

ing energy barrier in conformational changes should have been illustrated with equations and data. The concept of delta parameter is not clarified enough and the readers may be left with confusion. High resolution mass spectrometry has not been mentioned as also its impact on structure elucidation.

The language is, in general, simple although occasionally marred with too many repetitions, apart from some typographical errors (unnecessary capitalizations, incorrect use of articles, and indiscriminate use of 'e.g.'). Some statements are incorrect and may lead to confusion to the beginners. Thus in the beginning of Chapter 4, 'spin state of a nuclear magnetic moment' should better be 'spin state of a nuclear magnet'; in p. 170, 'tiny bar magnets' be replaced by 'tiny spinning bar magnets'.

On the whole the book is very informative and largely fulfils the requirements for the undergraduate students for whom it has been clearly meant. The price is affordable and the printing is good.

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The autobiographical article in this volume is by Esmond E. Snell, who did pioneering work on mechanisms of action of pyridoxal phosphate requiring enzymes. This prefatory chapter gives a personal glimpse of motivations for research and this account has added much to our understanding of how the research area on vitamins and coenzymes itself developed in the last 50 years.

There are six interesting articles covering various aspects of protein structure, function, folding and stability. Advances in spectroscopy, protein engineering and peptide synthesis have had a dramatic impact on our understanding of the struc-

tures and stabilities of transient folding intermediates. An article of great interest to biochemists is on 'Pathways of protein foldings' by C. Robert Mathews. This review discerns both the general and the specific features that characterize folding mechanisms. Representative examples of those approaches and findings that have led to an improved understanding of the foldings process are highlighted. Molecular chaperones which function in protein folding, oligomerization have emerged over recent years as an important topic in biological studies. The review article on 'Molecular chaperone functions of heat-shock proteins' by J. P. Hendrick and F. Hartl summarizes the major lines of evidence which suggest that these proteins are involved in a multitude of processes. While tyrosine phosphorylation was being avidly pursued as a central theme of many cellular processes in the early eighties, studies into tyrosine dephosphorylation seemed relegated to a 'back seat'. However in the last 5 years protein tyrosine phosphatases began to attract wider attention and to date there are almost 30 different protein tyrosine phosphatases that have been isolated and characterized. K. M. Walton and J. E. Dixon's article on protein tyrosine phosphatases gives an indepth view on these enzymes and their roles in different cellular pathways. In the past couple of years there has been a virtual explosion of new X-ray crystal structures aimed at characterization of precise interactions between inhibitors and their target enzymes. The review 'Structure-based inhibitors of HIV-1 protease' by A. Wlodawer and J. W. Erickson discusses the current state of structural investigations of HIV-protease inhibitor complexes and highlights the general features important for drug design. Since the last review on aminoacyl-tRNA synthetases appeared, new sequences and at least 3 new X-ray crystal structures have been reported. 'Cognition, mechanism, and evolutionary relationships in aminoacyl-tRNA synthetases' by C. W. Carter describes the exhaustive work on these biomolecules which have substantially altered many perceptions about these enzymes. Considerable progress has been made in quantitating the interactions that determine and stabilize protein structures in the last few years. An encouraging development in the last few years has been the freedom with which amino acid replacements can be introduced in a

protein of interest. Brian-Mathews' review on 'Structural and genetic analysis of protein stability' highlights studies on new insights into hydrophobic and electrostatic interactions that have been provided by studies of mutant proteins with emphasis on those studies for which high-resolution structural information is available.

Although two excellent reviews describing eucaryotic DNA replication/polymerases and on fidelity of DNA replication were published in this series, the two articles on this topic in this volume focus on the significant advances made in the last two years in our understanding of the mechanistic basis of DNA polymerase fidelity. The article on 'Eucaryotic DNA replication' by M. L. DePamphilis highlights the origins of replication in metazoan genomes. To determine how a polymerase can achieve such extraordinary fidelity, one must understand the mechanistic basis of DNA polymerase fidelity. The article 'Conformational coupling in DNA polymerase fidelity' by K. A. Johnson summarizes our current understanding of the structural, kinetic and thermodynamic basis of two distinct reactions, viz. the polymerization reaction per se, and the proof-reading exonuclease reaction.

It is now becoming clear that cells might regulate DNA replication by linking it to gene expression. This series has 3 articles on regulation of gene expression at the transcription level. Roeder and his colleagues prepared and fractionated transcriptionally active extracts and demonstrated that initiation by RNA polymerase II requires the action of multiple initiation factors. In the last couple of years many laboratories in the world have identified, purified and characterized general initiation factors from yeast, *Neurospora*, silkworm, *Drosophila*, chicken, mouse, rat and human cells. The review 'General initiation factors for RNA polymerase II' focusses on our understanding of the mechanism by which RNA polymerase II binds selectively to and initiates transcription. This article also discusses the work on the C-terminal domain (CTD) of RNA polymerase II and its role in transcription initiation.

Fifty years ago Monod extensively studied the 'glucose effect'. Cells when grown in the presence of a pair of sugars show a 2-step diauxic growth. It is now clearly established that cAMP and its receptor protein CRP have a role in the

glucose effect and catabolite repression. The roles of cAMP and CRP in transcriptional regulation is the main focus of the article 'Transcriptional regulation by cAMP and its receptor protein' by Kolb *et al.*

RNA-binding proteins can control the elongation-termination decision in transcription and evidence for this has emerged from fairly recent work. Asis Das summarizes the basic mechanisms of transcription elongation and termination and how RNA binding proteins influence the elongation-termination design in procaryotes. Workers in the area of transcriptional control in procaryotes will find this article extremely useful. The role of Tat protein of the retrovirus HIV, one of the few RNA-binding proteins known to control transcription in mammalian cells is also discussed.

Cell biologists will find at least three articles in this issue extremely interesting. The availability of both biochemical and genetic experimental approaches has made yeast an excellent model system to study the movement of proteins and RNAs between nucleus and cytoplasm. The article 'Nucleocytoplasmic transport in the yeast *Saccharomyces cerevisiae*' describes the general features of movement of proteins and RNA between the nucleus and cytoplasm and by which a cell can control gene expression.

The article on 'Membrane partitioning during cell division' highlights morphological changes, membrane traffic, mechanism(s) involved and accuracy of partitioning in endoplasmic reticulum and golgi apparatus, which are the two best

characterized systems. Microtubules have been implicated in intracellular organelle positioning and transport, generation of cell shape and polarity and in various developmental processes. The review on 'Cytoplasmic microtubule-associated motors' focusses on identification, structure, mechanochemistry, force generation and *in vivo* functions of the two motor super families—dynein-related proteins and kinesin-related proteins. Membrane traffic on the other hand is inhibited during mitosis (and meiosis) in animal cells. Mitotic membranes provide cell biologists with the opportunity to study division mechanisms at the molecular level. After reading this article there would appear a number of questions to be answered and therefore the field of microtubule motors will be busy for years to come.

For the past two or three decades genes responsible for positive signals called oncogenes have been the central focus of cancer research. The group of genes responsible for negative signalling are called tumour-suppressor genes. The recent development of animal models using methods to knock out tumour suppressor genes further substantiates the idea of cancer suppression. A. J. Levine in 'Tumour suppressor genes' describes the origins and properties of these genes. Point mutations of another group of oncogenes—Ras genes—are widely found in several different types of cancer. The article on 'Function and regulation of Ras' describes the analysis of Ras protein structure, function and regulation.

Homing endonucleases are a class of

enzymes that can cut double-stranded DNA with such great specificity that there may be only a single target sequence in the entire genome. The genes that encode them are widely spread but they are specially prevalent in group I introns of fungal mitochondria. Alan Lambowitz and Marlene Belfort in the article 'Introns as mobile genetic elements' summarize the recent findings on the structure, distribution and evolution of group I and group II introns. The section of homing endonucleases is particularly interesting to workers in the area of restriction-modification enzymes.

Surprisingly in this issue of Annual reviews there are only two articles that discuss methodology. The widespread use of photolabeling and cross-linking methods to probe both structural and biological properties of macromolecules definitely merits a review. 'New photolabeling and crosslinking methods' gives an overview of photoactivable groups currently in use, design of selective reagents and deals at length on hydrophobic photolabeling of membranes.

Overall, this volume of *Annual Review of Biochemistry* keeps up the high standard of articles usually published in this series. The illustrations in all the articles are superb and convey the message very clearly. I recommend that every science library of our Universities/Institutes should have a copy of this issue on their shelves.

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