Ethnobotany of India. T. Pullaiah, K. V. Krishnamurthy and Bir Bahadur (eds), Apple Academic Press, Waretown, New Jersey & CRC Press, Boca Raton, Florida, USA. 2017. Five volumes (**1**, 502 pages, **2**, 348, **3**, 393, **4**, 496, **5**, 694). ISBN 13:978–1–77188–338–2 (Hardcover). Price not mentioned.

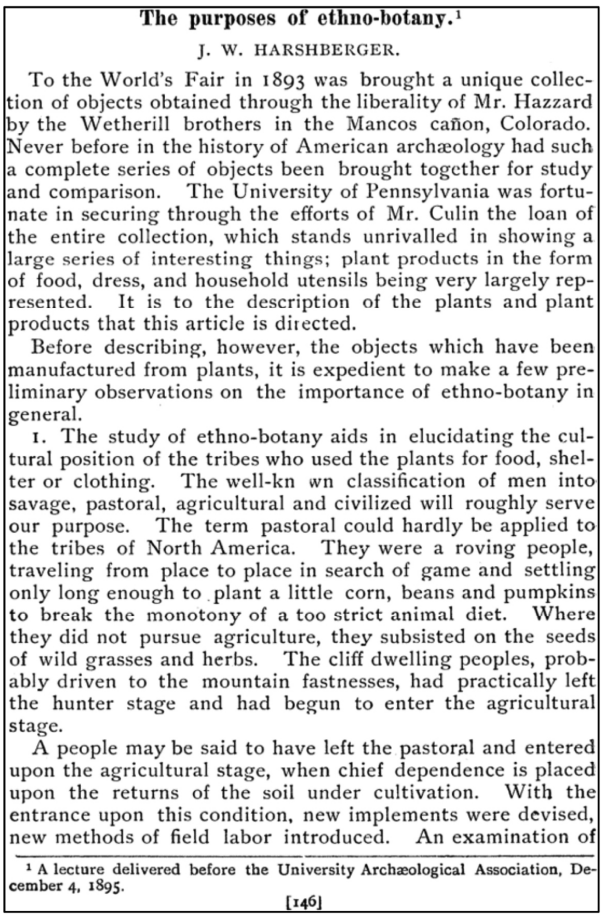
Harshberger[1] (Pennsylvania, USA) first used the term 'ethno-botany' in 1896 (Figure 1), referring to the science of relationships between humans and plants. Ethnobotany, today, has grown into a multidisciplinary science involving the bionomics, chemistry, uses and ecology of plants as relevant to human culture, heritage, economics, and in linguistics. This science has enabled us – humans – to know the 'better side' of plants. Through a *c*. 50,000-year experience, we have learnt to utilize plants for their benefits. Agriculture is one such[2]. Natural products chemistry is another, jump-started by Schmidt in 1811 (ref. 3). Simonsen, Chopra, Dey, Siddiqui, and Seshadri led natural products chemistry in India to great heights in the 20th century[4]. Besides, the botanical wisdom of ancient human societies, gained through experience has been another factor in empowering humans in this direction[5,6].

Ethnobotany is a continuum with humans and plants occurring at either end. Humans in the Indian subcontinent have evolved in a complex manner over time[7]. The Indian human germplasm has been significantly influenced by foreign genetic material: the Greeks and Romans coming into India millennia ago, Chinese in the 7th century, and Persians and Europeans in recent centuries. An Indo-Chinese race presently exists in Naduvattam (the Nilgiris, Tamil Nadu; 11°48′N, 76°57′E) because of the relocation of Malay–Chinese prisoners from the British Straits settlements in the 1870s (ref. 8). Such human movements, additionally, have impacted on Indian culture, customs and traditions. India's ethnic evolution – synonymous with cultural evolution – fastened by tolerance and acceptance, has no parallel in any other nation. Botanical knowledge of humans has been, and continues to be, useful in diverse ecosystem services. Importantly, we Indians, have been seeking plants for medications. For example, the *Çaraka* and *Šušruta Samhitã*-s, and *Ãstãṅga Sangrahã* speak eloquently on the medicinal uses of different plants[9]. A narrative on the symbiosis between Indian humans and plants could go on endlessly. India's ethnobotany is as delicate as, and yet as tough as, spider-silk fibre in the cultural fabric of the country.

In such a complex context, I dare to comment on this *c*. 2500-page book. It is presented as five volumes: vol. 1 pertaining to the Eastern Ghats and Deccan (EGD), vol. 2 to the Western Ghats and Malabar–Konkan Coast, vol. 3 to North-East India, Andaman and Nicobar Islands, vol. 4 to the Western and Central Himalaya, and vol. 5 to the Gangetic Plains and Central India. This structure, based on physiographic divisions, rather than state boundaries, impressed me as natural and logical. Sixty-four chapters written by nearly 100 authors from diverse professional backgrounds constitute this book set. My immediate impression was 'colossal'. I will selectively comment on a few chapters that excited me, since commenting on every chapter will be unwieldy.

The five volumes are of similar structure, dealing with ethnic tribal diversity, ethnobotanical worldviews and belief systems, plant genetic diversity, food plants and ethnic food preparation, ethno-medicinal plants, ethno-veterinary medicine, ethnic communities and their botany, and ethno-pharmacology, bioprospecting, and patenting, as appropriate to the bioregions the volumes refer to. Each volume, committed to a specific physiographic region of the subcontinent, includes a discourse on the ethnic diversity of that region, which is instructive. The above is the general pattern and a few chapters on specific topics sparkle in specific volumes. I shall now progress to a detailed analysis of individual volumes.

The Eastern Ghats and Deccan: The chapter on the ethnic plant genetic resource diversity by Pandravada *et al*. caught my attention. The Eastern Ghats is an incredible constituent of the Indian peninsula. This discontinuous stretch of hills running nearly parallel to the Coromandel coast has a composite geological



The purposes of ethno-botany.[1]

J. W. HARSHBERGER.

To the World's Fair in 1893 was brought a unique collection of objects obtained through the liberality of Mr. Hazzard by the Wetherill brothers in the Mancos cañon, Colorado. Never before in the history of American archæology had such a complete series of objects been brought together for study and comparison. The University of Pennsylvania was fortunate in securing through the efforts of Mr. Culin the loan of the entire collection, which stands unrivalled in showing a large series of interesting things; plant products in the form of food, dress, and household utensils being very largely represented. It is to the description of the plants and plant products that this article is directed.

Before describing, however, the objects which have been manufactured from plants, it is expedient to make a few preliminary observations on the importance of ethno-botany in general.

1. The study of ethno-botany aids in elucidating the cultural position of the tribes who used the plants for food, shelter or clothing. The well-kn wn classification of men into savage, pastoral, agricultural and civilized will roughly serve our purpose. The term pastoral could hardly be applied to the tribes of North America. They were a roving people, traveling from place to place in search of game and settling only long enough to plant a little corn, beans and pumpkins to break the monotony of a too strict animal diet. Where they did not pursue agriculture, they subsisted on the seeds of wild grasses and herbs. The cliff dwelling peoples, probably driven to the mountain fastnesses, had practically left the hunter stage and had begun to enter the agricultural stage.

A people may be said to have left the pastoral and entered upon the agricultural stage, when chief dependence is placed upon the returns of the soil under cultivation. With the entrance upon this condition, new implements were devised, new methods of field labor introduced. An examination of

[1] A lecture delivered before the University Archæological Association, December 4, 1895.

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Figure 1. Title page of Harshberger's paper from the *Botanical Gazette* (1896).

history. This hill range includes a generous dose of tropical semi-evergreen, moist deciduous, dry deciduous, thorny scrub, and dry evergreen forests[10] influenced by a distinct, tropical monsoon climate. This vegetation pattern starkly contrasts with that in its western counterpart. This chapter refers to the crop-plant diversity presented as a useful, 34-page long table. The sections 'Ethnic plant genetic diversity conservation', 'Utilization of plant genetic diversity in crop improvement', and 'Factors contributing to genetic erosion …' in this chapter offer an interesting read. The remarks of Pandravada *et al.* on plant genetic resource management should bear positive, long-term implications.

Next I will refer to the chapter on ethnomedicinal plants of the EGD by Karuppasamy and Pullaiah, who also provide a list of 800 plants, which, I am sure would help in promoting effective utilization and efficient conservation. Details of original references included in this table are valuable. But the section 'Methods' in this chapter confused me. In the first paragraph of the section, Karuppasamy and Pullaiah provide statements that appear to be more suitable to an original research paper and not to a review-type article such as this. They mention the 'emic-' (and 'etic-') field research approaches proposed by Roy Goodwin d'Andrade in 1995 in passing, which baffled me. The emic approach should have been explained for naïve readers such as myself. I wondered why the valid name *Vachellia* was not used for *Acacia* (Fabaceae)[11]. The table in chapter 8 is nearly similar to that in chapter 7, but a few inconsistencies in presentation and style in the two were glaring. For example, the names of authorities after the binomials supplied in the table in chapter 8 are absent in the table in chapter 7. The absence of Tamil (pãlai), Malayalam (ézhila-p-pãla), and Kannada (halé) names of *Alstonia scholaris* (p. 312) is distractive. Such irregularities are not major, but vexing.

Chapter 9 is impressive. It describes about fibre-, dye-, and wood-yielding plants and those that provide gums and resins, in addition to plants held sacred like *Diospyros melanoxylon* (Ebenaceae) which runs the beedi-industry economics, and the non-timber forest products used by Indians over centuries.

The succeeding chapter by Krishnamurthy *et al.* deals with the conservation, documentation, and management of ethnic communities. It emphasizes the need to empower indigenous communities to live peacefully, concurrently conserving plant materials intertwined with their cultures. Krishnamurthy *et al*. emphasize endogenous development and protection of communities living in the remote areas of EGD. In chapter 11, Pal and Bahadur refer to the pertinence of computer applications in ethnobotany. I am confident that this will be useful in a better interpretation of ethnobotany.

The chapter on bioprospecting and patenting and their relevance by Pushpangadhan *et al.* concludes the first volume. As I read the section 'Third world nations and intellectual property rights', the terms '*Azadirachta indica*', 'azadirachtin', 'Heinrich Johannes Schmutterer' and 'locust plague in Sudan' flashed through my mind. *A. indica* is used widely in the Indian subcontinent in folk and traditional medicine[12]. Although the exact centre of origin of this plant is not established, its natural populations occur plentifully in the subcontinent. It is a vital cog in the wheel of India's religious heritage[13]. One cannot avoid remembering the brilliant contributions of Govindachari to azadirachtin made in the 1960s (ref. 14). Although the active compound (azadirachtin A) was isolated in 1968 (ref. 15), Indian farmers have been using *A. indica* in repelling arthropods for centuries[16]. Anyhow, the IPR element surrounding *A. indica* is an ongoing battle. Emily Marden[17], a practising American solicitor, provides an impartial analysis of this issue.

The Western Ghats and West Coast: This volume includes chapters nearly similar to those in vol. 1. However, a few on the ethnic diversity, influence of trade, religion and polity, European contributions, human affinities with plants in the worldviews of indigenous communities, sacred groves, and ethnobryology render this volume colourful.

In the chapter on 'European contributions …' Krishnamurthy and Pullaiah speak of the contributions made by the Europeans Garcia da Orta, Cristóvão da Costa, Gerard Clusius, and H. A. van Rheede tot Drakenstein, who worked in different parts of the Malabar–Konkan coast in the 16th and 17th centuries. da Costa (Cristóbal Acosta) was a contemporary of da Orta living in Goa and Clusius (Charles de l'Écluse), who had never been to India. da Costa served as a physician to Késava-Rama Varmã (1565–1601), the titular king of Cochin, for a brief period. After returning to Burgos (42°21′N, 3°42′W) in 1578, he published *Tractado de las Drogas y Medicinas de las Indias Orientales con sus Plantas Debuxadas al Biuo* (https://archive.org/details/tractadodelasdr00acosgoog/page/n6). This volume is not fully original, because he pulled considerable volume of details from da Orta's *Colóquios dos Simples e Drogas he Cousas Medicinais da Índia e Assi Dalgũas Frutas Achadas nella onde se Tratam Algũas Cousas Tocantes a Medicina, Pratica, e Outras Cousas boas Pera Saber* (http://purl.pt/22937) published in Goa in 1563. Krishnamurthy and Pullaiah elaborately refer to van Rheede's *Horti Malabarici pars Tertia de Arboribus* (Amsterdam, 1678–1693). On reading this chapter, I wondered why a similar one, referring to the contributions of Johann Rottler (1749–1836), William Roxburgh (1751–1815), Whitelaw Ainslie (1767–1837), Edward Balfour (1813–1889) and Hugh Cleghorn (1820–1895), who wrote extensively on the medical botany of the Coromandel, was not included in vol. 1. Among these, Roxburgh (read as 'Rox-br-o(h)') sparkles because of his incredible volumes on the botany of southern India and India, and for his search for a potential anti-malarial drug in southern India. Roxburgh, while at Samalkot Botanical Garden (17°05′N, 82°17′E), searched for substitutes for *Cinchona* – later introduced into India through the efforts of Clements Markham[8]. Roxburgh found the Indian mahogany, which he named *Swietenia febrifuga* (currently *Soymeda febrifuga*, Meliaceae) in 1793 (ref. 18, Figure 2). He explained the chemical properties of *S. febrifuga* bark by testing it with chalybeate, limewater, vitriolic acid, vinegar, vegetable alkalis and magnesia. Roxburgh found that more bitter the bark, greater were the chemical contents in it. He also found that *S. febrifuga* bark included many compounds not known in the bark of *Cinchona*; the bioactive chemicals in *S. febrifuga* bark were more readily water-soluble, and water extracts were stable for a longer period of time than those extracted from *Cinchona*[8].

In the immediately following chapter 'Worldviews of indigenous communities …' Somashekhar speaks on the tight-knit relationship between the indigenous people of the Western Ghats and plants.

He speaks of practices such as plant veneration, celebration of nature, emotional values attributed to plants, ritual-specific uses of plants, and ecological consciousness recited as stories and verses. He describes the perceptions of plants and other elements of nature among the people of the Western Ghats, and contrasts them with the economics-driven 'values-based-on-use-and-utility' paradigm. One element that comes out powerfully in this chapter is the imperative need for us – humans – to shed the arrogant technocentric attitude, which has been driving us for the last few decades. Such a technocentric behaviour has led us to imagine that we are the world's most superior organisms. The kinds of peoples and their attitudes, Somashekhar speaks about, demonstrate that we – the human species – are indeed a diminutive fragment in the overall schema of the natural world. Whether a redemption from such a thinking, deeply soaked in arrogance, is a possibility, I am not sure, because selfishness and ego dominatingly steer us. Realistically, a shift towards ecological thinking coincides with an emotional shift to seeing ourselves as an integral part of a more complex and larger natural world. Such a shift will gel well with the shift from the supercilious efforts of humans to dominate over nature. The chapter was engrossing, but I felt traumatized by the use of the economic term 'resource' at many a place, which could have been simply replaced by the sobre term 'material'.

Figure 2. Original engraving of *Swietenia febrifuga* in William Roxburgh's *Plants of the Coromandel*, vol. 1. 1795 (Source: https://www.biodiversitylibrary.org/item/9711#page/57/mode/1up)

The chapter 'Traditional medical knowledge and malaria management' by Prakash *et al.* attracted my attention. A reference to malarial fever ('malaria' derived from 'mal' and 'aria' [Italian] implying 'bad air') can be found in Homer's *Iliad* (750 BC); of course, not as malaria, but as a fatal fever[19]. Prakash *et al.* list 60 plants from the Western Ghats as potent anti-malarials. The section on the epidemiology of malaria in Dakshina Kannada district was distracting. Greater care could have been exercised by the authors by staying within the focal theme of the book, and the editors making sure that the chapters gel well.

The last chapter in this volume by Alam refers to ethnobryology of India. I have never heard of the term 'ethnobryology', but realized that it was introduced by the American botanist Seville Flowers, in 1957. Whatever could be the justification for such new terms, I am not impressed. Are we continually adding new words and terms for our professional survival? The section on the relevance of bryophytes in folk medicine was interesting, but the remainder was reading more like an essay in economic botany.

North-Eastern India, Andaman & Nicobar Islands: This volume includes chapters on ethno-agriculture and on turmeric, in addition to the pattern of themes referred in other volumes. Agriculture practised by the indigenous people in North East (NE) India laces on instinctive ecological concepts and traditional wisdom, further to a strong sense of belonging, ownership and contentment. Reading this chapter, I remembered the pioneering work done by P. S. Ramakrishnan in NE India. Rai, the author of this chapter, discusses shifting cultivation in NE India, the ecology practised by the Tanw people of Arunachal Pradesh, and implications of agroforestry in the context of an ecologically sustainable model. Here he refers to subabul-based (*Leucana leucocephala*, Fabaceae) agroforestry. I am not sure whether this is a sustainable effort. *Leucana leucocephala* was introduced from Central America into India during the prime ministership of Indira Gandhi, portraying it as an environmental–economic panacea, amidst much fanfare, and thus christened subabul – 'the auspicious wattle'. Seldom did we realize then that we were inviting trouble along with it: *Heteropsylla cubana* (Hemiptera: Psyllidae) entered India along with *L. leucocephala*. Populations of *H. cubana* built up intensely and quickly, nearly in all *L. leucocephala* stands throughout India. In Africa and Asia, *H. cubana* populations have been detected, in recent years, on other related arborescent Fabaceae[20].

Curcuma longa (Zingiberaceae) is a popular perennial herb whose rhizome yields the prized turmeric. *Curcuma* rhizome includes more than 100 compounds, prominent among them being turmerone (a volatile oil) and a range of pigments (the curcuminoids), and various sterols. Although indicated as a native of South Asia, India tops in *Curcuma* husbandry. According to Duke *et al.*[21] (p. 34), 'Use of turmeric in magical rites intended to produce fertility became so entrenched that turmeric moved with the early Hindus to the "Hinduized kingdoms of Southeast Asia", quoted in Marco Polo records, China, in 1280. Turmeric reached East Africa in the eighth century and the West Africa in the thirteenth century. It reached Jamaica in 1783'. They[21] speak eloquently on the value of turmeric as an antiseptic and in popular cosmetic creams. The chapter on *Curcuma* by Samala and Veeresham is comprehensive. Maximum production of *C. longa* today in India occurs in Telangana (*c.* 260,000 MT in 2017; https://www.statista.com/statistics/870963/turmeric-production-by-state-india/; accessed on 18 January 2019). What perplexed me at this point, why this chapter was placed in vol. 3 and not in vol. 1?

Western and Central Himalaya: The chapter on psychedelic plants of the Western Himalaya and the identity of the mysterious soma by Krishnamurthy and Bahadur fascinated me. Soma, supposedly an inebriating preparation, is indicated as a 'drink', 'divine form', 'plant' in ancient ritualistic Indian custom (see *Ṛg Védã*, Book 8, Hymn 43, Verse 3). Curious that it attracts the attention of many botanists and chemists throughout the world today, who search its identity: from a succulent milkweed (*Sarcostemma viminale*, Apocynaceae) to marijuana (*Cannabis sativa* f. *indica*, Cannabinaceae) have been suggested. Robert Wasson stormed the world in 1968 by suggesting that *soma* is *Amanita muscaria* (Agaricomycetes: Amanitaceae) drawing evidences from the Siberian Shaman culture. Isoxazoles in *A. muscaria*, determined by the Swiss chemist Albert Hofmann (who first synthesized lysergic acid diethylamide) induce euphoria in

humans who use these mushrooms. Recent papers suggest the unique fungal taxon of the Himalaya, *Ophiocordyceps* (Sordariomycetes: Ophiocordycipitaceae) as the source of *soma*[22]. However, relying on David Frawley[23], Krishnamurthy and Bahadur conclude saying that *soma*, the drink, is a concoction of extracts from different plants and not from one plant. Nonetheless, it was interesting to recall the prevailing academic disagreements in the still messy subject of *soma* of ancient India.

The Indo-Gangetic Plains and Central India: This volume includes 15 chapters. The 'Ethnobotany of Indus Valley …' by Krishnamurthy and Bahadur stood out from the rest. Indus-Valley Civilization (IVC) is a remarkable signpost in India's culture and ethnicity, which flourished mostly in the western segments of the Indian subcontinent – Pakistan today. IVC was a leader in organized agriculture involving wheat–barley–cattle–sheep farming. Many plants such as *Oryza*, *Hordeum*, *Sorghum* (Poaceae) and *Gossypium* (Malvaceae) were domesticated during this cultural evolution. Although brief, this chapter offers a useful summary, which I strongly believe would excite many a young researcher to pursue the science of ethnobotany of India.

This book set is so informative that my comments could go on forever. However, I need to pull the plug somewhere and here I do. Although I have commented elaborately on specific topics, which caught my attention, I will readily say that this set is a worthwhile addition to the scant literature on the ethnobotany of India. The editors deserve our thanks and congratulations. Developing a concept such as the one enshrined in this set, for a humongous landscape that had experienced a vibrant cultural evolution over thousands of years and pulling relevant chapters together written by a range of people, can never be easy. In that sense, the outcome is excellent. The text is generally easy to read. Nevertheless, I did notice a few grammatically faulty sentences and inconsistencies in style. If at all I were to point out a weakness, then it is with the arrangement of chapters, about which I have already spoken citing a few examples. One other element I missed reading about is on *štala vrkša*-s (sacred trees), an integral element of Hindu temples of southern India, whereas a chapter on the sacred groves exists in vol. 2 pertaining to the west of the peninsula. Sacred groves are equally well known in the east of the peninsula[24]. How did the editors miss including a chapter on sacred groves in vol. 1? *Štala vrkša*-s symbolize the gratitude of Indians to nature and epitomize a deep ecological enlightenment[25]. They represent an unconscious conservation effort, since the genetic material is maintained with awe. The silver lining of this book set is the inclusion of certain chapters, which provide breezy reprieves. The stunning volume of data presented as tables would go a long way in stimulating further investigations and launching suitable conservation efforts. One strong factor in ethnobotany is the embedded pharmacological potential. The other factor is the understanding and evolution of human behaviour in relation to life and plants over time. In short, as mentioned at the start of this review, multidisciplinary focus underscores ethnobotany. The editors have nearly fully achieved that outcome. The book set should help, facilitate and motivate scores of Indian botanists, economic botanists, natural products chemists, pharmacologists, anthropologists, historians and others who would seek clarity in this context. A valuable addition to Indian biological and chemical literature.

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ACKNOWLEDGEMENTS. I am grateful to V. Srinivasan (organic chemist, Chennai), T. S. Suryanarayanan (botanist–mycologist, Coimbatore), and K. Chandrashekara (entomologist–insect ecologist, Bengaluru) who read and offered helpful remarks on the final draft of this review.

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