

**Annual Review of Plant Physiology and Plant Molecular Biology, 1994.** R. Jones, C. Somerville and V. Walbot. Annual Reviews Inc., 4139 El Camino Way, Palo Alto, California 10139, USA. Vol. 45. Price: \$52 (approx. Rs. 1560).

On the face of it, there seems to be little purpose in writing a review of a review! Especially since 'The Annual Reviews Inc.' is almost an institution in itself. For the forty odd years of its existence it has offered in-depth reviews written by people actively working in the area and has covered reviews on topics that are in the mainstream as well as those that are more obscure but equally interesting. The volume for 1994 is no exception. It comprises twenty-seven reviews clubbed under five different areas (Genetics and Molecular Biology; Tissue, Organ and Whole Plant Events; Biochemistry and Biosynthesis; Cell Differentiation; Acclimatization and Adaptation).

There are four reviews which address different aspects of hormone biology. Of these, two deal with the genetic and molecular approaches that are being used to understand the role of cytokinins (by Binns) and abscisic acid (ABA) (by Chandler and Robertson). Despite ABA being christened the 'stress hormone', there have been few clearly defined stress-tolerance-related biochemical functions assigned to any of the genes whose expression is regulated by ABA. Likewise, the relationship between cytokinins and stress biology needs further study. In both the fields there seems to be a concerted bid to make use of mutants and innovative screens to arrive at questions related to regulation and biosynthesis. Both the fields seem poised to make breakthroughs in the near future, although it may take a lot longer to understand the complex interactions that occur at the whole-plant level. Shibaoka's review categorizes the role of different hormones on the orientation of microtubules in plant cells.

Plant mitochondria seem to have come of age, with three reviews discussing some aspect of their biology. Of course, the one on the organization of the mitochondrial genome (by Schuster and Brennicke) was the most compelling because the first plant mitochondrial genome (albeit from the liverwort

*M. polymorpha*, which apparently has a somewhat unusual organization) has just been sequenced. This has revealed several surprises, including the identification of thirty additional open reading frames and a completely new set of mitochondrial genes that are probably involved in cytochrome biogenesis. There is little doubt that this triumph of sequencing will now pave the way for a deeper understanding of mitochondrial gene regulation and function. Comparatively speaking, the review on protein import into mitochondria (by Moore *et al*) and another on glycine decarboxylase (by Oliver) have less new information to offer.

We found the review by Aeschbacher, Schiefelbein and Benfey on the genetic basis of root development particularly exciting. The isolation and preliminary characterization of a number of mutants defective in root development has set the stage for a thorough understanding of organ formation, a hitherto little understood process. The *Arabidopsis* root follows a relatively simple and predictable developmental pattern, making it a very attractive system to dissect at a molecular level. Another review that caught our attention was on the molecular biology of carotenoids biosynthesis (by Bartley *et al*). Although the structures of carotenoids have been known for a long time, it is only recently that the genes for the biosynthetic pathway have been identified. Considering the vital role of carotenoids in photoprotection, it is very likely that the next step will be in the direction of understanding the regulatory aspects of carotenoid biosynthesis.

The reviews on the molecular aspects of alkaloid biosynthesis (by Hashimoto and Yamada) and on taxol (by Heinsteins and Chang) make fascinating reading. They highlight the enormous biochemical information already available on a bewildering variety of alkaloids and on the current interest in, as well as the scope of, biotechnological applications. Considering our enormous indigenous knowledge base about the uses of local medicinal plants, these reviews could be of great value both to the general reader and to researchers in the field.

This volume, like previous ones, contains a few lead articles on photosynthesis. Carbonic anhydrase (CA) has varied roles in photosynthesis, including its possible involvement in PSII-mediated  $O_2$  evolution. The multiple isoenzymes located in chloroplasts,

cytosol and in the periplasmic space of microalgal cells suggests diverse ways in which it functions to support efficient  $CO_2$  fixation by Rubisco. The relative abundance of CA and Rubisco (the CA/Rubisco ratio) seems to be a key feature for optimal photosynthesis and  $N_2$  use efficiency and thus the coordination of these two enzymes is important for the regulation of  $CO_2$  fixation. This review on CA will definitely be useful in teaching of graduate courses in plant physiology. A similar type of review by Huppe and Turpin discusses in detail the integration of carbon (C) and nitrogen (N) metabolism in plants and algal cells. Carbon requirement for N assimilation and the regulation of C flow through key TCA cycle enzymes have been adequately discussed. Assimilation in roots seems to be emerging as an area for future research in plant physiology.

During the past decade, there has been an extensive study of photoinhibition, i.e. how excess light inhibits photosynthesis and photooxidatively damages the photosynthetic apparatus. The role of photoinhibition of photosynthesis under natural conditions is the most current topic of research and has been discussed by Long, Humphries and Falkowski. The damage and recovery of photosystem II reaction centre D1 protein is considered a central phenomenon in photoinhibition, but, in nature, the role of xanthophyll cycle in protecting/avoiding photodamage may be crucial. It is becoming somewhat clear that photoinhibition is not only a damaging process but possibly also a strategy for survival under stress conditions. Photoinhibition studies during germination (seedling establishment) are likely to emerge as an important aspect for future investigation, as also the role of light stress in crop canopies and phytoplankton communities. The review on inhibitors of photosynthetic enzymes focuses on enzyme inhibition of assimilate export sucrose and starch biosynthesis and  $N_2$  assimilation besides the inhibition of C<sub>2</sub>, C<sub>3</sub>, C<sub>4</sub> cycles. This chapter will provide new material for courses offered in plant and crop physiology and plant biochemistry. Photoacoustic spectroscopy, PAS for short, is a relatively newer technique that has revolutionized photosynthesis research. It provides methods to monitor energy storage by photothermal methods and makes photobaric measurements of  $O_2$  evolution in intact leaves, fronds and thalli. In con-



junction with pulse-amplitude-modulated (PAM) Chla fluorescence. PAS will enable the investigators to make detailed and quantitative analysis of photochemistry *in vivo* as well as probe energy storage, energy transfer and adaptive state changes *in vivo*. Although the current chapter on PAS by Malkin and Canaan (who introduced this technique of 'listening' to photosynthesis) is a bit difficult because of the technical details for uninitiated readers, it contains useful details on how to use PAS in physiological studies.

The story of blue-light-mediated photomorphogenesis is fast becoming as interesting as phytochrome-regulated physiological processes. The transduction of blue light signals in higher plants and blue-light-mediated gene expression add significantly to our knowledge of signal transduction processes in plants. The correlation between blue-light-induced phosphorylation of plasma membrane protein, light-mediated activation of GTPase, changes in gene expression and involvement of nonmitochondrial b-type cytochromes tend to support the assumption that there are several different processes and independent pathways of regulation for common physiological processes. Signal transduction in plants is going to dominate the photobiological investigations in plants.

In short, the 1994 volume covers a wide spectrum of emerging research themes in plant biology. Its high cost puts it out of the reach of individual scientists in India but it should be an important addition for a teaching or research library. How wonderful it would be if a more affordable edition of the various Annual Reviews is made available for scientists in the less privileged parts of the world!

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**Patterning of Material Layers in Submicron Lithography.** U. S. Tandon and W. S. Khokle. Wiley Eastern Ltd., 4835/24, Ansari Road, Daryaganj, New Delhi 110 002. 1993. 183 pp. (including plates) Price. Rs 450.

Constant and continued search towards sophistication – required for high-performance devices like multimegabit memories, for low power consumption in high-frequency applications, and for utilization of the smallest real estate of the material – have all evoked a keen interest among technologists the world over to search for new avenues and methods for micrometer and nanometer geometry patterning. The technology has gone through sea changes in this direction during the last decade. Photolithography and electron beam lithography, though in use for a few decades, have been improved upon to achieve the industrial targets in the speed of writing patterns, the patterning areas and smaller features. Ion beam and X-ray lithography are somewhat more complex techniques but, due to breakthroughs in masking materials, mask fabrication and development techniques, are becoming more powerful tools. Due to the fact that they open up avenues for more application areas in the development of newer devices, they have of late been finding more thrust in R&D efforts. Many conferences have recently been held in this field. The submicron patterning of material layers forms the subject matter of this excellent and handy monograph and covers various facets of the techniques. The book is well-planned into five chapters for submicron patterning.

The first chapter discusses the factors evoking the technology push in patterning layers, the highlights of achievements in devices' performance in the industrial and biological fields and in basic research. It also discusses the various fundamental issues of importance in the realization of new devices, which are only with the use of submicron patterning.

The second chapter discusses the basics of electron beam lithography, which include the description of e-beam systems, their operation, the highlights of the resists used for this technology, the problems associated with high voltage e-beam lithography and their solutions, and a comparison of the available systems and their applications.

The third chapter provides reasonably good details on the various facets of ion beam lithography, various ion beam resists and their sensitivities, and exposure technologies. Also presented are some details of the most important technique of focussed ion beam (IB) lithography, including masked IB, multiple IB projection lithography, their problems and limitations and their applications with illustrations. The finer details of the newer resists, both organic and inorganic, have also been discussed. Also discussed are the various types of ion sources, their merits and demerits. The increase in the temperature of the mask due to the energetic ion beam and its application in direct write on wafer has also been dealt with in detail. A detailed comparison of the various machines presently available in the market, presented in this chapter, can be of help in choosing the appropriate system.

The fourth chapter describes the X-ray lithography system, X-ray masks and materials, their fabrication methods, resists types with their sensitivities and resolution, various alignment schemes and recent applications with illustrations. X-ray lithography is a new field and is of great importance in submicron patterning. The various sources of X-rays which seem suitable for lithography, various types of masks, with their merits and demerits and X-ray resists have been discussed. The alignment technique is quite intricate with this lithography and has been discussed well. The various available X-ray lithography systems have been described and the chapter concludes with applications and photographs of the generated patterns. The technology is so far limited in use but is a challenge in patterning for full commercial exploitation.

The fifth chapter as a conclusion delves into the present-day scenario in the area of micro and nanolithography, the trends results and projections for the near future.

The advancement in resist technology and excimer laser also pushed the optical photolithography limits to submicron range, which has been discussed in the first chapter as a passing remark. A chapter in this field would have given a completeness to the book.

The book is a monograph on the subject of submicron patterning, excludes the photolithography which also has its own standing in sub .5 micron region. Overall, this is an excellent document for all scientists/engineers working in