11. *Undescribed FOSSIL CARNIVORA from the SIVĀLIK HILLS in the Collection of the British Museum.* By P. N. BOSE, Esq., B.Sc. (Lond.), F.G.S. (Read December 17, 1879.)

[PLATE VI.]

INTRODUCTION.

THE able descriptions by Falconer, supplemented of late by Rütimeyer and Lydekker, have made the Sivālik Ungulates widely known in the scientific world; but the remains of the Carnivora, partly on account of their comparative rarity and, perhaps, partly because they mostly belong to forms which do not strike the imagination so forcibly, have had less attention bestowed on them. As long ago as 1836, Falconer and Cautley described two of the larger forms under the names of *Felis cristata* and *Ursus sivalensis**. The latter was afterwards raised to the rank of a genus, called by Falconer, *Hyænarctos*, evidently in opposition to De Blainville, who, under the designation of *Sivalarctos*, placed it at the head of his new suborder Subursidæ. Subsequently Dr. Falconer described another novel and highly interesting Carnivore under the title of *Euhydriodon sivalensis*. All these descriptions will be found in the first volume of the Palæontological Memoirs†. Owing to the untimely death of Dr. Falconer, science was deprived of the rare advantage of a description of the remaining Carnivora from the pen of that gifted comparative anatomist. Most of them, however, had been figured by Mr. Ford for the 'Fauna Antiqua Sivalensis'‡, but were never published. At the suggestion of Prof. Judd and Mr. Etheridge, I undertook an examination of these; and through the courtesy and liberality of Dr. Woodward, of the Geological Department, every facility was afforded to me for my investigation. I have also to acknowledge my obligations to Mr. Davies, of the Geological Department, whose thorough acquaintance with the fossils was of great service to me; and also to the authorities of the Zoological Department for the loan of specimens from the Osteological collection, which, as yet unknown to the public, contains hidden treasures of inestimable value. I am also indebted to Prof. H. G. Seeley for several valuable suggestions.

Besides the three species accurately described by Falconer, Messrs. Baker and Durand ably noticed the remains of several Carnivora in the pages of the Journal of the Asiatic Society of Bengal§; and lately

* Asiatic Researches, vol. xix.

† *Op. cit.* pp. 315, 321, 331. The figures 1-4, pl. xxv., accompanying the description of *F. cristata* in Pal. Mem., are wrongly referred to that species; and the index to the unpublished pl. K (Pal. Mem. vol. i. p. 548) is, by an error, headed *Felis cristata*.

‡ These figures are contained in the unpublished plates K, L, M, N, O, P, Q, now preserved in the Geological Department of the British Museum.

§ *Op. cit.* vol. v. p. 579.

Mr. Lydekker has discovered four new and interesting species of Carnivora*.

The following is a complete list of fossil Carnivora from the Sivālik Hills known at present:—

1. *Amphicyon palæindicus*, Lydekker.
2. *Hyaenarctos sivalensis*, Falc. et Cautl.
3. — *palæindicus*, Lydekker.
- 4.† *Lutra palæindica*, Falc. et Cautl. et nob.
- 5.‡ *Mellivora (Ursitaxus) sivalensis*, Falc. et Cautl.
6. *Enhydriodon sivalensis*, Falc. et Cautl.
7. *Ictitherium sivalense*, Lydekker.
- 8.† *Viverra Bakeri*, nob.
- 9.§ *Canis curvipalatus*, nob.
- 10.† — sp. ?
- 11.† *Hyaena sivalensis*, Falc. et Cautl. et nob.
- 12.† — *felina*, nob.
13. *Felis cristata*, Falc. et Caut.
- 14.† — sp. ?
- 15.† *Machærodus sivalensis*, Falc. et Cautl. et nob.
- 16.† — *palæindicus*, nob.
17. *Pseudelurus sivalensis*, Lydekker.

Until lately the Sivālik fossils used to be quoted by palæontologists as Miocene; but the Geological Survey of India refer the ossiferous Sivālik strata to the Pliocene epoch; and Messrs. Medlicott and Blanford have, in their valuable 'Manual of the Geology of India,' entered into a very elaborate discussion regarding their age. From the stratigraphical evidence, according to them, "there can be no reasonable doubt that the Manchhar beds of Sind, as a whole, correspond with the Sivālik formation of Northern India;" and the Lower Manchhar beds are shown by them to be most probably Upper Miocene||. But the evidence for correlating these beds with the Lower Sivāliks (the Nāhans), which are perfectly unfossiliferous, and the "almost unfossiliferous Upper Manchhar beds to the ossiferous strata of the Sivāliks," is, to say the least, not incontrovertible. Correlation of strata in the absence of fossils would be necessarily uncertain, especially seeing that, as we are informed by Messrs. Blanford and Medlicott, it is "extremely difficult to trace particular zones amongst the confused and contorted mass of the newer Tertiary deposits in the sub-Himalayan ranges and the Punjab." There is no reason why a part of the Lower Manchhars should not correspond to a part of the Sivāliks above the Nāhan group. Our knowledge of the Lower Manchhar fauna is derived from remains which, according to

* Records of the Geological Survey of India, vol. x. pt. 1, p. 32, pt. 2, p. 83; vol. xi. pt. 1, p. 103.

† Described here.

‡ Described by Messrs. Baker and Durand under the generic name of "*Gulo*" (J. A. S. of Bengal, vol. v.).

§ Description of Messrs. Baker and Durand supplemented here.

|| Manual of the Geology of India, p. 581.

Messrs. Blanford and Medlicott, "are extremely fragmentary, and chiefly consist of single teeth and broken portions of bones"*. Fifteen species of Mammalia have been determined from such remains; and of these ten are also met with in the ossiferous Sivāliks. One would therefore feel some hesitation in referring the latter to an age subsequent to that of the Lower Manchhars.

The palæontological evidence adduced by the learned geologists is, according to their own admission, far more unsatisfactory. In fact, in order to explain the Miocene facies of the Sivālik fauna, they have had to adopt the theory that some of the European Miocene forms survived in the Sivālik area during Pliocene times. The theory is simple in itself; and no objection can be raised against it. But obviously we should have recourse to such a theory only if the ossiferous Sivāliks were proved by clear stratigraphical evidence to belong to the Pliocene epoch, or if the Sivālik fauna could be shown to have decidedly stronger affinities with the Pliocene than with the Miocene faunas of other localities. It is greatly to be regretted that the exact horizons from which the fossils have been collected are not known; and there can be no doubt that a few of these (though their number must be very limited) are more recent than the rest. But it is certain that by far the great majority of the animals composing the Sivālik fauna lived at an epoch intermediate between the Middle Miocene and the Middle Pliocene; and the question is whether the fauna should be quoted as Upper Miocene or Lower Pliocene. I shall here only attempt to answer this question on the palæontological evidence afforded by the Carnivora, the subjects of this description; but I may say that if the Sivālik fauna were discussed as a whole, the answer would not be different.

There are 12 genera of Carnivora known from the Sivāliks. Of these, six (*i. e.* half), viz. *Machærodus*, *Pseudælorus*, *Ictitherium*, *Amphicyon*, *Hyænarctos*, and *Enhydriodon*, are extinct. Of the 11 genera of Carnivora† known from the Miocene of Sansan and Simorre, 6 (*i. e.* a little more than half) are extinct, viz. *Machærodus*, *Pseudælorus*, *Amphicyon*, *Hyænarctos* (*Hemicyon*), *Ictitherium* (*Thalassictis*), and *Pseudocyon*. The first five of these genera are common to the Sivāliks; *Machærodus* ranges from Miocene to Pleistocene; but *Pseudælorus*, *Amphicyon*, and *Hyænarctos* are characteristically Miocene genera, though the first and the third have been met with in deposits of Pliocene age, the former in America, and the latter in Europe. *Amphicyon*, however, is not yet known to have survived the Miocene epoch. *Enhydriodon* has been hitherto confined to the Sivāliks. Now if we examine the Lower Pliocene fauna of Montpellier‡, or the Upper Pliocene fauna of Mount Perrier§, we find only one extinct Carnivore, and that the ubiquitous *Machærodus*. The fauna begins to assume an altogether recent aspect. The fossils found at Pikermi present, as a whole, a close parallel to those from the Sivālik Hills—so much so that Messrs. Medlicott and

* *Op. cit.* p. 471.

† Pictet, 'Traité de Paléontologie,' tom. iv. p. 677.

‡ Pictet, *op. cit.* p. 681.

§ Pictet, *op. cit.* p. 683.

Blanford have made the age of the latter to hinge on that of the former. After quoting M. Gaudry's authority to prove that the Pikermi fauna is Pliocene and not Miocene, they conclude by saying that "there can be, therefore, no reasonable doubt that the Pikermi fossils, like the Sivalik, are of Pliocene age, and that the quotation of them as Miocene is an error"*. But if it is an error to quote the Pikermi fauna as Miocene, M. Gaudry himself, on whose authority this conclusion is based, is guilty of it; for in his latest work† he constantly cites the Pikermi fossils as Upper Miocene. Considering, therefore, the strong affinities of the Sivalik fauna, as a whole, to the known Miocene fauna, and having regard to its close relationship with the Pikermi fauna, it would, I venture to suggest, be advisable, for historical purposes, to place it on the same horizon as the latter, and regard them as Upper Miocene. In the Sivalik fauna, however, there is most probably an admixture of some Pliocene forms.

It will be seen from the list given above that there are 17 species of Carnivora known to occur as fossil in the ossiferous Sivaliks; but there are indications of some more. In the collection of the British Museum there are several mutilated skulls belonging, most probably, to small forms of Carnivora, but the affinities of which, in the absence of dentition, I have been unable to determine exactly. We may therefore safely add 3 more species, making the total number 20. In the Sivalik area, at the present day, there are altogether 17 or 18 species of Carnivora‡, showing a decrease of 3. The Carnivore fauna of India consists of about 40 species§, that is to say, double the number known from the Sivaliks. This is owing to the increase in the *smaller* forms, the number of the larger forms having decreased. The numerical strength of the existing Carnivore fauna of India presents a striking contrast to the extreme poverty of the Ungulate fauna (including the Proboscidiæ), which does not consist of more than 27 species||. No less than 60 species of Ungulates (including Proboscidiæ) are known from the Sivalik beds—that is to say, more than double the number now inhabiting the whole of India. The proportion of the fossil to the living Ungulates in the Sivalik area itself, as pointed out by Messrs. Medicott and Blanford, is as 5 to 2. We therefore come to the conclusion that if the Carnivore fauna has been impoverished, the impoverishment has been considerably less than that of the Ungulate fauna.

MACHÆRODUS SIVALENSIS, Falc. et Cautl. et nob. (Pl. VI. fig. 5.)

Two imperfect crania, six fragments of lower jaws, and two of upper jaws, in the collection of the British Museum, are all labelled *Drepanodon (Machærodus) sivalensis*. Of the six specimens of lower

* *Op. cit.* p. 584.

† 'Les enchainements du Monde Animal,' Paris, 1878, pp. 48, 264, 265, 271, 273, &c.

‡ Medicott and Blanford, *op. cit.* p. 589.

§ Jerdon's 'Mammals of India,' pp. 68-154.

|| Jerdon, *op. cit.* p. 228.

jaw, two* evidently belong to *Felis*, probably to the *Felis cristata* of Falconer; two others have been added to the collection since Dr. Falconer's death, and are not mentioned in the 'Palæontological Memoirs.' These are of much larger dimensions than, and otherwise differ from, the two remaining fragments of lower jaw. Of the crania, the size agrees with that of the former, which I have separated as belonging to a distinct species.

Of the four specimens for which I have retained the specific name of "*sivalensis*"†, two have been briefly described by Prof. Owen‡. One is a fragment of upper jaw with evidently the deciduous dentition, and the other is a portion of the lower jaw. The first is thus noticed by the learned palæontologist:—

"The molar series in the Sivālik *Machærodus* includes, in an extent of $1\frac{1}{2}$ inch, three teeth; the first, which is simple, single-fanged, and very small, is indicated by the socket; the second, measuring 8 lines in the antero-posterior diameter, is the carnassial or sectorial tooth; its crown is more compressed, its trenchant margins sharper, and the inner tubercle less developed than in the normal species of *Felis*. The socket of the third or tubercular molar is behind, or in a line with the sectorial tooth, as in the milk-teeth of the Lion. What remains of the canine indicates its great length; the breadth of its base is 5 lines; it is much compressed; the inner surface is flat, and both edges are finely but distinctly serrated."

On a careful examination of the specimen§ in question, I am obliged to differ from so high an authority as Prof. Owen in some points contained in the description just quoted. The canine and sectorial are *in situ*; and there is the alveolus for the back molar, which, as in the deciduous dentition of *Felis*, is very large. But I find no indication whatever of the presence of a molar between the sectorial and canine||; and I submit that, reasoning *à priori*, we should not expect to find that molar. The dentition in the specimen is obviously the deciduous dentition, as stated by Prof. Owen himself¶. In the adult *Machærodus*, with the single exception of

* B.M. no. 16537 and no. 16573; Pal. Mem. vol. i. p. 551; Fauna Antiq. Siv. unpublished plate N, figs. 6, 6a, 7, 7a. I find that Mr. Davies, too, referred these figures to the genus *Felis*.

† M. Pomel notices the Sivālik *Machærodus* as *Meganthereon Falconeri* (Cat. des Vert. Foss. &c. p. 56). M. Gaudry, following Pomel, mentions it as *Machærodus Falconeri* (An. foss. de l'Attique, p. 113).

‡ 'History of Brit. Foss. Mamm.' pp. 178, 179.

§ The specimen has been figured in one of the unpublished plates (pl. N) of the 'Fauna Antiqua Sivalensis.' But the artist, Mr. Ford, who was generally very careful, has by an error represented a tooth in front of the sectorial (fig. 3a). The specimen has been refigured in Pal. Mem. (pl. xxv.). It is numbered in the B.M. 16350.

|| Dr. Falconer, in a note on *Felis spelæa* (Pal. Mem. vol. ii. p. 456), expresses the same opinion. He says:—"In the Sowalik specimen [of *Machærodus*] there is an interval between the carnassier and canine of 0·3 inch, part of which has been artificially rubbed down; but there is not the least indication of a fang-pit or fang [Owen says there is, and that it is single-fanged and simple!]." (The italics are mine.)

¶ Op. cit. p. 178.

Leidy's somewhat aberrant species (*M. primævus*)*, there are altogether three molars, the anterior false molar of *Felis* (pm. 2) being absent. Now this tooth replaces the first milk-molar, that is to say, the molar between the deciduous sectorial and the canine †. Hence, as the anterior premolar of *Felis* is absent in the adult dentition of *Machærodus*, we should expect the corresponding molar of the milk-dentition also to be absent in the latter. The anterior false molar of the adult *Machærodus* is the homologue of the second of the molar series in *Felis*, and, as in this genus, replaces the deciduous sectorial, the permanent sectorial taking the place of the large back molar of the milk-dentition. Thus the deciduous dentition of the upper jaw on each side in *Machærodus* would be

d. i. 3, d. c. 1, d. m. 2=6,

instead of

d. i. 3, d. c. 1, d. m. 3 (*Felis*)=7.

There are two other points in Prof. Owen's description which call for a word or two by way of comment. He says that the "inner tubercle of the sectorial is less developed than in the normal species of *Felis*." But it is not developed at all. Both edges of the canine are asserted by the eminent naturalist to be "finely, but distinctly serrated." The serration of the posterior edge is distinct, but the anterior edge is damaged; and we cannot determine whether it was serrated or not.

The other fragment of upper jaw (B.M. no. 39730) evidently belongs to an adult individual, and exhibits three molars *in situ*. The canine has been removed, and the hinder part only of its alveolus is visible. It is separated by a short diastema (0.35 inch) from the anterior premolar, which is the homologue of the second of the molar series in *Felis*. It is two-fanged, the fangs being divergent. The crown has been damaged; but the base shows the tooth to have been smaller than the corresponding tooth of *M. neogæus*, as well as of *M. meganthereon*. The sectorial is intermediate in size between these two species; in antero-posterior length it is a little less than double the deciduous sectorial, and is much more stout and less trenchant than the latter. There is no internal tubercle, but a slight thickening of the cingulum is visible in its place; and a prominent flattened ridge (absent in the milk-sectorial) ascends from the thickened portion to the summit of the second of the three lobes into which the blade is as usual divided. In the anterior of these lobes a notch maps off a small lobe in front and a considerably larger one behind. The middle lobe has an elevated, triangular, pointed crown; the posterior lobe has a low, horizontal, sinuous edge.

Of the two fragments of lower jaw one has been briefly described by the learned comparative anatomist I have quoted above ‡. It

* 'Anc. Fauna of Nebraska,' p. 96. † Owen's 'Odontography,' p. 489.

‡ Owen, 'Brit. Foss. Mamm.' p. 179, figs. 4, 4a; unpublished plate N, Fauna Antiq. Siv.; fig. 6, pl. xxv. Pal. Mem. vol. i.

shows well the downward and forward extension of the mandibular symphysis, which is more elevated than in *M. meganthereon*. The canine is absent; but, from its inferred position, the diastema between it and the first false molar may be concluded to have been shorter than either in *M. neogæus* or *M. meganthereon*; and the height of the ramus in front of the molar series is proportionately greater than in these two species. These peculiarities are better exhibited by the specimens to be described under the next species. The crown of the first premolar is broken off, but it is entire in the other fragment of lower jaw*. The anterior accessory cusp, which is well developed in *M. meganthereon*, as well as in *M. neogæus*, is entirely absent; and the posterior is not so well marked as in these two. The antero-posterior extent of the crown is less than in *M. meganthereon*†. The next premolar (pm. 4) slightly overlaps the carnassial, and is composed of a low anterior cusp, a deltoid middle lobe, and a bilobed posterior cusp, the summits of all these pointing backwards, as in the Brazilian and French species. The antero-posterior length of the carnassial, like that of the preceding molar, is intermediate between that of the corresponding tooth in these two species.

MACHÆRODUS PALÆINDICUS, nob. (Pl. VI. figs. 1-4.)

The specimens just described indicate a species of *Machærodus* as large as the Jaguar‡; but the two specimens of lower jaw§ which have been added to the collection since Dr. Falconer's death, as well as the two crania mentioned above, must have belonged to much larger individuals, nearly equalling in size the Royal Tiger of Bengal.

One of the fragments of lower jaw exhibits the symphyseal extension downwards very well. In the other known species of *Machærodus* the extension takes place below the canine; but in *M. palæindicus* the downward prolongation of the outer border of the ramus takes place further back, below the second false molar (pm. 4). The fossa for the reception of the upper canine is much better defined than in any other species. In the Brazilian, as well as the French form, the border of each ramus curves upwards in front of the anterior premolar, and then downwards to meet the symphyseal extension. But in both the Sivālik forms there is no such curvature; consequently the height of the diastema (especially in *M. palæindicus*) between the canine and the first false molar is considerably greater. This, coupled with the relative shortness of the diastema, gives a very formidable look to the lower jaw of *M. palæindicus*. As noticed by De Blainville in *M. meganthereon*||, the mental foramen is situated further down than in the Lion or the Tiger. I have observed, in addition, that there is, as a rule,

* B.M. no. 16554; figs. 8, 8a, unpublished plate N (F. A. Siv.).

† The first premolar (pm. 3) is of very variable size in *M. neogæus*; and in one of the specimens in the British-Museum collection it is entirely absent.

‡ Owen, *op. cit.* p. 178.

§ B. M. nos. 48436 and 48437.

|| 'Ostéographie,' genus *Felis*, p. 130.

only one mental foramen; and this, or, if there are two (as in a specimen of the lower jaw of *M. neogæus* in the British Museum collection), the posterior of these is situated in front of a vertical line drawn from the front base of the anterior premolar; whereas in the Lion or the Tiger, in which there is always more than one mental foramen, the hindermost is situated behind that line. The canine and the first false molar are indicated by their alveoli; in antero-posterior length the latter is larger than the corresponding tooth of *M. meganthereon*. The next molar (pm. 4) and the carnassial are *in situ*, but they are both damaged; they are about the same size as the corresponding teeth in the Brazilian *Machærodus*.

The remaining specimens consist of the posterior portion of a skull* and a nearly entire, but mutilated, cranium†, which has been a good deal crushed.

They present the following peculiarities:—

1. The facial portion is considerably less in length than the cranial. This is a peculiarity common to the other species of *Machærodus*, and also to the *Felis cristata* of Falconer, which, as noticed by that learned comparative anatomist, is the only large feline animal that presents this Hyænoid characteristic.

2. The sagittal crest, which is very prominent, slopes gradually in front up to its point of bifurcation. This characteristic is also shared by the other two species of *Machærodus*, and, it is interesting to observe, by *Felis cristata* and *F. grandicristata* (?) alone of all the larger forms of *Felis*.

3. The zygomatic process of the squamosal is prolonged vertically downwards so as to form a strong and stout pedicel, separated by a narrow valley from the mastoid.

4. The mastoid portion of the petiotic is of much greater extent, and is prolonged further downwards than in either the Lion or the Tiger.

5. The occipital crest is very high.

The following measurements of *M. meganthereon*, and also of the bones of the skull and the upper-jaw teeth of *M. neogæus*, have been taken from the beautiful figures in De Blainville's Atlas‡; the measurements of the lower jaw of the last species have been taken from two specimens in the collection of the British Museum:—

* B. M. no. 39728; figs. 1, 1a, 1b, 1c, unpublished pl. N (F. A. Siv.).

† B. M. no. 39729; figs. 2, 2a, &c., unpublished pl. N (F. A. Siv.).

‡ Ostéographie, Atlas, genus *Felis*, pls. xvii. and xx.

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	<i>M. siva-</i> <i>lensis.</i> (adult.)	<i>M. palæ-</i> <i>indicus.</i>	<i>M. megan-</i> <i>thereon.</i>	<i>M. neo-</i> <i>gæus.</i>
UPPER JAW.	in.	in.	in.	in.
Antero-posterior length of pre-molar 3 (first of the molar series)	0.45	...	0.575	0.7
Antero-posterior length of the sectorial	1.3	...	1.1	1.67
Antero-posterior length of the tubercular	0.15			
Transverse length of the tubercular	0.275			
LOWER JAW.				
Antero-posterior length of pre-molar 3 (first of the molar series)	0.35	0.5	0.4	
Ditto, ditto of pm. 4	0.75	0.9	0.65	0.925
Ditto, ditto of carnassial	0.95	1.1	0.75	1.125
Length from the postorbital apophyses to the border of the incisives	...	4.425 (?)	4.25	4.75
Length from the postorbital apophyses to the occipital crest	...	6	4.75	6.25
Maximum height of the diastema (outer border) between the canine and pm. 3	1.75	2.3	1.175	1.575
Length of the diastema	...	1.275	...	1.95
Extreme height from the base of foramen magnum to occipital crest	...	4.1		

[With regard to the relations of the Sivālik species to *M. cultridens*, *M. latidens*, and *M. palmidens*, nothing can be said at present, as, with the exception of an imperfect specimen of the milk-canine, neither this tooth nor the incisors of the Sivālik species have yet been discovered. *M. palmidens*, however, could be distinguished by the size and form of the two lower premolars.]

FELIS, sp. ?

The specimen consists of a cranium* deficient in the facial portion in front of the orbits. The zygomatic arches, brain-case, and its base are beautifully preserved. The specimen is not mentioned in the 'Palæontological Memoirs,' but it is entered as *Felis cristata* (?) in the catalogue of the British Museum, and, as I am informed by Mr. Davies, comes from the Sivālik Hills. The skull belonged to an animal considerably larger than *Felis cristata*, and of about the same size as the larger varieties of the Royal Tiger. The sagittal crest (slightly damaged posteriorly) is much thicker

* B. M. no. 49175.

and more prominent than in *Felis cristata*, and stands vertically on the roof of the cranium. Its height anteriorly is six times greater than the corresponding height in the Tiger. The ridges which originate from behind the postorbital processes of the frontal are stronger and run obliquely to a greater distance than in any other large forms of *Felis*; and these, instead of perfectly blending to form the sagittal crest, run parallel nearly as far as the occiput, forming a narrow and shallow groove along the median line of that crest. The triangular valley included between the frontal ridges in front of the parietal crest, as well as the frontal fossa between the postorbital apophyses, slopes anteriorly, as in *Felis cristata*, and not posteriorly, as in other large Felidæ. The depth of the mesopterygoid fossa, as well as the length of the basicranial axis, is very nearly the same as in the larger individuals of Tiger; but the breadth of the cranium at the zygomatic arches is proportionately much smaller than in the latter.

	inches.
Length of basicranial axis to the anterior extremity of the mesopterygoid fossa . . .	5·075
Depth of the mesopterygoid fossa	1·025
Extreme breadth at zygomatic arches	8·125
Greatest breadth between outer surfaces of the occipital condyles	2·775

Further evidence is necessary before the species can be clearly separated from *F. cristata*. If it should prove a distinct species, as I am inclined to think it will, I propose to call it *F. grandicristata*.

HYÆNA SIVALENSIS, Falc. et Caut. ? et nob.*

The specimens consist of a tolerably perfect cranium and portions of palate and of upper and lower jaws †. These indicate an animal of about the same size as the living Indian Hyæna (*H. striata*). One of the specimens shows the incisors and the canine *in situ*, the former being much better developed than the corresponding teeth in the living Indian Hyæna. The crown of the second premolar, which is proportionately larger than in any of the living species, is formed by a stout cone; the anterior accessory cusp, so well marked in the living Indian Hyæna, is entirely absent; but the posterior accessory

* Dr. Murchison heads the indices to the plates L & M as *Hyæna sivalensis* (Falc. & Cautl.) (Pal. Mem. vol. i. p. 548); but in the same page he says:—"Unfortunately no account of it is to be found among Dr. Falconer's notes. This species is, no doubt, that designated *Hyæna sivalensis* by Messrs. Baker and Durand in the brief description given by them in the Journal of the Asiatic Society for October 1835, vol. iv. p. 569." If it were so, the specific designation would be due to Baker and Durand, and not to Falconer and Cautley. But I have not met with it anywhere except in the Palæontological Memoirs, and on the unpublished plates L and M of the F. A. Siv., where the name occurs in pencil writing, which Mr. Davies identified as Dr. Murchison's.

† B. M. nos. 37133, 37137, 37138, 37139, 16583, 16578, 39731, 37141. Figs. 2, 2a, 2b, 2c, unpub. pl. K; figs. 2, 2a, 2b, 6, 6a, 7, 7a, 8, 8a, unpub. pl. L; figs. 5, 5a, 7, 8, 8a, unpub. pl. M. The cranium has been refigured in Pal. Mem. vol. i. figs. 1, 2, 3, 4, pl. 25, under the title of *Felis cristata*.

cuspid is present. The cingulum is very pronounced, except posteriorly, and swells antero-internally into a talon-like prominence, from which a well-defined ridge ascends up the crown. The third premolar differs from the preceding in its greater size and in having the posterior accessory cusp proportionately less developed. The fourth premolar or sectorial consists, as usual, of a blade divided into three lobes and of a stout trihedral internal tubercle, separated from the outer lobes by a deep valley; the elongation of the posterior lobe of the blade approximates the fossil to *H. crocuta*. But the tubercular is still more highly developed proportionately than in the living Indian *Hyæna*, thus differing remarkably from the Cape *Hyæna*. This tooth is triangular and three-fanged. In the lower jaw, the first and second molars (pm. 2 and pm. 3) are entirely devoid of the anterior accessory cusps so well developed in *H. striata*. The third premolar (pm. 4) consists of a principal cone, a rudimentary anterior accessory cusp, and a tolerably well-developed posterior one. Two prominent longitudinal ridges, one anterior and the other posterior, ascend up the principal cone and divide it into two faces, of which the outer is much more convex than the inner. The dimensions of the tubercular part of the first molar or carnassial are intermediate between those of the corresponding part in the striped and the Cape *Hyænas*. The accessory cusp at the inner and posterior part of the base of that tooth is either entirely absent or, if present, quite rudimentary, thus differing remarkably from the living *Hyæna* of India, and approximating to *Hyæna crocuta*.

The large tubercular molar of the upper jaw in the fossil under examination differentiates it from *H. spelæa* and the allied species, or, rather, varieties, *H. intermedia* and *H. Perrieri**. It is distinguished from *H. prisca* and *H. arvernensis* by the absence of the anterior accessory cusps in the premolars†. The antero-posterior length of the upper tubercular in *H. hipparionum*‡ is proportionately much greater. *H. eximia*§ is separated, by the presence of premolar 1 in the lower jaw, from all other known species of *Hyæna*.

In its general outline the skull resembles that of *H. striata*. As in the latter, the brain-case is swollen behind and not laterally compressed as in *H. crocuta* or its allied fossil *H. spelæa*. The sagittal crest is very well marked. The lambdoidal crest is not so much reflected back at its apex as in *H. spelæa*. The postglenoidal processes are very stout and strong. The postorbital processes of the frontal are very well developed, and are proportionately longer than in any other known species.

It will be seen from what has been said that while in certain characters, as in the form of the skull, the dimensions of the upper tubercular, &c., *H. sivalensis* comes near to the most primitive of the three living species of *Hyæna*, in certain other characters, and

* W. Boyd Dawkins, 'Nat. Hist. Rev.' 1865.

† Blainville, 'Atl. d'Ost.' gen. *Hyæna*, pl. viii.

‡ Gervais, 'Zool. et Pal. Fr.' p. 242, pl. xii.

§ Gaudry, 'Anim. foss. et Géol. de l'Attique,' p. 82, pls. xii., xiii., xiv.

notably in the absence or extremely rudimentary character of the postero-internal basal denticule in the lower carnassial, as well as in the entire absence of the anterior accessory cusps in the upper and the first two lower premolars, it approximates to the most differentiated form, now represented by the Cape Hyæna. No other species of Hyæna is known in which there is such a remarkable combination of characters shared by such divergent forms.

	inches.
Length from occipital condyle to the front of the base of the canine	7·555
Height of occipital crest from base of foramen magnum	2·175
Upper jaw—	
Antero-posterior length of alveolus of premolar 1 ..	0·175
Minimum ant.-post. length of premolar 2	0·65
Maximum ant.-post. length of premolar 2	0·775
Minimum ant.-post. length of premolar 3	0·675
Maximum ant.-post. length of premolar 3	0·875
Minimum ant.-post. length of sectorial	1·175
Maximum ant.-post. length of sectorial	1·4
Transverse length of tubercular	0·55
Height of the crown of incisor 1	0·25
Height of the crown of incisor 2	0·3
Height of the crown of canine	0·875
Lower jaw—	
Antero-posterior length of premolar 2	0·575
Antero-posterior length of premolar 3	0·75
Antero-posterior length of premolar 4	0·8
Minimum ant.-post. length of carnassial	1·05
Maximum ant.-post. length of carnassial	1·1

HYÆNA FELINA, nob. (Pl. VI. fig. 6.)

The history of the specimen * on which this species is founded is thus given in the 'Palæontological Memoirs' † in the index to the unpublished plate K (headed *Felis cristata* by an error), in explanation of the figures 1, 1a, 1b, 1c:—"Four different views of an imperfect cranium from Mr. W. Ewer's collection. The left maxillary bone with the teeth is absent; but the portion was found after the drawing was made, and has been added to the specimen in the British Museum."

Dr. Falconer entered the left maxillary bone alluded to here as belonging to *Hyæna* in the British-Museum Catalogue. The skull as it now stands is deficient only in the zygomatic arches, and evidently belongs to an aged individual. The facial portion has suffered a crush anteriorly, and is slightly distorted in consequence. The incisors have been removed. The crown of the canine has been broken off, but its base shows it to have been proportionately stronger than the corresponding tooth of *Hyæna*; this, however, may be an individual variation. There is *no indication whatever* of the

* B. M. no. 15902.

† *Op. cit.* vol. i. p. 548.

presence of premolar 1, which is so constant in all known species of *Hyæna*, living or fossil; and the canine is separated by a short diastema from premolar 2 (first of the molar series in the fossil). This tooth is two-fanged, and resembles the corresponding tooth of *Hyæna* in its dimensions, as may be judged by its base, the crown being broken off. The second false molar too (pm. 3) is in form and size hyænoid. The sectorial is proportionately larger than in the living Indian *Hyæna*, and is provided with a very strong and stout internal tubercle. The alveolus of the tubercular molar, preserved on the right side, is situated as in the *Felidæ*, and shows that tooth to have been transverse and *exceedingly small*, thus differing from *H. striata* and *H. sivalensis*. The sagittal crest is very prominent and quite *Hyæna*-like, gently sloping on the sides; but the occipital crest is proportionately higher than in any other species of *Hyæna*. The specific name given to the fossil is based on the approach it makes to feline organization, especially in the entire absence of premolar 1 from the upper jaw.

In the following measurements the skull of the living Indian *Hyæna** selected for comparison is a little smaller than the fossil:—

	<i>Hyæna felina.</i> inches.	Living Indian <i>Hyæna</i> , inches.
Length from the postorbital apophyses to the border of the incisors	5·0	4·175
Length from the postorbital apophyses to the summit of the occipital crest	5·41	5·2
Height of the supraoccipital from the top of foramen magnum	1·875	1·25
Length from the posterior extremity of the basicranial axis to the hinder end of the palate	3·32	3·425
Length from this point to the hinder border of the alveolus of incisor 1	4·375	4·15
Length from the anterior end of the base of the canine to the posterior end of the sectorial	3·85	3·35
Length occupied by the molars	2·82	2·375
Upper jaw—		
Antero-posterior length of canine at its base	0·75	0·575
" " premolar 2	0·575	0·525
" " " 3	0·775	0·775
" " sectorial	1·35	1·07

VIVERRA BAKERII, nob.

The specimens consist of a mutilated cranium with the third premolar (pm. 3), the sectorial, and the two tuberculate molars of both sides *in situ*, and a portion of the upper jaw containing the sectorial and the first molar. On the authority of the 'Palæon-

* B. M. no. 136, c. It is from the Northern Circars.

tological Memoirs'*, these have been labelled "*Canis*," but have a note of interrogation added.

The skull indicates an animal of nearly the same size as the Civet (*V. civetta*). The third premolar, which is proportionately larger than the corresponding tooth in the latter, consists of a stout triangular crown, and presents no division into accessory lobes anteriorly or posteriorly. The cingulum is well pronounced, and sends up a ridge anteriorly, which, meeting with its fellow from behind, divides the crown into two parts, of which the external is much more convex than the internal. The sectorial is like the corresponding tooth in the Civet, but proportionately larger. The anterior of the two lobes into which its blade is divided is thick and conical, with a small accessory lobule in front, and is mapped off by a notch from the posterior lobe. The internal tubercle is stout and strong, and separated by a deep valley from the outer lobes, as in the Civet. The first tubercular is triangular and tricuspid, and is a little larger than the corresponding tooth in that species. The two subequal outer cusps are ground down into flattened crescent-shaped disks; and the inner cusp is separated from them by a deep pit. The second tubercular is proportionately longer laterally and narrower antero-posteriorly than the corresponding tooth in the Civet.

There are only three other fossil species of *Viverra* which have been made out with any thing like certainty, viz. *V. antiqua* and *V. exilis* of De Blainville and *V. sansaniensis* of Lartet. The last two are known by their lower jaws only, so that I am not in a position to compare them with the present fossil. It is readily distinguished from *V. antiqua* by the proportionately smaller size of the teeth, especially of the hindmost tubercular, in the latter species †.

In the following measurements the skull of the Civet selected for comparison is a little larger than the fossil :—

	<i>Viverra Bakerii.</i> inches.	<i>Viverra civetta.</i> inches.
Length from the posterior extremity of the basicranial axis to the anterior extremity of the palate	4·55(?)	5·1
Length from the anterior extremity of pm. 3 to the posterior extremity of m. 2	1·4	1·25
Upper jaw—		
Antero-posterior length of premolar 3	0·4	0·32
Maximum transverse diameter of ditto	0·2	0·2
Antero-posterior diameter of the sectorial at the base (outer border)	0·6	0·5
Height of internal tubercle of sectorial ..	0·2	0·2
Transverse diameter at base of m. 1	0·5	0·45
" " m. 2	0·4	0·3
Antero-posterior diameter of ditto	0·2	0·25

* Vol. i. p. 153. Mr. Davies had originally labelled the skull "*Viverra*." It is figured in an unpublished plate (figs. 1, 1a, 1b, and 3, pl. Q). B. M. nos. 40183 and 40180.

† Gervais, 'Zool. et Pal. Fr.' p. 223, pl. 28; De Blainv. Atl. d'Ost. (gen *Viverra*), pl. xiii.

LUTRA PALÆINDICA, Falc. et Cautl. et nob.

A specimen of cranium (B. M. no. 37151), deficient in the zygomatic arches, and another of the lower jaw (B. M. no. 37152) are so named in the index to the unpublished plate L of the 'Fauna Antiqua Sivalensis'*. The cranium shows the alveoli of the three incisors and the canine (on each side), and of the three anterior false molars (of the left side). The sectorial and the tubercular of this side, as well as the lower carnassial, are *in situ*.

In the number, form, and disposition of the teeth the fossil agrees very closely with the living Indian Otter†; but the skull of the fossil is smaller, and the teeth proportionately larger. The brain-case is broader and higher in the fossil than in its living representative. But the most characteristic feature in the fossil skull is the form of the forehead. In the common as well as in the Indian Otter the frontal narrows from behind the postorbital process, in the shape of a triangle, up to its junction with the brain-case proper; but in the fossil the part between the postorbital processes of the frontal and the cranial cavity is wider and is of uniform breadth throughout, so as to be quadrangular instead of triangular. In this respect the fossil resembles a peculiar form of Otter described by Gray as *Lutronectis*‡; but the orbit of the latter is scarcely defined behind.

Lutra Bravardi (with which Gervais§ and Pictet|| incorporate *L. elevaris* and *L. clermontensis*¶) and *L. dubia***, especially the latter, are considerably larger than the Sivālik fossil. The tubercular is squarer in *L. Bravardi* than in either the living or the fossil Indian Otter††. *L. affinis* is very like the common European Otter (*L. vulgaris*), and thus readily distinguished from the fossil under examination‡‡.

	<i>Lutra palæindica.</i> inch.	Living Indian Otter. inch.
Length from the posterior extremity of the basicranial axis to the anterior of incisor 1, taken as modulus	1·0	1·0
Height of occiput from the top of foramen magnum	0·251	0·189
Greatest breadth of the surface of brain-case opposite mastoid processes	0·587	0·466
Minimum breadth of frontal behind its post-orbital processes	0·216	0·141
Breadth of cranium at these processes	0·251	0·209
Greatest height of lower jaw below carnassial	0·139	0·11

* Pal. Mem. vol. i. p. 552. The specimens have been refigured in pl. xxvii. (figs. 5 & 7) of Pal. Mem.

† The skull of the Indian Otter I have had for comparison comes from Madras, B. M. no. 1668 a.

‡ 'Catalogue of the Carnivora,' p. 107. It may be noted that in the absence of the contraction of the frontal behind the orbits, as well as the proportionately greater capacity of the brain-case, the fossil approaches the Polecats.

§ Zool. et Pal. Fr. p. 243.

|| Traité de Pal. tom. i. p. 210.

¶ Blainv. Ostéographie (gen. *Mustela*), p. 52, pl. xiv.

** Blainv. *op. cit.* pl. xiv.

†† Gervais, *op. cit.* pl. xxvii. fig. 6.

‡‡ Gervais, *op. cit.* p. 244.

	<i>Lutra palaendica.</i>	Living Indian Otter.
Upper jaw—	inch.	inch.
Length occupied by the incisors on each side	0·077	0·061
" " molars and canines	0·385	0·343
Antero-posterior length of canine.....	0·084	0·061
" " sectorial (outer border)	0·127	0·111
Maximum transverse diameter of tubercular	0·127	0·111
Antero-posterior length of tubercular (outer border)	0·09	0·084
Lower jaw—		
Length occupied by the molar series	0·39	0·343
Antero-posterior length of carnassial	0·146	0·14

[The length taken as modulus in the above measurements is 3.575 inches in the fossil, and 4.075 inches in the living Indian Otter selected for comparison. The absolute measurements can be deduced from this.]

CANIS CURVIPALATUS, nob.

The specimen consists of a cranium deficient only in the zygomatic arches and in the anterior portion of the palate. The lower jaw of the left side shows the three hinder premolars and the first two molars *in situ*, and the alveoli of the first premolar and the last molar. The lower jaw of the right side is broken off posteriorly, but is more complete in front than its fellow of the left side and shows the base of the canine. The cranium has suffered from a crush, and has, in consequence, been somewhat flattened anteriorly; but no distortion, at least to any considerable extent, has taken place. The cranium was briefly described and figured by Messrs. Baker and Durand in the Journal of the Royal Asiatic Society of Bengal for 1836*. By comparing it with one of a living Indian Fox (with which the fossil is most closely allied), those able palæontologists found that the fossil, while agreeing generally with the latter, differed from it in the greater breadth of the brain-case, the height and thickness of the lambdoidal crest at the summit of the supraoccipital, the greater concavity and size of the postorbital processes of the frontal, and the closer approximation of the false molars in the upper jaw; but they did not notice the following important peculiarities of the fossil, nor did they give it any specific name:—

(1) In all Canidæ, and more or less in all other Carnivora, the basifacial axis is parallel to the basiscranial axis; but in the fossil now under examination the palate makes an angle, though a very open one, with the base of the cranium, somewhat as in the Rabbit. The specific name is derived from this the most characteristic feature of the fossil.

* This description has been quoted in the Pal. Mem. vol. i. p. 341.

(2) The rami of the lower jaw are not so much compressed as in the living species of the Canidæ.

(3) Each ramus, instead of being straight, forms an arc of a circle between the angle and the mandibular symphysis.

(4) As in the upper jaw, the premolars in the lower jaw also are closer together than in the Fox.

(5) The internal tubercle of the sectorial is stouter than in the Fox.

(6) The upper tuberculars, especially the hindermost one, are proportionately larger.

Messrs. Baker and Durand noticed a peculiarity about the frontal ridges, that these, starting from the rear of the postorbital apophyses, "converge towards the occiput in a curvilinear direction, until the distance between them is reduced to about half an inch, after which they run nearly parallel for some distance, and then converge again, till they unite near the occiput and become blended with the parietal crest." I find this peculiarity, which is absent in the European Fox, well marked in both the specimens of the Bengal Fox* (*Canis bengalensis*) I have had for comparison, as well as in the Fennecs†.

CANIS, sp. ? (Pl. VI. figs. 7-9.)

One of the two posterior parts of lower jaw‡ on which this species is founded was labelled by Dr. Falconer as "*Enhydriodon*;" and in a memorandum, published in the 'Palæontological Memoirs'§, he gives the measurements of the teeth and compares them with those of the Otter. The carnassial and the tubercular following it are *in situ*; but behind the latter there is a distinct alveolus for a small molar, which must have escaped the attention of Dr. Falconer. This tooth is *in situ*, though partially damaged, in the other fragment, which is exactly similar to the one supposed by Dr. Falconer to belong to his *Enhydriodon*. The specimens|| indicate an animal of the size of the Wolf; and the form of the teeth is exactly as in that animal. On comparing the two fragments with the lower jaw of the living Indian Wolf¶ from the osteological collection of the British Museum, the rami are found to be higher and thicker and the teeth proportionately smaller in the fossil. These differences are exhibited by the following measurements:—

	Canis sp. ?	Living Indian Wolf.
	inch.	inch.
Ant.-post. length of the carnassial	0·95	1
" " molar 2	0·425	0·475
Height of ramus below carnassial	1·1	1·025
Thickness of jaw	0·5	0·4

These differences may be only varietal; but it is highly probable that further evidence will establish the distinctness of the present form; in which case I propose to call it *C. Cautleyi*.

* B. M. nos. 174*h* and 174*b*. † B. M. nos. 182*c* and 815*a*.

‡ B. M. nos. 40181 and 40182. § Vol. i. p. 337.

|| These have been labelled as "*Canis*" by Mr. Davies.

¶ "*Lupus pallipes*" in Gray's Catalogue. No. 164 *g*.

EXPLANATION OF PLATE VI.

Figs. 1-4. *Machærodus palæindicus*, sp. nov.

1. Inner view of anterior portion of lower jaw.

2. Outer " " "

3. Front " " "

4. Outer " posterior "

5. Upper deciduous dentition of *Machærodus sivalensis*.

6. *Hyæna felina*, sp. nov.

7-9. *Canis*, sp. Fragments of lower jaw.