Because medicine deals with people and not disease, there are articles which revolve around areas that many of us do not know much about – and which are not taught in medical school. Some such examples include clinical trials, health care expenditure and reducing hospital readmission rates.

As the costs of healthcare spiral, with the USA leading this charge as well, calls are being heard to reduce the costs, but to maintain the quality of health care. Information technology can analyse data and trends better than could be done in the past. The increase in expenditure is due to increasing prosperity, private and public insurance players, defensive medicine, better technology – and because many previously untreatable diseases can now be addressed successfully by modern medicine. The increase in the incidence of diabetes and obesity has also added to this. Adherence to evidence-based guidelines in management has been shown to improve survival and response to medicine while increasing the quality of the outcome – and reducing the expenditure.

Clinical trials have of course been very much in the news in India for the past decade, for multiple reasons, ethical as well as commercial. The author, Shein-Chung Chow, does not of course discuss such issues; however, we are informed that advances in drug development have not kept pace with expenditure on research and trials. Among the fixes that have been suggested are to use 'adaptive clinical trials'. An adaptive trial is one that uses accumulating data to decide how to modify aspects of the trial as it continues without undermining the validity and integrity of the study. There are many ways of doing it – adaptive randomization design, adaptive group sequential design, flexible sample size re-estimation design, drop-the-losers design, adaptive dose-finding design, biomarker-adaptive design, adaptive treatment-switching design, adaptive hypothesis design (yes, this too!) and phase I/II (or phase III/IV) adaptive seamless design. The benefits of adaptive trials is that it allows the investigator to correct erroneous assumptions made before the trial, can help the investigator use information that may be available during the study (either from the same study or from other sources) and may reflect a real life situation in a clinical trial. The limitation, of course, is that great care must be taken not to unintentionally – or intentionally! – introduce bias into the study.

I have earlier referred to the chapter on retinoblastoma – which, to me, was the most fascinating one! Retinoblastoma is a unique cancer because it affects the eye/eyes of children and leads to blindness and often, subsequent death. Many of those who survive the cancer suffer from a second, non-ocular cancer. Though not very common, the fact that it is a paediatric cancer increases the poignancy of the disease; thus retinoblastoma has been the subject of an award winning Marathi movie a few years ago; users of Facebook would also remember that there appeared in 2010, an incident of a nurse who detected a 'cat's eye' appearance in the eyes of a friend's daughter on Facebook and alerted her (the mother) about the possibility of retinoblastoma. Abramson begins his essay with a brief account of the history of this disease, where we learn that enucleation of the eye was the first form of treatment offered in the early nineteenth century and that the 'pattern of advocacy for an unproven treatment criticized by contemporaries was to be repeated often during the next 200 years in the history of retinoblastoma treatment'.

Subsequently, in the early twentieth century, radiation – of different types – was employed as a means to control the disease. Systemic chemotherapy was advocated as a treatment in the second half of the twentieth century, but was soon abandoned because the side-effects were more harmful than the disease. However, the use of intraarterial chemotherapy – selective chemotherapy into the carotid artery on the side of the disease produced better results. The Japanese were among those who worked on this – because of religious reasons. The Japanese belief that removal of an eye prevented humans from proceeding to the next and more important phase of existence, meant that families would rather have a child die with a diseased eye than live with removal of an eye. Abramson's group has now initiated 'superselective infusion of chemotherapy' where the tip of the catheter is placed into the ophthalmic artery for introduction of the chemotherapeutic drug. This new form of treatment has eliminated the side effects of radiation as well as of systemic chemotherapy, preserved the eye and often produced a cure! The future for children with the misfortune of having a retinoblastoma – and for the parents – seems brighter and this made, for me, this essay the most inspiring chapter in the volume.

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Annual Review of Nuclear and Particle Science, 2014. Barry R. Holstein, Wick C. Haxton and Abolhassan Jawahery (eds). Annual Reviews, 4139 El Camino Way, P.O. Box 10139, Palo Alto, CA 94303-0139, USA. Vol. 64. vi + 416 pp. Price: US$ 96.

The present volume of the *Annual Review of Nuclear and Particle Science* is a collection of 16 articles on topics in Particle Physics and Field Theory and some topics on what has now come to be known as 'Beyond the Standard Model' physics. The articles are by the leading experts in the field and bear a magisterial stamp. One may even say that each of the articles is basically the last word on the subject at the time of the writing of the articles. Nevertheless, each of the topics is an active and growing subject, which requires a summation of the state of the art at various points in time, and the present collection is absolutely one such.

As is often the case, the series honours the lifetime achievement of an outstanding subject in the field, in the form of an article by an eminent person or as an article by the person himself or herself. In this volume, the reader is treated to an article by the Nobel Laureate James W. Cronin who was one of the discoverers of the phenomenon of CP violation (C stands for charge conjugation which relates the laws governing the interactions of particles with those that govern their anti-particle counterparts, and P stands for parity or mirror symmetry which governs the laws of physics in our world with that of a posited mirror world, and CP stands for their joint action on the laws of physics, the violation of which is not forbidden by the laws of relativity, but is today known to occur only in the physics of certain unstable particles known as mesons. On the other hand, this when combined with T, or time reversal to yield CPT must be conserved as a consequence of the special theory of relativity). Cronin has two distinct phases in his life, one between 1955–85 when he worked on particle

physics experiments and one after that when he moved to cosmic-ray research, which is not covered in the present article entitled 'A life in high-energy physics: Success beyond expectations' where he summarizes the first part. A child of the depression era, he describes with warmth the environment of learning in which he grew up. The author obtained his early education in Texas where his father had been a professor of classical languages and mentions that the schools had very high academic standards. After an education at the Southern Methodist University, Cronin moved to University of Chicago with an extraordinary faculty led by Enrico Fermi and mentions that perhaps he did not have enough background to grasp all that was being taught. After completing his thesis work that involved measuring some of the excited states of a carbon isotope, his early years involved participating in many experiments and eventually led to an appointment at Princeton University in 1958 as Assistant Professor, where he worked on the decays of baryons that contained the then newly discovered strange quark. Cronin learnt the use of spark chambers for the detection of polarization and then looked for new things to do. He then turned to the study of mesons that contained strange quarks (baryons, such as protons and neutrons contain three quarks, while mesons such as pions and kaons are made up of a quark and antiquark pair). It was at this time Cronin, with his later to be fellow Nobel Laureate Val Fitch, started to look into some anomalous events in the decays of neutral mesons. This was the celebrated discovery of CP violation in 1964, where some mesons which were not supposed to decay to a final state involving only two pions, actually did, every once in about a thousand instances.

After his discovery of CP violation, Cronin spent a sabbatical year at the Saclay laboratory in France to set up experiments to measure details of three-body kaon decays. These experiments were eventually and quickly superceded by more statistically accurate ones, but Cronin's year in France started a love affair for the country that lasted a lifetime. Upon returning to the United States, the author spent the next few years carrying out experiments to measure parameters related to the decay of the long lived neutral kaon to two neutral pions, before making a permanent shift to the University of Chicago as a tenured Professor of Physics in 1971. In the next section, the author talks about some of the important experiments he carried out at Fermilab, in particular those involving the parton model at high transverse momentum and those involving cross-section measurements of 'direct' muon production. Cronin proceeds to talk, with a dash of humour, about his experience in receiving the Nobel Prize in 1980, before concluding with a short discussion of his last experiment in the first phase of his life – a direct measurement of the neutral pion lifetime. Thereafter, he leaves high energy physics to work on cosmic rays, on which he works till date.

The article by Michael Moe on the first detection of double beta decay falls very much into the ambit of conventional nuclear physics, and talks about his fabulous quest to detect this rare decay. Early radioactivity due to beta decay had been established over several decades, and theory predicted a rare process by which two electrons would be emitted by an unstable nucleus to relax to a daughter that would differ from the mother by two charge units. The issue was to detect this unequivocally as the backgrounds due to other radioactive elements were to be enormous. Subtracting and eliminating these was a stupendous task. In this romantic story, Moe relates his travails, both the joys and the difficulties of the discovery.

Several articles pertain to the properties of hadrons: this is an important paradigm shift from nuclear physics into the domain of particle physics which is closest to nuclear physics both in terms of the particles studied and in terms of the methods. The article on 'Hadron polarizabilities' by Barry Holstein and Stefan Scherer is an important and detailed review article on the response of hadrons to the presence of electromagnetic fields, as in, e.g. Compton scattering. These polarizabilities encode the information due to the composite structure of the hadrons, such as the proton or neutron, and charged pions and kaons, and thereby provide a sensitive test of the effective field theories that describe these particles. A detailed tour is given on the experimental and theoretical information that is presently available. Johan Bijnens and Gerhard Ecker offer a detailed description of 'Mesonic low-energy constants' that arise in the effective theory of the strong interactions in the meson sector. This latter has been constructed over the last three decades, and has been rendered predictive by a massive effort to pin down the effective low-energy constants that has to be supplied from experimental information as well as from theoretical models for these. An accurate description of these also renders effective the study of the strong interaction on the lattice, into which several decades and millions of dollars have been pumped in. The study of the latter to the continuum from the discrete is an important and active field of research. Of great importance as far the study of the strong interaction sector is concerned, which provides inputs to the lattice and also provides a source of information on the strong coupling constant, is the bound state systems of heavy quarks such as the charm quark and bottom quark, leading to states denoted by various letters of the Greek alphabet. Eric Braaten and James Russ review 'J/ψ and Ψ polarization in hadronic production processes'.

The effective field theory paradigm is an important cornerstone of theoretical physics today, and if one is unable to directly say what lies beyond the standard model, all those effects may be 'integrated out' to replace the Standard Model's extensions by set of effective field theory, described by operators of 'higher dimension'. Effects of new physics would be felt only through indirect interactions and would affect the behaviour of Standard Model particles, by showing deviations from the behaviour dictated by the Standard Model itself. Scott Willenbrock and Cen Zhang review this field in the article 'Effective field theory beyond the standard model'. Eva Halkiadakis *et al.* on the other hand review the 'Status and implications of beyond-the-Standard-Model searches at the LHC'. It may be recalled that the last several years have been completely dominated by the physics flowing out of the enormous collider of over 27 km circumference running below the Franco-Swiss border at CERN, and has been in the news for its celebrated discovery of the Higgs boson, which led to the award of the Nobel prize to Peter Higgs and Francois Englert in 2013. At the enormous energies of the LHC, it is probable that particles that were too heavy to have been produced in earlier man made experiments, have been produced and have decayed since they would be immensely unstable, into Standard Model particles

which would be detected, or into other particles that may have evaded detection. Thus the LHC is the most probable place to see beyond the standard model particles, or their ghostly signatures in processes involving only standard model particles. Thus, the absence of any real signature would then translate into bounds on masses of hitherto undiscovered particles, or their couplings to known particles.

Prior to the discovery of the Higgs, and the tau-type neutrino, the last standard model particle to have been discovered was the top-quark at the Fermilab's Tevatron collider by the CDF and Dzero collaborations. It has also been studied in great detail now at the LHC, with the CMS and ATLAS collaborations gathering a large amount of data on the top-quark. Frederic Deliot *et al.* provide a detailed review on the 'Properties of the top quark' which is compulsory reading for any student of particle physics. In the quest to go beyond the standard model, one of the most popular avenues has been string theory. This theory purports to be the theory of everything and also advertises itself as a candidate for a quantum theory of gravitation, or at least one that would address the problems of conventional quantum theories of gravitation. A popular variant of this theory is given by 'TeV-Scale Strings' which has been reviewed by David Berenstein, where the phenomenological signatures of such a model are discussed in great detail. Of the many new ideas introduced by string theory, not the least significant are those introduced by Juan Maldacena, which in turn led to the work of Son *et al*. by applying such ideas to hydrodynamics and matter at high densities such as the quark gluon plasma, thereby predicting a bound on the ratio of the viscosity to the specific entropy to be a universal constant. Thomas Schaefer in his article 'Fluid dynamics and viscosity in strongly correlated fluids' reviews this fascinating field.

While it is widely known that the LHC is a proton–proton collider, it has an equally important role as a collider of very heavy ions, in particular to replicate on Earth the conditions that must have prevailed soon after the Big Bang. Edwin Norbeck (deceased) *et al.* in 'Hard-scattering results in heavy ion collisions at the LHC' provide a refreshing review of the results in this sector. None of these machines and experiments would have been possible but for the enormous advances made by accelerator physicists and engineers in the preceding decades, which render possible highly energetic as well as focused beams, without which event rates would have been abysmally low. Michael Blaskiewicz in 'Cooling of high-energy hadron beams' reviews the accomplishments and the challenges in this frontier area. Hasan S. Padamsee in 'Superconducting radio-frequency cavities' describes how without these no high energy physics experiments would have been possible.

Jens Erler *et al.* in 'Weak polarized electron scattering' explain how scattering polarized electrons provides an important probe of the weak interactions due to the intrinsic parity violating nature of the weak interactions. High precision experiments here may well provide us our first glimpse of physics beyond the standard model.

The existence of neutrinos was predicted by Wolfgang Pauli and were applied by Enrico Fermi to nuclear phenomena. Now, neutrino research has become a sensitive probe of the cosmos, because they are produced everywhere, in solar interiors and elsewhere. Such work has been made possible by completely mind boggling experiments defying human imagination. They are of gigantic scale and on far corners of the earth, if not deep beneath our feet. IceCube is one such, built in the clear ice of the South Pole, whose physics is described in an article by the same name by pioneers Thomas Gaisser and Francis Halzen. Takaki Kajita reviews 'The measurement of neutrino properties with atmospheric neutrinos' based on information coming from interactions of cosmic rays with the atmosphere.

To summarize, this volume is an outstanding collection of topical and authoritative articles on several subjects and represent the state of the art. No library would be complete without it.

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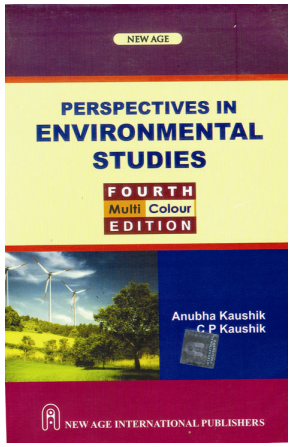

Perspectives in Environmental Studies, Fourth Multi Colour Edition. Anubha Kaushik and C. P. Kaushik. New Age International Publishers, 7/30A, Daryaganj, New Delhi 110 002. 2014. xviii + 357 pp. Price: Rs 200.

The fourth edition of *Perspectives in Environmental Studies* is the latest EVS guide book by Anubha Kaushik and C. P. Kaushik. Both authors are well versed in the subject and have, through this book, attempted to provide an overview of the host of environmental concepts that students need to understand. Given that these concepts are broad, multidisciplinary, fast growing and extremely active, the authors have attempted to provide a comprehensive overview without compromising on important details. The last 20 years have seen an overwhelming panoply of important discoveries and data in the field of environmental science. It is exceedingly difficult to keep up with current developments in these areas, let alone judge their long-term significance. Consequently, to bridge that gap, the authors have attempted to provide the most recent examples that will help a reader understand the gravity of some of the most significant global and local environmental issues that are currently a concern.

While covering a wide range of environmental concerns, the cause, impact and possible solutions for each issue have been clearly explained in a manner that gives the reader a clear understanding of the interconnectivity of development and sustainability. Each chapter is divided into sub-chapters for ease of understanding and throughout the book, for each sub-chapter, relevant examples and case studies have also been provided. Given that the book under review is