Annual Review of Nuclear and Particle Science, 2009. Barry R. Holstein, Wick C. Haxton and Abolhassan Jawahery (eds). Annual Reviews, 4139 El Camino Way, P.O. Box 10139, Palo Alto, California, USA. Vol. 59. ix + 568 pp. Price: US$ 214.

The *Annual Review of Nuclear and Particle Science* is produced annually and is a useful handbook on the most recent advances in the field. The collection of 21 articles in the present volume is indeed at the frontier and at the intersection of several frontiers, those of theory, experiment and observation in the fields of elementary particle physics and cosmology. The collection also contains highly theoretical articles based on string theory, a popular candidate for the unification of all forces including gravitation, and on its recent attempts to make contact with disparate phenomena. While there are common threads that run through some of the articles, each in itself represents a landmark contribution summarizing the state of knowledge in the field that each of the articles purports to address. Besides being pedagogical and lucid, the articles also contain useful bibliographies which would allow the interested student and scholar to peruse the topic of his or her choice.

As is the tradition with the Annual Reviews, the opening articles are often of biographical or autobiographical nature of a scientific kind. These volumes often contain articles which pay tribute to the contributions of specific individuals, and indeed the present volume has such tributes to three neutrino pioneers, John Bahcall, Raymond Davis Jr and Yoji Totsuka. The first of these is 'The Scientific Life of John Bahcall' by Wick Haxton, the second 'The life of Raymond Davis Jr and the beginning of neutrino astronomy' by Kenneth Lande and finally 'Yoji Totsuka (1942–2008) and the discovery of neutrino mass' by Henry W. Sobel and Yoichiro Suzuki. Indeed, Bahcall and Davis together over four decades established the solar neutrino problem, while Totsuka pioneered the study of astrophysical neutrinos using large water detectors.

The neutrino itself is a particle that was first introduced by Wolfgang Pauli around 1930 to explain the continuous energy spectrum of emitted electrons in nuclear beta decay. It was given the name neutrino subsequently by Enrico Fermi. As discoveries took place, it was established that there are three types, electron, muon and τ-type neutrinos. Neutrinos are produced in copious quantities in the sun in reactions that power the sun take place. Nevertheless, due to their very tiny interaction cross-sections, terrestrial experiments to detect them required the construction of highly specialized detectors. Davis pioneered a radiochemical technique to detect them by looking for radioactive argon produced in neutrino-induced reactions on chlorine nuclei. Over decades of painstaking experimentation he established that there was a shortfall in the numbers of neutrinos reaching the earth, which crucially required accurate computations of the expected rates at the earth, which in turn were pioneered by Bahcall. Thus, the present volume honours the two pioneers of the solar neutrino problem.

It may be noted that while M. Koshiba who shared the 2002 Nobel prize with Davis started the first large water Kamiokande experiment, it was Yoji Totsuka who took the technique to significantly higher levels with the super-Kamiokande experiment but sadly succumbed recently to cancer. The great achievement of super-Kamiokande was to prove beyond doubt the phenomenon of neutrino oscillation from one type to another which in turn proved the existence of mass for these particles. Thus, the first signs of physics beyond the standard model were detected.

Of immediate interest is the article 'The Sudbury Neutrino Observatory' by Nick Jelley *et al.*, which reports the achievements of the eponymous observatory which definitely established neutrino oscillation by the use of heavy water targets as the solution of the solar neutrino problem. The article recalls touchingly the history of the project which can be traced to the work of Herbert Chen who proposed the experiment in 1984 and died within five years of leukemia.

Neutrino physics is of immediate relevance of astrophysics as already seen above and also to cosmology. Indeed, there is an open question of the existence of sterile neutrinos which will not show up in particle physics considerations, but could easily leave their imprint on cosmology and on the future of the Universe. This subject is reviewed in the article entitled 'The role of sterile neutrinos in cosmology and astrophysics' by Alexey Boyarsky *et al.*

There are many sources of information from cosmology, but precisely how does one derive conclusions from some observations. Andrew R. Liddle in 'Statistical methods for cosmological parameter selection' explains how this is done. In the context of cosmology, one of the abiding mysteries is the origin of high energy cosmic rays. This subject is reviewed in 'The highest-energy cosmic rays' by James J. Beatty and Stefan Westerhoff, while the scenarios for how such cosmic rays come about is reviewed in 'The physics of cosmic acceleration' by Robert R. Caldwell and Marc Kamionkowski.

Of the many problems facing cosmology, the observed homogeneity and isotropy of the microwave background radiation is one of the most notable. Some decades ago an inflationary epoch soon after the big bang was proposed as a solution to the problem, with origins in grand unified theories, linking the microscopic to the macroscopic. Decades later and many satellite and balloon-borne experiments later, with the establishment of Wilkinson Microwave Anisotropy Probe providing accurate information on the primordial density fluctuations which seeded structure formation, cosmology in turn poses challenges to elementary particle physics. Such a challenge has been confronted by string theory. In the present volume, the article 'Advances in inflation in string theory' by Daniel Baumann and Liam McAllister gives a status summary of the subject. The present volume also includes review articles on more specialized topics in string theory; 'D-Brane instantons in type II orientifolds' by Ralph Blumenhagen *et al.* Interesting applications of string theories based on its internal consistency include those to strong interactions, summarized in this volume in the article 'From gauge-string duality to strong interactions: a pedestrian's guide' by Steven S. Gubser and Andreas Karch.

While the standard model has assumed a hegemonic standing in elementary particle physics, there are several sectors of it which are continuously studied at higher precision both in theory and in effective field theories where conventional methods fail. What precisely does the standard model hold for simple bound states of the strong interactions such as

protons and pions, and the like? The article 'Hadronic atoms' by J. Gasser *et al.* addresses this issue. High precision experiments involving studies using high-intensity photon beams are also planned and their prospects are studied. The article 'Chiral dynamics in photopion physics: theory, experiment, and future studies at the HIγS facility' by Aron M. Bernstein *et al.* presents an update on this subject.

Other strongly interacting systems include those that have heavier quarks such as the c and b quarks. Indeed, the article 'Charmless hadronic B meson decays' by Hai-Yang Cheng and James G. Smith presents the state of the science in this field. 'B physics at tevatron' by Christoph Paus and Dmitri Tsybychev is a report on the vast discoveries carried out at the Tevatron.

Standing on its own is the report on the outstanding physics studied in Cornell University in the article 'Physics at the cornell electron storage ring' by Karl Berkelman and Edward H. Thorndike.

The field of elementary particle physics is at the moment poised at the crossroads with the discoveries of the Large Hadron Collider in the immediate future. This machine collides protons on protons to search for physics beyond the standard model, and also has a mode using ions of lead to replicate the conditions of the big bang. The articles 'Unanswered questions in the electroweak theory' by Chris Quigg and 'Radiative corrections for the LHC and the linear collider era' by Eric Laenen and Doreen Wackeroth are important and mandatory reading for any student of this subject.

Despite all the major successes of the theories, one may always wonder how well we know the laws of nature. Can one conceive of simple experiments that can challenge all the known laws? Can these laws be violated by small effects? Martin L. Perl *et al.* review 'Searches for fractionally charged particles' for which currently there is no experimental evidence, while Stefano Libreati and Luca Maccione review the status of 'Lorentz violation: motivation and new constraints', where the signals of such violation would imply that the special theory of relativity would require modification.

In summary, the collection of 21 articles in the volume captures the most central developments in the fields of nuclear and particle physics in the recent times, and is a valuable addition to every library.

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Annual Review of Cell and Developmental Biology, 2009. Randy Schekman, Larry Goldstein and Janet Rossant (eds). Annual Reviews, 4139 El Camino Way, P.O. Box 10139, Palo Alto, California, USA. Vol. 25. x + 732 pp. Price: US$ 234.

The *Annual Review of Cell and Developmental Biology* (ARCDB) recently published its silver jubilee volume. The series originally started as *Annual Review of Cell Biology* under the editorial leadership of George Palade, Bruce Alberts and James Spudich. Developmental biology was added to its title in 1995 due to multiple, now obvious reasons (see preface to volume 11 by James Spudich). The 25th volume of ARCDB contains 27 reviews that cover recent progress and current understanding of a wide range of areas in modern biology. The volume does not have an underlying theme; this is natural because cutting-edge research is indeed carried out simultaneously on several fronts.

In spite of the variety in the topics covered, several of the contributions fall under cell differentiation, morphogenesis and cancer, and lipids and membranes. Certain aspects of endocytosis, stem cells, small and piRNAs, and cell signalling are also reviewed. An article each on chromosomes, single cell quantitative time-lapse fluorescence microscopy and innovations in undergraduate biology teaching make the volume interesting to a wider readership.

The 'perspectives' chapter by Joe Ball is a fascinating and inspiring story of his long and continuing career as a biologist. He brings out the enjoyment of doing biology. He tells us how he discovered the technique of *in situ* hybridization of nucleic acids, now a work-horse of cell, molecular and developmental biology. I rather liked the way he brings out the fact that the choice of model systems depends on the questions one is trying to answer. A biologist, therefore, often ends up using several model systems in his or her career.

Small RNAs that silence genes at transcriptional and post-transcriptional levels have attracted attention in recent times because in addition to targeting viral genes and transgenes, they also regulate various developmental and physiological processes. X. Chen has written about the biogenesis and role of microRNAs, transacting RNAs and heterochromatic siRNAs in plant development. The role of argonaute proteins that bind miRNAs and siRNAs is discussed. The other phylogenetic group of argonaute proteins is the PIWI subfamily proteins that bind piRNAs. T. Thomson and H. Lin describe PIWI proteins and piRNAs that have been predominantly reported from *Drosophila*, zebrafish and mammals. These molecules play crucial roles in germline development and gametogenesis through regulation of such diverse aspects as epigenetics, transposon activity and DNA integrity.

The crucial roles of lipids in membranes and organelle biogenesis are addressed in several articles. SREBP (sterol regulatory element binding protein) transcription factors are regulators of genes necessary for synthesis and uptake of cholesterol and fatty acids in membrane biogenesis of mammalian cells. The diversity and supply of membrane lipids is regulated through cross-regulatory effects and negative feedback loops. As pointed out by A. Nohturfft and S. C. Zhang, most of our current knowledge in these areas is gained from mammalian and yeast cells. In addition to assembling lipids into membranes, the latter need to be properly shaped for optimum function. Using endoplasmic reticulum (ER) as an example, Y. Shibata and coauthors describe how wedging and scaffolding mechanisms for membrane deformation are employed by proteins, reticulons and DP1/Yop1p to shape ER tubules. The shaping of mitochondria and caveolae is believed to be achieved through similar mechanisms. It is not clear, however, how ultimately the individual characteristic shapes of ER, mitochondria and caveolae are attained. Chloroplasts appear to be excellent models to study lipid transport across membranes. C.