Book reviews

The Eukaryotic Genome: organisation and regulation (Society for General Microbiology, Symposium 50). P. M. A. Broda, S. G. Oliver and P. F. G. Sims (eds). Cambridge University Press, Cambridge. 1993. Pp. 395. Price £60.00, hardback. ISBN 0 521 44364 4.

Studies on eukaryotic microbes have been important to our understanding both of the organization of eukaryotic genomes and of the molecular mechanisms which regulate their expression. The project to sequence the yeast genome has foreshadowed sequencing projects on other eukaryotic genomes and with the availability of the complete sequence of yeast chromosome III has come new insights into eukaryotic genome organization. Our understanding of the key cellular processes that regulate eukaryotic gene expression would be severely limited without the contribution of work on eukaryotic microbes, particularly yeast. The stated aim of this volume is to review progress in understanding the organization and regulation of eukaryotic genomes, from the perspective of complex microbial models, and to point the way forward in the field. This is an ambitious objective for a single volume and partially explains why I was left with the feeling that this book is a case of the whole being less than the sum of the parts. Being a multi-authored volume of symposium proceedings it might be expected to contain a diversity of styles and approaches. Unfortunately, the large range of topics covered, and the differences in the types of reviews, contribute to a rather unfocused feel.

The volume starts well with a chapter by Oliver *et al.* on the sequencing of yeast chromosome III. This is a concise and well-written account describing a project of which the yeast community can feel justifiably proud. The volume also ends well with the final chapter by Cavalier-Smith on the evolution of the eukaryotic genome. Although this was a more comprehensive review, the use of sub-headings made it very easy to dip in and out of the chapter as required. There are 12 further chapters covering DNA replication, telomeres, chromatin structure, mitochondrial genomes, gene organization in filamentous fungi, gene organization in trypanosomatids, homologous recombination, mating type genes, gene regulation in *Candida*, gene expression in filamentous fungi, yeast gene expression and regulation of mitochondrial biosynthesis in yeast. This seems a rather arbitrary selection of topics that gives a view of the field but not a clear picture. Furthermore, the chapters do not appear to be arranged in any logical order. I felt that the chapters by Turner, on gene organization in filamentous fungi, and by Caddick and Turner, on the control of gene expression in filamentous fungi, should have been consecutive, instead of being separated by four chapters. Out of the 12 further chapters the highlight for me was the contribution by Greider on telo-

meres. Although it contains much in common with a number of other recent reviews it was well written and included both an overview and some experimental data. It also ended with some discussion on the implications of results from microbial eukaryotes for the understanding of mammalian systems. Although this was one of the aims of the volume several of the reviews failed to attempt this.

I also enjoyed the chapters on yeast gene expression by Mellor and global regulation of mitochondrial biogenesis in yeast by Grivell *et al.*, probably because these were closest to my own interests. If anything the chapter by Mellor was a little too comprehensive. With the aid of clear diagrams it very successfully summarizes the complex range of transcription factor interactions unravelled from detailed studies of a number of model yeast promoters. The chapter by Grivell *et al.* is much shorter but raises some particularly important questions concerning the co-ordination of yeast genes encoding mitochondrial proteins. I am less familiar with the topics of the remaining chapters but all seemed to be competently written. The chapter by Williamson on microbial mitochondrial genomes was a particularly successful treatment of a difficult topic. I also found the chapter by Fangman *et al.* very worthwhile for the clear descriptions of the techniques developed to study the positions of DNA replication origins.

I read this volume sequentially and I failed to get a clear overall picture of the field. However, I probably approached it in a different way to the majority of readers. I imagine that most people will select particular chapters for reading in isolation. When viewed from this perspective it is much better; many of the individual chapters are very good and almost everyone will find something of interest within it. As such it should be regarded as a valuable addition to any library collection.

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Plant Breeding: principles and prospects. M. D. Hayward, N. O. Bosemark and I. Romagosa (eds). Chapman and Hall, London. 1993. Pp. 550. Price £65.00, hardback. ISBN 0 412 43390 7.

The first modern textbooks on plant breeding were R. W. Allard's *Principles of Plant Breeding* (1960) and F. N. Briggs and P. F. Knowles' *Introduction to Plant Breeding* (1967).

These were followed in 1979 by N. W. Simmonds' *Principles of Crop Investment*, which reflected the 'Green Revolution' and the growing anxiety about the erosion of genetic resources, but which pre-dated the revolution that occurred in genetics during the 1980s. Since then there have been multi-authored volumes comprising articles on a range of specialized topics, but no book attempting to give comprehensive coverage of the subject. This volume fills that niche. It is based on the Advanced Course in Plant Breeding organized by the Mediterranean Agronomic Institute of Zaragoza, and draws together expertise from all over Europe and beyond. The subject matter has, of course, been covered elsewhere, often by the same authors, but this book juxtaposes and interrelates the many topics relevant to modern plant breeding in a most useful way.

The book is divided into nine sections. An introduction is followed by sections covering systems and population structure, sources of variation, assessment of variation, manipulation of genetic systems, selection methods and adaptation. The book concludes with a section on specific-trait breeding and an epilogue. The introduction, by E. Sánchez-Monge, does not do full justice to the riches within. Its structure is somewhat rambling, and though it gives a nod in the direction of gene technology, it could almost have been written 20 years ago. It lays emphasis on Vavilov's concepts of crop evolution, and highlights the re-discovery of Mendel's work as a watershed in the history of plant breeding (but was it really?). In some parts of the book, the way in which the subject matter is divided works well. The section on sources of variation comprises chapters on topics ranging from plant genetic resources, through chromosome manipulation, to gene cloning and transfer, and forms a coherent sequence. B. Pickersgill gives a clear and well organized account of the objectives and techniques of interspecific hybridization, and a series of three chapters, on gene cloning and identification (by B. Xoconostle-Cázares, E. Lozoya-Gloria and L. Herrera-Estrella), gene transfer to plants (by I. Potrykus) and the role of gene technology in plant breeding (by F. Salamini and M. Motto), gives a good, uncluttered account of these techniques. Potrykus always relates the success or failure of gene transfer to the biology of the system, and shows an admirable level of scepticism in assessing the claims made, and of gloom in assessing the difficulties to be overcome. Salamini and Motto review the successes, actual and potential, of gene transfer, but although they do consider the difficulties of manipulating metabolically complex, polygenically controlled traits, in the end they are perhaps not sufficiently critical. Are we really going to select plants with enhanced efficiency of photosynthesis? Isn't that what evolution has been doing for millions of years? Still, who knows? — as the authors of one chapter note, 'a lot of work in the area in undergoing in the world'.

The chapters on the manipulation of genetic systems form another fairly coherent section, ranging from D. de Nettancourt's discussion of self- and cross-incompatibility systems to B. Forough-Wehr and G. Wenzel's account of andro- and parthenogenesis. So also do the chapters on adaptation. In this section R. B. Austin tackles the key problem of augmenting yield-based selection. The ground that he covers is tradi-

tional — the selection of genotypes to match changes in agronomy, the construction of experimental genotypes differing in specific traits, the design of ideotypes — and his prescription is pragmatic: as in the past, he argues, progress will come through the skill of the plant breeder's eye, provided that it is exercised in the right environment. However, his material, though not novel, is arranged so as to provide a systematic and valuable guide for action. In this chapter, gene technology is conspicuous by its absence. Another traditional source of information, genotype $\times$ environment interaction data, is discussed by I. Romagosa and P. N. Fox. The breeder seeking to make more effective use of $G \times E$ data will find a range of new and interesting techniques in their chapter — provided that he or she is prepared to tackle some fairly heavy multivariate statistics. The remaining chapters in the adaptation section cover resistance to abiotic stresses and to parasites.

Elsewhere, the arrangement of the subject-matter is less happy. L. Munck's quasi-mystical chapter on the utilization of renewable plant resources sits oddly in the section on specific-trait breeding, and the section on assessment of variation comprises two strange bedfellows — M. Pérez de la Vega's chapter on the biochemical characterization of populations (that is, on molecular genetic markers), and M. J. Kearsey's on biometrical genetics. Individually, however, these chapters are excellent. The former gives a good account of the types of genetic marker available, and argues shrewdly that the different types are suited to particular applications. P. Arús and J. Moreno-González's chapter on marker-assisted selection survives its unfortunate divorce from this foundation, and gives a good discussion of the uses to which genetic markers can be put, ranging from situations where only minimal information is available and the markers are unmapped, to the mapping of quantitative traits. Several other chapters mention molecular markers in one context or another, and I believe that this is the area in which modern genetics will make the greatest impact on plant breeding. However, in one respect the book's treatment of genetic markers is unbalanced. RAPDs are mentioned in at least three chapters, but in none of them in the intrinsic difficulty of obtaining repeatable results with these markers discussed. Conversely, microsatellites, which have proved to be ideal genetic markers in studies of animals, are not mentioned at all.

M. J. Kearsey introduces the reader to biometrical genetics with considerable theoretical rigour but also with great clarity, always relating his concepts to the questions plant breeders want to answer — what is the best inbred cultivar that can potentially be produced by a cross or what rate of response might we get to selection? — and so on. J. Moreno-González and J. I. Cubero build on this foundation in their densely-packed discussion of selection strategies and choice of breeding methods, but their presentation is not lucid, and I think I would return to Simmonds or Allard for clear guidance.

This is not a book for beginners, and to that extent, it does not supplant the earlier texts. Moreover, though it is inconceivable that a single author could match the book's range and depth, the multi-author approach inevitably means that

the advantage of a unified vision is to some extent lost. One misses the eloquent prose of R. W. Allard, or the magisterial if quirky voice of N. W. Simmonds. In fact, the writing often leaves something to be desired (though there are notable exceptions). For example, in their otherwise excellent chapter on marker-assisted selection, Arús and Moreno-González say, 'The limited number of markers inherent in isozymes does not exist with RFLPs.' One can figure out what this sentence means, but why should the reader have to work so hard? The book is intended to be the first of a series, but I think it will be of more value as a stand-alone, state-of-the-art, comprehensive text. As such, it is of considerable importance. In his epilogue, N. O. Bosemark presents persuasive evidence that the current global food surpluses are precarious, and that the task of plant breeders is far from over. This book squarely fills a gap which was beginning to grow uncomfortably wide, and deserves a place on the bookshelf of every serious student and researcher in the field of plant breeding – or at least, of every one who has a research grant against which they can charge £65.

References

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Genes, Crops and Environment. J. Holden, J. Peacock and T. Williams. Cambridge University Press, Cambridge. 1993. Pp. 162. Price £12.95, paperback. ISBN 0 521 43737 7.

This little book is what the fiction critic of the Times would describe as a 'jolly good read'. This is not to imply that it is a work of fiction, quite the reverse; it portrays the story of man and plant genetic resources in an interesting and stimulating way that should appeal to all biologists and 'environmentalists' as well as many science administrators. The policy-maker audience claimed in the publisher's introductory note may not read the whole book, though they would undoubtedly benefit if they did, for it illustrates the progress of science in support of development practice and highlights the essential need for international collaboration in the field of genetic resources.

The title does not include 'mankind' or 'human' but the entire book demonstrates the mutual impact of man and plants, their progressive interaction with the environment,

and the underlying importance of rapidly escalating human populations. The book explains in simple, non-jargon terms all the stages of the exploration, evaluation, conservation and utilization of crop plants with their intra- and inter-specific genetic variation. Other books have covered this topic but none so informatively.

The first chapter summarizes environmental and demographic change and shows how human migrations have influenced the distribution and structure of plant genetic resources. Chapter 2 provides an excellent history of the use and manipulation of these resources, together with the origin of landraces and the concepts of genomes and hybrids. Four major crops are taken as examples (banana, cotton, rice and wheat). The third chapter progresses to disease and pest resistance; it explains the evolution of host-parasite relations, dwarfing genes, the hazards of monoculture, the different strategies for resistance breeding, and the constant need for new genetic resources.

Chapter 4 considers the objects and problems of collecting germplasm; it emphasizes the different sources and levels of genetic diversity (allele, allele frequency, genotype, population, species) and the difficulties of allocating limited sampling resources. A brief report is given on the status of some of the major crop collections and this highlights the incomplete representation of some species and their natural or bred populations; it introduces the need for international action. The authors rightly consider that germplasm should be made freely available to all but one might have expected here a consideration of intellectual property rights both for the country of origin of a seed collection and for the breeder of an improved variety.

Although mention is made of conservation by vegetative means for species with recalcitrant or inadequate seed, Chapter 5 concentrates on conservation through seed. It considers the various types of genebank, their location and the possible genetic change and erosion that may occur in a collection. This leads logically into the management of such banks, especially the descriptive, passport and assessment data that are essential for each collection. The role of international collaboration is again stressed.

Massive efforts have been made by international and national organizations to explore and conserve the relatives, natural populations and both primitive and advanced cultivars of the major crop species. However, for some of these species, and for a large number of less well known ones, there are significant gaps in our knowledge of their distribution and biology. Chapter 7 identifies these gaps, stressing the need for studies of taxonomy, reproductive biology, seed physiology and disease resistance, while Chapter 8 examines genetic resource conservation within the political framework for the conservation of the biosphere.

Forest geneticists will be disappointed that, apart from a fascinating history of rubber, there is only one cursory sentence referring to forest trees. Trees are obviously not considered crops by the authors yet there are a large number of international and national institutions working on all stages of conservation for almost a hundred forest tree species; some of these are widely used in industrial plantations while others, the so-called multipurpose trees, have great potential