articles in the area during the last decade emphasizing on early evolution of photosynthesis with molecular evidences for evolution of the process. The present review is an exhaustive description of the non-oxygenic origin of photosynthesis and subsequent evolution of oxygenic photosynthesis with emphasis on manifestation of novel biosynthetic pathways of photosynthetic cofactors and alterations in electron transport carriers, pigments and protein complexes. The review touches upon few important points like mechanism of evolution, genetic evidence of evolution and endosymbiotic events. On the other hand, Pichersky and Lewinsohn have provided a different story of evolution describing how each plant lineage develops a mechanism for synthesis of specialized metabolites appropriate for its environment. They have, however, focused on a critical discussion on how plants independently evolved to synthesize metabolites that already exist in other plant lineages or synthesize different metabolites, which carry out the same function, examples indicating convergent of evolution in plant-specialized metabolites. Continuing on the theme, Popper and his associates describe evolution and diversity of plant cell wall, the field that had earlier drawn less attention. The review compiles literature in the area like variation and diversity in the composition of cell wall in plants and algae, cell-wall communication and differentiation and cell-wall diversity. The authors have emphasized on how terrestrialization, transition from saline to freshwater, and subsequent evolution of land plants have resulted in a dramatic alteration in cell-wall composition of the aquatic and land plants.

The two reviews under the theme 'Techniques and applied botany' relate to fluorescence imaging and genetic engineering, the techniques that have significantly contributed to the expansion of knowledge in plant science.

In many laboratories, small molecular weight fluorescent dyes are used to examine the dynamics, both spatial and temporal, of plant regulators and signalling molecules. Summarizing the recent data generated through the fluorescence imaging techniques, Swanson and associates have attempted to explain regulation of diverse developmental and physiological processes of plants induced by alteration in the levels of Ca^{+2}, pH and reactive oxygen species. The article with graphics and illustrations has emphasized how these fluorescent dyes in addition to well-studied GFP could be used to image the regulators and their cellular functions.

Food biotechnology, in recent years, is drawing attention both in developing and developed countries. New ideas and new techniques in biotechnology and genetic engineering are emerging to improve the quality of foods. The review is written by seventeen authors from Africa, America, Asia and Europe indicating global concern about this area of plant biotechnology research. Studies to have desired nutritional and caloric character in foods have gained importance specifically after the post-genomic era. Cassava, a shrub is one of the major sources of calories in sub-Sahara Africa. Its root is the main source of carbohydrates. The multiauthored review focuses on the strategy of the Biocassava (BC+) programme for developing genetically biofortified Cassava with better nutritional quality. For obvious reasons, this type of biotechnological approach by plant scientists has relevance primarily for underdeveloped and developing countries, where many people suffer from malnutrition. The review concludes with the future plan of BC+ programmes to target biofortification of food crops in Africa, and their commercial application with better technologies and management.

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This volume has an eclectic collection of 27 articles reviewing areas from the origin of life to optogenetics, including protein folding, bacterial organelles and the mechanism of myosin motor activity.

Martin Chalfie points out that mechanosensory ion channels transduce mechanical stimuli to electrical signals extremely rapidly, but are very sparse – around 50 transducing channels per sensory neuron. They have, consequently, been much more difficult to characterize than, say, rhodopsin, which is also reviewed in this volume and is present in 4×10^7 copies per rod photoreceptor cell. Candidate mechanoreceptors have been found in several families of ion channels, but confirmatory evidence is lacking in most cases. The channels are likely to mediate auditory transduction in hair cells of the inner ear and insect flight sensors, among other systems. The gating mechanism is yet to be elucidated, but may involve tethering to intra- and extracellular scaffolds, thus experiencing strain on membrane deformation.

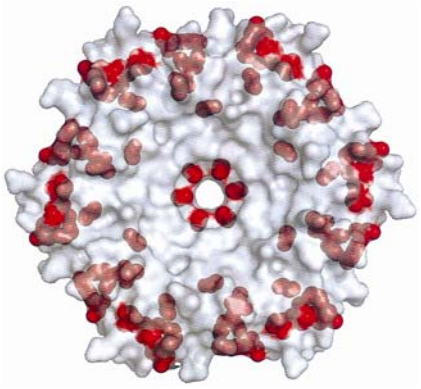
Anders Carlsson has reviewed actin dynamics which is crucial for cellular function. Actin is maintained in a non-equilibrium distribution by continuous input of energy, which results in such phenomena as travelling waves, which may be responsible for oscillations at cell edges. These oscillations, in turn, may be used by the cell to sample its environment. However, mechanisms linking actin polymerization to oscillations have yet to be elucidated.

The cell membrane is made up of a lipid bilayer within which proteins reside. The distribution of specific lipids among membranes of different compartments of a given eukaryotic cell and between the two leaflets of a specific membrane can be quite non-uniform. Leventis and Grinstein review the inner leaflet distribution and function of phosphatidyl serine (PS), which is most enriched in the plasma membrane. Appearance of the lipid on the outer leaflet (and hence the exterior of the cell) can trigger major events – such as attraction of clotting factors when exposed on platelets, or signalling phagocytes to engulf and devour cells undergoing programmed cell death. PS in the inner leaflet probably functions continuously in several contexts, many of which are still being analysed. How the asymmetric distribution is set up and the extent of such asymmetry in organelles is yet to be elucidated.

A statistical mechanics perspective and advances in experimental techniques have revolutionized our view of protein folding. Thirumalai *et al*. predict that the time for folding scales with the size of the protein – which has some experimen-

tal support. The prediction of heterogeneity in folding pathways also has been supported by experiment.

One of the most complex machines in the living system is the ribosome. X-ray and cryo-electron microscopy have revealed the structure of the ribosome itself and provided insights into the translocation of mRNA and tRNA following peptide bond formation. Retrospective proof-reading after the formation of the peptide bind has also been studied, although the detailed molecular mechanism remains elusive. Further, these techniques reveal structures of the endpoints, whereas the intervening dynamics is also crucial. For this, single-molecule techniques with millisecond resolution are required. Dunkel and Cate describe fluorescence and force measurements to examine global and local dynamics within the ribosome.



Sequence conservation among diverse bacterial microcompartment (BMC) shell proteins. Conserved amino acid positions (red) were defined as those having sequence identity above 80% in an alignment of 2174 BMC sequences. Positions of high conservation occur mainly at the perimeter, where hexamers meet. In the CcmK1 protein, these residues include A4, G6, A19, D21, K25, V29, G38, G48, V50, V53 and G70; the conserved residue in the pore is glycine G38.

The standard view of prokaryotes is that they do not contain any intracellular compartments. However, Yates and co-authors report that many bacteria contain virion-like protein shells encapsulating sequentially acting enzymes that mediate processes like CO_2 fixation to degradation (carboxysomes and ethanolamine utilization system for instance). Hexameric building blocks form flat facets that self-assemble to form polyhedral shells with the required permeability properties to facilitate their function.

α-Hemolysin forms nano-pores across membranes through which single-stranded DNA and RNA can be translocated by a transmembrane electric field. This allows the detection of single molecules in solution. Deamer points out that while current characteristics for different nucleotides are distinct, residence times of around 2 μs make it difficult to resolve transport of (and hence identify) individual bases in a nucleic acid chain. Processive DNA enzymes such as DNA polymerases and exonucleases can be used to slow down the process to the millisecond timescale. This allows the study of the catalytic activity of these enzymes at the single-molecule level. Moreover, the use of a combination of suitable pulse protocols together with these enzymes may soon yield sequence information from single molecules.

The prototypical sensory receptor is rhodopsin, present in much greater quantities than mechanosensory channels. The binding pocket for retinal in dark-adapted rhodopsin is optimized for 11-cis retinal. Absorption of a photon of light induces photoisomerization of retinal to all-trans and forces reorganization of the pocket to accommodate the ligand. This, in turn, stimulates relaxation of the rest of the protein to accommodate changes in the binding pocket, resulting in the exposure of residues that can interact with G-proteins. Details of how specific residues interact to form a light-activated G-protein-coupled receptor have been worked out. However, dynamics in the lipid environment is yet to be fully understood. Moreover, the nature of the binding to the heterotrimeric G-protein and the subsequent activation of the latter is poorly understood.

Yet another review involving rhodopsin is the use of rhodopsin-coupled ion channels to modulate neuronal activity. Szobota and Isacoff review one of the fastest growing fields in neuroscience – techniques to modulate the activity of selected sets of neurons optically. This allows the activation of specific neurons or circuits in awake animals, initiating stereotypic behaviour. The reagents used could be small molecules injected locally or photoactivable proteins expressed in subsets of cells. The latter allows for much more precise control of the targeted cells. Opsin-based approaches offer the most flexibility and ease of use and are also, in principle, wavelength tunable.

This volume keeps up with the tradition of excellent topical reviews of a number of areas in a manner comprehensible to non-specialists. The increasing use of illustrations makes the material more accessible and the box highlighting what is yet to come is useful. Overall, an excellent volume.

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