

Indica: A Deep Natural History of the Indian Subcontinent. Pranay Lal. Penguin Random House India Pvt Ltd, 7th Floor, Infinity Tower C, DLF Cyber City, Gurgaon 122 002. 2016. x + 468 pages. Price: Rs 999.

Indica encapsulates the geological evolution and natural history of the Indian land mass, and it is an amazing book on several counts. One amazing aspect is that it is authored not by a geologist, but by a biochemist (and an artist too), who has no formal training in geology. Despite the fact that the author is no professional geologist, it is a high-octave educative experience even for those formally trained in geology. The book is educative not only because it contains layers of under-appreciated information, but also because it illustrates ably, how geology can be made an exciting subject for the uninitiated. Pranay Lal has written this book in a most endearing tone that would make anyone with a modicum of curiosity to get immersed in its reading. The usual cliché that geology is a boring subject breaks down here and the book establishes the fact that it is ‘fun subject’. For the author this book is a labour of love and it took almost 20 years of his life to complete the work. He says in his personal note to the reader, ‘... what mesmerizes me now and as a child is how nature is constantly at work and how everything is related to each other. This book is a culmination of over twenty years of research travel, conversations, interviews, and a lifetime awe of nature’. The book is endowed with a section where the author thanks the help and guidance from some of India’s best known palaeontologists and geologists, and also acknowledges the basic infor-

mation gleaned from the research papers published in India and abroad.

The story of how India as a distinct geological entity has come about is chronicled in 15 chapters. The story starts with the formation of the Earth, how it slowly transformed itself into a ‘pale blue dot’ (courtesy Carl Sagan) in the solar system teeming with life after a long interval of ‘dull’ and ‘boring’ period, how the conveyor-belt system of plate movement started and how it kept changing the spatial configuration and composition of continents and oceans, how the plants and animals evolved, including humans, and how all these processes are co-mingled facilitating India’s evolution and its growth through its birth, transition to adulthood and eventual marriage with the Eurasian plate, giving birth to the Himalayan mountains, until India became the land as we see it today and a home for a diverse set of people and cultures. And, what a journey it was – covering more than 7000 km in about 200 million years! Wait for another 200 million years and you will probably see the Himalaya inching southwards with the disappearance of the Bay of Bengal, replaced by mountains. But who can vouch for this? Chance or contingency (like the end-Cretaceous Chicxulub meteoritic impact off eastern Mexico which contributed, among others, extreme events to a mass extinction) may also have a role in the evolution of nature, as predicted by the Harvard palaeontology professor, evolutionary theorist and science historian and a fine essayist to boot, late Stephen Jay Gould.

There was always an uncertainty that hung over the early Earth. Would it eventually evolve into a planet where the human mind ultimately blossomed, or become like Mars or some other planets which had gone the way of the dodo. Lal in his book carefully brings out all the fortuitous circumstances that made the Earth a living planet. In all these happenings, chance events like collision of a planet called Theia with the early Earth leading to remelting of the Earth and creation of the Moon from the ejected debris and gas are considered to have played singular roles in making the Earth habitable and in growing the buds of life. Lal takes us to Nandi Hills and Ramnagar and shows us the old rocks of 2.5–3.5 billion years that make all those building blocks of the Indian land mass. Those who have visited Ramnagar and

stood on one of those granitic hills would recall the beauty of a natural rock garden with endless horizon that unfurled in front of them. The book has some of those majestic illustrations of these rock formations that bring back all that cozy nostalgia.

The significance of this book is that each time such global events are discussed, the author takes the reader to the most dramatic geologic markers representing each of these events in India. For example, Lal’s study tour takes us to the little known Dhala meteoritic impact crater, Shivpuri, Madhya Pradesh (MP) – a 1.5–2.5 million year old preserved mark of a celestial collision when life must have just begun (the more famous Lonar crater in Buldhana district of Maharashtra was dated ~50,000 years). The tumultuous period of meteoritic bombardments in the early Archean times gave way to somewhat stable times. Around this time the Earth’s environment and landscape changed with the initiation of seas and the great oxygenation event. The initial rumblings of plate tectonics may also have been heard during this time. Land masses evolved to become continents and supercontinents which went through several windings and unwindings. India as an independent entity drove out sometime around 180 million years ago from the latest super-assembly of continents called Gondwana, named after the Gond tribe of central India. The long journey that the country undertook (as a part of the lithospheric Indian plate in plate tectonics parlance) eventually brought India to its destination, when it docked with the Eurasian plate. As some would say, the rest is history. This docking and its ramifications resulted in the massive Himalayan mountain, the highest plateau and generation of several great rivers, not to speak of the monsoon system, which changed the global weather pattern forever. These events have a deep impact on biodiversity and human evolution. Lal points out, ‘The development and intensification of the Indian monsoon coincides with the split between Asian and African apes, the former evolving into the apes in Asia and the latter eventually evolving into African apes, early humans and us the Homo species’. Many skeletal fossils of ape-like animals have been obtained from the Siwalik formations of the Himalaya. In his book *On the Origin of Species*, Charles Darwin mentions about the 12

million-year-old *Sivapithecus* fossil from Late Miocene Siwalik Formation of an extinct ape as the possible ancestor of humans. But what made the rift valleys of Africa a fertile ground for the rapid rise of Homo species rather than other parts of the globe is an exciting story to be told separately.

The book chronicles the natural history of India and the milestones in the evolution of Indian landmass (which mostly remained unchronicled for the purpose of public education, despite the existence of professional geological societies in the country; also geology still remains off the limits in school syllabi). For example, many in India would not know that a major part of the evolutionary history of dinosaurs is pieced together by the fossils collected from India's Mesozoic rift valley regions (e.g. Pranhita–Godavary valley and Kutch). These 'Jurassic Parks' were veritable breeding, hunting and playing grounds of a wide variety of dinosaurs, including the flying types until nature conspired to trigger the Deccan volcanism at the end of the Cretaceous (~66 million years ago). The complete skeleton of *Barapasaurus*, the gigantic herbivorous dinosaur measuring about 18 m and weighing about 7 tonnes is exhibited at the Indian Statistical Institute, Kolkatta. Many would have heard about Lucy, the skeleton of a female of the hominin species obtained from the Ethiopian rift valley region, but may not have heard about a 236,000-year old female of Homo species called 'Narmada Man' – discovered from our backyards – Hathmora, MP. Calling it initially as 'man' was a mistake; it was actually a woman of 27–32 years old. Maybe we should have given



An artist's representation of the Big Bang nucleosynthesis and the formation of the Sun and the planets. On 11 February 2016, an international team of physicists and astronomers announced that they had heard and recorded, for the first time ever, a faint murmur or chirp which they believe was the sound of two black holes colliding a billion light years away!

her a beautiful name like Lucy, which could have been etched in public memory. Lal enchantingly attracts our attention to such mostly forgotten or little-known facts outside the academic circles with great flair and panache.

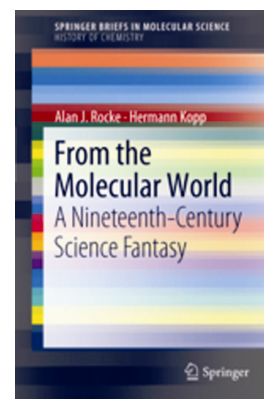
The book demonstrates how India as a unique geological entity showcases a diverse and informative natural history museum, and how this ancient land has been trampled over by spectacular creatures over millions of years in the backdrop of forests of strange-looking plants and trees, watered and washed by primitive rivers and oceans – all undergoing cycles of destruction and rebirth. The book also functions as an exposition of geo-diversity representing a variety of geological features, including rocks, minerals, fossils and landscapes that evolved over billions of years which tell us the spectacular cosmic tale of our origins. India's tumultuous geological past is recorded in its rocks and landscapes, and should be considered as our non-cultural heritage. Geological conservation seeks to ensure the survival of the best representative example of India's geological features and events, so that present and future generations can better appreciate one of the world's best natural laboratories. Unfortunately, geological conservation is an ignored subject in the country. The book cautions us about the disappearance of such treasures by the ever-expanding built environment. I have seen it happening in Kutch, Gujarat, where Mesozoic formations containing valuable geological information and fossils are being mindlessly scooped up to level the ground for construction. You may see the same mindlessness in the fast-disappearing Karewa Formation in Kashmir and Nepal, a treasure trove of 3.0 to 0.4 million old vertebrate fossils. Those who cry hoarse on vanishing cultural heritage and national pride should also worry about the disappearing geological heritage. The Geological Survey of India is the lead agency, but is it doing a good job in this regard?

This beautifully crafted book with colour figures, diagrams and photographs ends with this summation: 'There is no guarantee that the replay of the time sequence of all the chance events and accidents, starting from what happened one afternoon in a shallow stranded pool nearly 3.5 billion years ago, will again give rise to life as we know it.' This statement vaguely reminds me of what

Stephen Jay Gould, a proponent of contingency, wrote in his book, *Wonderful Life*, an old copiously annotated copy that I carry around which I bought while I was researching in University of South Carolina back in early 90s. Gould says that a replay of life's tape could 'yield an entirely different but equally sensible outcome'. He uses the analogy from a 1946 movie, a fantasy drama, called 'Wonderful Life' as an illustration for the basic principle of contingency – 'small but apparently insignificant changes lead to cascades of accumulating difference'. The hero of the movie, a frustrated businessman, who saw no meaning in his life was finally convinced by a neophyte angel who was sent from heaven to show him what life would have been like (for others around him), if he had never existed. Pranay Lal's book actually is a tutorial showing how everything in nature is related to each other and how each entity, big or small, counts in the overall scheme of things.

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From the Molecular World: A Nineteenth-Century Science Fantasy. Hermann Kopp. Translated, Annotated and Introduced by Alan J. Rocke. Springer-Verlag, Berlin. Series: Springer-Briefs in History of Chemistry. 2012, vii + 105 pages. Price: £44.99 (PB).

Picture this: You and a friend are visiting a newly constructed aquarium. You both walk through it, looking at the huge, gleaming compartments, each