Giraffa punjabiensis (Giraffidae: Mammalia) from Middle Siwaliks of Pakistan

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Abstract.—Giraffa fossils constitute rare findings in the Dhok Pathan Formation of the Middle Siwaliks. The described remains comprise two maxillar fragments of Giraffa punjabiensis. This paper deals with the study of the upper dentition of G. punjabiensis; recovered from the Padhri outcrops of the Pakistani Middle Siwaliks (Late Miocene). The giraffid suggests a woodland habitat with swamps.

Key Words: Giraffids, Ruminantia, mammals, vertebrates, Siwaliks, Late Miocene.

INTRODUCTION

Giraffa remains have been recovered from the Padhri outcrops of the Middle Siwaliks, Pakistan. The Padhri village is situated at about 57 km west of the Jhelum city in the Potwar Plateau of northern Pakistan (Fig. 1). Topographically, the locality represents water channels, levees and paleosols of varying length and width. Ponds and swamps may also be located but are less frequent. The fossil remains were collected from the site (32° 52' 009 N: 73° 18' 297 E) situated at the southeast of the Padhri village at an altitude of about 1083 ft (Fig. 1).

The fossiliferous Padhri outcrops are situated in the northwest of Hasnot and belong to the upper part of the Dhok Pathan Formation of the Middle Siwaliks, lithostratigraphically (isochronous to the European Late Turolian age, ca. MN 13), and the time of deposition ranges from 7 to 5 Ma (Badgley and Behrensmeyer, 1980; Barry et al., 1982; Barry, 1987; Khan, 2008). The fossiliferous outcrops consist of well cemented, orange red claystone and, light gray sandstone with horizons of small conglomerates in the upper part. The fossil bearing sediments were probably deposited by a fluvial system which led to the formation of a complex landscape exhibiting water bodies, reedy marshes, meadows of herbs and shrubs, wood lands and forests (Barry et al., 2002).

During the last 100 years the Padhri outcrops have become famous for their Miocene mammal record, and the fossil collection and detailed investigation of the collected vertebrate' fauna by several researchers (Colbert, 1935; Pilgrim, 1937, 1939; Akhtar, 1992; Khan, 2007, 2008). Despite the fact that the genus Giraffa was rather diversified during the Late Miocene, it is not well represented in any of the respective famous sites in the Siwaliks. However, Padhri has yielded two well-preserved Giraffa cranial part remains that probably belonged to a single individual. In this paper we describe these scarce remains, assigning them to the genus Giraffa.

Abbreviations
PUPC, Punjab University Palaentological Collection; AMNH, American Museum of Natural History New York; GSI, Geological survey of India.

MATERIALS AND METHODS

Materials
The studied material comes entirely from the Late Miocene deposits at Padhri, Jhelum district, Punjab province, Pakistan (Fig. 1). It comprises the following specimens: a right maxillar fragment with M1-M3 (PUPC 86/84A) and a left maxillar fragment with P1-M3 (PUPC 95/23). The studied material is
Fig. 1. Map of the Potwar Plateau, northern Pakistan with stratigraphic dates of the Siwalik formations; the studied locality is encircled and the studied chronostratigraphic context is shaded (data from Johnson et al., 1982; Barry et al., 2002; Nanda, 2002; Dennell et al., 2006; Cohen and Gabbard, 2008).

compared with other *Giraffa punjabiensis* samples from the Siwaliks stored in the collection of the Geological Survey of India (GSI). Measurements were taken with caliper to the nearest 0.1 mm.

**Nomenclature**

We use the terminology of Gentry and Hooker (1988) and Gentry et al. (1999).

**Source of the comparative material**

Matthew (1929), Colbert (1935) and Bhatti (2005).

**SYSTEMATIC PALAEONTOLOGY**

**Order** Artiodactyla Owen, 1848  
**Suborder** Ruminantia Scopoli, 1777  
**Family** Giraffidae Gray, 1821  
**Subfamily** Giraffinae Gray, 1821  
**Genus** *Giraffa* Brisson, 1762

### *Giraffa punjabiensis* Pilgrim, 1911

**Synonyms:** *Giraffa punjabiensis* Pilgrim, 1910.  
*Giraffa punjabiensis* Bohlin, 1927.  
*Giraffa punjabiensis* var. Matthew, 1929.  
*Giraffa punjabiensis* var. Matthew, 1929.

**Type specimen**  
(Lectotype) – GSI B184, maxillary fragments.

**Abbreviated diagnosis**

Smaller than *Giraffa sivalensis* Falconer and Cautley, 1843 or *Giraffa camelopardalis*. Upper premolars relatively small and narrow, upper molars long with seldom tubercles in the median valleys, lower molars long, lobes of molars set less obliquely to the axis of the jaw than in the extant giraffe (Pilgrim, 1911; Colbert, 1935).
Giraffa punjabiensis is known from the Middle Siwalik Hills of the subcontinent (Pilgrim, 1910, 1911; Matthew, 1929; Colbert, 1935).

**Studied material**
PUPC 95/23, left maxillary fragment with P1, M1; PUPC 86/84A, right maxillary fragment with M1-M3.

**Locality**
Padhri village, Jhelum district, Punjab province, Pakistan.

**Stratigraphic level**
Middle Siwaliks (Late Miocene).

**Description**
PUPC 95/23 is a left maxillary fragment bearing a fourth premolar and three molars (Fig. 2A). A shelf like palate part is present which is moderately thick. PUPC 86/84A represents right maxillary fragment with molar series (M1-M3).

P1: The premolar is in an excellent state of preservation and in early wear (Fig. 2A). The enamel is thick and rugose. The anteroposterior diameter of the tooth is smaller than the transverse diameter. The fossette formed by the union of the cusps is shallow. The major cusps are poorly developed. The para- and metastyles are fairly developed. The median rib is strong. It is slightly narrow at the tip and broad at the base of the crown.

M1: The major cusps are fairly developed and not in a straight line (Fig. 2A, B). Protocone is L-shaped. The prae-protocrista is slightly narrower than the post-protocrista. Paracone is broad in the middle with the prae-paracrista and post-paracrista. The prae-paracrista is united with the paracrista whereas the post-paracrista is just touching with the prae-metacrista. Metacone is well developed and slightly higher vertically than paracone. The prae- and postmetacrista are not fused. The prae-hypocrista is thick and the posthypocrista is bifurcated into two ridges. The styles are well developed: parastyle and mesostyles are strongly developed, metastyle is weakly developed, parastyle is the strongest among the styles, and it is expanded to the base of the crown and united with the posterior side of the mesostyle. The enamel sculpture is rough and the fossettes are equally prominent on the anteroposterior lobes. The cingulum is poorly developed. The entostyle is weak and the median ribs are strong.

M2: The second molar is in an excellent state of preservation (Fig. 2A, B). The entostyle is present. The molar is rugose with slight traces of the cingulum. This molar is actually a large version of the first molar, thus the aforementioned description covers it as well.

M3: The third molar is in an excellent state of preservation like the other molars in the maxillary fragment (Fig. 2A, B). The entostyle is moderately developed. The slight indication of the cingulum can be seen on the lingual base of the tooth. The major cusps are fairly developed. The protocone is crescent shaped and isolated from the paracone. The wear is more confined to the post-cristae than to the pra-cristae. The styles are strongly developed and stout. The parastyle is connected to the paraconus rib. The mesostyle represents an isolated pillar. The metastyle is moderately developed in the M3, while it is weakly developed in the other two molars. The fossettes are relatively deep.

**COMPARISON AND DISCUSSION**

The specimens are characterized by their large size, the depth of the central enamel folds, the enamel rugosity and obliquity of the labial cusps (Fig. 2). These features associate them clearly to the giraffids’ in distinction to the bovids’ specimens (Matthew, 1929; Colbert, 1935; Harris, 1987; Harris et al., 2010; Khan et al., 2010a, Bhatti et al., 2012). As the teeth are brachydont, they can be compared with the genera Giraffokeryx and Giraffa and not with the larger Siwalik giraffids such as Bramatherium and Sivatherium. Giraffokeryx is recorded from the Lower Siwaliks (Matthew, 1929; Colbert, 1935; Khan et al., 2010b) and a few findings are also reported from the lower portion of the Middle Siwaliks (Khan et al., 2012a).

The teeth of the studied specimens differ from that of Giraffokeryx in not having the major cusps in a straight line (Pilgrim, 1911) and also the enamel sculpture is not fine. On the contrary, the maxillary fragments show similar morphological
Fig. 2. *Giraffa punjabiensis*: A, PUPC 95/23, left maxillary fragment with $P^4$-$M^3$; B, PUPC 86/84A, right maxillary fragment with $M^1$-$M^3$. Views are occlusal (Aa, Ba), lingual (Ab, Bb) and labial (Ac, Bc). Scale bar equals 30 mm.
Table I.- Comparative measurements of the maxillar fragments of *G. punjabiensis* in mm. Referred data are taken from Matthew (1929), Colbert (1935) and Bhatti (2005).

<table>
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<th>Taxa</th>
<th>Number</th>
<th>Nature/Position</th>
<th>Length</th>
<th>Width</th>
<th>W/L ratio</th>
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<td></td>
<td>PUPC 86/84*</td>
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</table>

* The studied specimens. l = left, r = right.

Fig. 3. Scatter diagram showing dental proportions of the Siwalik *Giraffa* species. Referred data are taken from Matthew (1929), Colbert (1935) and Bhatti (2005).

Characters with those of *Giraffa*, in which the labial cusps are not located in a straight line and the enamel sculpture is rough. Several fossil *Giraffa* species have been proposed on the basis of tooth size and of the shape (Harris *et al*., 2010). The studied sample differs from *G. jumae* Leakey, 1967;
G. pygmaea Harris, 1976 and G. stillei Arambourb 1947 in the smaller size and the relatively less massive and shorter teeth (Harris et al., 2010). Three species of Giraffa have been recorded from the Siwaliks: G. sivalensis Falconer & Cautley, 1843 from the Pleistocene of the Upper Siwaliks, G. punjabiensis Pilgrim, 1911 from the Late Miocene-Pliocene of the Middle Siwaliks and G. priscilla Matthew, 1929 from the Middle Miocene of the Lower Siwaliks (Matthew, 1929; Colbert, 1935) (Fig. 3). The studied specimens differ from G. sivalensis mainly in the less reduced posterior lobe (Colbert, 1935). Giraffa priscilla represents more brachyodont teeth with prominent metastyle than those of the listed specimens (Matthew, 1929). Morphometrically, the teeth match with the Late Miocene-Pliocene G. punjabiensis (Figs. 2-3; Table I). The anatomical and ontogenetic matching of the maxillars remains strongly suggests that the fossils belong to a single individual.

Palaeoecology

The Padhri outcrops are remarkably famous for their spectacular mammalian fossils. Fossils associated with the Padhri site include crocodiles, snakes, Gazella, Pachyportax, Selenoportax, Hydaspitherium, Tragoportax, Dorcatherium, Chilotherium, Sivalhippus and Stegolophodon (Sarwar, 1977; Ghaffar, 2005; Khan, 2007, 2008; Khan et al., 2009, 2012a). The presence of Sivalhippus implies a restricted savannah area (Khan et al., 2011). Dorcatherium preferred a habitat of swamp and patches of dense forests (Khan et al., 2012b). The large forms (Pachyportax, Selenoportax, Hydaspitherium, Giraffa) indicate a habitat of open woodland intervened by some grassland and a relatively humid environment. The rhinocerotid Chilotherium as well as other grazer forms are common elements of the Late Miocene fauna of the Siwaliks. They prefer savannah habitats with patches of bushes (Heissig, 1972). The faunal elements of the Padhri fauna correlate better with those of the other Siwalik Late Miocene localities (Khan et al., 2009, 2010a). Therefore, it is suggested that the Padhri outcrops are characterized by the predominance of woodland to savannah habitats with some swamps and patches of dense forest.

CONCLUSIONS

The Late Miocene in the Padhri area has yielded cranial remains of G. punjabiensis. The Padhri locality is one of the richest Late Miocene Siwalik localities. Concerning palaeoenvironmental indications, Giraffa remains are found in deposits that accumulated in woodland or savannah near swamps and lakes, and the giraffids suggest the presence of woodland in the Padhri region at the time of deposition.

REFERENCES


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