New light on the antiquity of Siwalik Great apes

Until now, fossil hominids in the Siwaliks of Indian subcontinent were known from Chinji–Dhokpathan successions ranging between 13.1 and 5.1 m.y. (ref. 1). We document here two isolated hominid teeth (coll. SSG), a sivapithecine molar and a dryopithecine incisor collected from a vertebrate fossil-bearing succession resting conformably over the Upper Murree exposed at Ramchand in Udhampur district, J&K (Figure 1). Ramchand is situated about 10 km southeast of the classic vertebrate fossil locality of Ramnagar from where many vertebrate collections including hominids have been reported earlier[2–4].

Though the newly discovered fossil material is scanty, the specimens hold considerable significance in view of the extreme rarity of hominid fossils in Siwaliks, and more for their provenance from a much older stratigraphic level than previously known from this region. The find has an important bearing on the question of hominid diversification and their global distribution and migration patterns during Early Miocene.

The isolated molar tooth (Figure 2 *a–c*) was extracted *quasi in situ* from a sandstone bed, southeast of Ramchand Ridge, resting 100 m above the Murree/Dodenal (= Kamlial) Member contact[5]. It has suffered damage as a result of which its posterior part is missing. However, on the basis of morphological details of its well-preserved anterior two cusps, viz. protoconid and metaconid, and the enamel folds, the molar is indisputably referable to the genus *Sivapithecus* Pilgrim. The specimen represents the lower left last molar and evidently belongs to a robust form intermediate between *Sivapithecus indicus* Piligrim and *S. giganteus* (Piligrim)[6,7].

The other specimen, an isolated upper incisor (Figure 2 *d, e*) was extracted from a sandstone layer resting stratigraphically about 600 m up in the same continuous succession west of Ramchand (Figure 3). The source bed falls in the gradational contact zone of Dodenal/Ramnagar (= Chinji) Member[5]. The enamel folds on the internal side and wear pattern of the crown suggest the tooth to be of a large dryopithecine. We have provisionally assigned it to the genus *Dryopithecus* Lartet.

The Ramchand–Ramnagar section exhibits an uninterrupted sequence of Upper Murree to Middle Siwalik and consists of an enormous pile (4000 m) of sand/siltstone, red clay/shale and mudstone alterations (Figure 3) with gentle dips (8–20°) to the northwest. Ramnagar vertebrate fossiliferous horizon is located near the top of this succession whereas the present *Sivapithecus* yielding horizon stratigraphically lies about 1500 m below the Ramnagar hominid level. The incisor tooth was found near the middle of this succession.

Associated fragmentary vertebrate fossils recovered from vicinity of the *Sivapithecus* site, within 200 m of the stratigraphic column above the Murree Lower Siwalik contact include forms such as: Siluridae indet., *Trionyx* sp., *Gavialis* sp., *Deinotherium* sp., *Gomphotherium* sp. cf. *G. angustidens*, *Aceratherium* sp., Suidae indet., Tragulidae indet., *Dorcabune* sp., *Dorcatherium* sp., Anthracotheriidae indet.

Numerous other fragmentary limb bones, isolated vertebrae, coprolite and scutes belonging to fishes, chelonia snakes, etc. also form part of the faunal assemblage recovered from the Ramchand hominid locality.

The Murree/Lower Siwalik contact, particularly the base of Kamlial has been found to occur near the top of Chron 17 (18.3 m.y.) in Kamlial/Chinji stratotype in Pakistan[8], which is about 200 km from Ramchand as the crow flies. Since the Murree/Lower Siwalik lithologies show lateral continuity over large distances, we presume approximately the same age for our *Sivapithecus* molar specimen and aforelisted fauna. The assemblage indi-

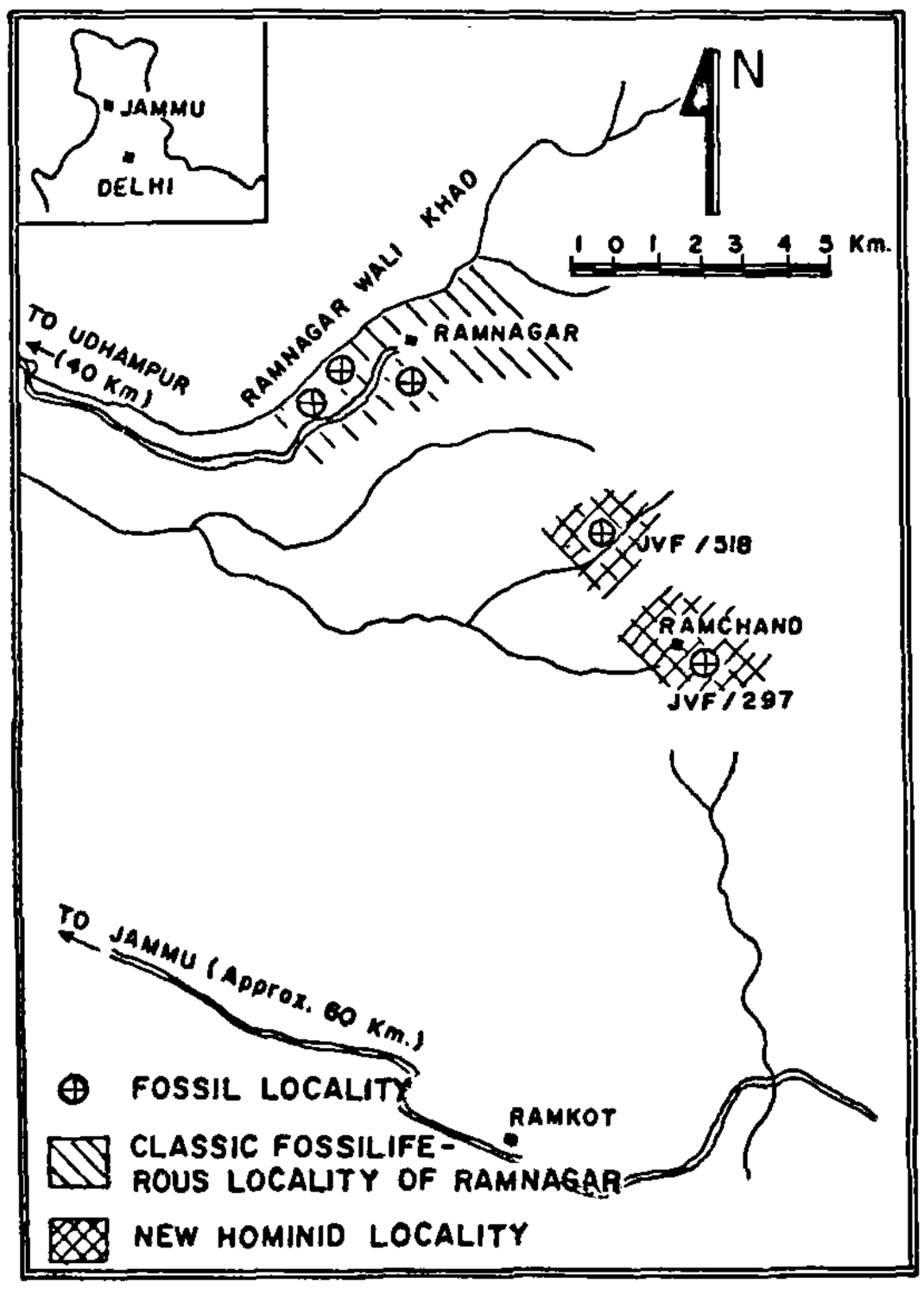

Figure 1. Map showing the classic fossiliferous locality of Ramnagar and the new hominid sites near Ramchand, Udhampur district, J&K.

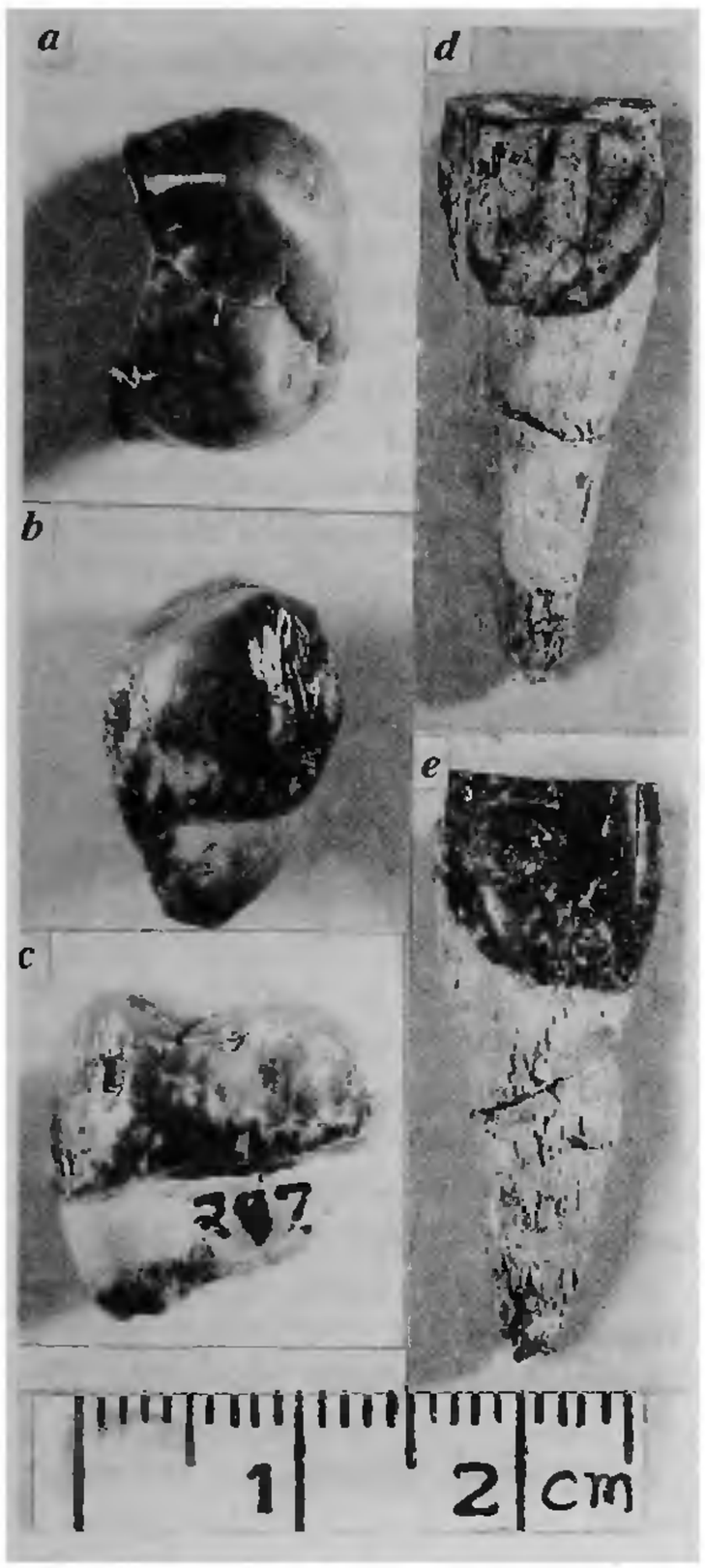

Figure 2. Hominid teeth from Ramchand *Sivapithecus* sp. (No. JVF/297), last lower left molar showing crown (*a*), lingual (*b*) and anterior (*c*) views. *Dryopithecus* sp. (No. JVF/518), upper incisor tooth showing internal (*d*) and external (*e*) views.

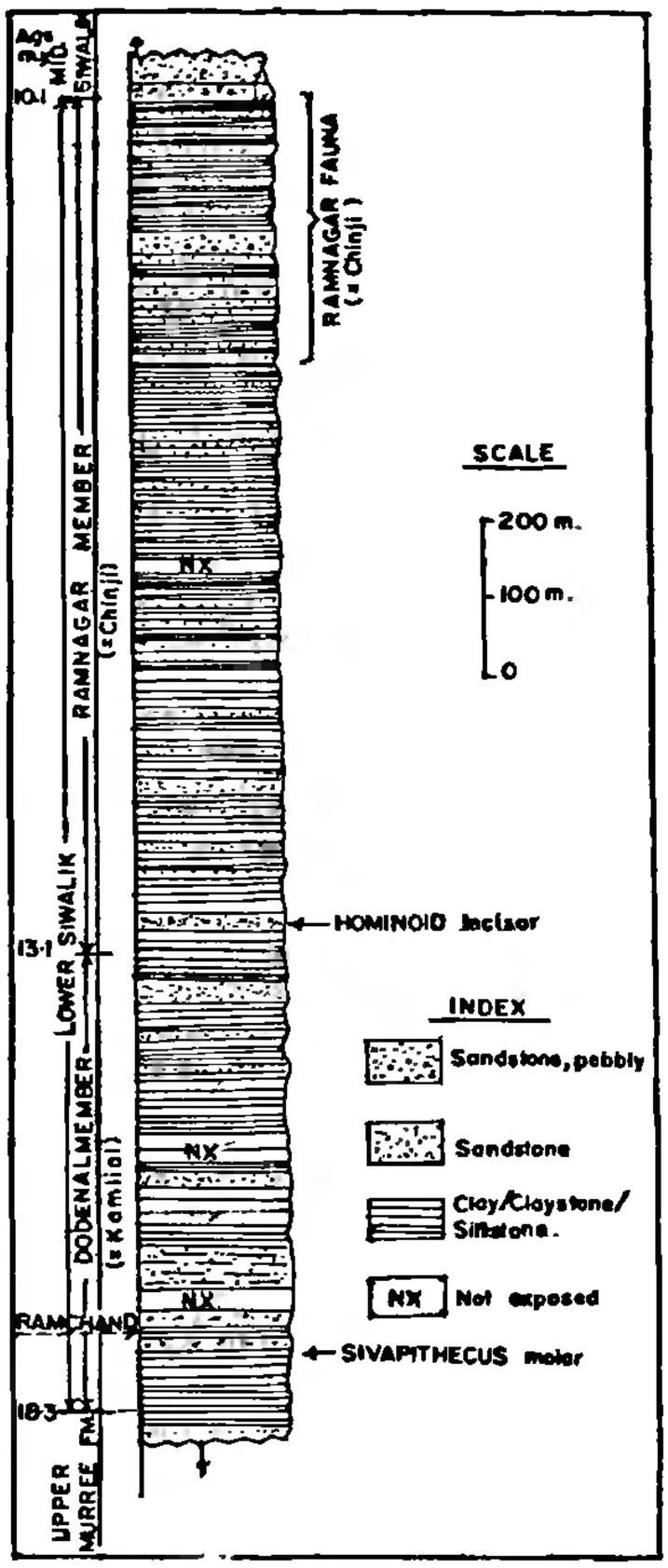

Figure 3. Lithocolumn along Ramchand–Ramnagar section showing stratigraphic position of the hominid teeth.

cates a Burdigalian affinity as well. In fact the approximate 18 m.y. datum for hominid existence in the Siwalik region is within expectations[9] and supports the earlier view of Andrews and Tobein[10] that the initial hominid diversification took place 'outside Africa and probably in central Asia'. The evolved character of the present *Sivapithecus* molar also indicates the pre-existence of its ancestral stock in Murree times as well and further suggests the Siwalik region to be the probable centre of hominid diversification and radiation. Further work, currently in progress in the area, is likely to substantiate the present find.

1. Johnson, N. M., Opdyke, N. D., Johnson, G. D., Lyndsay, E. H. and Tahirkheli, R. A. K., *Palaeogeogr. Palaeoclimatol. Palaeoecol.*, 1982, **37**, 17–42.
2. Colbert, E. H., *Trans. Am. Philos. Soc. Philadelphia*, 1935, **26**, 1–401.
3. Vasishat, R. N., Gaur, R. and Chopra, S. R. K., *Nature*, 1978, **275**, 736–737.
4. Verma, S. N. and Verma, B. C., Geol. Surv. India, unpublished report, Field Season 1968–69, 1–13.
5. Gupta, S. S. and Shali, A. K., *Geol. Surv. India Rec.*, 1989, **122**(8), 28–28b.
6. Lewis, G. E., *Am. J. Sci.*, 1937, **34**, 139–147.
7. Simons, E. L., *Primate Evolution*, The Macmillan Series in Physical Anthropology, New York, 1972, pp. 1–322.
8. Johnson, N. M., Stix, J., Tauxe, L., Cerveny, P. F. and Tahirkheli, R. A. K., *J. Geol.*, 1985, **93**, 27–40.
9. Delson, E., *Nature*, 1985, **318**, 107–108.
10. Andrews, P. and Tobein, H., *Nature*, 1977, **268**, 699–701.

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Ultrastructural evaluation, an useful method for fish leucocyte identification

Clarias batrachus is an air-breathing fish inhabiting unhygienic hypoxic waters of the swamp. Because of its air-breathing habit and survival in hypoxic water it is used as one of the model species for aquaculture in swampy water. Routine differential blood count reflects the pathophysiological status of the fish in culture. Sometimes difficulty was encountered in differentiating various leucocyte types by light microscopy[1–3] and scanning electron microscopy[4,5]. Identification of leucocytes at ultrastructural level is more authentic[6] and therefore, forms the basis of the present report.