New remains of *Giraffa priscilla* from Parrhewala Chinji Formation, Northern Pakistan

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**ABSTRACT**

New giraffid remains comprising upper dentition recovered from the Parrhewala outcrops (Upper Chinji Formation) of the Lower Siwaliks, northern Pakistan. The remains are assigned to *Giraffa priscilla*. *Giraffa priscilla* is endemic to the Lower Siwaliks and is unknown from outside of this region. *G. priscilla* is found in the Middle Miocene (14.2-11.2 Ma) of the Siwaliks. All the described specimens have broad crown, strong styles and median ribs.

**Keywords:** Mammalia, Giraffidae, Giraffinae, Middle Miocene, Siwaliks.

**INTRODUCTION**

The foot hills of Himalayas, Potwar, Suleman Range (Punjab), Kirthar (Sind), Waziristan (NWFP) and many scattered patches in Baluchistan are known as Siwalik Group. The Siwalik formations are also located in India, Nepal and Bhutan ranging 6-90 km in width (Acharyya, 1994). Siwalik Hills are famous for its fossil fauna. Almost all major vertebrate and invertebrate phyla have been recorded from these formations.

The Siwalik Hills are relatively low, having an altitude from 300 to 1200 meter above sea level (Ahmed, 1995). The Hills actually comprise a series of parallel ridges, forming a belt some 13 km in width (Colbert, 1935). Fossil record of Pakistan Potwar Plateau is best for the interval from 18 to 6 million years ago (Lihoreau et al., 2004).

The Suborder Ruminantia (Order Artiodactyla) is well represented in the Siwaliks from the small tragulid (*Darcotherium minus*) to the large giraffid (*Bramatherium*) (Barry & Flynn, 1989). Since then a number of genera and species of Family Giraffidae have been recovered from various formations of the Siwaliks by different workers such as Matthew (1929), Colbert (1935), Sarwar (1990).

Matthew (1929) described *Giraffa priscilla* from the Lower Siwaliks. However, the fossils of this species are limited. Pilgrim (1911) found upper left second and third molars of *Giraffa priscilla*, but post-cranial skeleton is not known. Basu (2004) identified *Giraffa priscilla* from lower Siwaliks of Ramnager (India). According to him, fossils of *Giraffa priscilla* are Middle Miocene in age. Pakistan Lower Siwaliks i.e. Chinji Formation represent the same fauna.

**Geography and geology**

The Chinji Formation lies in the Potwar Plateau of Pakistan. It is composed of bright red clays and sub-ordinate brown grey sandstones. The age of Chinji Formation is Middle Miocene from 14.2-11.2 Ma (Barry et al., 2002; Nanda, 2002, 2008). New remains of *Giraffa priscilla* described here have been recorded from locality of Parrhewala which is 12.2-11.2 Ma in age.

**Parrhewala**

Parrhewala (Late. 32° 41’ N; Long. 72° 16’ E) is a local farm located at about 1 km south east of the Chinji village (Fig. 1). Upper Chinjian rocks are well exposed bearing Lower Siwaliks fauna. Bright red clays with abundant of siliceous nodules forming pseudo conglomerates are the dominating feature (Sarwar, 1990).

**Abbreviations**

Ma, Million years ago; P, Premolar; M, Molar; l, Left; r, Right; GCUPC, Government College University Paleontological Collection, Lahore, Pakistan; PUPC, Punjab University Paleontological Collection, Lahore, Pakistan; GSI, Geological Survey of India; AMNH, American Museum of Natural History, New York, USA; W/L, Width/Length ratio; mm, Millimeters.
**MATERIALS AND METHODS**

The studied material was collected from the Parrhewala (Upper Chinji Formation) of Lower Siwaliks Pakistan. The clay was removed with the help of needles and brushes. The unwanted sediments were washed in the paleontology laboratory of Zoology Department of GC University, Lahore with the help of phosphoric acid. Each specimen was catalogued e.g. 1164/13, the nominator shows the serial number of the collection and the denominator denotes the collection year.

Length and breadth measurements were taken at occlusal level by a digital vernier caliper. The material is compared with the specimens present in the Indian Museum Calcutta, American Museum of Natural History New York and Punjab University Paleontological Collection in Zoology Department, University of the Punjab, Lahore, Pakistan.


**SYSTEMATIC PALAEONTOLOGY**

Order ARTIODACTYLA Owen, 1848
Suborder RUMINANTIA Scopoli, 1777
Infraorder PECORA Linnaeus, 1758
Superfamily GIRAFFOIDEA Gray, 1821
Family GIRAFFIDAE Gray, 1821
Subfamily GIRAFFINAE Zittel, 1893
Genus GIRAFFA Brisson, 1756

*Type species.* Giraffa giraffe Brisson, 1756

**Generic diagnosis.** Members of this genus are medium sized with much elongated neck and limbs. Basicranial and basipalatal inclined at a small angle. Both sexes have two short ossicones on parieto-frontal and a median naso-frontal protuberance. A pre-lachrymal vacuity is present (Colbert, 1935). Dentition is moderately brachyodont. Premolars are complex and molariform. Buccal enamel coarsely rugose (Harris et al., 2010). The enamel forms outgrowths into the central cavity from the crescents. Upper teeth are with strong external ribs. Breadth is in excess of length. Lower incisors and canines are robust. Lower molars not elongated, generally rudimentary tubercles but a large one always present in M₁ and generally in M₃ (Mathew, 1929; Colbert, 1935).

**Geographic distribution.** Giraffa is best known from Pakistan, India, Ethiopia, Kenya, Malawi, Tanzania, South Africa and Uganda (Pilgrim, 1911; Basu, 2004; Bhatti, 2005).

*Giraffa priscilla* Matthew, 1929

*Lectotype.* GSI B511, a left M³

*Type locality.* Chinji, Lower siwaliks, Punjab, Pakistan (Matthew, 1929).

*Stratigraphic range.* Lower Siwaliks (Chinji Formation of Pakistan and India) (Matthew, 1929; Colbert, 1935; Basu, 2004; Bhatti, 2005; Khan et al., 2012)

*Specific diagnosis.* Teeth are broad crowned and more brachyodont as compared to Giraffokeryx. Anterior rib and metastyle are very strong; in M₃ the more oblique-set inner crescents, broad third lobe with strong accessory basal cusp in front of it, as well as shorter crown (Matthew, 1929).

*New material:* GCUPC 1164/13-rP², GCUPC 1147/09- rP⁴, GCUPC 1138/09- lM², PUPC 68/13-rM².

**DESCRIPTION**

*P².* The specimen (GCUPC 1164/13) is an isolated lower right second premolar (Fig. 2(1)). The tooth is excellently preserved and moderately worn out. The dentine is exposed all over the crown surface. It is quadrangular in general contour. A thick layer of cingulum is present all over the crown surface. The enamel layer is thick, shiny and corrugated at the anterior, posterior and lingual sides. It is broad crowned tooth having four types of cones. The protocone and metaconule are low in vertical height than the labial cusps i.e. paracone and metacone.
The protocone is moderately worn out and its dentine is exposed. It is contiguous with the metaconule posteriorly. The metaconule and protocone are not differentiated due to wearing. The metaconule is connected with metacone by cingular ridges. The paracone is present anterolabially. Preparacrista is shorter than postparacrista. The enamel lining of paracone is thick and shiny. It is pushed outward and backward to form protostyle. It is visibly distinct and free at anterior part of cusp.

The metacone is present posterior to paracone. It is inverted “V” shaped. Its enamel border is thick and corrugated. The metacone is pushed outward posteriorly to form pillar like structure called metastyle. The enamel folding of metacone extend anteriorly and paracone posteriorly and outwardly to form a very strong and thick mesostyle which is supported by cingular ridges. A large V-shaped central cavity is present between lingual and labial cusp. Longitudinal valleys are wavy and shallow while transverse valley is open lingually but closed labially in the middle of crown.

The protocone is present at anterior lingual side of crown. It is moderately worn out and dentine is exposed. It is surrounded by thick layer of cement, but quite thick at the lingual side of crown. The enamel layer is rugose and somewhat shiny; mostly it is rough perhaps due to weathering. All the four principal cusps i.e. protocone, metaconule, paracone and metacone are clearly visible.

The paracone is present at anterior lingual side of crown. It is moderately worn out and dentine is exposed. It is surrounded by thick layer of cement. The metaconule is present at posterior side of protocone. Its enamel border is thick and rugose. It is completely worn and filled by a thick layer of cement. The metaconule and protocone are almost worn out forming a continuous structure. Therefore its dental morphology cannot be obscured.

The paracone is inverted V-shaped, having a thick and rugose enamel border. It is largely worn out to form dentinal island with metacone. The enamel surface of paracone is folded back anteriorly forming a thin pillar like parastyle. The metacone is present at posterior labial side of tooth. The metacone is somewhat spade shaped having a thick labial enamel lining.

The enamel lining of metacone posteriorly folded back to form a very strong pillar like structure called metastyle running up at the base of crown surface. The enamel lining of metacone extend anteriorly and paracone posteriorly and outwardly to form a very strong and thick mesostyle. The central cavity between lingual and labial cusps is not visible due to cement. The transverse valley is open at the lingual side but it is closed labially by the mesostyle. The longitudinal valleys are straight and open both anteriorly and posteriorly.

\[M^2\] GCUPC 1138/09 is \(\text{lM}^2\) (Fig. 2(3)) and PUPC 68/13 is \(\text{rM}^2\) (Fig. 2(4)). Both the teeth are broad crowned. A pressure mark is present anteroposteriorly, which indicates that they are second molars. The lingual cingulum is quite thick and it forms a shelf like structure which is highly corrugated and shiny while the labial cingulum present on the paracone and metacone are incipiently developed.

All the four cusps i.e. protocone, metaconule, paracone and metacone are mostly worn out; dentine is exposed forming isolated dentinal islands. The preprotocrista and postprotocrista are almost same in size. It is contiguous with paracone anteriorly by thick enamel vertical fold. It is bounded by thick layer of enamel and supported by cingular ridges and protostyle. The metaconule is present posterior to protocone. Its premetaconule crista is \(\text{V}\)-shaped while postmetaconule crista is crescent in shape. The metaconule is surrounded by thick layer of enamel. The enamel lining of the metaconule at the lingual side extends backward and connected with posterior border of protocone. The metaconule is supported by cingular ridges.

The paracone is present anterolabially. It is perfectly \(\text{V}\)-shaped and its enamel lining anterolabially directed forward and backward to form a very thick low in vertical height pillar like structure parastyle. The preparacrista and postparacrista are nearly equal in size. The paracone has a very strong and thick labial rib. The metacone is higher than paracone. The premetaconule is elongated in contrast to postmetaconule. The metastyle and mesostyle running at the base of teeth are quite broad and strong. Median ribs are quite thick and pillar like present in the middle of proto- and metacone.

The anterior and posterior fossettes are \(\text{V}\)-shaped and quite shallow, surrounded by thick layer of enamel border. Transverse valley is linear and shallow, open both lingually and labially while longitudinal valley is wavy and extend anteroposteriorly. Two root fangs are much clear at the base of the protocone and metaconule.
The teeth are selenodont having rugose enamel sculpture so they can be attributed to the family Giraffidae (Pilgrim, 1911). In the Lower Siwaliks, only small genera of this family are present, so the specimens can be compared with the maxilla of *Giraffokeryx* or *Giraffa* (Colbert, 1935; Bhatti, 2005). However, these two differ greatly in their dental morphological characteristics. In *Giraffokeryx*, major cusps are in a straight line (Pilgrim, 1911; Bhatti, 2005). Styles are weakly developed (Pilgrim, 1911; Colbert, 1935; Bhatti, 2005). Median ribs are very faint (Matthew, 1929; Colbert, 1935). Spur is present on anterior fossette (Bhatti, 2005). Crown is narrow as compared to *Giraffa* (Bhatti et al., 2012).

But in *Giraffa*, major cusps are not in a straight line (Pilgrim, 1911; Bhatti, 2005). Styles are strong and pillar like (Colbert 1935; Bhatti et al., 2012). Median ribs are prominent (Matthew 1929; Colbert, 1935). Spur is absent on anterior fossette (Bhatti, 2005). Crown is comparatively broad (Bhatti et al., 2012).

Regarding size and morphological dental features, the specimens are very close to genus *Giraffa* (Table 1, Fig. 3). Three species of this genus are present in the Siwaliks of Pakistan i.e. *Giraffa priscilla*, *Giraffa punjabiensis*, and *Giraffa sivalensis*. *Giraffa sivalensis* is a large species present in the Upper Siwaliks of Pakistan. The posterior half of tooth is much reduced as compared to other species of this genus. Metastyle is not prominent in this species (Colbert, 1935; Bhatti, 2005). *Giraffa punjabiensis* is recorded from Middle Siwaliks of Pakistan. It is distinguished from other species by having less reduced posterior half of tooth and weak metastyle. *Giraffa priscilla* is reported from Lower Siwaliks of Pakistan. It differs from other two species of *Giraffa* by having less reduced posterior half and strong pillar like metastyle.

The described dental material is collected from the Parrhewala (Upper Chinji Formation) of Lower Siwaliks Pakistan. All the specimens under study have broad crown. In all teeth, cusps are not in a straight line. Styles and median ribs are well developed especially metastyle is very strong. The posterior half of the tooth is also reduced as compared to *Giraffokeryx*. On the basis of these similarities i.e. morphological features, measurements and W/L index (Table 1, Fig. 3), all the premolar and molars refer to *Giraffa priscilla* and can be compared with the specimens discussed by Matthew (1929), Pilgrim (1911), Colbert, (1935), Bhatti (2005) and Bhatti et al. (2012). This species was identified by Matthew (1929) from Lower Siwaliks and is known only from Middle Miocene Lower Siwaliks localities of Pakistan and India (Colbert, 1935; Basu, 2004; Bhatti, 2005).
Table 1: Comparative dental measurement of the cheek teeth of the Siwalik *Giraffa priscilla* in mm (millimeters). *the studied specimens. Referred data are taken from Matthew (1929), Bhatti (2005) and Bhatti et al. (2012).

<table>
<thead>
<tr>
<th>Taxa</th>
<th>Number</th>
<th>Nature</th>
<th>Length</th>
<th>Width</th>
<th>W/L</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>G. Priscilla</em></td>
<td>GCUPC 1164/13*</td>
<td>P&lt;sup&gt;2&lt;/sup&gt;</td>
<td>21.7</td>
<td>14.5</td>
<td>0.67</td>
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<tr>
<td></td>
<td>GCUPC 1147/09*</td>
<td>P&lt;sup&gt;4&lt;/sup&gt;</td>
<td>20.3</td>
<td>22.5</td>
<td>1.11</td>
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<tr>
<td></td>
<td>GCUPC 1138/09*</td>
<td>M&lt;sup&gt;2&lt;/sup&gt;</td>
<td>25.2</td>
<td>28.6</td>
<td>1.13</td>
</tr>
<tr>
<td></td>
<td>PUPC 68/13*</td>
<td>M&lt;sup&gt;2&lt;/sup&gt;</td>
<td>25.0</td>
<td>27.5</td>
<td>1.10</td>
</tr>
<tr>
<td></td>
<td>PUPC 02/99</td>
<td>P&lt;sup&gt;4&lt;/sup&gt;</td>
<td>19.5</td>
<td>21.0</td>
<td>1.08</td>
</tr>
<tr>
<td></td>
<td></td>
<td>M&lt;sup&gt;2&lt;/sup&gt;</td>
<td>25.0</td>
<td>28.0</td>
<td>1.12</td>
</tr>
<tr>
<td><em>G. punjabiensis</em></td>
<td>GSI K 13/349</td>
<td>P&lt;sup&gt;4&lt;/sup&gt;</td>
<td>22.0</td>
<td>20.0</td>
<td>0.91</td>
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<tr>
<td></td>
<td>PUPC 95/23</td>
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<td>20.0</td>
<td>23.0</td>
<td>1.15</td>
</tr>
<tr>
<td></td>
<td>PUPC 86/84</td>
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<td>34.0</td>
<td>28.0</td>
<td>0.82</td>
</tr>
<tr>
<td><em>G. sivalensis</em></td>
<td>PUPC 69/123</td>
<td>P&lt;sup&gt;4&lt;/sup&gt;</td>
<td>18.0</td>
<td>22.5</td>
<td>1.25</td>
</tr>
</tbody>
</table>

Fig. 3: Scatter diagram showing dental proportions of the Siwalik *Giraffa* species. Referred data are taken from Matthew (1929), Bhatti (2005) and Bhatti et al. (2012).
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REFERENCES


