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First Report of the Late Pleistocene Fossil Lizards from Narmada Basin, Central India

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Abstract

The fossil agamid lizards are reported from a Late Pleistocene locality (ca. 0.74 ka in age) in the Narmada valley, central India. Although the fossil material is scanty, it is described keeping in view that, the fossil lizards are barely studied from south Asia, and secondly, this is the only report of fossil lizards from the Narmada valley. With the help of the jaw fragments and isolated teeth, the material is assigned to a new species, *Agama schleichi* sp.nov. The presence of lizards indicates dry/arid to semi-arid oscillations within otherwise warm/humid climatic conditions in the Narmada basin around the time of the *Homo erectus,* the only known *Homo* from India.

Key Words: agamid lizards, fossil lizards, Late Pleistocene, Narmada valley

Introduction

In Asia, the first material of the Early Eocene agamid lizards from Kyrgyzstan was made by Averianov and Danilov (1996) who proposed their diversity as characterizing the open landscape. In India, the fossil lizard remains are very scanty. The first report of a fossil lizard (*Varanus sivalensis*; Suborder Lacertilia) was made in 1884 by Lydekker (mentioned in Raghavan, 1991), from an unknown locality in the Siwalik sediments. However, the first well illustrated agamids (*Calotes* and *Uromastyx*) were reported from the Indian Siwalik by Patnaik and Schleich (1998). Recently, Prasad and Bajpai (2009) discovered some new species of agamids from the Early Eocene of western India. Excepting these reports, almost nothing is known from the Indian subcontinent as far as the fossil lizards are concerned. On the other hand, presently, there are over 150 species of lizards in India, majority of which belong to Geckos (*Hemidactylus*). Another widely distributed group is of the garden lizard (*Calotes versicolor*), followed by Chameleon (*Chameleo zeylanicus*). The largest and most conspicuous Indian lizard is *Varanus* with species like *V. salvator*, V. *flavescens* and *V. griseus*, the last being a desert species.

We describe agamids from the Narmada flood plain deposits from where the only known Indian *Homo* has been documented (Sonakia, 1984; de Lumley and Sonakia, 1985; Sankhyan, 1997, 2005) making the valley palaeontologically significant. Agamidae is an old world family of lizards found in Africa, central and southern Asia and Australia. A few forms migrated to northern Asia, Europe and North America during the Eocene. They are generally diurnal, terrestrial or arboreal forms occupying a variety of habitats. The important characters of this family are; premaxilla fused, maxilla forming the lower border of the orbit (jugul in some forms), post frontal absent, cheek teeth acrodont, palatal teeth absent, pleurodont anterior teeth present, splenial reduced or fused with the dentary. The meckelian groove is reduced to a shallow and narrow indentation. Many forms have dentary fangs.

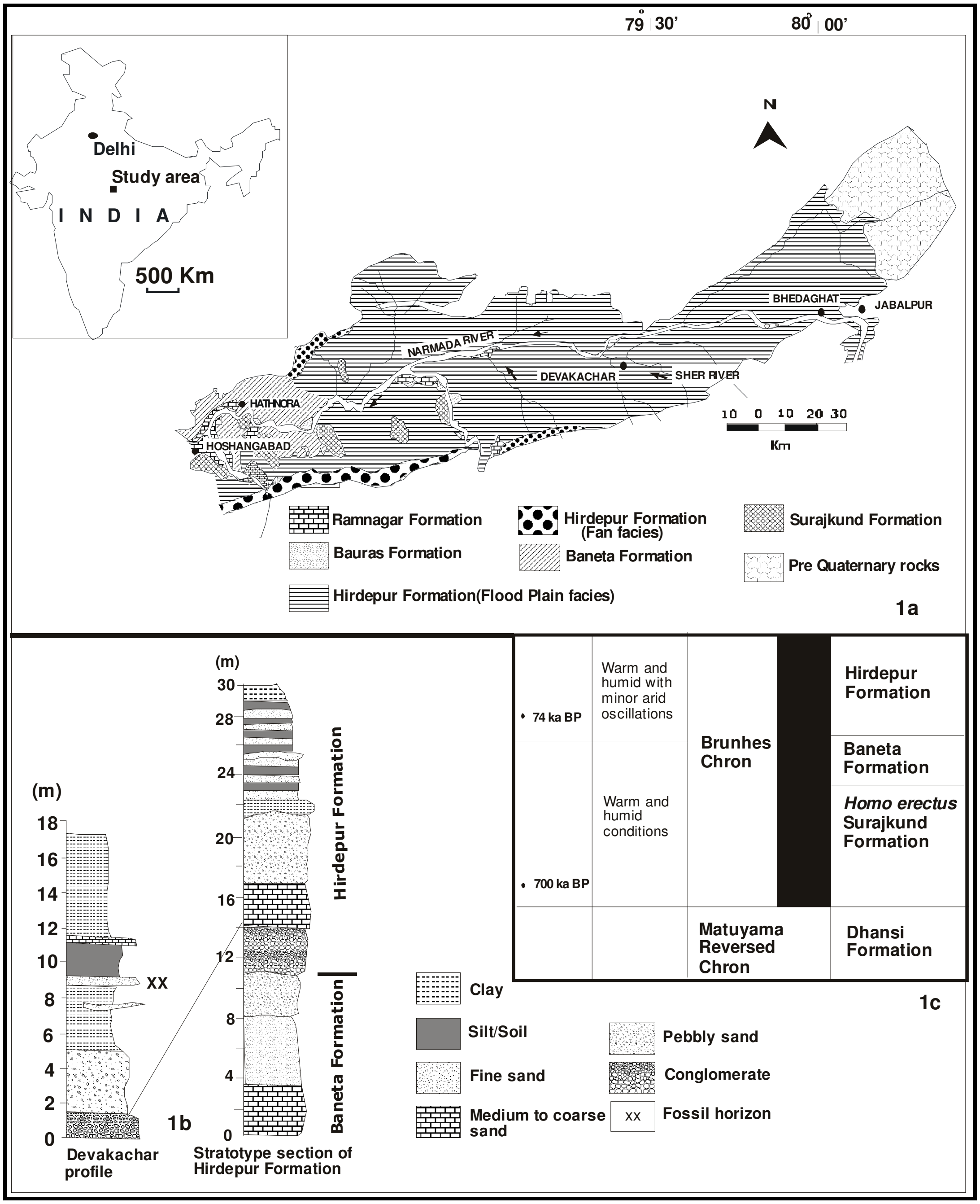

Fig.1: a) Location map showing the study area (modified after Tiwari and Bhai, 1997). b) Lithostratigraphy of the Devakachar section and correlation with the composite sequence (stratotype section of Hirdepur Formation is taken from Tiwari and Bhai, 1997). c) Chronology of a part of the Narmada sequence (compiled from Acharyya and Basu, 1993; Biswas, 1997; Rao *et al.,* 1997; Tiwari and Bhai, 1997; Kotlia and Joshi, 2008).

Description of the locality

At Devakachar site (23^0 23'N; 79^0 17'E), about 120km southwest of Jabalpur (Fig.1a), the sediment sequence is exposed by the Sher river, a tributary of the E-W flowing Narmada river. A 17m thick profile consists of cemented conglomerate, pebbly sand, silt and yellowish clay with a few scattered medium to coarse grained sand lenses (Fig.1b). The sequence belongs to the Hirdepur Formation which palaeomagnetically falls within the Brunhus magnetic chron. The Surajkund Formation which has yielded the *Homo erectus* is older then the Hirdepur Formation (Fig.1c). The fossil horizon, 8.5 m above the base, is a 0.5 m thick coarse pebbly sand bed and is approximated as ca. 0.74 Ma in age (Fig.1c). In addition to the agamid lizards, the collection also consists of murid rodents, fish remains, gastropods and pelecypods.

Systematic palaeontology

Class Reptilia
Order Squamata
Family Agamidae Gray, 1827
Genus *Agama*
Agama schleichi sp. nov.

Type locality: Devakachar (23^0 23'N; 79^0 17'E), 120km southwest of Jabalpur (Madhya Pradesh).
Fossil horizon and age: A pebbly sand horizon, 8.5m above the base (see Fig.1b) is approximated as ca. 0.74 Ma in age.
Holotype: NAR/L5, a dentary (Fig.2, i-j; Fig.3e).
Paratype: NAR/L4, upper jaw (Fig.2, g-h; Fig.3c).
Repository: The material is housed in the Palaeontology laboratory, Department of Geology, Kumaun University, Nainital.
Referred material: NAR/L1, NAR/L2 and NAR/L3, jaw fragments; NAR/L4, upper jaw; NAR/L5, dentary.
Etymology: Named in the honour of Prof. Dr. Hermann Schleich, an eminent scientist for his contribution in Palaeoherpatology.
Diagnosis: Crown tricuspate, central cusp largest, accessory cusps smaller and well developed, teeth widely spaced, meckelian groove narrow.
Measurements: See Table-1 below

Table-1: Height (in mm) of the cusps in *Agama schleichi* sp. nov.

sp. no.	central cusp	accessory cusp
NAR/L1	2.15	1.56
NAR/L2	2.15	1.56
NAR/L3	2.3	1.95
NAR/L4	1.95	1.56
NAR/L5	1.95	1.56

Description of the fossil material

NAR/L1 (Fig.2a-b; Fig.3a)**:** The single tooth is attached to the jaw bone. It is tricuspate with well developed cusps. The central cusp is the largest while the accessory cusps are comparatively smaller. NAR/L2 (Fig.2c-d; Fig.3b) is a broken jaw fragment with one complete and other partially broken tooth attached to the jaw bone. The teeth are tricuspate. The central cusp is the most prominent. The accessory cusps are smaller and have a blunt tip. NAR/L3 (Fig.2e-f; Fig.3d) bears two teeth on a fragmentary jaw bone. It is not possible to ascertain whether it is maxillary or dentary. The crown is tricuspate. The central cusp is the most prominent and largest of the three cusps. The meckelian groove can be seen at the base of the teeth. It is narrow but persists throughout the length of the jaw bone. The teeth are widely spaced.

The jaw (NAR/L4, Fig.2g-h; Fig.3c) tapers anteriorly. The crown height increases posteriorly. There are two teeth attached to the jaw. The anterior margin of the jaw bears a single, unicuspate tooth. The posterior teeth are tricuspate and anteriorly inclined. The central cusps are larger than the accessory cusps.

The right maxillary (NAR/L5, Fig.3e) is with five teeth arranged on the jaw bone. The crown height is more or less the same throughout. The central cusps are bigger while the accessory cusps are less developed. Teeth are widely spaced, transversely compressed and swollen at the base. The meckelian groove is continuous at the base.

Comparisons

Agamidae, an old world family of lizards has a geological range extending from the Palaeocene to the Holocene (Estes, 1983). Fossil forms have been recovered from the Palaeocene of Asia, Eocene of Asia, Europe and North America, Oligocene of Europe, Miocene of Asia and Europe, Pliocene of Asia, Pleistocene of Asia, Europe and Australia and Holocene of Europe (Table-2). *Agama* is an African agamid having a depressed body with a dorsal crest and gular sac (Estes, 1983). The crown is tricuspate with a prominent central cusp, smaller and less developed accessory cusps and meckelian grove is present at the base of the teeth.

Agama schleichi sp. nov. is distinct from other genera of family Agamidae. *Clamydosaurus* is a monotypic genus with a prominent erectile frill around the neck. *Mimeosaurus* is Upper Cretaceous agamid which differs from *Agama* in having a strongly developed coarse tubercular sculpture present on the skull roof. *Tinosaurus* differs from *Agama* in having caniniform, widely spaced teeth and open meckelian groove. *Uromastyx*, particularly reported from Indian Siwalik (Raghavan, 1991; Patnaik and Schleich, 1998) differs from *Agama* in having smaller sized unicuspate teeth, pointed crown and more closely spaced teeth compared to the tricuspate and widely spaced teeth in the later (see Fig. 2 k-l).

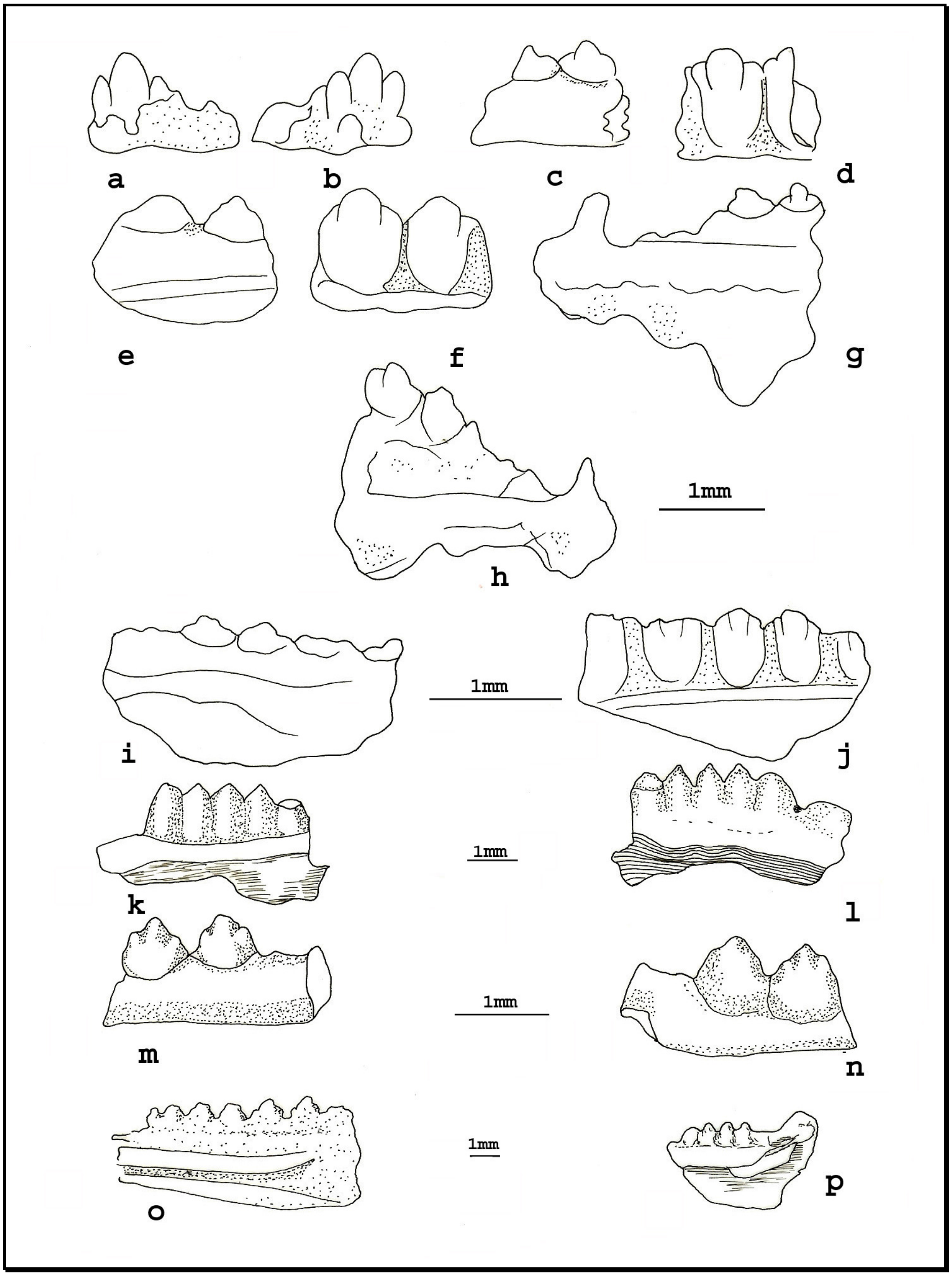

Fig. 2: *Agama schleichi* sp. nov. a-f (NAR/L1-3), labial and lingual views of the jaw fragments; g-h (NAR/L4), upper jaw; i-j (NAR/L5), dentary; k-l, *Uromastyx* sp. (Patnaik and Schleich, 1998); m-n, *Calotes* sp. indet ((Patnaik and Schleich, 1998); o, lingual view of *Tinosaurus stenodon* (Marsh, 1872); p, labial view of *Tinosaurus asiaticus* (Gilmore, 1943).

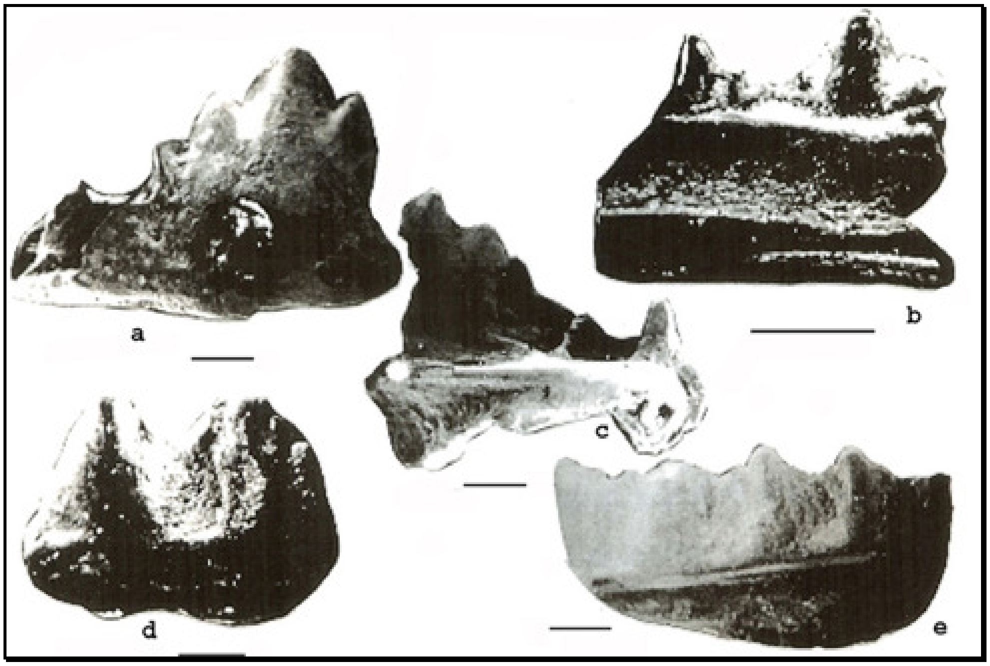

Fig. 3: *Agama schleichi* sp. nov. a, b, d, jaw fragments (NAR/L1-3); c, upper jaw (NAR/L4), e, dentary (NAR/L5) (Bar represents 1mm).

Table-2: Geological range of Agamidae (modified after Estes, 1943).

Age	Asia	Europe	N. America	Australia
Holocene		*Uromastyx*		
Pleistocene	*Agama schleichi* sp.nov. *Agama stellio*	*Agama stellio*		*Clamydosaurus*
Pliocene	*Uromastyx*			
Miocene	*Agamidae*	*Uromastyx*		
Oligocene		*Agama, Uromastyx*		
Eocene	*Tinosaurus, Agama*	*Tinosaurus*	*Tinosaurus*	
Palaeocene	*Tinosaurus*			

Agama schleichi sp. nov. differs from *Agama sinensis*, reported from the Palaeocene of China (Hou, 1974) in having better developed accessory cusps and a smaller sized *Agama galliae* (reported from the Upper Eocene of France by Filhol, 1877) differs from our material in having closely spaced teeth, poorly developed accessory cusps and a bigger size. Although, *A. schleichi* sp. nov. bears close resemblance with *Agama* sp. of Zwick and Schleich (1994) in having a tricuspate crown and presence of meckelian grove at the base, but the teeth of later are more widely spaced on the jaw bone and are larger than the Narmada teeth (see Table 3). *Tinosaurus stenodon* (Marsh, 1872) has tricuspate teeth (Fig. 2o) which are slightly larger in size than *Agama schleichi* sp. nov. Although *Tinosaurus asiaticus* (from the Republic of China; Gilmore, 1943) shares close morphological similarity with *Agama schleichi* sp. nov. (Fig. 2p) but it is much smaller in size (see Table-3) with very closely spaced teeth.

Table-3: Measurements of height of the cusps in various agamid lizards.

Name of the species	Reference	Height of central cusp (mm)	Height of accessory cusp (mm)
Agama schleichi sp. nov.	present work	2.10	1.83
Agama sp.	Zwick and Schleich, 1994	3.45	2.40
Agama galliae	Filhol, 1877	1.66	------
Agama sinensis	Hou, 1974	2.00	1.71
Tinosaurus asiaticus	Gilmore, 1943	1.60	1.30
Tinosaurus stenodon	Marsh, 1872	2.30	1.63
Uromastyx sp. indet.	Patnaik and Schleich, 1998	1.71	-----

Conclusion

The dental fragments of agamid lizards are reported for the first time from the Narmada valley. *Agama schleichi* sp. nov. is tricuspate with a prominent central cusp and lesser developed accessory cusps. The agamid lizards belong to the Acrodonta, a group which has been suggested to have a Gondwanan origin (Holmes et al., 2009). It seems that the tricuspid agamids appeared in India sometime in early Eocene and diversified in the Pleistocene particularly during the prevalence of semi-arid to arid climatic oscillations in the central India.

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References

Acharyya, S. K. and Basu, P. K. (1993) Toba ash on the Indian subcontinent and its implications for the correlation of Late Pleistocene alluvium. Quaternary Research, v. 40, pp. 10–19.

Averianov, A. and Danilov, I. (1996) Agamid lizards (Reptilia, Sauria, Agamidae) from the Early Eocene of Kyrgyzstan. Neus Jh. Geologie und Palaontologie, v. 12, pp. 739-750.

Biswas, S. (1997) Fossil Mammalia of the Quaternary sequence of the Narmada valley: their affinity, age and ecology. J. Geol. Soc. Ind.,Special Publication, v. 46, pp. 91-104.

de Lumley, M. A. and Sonakia, A. (1985) Premiere Dicouverte D'un *Homo erectus* Surte continent Indien a Hathnora, Dans la Mogenne Vallea de La. L'Anthropology, v. 89 (1), pp. 13-61.

Estes, R. (1983) Sauria, Terrestria, Amphisbaenia. Encyclopedia of Palaeoherpatology. Gustav Fisher, Verlag, Stuttgart, New York. 248p.

Filhol, H. (1877) Rescherches sur des phosphorites du Querey. Pt. II. Annals of Science, v. 8, pp. 1-338.

Gilmore, C. (1943) Fossil lizards of Mongolia. Bull. American Museum of Natural History, v. 81 pp. 361-384.

Holmes, R. B., Murray, A. M., Chatrath, P., Attia, Y. S. and Simons, E. L. (2009) Agamid lizard (Agamidae: Uromastycinae) from the lower Oligocene of Egypt. Historical Biology, DOI: 10.1080/08912960903302128.

Hou, L. (1974) Palaeocene lizards from Anhui, China. Vertebrate Palaeontology, v. 12, pp. 193- 202.

Kotlia, B. S. and Joshi, M. (2008) Reconstruction of Late Pleistocene palaeoecology of the Upper Narmada valley (Central India) using fossil communities. Palaeoworld, v. 17, pp. 153-159.

Lydekker, R. (1884) Siwalik and Narbada Equidae. Palaeontologica Indica, v. *2(*2), pp. 35-104.

Marsh, O. (1872) Preliminary description of new Tertiary reptiles Parts I and II. American Journal of Science, v. 4, pp. 298-309.

Patnaik, R. and Schleich, H. H. (1998) Fossil micro-reptiles from Pliocene Siwalik sediments of India. Veroffentlichungen aus dem Fuhlrott Museum, v. 4, pp. 295-300.

Prasad, G. V. R. and Bajpai, S. (2009) Agamid Lizards from the Early Eocene of Western India. Palaeontologia Electronica, v. 11(1), pp. 1-19.

Raghavan, P. (1991) Fossil frogs and a lizard from the Basal Pinjor Formation (Sub-Himalaya), Haryana, India. Bulletin of Panjab University, v. 42(1-4), pp. 1-6.

Rao, K.V., Chakraborti, S., Rao, K.J., Ramani, M. S. V., Marathe, S. D. and Borkar, B. T. (1997) Magnetostratigraphy of the Quaternary fluvial sediments. Jour. Geol. Surv. Ind., Special Publication, v. 46, pp. 65-78.

Sankhyan, A. H. (1997) Fossil clavicle of a Middle Pleistocene hominid from the Central Narmada Valley, India. Jour. Human Evolution, v. 32(1), pp. 3-16.

Sankhyan, A. R. (2005) New fossils of Early Stone Age man from Central Narmada Valley. Current Science, v. 88(5), pp. 704-707.

Sonakia, A. (1984) The skull cap of Early man and associated mammalian Fauna from Narmada valley alluvium, Hoshangabad area, Madhya Pradesh (India). Jour. Geol. Soc. Ind., v. 113 (6), pp. 159-171.

Tiwari, M.P. and Bhai, H. Y. (1997) Quaternary stratigraphy of Narmada valley. Geol. Surv. Ind., Special Publication, 46: 33-63.

Zwick, A. And Schleich, H.H. (1994) QuartareReptilifunde von der Grabungsstelle Karain, S. Turkei (Reptilia, Squamata. Courier Forschungs Institute Senckenberg, v. 173, pp. 267-281.

About the Authors

Dr. Moulishree Joshi worked on the project 'Palaeontology and Palaeoenvironment of Pleistocene–Holocene deposits of the Narmada Valley' from 1999-2002 and carried out the first comprehensive study of invertebrates of Narmada valley. She was a Research Associate of CSIR on Quaternary Geology of a part of Himachal Pradesh from 2004-2009. About half a dozen publications in national and international journals are to her credit.

Prof. B. S. Kotlia has about two decade's research experience in the palaeolakes and neotectonics of the Uttarakhand and Ladakh Himalayas. Discoverer of the first palaeolake in the Kumaun Himalaya, he has been Principal Investigator of several Govt. of India projects in various parts of the Indian Himalaya. He and his several Ph.D. students are presently working on the neotectonics, geomorphology, Holocene earthquakes and Asian monsoon variability by using a number of archives and proxies. He has convened a number of international conferences on the climate change in south Asia and is Guest Editor of two issues of the *Quaternary International*. A former Alexander von Humboldt Fellow, he has own a number of awards and has over 70 peer review publications to his credit.