The breeding objectives for each crop are discussed, practical difficulties are noted and the ways in which molecular biological methods could supplement or replace traditional methods are outlined succinctly. Although three crops attract most of the comment, there is sufficient generality in the discussion to make this text a useful summary of the kinds of practical problem likely to engage the attention of plant breeders for the next two decades.

At first glance, the shining new instruments of molecular biology promise a revolution in working methods, an extra dimension of genetic manipulation. There is the prospect of isolating genes by one means or another, identifying their products by polyclonal and monoclonal antibodies, transferring genes from one species to another, with or without tailoring to produce desirable effects, increasing the copy number of particular genes, locating specific alleles by exploiting restriction fragment length polymorphism, to mention some of the thrills in store. Transference of genes between species which do not hybridize beckons entrancingly as a route to novel genotypes, while the confident identification of the carriers of particular genes at an early stage of development will make selection faster, more precise and cheaper.

All these and other possibilities are discussed in relation to the three crops. But it is also made clear that, although some problems could and should be tackled by molecular biological methods right away, many of the exciting and potentially far-reaching applications hinge on a better understanding of the genetics, biochemistry and physiology of plant growth, differentiation and reaction to different kinds of environmental stress, both physical and biotic. Before they can be manipulated the right genes have to be identified. When successfully transferred, to be useful, they have to be de-repressed at the right time and in the right tissue or organ and they must be compatible with the genetic background.

The authors list four main areas which are particularly suitable for analysis by the new methods. Taking them in turn, photosynthesis, in spite of all that is known about it, remains a problem area because limiting components cannot be identified with certainty. It is suggested that molecular biological methods can make a unique contribution here by making it possible to change particular components of a complex system. Plant water relations, especially in relation to drought resistance, pose an economically important challenge which directs research attention to the properties of osmoregulation. There may be genes in wild species which confer drought resistance and would therefore be candidates for transference to crop species, if such genes could be identified. Seed composition has evoked a great deal of interest and much is already known about the seed proteins and other compounds in some species. But for oilseed rape and faba beans less is known and there is a need to alter the composition of the seed to make it more suitable for animal feeds. Finally there is pest and disease resistance, where there may also be a case for looking in other species for genes which confer general resistance. Progress in this area requires a better understanding of recognition systems and the molecular and cellular basis of defence reactions.

In all these, and other areas we have not space to notice, there is ongoing need for basic research on several fronts if the potentially great economic advantages of applying the methods of molecular biology are to be realized. At present there are very few short cuts; in future there may be many more. Traditional methods of analysis must be fully integrated with the molecular approach in a new operational synthesis. It is also worth remembering that, at the end of the day, the performance of any new cultivar will have to be evaluated in large scale field trials, which take account of variation in both soil and climate.

This very readable book can be recommended to anyone interested in the practical applications of genetics. It should also prove attractive to plant breeders, who would like to consider an imaginative but hard-headed assessment of the scope for molecular biology in plant breeding.

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Papillomaviruses. Ciba Foundation Symposium 120. John Wiley. 1986. £27.50. 259 pages.
ISBN 0 471998370.

Anyone reading the popular press or viewing the television in current times cannot fail to be reminded that screening for cervical precancerous cells in the UK as a whole is not a prodigious success. This trend is not, however, universal for all of the UK; several areas including Aberdeen do show significantly decreased statistics for deaths from cervical carcinoma as a result of early detection of precancerous cells. In addition, several countries, notably Canada, have highly significant figures to show that screening of women for precancerous cells (smear tests) leads to significantly reduced mortality from the cancer.

Since cervical cancer is a venereal disease interest has always centred on detecting the virus (presumably) responsible. At present the most likely candidate is the human papilloma virus (HPV). In the West of Scotland and North East of England 83% of all genital cancers are associated with the detection of the genome of one specific type of the virus, HPV type 16, whose DNA can be detected in tumour tissues.

The human papilloma group of viruses consist of about 40 different types and new types are added to the current list frequently. To be considered a new type requires that the isolate share less than 50% DNA homology under stringent conditions with any previous isolate. Whether HPV actually causes genital cancer is not clear since the genome can also be found

in histologically normal tissue adjacent to but distinct from a cancerous genital lesion. However, current interest in this group of viruses is intense, and if indeed these viruses are one cause or a cocausal agent in genital neoplasia the interest in them must reside at the level of papilloma-virus/host-cell interactions.

This topic is the subject dealt with in a new book entitled 'The Papilloma Virus', being the report of the 1985 Ciba meeting held on this subject in London. The London meeting dealt not only with the human papilloma virus but also with those viruses which infect cattle – the bovine papilloma viruses (BPV), those associated with tumours in rabbits – the Shope papilloma virus, and also papilloma viruses of the deer and the European elk.

Papilloma viruses initially cause warts and are frequently referred to as wart viruses. In this benign condition a proliferation of tissue occurs after virus infection and the annoying but not serious wart results. These warts in the presence of certain cofactors progress to malignancy. In cattle in the West of Scotland, Bill Jarrett's group in the Veterinary School of Glasgow University has shown that the cocarcinogen is the ingestion of bracken, whereas with Shope papilloma virus the geographical location of the rabbit (the Missouri basin) is linked to the development of malignant lesions. In warts virus particles may be seen in the EM and the benign form of the disease is infectious. No system of *in vitro* culture of these viruses has been successfully described and in the animal host the wart virus is only shed from the keratinizing epithelium of the differentiated cell. However, in tumours virus particles are frequently not seen in the EM and presence of the virus DNA genome in tumour cells is the only evidence of the involvement of the infectious viruses in malignancy.

Lack of differentiating host cell has been a major drawback in studying virus function and *in vitro* genetics of this virus is not a feasible proposition in the absence of a suitable culture system. However, some of these virus types have now been sequenced and it is particularly relevant that the organization of the genome is similar in all types. In addition, transcript mapping has stressed the similarity between both the different types and also the strains.

The viruses are particularly appealing because they replicate as plasmids extrachromosomally and are only integrated when associated with malignant or premalignant disease in which their transcription is host cell specific. In other words the host may suppress virus transcription. Of especial interest is the fact that the HPV 16 genome found so frequently in genital cancer is often integrated and, as previously stated, virus particles are seldom seen in these tumours. If indeed the recent increase in cervical cancer is due to an infectious agent such as HPV 16 the question arises – how is it transmitted if it is not packaged into potentially infectious virions?

The CIBA Foundation book on the Papilloma Viruses contains an introduction and also closing remarks by Peter Howley of NCI, an acknowledged world expert on the molecular biology of these viruses. The rest of the book consists of 14 chapters each of which is devoted to one aspect of the papilloma viruses. In addition, a general discussion forms the penultimate chapter.

As is common with all CIBA Foundation meetings the invited participants consist of a selected few scientists of world renown, all acknowledged experts in their field. For this reason the standard of each chapter is high and each chapter usually covers in some depth one particular aspect. Chapter 1 – Classification of the papilloma viruses – mapping the genome, by Pfister from Erlangen-Nürnberg, capably sets the scene for the further chapters. This introductory chapter is sufficient to allow the less expert reader to understand some background to these viruses and provides knowledge of the genome mapping and function. Petterson from Uppsula in the following chapter describes in detail the genome of BPV 1 and compares its transcription pattern with HPV 1, HPV 6 and the cotton tail rabbit papilloma virus (CRPV). This chapter further stresses the similarities of the organization of the genomes of viruses from widely divergent species.

In the third chapter the area of virus transformation is covered by Peter Howley. This property of 69% of the BPV to morphologically transform hamster cells is of interest to those specifically drawn to virus transformation as evidence of oncogenic potential of a virus. The *in vitro* transformation system has aided the understanding of the BPV replicon and the essential nature of some genes in virus plasmid maintenance. The E6 (early) gene product is responsible for transformation with BPV and codes for a 15.5 Kd protein. Different approaches have been made by different groups to establish transcript and protein mapping in BPV and sequencing data are heavily relied upon with a virus which has no *in vitro* replication system.

The book has several interesting chapters including studies by Campo on bovine papilloma viruses. The genome of these viruses is not required to maintain the malignant state once established. Significant contributions on epidemodysplasia verruciformis, the diagnosis of HPV infection, and laryngeal papillomatosis and its association with a defect in cellular differentiation are presented. Interferon as a treatment for papilloma virus infection is dealt with in a chapter by Androphy.

One of the features of the book is the report of the discussion held at the end of each presentation. This discussion is always interesting and sometimes reveals points which do not come out in the general presentations. One such point is that tumours containing the virus do not seem to express cellular oncogenes at least of the *ras* or *myc* family as detected by transfection into NIH 3T3 cells.

Who will the book benefit? Probably the general research worker of postgraduate level and the more serious worker whose main interest is not solely the molecular biology of the papilloma viruses. I say this because even if a book of a meeting were speedily printed, as it was in this case, it is inevitably somewhat out of date by the time of publishing.

What I should have liked to see in the book was the *in situ* hybridization of Crumm's group from Norfolk in which I believe cell types harbouring virus are now identified. As far as general introduction is concerned there is too little of this for the book to be very useful to complete newcomers to the field. Final year undergraduates, however, will find it interesting. Some knowledge of molecular biology is really necessary to understand the more elegant approaches discussed in the sections by Howley, Botchan, Danos and Petterson.

I found the book most useful and where it lacks sections on certain approaches and also lacks an overview of the problems in studying these viruses one may feel more inclined after reading the book to go and look up the current literature.

At a cost of £27 the volume is good value.

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Regulation of Gene Expression – 25 Year On. Edited by I. R. BOOTH AND C. F. HIGGINS. Society of General Microbiology Symposium 39. Cambridge University Press. 1986. 309 pages. £32.50, $59.50. ISBN 0 521 32201 4.

This book, and the Symposium for which it was produced, celebrate the quarter century since Jacob, Monod and others developed their elegant concepts of the operon, and of the negative regulation of gene expression at the level of mRNA transcription. Since then, the refined simplicity of their model has given way to a far more detailed understanding of the complex underlying realities. Thus, few repressors bind to only single DNA sites; few prevent RNA polymerase from initiating transcription through simple steric exclusion of the enzyme from the promoter; and many promoters and most operons are themselves complex. Nevertheless, the basic ideas presented around 1961 are correct, and remain as splendid examples of successful reductionism. They have also stimulated the discovery of many other unforeseen, and sometimes intricate mechanisms of gene regulation, such as attenuator control in amino acid biosynthetic (and *pyr*) operons, and the feedback repression of translation (and in one case transcription) of ribosomal protein mRNA molecules by one of their own protein products. Despite the long passage of time, and the shift of emphasis towards studies of eukaryotes, the literature on prokaryotes continually renews the enthusiasm and admiration of even such ancients as myself, by unveiling new and unexpected tricks of molecular genetical magic. Many are described in this book. One which is not, but which 'wowed' me recently, is the ability of some plasmids to leave a lethal time-bomb behind in erstwhile host bacteria rash enough to lose them. Mechanisms such as RNA splicing, discovered in eukaryotes and initially thought exclusive to them, frequently turn out to be used also by prokaryotes or their viruses. It is difficult to escape the impression that any molecular mechanisms of which we can dream, in our long articulation of the double helix and genetic code paradigms, will turn out to have been exploited by some organism. Indeed, molecular biology comes more and more to resemble the biology of whole organisms in the variety of elegant, intricate or astonishing modes and mechanisms of life it is revealing.

At such a stage of development of a subject, the great danger for writers is that they may bury their readers under a welter of detail, and fail to elicit the essentially simple, coherent and inspiring realities which lie beneath. The present book has, I think, largely avoided this failing. The organizers chose an excellent set of contributors, who produced 14 chapters which, while varying considerably in style and depth of coverage, are in general clear and concise reviews. These are up to date and of high standard, and mostly thoroughly referenced, but are much quicker and easier to read than typical Annual Reviews. They should therefore be particularly useful for final year undergraduates and their teachers, and for postgraduates and researchers wishing to maintain breadth without excessive expenditure of time. I dare to predict that most of these articles will still be very useful at least five years hence. The Editors are to be congratulated on producing an enjoyable and valuable book (and meeting); and incidentally on proving, in these days of galloping Metropolitanization, that there is vigorous intellectual life North, not only of Watford Gap, but even at the Antonine Wall.

Typographical errors are present, but few if any that are misleading; and what book or paper lacks them, despite repeated proof-reading? My own copy betrayed defective binding, with pages coming loose shortly after I first opened it; it remains as useful as before. Needless to say this book does not completely cover even the field of prokaryotic gene regulation. Most chapters deal with *E. coli* and its close relatives or satellites, with only one and a half centred on Gram-positive bacteria, and one on *Dictyostelium*. It is easy to discover minor but interesting mechanisms of gene regulation in *E. coli* which are nowhere mentioned: for example, gene expression dependent on such rare translational aberrations as frameshifting, or read-through of stop codons.

Rather than dwell on omissions, it may be useful to