

PRECISIONS CONCERNING THE DISTRIBUTION AND IDENTIFICATION OF MIOCENE HOMINOIDS FROM INDIA

Martin PICKFORD¹ and Brahma N. TIWARI²

¹ College de France and Département Histoire de la Terre, CR2P, UMR 7207 du CNRS, 8, rue Buffon, 75005, Paris, France (pickford@mnhn.fr)

² Wadia Institute of Himalayan Geology, Dehra Dun 248 001, India (bntiwari@wihg.res.in)

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ABSTRACT

During the past four decades, the Indian Subcontinent has been a focus of palaeoanthropological research on account of the abundance of Middle and Late Miocene hominoid fossils that have been reported from it. In India, well known hominoid-bearing localities occur at Ramnagar (Lower Siwaliks) and Hari Talyangar (Middle Siwaliks), but there are less well known occurrences in the literature, such as the material from Dhara and Nungarh near Kalagarh in Pauri Garhwal District, not far from the Nepalese and Chinese frontiers. Reports of the discovery of hominoid fossils at other poorly known localities at Ramchand Ridge and Dhiran near Ramnagar (Jammu & Kashmir) and Bandal (Himachal Pradesh) formed the basis for claims that hominoids existed in the subcontinent earlier than the Chinji zone. If so, then current views of hominoid palaeobiogeography would need to be modified to the extent that an earlier passage of large hominoids out of Africa towards the Indian subcontinent than is generally accepted, would need to be postulated. We also examine a claim for the persistence of large hominoids up to the Mio-Pliocene boundary (ca 5.5 Ma) on the basis of a tooth found near Bharari, east of Hari Talyangar.

The aim of this paper is to examine the soundness of the basis of claims for the presence of pre-Chinji large bodied hominoids in the region and for their persistence in the subcontinent up to the end of the Miocene epoch.

With this aim in mind, in January, 2009, the authors surveyed the zone northwest of Dera Gopipur; 1) to locate the place from which a partial set of upper and lower teeth attributed to *Ramapithecus* cf. *punjabicus* were collected by S.S. Gupta and B.C. Verma in the 1978-79 field season of the Geological Survey of India, 2) to recover biochronologically informative faunal remains. No such faunal remains were found, making it difficult to substantiate the claims of Lower Siwalik age for the deposits. Other published reports of the presence of early hominoids in India were also examined, but the sites were not visited.

Key Words: Hominoidea, Siwaliks, Miocene, India, Geological context, Distribution.

RESUMEN

Durante las últimas cuatro décadas el subcontinente Indio ha sido un foco de interés para la investigación paleoantropológica, dada la abundancia de hallazgos de hominoideos fósiles del Mioceno Medio y Final. En la India son bien conocidas las localidades con restos de hominoideos de Ramnagar (Siwaliks inferior) y Hari Talyangar (Siwaliks medio), pero hay otros hallazgos menos conocidos en la bibliografía, como es el caso del material procedente de Dhara y Nungarh cerca de Kalagarh en el distrito de Pauri Garhwal, no muy lejos de la frontera con Nepal y China. Informes sobre el descubrimiento de hominoideos fósiles en otras localidades poco conocidas como Ramchand Ridge y Dhiran cerca de Ramnagar (Jammu y Cachemira) y Bandal (Himachal Pradesh) forman la base para fundamentar que los hominoideos existían en el subcontinente antes de la zona de Chinji. Si esto es así, las ideas actuales sobre la paleobiogeografía de los hominoideos deberían ser modificadas, con la inclusión de una salida más temprana de los grandes hominoideos desde África hacia el subcontinente Indio previa a la generalmente aceptada. Otra afirmación que se analiza es la persistencia de los grandes hominoideos hasta el límite Mio-Plioceno (ca. 5,5 M.a.) de acuerdo con el hallazgo de un diente cerca de Bharari, al este de Hari Talyangar.

El propósito de este trabajo es examinar la solidez de los argumentos en los que se basa la afirmación de la presencia de grandes hominoideos pre-Chinji en la región y su supervivencia hasta final de la época Miocena en el subcontinente.

Con esta idea los autores en enero de 2009 investigaron la región noroeste de Dera Gopipur con el propósito de; 1) localizar el lugar en el que se había encontrado un conjunto parcial de dientes superiores e inferiores atribuidos a *Ramapithecus* cf. *punjabicus*, recolectados por S.S. Gupta y B.C. Verma en la campaña de campo del *Geological Survey of India* de 1978-79; 2) obtener restos de fauna que pudieran aportar una información biocronológica más precisa. Estos restos no fueron encontrados, por lo que la confirmación de la edad de los depósitos de Siwalik inferior sigue siendo problemática. También se han examinado otros trabajos publicados sobre la presencia de hominoideos tempranos en la India, aunque no se han visitado las localidades.

Palabras clave: Hominoidea, Siwaliks, Mioceno, India, contexto geológico, distribución.

INTRODUCTION

During the past four decades, several papers have been published recording the discovery of fossil hominoids in Lower Siwalik strata of India, some of which were reported to be older than the Chinji Zone (equivalent to MN 7/8 in Europe, ca 13-11.5 Ma), some as old as 18.3 Ma (Gupta *et al.*, 1979, 1982) which would make them equivalent to MN 3 or MN 4 in the European mammal zonation. If these reports are correct, then biogeographic scenarios concerning the emigration of large hominoids out of Africa towards the Indian Subcontinent (via Europe?) would need to be re-assessed (Andrews *et al.*, 1999). One of the aims of this contribution, therefore, is to examine reports of Lower Siwalik fossil hominoid specimens from various localities in Northern India. The fossils concerned are from Dera Gopipur and Bandal (Himachal Pradesh), Ramchand Ridge and Dhiran (Jammu & Kashmir) and Dhara and Nungarh (Uttar Pradesh). These fossils have generally been interpreted by their respective authors as providing evidence for the presence of hominoids in India earlier than their earliest records in Pakistan. The second aim is to assess whether a report of the persistence of hominoids in India up to the Mio-Pliocene boundary (5.5 Ma), based on a tooth from Bharari (Himachal Pradesh) can be substantiated.

Pickford (1977) showed that a misidentification of a suid lower molar as a hominoid (*Adaetotherium incognitum* Lewis, 1934) had occurred in the Pakistan fossil record, a theme that was followed by Kelley (2005) who demonstrated how mis-attribution of suid canines to *Sivapithecus* Pilgrim, 1910 led to misconceptions regarding the morphology and sexual dimorphism of the taxon, and how down line interpretations (taxonomy, phylogeny) that flowed from these misconceptions were adversely affected. These kinds of mis-attribution also impact on biochronology and biogeography, two aspects that particularly concern us in this paper (Patnaik *et al.*, 2005).

Precisions are provided regarding the discovery loci of the fossils, and the fossil material is re-identified where necessary. Several of the specimens belong to suids, whereas others are genuinely hominoid although some of the serial positions of the teeth have been misidentified.

We examine each case separately on a locality by locality basis. In the case of the supposedly Mio-Pliocene (5.5 Ma) Bharari hominoid, we re-interpret the age of the fossil relative to the palaeomagnetic stratigraphy of the deposits using an updated GPTS and conclude that the specimen is likely to be older than 7.5 Ma.

Details concerning the location of the discovery of a set of hominoid teeth near Dera Gopipur (Gupta *et al.*, 1982) are provided, and precisions are given concerning a hominoid upper molar from Dhara, Kalagarh District (Sahni *et al.*, 1974, 1980, 1983) and a lower premolar from Nungarh (Tiwari, 1982) in order to complete the known geographic distribution of hominoid fossils in the country. Two supposed hominoid specimens from Ramchand Ridge and Dhiran near Ramnagar (Jammu & Kashmir; Gupta *et al.*, 1979, 1982) are re-assessed as are two specimens from Bandal (Himachal Pradesh; Gupta, 1969).

DERA GOPIPUR

PREVIOUS RESULTS

Gupta *et al.* (1979, 1982) reported the discovery of associated hominoid teeth from an area northwest of Dera Gopipur, Kangra District, Himachal Pradesh, India, that were collected during the 1978-79 field season of the Geological Survey of India (Verma *et al.*, 2002). The seven isolated teeth were attributed to *Ramapithecus* cf. *punjabicus* (Pilgrim, 1910).

In the 1979 report, the locality was given as “around Mangarh”. In the 1982 paper, the authors provided a geological map (their figure 1) on which the discovery locus (GVT) and the line of the stratigraphic section (s-s) are marked, a stratigraphic section (their figure 2) on which the *Ramapithecus* level and a Fort is marked, a photograph (their plate 1) on which the hominoid site (GVT) was marked, and written descriptions in the text, in which reference is made to a sediment exposure 50 metres north of the main road (Dera Gopipur – Kangra) close to a footpath leading to the village of Gharat. In the publication by Verma *et al.* (2002), the locality is given as 1.5 km south of Bankhandi, northwest of Dera Gopipur (Fig. 1), Kangra (H.P.) and the horizon as Chinji.

CONTEXT

In January, 2009, the authors surveyed the region between Mangarh Fort and Bankhandi on the northeast side of the tarred road, and paid particular attention to the indications provided in the paper by Gupta *et al.* (1982) concerning the discovery locus of a set of hominoid teeth. It was found that some of the indications provided did not agree with each other. The only outcrop within 50 metres of the road in the vicinity of the point GVT marked on the geological map is at $31^{\circ}56'36.3''\text{N} : 76^{\circ}11'49.3''\text{E}$. The spot marked GVT on the photograph in Gupta *et al.* (1982: plate 1) is at $31^{\circ}55'50.6''\text{N} : 76^{\circ}12'28.8''\text{E}$, 1.75 km southeast of the spot marked on the map in the same paper. A second fossiliferous locality near Pakhrun, marked (F) on the same map ($31^{\circ}56'18.1''\text{N} : 76^{\circ}12'16.3''\text{E}$), is midway between the GVT map location and the GVT photo location. The Fort which features in the stratigraphic section is at $31^{\circ}55'28.7''\text{N} : 76^{\circ}12'35.23''\text{E}$, 2.4 km south of the line of section marked in Gupta *et al.* (1982: fig. 1). The

positions of the section and the various points are indicated in figures 2 and 3.

The only fossil that the authors found was a fragment of crocodile bone from the exposures near point (F) of Gupta *et al.* (1982) (point 3 in Fig. 2). Extended searches at the two points labelled GVT (points 1 and 2 in Fig. 2) failed to yield a single fossil, but screening was not tried.

It should be noted that Gupta *et al.* (1982) mentioned that the roadside exposure of sediment yielded numerous bone fragments dominated by chelonians, a few bovid post-cranial bones and a possible tragulid tooth fragment. They also reported that a "thin band of compact sandstone is profusely rich in micro-vertebrates and coprolitic material". Our examination of this sandstone band revealed that it is poorly fossiliferous, possibly azoic.

The survey carried out by the authors revealed that the map, photograph, stratigraphic section and text published in the definitive paper on these hominoid teeth are inconsistent with each other. It is concluded that the Dera

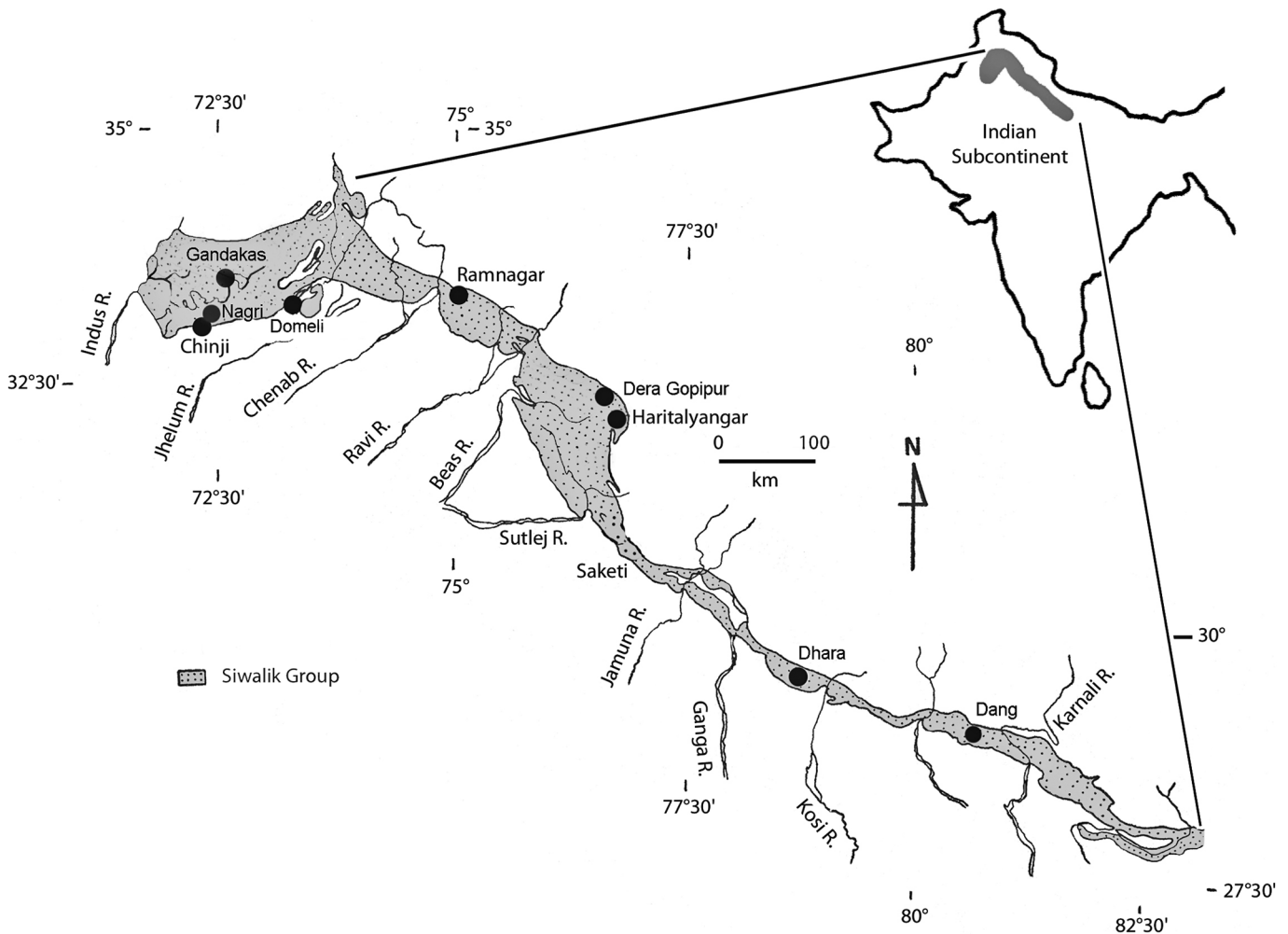


Figure 1. Distribution of Siwaliks in the Indian Subcontinent, and the location of localities from which hominoids have been reported (Bharari is 2 km east of Hari Talyangar; Nungarh is near Dhara).

Gopipur hominoids have poorly constrained geographic provenience and with currently available data cannot be reliably dated either by stratigraphy or by biochronology. The hominoid fossils are re-assessed and several of the previous identifications of meristic position and side are revised. Nevertheless, the hominoid specimens from Dera Gopipur are of interest and merit further study. They are remarkable for their diminutive dimensions.

PALAEOANTHROPOLOGY

Gupta *et al.* (1979, 1982) described seven isolated, but associated teeth of a medium-sized hominoid that they attributed to *Ramapithecus cf. punjabicus*. These specimens are stored at the Saketi Fossil Park, where the authors were able to study them in 2007 and 2009. Three of the teeth were illustrated by Verma *et al.* (2002).

Our examination of the fossils reveal that the side or meristic positions of some of the teeth were previously incorrectly identified (Table 1).

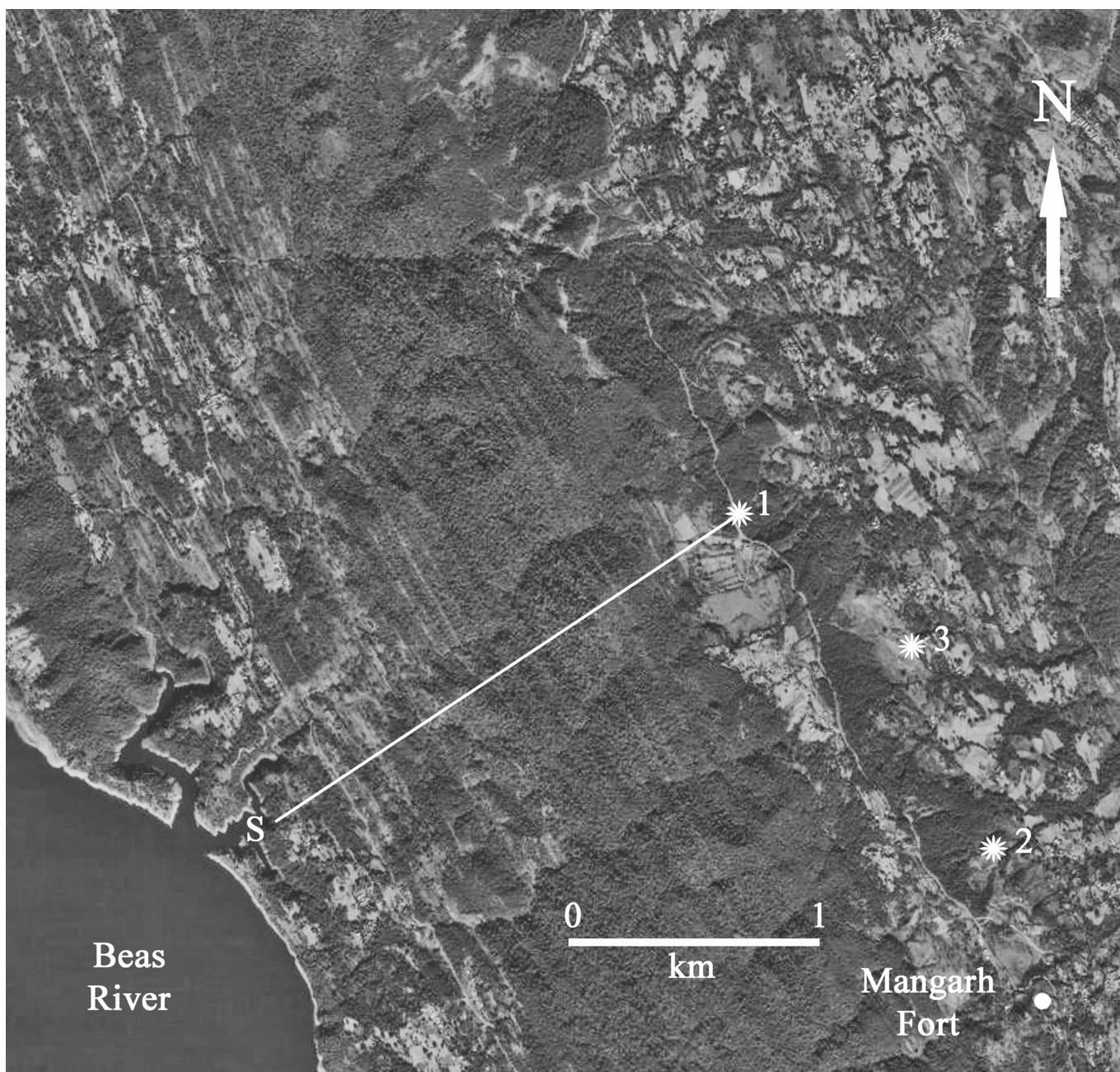


Figure 2. Location of points northwest of Dera Gopipur, Himachal Pradesh, India, discussed in the text. **1**, Point GVT marked on the map in Gupta *et al.* (1982), corresponding to the sediment exposure 50 metres from the main road; **2**, Point GVT marked on the photograph in Gupta *et al.* (1982); **3**, Point F marked on the map in Gupta *et al.* (1982); **S**, section line marked on the map in Gupta *et al.* (1982) (modified from Google Earth).

Table 1. Hominoid teeth from Dera Gopipur, Himachal Pradesh, India, stored at the Saketi Fossil Park, with measurements by the authors.

Specimen number	Gupta <i>et al.</i> (1982)	This paper	Length (mm)	Breadth (mm)
SFP 187	Right M1/	Left M2/	9.7	11.7
SFP 188	Left M2/	Right M2/	--	11.4
SFP 189	Right m/2	Right m/2	--	9.6*
SFP 190	P3/(?)	Left p/3	7.8	8.8
SFP 191	Left i/2	Right m/1 fragment	--	--
SFP 192	Left C1/	Left P3/	--	6.2
SFP 193	Left c/1	Indeterminate	--	--

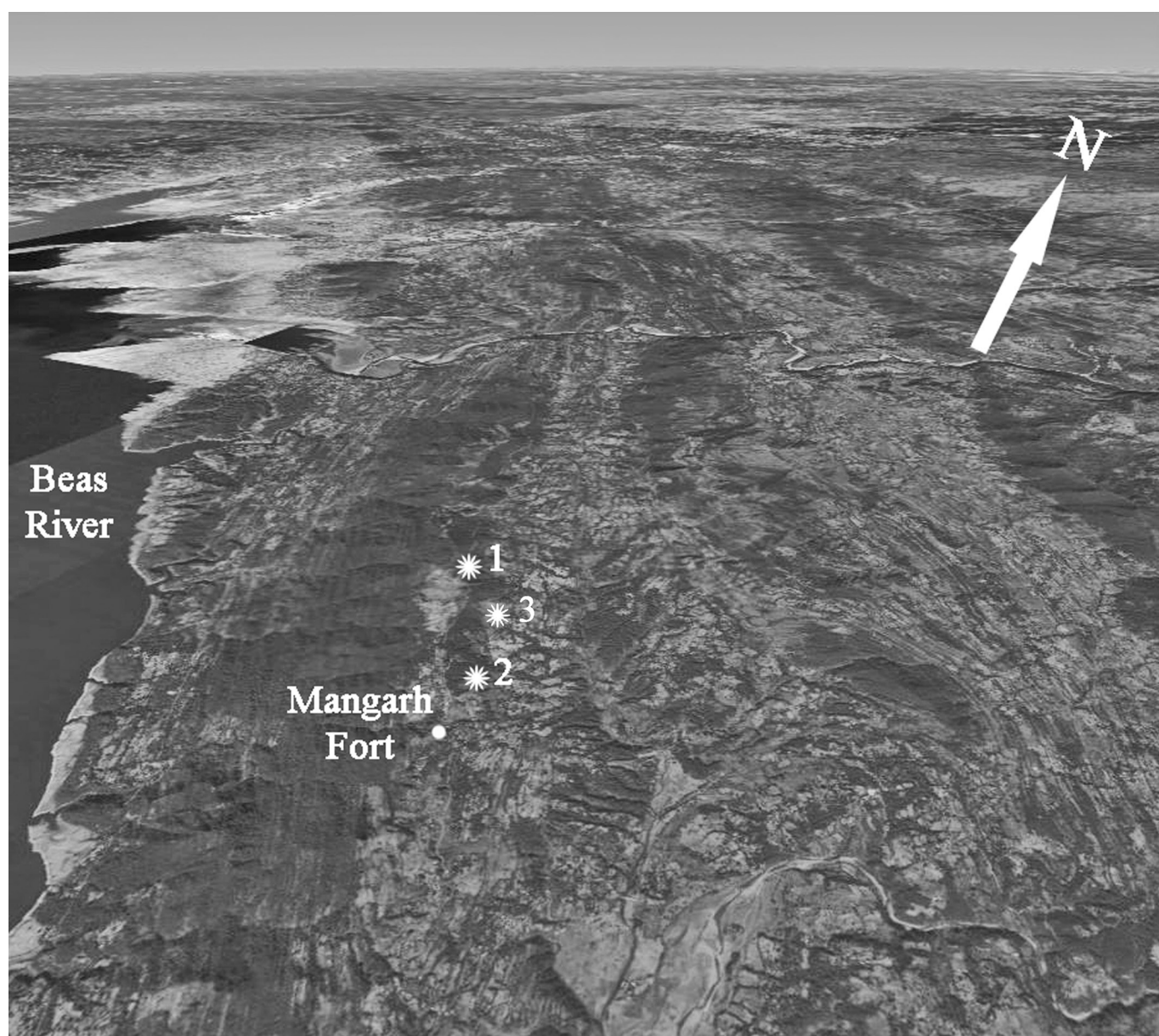


Figure 3. Oblique view of the Dera Gopipur anticline looking northwestwards, showing the position of points 1, 2 and 3 (see legend of Fig. 2) to the west of the axis of the anticline. The sunken topography in light tones to the north of the numbered localities has been interpreted as representing Chinji Formation (Verma *et al.*, 2002) although no fossils have been found to confirm this correlation (image modified from Google Earth).

SFP 187 is a complete but moderately worn left upper molar (Fig. 4b). On the basis of its wear stage and by occlusion with the m/2 from the same site, we consider that this tooth is an M2/. The cusps of the trigon are subequal in stature. The metacone is separated from the protocone by a shallow valley. The hypocone is smaller than the other three cusps. There is no sign of a lingual cingulum, but the mesial and distal ones are prominent.

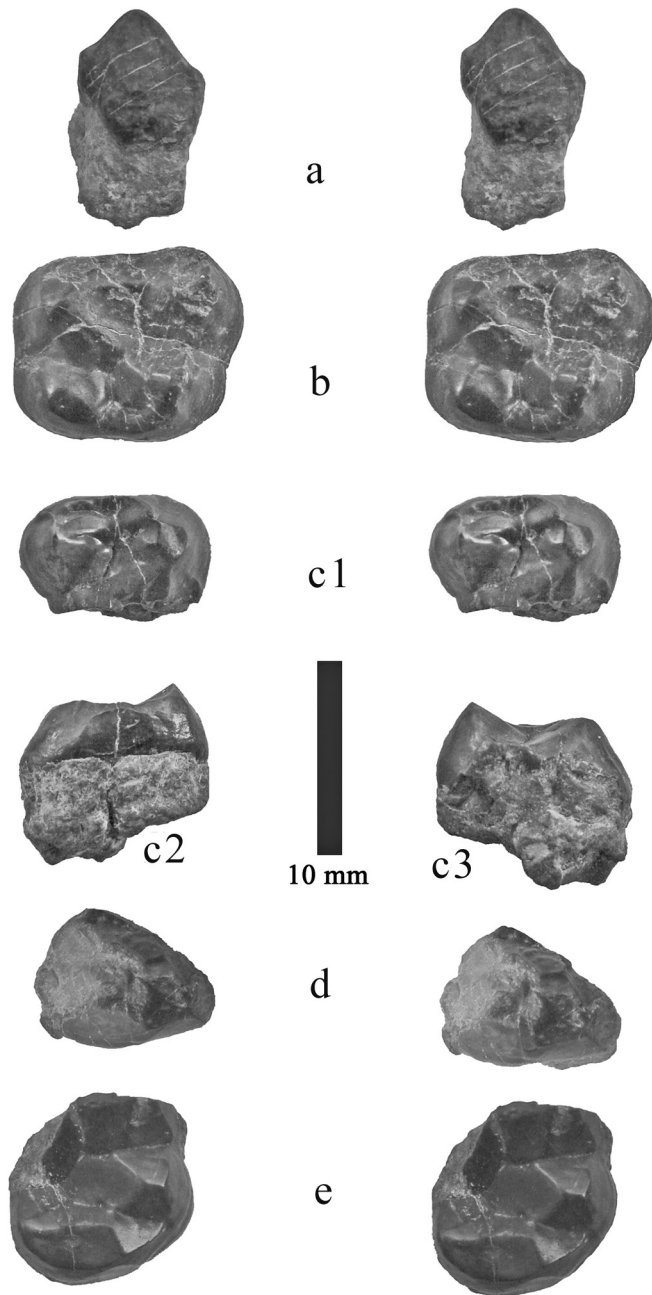


Figure 4. Hominoid teeth from Dera Gopipur, Himachal Pradesh, India. **a**, SFP 192, left P3/ stereo buccal view; **b**, SFP 187, left M2/, stereo occlusal view; **c**, SFP 188, mesial half of right M2/; **c1**, stereo occlusal view, **c2**, anterior view; **c3**, distal view; **d**, SFP 190, left p/3 stereo occlusal view; **e**, SFP 189, right m/2, stereo occlusal view.

Kay (1982) provided dimensions (mean and standard deviation) of the teeth of Siwalik hominoids which he attributed to three species [*Sivapithecus indicus* Pilgrim, 1910, *Sivapithecus sivalensis* (Lydekker, 1879), and *Sivapithecus simonsi* Kay, 1982] (Table 2). Whether the Dera Gopipur specimen is a first or a second upper molar, it is clear that it is small within the context of Siwalik hominoids, and we consider that it belongs to *Sivapithecus sivalensis*, or, if *Sivapithecus simonsi* is valid (see below), then possibly to the latter species. The specimen is close morphologically, and features similar crysodont wear facets, to a specimen from Tinau Khola, Dang Valley, Nepal (Fig. 1), hitherto attributed to *Sivapithecus punjabicus* (see Munthe *et al.*, 1983).

There are two species of small Siwalik hominoids with priority over *Sivapithecus simonsi* Kay, 1982. The earliest named is *Sivapithecus hysudricus* (Pilgrim, 1927) originally classified as *Hylopithecus hysudricus*, with the holotype (GSI D 200, an isolated right lower molar from Hari Talyangar) (Fig. 5). The second is *Bramapithecus thorpei* Lewis, 1934, based on a mandible fragment (YPM 13814) containing m/2 and m/3 from near Hasnot, Pakistan. The valid name for these diminutive Siwalik hominoids is thus *Sivapithecus hysudricus* (Pilgrim, 1927).

SFP 188 is the anterior half of a right M2/ (Fig. 4c), possibly the antimere of SFP 187. It is missing the distal half.

SFP 189 is the rear 2/3rds of a right m/2 (Fig. 4b). The distal facet produced by contact against the m/3 is located on the bucco-distal corner of the tooth, indicating that the m/3 was slightly twisted buccally with respect to the long

Table 2. Dimensions (in mm) of Siwalik hominoid upper M1/s and M2/s. Dimensions are from Kay (1982) except for Tinau Khola, which is from Munthe *et al.* (1983), and the Dera Gopipur tooth which are the authors' measurements.

Species (number of individuals)	Length mean (standard deviation)	Breadth mean (standard deviation)
M1/		
<i>Sivapithecus indicus</i> (8)	11.3 (0.55)	13.0 (0.52)
<i>Sivapithecus sivalensis</i> (4)	10.3	11.5
<i>Sivapithecus hysudricus</i> (ex <i>simonsi</i>) (1)	10.4	10.8
Tinau Khola (Nepal) (1)	10.0	10.9
Dhara (India) (1)	10.6	11.5
M2/		
<i>Sivapithecus indicus</i> (7)	13.0 (0.53)	14.3 (0.56)
<i>Sivapithecus sivalensis</i> (4)	11.5	12.7
<i>Sivapithecus hysudricus</i> (ex <i>simonsi</i>) (1)	10.4	11.0
Dera Gopipur (1)	9.7	11.7

axis of the tooth row. The hypoconulid is positioned in the centre line of the tooth and the small mesio-distally compressed entoconid is located lingually, with a prominent groove between it and the hypoconulid. The talonid basin is small and crowded onto the lingual half of the crown. The wear facets on this tooth are planar, shaped like crystal surfaces. Within the context of Siwalik hominoids, this tooth is small, compatible in dimensions to *Sivapithecus hysudricus* (see table 3).

Table 3. Dimensions (in mm) of Siwalik hominoid lower second molars. Dimensions are from Kay (1982) except for the Dera Gopipur tooth which are the authors' measurements.

Species (number of individuals)	Length mean (standard deviation)	Breadth mean (standard deviation)
<i>Sivapithecus indicus</i> (11)	14.3 (1.13)	13.0 (0.78)
<i>Sivapithecus sivalensis</i> (12)	12.0 (0.68)	10.6 (0.60)
<i>Sivapithecus hysudricus</i> (ex <i>simonsi</i>) (1)	10.0	9.0
Dera Gopipur (1)	--	9.6

SFP 190 is a left p/3 (Fig. 4d) with a damaged crown, but preserves portions of the anterior and posterior interstitial facets made by contact with the neighbouring teeth. Because the p/3 is obliquely oriented in the tooth row, maximum and transverse measurements differ from mesio-distal length and bucco-lingual breadth measurements. In table 1 we provide the mesio-distal and bucco-lingual measurements using the interproximal facets as a guide to the orientation of the tooth in the jaw. Note that

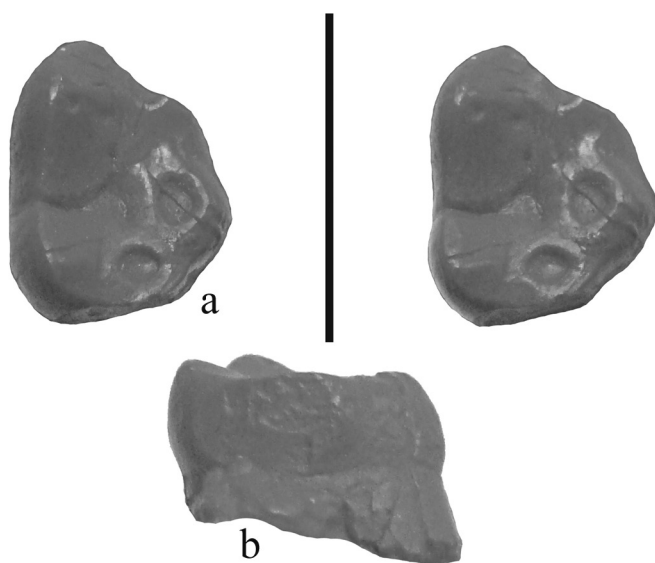


Figure 5. GSI D 200, right m/1 from Hari Talyangar, the holotype of *Sivapithecus hysudricus* (Pilgrim, 1927); **a**, stereo occlusal view of a cast; **b**, lingual view (Scale: 10 mm).

the length is less than the breadth. In table 4 we provide maximum and transverse measurements, as this appears to be the way of measuring employed by Cameron *et al.* (1999). In the latter approach the “length” is greater than the “breadth”. The tooth has an anterior cingulum, and a central fovea towards the lingual side of the tooth.

This lower premolar is exceptionally small in the context of Siwalik hominoids. It is slightly smaller than the smallest specimen known from the Potwar Plateau (GSI D-295), attributed by Kay (1982) to *Sivapithecus simonsi*, but here identified as *Sivapithecus hysudricus*.

SFP 191 is the disto-lingual corner of a right m/1. It preserves a large distal facet produced by contact with the

Table 4. Metric comparison (in mm) of lower third premolars of Miocene hominoids from the Indian Subcontinent (data and identifications for specimens from Ramnagar, Hari Talyangar and Potwar Plateau are from Cameron *et al.* (1999). Values of original specimens taken from (a) Gregory & Hellman (1926); (b) Chopra & Kaul (1975); (c) Pilgrim (1927); (e) Pilbeam *et al.* (1980); (f) Preuss (1982); (g) Kay (1982); and (h) Kelley (1988). Prasad (1968) gives 9 x 9 mm for GSI 18039 and Pilgrim (1927) gives 11.2 x 11.2 mm for GSI D-197. These measurements are evidently taken obliquely to the long axis of the teeth. We here estimate the greatest length x perpendicular breadth, in order for the comparisons to be realistic. (* //estimated from roots of the tooth).

Location and specimen number	Length (max)	Breadth (trs)	Identification
Dera Gopipur, Himachal Pradesh, India			
SFP 190	8.8	6.5	<i>S. hysudricus</i>
Rammagar, Kashmir, India			
AMNH 19411a	11.3	7.2	<i>S. sivalensis</i>
Hari Talyangar localities, India			
PUA 1047-69b	11.9	7.8	<i>S. sivalensis</i>
D-197	14.1	9.1	<i>S. indicus</i>
YPM 13828/D-189/190c	14.1	11.6	<i>S. indicus</i>
GSI-18039	12.7	10.0	<i>S. indicus</i>
Bandal, India			
ONGC V/790	16*	9.2*	<i>S. lewisi</i> Holotype
Potwar Plateau localities, Pakistan			
AMNH 19412b	11.3	7.5	<i>S. sivalensis</i>
GSP 9563e	11.5	6.3	<i>S. sivalensis</i>
GSP 13445e	10.4	6.5	<i>S. sivalensis</i>
GSP 6160e	11.1	6.5	<i>S. sivalensis</i>
GSP 15000f	13.4	8.7	<i>S. indicus</i>
GSI D-298g	9.8	5.5	<i>S. simonsi</i> Holotype
BSPHG 1939 X4h	17.4	9.9	<i>S. parvada</i> Holotype

m/2. This specimen, originally interpreted as a lower incisor, is in fact a lower m/1, marked distally by a deep interstitial facet made by abrasion against the m/2. The groove between the hypoconid and hypoconulid is preserved and the hypoconulid itself is antero-posteriorly compressed.

SFP 192 is the buccal cusp of a left P3/ (Fig. 4a), showing anterior and posterior contact facets produced by the neighbouring teeth. The mesial and distal “shoulders” of the tooth are relatively high and the buccal enamel surface between them curves strongly rootwards. For the Siwaliks this is an exceptionally small hominoid tooth (Table 5).

Table 5. Measurements (in mm) of the Dera Gopipur P3/, VPL/ RP-H1 from Dangar, India, and means of *Sivapithecus* species. *Sivapithecus* metrics are means from Kay (1982) and Kelley (1988), RP-H1 is from Patnaik & Cameron (1997).

Species	Maximum length
<i>Sivapithecus parvada</i>	8.1
<i>Sivapithecus indicus</i>	9.2
<i>Sivapithecus sivalensis</i>	9.0
<i>Sivapithecus hysudricus</i> (ex- <i>simonsi</i>)	7.9
RP-H1 (Dangar)	7.0
Dera Gopipur	6.2

SFP 193 is a fragment of enamel with coarsely wrinkled surface, sporting a small basal cusplet called the metaco-nid by Gupta *et al.* (1982), who considered the specimen to be a lower canine. Because of the presence of a small basal cusplet the specimen is likely not a canine; it is so fragmentary that it is doubtfully primate, possibly from a suid or a tragulid.

INTERPRETATION

In the overall context of Siwalik hominoids, the Dera Gopipur teeth are extremely small, falling within the lower part of, or below the range of metric variation of *Sivapithecus sivalensis*. In some measurements the teeth are slightly smaller than those of *Sivapithecus hysudricus*, but in others they are somewhat greater. Judging from the morphology of the p/3, the Dera Gopipur material is female, and this explains, to some extent, its small dimensions. Further material is required to throw light on this possibility.

In any case *S. hysudricus* is extremely rare, only a few specimens having been attributed to it: GSI-D 200 (holotype m/1 from Hari Talyangar); YPM 13814, from Hasnot, Pakistan [type specimen of *Bramapithecus thorpei* Lewis, 1934, considered by Simons (1964), and Simons & Pilbeam (1965), to represent *Ramapithecus punjabicus*]; M 15423, left mandible containing roots of p/3 and crowns of p/4-m/2, from Domeli, Pakistan [= M 15243 in Simons & Pilbeam (1965), *Dryopithecus laietanus* Villalta

& Crusafont, 1944]; BSPG 1939 X 1, right M1/, Kundal Nala; BSPG 1956 II 2366 [Field N° 750 (9-12-55)], left p/3 from Kadirpur, Pakistan; GSI D-298, right mandible with p/3-m/2 from Kundal Nala, near Chinji, Pakistan [= GSI D 618 in Simons & Pilbeam (1965), *Dryopithecus laietanus*; = type specimen of *Sivapithecus simonsi*, Kay, 1982]; GSI D 185, right maxilla containing P3/-M2/, from Hari Talyangar, India; SFP 187 – left M2/, SFP 188 – right M2/, SFP 189 – right m/2, SFP 190 – left p/3, SFP 191 – right m/1 fragment, SFP 192 – left P3/ fragment, from Dera Gopipur, India (Gupta *et al.*, 1982).

DHARA AND NUNGARH

CONTEXT

Sahni *et al.* (1974, 1980, 1983), Sahni & Tiwari (1979) and Tiwari & Kumar (1984) provided written and map indications of the discovery locus of a hominoid upper molar from Dhara that they attributed to *Ramapithecus punjabicus*. The location of the find was described as being 2 kms north of Dhara village in the Dhara Reserve Forest, Uttar Pradesh. The map published by Cameron *et al.* (1999) is at a large scale but does not provide a precise position of the site [note that Kalagarh (as given in title) and Kashmir are inaccurately mentioned as Districts whereas the former is a town in Pauri Garhwal District and the later is a regional entity of Jammu & Kashmir State of India]. The text repeats the location given by the Tiwari & Kumar (1984) as 2 kms north of Dhara village.

The map in Tiwari & Kumar (1984) shows the discovery locus near a prominent bend in the course of the Dhara River. We have determined the position of the locality (29°28'04.2"N : 78°50'55.4"E) using Google Earth (Fig. 6), but it should be borne in mind that the fossil was found in a loose boulder in the bed of the river. The locality of Nungarh (29°29'32.5"N : 78°49'08.2"E; see Tiwari, 1982) which yielded a tooth interpreted as a lower premolar of a hominoid, is ca 4 km northwest of the Dhara hominoid site (Fig. 6).

PALAEOANTHROPOLOGY

LUVP 7045, the upper molar from Dhara is small for a Siwalik hominoid, and probably belongs to *Sivapithecus sivalensis* (see Cameron *et al.*, 1999) or possibly *Sivapithecus hysudricus*.

LUVP 7005 from Nungarh, was interpreted as a left p/3 by Cameron *et al.* (1999) who concluded that “While it is metrically closer to the scores observed in *S. sivalensis* from Hari Talyangar, its specific status remains problematic”. The specimen has a single root, broken lingually (Fig. 7, 8), the enamel extends further rootwards disto-buccally than it does mesio-buccally (Fig. 8e), it has a prominent central ridge descending from its apex down the lingual side of the crown (originally complete but now

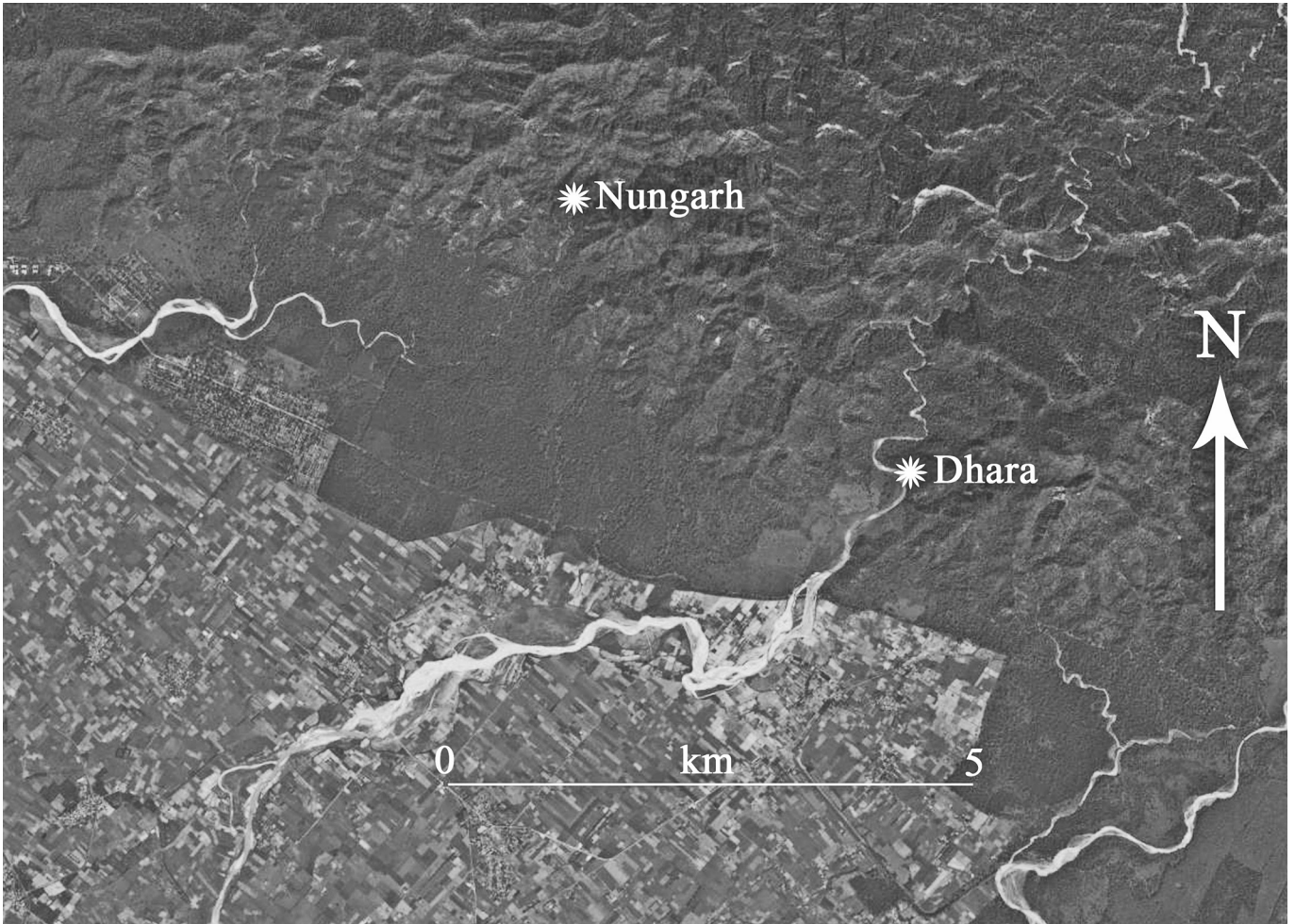


Figure 6. Location of the Dhara hominoid molar and Nungarh tooth, Uttar Pradesh, India (image modified from Google Earth).

with a broken part in the middle), and on this ridge there is a groove basally. The wear facet which slopes lingually apically, bends both mesially and distally towards cervix, the mesial part appreciably more capacious than the distal one (Fig. 8d), thereby removing enamel from most of the surface of the tooth (Fig. 7d). There is an “indent” [a

horizontal groove worn beneath cervix mesially which extends right across the specimen from buccal to lingual sides (4 in Fig. 8)]. There is no sign of a honing facet and the enamel is too thin for the tooth to belong to a hominoid. In addition, the microwear (Fig. 9) is inconsistent with primates, but resembles that induced in carnivore incisors when they repeatedly tug at hair-covered skin during the processing of prey items.

In view of the crown morphology, positions and inclinations of major wear facets, and the pattern of micro-

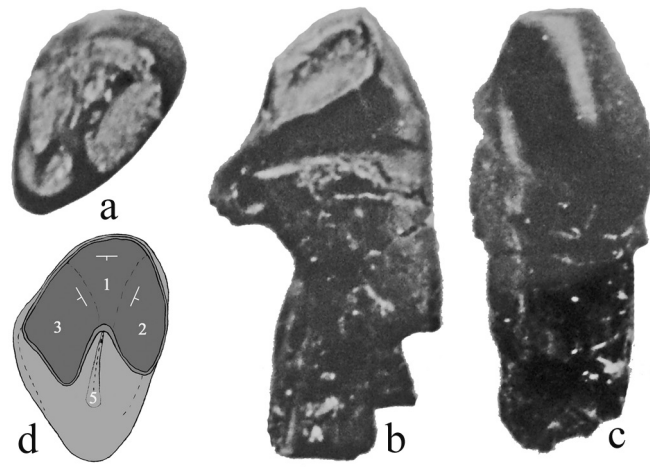


Figure 7. LUVP 7005, carnivore upper incisor from Nungarh, India, previously interpreted as a left p/3 of a hominoid, illustrated prior to damage occurring to the crown and root (images a-c are from Plate 6 of Tiwari, 1982). **a**, occlusal; **b**, mesial; **c**, labial; **d**, apical views. In image **d**, note the three contiguous wear facets (1, apical; 2, mesial; 3, distal) dipping lingually, mesially and distally respectively, and the presence of a narrow groove on the lingual ridge (5) and the thin enamel (Scale 10 mm).

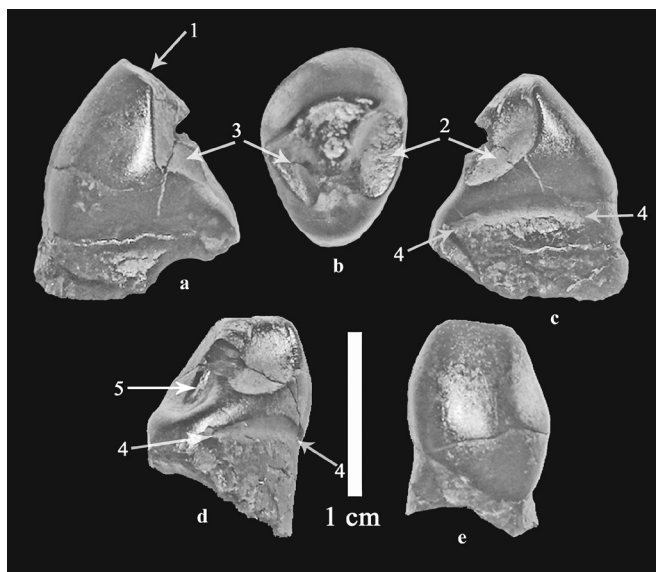


Figure 8. SEM images of LUVP 7005, tooth from Nungarh, Uttar Pradesh, India (same specimen as in Figure 7). **a**, distal; **b**, apical; **c**, mesial; **d**, antero-lingual; **e**, labial views. Note the damaged lingual ridge which significantly complicates interpretation of the fossil. The apical wear facet (1) is contiguous with two scoop-shaped depressions (2, mesial; 3, distal) which are not foveae as previously thought, but were produced by wear. Note the narrow groove (5) near the base of the lingual ridge, and the “indent” (4) extending right across the root immediately beneath cervix on the mesial side of the tooth. Note also the thin enamel (Images courtesy of Rajeev Patnaik).

wear, we consider that this specimen does not belong to a primate, but that it is likely to represent an upper lateral incisor of a large carnivore, possibly an amphicyonid. The combination of an apical wear facet dipping lingually, accompanied by two wear facets descending mesially and distally, and the presence of an “indent” often occurs in carnivores that tug at skin and sinews of their prey, the fibrous tissues producing a groove-like wear channel on the root at gingival level, and the tugging producing pervasive wear of the crown (Fig. 9), especially where the upper and lower incisors interlock.

RAMCHAND RIDGE: PALAEOLOGY

The anterior half of a lower molar from the “southeast face of Ramchand Ridge, south of Ramnagar” in the Doda Member of the Mansar Formation (GSI 20825 (JVF 297) curated in Lucknow) was attributed to *Sivapithecus* sp. by Verma & Gupta (1997) and Verma *et al.* (2002). It is in fact the anterior lophid of a left lower m/3 of the suid *Conohyus*. The specimen is 14.6 mm in bucco-lingual breadth. The protoconid and metaconid are robust, thickly enamelled cusps with subdued “furchen” with coarsely wrinkled enamel. The tooth is moderately worn, and the

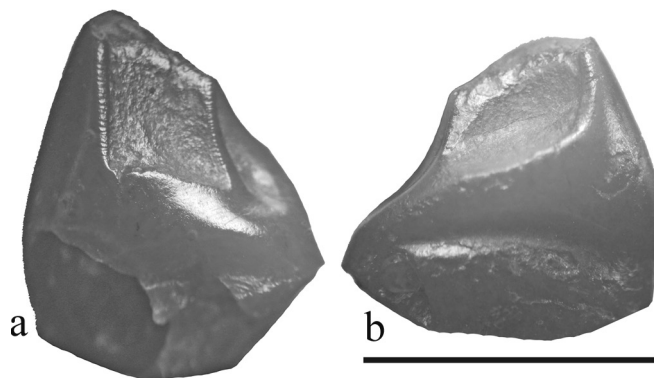


Figure 9. LUVP 7005 from Nungarh, Uttar Pradesh, India, carnivore upper incisor, **a**, distal view of crown showing large distal wear facet bordered by thin enamel scored by numerous narrow grooves sub-parallel to cervix, probably caused by hair abrasion during tugging at skin of prey items. Note also the highly polished enamel surface scored by long striations; **b**, mesial view of crown showing similar but fewer narrow grooves in the enamel, and a large “indent” beneath cervix. The position of the major wear facets, the thin enamel, the presence of an “indent” beneath cervix mesially and the microwear indicate that this tooth does not belong to a primate, but more likely to a carnivore.

roots are fused for a short distance beneath cervix. This tooth evidently represents the species *Conohyus sindiensis* (Lydekker, 1884) as it is compatible in size with teeth of this species (Pickford, 1988).

DHIRAN: PALAEOLOGY

Specimen GSI 20826 (JVF 518) from the basal part of the Ramnagar Member of the Mansar Formation “near Dhiran Village, south of Ramnagar” was identified as an isolated upper incisor of *Dryopithecus* sp. by Verma & Gupta (1997) and Verma *et al.* (2002). The specimen, which is stored in Lucknow, is a left i/1 of the lophodont suid *Listriodon pentapotamiae* (Falconer, 1868). Similar specimens are known in mandibles from the Siwaliks and Europe (Pickford, 1988).

BANDAL

PALAEOLOGY

Gupta (1969) described two fossil specimens from three miles (ca 5 km) east of Bandal, Himachal Pradesh (32°01'38"N : 76°14'11"E) from rocks correlated to the Nurpur zone which were reported to be equivalent to the Chinji Zone of the Lower Siwaliks. The fossils were attributed to *Sivapithecus indicus*, and were claimed to represent “the oldest record of the occurrence of fossil primates from the lower Siwaliks of India”. Examination of

the illustrations (Gupta, 1969: Figs 1, 2) reveal that both fossils belong to Suidae. The supposed left mandible interpreted to contain the fourth premolar and second molar is in fact a right maxilla with P4/-M1/ of *Propotamochoerus hysudricus* (Pickford, 1988) as shown by the presence of three cusps (two buccal, one lingual) in the P4/ and four cusps in the M1/, the bunodont aspect of the teeth and the size relationship between the P4/ and the M1/. The second specimen from the site is also an upper right P4/, more worn than the first specimen but with similar morphology.

The bunodont morphology and dimensions of the Bandal suid teeth are compatible with two species known from the Siwaliks, *Hyotherium pilgrimi* and *Propotamochoerus hysudricus*. The available illustrations are rather dark, making them difficult to interpret, but the specimens resemble *Propotamochoerus hysudricus* rather more than they do *Hyotherium pilgrimi*. Only a re-examination of the original fossils will permit a confident identification.

The Bandal specimens cannot therefore be used to infer a great age for the occurrence of *Sivapithecus indicus* in India.

Nevertheless, there is a mandible of *Sivapithecus* from a different locality at Bandal, described by Pandey & Sastri (1968).

PALAEOANTHROPOLOGY

Sivapithecus lewisi was described by Pandey & Sastri (1968), on the basis of a partial right mandible of large dimensions (Fig. 10) found at Bandal, India (32°01'55" N : 76°16'15"E) not far from Dera Gopipur. The holotype, ONGC/V/790, is a right mandible with roots of the canine

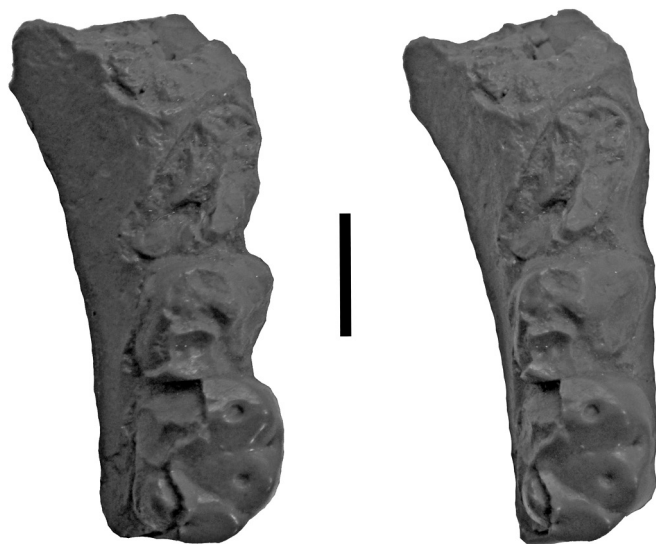


Figure 10. *Sivapithecus lewisi* Pandey & Sastri, 1968, ONGC/V/790, holotype, right mandible fragment containing the roots of canine and p/3 and the crowns of p/4 (lacking most of the enamel) and m/1, from Bandal, India, stereo occlusal view (scale: 10 mm).

and p/3, crowns of p/4 and m/1, and is curated at the Oil and Natural Gas Commission, Dehra Dun. Subsequently, Kelley (1988), created the species *Sivapithecus parvada* for large hominoid specimens from Sethi Nagri, Pakistan. Examination of the Bandal specimen reveals that it belongs to the same species as that from Sethi Nagri, and thus *S. parvada* Kelley, 1988, is a junior synonym of *S. lewisi* Pandey & Sastri, 1968.

The holotype of *Sivapithecus aiyengari* Prasad, 1962, which is a left mandible from Hari Talyangar containing worn p/3-m/2, falls into the range of morphological and metric variation of *Sivapithecus indicus* as was shown by Kelley (1988). Our own analysis of the jaw using the dimensions of the teeth given by Prasad (1968) and a visual inspection of the specimen (GSI 18039) housed in the Geological Survey of India, Calcutta, agrees with this finding (Fig. 11).

Table 6. Measurements (in mm) of the teeth of the holotype of *Sivapithecus lewisi* (ONGC V/790) from Bandal, India (* estimated measurement).

Tooth	Mesio-distal length	Bucco-lingual breadth
Right p/3	16*	9.2*
Right p/4	11.0*	11.6*
Right m/1	13.7*	12.0

BHARARI

CONTEXT

Sankhyan (1985) reported that a hominoid tooth was found in strata west of Bharari and 2 km east of Hari Talyangar, aged about 5.5 Ma, which would mean that it is, by far, the youngest hominoid fossil from India (not counting Pleistocene hominoids). However, the palaeomagnetic data for the Hari Talyangar succession, which was used to determine the age of the specimen, was reinterpreted by Pillans *et al.* (2005) using the GPTS (Geomagnetic Polarity Time Scale) of Brozovic & Burbank (2000), and the R7 polarity chron from which the Bharari molar is reported to have been collected (Sankhyan, 1985) would, in this reinterpretation, be about 8.1 Ma. However, Sankhyan (1985) appears to have misnumbered the chrons above R6. Whereas Johnson *et al.* (1983) show three normal polarity zones above R6 (N7, N8 and N9), Sankhyan (1985) numbered the two lower zones as N7 and the top one as N8. Thus the reported find level of the Bharari tooth should probably be R8 rather than R7. Even with this adjustment, the age of the tooth would likely be about 8 Ma to 7.5 Ma. However, considering the possibility of circular argument when employing palaeomagnetic stratigraphy (Pickford, 1998), it is best not to rely too much on this evidence for dating the tooth. However, an age of 5.5 Ma appears to be far too young for it.

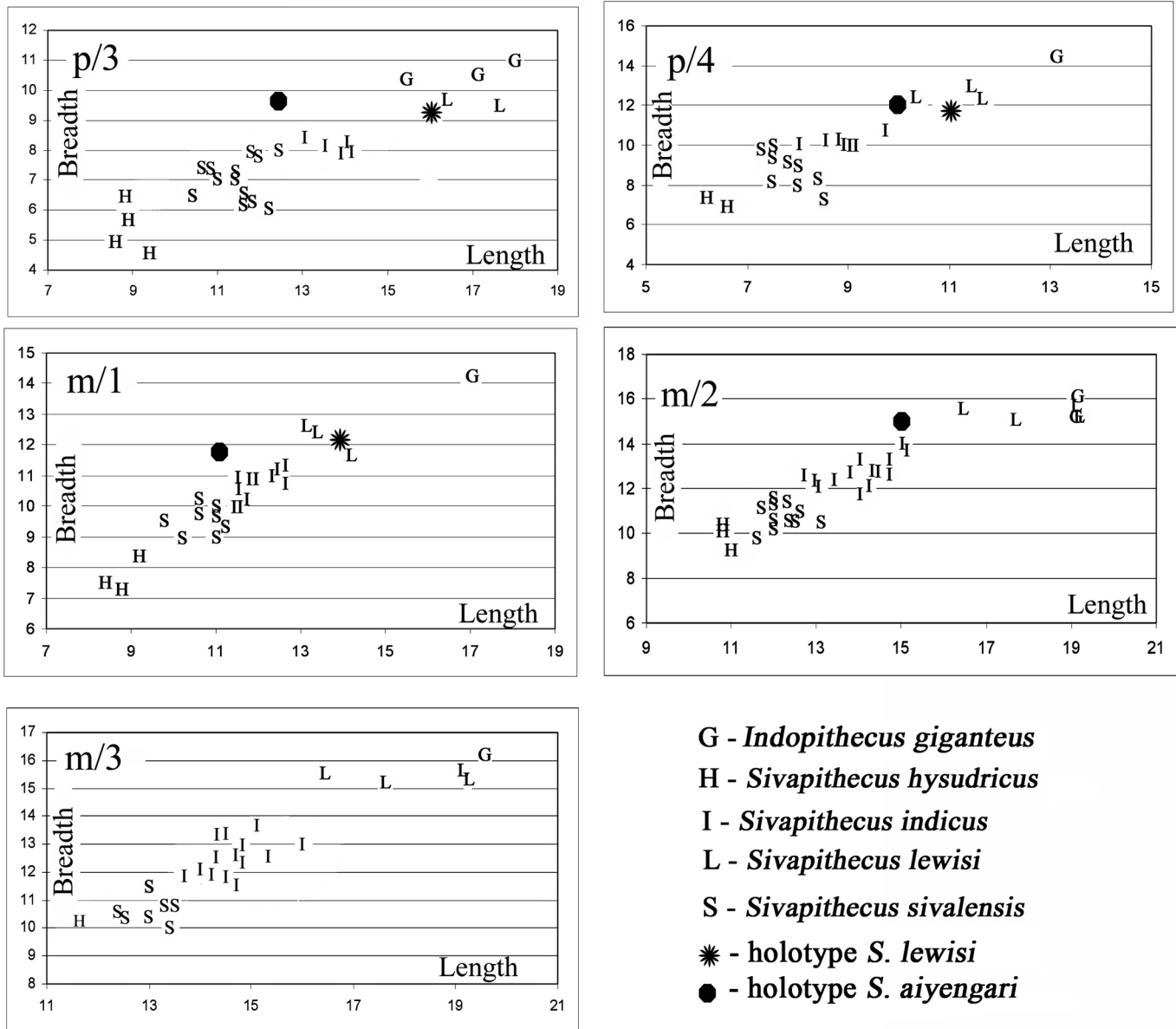


Figure 11. Bivariate plots of lower cheek teeth of Siwalik hominoids (*Sivapithecus* and *Indopithecus* species). Included are the teeth from Dera Gopipur, here attributed to *Sivapithecus hysudricus* (Pilgrim, 1927), and the specimen from Bandal belonging to *Sivapithecus lewisi* Pandey & Sastri, 1968.

PALAEOANTHROPOLOGY

Sankhyan (1985) interpreted a fragmentary tooth from Middle Siwalik deposits 500 metres west of Bharari (31°32'20"N : 76°39'40"E) ca 2 km east of Hari Talyangar, as representing a lower right second molar of *Sivapithecus*. The linguo-mesial part of the metaconid is broken (Fig. 12). The distal interstitial wear facet was described by Sankhyan as being distinct and rounded and positioned on the posterior aspect of the tooth and the mesial interstitial facet is partly preserved despite the broken metaconid. This combination is compatible with interpretation of the tooth as an m/1 or an m/2. In view of its fragmentary nature, the orientation of the intercuspal valleys and the position of

the interstitial facets, this tooth needs to be re-examined in order to confirm its meristic position and affinities.

DISCUSSION AND CONCLUSIONS

There remains some uncertainty about the discovery locus of fossil hominoid teeth from Dera Gopipur (Gupta *et al.*, 1982) on account of the presence of contradictions between the map, the photograph and the text of the paper describing the specimens.

Examination of the fossils reveals that some of the previous determinations of side and meristic positions are

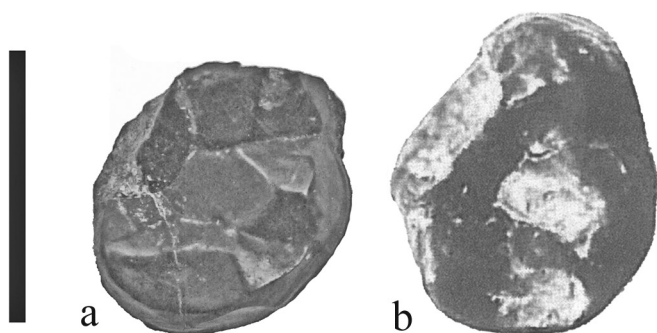


Figure 12. Comparison of the Dera Gopipur right m/2 (a) with a specimen from Bharari (b) (image of Bharari specimen from Sankhyan, 1985) (scales: 10 mm).

incorrect. In comparison with other fossil hominoid teeth from the Siwaliks of the Indian Subcontinent, the Dera Gopipur fossils are small, falling near the low end of the range of variation of *Sivapithecus sivalensis* or beyond it. The shape of the p/3 in the Dera Gopipur sample suggests that it represents a female individual. We here attribute the material to *Sivapithecus hysudricus*.

There are almost no other fossils associated with these hominoid teeth, making it impossible to estimate their age on the basis of biochronology. Correlations of the strata, from which the teeth are reported to have been excavated, remain uncertain, although they have been considered to be equivalent to the Chinji zone by Verma *et al.* (2002).

Kelley (1988) wrote that small Siwalik hominoids are generally geologically younger than the large ones. According to him, *S. sivalensis* is best known from Hari Talyangar, correlated by him to the Dhok Pathan zone which is appreciably younger than Sethi Nagri which yielded *Sivapithecus parvada* and other sites in the Potwar Plateau, Pakistan, up to the U-sandstone level which contain *Sivapithecus indicus*. Thus, if Kelley (1988) is right, then a correlation of Dera Gopipur to the Chinji zone may be too old. However, most of the specimens attributed to *Sivapithecus hysudricus* come from the Chinji type area (Kundal Nala, Kadirpur), and we see no great obstacle to correlating Dera Gopipur to the Chinji zone.

The Dhara (Uttarakhand) hominoid molar also probably belongs to *S. sivalensis* or possibly to *S. hysudricus*. The report of a p/3 from Dhara (Cameron *et al.*, 1999) is based on a single rooted tooth from Nungarh (Uttarakhand) (Tiwari, 1982) which we consider to represent a carnivore incisor.

Two supposed hominoid teeth from Ramchand Ridge and Dhiran near Ramnagar (J&K), are here identified as suids. The inferred presence of Early Miocene (18.3 Ma) large hominoids in India (Verma & Gupta, 1997) cannot be substantiated on the basis of these fossils. Finally, two specimens reported to be from the Nurpur Zone near Bandal (HP), attributed to *Sivapithecus indicus* by Gupta (1969) belong to suids, and cannot therefore be used to infer a great age for the presence of hominoids in India.

Nevertheless, the Bandal region has yielded a large *Sivapithecus* mandible, here attributed to *S. lewisi* Pandey & Sastri, 1968, of which *Sivapithecus parvada* Kelley, 1988, is a junior synonym.

The earliest well substantiated records of large hominoids in India are those from Ramnagar from deposits which are probably equivalent in age to Chinji levels, and thus about 13-11.5 million years old. The fossil molar from Dhara is likely to be somewhat younger, perhaps ca 11-10 Ma (Cameron *et al.*, 1999). The Indian evidence thus accords with that of Pakistan, with large bodied hominoids currently unknown from levels older than 13 Ma. This contrasts with Europe, where large hominoids have been reported in MN 5 (or MN 5-6) (Engelswies, Germany: Heizmann, 1992; Heizmann & Begun, 2001) and MN 6 (Candir and Pasalar, Turkey; ca 14 Ma: Andrews *et al.*, 1996). The dating of the European deposits is the subject of debate (Agustí *et al.*, 2001) but Heizmann & Begun (2001) estimated an age of 16.5 Ma for Engelswies. Pickford (1998) in contrast dated Engelswies at ca 14 Ma. The Hari Talyangar hominoids (ca 8-7 Ma) are among the youngest known from the subcontinent, although a doubtful claim for an even younger specimen (ca 5.5 Ma) has been made (Sankhyan, 1985). If our assessment of the ages of the Indian fossils is correct, then it is concluded that large bodied hominoids survived in the subcontinent from ca 13 to ca 8-7 Ma (Pickford, 1998).

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