

subtypes of NSCLC had been developed. Targeted therapy, for example, exists for adenocarcinomas of the lung which express EGFR mutation, ALK and ROS-1 rearrangements, BRAF V600E mutation and NTRK fusion genes.

Another significant advance – which resulted in a Nobel Prize in 2018 – is that of immune checkpoint inhibitors. Tumour cells evade the cells of the immune system by expressing immune checkpoints to disrupt the function of cytotoxic T cells, which then undergo apoptosis. Monoclonal antibodies against PD-1 and PDL-1 block these immune checkpoints and help sustain the activity of T cells, and thus fight the cancer. The presence or absence of driver mutations as well as geographic variations (according to the data available on East Asians and Caucasians) in the mutations and gene arrangements mentioned above illustrate how medicine in the near future will necessarily have to be personalized.

The human microbiome which consists of commensal bacteria – and now considered by some to be an organ by itself – has been in the news for about a decade now and two chapters are devoted to specific aspects of the microbiome. Changes in the microbiome are associated with various diseases. One chapter deals with the microbiome anomalies in allogeneic haematopoietic cell transplantation, while the other is on the role of diet in the relationship between gut microbiota and cardiometabolic disease.

Allogenic haematopoietic stem-cell transplant affects the diversity of the microbiome because of the effects of chemotherapy, radiation and donor haematopoietic cells. Antibiotics which are used to prevent and treat infections also impact the composition of the microbiome. Remarkably, even the timing of the treatment matters. Patients who have received the antibiotics prior to transplant have poorer outcomes than those who have received them post-transplant. Besides, *Clostridium difficile* infection which manifests as diarrhoea in the peri-transplant period is also exacerbated by the change in the gut flora caused by the antibiotics. Finally, graft-versus-host disease is another serious complication of the transplant and is related to the host microbiome. Whether the donor's microbiome also has an effect on graft versus host disease is yet to be resolved. It has been hypothesized that damage to the intestinal microbiome can be reduced and can result in better patient outcomes. This attractive hypothesis needs to be tested; but it has limitations, prime among them being methodological

ones which are related to determining the exact composition of a person's microbiome. Strategies to modify the microbiome also include modification in the diet, use of prebiotics and probiotics as well as faecal microbiota transplantation.

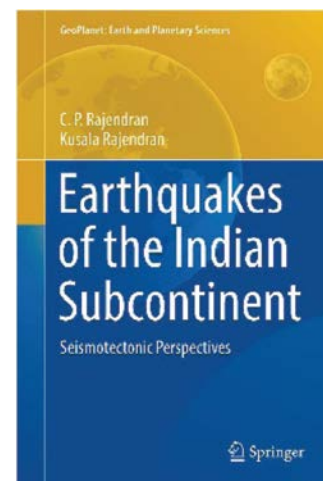
That diet is linked intimately to the microbiome also indicates that another disease that is intricately linked to the diet is also affected by the microbiome – the disease in question, of course, being cardiometabolic disease. The problems of interpreting dietary studies is clear when one realizes that there exists a substitution effect: when we compare a high-protein and a low-protein diet, we are also simultaneously comparing a low-carbohydrate/low-fat and a high-carbohydrate/high-fat diet.

Even in this age of omics, brilliant discoveries can be made from routine tests which have been around for more than a century. The chapter on asthma gives us one such example. We have known for decades that the sputum in asthma contains eosinophils. Yet, in the early part of this century, it was realized that sputum count could be used to adjust treatment doses. Based on this finding, those with high eosinophil counts in the blood and sputum are treated with the monoclonal antibody mepolizumab. In fact, a new subtype of asthma has now been defined, called severe eosinophilic asthma. Cutting-edge therapy also exists for asthma. While bronchodilators and steroids have been the mainstay for the past half century, we now have new options like monoclonal antibodies. Besides mepolizumab, there are others too – omalizumab (which inhibits the activity of IgE), benralizumab (which inhibits the actions of IL-5 receptor) and dupilumab (which inhibits the actions IL-4 and IL-13). The latest approach for the treatment of this 'medical' disease is to anatomically alter the airway. Patients with severe asthma may now undergo bronchial thermoplasty, which consists of delivering radiofrequency energy via catheters in the bronchial tree. This results in reducing the mass of the smooth muscle, which is hyperplastic, hyper-reactive and hypertrophied in asthma.

As I stated at the beginning the *Annual Review of Medicine* makes you question your cherished ideas.

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**Earthquakes of the Indian Subcontinent: Seismotectonic Perspectives.** C. P. Rajendran and Kusala Rajendran. Geo-Planet: Earth and Planetary Sciences. Springer Nature Singapore Pte Ltd, 152 Beach Road, #21-01/04 Gateway East, Singapore 189721. 2020. 253 pages. Price: €29.99. doi.org/10.1007/978-981-16-4748-2.

In the Preface of this book, the authors pose a question, 'Why another book on this topic'? This is a question commonly posed whenever a new book comes out. The answer to this question (according to one of my teachers) is 'because there are so many books on the topic, here is yet another one' (which brings more clarity and comprehensiveness).

Albeit a plethora of scientific literature on earthquakes of the Indian subcontinent, most of it exists in the form of focused research papers. Thus, for a geoscientist interested in comprehending the genesis of Indian earthquakes and understanding their diversity and common characteristics, it is highly desirable to access this information at one place. This book serves the purpose since the authors succeed in synthesizing all the information on recent and historical earthquakes from a seismotectonic perspective. Rajendran and Kusala Rajendran have pioneered earthquake studies over the past three decades, and have extensively investigated almost all the prominent earthquakes in India and adjoining regions. With increasing instrumentation and our understanding on earthquake occurrence, the amount of data to describe an earthquake and its rupture process, keeps increasing with each new one, thereby populating the number of articles. At the same time, lack of instrumental data resulting mostly in qualitative information on historical and pre-historic earthquakes, poses non-uniqueness

in the interpretation, leading to an increasing number of publications of such earthquakes. Thus, each earthquake deserves not just one, but probably several books to be written describing it. Indeed, this is what has been done for many great and major Himalayan earthquakes, e.g. the Geological Society of India (GSI) memoirs on the 1905 Kangra and 1897 Shillong plateau earthquakes are masterpieces. Irrespective of a recent or past earthquake, assembling relevant and interesting information related to it and weaving together material for a book becomes a tough task; there could be some omissions, sometimes due to a personal bias or because of limited space available. This book too is not an exception in that sense. Nevertheless, this is probably the first book that contains information on all the Indian earthquakes in the most complete and concise manner.

The book is divided into three parts. The first one is devoted to intraplate earthquakes, while the second and third parts deal with earthquakes in the northwest and central Himalaya, and North East India respectively. Chapter 1 serves as an Introduction to the book, which lists the major earthquake-producing tectonic zones of India, the strong to great earthquakes in the country and adjoining regions since 1800, and the seismic zonation map of India published by the Bureau of Indian Standards. As rightly pointed out by the authors, although extensive work has been carried out on the intraplate and reservoir-triggered 1967 Koyna earthquake and the subduction zone earthquakes, namely the 1881 Car Nicobar, 1941 Andaman, 1945 Makran and the 2004 Sumatra Andaman earthquakes, the authors have not included a detailed discussion on these earthquakes in this book.

Chapter 2 of part I, chapter 7 of part II and chapter 13 of part III should not be missed out since they provide details on the basic tectonic framework and earthquake occurrence processes. Also, the last section of each chapter on the 'importance', 'outstanding questions', 'implications', or 'hazard perspective' is worthy of attention, since these sections prompt the reader with leads for future research work. Intraplate earthquakes are most notorious and their mechanisms are least understood. Chapter 2 describes various proposed mechanisms of intraplate seismicity and aptly warns the readers not to use the concept of recurrence interval and seismic cycle in the context of intraplate earthquakes. Chapter 3 lucidly describes the 1819 Kachchh (or Allah Bund) earthquake, the first well-documented case

of coseismal surface faulting. Chapter 4 deals with the 2001 Bhuj earthquake which, like the 1819 earthquake, occurred within the Kachchh failed rift. Unlike the 1819 earthquake, it probably did not cause surface rupture, though some researchers now differ with this proposition. The authors postulate that this earthquake is a diffused plate boundary earthquake which, in my opinion, needs further validation. Chapter 5 describes the 1993 Killari (Latur earthquake), which is a stable continental earthquake in the true sense. Its occurrence led to a significant change in seismic hazard perception, not just in India but around the globe. It also led to modernization of the Indian seismic network. Chapter 6 deals with the 1997 Jabalpur earthquake which occurred in the lower crust of Narmada Son failed rift. It highlights that even a moderate magnitude earthquake at greater depths can cause substantial damage.

Chapter 7 of part II of the book presents an overview of earthquake processes, seismicity, geological and structural setting of the Himalaya, and serves as a good introduction to the Himalayan earthquakes. The 1803 Uttarkashi (or Srinagar and Devprayag) earthquake is described in chapter 8. The earthquake caused damage to the cupola of Qutb Minar in Delhi, in addition to soil liquefaction and ground failure at a few places in the Indo-Gangetic Plains. However, it only turned out to be a major earthquake without any surface manifestation, whose rupture on the Main Himalayan Thrust (MHT) remained confined within the Lesser Himalaya without extending up-dip up to the Main Frontal Thrust (MFT). Chapter 9 deals with the 1905 Kangra earthquake, whose effects have been described by Middlemiss in a memoir of GSI in 1910. This too did not cause any surface rupture on the MFT. Interestingly, this earthquake had two centres of distantly located high intensity. The 2005 Kashmir earthquake is described in chapter 10. This was clearly an out-of sequence earthquake whose rupture extended up to the surface and manifested itself in the form of extensive landslides in the region. Despite this being only a major (and not great) earthquake, it caused more than 80,000 fatalities. Chapter 11 deals with the 1934 Nepal-Bihar earthquake which caused great damage in the adjoining Indo-Gangetic plains. The authors have unearthed an interesting political and social conversation between Gandhi and Tagore on this earthquake. Another interesting observation made by the authors is that, apparently after the earthquake, a pamphlet was circu-

lated describing its cause invoking the continental drift theory, which was in its infancy during that period. It is amazing that the authorities were aware of this development. Although this earthquake involved the entire seismically active MHT of the segment, it did not cause any surface rupture. Hence, the rupture remained blind for this earthquake. The 2015 Gorkha earthquake is the latest event described by the authors. Extensive instrumentation in the region has led to a significant increase in our understanding of the earthquake rupture and the tectonic processes involved in the Himalayan arc. This was a partial rupture of the downdip part of the MHT and the rupture remained blind. The authors warn about the future seismic hazard to the west of the 2015 Gorkha earthquake. Chapter 13 of part III deals with the Eastern Himalaya. It describes the tectonics of the Himalayan arc, Eastern Himalayan syntaxis, Indo-Burmese arc and the Shillong plateau. Chapter 14 deals with the famous 1897 Shillong plateau earthquake. In 1899 Oldham brought out an exhaustive memoir on this earthquake. The debate on the source of this earthquake, whether on Dauki, Brahmaputra or Oldham faults, is nicely summarized by the authors. Chapter 15 describes the 1950 upper Assam (now Arunachal Pradesh) earthquake. Despite being the latest great earthquake with the largest magnitude ( $M$  8.6) in the instrumentally recorded history of the Himalaya, our understanding of this earthquake is poor. Whether the rupture of this earthquake was complex, or is it a lack of data and/or our understanding, is a matter of debate. The last chapter, Epilogue, describes the seismic hazard assessment, preparedness, building codes, public response and new developments in instrumentation.

Although the authors did not write a separate chapter on the past earthquakes inferred from palaeoseismological studies, they have included it in parts in the relevant chapters. They have also highlighted the limitations of these studies in a subtle manner without much criticism. I was hoping to see a chapter on the 1505 earthquake, which has been considerably deliberated and is now hypothesized to be the largest earthquake in the known history of Himalayan earthquakes. While a chapter is devoted to the 1803 earthquake, a detailed discussion on the 1833 Kathmandu earthquake is missing. I also expected the authors to write a short chapter on the earthquakes of the Indo-Burmese arc, particularly the recent intra-slab earthquakes and also the largest

known 1869 Cachar earthquake. In chapter 13 of part III on plate boundary earthquakes: Eastern Himalaya, I am not sure why the authors chose to club the discussion on the Indo-Burmese arc and Shillong plateau with that on the Himalayan arc. Further, the 1897 Shillong plateau earthquake, described in chapter 14, which is considered as an intraplate earthquake, could have ideally been placed in part I under the intra-continental earthquakes. There is a typographical error in the seismic zonation map in chapter

1, which is worth pointing out to avoid misuse. There are four seismic zones with zone names as II, III, IV and V, with each zone assigned with PGA values of 0.1, 0.2, 0.25 and  $>0.4$  g respectively. The earlier zones I and II are now merged and referred as zone II. In the same chapter, it is better to refer to the 6 August 1988 earthquake as the India–Myanmar border earthquake. Also, since the magnitude of 27 August 1960 earthquake is now revised as 4.9, it should not be listed as a strong earthquake.

Overall, this is a good book on earthquakes of the Indian subcontinent and is a must read for all the geoscientists. It nicely describes the source mechanisms of these earthquakes and the geodynamic processes responsible for their occurrence.

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