

Geology and Tectonics of India: An Overview. M. N. Balasubrahmanyam. Memoir No. 9, International Association for Gondwana Research, Department of Natural Environmental Sciences, Kochi University, Akebono-cho 2-5-1, Kochi 780-8520, Japan. 2006, 204 pp. Price Rs. 750.

The book is divided into thirteen chapters comprising Archaean to Quaternary geology of India. It describes a variety of aspects like geophysics, stratigraphy, general geology, geochemistry and tectonics of different cratons and mobile belts of India. However, chapter on northeast India has not been included in the book.

The first chapter presents a concise picture of different tectonic elements of the Indian crust. The basin classification given in the book is not complete, some important Precambrian basins, like Aravalli and Delhi basins, are missing in the list. The second chapter is on geophysics, which includes the work of different geophysicists. The chapter describes gravity, magnetism, DDS, seismic and tectonic stress and thermal studies of the Indian shield. There is no mention about palaeomagnetism and AMS characteristics of the Indian shield. Chapters three and four are focused on the geology and tectonics of South India. This could have been merged into one. Chapter four entitled 'The granulite province'. One explores the granulite plutons of North India in this. In Rajasthan, granulites are outcropping in a large area from Bhinai, Gyangarh to Sandmata and further south in the Aburoad region. These are also present in the Eastern Ghats region of India. Nevertheless, both chapters give detailed account of geology and tectonics of southern India explicitly. Chapter five describes Singbhum craton and Chotanagpur gneissic terrain. There is a detailed discussion on the age of Singbhum rocks in comparison with other aspects of the craton. Evolution of Chotanagpur Granitic Gneissic Complex is described in great detail. Chapter six provides a good overview of the geology and tectonics of the Bastar and Budelkhand craton.

Chapter seven on western India presents inadequate inputs on the geology and tectonics of the region. Description of the Aravalli region is based on Gupta *et al.* (1980) of GSI. Since then, several new data are available on this region. As a consequence, the tectono-stratigraphy has been significantly revised. The Malani

volcanic section describes a confusing statement regarding the age of magmatism. There are references of the 1680 Ma age of emplacement of Ajmer granite, which has nothing to do with the Malani rocks. Chapters eight and nine give details about Purana and Gondwana basins, which are concise and encompass all aspects. The chapter on Deccan volcanism is brief. The Deccan as a big K-T event in terms of tectonics of India and requires a detailed comment. However, the author took into account of the non-plume origin of Deccan volcanism. A detailed description of Himalayan evolution is made in the eleventh chapter. A number of figures, stratigraphic and other tables are used to explain the Himalayan tectonics. The northeast part of Himalaya is also included in this chapter.

A separate chapter (twelve) on the Cenozoic formation of India has been included. However, descriptions of Paleozoic and Mesozoic formations of India are completely missing. The development of Mesozoic basins in Kutch and western Rajasthan constitutes important tectonic elements of the western Indian shield. The story of tectonic evolution is incomplete due to this. A separate chapter on Quaternary geology deserves appreciation. This gives an idea about the development of present-day geomorphology and major tectonic features of India.

Barring some shortcomings, the attempt to present an overview of geology and tectonics of India is significant. The book gives a brief and synoptic insight about the geology and tectonics of India.

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Birds of Two Worlds: The Ecology and Evolution of Migration. Russell Greenberg and Peter P. Marra (eds). The John Hopkins University Press, 2715, North Charles Street, Baltimore, Maryland 21218-4363, USA. 2005. 466 pp. Price: US \$110.

Movement, as the authors say, is the hallmark of avian life and this is exemplified by migration. This is the regular movement of some species of birds between

breeding and wintering sites. The study of this field started with understanding migratory routes and has now gone on to become a multidisciplinary field that is amply reflected in the breadth of topics covered in this book.

This book is the Proceedings of the Third International Meeting on Bird Migration hosted in 2002 by the Smithsonian Institution, USA. The first such meeting was held twenty-five years ago, when 50 bird ecologists got together to discuss important unanswered questions in bird-migration ecology. This volume examines cutting-edge findings in bird ecology and the evolution of migratory birds. It is divided into seven parts, each of which deals with a thematic trend: evolution of migratory systems, adaptations for two worlds, biogeography, connectivity, behavioural ecology, population ecology and migration itself. The book is a compendium of 32 research articles in the form of chapters and each article is written by a leading researcher in the field. Some chapters in the book are mostly reviews that assess previous work done and point to new directions for further research, while others are based on long-term field research. Needless to say, there is much information here that can be useful to ornithologists, wildlife researchers and serious bird-watchers.

One of the main threads of the book is understanding of the evolution of migratory systems and the biogeography of migrants. Researchers have used fossil records and molecular information to suggest where and when migration evolved. Studies have examined various characters of extant migrants to predict the kinds of species that are likely to evolve to be migrants. Two chapters hypothesize that long-distance migrants actually evolved in the tropics, contrary to popular belief; and it might take some time for it to sink into many of us that the migratory birds arriving here in winter are not 'visitors'! Researchers have suggested and used novel methods of examining biogeography of migrants – by tracing the phylogeography of the parasites of migrants, by examining trace elements and stable isotopes and even by the use of radio-telemetry using the International Space Station. One of the most exciting chapters in the book includes the findings of a 35-year radio-telemetry study on *Catharus* thrushes. Using heart-beat and wing-beat sensors in the radio-transmitters, scientists followed, using cars and air-

planes, several birds from their wintering grounds along the southern coast of North America to various breeding grounds in the north of the continent. The work gives an account of when and where birds decided to stopover, their orientation, body condition, energy expenditure and the environmental conditions all through their migratory flight.

Discovering the precise migratory connectivity between bird wintering and breeding sites has important implications for our understanding of gene flow and consequently speciation, and this is the second major thread of the book. An interesting chapter on the Siberian migratory divide tells us about the Tibetan plateau being a major barrier to migration and demonstrates that the choice of the route (east or west) around this has led to reproductive isolation in many species (a common Indian example being *Phylloscopus trochiloides*) and consequently, perhaps, to speciation. Apparently, hybrids of the two migratory paths tend to have intermediate characters (including orientation) and hence are not successful. Birdwatchers might find interesting a list of birds visiting India from the two sides of the plateau. Another chapter describes a new mode of speciation called 'migrant dosing' in a study of three species of raptors and their migratory behaviour.

Migratory birds must live in more than one world and the adaptations to one world may complement or constrain adaptations to the other; adaptation thus forms the third major focus of the book. The chapters in this section describe various adaptations and characters that help birds in migration: nutritional and physiological traits, ecomorphological characteristics (pointed wings, shape of the tails, mass in hind limb, moult and its timing) and decision-making skills. Such skills may include the ability to recognize habitats most similar to their natal habitat while choosing wintering grounds and the ability to opportunistically use prevailing winds to ease their migratory flight (sometimes even

using winds between 5000 and 9000 m asl at speeds up to 180 km/h). Being migratory influences all aspects of the species' biology and they develop unique life-history strategies and social behaviour that need to be understood. In the only study from India in this book, Price and Gross examine the segregation of *Phylloscopus* warblers by altitude in the breeding areas in the Himalayas, and their prey size and foraging behaviour in breeding and wintering areas. Researchers have also addressed questions on habitat availability in wintering and breeding areas, quality of habitat and its effects on various aspects of the birds' biology, including population size and structure, dispersal and reproductive success. In a unique study, the feeding rates of Redknots in wintering sites all over the world are examined using data from an international web of scientists, perhaps indicating ways in which migratory research can be taken forward. Most chapters have provided a list of questions that remain unanswered and that need to be addressed in future research; perhaps researchers and students would be motivated to take up some studies based on these.

An interesting subtext in the book concerns the term 'two worlds', which is interpreted differently by different authors. While some of them interpret it in terms of the breeding world and wintering world, others think of it as the Nearctic–Neotropic, and the Afrotropic–European and Asian worlds. Some authors do mention that migratory birds do not just live in two worlds but in many worlds, as there are several stopover sites between the wintering and breeding grounds, where birds have numerous challenges to face.

Although the book brings new insights into the ecology and biology of bird migration, there are some shortcomings. Some chapters could do better with maps for understanding biogeography and migration patterns. Some chapters have key references missing from the reference list. As is inevitable with a compilation

of scientific papers from many authors, chapters like the ones on the Siberian migratory divide and radio-tagging work on *Catharus* thrushes are easy to read, while others are not. Although it is understandable that no book can cover all possible subjects, a chapter on navigation is clearly missing from the book. Perhaps some chapters covering similar topics could have been merged. A chapter on conservation could possibly have been added and would have brought in a new dimension to the areas covered in the volume. Many in India know of the decline of the Siberian crane over the last few decades and the roles of habitat loss and crane hunters along the migratory path have played in this tragedy. In fact, it is surprising that most of the work presented in the book concerns forest birds, with few wetland birds finding space in it. Cranes and the work of the International Crane Foundation, well documented even in popular books, have not found any mention. It is disheartening to see little work from India in this book despite extensive migratory bird banding and monitoring programmes, perhaps reflecting more on Indian researchers than on the editors.

All negatives notwithstanding, the book does cover a wide range of subjects from the evolution and diversity of migratory systems to micro- and macro-distribution patterns, demography, speciation and connectivity. It is worth a mention that importance has been given to the wintering ecology of migrants, a subject much neglected until recently. The book would be invaluable to ornithologists and is a must-have for libraries with interest in wildlife.

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