

III. DESCRIPTION  
OF  
SOME FOSSIL REMAINS  
OF  
DINOTHERIUM, GIRAFFE, AND OTHER MAMMALIA,  
FROM THE GULF OF CAMBAY, WESTERN COAST OF INDIA,  
CHIEFLY FROM THE COLLECTION PRESENTED BY  
CAPTAIN FULLJAMES, OF THE BOMBAY ENGINEERS,  
TO THE MUSEUM OF THE GEOLOGICAL SOCIETY,  
BY  
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DURING the late meeting of the British Association, at Cambridge, I made a communication † to the Geological section on some new additions to the Fossil Fauna of India, from Perim Island, in the Gulf of Cambay. Among these were mentioned a species of *Dinotherium*, *Giraffe*, and a new Ruminant genus of a size nearly equalling the *Sivatherium*, found associated with remains of *Mastodon*, *Elephant*, *Rhinoceros*, *Hippopotamus*, and several species of Ruminants. The occurrence of *Dinotherium* in the extinct Fauna of India, is a point of such interest, that no delay ought to take place in laying before palæontologists the evidence upon which the statement is founded; and as the Geological Society possesses the largest collection of Perim Island fossils to which I have had access, including remains of most of the species to be noticed in the sequel, the pages of its journal are the fittest place for this communication, the main object, indeed, of which is to do justice to the meritorious labours of Captain

\* NOTE BY THE PRESIDENT. — The following letter with reference to the subject of this Memoir has been received from Dr. Falconer: —

To the President of the Geological Society.

SIR,

HAVING had occasion to examine the Indian fossils in the Museum of the Geological Society with reference to the work on which I am at present engaged on the extinct Fauna of Northern India, and having found in the collection of fossil bones from Perim Island, presented to the Society in 1840, by Captain Fulljames, several remains of the highest interest which have not yet been described, I have in compliance with your desire made a brief description of them which I have now the satisfaction of forwarding.

I have the honour to be, Sir, your most obedient Servant,  
London, July, 1845. H. FALCONER.

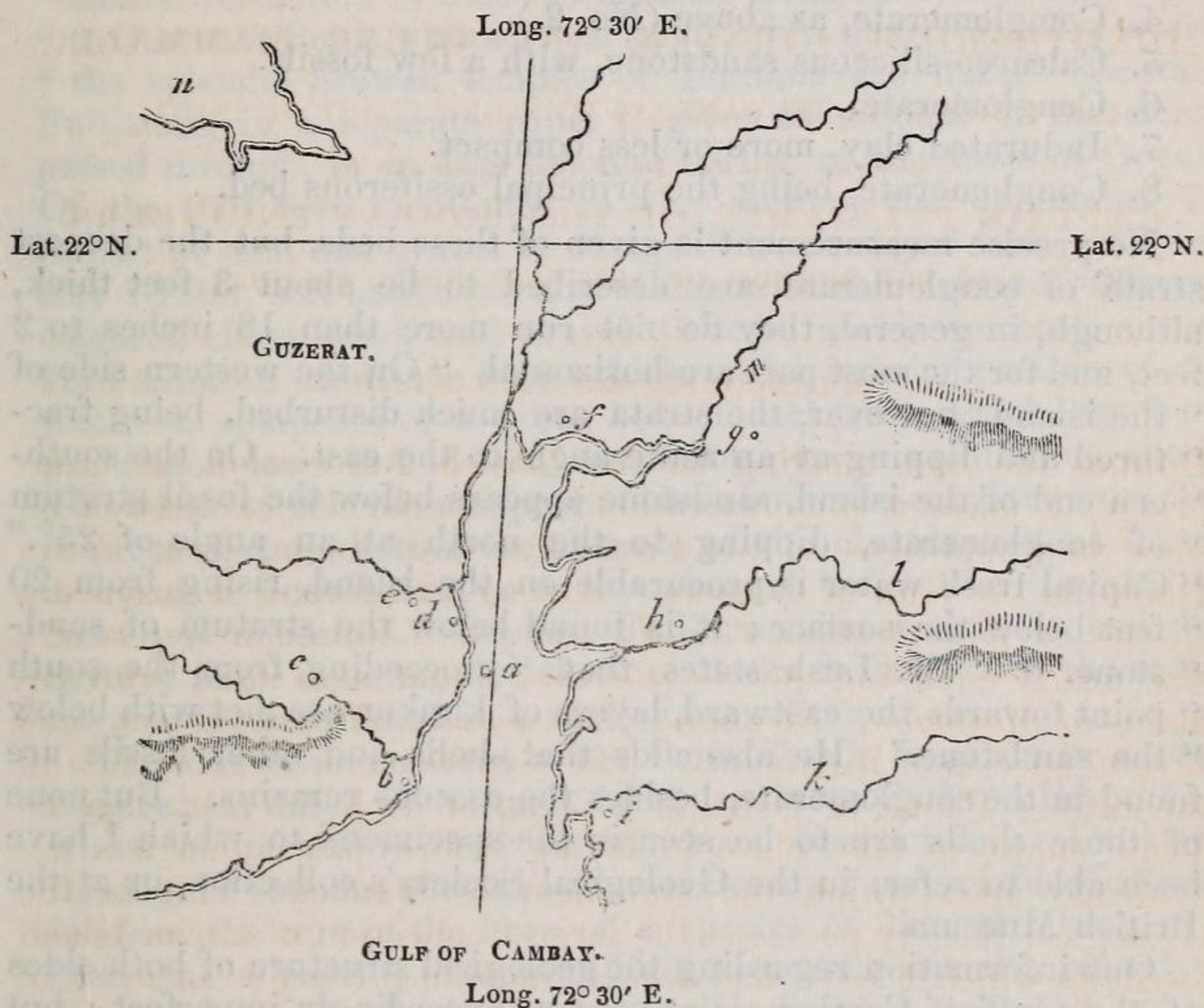
The collection of fossil bones presented to the Geological Society by Captain Fulljames not having been accompanied by any memoir, and no description of it having yet been given in the publications of the Society, the President and Council have not hesitated to deviate from their usual course with regard to the publication of memoirs, and have directed the insertion of Dr. Falconer's communication in the present number of the Journal of the Society.

† This communication was read on Tuesday, 24th June.



Fulljames, of the Bombay Engineers, one of the earliest and most successful explorers of the ossiferous beds of Perim Island. This is the more called for, as considerable delay has occurred in the description and determination of the remains which that officer collected and transmitted to England several years ago.

Perim \* is a small island, situated in lat.  $21^{\circ} 31'$ , in the Gulf of



MAP of the District near PERIM ISLAND. *References.*

- |                  |                |                   |
|------------------|----------------|-------------------|
| a. Perim Island. | e. Bhownuggur. | i. Surat.         |
| b. Gopenaut.     | f. Cambay.     | k. Tapy River.    |
| c. Politana.     | g. Baroda.     | l. Nerbudda R.    |
| d. Gogah.        | h. Baroche.    | m. Mhye R.        |
|                  |                | n. Gulf of Gutch. |

*Note.* Between the Nerbudda and Tapy rivers is the river Keem, the mouth of which is seen, but whose course is not indicated on the map.

Cambay, nearly opposite the estuary of the Nerbudda River, and separated about 500 yards from the coast of Kattiwar in Guzerat, by a channel which Captain Fulljames states to be 75 fathoms deep. The island is about three miles in circumference, being from one and a half to two miles in length, and in breadth one half to three-quarters of a mile. The only particulars regarding its structure, with which I am acquainted, have been given by Captain Fulljames and Dr. Lush.† The highest point of the land is said to be not more than 60 feet above high-water mark. The western side presents cliffs of conglomerate, of about 30 feet above the sea, "the upper strata

\* Captain Fulljames, Journ. Asiat. Soc. of Beng., vol. v. p. 289.

† *Loc. citat.* Lush, idem. vol. v. p. 767.



being of compact sandstone, all perfectly horizontal."\* Captain Fulljames describes the order of succession, commencing from the surface, as thus:—

1. Loose sand and gravel.
2. Conglomerate, composed of sandstone, clay, and silex.
3. Yellow and whitish clay, with nodules of sandstone.
4. Conglomerate, as above (No. 2.).
5. Calcareo-siliceous sandstone, with a few fossils.
6. Conglomerate.
7. Indurated clay, more or less compact.
8. Conglomerate, being the principal ossiferous bed.

No precise measurement is given of these beds, but the deepest strata of conglomerate are described to be about 3 feet thick, although, in general, they do not run more than 18 inches to 2 feet, and for the most part are horizontal. "On the western side of the island, however, the strata are much disturbed, being fractured and dipping at an acute angle to the east. On the southern end of the island, sandstone appears below the fossil stratum of conglomerate, dipping to the north at an angle of 25°." "Capital fresh water is procurable on the island, rising from 20 feet below the surface; it is found below the stratum of sandstone."\* Dr. Lush states that "proceeding from the south point towards the eastward, layers of kunkur are met with below the sandstone." He also adds that shells and other fossils are found in the conglomerate, besides the osseous remains. But none of those shells are to be seen in the specimens to which I have been able to refer, in the Geological Society's collection, or at the British Museum.

Our information regarding the geological structure of both sides of the Gulf of Cambay, is at present exceedingly imperfect; but much may be expected when the unpublished researches of the lamented Malcolmson are brought out, as he is known to have carefully determined the succession and age of the tertiary beds along the coast of the Northern Concan. In regard to what is known, Dr. Lush describes the sandstone of Bombay as appearing at Mahim, Seergaum, and Danù, in horizontal strata, and "evidently above the trap." At Gundavie, the shell sandstone disappears, and beds of clay and kunkur present themselves in the line of section from Gundavie to Surat. From this point to the Keem River, nothing is seen but the "black cotton soil;" on the right bank of the Keem, sandstone and conglomerate are exposed, according to Dr. Lush, in the following order:—

*Section on the Right Bank of the Keem.*

- |  |   |   |         |
|--|---|---|---------|
| 1. Alluvial soil with masses of conglomerate   | - | - | 6 feet. |
| 2. Horizontal beds of sandstone in thin layers | - | - | 3 feet. |
| 3. Sandstone                                   | - | - | 5 feet. |
| 4. Coarse conglomerate (bed of the river).     |   |   |         |

Respecting the Kattiwar coast, nearest which Perim Island is

\* Lush, *loc citat.*

† Fulljames, *loc. citat.*



placed, Dr. Lush mentions the conglomerate as reappearing at Gogah, close to the island, where masses of the rock containing shells are dug out of the beach. This conglomerate appeared to him to contain no fragments of trap, although the central ridge of Kattiwar, including the hill of Politana, is composed of trap, which is also seen at Bhowuggur.\* Captain Fulljames states that he has found “a similar formation to that of Perim all along the coast from Gogah to Gossnath Point, where a firm sandstone is quarried, and of which the splendid Sráwak temples of Politana are built.” Captain Fulljames, in a separate paper †, gives an account of the strata passed through, in an experimental boring at the town of Gogah. Of the 320 feet mentioned in the section, the uppermost 74 consist of sand and gravel 11 feet, stiff black clay 6 feet, sand and clay 10 feet, soft sandstone alternating with thin seams of different coloured clays, sand, and gravel 13 feet; and lowermost, a very hard siliceous sandstone 9 feet thick. The inferior portion of the section is composed of a great bed of dark clay, which has been penetrated down to 246 feet, containing pyrites and broken shells. The whole of this mass appears to be above the conglomerate, but it is not shown whether the absence of the clay deposit at Perim is owing to denudation, or to its upheaval before the clay on the coast was deposited. Captain Fulljames states that he had discovered fossil remains, like those of Perim Island, down the coasts towards Gossnath, and in a similar formation.

The first announcement of the Perim fossils is given in a communication, dated 17th April, 1836, by Baron Carl von Hügel ‡, in which he mentions their having been discovered by Dr. Lush. Among the remains which he enumerates are, bones of the *Mastodon latidens*, the core of the horn of a species of *Bos*, the head of a boar, and a rodent. Captain Fulljames concedes the priority of discovery to Dr. Lush; but immediately after followed up the inquiry by more extended researches, commencing in April of the same year; and it is to him that we are indebted for the greater part of the Perim fossils, which are to be found in the museum of the Asiatic Societies of Calcutta and Bombay, and of the Geological Society of London. Among those which he first met with, he mentions “teeth of *Mammoth*, *Mastodon*, *Palæotherium*, *Hippopotamus*, *Rhinoceros*, and a number of other smaller animals; elephant’s tusks; the head of some large saurian animal; tortoise; one-half of a deer’s foot; and a shell in siliceous sandstone.” In the collection which Captain Fulljames sent to the Asiatic Society of Calcutta, Mr. James Prinsep § enumerates “many jaws of the *Mastodon* in fine preservation; also teeth or jaws of the *Hippopotamus*, *Elephant*, *Rhinoceros*, a large animal assimilating thereto (*Lophiodon?*), *Sus*, *Anthracotherium* (?),

\* Dr. Malcolmson however (vide post p. 367.) mentions the occurrence of trap pebbles in these same tertiary beds.

† Jour. Asiat. Soc. of Beng., vol. vi. p. 787.

‡ Ib., vol. v. p. 288. (May, 1836.)

§ Loc. citat., vol. v. p. 290.



“ *Deer, Ox*, many vertebræ and unidentified bones and horns ; tortoise fragments, and a peculiarly perfect Saurian head.”\* These identifications are not to be considered, in several of the instances, as more than approximative ; for neither of these gentlemen profess to be familiar with the subject of fossil bones.

No further account of these remains has appeared in any of the Indian journals since that time. In 1840, Captain Fulljames sent his donation to the Geological Society, and about the same time some specimens from the same locality were presented by Miss Pepper to the British Museum.

Judging from the matrix which adheres to them, the Perim fossils seem to be imbedded, in most cases, in a calcareo-ferruginous conglomerate, composed of nodules of indurated yellow clay, cemented together by a paste of sand and clay. Some of them are attached to patches of a hard argillaceous sandstone. Many of them have had the matrix washed off by the action of the sea, and are in this case generally covered over with the remains of small species of *serpula* and other recent marine shells. The mineral character of the bones shows that they are penetrated with siliceous infiltration, like a great portion of the Sewalik fossils ; and in consequence they present a great degree of hardness. The same character holds in many of the osseous remains from the crag ; like the latter, the Perim bones, under the action of the sea, wear down into a polished vitreous surface.

DINOTHERIUM. See Pl. 14. fig. 1. 1a.

The first of these remains to be noticed is a fragment (figs. 1. and 1a.) consisting of the posterior half of one of the inferior molars of a species of *Dinotherium*. The correspondence of the specimen with the teeth of the large European species is so complete in the form of the gable-shaped grinding ridge, its transverse direction, and the reflected marginal bulges into which it swells out on either side, together with the characteristic crenulation of the edge, that there can be no doubt of its belonging to the genus *Dinotherium*. The peculiar “talon” or heel ridge is developed in the same degree and with a like amount of crenulation along its edge. The fragment is represented in section in fig. 1a., the internal structure exhibiting the same agreement with that of the European *Dinotherium* indicated by the external form. The centre is occupied by a rhomboidal core of arenaceous matrix marking the form of the unossified pulp nucleus. I have compared it minutely with a corresponding section of the same tooth (the penultimate of the lower jaw) of *Dinotherium giganteum* (figs 2. and 2a.) from Eppelsheim ; and the only perceptible difference is, that the angle formed by the ridge of the ivory is more acute, and the enamel thicker in the Indian than in the European form. Perhaps no conclusion can be safely drawn from this observed difference of angle in the ivory ridge ; as it may be a peculiarity of the individual. The greater thickness of enamel is probably of more importance, and may represent a mark of

\* Jour. Asiat. Soc. of Beng. vol. vi. 78. (January, 1837.)



specific distinction. The specimen, however, is much too defective to warrant any opinion in regard to the relations of the Perim fossil to the European species, except that it was quite as large as the *D. giganteum*. We are fortunately able to determine the position of the tooth in the jaw with some confidence. The upper grinders in *Dinotherium* have a long low basal ridge in front and behind; while the same teeth in the lower jaw have hardly any ridge in front, and the hind one is considerably more developed than in the upper grinders, so as to form a strongly marked "talon" or heel. The Perim fossil exhibits this heel of large size, while the presence of an impression on the posterior surface proves that there was a tooth behind it. It, therefore, belonged to the penultimate molar of the lower jaw, and apparently to the left side.

In short, there can hardly be a doubt about the specimen belonging to a species of *Dinotherium*. The only question which can arise is in regard to the correctness of the locality whence the specimen is said to have come. It was presented to the British Museum by the lady whose name is mentioned above, as a Perim Island fossil, along with teeth specimens of a species of mastodon known to be found in the Perim deposit. M. König, the eminent conservator of the Palæontological department, who had early recognised the generic relations of the fossil, is confident about the donor and the mentioned locality. An additional confirmation is met with in the mineral condition of the specimen. It exhibits the silicified appearance, which is so prevalent in the Ava, the Sewalik, and Indian fossils generally. The ivory core is fissured into a vast number of radiating minute segments which have been re-cemented by a siliceous paste (as has happened to certain agates), and the whole of the structure, — enamel and ivory, — has become so thoroughly penetrated with siliceous infiltration, that it resists the knife and takes on the highest degree of vitreous polish in the section, while the external surface of the enamel, from the same cause, presents an opaline appearance. All the Eppelsheim specimens of *Dinotherium*, which I have had an opportunity of examining, are, on the other hand, unsilicified, softer, and of less specific gravity. In section their ivory cuts under the knife, and yields a dull earthy surface; while the harder enamel takes on but a very imperfect polish. This circumstance strongly confirms the Indian origin of the fossil. It is very possible that the large animal — "assimilating to the rhinoceros (*Lophiodon?*)" — mentioned by Mr. James Prinsep in the quotation above given, may also belong to *Dinotherium*. This conjecture is thrown out for the guidance of those connected with the museum at Bombay and that at Calcutta, who have access to the original specimens. What we know at present must serve in a great measure as an index merely to further inquiries. I would suggest in the meantime designating the Perim fossil provisionally, by the specific name of *Dinotherium Indicum*.

The following are the dimensions of the fragment compared with those of the same tooth of the *Dinotherium giganteum* from Eppelsheim.



	Perim Fossil.	Eppelsheim Specimen.
	inc.	inc.
Length of penultimate molar lower jaw - -	- -	3·75
Width of ditto at the posterior ridge - -	3·1	2·75
Length in section of the posterior ridge of ivory at base - - - - -	1·5	1·75
Height of ditto - - - - -	·63	·63
Thickness of the enamel - - - - -	·25	·19

The fossil is represented in the figures of the natural size.

GIRAFFE (*Camelopardalis*). Pl. 14. fig. 5.

This figure represents a fragment comprising the posterior half of the second cervical vertebra of a giraffe, a good deal mutilated. It shows the characteristic form of the body of the vertebra in this genus, and the cup-shaped articulating surface for the head of the third cervical vertebra. The upper half is wanting, and the posterior oblique processes are broken off. Along the middle of the body, there is a well-marked longitudinal ridge, corresponding exactly in form and development to that mentioned as characterising the third cervical vertebra of the *Camelopardalis Sivalensis* described in the Proceedings of the Geological Soc. (vol. iv. p. 242.); the same remark applies to the lateral ridges of the body, which are decurrent from the inferior transverse processes terminating at the posterior end of the bone in thick expansions. This part of the vertebra is differently formed in both respects in the existing species. The same resemblance is further shown by the spinous process, the projecting part of which, as in the Sewalik specimen, is placed lower down on the arch than in the living species. The mutilated condition of the fragment prevents the form of this process from being well ascertained; but the very low position and shape of the most salient part determines the vertebra to have belonged to the second of the neck series. There is enough remaining to indicate that there was a like correspondence with the Sewalik fossil in the curve of the body on its under surface, which is more arched than in existing giraffes. The specimen is so weathered and abraded as to present only few points for measurement; but such as may be taken indicate the closest agreement between the fossils:

	Perim Island Fossil.	Sewalik Fossil.
	inc.	inc.
Greatest width at the posterior end of the body between the transverse processes - -	3·1	3·1
Vertical diameter of articulating cup - -	2·1	2·
Transverse diameter of ditto - - -	2·1	2·



The Perim fossil, like the Sewalik one, is proved to have belonged to an adult and even aged animal, by the marked relief of the ridges, the depth of the muscular depressions, and especially by the circumstance that the posterior articulating surface is completely synostosed with the body of the bone, which is not the case in young animals. With this united correspondence in form, size, and other particulars, I have little hesitation in referring the Perim Island fossil to the second cervical vertebra of the *Camelopardalis Sivalensis*. This specimen is from the collection sent by Captain Fulljames to the Geological Society.

BRAMATHERIUM. Pl. 14. fig. 3., 3a., 4a., 4.

The next of these remains to be noticed are of great interest, as they appear to indicate a large and peculiar form of Ruminants, nearly equalling the *Sivatherium* in size, but at the same time essentially different. The remains consist of two fragments of the left side of the upper jaw, including the entire series of the superior grinders. Although, probably of the same species, they are certainly not derived from the same individual. The first fragment (fig. 3.) is from the collection sent by Captain Fulljames to the Geological Society. It contains the three false or premolars nearly perfect, together with the broken remains of the first true molar. The surface of the enamel (fig. 3a.) shows the rugosely furrowed character, which is found in the *Sivatherium*; but the whole of the teeth in the fossil are at once distinguished from those of that genus, by the absence from all of them of the sinuous plaited flexures, which the inner crescent of enamel presents in it: they also want the basal collar or "burr" on the inside, which is seen in those of *Sivatherium*. With these discrepancies, which are of considerable importance in the Ruminantia, from the constancy of such modifications in the different groups of this order, the premolars of the fossil correspond in general form, and in the relative proportion of width to length with those of *Sivatherium*. The only other genus of Ruminants which shows the peculiar rugose enamel furrowing, in a marked degree, is the giraffe, which agrees with the Perim fossil in the simple direction without fold, of the inner crescent of enamel. But, in this genus, the upper premolars are distinguished from those of all other Ruminants by their great excess of width compared with their length. In this respect, and further in being considerably more oblique, both in form and in their relative position in the jaw, these teeth in the Perim fossil differ from those of the giraffe. The dimensions of the fossil contrasted with those of the *Sivatherium giganteum*, and of the skull of an adult male giraffe in the collection of the College of Surgeons, are as follow:—



	Perim Fossil. No. 1.	Sivathe- rium giganteum.	Male Giraffe.
	inc.	inc.	inc.
Length of the three premolars - -	4	4.5	2.9
Length of the 1st premolar - - -	1.5	1.75	.9
Width of the 1st — - - -	1.3	1.63	1.1
Length of the 2d — - - -	1.4	1.5	1.
Width of the 2d — - - -	1.5	1.75	1.1
Length of the 3d — - - -	1.25	1.75	1.
Width of the 3d — - - -	- -	1.9	1.2
Length of the 1st or antepenultimate true molar	1.6	1.6	1.33

The second specimen (fig. 4. and 4a.), (for an examination of which I am indebted to the kindness of Major Jervis, of the Bombay Engineers,) is also from Perim Island, and shows the hindmost premolar, together with the three back or true molars nearly perfect. Like the premolar of the other specimen, these teeth, besides being smaller, differ from their equivalents in *Sivatherium giganteum*, by the absence of the flexuous direction of the enamel, and of the basal ridge at the inside. In these particulars, and also in the presence of a minute or rudimentary cone of enamel on the inner side at the base, between the barrel divisions of the teeth, but attached only to the posterior lobe, they correspond with the other molars of the giraffe. But the anterior pillar of enamel, on the outer surface of the front half of these teeth, is considerably thicker in proportion in the fossil than in the giraffe; while the outer surface of the posterior half is more expanded in length, and is more hollow than in the latter genus. A still more important difference is, that in the fossil there is no tendency to a basal mammilla or enamel lobe at the outside between the barrel divisions of the two backmost molars as in the larger fossil giraffe of India (Geol. Proceed. *antè cit.* pl. ii. figs. 3., 3a., and 4.); while the middle of each of these divisions at the inner side is so compressed vertically, as almost to present an obsolete or indistinct form of keel. The following are the comparative dimensions as in the case of the previous specimen.

	Perim Fossil. No. 2.	Sivather. Gigant.	Male Giraffe.
	inc.	inc.	inc.
Length of the series of three back molars -	4.63	5	3.9
Length of the 1st — - - -	1.6	1.63	1.33
Width of the 1st — - - -	1.75	2.	1.97
Length of the 2d — - - -	1.75	2.	1.37
Width of the 2d — - - -	1.9	2.	1.37
Length of the 3d — - - -	1.6	2.	1.37
Width of the 3d — - - -	- -	1.75	1.37

It is not necessary to follow up the comparison of the fossil teeth with those of the *Bovidaë*, *Cervidaë*, and other families of the



order, from all of which they appear to be more removed than from the *Sivatherium* and *Giraffe*. The molars of the Ruminantia generally are formed so much upon the same plan, that it is not easy to draw sufficient generic distinctions from them alone. The characters presented by these Perim fossils, so far as they go, certainly distinguish them from the *Sivatherium*, and also from the giraffes, fossil and recent, but their nearest affinity appears to be with the latter genus: and they probably belong to the same family. The materials presented here, as in the case of the *Dinotherium*, are much too scanty at present for any conclusive opinion on the subject. Meanwhile, under the conviction of the generic distinctness of the Perim Ruminant, I propose considering it as a genus under the name of *Bramatherium*\*, with the specific title of *B. Perimense*, to mark the rich and interesting fossil locality where it was found.

The *Dinotherium*, Giraffe, and *Bramatherium* are the only Perim fossils which it is intended to particularise by description in this communication. But Captain Fulljames's collection includes specimens of a great many other forms, which prove that the clay conglomerates of the Gulf of Cambay contain entombed in them the remains of a very extensive and varied fauna. Among them there occurs one species of Mastodon, one of Elephant, a large species of Rhinoceros, Hippopotamus, Sus, Equus, several species of Antelope, Bos, two species of Crocodile, one of which is of the Gavial type; several forms of fresh-water Tortoises, with fish vertebræ two and a half to three inches in diameter. These will be noticed in detail, in the work upon which Captain Cautley and myself are engaged, on the fossil fauna of the Sewalik Hills. The principal point of interest about them, requiring mention on this occasion, is, that the mass of the Perim fossils belong to the same genera and species which are found in the Sewalik Hills, and in the ossiferous beds of the Irawaddi in Ava. We have thus conclusive proof that, in the later tertiary period, as at present, one and the same vertebrate fauna ranged from the banks of the Irawaddi, on the eastern side of the Bay of Bengal, 1700 miles up along the foot of the Himalayahs, to the Indus, where it escapes from these mountains, and thence across the continent to the western side of India. We are now getting the first glimpse of the evidence, regarding the range and distribution of the species. Some, as at present, were common over the whole extent of country, while others appear to have been limited to, or had their force of development in a particular tract. The prevailing species of Mastodon from Perim is identical with one of the forms described by Mr. Clift, under the name of *M. latiaens*, in his excellent memoir in the Geol. Transact., 2d. Ser. vol. ii.

\* The name *Sivatherium*, derived from the Hindoo God *Siva*, having been admitted for one great fossil Ruminant from India, *Bramatherium*, derived from the God *Bramah*, may conveniently be applied to another: the ordinal relationship of the two will thus be easily remembered, together with their common Indian origin.



p. 371., this nominal species appearing to include two very distinct forms. One of these (Mr. Clift's, pl. 37. figs. 1—4) seems to have been common on the western side of India, and in Ava, while it is but rarely found in the Sewalik Hills. The Perim *Sus* is identical with a Sewalik species (*Sus Hysudricus* Fal. and Caut.); and a like agreement has been noticed as holding with one species of Giraffe. The Dinotherium and Bramatherium have not yet been observed amidst the fossils of the Sewalik Hills, while the gigantic tortoise (*Colossochelys Atlas*) ranged from the Sewalik Hills to the Irawaddi.\* The Hexaprotodon form of Hippopotamus occurs in Perim Island, Ava, the valley of the Nerbudda River, and the Sewalik Hills.

I have had occasion, in more than one instance, in joint communications with Captain Cautley to the Geological Society, to refer to the singular richness of the ancient Fauna of India, in mammiferous forms. As a general expression of the leading features, it may be stated that it appears to have been composed of representative forms of all ages, from the oldest of the tertiary period down to the modern, and of all the geographical divisions of the old continent grouped together into one comprehensive fauna, in the countries along the valley of the Ganges. The Dinotherium of the miocene period of Europe was, till now, a notable exception; but the fossil described in the preceding pages shows that ancient India was not without a representative of this most remarkable genus. In addition to most of the known types of Ruminants, we have now evidence that the same country had, in the Sivatherium and Bramatherium, at least two colossal forms of this order.

In regard to the precise determination of the age of the ossiferous deposits of India, the problem still remains to be solved. The western coast of the peninsula will, in all probability, furnish the most certain and numerous data for its solution; as we may expect there to find deposits and organic contents corresponding to the numerous alternations of upheavement and submergence which the land on that side of the continent has undergone. Fossil remains of Elephant, Hippopotamus, Equus, &c., were discovered by Dr. Spilsbury †, in the valley of the Nerbudda, near Jabalpur, in a bed of limestone capped by a thick mass of basalt, and traces of mammiferous remains have been found in other parts of the basaltic district of Central India. Extensive lacustrine deposits disrupted and altered by the same igneous rock have been met with over a wide extent of the Deccan, containing the same species of *Paludina*, *Physa*, *Limnea*, *Unio*, and *Cypris*. ‡

Reasoning from these facts, Dr. Malcolmson was led to the inference "that the part of the Vindhya range near Mandoo was

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\* There are fragments of this great Chelonian among the fossils brought by Mr. Crawford from Ava.

† Jour. Asiat. Soc. of Bengal, vol. ii. p. 583.

‡ Malcolmson, Geol. Trans. series 2. vol. v. p. 570.



“elevated during the same comparatively recent epoch as the Sichel Hills, between the Godavery and Taptee, the Gawulgurh range, and the Satpoora mountains, south of the Nerbudda.” He adds also the following startling generalization: “Over all these tracts then I am justified in believing that at one time extensive lakes and marshy plains existed, full of the ordinary forms of lacustrine life. The precipitous and thirsty mountain ranges which intersect India, and which now rise bare and burnt up in inaccessible cliffs, which for months of every year hardly afford water for the birds of the air, must then have exhibited vast plains, full of fresh-water lakes and marshes, on the muddy shores of which multitudes of gavials, crocodiles, and tortoises must have preyed; and amidst the rank luxuriance of the bordering vegetation the *Mastodons*, *Hippopotami*, *Bisons*, and *Sivatheria*, must have ranged, whose bones are now found so abundantly scattered over India.”\* Unfortunately, this excellent observer’s researches on the Gulf of Cambay have never been published; but in a note appended to the paper quoted above, he mentions the occurrence of trap pebbles in the tertiary sandstones of Perim Island and Kattiwar, (see *antè*, p. 359.) and in the cornelian conglomerates of Rajpeepla and Broach, which are said to be remarkably altered by the intrusion of igneous rocks of a late date.

*Supplementary Observations.* Since the preceding remarks were in type, I have had occasion to examine some other Perim Island fossils presented to the British Museum by Miss Pepper: one of which has furnished additional and most unequivocal evidence of a huge Indian species of *Dinotherium*. The specimen is a superb fragment of the left half of the lower jaw, containing nearly the whole of the adult series of five molars in situ. The contour of the body of the jaw is shown in the most perfect state of preservation, the fossil having fortunately been mineralised by means of a very hard siliceo-ferruginous infiltration. But it has evidently been long rolled about on the sea-beach as a boulder, so that the crowns of the whole series of molars have been hammered off nearly level with the alveolar margin of the jaw; the surface of the fossil is jet black, and almost all of the matrix has been cleared away, probably by the long-continued action of the sea, which has given it a semi-vitreous polish. That it had latterly been in the sea is distinctly proved by adherent patches of recent marine shells identical with those found on others of the Perim fossils: and the testaceous remains being white, pearly, and fresh-looking, are seen in marked relief upon the black surface of the fossil. The symphysis of the jaw is broken off about  $2\frac{1}{2}$  inches in front of the anterior premolar, and the bone is truncated behind exactly opposite the point where the coronoid margin of the ramus begins to rise up, the

\* Malcolmson, *Journal Bombay Geograph. Society*, vol. for 1841—1844, p. 371.



fracture passing through the middle of the last molar, the anterior ridge of which is visible in situ in the jaw.

The dimensions given below will indicate most distinctly the characters by which this fossil differs from the jaw of the *D. giganteum* of Kaup. In relative length, the two agree very closely, the four anterior molars measuring but half an inch more in the Indian than in the European species. But the other proportions are very different. The depth of the jaw measured to the alveolar margin of the second premolar, where the deflexion of the symphysis begins alike in both, is 9.2 inches in the former, while it is but 6.9 in the latter, and at the back of the third tooth or first true molar, 8.7 inches to 6.2 inches. The Perim fossil exhibits a like excess of dimensions in relative thickness, the jaw measuring 5.1 inches in diameter under the second premolar, and 6.4 inches at the middle of the penultimate molar, while in the European species the corresponding dimensions are respectively 4 and 5 inches. In consequence of this great depth and thickness, the jaw of the Indian fossil approaches very closely the massive and turgid form seen in the typical mastodons, such as the *M. giganteus*; while that of the European *Dinotherium* is comparatively much thinner and more compressed. The inner side of the jaw in the latter is very flat, differing in this respect widely from the mastodons generally: in the Perim fossil this flatness is much less, not exceeding that of the *Mastodon giganteus*, and behind the body of the jaw bulges out on either side, so as to yield nearly a circular outline in section, and exactly to represent the form in the American Mastodon. This resemblance is so great, that in the absence of the crowns of the teeth, and from its huge proportions, the fossil, when presented to the Museum, and up to this time, has always been regarded as the jaw of a Mastodon. The relationship indicated by the shape of the jaw, is further borne out by the form and structure of the penultimate lower tooth, as described in the preceding part of this paper. The enamel, which is thinner in the *D. giganteum*, is as thick in the Indian species as in the lower penultimate of the American mastodon: the outline of the ivory ridge beneath the enamel is the same in both; the crown ridges have the same transverse, continuous, crenulated, and trenchant form; and what is most important and significant of all, the hind talon, in respect of form, amount of development, and the characteristic crenulation of its edge, is so precisely similar that this part in the one exactly represents the corresponding part of the same tooth in the other. The same direction of affinity is further indicated by the nearly horizontal line of protrusion and horizontal plane of wear in the teeth, by the form of the ramus, coronoid process, and angle of the jaw, and by the absence of antero-posterior curvature in the outline of its lower surface, in all of which particulars the American Mastodon deviates widely from its congeners, and from the Elephantine type generally, and approximates towards the *Dinotherium*. This tendency is also shown in the very reduced formula of the teeth ridges, in the deflexion of the symphysis,



its thick bluff termination, and in the inferior tusks. I shall soon have occasion in another place to follow up this subject at greater length, and in the meantime must content myself with the simple statement, that the North American Mastodon and the Indian Dinotherium are the nearest connecting forms of the two genera yet known, and that their relationship is far from being remote, perhaps even nearer than that of the American Mastodon to the Indian Elephant or the Mammoth.

The deflexion of the symphysis commences immediately behind the second molar, as in the *Din. giganteum*, and it is evidently produced into a great bluff mass, bent downwards as in that species. The section at this point does not include any part of an inferior tusk, or of an alveolus for it; but Dr. Kaup\* tells me that the large tusks of the Eppelsheim species, with their alveoli, always terminate considerably in front of the anterior premolar. There is no reason, therefore, to conclude that the Indian had not tusks resembling those of the European species: and although there is no direct evidence to the point, everything in the construction of the symphysis goes to support the presumption that there were tusks. The posterior mentary foramen is of large size, and situated at the outside under the anterior premolar, exactly as in the Eppelsheim fossil, but at a greater distance from the alveolar border of the jaw. It is much larger than the foramen seen in the cast of the Eppelsheim lower jaw; but no faith can be put in the dimensions of a foramen measured on a cast.

In regard to the teeth, nothing is seen of their crowns, which have been broken off close to the alveolar margin: but the bony partitions between five teeth are distinctly visible, showing the usual complement in Dinotherium, and proving that the fossil was derived from an adult animal. These five teeth consist of two premolars, and three true molars. They diminish in width from the backmost forwards, as in the European species. The anterior premolar has two lobes, the front one being compressed and sharpened off forwards into a cuneiform edge; the rear lobe being shorter and broader. This tooth is upwards of half an inch longer than that belonging to the jaw of the great specimen figured by Kaup. The second premolar is nearly square in outline, but wider behind. It appears to have had two ridges, and four fangs. The third tooth or first true molar, presents a length of 4 inches by 2·8 of extreme breadth; while that of the Eppelsheim cast measures 3·6 by 2·6. We have in this excess of length conclusive proof that the Indian, like the European species, possessed the remarkable character of having the first true molar three-ridged, and more complex in its form than the two backmost

\* I have had the advantage, while engaged on the examination of this fossil, to benefit, during his present residence in London, by the intimate knowledge of the structure of the Dinotherium, possessed by this distinguished palæontologist, the founder of the genus. Dr. Kaup was at once convinced of the generic relations of both the fossils, but he is in nowise responsible for any of the opinions here advanced regarding the distinctness of the species, or its affinities.



grinders. The crown is so utterly mutilated as to afford no evidence regarding the form of these ridges. The second, or penultimate true molar is nearly square in its plan outline, but more than half an inch longer and wider than in the European species. The tooth specimen described in the body of this paper was inferred to be the penultimate inferior, and it was probably derived from a female or small-sized individual. The remains in the jaw appear to indicate that this tooth was two-ridged, with a talon as in the European species. Of the third and last molar only the anterior half remains, and we have no direct proof how many ridges it bore; but the number was most probably two, with a talon, as in the European species. The portion which remains presents two distinct and slightly divaricating fangs, indicating, among many others which could be added, another character of resemblance to the North American mastodon.

The following are the dimensions of the fossil compared with those of a cast of the jaw of the great head specimen, supposed to have been a male, figured and described by Kaup.

	Mastodon giganteus.*	Dinotherium Indicum, from Perim Island.	Dinotherium giganteum of Eppelsheim.
	inches.	inches.	inches.
Length of the fragment - - -	- - -	17.	
Ditto of the 4 anterior teeth - - -	- - -	13.5	13.
Ditto of the first premolar - - -	- - -	3.5	2.9
Width of ditto behind - - -	- - -	2.2	2.2
Length of 2d ditto - - -	- - -	2.9	3.3
Width of ditto behind - - -	- - -	2.6	2.7
Length of 3d or first true molar tooth - - -	- - -	4.	3.6
Width of ditto behind - - -	- - -	2.8	3.
Length of 4th tooth (2d true molar) - - -	- - -	3.9	3.3
Width of ditto - - -	- - -	3.5	2.9
Depth of jaw to alveolar margin at the 2d premolar - - -	7.5	9.2	6.9
Ditto at 3d tooth (1st true molar) - - -	6.6	8.7	6.2
Width of jaw at 2d premolar - - -	5.7	5.1	4.
Ditto at the middle of 4th tooth (or penultimate true molar) - - -	6.5	6.4	5.
Distance between the upper margin mentary foramen and alveolus of 1st premolar - - -	- - -	3.6	2.2
Ditto from inferior margin to ditto - - -	- - -	4.75	3.4

\* N.B. The four measurements of *Mastodon giganteus*, given for comparison, are taken at points of the jaw corresponding to those of the *Dinotheria*.

The *Dinotherium* of Eppelsheim is known to range through a very wide difference of size, dependant on sexual or individual peculiarities, and several nominal species, chiefly founded upon this character, have been described by authors. But Dr. Kaup informs me,



that he now admits but two species, *D. giganteum* and *D. Koenigii*, as he regards all the rest, such as *D. Cuvieri*, *D. Bavaricum*, *D. proavum*, &c., to be merely dwarfed varieties, or females of *D. giganteum*. M. De Blainville has arrived at nearly the same conclusion in his *Osteographie*. It would be unsafe, therefore, to found any opinion regarding the Indian fossil merely on a difference of size. But, in addition to the larger dimensions, the very remarkable peculiarities in the form of the jaw, indicated by its great depth in front, the excessive width, massive form, and circular outline in section behind, together with the absence of the flattening of the inner side, which is so marked in every specimen of *D. giganteum*, taken in conjunction with the very significant difference in the thickness of the enamel, appear to furnish the strongest evidence that the Indian fossil belongs to a distinct species. It is to be kept in mind also, that all these differential characters tend, in a remarkable manner, in the direction of greater affinity with the *Mastodon giganteus*. In corroboration of this view, it deserves to be stated that, of the numerous fossil Proboscidea discovered in India we \* have found that all the forms are specifically distinct from those which occur in Europe. I have now no hesitation in regarding both the Perim fossils to belong to a distinct species of *Dinotherium*, larger than the *D. giganteum*, and more closely allied to the Mastodons, which, as proposed in the preceding pages, may be called *D. Indicum*.

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NOTE. — In the *Athenæum*, No. 923, p. 662., there is an abstract of a paper by Mr. A. Bettington, read to the Royal Asiatic Society, on the 21st of June of this year, giving an account of a finely-preserved cranium of a huge Ruminant, found by that gentleman in Perim Island: I have repeatedly seen the specimen, which was exhibited at the anniversary meeting of the Geological Society on the 17th of February last; but as unpublished material, which I had no authority to quote, I have not felt at liberty to refer to it in the descriptions given in this paper. Mr. Bettington institutes a comparison of his fossil with the *Sivatherium* and Giraffe, and considers it, so far as the abstract above quoted indicates, to be distinct from both. The circumstance that this cranium and the fossils here described are from the same locality, creates a strong presumption that they may belong to the same genus or even to the same species; but I am unable to say in how far the teeth agree, as I have not had an opportunity for making the necessary comparison. Mr. Bettington, as quoted in the abstract, appears to consider that, in addition to horn buttresses behind the orbits, there was a pair of recurved rear horns in his fossil, at the side of the occiput, placed as in the buffalo. This inference, if well founded, would be against the affinities here attributed to Captain Fulljames's fossil, should it prove to belong

\* In stating this, I use the plural pronoun *we*, intending to intimate that the opinion is one in which my colleague Capt. Cautley also concurs.



to the same species. Among the remains mentioned as having been found associated with this cranium by Mr. Bettington, are species of Mastodon, Rhinoceros, several forms of Ruminants, Crocodiles, &c.

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REFERENCES to the Figures in Plate 14.

- Fig. 1. *Dinother. Indicum*; — posterior ridge and *talon* of the penultimate lower molar left side seen from outside: (*a*) the ridge, (*b*) the talon.  
 Fig.<sup>a</sup> Ditto in section, showing the enamel ivory and pulp nucleus; (*a'*) ridge; (*b'*) talon.  
 Figs. 2. and 2<sup>a</sup>. The same in *Dinother. giganteum*.  
 Figs. 3 and 3<sup>a</sup>. (*a, b, c,*) the three premolars of *Bramatherium Perimense*; (*d*) the ante-penultimate or anterior true molar; (*b', 3<sup>a</sup>*) showing the rugous surface of the enamel.  
 Figs. 4, 4<sup>a</sup>. Plan and erect views of the last premolar (*c, c'*); and the three true molars (*d, d'*; *e, e'*; *f, f'*;) of *Bramath. Perimense*.  
 Fig. 5. *Camelopardalis Sivalensis*, second cervical vertebra, side view; (*b*) mesial longitudinal ridge under side of the body; (*e*) alæform expansion of the transverse processes; (*g*) inferior oblique process; (*h*) ridge of the spinous process.

N. B. — The figures in the plate are drawn to the natural size.



Fig. 1 a



Fig. 2



Fig. 3 a



Fig. 3



Fig. 1

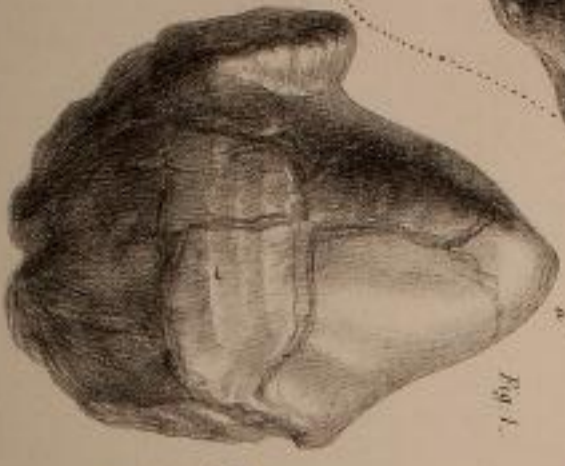


Fig. 1 a



Figs. 1, 1a *Dianthidium Indicum*  
2, 2a *Dianthidium Giganteum*

Figs. 3, 3a, 4, 4a *Dianthidium Parvum*  
5 *Camelopardalis Somalensis*

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