

at the Relativistic Heavy Ion Collider, where ultrarelativistic collisions take place of ions with enormously high multiplicities. Carl E. Carlson and Marc Vanderhaegen author the review entitled 'Two-photon physics in hadronic processes', where such exchange contributions to elastic electron scattering are reviewed. Such contributions are of importance to the resolution of experimental discrepancies arising from the extraction of nucleon form factors between polarized and unpolarized electron beam scattering experiments. Stanislaw Mrówczyński and Markus H. Thoma author an interesting article entitled 'What do electromagnetic plasmas tell us about the quark-gluon plasma?' Although the underlying forces of electromagnetic and strong interactions are qualitatively and quantitatively different, the authors here point out that there are some properties of the latter which can be studied by analogy with the former, keeping in mind that the former have been well studied.

As mentioned in the introductory part of this article, the microscopic and the macroscopic each affects the latter. The laws of one determine the gross properties of the other; the observation of effects on the latter provides constraints on the former. Appearing in this broad category is the article entitled 'The cosmic microwave background for pedestrians: A review for particle and nuclear physicists' by Smatleben *et al.* Today is an age of precision measurements of the properties of the cosmic microwave background radiation, with its anisotropies mapped out in great detail. Another effect is the polarization of this background which fingerprints the anisotropy. Future experiments are likely to study this in great detail. Strong *et al.* present a review entitled 'Cosmic-ray propagation and interactions in the Galaxy', surveying the theory as well as experimental tests for the propagation of highly energetic cosmic rays in the Galaxy. Cosmic-ray physics which is the progenitor of modern-day experimental elementary particle physics, continues to present puzzles and is a subject that engages the attention of several experiments worldwide. Gary Steigman, one of the pioneers of the big bang nucleosynthesis calculations, authors the review entitled 'Primordial nucleosynthesis in the precision cosmology era', wherein he demonstrates the state-of-the-art of the subject and also reviews the manner in which the in-

ternal consistency of the computations is able to constrain beyond the Standard Model physics.

Among the astonishing findings in theoretical physics in the recent past, there are tools provided by string theory, the esoteric candidate for the theory of everything, including unification of gravitation with the Standard Model, for the study of the quark-gluon plasma. Dam T. Son and Andrei O. Starinets in their review entitled 'Viscosity, black holes, and quantum field theory' provide a rapid summary of these astonishing trends. In particular, it is shown that the application of the Anti-de Sitter/Conformal Field Theory correspondence to finite-temperature field theory and the resulting hydrodynamic behaviour of field theory leads to a bound on the ratio of the shear viscosity to the specific entropy. In the review entitled 'Physics of string flux compactifications' by Denef *et al.*, the state of this subject is presented. Flux compactification arises in a specific string theory known as Type IIB string theory, which has the promise of addressing several outstanding problems both in cosmology and in particle physics. Although string theory is yet to provide realistic candidates for particle physics, it remains one of the most active fields of research in theoretical physics.

In the past, the *Annual Reviews* would often carry the reminiscences of a life spent in science. In the present volume, this has been replaced by the life story of the Indiana Cooler, which spent a lifetime exploring the properties of electron cooling. A detailed description of the achievements of this venerable facility is presented. Kai Vetter has authored the review 'Recent developments in the fabrication and operation of germanium detectors'. Germanium detectors are crucial for detection of photons over several orders of magnitudes and find applications in particle and nuclear physics experiments.

Joel Heinrich and Louis Lyons have authored 'Systematic errors', which is a general article on the subject, and is accessible to any scientist. It is a valuable article in the collection.

Finally we turn to the article by Judy Jackson and Neil Calder entitled 'Quantum communication', which is not on the popular subjects such as teleportation and information of the scientific kind, but on the art of communication to a general and interested public, on what is

happening in the extreme quantum world of elementary particle physics. The magazine *Symmetry* from Fermilab and SLAC in USA, is a example of such fine journalism which is discussed in detail in this article, in addition to the dynamics associated with the production of several popular accounts of particle physics.

In summary, I have reviewed a collection of fifteen articles in the present volume which captures the most central developments in the fields of nuclear and particle physics in recent times, and is a valuable addition to every library.

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Plant Mitochondria: From Genome to Function. *Advances in Photosynthesis and Respiration Series.* David A. Day, Harvey Millar and James Whelan (eds). (Series Editor, Govindjee). Springer, 2005. vol. 17. 2005. 325 pp. Price: US\$ 269.

Advances in Photosynthesis and Respiration is a book series that has covered, in great depth and breadth, various research topics related to photosynthesis and respiration. Its founding editor is Govindjee, University of Illinois at Urbana, Illinois; its first volume was published in 1994, and its 27th volume in 2007. Book reviews on almost all the volumes have appeared in *Current Science*, with a few

exceptions. Volumes 17 and 18 are a sequel to the previous volumes of the series. The uniqueness of these volumes is that both deal with plant respiration. We review here volume 17 that deals with the molecular aspects of plant mitochondrial function.

Mitochondria are designated as the powerhouse of the cell as they are the major producers of the energy-giving molecule, ATP. Mitochondria, that play a crucial role in many aspects of plant development and performance, are also the site of generation of reactive oxygen species (ROS) during environmental stress and have had a profound effect on the evolution of the nuclear genome. As stated in the website of volume 17 (<http://photoscience.la.asu.edu/photosyn/books/Day-Mitochondria-Bk.html>), 'the two main themes running through the book are the interconnection between gene regulation and protein function, and the integration of mitochondria with other components of plant cells'.

The introductory chapter provides an overview of the basic structure and function of plant mitochondria and gives sufficient background for the subsequent chapters. The second chapter deals with the morphology, dynamics and inheritance of the mitochondria. This chapter mainly focuses on the recent progress made in the understanding of control of plant mitochondrial dynamics. The effort taken by the author in listing all the known proteins involved in mitochondrial dynamics is appreciated. Chapters 3 and 4 deal with the targetting and import of nuclear encoded proteins to the plant mitochondria and the expression of plant mitochondrial genome respectively. How the mitochondrion regulates the nuclear gene expression through retrograde signalling is discussed in chapter 5. This chapter deals in detail about signalling in response to the various causes of mitochondrial dysfunction, followed by potential components of the signalling pathways. The next sections address the transfer of mitochondrial genes to the nucleus (chapter 6) and the consequences of mitochondrial mutations (chapter 7). Mitochondrial mutations are widespread in the plant kingdom. The first chapter in this section begins with the general introduction on plant mitochondrial genome followed by the chimeric genes associated with cytoplasmic male sterility. It then discusses other mitochondrial mutations like non-chromosomal stripe in

maize, maternally-inherited distorted leaf in *Arabidopsis* and mosaic in cucumber. The chapter ends with a discussion of recent progress on the interaction of nuclear and cytoplasmic genomes.

Chapter 8 deals with the characterization of mitochondrial proteome and the techniques used to characterize the plant mitochondrial proteome. The chapter is divided into two parts. The first part deals with the use of 2D-gel electrophoresis in systemic mapping of total mitochondrial proteins, mapping of proteins from sub-mitochondrial compartments, mapping of mitochondrial encoded proteins, comparative characterization of mitochondrial proteins in the mutant and wild-type plants, and analysis of the induction of mitochondrial proteins upon stress. The second part gives further insights into the mitochondrial proteome by the analyses of *Arabidopsis* mitochondrial proteome based on protein separation and systemic protein identification by mass spectrometry.

In addition to the basic cytochrome-mediated electron transfer chain, plant mitochondria contain two unique non-phosphorylating respiratory pathways. They are (i) alternative oxidase pathway and (ii) rotenone-insensitive NAD(P)H dehydrogenase pathway. Alternative respiratory pathways are important in the unusual thermogenic metabolism of some highly specialized flowers belonging to the family Araceae, and are reviewed in chapter 9 on alternative electron transport proteins. This is followed by the chapter on regulation of electron transport in the respiratory chain of plant mitochondria (chapter 10). This chapter deals with the understanding of phosphorylating and non-phosphorylating electron flow pathways and the H⁺ flux-linked processes in plant mitochondria.

Mitochondria contain a family of carrier proteins in the inner membrane that allow a continuous movement of the metabolites, nucleotides and cofactors across the inner envelope membrane. Chapter 11 on plant mitochondrial carriers overviews the basic structure of a carrier protein followed by the identification of different types of carriers by pre- and post-genomic evidence. Research done on the model plant *Arabidopsis*, where several genes have been identified, is thoroughly discussed in this book.

Chapter 12 deals with one-carbon transfer reactions (mediated by tetrahydrofolate), essential for the synthesis of

nucleic acids, protein biosynthesis in organelles, amino-acid metabolism, pantothenate biosynthesis and biogenesis of many methylated products. This chapter mainly focuses on the role of mitochondria in the biosynthesis of tetrahydrofolate and recent advances in the knowledge of C1 metabolism in plants.

The last two chapters deal with photorespiration (chapter 13) and the role of ROS and antioxidants in plant mitochondria (chapter 14). The chapter on photorespiration begins with the oxygenase reaction of rubisco (ribulose bis phosphate carboxylase/oxygenase) followed by a discussion of the photorespiratory cycle. Although mitochondria produce low amount of ROS compared to photosynthesis, they may play a crucial role in oxidative stress tolerance. The last chapter (14) of the book reviews the process and extent of ROS production by plant mitochondria. This chapter also reviews mitochondrial mechanisms like alternative oxidase and uncoupling proteins in protecting the organelle from oxidative damage.

Readers may find the complete listing of all the chapters in this book at the following website: <http://www.life.uiuc.edu/govindjee/References/Volume%2017%20By%20Chapter.htm>. Members of the International Society of Photosynthesis Research (<http://www.photosynthesis-research.org/>) receive 25% discount on the sale of all books *Advances in Photosynthesis and Respiration Series*.

Printed using high-quality paper, this book contains eight colour plates. The book is useful for postgraduates and those beginning researcher in the area of molecular and cellular biology, biochemistry, integrative biology, bioenergetics, proteomics, and plant and agricultural sciences. We recommend that all the major libraries purchase this book for their students as well as teachers.

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