig. 22. *Canis curvipalatus*. Upper teeth, crown view, natural size. From the type skull. Upper Siwalik.

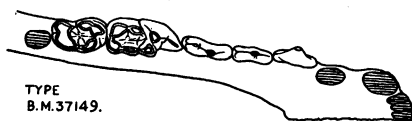


Fig. 23

Fig. 23. *Canis curvipalatus*. Lower teeth, crown view, natural size. From the type specimen in the British Museum, No. 37149.

wider condyles, more extended over the basioccipital, the wide, broad occiput and prominent occipital crest must be at least in part natural. The sagittal crest is stronger, and extends somewhat further forward to the lyrate area, which is better defined than in *bengalensis*.

### *Canis cautleyi*

*Enhydrionodon* FALCONER, 1868, Pal. Mem., I, p. 337.

*Canis cautleyi* BOSE, 1880, Quar. Jour. Geol. Soc., XXXVI, p. 135; LYDEKKEK, 1884, Pal. Ind., (X) II, p. 259, text figure 10, and Pl. XXXII, Figs. 3, 6.

TYPE.—No. 40181, lower jaw fragment  $m_{1-2}$  and alveolus of  $m_3$ , left side.

PARATYPE.—No. 40182, lower jaw fragment,  $m_{1-3}$  l., condyle and angle complete and part of coronoid. Both from the Upper Siwaliks.

The species was founded by Bose upon the two specimens listed above, of which No. 40181 has page priority in the description, and No. 40182 in the explanation of figures. In the British Museum catalogue, No. 40182 is listed first, with the statement that "this specimen with the next (40181) is the type of the species."

No. 40181 is selected as type, as a previously published specimen, and as the first one described in the type description. Both specimens are figured by the author<sup>1</sup> and his measurements are taken from both, although not so indicated. The type is a trifle larger and more robust, the paratype has  $m_3$  preserved, but hopelessly damaged, and shows the characters of the back of the jaw not preserved in the type.

The species is a typical *Canis*, with bicuspid heel on  $m_1$ , paraconid wholly absent on  $m_2$ , which has no distinct entoconid;  $m_3$  is quite small, long oval crown in paratype, short oval alveolus in type. Compares in size with a small wolf, cf. *C. pallipes* of India.

Lydekker notes that in *pallipes* and other modern wolves the angular process is "smaller in all its dimensions, and has a recurved upper angle which is entirely wanting in the fossil. The masseteric fossa is also larger and deeper in the fossil, and the pedicle of the condyle wider and flatter; in consequence of which there is a smaller upward bend of the inferior border below the ascending ramus than in the recent species." In fact the angular process is broken off in the fossil, and its apparent robustness is at least partly a result of unskillful preparation. The width and depth of the masseteric fossa is so much an individual and age character that it deserves no weight.

#### *Canis* cf. *aureus*

*Canis*, non det., LYDEKKER, 1884, Pal. Ind., (X) II, p. 264, Pl. xxxii, Fig. 2.

This species is known from the Siwaliks by a single upper jaw fragment, B. M. No. 1592f, with  $p^4-m^1$  r., and alveolus of  $p^3$ , the inner lobe of  $m^1$  and part of the carnassial crown broken off.

In absence of more material no satisfactory comparisons are practicable.

### VIVERRIDÆ

#### *Viverra bakerii* Bose

*Canis* ? sp. FALCONER, 1868, Pal. Mem., I, p. 553, plate descriptions of Fauna Antiqua Sivalensis, unpublished Pl. q, Figs. 1, 3.

*Viverra bakerii* BOSE, 1880, Quar. Jour. Geol. Soc., XXXVI, p. 131.

*Viverra bakeri* LYDEKKER, 1884, Pal. Ind., (X) II, p. 268, Pl. xxxiii, Figs. 1, 2.

TYPE.—A skull, B. M. No. 40183, from the Upper Siwaliks.

Viverrid affinities of this and the following species (*V. durandi*) are shown in the following:

1. Two upper molars, which have the protocone internal, crescentic, without internal cingular crest, external cusps strongly asymmetric, the row of outer cusps angling in sharply from the carnassial notch. No internal expansion as in Mustelidæ.
2. Carnassial maintains the primitive oblique shear and more triangular outline than in Canidæ. Parastyle on carnassial, although small and not well separated in these species.
3. Paroccipital process flat and widely expanded over the posterior face of the bulla.
4. Long skull, narrow cranium and vertical, narrow, triangular occiput.

<sup>1</sup>Lydekker's statement, *loc. cit.*, p. 259, that "the more perfect of the two specimens was figured by Bose," ignores his figure of No. 40182.

Lydekker describes the species as intermediate between *Viverra civetta* and *zibetha*, but on the wholly indefensible principle that the more carnivorous types of dentition in Carnivora are always secondary, he denies that it can be ancestral to *civetta* but considers that it may be so to *zibetha*. I should be more inclined to the reverse conclusion, as the *V. bakeri* teeth look like a species progressively adapting for less carnivorous diet; but the discussion would be futile without more evidence.

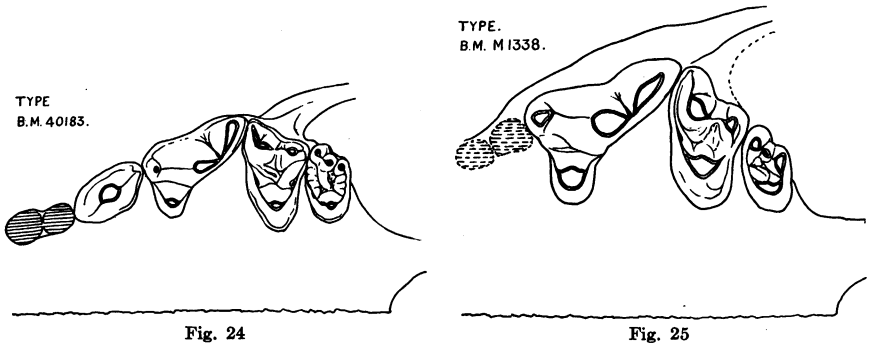


Fig. 24

Fig. 25

Fig. 24. *Viverra bakeri*. Upper teeth, crown view, natural size. From the type skull, British Museum No. 40183.

Fig. 25. *Viverra durandi*. Upper teeth, crown view, natural size. From the type skull, British Museum No. M1338. Upper Siwaliks.

### *Viverra durandi* Lydekker

*Canis* ? sp. FALCONER, 1868, Pal. Mem., I, p. 553, plate descriptions of unpublished plates of Fauna Antiqua Sivalensis, Pl. q, Figs. 2, 2A, 2B.

*Viverra durandi* LYDEKKER, 1884, Pal. Ind., (X) II, p. 271, Pl. XXXIII, Fig. 3.

TYPE.—A skull, incomplete,  $p^4$ - $m^2$  r. and l., alveolus of  $p^3$ . British Museum No. M1338.

PARATYPE.—Anterior half of skull, B. M. No. 37150, figured by Falconer, *loc. cit.* Both from Upper Siwalik beds.

The molars differ very considerably from *V. bakeri*, the carnassial being relatively large, the carnassial angle much sharper,  $m_2$  relatively reduced. On this, as on *bakeri*, there is a very weak parastyle on  $p^4$ , but less prominent here although the wear has opened a large worn space on it.

### *Progenetta proava* Pilgrim, 1910

*Palhyaena proava* PILGRIM, 1910, Rec. Geol. Sur. Ind., XL, p. 65; *Progenetta* PILGRIM, 1913, *idem*, XLIII, p. 312.

TYPE.—Not stated, presumably in Indian Museum.

HORIZON AND LOCALITY.—Lower Siwaliks, Chinji.



Described by Pilgrim as "much smaller than *Palhyæna indica*, with relatively narrower teeth." Subsequently transferred to *Progenetta* "near *P. crassa*."

### HYÆNIDÆ

#### *Hyæna sivalensis* Falconer and Cautley, 1868

*Hyæna* BAKER, 1835, Jour. Asiat. Soc. Beng., IV, p. 569, figures.

*Hyæna sivalensis* FALCONER AND CAUTLEY, 1868, in Falconer, Pal. Mem., I, p. 548, description of unpublished plates of Fauna Antiqua Sivalensis.

?*Hyæna sinensis* OWEN, 1870, Quar. Jour. Geol. Soc., XXVI, p. 422, Pl. xxviii, Figs. 5-7.

?*Hyæna sivalensis* FALCONER AND CAUTLEY, emend. BOSE, 1880, Quar. Jour. Geol. Soc., XXXVI, p. 128 (forsan in parte, exemplo typico excluso).

Not "*Hyæna sivalensis* Bose" LYDEKKER, 1884, Pal. Ind., (X) II, p. 303, Pl. xxxiv, nor of Pilgrim and other later authors.

"*Hyæna felina* Bose" LYDEKKER, *loc. cit.*, p. 281, Fig. 13, etc. (at least in part).

TYPE.—A skull and jaws, No. 42, Science and Art Museum, Dublin.

The name *H. sivalensis* appears for the first time in 1868, *loc. cit.*, without description and referring in the main to unpublished plates of the Fauna Antiqua Sivalensis, so that Lydekker considered himself justified in regarding it as a nomen nudum and dating the species from Bose's description of 1880.

But the 1868 plate description refers in the first place to a skull described and figured by Baker in 1835, erroneously stating that it was described under the species name *sivalensis* and by Baker and Durand, but quite definitely identifying *Hyæna sivalensis* Falconer and Cautley with "that designated *Hyæna Sivalensis* by Messrs. Baker and Durand."

Making allowance for the errors indicated, this constitutes an identification of *H. sivalensis* Falconer and Cautley, 1868, with *Hyæna* sp. of Baker, 1835, and bases the 1868 name upon a published, figured and described specimen, as well as upon the various unpublished specimens of Pl. κ of the Fauna Antiqua Sivalensis. The species is therefore not a nomen nudum, but based upon the Baker skull now in the Dublin Museum, as being the only published specimen included in it at the date of publishing the name.

Bose's procedure in emending the species so as to base it primarily upon a skull referred in the 1868 descriptions to *Felis cristata*, secondarily to other specimens figured in the unpublished plates of Fauna Antiqua Sivalensis, to the exclusion of the skull published by Baker, does not appear to be permissible.

Lydekker's further emendation, basing the species wholly upon the '*Felis cristata*' skull and attributing it to Bose, dropping the *sivalensis* of Falconer and Cautley altogether, appears objectionable on the grounds

TYPE.

Dubl. Mus. 42.

B.M. 3563 (cast)

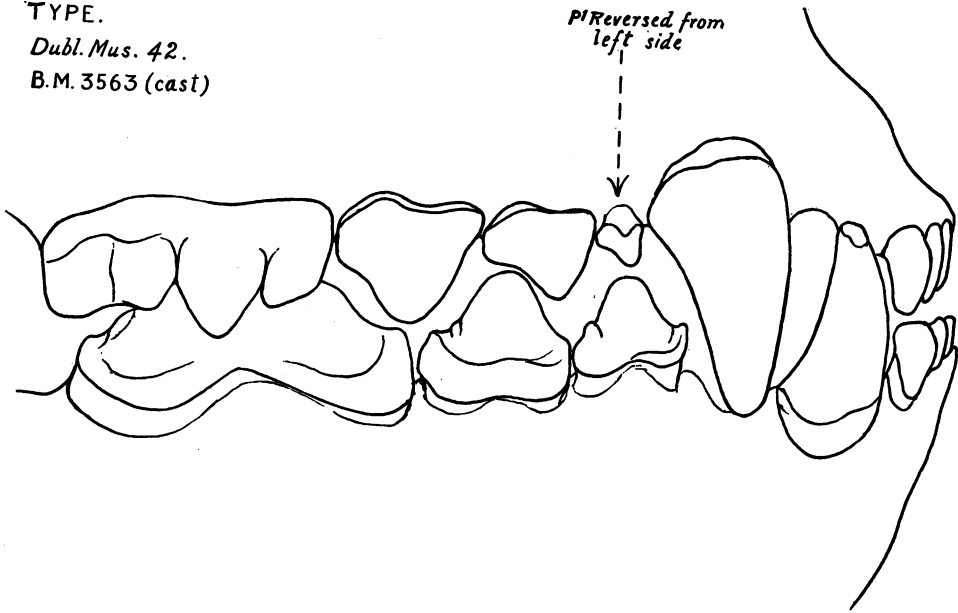


Fig. 26. *Hyæna sivalensis* Falconer and Cautley. Right side view, natural size, of teeth of type skull, Dublin Museum of Science and Art No. 42. Drawn from the cast in the British Museum, No. 3563. Upper Siwaliks.

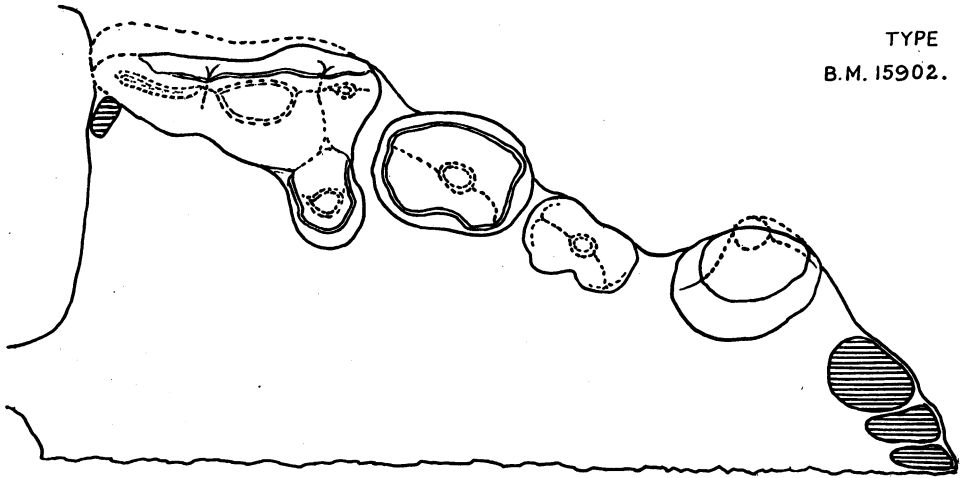


Fig. 27. *Hyæna sivalensis* Falconer and Cautley. Upper teeth, crown view, natural size, of type specimen of *Hyæna felina* Bose, British Museum No. 15902. Upper Siwalik beds.

first that *sivalensis* is not a nomen nudum but a properly based species name dating from 1868, and second that, even if it were, it would as a homonym preoccupy *sivalensis* Bose.

The Dublin skull, a very poor cast of which is in the British Museum, No. M 3563, is a very large and fine one, with the lower jaws attached in such manner as to conceal a great part of the dentition.

The type of *Hyæna felina* Bose is a decidedly smaller skull, with dentition somewhat smaller throughout (but the differences in apparent size are partly due to wear, the Dublin skull being a young adult, the Bose type an old individual; and are explained by Lydekker on the ground of sex).

The species appears to be nearly allied to *H. crocuta* but its affinities can be more safely determined after the type has been properly prepared, the jaws taken off and the dentition cleaned up.

#### ***Hyæna felina* Bose, 1880**

Probably a synonym of *H. sivalensis* Falconer and Cautley, 1868.

*Felis cristata* FALCONER AND CAUTLEY, 1868, in Falconer, Pal. Mem., I, p. 548, description of unpublished plates of Fauna Antiqua Sivalensis.

*Hyæna felina* BOSE, 1880, Quar. Jour. Geol. Soc., XXXVI, p. 130, Pl. vi, Fig. 6; LYDEKKER, 1884, Pal. Ind., (X) II, p. 278.

TYPE.—B. M. No. 15902, a skull.

The left maxilla is lacking in the Fauna Antiqua Sivalensis plate, and was added subsequently. It is present in Mr. Bose's figure. Lydekker does not figure the type. This type, a skull with heavily worn teeth, has a general though not very close resemblance to the type of *sivalensis*, but is notable for an extreme reduction of  $m^1$ , short, wide palate with very little spacing between  $c^1$  and  $p^2$ , large internal lobe to carnassial—all characters allying it to *crocuta*. As the characters visible in the type of *sivalensis* also ally that species to *crocuta*, it would seem wholly probable that Lydekker was right in regarding the two skulls as of the same species.

#### ***Hyæna colvini* Lydekker**

*Hyæna colvini* LYDEKKER, 1884, Pal. Ind., (X) II, p. 290, Pl. xxxv, Fig. 2 (type), Pl. xxxv, Fig. 1, Pl. xxxvi, Fig. 1 (second skull).

TYPE.—Ind. Mus. D47, part of skull. Cast in British Museum, No. 1552.

PARATYPE.—A skull, Ind. Mus. D45, cheek teeth mostly gone. Cast in British Museum, No. M1551.

A number of additional specimens referred.

HORIZON.—Upper Siwaliks (as recorded by Pilgrim).

This species appears to be nearly allied to *H. sivalensis*, of which it may be perhaps a small variety. The upper molar is much larger, the inner cusp of the carnassial appears to be somewhat smaller and the premolars less robust; but if fully distinguishable it is at all events closely

related to *sivalensis* and belongs to the *crocuta* group. Has the same short face, wide palate, long blade and fairly large inner cusp to carnassial, robust, crowded premolar. In the second skull, the  $m^1$  is (apparently) considerably smaller than in the type (but as only the root of  $m^1$  is present in the type, this is not so certain).

***Hyæna (Lycyæna) macrostoma* Lydekker**

*Hyæna macrostoma* LYDEKKER, 1884, Pal. Ind., (X) II, p. 298, Pl. xxxvii, Pl. xxxvi, Fig. 2. *Lycyæna* PILGRIM, 1910, Rec. Geol. Sur. Ind., XL, p. 199.

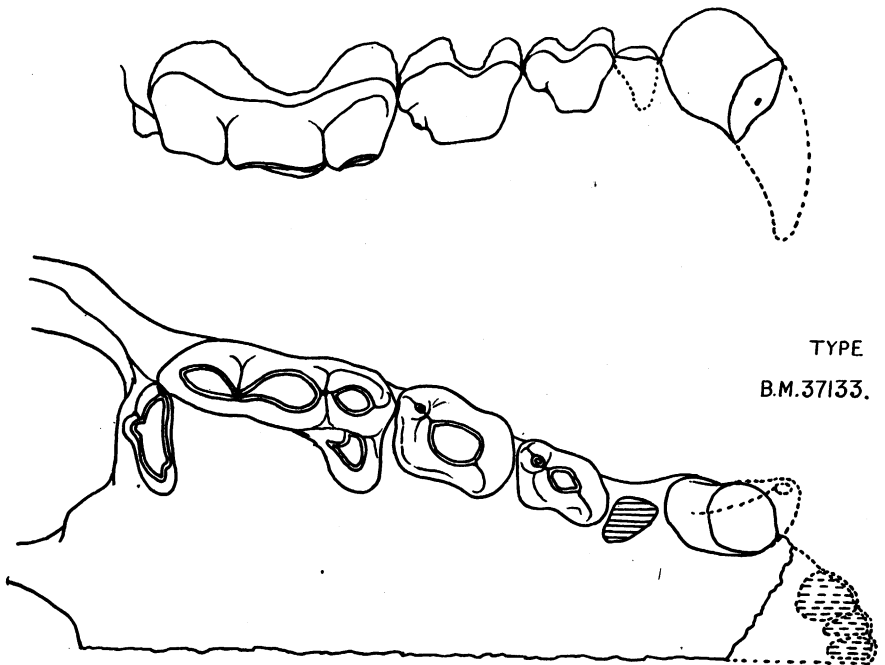


Fig. 28. *Hyæna bosei*, upper teeth, external and crown views, natural size, from type skull, *Hyæna sivalensis* of Bose and Lydekker, not of Falconer. British Museum No. 37133. Upper Siwalik beds.

TYPE.—Ind. Mus. No. D44. Cast in British Museum, No. M1547. Collected by Theobald at Jabi, Punjab—Middle Siwaliks. Reported by Pilgrim from other Middle Siwalik localities.

The skull differs notably from the short, deep type of *sivalensis*, and the dentition is much more primitive.  $P^1$  is present, spaced between  $c$  and  $p^2$ ; the following premolars appear rather narrow; the carnassial has no such great development of the posterior blade as in the *crocuta* group, and the protocone (deuterocone) is either

reduced or absent, although there is a fairly strong internal root. The  $m^1$  is a quite large and trihedral tooth, presumably tricuspid. The palate is narrow and elongate, quite approaching *Ictitherium* in proportions.

This species compares with *H. eximia* of Pikermi, as well as with *H. chæretis* of Pikermi (type of *Lycyæna*). The skull is more primitive than *eximia*, perhaps comparable with *chæretis*. Probably deserves at least subgeneric separation from the *crocuta* group.

#### **Hyæna (*Hyænictis*) *bosei*, new species**

*Felis cristata* (in errore) FALCONER, 1868, Pal. Mem., I, Pl. xxv, Figs. 1-4.

*Hyæna sivalensis* FALCONER AND CAUTLEY, emend. BOSE, 1880, Quar. Jour. Geol. Soc., XXXVI, p. 128, in part.

*Hyæna sivalensis* BOSE LYDEKKER, 1884, Pal. Ind., (X) II, p. 303, Pl. xxxiv, and of later authors.

TYPE.—B. M. No. 37133, a skull, nearly complete.

HORIZON.—Upper Siwaliks, auct. Pilgrim. The matrix is like that of *Canis curvipalatus*, etc.

This skull is of very definitely primitive type, decidedly more so than *H. macrostoma*, comparable with *H. chæretis* or *Hyænictis græca* of Pikermi. These species are apparently nearly related to the striped hyena, *H. striata*.

The whole aspect of the dentition is rather primitive, suggesting *Palhyæna hipparionum*. Referred specimens show  $m_2$  sometimes present, sometimes absent. It is present in *H. græca*, absent in *striata*. A small metaconid on  $m_1$  absent in *græca*, present in *striata*.

#### **Palhyæna indica Pilgrim**

*Palhyæna indica* PILGRIM, 1910, Rec. Geol. Sur. Ind., XL, p. 64.

TYPE.—A maxilla, presumably in Indian Museum.

PARATYPE.—A mandible, Ind. Mus. D53, described by Lydekker under the name of *Hyæna sivalensis* BOSE (Pal. Ind., (X) II, Pl. xxxviii, Fig. 2; Pl. xxxix, Fig. 5).

HORIZON AND LOCALITY.—Middle Siwaliks, Hasnot.

DESCRIPTION.—“Last premolar more nearly equals carnassial than in Chinese specimens referred by Schlosser to *Palhyæna* aff. *hipparionum*.”

#### **LEPTYÆNA**

TYPE.—*Ictitherium sivalense* LYDEKKER, 1880, Rec. Geol. Sur. Ind., X, p. 32.

Pilgrim states that the entire dentition of this species is known to him, and notes its resemblance to *Palhyæna hipparionum*.

Probably the genus is not separable from *Palhyæna*.

**FELIDÆ****Felis cristata** Falconer and Cautley

*Felis cristata* FALCONER AND CAUTLEY, 1836, *Asiat. Res.*, XIX, p. 135, Pl. **xxi**, Figs. 1-2; FALCONER, 1868, *Palæont. Mem.*, I, p. 315 (but not Pl. **xxv**, Figs. 1-4, erroneously so described in plate description).

TYPE.—A skull in the Mus. Roy. Coll. Sing., cast, B. M. No. 28913. From Upper Siwaliks.

The skull has lost the left maxilla almost wholly, and the crowns of all the remaining teeth. It has been carefully described and compared and figured by Lydekker, and there is nothing further to be said about it.

I refer provisionally to this species two jaw fragments, B. M. Nos. 48437, M1567, described by Bose and Lydekker under *Machærodus palæindicus*. They are certainly not machærodontine, and either one may represent the lower dentition of *F. cristata*, although they differ so much in the  $p_4$ , the only comparable part, that I have doubts of their belonging to the same species. They are of no great importance at the best. The first shows  $p_4$ - $m_1$ , the second  $p_4$  and the root of  $p_3$ , all badly battered.

**Felis brachygnatha** Lydekker

*Felis (Cynælurus) brachygnatha* LYDEKKER, 1884, *Pal. Ind.*, (X) II, p. 326, Pl. **xliii**, Figs. 1-2.

SYNONYM.—*Cynælurus pleistocænicus* ZDANSKY, 1925, *Pal. Sin.*, (C) II, fasc. II, p. 23, Figs. 3 and 4 of Pl. IV.

TYPE.—Lower jaw, B. M. No. 16573, with  $i_2$ - $m_1$ , the canine broken off and other teeth more or less damaged.

This species is also represented by a second lower jaw, B. M. No. 16537, very similar in size and parts preserved, except that the canine and incisors are lost, and that  $p_3$ , incomplete anteriorly and poorly preserved in the type, is here complete and well preserved.

Lydekker refers the species to the subgenus *Cynælurus* upon rather inadequate grounds, chiefly the shortness of the jaw. He also compares it to *Felis arvernensis* Croizet and Jobert, and notes the close resemblances, but differentiates the two by the somewhat shorter diastema and the smaller  $p_3$  with less development of the "anterior and posterior talons" (*i.e.*, accessory cusps). The latter character, however, is probably drawn from the type of *brachygnatha*, which has  $p_3$  imperfectly preserved; in the second jaw the  $p_3$  is as large as in *arvernensis* and other cats of similar size, and has well developed accessory cusps. It would appear therefore that there is little to separate *brachygnatha* from *arvernensis* except geographical distance.

*Cynælurus pleistocænicus* Zdansky is very closely related to *F. brachygnatha*, and so far as comparisons can be made appears to be identical. The distinctions which Zdansky draws—(1) reduced  $p_3$  in the type jaw, (2) greater compression of the premolars, and (3) different outline of premolars, their greatest width not so much above the posterior root—are all the results of comparison with a poor drawing of

damaged teeth, which have lost a considerable part of the outer surface at the sides, especially near the base, altering their apparent outlines. If the lost enamel and surface chipping be restored or allowed for, the outlines of premolars and molars are nearly identical.

#### **Felis aff. pardus**

*Felis* non det., allied to *F. pardus*, LYDEKKER, 1884, Pal. Ind., (X) II, p. 328, Pl. XLIII, Figs. 4, 4A.

TYPE.—No. 16537A, British Museum, a lower jaw with  $p_3$ - $m_1$ .

The most notable characters of this jaw except size are brachydonty of the teeth, abrupt depth of the masseteric fossa and relative depth of the jaw, especially anteriorly.

The second jaw referred by Lydekker to this species, No. 48929 British Museum collection, is a machærodont, probably *M. falconeri*.

#### **Felis subhimalayana Brown**

*Felis* BAKER AND DURAND.

TYPE.—A skull in the Museum of Science and Art, Dublin.

Size of domestic cat.

#### **METAILURUS Zdansky**

Zdansky has recently erected another new "genus" of Felidæ that needs comparison with the Siwalik species. It is, as he recognizes, related to *Pseudælorus*, but he distinguishes it from that genus: (1) because of the relatively long, straight canines, which still retain a trace of the anterior and posterior ridges of the primitive cats. This he considers absent in *Pseudælorus* because it is said to be absent in certain referred specimens of *P. larteti*. (2) Because  $m^1$  is stated to have "noch deutlich trituberculären Bau" in *Pseudælorus*, which presumably means that it retains something of the inner cusp, lost in *Metailurus*. And (3) the talonid is less reduced in *Pseudælorus*.

Dr. Zdansky quite puts aside as impossible that *Pseudælorus* could be in any degree ancestral to *Metailurus*, or the latter to *Felis*. I do not understand why, unless it be that he wholly rejects the view that the modern cats are derivatives of animals more or less of the *Dinictis* type, through *Nimravus* and *Pseudælorus*. If the *Dinictis* ancestry be accepted, there is no great difficulty in the phylogeny, nor any especial need to separate *Metailurus* from *Pseudælorus*, still less to regard it as having nothing to do with the ancestry of any later forms. The characters which Zdansky regards as specialized are really primitive and quite what should be expected in an early Pliocene feline. The characters of *Pseudælorus*, aside from the alleged lack of crests on the canine, are a little more primitive throughout, and quite what should be expected in a Miocene feline. As for the canines of *P. larteti*, this species may have been in this particular more progressive towards the feline type—or the tooth may

be worn or damaged (as in the case of *Felis brachygnatha*, q. v.). In any case, it does not determine the affinities of that genus, and all the rest of the evidence falls in line, unless indeed one reverts, with Scott and some other writers, to the older view, under which detailed study of the Felidæ led to hopeless confusion, and a tangled phylogeny in which everything is a side branch, and "für die Abstammung späterer Formen kommt sie nicht in Betracht." Scott's argument in support of that view can be sufficiently answered by saying that in the first place he greatly exaggerates the amount of reversion in the Felidæ, that they do not by any means revert to exactly the normal type of æluroid dentition, but retain many traces of a sub-machærodont ancestry; and in the second place his interpretation of irreversibility in evolution, that its general direction cannot be reversed in any phylum, is contradicted by innumerable cases on a larger or smaller scale, to many of which Dollo has drawn especial attention and set forth with his usual brilliancy. For it is not at all Dollo's concept of irreversibility that Scott in this instance and Petronievics as a general law have set forth, but the old concept of a bygone era of palæontology. Dollo pointed out that traces of past adaptations are always to be found in a new adaptation, and that is eminently the case with the cats; when one compares them with viverrids or mustelids or with the hyænids, it is easy to see various peculiarities that point back to a *Dinictis* or *Ælurictis* ancestry.

*Metailurus* does not seem to me to be separable generically from *Pseudælorus*, although it represents an intermediate stage between that genus (typically) and *Felis*. Nor do I find any reason for removing the American species from *Pseudælorus*, with the typical species of which they agree more nearly than they do with the types of *Metailurus*.

#### ÆLUOPSIS Lydekker

*Æluopsis* LYDEKKER, 1884, Pal. Ind., (X) II, p. 316.

?SYNONYM.—*Sivælorus* Pilgrim.

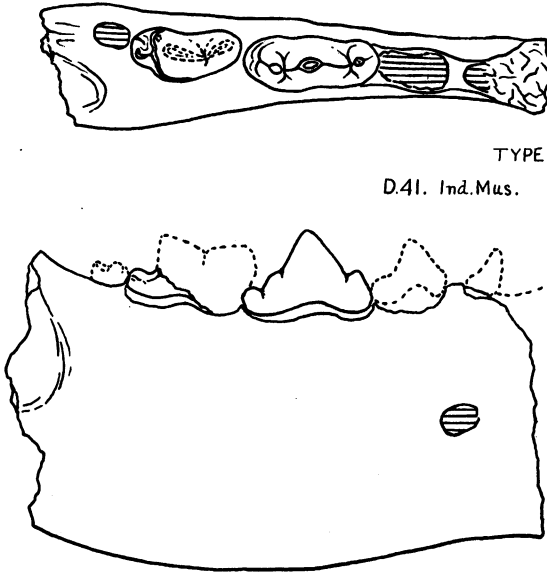
TYPE.—*Æluopsis annectens* Lydekker, *loc. cit.*, known from a lower jaw fragment from the Middle Siwalik beds, Hasnot.

The affinities of this genus appear to be with the true cats, not with the machærodontine group. At the anterior end of the jaw, beneath the alveolus of  $p_3$ , the lower border turns inward as toward a normal feline symphysis; the infraorbital foramen is in the position normal to the Felinæ, further back and higher up than in the Machærodontinæ. The third premolar appears to have been unreduced; the fourth has small accessory lobes even for a feline, much smaller than in machærodontines. The presence of a definite crested heel, and of an oval alveolus for a small  $m_2$  are primitive characters which are also seen in an undescribed feline jaw found in the American Mio-Pliocene. They indicate the survival of a type rather closely allied to *Nimravus*



of the Lower Miocene of America and *Ælurictis* of the ?Oligocene and Lower Miocene of Europe.

It seems probable that *Sivælorus* Pilgrim is an intermediate or related stage, a smaller and more primitive species of *Æluropsis*, but Pilgrim's genus is at present known only from an upper jaw and a provi-



TYPE

D.41. Ind. Mus.

Fig. 29. *Æluropsis annectens*. Lower jaw, type specimen, Ind. Mus. D41, natural size, crown and external views with reconstruction of the cheek teeth. The premolars may be interpreted as one large  $p_3$  in place of the two smaller teeth,  $p_2$  and  $p_3$  as here shown; this, however, appears the more probable interpretation. The metaconid on  $m_1$  is either minute, as here indicated, or wholly absent. Middle Siwalik beds.

sionally referred lower jaw, incomplete posteriorly and doubtfully associated in the writer's opinion; and *Æluropsis* is even more imperfectly known, from the lower jaw fragment containing only  $p_4$  and the heel of  $m_1$  complete.

#### ***Æluropsis annectens* Lydekker**

*Æluropsis annectens* LYDEKKER, 1884, Pal. Ind., (X) II, p. 316, Pl. xxxiii, Figs. 4, 4A.

TYPE.—Part of lower jaw, with  $p_4$  and heel of  $m_1$ .

**SIVÆLURUS** Pilgrim, 1913

## ?ÆLUROPSIS Lydekker

TYPE.—*Pseudæluxurus chinjiensis* Pilgrim, 1910.

This is a considerably more primitive type than any of the Siwalik sabre-tooth cats, and nearer to the true cats. Following are the generic characters:

1. Upper canine oval, probably not greatly elongate.
2.  $P_2^3$  present,  $p_3^3$  unreduced with no anterior and quite small posterior accessory cusps.
3.  $P^4$  with distinct inner cusp, small parastyle and quite rudimentary fourth cusp.
4.  $M^1$  transverse, narrow, elongate.
5. Small infra-orbital foramen.

It seems doubtful whether the lower jaw referred by Pilgrim to *S. chinjiensis* really belongs to the genus and species. There is no evidence of machærodontine affinity in the upper jaw; on the contrary, it shows distinct feline affinity in the round-oval canine (not too large for a true cat although Pilgrim seems to think it so), in the small infra-orbital foramen, the well developed internal cusp on  $p^4$ . The weak parastylar cusp, and the transverse, unreduced  $m^1$  are primitive characters, approaching *Dinictis*, and indicate (1) corresponding weakness in the posterior and ? anterior accessory cusps of  $p_4$ , and (2) probable presence of a considerable talonid on  $m_1$ . These are characters of *Æluropsis* Lydekker, q.v.

It seems very likely that the type of lower jaw that belongs with *S. chinjiensis* is one which we have found in the *Hipparion* zone of North America. It resembles *Ælurictis* of the Phosphorites, but differs in absence of  $m_2$  and reduction of  $p_3$ ; differs from *Pseudæluxurus* in retaining a distinct and fairly well developed heel on  $m_1$ , and has little if any trace of the angulation of the symphysis distinguishing that genus.

Pilgrim's attempt to associate *Sivæluxurus* with *Felis nebulosa* as a separate distinct phylum from the other felids appears to me too speculative for serious discussion. The only point in its favor is that *nebulosa* is in several ways the most primitive of living Felidæ, and naturally comes a little nearer to any late Tertiary form of appropriate size. But there is no reason that I can see for giving preference to *Sivæluxurus* over *Pseudæluxurus* as an ancestor for this species of *Felis*, and the primitive characters of *Sivæluxurus* point to its being rather a persistent primitive survival, like the American species compared with it, than an ancestor of any species of *Felis*. Much more adequate evidence is needed for

placing its phylogenetic affinities, save in the manner of the 'schwindelbäume' so beloved of palæontologic literature of a few decades ago, and still most prevalent in discussions of the ancestry of man.

#### The Genera of **MACHÆRODONTINÆ**

The sabre-tooth cats are in great confusion both as to nomenclature and taxonomy. European writers until recently have lumped under *Machærodus* a great variety of species while separating out certain other genera no better, if as well, entitled to separation. In reviewing the Indian species it has been necessary to look into the European Tertiary and Pleistocene sabre-tooths, and make some attempt to clear up the confusion.

Three distinct genera appear to have been confounded under the current name *Machærodus*. One of these, and the earliest found, is a type found at Val d'Arno and various Pleistocene localities in Europe, North and South America and probably in Asia and Africa. The best known, but one of the most specialized, representatives of this type is the great South American sabre-tooth; somewhat less specialized species are found in North America, even better represented by the hundreds of skulls and proportionate quantities of skeleton material found at Los Angeles. This type is represented in the British Museum by a jaw from Kessingland, Norfolk, probably by other remains; by casts of jaws from the Val d'Arno, etc. Its characters will be specified under the genus-heading *Smilodon*.

A second type is that represented by the fine skull and jaw from the Upper Pliocene of Mont Perrier, named *Felis meganthereon* by Bravard in 1828, and had apparently been distinguished as a subgenus *Meganthereon* by Croizet and Jobert in the same year.

A third type is that found at Eppelsheim and Pikermi, to which the name *Machærodus* properly applies.

These three types of the later Cenozoic are all quite distinct from the true cats, *Pseudælurus* and *Felis* (with its subgenera), and also from the middle Tertiary genera *Dinictis* and *Nimravus* (including *Ælurictis*) of the feline series, *Hoplophoneus* (with *Eusmilus* as a subgenus) of the machærodontine series, and *Pogonodon*, partly intermediate but belonging to the feline group (not, however, *P. davisii*, which is a *Hoplophoneus*). Cook's genus *Heterofelis* is nearly related to the true *Machærodus* of Pikermi, but may prove to rank as a subgenus. The rest of the thirty-five or forty generic names given to fossil sabre-tooth cats are for the most part pure synonyms; some, however, like *Trucifelis*, *Homotherium* and *Sivælurus* may deserve subgeneric rank when better known.

**SMILODON** Lund, 1842

TYPE.—*Hyæna neogæa* Lund, from the Pleistocene of Brazil.

Represented by skeletons of *S. bonærensis* from Argentina in Museo Nac., Buenos Aires, American Museum of Natural History, New York, skulls and casts of skulls in London and Paris museums and elsewhere.

Also by numerous skulls and composite skeletons of *S. californicus* from Rancho-La-Brea, Los Angeles, California. Some nine hundred skulls were secured at this locality, and they are principally assembled at the Los Angeles and Berkeley, California, Museums.

Here are referred jaws of sabre-tooth cats and separate tusks from the Val d'Arno Lower Pleistocene. Jaw described by Fabiani in 1890 as *Machærodus crenatidens*; tusk originally figured and described by Cuvier as belonging to *Ursus etruscus* renamed *cultridens*, but the name *cultridens* is inapplicable for reasons specified under *Machærodus*.

## CHARACTERS.—

1.  $P_3^2$  reduced to a vestigial tooth or wholly absent.
2. Accessory cusps of  $p_4$  very large, sometimes almost equaling the protoconid, the cusps much pitched backward.
3. Accessory cusp of  $p^4$  (in front of parastyle) well developed, often as large as the parastyle itself. Sometimes a rudimentary fifth cusp in front of it.
4.  $M^1$  a small vestigial rudiment.
5. Lower canine greatly reduced, almost incisiform, the dependent flange of the lower jaw little marked, more or less degenerate, but the angulation marked.
6. Upper canine gigantic, a long, broad, flattened blade.
7. Size mostly very large, skull and skeleton extremely specialized, tail short, etc.

This is the Pleistocene sabre-tooth on which the general concept of the group has been chiefly founded.

*Trucifelis*, *Dinobastis*, *Smilodontopsis*, all based upon extremely fragmentary material from the American Pleistocene, are probable synonyms, perhaps of subgeneric value when adequate neotypes are known.

*Smilodon* does not appear to be in the described Siwalik fauna (but probably is in Pleistocene of India as well as China), but is in the Pleistocene of Europe as well as North America. The Holarctic species may need separation into subgenera when more carefully compared.

**MACHÆRODUS** Kaup, 1833

SYNONYM.—? *Heterofelis* Cook, *Paramachærodus* Pilgrim.

Non SYNONYM.—*Drepanodon* Nesti, *Steneodon* Geoffroy.

TYPE.—An upper canine. No species name; probably = *Felis aphanista* Kaup.

*Machærodus* KAUP, 1833, Oss. Foss. Darmst., p. 24, Pl. 1, Fig. 5.

[Not *Drepanodon* NESTI, 1826, N. Giorn. Lett. (Pisa), XIII, p. 6; Type, ?*Ursus cultridens* = *U. etruscus* Cuvier. (Auct. Sherborn, Index Mam.)].

Lydekker's statement that *Drepanodon* was only described as a species name appears to be due to his referring the name to another

publication of Nesti's (listed by Sherborn). It appears to be a generic name with *Ursus cultridens* as type.

But Cuvier's *Ursus cultridens* is specifically stated by him to be a new name for his *Ursus etruscus*, of which the types are undoubted ursid (?*Ursus*) jaw fragments from the Val d'Arno (Lower Pleistocene). The species name *cultridens* Cuvier is therefore a *synonym* of *etruscus*, and the machærodont upper canine which suggested his new name does not belong to the species.

The names *Drepanodon*, *Steneodon*, *Cultridens* and some others based on this *species* will therefore fall into the synonymy of the Ursidæ, however inappropriately.

This, however, is not the case with Kaup's *Machærodus*, which is based not upon the species *etruscus* but upon canines (specifically upon the one which he figures) which he considers were wrongly referred to the species *etruscus* and which he thinks to be neither bear nor cat, and compares to *Megalosaurus*. He does not positively state it to be a reptile, but evidently thought so.

It appears almost certain, as Boule has shown, that Kaup's *Felis aphanista* is the same species as his *Machærodus* tusk. Lower jaw from Eppelsheim in the British Museum shows the characters of *F. aphanista* very well. The characters of the genus are admirably shown in the specimens from Pikermi referred by Gaudry and others to *Machærodus 'cultridens'*, and in the somewhat smaller form distinguished as *M. schlosseri* by Weithofer.

CHARACTERS.—

1.  $P_3^2$  little reduced,  $p_3$  similar in construction to  $p_4$ .
2. Accessory cusps only moderately developed on  $p_3-4$ , and with little backward pitch of cusps.
3. Accessory cusp of  $p^4$  well developed.
4.  $M^1$  long, transverse, less reduced than in the other genera.
5. Lower canine stout, rather compressed oval, no dependent flange on jaw but a prominent angulation of surface at symphyseal region in front and beneath.
6. Upper canine very large, stout, flattened, not so long as in others.
7. Size medium to large.
8. Lower molar has mostly a vestigial metaconid (or heel).

**MEGANTHEREON** Croizet and Jobert

*Meganthereon* CROIZET AND JOBERT, 1828, Recherches Oss. Foss. Dept. Puy-de-Dôme, p. 200.

TYPE.—*Felis meganthereon* Bravard.

This genus and species appear to rest upon the admirably preserved skull and lower jaw from the Upper Pliocene (= ?Pleistocene) of Mont Perrier, of which the type is in the Paris Museum, and casts in the British Museum and elsewhere. It

B.M. 39730.

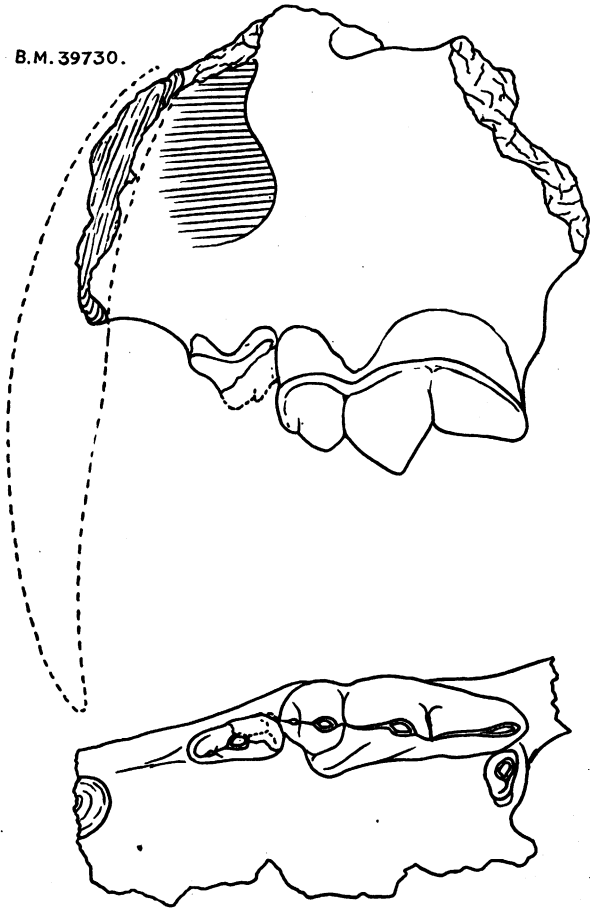


Fig. 30. *Meganthereon falconeri* Pomel (= *Drepanodon sivalensis* Falconer). Upper jaw, natural size, external view and crown view of teeth. British Museum No. 39730. The dotted restoration of the canine is based upon the indications of the alveolus and the proportions of the tooth in allied European species. Upper Siwalik beds.

includes species of rather small or moderate size with a very long, slender canine, unlike the short broad blade of *Machærodus* and the long, broad blade of *Smilodon*. It has a well developed dependent flange on the lower jaw, very short face, and the cheek teeth of intermediate specialization between *Machærodus* and *Smilodon*.

It was to this genus that the machærodont canine from Val d'Arno, wrongly ascribed by Cuvier to *Ursus etruscus*, appears to have belonged, according to Boule. But, as already noted, it seems impossible to accept Boule's transfer of the species name *cultridens* to a sabre-tooth, as Cuvier specifically states that it is a new name for *etruscus* and therefore by the laws of nomenclature the type of *etruscus* is the type of *cultridens*, and the machærodont tusks were no part of the type but subsequently referred material.

CHARACTERS.—

1. Upper canines long, slender, not crenulate (this last may be merely specific or accidental).
2. Lower jaw with well developed dependent symphyseal flange.
3.  $P_3^2$  reduced,  $p_3$  being much smaller than  $p_4$ —two-rooted or with somewhat connate roots.
4.  $P_4$  with moderate accessory cusps considerably smaller than protoconid, well developed talonid, the cusps all pitched considerably backward.
5. Minute vestigial heel on  $m_1$ .
6.  $P_4$  with rudimentary 'fourth cusp' anterior to parastyle, no inner cusp.
7.  $M^1$  small, round-oval.

A more complete revision of the European species referable to this group may make some revision necessary in the above characterization. It is represented primarily by the small Mont Perrier species, occurs also at Val d'Arno, and at La Grive and Sansan occur species that may be referable to the genus, though probably more primitive.

**Meganthereon falconeri Pomel**

*Machærodus* OWEN, 1846, Brit. Foss. Mamm. and Birds, pp. 178-9.

*Meganthereodon falconeri* POMEL, 1853, Catal. Méthodique, p. 56.

*Machærodus falconeri* GAUDRY, 1862, Anim. Foss. et Géol. de l'Attique, p. 113.

*Drepanodon sivalensis* FALCONER AND CAUTLEY, in Falconer, 1868, Pal. Mem., I, p. 550, Pl. xxv, Figs. 5, 6.

*Machærodus sivalensis* LYDEKKER, 1884, Pal. Ind., (X) II, p. 334, Pl. xlv, Figs. 1, 2, 4-6.

The first description of this Siwalik machærodont is in Owen's volume of 1846, where he specifies and describes three specimens, all in the British Museum collections:

No. 16350, right maxilla, young, with milk canine and milk carnassial:

No. 39730, part of upper jaw, permanent dentition  $p^3$ - $m^1$  l.

No. 16557, part of left lower jaw,  $p_4$ - $m_1$  and root of  $p_3$ . Owen evidently regarded this material as representing a distinct species, but gave no name to it.

Pomel in 1853 gave the name *falconeri*, with a species diagnosis evidently based upon Nos. 16350, 16554 and either 16557 or 48436 or both. No specimen can be said to be definitely indicated as type.

In the Plate Descriptions of the Fauna Antiqua Sivalensis, Falconer in 1868 gives the name *sivalensis*, Nos. 16350 and 16557 being figured.

Mr. Bose in 1880, while separating certain specimens as *M. palæindicus*, does not specify any type for '*sivalensis*.'

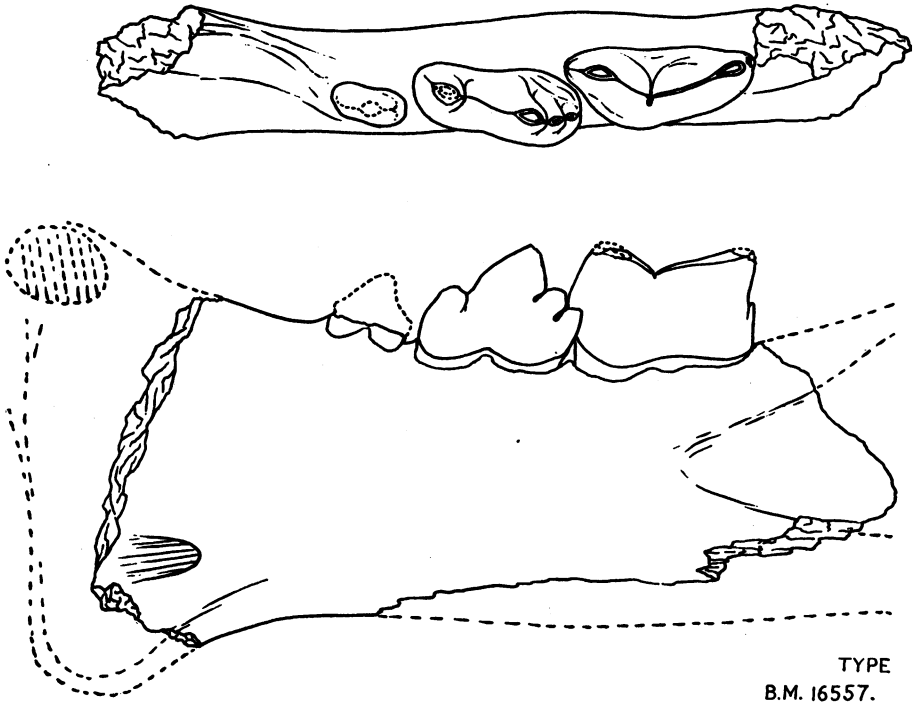


Fig. 31. *Meganthereon falconeri*. Lower jaw, type specimen, natural size, external and superior views. British Museum No. 16557. Front of jaw reconstructed on analogy of *M. palæindicus*.

Lydekker in 1884 selects No. 16557 as type.

It would appear therefore that the lower jaw, No. 16557, is the type of *M. sivalensis* = *falconeri*.

With this jaw agree quite closely Nos. 16554, a right lower jaw,  $p_3$ - $m_1$ , and 48929, left lower jaw with  $p_4$ - $m_1$ ; these two specimens lack the minute vestigial metaconid of the type and are slightly smaller; No. 16554 was referred by Lydekker to *M. sivalensis*, No. 48929 to *Felis* sp.

On this basis *M. falconeri* is a species of moderate size closely related to *M. meganthereon* of Perrier and Val d'Arno, decidedly smaller than *Smilodon crenatidens*