author discusses the mineral characterizations by Raman and Fourier transform infrared techniques. Raman spectrum has been used to determine the correlation between the peak position and the element content of characteristic peaks in the olivine and pyroxene spectra as an alternative method to determine the composition of olivine and pyroxene in ordinary chondrites. The data were used to evaluate their classification into the chemical groups of ordinary chondrites. Chapter 5 discusses the presence of organic traces in the NE ordinary chondrites. It is well established that the carbonaceous extracts of Murchison and other carbonaceous chondrites contain organic compounds like amino acids. But the presence of organic matter in ordinary chondrites has been reported only recently.

Overall, this book is well written and concise, with a particular focus on the usefulness of vibrational spectroscopic methods in meteorite research with sufficient references to the recent literature pertaining to meteorite research. The appendix provides a comprehensive list of all meteorites observed in India.

I recommend this book to all students, academic researchers and university teachers interested in learning about the usefulness of spectroscopic techniques (often used by Experimental Physics and Chemistry communities) in studying Earth and planetary materials.

I am grateful to National Institute of Advanced Studies, Indian Institute of Science Campus, Bengaluru, and Indian National Science Academy, New Delhi for the support.

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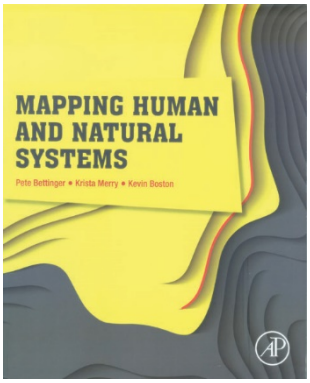

Mapping Human and Natural Systems. Pete Bettinger, Krista Merry and Kevin Boston. Academic Press, an imprint of Elsevier, 125 London Wall, London EC2Y 5AS, United Kingdom. 2020. xiv + 341 pages. Price: US$ 99.95.

Three distinguished forestry researchers have come together to bring out this excellent book as a practical guide to modern cartographers and map users in general. Two of them are experts in forestry and one in geography, an essential combination to publish a book of this kind, which does not require a review but an introduction for the benefit of map developers and users in the digital age. This pool of expertise has produced a book useful for students and researchers in environmental science, forestry, ecology, wildlife and natural resource management.

Pete Bettinger, in addition to his expertise in forestry, is acknowledged for his skills in geographic information systems (GIS) analyses of resources and resource conditions, time and cost of forest operations and assessment of geographical positioning systems' (GPS) accuracy in a forested environment. He teaches forest planning, forest measurement, and aerial photogrammetry and conducts research in applied forest management with particular emphasis on harvest scheduling, precision forestry and geospatial technologies. Krista Merry is a geographer who researches applied forest management, emphasising remote sensing, geospatial technologies, landscape planning and precision forestry. She has skills in using GIS, satellite imagery and aerial photography. Kevin Boston specialises in forest engineering, applied forest management, landscape planning and geospatial technologies. These authors have nurtured a fascination for drawing maps since childhood. As adults, they have mastered the fundamentals of digital mapping and produced a book that provides the users with a ready reference to learn about map creation and interpretation and to help them better interact with and construct maps. It is no exaggeration to say that this book fills the long-felt need for a single source on the fundamentals of mapping in the digital age. It is indeed a compulsory read to understand the principles and methods of map development in the modern world.

The book has been divided into nine chapters, intended to cover an array of topics connected to mapping in a logical manner that 'allows general thoughts regarding maps and mapping processes'. The novelty of this book is that each chapter's content is intermixed with reflections, diversions, inspection and translation 'to encourage curiosity, and help develop creativity and critical thinking skills'. Reflections are meant to encourage 'readers to think deeper about the mapping ideas'. Diversions are meant to divert the reader from the book and 'ask the reader to put the book aside and solve a problem'. The readers will be asked to obtain and organize the necessary data and develop a map that communicates a certain message. Inspection encourages the user or reader to 'analyse the map and determine the relative quality of the map with respect to the chapter topics within which each inspection is introduced'. Translation refers 'to the potential message that the map developers have been attempting to communicate the use of works…'. According to the authors, these aspects are likely to 'engage readers in the process of spatial thinking… and to improve readers' ability to communicate and receive messages through maps, and to ensure that they are better positioned to understand the purpose of maps and mapping procedures.

Chapter 1 opens with a series of axiomatic statements about map(s). It includes four sections: (a) maps as models, (b) maps as memories, (c) maps as inspiration and (d) maps as products. Each section is intermixed with reflection, diversion, inspection and translation. These are common to all the chapters to serve the intended purpose. The authors observe that 'People now naturally access cartographic information on digital devices, and while the traditional role of a map as depository of source of information still remains, its role has shifted in many respects to a tool of interaction with map user.'

Chapter 2 provides a historical account of multitude of types of maps through the ages. Two broad sections deal with this theme. The traditional types of maps

include thematic maps, choropleth maps, isopleth maps, isarithmic maps, hypsometric maps, dasymetric maps, planimetric maps, and base maps. The specific types include world maps, navigation maps, nautical maps, location maps, geologic maps, topographic maps, bathymetric maps, property maps, soil maps, vegetation maps, zoogeographic maps, environmental maps, weather maps and digital maps to meet the requirements of researchers and users belonging to respective disciplines.

Chapter 3 on map components provides instructions to be followed for developing professional maps. According to the authors, a 'professional map should enable the users to understand the desired message crafted by the map developer'. They assert that fundamental elements of map development should focus on map title, landscape orientation, scale, symbols, legends, labels and text annotation, insets, neat line, reference information, etc. Each of these is clearly explained with appropriate examples.

Chapter 4 deals with map reference systems. They help the user to understand where they stand with respect to other places on Earth. The chapter has three broad subdivisions: coordinate systems, datums and map projection systems. It discusses various components of coordinate systems in terms of latitude and longitude, plane coordinates, universal transverse Mercator system, mete and bound surveys, etc. The chapter presents a graphic description of the essentials, including datum map projection systems and map grids.

Chapter 5 deals with how geography can be obtained by interpreting maps and basic information about places prior to physically visiting the landscape. Scale, elevation, slope, direction and orientation, aspect, relief, distance, area, etc. help the user with directions to reach a particular place, identify the tallest feature in the area, and how far a particular feature on land continues. This chapter discusses map interpretation concepts focusing on maps made with modern mapping technology and techniques.

Chapter 6 deals with the use of colours and colour schemes to effectively reflect human and natural systems on Earth. The authors rightly observe that 'The selection and use of colour on maps is perhaps the most challenging aspect of map development…The selection of colours is further complicated by the need to adhere to established conventions in cartography.' The map user must be able to 'understand spatial pattern, landscape classification, or other important information communicated by the map developer'. Colours and colour combinations should communicate messages on maps and interpretation of information by the user. The chapter presents various colour models, colour schemes, colour order systems, etc. as essential aspects of developing maps that effectively communicate messages.

Chapter 7 discusses map development and generalization. It has four sections: drawing a map by hand, developing a map in a geographic information system, generalizing landscape features, and rendering digital maps on computers and devices. It notes that it is imperative to follow appropriate cartographic practices to develop a high-quality map. This also means 'a balance must be struck between providing the minimum amount of relevant information, retaining the maximum amount of relevant information, and displaying this information as clearly as possible'.

Chapter 8 presents map errors; some are deliberate, some are inevitable, and some are unavoidable. Map errors are attributed to skill deficiency, lack of knowledge of the map development process and non-adherence to mapping rules. These issues are discussed with graphic examples.

Chapter 9 is a fascinating account of how maps have made an inroad into popular culture and the day-to-day lives of modern society. In this digital age, cell phones have become an extra-corporal limb of humans, finding a person without them is difficult. Human navigation on Earth is directed by digital maps on cell phones, and so is his/her connectivity with the world of popular culture. 'Popular culture encompasses various forms of expressions, such as music, dance, fashion, art, cinema and television', and maps support these forms of expression. For instance, maps are used by political correspondents to communicate election results. They use colours to illustrate a political party 'receiving the majority of votes within various levels of political geographical units'. This helps attract the attention of the general public as 'they are created to address the tastes and perspectives of large masses of ordinary people'. Further, this chapter provides a comprehensive account of the place of maps in: (a) cinema, (b) television, (c) music, (d) newsprint, (e) magazines and books, (f) advertising, (g) digital devices, (h) video gaming, etc. The authors suggest that it is essential to ponder over the design of a popular map by paying attention to 'map elements, projection, coordinate systems and annotations' before it is put in the public domain.

This is not a review of the book but a simple introduction to its usefulness to map developers and users. The technology and techniques of production of modern maps have developed in accordance with the developments in digital technology. This book admirably succeeds in presenting a graphic account of various elements of map production and their application to produce user-friendly maps that cater to the needs of a multitude of researchers and students of human and natural systems.

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