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FURTHER NOTICES OF SIWALIK MAMMALIA by R. LYDEKKER, B. A., *Geological Survey of India.*

[WITH A PLATE.]

Since my last notice of Siwalik Mammalia,¹ another collection has been received from Mr. Theobald, and a few interesting teeth have been obtained through Mr. Blanford from Sind. Many of Mr. Theobald's specimens have added considerably to our knowledge of the dentition and osteology of previously known species. On the present occasion I shall only very briefly notice the most interesting of the majority of the new specimens, reserving their fuller description for a future occasion, when I shall have an opportunity of giving figures of them. One specimen, however—the jaw of a large monkey—is of so interesting a nature, that I have given a figure of it here, as it would otherwise have been long before I should have been enabled to do so. On the same plate I have likewise had drawn the molars of the *Macacus* and the *Rhizomys* described in my last notice.

Among the rarer specimens is the greater portion of one side of the lower jaw of *Anthracotherium punjabiense*, showing the three true molars.

PRIMATES.

PALÆOPITHECUS SIVALENSIS, n. gen. nobis.

The most interesting specimen in the whole of Mr. Theobald's Siwalik collection is the fragmentary palate of a large anthropoid ape, represented in figures 1 and 5 of the accompanying plate. This specimen is of the highest interest, because, with the exception of a single canine tooth obtained years ago by Dr. Falconer from the Siwaliks, it is the only specimen which affords us any evidence of the former existence of anthropoid apes in India, or indeed, if we except *Dryopithecus* and the smaller genera, in the whole world.

The specimen was obtained by Mr. Theobald from the Siwaliks of the Punjab, somewhere near the village of Jabi, though I do not know the precise locality; it was originally in three fragments, but two of them have been united; and as the fractures are quite recent, I presume that the specimen was broken up by the natives in extracting it from its matrix. The portion that remains shows the greater part of the right maxilla, broken near the centre of the palate, and superiorly at the zygomatic root; the second fragment is a portion of the left maxilla; in the figure the two fragments have been placed in their relative position in the proportions of the palate of the living Orang.

The fragment of the left maxilla contains the complete penultimate, and the bases of the first and last molars. The right maxilla exhibits the entire dental series, from the outer incisor to the last molar; the crown of the incisor, of the penultimate premolar, and the summit of the canine have been broken off; the penultimate molar has the centre of its crown somewhat decayed. The premolars are two in number, which shows that the specimen belongs to the Catarhine

¹ Records, Vol. XI, p. 64.

section of the Primates; all the teeth are well worn, which shows the animal to have been adult at the time of its death.

The molars and canine are arranged in a straight line, and there is a small diastema between the canine and the outer incisor; each tooth of the molar series is inserted by four fangs. In the true molars, the last is the smallest of the three; each tooth carries four cusps on the masticating surface, which form an irregular quadrangle, arranged obliquely to the long axis of the tooth; thus, in relation to a line drawn transversely across the palate, in front of any one molar, we find the antero-external cusp placed first, then the antero-internal cusp, then the postero-external, and lastly, the postero-internal; an imperfect ridge connects the two internal cusps. The crowns of the molars are square or oblong, with their angles rounded off. The one remaining premolar carries two cusps on its masticating surface: both this and the penultimate premolar are remarkable for the shortness of their antero-posterior diameter in relation to the transverse. The canine is a short and blunt conical tooth, with the outer side of the crown rounded, and the inner side bevelled away obliquely from base to summit; no portion of the tooth which remains has been at all affected by wear. The fang of the incisor is small and laterally compressed.

The profile view of the specimen (fig. 1) shows the fangs of the molars and the root of the zygoma which arises above the interval between the first and second true molars; in front of the zygoma there is a channelled hollowing of the jaw, in front of which the fang of the canine bends round in an arch.

From the shortness and bluntness of the canine it is inferred that the jaw belonged to a female individual.

With this description, we may proceed to compare the new jaw with the jaws of other Primates. First, we shall have no difficulty in saying that our specimen does not belong to either of the genera *Semnopithecus*, *Macacus*, or *Cercopithecus* and their allies, because in those genera the cusps on the molars are much higher and sharper, and are arranged in pairs directly transverse to the long axis of the tooth; in addition, the last molar in those genera is always as large, or larger, than the first, and the angles of the molars are square.

In *Cynocephalus* and its allies the teeth have much the same general characters as in the last group, and the last molar is much larger than the first.

As we have already seen, the Siwalik jaw cannot belong to the Platyrrhine monkeys, and there only remains, therefore, the group of the *Simiæ*, or the anthropoid apes and man to which it can belong. Now, in all the anthropoid apes and in man the molars are exactly of the pattern of those of our specimen, and there can be no doubt but that the latter belongs to this group. The molars, however, of these apes and of man are so much alike, that it is, I believe, frequently quite impossible to distinguish isolated molars, and we can only therefore arrive at specific or generic distinctions by a comparison of the whole dental series.

Commencing with the lowest of the anthropoid apes—*Hylobates*—we find that the general structure of the molars of that genus is much the same as in the

Siwalik jaw: the premolars are, however, much squarer, the canine relatively longer and sharper, and grooved and concave internally; further, the face in the Siamang is shorter, the hollow in front of the zygoma less deeply channelled, and the canine more approximated to the zygoma, and its alveolus much less arched than in the Siwalik jaw. Finally, as a character of less importance, all the species of *Hylobates* are of much smaller dimensions than the animal to which the fossil jaw belonged.

There now remain only the Orang, Chimpanzee, and Gorilla among the living anthropoid apes, with which to compare our specimen. For this comparison I have drawn up the following tables of the dimensions of the upper teeth in these animals, and in man and *Hylobates*, which it may be well to study before proceeding further.

Table showing dimensions of upper teeth in the higher Primates.

	Siwalik jaw ♀	Simia satyrus ♀	Simia satyrus. ♂	Troglodytes gorilla ♂	Troglodytes niger ♂	Human ♂ Euro-pean.	Hylobates syndactylus ♂
Antero-posterior diameter of outer incisor ...	0.30	0.30	0.33	0.30	0.30	0.25	0.13
Transverse ditto of ditto ditto ...	0.19	0.23	0.25	0.25	0.26	0.18	0.18
Antero-posterior diameter of canine ...	0.53	0.46	0.68	0.80	0.62	0.34	0.36
Transverse of ditto ...	0.51	0.38	0.59	0.60	0.45	0.22	0.27
Length of molar series, ...	1.87	1.94	2.13	2.70	1.80	1.55	1.21
Ditto of premolars ...	0.58	0.70	0.74	0.90	0.61	0.50	0.43
Ditto of true molars ...	1.31	1.26	0.48	1.80	1.20	1.05	0.80
Ditto of penultimate premolar ...	0.30	0.35	0.39	0.45	0.31	0.25	0.25
Width of ditto ditto ...	0.50	0.49	0.50	0.64	0.42	0.39	0.25
Length of last ditto ditto ...	0.30	0.35	0.39	0.48	0.32	0.25	0.25
Width of ditto ditto ...	0.35	0.49	0.50	0.60	0.44	0.39	0.24
Length of 1st molar ...	0.45	0.43	0.50	0.55	0.45	0.36	0.28
Width of ditto ...	0.51	0.45	0.53	0.60	0.49	0.43	0.30
Length of 2nd molar ...	0.50	0.42	0.49	0.63	0.43	0.38	0.30
Width of ditto ...	0.51	0.48	0.53	0.60	0.49	0.43	0.31
Length of 3rd molar ...	0.41	0.42	0.49	0.60	0.35	0.35	0.28
Width of ditto ...	0.46	0.48	0.53	0.60	0.48	0.41	0.30

Table showing relative lengths of first upper true molar and last premolar in the higher Primates.

					Length of 1st molar.	Length of last premolar.	Difference between these lengths.	Proportionate length of P. M., 4 on scale of Siwalik jaw.	Excess of real over proportionate length.
Siwalik jaw	...	...	...	...	0.45	0.30	0.15	0.30	0.00
Human ♂	...	...	...	...	0.36	0.25	0.11	0.24	0.01
Troglodytes niger ♂	...	...	...	...	0.45	0.32	0.13	0.30	0.02
Simia satyrus ♂	...	...	...	...	0.50	0.39	0.13	0.33	0.06
Ditto ♀	...	...	...	...	0.43	0.35	0.07	0.28	0.07
Hylobates syndactylus	...	...	...	...	0.28	0.25	0.03	0.18	0.07
Troglodytes gorilla	...	...	...	...	0.55	0.48	0.07	0.36	0.12

The first of these two tables exhibits merely the absolute dimensions of the different teeth; while the second is intended to show the relative lengths of the first molar and the last premolar in the same group. In the fourth column of that table is given what would be the length of the last premolar, if that tooth bore the same relationship as regards length to the first true molar, which it does in the Siwalik jaw. From that table it will be seen that the new jaw is distinguished from the jaws of all other Primates by the relative smallness of the antero-posterior diameter of the last premolar; this shortness is in excess of what occurs in man, in which the same premolar is relatively shorter than in all the other higher Primates; next to man in this respect comes the chimpanzee, then the orang, and last of all the gorilla; and it is worthy of notice that the two species which (excepting man) exhibit the greatest variety in this respect are placed in the same genus. Professor Owen, at page 446 of his "Odontography," notices the small antero-posterior diameter of the premolars in the chimpanzee, as distinguishing it from the orang, and approximating it to man. The new Siwalik jaw, as we have seen, stands on the opposite side of man to the chimpanzee in this respect, and therefore should be still more removed from the orang. The new jaw agrees with that of the orang, gorilla, and chimpanzee, in having the molar series approximately straight, and with no indications of the horse-shoe form which occurs in the human subject; it therefore belongs to a true ape.

Turning our attention once again to the first of the two tables of measurements, we may note in what other respects the fossil jaw resembles or differs from the jaws of the orang, the chimpanzee, the gorilla, and man. In regard to

the relative length of the last molar, we find that the fossil agrees most closely with the chimpanzee and man, in both of which this tooth is much shorter than either of the other true molars. In the orang there is a very slight difference between the lengths of the first and the third true molars; in the gorilla, on the other hand, the last molar is much larger than the first. This difference in the relative lengths of the first and last molars in the gorilla, and the Siwalik jaw, together with the difference which we have already seen to obtain between the last premolars of the same, renders it evident that there is no great affinity between these two, and makes it unnecessary to carry our comparisons any further in this direction.

Comparing the dimensions of the molars of the fossil jaw with those of the female orang, we find that the true molars of the former are larger than those of the latter, and that the united length of the true molars is also greater. When, however, we take the whole molar series, we find that the five teeth of the female orang have an absolutely greater united length than the same five teeth in the Siwalik jaw, this being of course due to the small size of the premolars in the latter. In the chimpanzee, the length of the united molar series is less than in the Siwalik jaw, but the united length of the two premolars is greater, while the length of the three true molars is less: the proportions in the human jaw are in this respect nearest to the fossil.

Again, in the width (transverse diameter) of the base of the outer incisor, the fossil jaw is closer to man than to any of the large apes. In man there is no diastema between the canine and the incisor; in the orang this diastema is larger than in the chimpanzee, which in this respect approaches man. In the fossil jaw this diastema is very slightly larger than in the orang.

The dimensions of the base of the canine are considerably stouter in the fossil jaw than in either the female orang or the male chimpanzee, and approach those of the male orang and gorilla; though the shortness of the crown proves, as we said, that our specimen belongs to a female. In the female orang there is a disk of wear on the posterior border of the canine, which does not occur in the fossil specimen.

The following summary exhibits the points of resemblance and difference between the fossil jaw and the jaws of man, the [chimpanzee, and the orang, which are the only three species which are closely related to it:—

MAN.

Resemblances.—Shortness of premolars; small size of last molar and of incisor.

Differences.—Straight line of teeth; large canine and diastema.

CHIMPANZEE.

Resemblances.—Straight line of teeth; shortness of premolars in a less degree; small size of last molar; large canine and diastema.

Differences.—Small incisor.

ORANG.

Resemblances.—Straight line of teeth; large canine and diastema.

Differences.—Shortness of premolars; small size of last molar; difference in wear of canine; small incisor.

It thus seems to be apparent that the fossil jaw has most points of resemblance with the chimpanzee, and that when it differs from that species it has an ultra-human character. It now remains to consider to what fossil form the jaw presents any points of affinity, and we will first direct our attention to the Siwalik Primates.

As regards size alone, the only one of the jaws of Siwalik Primates represented in Plate XXIV of the first volume of the "Palæontological Memoirs" which could possibly have any affinity to our specimen, is that of *Semnopithecus subhimalayanus* (figs. 1 and 2); the teeth of that jaw, however, and of all the specimens on the same plate, are of the semnopithecine type, and have therefore no affinity to our fossil. The same remark of course applies to the teeth of *Macacus* represented in figs. 3 and 4 of the plate accompanying this paper.

One other tooth of a quadrumanous animal from the Siwaliks is, however, described and figured by Falconer on page 304 of the first volume of the "Palæontological Memoirs;" this specimen consists of the crown of the upper canine of a large ape allied to the orang; the specimen evidently belonged to a male individual, and is somewhat larger than the canine of the male orang. Our fossil jaw, which, as we have already seen, belonged to a female, has teeth somewhat larger than those of the female orang; there is therefore every probability that Falconer's canine and our new jaw belonged to the same species.

Turning, now, to the fossil quadrumanous animals of Europe, the only three genera with which I am acquainted which are likely to have any affinity to our specimens are *Mesopithecus*, *Pliopithecus*, and *Dryopithecus*.

Mesopithecus, from the Pikermi beds,¹ is of small size, and is regarded as being intermediate between *Hylobates* and *Semnopithecus*; the teeth are, however, distinctly of the semnopithecine type, and consequently quite different from those of our fossil.

Pliopithecus,² from the Miocene of France and Switzerland, is also of small size, and resembles *Hylobates* so closely, that it is referred by Professor Rutimeyer to that genus.

Dryopithecus,³ from the Miocene of France, is an ape of larger size, which is, I believe, only known from the lower jaw and some limb-bones, and which from the small size of the canine and diastema is regarded as having an affinity to

¹ "Animaux fossiles et Geologie de l'Attique," Gaudry, Pl. I.

² Lartet: "Comptes Rendus," Vol. 3, p. 222, and plate. Heer: "Primæval World of Switzerland," Vol. II, p. 82, Pl. XI.

³ Lartet: sup cit. Owen, "Palæontology," p. 383.

man. The antero-posterior extent of the second premolar, according to Professor Owen, is, however, greater than in the chimpanzee, and therefore still greater than in the Siwalik fossil; the latter, however, agrees with *Dryopithecus* in having narrow incisors.

Reviewing the whole of the foregoing facts, it does not appear that our fossil jaw agrees precisely with the jaw of any known living or fossil anthropoid ape, though it seems to make the nearest approach to that of the chimpanzee, and also shows some points of affinity with the jaws of man, *Dryopithecus*, and the orang. The resemblance between the Siwalik jaw and that of the chimpanzee does not, however, appear to me to be so close as to warrant our classing the two under the same genus, because, with the very marked difference which occurs in the relative dimensions of the last premolars in the two jaws, there is every probability that equally well marked differences existed between the crania of the two animals. It must, however, be again borne in mind that the chimpanzee and the gorilla, which present such difference in the form of this tooth, are classed in the same genus.

Since I do not think that we are justified in referring the Siwalik jaw to any known genus, I propose to form for it the new generic name '*Palæopithecus*,' with the specific affix of '*sivalensis*.'

I can only hope that on some future occasion we may be fortunate enough to come across the cranium of this most interesting relic of the past, when we shall be able with some approach to certainty to assign to it its exact affinities, which with our present meagre specimens we can only vaguely guess at. We can only say that there lived in the Siwalik period of India, a huge anthropoid ape intermediate in size between the orang and the gorilla, the males and females of which were provided with canines exceeding in size the other teeth, and that those of the former bore about the same proportion to those of the latter as we find prevailing in the living anthropoid apes. Further, in the form of its teeth, this ape was nearest to the chimpanzee; but in the points in which it differed from that species, it shows great resemblances to the teeth of man.

I will conclude this notice with a few general considerations regarding the past and present distribution of the anthropoid apes. If this distribution in time and space be tabulated, as is done in the accompanying note,¹ it will, I think, be apparent that such living and fossil anthropoid apes as we are now acquainted with are merely a few from a large number of species which once existed on the earth.

			Miocene.	Pliocene.	Recent.
¹ <i>Troglodytes</i>	...	...	...	...	W. Africa.
<i>Simia</i>	...	...	...	...	Borneo and Sumatra.
<i>Palæopithecus</i>	...	...	...	N. India.	
<i>Dryopithecus</i>	...	...	W. Europe.		
<i>Hylobates</i>	...	...	...	...	Malaya, Assam, and China.
<i>Pliopithecus</i> (= <i>Hylobates</i> ?)			W. Europe.		

Further, it seems hardly to admit of doubt that three such closely allied genera as *Troglodytes*, *Palæopithecus*, and *Simia* must have had a common parentage and a common ancestral home. For three tropical or sub-tropical genera inhabiting respectively Western Africa, Northern India, and Sumatra and Borneo, the unknown common home may have possibly been situated in the Indian Ocean, being in fact the hypothetical sunken southern continent, whether it be called 'Lemuria,' 'Indo-Oceania,' or what not, to the former existence of which so many separate lines of evidence point. This vanished land was probably once the common home of the African and Indian ostriches,¹ which must have had a common centre of dispersion. Here also we may possibly look for the old home of the *Manis* of Siwalik and modern India, and of modern Africa.

If this hypothetical sunken southern continent² was the centre of dispersion of the anthropoid Primates, it is not improbable, nay rather it is almost certain, that numbers of species and genera must have lived and died, and finally become extinct, on that continent, and that only some of their descendants reached the borders of that continent—in other words, Africa, India, and Borneo. If this be so, it is probable that all records of some anthropoid Primates have long since, and for ever, been entirely removed from human cognizance, while it is possible that among these may have been forms nearer to man than any of those of which we have any records. On this supposition it is possible that we may never discover the "missing links." On the other hand, we have in the tropical countries which border the Indian Seas the probable periphery of this sunken continent, and it is among the unexplored tertiaries of these countries that we may yet hope to find fossil forms of *Primates*, which may tend to bridge the great gulf which now exists between the highest known ape and man. Of these countries, the geology of Africa and Sumatra and Borneo is virtually unknown. In India only a few scattered localities have hitherto yielded mammalian remains, and remains of Primates are of extremely rare occurrence in them. Thus, in the much-worked Siwaliks we only know of two specimens of the remains of anthropoid apes, which have been discovered at an interval of many years apart, among thousands of specimens obtained. There is, therefore, no reason to assume that other forms of anthropoid apes did not exist in that period. In Central and Southern India, with the exception of the little known Perim beds, we have no equivalents of the Siwaliks; and there is here therefore abundant room for older Primates to have existed without our having the least knowledge of them.

In the newer Nerbudda group scarcely any small fossils have been collected; and yet there is an absolute certainty that many forms of Primates

¹ STRUTHIO ASIATICUS, M.-Edwards, "Oiseaux Fossiles de la France," Vol. II, p. 587, and article in present number.

² Mr. Wallace ("Tropical Nature," p. 329) has come to the conclusion that "Lemuria" never existed, or that it at all events must have disappeared before the miocene. There appears to me, however, to be a great weight of evidence in favor of a former land connection between the continents of the old world, though this connection may very possibly have disappeared in comparatively early Tertiary times.

must have existed at that time, many of which were probably distinct from living species.

Our knowledge, therefore, of the tertiary faunas of the Tropics and Sub-Tropics is really extremely slight; and until this slight knowledge has been amplified by the fullest explanation of every tertiary rock stratum in Africa, India, and Malaya, no one is entitled to assert that man and the anthropoid apes had no common ancestor, because no such ancestor has hitherto been discovered; and even if such exploration were made without results, there remains the hypothetical sunken southern continent, with the disappearance of which may also have disappeared the "missing links."¹

Finally, one other lesson is to be learnt from the Siwalik ape. We know that the living anthropoid apes dwell only in the deepest gloom and solitude of primeval forests, where vegetation grows luxuriously, and offers a constant supply of fruits throughout the year. From this we may probably infer that the Siwalik ape inhabited a similar forest-clad country, and that, consequently, the present Siwalik area of the Punjab was in parts at all events clothed with forests in which dwelt the *Palæopithecus*, instead of being, as now, a sun-scorched and somewhat desolate region. Evidence of the former existence of these forests is, as I have previously remarked,² afforded us by the occurrence of numbers of fossil tree-stems in various parts of the Siwaliks.

MACACUS SIVALENSIS, *nobis.*

In figs. 2 and 4 of the accompanying plate are represented the two fragmentary upper jaws of *Macacus sivalensis*, which were described by me on page 66 of the last volume of the "Records," and which, therefore, need no further notice on the present occasion.

RODENTIA.

RHIZOMYS SIVALENSIS, *nobis.*

The specimen drawn in fig. 3 of the same plate is a fragment of the left ramus of the mandible of the *Rhizomys* described by me at page 100 of the last volume of the "Records," and which I then considered to belong in all probability to a new species. The first molar has been broken away in the specimen but the second and third molars are in excellent preservation; the greater part of the incisor is seen on the inferior border.

PROBOSCIDA.

DINOTHERIUM INDICUM, *Falc.*

A detached first lower true molar of a *Dinotherium* has been obtained through Mr. Blanford from the Laki Hills of Sind, which is larger than and of different shape from the corresponding tooth in the lower jaw of *Dinotherium*

¹ See an article on this subject in the Quarterly Journal of Science for October 1878.

² Rec. Geol. Surv. India, Vol. IX, p. 100.

pentapotamiæ from Sind, noticed at page 75 of the last volume of the "Records", and which agrees so exactly, as regards dimensions, with the base of the corresponding tooth in the lower jaw of *D. indicum* from Perim Island represented in fig. 6 of plate 35 of the "Fauna Antiqua Sivalensis," that I have considered it to belong to that species.

The tooth is considerably worn, and carries three equal sized transverse ridges, which show no sign of a median longitudinal division, which, with the bluntness of the ridges, shows that the tooth did not belong to a *Trilophodont Mastodon*. The tooth is relatively narrow in proportion to its length, which shows that it belongs to the lower jaw, while the greater elevation of the inner side of the ridges shows that it belonged to the left side. On the outer and posterior sides of the tooth there is a large thick cingulum.

I have given below the dimensions of this tooth, together with those of the corresponding tooth of *D. giganteum* in the large Eppelsheim cranium, and of the corresponding tooth in the above-mentioned jaw of *D. pentapotamiæ*:—

				New tooth.	<i>D. giganteum.</i>	<i>D. pentapotamiæ.</i>
Length of tooth	...	...	...	3·9	3·5	2·35
Width of 1st ridge	...	...	...	2·5	2·6	1·8
„ of 2nd „	...	...	...	2·5	2·6	1·8
„ of 3rd „	...	...	...	2·4	2·2	1·7

The tooth is slightly larger than the corresponding molar of *D. giganteum*, in which it agrees with Falconer's fragment, and is far too large to have belonged to *D. pentapotamiæ*; it is further distinguished from the same tooth in both those species by the presence of the large cingulum.

If now we turn to the description of the above-mentioned jaw of *D. indicum* on page 407 of the first volume of the "Palæontological Memoirs,"¹ we shall find that the dimensions of the base of the crown of the first true molar are as follows—length 4, width 2·8; these dimensions agreeing very closely with those of our new tooth. The latter further agrees with a fragmentary tooth of *D. indicum* from Perim Island, described by Dr. Falconer at page 397 of the first volume of the "Palæontological Memoirs," in the great thickness of the enamel, which in both measures 0·25 inch; in *D. pentapotamiæ* and *D. giganteum* the enamel is much thinner. Although, therefore, the perfect corresponding tooth of *D. indicum* is unknown, I think on the above grounds I am justified in referring the new tooth to that species. This identification is of great importance in connecting the horizon of the Perim Island and Sind rocks as I shall have occasion to note more fully below.

A portion of another tooth of a large *Dinotherium* has been received among a collection made by the late Dr. Verchere, which appears to have come from

¹ P. 397.

Dera Ghazi Khan, and which seems undoubtedly to belong to the same species. The specimen consists of the last ridge of a third upper molar of the left side, but very little worn. Its dimensions are given below, together with those of the second upper molar of *D. pentapotamiæ*, described at page 55 of the second fasciculus of the tenth series of the "Palæontologia Indica," and also with those of the same tooth of *D. giganteum* :—

	<i>D. indicum.</i>	<i>D. giganteum.</i>	<i>D. pentapotamiæ.</i>
Width of last ridge	3·7	3·4	2·3
Thickness of base of ridge	1·8	1·6	1·1

The new tooth differs from the figured specimen of *D. pentapotamiæ* in having no ledge on the hinder side of the last ridge, and in the ridge itself being somewhat less curved; it agrees with the other teeth of *D. indicum* in having very thick enamel, and being slightly larger than the corresponding tooth of *D. giganteum*; there is a tubercle on the inner side of the transverse valley.

NEW SPECIES OF DINOTHERIUM.

In addition to *Dinotherium indicum* and *D. pentapotamiæ*, we have now evidence of a third species of Indian species of the genus. The specimen from which this evidence is derived consists of a portion of the lower jaw, containing the two last molars, collected by Mr. Fedden in Sind. The jaw and teeth are much smaller than those of *D. pentapotamiæ*; the characteristic point of the jaw is, however, its cylindrical form, in which respect it differs from all other species of the genus.

GENUS MASTODON.

Of the genus *Mastodon*, Mr. Theobald's last collection contains a great number of specimens of the jaws and teeth, some of which are of great interest, and add considerably to our knowledge of these animals. A few of the most interesting specimens are noticed here cursorily, as it will be a long time before I shall be able to describe them in detail.

MASTODON PANDIONIS, Falc.

The first specimen in this collection which calls for especial notice is a portion of the mandible of a *Mastodon*, which cannot be referred to any of the previously known Siwalik species. The specimen comprises a portion of the horizontal ramus with two molars, and the symphysis of the mandible; the intermediate portion of the specimen was also discovered, but unfortunately crumbled to dust during its transit down country. The most noticeable portion of this jaw is the symphysis, of which the part now remaining has a length of 22 inches; this part is laterally compressed, and on its upper surface is excavated by a large groove upwards of 5 inches in depth at its proximal extremity.

The one complete tooth in this jaw carries four transverse ridges and a hind talon; its length is 8·5, and its width 3·7 inches; this tooth is the last true molar, and the jaw therefore belongs to a *Trilophodon*. The crown of the penultimate

molar is unfortunately broken away, but from the small size of its base, I imagine that it could only have carried three ridges. The last molar has a very deep longitudinal valley, which divides each transverse ridge into a distinct outer and inner column; large accessory columns are placed in the valleys, which are in consequence completely blocked. The disks of wear of the columns form irregular circles; the tooth has some resemblance to some varieties of the molars of *M. sivalensis*, in which the alternate arrangement of the columns is less pronounced than usual; the last molar of the latter has, however, five or six ridges. When complete, the distal extremity of the mandible must have been at least 30 inches in advance of the last molar.

There are no tusks in this specimen; among Mr. Theobald's collection, however, there is the distal extremity of an elongated mandibular symphysis of a species of *Mastodon*, which carries portions of two very large tusks. This mandibular rostrum cannot belong to any of the described species of Siwalik *Mastodon*; and as it agrees in form with the last specimen, I consider it probable that both belonged to the same species; the tusked jaw being that of a male, and the tuskless that of a female individual. The fragments of tusks remaining in the specimen are only some 10 inches in length; they are much compressed laterally, the transverse section being pear-shaped, having the thinner end upwards. The inferior border of the fragments is convex, and the superior border concave; the vertical diameter is 3.2 inches, and the transverse diameter at the thickest part 1.11 inches.

Another specimen of the mandible of a trilophodont *Mastodon* broken off at the symphysis, carries two molars, which are respectively the penultimate and last. The second of these teeth agrees precisely with the corresponding tooth of the last specimen of the mandible, but being less worn, is more suitable for description; the identity of these teeth shows that the two mandibles belonged to the same species. The penultimate tooth in the second mandible carries three ridges and a hind talon, which proves that the first jaw belongs to a *Trilophodon*. In these teeth each ridge is divided by a longitudinal channel into an inner and an outer column; each outer column gives off an accessory column from either side, which together project obliquely into and quite block the transverse valleys. The whole arrangement of the columns on the outer side form a zigzag arrangement; while the summit of each column wears into a circle.

Now, the only two known Indian trilophodons are *M. falconeri* and *M. pandionis*; the molars of the former I have not yet been able to describe. The penultimate lower molar of that species is, however, much larger than the same tooth in our new specimens, and has nearly open valleys, with distinct and clear ridges, whose summits wear into trefoils and not into circles. I shall hope shortly to be able to show by a figure the complete distinctness of these two teeth. The jaws of the two are further very different—that of *M. falconeri* being thick and rounded, while the present specimens are thin and flat.

Of *M. pandionis* a description of the penultimate upper molar will be found at page 124 of the first volume of the "Palæontological Memoirs of Dr. Fal-

coner"; if the description of that tooth be compared with that of the corresponding lower tooth noticed above, it will be seen that the two agree precisely, except that one is the reverse of the other, as is always the case in upper and lower molars. I have therefore no doubt but that these new jaws belong to *M. pandionis*, which was consequently a species provided with a long spatulate mandible, and of which the male carried inferior tusks.

The interest of this discovery of *M. pandionis* in the Siwaliks is very great; the other known teeth are said to have been obtained from the Deccan from deposits supposed by Falconer¹ to be of pliocene age; wherever they came from, it is now probable that they belong to the same period as that in which lived the other animals of the Siwalik fauna. In cataloguing the fossil *Proboscidea* in the Indian Museum, I have lately come across a last milk-molar of a trilophodont *Mastodon* from Perim Island which seems undoubtedly to belong to the same species.

In treating of *M. pandionis* at page 124 of the first volume of the "Palæontological Memoirs," Dr. Falconer remarks on the great similarity of the general plan of the teeth of *M. pandionis* and *M. angustidens*, the plan of the former being, however, rather the more complex of the two. It is interesting to observe how this similarity of plan in the structure of the teeth extends into as much as we know of the osteology of the two animals; thus the newly discovered specimens reveal to us that both the species were furnished with a long spatulate symphysis to the mandible, tuskless in the female, but in the male provided with a pair of relatively large and slightly-curved tusks. From this similarity in structure we may, I think, infer that these two species of *Mastodon* were very closely related to one another, and that it is not impossible that at no relatively distant epoch they must have had a common parentage. One very important difference, however, exists in the structure of the teeth of the two species, which is that in *M. pandionis* (though this is not mentioned in Falconer's specimen) there is a large quantity of cement in the valleys, which is entirely wanting in the molars of *M. angustidens*.

MASTODON PERIMENSIS, Falc. & Caut.

Two very interesting points in relation to the dentition of this species are shewn among Mr. Theobald's last collection; one of them is, that this species, like *M. latidens*, was provided with an ultimate upper premolar, and the other that the species carried tusks in the mandible. The specimen proving the existence of an upper premolar consists of a portion of the left maxilla containing two teeth; the hinder of these teeth is $4\frac{1}{2}$ inches in length, carries four transverse ridges, and small fore-and-aft talons; the anterior tooth has not yet come into wear, being only in germ, and having its masticating surface on a level with the base of the crown of the hinder tooth, which proves it to be a premolar, which has only just displaced the milk-molar which it has succeeded.

¹ Pal. Mem., Vol. II, table, p. 14.

The premolar is rounded, and carries two transverse ridges and two small talons. The larger tooth corresponds exactly in form with the first or antepenultimate molar of *M. perimensis* from Perim Island, represented on plate 9 of the first volume of the "Paleontological Memoirs of Dr. Falconer," and which is now in the Indian Museum. Mr. Theobald's specimen is, however, rather the smaller of the two. From the large size of the premolar in the new jaw, I think that that tooth must be the last, and that the tooth which it has replaced must consequently have been the last milk-molar; the second tooth will consequently be the first or antepenultimate true molar, and will correspond to the above-mentioned specimen of Falconer's: the slight difference in size of the two specimens is very probably due to difference of sex.

I have already mentioned at page 71 of the last volume of the "Records" the discovery of a complete mandible of this species, and of the possible occurrence of lower tusks. Two specimens of the symphysis of the mandible of the same species in Mr. Theobald's last collection have now made it certain that certain individuals, probably males, were furnished with small mandibular tusks. Both the new specimens have been fractured, and exhibit sections of the tusks in their alveoli; these tusks were of small size, and show an oval cross-section, of which the vertical diameter in the middle of the symphysis is 1.6 inches, and the transverse diameter 1.3.

PERISSODACTYLA.

ACEROTHERIUM PERIMENSE, Falc. & Caut.

The discovery of a nearly complete cranium of this species in the Siwaliks of the Punjab by Mr. Theobald is of great interest, as only very fragmentary remains of the species have hitherto been known. The new cranium is further interesting, as showing the accuracy of Falconer's opinion (formed on the evidence of a few generally imperfect teeth), that the Perim Island Rhinoceros was hornless, and belonged to the genus *Acerotherium*.

The cranium, with the exception of a few minor injuries, only lacks the extremity of the nasals, and maxillæ and premaxillæ, together with the greater part of the zygomatic arches, to be complete, and is generally in a very excellent state of preservation. As I shall hope on a future occasion to give a figure and a more detailed description of this cranium, it will only be noticed very shortly here.

The cranium is that of a fully adult animal, the permanent molars being greatly worn down, and the cranial sutures mostly obliterated; it is also of huge dimensions. It is at once distinguished from the three species of true Siwalik Rhinoceros, of which figures of the cranium are given in the "Fauna Antiqua Sivalensis" by its straight profile, in place of the highly curved profile which characterizes the other species. It is further distinguished by the very small size of the nasals: these bones are unfortunately broken off near their base, but sufficient of them remains to show that they formed merely a short conical pro-

jection, having no resemblance to the broad and curved bones which occur in the other species. The transverse diameter of the base of these bones in the new cranium is only 3.3 inches, whereas in the smaller crania of *R. sivalensis* and *R. palæindicus* it is 5 and about 4.8 inches respectively, and in the large *R. platyrhinus* is upwards of 6.5 inches. Again, the base of the nasals in the new cranium is perfectly smooth even on the upper surface, shewing that there was no nasal horn, such as exists in the other species; the frontals are also perfectly smooth, and shew no signs of having ever carried a horn. The cranium, therefore, is truly that of an *Acerotherium*, and as such quite distinct from the other Siwalik species of Rhinoceros.

Together with this cranium, Mr. Theobald has sent the less worn upper dentition of another individual of the same species, which is in a better state for comparison than the more worn dentition of the cranium. The antepenultimate upper premolar in both these specimens agrees exactly with the corresponding tooth represented in fig. 15 of plate 75 of the "Fauna Antiqua Sivalensis," which is the type of *A. perimense*; the true molars in Mr. Theobald's specimens also agree with the fragmentary molars of the same species represented on the same plate; the new cranium may, therefore, be safely referred to *A. perimense*.

This being so, the complete dentition of this species now enables me to correct a very serious error into which I had fallen, and through which I had been led to form a new species of Siwalik Rhinoceros, (*R. planidens*), though working with imperfect materials.

If we turn to figures 7 and 8 of the second part of the tenth series of the "Palæontologia Indica," it will be found that I figured two imperfect upper molars of a Rhinoceros, which I considered to be different from the corresponding teeth of any other species, and which I accordingly referred to a new species under the name of *R. planidens*. Subsequently several complete upper molars, and a considerable portion of a mandible, together with an upper incisor, all of large size, were obtained by Mr. Theobald, and were referred to under the same specific name at page 96 of the last volume of the "Records."

Now, the true molars in Mr. Theobald's two latest specimens agree precisely with the above-mentioned upper molars, and clearly belong to the same species. It is therefore clear that the new species *R. planidens* must be merged in *A. perimense*.

In figure 5 of Plate VI of the same volume of the "Palæontologia Indica" I figured two teeth of *A. perimense*, which I considered to be the last premolar and the first true molar, because, as will be seen by the figure, the second of these two teeth is the most worn. Considering this latter tooth to be a true molar, it was apparent that the true molar referred to *R. planidens* could not belong to *A. perimense*. A comparison of the two teeth in question with the dentition of Mr. Theobald's specimens shows, however, that these teeth are really the first and second premolars, and that their relative rate of wear must be an abnormality. I may add that I ought to have known that these two teeth must

have been the two middle premolars, because no such discrepancy in size occurs between the last premolar and first true molar as occurs between these two teeth, while the smaller tooth is of too small dimensions to have been the last true molar. I may add that the tooth represented on Plate VI, figure 2 of the above referred to volume of the "Palæontologia Indica," as the first true molar of *A. perimense*, is really the penultimate premolar; and that the unnamed tooth from Sind, represented on figure 6 of the same plate, seems to be the antepenultimate upper premolar of the same species.

On a future occasion I shall hope to be able to give figures of the almost complete upper and lower dentition of the present species; and I cannot but regret that I have previously published figures of such very imperfect specimens. It is interesting to observe that *A. perimense* agreed with the European *A. incisivum*, in being hornless, and in being furnished with a single pair of very large upper and lower incisors, clearly showing that the absence of one weapon of offence or defence is compensated for by the greater development of another.

I may here mention that we seem to be gradually obtaining evidence that the mammalian fauna of the Punjab and Sind forms a connecting link between the fauna of Perim Island on the one hand and of the more eastern Siwaliks on the other. Thus, as will be gathered from a perusal of this and my previous papers in the Records, we have in the Siwaliks of the Punjab and Sind the following Perim Island mammals, which were not known to Falconer from the more easterly Siwaliks, viz. :—

- Dinotherium indicum. P.; I. P. S.
- Mastodon pandionis. P.; I. P. Deccan (?)
- Mastodon perimensis. P.; I. P. S. (?)
- Hyotherium sindiense. P.; I. S.
- Acerotherium perimense. P.; I. P. S. (?)
- Hippotherium theobaldi. P.; I. P.

All these mammals belong to old forms, and seem to indicate that the Perim Island deposits and the zone in which they occur in the Punjab (position unknown) are low down in the series and correspond to the older Sind Siwaliks.

Distribution of genera of Siwalik Mammals.

Since the publication of my paper on the "Fossil Mammalian Fauna of India and Burma,"¹ several new genera have been added to these fauna, and the distribution of the previously known genera has been further elucidated. I have therefore compiled the following table of the distribution of the mammalian genera in the Siwalik and the other tertiaries below the Nerbudda group, which must be taken as superseding the tables given on pages 90-92 of my above quoted memoir.

¹ Rec. Geol. Surv. Ind., Vol. IX, pt. III.

Table of distribution in India of Siwalik Mammalian Genera.

Order.	Genus.	Burma.	Sylhet.	Country east of Jhelam R.	Punjab west of Jhelam R.	Sind.	Perim I.
PRIMATES	Palæopithecus	...	...	×	×	...	...
	Semnopithecus	...	...	×	...	...	...
	Macacus	...	...	×	×	...	...
PROBOSCIDA	Dinotherium	...	...	...	×	×	×
	Mastodon	×	...	×	×	×	×
	Stegodon	×	×	×	?	...	...
	Loxodon	...	...	×	...	...	...
	Euelephas	...	...	×	...	...	...
UNGULATA	Sus	...	×	×	×	×	×
<i>Artiodactyla</i>	Hippohyus	...	...	×	×	...	×
	Tetraconodon	...	...	×	×	...	...
	Hippopotamus	×	...	×	?	...	...
	Sanitherium	...	...	...	×	...	...
	Listriodon	...	...	...	×	?	...
	Hyotherium	...	...	...	...	×	×
	Anthracotherium	...	×	...	×	×	...
	Hemimeryx	...	...	...	...	×	...
	Sivameryx	...	...	...	...	×	...
	Hyopotamus	...	...	...	...	×	...
	Chœromeryx	...	×	...	...	...	...
	Merycopotamus	×	...	×	×	...	...
	Chalicotherium	...	...	×	...	×	...
	Camelus	...	...	×	...	...	...
	Sivatherium	...	...	×	...	...	...
	Hydaspitherium	...	...	...	×	...	...
	Vishnutherium	×	...	...	?	...	...
	Bramatherium	...	...	...	...	...	×
	Camelopardalis	...	...	×	×	...	×
	Antilope	...	...	×	×	...	×

In the above table there are a few points which call for short notice. In the first place, the number of specimens collected from Sylhet is so small, that no inference as to the absence of genera from the formations of that district can be drawn from their absence in the table: to a less degree the same remark applies to Burma and Perim Island. Again, in the three columns headed respectively "Country east of Jhelam R.," "Punjab, west of Jhelam R.," and "Sind," I do not wish to lay any great stress on the absence in any of these columns of any of the rarer genera, such as *Sanitherium*, *Amphicyon*, or *Lutra*, as indicating their absence from the formations under those columns. On the other hand, the presence or absence in any of these columns of any of the common genera, such as *Euelephas*, *Merycopotamus*, *Bos* or *Equus*, is of great weight, and is to be considered in many cases as a fact in distribution.

We may notice in Sind the complete absence of the following common Siwalik genera, viz., *Stegodon*, *Loxodon*, *Euelephas*, *Hippopotamus*, *Merycopotamus*, *Camelus*, *Camelopardalis*, *Bos*, *Bison*, and *Equus*; and we may further note that most of these genera are modern forms, and that most of them are not found in the country to the west of the river Jhelam, but that they occur commonly enough in the country to the east of that river. Again the genera *Dinotherium*, *Listriodon*, *Hyotherium*, various *Suina*, *Hyopotamus*, and *Acerotherium*, are of fairly common occurrence in Sind and the Punjab, and do not, I believe, occur in the country to the east of the Jhelam, with the exception perhaps of *Acerotherium*, which has been found a little to the east of that river. Again the genus *Equus*, which is extremely common in the Siwalik country of Falconer, is unknown in the Western Punjab, and is there replaced by *Hippotherium*, of which genus at least two species occur there very commonly, of which one (*H. artilopinum*) occurs in the more eastern country, while the other (*H. theobaldi*) is only known from the Western Punjab and Perim.¹

The table in fact shows that the more modern genera are mainly characteristic of the country to the east of the Jhelam, while the Punjab, Sind, and Perim Island are characterized by an older facies of genera,—the greater number of old genera occurring in Sind. The Sind fauna is consequently to be regarded as the oldest of the Siwalik group, that of the Punjab and Perim Island probably the next in age, and the Siwaliks of the Dehra Dún and neighbouring country as the newest of all. I wish, however, to add that although I think the difference in the mammalian faunas of the different districts under discussion are due in great measure to differences in relative age, yet that it is probably that many of the genera, such as those of the *Sivatheridæ*, were strictly contemporaneous, and were limited in their geographical range.

¹ In Falconer's catalogue of the *Vertebrata* in the collection of the Asiatic Society of Bengal, the molars of this species are referred to *Equus*. I believe I have evidence of the existence of four species of the genus in the Púnjab.

DESCRIPTION OF PLATE.

- Fig. 1. PALÆOPITHECUS SIVALENSIS, nobis.
Lateral view of right maxilla.
- „ 2. MACACUS SIVALENSIS, nobis; palatal view of right maxilla.
- „ 3. RHIZOMYS SIVALENSIS, nobis; palatal view of left ramus of mandible.
- „ 4. MACACUS SIVALENSIS, nobis; palatal view of left maxilla.
- „ 5. PALÆOPITHECUS SIVALENSIS; palatal view of specimen represented in fig. 1.

Fig. 3 twice the natural size; the rest natural size. The two sides of the maxilla represented in fig. 5 have not been placed quite symmetrically. The perfect tooth on the left side of the figure should be opposite the decayed tooth on the right side.

NOTES ON SOME SIWALIK BIRDS, by R. LYDEKKER, B. A., *Geological Survey of India.*

INTRODUCTION.

In the Siwaliks, as in many other ossiferous formations, the fossil remains of birds are of extremely rare occurrence, and such bones as do occur are generally, owing to their delicate structure, merely fragments of the stouter extremities. Except in formations like the lithographic slates of Solenhofen, the skull of birds are scarcely ever preserved as fossils, and none have as yet been obtained from the Siwaliks. From time to time, however, a few fragments of bird-bones have been obtained from these deposits, and these are of extreme interest, as being the only evidence we have at present of the existence of an avian fauna in the Siwaliks. Some of these bones were collected by Dr. Falconer, and were deposited by him in the British Museum, figures being given of them on Plate R of the unpublished plates of the "Fauna Antiqua Sivalensis."¹ On the evidence of these bones M. A. Milne-Edwards² established two species of extinct Siwalik birds, namely, *Struthio asiaticus* and *Argala falconeri*. From the evidence of another bone which is not figured in the "Fauna Sivalensis," the same writer considered, that a bird allied to *Phaëton* must have lived with the Siwalik fauna.

Among the vast collection of mammalian and reptilian bones obtained by Mr. Theobald from the Siwaliks, there are a few fragmentary bird bones; and these together with the bones collected by Dr. Falconer, form mainly the subject of the following short notes. These notes are not intended as an accurate description of the bones, because I wish to defer that description in the hope that I may hereafter obtain more complete materials. Some of the bones are, however, of such interest, that I have thought it well to bring their existence into notice, without deferring them to the indefinite period when I shall be enabled to give figures of them.

¹ Photographic copies of these plates can now be obtained at the British Museum.

² Oiseaux fossiles de la France, Vols. I, p. 449, II, p. 587.

Lydekker: Siwalik Mammalia.



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