It will be seen that in this rough and approximate table a gap occurs in the second column between the lower slates and the "central gneiss," which cannot be filled up until the relations of the two in the matter of conformity or unconformity are settled; if they are unconformable, and the "central gneiss" is older than the Pír Panjal gneiss, it may then not be improbable that some part of the Simla slates may be the equivalent of the Pír Panjal gneiss.

Since the above was written I have seen the able paper of Colonel McMahon on the Simla Himalayas.[1] The author is there of opinion that the Simla slates and other non-crystalline series are certainly newer than the crystalline series; he also thinks that the hypothesis of inversion will not explain the case, but that there was an original unconformity between the two series; the slates having been deposited on a denuded surface of gneiss. In the Pír Panjal and in Pangi, I think the latter explanation cannot be adopted, as there is a passage between the crystalline and non-crystalline series. If original unconformity exists in the Simla region, it would tend to confirm my suggestion that there exists gneiss belonging to two periods in these regions; the Simla or "central" gneiss being older and unconformable to the slates, while the gneiss of the Pír Panjal is conformable to the slates, and has been metamorphosed out of their lower beds, and may consequently be in part the equivalent of the lower Simla slates.

It will require another season's work to trace the relations of the triassic rocks of the Zoji-la to the gneiss of Súrú and the Zanskar range, and also, as I have previously said, to trace the former rocks in the opposite direction into the Tilail or Kishenganga valley.

NOTICES OF SIWALIK MAMMALS, BY R. LYDEKKER, B.A., *Geological Survey of India.*

The Indian Museum has again been enriched by a large collection of vertebrate fossil remains obtained from the Siwalik series of Sind and the Punjáb, by Messrs. Blanford, Fedden, and Theobald, and their native assistants. Many of these fossils are, of course, merely duplicates of previously acquired specimens, while others belong either to new genera or species, or illustrate more fully other species whose existence has hitherto been only slightly indicated to us by the evidence of a few fragments of bone, or isolated teeth.

In the present paper I shall shortly notice a considerable number of the more interesting of these specimens, reserving for a future opportunity the figuring, and more detailed description, of the specimens, in the hope that I may then have still more materials to work upon.

Before proceeding further, it may be well to notice certain conclusions which I have lately arrived at respecting the distribution in time of some of the fossils.

It may, I think, be now stated with considerable probability, that, as I have hinted before, the mammaliferous beds of Sind belong to a somewhat lower horizon than that which yields the majority of the fossils in other areas. These mammaliferous Sind beds (Manchhar) overlie the Gáj beds, which seem to be upper miocene, and cannot therefore be much older than the lower pliocene, or

[1] Rec. Geol. Surv. Ind., Vol. X, p. 204.

the very highest of the miocene. Their mammalian fauna is nearest to that of the miocene of Europe, and does not contain, as far as we know, any of the modern forms which occur in the Siwaliks of the Punjáb, which may probably be considered to be higher up in the older pliocene. The occurrence of a large number of mammalian genera which are confined to the miocene in Europe, in the pliocene of India, is paralleled by what occurs according to Professor Marsh in North America, where European miocene mammals occur in the older pliocene.[1]

The mammalian tertiary fauna of Sind is characterized most especially by the presence of great numbers of both bunodont and selenodont pig-like animals, the majority of which are, however, unfortunately only known to us (with the exception of those genera which also occur in Europe) by isolated teeth.

These same Siwalik or Manchhar beds also contain the remains of *Dinotherium* in considerable abundance; in India this genus is elsewhere known only from Kach, Kúshalghar, and Perim Island, from beds which are probably low in the Siwalik series. In the Sind area *Mastodon* and *Hippotherium* are common, and two teeth of the miocene genus *Amphicyon* have also been found there.

Of the modern and existing genera *Euelephas*, *Equus*, *Bos*, *Bubalus*, *Capra*, and *Hippopotamus*, which are so characteristic of the typical upper Siwaliks, I am not aware that any remains have been obtained from the Manchhar beds. The only two living genera of Mammals of which we have clear evidence as occurring in these beds are *Rhinoceros* and *Sus*, both of which have existed since the miocene epoch.

From the still older marine Gáj beds, Mr. Fedden has this year obtained a part of a skull and three upper molars of *Rhinoceros sivalensis;* the specimen was obtained at a considerable distance below the Manchhar horizon, but its precise position, Mr. Fedden tells me, could not be defined, owing to the irregularity of the thickness of the beds in different localities and the absence of the Manchhars at this spot. This *Rhinoceros* is thus proved to have been one of the earliest of the Siwalik Mammals, having lived in the Gáj period.

In the Siwaliks of the Punjáb Mr. Theobald seems to have proved pretty clearly from the sections sent down with the fossils, that in this region the greater number of extinct genera do occur in the lower beds of the series, while the greater number of living genera occur higher up; this idea cannot, however, be thoroughly worked out, owing to the fact that the fossils occurring in one bed are washed out and mingled with those from another. I imagine that this confusion is especially the case with the very few fossils which occur below the great fossiliferous zone, as they are generally picked up by native collectors and mixed with those from other zones. The lower beds, like those of Núrpur and Kúshalghar from which *Amphicyon* and *Dinotherium* have been obtained, are very probably the equivalents of the Manchhars.

Hitherto all, or nearly all, the Siwalik fossils seem to have been found as isolated bones; during the past season, however, Mr. Theobald has discovered a bed at Nikí in the Punjáb, where a vast number of associated bones of many

[1] Address to American Science Institution, New-Haven, 1877, p. 24.

species are found mixed *pell-mell* together; and which probably indicates an old quicksand in which the Siwalik animals were engulphed.

From this deposit I hope that many valuable specimens will yet be obtained, which will throw more light on the affinity of some of the less known Siwalik animals than can be obtained from the study of a few isolated bones or teeth. The bed has already yielded many specimens, among which I may notice the complete cranium of a gigantic pig, part of the cranium with milk dentition of the new trilophodont *Mastodon* and several associated sets of foot bones. Among the latter is a nearly perfect foot of *Hippotherium*, which shews us that the Asiatic species of the genus had precisely the same conformation as the European forms.

I will now mention the most important and interesting of the specimens obtained during the past year; in the course of these notices I shall have to mention several re-determinations of previously noticed specimens; these re-determinations have either become necessary owing to the discovery of more perfect specimens or owing to the errors of previous determinations.

These re-determinations, though of course to be regretted, are almost unavoidable in determining such isolated specimens as are the majority of the fossils from the Siwaliks, and are also made more frequent in the present instance, owing to the extremely unsatisfactory state of the previous literature referring to Siwalik Mammalia.

I may also here mention that Mr. Theobald has collected several bones of Siwalik Birds, and a considerable number of the remains of Reptiles; these, however, will not be further noticed at present, as I have not yet had an opportunity of studying these in any detail.

PRIMATES.

Genus: MACACUS.

Remains of quadrumanous Mammals have been long known from the Siwaliks, and indeed the specimens obtained from those rocks were the first known fossils belonging to the order. These remains, however, are of extremely rare occurrence, the known specimens only numbering some five or six; up to the present time, no specimens of the remains of this order have been obtained among the many hundreds of specimens which Mr. Theobald has forwarded from the Siwaliks of the Punjáb to the Indian Museum. In December last, however, two specimens of the upper jaw of a small monkey were received at the Indian Museum from Mr. Theobald, which had been obtained from the Siwaliks of the village of Asnot, in the Punjáb, and which form the subject of the present notice.

Before describing the new specimens, it may be well to consider for a moment the remains of Monkeys which have been previously obtained from the Siwaliks; the memoirs on the specimens will be found collected in the first volume of the "Palæontological Memoirs," accompanied by a plate.

The first specimen discovered was a part of the right maxilla with the molar series. In speaking of the specimen the discoverers (Messrs. Baker and Durand) conclude by observing: "This circumstance and the differences before pointed out,

desire to call attention to it. The specimen in question is far larger than the lower milk-molar which I have referred to *Camelopardalis sivalensis* and cannot belong to that species; it also differs very considerably in form from that specimen, from which I think that it does not belong to that genus.

The tooth is composed of three complete barrels, the hindmost of which is the largest: these two characters assure us that the specimen is a last milk-molar, and not a last true molar. The outer columns of the barrels are set very obliquely to the long axis of the jaw, and the median costa on the one perfect dorsum is slightly developed; in these respects the tooth differs from the true molars of *Camelopardalis* and agrees with those of *Hydaspitherium*. Each of the valleys on the outer side contains a large and pointed tubercle reaching to half the height of the crown. The length of the specimen is 1·9 inch and its greatest width 0·94 inch.

The tooth is slightly longer than either of the two anterior molars of *H. leptognathus*, which is the same relation as exists between the corresponding teeth of *Camelopardalis sivalensis* and ordinary Ruminants: and I think it extremely probable that it should be referred to the former species; it is true that the permanent molars of *H. leptognathus* have no accessory columns like the milk-molar in question, but it not unfrequently happens that the lacteal series does differ from the permanent series in certain points of detail, such differences generally consisting in that the lacteal molars retain ancestral characters which have been lost in the permanent series.

Among the whole of the specimens sent down by Mr. Theobald from the Siwaliks of the Western Punjáb, I cannot find any remains which I can with certainty refer to *Sivatherium giganteum*, and it is not improbable that the range of that animal did not extend into the area in question, where it was replaced by the allied genera; no species of this group have hitherto been found in Sind. Among Mr. Theobald's collection there are a considerable number of the limb bones of various Sivatherioid animals, which are generally smaller than those of *S. giganteum*, and which most probably belonged to some of the above described smaller species. I have not yet had time to examine those bones in any detail.

PERISSODACTYLA.

Genus: RHINOCEROS.

During the present and past year the Indian Museum has acquired a large series of specimens of the osteology and dentition of the fossil species of this genus, which have been obtained by the exertions of Mr. Theobald in the Siwaliks of the Punjáb, and most especially from the highly fossiliferous beds of the village of Asnot in the Jhelam district.

Among these specimens are the complete adult molar series of *Rhinoceros sivalensis*, the upper milk dentition of *R. palæindicus*, and a complete ramus of the mandible with the symphysis of the same species, and, most important of all, a large series of the upper and lower dentition of the new species *R. planidens*, which appears to be confined to the Punjáb. No specimens of *R. platyrhinus* occur either in the present or in previous collections from the Punjáb, and it is not improbable that this species did not occur in that area.

In the present notice I shall only refer to certain upper teeth of *R. planidens*, which are far more perfect than the specimens of upper molars described at page 23 of "Molar Teeth and Other Remains of Mammalia,"[1] and upon the evidence of which the species was founded; and also to a portion of the lower jaw of the same species. The new specimens incontestably prove the distinctness of the species.

Of the two specimens of upper molars which I have selected for notice here, one is the penultimate tooth, and the other the last tooth of the right side. Both teeth are quite complete and in a middle state of wear; they are of such a size that by this character alone they might be well distinguished from *R. sivalensis*, which is the only one of the Siwalik species of *Rhinoceros* with which they have any affinity.

Both of the original specimens on which the species was founded lacked the external surface of the crown, the form of which has been therefore hitherto unknown. In the present specimens we find that the dorsum or external surface is produced into a bold buttress at its antero-external angle, and that the rest of that surface is nearly flat; the presence of this buttress alone is sufficient to distinguish these teeth from those of *R. platyrhinus*.

The other characters of the penultimate tooth are similar to those of the previously-acquired specimens, and need no further notice here. The last tooth, allowing of course for its different form, agrees in general characters with the previous specimen; it is readily distinguished from the corresponding tooth of *R. sivalensis* by its vastly superior size, and by having a very wide cingulum surrounding the outer and inner sides of the anterior collis, and which is continued into the median valley to form a low and wide tubercle at the entrance, of which there is no representative in the corresponding tooth of *R. sivalensis;* the tooth has a small crochet and a large antecrochet.

The dimensions of these two teeth are compared below with the same dimensions of the corresponding teeth of *Rhinoceros sivalensis* :—

	R. plani.	*R. siva.*
Penultimate molar.	In.	In.
Length of anterior surface	3·20	2·70
„ of internal surface	2·45	1·82
„ of posterior surface	2·60	2·34
„ of external surface	3·40	2·50
Height of crown	2·22	2·10
Last molar.		
Length of anterior surface	3·20	2·30
„ of internal surface	2·95	1·90
„ of posterior surface	3·20	2·35
Height of crown	3·05	1·75

The difference in size is, therefore, so great that from this alone there would be no doubt as to the specific distinctness of *R. planidens*, which indeed seems to have been next in size to the largest specimens of *R. platyrhinus*, the largest of any species of *Rhinoceros* with which I am acquainted; the dorsum of the penultimate molar measuring upwards of four inches in length.

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[1] Palæontologia Indica, Ser. X, Vol. I, pt. 2.

In addition to these upper molar teeth Mr. Theobald has sent down the symphysis and part of one ramus of a mandible of a species of *Rhinoceros*, which was found with the upper molars, and which I have no doubt from its size belongs to the same species. Before going further, it may be well to remind the reader that the mandibles of three species of Siwalik *Rhinoceros* are figured in the "Fauna Antiqua Sivalensis," and were referred by Falconer to his three species *R. sivalensis*, *R. palæindicus* and *R. platyrhinus*; I do not know on what grounds the lower jaws were referred to their respective species, which were founded upon crania; there is, however, no doubt but that these three jaws belonged to the three above-mentioned species, irrespective of the question of assigning each to each. Now, these three kinds of mandibles all differ from the present specimen, and there is, therefore, every presumption in favor of the Punjáb lower jaw having belonged to the Punjáb *R. planidens*.

The portion of the lower jaw in question consists of the symphysis, and a part of the right ramus containing the three last premolars and the first true molar; on either side of the symphysis there is a single huge incisor, that of the right side being broken off near its summit, and that of the left at the summit of the alveolus; there are no inner incisors. The single incisor has a flattened surface superiorly, looking upwards and inwards, while the inferior and external surfaces are rounded, the tooth is strongly curved upwards, and extends above the level of the plane of the grinding surfaces of the molars; the jaw is of great vertical depth.

The lower jaw of *R. sivalensis* (F. A. S., pl. 74, fig. 6) has no incisors, and is therefore quite unlike this specimen. In the lower jaw of *R. platyrhinus* (F. A. S., pl. 75, fig. 10), there are two small inner incisors, as well as larger outer incisors; the latter are directed less upwards, and are straighter and smaller than those of the present specimen.

The lower jaw of *R. palæindicus* (F. A. S., pl. 74, figs. 3 and 4) agrees with the present specimen in having the outer incisors only; the latter are, however, smaller and shorter, and are directed very slightly upwards, so that only their extremities reach the level of the grinding surface of the molars; and the jaw is shallower and the symphysis shorter.

In the following table I have compared together the dimensions of the present specimen, with the corresponding dimensions of the mandible of *R. platyrhinus* and *R. palæindicus*; the latter are taken in part from the description of the plates of the "Fauna Antiqua Sivalensis," and in part from specimens in the Indian Museum:—

	R. plan.	*R. plat.*	*R. pal.*
	In.	In.	In.
Depth of jaw at last premolar . . .	4·5	...	3·4
Length of symphysis	6·4	6·9	4·5
Vertical diameter of outer incisor . .	1·8	0·7	1·1
Transverse „ „ . . .	2·4	1·5	1·3
Length of incisor (broken in *R. planidens*) .	3·5	2·1	1·9
„ of three last premolars . .	5·1	3·8	4·7

No other *Rhinoceros* that I have seen has lower incisors at all approaching in size to those of the present specimen; in correlation with these enormous lower incisors

we should expect that the upper incisors were likewise of unusual size in *R. planidens*, and such appears to have been the case. From the district where the upper molars and lower jaw of *R. planidens* were obtained, Mr. Theobald has obtained two upper incisors of a *Rhinoceros* of gigantic size, which I have no doubt belonged to the same species; the length of one of these specimens is upwards of 4·3 inches, its thickness 1·5 inch, and the height of its crown 1·9 inch. The upper incisors of the other Siwalik species of *Rhinoceros* are not known; the present specimen is, however, far too large to have belonged to *R. sivalensis* or *R. palæindicus*, while *R. platyrhinus* is not known to occur in the Punjáb, and if we may judge from Colonel Baker's cranium of this species seems not to have had permanent upper incisors.

The above comparisons point most clearly to the specific distinctness of the gigantic fossil *Rhinoceros* of the Punjáb; in its upper molars this species approaches nearest to *R. sivalensis*, but is distinguished by their larger size and their bold cingulum and tubercle in the median valley; in the number of its lower incisors the new species agrees with *R. palæindicus*, but is distinguished by their curved form and much greater size.

Genus: LISTRIODON.

Of this genus, which has still an *incerta sedes*, Mr. Theobald has obtained an upper molar of a very small species quite distinct either from the Indian *L. pentapotamiæ* or the European *L. splendens*, or *L. lartetii*, and which must be referred to a new species. The specimen was obtained from the Siwaliks of the village of Jabi in the Punjáb, and will be described and figured on a future occasion; I propose to call the species after its discoverer, *L. theobaldi*.

RODENTIA.

Genus: HYSTRIX.

At page 706 of the fourth volume of the "Journal of the Asiatic Society of Bengal," in a list of Siwalik fossils given by Falconer and Cautley, there occurs the name of the genus *Hystrix*, as having been obtained with the other specimens. The name of the genus again appears on page 293 of the fifth volume of the same Journal, and also in the Introduction to the "Fauna Antiqua Sivalensis" (Pal. Mem., Vol. I, p. 23). I can find, however, no further mention of the genus in Falconer's papers, nor any notice of the specimen on which the determination was made; this specimen (or specimens) has, in all probability, been lost.

With the exception of the occurrence of the name in the above lists, we have hitherto known nothing of the occurrence of *Hystrix* in the Siwaliks; towards the end of last year, however, Mr. Theobald forwarded to the Indian Museum a portion of the mandible of a species of this genus, obtained from the Siwaliks of the village of Asnot, which forms the object of the present preliminary notice.

The specimen consists of the middle portion of the right ramus of the mandible containing the two first molars, and the sockets of the last premolar and last molar; the cutting extremity of the incisor of the same side was also obtained.

The new specimen is unlike any other described species, and must consequently be referred to a new species, which I propose to call *H. palæindicus*.

It may be not of out of place here to notice an upper molar of this genus which has been figured by Professor Flower in the August number of the Quarterly Journal of the Geological Society,[1] and which, as well as another specimen, was obtained from the English Red Crag. The figured tooth is the first upper molar of the right side, and agrees exactly with the corresponding tooth of Mr. Theobald's specimens of *H. sivalensis;* the latter tooth being unworn and more perfect than those of Falconer's cranium of this species (with which Professor Flower compared his specimens) are more suitable for comparison with the unworn English specimen. Professor Flower mentions that "the fine striation of the surface of the enamel in lines converging to the apices of the cusps, which is beautifully seen in both the Crag teeth," is very indistinct on the more worn Siwalik teeth; Mr. Theobald's specimens, however, agree exactly in this character with the Crag teeth, and I can but adopt the opinion of Professor Flower that there is no specific distinction between the English and the first-named Indian *Hyœnarctos*.

In noticing the range of the genus, Professor Flower only alludes to its occurrence in Europe and Asia; he might have added that it also occurs in the newer pliocene of South America.[2]

Alleged Cetacean.

A cast of the bone referred to the Cetacea on page 103 of the ninth volume of the "Records," has been submitted to Professor Flower, who considers that it belongs to the Ungulata and not to the Cetacea; there is, therefore, at present no evidence of the presence of the latter order among the Siwalik Fauna.

The Palæontological relations of the Gondwana System: a reply to Dr. Feistmantel, by W. T. Blanford, F.R.S., *Deputy Superintendent, Geological Survey of India.*

Introduction.—I have allowed more than a year to elapse without attempting to answer any of Dr. Feistmantel's remarks in the "Records of the Geological Survey," although I cannot admit that in his reply[3] to my first paper[4] he has either confuted my arguments, or, except in one case,[5] of which I think he has exaggerated the importance, and twice when I had been misled by his own mistakes, shown me to be in error. My reasons for waiting were partly that I had other matters of greater urgency to attend to; partly that I hoped the irritation which

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[1] Vol. XXX, p. 534.

[2] O. C. Marsh: "Address to American Science Association," Newhaven, 1877, p. 46.

[3] Rec. G. S. I., vol. IX, p. 115.

[4] Ib. pp. 79.

[5] This refers to the presence of *Cycadeaceæ* in the lower Gondwánas. The only error I committed was in overlooking the fact that *Noeggerathia* is classed by many writers as a Cycad. The affinities of this plant are by no means determined with certainty.—See Geol. Mag. 1876, p. 489; 1877, pp. 190, 431; Rec. G. S. I., vol. IX, pp. 118, 140.

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