

of the nasal 'cloison,' of which there is no trace in the Indian fossil. The true molars of the two forms, though presenting great general resemblances, as far as I can judge, are distinguished by the fact that in the Indian species the entrance to the 'median valley' is open nearly to its base, whereas in the European it is blocked by a 'pass,' joining the bases of the two 'colles', sometimes for a distance of nearly half their height.

The living African rhinoceroses are distinguished by the abortion of the pre-maxillæ, from the present species, in which they are well developed. In the true molars of *R. bicornis* an 'accessory fossette' is not normally present. In *R. simus*, the peculiar blunted form of the nasals is a very distinguishing character. From *R. pachygnathus* of the European miocene, the present species is distinguished by the characters of the upper molars, those of the former not presenting an 'accessory fossette':¹ the upper molars of the Indian *R. deccanensis* of the pleistocene, probably also a bicorn form, present no close resemblance to those of the present species.

Upper milk-molars.—In figure 4 of plate VII there are represented two small upper molars of a rhinoceros from the left side of the jaw. The figure is taken from the cast of two teeth in the British Museum, where they are, I believe, labelled as milk-molars of *R. palæindicus*: they were obtained from the Siwaliks. From the small size of these teeth, together with their general form, there can be no doubt but that they belong to the milk-molar series; while from the considerations advanced in treating of the milk-molars assigned above to *R. sivalensis*, they must be respectively the second and third of that series.

The anterior tooth (mm. 2) is of somewhat irregular form, as is generally the case with the early milk-molars, and carries a bold 'costa' opposite the entrance to the 'median valley.' The hinder tooth (mm. 3) is of the regular form, and carries a distinct 'costa' opposite each of the 'colles', the anterior being the most developed. Both teeth exhibit clearly the presence of a large 'crochet' and a 'combing-plate, which unite to form an 'accessory fossette.' There are also rudiments of additional 'combing-plates.' A 'cingulum' is present on the anterior surface of each tooth. The entrance to the 'median valley' is perfectly free and open, without any trace of a 'pass.'

The large size of the 'combing-plate' and its distinct union with the 'crochet' to cut off a very large 'accessory fossette', in both these teeth, sufficiently distinguishes them from the milk-molars referred above, respectively, to *R. sivalensis* (pl. VI, fig. 2), *R. palæindicus* (pl. VII., fig. 3), and *Acerotherium perimense* (pl. III, fig. 2). There is, therefore, every presumption that they should be referred to *R. platyrhinus*, a presumption rendered almost a certainty by the agreement in the general characters of these teeth with those of the true molars of that species.

This provisional reference has a bearing on a tooth described and figured in the previous volume of this series (pl. VI, fig. 10). In describing that specimen

¹ See "Animaux Fossiles et Géologie de l'Attique," plate XXVII, fig 2.

(p. 46), it was considered that it belonged to the premolar series, and it was hence concluded that it could not belong to *R. platyrhinus*, though it was shown that it presented the general characters of the true molars of that species. In the subsequently issued preface to the first volume (p. xii), it was stated that this tooth was probably an anterior milk-molar of *R. platyrhinus*. A comparison of the figure with that of the teeth considered to be the milk-molars of that species will show that the single tooth agrees so closely with the second milk-molar that the two are doubtless homologous. The detached tooth is somewhat more produced antero-posteriorly, but this cannot be considered as a character of more than individual value. Besides the last specimen, there is another specimen of a right upper milk-molar of a Siwalik rhinoceros in the Indian Museum, numbered S. 854 in Dr. Falconer's "Catalogue of the Fossil Vertebrata of the Asiatic Society of Bengal." This tooth agrees precisely with the third upper milk-molar (mm. 3) referred above to *R. platyrhinus*, and must be the corresponding tooth of the opposite side.

The dimensions of the four above-described milk-molars are as follows; the dimensions of the casts of the British Museum specimens are given in the first column and those of the Indian Museum specimens in the second:—

Length of second milk-molar	1·7	1·6
Width of " " "	1·4	1·4
Length of third " "	2·0	1·94
Width of " " "	2·0	1·91

A comparison of these milk-molars with the corresponding teeth of the European *R. tichorhinus* shows that the latter are distinguished by the presence of a distinct 'pass' at the entrance to the 'median valley.' In this respect, therefore, the milk-molars of the two species agree with the true molars.

Mandible.—The reasons for the provisional assignation of the mandible represented in figure 6 of plate LXXIV of the "Fauna Antiqua Sivalensis" under the name of *R. sivalensis* to the present species have already been given at length when treating of that species.

The specimen as figured shows that the premolars extend up to the extremity of the part of the symphysis remaining, thereby giving the jaw very much the appearance of the mandibles of the African rhinoceroses. From the description of the plate, however, it may be inferred that the extremity of the symphysis has been broken off. Now, since we have already seen that the premaxillæ of *R. platyrhinus* (in common with other Siwalik rhinoceroses) are well developed, I infer that the extremity of the mandible, when complete, was produced into a 'spatula' beyond the premolars. Its original form was probably very like that of the mandible of the extinct European *R. etruscus*,¹ in which the anterior premolars are situated above the hinder part of the symphysis, and still have the spatulate portion in advance of them.

The specimen under consideration has lost the hinder portion of each ramus,

¹ "Pal. Mem.," Vol. II, pl. XXVII, fig. 3.

and shows the three last premolars and the first and second true molars. Its dimensions are as follows as given by Falconer:—

Length of fragment	9.4
„ of existing portion of symphysis	3.1
„ of five molars	7.0
Width between 2nd true molars	2.7
„ „ premolars	2.0
Greatest depth of ramus	3.6
Thickness of ramus	2.0
Length of second premolar	1.2
Width of „ „	0.75
Length of third „	1.2
Width of „ „	1.0
Length of fourth „	1.7
Width of „ „	1.15
Length of first true molar	1.6
Width of „ „	1.3
Length of second „	1.9
Width of „ „	1.36

These dimensions show that this mandible must have belonged to a smaller individual than the cranium described above: the one may have belonged to a female and the other to a male.

Young mandible.—In figure 5 of plate XVI of the memoir of Messrs. Baker and Durand, already cited, there is engraved the symphysis of the mandible of a rhinoceros, which is stated in the text to contain four molars, the last of which is unworn; as there are no earlier teeth, it is presumed that they belong to the milk-molar series. These teeth extend nearly up to the present end of the symphysis, the tip of which is stated to have been broken away. Unfortunately the posterior extremity of the symphysis is not shown in the figure, it being probably not cleared from matrix. The extension of the early part of the molar series, far on to the symphysis, seems to show that this jaw is of the same type as the one described above, and that when complete it was produced into an edentulous spatulate extremity. The dimensions of the specimen are not given.

The last milk-molar in this specimen, as noticed by its describers, is remarkable for bearing an isolated pillar in its posterior crescent. In this character it agrees with a lower molar of a rhinoceros figured in plate VI, figure 7 of the first volume of this work. That specimen belongs to a fragment of the right ramus of the mandible containing a similar but larger tooth. The figured tooth was considered in the first volume to be a true molar, but from its agreement with Messrs. Baker and Durand's specimen it would seem to be a milk-molar, as was considered to be the case by Dr. Falconer. The symphysis of this jaw is not shown, but it does not seem likely that it could have extended backwards as far as the figured tooth. In figure 5 of the same plate of Messrs. Baker and Durand's memoir, there is figured the fragment of the left ramus of a young mandible, stated to contain the third and fourth milk-molars, each of which presents a similarly isolated pillar in the posterior crescent. This specimen, however, seems to show pretty clearly that these

teeth were placed behind the symphysis, and accordingly this jaw would seem to belong to a distinct species from the other specimen with similar teeth figured by the same writers. Hence it would appear that the presence of the isolated pillar in the posterior crescent may appear in the lower milk-molars of more than one species, and that it cannot be regarded as of specific value. The first specimen figured by Messrs. Baker and Durand probably belongs to *R. platyrhinus*, the second and also the specimen figured in the first volume of this series cannot be specifically determined.

Sub-generic position of the species.—If all the remains, provisionally referred above to *Rhinoceros platyrhinus* be correctly determined, it would seem probable that that species belonged, like the four bicorn species of the European pliocene and pleistocene, to a modification of the group, sub-genus, or genus *Atelodus*, the typical members of which are the living African rhinoceroses, and the extinct *R. pachygnathus* of the Pikermi beds, and to which, in all probability, the Indian pleistocene species, *R. deccanensis*, should be referred.

If, on the other hand, Falconer's reference of a mandible, furnished with two pairs of incisors, to this species be correct, it will then belong to the group *Ceratohinus*. Very strong reasons have, however, been already advanced against this reference.

Distribution.—As far as I am aware, remains of this species have only been found in the typical Siwaliks near the Ganges and Jamna.

UNDETERMINED REMAINS.

Limb-bones.—A large series of limb-bones of rhinoceroses from the Siwaliks is contained in the collection of the Indian Museum, but as I have at present been unable to refer them to their respective species, it would be useless to notice them further on this occasion. It may, however, be observed that even if we had not the evidence of the teeth and skulls described above, the existence of at least three Siwalik species of rhinoceros could have been predicated from the evidence of certain of the limb-bones, such as the astragalus.

Lower molars.—The extreme difficulty, or even impossibility, of generally distinguishing species of fossil rhinoceros from the evidence of detached lower molars has already been commented upon. In certain instances, however, there are peculiarities which serve to distinguish these teeth from the ordinary forms.

Such an instance is afforded by the lower molar from the Siwaliks of Kúshalghar in the Punjab, represented in figure 3 of plate VI of the preceding volume. This tooth is characterised by a distinct wall on the inner side of the 'posterior valley.' No such wall is found in the lower molars of any of the species described above, and unless this character be an abnormality, it seems probable, as stated in the first volume, that this tooth must belong to a fifth species of Siwalik rhinoceros. It must, however, be observed that in a mandible of *R. javanicus*, in my own possession, the second premolar on the left side only shows a wall in the anterior

crescent, very similar to that occurring in the posterior crescent of the figured specimen.

With the exception of the latter tooth, it has now been shown that none of the described teeth of Siwalik rhinoceroses known to me can be said with any degree of certainty to belong to any but the named species.

Tibetan species.—In the “Fauna Antiqua Sivalensis”¹ are figured certain limb-bones of a fossil rhinoceros from the Húndes plain in Tibet. In Royle’s “Illustrations of the Botany, &c., of the Himalaya Mountains,”² there is also figured a specifically undeterminable fragment of an upper molar of the same genus. It was formerly considered that these Húndes deposits were the equivalents of the Siwaliks, but in a recent paper by myself³ it has been shown that they are probably of pleistocene age. The fossil rhinoceros obtained from them does not therefore come within the scope of the present memoir. It may, however, be added that it would be a matter of the highest interest to obtain specimens of the skull or complete upper molars of the Húndes rhinoceros, in order to see whether it was most nearly related to the Siwalik or the living species.

REMARKS ON THE PEDIGREE OF THE INDIAN SPECIES OF RHINOCEROS.

In his admirable work, entitled “Les Enchainements du Monde Animal,” to which reference has so frequently been made in the preceding pages, Professor Albert Gaudry has devoted a chapter to the pedigree of the *Rhinocerotidæ*, both generically and specifically. It has there been shown that *Acerotherium* connects the more highly specialised genus *Rhinoceros* with the older generalised forms of *Perissodactyla*, and that traces of this connection are retained in the former genus by the small development of the nasals, and by the presence of the ‘cingulum’ on the lower molars. In the preceding pages of this volume it has likewise been shown that the molars of the large Indian unicorn rhinoceros, and those of similar pattern, belong to the most specialised and modern type, while those of *Acerotherium* belong to the simplest type found in the family.

With regard to the evolution of the species, Professor Gaudry has commented upon the resemblance of *Rhinoceros pachygnathus* of the Pikermi beds, to the living African forms, and both that writer and Professor Flower⁴ have noticed the points of connection between *R. schleiermacheri* of the European miocene and the living *R. sumatrensis* (and (?) *lasiotis*). In the following paragraphs a few remarks, more especially bearing on the evolution of the Indian forms, will be added.

With regard to the unicorn species, very strong evidence has been adduced to show that *R. javanicus* is probably the descendant of *R. sivalensis*. In the case of *R. indicus*, it has been shown in the preface to the first volume that teeth obtained from the pleistocene deposits of the Narbada valley are practically indistinguishable from those of the living form, and the two have accord-

¹ Pl. LXXVI, figs. 9, 10.

² Pl. III, fig. 3, copied in fig. 9, of above-quoted plate in ‘F. A. S.’

³ R. G. S. I., Vol. XIV, p. 178.

⁴ *Loc. cit.*, p. 456.

ingly been provisionally identified; it is, however, very much to be desired that the cranium of the Narbada form may some day be obtained in order to see whether there may be any difference between it and the living form. Of the rhinoceroses of the pliocene (Siwalik), no form can be decidedly fixed upon as the direct ancestor of *R. indicus*.¹ The Siwalik *R. palæindicus*, however, if all the remains assigned to it above be correctly referred, agrees with the large living Indian species in being unicorn, and also in the form of the mandible and the number of its lower incisors. In the form of its upper true molars this species, moreover, makes an approach to the living species, since its teeth lack the distinct 'buttress' at the antero-external angle, so characteristic of the teeth of the Sumatran type. There is no 'combing-plate' in the true-molars of *R. palæindicus*, the presence of which is such a characteristic feature in those of *R. indicus*: the want of this process in the earlier form might, however, be readily explained by evolution, as it never occurs in molars of the Sumatran type, to which those of all the species of *Acerotherium* belong. In the above respects the upper molars of *R. palæindicus* are exactly intermediate in character between those of the Sumatran or Acerotherian type, and those of *R. indicus*, and it has accordingly appeared to me not improbable that *R. palæindicus* may belong to the *stirps* from which the living species has been derived, though the line of descent may not have been directly through the former.

We now come to the consideration of the living bicorn Indian species *R. sumatrensis*, which with *R. lasiotis*² is the modern representative of the group *Ceratorhinus*. Professor Flower has shown in what respects the European miocene *R. scleiermachi*, which belongs to the same group, resembles and differs from the living species. The latter is distinguished from the former by the non-union of the post-glenoid and post-tympanic processes of the squamosal below the meatus auditorius; it is also further distinguished by the presence of one, in place of two pairs, of incisors in both upper and lower jaws. As is observed by Professor Flower,³ the difference in the number of the teeth of the two forms is in accordance with the hypothesis of the evolution of the one from the other, being a progress from the general to the special. The relations of the squamosal processes point, however, exactly in the opposite direction, being from the special to the general, and it is accordingly very hard to see how the miocene can be the direct ancestor of the recent species. The general form of the skulls and mandibles of the two forms, as is noticed by Professor Gaudry,⁴ is, however, so very similar that it seems probable they are closely related. Both species may have been derived from a common stock, from which *R. scleiermachi* branched off at an earlier period, the direct progenitor of *R. sumatrensis* being, according to this view, still unknown.

¹ On page 55 of the first volume of this work it was suggested, perhaps somewhat hastily, that *R. indicus* was descended from *R. platyrhinus*: the re-determination of the mandible of the latter, apart from the horn-question shows that this idea cannot be entertained.

² *R. lasiotis*, if it be more than a variety of *R. sumatrensis*, is not distinguished, as far as is known, by any peculiar dental or osteological characters.

³ *Loc. cit.*, page 456.

⁴ *Loc. cit.*, pp. 44-45.

With regard to *R. platyrhinus*, there is some difficulty in deciding to which group of the genus it should be referred.¹ If the lower jaw assigned to it in this work really belong to it, it would appear, as said above, that the species must be a modified form of the *Atelodus* group, to which belong the living African rhinoceroses, the Pikermi *R. pachygnathus*, and, as modified forms, the four newer pliocene and pliestocene British bicorn species. The Indian form had not the aborted premaxillæ of the Pikermi and African species, and is further distinguished from the two latter by the union of the inferior squamosal processes; it is, therefore, difficult to imagine this species to have been a direct ancestor of either of the living African forms. In the form of its upper molars *R. platyrhinus* agrees very closely with *R. simus*. Similarly the upper molars of *R. pachygnathus* approach those of the African *R. bicornis*; but the same difference in the relations of the inferior squamosal processes occurs in these species. In both instances, however, the general similarity of the form of the skulls would seem to indicate some kind of relationship between these four species as respectively coupled; the precise nature of this relationship, however, cannot at present be more closely pointed out.

The pleistocene Indian *R. deccanensis*, judging from the shape of its mandible, as already said, would also seem to be a bicorn form, belonging to a modification of *Atelodus*. From the shape of its mandible, the species shows resemblance to the British fossil forms of the group; but the structure of its upper molars indicates affinity with older forms of the family.

Nothing can be predicated as to the subsequent history of the Indian form known as *Acerotherium perimense*.

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