The laws regulating the production and handling of sandalwood are so stringent that large-scale decimation of trees and smuggling continue unabated and outlaws continue to pose a threat to the police and forest officials. Owing to the ban on export of sandalwood from India by the Central Government, international prices have gone up and synthetic santalol (considered inferior to the natural sandalwood oil by the manufacturers of high quality perfumes) and inferior woods of other species of *Santalum* and other genera are being substituted. The losses due to ban on export are serious. It is claimed that over 6000 tonnes of superior quality sandalwood are lying unused in the depots in Tamil Nadu alone, causing an annual loss of Rs 100 crores.

The paper by Kushalappa has underlined that the outmoded and impractical laws in Karnataka have been counterproductive and has advocated rethinking and liberalization of rules, regulations and restrictions. He argues that rosewood, catechu and teak trees are better looked after by private owners and their woods are not under severe threat like sandal.

Sandalwood is difficult to propagate vegetatively. Seed-raised plants are heterozygous. Owing to the excellent work done by P. S. Rao (BARC, Bombay) and Lakshmi Sita (IISc, Bangalore) and their associates, sandal can be micropropagated and the plantlets raised can be hardened and successfully transferred to field conditions. This volume includes several new reports on the same subject, including responses of tissues from healthy and diseased plants. Sandal is also one of the few tree species in which somatic embryos have been produced in bio-reactors and converted into artificial seeds.

There are serious attempts to introduce VAM fungi to the seedlings to ensure better survival, growth and yield under forest conditions. The role of nitrogen fixing and non-nitrogen fixing host plants on sandal has also been discussed. Till recently, the extraction of oil was based on traditional methods such as steam distillation and solvent extraction. The seminar proceedings report recently developed approaches to chemistry and utilization. The paper on the anatomy of sandalwood and identification of adulterants on the basis of wood structure is elegantly presented.

The most valuable part of the book relates to tree improvement. It deals with the identification of provenances; use of alloenzyme markers and their application in population genetics; floral biology and breeding systems. These are areas in which a positive effort can be made in India where trained human resource is available.

The spike disease has been a major scourge of sandalwood, taking a heavy toll of trees. Tips of shoots start bearing little leaves, causing a bushy appearance. At later stages the shoots become bare and sterile and the diseased plants add little heartwood. The nature of the disease and the physiological and biochemical changes caused in the tissues have been intensively investigated in IISc since the early 1930's. The causal organism of the spike disease is a phytoplasma (formerly also called mycoplasm-like-organism or MLO), confirmed by transmission electron microscopy. The unicellular, non-culturable phytoplasma can be specifically stained by using DAPI stain (4,6-diamidino-2-phenyl indole) under the fluorescence microscope. The paper by Sunil and Balasundaram demonstrates the localization of phytoplasma in the phloem tissues of infected plants. Sandal is also attacked by borers leading to die back and mortality of smaller trees. There are also reports that large quantities of heartwood stored in government depots in Tamil Nadu and Karnataka are damaged by borers and termites.

The excellent research done in India on sandal over the past six decades has had little impact in solving the wide range of problems facing this tree of immense cultural and commercial significance. It is time that problem-solving is given serious priority. The seminar has taken note of this malady. Besides suggesting collaborative research in areas that interface, the participants have identified gaps in our knowledge and have listed research needs in their recommendations.

Removal of restrictions on government ownership and encouragement to grow sandal trees on private lands in Karnataka would be measures that need immediate consideration. International support should be provided for evaluation of genetic resources (especially for resistance to spike disease), improvement, breeding, selection and commercial viability of tissue culture-raised plants cloned from exceptional individuals.

The volume has much valuable information and is elegantly produced with excellent illustrations. There are a few avoidable typographical errors, including the spelling of the name of one of the editors. I would recommend this book to foresters, geneticists, breeders, botanists, biotechnologists, pharmaceutical chemists, planners and decision makers.

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Geology of Andhra Pradesh. P. K. Ramam and V. N. Murthy. Geological Society of India, P. B. No. 1922, Gavipuram, P. O., Bangalore 560 019, India. 1997. 245 pp. Price: Rs 250.

The Geological Society of India has launched a programme to publish textbooks on the geology and/or mineral resources of the different states of the Indian Union and the present book *Geology of Andhra Pradesh* is one among the series of 9 that have so far been published. This book is organized into 16 chapters which cover the descriptions of the geological record from the Archaean to the Holocene time. The authors are experienced field geologists and though they state that the thrust of the presentation is on litho-stratigraphy and field relations (pp. 3–4), they have judiciously mixed the concept and the field data to achieve cogent presentation in the compilation.

There is unity in the operation of a geological process which is manifested worldwide though the type and/or magnitude of a particular process varied with geological time. Further the geological boundaries of the litho-stratigraphic units or tectono-metamorphic belts may transgress the political boundaries of the provinces (states) or the countries. In some states complete geological succession of an epoch/period could have developed

which could be taken as typical for comparison, but all states contain fairly good record of the strata formed during one epoch/period or more that gives importance to the region. Andhra Pradesh (AP) by virtue of its location in peninsular India embodying defined tectonic elements contains fairly good record of the Archaean, the Middle–Upper Proterozoic and the Gondwana strata. During the last two decades substantial geological information came from at least three new areas in AP: the auriferous minor greenstone belts of Chittoor–Anantapur Districts, alkaline and other intrusive rocks of Prakasam District, and the sub-crop Tertiary sequences of coastal and off-shore K. G. basin. This has enhanced the importance of highlighting the regional aspects of the state's geology. All these are given due treatment in the book.

In southern peninsular India, the Archaean Schistose rocks and the Gneissic Complex of the Dharwar–Karnataka (craton) served as a reference standard for various reasons. The authors of the book have thus taken recourse to introduce the Archaean litho-stratigraphy of the Dharwar area before describing the schistose formations or the gneisses of AP in the related chapters. This is justified and more particularly so when the Archaean group of rocks of AP forms part of the Dharwar craton and that nearly two-thirds of the Eastern Block of Dharwar craton lies within AP and that itself constitutes 60% of the state (p. 10).

Chapter 1 gives an outline map of AP with district boundaries. Chapter 2 mentions the four tectonic sub-divisions of the state–Cratonic part, Marginal Transition Zone (MTZ), Godavari Graben and the Eastern Ghats Mobile Belt (EGMB). Chapter 3 gives a generalized summary of the litho-stratigraphic succession and the age data on dated rocks. In Table 2, there is a compiler's mistake in placing the formations of the Gondwana: Kota and Maleri against the appropriate row; Talchir, Barakar, Barren Measures and Kamthi under the appropriate column.

The minor schist belts of Veligallu, Gadwal, South Kolar belt (known earlier as Bisanattam schist belt), Kadiri, Ramagiri–Penakacherla, Jonnagiri and Peddavuru, which are equated with the Kolar-type auriferous greenstone (2700 M.a. age), are adequately described with geological sketch maps. The authors mention (p. 74) that the environment of the Ramagiri Schist Belt is that of island arc setting while the Kolar Schist Belt is that of the ocean floor. This is based on the geochemical studies of the associated basalts, but the two specific published papers related to these are not given under the references cited at the end of the Chapter 1. The supracrustal rocks of Nellore Schist Belt (NSB) and the Khammam Schist Belt (KSB) forming the MTZ are given full treatment. So also are the newly found Karimnagar Granulite Belt (KGB) and the counterpart Bhopalpatnam Granulite Belt (BGB) across the Gondwana of the Godavari valley in Bastar. In Figure 15, extension of KSB north of the Gondwana in Khammam district should be shown as the supracrustals of Mailaram part of this belt with copper mineralization occurring here. This extension, however appears in the coloured geological map of AP (opposite p. 18).

The Eastern Ghats is a prominent belt in AP extending NE–SW for 600 km in the state along the coast with a width varying from 100 km to 20 km. This belt continues to defy systematization of the litho-stratigraphy and tectonic interpretation with dated ages spreading from 2600 M.a. to 500 M.a. In chapter 5, the authors have adopted a division of the Eastern Ghats Belt into three longitudinal zones, the Western (WCZ), the Central (CKZ) and the Eastern (EMZ) based on the relatively greater occurrence of the Charnockite, Khondalite and Migmatite in the respective order. The Charnockite Region of Fermor of high grade granulites in peninsular India is re-defined in recent years principally based on the work in southern Karnataka and the northern Tamil Nadu and in this exercise the Eastern Ghats Granulite Belt (EGGB) is described as the Middle Proterozoic Mobile Belt (MPMB) or Eastern Ghats Mobile Belt (EGMB). In recent years a lot of work on the Granulite Belts and their fit in a reconstructed East Gondwana Continent (EGC) has been carried. A map showing the position and fit of EGGB with the granulite belts of EGC could be given.

The Gneissic Complex which constitutes a very large part of the state is classified into Penninsular Gneiss (chapter 6) and Younger Granites (chapter 7). Geological information on the distribution of these two types covering the entire state is still incomplete partly due to their field disposition with frequent intermixing and migmatization on various scales. Consequently, the two types appear as one unit of Unclassified Crystallines (Gneissic Complex) in the coloured geological map of AP (opposite p. 18). As described by the authors petrologically, there is worldwide recognition from the studies on different shield areas that Na-rich granitic rocks of tonalite-trondhjemite-granodiorite (TTG) are Early (> 3400 M.a.) to Middle Archaean (3400–2800 M.a.) in age, the tonalite granodiorite-adamellite (TGA) and the granodiorite–adamellite granite (CAG) are mostly Middle Archaean in age, while K-rich granite-adamellite (KGA) are mostly Late Archaean (2800–2500 M.a.) to Palaeo–Proterozoic (2500–1600 M.a.) in age. In classifying the Gneissic Complex of AP, the authors have retained the term Peninsular Gneiss for all the granite gneisses of the above petrological types (like the TTG south of Mahabubnagar) other than KGA, while the latter is put under younger Granites (like the KGA of Anantapur) corresponding largely to the well-known Closepet granite of Karanataka. In chapter 8, mafic dyke swarms largely made up of dolerites of Meso–Proterozoic age (1600–950 M.a.) are described along with a map of their distribution west and south of the Cuddapah basin based on the LANDSAT image and these dykes show the dominant E–W trend.

Chapter 9 describes the Purana basins of Cuddapah, Pakhal and Bhima containing the strata of Meso–Proterozoic age (1600–950 M.a.) and/or Neo–Proterozoic age (950–550 M.a.). Cuddapah is a very prominent basin in AP and King's classification of the strata withstood for a century. With the results of detailed mapping of the Cuddapah basin by GSI during the last two decades and their classification of the strata in accordance with the international code of stratigraphic nomenclature, the authors have rightly adopted the revised litho-stratigraphic classification of the Cuddapah basin. Probably they could have also given the classification of King for comparison and ex-

plained the changed status of certain Formations of the Cuddapah Supergroup just as they cited the one for the Kurnool Group (p. 127). In the revised litho-stratigraphy given in the coloured map of the Cuddapah basin (opposite p. 122), the Srisailam Quartzite which has a Formation status is inadvertantly bracketed with the Kurnool Group, instead of the Cuddapah Supergroup. In the Pakhal basin, folding and metamorphism is confined to the south-eastern end of the belt around Yellandlapad in Khammam district. There is no development of kyanite in the Pakhals as stated (p. 142), but ottrelite is reported from the Pakhals which is not mentioned or cited under the references.

In chapter 10, the Middle to Late (Meso- to Neo-) Proterozoic igneous activity of alkaline rocks of Prakasam district, the cratonic kimberlite diatremes and dykes of Anantapur, Kurnool and Mahabubnagar districts, the pegmatites of NSB and rocks suspected to be carbonaties from Visakhapatnam and Nellore Districts are described. In chapter 11, the Gondwana of the Godavari valley of Palaeozoic–Mesozoic age is described incorporating some revision of the stratigraphy in the Chintalapudi sub-basin. The description on the boundaries of the sub-basins of the Gondwana and the faults in the Godavari valley (pp. 170–171) could be appreciated better if the related map with names is given and the reference is duly cited at the end. In chapter 12, the Deccan trap volcanic activity at the Crataceous–Tertiary Boundary (KTB) is described mentioning the number of flows up to eight encountered in the drilling in the KG basin by ONGC. A general view on the linkage of Deccan volcanism in India to the movement of the Indian plate over the Reunion hotspot is also given. In chapter 13, the Tertiary rocks, principally the Middle Miocene Rajahmundry sandstone are described. In chapter 14, the Quaternary geology is described. The occurrence of oolites in the present outer shelf off Visakhapatnam reported in marine geological publications could be cited as evidence for the lowering of the sea level during Pleistocene. In chapter 15, the sub-surface geology containing the hydrocarbon–bearing Tertiary strata of the coastal and off-shore KG basin is adequately described giving suitable sketch maps. The last chapter gives an account of the geomorphology and soils of the state.

In any attempt of this nature, there is always a scope for improvement. The references could be better organized. A few field photographs could be included. The book is well-written and is readable. It brings out up-dated regional geological information under one cover and is very useful to students of geology and related branches of earth sciences.

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Erratum

Mechanism of ATP synthesis by proton motive force

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The numbering of amino acid residues of the ε subunit of ATP synthase corresponds to *Escherichia coli* (and not to bovine heart mitochondria, as inadvertently implied). Thus, lines 36–37 on p. 718 should read, 'Further Ser-108 of the rotating ε subunit (*Escherichia coli* numbering) interacts covalently[14,17] with Glu-381 (*Escherichia coli* numbering, corresponding to Glu-395 in bovine heart mitochondria) of β_E...' Similarly, in Figure 1, the numbering of the important amino acid residues is for *Escherichia coli*, while the labeling in the Figure is for mitochondria. Therefore, in Figure 1, the label, 'Inner membrane' should be substituted by 'Inner membrane/periplasm', while the label, 'Matrix' should be replaced by 'Matrix/cytoplasm'. The second line in the legend to Figure 1 should read, 'The important amino acid residues are shown.' These corrections do not in any way alter the results or conclusions of our communication.

Correction

The debate on the dawn of multicellular life on earth

A. V. Sankaran

[*Curr. Sci.*, 1999, **76**, 137–141]

I am thankful to Dr Vishwakarma for pointing out an error which had unfortunately crept in my paper due to oversight. The pertinent observation about the age of the Semri Group in relation to the kimberlite intrusion was indeed made by him in his paper *Curr. Sci.*, 1998, **75**, 1297–1300. My reference to this view of Vishwakarma in my paper on page 141, wrongly numbered as 21, should be corrected to No. 23.