

shoshonitic lamprophyres (minettes) with shoshonitic alkaline rocks (shonkinites) (Figure 1), their coeval relationship, and mineralogical, chemical similarities—all assume considerable petrogenetic significance. The same hydrous, basic (mildly potassic) magma, which crystallized shonkinite as the earliest manifestation of intrusive event, was also responsible for the crystallization of minettes but subsequent to the emplacement of the main nepheline syenite pluton. The shonkinites have crystallized at greater depth (before being brought to the present level as autoliths by the nepheline syenite magma) when compared to lamprophyres and this partly explains the contrasting textural aspects observed in the two rock types. The pyroxene was seemingly the first to crystallize in minettes and the rapid growth of this mineral as phenocrysts is attributed to the hydrous condition of magma⁶ and its crystallization at relatively shallower depth.

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First fossil mouse (*Mus*, Rodentia) from Indian Siwaliks, Tatrot Formation (Saketi, H.P): Implications for evolutionary history

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Fossil remains of *Mus* sp. were recovered from the Tatrot Formation (Late Pliocene) of the Indian Siwaliks. Here I relate the new finds to other murid genera of the Pakistan Siwaliks, place it in the generalized evolutionary lineage of the Siwalik *Mus*.

THE fossil remains of murids (rats and mice) are very rare¹⁻⁴ and therefore the finds of murids in Siwaliks are important both for taxonomic identification and phylogenetic reconstruction. The present specimens

were recovered while screening mudstones brought from a fossil locality (Figure 1) about 2.5 km (road distance) east of Saketi (77°14'30" N:30°0'30" E). Murid taxa reported so far from the Upper Siwaliks include *Mus*, *Golunda*, and cf. *Rattus* from Pakistan⁵ and *Nesokia*³ and *Rattus*⁴ from India. The genus *Mus* is known from Miocene of Pakistan⁵, Pliocene of Yunnan, Turkey and South Africa and Pleistocene of Pakistan, China, Europe and South Africa⁶. Now it has a worldwide distribution, because of the influence of man.

The fossil mouse described here is represented by two isolated molars, right lower molar (VPL/RP-10, Figure 2a) and left upper molar (VPL/RP-11, Figure 2b). *Mus* is characterized by the presence of a M₁ (first lower

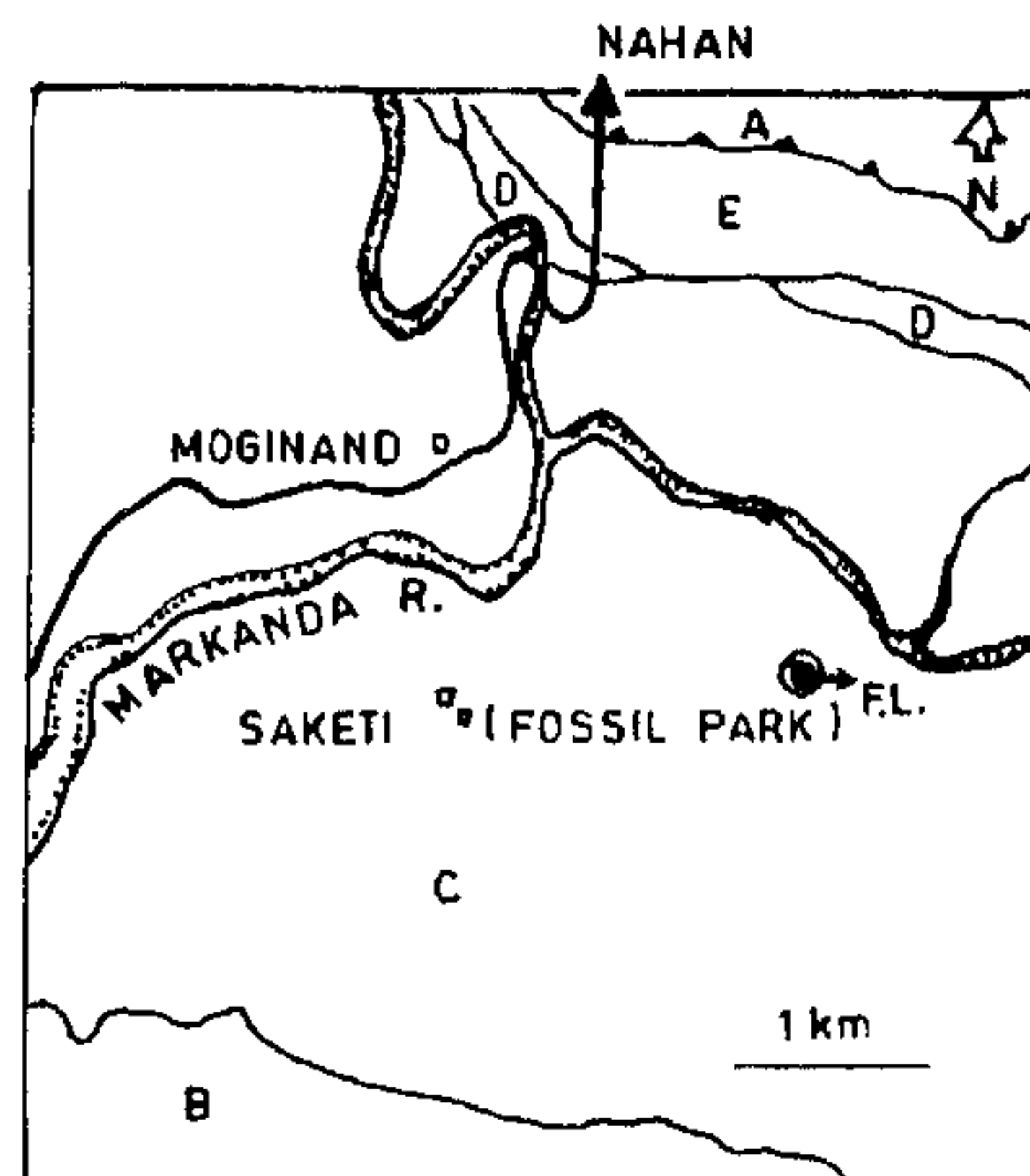


Figure 1. Geological map around Saketi (modified after Verma⁸). A, Lower Siwalik; B, Middle Siwalik; C, Tatrot Formation; D, Pinjor Formation; E, Boulder Conglomerate Formation; FL, Fossil locality.

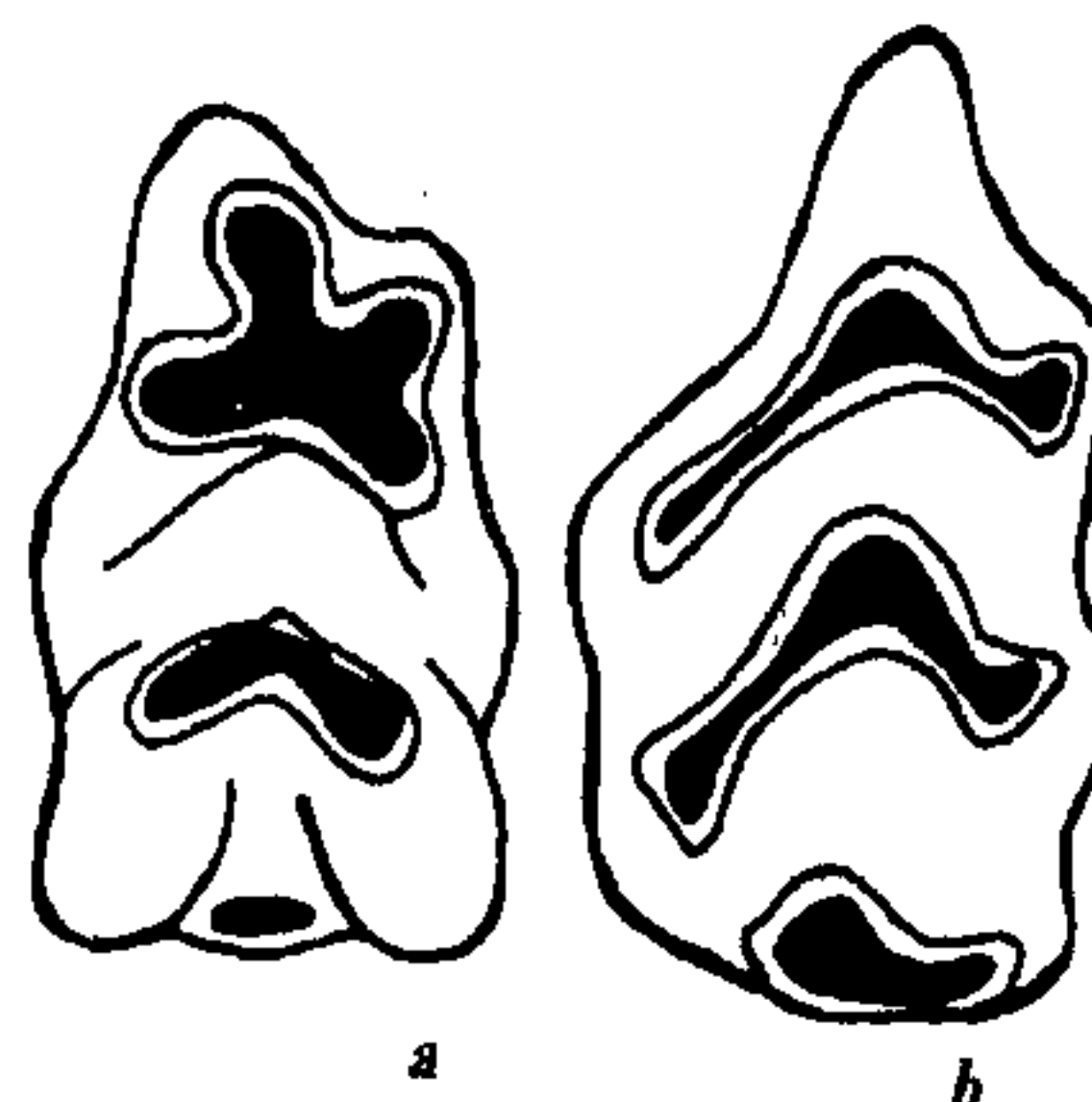


Figure 2. *Mus* sp. a, Occlusal view of right lower molar. b, Occlusal view of left upper molar. Bar represents 1 mm.

Table 1. Evolutionary lineage of mice in the Siwaliks.

Formation	Murid genera	Age
Pinjor Formation	<i>Mus</i> sp.	Early Pleistocene of Pakistan (Jacobs ⁵)
Tatrot Formation	<i>Mus</i> sp.	Late Pliocene of India (Patnaik in this work)
Dhok Pathan Formation	<i>Mus auctor</i>	Late Miocene of Pakistan (Jacobs ⁵)
Nagri or Dhok Pathan Formation	<i>Progonomys debruijini</i>	Late Miocene of Pakistan (Jacobs ⁵)
Chinji Formation	<i>Antemus chinjiensis</i>	Middle Micoene of Pakistan (Jacobs ⁵)

molar) with an asymmetrical 'X' pattern at the anterior portion of the tooth and the absence of labial cingulum. In M^1 (first upper molar), anterostyle is antero-posteriorly compressed and is posterior relative to the anterocone and the posterior cingulum is reduced.

The present *Mus* sp. can be differentiated from *Mus auctor* and *Progonomys debruijini* of Late Miocene of Pakistan on the basis of the absence of labial cingulum in M_1 . It differs from *Karnimata* and *Parapodemus* of Late Miocene of Pakistan by its smaller size, absence of anterior mure, labial cingulum and medial anteroconid in M_1 . It can be differentiated from *Parapelomys* of Late Miocene of Pakistan by the presence of pattern 'X' and the absence of anteromedial cingulum in M_1 . It differs from *Golunda* of Pleistocene of Pakistan by the absence of medial anteroconid and labial cingulum in M_1 . The present molars compared with those of *Mus booduga* (recent field mice found in India⁷) showed that both are similar to each other, except that in the M_1 of the recent ones, the hypoconid and the entoconid are more strongly connected and the 'X' pattern is more asymmetrical. M^1 of *Mus booduga* has a less elongate anterior portion and a small prestyle.

Antemus chinjiensis of Middle Miocene of Pakistan is considered to be the oldest murid known so far and its low crowned nature of M^1 , weakly connected cusps and weak labial cingulum in M_1 marks it to be more primitive than *Progonomys debruijini* and *Mus auctor* of Late Miocene of Pakistan⁵. *P. debruijini* is considered as ancestral to *Mus auctor* in having cusps in the chevron less strongly connected and anterostyle more posteriorly placed⁵. *P. debruijini* can be considered as more primitive than the present *Mus* sp. in having a M^1 with posterior cingulum (from primitive characters of murids⁵). *Mus auctor* is more primitive than the *Mus* sp. described here with an anterostyle more posteriorly placed, anterior portion less wide in M^1 , a prominent labial cingulum, a hypoconid and an entoconid less strongly connected. The present specimens are very similar to those of *Mus* sp. reported from Early Pleistocene of Pakistan⁵, but these specimens can be considered as ancestral to the *Mus* sp. from Pakistan, as they occur in older sediments of Siwaliks. *Mus* sp. described here can be linked (Table 1) with the above mentioned genera, as all of them share the character of an anterostyle rather posterior in position than those in other murid genera.

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A method for the estimation of food consumption by insect parasitoids

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Considering the growth of parasitized host after parasitization, a new method was developed to estimate the bioenergetic parameters of parasitic insects. *Spodoptera exigua* Hubner parasitized by *Apanteles prodeniae* Viereck was taken as the model system. *A. prodeniae* consumes 16.5 J, excretes 0.53 J, assimilates 15.97 J and produces 11.37 J. Rates of feeding, assimilation, production and metabolism can be estimated using this method.

ESTIMATION of food available to the parasitoids, which infect actively growing stages of their hosts, is difficult for the following reasons: (i) After parasitization, the host ingests less food and grows slowly, (ii) on any particular day after parasitization, the weight or the energy content of the parasitized host represents not only the weight or the energy content of the host but also of the parasitoid developing inside. However, for parasitoids infecting non-growing stages of their hosts such as egg or pupa, estimation of host energy available