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The paper by Kushalappa has underlined that the outdated and impractical laws in Karnataka have been counterproductive and has advocated rethinking and liberalisation of rules, regulations and restrictions.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 problemsolving 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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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 sub-
stantial 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 se-
quencies 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 forma-
tions or the gneisses of AP in the related
chapters. This is justified and more par-
ticularly 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–Cretaceous part, Marginal
Transition Zone (MTZ), Godavari Gra-
ben and the Eastern Ghats Mobile Belt
(EGMB). Chapter 3 gives a generalized
summary of the litho-stratigraphic suc-
cession and the age data on dated rocks.
In Table 2, there is a compiler’s mistake
in placing the formations of the Gond-
wana: Kota and Maleri against the ap-
propriate row; Talchir, Barakar, Barren
Measures and Kamthi under the appro-
priate column.

The minor schist belts of Veligallu,
Gadwal, South Kolar belt (known ear-
lier as Bisanattam schist belt), Kadiri,
Ramagiri–Penakacherla, Jonnagiri and
Peddaavuru, which are equated with the
Kolar-type auriferous greenstone
(2700 M.a. age), are adequately de-
scribed 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 Gond-
wana in Khammam district should be
shown as the supracrustals of Mallaram
part of this belt with copper mineraliza-
tion occurring here. This extension,
however appears in the coloured geo-
logical 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 inter-
pertion with doted 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, Khon-
dalite and Migmatite in the respective
order. The Charnockite Region of Fer-
mor of high grade granulites in peninsu-
lar India is re-defined in recent years
particularly based on the work in south-
ern Karnataka and the northern Tamil
Nadu and in this exercise the Eastern
Ghats Granulite Belt (EGB) is de-
scribed as the Middle Proterozoic Mo-
 bile 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 Gond-
wana 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 consti-
tutes 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 cov-
ering 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 Un-
classified Crystallines (Gneissic Com-
plex) 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–
2300 M.a.) to Palaeo–Proterozoic
(2500–1600 M.a.) in age. In classifying
the Gneissic Complex of AP, the
authors have retained the term Peninsu-
lar 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 An-
antapur) corresponding largely to the
well-known Closepet granite of Karanatak.
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 Cud-
dapah basin based on the LANDSAT
image and these dykes show the domi-
nant 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 Cud-
dapah basin by GSI during the last two
decades and their classification of the
strata in accordance with the interna-
tional code of stratigraphic nomenclature,
the authors have rightly adopted the
revised litho-stratigraphic classifi-
cation of the Cuddapah basin. Probably
ty they could have also given the classifi-
cation of King for comparison and ex-

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plained the changed status of certain Formations of the Cuddapah Super-group 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 inadvertently bracketed with the Kurnool Group, instead of the Cuddapah Super-group. In the Pakhal basin, folding and metamorphism is confined to the southern-east 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 carbonatites 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 Cretaceous-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

H. Rohatgi, A. Saha and S. Nath
[Curr. Sci., 1998, 75, 716-718]

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' with Glu-381 (Escherichia coli numbering, corresponding to Glu-395 in bovine heart mitochondria) of βE. '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.