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MEMOIRS
OF THE
GEOLOGICAL SURVEY OF INDIA.

Palæontologia Indica,

BEING

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Ser. X.

INDIAN TERTIARY AND POST-TERTIARY VERTEBRATA.

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- Pt. v, 1880.—SIWALIK AND NARBADA PROBOSCIDA.—By R. LYDEKKER, B.A., *Geological Survey of India.*

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INDIAN TERTIARY AND POST-TERTIARY VERTEBRATA.

DESCRIPTIONS

OF THE

MOLAR TEETH AND OTHER REMAINS OF MAMMALIA.

By R. LYDEKKER, B.A.,

GEOLOGICAL SURVEY OF INDIA.

THE present memoir is the second of a series intended, as far as possible, to complete our knowledge of the Vertebrate Faunæ of the tertiary and post-tertiary strata of India, a work which was left unfinished at the death of Dr. Falconer; since that time many new forms of mammalia have been collected by different members of the Geological Survey, and more especially by Mr. Theobald. The present part chiefly contains descriptions of specimens selected from a very large series of detached molar teeth, now in the collection of the Indian Museum. Many of these belong to new species or genera, or have been hitherto known merely by slight notices or small-sized figures in the "Fauna Antiqua Sivalensis" and the "Palæontological Memoirs" of Dr. Falconer.

The first part of the paper treats of the molar teeth of all the species of fossil Indian *Rhinoceros* at present known, and of which there are a large series in the Indian Museum; the second part describes the molars of other genera, chiefly *Ungulata*, but also comprising *Dinotherium*, *Manis*, and *Amphicyon*; this somewhat heterogeneous mixture of genera can scarcely be avoided in taking up a subject parts of which have already been completed; in this paper I have described species of which in most cases we possess little more than the molar teeth or solitary bones, or species of which the crania have been previously figured, but of which the teeth have never been described.

The next part of the series will contain figures and descriptions of the crania of a large number of new and undescribed *Ruminantia*, while a third part will be devoted to the description of the remains of *Carnivora*, of which order several species were named, but only a few described by Dr. Falconer; at the end of this part I shall add a classified synopsis, with references, of all the extinct Indian Mammalia.

Before proceeding to the description of specimens, a few facts may be noticed as to the distribution of some of the species of mammals treated of in this part. Of the genus *Rhinoceros* we have one new species, *R. iravadicus*, now for the first time described, which is confined to Burma, while *R. platyrhinus*, *R. sivalensis*, and *R. palæindicus* are found throughout the typical Siwaliks to the east of the river Sutlej; to the west of the Sutlej, the new species *R. planidens* seems to replace *R. platyrhinus*, as no remains of the latter species have been brought among a large series of specimens by Mr. Theobald from the latter area, and the former species was not known to Dr. Falconer, whose specimens were chiefly obtained from the country to the east of the Sutlej: *Acerotherium perimense* had a larger range than any other mammal, extending from Perim Island along the Siwaliks to Burma. *Dinotherium* has hitherto been only found in Perim Island, Kach, Sind, and the Punjab. *Tapiroid* animals (*Listriodon* and *Tapirus*) have been found in Sind, the Punjab, Burma, and China (Owen); *Amphicyon* has hitherto occurred only in the Punjab district, in strata which are probably somewhat older than the typical Siwaliks, while *Dorcatherium* is found along the whole of the Sub-Himalayan Siwaliks and in Sind. Ruminants of the genera *Cervus* and *Antelope* are much more common in the Tertiaries of the Punjab than elsewhere, while *Elephants*, and more especially *Stegodon*, are there much more rare than in the Siwaliks to the east. The remains of *Hippopotamus* are found very abundantly in the strata on the banks of the Markanda and Jhilam rivers; far away from the present river-courses, the remains of this genus do not seem so common; if this be more fully confirmed, it will lend support to Mr. Medlicott's suggestion that the present river-courses existed in Siwalik times.

It will perhaps be said by some that I have formed species on somewhat insufficient material; to this I must reply that I have been very careful never to name any species except on the evidence of characteristic molar teeth or of very characteristic and unmistakeable bones. From the condition of the fossils of the Siwaliks the occurrence of entire skulls of the larger species, except of the stout skulls of *Elephants* and *Bovines*, is extremely rare in comparison to the vast number of specimens discovered.

In the case of the *Cervidæ*, I cannot find instances of any crania having been found in India, either before or since Falconer's time. We are therefore obliged to depend solely upon the characters of the molar teeth, of which we possess a very large collection in the Indian Museum, for specific determination. As there appears but little chance of ever obtaining a skull of this family from the Siwaliks, these teeth alone are important as giving us an idea of the numerous species of these *Ruminants*

which prevailed in former times; should a skull with teeth be hereafter discovered, there will be no difficulty in assigning it to its respective species. The same remarks apply to other animals, of many of which we only possess single teeth. The following species or genera are now for the first time made known or fully described:—

<i>Listriodon pentapotamiæ</i> , Falc. sp.	<i>Dorcatherium majus</i> , nobis.
<i>Rhinoceros planidens</i> , nobis.	<i>Dorcatherium minus</i> , nobis.
<i>Rhinoceros iravadicus</i> , nobis.	<i>Vishnutherium iravadicum</i> , nobis.
<i>Cervus triplidens</i> , nobis.	<i>Dinotherium pentapotamiæ</i> , Falc.
<i>Cervus simplicidens</i> , nobis.	<i>Manis sindiensis</i> , nobis.
<i>Cervus latidens</i> , nobis.	<i>Amphicyon palæindicus</i> , Falc. et nobis.

I have here to mention my obligations to Dr. Anderson, the Director of the Zoological Department of the Indian Museum, for his kindness in furnishing me with specimens of the osteology of living mammals for comparison with the fossil forms.

Order: UNGULATA.

DIV. PERISSODACTYLA, GENUS RHINOCEROS.

In the "Fauna Antiqua Sivalensis," the late Dr. Falconer distinguished three well-marked species of *Rhinoceros* the remains of which had been found in the strata of the Sub-Himalayan Siwaliks; these species were respectively named *R. sivalensis*, *R. palæindicus*, and *R. platyrhinus*; all these species were founded upon well-preserved crania. A fourth species, *R. namadicus*, from the Nerbudda, was named in manuscript, but only a few limb bones from this locality are figured in the "Fauna Antiqua Sivalensis." Beyond a short description of the cranium of *R. sivalensis*, given by Messrs. Baker and Durand in the Journal of the Asiatic Society of Bengal for 1836, no description of any of the above has appeared. A fifth species of the allied genus *Acerotherium* was also determined by Dr. Falconer on the evidence of molar teeth obtained from the ossiferous beds of Perim Island in the Gulf of Cambay: the name of *A. perimense* was assigned to this species.

Since Dr. Falconer's death another species—*R. deccanensis*, described by Mr. Foote in the first part of the present volume—has been added to the Indian fossil fauna: this species was probably of Pleistocene age; from Pliocene strata in China, Professor Owen has described molar teeth of another species, *R. sinensis*, allied to *R. sumatrensis*.

With the exception of a figure of an isolated upper molar tooth of *R. platyrhinus*, the teeth of all the species of *Rhinoceros* figured in the "Fauna Antiqua Sivalensis" are drawn on so small a scale, and the specimens themselves are generally so imperfect, that the figures, which have no accompanying description, are almost useless for the specific determination of detached molar teeth.

In endeavouring to refer to their respective species a large series of molar teeth of *Rhinoceros* now in the collection of the Indian Museum, I found the great want of good figures and descriptions of the known fossil species with which new ones might be compared. In the present memoir I have endeavoured to remedy this want by giving figures and descriptions of the molar teeth of these old species, together with those of others which could not be referred to any of them.

For the technical names assigned to the different portions of the molar teeth of *Rhinoceros*, I may refer to Mr. Boyd Dawkins' paper on the molars of *Rhinoceros tichorhinus* (Nat. Hist. Rev., 2nd Ser., Vol. 3, p. 526), where they will be found fully explained. There is also a list of most of these terms given in Mr. Foote's Memoir in the first part of this volume.

In the old Siwalik area it will be found that, including the new species here described and the Perim Island species which has lately been discovered in the Siwaliks by Mr. Theobald, there were five species inhabiting the Sub-Himalayan area, though not perhaps all living in the same spot. The assemblage of such a large number of forms of the same genus in a limited area is, to say the least, very remarkable, and one is led to wonder how or for what purpose so many distinct species were differentiated at the same time. The explanation is probably to be found in the existence of an abundant supply of food suitable for the nourishment of large herbivores, and in the presence of a large area for them to wander over. Herbivores, such as the *Elephants* and *Rhinoceros* of the Siwaliks, were of too large a size to be much molested by the attacks of *Carnivora*, and they were also, as far as we know, free from human persecution. Under such circumstances the species of a genus might increase almost indefinitely in number. It appears to me probable that when in any given area the conditions of life are peculiarly suitable for a genus of animals, in that area one would expect to find a great number of species of that genus; the production of species being, according to my ideas, merely an extension of the production of individuals. In a suitable area, the number of individuals would clearly be large, and some of them would vary, and so would originate a new species. When the physical conditions in the same area became less favourable to the genus, the "*survival of the fittest*" would come into play, and the less hardy or less modifiable forms would die out. In the gravels of the Thames valley three species of *Rhinoceros* lived contemporaneously in the same area,* being, I think, next to those of the Siwaliks, the largest number of species in one area.

RHINOCEROS PALÆINDICUS, *Falconer*. Pl. 4, figs. 3 and 4.

Of the upper molar teeth of this species of Siwalik *Rhinoceros*, we have no very complete specimens in the collection of the Indian Museum; I have therefore been obliged to content myself with figuring the imperfect but characteristic

* Boyd Dawkins : Nat. Hist. Rev., 1865, p. 403.

fragment drawn in the accompanying plate, together with a figure of a complete premolar tooth copied from the "Fauna Antiqua Sivalensis" (*plate 75, fig. 4*). A fair idea of the general form of the upper molars may be obtained from the small-scale figure of a cranium in the above work (*plate 70, fig. 6*). My descriptions are in part taken from other incomplete teeth in the Indian Museum.

The fragment drawn (*fig. 4*) is a portion of the inner half of, probably, the second upper molar of the right side; it exhibits the crochet, median valley, and portions of the adjacent colles, which are the most characteristic portions of the tooth. The entrance into the median valley is seen to be extremely narrow, with a very low pass, and no tubercle. The crochet (projecting into the valley from the right) is large, simple, and slightly recurved at its free extremity. In the present state of the tooth (about half-worn) it almost completely blocks the median valley; were the tooth still more worn down, the valley would be completely blocked and the crown would show three pits or fossettes: one of these would be formed by the posterior valley, and the other two by the divisions of the median valley. At a still later stage of abrasion the crown would show two fossettes only; this would be caused by the disappearance of the shallower portion of the median valley, which is placed on the inner side of the crochet, the outer extremity of the median valley being much deeper than the inner.

The anterior collis (*on the left side of the figure*) forms a nearly symmetrical blunt cone, without any "antecrochet," projecting into the median valley opposite to the crochet. This collis is larger than the median collis (*of which a portion is seen on the right side of the figure*), and the two do not overlap one another at the entrance to the median valley. The anterior face of the tooth is nearly straight, having a narrow cingulum along its internal half; the anterior valley is scarcely defined.

The general outline of the crown is approximately square; the dorsum is almost flat, and parallel to the long axis of the tooth. This is the most characteristic part of the tooth, by which it is at once distinguished from the teeth of *Rhinoceros sivalensis*—the only species which it at all resembles: there is one prominent costa on the dorsum situated about half an inch behind the antero-external angle; the latter angle has another rounded costa, but is not produced into a buttress—another characteristic point. The costa on the dorsum does not extend down to the neck of the tooth; the free edge of the dorsum rises into two very slight prominences,—one at the termination of the costa, and another at an equal distance from the postero-external angle. The posterior valley is large and approximately circular.

The length of the dorsum of an imperfect specimen in the Indian Museum is 1.95 inches; this is the only measurement I can give, owing to the imperfect state of our specimens.

The premolar of the same species (*plate 4, fig. 3*) belongs to the right side: the general characters of the tooth are the same as those of the molar, *viz.*, the narrow median valley, the large anterior collis (*on the right of the figure*) bending

towards the smaller posterior collis (*on the left*). The crochet is long, pointed, and simple: there is no antecrochet or combing-plate. The posterior valley forms a long narrow slit, cutting into the left side of the figure. There is a small infold of enamel on the anterior side of the first collis; there appears to be no cingulum on the anterior surface.

The peculiar straight dorsum occurs, as in the molars; but this is distinguished in the premolars by the absence of any distinct costa, and by the antero-external angle being sharper. The dimensions of the premolar are—

	In.
External side	2·5
Internal side	1·8
Anterior side	2·6
Posterior side	2·3

The molars of this species may be shortly distinguished by the following points:—

“Narrow median valley; simple crochet; straight dorsum; absence of combing-plate, of buttress at external angle, of antecrochet, and of tubercle at entrance of median valley; three fossettes on worn-crown.”

The persistent dentition of this species seems to be less complete than that of any other species of *Rhinoceros*. In the young skull figured in the “Fauna Antiqua Sivalensis” (*plate 74, fig. 1*) the last molar has not pierced the gum, and only two premolars are present: the first of these is a small, imperfect, triangular tooth, and does not seem to have had any tooth in advance of it, which view is borne out by the narrowness and smallness of the alveolar border of the maxilla in front of this tooth. If still younger specimens are procured, it would be interesting to make a section of the maxilla to see if there are any rudiments of the anterior premolars “in alveolo.” For the present the persistent dental formula must be written as follows:—

$$I. \frac{0-0}{1-1} \quad C. \frac{0-0}{0-0} \quad P. \frac{2-2}{3-3} \quad M. \frac{3-3}{3-3}$$

The penultimate upper premolar, as before said, is a small and irregularly triangular tooth with a smooth dorsum; the least premolar is a much larger tooth, with a straight dorsum having a single median costa opposite the median valley; the true molars have all two costæ on the dorsum. The dimensions of the molars in the above-mentioned cranium are as follows:—

	In.
Length of penultimate premolar	1·10
Length of last ditto	1·65
Length of first molar	1·90
Length of second ditto	2·20
Width of penultimate premolar	0·89
Width of last ditto	1·50
Width of first molar	1·85
Width of second ditto	1·90

The upper molars of this species somewhat resemble those of the European *R. leptorhinus*, Cuv. (*R. megarhinus*, Christol.), in having the dorsum nearly straight and without a buttress at the antero-external angle. The molars of the Indian species are, however, at once distinguished by having three fossettes on the worn-crown, whereas those of the European species have only two; further, the two colles are more equal-sized in the former, and the median valley is much narrower at the entrance than in the latter. The molars of *R. leptorhinus* are further distinguished by a small combing-plate. *R. hemiteachus*, Falc., also has its upper molars with a straight dorsum; and the two colles are in close opposition, as in *R. palæindicus*: the teeth of the former are, however, sufficiently distinguished by never showing more than the two fossettes on the worn-crown, and by having a small combing-plate.

From the molars of *R. sumatrensis* and *R. javanicus* those of the present species are distinguished by having three fossettes on the crown-surface instead of only two.

The upper molars both of this species and of *R. indicus* present three fossettes on the worn-crown, but the fossettes are formed in a different manner: in the present species the two fossettes in the median valley are formed by the valley being divided by the crochet; in *R. indicus* the two fossettes are formed by the union of the crochet and the combing-plate; the molars of *R. palæindicus* have no combing-plate. The same remarks apply to the molars of *R. tichorhinus*, (Cuv.), which are formed on the same plan as those of *R. indicus*.

A figure of the lower molars of this species will be found in the "Fauna Antiqua Sivalensis" (*plate 75, fig. 2*); they are characterised by having the posterior valley considerably larger and deeper than the anterior valley, so that the latter becomes completely obliterated at an early period of wear. The median collis is the larger of the three, and the limited dentine surfaces of this and the anterior collis form a complete semicircle.

The lower molar figured in the accompanying plate (*plate 6, fig. 8*) seems to belong to this species; it was brought by Mr. Fedden from the Manchhar (Siwalik) beds of Sind. The tooth is from the left ramus of the mandible, and is about one-third worn down. The posterior collis (*left of figure*) is small, and has its dentine surface placed obliquely to the long axis of the crown; the inner extremity of this collis is rounded and narrow; the posterior valley is of considerable depth and size with a wide open entrance; it would not be obliterated until the crown became worn down almost to its base. The median collis (*centre of figure*) forms by far the greater part of the worn-crown surface; its inner wall is flat and vertical, and angulated next the posterior valley; the anterior boundary of the posterior valley forms a wall of enamel running nearly at an angle of 45° to the long axis of the tooth; on the outer side there is a marked angulation in the enamel wall of the anterior moiety of this tooth; the anterior collis (*right of figure*) is very small, though it extends to the inner border of the tooth; the anterior valley is very small and shallow, and

would be soon obliterated. The whole inner border of the tooth forms a nearly straight line; the dorsum has a single vertical groove; there is no cingulum on any part of the crown; the enamel has a nearly uniform thickness. The length of the specimen is 2·2 inches and its greatest breadth 1·1 inches.

This tooth differs from Falconer's figure by the inner wall of the median collis being longer and flatter, and by the obliquity of the median enamel wall to the long axis of the crown. The tooth is, however, nearer to those of this species than to those of any other.

The mandible of this species is spatulate and provided with one large broad incisor on each side.

RHINOCEROS SIVALENSIS, *Falconer*. Plate 4, figs. 2 & 8; and Plate 5, figs. 2 & 5.

Of this species I have figured a very splendid specimen of the upper second molar of the left side, collected by Mr. Theobald in the Siwaliks of the Potwar district. Figures of penultimate and ultimate molars of the right maxilla are given in Messrs. Durand and Baker's paper, noticed above; these figures have been copied in De Blainville's "Osteographie" (*Vol. III, plate 4*). I have again copied the figure of the penultimate molar, as it presents slight differences from our specimen. I have also figured (*plate 4, fig. 2*) the ultimate molar of the right side taken from a cranium in the Indian Museum, collected by Mr. Theobald; this tooth, though considerably worn down, still shows the general relations of its component parts.

Taking first the specimen from the Potwar (*fig. 5*), we find the general shape of the crown is approximately square, with a protrusion at the antero-external angle. The anterior collis (*left side of figure*) is considerably the larger of the two; it is a blunt cone in form; the worn dentine surface of this collis runs obliquely towards the antero-external angle of the crown; there is a vertical hollow on the anterior surface of the collis. The median valley (*centre of figure*) runs in approximately the same direction as the dentine surface of the anterior collis; it becomes deeper as it passes, outwards and terminates in a triangular-shaped cavity, which extends deep down into the crown. The median valley is entered by an exceedingly narrow pass, with a sudden fall on either side; there is no tubercle at the entrance to this valley, the bottom of which forms a mere line between the colles. A single pointed crochet extends three-fourths across the valley from the median collis. There is no combing-plate or antecrochet in the median valley.

The median collis (*right side of figure*) forms a slender cone slightly twisted on itself; a small but distinct third or posterior collis is seen on the right side of the former separated by a shallow cleft; this posterior collis is continued outwards, as a narrow wall, becoming lower as it passes outwards, which forms the boundary to the posterior valley (*middle of right side of figure*); this valley is ovate at the top, becoming circular at the base.

On the anterior side of the tooth (*left of figure*) a cingulum runs along the greater part of the surface; the cingulum is broadest on the inner half of the anterior surface, and forms a distinct but shallow, and triangular anterior valley; there is a gap in the cingulum at the middle of this valley: there is no cingulum along the inner surface of the tooth. The antero-external angle of the crown is produced into a very prominent process, the worn surface presenting the section of two arches separated by a valley, and with another valley on the inner side of the most anterior of the two arches; the postero-external angle forms an acute spur.

The dorsum of the tooth is placed obliquely to the long axis of the crown; its upper half curves over towards the inner side; posteriorly to the buttress there is no distinct costa on the dorsum. The worn-crown presents two fossettes only.

The characteristic points of the teeth of this species are as follows:—

“Buttress at antero-external angle: single crochet; curved dorsum and narrow median valley; absence of combing-plate, of antecrochet, and of tubercle at entrance to median valley; two fossettes on worn-crown.”

The measurements of this specimen are as follows:—

Length of	anterior surface	...	...	...	In.
					2.4
Ditto	external surface	...	...	...	2.55
Ditto	internal surface	...	...	...	1.85
Ditto	posterior surface	...	...	...	1.95

The presence of the buttress, of only two fossettes on the crown, and the curved line of the dorsum, at once distinguish the molars of this species from those of the preceding species.

The molar tooth figured by Baker and Durand is remarkable for the unequal development of the two colles, the anterior collis being placed much nearer to the inner border of the crown than the median collis.

The ultimate upper molar drawn in plate 4 (*fig. 2*) is from the right side; it shows an anterior collis of large size; the median valley is narrow at the entrance, expands and becomes deeper as it passes outwards; the crochet is very small and blunt, the median collis (*on the left of the figure*) is placed obliquely to the anterior wall (*right of figure*) and is confluent with the outer dentine mass, as in all ultimate molars. In one of Messrs. Baker and Durand's figures of an ultimate molar of this species the crochet is divided at the extremity.

In both this and the preceding species there are no combing-plates present in the median valley, by which the molar teeth are at once distinguished from those of the two next species. The presence of only two fossettes on the worn-crown distinguishes the upper molars of *R. sivalensis* from those of *R. platyrhinus*, in which there are three. The molars of this species have some resemblance to those of *R. javanicus*; the buttress at the antero-external angle is, however, more produced in the fossil species, and the dorsum in consequence is more curved: the cingulum is also larger on the anterior surface in the fossil species: the crochet is

much larger and more pointed in the Siwalik form than in the living species; the molars of both species agree in having only two fossettes on the worn-crown. The molars of *R. sivalensis* are distinguished from those of *R. tichorhinus* (Cuv.), and of *R. indicus* by the presence of only two in place of three fossettes on the worn-crown and by the absence of the combing-plate. They resemble those of *R. sumatrensis* in having a large buttress at the antero-external angle; the median collis is, however, much smaller in proportion to the anterior collis in the fossil than in the living species, and the latter lacks the large cingulum which occurs on the anterior surface of the teeth of the former species.

From the molars of *R. leptorhinus* and *R. hemitæchus* the very prominent buttress at the antero-external angle, the absence of the combing-plate, and the curved dorsum of the molars of the present species are sufficient distinctions.

The molars of *R. etruscus* ("Fal.: *Pal. Mem., Vol. II, plate 25, fig. 7*) somewhat resemble those of *R. sivalensis*, both having a buttress at the antero-external angle, a long cingulum on the anterior surface, unequal colles, a simple pointed crochet, no combing-plate, and presenting only two fossettes on the worn-crown surface. The molars of *R. sivalensis* are, however, distinguished by the posterior collis being more distinct and elongated, by the inner extremity of the median valley being three-cornered instead of oblong, by the crown being relatively longer in proportion to its width, and by the ridges of the buttress being placed farther apart, and extending lower down on the surface of the crown.

The persistent dentition of this species seems to be as follows:—

$$I. \frac{0(?) - 0(?)}{0-0} \quad C. \frac{0-0}{0-0} \quad P. \frac{4-4}{3-3} \quad M. \frac{3-3}{3-3}$$

Figures of very much worn lower molars of this species are given in plate 75 of the "Fauna Antiqua Sivalensis." The specimen figured here (*plate 6, fig. 1*) is the last molar of the left ramus of the mandible; the crown is in an early state of wear. The anterior collis (*extreme left of figure*) is remarkable for its very small size; its inner boundary not extending beyond the middle line of the crown; the anterior valley (*left of figure*) is narrower and shallower than the posterior valley (*right of figure*), and extends farther on the outer side; the worn dentine-surface of the median collis (*centre of figure*) runs nearly at right angles to the antero-posterior axis of the tooth, while that of the posterior collis is placed very obliquely to the same axis. The posterior surface of the tooth is divided by a deep and nearly vertical groove; on the inner side of this groove there is a very small conical tubercle; there is no cingulum on any part of the tooth; the enamel is smooth and polished and of uniform thickness. Owing to its shallowness the anterior valley becomes obliterated at an earlier period of wear than the posterior valley. The length of the specimen is 2.4 inches, and its width 1.4 inches.

From Falconer's figure the species seems never to have developed the first premolar in the lower jaw; the second premolar is of relatively large size. The

mandible is but little produced in front of this tooth, and seems to have been unprovided with incisors.

RHINOCEROS PLATYRHINUS, *Falconer*. Plate 4, fig. 4.

The subjoined description of the upper molars of this species is partly derived from the restored figure of a penultimate upper molar of the right side given in the "Fauna Antiqua Sivalensis" (plate 76, fig. 11 a): [*this figure is copied in the present paper (plate 4, fig. 4,) on a scale of one-half the natural size;*] and partly from a cast of the molars of the complete cranium of the species discovered by Colonel Baker, and now in the British Museum. The species is confined to the Siwaliks.

The specimen in the accompanying figure is the above-mentioned penultimate right upper molar; the transverse diameter of the anterior collis (*on the right of the figure*) considerably exceeds that of the median collis (*on the left*); the base of the median collis overlaps that of the anterior collis, so that, in the position of the figure, no part of the base of the median valley externally to the crochet is visible from the front. The anterior collis forms a thick depressed cone, projecting on the posterior side into the median valley. The median collis is unsymmetrically shaped, the posterior wall being nearly vertical, while the anterior boundary forms an irregular convex line, blocking the entrance to the median valley. The pass to this valley is sharp and well marked, somewhat external to the inner boundary of the tooth, and as high as the level of the cingulum, with an abrupt descent into the valley. There is no tubercle obstructing the entrance to the median valley, which winds between the bases of the two colles as a narrow sinuous line.

The crochet is given off from the side of the median collis nearly at right angles to the inner border of the tooth, and has a loop of enamel on its external side; in the angle formed between the internal wall of the crochet and the anterior wall of the median collis there is a small fold of enamel; the base of the crochet is but slightly constricted; the anterior wall of the crochet slopes towards the inner side of the tooth, so that the bottom of the valley is very narrow at this point; the whole of the bottom of the valley, from the entrance as far as the crochet, forms, therefore, a mere line between the colles.

Externally to the crochet the median valley is divided into two parts by the combing-plate (*seen at the top of the median valley*), which is small and blunt, and forms an angle of 45° with the internal border of the tooth; there is no antecrochet given off from the anterior collis; the anterior boundary of the median valley forms a line running at right angles to the inner border of the tooth, and there is consequently no production of the valley in the direction of the antero-external angle of the tooth.

The dorsum of the tooth is marked by a slight anterior costa; the antero-external angle forms a sharp edge, but is not produced into a buttress; the postero-

external angle is produced backwards. A distinct cingulum runs along the whole of the anterior surface and that surface only.

The anterior valley is very narrow, bounded by the straight anterior portion of the cingulum; the posterior valley (*on the left side of the figure*) is very small and narrow; the median collis in the specimen is worn down and united with the small posterior collis.

Were the crown to be more worn down than in the figured specimen, the combing-plate and the crochet would unite and form a second fossette in the median valley, so that the crown would present three fossettes, two formed by the median valley and the third by the posterior valley.

The dorsa of the molars can be best studied from Colonel Baker's cranium: in the premolars there are two vertical ridges placed opposite the two large colles; in the first molar the hindmost of these ridges is much smaller than the other; in the second molar it has nearly, and in the last molar quite disappeared. The outer border of the crown in all the teeth is nearly parallel to the long axis of the tooth, and wears quite flat. The colles in the premolars are more equal sized and the pass into the median valley is higher in the premolars than in the molars. The following are the dimensions of the molar series in Colonel Baker's cranium:—

	In.
Length of six molars	13·0
Do. of outer surface of last molar ...	2·75
Do. do. do. of penultimate molar ...	2·70
Do. do. do. of first do. ...	2·40
Do. do. do. of last premolar ...	2·10
Do. do. do. of penultimate do. ...	2·05
Do. do. do. of first do. ...	1·75
Width of penultimate molar	3·00
Width of first premolar	2·22

The dimensions of the figured upper molar of this species, as given by Dr. Falconer, are as follows:—

	In.
External side	4·0
Internal side	2·7
Anterior side	3·0
Posterior side	2·5

A smaller specimen, also figured in the "Fauna Antiqua Sivalensis" (*plate 72, fig. 6*), has the following measurements:—

	In.
External side	3·6
Internal side	2·2
Anterior side	2·9
Posterior side	3·0
Height of crown	3·1

The persistent dentition of this species is as follows:—

$$I. \frac{0-0}{2-2} \quad C. \frac{0-0}{0-0} \quad P. \frac{4-4}{3-3} \quad M. \frac{3-3}{3-3}$$

The median lower incisors were very small and functionless; the first upper premolar was shed before the last molar pierced the gum. Falconer compared the upper molars of this species to those of *Rhinoceros tichorhinus* of Cuvier: the molars of the two species agree in presenting three fossettes on the crown-surface; but the molars of the European species are distinguished by the greater size of the posterior valley, by the non-prolongation of the postero-external angle of the crown, by the combing-plate being placed nearly at right angles to the external border, by the absence of the cingulum on the anterior surface, and by the dentine-surface of the anterior collis being curved instead of straight. The presence of three fossettes on the worn-crown sufficiently distinguishes the upper molars of *Rhinoceros platyrhinus* from those of *R. hemitæchus*, *R. leptorhinus*, and *R. etruscus* of Falconer.

From the molars of both the preceding Siwalik species, the presence of the combing-plates in the molars of this species is a sufficient distinction.

The upper molars of *R. platyrhinus* agree with those of the living *R. indicus* by having a combing-plate and three fossettes on the worn crown-surface; those of the latter species are, however, distinguished by the non-development of the postero-external angle, and by the curvature of the dentine surface of the anterior collis, together with the absence of the cingulum on the anterior surface. Irrespective of the upper molars the two species are at once distinguished by *R. indicus* having but one nasal horn, while *R. platyrhinus* had two; both species agree in having a somewhat spatulate mandible provided with large outer incisors.

The upper molars of *R. sumatrensis* and *R. javanicus* are distinguished from those of the present species by having only two fossettes on the worn-crown, and by the absence of a combing-plate.

To show the form of the lower molars of this species I have figured a detached premolar of the right ramus of the mandible. The specimen is but little worn down, and corresponds in size with the last premolar of the mandible of this species figured in the "Fauna Antiqua Sivalensis" (*plate 75, fig. 10*). The anterior collis (*extreme left of figure*) is very narrow, and extends as far inwards as the other two. The anterior valley (*left of figure*) is noticeable for its very small size and narrowness; the posterior valley, on the other hand, is very large and deep; the anterior valley would be therefore obliterated at an early stage of wear, while the posterior would remain for a much longer period. The difference in the times of disappearance of the two valleys is greater than in the lower molars of *R. sivalensis*. The worn dentine-surface of the posterior collis (*right of figure*) is placed at right angles to the long axis of the crown; the dentine-surfaces of the other two colles are also nearly at right angles to the same axis. There is a distinct cingulum running upwards and backwards from the entrance of the posterior valley along the

inner surface of the posterior collis. The enamel is very thin on the anterior collis; over the whole of the tooth it is minutely reticulated. The length of the specimen is 1.6 inches, and its width 1 inch.

A last lower molar of this species in the collection of the Indian Museum has the following dimensions:—

Extreme length ...	...	...	...	In.	2.95
Width ...	...	...	...	...	1.55
Height of crown ...	...	...	...	...	1.42

The form of this tooth is precisely similar to the figured specimen.

The first lower molar of this species is never shown: the second is very small and conical; the mandible is produced into a somewhat spatulate-formed symphysis, and was furnished with a pair of large triangular outer incisors, and a small central pair of round functionless ones.

RHINOCEROS NAMADICUS, *Falconer*. Plate 4, figs. 5 and 6.

Falconer assigned the above specific name to certain limb-bones of a species of *Rhinoceros* from the Nerbudda valley, but I believe no teeth had at that time been obtained. I am not aware whether these limb-bones had ever been compared with those of the other species of the genus. The upper molar teeth in the Indian Museum from the Nerbudda valley closely resemble in form those of the Siwalik *R. platyrhinus*, though they are of much smaller size; and it is only after considerable hesitation that I have separated the two species; my conclusions are partly drawn from certain differences in the teeth, partly from Falconer's separation of the two species, and partly from the fact that almost all the Nerbudda Mammals are distinct from those of the Siwaliks.

The first specimen that I have to describe is an upper molar of the right side (*plate 4, fig. 6*); the specimen is probably the second of the series; it is considerably smaller than the corresponding tooth of the last species. The fangs of the specimen are embedded in a hard matrix; the crown is about one-third worn down; the whole of the anterior half and the inner side are complete, but the postero-external angle is wanting.

The transverse diameter of the anterior collis (*right of figure*) is slightly greater than that of the median collis; the base of the latter does not overlap that of the former, so that the entrance to the median valley is nearly at right angles to the inner border of the crown, and is but slightly curved; when the tooth is placed in the position of the figure, the whole of the bottom of the median valley is seen from the front. The anterior collis is of a regular conical form, the median collis is concave on the anterior side; there is scarcely any distinct pass leading into the median valley, the bottom of which is of uniform depth up to the crochet; conse-

quently the entrance to the valley is remarkably low, almost on a level with the base of the crown, and below that of the cingulum; there is no tubercle at the entrance; the basis of the two colles are in contact along the bottom of the valley.

At a distance of one inch from the internal border of the crown the median collis gives off a very large and thickened crochet, which is directed forwards and a little inwards; the neck of the crochet is constricted, and there is no process of enamel in the angle formed between the internal wall of the crochet and the anterior wall of the median collis; the crochet thickens slightly in the middle, and again contracts towards its free extremity; at a level a little below that of the present surface of the crown, the crochet extends completely across the median valley; there is no loop of enamel on its external wall; the moiety of the median valley situated on the inner side of the crochet forms a triangle with curvilinear boundaries, the whole of which is visible from the inner side of the tooth. Externally to the crochet the valley is trefoil-shaped; the leaves of the trefoil are divided by two processes,—firstly, a small wedge-shaped combing-plate, projecting into the valley from the outer side of the tooth; and, secondly, a similarly shaped antecrochet from the anterior collis. The direction of the combing-plate is exactly at right angles to the internal border of the crown of the tooth: when worn down the surface of the crown would display four fossettes,—one formed by the posterior valley; a second consisting of that portion of the median valley which is internal to the crochet. This fossette would not be completely isolated until the tooth becomes worn down almost to the base of the crown, owing to the low level of the entrance to the median valley; the two other fossettes would be on the outer side of the crochet, divided from each other by the combing-plate; they would be isolated at an early period of wear.

The dentine-surface of the anterior collis is directed at an angle of 45° to the internal border of the crown, so that the outer extremity of the median valley is produced towards the antero-external angle of the tooth.

The anterior side of the tooth (*on the right of the figure*) has an undulating outline, prominent in the centre; a wavy cingulum runs along the whole length of this surface; on the internal half of this side the cingulum diverges from the main wall, and forms a well-marked triangular "anterior valley," extending up to the antero-internal angle of the anterior collis. There is no trace of any cingulum along the internal surface.

The posterior valley (*on the extreme left of the figure*) is of very large size, and has a regular oval shape; the longer axis of the oval is nearly parallel with the antero-posterior axis of the crown; the external wall of this valley is nearly vertical, while the internal wall slopes rapidly away towards the median collis; the pass into this valley is sharply defined, forming a ridge descending from the summit of the median collis; the pass leading into the posterior valley is considerable above the level of that leading into the anterior valley, and above that of the cingulum, so that this valley would be isolated at a very early period of wear.

The antero-external angle of the tooth forms a small, sharp, wedge-shaped process; there is one prominent costa on the dorsum of the tooth near this angle; it is not continued upwards as far as the neck. Unfortunately the postero-external angle of the tooth is broken away, so that it is impossible to determine the form of this portion of the crown: from an examination of the base of the crown, where it is buried in the matrix, I consider that the whole of the outer side of the tooth was nearly parallel to the inner side; and that the antero-posterior angle was not produced. The dimensions of this specimen are—

				In.
External side	...	...	...	2·0
Internal side	...	...	...	1·3
Anterior side	...	...	...	2·0
Posterior side	...	...	...	1·5

The molars of both *Rhinoceros platyrhinus* and *R. namadicus* are distinguished from those of *R. sivalensis* and *R. palæindicus* by the complex form of the crochet, and by the presence of a combing-plate. The points by which the molars of the present species are distinguished from those of *R. platyrhinus* are the following:—

- Difference in form of the median valley and the base of the two colles.
- Presence of an antecrochet.
- Difference in size of combing-plates.
- Greater size of anterior valley and cingulum.
- Relations of posterior valley to median collis, and its relative size.
- Smaller size.

The other specimen figured (*plate 4, fig. 5*) is the entire and perfect germ of a third or ultimate molar of the left maxilla from the Nerbudda valley; the specimen is in the Indian Museum. I refer the specimen to the same species as the preceding. The figure is taken from the postero-internal aspect of the specimen, looking directly into the median valley; the anterior collis occupying the left side of the valley and the median collis the right.

The anterior collis forms by far the greater extent of the base of the tooth; its transverse section has the form of an isosceles triangle; the summit is bent over towards the inner side; on the anterior side the cingulum commences on the external edge, and forms a V-shaped line along this side of the tooth, running as far as the base of the anterior collis; close to the anterior collis there is a narrow anterior valley of triangular form (*seen on the extreme left of the figure*); the lowest point of the cingulum is rather more than half an inch above the neck of the crown. The median valley is entered by a low pass, without any tubercle at the entrance; this valley becomes deeper as it passes outwards; the level of the pass is the same as that of the cingulum; the entrance of the valley is wedge-shaped. The crochet (*the first projection across the valley*) is of great size and extends com-

pletely across the valley; the combing-plate (*the second projection, on the same side as the last*) is shorter than in the last specimen; it is opposed by the large antecrochet (*the projection from the opposite side to the two former ones*) from the anterior collis; the difference in the relative position of these processes of the median valley from those of the last specimen is caused by the different relations of the boundary walls of the two teeth. Were the crown of this specimen worn down it would present three fossettes in the median valley, one on either side of the crochet, and a third, formed at the outer extremity of the valley, by the combing-plate and the antecrochet. The posterior valley, as in all ultimate molars, is not present, and the median collis becomes confluent with the external wall of the tooth: the antero-external angle is sharp and pointed; there is a single vertical costa on the dorsum, situated at a distance of 4 inches from the antero-external angle. The measurements of this specimen are as follows:—

					In.
Anterior side	...	...	...	...	2·1
External side	...	...	...	...	2·5
Posterior side	...	...	...	...	2·0
Height of crown	...	...	...	...	2·8

A figure of an ultimate upper molar of the right side of *Rhinoceros platyrhinus* is given in the “Fauna Antiqua Sivalensis”; in this it will be seen that there is no antecrochet, as in the present specimen, and the crochet is of much smaller size, not extending right across the valley, while the anterior valley is scarcely distinct from the cingulum; the dimensions given below are also much larger than those of the present specimen; tending to confine the distinctness of the two forms.

The measurements of the ultimate molar of *R. platyrhinus* given by Dr. Falconer are as follows in inches:—

Length (external side)	...	...	...	...	3·2
Breadth (anterior side)	...	...	...	...	2·8
Height of crown	...	...	...	...	3·1

The Nerbudda species of *Rhinoceros* must, therefore, have been considerably smaller than *R. platyrhinus*, which, apart from other characters, would probably be sufficient to establish its distinctness.

The last upper molar of this species is distinguished from the last molars of *R. sumatrensis* and *R. javanicus* by the presence of a combing-plate and an antecrochet, and by the greater size of the crochet, and by the presence of three fossettes instead of two on the worn crown-surface.

The last molar of *R. indicus* has a combing-plate, an antecrochet, and a large crochet; the combing-plate and antecrochet do not, however, unite, so as to divide the median valley in *R. indicus* as they do in the present species: moreover, the crochet of the former species is recurved at its extremity, and passes up the median valley between the combing-plate and the antecrochet. The crown of the present

specimen is considerably more "hysodont" than that of the last molar of *R. unicornis*, being absolutely higher and also narrower at the base.

It is to be hoped that eventually the skull of this species will be obtained from the Nerbudda valley, that we may have more complete evidence as to the distinctness of the species. The lower molars are unknown.

RHINOCEROS IRAWADICUS, N. SP. NOBIS. Plate 5, figs. 1 and 2.

The species is founded on two upper molars from the mammaliferous strata of Ava (*plate 5, figs. 1, 2*); both specimens are in the Indian Museum.

The most worn of the two molars (*fig. 1*) was discovered in a pagoda at Prome, and presented to the Indian Museum by Colonel Phayre; from its mineral condition there can be no doubt but that it is derived from the bone beds of the Irawadí valley. The crown is complete, with the exception of a small triangular piece of enamel chipped from the outer wall; the "fangs" have been broken off close to the neck. The tooth has been in wear for a considerable period, the height of the anterior collis above the neck being only .9 inch. The specimen is from the left maxilla; and from its large size and elongated shape is probably the penultimate true molar. This is the specimen referred to by Mr. Foote in his Memoir on *R. deccanensis*, in the first part of this volume (p. 16).

The anterior collis (*on the left side of the figure*) is of much greater size than the median (*on the right side of the figure*), occupying nearly one-half of the internal face of the tooth; on its inner side it slopes away slightly from its base downwards to the outer side; on its posterior side, it gives off a blunted antecrochet, projecting into the median valley (*the centre of the figure*) internally to the crochet. The anterior surface of the tooth has a projecting angle (*the centre of the left border of the figure*) in the middle of its course; the cingulum commences at this angle, and is continued as a distinct ledge up to the antero-internal angle of the tooth; there is a very small and shallow anterior valley between the cingulum and the anterior collis; along the internal surface of the anterior collis the cingulum may be traced as a slight wavy line on the enamel, and as a still fainter line on the median collis.

The entrance to the median valley is blocked by a large ovate tubercle, vertically grooved on its internal surface; this tubercle is continued outwards along the bottom of the median valley as a rounded ridge. The median valley runs, from its commencement, forwards and outwards, becoming deeper as it advances; it is of great width throughout its extent; its transverse diameter at the entrance is .4 inch, and at its narrowest part, caused by the projection of the crochet, .2 inch; throughout its length it preserves a considerable width along the bottom; the bases of the colles being nowhere contiguous.

The walls of the median collis are more abrupt than those of the anterior; the crochet is short and blunt, not projecting more than half way across the valley;

the posterior valley (*in the middle of the right side of the figure*) is very deep, and almost perfectly oval in form; the pass leading into this valley from the posterior side of the tooth is divided by a median fissure.

The antero-external angle of the tooth (*left-hand top-corner of the figure*) is produced into a prominent vertical buttress (as in *Rhinoceros javanicus* and *R. sivalensis*) divided by a median groove, so that the enamel in this part of the crown-surface forms two contiguous arches. Owing to the depth of the outer end of the anterior valley, the worn-crown would present an isolated fossette at this point, or two fossettes in all.

On the dorsum, the free edge forms a nearly horizontal line; the surface is concave antero-posteriorly. The costæ of the buttress do not extend as far as the neck of the tooth. The measurements are as follows:—

					In.
External side	...	...	...	...	2·6
Internal side	...	...	...	...	1·9
Anterior side	...	...	...	...	2·7
Posterior side	...	...	...	...	2·0
Thickness of enamel on outer side	...	...	...	...	0·1
Ditto on sides of median valley	...	...	...	...	0·06
Width of base of anterior collis	...	...	...	...	1·0
Ditto median ditto	...	...	...	...	0·7
Height of summit of tubercle above neck	...	...	...	...	0·4
Height of lowest part of cingulum above neck	...	...	...	...	0·5

The other specimen (*plate 5, fig. 2*) is from the bone-beds of the Irawádi; it is the second upper molar of the right side. The whole of the grinding surface is complete, but a considerable portion of the base of the external wall and the anterior angle has been broken away; the crown is much less worn than that of the last specimen.

The tooth being of the same form as the last, it is only necessary to note a few points.

The median collis (*on the left side of the figure*) is somewhat twisted upon itself, and constricted in the middle: the pass into the posterior valley (*the middle of the left side of the figure*) is more deeply cleft than in the last specimen, the outer half being higher than the inner.

The crochet becomes gradually thinner towards its summit, and is sharply bent inwards on itself; a small process of enamel is seen at the outer extremity of the median valley, which may, perhaps, be the rudiment of a combing-plate. The measurements of this specimen are as follows:—

					In.
Length of external surface	...	...	...	...	2·6
Ditto internal surface	...	...	...	...	1·9
Ditto anterior surface	...	...	...	...	2·2
Ditto posterior surface	...	...	...	...	2·0