Annual Review of Nuclear and Particle Science, 2012. B. R. Holstein, W. C. Haxton and A. Jawahery (eds). Annual Reviews, 4139 El Camino Way, P.O. Box 10139, Palo Alto, California 94303-0139, USA. Vol. 62. 530 pp. Price: US$ 89.

The field of elementary particle physics is now in a precision era. The laws governing phenomena are now said to be understood and are being tested at precision and under extreme conditions, from the largest length scales to the smallest, at the highest energies and at the highest possible precision if at low energies. Indeed, at high energies the smallest length scales are probed. In particular, it is not uncommon to say that we are now in the Large Hadron Collider (LHC) era: the era in which highly energetic protons have been collided under precisely calibrated conditions and the products of their collisions gathered and analysed by several gigantic detectors. In addition, the LHC has also been used to collide heavy nuclei to try and replicate conditions of high temperatures and densities not known since possibly the time of the big bang. However, it is also possible to study the laws of elementary particle physics at high precision and low energies, where any deviations from known laws would manifest themselves. Often, the laws of cosmology are inter-related with the laws of elementary particle physics and a fertile cross-pollination between these fields has been possible. How does one apply the laws of elementary particle physics in extreme conditions and in astrophysical objects? Are the laws predictive and amenable to modelling in such extreme environments? How does one go beyond the known laws to rich theoretical scenarios? The present collection, while dealing with elementary particle physics as the main course, also presents some side dishes that address such exotica.

Of the 19 articles in this excellent collection, the article entitled 'Hard processes in proton–proton collisions at the Large Hadron Collider' by Butterworth *et al.*, as the title suggests is directly involved with the physics at the LHC. The authors provide an elegant introduction to the fundamental collision processes through which we have, and are, learning physics at the LHC.

In the article entitled 'The underlying event in hadronic collisions', by Field, the author begins by describing the studies of the so-called underlying events at what can be considered the precursor to the LHC, which is the now shutdown Tevatron at Fermilab, USA. The author also reviews underlying events studied already at the LHC. It would, of course, be a truism to say that science is not what it used to be: inferences of the laws of physics are indirect and highly computational. In the environment of the LHC, for instance, enormous amounts of data are collected and processed and compared with predictions of known laws. Such a comparison would not be possible without detailed computer simulations of the phenomena, for which one needs event simulators.

In the article entitled 'Next-to-leading-order event generators' by Nason and Webber, an elegant introduction is provided for some of the most up-to-date event generators, including the theory of the event simulators MC@NLO and POWHEG.

It may again be worth recalling that although most of the imagination of the public has been captured by the proton–proton collisions at the LHC and the results coming from them, the LHC is a versatile machine that can also be used to collide nuclei with nuclei.

In the article entitled 'First results from Pb + Pb collisions at the LHC' by Muller *et al.*, the data from the first year of the run at the LHC of what are effectively ultra-relativistic heavy-ion collisions are reviewed, where the three detectors ALICE (A Large Ion Collider Experiment), CMS (Compact Muon Solenoid) and ATLAS (A Toroidal LHC Apparatus) have been used. As the LHC era has entered its morning and will soon flourish, and eventually move towards its dusk, what of the future? Will there be experiments to succeed the LHC? An important proposal to probe the LHC results at high precision is one that will use electrons and positrons for collisions. A generation of physicists has already worked on an idea that has led to a proposal known as the International Linear Collider. An alternative proposal to reach higher energies based on alternative technologies has come to be known as the CLIC (Compact Linear Collider). The prospects of this are reviewed in the article entitled 'The CLIC study of a multi-TeV linear collider' by Delahaye.

While the physics at the energy frontier has been popular in the media, scientists have been working hard trying to make sense of laws that have already been established. That is to say, in the field of elementary particle physics, one knows the laws governing the behaviour of the microscopic degrees of freedom, such as electrons and their neutrinos (and the corresponding heavier cousins) that participate in the electromagnetic and weak interactions with photons and W and Z bosons being the force carriers, and quarks and gluons, the latter being the force carriers of the strong interactions (note that quarks participate in the electromagnetic and weak interactions as well). However, the collective properties of strongly interacting matter, namely the hadrons (baryons such as protons and neutrons, and mesons such as the pions and kaons) have not been derived ab initio. In the article entitled 'Twenty-first century lattice gauge theory: Results from the quantum chromodynamics Lagrangian', Kronfeld reviews the progress made in solving the strong interactions on the computer using lattice gauge theory. The subject has been formulated several decades ago, but significant roadblocks have existed due to the limitations of computer speeds and memory. However, improvements of hardware and giant strides in design of algorithms have allowed workers to make great progress. Kronfeld presents some of the recent results in this field in some detail. In the article entitled 'Puzzles in hadronic physics and novel quantum chromodynamics phenomenology' by Brodsky *et al.*, a list of outstanding experimental puzzles in the physics of strongly interacting problems is presented and described. These include decays of certain particles at unexpected rates and into unexpected daughters, and problems even as straightforward as the measurement of the radius of the proton. In general, many of the problems are associated with the complex environment in which the strongly interacting matter resides and hence the difficulty in extracting clean results. The authors also review important developments that have fed into the subject from unexpected connections with developments in esoteric subjects such as string theory. On a more traditional note, in the article entitled 'Chiral dynamics of few- and many-nucleon systems' by Epelbaum and Meissner, the authors describe the power of the chiral symmetry present in the strong interaction sector under certain approxima-

tions. Exploiting these symmetries allows us to gain insights into as complex phenomena as nuclear forces. Studies that involve lattice methods have enriched our understanding of the subject. Scattering experiments have been, and will always be, a way in which one can probe the properties of matter. While it is known that there are no valence strange quarks in the proton, the question of the strange sea has always been a subject of great interest. In the article entitled 'Parity-violating electron scattering and the electric and magnetic strange form factors of the nucleon' by Armstrong and Mckeown, the status of these measurements at a variety of experiments is reviewed.

In general, while it is possible to think about the consequences of our understanding of the microscopic laws of nature and to test them in detail, it is also a truism that the same laws apply to celestial bodies. In the article entitled 'The nuclear equation of state and neutron star masses' by Lattimer, the author takes the reader through a grand tour of neutron stars and on improvements in the nuclear state of matter. Improvements have been spurred by detailed theoretical studies as well as by observational data on radii and masses of neutron stars.

While on the subject of celestial bodies, especially those where matter is subjected to extreme conditions due to the forces acting on the medium that constitutes the matter, one may ask where our knowledge of other celestial bodies meets significant challenges. The article entitled 'Explosion mechanisms of core-collapse supernovae' by Janka, reviews the status of supernova theory and recent advances in the role of many competing factors that constitute our understanding. While there has been progress, the author also warns that many issues are not settled yet. The role of neutrinos in supernova explosions has now been established as being of central importance. In particular, the detection of the neutrino burst from SN1987A signalled the birth of the subject of neutrino astrophysics, which has grown in popularity.

In the article entitled 'Supernova neutrino detection' Scholberg reviews the theory of supernova neutrino detection and also describes the various important experiments and the principles of these experiments. A new era of precision supernova neutrino detection is in the offing. How much do we know about neutrino properties? Suffice it to say that we need to know a lot more. In particular, to date we know only the mass difference between neutrinos that have arisen from solar neutrino and atmospheric neutrino data.

In the article entitled 'Neutrino masses from the top down', Langacker reviews the theory of neutrino masses and how we could try and think of these as arising from some larger, richer theory, such as even string theory or other competing extensions of the standard model of elementary particle interactions. In the article entitled 'Results from the Borexino solar neutrino experiment' by Calaprice *et al.*, measurements of solar neutrino fluxes associated with low-energy neutrinos at an experiment in Italy are reviewed. Interestingly, the experiment has also measured fluxes of geoneutrinos that are in accordance with the paradigm that the interior of the Earth is consistent with a bulk silicate composition.

Thus far, we have been occupied with matter at extreme conditions or high energies. However, even at low energies, at high precision one can probe the possibility of uncovering deviations from known laws of nature. One could also contend with the intrinsic quantum mechanical nature of phenomena. One of the most important benchmarks of this is the so-called Casimir effect due to the zero-point energy of vacuum. This leads to forces between uncharged metallic plates in vacuum. In the article entitled 'The Casimir force and related effects: The status of the finite temperature correction and limits on new long-range forces' Lamoreaux, the status of measurements as well as the finite temperature corrections are reviewed.

How about fundamental properties of elementary particles? In particular, something as simple to describe as the anomalous magnetic moment of the electron and its heavier counterpart the muon have been important laboratories to test the laws of nature. In the article entitled 'Electron spin and its history' by Commins, the reader is presented with a fascinating account of just that. A closely related article is the one entitled 'Muon (g-2): experiment and theory' by Miller *et al.*, which remains one of the important places where there is discrepancy between theory and experiment. In particular, the Brookhaven experiment that concluded some years ago, has provided one of the sharpest measurements of any basic property of an elementary particle, which is that of the anomalous magnetic moment of the muon.

Two stand-alone articles are made available to the reader in this outstanding collection: 'M-theory and maximally supersymmetric gauge theories' by Lambert, takes the reader through a tour of an emerging candidate for a theory of everything, while 'Backreaction in late-time cosmology' by Buchert and Rasanen, provides an introduction to an unconventional extension of cosmology.

In conclusion, this collection of 19 articles is outstanding, one, a great pleasure to read and an encyclopaedic reference as well as a treasurehouse for a bibliography on the subjects covered. A must for any library.

ACKNOWLEDGEMENT. I thank Shayan Ghosh for comments and a careful reading.

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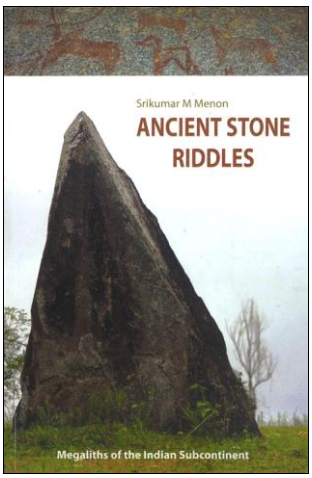

Ancient Stone Riddles – Megaliths of the Indian Subcontinent. Srikumar M. Menon. Manipal University Press, Manipal Centre for European Studies, Manipal 576 104, 2012. x + 100 pp. Price: Rs 185.

This short book describes megaliths found at various sites in India, particularly in Karnataka and Kerala. Within its brief extent the book includes a discussion on the possible origin and meaning of these fascinating structures, their spread in the subcontinent, the culture of