

Foreword

India's fossil biota: Current perspectives and emerging approaches

In recent years, research in palaeontology, or the science of fossils, has seen one of the most challenging and exciting phases in its history. The spectrum of scientific issues and themes being addressed using fossils is truly remarkable, encompassing as it does such diverse perspectives as the dating and correlation of rock formations, origin, evolution and extinction of biota, palaeogeography, palaeoclimates, form and function, and many others. More recent approaches involve integration of the fossil data with molecular phylogenetics, evolutionary developmental biology (*evo-devo*) and biomechanics. Also remarkable is the range of temporal and spatial resolution made possible by the fossil data, with studies ranging from individual organisms to larger taxonomic assemblages; dental and bone microstructure to whole organisms; empirical to theoretical; local to global and qualitative to quantitative.

This is indeed a special year for palaeontology: We celebrate not only the bicentennial birth of Charles Darwin but also the birth of an idea that has changed the way we look at life, its diversity and its evolving dynamism. One of the pillars that has steadfastly supported the idea of evolution is the fossil record. It provides a dimension so crucial in documenting evolution, the dimension of time. Time does not merely afford information on when lineages diverged but also provides insight into rates of processes, gradual or by fits and starts. In addition there is a spatial dimension of how life spread across the globe and how extinctions result in biotic reorganization tuned to the new world around them.

The Indian subcontinent has a unique fossil history. This is because the Indian landmass, joined as it was to the assembly of southern continents called Gondwanaland, broke free from its moorings with Madagascar about 90 million years ago and drifted rapidly northwards as an isolated, island subcontinent. Later, around 50 million years ago (mya) it crashed into Asia and literally pushed up the great Himalayan Range. The Indian fossil record has immensely contributed to a better understanding of some of the fundamental aspects of biotic evolution that basically underscore the role of major geodynamic events in the earth's history during the course of biotic evolution. In this special issue, we present glimpses of the Indian fossil record from a variety of perspectives, with some of the articles emphasizing the growing integration of palaeontology with biogeography, molecular phylogenetics and biomechanics.

The first article by Prasad discusses the relevance of recent fossil finds (65–50 million years before present or MYBP) from India in the context of molecular data on the origin of placental mammal origins and diversifications. This paper also presents new evidence based on fossil mammals that suggests possible faunal exchanges between India and Europe/Africa as early as around 65 MYBP.

Ray *et al.* discuss how bone microstructure (histology) can be used to assess varied growth patterns in fossil vertebrates from the Gondwana deposits.

In recent years, the spectacular fossil finds from the Indian subcontinent have shown this region to be the birthplace of whales (Cetacea). Bajpai *et al.* provide a glimpse of this major evolutionary transition from a four-footed land mammal to an obligate marine swimmer, as documented by a remarkable series of intermediate fossils found in the Eocene rocks of the Indian subcontinent.

Another topic of much current interest is the *Out-of-India* hypothesis, which postulates an Indian (Gondwanan) origin for several groups of modern Asian biota. Roy and Karanth evaluate the existing molecular data on a range of taxa relevant to this interesting hypothesis.

Dendrochronology (tree-ring analysis) is becoming increasingly important as a proxy for climate changes. In an authoritative work, Yadav demonstrates the utility of this technique in tracing long-term climate records in the Himalayan region.

Keller *et al.* summarize the recent advances in our understanding of the timing of Deccan volcanism with respect to the Cretaceous-Tertiary (K-T) boundary mass extinctions 65 million years ago. The new data convincingly demonstrates the critical role of Deccan volcanic activity in the extinction of dinosaurs and other faunal groups.

Patnaik and Chauhan review the hominid fossil record of India, with emphasis on the past 8-9 million years. They highlight important gaps in the fossil record and discuss their potential importance for a better understanding of hominid evolution.

Sarkar and Gupta present the results of their micropalaeontological investigations aimed at understanding the deep-sea palaeoceanographic evolution of Hole 716A, Maldives Islands, equatorial Indian Ocean during the late Quaternary (~444 to 151 Kyr).

Sharma and Shukla provide a glimpse of early (Precambrian) life forms and highlight important chronological milestones during the evolution of Bacteria, Archaea and the Eucarya.

Prasad *et al.* present interesting new evidence for the existence of equatorial rain forests in the Western Ghats of India during the Late Palaeocene-Early Eocene time.

Application of biomechanical principles to fossils is in a relatively nascent stage of development. Mishra outlines the principles of this approach using vertebrate bones, and explains how it can help understand the relationship between form and function in extinct and extant forms.

Finally, Samant and Mohabey discuss the use of fossil palynoflora from India's Deccan volcanic province in the temporal correlation of widely separated localities.

We hope that this special issue provides a glimpse of the diversity of the Indian fossil record and the variety of current approaches; and that it will be of use not only to palaeontologists and geologists but also to those interested in evolutionary biology, biogeography, embryology and biomechanics.

We would like to take this opportunity to extend our sincere thanks to the authors for their scholarly contributions and to the reviewers for their constructive criticism and helpful suggestions.

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