

The characteristics of the upper molars of this species may be shortly summarised as follows :—

“Buttress at antero-external angle; anterior collis the larger; crochet simple and blunt; median valley very wide; broad tubercle at entrance; blunt antecrochet and anterior collis. No combing-plate, and only two fossettes on the worn-crown.”

The only one of Falconer's three species of Siwalik *Rhinoceros* to which the molars of the present species have any resemblance in form is *Rhinoceros sivalensis*; the teeth of both these species agree in having a buttress at the antero-external angle, in the anterior collis being larger than the median, in the absence of a combing-plate, and in the presence of two fossettes only on the worn-crown.

They are distinguished by the following points :—

In *R. sivalensis* there is no antecrochet; neither is there any tubercle at the entrance to the median valley, nor any trace of a cingulum on the inner surface. The median valley is very wide in *R. iravadicus*, and very narrow in *R. sivalensis*. The cingulum on the anterior surface of the latter is cleft, and forms a wall above a distinct anterior valley; in the former this cingulum is not cleft, and merely forms a flat ledge, without any distinct anterior valley: the process at the postero-external angle is much more produced in *R. sivalensis* than in *R. iravadicus*.

From the molars of *R. palæindicus* the present specimens are distinguished by the presence of only two fossettes on the worn-crown; and from those of *R. platyrhinus* and *R. namadicus* by the absence of the combing-plate and by the presence of two fossettes only on the crown.

There is no marked resemblance between the molars of any of the European species and these specimens; from the molars of *R. tichorhinus*, *R. leptorhinus*, Cuv., *R. hemitæcus*, Falc., and *R. Indicus*, the present specimens are distinguished by the absence of any combing-plate.

The presence of the large tubercle in the median valley distinguishes the teeth of *R. iravadicus* from those of *R. etruscus*, Falc., and *R. deccanensis*, Foote.

From *R. sinensis* of Owen they are distinguished by most of the above characters, and by the fact of the median valley becoming deeper as it passes outwards, instead of becoming shallower.

They approach nearest in form to the molars of the recent *Rhinoceros sumatrensis* and *R. javanicus*; all the species having the buttress at the antero-external angle and the wide median valley, with occasionally a small tubercle at the entrance; they are, however, distinguished by the nearly horizontal line formed by the free boundary of the dorsum, in place of the angulated line of the recent species; the two colles are more equally sized in the recent species, the anterior valley smaller, and the cingulum less marked: the crochet is larger and extends further across the valley in the recent species; and from the larger diameter of the median collis, the posterior valley is smaller. It is, however, quite probable that the *Rhinoceros* of the Irawádí may have been the direct ancestor of the recent

Rhinoceros sumatrensis, now inhabiting the same regions of Asia. The measurements of the penultimate upper molar of *Rhinoceros sumatrensis* are—

					In.
External side	...	...	...	...	2·0
Internal side	...	...	...	...	1·4
Anterior side	...	...	...	...	2·0
Posterior side	...	...	...	...	1·6

These measurements indicate a tooth rather smaller, but having the same relative dimensions as that of the Irawádí species.

In addition to the molar teeth described above, I have discovered, in the Indian Museum among some bones brought from Pegú, some years ago, portions of the occiput of a species of *Rhinoceros*; these have been placed in their relative positions and drawn (*plate 5, fig. 3*) with an approximate outline of the whole occiput. From the large size of the fragments, and from the locality in which they were found, as well as from the difference of their form from the occiputs of either of Falconer's three species of Siwalik *Rhinoceros*, I have no doubt but that they belonged to the large *Rhinoceros iravadicus* of Burma.

The fragments consist of two detached portions of the occiput, as shown in the figure; one of these comprises the left half of the lower portion of the occiput, with the condyle, partly broken on its lower border, of the same side. The second fragment consists of the central portion of the upper half of the occiput, showing the crest or superior curved line, and the depressions for the attachment of the cranio-cervical muscles; a small portion of the parietals between the temporal fossæ, with parts of the latter, are also attached to the specimen. I cannot be quite sure whether the relative positions of the two fragments are rightly placed in the figure or not; I made the interval between the summit of the condyle and the summit of the occiput equal to two and a half times the long diameter of the former, this being the average interval between the two points in the skulls of such species of *Rhinoceros* as I have had an opportunity of observing. As the specimen is in too imperfect a condition for exact description, I have given its measurements below, and then compared it with the figures of the occipital regions of the three Siwalik species figured in the Fauna Sivalensis:—

Long diameter of condyle (partly broken)	...	...	...	3·6
Short ditto	...	...	...	2·4
Width of occiput above condyles	...	...	...	13·5
Width of upper fragment	...	...	...	7·0
Height of ditto	...	...	...	5·4
Width of parietals 1½ inches in advance of occipital crest	...	...	...	1·8
Height from lower border of occipital foramen to crest (?)	...	...	...	10·10
Between external angles of condyles	...	...	...	6·3
Height of foramen magnum	...	...	...	2·4

From *Rhinoceros sivalensis* and *R. palæindicus*, this specimen is at once distinguished by its greatly superior size; the interval between the lower border of

the foramen magnum and the summit of the occipital crest of the specimens of the above species figured in the "Fauna Antiqua Sivalensis" is respectively 9 and 7·7 inches; while that of our specimen is at least 10·10 inches and perhaps rather more; the height of the occipital foramen in Falconers two species is 1·9 and 1·2 inches respectively; and the interval between the external angles of the condyles 4·8 inches. These measurements are much smaller than those of the present specimen. The dimensions of the condyles of the Siwalik species are not given.

The occiput of *R. palæindicus* is further distinguished from the present specimen by the great width of the parietals between the temporal fosse,—nowhere less than 3·4 inches; further, the occiput of *R. palæindicus* drawn in plate 74, fig. 2c of the "Fauna Antiqua Sivalensis" differs from the present specimen not only by its much smaller size, but by the square form of the upper half of the occiput, and by the absence of the unusually deep lateral fossæ, and the large median tubercle seen beneath the crest of the present specimen.

Of *R. sivalensis* there is no figure of the occipital crest given in the "Fauna Antiqua Sivalensis;" the parietals of *R. sivalensis*, between the temporal fossæ though in a much smaller specimen, are wider than in our specimen; the relative size of the two is, however, a quite sufficient distinction.

Between our specimen and the occiput of *Rhinoceros platyrhinus*, which is the only one of the Siwalik species which approaches it in size, there are very wide and well-marked differences. An excellent figure of the occiput of *R. platyrhinus* is given in the "Fauna Antiqua Sivalensis" (plate 72, fig. 2). On comparing this with the figure of the present specimen, the two will be seen to differ greatly in the length of the vertical diameter; this, however, cannot be relied upon, owing to the conjectural restoration of the present specimen. The condyle of this specimen, though broken, is slightly larger than that of *R. platyrhinus*, and the breadth of the occiput is also rather larger. The occipital crest, however, at once distinguishes the two; the superior border of this is broad and convex in *R. iravadicus*; in *R. platyrhinus* it is narrow and with a median excavation; so that the surface of the parietals between the temporal fossæ in the latter species, as is seen in the crest of Colonel Baker's cranium, is concave, and placed considerably below the outer borders of the crest. In the present specimen this surface of the parietals is flat or slightly convex, and forms the highest part of the cranium. The narrowest part of the parietals in the Siwalik species is 3·3 inches, while the narrowest part remaining in the present specimen is only 1·8 inches. The whole of the upper part of the occiput beneath the crest in *R. platyrhinus* is somewhat hollowed, but not deeply so, and with no prominent median projection; entirely wanting the wide and deep hollows of the present specimen.

The above description or comparison, although, from the state of the materials, necessarily incomplete and crude, serves nevertheless to confirm the conclusions previously arrived at from the study of the upper molar teeth as to the specific distinctness of the large fossil *Rhinoceros* of the valley of the Irawádí: it may be

expected that further researches will bring to light more perfect specimens for future examination and description. The lower molars of this species are unknown, as we have none of these teeth from Burma in the Indian Museum.

RHINOCEROS PLANIDENS, N. SP. NOBIS. Plate 4, figs. 7, 9.

The two upper molars of this species (*plate 4, figs. 7 and 9*) were collected by Mr. Theobald in the Siwaliks; the specimen drawn in *fig. 9* is from the left side; that in *figure 7* is from the right side. *Fig. 9* shows the median collis, and posterior and median valleys, with the adjoining half of the anterior collis; *figure 7* comprises the whole of the internal half of the crown; the summit of the median collis is broken off; unfortunately neither of the specimens show the dorsum. The teeth present a good many points of resemblance to the Burmese specimens, but also show other points of divergence, which, taken together with the wide distance between the localities from which they were obtained, fully justify specific distinction.

The median valley is wide at the entrance, and, as in the Burmese and the other Siwalik species, becomes deeper as it passes outwards; so that the worn-crown would present an isolated enamel pit. The crochet is blunt and simple, and does not extend more than half-way across the median valley. The antecrochet is much larger than in the Burmese species, bounded by a deep vertical groove at its internal border.

The tubercle at the entrance to the median valley is much wider than in *Rhinoceros iravadicus*, and its inner border is nearly on a line with the inner border of the tooth, instead of being considerably external to it; the outer side of this tubercle descends suddenly to the bottom of the valley; externally to the antecrochet the valley is continued as a mere line between the bases of the colles, which are contiguous, the broad floor of the valley of the Burmese specimens being absent. This narrowness of the bottom of the valley is caused by the greater proportionate size of the median collis, the two colles being nearly equal in diameter; the diameter of the base of the anterior collis is .9 inch, and that of the median collis .8 inch.

The anterior valley (*seen on the right side of fig. 7*) forms in this species a distinct cavity, instead of a flat surface as in *R. iravadicus*; the cavity is triangular and bounded by the continuation of the cingulum; externally to this valley the enamel of the crown is sharply folded on itself, and is of the same thickness as on the inner side of the tooth. On looking at the corresponding part of the Burmese tooth (*the centre of the left side of fig. 1, plate 2*), the enamel is seen to have almost entirely disappeared at this point, and to have no trace of the fold. The folded portion of the enamel of the Siwalik specimen forms a thick isolated ledge on the side of the tooth, at a point where there is no appreciable coating of enamel at all in the Burmese specimen.

The cingulum commences in the middle of the anterior surface of the tooth, and is continued as a distinct ledge round the whole of the anterior collis (*right*

side of fig. 7), joining on to the median tubercle, which thus appears to be merely a portion of the cingulum, and is not isolated as in *Rhinoceros iravadicus*. The cingulum is continued posteriorly for a very short distance along the internal face of the median collis (left side of fig. 7 and right side of figure 9); it then stops abruptly, and for a space of half an inch in length, this surface has no trace of a cingulum; posteriorly to this space the cingulum again suddenly commences as a bold wide ledge (well seen in fig. 9) very different from the slight cingulum at this part in the Burmese specimens (right side of fig. 1, plate 5). This ledge, two-tenths of an inch in width, is continued along the posterior surface of the tooth till it joins the outer wall of the posterior valley. The pass to the posterior valley is very sharp (while it is broad and flat in *R. iravadicus*), and the valley itself long and oval, and less deep than in the Burmese species.

The cingulum is placed much higher up on the crown than in *R. iravadicus*; its lowest portion is .8 inch above the neck of the tooth: the height of the summit of the median tubercle is .7 above the neck. In consequence of the median tubercle being situated externally to the entrance of the valley, instead of within it, as in *R. iravadicus*, the interval between its summit and the outermost portion of the median valley is greater. This interval in the Siwalik specimens is respectively 1.6 inches and 1.7 inches, while in the Burmese specimens the same interval is only 1.2 inches. The interval between the centre of the pass leading into the posterior valley, and the centre of the internal surface of the median collis, is in the Siwalik specimens 1.1 inches, and in the Burmese species 0.9 inch. The length of the internal surface of the specimen drawn in figure 7 is 2.2 inches, or .3 inch longer than the corresponding surface of the molar of *R. iravadicus*; the antero-posterior diameter of the anterior collis, taken through the antecrochet, in the specimen drawn in figure 7, is 1.3 inches; the corresponding line in the molar of *R. iravadicus* is 1.1 inches. From the parallelism of the dentine-surfaces of the two colles in the molars of *R. planidens*, I am inclined to think that the antero-external angle of the tooth was not produced into a buttress. The worn-crown would present two permanent fossettes only, although for a very short period there might be a very small third fossette, placed internally to the crochet, the median valley being very shallow at the crochet.

The molars of this species are distinguished from those of *R. sinensis* by the presence of the tubercle at the entrance of the median valley, and by the valley becoming deeper as it passes outwards.

From the molars of *R. sivalensis* the present specimens are distinguished by the presence of the large tubercle at the entrance to the median valley, and the very prominent cingulum on the inner and anterior surfaces, as well as by the presence of the large antecrochet and the temporary third fossette.

The presence of only two permanent fossettes on the crown distinguishes the present specimens from the molars of *R. Indicus*, *R. platyrhinus*, *R. namadicus*, and *R. palæindicus*. The absence of any combing-plate distinguishes these teeth from

those of *R. etruscus*, Falc., *R. tichorhinus*, and *R. leptorhinus*, Cuv.; the presence of the tubercle at the entrance to the median valley distinguishes them from the upper molars of *R. etruscus* and *R. deccanensis*.

The great width of the median valley, the large antecrochet, and the unusual size of the tubercle at the entrance, together with the wide cingulum on the posterior side, apart from other characters, are amply sufficient to distinguish these specimens from the molars of *R. sumatranus* and *R. javanicus*.

RHINOCEROS, SP. VAR.

In addition to the above species of *Rhinoceros*, we have in the Indian Museum, various upper premolar and lower molar teeth which I am unable to refer to any of the above species, but of which I do not think it desirable at present to establish new species. The first of these specimens (*plate 6, fig. 6*) is an upper molar, or premolar tooth brought by Mr. Fedden from Sind: the specimen is from the left side of the upper jaw, and is complete with the exception of the dorsum, which is broken away; from its small size it is probably a premolar.

The general shape of the crown is squared, with the postero-internal angle rounded off; the transverse diameter of the tooth, when complete, probably exceeded the antero-posterior. The two colles are approximately equal in size, and their worn dentine-surfaces are directed obliquely to the median transverse line of the tooth, and run outwards and forwards in parallel directions; there is a vertical groove on the antero-internal surface of the anterior collis (*right of figure*).

A cingulum surrounds the greater portion of the crown; this commences at the posterior valley (*hollow on left of figure*) as a flat-topped ridge, reaching nearly to the summit of the median collis (*left of figure*); it descends obliquely along the front of this collis, forming a waving line on its anterior surface. Between the two main colles (*centre of base of figure*) at the entrance to the median valley the cingulum forms a wide ledge; this becomes narrower on the inner surface of the median collis, and again expands into a broad ledge along the whole of the anterior surface of the tooth (*right side of figure*). There is no distinct anterior valley. The median valley does not properly commence at the gap between the two colles above the cingulum, as is generally the case. Interiorly to the cingulum the two colles are connected nearly up to their summits; on the outer side of this pass there is a sudden descent into the median valley; this valley is consequently very short and becomes deeper as it passes outwards. A triangular crochet projects about three-fourths of the way across this valley; there is no combing-plate. The posterior valley is somewhat heart-shaped at its summit, becoming more circular as it descends. The greatest length of the tooth is 1.35 inches, and the height of the crown .9 inch.

Following my usual rule, I have not made a distinct species upon the evidence of this solitary premolar tooth, though I think it extremely probable that it is distinct from all the species noticed above.

The presence of the surrounding cingulum and the position of the pass into the median valley sufficiently distinguish it from Falconer's three species of Siwalik *Rhinoceros*, and from the Nerbudda and Burmese species.

The only one of the above noticed species with which I think the present specimen can have the least affinity is *R. planidens* of the Siwaliks. The general form of the cingulum is, however, very different in the two: in the present specimen this continues in a straight line along the whole of the anterior surface, whereas in *R. planidens* it bends to form a distinct anterior valley, and does not extend more than half-way across the anterior surface of the tooth; the cingulum, moreover, in the latter species does not extend completely across the inner surface of the median collis, as in the present specimen.

The greatest difference, however, is found at the entrance to the median valley in the two specimens: in *R. planidens*, the cingulum forms a distinct tubercle at the entrance to the median valley, and the top of this tubercle becomes the pass into the valley, there being no contact of the base of the collis further in.

These differences are so great that I do not think the two specimens can belong to the same species: at the same time it is not quite impossible, as considerable variations do sometimes occur between the molar and premolar series of the same species.

The only described species of *Rhinoceros* with which this specimen agrees at all closely is *R. deccanensis* of Mr. Foote. The premolars of that species (*plate 1 of the first part of this volume*) are of exactly the same general form and type as the present specimen. They both have a complete cingulum, are of the same size, and have the same internal pass between the colles into the median valley. The main differences I can detect between the two are the following: in *R. deccanensis* the cingulum forms a more complete collar round the crown, it makes a distinct ledge on the inner surface of the median collis, instead of only a waving line; while on the anterior surface it is raised up into a sharp edge on its free border, and so forms an anterior valley, instead of a flat ledge. The pass between the colles is still further away from the cingulum in the present specimen than in *R. deccanensis*; and in the latter there is not the vertical groove on the antero-internal surface of the anterior collis. Further, the lowest part of the cingulum in the premolars of *R. deccanensis* is opposite to the pass between the two colles; the cingulum rises continuously on either side from this lowest part; on the anterior surface the cingulum is higher than on any part of the internal surface of the anterior collis. In the present specimen the cingulum has its lowest level along the anterior surface; the portion on the internal surface of the anterior collis is higher than that on the anterior surface.

I hope that further specimens will subsequently be acquired which will further elucidate the affinities of this specimen; for the present I think that it is probably a distinct species. Its relationship with the Deccan *Rhinoceros*, the two separated far in time and space, is very interesting, as I pointed out in my papers on tertiary

mammals (Rec. Geol. Surv. Ind., Vol. IX), the Deccan fossil species showed affinities to older forms, especially in the presence of its large cingulum; the present specimen shows another link in the chain which relates it to the extinct *Rhinocerotus* and *Acerotheria* of the European Miocene beds.

The specimen drawn in plate 5, figure 4, is a portion of the right maxilla of a species of *Rhinoceros*, containing two teeth, from Burma, in the Indian Museum. At the distal extremity of the bone (not shown in the figure), there is the alveolus of a third tooth, containing portions of the "fangs." This tooth will probably be the second premolar, as the first usually falls out at an early period; consequently the two teeth drawn will be respectively the third and fourth of the premolar series. At the proximal extremity of the bone (*also omitted in the figure*) are the imbedded fangs of a *fourth* much larger tooth, which, if this view be correct, will be the first of the true molar series: these teeth are referred to by Mr. Foote in the first part of this volume (p. 16).

The penultimate premolar (*on the right side of the figure*) is complete and uninjured; a portion of the enamel of the anterior collis of the ultimate premolar has been broken away, and a caste of the dentine only remains.

Taking first the penultimate premolar, we find the external surface or dorsum of the tooth divided into two equal portions by a prominent vertical costa; the antero-external angle (*the right upper angle of the figure*) is wedge-shaped and slightly produced; the anterior side is angulated in the middle, and set obliquely to the outer side. The anterior and median colles are of nearly equal diameter; the latter gives off a sharp wedge-shaped crochet, small and simple; it projects about half-way across the median valley. A large combing-plate is given off from the outer wall of the valley; this plate is thicker at its free extremity than at its origin: the free extremity is separated by a small interval from the crochet; the worn-crown would present three fossettes. The pass leading into the median valley is very low, nearly at the base of the crown; it is of considerable length, running as a level line between the contiguous bases of the colles for a distance of rather more than a quarter of an inch, at which point there is a sudden descent into the expanded valley: there is no tubercle at the entrance of the valley.

The cingulum occupies almost the whole of the anterior side of the tooth, and forms a distinct ledge; there is no cingulum on the inner side; the anterior valley is scarcely distinguishable. The posterior collis (*on the extreme left of the figure*) is small, though distinct, separated by a channel from the median collis; the posterior valley is large and nearly circular with a sharp narrow pass. The measurements are as follows:—

						In.
External side	...	...	...	...	...	1.4
Internal side	...	...	...	...	...	0.9
Anterior side	...	...	...	...	...	1.2
Posterior side	...	...	...	...	...	1.1

The ultimate premolar is larger than the other; it resembles the penultimate, with the exception that the costa on the dorsum is placed, not mesially, but close to the antero-external angle. Its measurements are—

External side	...	...	...	...	...	In. 1·8
Internal side	...	...	...	...	...	1·2
Anterior side	...	...	...	...	...	1·7
Posterior side	...	...	...	...	...	1·4

As these teeth belong to the premolar series, which is subject to considerable variations in the same species, it would not be safe to found a new species upon their evidence alone, although I doubt if they can be referred to any of the described forms: Mr. Foote considers them as belonging to a second Burmese species.

The premolars of *Rhinoceros iravadicus*, as in the recent *Rhinoceros sumatrensis*, probably had a buttress at the antero-external angle, were nearly quadrate in form, and had a wide open valley, without any combing-plate.

A figure of the premolar of *Rhinoceros palæindicus* is given on plate 4, figure 3, which will be seen to have no resemblance to the present specimens; the ultimate premolar of that species has but one costa on the dorsum and no combing-plate.

In plate 73, figure 26, of the "Fauna Antiqua Sivalensis," the premolars of *Rhinoceros sivalensis* are shown: they are quite quadrangular in form, with no very prominent costa, no combing-plate, a narrower valley, and only two fossettes on the worn-crown.

With *Rhinoceros platyrhinus* the present specimens are connected by the presence of a combing-plate: this, however, is the only point in common. The premolars of Colonel Baker's specimen of *R. platyrhinus* in the British Museum are double the size of the present specimens, are more quadrangular in form: they have two costæ on the dorsa of the whole of the series, and their external border is quite straight and never like that of the second of the present specimens; while the combing-plate and crochet are of much larger proportionate size, and closely approximated.

The premolars of *Rhinoceros deccanensis* are distinguished by the cingulum encircling the whole of the internal surface.

The same remarks apply to *Rhinoceros planidens* as to *R. iravadicus*.

We do not know the form of the premolars of *Rhinoceros namadicus*, though they no doubt had a combing-plate, and were somewhat oblique. The specimens might possibly belong to that species, though the distance of the localities and the difference of the age of the beds in which the two specimens occur tells somewhat against it.

The specimen drawn in plate 6, figure 10, is from Siwalik strata, and is in the collection of the Asiatic Society of Bengal; it belongs to the right maxilla of a species of *Rhinoceros*. As there is no disc of pressure on the anterior side it is pro-

bably the first, or perhaps second (the first disappearing), of the premolar series. The anterior wall of a larger succeeding tooth is seen on the left side of the figure. The specimen is quite complete; it had only just come into use, the tip of the anterior collis and the anterior part of the external wall being the only portions flattened by abrasion.

The tooth is remarkable for the excessive prolongation of the antero-external angle (*the angle on the right of the figure*) in a manner unlike that of any other recent or fossil form that I have seen. From the presence of a combing-plate the tooth belongs to the type of *R. platyrhinus* and *R. namadicus*; but differs entirely in form from the premolars of the first of these species, which, as shown in Colonel Baker's cranium, are nearly square.

The dorsum has three costæ, one at the posterior angle (*left of figure*) and two others placed at equal distances in advance of this, the anterior one occupying the middle of the dorsum; from this anterior costa the dorsum slopes away to the antero-external angle. The anterior collis on the right of the figure is very small, with a concave border towards the median valley; the dentine surface proceeding from this collis towards the outer wall of the tooth runs obliquely forwards so as to be almost parallel with the posterior half of the outer wall.

The median collis (*on the left of the figure*) is larger than the anterior; it gives off a long sinuous crochet, stretching far into the median valley: from the external wall of the tooth there are two long and slender combing-plates, parallel to one another; the posterior of these unites with the extremity of the crochet, while the anterior joins the anterior crochet; a third small process occupies the angle between the posterior combing-plate and the outer wall.

The median valley is entered by a low pass, without any tubercle at the entrance; it extends far up towards the antero-external angle of the tooth, and is of larger extent than in any other described tooth.

Along the anterior side there is a wavy cingulum, but little raised from the surface; there is no distinct anterior valley. The posterior valley is large and nearly circular, entered by a high and narrow pass.

The measurements of this specimen are—

						In.
External side	...	...	...	...	...	1·6
Internal side...	...	...	...	...	...	0·6
Anterior side.	...	...	...	...	...	1·4
Posterior side	...	...	...	...	...	1·3

The specimen differs from the preceding Burmese specimens by the greater production of the antero-external angle, by the small size of the anterior collis in proportion to the median, by the double combing-plates, and by the slighter cingulum, and by the absence of the anterior valley. It belongs to the hypsodont type, though tending towards the brachyodont. The only species to which it could possibly belong is *Rhinoceros namadicus*; and until a larger series of the molars

of that species be discovered, it cannot be said that it does not. Possibly, however, from its very aberrant form, it belongs to yet another undescribed Siwalik species. The premolars of *R. platyrhinus* have each two costæ on the dorsum. The ultimate premolar of *R. palæindicus* has a large median costa on the dorsum, but no combing-plates. In Falconer's figure of a premolar of this species there is no costa on the dorsum.

The tooth figured in Plate 6, Figure 9, was collected by Mr. Theobald in the Siwaliks; it is probably either the milk molar or a premolar of the left maxilla of a species of *Rhinoceros*. The crown is perfect with the exception of a few chips out of the enamel; it is about a third worn down.

The configuration of the crown surface presents some very remarkable peculiarities which I have not seen in any other specimens of *Rhinoceros* molars. The crown surface is approximately square, with a slightly produced antero-external angle; the external surface or dorsum is nearly plane, having only a very slight costa half-an-inch behind the anterior border. On the anterior surface (*the left side of the figure*) a slight cingulum occupies the internal half; between this and the external side of the anterior collis (*left lower angle of the figure*) there is a small oval anterior valley (*the pit on the left side of the figure*) placed more externally than usual. The anterior and median colles are of nearly the same diameter: their internal walls are nearly vertical, with no trace of any cingulum on them.

The anterior collis (*left of figure*) has a somewhat triangular cross-section. Instead of being connected by a column of dentine with the dentine of the outer wall of the tooth, the anterior collis forms a completely isolated pillar, there being a narrow pass on its outer side connecting the anterior and median valleys. This pass is so low that it would not be touched by wear until the crown became worn down to the level of the cingulum. I have seen no other specimen, either recent or fossil, in which the anterior collis is isolated in a similar manner.

The entrance to the median valley (*middle of lower border of figure*) is by a narrow pass, slightly higher than the level of the cingulum, and without any tubercle at the entrance. Externally to the pass the descent into the valley is very abrupt and steep; the extremity of the valley is nearly half-an-inch below the level of the pass.

The median collis (*right lower angle of figure*) is united to the external dentine wall by a very narrow neck of dentine, running at first forwards and outwards, and then bent back on itself. On its anterior side this neck gives off a very small bifurcate crochet, projecting about half-way across the median valley. On its posterior side the dentine neck gives off another bluntly conical process, projecting into the posterior valley (*the pit on the right side of the figure*); the narrowness of this dentine neck and the posterior process are quite unusual.

In consequence of the narrowness of this neck, the posterior valley is of large diameter: its external wall is nearly vertical, and its anterior and posterior walls sloping: the pass into this valley is very sharp and abrupt.

The dimensions of this specimen are—

					In.
Anterior side...	...	...	...	...	1·6
Internal side...	...	...	...	...	1·2
External side	...	..	...	...	1·6
Posterior side	...	...	...	...	1·7

The lower molar figured in Plate 6, Figure 7, is the antepenultimate tooth of a right mandible of a *Rhinoceros* from the Siwaliks, different from either of the three species of Falconer. The specimen is in the collection of the Asiatic Society of Bengal; there is also a detached portion of the same jaw containing the ultimate and penultimate teeth. The state of wear of this specimen is about the same as that of the last. Dr. Falconer described this specimen as a milk molar, but he was, apparently, not aware that the next specimen in the catalogue belonged to this jaw. The tooth differs from the lower molars of any other species of *Rhinoceros* that we have seen, in the great relative size of the anterior collis (*left of figure*) which projects on the inner side in advance of the other colles. The anterior valley is large (*left of figure*) and of equal depth with the posterior (*right of figure*); on the worn-crown, therefore, the two valleys would remain, as notches on the inner side, for an equal period. The outer end of the anterior valley is rounded, and that of the posterior valley angulated; the three worn dentine surfaces leading from the colles are nearly parallel, and placed obliquely to the longer axis of the tooth.

On the anterior side of the tooth, the enamel of the crown shows a transverse section of two vertical costæ; these extend downwards to the base of the crown. On the anterior side of the median collis (*middle of figure*) there is a slight infolding of the enamel, and other crenulations may be seen on the outer wall. The posterior collis (*right of figure*) has its inner extremity expanded antero-posteriorly. In the middle of the inner border of the posterior valley (*right of figure*) there is a simple ovate tubercle detached from the posterior collis. There is no cingulum on the inner face of the tooth; but a small, though distinct cingulum, occurs both on the anterior and posterior surface. The length of this tooth is 1·8 inches, and the width ·9 inch.

The succeeding tooth of this jaw (*A. S. B. No. $\frac{8}{3\frac{2}{3}}$*) is unworn; it has the same form and the same crenulated enamel as the figured specimen; the tubercle in the posterior valley is, however, considerably larger. The length of the tooth is 2 inches.

The large anterior collis, the crenulated enamel, and the tubercle in the posterior valley, sufficiently distinguish the tooth from the figured Siwalik specimens; but it would be somewhat unsatisfactory to found a new species on a lower molar only.

The specimen drawn in Plate 6, Figure 3, is another right lower molar of a species of *Rhinoceros*, different from any of those described above. The tooth is

from tertiary beds at Kushalghar, near Attock, the precise age of which has not yet been determined. A portion of the posterior collis was broken, which has been restored in the figure.

The crown is very unsymmetrically shaped, the posterior valley (*right of figure*) being greatly larger than the anterior valley (*left of figure*); the posterior half of the tooth is worn down a quarter of an inch below the anterior half. The dentine surface joining the posterior collis with the outer wall of the tooth is situated obliquely to the long axis of the crown: the median collis exposes the largest dentine surface; its postero-internal angle is acute; the posterior collis (*extreme left of figure*) is smaller than either of the others, its innermost border not extending so far inwards as those of the other two colles.

The inner border of the tooth presents a nearly continuous wall for some distance up on the crown, which takes away from the prominences of the colles, usually so conspicuous in the lower molars of other species of *Rhinoceros*. The anterior valley is entered by a small and narrow pass through this innermost wall. The entrance to the posterior collis is blocked for half its length by the inner crown-wall. Behind this there is an open space of rather more than a quarter of an inch in width leading directly into the valley; the inner wall is again continued on the anterior aspect of the posterior collis. The narrow channel leading into the posterior valley is slightly higher than the bottom of the outer extremity of the valley. When the crown becomes worn down, the outer extremity of the posterior valley would be left as an isolated fossette upon the crown surface, the outer extremity of the valley disappearing last; in the lower molars of all other species of *Rhinoceros* which I have seen described, except those of *Rhinoceros simus* of Africa, which have the same peculiarity as this specimen, the posterior valley is shallower on the external than on the internal side, and consequently never forms an isolated fossette on the crown, but merely forms a shelving notch on the inner border. The whole of the anterior valley on this specimen would disappear at an early stage of wear. There is no cingulum on any part of the crown. The enamel is thinner on the inner than on the outer side of the tooth.

The flatness of the inner wall of the tooth, together with the peculiar shape of the posterior valley, sufficiently distinguish the specimen from the lower molars of any of Falconer's species of Siwalik *Rhinoceros*; the dimensions are—

				In.
Extreme length	...	...	...	2·2
Breadth at centre	...	...	...	1·2

A single lower premolar of *Rhinoceros merkkii* figured in *Gervais' "Paléontologie et Zoologie"* (*Plate XIV, Fig. 3*) shows a fossette on the worn crown, representing the posterior valley; but there is none on the molars of the same specimen.

I have but little doubt that this tooth belonged to another distinct species of *Rhinoceros*, which must have had affinities with the African *R. simus*.

GENUS ACEROTHERIUM, *Kaup.*

Of this genus we have one species in India; the species is only known by its molar teeth, which correspond in general form with those of the Miocene European species, but we have no means of knowing whether the Indian form was hornless, or whether the number of its digits were similar to those of the European genus.

ACEROTHERIUM PERIMENSE, FALCONER. *Plate 6, Figs. 2 and 5.*

The specimen drawn in figure 5 is a portion of a left maxilla from the collection of the Asiatic Society of Bengal, which was obtained in Perim Island in the Gulf of Cambay; it contains the last premolar and the first molar teeth. The other specimen in the same plate (*Fig. 2*) is a first molar of the left maxilla; this specimen with two others was collected by Mr. Theobald in the Siwaliks of the Punjab. These are the first recorded specimens from that formation. The Siwalik specimen is less worn than those from Perim Island, but the two agree precisely in size and form.

The molars of this species are distinguished from those of *Rhinoceros* by their transverse diameter exceeding their antero-posterior in length. The median collis (*right side of figures*) is slightly larger than the anterior collis (*left side of figures*). A cingulum surrounds the whole of the inner half of the crown and is lowest on the inner face. The median valley (*middle of lower border of figures*) is entered by a high pass. The bases of the colles are in contact at the pass. A small and blunt crochet is seen in Figure 2. In the Perim Island specimens this has become obliterated by wear; the direction of the upper portion of the valley is different from that of the bottom, so that the valley in the two specimens have contrary directions. A very small enamel island would be formed on the crown were the tooth worn down to the level of the cingulum. The posterior valley (*on the right side of the figures*) is small and oval; the inner wall slopes rapidly. The antero-external angle (*left top angle of figures*) forms a small buttress with two costæ; this angle is more bevelled away in the specimen drawn in Figure 2 than in the specimen drawn in Figure 5.

The measurements of the Perim Island molar are—

				In.
External side	...	...	...	1.5
Anterior side	...	...	...	2.5
Internal side	...	...	...	1.4
Posterior side	...	...	...	2.8

The premolar is less worn than the molar, and is almost square in shape. The cingulum has been partly broken away along the inner side. Its measurements are—

				In.
External side	...	...	...	1.5
Anterior side	...	...	...	1.4
Internal side	...	...	...	1.2
Posterior side	...	...	...	1.4

A figure of an unworn left molar of this species is given in the "Fauna Antiqua Sivalensis" (*Plate 75, Fig. 15*) from Perim Island.

The molar and premolar teeth of a right maxilla of *Rhinoceros* brought from Ava by Mr. Clift and figured in the Transactions of the Geological Society of London (*Second Series, Vol. II, Plate 5*) belong to the present species. Clift's figure is copied in Dr. Blainville's Osteography (*Atlas, Vol. III, Plate 14*). On the same plate there is another figure of an upper molar of the right side, also from Burma, belonging to the same species.

This species had therefore a very wide distribution, having been obtained from Burma, from the Sub-Himalayan Siwaliks and from Perim Island.

On comparing the above specimens with the upper molars of *Acerotherium incisivum* of Kaup., the general form of the two, though sufficiently different for specific distinction, is very similar, evidently belonging to the same type, and leaving no doubt in my mind that the Indian specimens are rightly placed in the sub-genus. In both species we note the excess of the transverse over the antero-posterior diameter of the crown (carried to the greatest extent in the Indian species), the wavy cingulum, surrounding the inner half of the tooth; the simple valley and single crochet; the direction of the median valley is the same in both species. The European species is distinguished by an antecrochet, nearly blocking the median valley on the inner side of the crochet.

The presence of *Acerotherium* among the Indian Tertiary *Rhinocerot*s is another link connecting the faunas of early India and Miocene Europe; in the presence of the cingulum, and the simple form of the crowns of the molars, *Acerotherium* is a connecting link between the true *Rhinocerot*s and the *Palæotheria*.

Including the above new species and the living forms, we have the following large list of species of *Rhinoceros* (or its sub-genera), which have been described, from South-Eastern Asia; some of the modern species are, however, probably only varieties:—

<i>R. nasalis</i> , Gray.	<i>R. niger</i> , Gray.
<i>R. indicus</i> .	<i>R. namadicus</i> , Falc. et nobis.
<i>R. javanicus</i> .	<i>R. planidens</i> , nobis.
<i>R. sumatrensis</i> ,	<i>R. sinensis</i> , Owen.
<i>R. stenocephalus</i> , Gray.	<i>R. deccanensis</i> , Foote.
<i>R. sivalensis</i> , Falc.	<i>R. (A) perimensis</i> , Falc.
<i>R. palæindicus</i> , Falc.	<i>R. iravadicus</i> , nobis.
<i>R. platyrhinus</i> , Falc.	

In addition to these there seems to be evidence of another species from Burma, another from Attock, and a third from Sind. The fossil *Rhinocerot*s of Asia therefore vie with the *Proboscidea* in the number of species. In the above list nine of the species are extinct, while the total number of living forms is only six. It must

also be remembered that many of the latter are distinguished simply on external characters—a kind of evidence not available in the case of fossil species.

Of three of the above fossil species, *viz.*, *R. sivalensis*, *R. palæindicus*, and *R. platyrhinus*, the crania, in a more or less complete state, have been discovered. The two first species were unicorn and the latter bicorn. The fossil forms do not bear out the relationship between the number of horns and the lower incisors which occur in the living species, and which Dr. Gray has taken as a character affording a distinction of sub-generic value. Among the living species, in the single-horned forms, the mandible has one pair of large outer incisors, and a smaller median pair; while the two-horned forms have only the outer pair of incisors present. Precisely the reverse of the above occurs among the Sivalik species: the bicorn *R. platyrhinus* has a pair of large outer incisors in the mandible, and a smaller central pair; while the unicorn *R. palæindicus* has the outer pair only. (See "*Fauna Antiqua Sivalensis*," Plate 74, Fig. 4, and Plate 75, Fig. 10.) Dr. Gray's distinction, therefore, founded, on this relationship, is not of real classificatory value, as it is confined to the species of *Rhinoceros* of one period only.

A statement made on the authority of Dr. Falconer regarding Siwalik Mammals, must of course meet with general acceptance; in relation, however, to our present subject, there is one which does not appear to me to be borne out by the facts at our command. In the "Introduction to the Siwalik Fauna" (Falconer's "*Palæontological Memoirs*," Vol. I, p. 21), it is stated that *Rhinoceros sivalensis* was provided with six incisors in both the upper and lower jaws; that this statement was not a local error we infer from a passage in Owen's "Odontography," (Vol. I, p. 589), where it is asserted, from the verbal authority of Dr. Falconer, that one of the Siwalik *Rhinocerotus* was "hexaprotodont" in both jaws; this species can only be *Rhinoceros sivalensis*. None of the figures, however, in the "Fauna Antiqua Sivalensis" bear out this statement, as none of the incisor teeth of *R. sivalensis* are shown: a figure of the mandible of this species, however (plate 75, Fig. 6), shows the whole of the molar and premolar series, but no incisors. In this figure, the anterior premolars extend almost up to the symphysis of the mandible, precisely in the same manner as in the mandibles of *Rhinoceros leptorhinus* of Cuvier (Owen, *British Fossil Mammals*, Fig. 135), and of the African *Rhinoceros simus* (*De Blainville's Osteographie*, Vol. III, *Rhinoceros*, Plate 4), in both of which species there are no persistent incisors. In all recent *Rhinocerotus*, in which the lower incisors are persistent, the symphysis of the mandible is prolonged in a spatulate form, considerably in advance of the first premolar, and there is a very long diastema between the two series of teeth (Owen's "Odontography," Vol. I, p. 596). In the mandible of *Rhinoceros sivalensis* there seems to be no room for six incisors, even without a diastema, a condition quite unknown in any animals of this class. It appears to me that until some conclusive evidence of the hexaprotodont character of this species be forthcoming, we are quite justified in regarding it as being without permanent incisors. It is, to say the least, very remarkable that if

Falconer had a specimen showing these six incisors, he did not give a figure of it in the "Fauna Antiqua Sivalensis."

In the form of their complex molar teeth, furnished with a large crochet and combing-plate, *R. platyrhinus* and *R. namadicus* approach the living *R. indicus* of India; the lower incisors of *R. platyrhinus* and *R. indicus* have also the same form and arrangement. Dr. Falconer, moreover, considered the upper molars of *R. platyrhinus* to approach those of the European *R. tichorhinus*. Both these species also agree in having been bicorn. The lower incisors of *R. tichorhinus*, however, differ from those of *R. platyrhinus* in having been deciduous at an early period. The three species, *R. platyrhinus*, *R. tichorhinus*, and *R. indicus*, agree in having had spatulate mandibles, and combing-plates in the upper molar teeth.

The molars of the unicorn *R. sivalensis* are formed on the same plan as those of the European *Rhinoceros etruscus* (Falc.), but the latter was a bicorn species, and had a spatulate mandible without permanent incisors. The mandible of *R. sivalensis* is like that of the African *R. simus*.

The form of the cranium of the unicorn *R. palæindicus* is very like that of the unicorn *R. javanicus*, and the mandibles of the two species are alike furnished with large outer incisors; but the form of the upper molars is different. The upper molars of *R. iravadicus* and *R. sinensis* have their nearest representatives in those of the living *R. sumatrensis*.

The upper molars of *Acerotherium perimense* and of *R. deccanensis*, together with the upper premolar noticed above from Sind, are cingulated on the inner side like those of Kaup's typical forms of the sub-genus (or genus) *Acerotherium*. Whether any of these Indian forms were hornless or provided with four toes on the anterior limb, we have no means at present of knowing; the mandible of *R. deccanensis* was spatulate and edentulous in the adult state, as in *R. etruscus*.

The lower molar from Attock, described above, presents a peculiarity of structure which is only found in the living *R. simus* of Africa.

The affinities of the Indian fossil species of *Rhinoceros* are therefore widely spread, showing relationships to forms, both living and extinct, scattered over Europe, Asia, and Africa. Unless the hexaprotodont character of *R. sivalensis* can be proved, there seems to be no more generalised form among the fossil than among the living species; while the highly specialised outer and inner lower incisors is a character common to some of both fossil and living forms.

The difficulty of determining with accuracy the lower molar teeth, in the absence of the original type specimens, from the Siwaliks, has prevented me from making new species, in any case, on the evidence of these teeth alone. In the case of upper premolars I have followed the same rule, from the known liability of these teeth to vary in different individuals of the same species.

The three species of fossil Asiatic *Rhinoceros* described by Dr. Falconer belong to the hysodont type of Mr. Boyd-Dawkins; as does *R. deccanensis* and the three

new species described above; the molars of *R. iravadicus*, however, present a tendency towards the hysodont type, and they are characterised by the very open median valley, which is a remnant of a primitive type of tooth; the only true brachydont species is *A. perimense*. As all the Miocene species of European *Rhinoceros* belong to the brachydont type, while the Pliocene species and all existing species belong to the hysodont or specialised type, the Siwalik species of *Rhinoceros* evidently belong to a modern group, and, as far as they go, are another argument for the Pliocene age of the deposits in which they occur; while the Irawadí species shows a tendency to an older type, and therefore confirms the conjecture as to the somewhat older date of these Irawadí beds.

I have lately seen a note in "Nature" (Oct. 1876, p. 572), in which an extract is given from a recent paper by Professor Flower (P. Z. S. 1876, p. 443) on the crania of *Rhinoceros*, in which the following interesting difference is pointed out between the skulls of the single and double-horned living species; in the former group, "the external auditory meatus is embraced below by the fusion of the post-glenoid and post-temporal processes of the squamosal portion of the temporal bone, whilst in the other these two processes remain separate." On looking at the skulls of our fossil Indian species, I find that in the crania of *R. sivalensis* and *R. palæindicus*—both single-horned species—these two processes are united; on examining the cast of Colonel Baker's cranium of *R. platyrhinus* (the original of which is in the British Museum)—a double-horned species—I find that in this species also the two processes are similarly united, the external auditory meatus forming a long tubular funnel, looking almost directly upwards, precisely as in the single-horned *R. indicus* (*unicornis*). This shows that Professor Flower's distinction between the two groups will not hold for the fossil Indian species; the union of the two processes is another point, in addition to the form of the upper molars, which connects *R. platyrhinus* with *R. indicus*, and lends support to the idea that the one may be the ancestor of the other.

Sub-Order: RUMINANTIA.

VISHNUTHERIUM IRAVADICUM, *nov. gen. nobis*, Burma. Pl. 7, figs. 1 and 2.

A short notice of the specimen on which this genus is founded was given by me in my paper on the Siwalik fauna (*Rec. Geol. Surv. Ind. vol. IX, pt. 3*); I now give a figure and a more detailed description of the specimen.

The specimen is a portion of the left ramus of the mandible; it contains the first and second teeth of the permanent molar series; these have only been in use for a short period; the animal was scarcely adult at the time of its death. The inner sides of the anterior barrel of the first molar, and of the posterior barrel

The lower molar of the Indian form is, therefore, as much larger than the corresponding tooth of *A. major*, as the upper is smaller; assuming that the proportion between the lower and upper teeth is the same in the Indian form as in the European, the width of the upper molar corresponding to this specimen should be 1.4 inches, whereas the width of the Attock specimen is only 1.12 inches; from this I think it quite probable that there may be two Indian species of the genus.

The present specimen is chiefly distinguished (in addition to its greater absolute size) from the carnassial of *A. major* by the greater proportionate size and thickness of the third lobe, and by the presence of the groove on the outer side of the middle lobe. The depth of the jaw in this specimen is nearly the same as in *A. major*. From all the other small European and American species, the large size of the present specimen is a sufficient distinction.