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MEMOIRS
OF THE
GEOLOGICAL SURVEY OF INDIA.

Palæontologia Indica,

BEING

FIGURES AND DESCRIPTIONS OF THE ORGANIC REMAINS PROCURED DURING
THE PROGRESS OF THE GEOLOGICAL SURVEY OF INDIA.

PUBLISHED BY ORDER OF HIS EXCELLENCY THE GOVERNOR GENERAL OF INDIA IN COUNCIL.

Ser. X.

INDIAN TERTIARY AND POST-TERTIARY VERTEBRATA,

Vol. II.

By R. LYDEKKER, B.A.; F.G.S.; F.Z.S.

Part	I., Dec., 1881	- -	SIWALIK RHINOCEROTIDÆ.
„	II., „ „	- -	SUPPLEMENT TO PROBOSCIDA.
„	III., Jan., 1882	- -	SIWALIK AND NARBADA EQUIDÆ.
„	IV., Dec., „	- -	SIWALIK CAMELOPARDALIDÆ.
„	V., Feb., 1883	- -	SIWALIK SELENODONT SUINA.
„	VI., Jan., 1884	- -	SIWALIK AND NARBADA CARNIVORA.

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PREFACE.

THE present volume contains descriptions of the following groups of Indian fossil mammals; *viz.*, the rhinoceroses and horses; certain Proboscidea; the giraffe-like and sivatheroid animals; a group of Pig-like Artiodactyle Ungulates; and the Carnivora. It will thus be seen that the order of the parts follows no systematic arrangement; the different groups having been taken up as materials accumulated. It will also be noticed that in the majority of cases the remains described are either teeth, jaws, or skulls; this circumstance being due to the following causes. In the first place, since the remains of Siwalik animals are nearly always found disassociated, with the long-bones generally broken, while in many of the genera there are numerous species often closely agreeing in respect of size, there is usually no kind of clue towards assigning individual bones to their respective species, even when they are generically determinable; so that under these circumstances in many instances nothing would be gained by describing them. In the second place, the quantity of remains of Siwalik vertebrates in the Indian Museum is so great that to attempt a description of anything like the whole collection would simply swamp the present arrangements for publication. The plan hitherto followed has been to describe the more important and characteristic remains of each species, in the manner best adapted in the writer's opinion to display its general affinities. It is only by adopting some such restrictions that it will be possible (if the present arrangement be continued) to give a general survey of the whole Siwalik Fauna.

It is hoped that palæontologists will find the execution of the plates of the last two parts more satisfactory than some of those of the earlier parts, many of which were drawn and lithographed by native artists.

In regard to the same parts, I have to return my thanks to Dr. Henry Woodward, LL.D., F.R.S., Keeper of the Geological Department of the British Museum, for access to, and the liberty to figure the specimens under his charge. To Prof. Flower, LL.D., F.R.S., Curator of the Museum of the Royal College of

Surgeons, for permission to figure specimens in that collection, and for free access to the whole of the same. To Dr. Günther, M.A., F.R.S., Keeper of the Zoological Department of the British Museum, for free access to the osteological collection of that institution. To Mr. William Davies, F.G.S., of the British Museum, for much valuable information regarding the Siwalik Carnivora in the National Collection. To Prof. V. Ball, M.A., F.R.S., Director, and Mr. A. G. More, Curator of the Science and Art Museum, Dublin, for the opportunity of examining the Siwalik Carnivora in that collection. To Dr. J. E. Taylor, Ph.D., Curator of the Ipswich Museum, for permission to figure an important specimen in that collection. To Prof. George Busk, M.D., F.R.S., for the opportunity of figuring a specimen lately in his possession, and now presented to the British Museum. To the Publishing Committee of the Zoological Society, to the Council of the Geological Society, and to the Chief Librarian of the British Museum, for permission to reproduce woodcuts from their publications. My thanks are also due to numerous palæontologists for copies of their memoirs on fossil mammals; and to the Editorial Staff of the "Geological Record," for the opportunity of seeing the manuscript of several of the forthcoming volumes.

In answer to several inquiries why the English, in place of the decimal, system of mensuration has been adopted, I may state that this course has been followed in order to bring this work into harmony with the "Fauna Antiqua Sivalensis."

I cannot conclude without expressing my sense of the high value for palæontological purposes of the two following memoirs; *viz.*, one by Prof. Busk, "On the Cranial and Dental Characters of the existing species of *Hyæna*"; and the other by Prof. Huxley "On the Cranial and Dental Characters of the *Canidæ*." It is to be hoped that other families may be treated in the same manner.

It should be observed that in the earlier parts the names of the founders of species are universally enclosed in brackets: in the latter parts they are only so enclosed when the generic name has been changed.

RICHARD LYDEKKER.

THE LODGE,

HARPENDEN,

HERTFORDSHIRE,

January, 1884.

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ADDENDA AND CORRIGENDA.¹

Page 5-7. The range in time of the rhinoceroses of the later European tertiaries, according to Prof. Boyd Dawkins,² should be as follows, *viz.* :—

- R. etruscus.* Up. pliocene to lower pleistocene.
R. leptorhinus, Ow. Mid. and upper pleistocene.
R. megarhinus, Christ. Low. pliocene to mid. pleistocene.
R. tichorhinus. Mid. and upper pleistocene.
- „ 21, line 17 from top for *occidentale* read *occidentale*.
„ 60, „ 9 „ „ „ *Géraund* „ *Gérand*.
„ 76. In the table of measurements the premolars numbered 1st, 2nd, 3rd, should be 2nd, 3rd, 4th.
„ 100, line 18 from top for *Qrasius* read *Orasius*.
„ 126, „ 16 „ bottom „ *proximals* „ *proximal*.
„ 134, „ 13 „ „ „ *bar* „ *base*.
„ 140, „ 2 „ top „ *Mesacerops* „ *Megacerops*.
„ 146. According to Prof. Gaudry, it is *Palæochærus*, rather than *Hyotherium*, which is nearest to *Dicotyles*: it is, however, probable that the two fossil genera, together with *Chæromorus*, should be united. *Amphichærus* is a synonym of *Hyotherium*.
„ 149, top line after *Up. eocene* add *and low. miocene*.
„ 164, line 12 from top for *Gándri* read *Gandoi*.
„ 171, „ 15 „ bottom „ *Láki* „ *Laki*.
„ 189, „ „ „ „ „ *H.* „ *A.*
„ 211, „ 11 „ top „ *caudivolus* „ *caudivolvulus*.

VOLUME I.

„ 283-284 (and elsewhere) the range in time of the three following species of proboscidi-ans should according to Prof. Boyd Dawkins,³ be as follows, *viz.* :—

- Mastodon arvernensis.* Pliocene.
Elephas meridionalis. Up. pliocene and low. pleistocene.
„ *antiquus.* Pleistocene.⁴

„ 286, line 18 from top for *India* read *Asia*.

In description of plate XLVI., fig. 4, for *true molar* read *milk-molar*.

¹ A few self-apparent misprints (especially in pt. IV., of which the writer did not see the final revise) have been left uncorrected.

² 'Quart. Journ. Geol. Soc.,' vol. XXXVI., p. 379, *et. seq.* This memoir had not reached the writer when pt. I. was sent to press. It should be observed that the lower pliocene of Prof. Dawkins does not include the Pikermi beds; which, if classed in that period, may be termed 'Lowest pliocene' (*vide infra* "Introductory Remarks").

³ *Op. cit.* It may be observed in self-justification that the geological ages of the two species of elephant given in the first volume were taken from Falconer's table ("Pal. Mem.," vol. II., pp. 14-15): the present writer not being then aware of the incorrectness of many of the statements contained therein.

⁴ The pleistocene age of this species invalidates the connection between the geological age and the ridge-formula of the species of *Elephas* noticed in vol. I., p. 288: and also the inference as to *E. antiquus* being older than *E. namadicus* mentioned in note 2, p. 281.

INTRODUCTORY OBSERVATIONS.

American rhinoceroses.—Since the first part of this volume was written a memoir by Prof. Cope¹ has come under the writer's notice, in which the conclusion is arrived at that none of the American hornless rhinoceroses should be referred to the European genus *Aceratherium*.²: they are now classed as follows,³ viz.:—

Genus I.: PERACERAS, Cope.

I. $\frac{0}{0}$, C. $\frac{0}{0}$, Pm. $\frac{4}{4}$, M. $\frac{3}{3}$. Digits?

Peraceras superciliosus, Cope.

„ *malacorhinus*, Cope.=*Aphelops malacorhinus*, Cope.

Genus II.: APHELOPS, Cope.

I. $\frac{1}{1}$, C. $\frac{0}{0}$, Pm. $\frac{4}{4}$, M. $\frac{3}{3}$. Digits $\frac{3-3}{3-3}$.

Aphelops meridianus (Leidy).

„ *megalodus*, Cope.

„ *fossiger*, Cope.

Genus III.: CÆNOPUS, Cope.

I. $\frac{2}{2}$, C. $\frac{0}{0}$, Pm. $\frac{4}{4}$, M. $\frac{3}{3}$. Digits $\frac{3-3}{3-3}$.

Cænopus mitis, Cope.=*Aceratherium mite*, Cope.

The European genus *Aceratherium* has the dental formula of *Cænopus* or *Aphelops*, but the digits (in the type species) are $\frac{4-4}{3-3}$.

The present writer being strongly opposed to the great multiplication of genera, as tending to obliterate the affinities of animals, would prefer to unite the whole of these three new genera with *Aceratherium*; giving them at the most sub-generic value. The differences in their dentition are not greater than those found in the existing rhinoceroses, which the writer likewise unites under one genus; the terms *Atelodus*, *Ceratorhinus*, etc., being used, if at all, as of subgeneric value.⁴ The

¹ "Amer. Nat.," pp. 540-610.

² It appears to be the custom now to spell this name *Aceratherium*, in place of *Acerotherium*.

³ The outer so-called lower incisor is probably a canine.

⁴ Among both the tetralophodont and trilophodont mastodons there are some forms with a produced mandibular symphysis furnished with incisors, while in others the symphysis is short and edentulous. Both of these forms (belonging, be it remembered, to distinct subgeneric groups) would be quite as well entitled to generic distinction, as the various forms of American aceratheres. If the writer were rewriting the first volume of this work, he would drop the names *Stegodon*, *Loxodon*, and *Euelphas*, and merely retain the generic name *Elephas*. He would also pursue much the same course with the *Bovidae*; using the term *Bos* in its old Linnean sense.

x. INDIAN TERTIARY AND POST-TERTIARY VERTEBRATA.

presence of a small fourth anterior digit in (at least some of) the European *Aceratheria* need not, in the writer's opinion, be reckoned as a character worthy of generic distinction. In the Indian *A. perimense* the feet are unknown, and it is, therefore, impossible to say whether it may not have belonged to one of the American so-called genera.¹

The statement on page 9, note 2, that the post-tympanic and post-glenoid processes of the squamosal of *Aceratherium* appear to be united inferiorly has been found to be incorrect.²

It is stated by Prof. Cope³ that "it is possible that a species of *Aphelops* still exists in some of the Indian islands in the *Rhinoceros inermis*, Less." The present writer, from having seen in Calcutta specimens of the Javan rhinoceros with a very minute horn, is strongly inclined to think that the so-called *R. inermis* is the same as that species. The existence of that form, together with some of the miocene European species, probably indicates that there is really no distinction between *Aceratherium* (in the sense in which it is used here) and *Rhinoceros*; although the retention of the former is convenient.

A separate genus, *Diceratherium*, Marsh, has been formed for the reception of *Aceratherium pacificum* (Leidy), and *Rhinoceros oregonensis*, Marsh, and is said to include⁴ the European *Rhinoceros pleuroceros*, Duvernoy, which in the present volume, after Kaup⁵ and Brandt, has been included with *Aceratherium minutum*; although regarded by others as distinct.⁶

Rhinoceros mercki.—In the list on pages 5-6 *Rhinoceros mercki*, Jäger, is given as a synonym both of *R. etruscus*, Falc., and *R. leptorhinus*, Owen. In the former instance it should have been *R. mercki*, Meyer, which is not the same as Jäger's species.⁷

Additional species of Aceratherium.—To the list of species of *Aceratherium* given on page 4 add—

17. ACERATHERIUM VELAUNUM⁸ (Aymard). Low. miocene, Europe.

Rhinoceros cuvieri (?), Aymard.

Rhinoceros velaunus, Aymard.

Ronzotherium velaunum, Aymard.

Names of the existing Asiatic rhinoceroses.—It is well to mention that, on the grounds of priority, the proper names of the three well-determined species of Asiatic rhinoceroses are undoubtedly *R. sondaicus*, *R. sumatrensis*, and *R. unicornis*: the names *R. javanicus*, *R. sumatrensis*, and *R. indicus* are, however, so convenient, as being exactly equivalent to the terms, Javan, Sumatran, and Indian rhinoceroses, that the first and third have been adopted in place of *R. sondaicus* and *R. unicornis*.

¹ The present writer has been sharply pulled up by Messrs. Scott and Osborn ("Contributions from the E. M. Museum of Geology and Archæology of Princeton College"—Bul. No. 3, p. 21, Princeton, U.S.A.) for including *Aphelops* with *Aceratherium*. The writer maintains that it was his only course, as the distinctions between the two (apart from the views mentioned above) are not of general applicability.

² Scott and Osborn, *loc. cit.*

³ "Amer. Nat.," Dec., 1879, p. 771b.

⁴ *Ibid*, p. 771h.

⁵ Kaup, "Beiträge," pt. I. p. 3.

⁶ See Gaudry, "Les Enchainements du Monde Animal, etc.—Mammifères Tertiaires," pp. 75-6.

⁷ See Forsyth-Major, "Supra alcuni Rhinoceronti fossili in Italia." 'Boll. R. Com. geol. Ital.,' 1874, p. 94.

⁸ Filhol, "Étude des Mammifères Fossiles du Ronzon." "Ann. Sci. Geol." vol. XII., art. 3 (reprint), p. 75, 1881.

Hippotherium.—The generic name *Hippotherium*, in place of the older *Hipparion*, has been mainly adopted in conformity with the usage of the “Fauna Antiqua Sivalensis”; of which this work is to be regarded as a continuation.

One of the equine bones from Húndes, in Tibet, noticed on page 68, is a cannon-bone, now in the collection of the Geological Society, and evidently belongs to *Hippotherium*. If the Húndes beds are pleistocene, it is the only known instance of the occurrence of the genus in that period.

Additional species of Equus and Hippotherium.—To the list of species of *Equus* given on pages 71-2 add—

EQUUS TENIOPUS,¹ Heuglin. Recent, North Africa.

About the time that the third part of this volume was in the press, a new species of horse, said to be allied to the zebras, was described from the pleistocene of S. America, under the name of *E. lundii*, Boas.² Since the publication of the same part a new species of zebra, inhabiting Shoa and the adjacent districts of that part of Africa, has been described by M. A. Milne-Edwards³ under the name of *E. grevyi*. Assuming this form to be distinct from the allied *E. zebra* of South Africa (not improbably extinct) these additions⁴ make the number of species of *Equus* 25 (of which 10 are, or were recently, living), the African species 7, and the American 12. A new species of *Hippotherium* has been described by Prof. Leidy⁵ from Panama, under the name of *H. montezuma*.

Connection between Hippotherium and Equus.—It may be noticed in reference to the observations on page 79 that there is in the British Museum the metatarsus of a hippothere from Eppelsheim, in which, while the lateral bone is fully developed on one side, on the other it is extremely small, though extending along the whole length of the ‘cannon-bone.’ This instance looks much like the incipient disappearance of the lateral digits, and indicates a transition from the hippotherian to the equine type. It has been observed by Prof. Flower⁶ that in many of the instances of polydactylism among existing horses, the additional digit (for there is usually but one developed) is due to a splitting of the mesial digit, and cannot therefore be regarded as in any sense a reversion towards *Hippotherium*. In many of these instances, moreover, the supplementary digit is on the inner side; whereas in other perissodactyles the inner digits disappear before the corresponding outer ones. In a polydactyle horse from Bagdad, of which the right *pes* is figured by Mr. J. Wood-Mason,⁷ the supplementary

¹ See Sclater, ‘Pro. Zool. Soc.’ 1864, p. 374.

² “Om en fossil Zebra.”—‘Mem. Acad. Roy. Copenhagen,’ 6th ser., Classe des Sciences, vol. I., 1881, p. 307.

³ See ‘La Nature,’ No. 470 (3rd June, 1882); ‘Pro. Zool. Soc.’ 1882, p. 721: *Ibid*, 1883, p. 175.

⁴ From his own observations on their skulls the writer is disinclined to accept the views of some zoologists as to the specific identity of all the wild asses of Asia. See W. T. Blanford, “Eastern Persia, etc.,” London, 1876, vol. II., p. 84. *Equus hemippus*, Geoffr., St. Hil., of Syria is by some regarded as distinct from *E. onager*, under which its name should be put on page 72, instead of under *E. hemionus*.

⁵ ‘Pro. Ac. Philad.’ 1882, p. 290.

⁶ Lectures on the Anatomy of the Horse; Royal College of Surgeons, 1883.

⁷ ‘Pro. Asiat. Soc.’ 1871, p. 18, pl. I.

digit is, however, the outer one (4th), while the 'splint-bone' of the inner digit (2nd) is more developed than usual; and there is no sign of an unsymmetrical development of the main digit (3rd). It seems not improbable that this instance may be one of true reversion; the development of the digits being probably very similar to those of the hippothere mentioned above.

Name of giraffe.—Considerable difficulty has been found in deciding on the generic name to be adopted for the giraffe, since while palæontologists invariably use the name *Camelopardalis* in this sense, by modern zoologists it is restricted to its original Linnian sense of a specific designation for the existing species.¹ The origin of this confusion resulted from the old practice, in cases when a species had to be removed from the genus where it was first placed and assigned to a new one, of taking the specific as the new generic name, and giving a new specific name. Thus *Cervus camelopardalis*, Linn., became *Camelopardalis giraffa*, F. Cuv., instead of *Giraffa camelopardalis* (Linn.). Although there is no question that the latter term is correct, it has been thought best in the text to retain the Cuvierian and palæontological usage of these names.²

Ursus piscator.—On the authority of Prof. Busk,³ *U. piscator*, Puch.,⁴ has been doubtfully classed in the text as a synonym of *U. horribilis*: it is, however, really the same as *U. lasiotis*, Gray⁵: which for palæontological purposes must be included in *U. arctos*.

Hyænarctos from Pikermi.—Since the description of *Hyænarctos* was printed remains of a species of this genus have been recorded by Prof. Dames⁶ from Pikermi; although not specifically determined.⁷

Miocene Caninæ.—A paper by Prof. Cope⁸ on some miocene canoids has come under the writer's notice since the greater part of the text was in type. The dental formula of *Hyænocyon* is therein corrected to Pm. $\frac{3}{3}$, M. $\frac{1}{1}$: and a canoid previously referred to *Icticyon* is classed in the new genus *Oligobunis*; the dental formula being Pm. $\frac{4}{4}$, M. $\frac{1}{2}$, and $\overline{m.1}$ being furnished with an inner cusp and basin-shaped talon.⁹

Additional Viverra.—*Viverra miocenica*,¹⁰ Pet., a small species from the miocene of Styria, is omitted from the list on pages 267-8.

1 "Systema Naturæ," ed. 1766, vol. I., p. 92.

2 Following the Cuvierian custom (see 'La Regne Animal') the generic term *Camelopardalis* is given with the affix *Linn.*; though it was never employed by him in this sense. After the name *C. giraffa* the affix *F. Cuv.* should be substituted for *Linn.*

3 'Trans. Zool. Soc. Lon.', vol. X., p. 64.

4 In the text, *errorim*, Gray.

5 See "List of Vertebrate Animals in the Gardens of the Zoological Society of London," 1883, p. 87.

6 'Sitz. Ges. nat. Freunde Berlin,' Oct., 1883, p. 132.

7 In comparing $\overline{m.1}$ of *H. palæindicus* (*infra.*, p. 230) with that of *Dinocyon* and *Canis*, it might have been observed that the inner cusp of the blade is relatively larger in the former.

8 'Amer. Nat.,' vol. XV., p. 497.

9 The original reference of this form to *Icticyon* was the cause of Prof. Cope's erroneous definition of that genus mentioned in the note on page 242.

10 Peters 'Denks. Ac. Wiss.,' vol. XXIX., p. 194, pl. III., figs. 8-10.

List of, and remarks on, Siwalik Carnivora.—The list of Siwalik Carnivora, as described in the concluding part of this volume, comprehends 33 species; most of which are based on fairly sufficient remains. These may be tabulated as follows, viz.:

Mustelidæ	{	Mellivora sivalensis (F. and C.)	{	Hyæna felina, Bose.
		„ punjabiensis, Lyd.		„ colvini, Lyd.
		Mellivorodon palæindicus, Lyd.		„ macrostoma, Lyd.
		Lutra palæindica, F. and C.		„ sivalensis, Bose.
		„ bathygnathus, Lyd.		„ sp. non. det.
Ursidæ	{	„ sivalensis (F. and C.)	{	Lepthyæna sivalensis, Lyd.
		Ursus theobaldi, Lyd.		Æluropsis annectans, Lyd.
		Hyænarctos sivalensis, F. and C.		Ælurogale sivalensis, Lyd.
		„ punjabiensis, Lyd.		Felis cristata, F. and C.
		„ palæindicus, Lyd.		„ (? Cynælurus) brachygnathus, Lyd.
Viverridæ	{	Amphicyon palæindicus, Lyd.	{	„ sp. (allied to <i>F. pardus</i>)
		Canis curvipalatus, Bose.		„ sp. (allied to <i>F. lynx</i>)
		„ cautleyi, Bose.		„ subhimalayana, Bronn.
		„ sp. non. det.		„ (? sp. non. det.)
		Viverra bakeri, Bose.		Machærodus sivalensis, (F. and C.)
„ durandi, Lyd.	„ palæindicus, Bose.			

Hyænodontidæ—*Hyænodon indicus*, Lyd.

The most striking feature in this list is the strange mingling of essentially modern forms, with those generally characteristic of the older tertiaries; this being a feature noticeable in all the orders of Siwalik Mammalia, but perhaps in none so strongly as in the present instance. Thus by the side of ratels, bears, jackals, and civets, some of which are scarcely distinguishable from existing species, there occur essentially primitive forms like *Hyænodon* (or a closely allied genus), *Amphicyon*, *Lepthyæna*, and *Ælurogale*. Although this feature is probably exaggerated by the mingling of genera peculiar to different horizons, yet from the mode of occurrence of many of the forms it must be in the main true; and, in view of the invertebrate evidence afforded by the associated deposits in Sind, admits of but one reasonable explanation:—namely, the survival in the Indian and African areas of old types long after they had disappeared from other parts of the world.¹ This view fully accords with all the facts, and is the only one which brings the condition of the ancient fauna of India into harmony with that of the present day.

Equally noteworthy is the apparently contemporaneous existence of specialized and generalized forms of the same genus; especially well shown in the hyænas. The same group also shows the remarkable fact that the solitary existing Indian hyæna is of a less specialized type than some of the extinct species; probably indicating, as seems to have been the case with the machærodonts, that a high degree of specialization was not invariably advantageous; and thereby conducive to the life of a species.

The Siwalik carnivorous fauna fills up many gaps in the chain of relationship; the points most strongly brought out being the intimate connection between the bears and the dogs; the viverroids and the hyænas; and the cats and the hyænas. There

¹ This explanation was proposed by Mr. W. T. Blanford (“Manual of Geology of India,” pt. I., p. LXX.)

are also not wanting certain signs of the connection of the latter with the dogs, which are well known to be intimately related to the viverroids; while *Otocyon* has been brought closer to *Canis*, *Cynælurus* to *Felis*, and *Machærodus* to the more primitive cats. Thus the impartial study of the previously little-known extinct local members of one order of the Mammalia has most decidedly added to the already enormous difficulty of interpreting the mutual relations of extinct and existing beings by any other hypothesis than that of evolution.

Perhaps the most important fact in relation to the distribution of the tertiary Carnivora is that the Siwalik species of *Machærodus* are intermediate between those of Europe and those of S. America. As the latter are the most specialized forms of the genus, and are found in the pleistocene, while the European forms are the most generalized, and usually occur in older strata, it seems probable that the migration of the genus took place in an easterly direction from Europe, through Asia, to America.

Age of lower Siwaliks and European tertiaries.—A word is advisable as to the view taken of the age of the lower Siwaliks on page 143. In 1880, Prof. P. M. Duncan¹ gave a table of the tertiary rocks of Sind in which the lower Manchhars (Siwaliks) were considered to be either of upper miocene, or lower pliocene age; the upper Manchhars (Siwaliks) being referred to the pliocene. In a later paper² (1881) the same writer observed that “the disassociation of the Manchhar and Gáj series is a necessity; and the nature of the fauna, so singularly allied to that of Pikermi, *necessitates* its relegation to the early Pliocene time.” Although there is a little ambiguity in the wording of the sentence, there is no doubt from the context that the beds referred to the early pliocene are the lower Manchhars; and from the use of the word ‘*necessitates*’ the present writer felt bound to adopt that view in the passage already cited.³ In the introduction to a still later work by Prof. Duncan, Mr. W. T. Blanford⁴ prefers, however, to class the lower Siwaliks as of upper miocene age; remarking that the evidence of the fossil corals and echinoderms of Sind is in favour of the classification of the tertiaries in which the lower Siwaliks occupy this geological horizon. It is perhaps on the whole inadvisable at present to press the question too closely.

Owing to the recent changes of view as to the age of some of the later tertiary faunas of Europe, some difficulty has been found in assigning their proper geological ages to many of the European tertiary mammals. In most cases the tables given by Prof. Boyd Dawkins⁵ have been followed; but as the lower pliocene of that writer does not include the Pikermi beds,⁶ these, if referred to the same period, must be regarded as an inferior member, which may be called ‘lowest pliocene.’ The Eppelsheim beds are classed as upper, and the Sansan and Simorre beds as middle

¹ “Pal. Ind.,” Ser. XIV., vol. I., pt. I. (“Sind Fossil Corals, etc.”) p. 4.

² ‘Quart. Journ. Geol. Soc.,’ vol. XXXVII., p. 207: the italics are the present writer’s. ³ The same view has been adopted in the writer’s “Geology of Kashmir,” ‘Mem. Geol. Surv. Ind.,’ vol. XXII.

⁴ “Pal. Ind.,” ser. XIV., vol. I., pt. 4 (“Fossil Echinoidea of Kachh and Kattywar,” p. 2. 1883.)

⁵ Especially the paper in ‘Quart. Journ. Geol. Soc.,’ vol. XXXVI., p. 379, *et. seq.*

⁶ With these must be classed the beds of Baltavar (Hungary), Mt. Léberon (France), and Concud (Spain).

miocene: if, as Prof. Duncan¹ thinks probable the Eppelsheim beds are at the base of the pliocene,² then the Sansan and Simorre beds must be transferred to the upper miocene.

Fossil Persian mammals.—It is well to record that from Maragha, in western Persia (nearly due south of Tabríz) fossil remains of mammals have been recently obtained, and named as follows,³ *Helladotherium*, sp. (metacarpal); *Rhinoceros*, sp. (not *tichorhinus*); *Mustodon* (?) sp.; *Tragoceros*, sp. (tibia); and *Hippotherium*, sp.: also *Rhinoceros tichorhinus*, *Elephas primigenius*, *Bos bison*, *Cervus elaphus*, *Equus caballus*, and *E. onager*. It is inferred that these remains probably indicate the presence of the Pikermi beds, together with pleistocene strata. They may possibly also indicate a western extension of the Siwaliks, the fauna of which has a more marked European facies in eastern Balúchistán; and hence render it not improbable that the Siwalik and Pikermi faunas may be eventually brought into actual connection. The occurrence of pleistocene forms in the same region as Pikermi genera is paralleled by the association of Siwalik and Narbada strata in Japan.

¹ 'Quart. Journ. Geol. Soc.,' vol. XXXVI., p. 206.

² If this view be eventually maintained the lower Siwaliks would unquestionably be of pliocene age.

³ C. Grewingk, "Über fossile Säugethiere von Maragha in Persia," 'Verh. k. k. geol. Reichs.,' 1881, p. 296.