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INDIAN TERTIARY AND POST-TERTIARY VERTEBRATA.

Vol. I.

Pt. i, 1874.—RHINOCEROS DECCANENSIS.—By R. B. FOOTE, F.G.S., *Geological Survey of India.*

Pt. ii, 1876.—MOLAR TEETH AND OTHER REMAINS OF MAMMALIA;

Pt. iii, 1878.—CRANIA OF RUMINANTS;

Pt. iv, 1880.—SUPPLEMENT TO CRANIA OF RUMINANTS;

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

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INDIAN TERTIARY AND POST-TERTIARY VERTEBRATA.

VOL. I.

PREFACE.

IN completing this first volume of the series of the "Palæontologia Indica," entitled "Indian Tertiary and Post-Tertiary Vertebrata," I avail myself of the opportunity afforded of making certain corrections and additions, which subsequent investigations have rendered necessary, in regard to some of the descriptions. I may mention that at the time of publication of the second fasciculus, there were contained in the Indian Museum only very fragmentary remains of many species, now represented by a much larger and more complete series: by the help of these more ample materials, I am now enabled in several cases to correct certain errors into which I had previously fallen. I may further add that had I had any idea, at the time of publication of that fasciculus, that the Indian Museum was at all likely to obtain such a magnificent collection of Siwalik vertebrate fossils as now enrich its cases, I should not have described remains of different orders in the heterogeneous manner in which they are there placed, but should have devoted a fasciculus to each order or sub-order, as has been subsequently done.

I cannot but regret that the execution of many of the plates in the second and third fasciculi is so poor; it was, however, the best that could be done at the time. A change in our arrangements has produced better results in the last fasciculus. Three of the worst of the earlier plates have been reissued with the fourth and fifth fasciculi.

In the references given below, and also in the index to the volume, the number of the pages refers to the continuous paging of the volume, and not to the separate paging of the five component parts.[1] The plates, with the exception of the first three, have the same heading, "Tertiary Mammalia," as forming one continuous series of illustrations of mammalian remains. The measurements given in this volume are all in inches and tenths.

[1] In the first fasciculus, there is of course only one system of paging; in the second, the volume numbering is at the bottom of each page; and in the succeeding parts, on the outer side of the part numbering.

The first fasciculus of this volume bears a different serial title from the succeeding fasciculi; this discrepancy is owing to the circumstance, that at the time of the publication of the first fasciculus, there was no idea entertained that the Indian Museum was likely to acquire the large collection of Siwalik fossils which are now exhibited in its cases.

In the introductory remarks to the second fasciculus, it was stated that the fourth fasciculus would be devoted to the description of the remains of Carnivora, and that a classified synopsis of the fossil Mammalia of South-Eastern Asia would be appended. Since the publication of the second fasciculus the collection of fossil Proboscidia in the Indian Museum has increased to such an unexpected extent, that it has afforded ample materials for a large fasciculus of itself: the collection of fossil Carnivora, on the other hand, is still very imperfect, and its description has accordingly been postponed: the publication of the synopsis has likewise been deferred.

No strict systematic arrangement has been adopted in the second, third, and fourth fasciculi, many of the specimens having been obtained while the work was still in progress, and described out of their proper serial succession: in the fourth fasciculus the same arrangement of the ruminants has been adopted as in the third, for convenience of reference. Similarly in the lists of ruminants given on pages 92 and 180, the same grouping has been adopted: the reader will understand, therefore, that the arrangement in those lists is in no wise a systematic one. in a systematic list the goats and sheep would of course be placed with the other *Cavicornia*. In the last fasciculus, where the materials were all at hand at the commencement of the work, a strictly systematic arrangement has been adopted.

Rhinoceros deccanensis.—Professor Flower[1] classes this species under the generic, or sub-generic, division *Atelodus*, in which are included the living *R. bicornis* and *R. simus* of Africa, and the fossil *R. pachygnathus*, *R. etruscus*, *R. leptorhinus*, *R. hemitœchus*, and *R. tichorhinus* of Europe. The lower jaw figured in Plate LXXIV, fig. 6, of the "Fauna Antiqua Sivalensis," under the name of *R. sivalensis*,[2] seems also to indicate an animal belonging to the same group.

Narbada Rhinoceros.—A recent re-examination of the two upper molars of a rhinoceros from the pleistocene rocks of the Narbada valley, figured on Plate IV, figs. 5 and 6, of this volume, and described on page 32 under the name of *Rhinoceros namadicus*,[3] has convinced me that these teeth are specifically indistinguishable from those of the living *R. indicus*, the very slight differences which I pointed out as existing between the recent and fossil last molars not being more than individual varieties. If, therefore, the similarity in the teeth can be relied on, we

[1] Proc. Zool. Soc., 1876, p. 457.

[2] Although in the text I have adopted Falconer's determination of the lower jaws of the Siwalik Rhinocerotes, I am quite unacquainted with the grounds on which such determinations were made.

[3] The name *R. namadicus* of Falconer occurs in the introduction to the "Fauna Antiqua Sivalensis" (Pal. Mem., Vol. I, p. 21), and was, I believe, as stated in the sequel, applied to limb-bones from the Narbada.

have evidence of the existence of *R. indicus* in the pleistocene of India,[1] contemporaneously with the extinct mammals.

I cannot discover the history of the two molars under discussion: when I joined the Geological Survey, they, in company with other fossils, were in the Museum of the Survey and were labelled "Nerbudda valley." Both teeth are in a highly mineralised condition, and the earlier one (fig. 6), is embedded in a block of hard brown clayey sandstone, like many other Narbada specimens; I have therefore no doubt as to their origin.

An ultimate upper molar of *R. indicus* has been obtained by Mr. Foote from the alluvium of Madras, showing, in conjunction with the Narbada specimens, that the former geographical range of the species must have been very extensive.[2]

A right humerus of a fossil rhinoceros from the Narbada, in the collection of the Indian Museum, differs considerably in form from the corresponding bone of *R. indicus*, and would, therefore, seem to indicate the former existence of a second Narbada species. If the species should eventually turn to be distinct, the name of *R. namadicus* might be applied to it: the name is provisionally retained in the list of species of *Rhinoceros* given below, in order to mark the existence of a second Narbada species.

Siwalik Rhinocerotidæ.—Since the publication of the second fasciculus of this volume, in which the teeth of the Indian fossil species of *Rhinoceros* were treated of, as far as my materials then went, Professor Brandt[3] has published a synopsis of the living and fossil species of *Rhinoceros*, in which he has arrived at conclusions, which appear to me unaccountable, in regard to Falconer's three species of Siwalik *Rhinoceros*. On page 39 of that memoir, *R. sivalensis* and *R. palæindicus* are considered as being specifically identical with *R. indicus* (*unicornis*); no reasons, however, are given for this union of the three species, except a vague remark of the late Mr. Blyth, to the effect that there is a great resemblance in the form of the skulls of the three forms. Professor Brandt appears to have entirely overlooked the characters of the molars of the three species. The molars of *R. indicus* are characterized by their complex structure, that is to say, they are furnished with a "combing-plate" and a "crochet," or, in other words, the second main internal column is connected with the outer wall of the tooth by a continuous ridge of enamel, and when the tooth becomes worn there are at least three islands, or fossettes, on the crown: further, the external surface of the tooth runs nearly parallel to the long axis of the crown and is not produced into a buttress at the antero-external angle. The three fossettes on the worn crown are situated nearly

[1] A single upper molar in the Indian Museum, collected by Mr. Hacket in the Narbada deposits, is indistinguishable from the corresponding tooth of the living *Cervus (Rucervus) duvaucellii*, indicating the existence of another living mammal in the pleistocene.

[2] I regret that the execution of the figures of the Narbada specimens is so defective, not giving at all a fair idea of their form.

[3] Mem. de l'Acad. Imp. des. Sci. de St. Pet., Ser. VII, Vol. XXVI, No. 5.

in the same line, and parallel to the antero-posterior axis of the crown. In *Rhinoceros sivalensis*, on the other hand (as is well shown in the upper molar figured in Plate V, fig. 5 of this volume), there is no combing-plate, and the crochet is quite unconnected with the outer wall of the tooth; consequently when the tooth is worn down, there are normally not more than two fossettes[1] on the crown (as is well shown in fig. 5 of Plate LXXIV of the "Fauna Antiqua Sivalensis"), while the antero-external angle of the tooth is produced into a large buttress (shown well in my figure). The teeth of *R. sumatrensis* are of the same type, but that species is distinguished from *R. sivalensis* by having two horns in place of one horn.

The true molars and premolars of *R. palæindicus* (I am here doing little more than repeating the matter given in the text of this volume), likewise never have a combing-plate (though from specimens lately acquired by the Indian Museum, as well as from the young skull represented in fig. 1 of Plate LXXIV of the "Fauna Antiqua Sivalensis"), it appears that the milk-molars are, at all events sometimes, furnished with one. In the adult dentition (as is shown in fig. 2*a* of Plate LXXIV of the "Fauna Antiqua Sivalensis") there are normally three fossettes on the worn crown of each tooth, at some period of its wear: these three fossettes are not, however, placed in the same antero-posterior line, as in *R. indicus*, but the middle one is placed somewhat externally to the other two ("Fauna Antiqua Sivalensis", Plate LXXIV, fig. 2*a*, Plate LXXV, fig. 1), being cut off from the end of the main valley, and not from the hinder side of it. Finally, there is no distinct buttress in the true molars of *R. palæindicus* ("Fauna Antiqua Sivalensis," Plate LXXIV, fig. 2*a*) as in *R. sivalensis*, the outer surface of each molar being nearly flat in the former species. In treating of *Rhinoceros palæindicus* at page 24 of this volume, I noticed a young cranium of that species, which is figured in the "Fauna Antiqua Sivalensis" (Plate LXXIV, fig. 1), and of which there is a cast in the Indian Museum. In noticing this cranium in the description of the plate, Dr. Falconer observes: "Very perfect specimen of cranium with both zygomatic arches entire. Shows two molars and two posterior premolars on either side. The third molar is still in germ." From the mention of premolars by Dr. Falconer, it is quite evident that he considered the specimen as showing the permanent dentition, and in my notice of the cranium, I naturally followed this identification. If, however, we refer to the figure of the cranium in question in the "Fauna Antiqua Sivalensis," we shall see that the last tooth is less worn than the third, or any of the preceding teeth. On Falconer's supposition, the third tooth, being the first true molar, should have been more worn than the second tooth, or last premolar. Again, had the second tooth been the last premolar, and being as much worn as it is, the last true molar would have been in use; further, the first tooth is quite unlike a second premolar. From the above, it will be quite evident that the four teeth in Falconer's cranium really are the four milk-molars. There is therefore no abnor-

[1] A broken skull, probably belonging to this species, in the Indian Museum shows three fossettes on the two middle premolars, but none on the true molars or last premolar.

mality in the dental series of this species, as was the case according to Dr. Falconer's supposition, and the permanent dental formula given on page 24 must now be made to stand as follows[1] :—

$$\text{I. } \frac{0-0}{1-1} \qquad \text{C. } \frac{0-0}{0-0} \qquad \text{P. } \frac{3-3}{3-3} \qquad \text{M. } \frac{3-3}{3-3}$$

The table of measurements of the molars will also require the alteration of their names, and will read as follows :—

		In.
Length	of 1st milk-molar	1·10
„	of 2nd „	1·65
„	of 3rd „	1·90
„	of 4th „	2·20
Width	of 1st milk-molar	0·89
„	of 2nd „	1·50
„	of 3rd „	1·85
„	of 4th „	1·90

Professor Brandt, in identifying *R. sivalensis* with *R. palæindicus*, overlooks the above differences in the dentition, as well as the differences in the crania. *R. sivalensis* ("Fauna Antiqua Sivalensis," Plate LXXIII, fig. 2*a*) has the summit of the occiput and parietals raised to a much higher point than in *R. palæindicus* (*Ibid.*, fig. 1*a*); the interval between the nasals and maxillæ is much narrower in the former than in the latter; *R. palæindicus* is further distinguished by its broader forehead. Both species agree in being unicorn.

On page 44 of the same memoir, Professor Brandt classes the Siwalik *R. platyrhinus* with *R. sumatrensis*, in the genus, or sub-genus *Ceratorhinus* of Gray, apparently merely on the grounds that both species were furnished with two horns. Now, the molars of *R. platyrhinus* are of the complex type (as is explained in the text) of *R. indicus* and *R. tichorhinus*, and not of the simple type of *R. sumatrensis*. The descriptions given in the text will amply show the distinctness of the two species above mentioned, and there are now additional materials in the Indian Museum which still further illustrate the dentition of the fossil species, and which I hope to bring to notice on a future occasion. As evidence apart from the upper molars, the occurrence of three distinct forms of mandible of *Rhinoceros* (apart from *Acerotherium perimense*, which is also represented in the Indian Museum) in the Siwaliks, proves the existence there of three species, although their references to the three named species by Falconer (which I have accepted in the text) is very probably open to doubt. I have shown that *R. platyrhinus*, as regards its dentition, is nearest to *R. indicus*, and *R. sivalensis* to *R. sumatrensis*, which is precisely the reverse of the, what I cannot but call, arbitrary identifications of Professor Brandt. If characters like those of the teeth described in the sequel are to be completely ignored, both Zoology and Palæontology together would be impossible, and all the species of a genus might as well receive a single name. Professor Brandt

[1] The first milk-molar, which often persists, is not counted here in the permanent series.

makes no mention of the somewhat startling instance (according to his identifications) of a Miocene mammal (for *R. sivalensis* lived in the Miocene period in Sind) being identical with a living species, or, in other words, that *R. indicus* is a Miocene species, and was a contemporary of the long extinct *Dinotherium*, *Hyopotamus*, and *Anthracotherium ; R. sumatrensis* being also, according to the same author, at least a Pliocene species. As far as I am aware, there are hardly any instances of newer Pliocene mammals being identical with living species, and even by far the greater number of the Pleistocene forms are extinct. I should be inclined to look very doubtfully on such pedigrees for the Indian rhinocerotes even, were they supported by strong evidence, which in the present case is conspicuous by its absence.

The small *Rhinoceros* tooth described on page 46 and drawn in fig. 10 of Plate VI of this volume, as a premolar of an undetermined species, I now think, in all probability, is an anterior milk-molar of *R. platyrhinus*.

In a recently published memoir on the fossil species of *Rhinoceros* and the allied families,[1] Professor Cope has placed *Rhinoceros sivalensis* in a distinct genus under the name of *Zalabis*.

This generic distinction is made on the strength of the statement originally made by Falconer, that this species was "hexaprotodont."[2] I have already shown in the text of this volume (p. 53), that the specimens figured in the "Fauna Antiqua Sivalensis" do not support this statement. In that work, there are figured three forms of lower jaws of Siwalik *Rhinoceros*, referred to the three named species, none of which are hexaprotodont, and of which the one referred to *R. sivalensis* has no incisors. None of the skulls of *R. sivalensis* with which I am acquainted show any upper incisors. I cannot, therefore, see that there is any evidence on which Professor Cope's new genus can be supported.[3]

The very different conclusions arrived at by Professors Brandt and Cope in regard to *Rhinoceros sivalensis*, afford subject for the most serious reflexions as to the present conditions under which palæontological research is carried on. In this case we find two eminent palæontologists, with precisely the same materials before them, arriving at the most opposite conclusions; Professor Brandt identifying *R. sivalensis* with a living species, and Professor Cope referring it to an entirely new genus! The former writer appears to have arrived at his conclusions from neglecting to notice the specific differences pointed out by other workers, while the latter has relied upon alleged differences which have been shown to be unsupported by any kind of tangible evidence. In both cases it was incumbent on the writers to have decidedly refuted all points which militate against their own conclusions, before instituting the sweeping changes which such conclusions involve.

[1] Bull. U. S. Geol. Geog. Surv., Vol. V, p. 232.

[2] Professor Cope reckons the outer lower tusk of *Rhinoceros* as a canine.

[3] I may mention that on page 229 of his above quoted memoir, Professor Cope omits *Acerotherium perimense* from his list of that genus, *Rhinoceros iravadicus* from the genus *Rhinoceros*, and *R. deccanensis* from the genus *Atelodus ;* Professor Cope also alludes to the Siwaliks as being undoubtedly of upper Miocene age!

If the lower jaw assigned to *R. sivalensis* in the "Fauna Antiqua Sivalensis" be rightly assigned, and if we admit the sub-divisions into which the old genus *Rhinoceros* is split up by many modern naturalists, *R. sivalensis* would seem from this point of view to belong to the genus *Atelodus* characterized by the symphysis of the mandible of the adult being edentulous, as in *Rhinoceros simus*. The skull of *R. sivalensis* is, however, unicorn, and, therefore, differs from that of *R. simus*. The species in fact, if the remains are rightly correlated, will not fit into any of the modern sub-divisions of the genus.

RHINOCEROS IRAVADICUS.—The fragment of a right maxilla of a species of *Rhinoceros* with two teeth described on page 45, and figured in Plate V, fig. 4, of this volume, which was not specifically determined, and the teeth in which were considered to be premolars, I now find to belong to a young individual with the milk-molar dentition. It appears probable that these milk-molars may have belonged to a young individual of *Rhinoceros iravadicus*, the permanent molars of which species are figured on the same plate: in having a combing plate they are more complex than the true molars.

ACEROTHERIUM PERIMENSE (*Rhinoceros planidens*).—As I have already mentioned in the "Records,"[1] the two imperfect upper molars of a rhinoceros figured on Plate IV, figs. 7 and 9, and described on page 41 of this volume, as belonging to a new species of *Rhinoceros*, under the name of *R. planidens*, really belong to *Acerotherium perimense* of Falconer and Cautley. The upper teeth of that species figured on Plate VI, figs. 2 and 5, as upper true molars, really are premolars, and the unnamed specimen represented in fig. 6 of the same plate is likewise an upper premolar of the same species.[2] The name of *R. planidens* must accordingly be erased from the list of Asiatic species of *Rhinoceros* given on page 52, and the description of its upper molars be read as those of *A. perimense*. In a subsequent volume I shall hope to illustrate more fully the dentition and craniology of the last named species: a cranium is now in the collection of the Indian Museum. As the teeth of this species, described on page 51 as molars, are really premolars, the statement as to the difference in shape of the molars of this species from the molars of *Rhinoceros* will consequently not stand.

It is at present unknown whether *Acerotherium perimense* was furnished with three or four digits to the forelimb, and from the condition in which Siwalik fossils usually occur, it is very improbable that this point will ever be determined. It is, therefore, impossible to say whether the species really belongs to *Acerotherium* or to the new genus *Aphelops* of Professor Cope,[3] differing from *Acerotherium* in having only three anterior digits. I prefer provisionally to retain the species in the older genus.

[1] Vol. XII, p. 47.

[2] On page 44 I mentioned that I thought it possible this tooth should be referred to *R. planidens (A. perimense)*. The cingulum is remarkably developed in this tooth, and causes it to resemble the premolars of *R. deccanensis*, as noticed in the description.

[3] Bull. U. S. Geol. Geog. Surv., Vol. V, p. 236.

Species of Asiatic Rhinocerotidæ.—I append a few notes on the list of species of *Rhinoceros* given on page 52. Professor Brandt, in his memoir quoted above, admits *Rhinoceros inermis* of Lesson as a distinct species, which should, therefore, be added to the list. Professor Cope, in the above quoted memoir, suggests that this species should be referred to the genus *Aphelops*. Professor Brandt includes under *Rhinoceros javanicus* (*sondaicus*) both *R. nasalis* and *R. floweri* of Gray (the latter species classed as a synonym in my list). By the same writer *R. stenocephalus* of Gray is considered to have been founded on a young individual of *R. indicus* (*unicornis*). Again, under *Rhinoceros* (*Ceratorhinus*) *sumatrensis*, Professor Brandt includes *R. crossii*, *R. blythii*, and *R. niger* of Gray; the two former so-called species were omitted from my list, as being probably synonyms.

The following list of the recent and fossil species of *Rhinocerotidæ* of South-Eastern Asia is given to replace the one given on page 52, as embodying the more recent views. The synonomy of the existing species is given on the authority of Professor Brandt, and is taken from the memoir already cited. The name by which each species has been referred to in this volume is taken as the name of the species. The sub-generic (or generic) divisions of *Rhinoceros* (except *Acerotherium*) have been ignored, as they are, in many cases, inapplicable to the fossils, and the species have been arranged in alphabetical order; synonyms are in italics.

1. Acerotherium perimense (Falc. and Caut.) Mio-Pliocene. India and Burma.
   Rhinoceros perimensis (Falc. and Caut.)
   Rhinoceros planidens (*olim nobis*).
2. Rhinoceros deccanensis (Foote). Pleistocene. India.
3. Rhinoceros indicus (Cuv.) Recent and Pleistocene. India.
   R. asiaticus (Blum.)
   R. namadicus (*olim nobis*).
   R. stenocephalus (Gray).
   R. unicornis (Linné).
4. Rhinoceros inermis (Lesson). Recent. India.
5. Rhinoceros iravadicus (*nobis*).[1] Mio-Pliocene. Burma.
6. Rhinoceros javanicus (Gray). Recent. South-Eastern Asia.
   R. floweri (Gray).
   R. javanus (Cuv.)
   R. nasalis (Gray).
   R. sondaicus (Horsfield).
7. Rhinoceros lasiotis (Sclater). Recent, Mallacca.
? 8. Rhinoceros namadicus (Falc. and Caut.) Pleistocene. India.
9. Rhinoceros palæindicus. (Falc. and Caut.) Mio-Pliocene. India.
10. Rhinoceros platyrhinus (Falc. and Caut.) Mio-Pliocene. India.
11. Rhinoceros sinensis (Owen). ? Pliocene. China.
12. Rhinoceros sivalensis (Falc. and Caut.) Mio-Pliocene. India.
    R. indicus fossilis (Baker and Durand).
13. Rhinoceros sumatrensis (Cuv.) Recent. South-Eastern Asia.
    R. blythii (Gray).
    R. crossii (Gray).
    R. niger (Gray).
    R. sumatranus, (Raffles).

[1] The word *nobis* in this volume always refers to myself, and not to Mr. Foote.

Siwalik Artiodactyla described in 2nd part.—Since the publication of the second fasciculus of this volume, the list of Siwalik suine *Artiodactyla* has been considerably increased, and the list given on page 78 is consequently incomplete: to that list must now be added—

Sus punjabiensis.
Hyotherium sindiense.
Hyopotamus palæindicus.
Sivameryx.
Hemimeryx.
Chæromeryx silistrensis has also turned out to be distinct from *Anthracotherium silistrense.*[1]

Palæoryx.—Two upper molars in the Indian Museum, from the Siwaliks, seem to me to be in all probability generically identical with *Palæoryx* of the Pikermi beds of Attica.[2] I cannot, however, at present be quite certain of this determination, owing to the extreme difficulty of distinguishing the molars of many genera of ruminants.

Portax.—Some upper and lower jaws with ruminant teeth, from the Siwaliks, appear to me generically indistinguishable from those of *Portax*, and indicate a Siwalik representative of that genus.

Portax namadicus (Rüt.). When noticing the additions made by Professor Rütimeyer to the Indian fossil Ruminants,[3] I had not observed the new Narbada species of *Portax* (*P. namadicus*) named by the Professor, from the hinder part of a skull in the British Museum.[4] The addition of this species to the Narbada fauna is of great importance, as connecting the living and Siwalik species.

An atlas of a ruminant in the Narbada collection of the Indian Museum corresponds so exactly with the atlas of *Portax pictus* (except in being slightly larger) that I think it probably belongs to *Portax namadicus*. Two left molars of a ruminant, formerly in the Museum of the Asiatic Society of Bengal, and entered on page 255 of Falconer's catalogue of that collection, as being from the Narbada,

[1] I am now uncertain of the generic distinctness of *Hippopotamodon.*

[2] "Animaux fossiles et Géologie de l'Attique," Plate XLVII.

[3] pp. 178-180.

[4] "Die Rinder der Tertiär-Epoche, &c.," p. 89, Plate VI, figs. 7 and 8. I hope Professor Rütimeyer will pardon me if I mention the inconvenience which arises from first mentioning the name of a new species in the midst of a paragraph, as he has done in this case. The description of every new species ought to have a distinct heading, by which it at once catches the eye. In the case of *Portax namadicus* not at first having time to read Professor Rütimeyer's memoir through, the name of this species, from appearing in the middle of a sentence, did not catch my eye until I had time for a more leisurely perusal of the work. Dr. Gray uses the name *Portax picta* for the living species, which also occurs in a former part of this volume; the Greek word Πόρταξ, a young bovine animal, is, however, either masculine or feminine, and the former gender should have the preference. Hence *Portax pictus*, as given by Jerdon and *P. namadicus*, by Rütimeyer, are correct.

and doubtfully referred to the genus *Cervus* (No. N, 68), I have carefully compared with the corresponding teeth of *Portax pictus*, and find that the two are generically indistinguishable, and I therefore come to the conclusion that the fossil teeth probably belong to *Portax namadicus* of Professor Rütimeyer. Similar teeth have been obtained by Mr. Hacket from the Narbada, and by Mr. Fedden from the Pem-ganga.

Bovidæ.—Among Mr. Theobald's Siwalik collection, I have lately determined two specimens of the axis vertebræ of a bovine, which, from their large size, must, I think, undoubtedly belong to *Bos acutifrons*. I have compared these vertebræ with a perfect specimen of the axis of *Bos primigenius* in the Indian Museum, and with another specimen figured by Professor Rütimeyer,[1] and I find that although the Indian and European vertebræ are similar in general plan, yet there are many points of detail in which they differ considerably, thus confirming my conclusions drawn from the skulls.

It may be well to mention here that at the time of writing the third fasciculus of this volume,[2] I was unacquainted with the fact that some varieties of *Bos primigenius* have horn-cores with an elliptical cross section at the base, as the specimen drawn in fig. 3 of Plate II of the above-quoted memoir of Professor Rütimeyer. In this respect, therefore, there is a closer relationship between *Bos primigenius* and *B. planifrons* and *B. acutifrons* than I have indicated in the text.

It should also be observed that Professor Boyd Dawkins[3] drops the name *Bos primigenius*, and identifies that animal with the prehistoric and historic *Bos urus*, now represented by the cattle of Chillingham Park. By Professor Rütimeyer, in his last published memoir,[4] the name *Bos primigenius* is retained for the Pleistocene form, and the name *Bos taurus* adopted (as a race name) for the living form.

With regard to the bisons, Professor Rütimeyer has come to the conclusion that the bones of *Bison priscus* are indistinguishable from those of *Bison americanus*, while, on the other hand, *Bison priscus* and *B. europæus* are also indistinguishable specifically.[5] There is thus established an intimate connection between the now widely different European and American bisons. In his latest work, however, Professor Rütimeyer[6] retains the three above mentioned specific names, and places *B. sivalensis* as the earliest representative of the group.

The genus *Bubalus* of other writers is split up by Professor Rütimeyer into two genera,[7] which are termed *Bubalus* and *Buffelus;* the former includes the European Pleistocene *B. antiquus* and the living African *B. caffer* and *B. brachyceros;* the latter includes *B. platyceros* (*sivalensis*), *B. paiæindicus*, and *B. pallasii* in the Pleistocene. In the recent period Professor Rütimeyer names the living Indian

[1] Nov. Mem. Soc. Helv., Vol. XIX, Pl. IV, figs. 1, 2.
[2] See page 112.
[3] Quar. Journ. Geol. Soc., Lond., Vol. 22, p. 394.
[4] "Die Rinder der Tertiär-Epoche, etc.," p. 189.
[5] See "Prehistoric Times," 2nd ed., p. 296.
[6], [7] *loc. cit.*

buffaloe, *Buffelus indicus:* this name is, of course, synonymous with the name *Bubalus buffelus* adopted by Gray,[1] and *B. arni*, adopted in this volume, after Jerdon.[2]

Professor Rütimeyer also mentions another, apparently Indian species, under the name of *Buffelus sondaicus*.

The genus *Bibos*, according to Professor Rütimeyer, includes the domestic Indian cattle, *B. indicus*, the Gour, *B. gaurus*, a doubtful species named *B. gavæus*, and *B. sondaicus* (*banting* of Gray and this work). *Bibos frontalis* (the Mithun or Gayal) of Lambert and Hodgson is omitted from the list, unless it be *B. gavæus*. Whether or no the Mithun occurs now in the wild state or not, it appears to me to be a distinct species, though there are some skulls in the Indian Museum which bridge over the gap between this animal and the typical Gour.

Cervus.—A palatal portion of a skull containing teeth similar to those figured on Plate VIII, fig. 3, under the name of *Cervus simplicidens*, seems to confirm the generic identification of those teeth. Of *Cervus triplidens* (figs. 1, 2, Plate VIII) I have not obtained any additional specimens, but I think the generic identification is here also correct. One of the Siwalik deer had flattened and branching antlers much like those of *Cervus duvaucellii*, indicating the high state of evolution of the group in Siwalik times.

The Indian Museum has lately obtained a complete maxilla, containing molars like the one tooth drawn in figs. 7 and 10 of Plate VIII. I had some hesitation, as noticed in the text, in referring the figured tooth to *Cervus*, and I still am not quite sure whether such reference is correct, though I think it very possibly is. The amount of variation in the form of the molars of the *Cervidæ* is so great that it is very difficult to say, in the case of isolated teeth, how far this variability may extend. I have, on account of the possibility of doubt, not included *Cervus latidens* in the list of ruminants given on page 180. I hope eventually to obtain materials which will decisively indicate the genus of the teeth in question.

The lower molars of a *Cervus* drawn in fig. 5 of Plate VIII, which I thought might possibly belong to *C. simplicidens*, I now find, from the character of their enamel, belong, in all probability, to a new species, which I propose, on a subsequent occasion, to call *C. sivalensis*.

Palæomeryx.—A single tooth of a ruminant from the Siwaliks, lately presented to the Indian Museum by the Roorkee (Rúrki) Museum, seems to belong to *Palæomeryx*, and to have been about the size of *P. bojani:* this tooth seems to have come from the lower Siwaliks (Nahans), and a lower molar from probably the same horizon in Sind, not impossibly belongs to the same genus.

Camelopardalis.—A more complete lower jaw of *Camelopardalis sivalensis* than the one of which the molars are drawn in fig. 5 of Plate VII of this volume has lately been acquired by the Indian Museum; the new specimen is

[1] Brit. Mus. Cat.

[2] Mammals of India, p. 370.

rather smaller than the figured one. A large series of molars of this genus have also been obtained which seem to indicate the existence of other Siwalik species.

VISHNUTHERIUM.—Two associated upper molars of a sivatheroid from the Siwaliks of the Punjab, present characters which distinguish them from the molars of *Sivatherium*, *Bramatherium*, and *Hydaspitherium;* from the size, and certain details of the form of these teeth, I have thought it not impossible that they may belong to *Vishnutherium iravadicum*, of which the lower molars are figured in Plate VII, figs. 1 and 2.

HYDASPITHERIUM MEGACEPHALUM.—It is possible that some critic may say that the specific name of this species is a barbarism, and, therefore, should be replaced. The name *megacephalum* is undoubtedly a barbarism, but the termination appears to have gained general acceptation as a convenient adjectival form for scientific names. The Greek substantive Κεφαλή if translated into Latin, should probably be *Cephala*, and the only direct adjectival form is Κεφαλωτός; by naturalists, however, a latinised adjectival termination, *Cephalus,-a-um*, is in common use; *e. g.*, *Plesiosaurus brachycephalus*, *Halcyon leucocephala*, *Ptychozoon homalocephalum*. The term *megacephalum* is used for brevity in place of *megalocephalum*, on the precedent of *Megatherium* for *Megalotherium*.

HELLADOTHERIUM.—M. Gaudry[1] states that *Helladotherium* occurs in India. I am not aware on what grounds this statement rests.

These additional specimens will afford ample material for another memoir, illustrative of Siwalik ruminants and their allies.

TETRACONODON MAGNUM.—Since publishing (p. 79) the description of the imperfect mandible figured on Plate X, I have discovered the two last molars belonging to that specimen, which had previously been mixed up with some other specimens. As the execution of Plate X was very poor, I take the opportunity of re-issuing that plate with one of the newly found teeth in its proper serial position. To the measurements of the molars of the figured specimen given on page 80 must be appended, "length of last molar 1·95 inches, width of ditto 1·3 inches." This tooth shows that Falconer's specimen belonged to the upper jaw.

CONCLUSION.—The above additions and corrections will, I hope, render the contents of this volume correct, as far as my present knowledge goes. European palæontologists will, I hope, pardon many shortcomings and redeterminations in my work, which have been in many cases almost unavoidable. The work of a student in vertebrate palæontology in India is one of peculiar difficulty in many ways. He has first of all the difficulty, common to workers in other countries, of having very frequently exceedingly imperfect and scanty remains from which to determine the affinities of an animal, and is consequently liable to false inferences from this source. *Secondly*, he feels the want of a large collection of the remains of described European species of vertebrates for comparison: it is true the Indian Museum in Calcutta possesses a

[1] "Les Enchainements du Monde Animal, Mammifères Tertiaries," p. 79.

considerable collection of casts and remains of non-Indian fossil vertebrates, but these really comprehend only a few of the better known genera.[1] *Thirdly*, although the library of the Geological Survey is an extensive one, there are wanting a great number of the older works on vertebrate palæontology, many of which are now out of print: in many cases, moreover, works, when ordered from England, arrive in India too late for the purposes of the worker who required them. *Fourthly*, the student in Indian vertebrate palæontology at the present time labours under the great disadvantage of working without the possibility of appealing to other workers in the same branch of study for assistance and advice in cases of doubt and difficulty. There are also wanting in the zoological department of the Indian Museum skulls of many genera of living mammals which are required for an exhaustive comparison of their fossil congeners. *Finally*, in the case of Siwalik fossils, there occurs the additional and special difficulty of taking up the work in the incomplete state it was left at the premature death of Dr. Falconer, and of determining ill-defined, imperfectly described species in Calcutta, without access to the original specimens in London. This last difficulty has been the cause of several errors in the specific determinations which occur in this volume.

On the above grounds, I venture to hope that any want of references or comparisons to European fossils, and consequent possible shortcomings in this work, will be looked upon with a lenient eye by my European and American fellow workers.

In conclusion, it is but fair to mention that although there has devolved upon myself the task of describing the Siwalik fossils in the Indian Museum of Calcutta, yet that the far more onerous task of amassing and bringing together that, perhaps, unrivalled series has devolved upon my colleagues in the Geological Survey, chief among whom are Messrs. W. T. Blanford, F. Fedden, W. Theobald, and A. B. Wynne. By far the largest share of this work has been executed through the indefatigable energy and perseverance of Mr. Theobald, who, through heat and cold, drought and rain, has traversed many a weary mile of the hills and plains of the Punjab to attain his object: to him especially are due the thanks of all interested in the history of the tertiary vertebrates of India.

R. LYDEKKER.

INDIAN MUSEUM,
Calcutta, January 1880.

[1] I have the authority of the Superintendent of the Geological Survey of India to offer named duplicate specimens of described Siwalik fossils in exchange for named specimens of teeth of European or American tertiary mammals.

LIST OF PLATES.