

matter supply is sufficient to consume oxygen within pore waters, sulphate reduction occurs and results in metal sulphide precipitation<sup>2</sup>. Dispersed grains of pyrite were found in the slope sediments off Ratnagiri and Vengurla, between water depths 200 and 400 m. Therefore it is suggested that the sulphides and organic matter from the slope region have been transported to the present site along with the sediments by slumping and debris flows. Considerable amounts of organic matter might have been destroyed while passing through oxygenated bottom waters, whereas sulphides in the form of pyrite might have been deposited unaltered, affecting the organic carbon-sulphur relationship. Due to rapid sedimentation, however, some organic matter would also be deposited which is responsible for diagenetic pyrite formation and further sulphide accumulation.

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Received 15 July 1991; revised accepted 5 February 1992

## Subrecent remains of great one-horned rhinoceros from southern West Bengal, India

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We report here subfossil remains of the great one-horned rhinoceros for the first time from southern West Bengal. The finding testifies that, like the recently extinct lesser one-horned rhinoceros (*Rhinoceros sondaicus*), a clan of the greater one-horned rhinoceros also thrived in the riverine grass-jungles close to the Sunderban mangrove swamps about 3000 years ago.

DURING May 1990, some skeletal remains of one ponderous animal were unearthed by a fisherman while

venturing to deepen a puddle in Ramchandrapur village (c. 22° 25' 50" N, 88° 24' 42" E) under Bon-Hugli Panchayat, P. S. Sonarpur in south 24-Parganas, West Bengal (Figure 1). We examined the silty pit four metre below the surface from where the bones were recovered and collected the material. On closer examination and comparison, the remains appeared to belong to some massive subadult rhino, akin to the great one-horned rhinoceros.

The description and measurements of the specimens are given below. Class, Mammalia; Order, Perissodactyla; Family, Rhinocerotidae.

*Rhinoceros unicornis* Linnaeus: The great one-horned rhinoceros.

Broken mandible with body, having eruptive secondary I<sub>2</sub> on each side, P<sub>4</sub>, M<sub>1</sub>, M<sub>2</sub> and embedded M<sub>3</sub> on the right ramus; sternal bone, three fragmentary ribs; 7th thoracic vertebra; distal end of right radius; cuneiform of right manus; right astragalus.

The specimens (Figure 2) are not fossilized and the porosities in the spongy bone are visible. Of course, these have become slightly heavier and little carbonized. The pit underlies a four-m thick stratum of sandy clay (Figure 3) and just above a layer of peaty clay. About 50 cm below the peat, a soft, little sticky and dark clay bed was encountered. A sample akin to this soft clay from 550 cm below at Bagerhat (22° 24' N, 88° 25' E), a closely situated site under the same geographical unit,

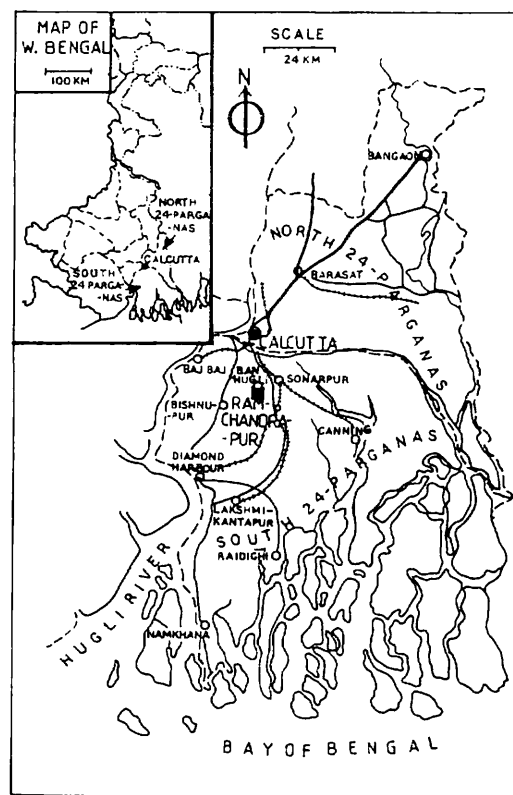


Figure 1. Location of Ramchandrapur village.

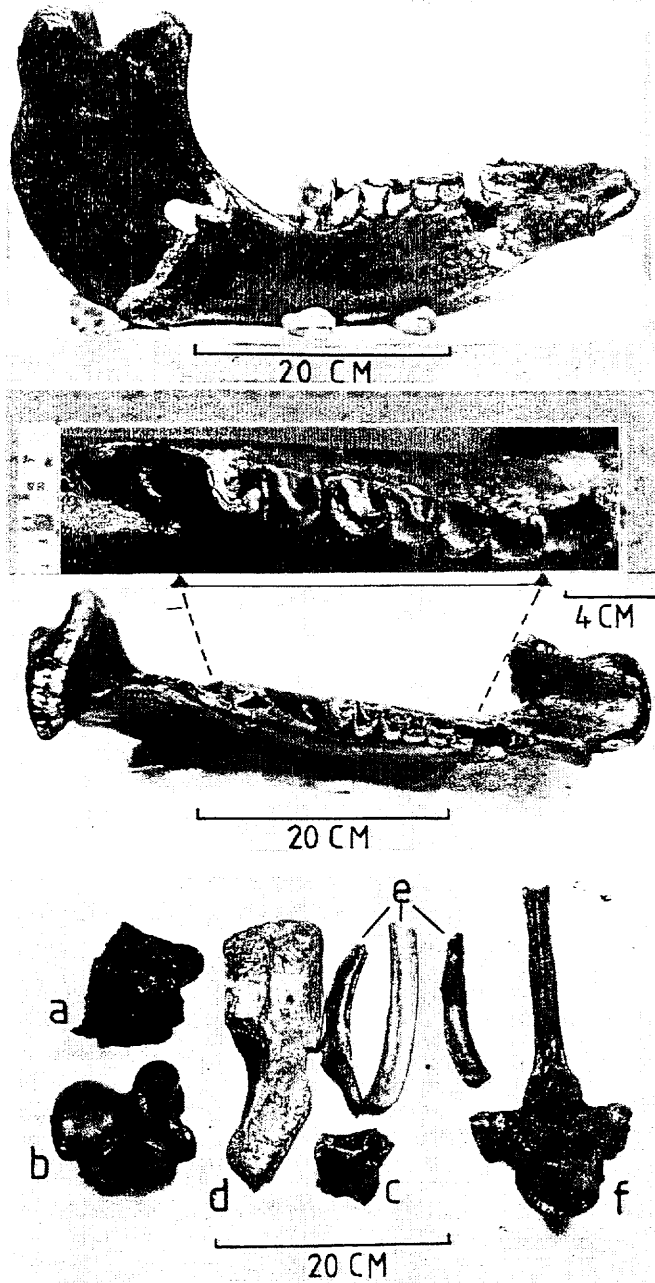


Figure 2. Subrecent remains of great one-horned rhinoceros from southern West Bengal, India.

i.e. Inactive Estuarine Plain, had been  $^{14}\text{C}$  dated  $5080 \pm 110$  yrs BP (ref. 1). In a recent paper, Banerjee and Sen<sup>2</sup>, while reporting on the succession of Holocene sediment in this part of West Bengal, the age of the grey clay (with sand), similar to that covering the specimens in question has been attributed to 2500 yrs BP to Recent and that of the peat bearing some reptilian fossils at Barrackpur, a little north of Calcutta,  $3030 \pm 100$  yrs BP. Thus the specimens from Sonarpur appear to be within a chronological range of 2500 to 3030 yrs BP.

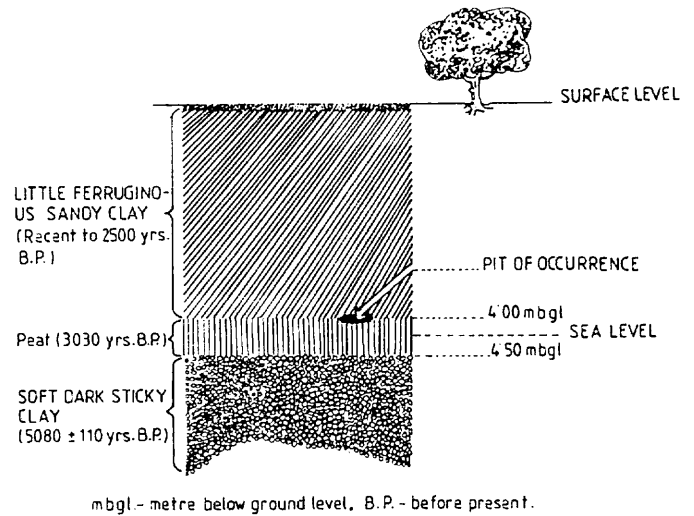


Figure 3. Litho-column showing the pit of occurrence of the specimens.

The vertical and horizontal lengths of the ramus of mandible of this subadult rhino not only approach those of the *R. unicornis* and exceed those of the adult *R. sondaicus* (Table 1), but also resemble the former in structural details. It has been observed that irrespective of the lengths of ramii, their angular measurements at the symphyseal apices (point of convergence) are conspicuously constant and distinct in the two species. It is 30 in *R. unicornis* and 40 in *R. sondaicus* (Figure 4).

The under-surface of the body of mandible is very flat. The  $\text{dI}_1$  have fallen, leaving two closely situated roundish sockets. The permanent  $\text{I}_2$  project forward horizontally. The under-surface of these teeth is much convex and enamel covered, but the lingual upper surface are less so and filled with dentine. The  $\text{dP}_4$  is moderately roded, less hypsodont and with exposed cementum. The  $\text{M}_1$  and  $\text{M}_2$  are hypsodont. The lophids (crescentic lobes) are slightly eroded. The horns of the hypolophids (hind cusp) abut a little inferiorly near the middle of the posterior ridges of the metalophids, a character very common in the lower molars of *R. unicornis*. The  $\text{M}_3$  is embedded within the incised socket.

The spatulated sternum and narrow ribs are typical of the rhinocerotids and along with the accessory limb bones showed clear resemblances to those of *R. unicornis*. The out-sizes of the accessory limb bones have been given in Tables 2 and 3.

It was observed<sup>3</sup> that unless the size, proportion and other qualitative criteria are taken into consideration, it becomes difficult to distinguish the two species only on dentition or osteological measurements. This is because the Asiatic species of one-horned rhinos, extinct or extant, were monophyletic in origin. The Pleistocene fossil *R. sinensis* Owen very often shows characters intermediate between *R. unicornis* and *R. sondaicus*<sup>4</sup>.

Table 1. Comparison of mandibular bone and teeth from Sonarpur with those in known material present in the ZSI repository

	Specimen from Sonarpur (subadult)	<i>R. unicornis</i> (adult, Nepal; reg. no. 10438)	<i>R. unicornis</i> (juvenile, Nepal; reg. no. 2736)	<i>R. unicornis</i> (adult female)	<i>R. sondaicus</i> (adult male reg. no. 2675)	<i>R. sondaicus</i> (adult female reg. no. 3521)
Length of ramus	532	580	504	560	472	480
Vertical height	265	307	267	292	235	—
Condylar width	120	130	112	135	120	125
Height near M <sub>3</sub>	100	103	79	100	85	—
Width of body	110	122	102	119	95	84
Diastema length	88	112	85	101	89	—
Symphyseal length	130	152	126	142	117	117
P <sup>1</sup> Length	43 (milk)	41	40 (milk)	—	40	—
P <sup>1</sup> Width	27	29	24	—	27	—
M <sub>1</sub> Length	45	37	47	38	42	39
M <sub>1</sub> Width	27	28	24	31	29	31
M <sub>2</sub> Length	49	45	—	45	46	44
M <sub>2</sub> Width	30	32	—	35	29	32

All measurements are in mm.

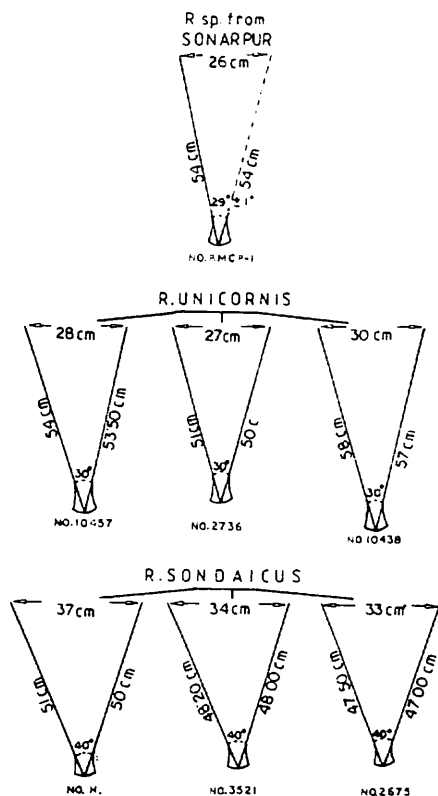


Figure 4. The angular measurements of the jaws in *R. sondaicus*, *R. unicornis* and in the specimen from Sonarpur.

Table 2. Comparison of astragalus and distal end of radius from Sonarpur with those of a mounted adult female *R. unicornis* (reg. no. 19262) in the Indian Museum

	Specimen from Sonarpur	<i>R. unicornis</i> (reg. no. 19262)
Astragalus		
Length	112	110
Length along the condyle	90	92
Length across the condyle	80	74
Radius (distal end)		
Width	94	80
Breadth	71	67

All measurements are in mm.

Table 3. Some typical measurements (in mm) of the cuneiform from Sonarpur

Anterior height	56
Distal width	42
Distal breadth	45
Maximum horizontal diameter	63
Antero-posterior diameter	49

Moreover, within the same population of the great one-horned rhino, both tall and slender type and stumpy type are encountered. However, from osteometric measurements and structural resemblances, the present

specimens appear to be that of a stumpy great one-horned rhino.

The ancestral species of Rhinocerotidae evolved during the Tertiary and flourished to a maximum in the Miocene to Early Pleistocene. But most of the species,

barring the present day Ethiopian and Oriental species, died by the middle of the Pleistocene as evidenced from the Siwalik fossils. Of late, three species were more or less happily thriving in the Indian subcontinent, viz. *Rhinoceros unicornis* Linnaeus, *R. sondaicus* Desmarest and *Dicerorhinus sumatrensis* (Fischer). Among them the *R. unicornis* was extensively distributed in the northern India<sup>5</sup>, but dwindled to a vulnerable position, localized in the foothills of Nepal, Assam and West Bengal.

It appears that the Great Swampy Forest of Sunderban provided ideal shelter to both the greater and lesser rhinos along with massive swamp buffalo<sup>6</sup>. Unfortunately, these animals were systematically killed by the hunters in the 19th century. Baker<sup>7</sup>, in spite of his interest in zoology, shot dead numerous rhinos in the lower Bengal, alleging that the species was multiplying too fast. Increase in predation of calves by tigers also contributed to their decline in numbers.

The fossil species from south India and Sri Lanka, excepting one unconfirmed molar of *R. unicornis* from Tamil Nadu<sup>8</sup>, were of different species, viz. *R. deccanensis* from the Pleistocene Krishna Valley, *R. karnulensis* from the Ossiferous bed of Karnool, *R. sinhalensis* and *R. keqvena* from the Pleistocene Ratnapura, Sri Lanka. Jayakaran<sup>9</sup> reported one partial

skull of rhinoceros from Tamil Nadu. But its taxonomic position could not be ascertained. Therefore, the present occurrence, is redolent of a more southern habitat of the great Indian rhino. This discovery may help present day planners interested in finding habitats for the species in some suitable pockets of its earlier domains.

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ACKNOWLEDGEMENTS. We thank Dr Manju Banerjee of the University of Calcutta, and Mr Parthasarathi Chakraborty of the Geological Survey of India, for discussion on the lithology in lower Bengal.

Received 3 June 1991; revised accepted 16 January 1992

## Influence of nitrogen status and mutation on the fatty acid profile of *Rhodotorula gracilis*

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We isolated the mutants of *Rhodotorula gracilis* that produce low levels of lipid. These mutants were deficient in ATP:citrate lyase, a key enzyme in lipid over-production. Additionally, these mutants were altered in the fatty acid profile, most pronounced alteration was seen in the mutant CFR-9 which produced only 25% of the lipid compared with the parent strain. In this variant a six-fold decrease in myristic, a two-fold decrease in palmitic and linolenic, but a four-fold increase in linoleic acid were seen.

SOME of the yeasts, mycelial fungi and algae are referred to as oleaginous organisms by virtue of their ability to accumulate large quantities of triacyl glycerol as storage lipid, which they most often do in carbon-rich and nitrogen-poor growth media<sup>1</sup>. This is an example of nutrition stress-induced modulation of physiology and metabolism in microorganisms, a phenomenon not so well understood so far. Besides such a quantitative change, qualitative changes in the lipid in terms of the

composition of fatty acids have also been found in the oleaginous organisms cultured at non-optimal pH or temperature conditions<sup>2-5</sup>. Non-oleaginous microorganisms have also been known to respond to environmental stress by altering the fatty acid composition of their lipids. Ingram *et al.*<sup>6</sup> found that *Escherichia coli* grown in medium containing ethanol modifies its lipid by increasing the level of vaccenic acid (C18:1,  $\Delta^{11}$ ) with corresponding decrease in palmitic acid (C16:0). Changes in fatty acid composition of lipid were also detected when *E. coli* was cultured at a suboptimal temperature<sup>7</sup>. Beaven *et al.*<sup>8</sup> found that *Saccharomyces cerevisiae* exposed to high levels of ethanol produces a lipid with extensive modification, most pronounced in the increase of oleic acid (C18:1,  $\Delta^9$ ) and decrease in palmitic acid (C16:0).

The biological significance of the modification of fatty acid profile of lipid by the organism in response to changes in environmental factors is obscure. Presumably these organisms cope with environmental changes by suitable adjustment of their lipid composition. Our interest has been focused on finding genetic and biochemical factors influencing modification of fatty acid profile of *R. gracilis*. This yeast accumulates large quantities (about 60% w/w) of triacyl glycerol as storage lipid<sup>9</sup>. In the present studies, it was the objective to see if mutation could cause modification of fatty acid profile as this would be a first step in