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 THE GOVERNMENT OF INDIA.

New Series.

Vol. IV, Memoir No. 2.

The Vertebrate Fauna of the Gaj Series in the Bugti Hills and the Punjab.

By

GUY E. PILGRIM, D.Sc. (LOND.), F.G.S.

PLATES I TO XXX
AND MAP.

CALCUTTA:

SOLD AT THE OFFICE OF THE GEOLOGICAL SURVEY, 27, CHOWRINGHEE ROAD
LONDON: MESSRS. KEGAN PAUL, TRENCH, TRÜBNER & CO.
BERLIN: MESSRS. FRIEDLÄNDER UND SOHN

1912.

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Geological Survey of India.

INTRODUCTION.

The specimens, which are about to be described in the following pages, have already been alluded to in a short paper published by the present writer in 1908.[1] Brief notices of most of the species were published in this paper, so that but few of the new generic and specific names appear here for the first time. The whole of the material has, however, been carefully looked over, and many specimens, which had previously escaped notice, have been developed from their matrix. I have, thus, in some cases been led to modify my first opinion on the systematic position of some species. The present paper must be held to express my deliberate judgment, as based on the material up till now at my disposal.

The region, where the remains occur, is a hilly tract of country, sparsely peopled by a Baluchi tribe—the Bugtis—and situated just beyond the frontiers of Upper Sind, and the district of Dera Ghazi Khan in the Punjab. They are governed with a firm hand by one of the most efficient chieftains to be met with in the whole of Baluchistan, Nawab Sir Shahbaz Khan, on whom the government have conferred the honour of a K. C. I. E. The country is approached most easily from Jacobabad, from which Dera Bugti, the chief village, is distant about five marches. Its geology was first reported on by Vicary,[2] who also discovered the existence of vertebrate remains and mollusca, near Dera Bugti. It was visited in 1882 by Blanford,[3] who brought back the interesting Anthracotheroid and Rhinocerotoid remains, subsequently described by Lydekker.[4] The present writer re-surveyed it during the field season 1907-1908, and the map forming plate XXXI is a result of that survey.

The stratigraphical relations of the bone deposits were fully discussed in the above quoted paper, and reference should be made to it for detailed information on this point. Quite recently, however, I have been induced to make certain important

[1] Pilgrim, Tertiary freshwater deposits of Baluchistan and Sind, *Rec. Geol. Surv. Ind.*, XXXVII, pt. ii, p. 139 (1908).

[2] Vicary, Geological Report on a portion of the Beloochistan hills, *Quart. Jour. Geol. Soc.* ii, p. 260 (1846).

[3] Blanford's account of the geology of these hills was published in *Mem. Geol. Surv. Ind.*, XX, p ii.

[4] Lydekker, *Pal. Ind.*, Ser. 10, vol. II, pt. v, and vol. III, pt. i.

modifications in the correlation, which I at first adopted. This is due to some valuable information, which my colleague Mr. E. W. Vredenburg, after a careful examination of their oyster fauna, has been good enough to give me. The bones are scattered through a series of coarse ferruginous sandstones and conglomerates, some 1,000 feet in thickness. These beds unconformably underlie the lower Siwaliks and pass down quite gradually into an estuarine stage, characterized by deposits containing oysters and mammalian remains intermingled. Below this again is a marine layer containing *Nummulites intermedius*, a species which must be regarded as no later than uppermost stampian. In the estuarine portion three species of oyster occur which Mr. Vredenburg has identified with *Ostrea gajensis*, Vred., *Ostrea vestita* Fuchs and *Ostrea bicolor*, Hanley. My colleague has devoted considerable study, both in the field and the museum, to the Gaj fauna and he considers that these three species are either quite characteristic of the Upper Gaj of Sind or, at all events, are not found in older strata. It follows from this that a stratigraphical break must succeed the lower marine band with *Nummulites intermedius*, and although it is unwise to claim absolute exactitude for any correlation of Tertiary horizons based merely on a few species of mollusca, still it is, perhaps, not too much to say that these determinations justify us in regarding the ossiferous beds of the Bugti hills as contemporaneous with the Gaj and probably with the upper division of that series. On the evidence of the Foraminifera, Vredenburg regards the mass of the Gaj as upper aquitanian and the remainder of it as lowermost burdigalian. Arguing, therefore, on these lines the Bugti bone beds can be assigned to the uppermost aquitanian or the lowermost burdigalian. As will be shown later this agrees as closely as could be expected with their age as estimated by their vertebrate fauna.

I have elsewhere remarked upon the close similarity to the Bugti bone beds presented by certain unfossiliferous sands and conglomerates at Bhagathoro in Lower Sind. These also rest upon Lower Nari limestones and were referred by Blanford to the Upper Nari. Mr. Vredenburg, however, considers that a shell bed, which overlies them, is Upper Gaj. There seems, therefore, little doubt that these, like the Bugti beds, represent a fresh water facies of the Gaj. No continuity of outcrop exists between the beds in the Bugti hills and those in Lower Sind, but going northward, these beds have actually been traced beyond Dera Ghazi Khan. Quite recently, the writer has discovered that a series of equivalent beds are widely distributed through the Salt Range, in the Kala Chitta Hills, and west of the Indus, in the Kohat and Bannu districts. In the Muree hills these have been mapped under the name of Kuldanas by Middlemiss. Generally, these beds do not contain more than mere fragments of vertebrates, but near Fatehjang, *Anthracotherium bugtiense*, *Brachyodus* cf. *africanus*, *Teleoceras fatehjangense*, a species very closely allied to *Teleoceras blanfordi*, and a species of *Hemimeryx* have been found. Across the Indus, in the Kohat district, there occurs in similar beds a ribbed *Unio*, which may be the same as one of the curious ribbed species found in the Gaj series of the Bugti hills.

It must, at present, be regarded as uncertain whether the outcrop of these beds in the Bannu district is in continuity with that in the latitude of Dera Ghazi Khan. La Touche and Tipper certainly did not observe these beds in the Sherani hills, but, as it is by no means always easy to differentiate them from the overlying Lower Siwaliks, it is possible that they may be represented, but have escaped notice. Rather fuller details as to the stratigraphical relations of these Kuldana beds are contained in a paper by the writer in a recent number of the Records.[1]

The following list includes all the vertebrate species known up to the present from the Gaj series of India.

CARNIVORA.

Pterodon bugtiensis, Pilgrim.
Pterodon sp.
Amphicyon *cf.* major, Blainv.
Cephalogale shahbazi, Pilgrim.

PROBOSCIDEA.

Mœritherium sp. ?
Dinotherium indicum, Falconer, var. gajense, Pilgrim.
Hemimastodon crepusculi, Pilgrim.

PERISSODACTYLA.

Cadurcotherium indicum, Pilgrim.
Diceratherium naricum, nov. nom.
Diceratherium shahbazi, Pilgrim.
Aceratherium bugtiense, Pilgrim.
Aceratherium gajense, Pilgrim.
Teleoceras blanfordi, Lydekker.
Teleoceras fatehjangense, Pilgrim.

ANCYLOPODA.

Schizotherium sp. ?
Phyllotillon naricus, Pilgrim.

ARTIODACTYLA.

Palæochœrus affinis, Pilgrim.
Bugtitherium grandincisivum, Pilgrim.
Anthracotherium bugtiense, Pilgrim.
Anthracotherium sp.
Anthracotherium (Microselenodon) mus, Pilgrim.

[1] Pilgrim, Preliminary Note on a revised classification of the Upper Tertiaries of India, *Rec. Geol. Surv. Ind.*, XL, p. 187 (1910).

Brachyodus giganteus, Lydekker.
Brachyodus hyopotamoides, Lydekker.
Brachyodus africanus, Andrews.
Merycops longidentatus, Pilgrim.
Hyoboops maricus, Pilgrim.
Ancodus ramsayi, Pilgrim.
Gonotelma shahbazi, Pilgrim.
Telmatodon bugtiensis, Pilgrim.
Hemimeryx speciosus, Pilgrim.
Prodremotherium (?) beatrix, n. sp.
Gelocus (?) gajensis, n. sp.
Progiraffa exigua, Pilgrim.

CROCODILIA.

Crocodilus bugtiensis, Pilgrim.
Garialis curvirostris, Lydekker, var. gajensis, Pilgrim.
Garialis breviceps, Pilgrim.

CHELONIA.

Trionyx sp. various.

PISCES.

Siluroid, Genus indet.

The following are the freshwater mollusca associated with the vertebrates :—

Melania pseudepiscopalis, Blanf.
Melania gradata, Blanf.
Paludina bugtica, Blanf.
Unio vicaryi, Blanf.
Unio cardiiformis, Blanf.
Unio cardiiformis, var. Blanf.
Unio cardita, Blanf.
Unio pugiunculus, Blanf.
Unio, n. sp.

It is impracticable to regard any of these species, as confined to one particular horizon in the series. The species, known to occur in the lowest beds, are *Cadurcotherium indicum*, *Anthracotherium bugtiense*, *Bugtitherium grandincisivum*, *Prodremotherium* (*?*) *beatrix*, *Gelocus* (*?*) *gajensis*, *Mœritherium sp.*, and *Crocodilus bugtiensis*; of these, however, *Anthracotherium bugtiense* and *Bugtitherium grandincisivum* are also met with at a much higher horizon, and we have no rea grounds for doubting that a more successful search would also bring the others to light in the upper part of the series. Consequently, it is necessary to consider the affinities of this fauna as a whole.

First, it is apparent that the differences between it and that of the Lower Siwaliks of Sind and the Punjab are very great. The specific identities are *Dinotherium indicum*, *Aceratherium gajense* and *Garialis curvirostris*. All of these, probably, possess varietal differences in the two series. On the other hand, the rich Anthracotheroid fauna of the Gaj beds is reduced in the Lower Siwaliks to a small species of *Anthracotherium* (*Microselenodon*), and the genera *Hyoboops*, *Hemimeryx*, and *Choeromeryx*. *Pterodon*, an early Creodont, and *Cephalogale*, as also the primitive Proboscidean types, seen in *Mœritherium* and *Hemimastodon crepusculi*, have disappeared. The tooth structure of the Perissodactyla of the Gaj series as shown not only in *Cadurcotherium* but also in the crochetless molars of *Aceratherium bugtiense* and *Diceratherium naricum* and *shahbazi* is of a kind, that is not met with in the Lower Siwaliks. The palæontological is, therefore, in complete accord with the stratigraphical evidence, in the indication of a great unconformity between the two series.

Proceeding farther afield in our comparisons, the only identity with a European species is *Amphicyon* cf. *major*. This has not been found in Europe earlier than burdigalian. Its remains in the Bugti hills are, however, very fragmentary, and it is unsafe to lay too great stress on them. *Brachyodus africanus* is found in strata of burdigalian age in Egypt, but the Bugti species certainly differs varietally from the African one. The occurrence in these beds of the proboscidean genus *Dinotherium* is also particularly noticeable. In Europe, this genus does not make its first appearance until the burdigalian. On the other hand, the large *Anthracotherium* species of Europe, which are allied to *A. bugtiense* are stampian and aquitanian; *Cadurcotherium* is stampian and *Diceratherium* is for the most part stampian and aquitanian, although *Diceratherium douvillei* occurs in the burdigalian. *Cephalogale* is stampian to burdigalian. In the old world, *Pterodon* has not been found in strata younger than sannoisian, although if we accept Cope's *Hemipsalodon* from Canada as a *Pterodon*, then the range of this genus must be extended to stampian. *Schizotherium* and *Ancodus* are no newer than stampian. *Mœritherium* is bartonian to sannoisian, and the nearest ally to *Hemimastodon crepusculi* is found in the sannoisian *Palæomastodon* from the Fayûm. In conclusion, therefore, it seems improbable that the bone beds of the Bugti hills are younger than uppermost aquitanian.

The most striking feature of this fauna is the large representation of the Anthracotheriidæ. Nowhere else is such variety of genera and species met with. It seems not unlikely that the original home of the family was, if not in India itself, at all events, in a neighbouring area.

An ancestral form of the Giraffidæ, a family which was to become so numerous and varied in India at a later period, is already present in these deposits.

It will not be amiss to draw attention to the gigantic size attained by many of the animals, whose remains are found in these deposits. Genera, which elsewhere include only small species, are here represented by large ones. This is particularly

the case with genera, which became extinct at an earlier stage elsewhere. It would almost seem that a necessary condition of their survival was that they should increase in size. Perhaps, being unable to vary their structure to suit a changed environment, their only hope of holding their own against other types, in the struggle for existence, was to crush their opponents by sheer weight. Examples of this are seen in the species *Pterodon bugtiensis*, *Cephalogale shahbazi*, *Moeritherium* sp., *Aceratherium bugtiense*, *Bugtitherium grandincisivum*, *Crocodilus bugtiensis*, and *Cadurcotherium indicum*.

The descriptions, which follow, are confined to the specimens of skulls and teeth. There are, however, a considerable number of vertebræ and limb bones amongst the collections. These are chiefly Anthracotheroid and Rhinocerotoid. As the various remains are found mixed up in the most inextricable confusion, it is impossible to assign the bones with any certainty to their respective species. Under these circumstances, it has not been thought that any useful purpose would be served by describing or figuring them at present.

The figures which illustrate the memoir are in every case reproduced from photographs of the actual specimens, except figure 2 of plate XI. For this portion of the work Mr. H. B. W. Garrick is entirely responsible, and I would here like to express my grateful thanks for the skill and patience applied by him to material, which has often been unsatisfactory for photography.

type of a new genus, which is at an evolutionary stage midway between *Palæomastodon* and *Tetrabelodon*.

Measurements.

	Maxilla.		Young Maxilla.		Mandible.		
	Ind. Mus. No. A. 446.	Ind. Mus. No. A. 427.	Ind. Mus. No. A. 448.		Ind. Mus. No. A. 447.	Ind. Mus. No. A. 450.	Ind. Mus. No. A. 451.
	M_3	M_2	Mm_3	Mm_2	M_2	Pm_4	Pm_3
Length	93	88	58	34	...	36	30
Breadth	62	61	...	...	51	26	20

Sub-Order: PERISSODACTYLA.

Family: *AMYNODONTIDÆ.*

Genus: CADURCOTHERIUM, Gervais.

Comtes Rendus Acad. Sci. LXXV, p. 106 (1873),

One of the most interesting discoveries made in the Gaj beds of the Bugti hills, is that of the dentition of an animal, which must, beyond all doubt, be referred to the curious genus *Cadurcotherium* of the Oligocene of Europe. In my preliminary notice of this fauna, I did no more than refer to the present upper molars in the list of species[1] under the name *Amynodon sp.* A more thorough development of the specimen, now reveals clearly that it belongs, not to *Amynodon*, but to *Cadurcotherium*, a genus, however, which, according to Osborn, must certainly be placed in the *Amynodontidæ*.[2] A mandible, found in the same beds also possesses the peculiar characters of that of the European genus, and since in size it corresponds exactly to the Bugti upper molars, it must belong to the same species.

For long, the descriptions and figures of Gervais,[3] based on some rather fragmentary material from the Phosphorites of Quercy, remained almost our only source of acquaintance with this genus. On these Gervais founded the species *Cadurcotherium cayluxi*, and subsequently Filhol[4] gave the specific name of *C. minus* to the lower premolar of a much smaller animal from the same locality. However, even as the present description is being penned, there has come under my notice Roman's and Jolleaud's comprehensive monograph[5] on the genus *Cadurco-*

[1] Pilgrim, *Rec. Geol. Surv., Ind.*, XXXVII, p. 149 (1908).

[2] H. F. Osborn, The Extinct Rhinoceroses, *Mem. Amer. Mus. Nat. Hist.*, I, pt. 3, pp. 80 and 84 (1898).

[3] Gervais, *Journal de Zoologie*, II, p. 362, and *Zoologie et Paléontologie générales*. 2nd part, p. 38 (1876).

[4] Filhol, *Bull. Soc. Phil.* (7), IV, p. 125 (1879-80).

[5] F. Roman and L. Jolleaud, Le Cadurcotherium de l' Isle-sur-Sorgues et Reaision du genre Cadurcotherium *Arch. Mus. d'Hist. Nat. Lyon*, X, pp. 1—44 (1909).

therium, in which another much larger species, *C. nouleti* has been established. A complete diagnosis of the genus, from its dentition, is given in this monograph. The authors fully endorse Osborn's opinion, that it is a specialized member of the *Amynodontidæ*. They consider that the latest European representative of the genus, *C. nouleti*, is no later in age than uppermost stampian. Since the Indian species is even larger than *C. nouleti*, and possesses characters pointing to an even more extreme specialization, it is entirely in accordance with inherent probability that it should belong to the aquitanian stage.

CADURCOTHERIUM INDICUM, Pilgrim. Plates V and VI.

1908. *Amynodon sp.* Pilgrim, Tertiary Freshwater deposits of Baluchistan and Sind, Rec. Geol. Surv., Ind., XXXVII, p. 149.

1910. *Cadurcotherium indicum*, Pilgrim, Rec. Geol. Surv. Ind., XL, p. 65.

The actual remains, which I can refer to this species, are a maxilla, containing the three molars, which are in an advanced condition of wear, and the last premolar, and a mandible with the three molars. The former, I obtained, myself, from the very lowest beds of the series in Khajuri nala; it is, therefore, probably, upper aquitanian. The locality of the mandible is unknown.

There can be no doubt as to the close affinity of these fragments with the European species of *Cadurcotherium*, and, therefore, they cannot be separated generically. As will be shown, however, the dentition presents many points of difference from that of *C. nouleti*, the European species, which approaches it nearest in size, as well as from that of *C. cayluxi* and *C. minus*. Accordingly, the Bugti species may be known as *C. indicum*.

Description. Upper molars.—These are, clearly, of the Rhinocerotoid type, with perfectly formed transverse crests. The transverse valley between the protoloph and metaloph is deep but much contracted. They differ from one another, in point of size and shape, in the most remarkable way, and show, what can only be described as the most extraordinary distortion.

M_2 is the largest tooth. Its ectoloph is set very obliquely to the longitudinal axis of the jaw; consequently the tooth is more than half as broad again in front as behind, and the length of the ectoloph is just as much in excess of the internal length of the tooth. The ectoloph is flat. No paraconal ridge is visible, and no trace of a fold between the paracone and parastyle. The latter is, however, prominent. There is no internal cingulum and no cingule. The protoloph is large but without a protoconule fold. No crochet or metaconule fold is visible in this worn tooth. The internal face of the protocone is marked by a depression, even deeper than that seen in a similar position in *Aceratherium bugtiense*.

M_3 is very much shorter than m_2. It differs from the last molar of the Rhinocerotidæ by the possession of a metaloph, distinct from the ectoloph. This

is, however, very short, compared with the protoloph and with the metaloph of the front molars. It is also much more nearly in the same line as the ectoloph than is the case in *C. cayluxi*, and *C. nouleti*. Its distinctness from the ectoloph is, however, very strongly marked by the prominent metastylar ridge, which is absent in the Rhinocerotidæ. The transverse valley between protoloph and metaloph is very narrow, as in m_2. The depth and extent of the posterior valley is obscured by fracture. The ectoloph is as in m_2, but the parastyle is narrower and more acute than in the preceding tooth. The internal border of the metaloph possesses numerous small folds or processes. There is no cingulum or cingule. The protocone is smaller than in m_2, but has the same depression on the internal face. All the sides of the tooth slope in so greatly from the base towards the summit of the crown, that it is evident that, in the unworn condition, it must have been a true three-sided pyramid of great height, precisely like the corresponding tooth of *C. cayluxi*.

M_1 is more like the ordinary Rhinocerotoid molar. It is very broad and short and in this particular, differs greatly from the corresponding tooth in *C. nouleti*. The ectoloph is oblique to the longitudinal axis of the jaw, though less so than in m_2 or m_3. A depression is present on the internal face of the protocone.

Pm_4 is small. It is very broad in proportion to its length. There is a very strong internal cingulum, stronger even than that surrounding the premolars of *Aceratherium bugtiense*. The transverse crests appear to be complete and are quite separate, though the tooth is well worn. Nothing anterior to this is known with certainty.

Lower molars.—These are constructed on the general Rhinocerotoid type. They are, however, very narrow and elongated, and resemble Rhinoceros lower molars, which might have, by some means or other, been squeezed out by lateral pressure. The two half-crescents have fused, so that not the faintest trace of the suture is visible on the external wall of the tooth, which is continuous and only very slightly convex. Internally, two irregular concavities remain. The lower molars are rather shorter than the upper molars, which have just been described, but agree in their relative proportions, m_1 being much smaller than either of the others.

Remarks.—The European species resemble one another very closely in regard to their structure, differing chiefly in size. The Indian species is much larger than *C. nouleti*, the largest of the European forms. All the teeth of *C. indicum* are, relatively, much broader and less elongated. This is particularly noticeable in m_1 and pm_4. The upper molars of the European species do not show the same disproportion in breadth in their anterior and posterior part which is observed in *C. indicum*. The last upper molar of the Bugti species differs from that of the others by the fact that the metaloph is more nearly in a line with the ectoloph, while the metastylar ridge is more acute. The hinder wall of the metaloph is shorter ; finally, its anterior wall is characterized by the presence of numerous small folds or processes of enamel, which are absent from m_3 in the European species.

Measurements.

	Maxilla.				Mandible.		
	M_3	M_2	M_1 app.	Pm_4 app.	M_3	M_2	M_3
Max. Length	84	87	44	33	77	65	44
Max. Breadth	56	80	70	60	25	29	28
(Measured at right angles to longitudinal axis.)							
Breadth in anterior part	62	82					
Breadth in posterior part	27	46					

Depth of mandible below M_3 . . . . . 90 mm.

Family : *RHINOCEROTIDÆ.*

Genus : DICERATHERIUM, Marsh.

Amer. Jour. Sci. IX, p. 242 (1875).

Diceratherium (?) naricum, Pilgrim.

1884. *Aceratherium blanfordi*? var. *minus*, Lydekker, Additional Siwalik Perissodactyla, Pal. Ind. (10), III, pt. 1, p. 3 Plate II, figs. 4, 5.

1910. *Diceratherium* (?) *naricum*, Pilgrim, Rec. Geol. Surv. Ind., XL, p. 66.

Under the head of ***Teleoceras blanfordi***, page 30, I have, briefly, given my reasons for making two distinct species out of Lydekker's two varieties of his ***Aceratherium blanfordi***. I have there stated why I have chosen that the *majus* variety should retain the specific name of *blanfordi*. I shall now enter rather more fully into the difference between the dentition of the present species and *Teleoceras blanfordi*. It is evident that here we find a far greater tendency to dolichocephaly. All the teeth are much longer in proportion to their breadth. This is chiefly noticeable in the premolar series and in the 1st molar. In *Teleoceras blanfordi*, both the antecrochet and the metaconule fold of the molars are far more pronounced. In fact in *T. blanfordi*, the projections from the protoloph and metaloph are so great as to almost block the median valley. In the 1st molar, at an only moderately advanced stage of wear, the crochet and antecrochet coalesce to enclose a medifossette, which in *D. naricum* is of much later formation. The differences are still more pronounced in the premolars. In *D. naricum* the most advanced premolar is pm_4. In this the transverse crests remain distinct until a late period of wear, and both crochet and crista are stronger than in pm_3. In pm_3 and the forward premolars the transverse crests fuse much earlier in wear. In *T. blanfordi*, on the contrary, the

most advanced premolar is pm_3 in which the crests fuse, at an exceedingly advanced stage of wear, while in pm_4 they unite comparatively early. Thus, the order of development of the premolar series in these two species is reversed. Moreover, in *T. blanfordi*, instead of the strong cingulum, which surrounds the inner side of all the premolars of *D. naricum*, there is only a cingule at the entrance of the median valley, just as in the molars.

Respecting the generic designation *Diceratherium*, I may say that I intend it to be quite provisional. In Europe, the smaller rhinoceroses of the Oligocene, belong to this phyle, which the present species suggests by its elongated dental series, its quadrate molars, the tubercle in the median valley of m_3, and its general likeness to *Diceratherium minutum* and *D. douvillei*. It is therefore, quite likely to belong here. It is distinguished from *Diceratherium shahbazi* by its rather smaller size, and by the feebler paracone and parastyle. The difference between the two is best marked in the premolars. In *D. shahbazi*, these are more unlike the molars and have not reached such a forward stage of development.

The milk molars of the species are not known with certainty.

MEASUREMENTS.

	M_3	M_2	M_1	Pm_4	Pm_3	Pm_2
	(inside.)					
Maximum length	37	41·5	39·5	33	33	24
Maximum breadth . . .	38	43	41·5	44	41	33

DICERATHERIUM SHAHBAZI, Pilgrim. Plate VII, figs. 1—3.

1910. *Diceratherium shahbazi*, Pilgrim, Rec. Geol. Surv. Ind., XL, p. 66.

This species is founded upon the associated last three premolars and last two molars of the upper jaw. They are only very slightly larger than in *Diceratherium naricum*, but differ in some very important particulars.

Upper molars.—Longer than broad; pronounced antecrochet, strongest in m_1 and weakest in m_3; much constricted protocone; strong crochet; weak fold on the protoloph (abnormal crista?) just external to the antecrochet, vanishing at a somewhat early stage of wear; no cingulum on the internal side; cingule at the entrance of the median valley; posterior valley slit-like; parastylar fold stronger than in *D. naricum*; last molar having indications of another fold on the metaloph just external to the crochet.

Upper premolars.—Quadrate; very unlike the molars and in a backward stage of development; crests uniting at a very early stage of wear; pm_2 most advanced, then pm_3 and last of all pm_4; pectinate crochet; broad cingulum entirely surrounding tooth.

Upper milk-molars.—The milk-molars figured in Pl. VII, fig. 1, probably belong to this species, and probably also the first two milk-molars figured by Lydekker in Pal.

Ind., (10), III, pt. 1, Pl. 1, fig. 6, under the name of *Aceratherium blanfordi*. Mm_2 has a strong cingulum, which is less on mm_3 and absent on the inner side of mm_4 weak external cingulum; transverse crests complete; strong crochet, antecrochet and crista; crochet and crista uniting quite early to enclose a medifossette; rather strong parastylar fold; strong paracone fold on the ectoloph in mm_2.

Remarks.—This species is very near to *D. douvillei* Osborn, from the burdigalian of the Sables de l' Orleanais. It differs from it by the less advanced condition of the premolars. It differs from *D. naricum* by the greater length of the premolars, by the pectinate crochet, by the early fusion of the transverse crests of the premolars, and by the stronger parastylar fold.

MEASUREMENTS.

	IND. MUS. No. C. 297.					IND. MUS. No. C. 298.			IND. MUS. No. C. 299.	
	M_3	M_2	Pm_4	Pm_3	Pm_2	Mm_4	Mm_3	Mm_2	Mm_2	Mm_1
	(inside.)									
Maximum length . . .	42(?)	47(?)	37	36	30(?)	41	38	38(?)	37	25
Maximum breadth . . .	44·5	46(?)	43	40	34(?)	37	36	32	31	16·5

Genus: ACERATHERIUM, Kaup.

Isis, p. 898, (1832).

ACERATHERIUM BUGTIENSE, Pilgrim. Plates VIII, IX and X.

1910. *Aceratherium bugtiense*, Pilgrim, Rec. Geol. Surv. Ind., XL, p. 65.

This was, evidently, the most plentiful of the rhinoceroses of the Gaj stage in the Bugti Hills. It was a species of enormous size, and will easily bear the palm for this, in competition with the rhinoceroses of the world, the only species at all approaching it in this respect being *Aceratherium perimense* Falc. of the Lower Siwaliks and *Aceratherium lydekkeri* Pilg. of the Middle Siwaliks. It is known only by the dentition. This is of an exceedingly primitive character, and can be compared with *A. platycephalum* O. and W. of the Oligocene of America and *A. filholi* Osborn of the Oligocene of Europe. It may be regarded as ancestral to *Aceratherium perimense* of the Siwalik beds in other parts of India.

Upper molars.—With strong internal as well as anterior and posterior cingula; external cingulum probably present on all the molars, but not apparent on every specimen; ectoloph rather flat, with a broad, but only slightly prominent paracone, and a very strong parastyle, separated by an exceedingly faint fold from the paracone; anticrochet well marked in all the molars; crochet absent, except for the feeblest rudiment in one unworn specimen of m_3; no crista; metaconule fold practically absent; protocone not constricted off, its internal surface flattened or with a small depression; posterior valley open and very shallow; m_3 contains a very distinct trace of a posterior pit corresponding to this valley.

Upper premolars.—Primitive in character. Most of the specimens are in an advanced stage of detrition and show a crown, either worn away to an entirely plane surface, or with united crests. One specimen, however, referred to in a preliminary notice[1] as a molar, but really a premolar, probably the 3rd, shows the disposition of the elements well. Cingulum broad and unbroken, completely surrounding the tooth, internally broadest; externally the cingula from opposite sides descend towards the summit of the ectoloph as they approach the median line and unite at a different level to the rest of the cingulum, forming a rudimentary costa, reminding one of the symmetrical ectoloph of *Hyracodon*; surface of ectoloph regularly convex, with a pronounced parastyle; tetartocone in the unworn premolar quite distinct from the protoloph and the metaloph; a weak spur shows a later connection with the short and extremely slender metaloph; in advanced wear it is united to the protoloph as well as to the metaloph. This condition of affairs exactly resembles that which obtains, according to Osborn, in *A. mite* and *A. platycephalum.*

Upper milk molars.—These are similar to the molars, but with a metaconule fold, and with less indication of a paracone fold on the ectoloph.

Remarks.—This species differs from *A. filholi* by its greater size, by the larger antecrochet on the molars and by the difference in the development of the premolars. From *A. platycephalum* it is distinguished by its larger size, by the presence of an antecrochet in m_3, by the absence of an internal cingulum in the molars and by the stronger paracone on the ectoloph. Its molars are easily separated from those of all the other Gaj Rhinoceroses by the absence of a crochet. *A. bugtiense* can be distinguished from *A. perimense* and *A. lydekkeri*, with which its size might lead it to be confounded, by the presence of a crochet in those species, the absence of an antecrochet in m_3, by the much weaker molar cingulum, the deeper postfossette, the strong paracone, the absence of a posterior pit in m_3, and the very much more advanced development of the pre molars, which hardly differ at all from the molars.

MEASUREMENTS.

	Ind. Mus. No. C. 282.	Ind. Mus. No. C. 283.	Ind. Mus. Nos. C. 287 & 279.		Ind. Mus. No. C. 281.			Ind. Mus. No. C. 287.		Ind. Mus. No. C. 288.		Ind. Mus. No. C. 286.		Ind. Mus. No. C. 284.	Ind. Mus. No. C. 285.			Mandible. Ind. Mus. No. C. 289.			
	M_3	M_3	M_2	M_1	M_1	Mm_4	Mm_3	Mm_4	Mm_3	Mm_3	Mm_2	Pm_4	Pm_3	Pm_3	Pm_3	Pm_2	Pm_1	M_3	M_2	M_1	Pm_2
Max. length	71 (inside)	74	93	90	85(?)	64		64(?)	56		42	76	75	65	63(?)	58	50	82	76		47
Max. breadth	79		88·5	81	76	60(?)	49(?)	61	52	48	40·5	88	86	74	70	64	47·5	44	43·5	39·5	33

[1] Pilgrim, Tertiary and Post-tertiary freshwater deposits of Baluchistan and Sind, *Rec. Geol. Surv. Ind.* XXXVII, p. 156, (1908).

ACERATHERIUM GAJENSE, n. sp. Plate XI, figs. 1—3.

1881. *Rhinoceros sivalensis*, Falc. and Caut. var. *gajensis* Lydekker, Siwalik Rhinocerotidae, Pal. Ind., (10), vol. II, pt. i., p. 40, Pl. VII., fig. 1, Pl. V., fig. 7.

1884. *Rhinoceros sivalensis*, Falc. and Caut. var. *gajensis* Lydekker, Additional Siwalik Perissodactyla, Pal. Ind., (10), vol. III, pt. i., p. 5, Pl. I, fig. 4.

From the Gaj series of Sind, Fedden obtained the hinder part of a young rhinoceros skull, associated with two molariform teeth. These were figured and described by Lydekker on page 40 of his "Siwalik Rhinocerotidæ." He considers that the tooth figured cannot belong to the deciduous series, because of the great development of the parastyle and of the curvature of the ectoloph. He compares it with a specimen from the Lower Siwaliks of Sind, referred by him on page 30 of the same memoir to *Rhinoceros sivalensis*. The latter specimen is considered to be a connecting link between the Gaj form and typical specimens of *Rhinoceros sivalensis* from the Middle and Upper Siwaliks. The same conclusions are again stated on page 5 of his "Additional Siwalik Perissodactyla", in which the resemblance of the Gaj tooth to molars of *Aceratherium blanfordi*, Lyd. is noticed. He designates the Gaj form as *Rhinoceros sivalensis* var. *gajensis* and the Lower Siwalik tooth as *Rhinoceros sivalensis* var. *intermedius*.

Amongst the Bugti hill material are a few specimens of the dentition of a rhinoceros, which throw considerable light on the question. The most important of these is the maxilla, figured in Pl. XI, fig. 1, containing the 1st true molar and the last two milk molars. The 3rd premolar (*in alveolo*) has been exposed by chipping away the jaw beneath the 3rd milk molar. The first point to notice is that the 2nd milk molar agrees perfectly in size and character with the Sind tooth, allowing for their different stages of wear. They both of them possess a strong anticrochet and crochet. The rudimentary crista in the Sind tooth, has vanished at the advanced stage of wear reached in the Bugti tooth, as might naturally be expected. There is no metaconule fold. Both paracone and parastyle are strong. There is a cingule in the median valley. The strong parastyle and paracone in the Sind tooth, together with the absence of a metaconule fold, and the altogether different contour of the ectoloph, which is concave, with a pronounced metastyle, prohibit its reference to the true molar series of *Teleoceras blanfordi*. It is equally distinct from the milk molars of that species, owing to the same distinctive characters. It seems needless, therefore, to search further in order to identify the Sind tooth, and we may definitely regard it as a milk molar, belonging to the same species as the Bugti maxilla.

As Lydekker has remarked, if it had not been for the existence of the Lower Siwalik tooth, the Gaj form would, without hesitation, have been referred to a distinct species from *Rhinoceros sivalensis*. The differences are, in fact, so great that it seems absolutely necessary to recognize them by establishing another species, under the name of *Aceratherium gajense*.

With regard to the Lower Siwalik tooth, it seems absurd, as it is an isolated specimen, to make a distinct species out of it, at all events, until more material is forthcoming. It only remains to decide as to the expediency of classifying it with *R. gajensis* or *R. sivalensis*. I shall be guided by the following easily distinguishable characters of the Lower Siwalik tooth, all of which are entirely absent in *R. sivalensis*.

1. An antecrochet distinct, though weaker than in *R. gajensis* type.
2. A slit-shaped post-fossette, instead of a deep pit.
3. A rounded entrance to the transverse median valley, with a small tubercle.

Since these characters are all present in *R. gajensis*, but rather more strongly marked, it seems better, for the present, to know the Lower Siwalik tooth as *Rhinoceros gajensis* var *intermedius*. It should be remarked that my former statement, as to the presence of this variety in the Gaj beds of the Bugti hills, was a mistake, based on some milk teeth, which are probably those of *R. gajensis* type.

The species is a rare one in the Gaj of the Bugti hills, as compared with the other rhinocerotidæ, the only remains, that can definitely be referred to it, being the maxilla mentioned above, an isolated 1st molar and a few isolated milk teeth. It was a very large species, ranking next in size to *Aceratherium bugtiense* and greatly exceeding *Teleoceras blanfordi*.

Description. Upper molars.—Square; with a fairly strong antecrochet; a very strong crochet; a slight metaconule fold; no crista; median transverse valley open, with a small tubercle at the entrance; cingulum strong anteriorly, internally absent or only present on the protocone; posterior valley very shallow,—more so than in *Teleoceras blanfordi*; ectoloph, with a prominent paracone and parastyle, concave behind the paracone, with a pronounced metastyle; m_3 is unknown; m_1 is a very much more elongate tooth than in *Teleoceras blanfordi*, being readily distinguishable from m_1 in that species by this character alone. The other points in which the species differs from *Teleoceras blanfordi* are by its greater size, by the strong paracone and parastyle and the different shape of the ectoloph, the shallower posterior valley, the weaker antecrochet, metaconule fold and cingule in the median valley, and the stronger crochet. *Diceratherium naricum* is a still smaller species, and its molars differ from *Aceratherium gajense* in the same points as do those of *Teleoceras blanfordi*.

Upper premolars.—The 3rd premolar, which alone is known with certainty, is quite different to the 1st molar. The transverse crests fuse with one another at an extremely early stage of wear. The paracone is well marked and the parastyle is exceedingly strong. A crochet is present, but none of the other folds are clearly seen. A very strong cingulum surrounds the tooth on every side and there is a large tubercle at the entrance to the median valley.

Upper milk molars.—These resemble the molars very closely. In the much worn two last milk teeth of the maxilla, the only differences between them and the 1st molar are the rather more open median valley and the entire absence of a metaconule fold. In one or two other isolated specimens, probably the milk

teeth of this species, which are but little worn, the metaconule fold is slightly indicated and there is a trace of a crista.

Cranium.—The very perfectly preserved occiput of the Sind form of this species has already been described and figured by Lydekker.[1] The low occiput, overhanging the condyles, and the situation of the external auditory meatus and its relation to the surrounding bones, are suggestive of a specialized member of the *Aceratherium* phyle, a conclusion, which is not contradicted by the relative dimensions, and structure of the teeth, so that the species will provisionally be referred to the genus *Aceratherium*.

MEASUREMENTS.

—	Ind. Mus. No. C. 291.				Ind. Mus. No. C. 292.	Ind. Mus. No. C. 296.	
	M_1	Mm_4	Mm_3	Pm_3	M_1	Mm_4	Mm_3
Max. length	67	56	45·5	51	69	56	47
Max. breadth	71	56	47·5	60	69·5	57	54

Genus : TELEOCERAS, Hatcher

Amer Geol., p. 149, (1894).

TELEOCERAS BLANFORDI, Lydekker. Plate VII, figs. 4—7.

1884. *Aceratherium blanfordi* var. *majus*, Lydekker, Additional Siwalik Perissodactyla, Pal. Ind., (10), vol. III, pt. 1, p. 2.

Under the name of *Aceratherium blanfordi*, Lydekker described and figured the complete upper dentition of a small Rhinoceros and the molar dentition only of a much larger one. Since the resemblance in structure between the upper molars of these two is a very close one, he naturally concluded that there were insufficient grounds for separating them specifically, and contented himself with designating them as var. *minus* and var. *majus*. Among the rich material, collected by me in the Bugti hills, occur specimens, showing the premolar dentition of Lydekker's var. *majus*. These show such decided differences from the corresponding teeth of Lydekker's var. *minus* that there is no doubt as to the specific distinctness of the two. It is also probable that, while the smaller inclined to dolichocephaly, the larger was a brachycephalic type. This brachycephaly, united to the strong constriction of the protocone, and the absence of an internal cingulum, renders it probable that it is a *Teleoceras*. This probability is strengthened by the similarity in structure to the molars of a species obtained from beds of a similar age near

[1]Lydekker, Siwalik Rhinocerotidæ, *Pal. Ind.*, (10), II, p. 40, (1881).

Fatehjang in the Punjab. This is shown, by its broad heavy palate, to have belonged to the Teleocerine phylum. It will be described, further on, under the name of *Teleoceras fatehjangense*. The dentition of both these forms reminds one strongly of that of the American species *Teleoceras fossiger*.

Since Lydekker first described the upper molars of the larger variety under the specific name of *blanfordi*, he, evidently, means these to be regarded as the type. The dentition of the Chinese variety, described by Koken and Schlosser as *A. blanfordi* var. *hipparionum*, resembles var. *majus* and not var. *minus* Therefore, by keeping the specific name of *blanfordi* for the larger species, we shall both fulfil the law of priority and avoid confusion in other ways. Accordingly, it will be better that Lydekker's smaller rhinoceros should be recognized under a new specific name, for which I propose *naricum*. In this memoir, further remarks on this species will be found under the head of *Diceratherium naricum*, as there seem some grounds for thinking that it belongs to that genus.

The material, belonging to this species, is fairly abundant in the Bugti hills. The milk molars, figured in Pl. VII, fig. 6, were found associated with numerous remains of *T. blanfordi*, and there is no reasonable doubt that they belong to that species. A fine specimen of pm_3 has been developed out of its alveolus beneath mm_3 in the young maxilla just mentioned. Several specimens of pm_4 exist, both separately, as well as united with the succeeding molars.

Description. Upper molars.—The upper molars of this species have been figured and fully described by Lydekker. In structure, there is remarkably little difference between them and those of *Diceratherium naricum*. They are, however, very distinctly shorter teeth. The transverse valley is blocked by a very much more pronounced antecrochet, which becomes united to the crochet, enclosing a medifossette, in an only moderately advanced stage of wear.

Upper premolars.—These differ, much more than the molars, from the corresponding teeth of *D. naricum*. They form an altogether shorter series. In pm_3, the transverse crests are quite completely formed, and do not fuse with one another until an extremely advanced stage of wear. In pm_4, the union of the crests takes place very much earlier. Consequently, pm_3 is the most developed tooth of the premolar series, the order of development being just the reverse of that which obtains in *Diceratherium naricum*. On the whole, however, they are more like the molars than is the case in the latter species. A crochet and a small crista are present in pm_3, but the antecrochet is much weaker than in the molars ; no metaconule fold ; a distinctly marked parastyle and paracone, rather stronger than they are in *D. naricum* ; a strong anterior cingulum ; no inner cingulum, but a strong cingule at the entrance to the transverse valley, attached chiefly to the metaloph.

Upper milk molars.—A young maxilla, containing the milk dentition, is figured in Pl. VII, fig. 6. The milk teeth differ from the permanent molars by their more open valleys, and by the weaker development of antecrochet, metaconule fold and cingule at the entrance of the transverse valley. Their smaller size, the presence of

the metaconule fold, the stronger cingule, and the entire absence of a crista distinguish them from the corresponding teeth of *Aceratherium gajense*. The most characteristic tooth of the series is mm_2, which is remarkably short, thus differing in the most striking fashion from the corresponding tooth in all the other rhinoceroses met with in India, and also in the genus *Aceratherium*.

MEASUREMENTS.

	Ind. Mus. No. C. 266.			Ind. Mus. No. C. 293.					Ind. Mus. No. C. 311.	Ind. Mus. No. C. 295.
	M_3	M_2	M_1	Mm_4	Mm_3	Mm_2	Mm_1	Pm_3	P_4	Pm_3
Max. length	(inside.) 50(?)	51·5	39	47(?)	42	36(?)	32(?)	41	46	41
Max. breadth	56	63	58(?)	49(?)	43	39	21(?)	47	57	54

TELEOCERAS FATEHJANGENSE, Pilgrim. Plate XI, fig. 4.

1910. *Teleoceras fatehjangensis*, Pilgrim, Rec. Geol. Surv. Ind., XL, p. 66.

This species is founded on a palate, containing the first two molars and the last premolar on either side, which was obtained by Mr. E. Chisholm from the so-called Kuldana series near Fatehjang in the Punjab. These beds are essentially of the same age as the Gaj series of the Bugti hills.

Description. Upper molars.—The molars show practically no differences, in their general structure, from those of *T. blanfordi*. A strongly constricted protocone; strong crochet, ante crochet and metaconule fold; slit-shaped post-fossette; medi-fossette produced, in advanced wear, by the union of crochet and antecrochet; cingulum absent internally. They are broader than in *T. blanfordi* and, apparently, there is no cingule in the median valley. Paraconal and parastylar folds are both somewhat stronger than is the case in the Bugti species.

Upper premolars.—These are also similar, in general structure, to those of *T. blanfordi*. There is a similarly situated cingule, attached mainly to the metaloph. The transverse crests fuse earlier than in the Bugti species. It is, however, the appearance of the ectoloph which mainly differentiates these teeth from those of *T. blanfordi*. On it, is an equally strong metaconal and paraconal fold, whereas in the Bugti premolars there is no trace of a metaconal fold.

Remarks.—The broad palate and short broad teeth, united with the characteristic structure of the molars, makes it highly probable that this form belongs to the brachycephalic genus *Teleoceras*. This conclusion supports the view that the closely allied species *T. blanfordi* must also be assigned to the same genus.

MEASUREMENTS.

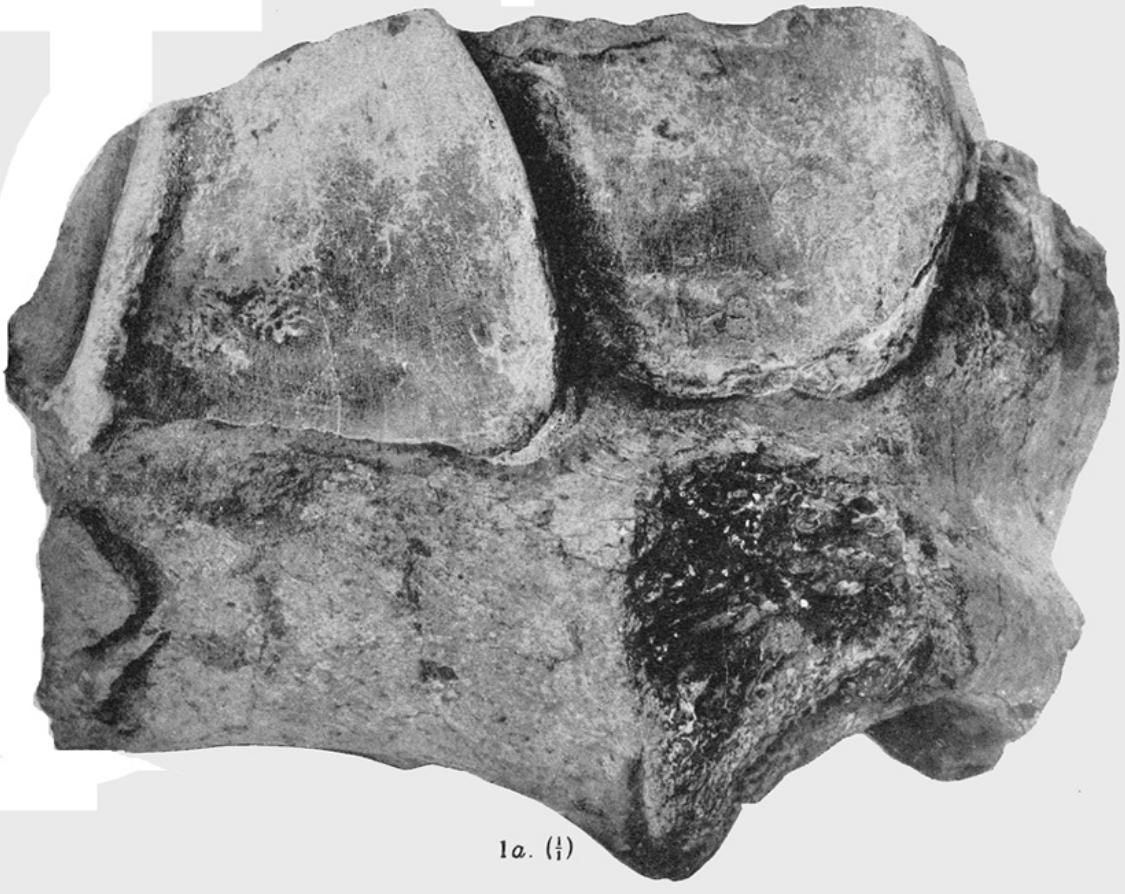
	M_2	M_1	Pm_4
Length	63	48	44·5
Breadth	74	60	61
Breadth of palate between 2nd molars		about 76.	

PLATE V.

Fig. 1, 1*a*. CADURCOTHERIUM INDICUM, Pilg. Left maxilla with three molars and the last premolar. 1, surface view, 1*a*, external view. From the base of the Gaj near Khajuri, Bugti Hills. (Ind. Mus., No. C 300.) Page 22

All figures natural size.

1. ($\frac{1}{1}$)



1*a*. ($\frac{1}{1}$)

PLATE VI.

Fig. 1, 1*a*. CADURCOTHERIUM INDICUM, Pilg. Right mandibular ramus with three molars. 1, external view, $\frac{2}{3}$ natural size, 1*a*, surface view. From the Gaj of the Bugti Hills. (Ind. Mus., No. C 301.) Page 23.

All figures natural size except where otherwise indicated.

1. ($\frac{2}{3}$)

1*a*. ($\frac{1}{1}$)