
Reviews

Crop Evolution, Adaptation and Yield. By L. T. EVANS. 23 × 15 cm. Pp. xi + 500 with 131 text-figures. Cambridge: Cambridge University Press, 1st paperback edition, 1996. Price: £22.95. ISBN 0 521 29558 0.

The first (hardback) edition of this book, issued in 1993, was greeted with a wealth of positive and enthusiastic reviews. This paperback edition, released three years later but without alteration to the text, should improve access to a most authoritative guide to the past, present and future of crop improvement.

Starting with a general introduction to the field (chapter 1), the author reviews the interrelationships between human population and crop yield (chapter 2) before embarking on a scholarly account of the domestication of the major crop species (chapter 3), in which he deploys evidence from a wide range of sources: archaeology, anthropology, etymology and economics, as well as the more familiar biological disciplines. An interesting feature of this chapter is his interest in the early origin of cropping in south-east Asia.

The following three chapters form the core of the book: the ecology of yield (chapter 4, 55 pages); the physiology of crop yield (chapter 5, 99 pages); and prospects for yield improvement (chapter 6, 47 pages). The density of the writing and the prolific citation do not make for easy reading in places, but they ensure that this will be a standard work of reference for many years. Highlights for me include his exhaustive and very revealing analysis of the question of source or sink limitation of yield (a subject which so vexed crop physiologists in the 1960s and 1970s), and the distinction between low latitudes, where development is fast and the aim should be multiple crops, and high latitudes, where conditions permit high yield of a single annual crop. Others will appreciate his treatment of the yield potential of old and new varieties at different levels of input, and the long history of yield increases when plateaux were predicted.

The book concludes by considering the efficiency of use of inputs (chapter 7), including a valuable essay on energy economics, and a final chapter on 'the future of yield', incorporating his thoughts on the impact of climatic change and current policies for research funding and management. Here, as elsewhere in the book, he cannot suppress his innate optimism.

A book review in *Nature* on 28 May 1896, one hundred years ago, begins with the opinion that 'facts of science are amassed only in order that they may be synthesized'. This is hardly the philosophy of our times, when the securing of research funding and the publication of original results score much more highly than synthesis and review. L. T. Evans has had a long and distinguished career in both arenas, pushing back the boundaries of knowledge, but also placing his work in the context of his own and related

fields of scholarship. I hope that he is not the last of his line, and commend his book, without qualification, to the rising generation of crop scientists.

R. K. M. HAY

The Algorithmic Beauty of Plants. By PRZEMYSŁAW PRUSINKIEWICZ and ARISTID LINDENMAYER. 27.8 × 21.6 cm. Pp. xii + 228 with 150 illustrations, 48 in colour. New York, Berlin, Heidelberg: Springer-Verlag, 1996. Price p/b: £19.50, ISBN 0 387 94676 4.

This book demands respect for three reasons. It is the first to give an account of algorithms behind the creation of 'virtual' plants, mostly based on the concept of Lindenmayer Systems (L-systems). Secondly, it unashamedly links science with art, the 'excitement of applying mathematics to explore the beauty of plants'. Thirdly, it is special simply because it *is* a book: the subject matter is graphic simulation, a 'virtual laboratory' is presented as a playground for experimentation, the whole concept is entirely computer based and thus belongs on the internet and yet, thankfully, *The Algorithmic Beauty of Plants* exists as a book. Something you can hold, flick through, and even smell. Books will surely never die.

The eight chapters act as individual manuals introducing the application of L-systems to the simulation of various aspects of plant form. Chapter 1 presents the fundamentals of L-system creation and usage and the authors then proceed to explain in increasing detail the modelling of trees, herbaceous plants (particularly their inflorescences) the generation of phyllotaxis, and the production of 'surfaces', e.g. leaves. Each leads ultimately to the creation of 3-D images of plant architecture. Chapter 6 emphasizes the addition of the time element and thus the animation of plant development. This is where the physiologists could become involved, simulations can now incorporate internal control mechanisms affecting form by virtue of 'nutrient' or 'hormone' flow, for example. Chapter 7 applies L-systems to the topography of cell division patterns and thence to cell expansion and packing. The final chapter uses L-systems to play with fractals in a botanical context.

Throughout this book, of necessity, there is an intriguing mixture of disciplines. Botanical concepts are introduced and explained simply as they crop up. In depth details of mathematical modelling form the main core, which you may or may not follow depending upon your background (or start very slowly on page 1, chapter 1), and then there are the pictures, beautiful pictures.

It is seven years since this book first appeared, in rather expensive hardback. Graphic simulation of plants has been proceeding steadily and access to a number of 'virtual laboratories', not all based on L-systems, *is* becoming available via the internet. This consolidates rather than

diminishes the value of this book. Everybody in the field will quote it; it is a link-pin of background information and will be a constant reminder of the beauty of the algorithms lurking behind the plant images on the screen.

ADRIAN D. BELL

Plant-Soil Interactions at Low pH: Principles and Management. Ed. by R. A. DATE, N. J. GRUNDON, G. E. RAYMENT and M. E. PROBERT. 26 × 19 cm. Pp. 822. Kluwer Academic Publishers: Dordrecht, the Netherlands, 1995. Price h/b: £299.00, ISBN 0 7923 3198 2.

This book is a compilation of the papers presented at the Third International Symposium on Plant-Soil Interactions at Low pH presented at Brisbane, Australia in September 1993. Thirty one of the 131 papers were originally published in *Plant and Soil* in April 1995 with the emphasis in that selection on mechanisms of acid tolerance of plants. This book groups the papers into seven sections, ranging from the chemical and physical properties of acid soils, through biological responses of both plants and soil organisms, to management options including selection and breeding of tolerant plants, and socio-economic aspects.

The scale of the problem is indicated in the opening review which states that about 30% of the world's ice-free surface is covered by acid soils (pH in water < 5.5) of which about 60% lie within the humid tropics. It is these tropical regions where the need to expand agricultural land to feed the rapidly increasing population conflicts directly with the need to preserve the biodiversity of natural systems. However, the emerging understanding of the molecular and cellular mechanisms of tolerance to high concentrations of aluminium, coupled with the possibilities of breeding tolerant genotypes, offer new prospects for food and fibre production in addition to the more traditional management techniques of soil amendment.

This book contains a wealth of research findings to which this brief summary cannot do justice. It is clearly priced for library purchase and will be a good source of reference.

P. J. GREGORY

Soils, Sustainability and the Natural Heritage. Ed. by A. G. TAYLOR, J. E. GORDON and M. B. USHER. 25.5 × 19.5 cm. Pp. xiv + 316 with 46 figures, 6 colour plates and 25 tables. Edinburgh: HMSO, 1996. Price h/b: £70.00. ISBN 0 11 495270 1.

This is the proceedings of the third annual conference of the Research and Advisory Services of Scottish Natural Heritage, held in Ayr in 1994. The publication is timely as the need for soil conservation is emerging on national and international agendas, and policy makers are beginning to recognize that the loss of soil functioning is a critical issue for sustainability. These issues are addressed in four sections: 'The natural heritage and soils resource'; 'Pollution and environmental change'; 'Soils and land use'; and 'Towards sustainability'. Overall, the intro-

duction, identification of knowledge gaps, and the conclusion on future goals for sustainable soils management, provide a useful perspective on the needs, approaches and problems of soil conservation. The material supporting this assessment, however, is a rather mixed collection (in both quality and information content) of reviews, position papers, assessments of monitoring procedures and requirements, some technical papers on soil processes and a number of poster abstracts (too brief to fulfil their potential).

Some papers stand out, such as 'Forestry, soils and sustainability' (D. C. Malcolm and A. J. Moffat), 'Climate change, soils and sustainability' (M. D. A. Rounsevell, P. Bullock and J. A. Harris) and an interesting assessment of crofting for sustainable land use by M. M. Grantham (though more consideration could have been given to the economic incentives for overgrazing under current EC headage payments for sheep). F. A. M. de Haan compares pollution control legislation in the Netherlands, with that in the US in 'Points of departure in soil protection policy' and a useful overview of 'Heavy metals in soils' is given by I. D. Pulford. However, M. N. Aitken concludes that at present, loading of heavy metals in sewage sludge on agricultural land in Scotland is sustainable in the long term (> 100 yr). It is questionable whether the concept of sustainable land use can involve deferring the problems of progressive soil pollution to future generations and also whether the present heavy metal inputs to sewage systems are acceptable.

The readership for this book is not well defined or targeted and, with its regional focus and general subject coverage, it may not be attractive to many individuals at this price. The book does, however, provide a wide overview of the needs, criteria and practices for sustainable use of soil in Scotland and will be a useful landmark text against which to assess progress in the future.

J. M. ANDERSON

Crassulacean Acid Metabolism: Biochemistry, Ecophysiology and Evolution (Ecological Studies: vol. 114). Ed. by K. WINTER and J. A. C. SMITH. 24 × 15 cm. Pp. xxxii + 449 with 123 text-figures and 44 tables. Berlin, Heidelberg: Springer-Verlag, 1996. Price h/b: £86.00, ISBN 3 540 58104 9.

Originating from an international workshop on crassulacean acid metabolism, held in Panama in 1993, this book provides a detailed overview of all important topics of recent research on CAM. More than 60 scientists review the major advances in the knowledge about the biology of CAM plants.

In a comprehensive introduction, the editors give a brief definition of the CAM cycle and summarize the basics of its biochemistry. Furthermore, they outline the environmental and developmental control of CAM as well as the ecology and species diversity of CAM plants. This chapter, thus, lays the rational foundation of the three major sections of this book.

The first section surveys the rapid development of current understanding of the biochemistry of CAM and of the regulation of carbon flow during CAM. This includes

the level of carbohydrate mobilization and the possible diurnal control of phosphoenolpyruvate carboxylase activity, and also emphasizes the importance of the tonoplast in this context. Other authors focus the readers' attention on the difficulties as well as the possibilities that measurements of photosynthetic O₂ and CO₂ exchange, eventually combined with chlorophyll fluorescence, will provide to increase our insight into the reactions proceeding during the light phase. Additionally, the role and the functioning of the xanthophyll cycle in CAM plants are discussed.

In the second section, several contributions deal with the interaction of plant development and different environmental signals in affecting the C₃ to CAM shift in the annual *Mesembryanthemum crystallinum* and several perennial C₃/CAM intermediates. These chapters demonstrate the rapid advances achieved in investigations on the molecular basis of CAM response to environmental stresses, as well as the advantages that the on-line carbon-isotope-discrimination technique can provide. This section also gives a reappraisal of the significance of CAM cycling.

CAM plasticity in the Clusiaceae and the Crassulaceae and its relation to ecological diversity and evolutionary origins are the major topics of the last section. Reviews on the ecophysiology of submerged aquatic CAM plants, productivity of certain agronomic CAM species, features of roots of CAM plants and the use of carbon- and hydrogen-isotope-discrimination in research on CAM complete this section. The book is finally rounded off by two summary chapters in which the editors assess the current status and perspectives of CAM research. There is also a complete list of genera in which CAM has been documented.

Certainly this comprehensive book contains a wealth of recent information on nearly all aspects of CAM. It may be seen as a kind of continuation of vol. 30 of Ecological Studies, i.e. the excellent book of Kluge and Ting. As many different groups of scientists contributed an overview of their work, there is some repetition, sometimes resulting in contrasting conclusions. This, however, is not a disadvantage, because such diversity of views clearly demonstrates the vitality of research on this metabolic example of an ecological adaptation to environmental stresses. Therefore, the book is not only useful for research scientists and advanced students, as the editors hope, but reading it is almost a must for all those who are interested in any aspect of CAM.

W. B. HERPPICH

REFERENCE

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Centres of Plant Diversity. A Guide and Strategy for their Conservation. WWF and IUCN. 29.6 × 21.3 cm. 3 volumes. 1, xiv + 354; 2, xiv + 578; 3, in press. Cambridge, UK: IUCN Publications Unit, 1994–1996. Price per volume: 1, £30, 2, £45, and 3, in press. Vol. 1, ISBN 2 8317 0197 X, Vol. 2, ISBN 2 8317 0198 8.

Publications emerging as a result of the 'Convention on Biological Diversity' in Rio (1992) are epidemic. Ap-

parently delivering relevant information on what should be done to protect biodiversity, bookshelves are awash with statistical catalogues of Yellow Pages dimensions, recycled manuals and dreary grey literature aimed at providing guidance of all kinds on the status of Earth's living resources. Publications continue to flow from both governmental and non-governmental agencies (e.g. Groombridge, 1992; UNEP, 1995; DOE, 1996), and amongst the recent batch is *Centres of Plant Diversity* (CPD), a publication project which is close to completion, with the first two volumes now available and volume 3 in press.

The idea of CPD had its origins in the 'Threatened Plants Unit of the Royal Botanic Gardens, Kew', at an informal meeting during 1982. The idea became incorporated into the 'Plants Programme' being developed by IUCN and WWF in 1984, and first appeared in a published draft within this programme under the theme of 'Promoting plant conservation in selected countries'. After various transitional developments, involving red data books of habitats, and other listings, the first manifestation of CPD was published as an IUCN brochure in 1988, and now the completed works are upon us.

Although extremely impressive at first sight, the CPD has all the hallmarks of a committee publication – an authoritarian document, of varying quality, resulting from a major international collaborative exercise involving more than '400 botanists, conservationists and resource managers worldwide, together with 100 collaborating institutions and organisations'. Looking a little like expensive eco-tourism manuals, with their garish dust-jackets, the present volumes include a comprehensive collection of data sheets which account for nearly 250 major sites for conservation of plant diversity worldwide. Volume 1 covers Europe, the Atlantic Islands, Africa and the islands of the West Indian Ocean, South West Asia, and the Middle East; volume 2 concentrates on the rest of Asia, Australasia and the Pacific islands; and volume 3 covers the Americas.

Co-ordinated by S. D. Davis, V. H. Heywood and A. C. Hamilton, information is provided in similar format in all three volumes; a preface written by Claude Martin, Director General, WWF International and Martin Holdgate, former Director General, IUCN; a detailed list of acknowledgements and contributors; a useful global introduction about the rationale and methods adopted for preparation of data sheets; regional overviews providing essays on geology, physical features, climate, vegetation, flora, useful plants, factors causing loss of biodiversity, and conservation. Finally, brief introductions to the key areas of endemism and species richness serve as introductions to the localized data sheets, which give detailed accounts on geography, vegetation, useful plants, social and environmental values, threats and conservation status.

CPD has all the gravitas one would expect of such co-ordinated authorship, but looks can be deceiving. Having read several accounts of areas with which I am familiar, it turns out that all of the accounts are literature reviews, heavily recycled material with little in the way of comparative assessment or detailed analyses as to where one might proceed with such information. Despite leaps and bounds in the sophistication and utility of systematic methods for reserve selection and biodiversity conser-

vation (see Vane-Write, 1996, for example), CPD considers that rational approaches to reserve selection are unable to take care of myriad competing claims on the environment: 'Any top down approach, no matter how sophisticated the science, is liable to fail unless full cognizance is taken of the detailed needs, perceptions, aspirations and political realities of the countries and regions are concerned' (volumes 1 and 2, page 3). The meaning of such a statement is incomprehensible, as CPD itself is not detailed enough for local consumption; it cuts short on national priorities through arbitrary *a priori* selection of areas, and there is absolutely no way of knowing that this particular selection of 250 areas represents plant diversity on a global scale. In short, CPD is nothing more than a top down compilation, a very coarse approximation to the Earth's plant resources, without the sophistication obtained by the systematic methods being advocated in South Africa, Australia, UK and North America and now being employed within planning agencies.

For example, the selection of nine areas of species richness and rarity richness in Australia are first-cut selections that provide little in the way of understanding diversity on the continental scale. The authors have misunderstood the elegance of recent efforts to raise awareness of the importance of new data, new methods and new principles that guide actions to conserve biodiversity in Australia (in South Australia, the Western Division of New South Wales and so on; see, for example, Margules & Austin, 1991) except perhaps for the account on Tasmania. It takes little account of the magnificent work of CSIRO and other agencies, such as the New South Wales National Parks Service, in their efforts to overcome threats and maintain viability of different habitats, to find complementary solutions for competing land uses, to preserve irreplaceable areas and determine negotiable areas, and development of relevant decision-taking methods for plant resource management.

CPD is clearly a pragmatic descriptive anthology, concentrating on the various obvious and largely protected areas in Australia, but lacking the detailed and coordinated national and local assessments at the various appropriate scale. I suppose it is inevitable, as with all documents of this sort, that CPD provides only broad brush strokes of the existing literature. I suppose too that it is useful to have a coded scheme for at least the 250 areas covered, and a fairly detailed annotation of the literature published in the same format for different areas of the world. But, for me, there is precious little here that cannot be found in greater detail elsewhere. There are no new analyses and very few insights.

It has been realized for some time now that there is no substitute for careful analysis. The time has come for the major NGOs to realize that the world desperately needs proper action plans based on carefully thought-out surveys geared to particular goal requirements, however complex these might be. For conservation of biodiversity in the 21st century we need prescriptions that allow structural information on biodiversity to reach the level of decision-taking enjoyed by plans for other economically driven land uses, rather than levelling overviews of existing literature.

C. J. HUMPHRIES

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Somatic Embryogenesis in Woody Plants, Vol. 3: Gymnosperms. Ed. by S. M. JAIN, P. K. GUPTA AND R. J. NEWTON. 24 × 16 cm. Pp. xiv + 388 with numerous text-figures. Dordrecht/Boston/London: Kluwer Academic Publishers, 1995. Price h/b: £123.00. ISBN 0 7923 2938 4.

The third volume in a series on somatic embryogenesis in woody plant species, this book contains 22 chapters describing diverse aspects of the process in selected gymnosperms. The more fundamental aspects of the biology of somatic embryos are covered in the first volume, while volumes 2 and 3 concentrate on features of angiosperm and gymnosperm woody species respectively. Therefore, this particular volume is not for the general reader, but contains detail on the tissue culture requirements and other practicalities of generating somatic embryos and transferring the derived seedlings to the field for a range of genera. In each chapter these more practical aspects are put into a wider context by some consideration of the geographical distribution, ecology and breeding problems of the particular species. Species covered include: the cycads, *Picea abies*, *P. glauca*, *P. engelmannii*, *P. glauca-engelmannii* complex, *P. glehnii*, *P. jezoensis*, *P. mariana*, *P. omorika*, *P. pungens*, *P. rubens*, *P. sitchensis*, *Pinus caribea*, *P. elliotii*, *P. lambertiana*, *P. nigra*, *P. pinaster*, *P. radiata*, *P. strobus*, *P. sylvestris*, *P. taeda*, *Pseudotsuga menziesii*, *Larix* spp., *Abies* spp. and *Sequoia sempervirens*. For the forestry specialist, then, this book is likely to be a rather useful source of information.

K. LINDSEY

In Vitro Embryogenesis in Plants. Ed. by T. THORPE. 24 × 16 cm. Pp. ix + 558 with numerous text-figures. Dordrecht/Boston/London: Kluwer Academic Publishers, 1995. Price h/b: £104.00. ISBN 0 7923 3149 4.

One of the more important differences between plants and animals is the developmental plasticity that plants enjoy. They have evolved the ability to respond to mechanical

damage and other environmental stresses by initiating cell division in otherwise dormant cells, whether to generate new shoots from axillary meristems following grazing, or to seal wound sites. This facility suits the plant life-style. The most extreme examples of this plasticity are seen in the demonstrable totipotency of somatic cells of plants, and perhaps most elegantly in somatic embryogenesis, a process in which cultured cells undergo organizational changes that reflect morphogenesis during zygotic embryogenesis. A number of questions are raised by somatic embryogenesis: how similar is it to zygotic embryogenesis, and indeed to apomictic embryogenesis, in terms of the structural, biochemical and physiological changes that take place? Are the same programmes of gene expression elaborated in each type? Does somatic embryogenesis therefore represent a good model system for improving our understanding of the real thing? There have been a number of important advances in our understanding of the genetic control mechanisms that regulate components of zygotic embryogenesis recently, and a detailed comparative consideration of the features of somatic embryogenesis is timely. This book goes much of the way to achieve that.

This multi-authored volume (12 chapters in all) covers many aspects of somatic embryogenesis, considering structural, biochemical, physiological and molecular characteristics of somatic embryos from both monocotyledonous and dicotyledonous species. There is also discussion of applied aspects, including haploidy and other biotechnological applications, and a summary of more technical aspects.

W. Halperin sets the scene with an historical overview of the field, with emphasis, of course, on the carrot system. He makes the point that the original and much-cited work of Steward that demonstrates totipotency does not actually describe embryogenesis, though is erroneously quoted as doing so in many texts: including this one! There is a useful discussion of the old question of unicellular vs. multicellular origins of somatic embryos, a topic also taken up from time to time elsewhere in the book.

In chapter 2, K. Sharma and T. Thorpe discuss naturally occurring asexual embryogenesis, and the discussion is confined mostly to apomixis. The authors describe the various mechanisms and structural events: they provide a large survey of the types of asexual embryogenesis over an enormous range of species.

V. Raghavan and K. Sharma (chapter 3) attempt a wide-ranging description of zygotic embryogenesis in gymnosperms and angiosperms, with most emphasis on structural changes, while the molecular biology is restricted to a discussion primarily of storage protein accumulation. I did feel that much of the more important recent work on the dicot system was missing; in particular using *Arabidopsis* for mutant analysis to reveal both the relationships between, for example pattern formation, morphogenesis and cell differentiation, and on cell fate determination in the embryo. The most recent reference in this chapter dates to 1991, though work from 1994 is reported in other chapters.

M. Monnier discusses the *in vitro* culture of zygotic embryos in chapter 4, providing an historical perspective, a description of the practicalities, and an overview of the potential applications of the technology. Again, some of the more recent work (*c.* 1992, 1993) has not been cited.

Turning to somatic embryogenesis once more, S. Merkle *et al.* discuss morphogenic aspects (chapter 5), describing the role of hormones, other media components and genotype in the induction, proliferation, maturation and germination of embryogenic tissues. There is also a consideration of scale-up/bioreactors and artificial seeds.

In chapter 6, E. Yeung provides a very interesting discussion of structural and developmental patterns in somatic embryogenesis. He gives a pretty much up-to-date review of ideas on the events leading to embryogenic cell formation, the establishment of polarity (which is an area still far from understood) and structural aspects of embryo formation, with a discussion on similarities between somatic and zygotic processes. He points to the importance of model genetic systems such as *Arabidopsis* to answer questions that so far have proved intractable using other systems, including somatic embryogenesis.

K. Nomura and A. Komamine (chapter 7) describe advances in the development and exploitation of synchronous systems, useful for the characterization of stage-specific biochemical and physiological events, and in chapter 8, D. Dudits *et al.* focus on molecular biological events, with particular reference to the alfalfa system. The authors promote some interesting ideas: that the somatic embryogenesis pathway represents an extreme stress response, and that signalling events in 2,4-D-treated somatic cells may be similar to the events following fertilization in the ovule. My feeling is that, since we know so little about signalling mechanisms in either system, this latter concept may be difficult to sustain. Another controversial statement made is that, 'The embryogenic induction cannot be understood without knowing the regulatory elements in cell cycle control'. However, genetic analysis allows us to separate cell division from other fundamental aspects of embryogenesis such as the establishment of polarity and pattern formation, and an understanding of cell division mechanisms does not perhaps reveal anything of how dividing cells may adopt different fates. The authors do, however, point out the power of a genetic/mutational approach to understand molecular mechanisms, and put forward some stimulating views.

In chapter 9, Kerrie *et al.* describe factors influencing the induction of both male and female haploid embryogenesis, summarize protocols for solanaceous, graminaceous and cruciferous species, and discuss applications of this important technique. The last three chapters represent wide-ranging surveys documenting progress in achieving somatic embryogenesis in three groups of plants: herbaceous dicots (D. Brown *et al.*), herbaceous monocots (S. KrishnaRaj and I. Vasil) and woody plants (D. Dunstan *et al.*). These chapters contain a huge amount of data, including tables of media and explants used, and each with 400–500 references.

Overall, this represents a useful compendium of ideas and data, and certainly provides ready access to the literature, at least that prior to 1993, with some later work cited by some of the authors. It also contains some thought-provoking discussion. Like other Kluwer publications, the production standard is high, though the English in one or two chapters could have been better edited.

The Cambial Derivatives. Ed. by M. IQBAL. 24 × 17 cm. Pp. xi + 363 with 74 text-figures. Berlin: Gebrüder-Borntraeger, 1995. Price h/b: £85.00 (198 DM), ISBN 3 443 14021 1.

Could the sacred texts of the world's religions have been made available to the millions of devotees were it not for paper? Would the great voyages of discovery in the 15th and 16th centuries have been possible without wooden ships? Could people in societies less technologically burdened than ours cook and keep warm were it not for fires made from wood? No, no, no. Trees are of fundamental importance to Man as timber, wood pulp for paper manufacture, and, increasingly, as the most environmentally cost-effective renewable source of energy. On a global basis, trees are of importance in removing the excess of CO₂ generated by the burning of fossil fuels, and hence in stabilizing climatic changes. If we are to manage this resource thoughtfully and exploit it intelligently, we need to know more about the process of wood – and phloem! – formation. *The Cambial Derivatives*, edited by Mohammed Iqbal, part of the new series of the *Encyclopaedia of Plant Physiology*, is a welcome reminder of the debt we owe to the woody plants. The subject matter is almost exclusively trees, but, whilst concentrating on the more familiar northern temperature species, it does embrace tropical taxa as well. Although it is a comparatively slim volume, it deals with a subject of immense importance to us all.

The book is arranged in 12 chapters, grouped together into three topics: The meristem, The inner derivatives, and The outer derivatives. The scene is set with the first chapter by Iqbal dealing with a review of the vascular cambium – ‘cambium’ – (the majority of whose cells are cambial derivatives in their own right). There then follows a consideration of the phenomenon of morphogenetic waves in the cambium by Zagórska-Marek. We then proceed to look inwards, with articles concerning the woody tissues: Vessel element differentiation (Butterfield), Ultrastructural factors affecting xylem differentiation (Barnett), Cell wall structure, function and degradation (Berlyn, Beck and Wolter), Sapwood and heartwood (Nair), and Comparative wood anatomy (Carlquist). Our journey then proceeds outwards, to consider the phloem and bark. In this section we have contributions on: Secondary phloem: origin, structure and specialization (Iqbal and Zahur), Ultrastructural differentiation of sieve elements (Iqbal), Phloem proteins: structure, biochemistry and function (Sabnis and Sabnis), Developmental and functional aspects of the periderm (Waisel), and Some notes on gum and resin ducts and cavities in angiosperms (Nair).

All the chapters are written by well known international names who are major players in their particular fields of expertise: an equally impressive panel of experts has been involved in critical review of the chapters. Each contribution is thus authoritative in presenting an up-to-date account of the important issues in the subject area, and in suggesting fruitful lines of future enquiry. In a world in which vast resources are devoted to understanding primary meristems and primary growth systems (whose importance cannot be denied!), it is timely that we should be reminded of the existence of, and problems of developmental biology inherent in, secondary meristems and secondary growth systems.

Further, although xylogenesis has long been considered a model system for study of cell differentiation, it is rare to find work being carried out at this level of enquiry on natural systems such as trees. Instead most attention is devoted to *in vitro* systems such as the transformation of isolated *Zinnia* mesophyll cells into ‘tracheary elements’. Although it cannot be denied that such an approach gives valuable fundamental information, its relevance to the natural system – which has to cope with the generation of many different cell types, all produced in a co-ordinated way having regard to ‘positional information’ and a wide range of environmental, physical and chemical cues – is at best limited. This book, to some extent, provides the arguments against the ‘*in vitro* trend’.

It is also encouraging to note that a significant portion of the book deals with hardwood systems. Hitherto, much of our knowledge about the secondary vascular system of trees has been derived from work dealing almost exclusively with softwoods (such as spruce and pine). Softwoods (gymnosperms), because of the much simpler construction of their secondary vascular tissues, are not necessarily good models for hardwoods (dicotyledonous angiosperms). Indeed, given the current rekindling of interest in use of hardwoods as biomass crops, it is essential that they be accorded more prominence these days. And, for placing wood in its true context, the opening and closing paragraphs of the chapter by Berlyn *et al.* are unlikely to be bettered (and are a joy to read).

The chapters on periderm, phloem proteins and resin ducts are perhaps strange inclusions in a book devoted to derivatives of the cambium. However, the periderm includes the *cork* cambium, which is an example of a secondary meristem, as is the *vascular* cambium, the activity of both contributing to the radial growth of wood species. Waisel's chapter is therefore of value in a ‘compare-and-contrast’ situation. However, I am still left with the impression that somebody ‘discovering’ the secondary vascular system for the first time, might have gained a better appreciation of it had these three chapters been replaced with others dealing with vascular cell types other than the sieve and xylem elements which are more than well served by the rest of the book, and which also emphasize the existence of the radial component of this subtle and intriguing growth system.

Mercifully, spelling mistakes seem to be few, but I was amused by the over-populous internal ‘p’ in *Populus deltoides* on p. 350 of the plant index. Generally the illustrations are good, relevant and clear, but the electron micrographs in Barnett's chapter appeared to have suffered somewhat in reproduction. Although the book has a 1995 publication date, a cursory glance at the reference lists accompanying each chapter will reveal few references more recent than 1993. This may be a reflection of how little work on ‘cambial derivatives’ is currently being funded. It is more likely to indicate significant delays between completion of the manuscripts and the final publication of the book. This might explain the curious omission of mention of the most comprehensive recent review of the vascular cambium (Larson, 1994) in Iqbal's first chapter. Although this may to some extent detract from the ‘up-to-dateness’ of the book, it should not take anything away from the value of the review-type nature of the individual chapters.

It is rare these days to find a single volume that is brave enough to deal with both wood formation and phloem formation. Too often it is the case that it deals with either one or the other, but the coming together of chapters dealing with the inner and outer cambial derivatives serves to emphasize the essential duality of the cambium, and the equal importance of xylogenesis and phloem-formation. It does not aim to compete with the recent single-subject reviews, such as Donaldson *et al.* (1996); Behnke & Sjölund (1990); Larson (1994); rather it complements them.

Of course, one can find deficiencies in any book; I would like to have seen more on the role of the cytoskeleton in the cytomorphogenesis which takes place as cambial derivatives differentiate as vascular cells. Others might like to see more of the impact that molecular biology is having on xylogenesis, for example, with exploitation of the *Zinnia* mesophyll system (but, then, these are not cambial derivatives...). However, the main point is not what is *not* there, but what *is* there. The chapters themselves often identify clearly the challenges that need to be overcome if we are to improve our knowledge about wood (and phloem!) formation, and exploit this immense natural resource efficiently. The gauntlet has been thrown down; current and future generations of developmental botanists must pick it up and rise to the challenge of studying secondary meristems.

All students of tree biology should own a copy of this book: the price will deter many from doing so. All other biologists should have access to a copy, if only to gain an appreciation of a subject which seems increasingly rarely to be taught at undergraduate level.

NIGEL CHAFFEY

REFERENCES

- Behnke HD, Sjölund RD (eds.). 1990.** *Sieve elements*. Berlin: Springer-Verlag.
- Donaldson LA, Singh PA, Butterfield BG, Whitehouse LJ (eds.). 1996.** *Recent advances in wood anatomy*. Rotorua: New Zealand Forest Research Institute Ltd.
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Leaf Structure: Montane Regions of Venezuela with an Excursion into Argentina. By INGRID ROTH. 24 × 17 cm. Pp. ix + 249 with 129 plates and text-figures. Berlin, Stuttgart: Borntraeger, 1995. Price h/b: DM 188/US\$130, ISBN 3 443 14022 X.

Thin and expensive scientific books need quality science and attractive characteristics to encourage purchase. Unfortunately this book has neither. Opening this book for the first time was a surprise, as a single unbound page – the very short preface – drifted onto the floor. After recapture it then became clear that this short preface of only a few lines was all that prepared the reader by way of any explanation about the succeeding contents. There is certainly no explanation of the underlying philosophy of the work or even an explanation of the title. The inside cover, a grey-scale vegetation of a map of Venezuela, suggested some relevance to vegetation ecology. However,

the legend for the map was so small as to be indecipherable, even with a lens.

The various pages of the book unfurled to present a large number of black and white optical photomicrographs of leaf sections, in addition to a number of line drawings of leaf sections and a few black and white photographs of the Andean paramo. The philosophy of the book emerged to indicate the author's concern that anatomical and structural studies of plants are underdone – too much physiology – and that structural studies are often sufficient to explain plant adaptations to the environment. Such an unworldly philosophy soon breaks down with function frequently being applied to structure with no supporting evidence. There is no doubt that dual studies of structure and function are enormously powerful in teasing out adaptations or responses to the environment, but this approach is not presented here.

There are too many typographical errors for a book of this cost. A significant number of the photomicrographs are so dense as to provide no information content. There is no evidence for a systematic approach to relating leaf structure and environment, there is no mention of why particular species were singled out for study, or how many replicates leaves were collected from how many plants, or how much variation in structure is likely between different plants of the same species, and so on. Unfortunately, considering the extended time taken over this study, it is not possible to recommend this book for purchase.

F. I. WOODWARD

The Plant Viruses (vol. 5: Polyhedral Virions and Bipartite RNA Genomes). Ed. by B. D. HARRISON and A. F. MURANT. 25 × 16.5 cm. Pp. xvi + 362 with 21 plates and 25 text-figures. New York, London: Plenum Press, 1996. Price h/b: \$95.00, ISBN 0 306 45225 1.

This book is the fifth volume of the series *The Plant Viruses* edited by H. Fraenkel-Conrat and R. R. Wagner, and completes the coverage of viruses with isometric particles and genomes consisting of single-stranded positive-sense RNA. The first chapter introduces the common characters and the specificity of these particular plant viruses. Then the 12 following chapters deal with the presentation of the major families: the Comoviruses (4 chapters), the Nepoviruses (4 chapters), the Fabaviruses, the Dianthoviruses and the Idaeoviruses (1 chapter each), and, finally, the Enamoviruses (2 chapters). These six virus genera present bipartite RNA genomes and isometric particles. Usually, the two genomic RNAs encode for viral RNA replicases, viral proteases, and coat or movement proteins. The RNA is translated in a polyprotein which is then cleaved in functional polypeptides by the specific viral proteases. Another characteristic is the presence of a genomic RNA-encoded protein bound to the 5' end of the RNA, and a polyadenylate sequence at the 3' end of each RNA species. These viruses are transmitted by beetles, aphids and soil-borne nematodes.

The different chapters of this book – written by different authors, all specialists in plant viruses – fully describe the state-of-the-art of current knowledge for each type of

virus. This includes, in most cases, identification and diseases caused, molecular biology and replication, transmission, epidemiology, ecology and control. However, the use of genetic engineering to protect plants against viral attacks is poorly described.

The first impression is of a catalogue of the bipartite RNA genome viruses. Thus, this is not a text book for

students. It is rather a volume for specialists, where all the characteristics of these viruses can be found. There are few general principles but much detailed information which will be useful for scientists wishing to develop their research in this field.

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