DORCATHERIUM MINUS FROM THE SIWALIKS, PAKISTAN

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ABSTRACT

New material of the tragulid *Dorcatherium minus* from the Lower and Middle Siwaliks of Pakistan is described in this paper. The recently discovered dental remains are an essential contribution to our knowledge about intraspecific variability in dentition of *D. minus.* This paper describes specimens found from the Lower and Middle Siwaliks of Pakistan. The following investigation documents new material and contribute to recent work on *D. minus* from the Siwaliks of Pakistan.

Key words: Siwaliks, *D. minus*, Fossils, Protocone, Paracone, Metacone, Hypocone.

INTRODUCTION

The Tertiary continental formations of the northern Pakistan have yielded some of the richest fossil mammalian faunas from South Asia. Fossil remains from this area have been known since the nineteenth century and large mammals have been the object of several monographies (Lydekker, 1883a, b, 1884; Pilgrim, 1910, 1912; Colbert, 1935; Barry, *et al*, 2002). The Siwalik Group in Pakistan can be clearly divided, according to the lithological characters, into the usual three subgroups-Lower, Middle and Upper, and further into their formation scale lithostratigraphic units (Quade and Cerling, 1995; Flynn, 2003; Flynn *et al*., 1995; Basu, 2004). The Siwalik hills are relatively low in their heights bearing an altitude from 300 to 1200 meter above the sea level. These hills contain a series of parallel ridges, giving rise a belt of 13 km or so in width (Colbert, 1935). The thickness of Siwalik Group is variable. Its maximum thickness is 4400 meters, reported at the Sil River. The Siwalik group is richly fossiliferous from Middle Miocene to Early Pleistocene (Pilbeam *et al*., 1977; Barry *et al*., 1982, 1985; Flynn, 1986). The Siwalik hills are thoroughly visited and many specimens of *D. minus* are found from various localities of the Lower and Middle Siwaliks of Pakistan.

MATERIALS AND METHODS

Surface collection is the primary method to collect the fossils of *D. minus*. Some fossils were found lying completely exposed on the surface so they were simply collected. However, some specimens were found partly exposed and embedded within the rocks. So the excavation method had to apply and the embedded material was excavated with the help of the fine chisels and geological hammer. The material was washed, cleaned and prepared for the identification in the Palaeontolgy laboratory of Punjab University. In the following descriptions comparisons are made with fossils in the American Museum of Natural History (AMNH), (Colbert, 1935) Geological Survey of India (GSI) (Colbert, 1935) and Punjab University Palaeontological Collections. The material is the property of the Punjab University Palaeontological Collection, Pakistan (institutional abbreviation PUPC). The specimens catalogued number consists of series i.e., yearly catalogued number and serial catalogued number, so figures on the specimen represents the collection year and serial number of that year.

SYSTEMATIC PALAEONTOLOGY

Suborder: Ruminantia (Scopoli, 1777)
Family: Tragulidae Milne-(Edwards, 1864)
Genus: *Dorcatherium* (Kaup, 1833)
Type Species: *Dorcatherium nauii* (Kaup, 1833)
Included Species: *Dorcatherium majus* (Lydekker, 1876); *Dorcatherium minus* (Lydekker, 1876); *Dorcatherium minimus* (West, 1980); *Dorcatherium nagrii* (Guar *et al*., 1983).
Distribution: Europe, East Africa and the Siwaliks.

***DORCATHERIUM MINUS* (Lydekker, 1876)**

Type Specimen: GSI 195, two upper molars, namely right M^{1-2} (Colbert, 1935).
Material: PUPC 68/355, PUPC 87/40, PUPC 87/84, PUPC 95/01, PUPC 02/01, PUPC 68/41, PUPC 86/81, PUPC 02/158, PUPC 68/312, PUPC 68/313, PUPC 68/294, PUPC 68/311, PUPC 85/59, PUPC 83/610, PUPC 83/626, PUPC 84/82, PUPC 85/35, PUPC 86/266, PUPC 96/66.
Localities: Hasnot, Nagri, Chinji, Rati Dheri, Bhandar, Vasnal, Bhilomar.
Stratigraphic Range: Lower to Middle Siwaliks.
Diagnosis: The cheek teeth are prominently hypsodont. The upper molars bear strongly developed styles and

basal cingulum. The lower molars are characterized, either by well-developed median basal pillar or by a vestigial median basal pillar. A small species of the genus *Dorcatherium* with sub-hypsodont molar and broad crowned molars having well developed cingulum, rugosity, styles, moderately developed ribs and a vestigial median basal pillar.

DESCRIPTION

PUPC 68/355 (Fig. 1a and b) includes a right maxilla having M^{1-3}. The teeth are in the excellent state of preservation. The maxilla anterior to M^1 and posterior to M^3 is missing. A portion of maxilla in front of M^{1-2} is well preserved, which indicates that maxilla was moderately thick. The first molar is half worn causing the exposure of dentine of all the four cones. The protocone is less crescentic as its inner border is rounded and outer border is straight, parallel to the longitudinal axis of the dentary. The second molar is in its best form of preservation. The enamel is 0.5 mm thick and is finely wrinkled all around the tooth except the labial side of the tooth where it becomes very faint. A well developed cingulum is present on all sides of the tooth except the labial side. The parastyle is well developed but the mesostyle is more developed than both the parastyle and metastyle. Metastyle is almost negligibly developed. Median rib of paracone is strongly developed, whereas that of metacone is very weakly developed. The third upper molar is complete and well preserved. The tooth is entirely unworn, so the thickness of enamel could not be measured. The enamel is very finely rugose all around the tooth. This rugosity is more prominent on the lingual side of the inner cones. A well developed cingulum is present on the anterior, lingual and posterior sides of both the lingual cones. Transverse valley is deep enough.

PUPC 87/40 and PUPC 87/84 are well preserved except the labial side of the specimens. PUPC 95/01 is complete and in its excellent state of preservation. It is at middle stage of wear. PUPC 02/01 is a fragment of right maxilla having M^{1-3}. The first molar is extremely damaged but the second and third molars are well preserved. PUPC 68/41 and PUPC 86/81 are isolated second right upper molars. The molars are complete and well preserved. PUPC 02/158 (Fig. 2) is a right mandibular ramus having P_3-M_3. The mandibular ramus is in its excellent form of preservation. It is posteriorly damaged from the ventral side of the ascending ramus. Its anterior margin is at the start of P_3. The mandible is thick.

The antero-posterior length of the molar series M_{1-3} is 43 mm, while that of ascending ramus is 14.6 mm. The depth of the ascending ramus is 25.6 mm, whereas the depth of the horizontal ramus below the first lobes of P_3, P_4, M_1, M_2 and M_3 are 12.9 mm, 13.2 mm, 16.1 mm, 14.8 mm and 17.3 mm respectively. There is a longitudinal depression on the labial side, along the inferior border of the ramus, which loses its prominence towards the anterior side gradually. The third lower premolar is well preserved but its first lobe is missing. PUPC 68/312 is a left mandibular ramus bearing M_{1-3}.

Table 1: The comparative measurements of the studied cheek teeth of *D. minus*.

Number	Position	Length	Width	Height
PUPC 68/355	M^1	9.2	10.0	4.6
PUPC 87/40	M^1	10.0	11.7	10.6
PUPC 87/84	M^1	9.3	10.0	7.5
PUPC 95/01	M^1	9.3	9.0	4.8
PUPC 02/01	M^1	8.0	10.0	4.0
AMNH 19517	M^1	12.0	11.0	7.5
AMNH 29856	M^1	9.8	10.0	7.0
GSI B.195	M^1	10.0	10.0	8.0
PUPC 68/41	M^2	11.0	13.0	10.0
PUPC 68/355	M^2	10.5	11.8	7.8
PUPC 86/81	M^2	10.0	12.2	10.5
PUPC 95/01	M^2	10.0	11.0	6.6
PUPC 02/01	M^2	10.55	11.65	5.2
AMNH 29856	M^2	11.3	12.0	8.5
GSI B.195	M^2	11.0	12.0	10.0
PUPC 68/355	M^3	11.7	13.0	11.2
PUPC 01/2002	M^3	11.75	12.35	8.0
AMNH 29856	M^3	11.5	13.0	10.0
PUPC 68/312	M_1	9.15	5.35	5.95
PUPC 68/313	M_1	8.95	5.6	5.8
PUPC 02/158	M_1	10.6	6.7	5.5
GSI B.594	M^1	12.5	7.5	--
PUPC 68/294	M_2	11.0	6.45	7.7
PUPC 68/311	M_2	10.0	6.6	6.0
PUPC 68/312	M_2	10.0	6.2	6.75
PUPC 68/313	M_2	10.25	6.75	7.0
PUPC 85/59	M_2	9.5	7.0	4.5
PUPC 02/158	M_2	12.7	8.25	7.85
AMNH 19365	M_2	13.0	12.0	12.5
AMNH 19366	M_2	7.5	7.5	7.5
GSI B.594	M_2	--	9.0	--
PUPC 68/294	M_3	16.1	6.8	7.8
PUPC 68/311	M_3	14.8	7.85	6.8
PUPC 68/313	M_3	15.65	7.4	8.25
PUPC 83/610	M_3	18.5	8.5	6.5
PUPC 83/626	M_3	12.5	8.0	7.0
PUPC 84/82	M_3	18.4	8.3	8.5
PUPC 85/35	M_3	15.0	7.0	8.0
PUPC 85/59	M_3	14.25	7.0	5.55
PUPC 86/266	M_3	14.5	6.4	9.7
PUPC 96/66	M_3	13.0	6.30	7.6
PUPC 02/158	M_3	18.55	8.7	9.6
AMNH 19365	M_3	18.0	16.0	16.7
AMNH 19366	M_3	8.0	8.0	8.3
GSI B.594	M_3	10.0	10.0	9.0

The specimen is nicely preserved and includes a mandibular ramus with completely erupted first and second molars and partially erupted third molar. PUPC 68/313 a right mandibular ramus bearing M_{1-3}. The anterior margin of the horizontal ramus lies approximately beneath the first lobe of the P_4, whereas P_4 itself is completely damaged; the remaining anterior portion of the ramus is destroyed. PUPC 68/294, PUPC 68/311 and PUPC 85/59 are mandibular ramii having second and third molars. The specimens are well preserved and showing all the morphological characters of the species. PUPC 83/610, PUPC 83/626, PUPC 84/82, PUPC 85/35, PUPC 86/266 and PUPC 96/66 are isolated lower third molars. The specimens have well developed talonid and all the major conids are well differentiated. The comparative measurements of the upper and lower dentitions are provided in table 1.

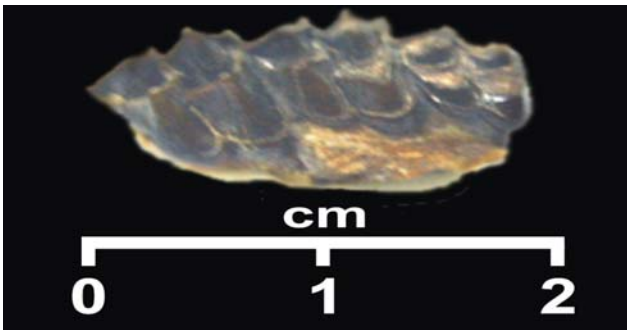

Figure 1A: *D. minus*, Occlusal view of the upper first, second and
third molars (PUPC 68/355).

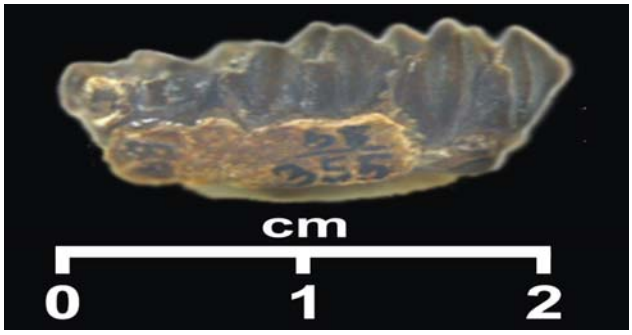

Figure 1B: *D. minus*, Buccal view of the upper first, second and third molars (PUPC 68/355).

DISCUSSION

The studied specimens have crescentic cones which make their inclusion to ruminants and exclude them to Perissodactyls and Proboscideans. The specimens are not large enough to belong to giraffids, bovids and cervids. The specimens including maxillary ramii bearing molars, mandibular fragments with molars, and isolated upper and lower molars are referred to the genus

Figure 2: *D. minus*, Occlusal view of the lower third, and fourth premolar
and first, second and third molars (PUPC 02/158).

Dorcatherium on the basis of well developed styles and basal cingulum in upper molars and a median basal pillar in the lower molars. Both upper and lower molars display the morphological characters of *Dorcatherium minus* described by Lydekker (1876) and Colbert (1935) e.g., the small sized upper and lower molars. The upper molars are characterized by their finely rugose enamel, a comparatively weak mesostyle and well developed internal cingulum, whereas the lower molars are characterized by slight rugosity and a vestigial median basal pillar. Regarding measurements almost all the specimens under study are found to closely resemble to the type specimens. The comparative study of first upper molar of referred specimens PUPC 68/355, 87/40, 87/84, 95/01 and 02/01 with the type specimen AMNH 19517 and 29856 and GSI B195 indicates close resembling in their antero-posterior lengths, widths and indices of W/L and H/W, whereas the differences fall within the limits of variations. As far as the second upper molar is concerned, displaying the comparison of lengths, widths and indices of W/L and H/W between the referred specimens PUPC 68/355, 86/81, 95/01, 02/01, 01/2002 and the type specimens AMNH 29856 and GSI B195. The third upper molars of referred specimens PUPC 68/355 and 01/2002 are found to have very close measurements of lengths, widths and indices of W/L and H/W with the type specimen AMNH 29856. As far as the lower molars are concerned, the first molar is not described by Lydekker (1876) and Colbert (1935), so comparative study is not possible. All the referred specimens PUPC 68/312, 68/313 and 02/158 bear very close measurements regarding their lengths, widths and indices of W/L and H/W. The second lower molars of the referred specimens, including PUPC 68/294, 68/311, 68/312, 68/313, 85/59 and 02/158 are compared with the type specimens AMNH 19365 and 19366. It is found that their antero-posterior lengths, widths, lie within the limits of variation. Their indices of W/L and H/W exhibits that all

the specimens are narrow crowned and hypsodont except one specimen PUPC 85/59, which is sub-hypsodont. A large number of referred specimens with third lower molar including, PUPC 68/294, 68/311, 68/312, 68/313, 83/610, 83/626, 84/82, 85/35, 85/59, 86/266 and 96/66 are compared with the type specimens AMNH 19365 and 19366 and found that almost all the measurements regarding lengths, widths and indices of W/L and H/W falls in the range of variation within a species. The above said discussion leads to the conclusion that all the specimens belong to the species *Dorcatherium minus* Lydekker undoubtedly.

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