electrodynamics is taken up. With great ease and clarity the author sets up these and introduces the Lorentz transformation, the keystone for the rise of the theory of relativity and describes the solutions of the Dirac equation which are the relativistic equations that describe half-integral spin objects. The author goes on to describe photons, the quanta of spin-1 (vector) fields which couple of electrons to give rise to electrodynamics. The full quantum theory was later developed and studied by Richard Feynman, Julian Schwinger, Sin-Itiro Tomonaga and also Freeman Dyson. The upshot of all the theory is that it gives a framework for the computation of what physicists measure in experiments such as collision 'cross-sections' and decay lifetimes.

An important organizing principle which reproduced quantum electrodynamics is known as a gauge principle, which was first introduced by Hermann Weyl. The vector fields naturally arise when one demands an invariance under symmetry operations of a quantity known as the Lagrangian that is written in terms of the fields of which the particles are the quanta. The Lagrangian is associated with kinetic and potential energies of the system, and describes the content of the physical system. Electrodynamics arises when the symmetry is a simple commutative (Abelian) rotation in an internal space. The weak interactions can be introduced if a more complicated 'non-Abelian' rotation based on mathematical structures known as special unitary groups is postulated, and so can the strong interactions. For the weak interactions, this does not account for why its force carriers become massive. That can happen when a suitable condensate forms in the vacuum. The original Higgs mechanism that was set up for the simple rotation can be suitably generalized for the case of non-Abelian rotations. Chapter 3 concerns itself with all these phenomena and provides a highly accessible but sufficiently detailed introduction to all the ideas that are needed.

In chapter 4, the author turns his attention to matter that is made up of quarks (and anti-quarks) and gluons. He introduces in a very physical manner some of the deep properties of field theories, including that of 'renormalization' due to which even the strength of the interaction changes as the distance scale that is probed is changed. This is at the heart of the strong interactions, which the author introduces with great ease. In chapter 5, the author goes on to the principles of detectors and measurements, covering such diverse topics as experiments to detect the as yet unseen dark matter. Esoteric topics such as the observation of 'jets' of strongly interacting particles that are omnipresent in experiments such as in the Large Hadron Collider are discussed.

A particularly commendable chapter is chapter 6 on neutrino properties and measurements of the mixing in the quark sector (named after Cabibbo, Kobayashi and Maskawa) – although these are well known in seminar circuits, they have rarely made it to textbooks. The treatment of the masses and mixings of neutrinos, and of the mixing of the quarks is a highly accessible introduction and is useful also to the practitioner. Notions such as the 'unitarity triangle' which tests the consistency of models of mixing are elegantly described.

In chapters 7 and 8, the author turns to collider physics at electron–positron machines and hadron colliders, and discusses at length important technical topics associated with exotic particles such as the W bosons, τ leptons and top quarks, to name a few. Electron–positron colliders have been successful in the past, including the famous Large Electron Positron (LEP) collider at CERN, and the Stanford Linear Collider in USA, which have studied the properties of the neutral weak force carrier, the Z boson, and the charged ones, namely the W bosons. Properties of the exotic τ lepton have also been studied in this environment. There is now worldwide interest in a high-energy counterpart of these for the future, known as the International Linear Collider project, which is now at an advanced stage of consideration for sanction and construction. Hadron colliders, the topic of chapter 8 on the other hand, can reach much higher energies than the electron–positron counterparts, since the synchrotron losses are much smaller. On the other hand, since hadrons are composite objects, the actual energy available for a given collision is degraded since the momentum is distributed among the constituents. Furthermore, the initial state is not a 'clean' one, as the ubiquitous strong interactions cannot be switched-off. These introduce important complications which need to be understood. The author provides a thorough discussion of the necessary background needed in the chapter. In chapter 9, there is a round-up on Higgs physics up to the present and in future experiments. For instance, the important limits obtained from the LEP experiment are discussed in some detail, the mechanisms for the production at electron–positron and hadron colliders compared, and many details on the experimental aspects are provided.

In summary, the book is a valuable and important addition to libraries, personal and institutional. It would serve as an excellent textbook to students taking up research in elementary particle physics and also as a reference volume. It has useful exercises and references. It is my hope that in the coming years, as the Large Hadron Collider sheds light on the high-energy frontier, the author would update the book and bring out a future edition.

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Annual Review of Physical Chemistry, 2011. S. R. Leone *et al.* (eds). Annual Reviews, 4139 El Camino Way, P.O. Box 10139, Palo Alto, California 94303-0139, USA. Vol. 62. xii + 681 pp. Price: US$ 86.

The *Annual Review of Physical Chemistry* has remained an important source for authoritative and critical reviews on various topics in physical chemistry for over six decades. I have personally been a beneficiary of excellent reviews on topics in and beyond my areas of research interest. I vividly remember the excellent reviews by H. S. Johnston on atmospheric chemistry in volumes 35 and 43, and reading these made me an 'expert' in atmospheric chemistry giving popular talks in many places. I have, of course, never worked on atmospheric chemistry myself. Every time my students ask for topics to give literature seminars which have to be outside their research areas, I tell them to go through the last few volumes of *Annual Review of Physical*

Chemistry. When this journal offered to give me a personal copy of volume 62 for reviewing, I could not refuse, despite having committed to many other things. Atmospheric chemistry is featured in this volume as well. Seakins and Blitz review the developments in laboratory studies of gas-phase reactions for atmospheric chemistry. Leopold reviews hydrated acid clusters aimed towards molecular level understanding of acid–water interactions and also points out their relevance to atmospheric chemistry. Did I hear from someone that gas-phase studies have no relevance anymore?

The 62nd volume is a true reflection of where physical chemistry is today and the focus is on complex systems, from biology to materials science. As is typical of the *Annual Reviews*, this issue begins with the memoir by an eminent physical chemist. Benjamin Widom (Cornell University) starts the issue recollecting his 'laboring in the vineyard of physical chemistry' for over six decades. While it is fashionable 'jumping on the band wagon' to do something new and improved, Widom's account shows the importance of understanding the basics: thermodynamics, kinetics and statistical mechanics. It is interesting to note that the issue with some focus on complex systems has about one-third of the articles discussing simple molecules and clusters. Indeed, the devil is in the details. The second article by Deb and Weber discusses our current understanding of photon-induced electrocyclic ring-opening pathways, with 1,3-cyclohexadiene as a test case. Deb and Weber describe this reaction detailing every step in femtosecond timescale alluding to the importance of conical intersections, which result from actual degeneracies between electronic states. These are ubiquitous in excited-state reactions. The importance of conical intersections cannot be overemphasized. They provide radiationless decay pathways in the building blocks of DNA and protein, leading to their photostability. A newspaper reporter can give a catchy title: 'Without conical intersections there is no life'. Somewhat coincidentally, the second-last article in this issue is devoted to conical intersections. Matsika and Krause review the state of the art in conical intersections.

Theory and experiment are indeed like the two wheels that drive physical chemistry. Without either of them, it would be difficult to have meaningful progress. While every article discusses theoretical and experimental work, about one-third has its main focus on theory. Three of the articles discuss advances in coarse-grained (multi-scale) models, which are indeed important for complex systems. The review by Kamerlin *et al.* focuses on the technical developments pointing to protein folding as one of the key motivations for development. Chen *et al.* focus on protein-folding studies, while de Pablo describes studies aimed at DNA and other polymer nanocomposites. Even the memoir by the eminent theoretician Widom, includes the brief experimental work carried out by his group on measurement of interfacial tensions. Kassal *et al.* review the developments in simulating chemistry using quantum computers, which really have their origin in physical chemistry.

The review on 'Roaming radicals' by Bowman and Shepler is an excellent example of the interplay between theory and experiment. This new pathway for a chemical reaction, which challenges the conventional and enormously successful transition state theory, could be conceived recently through the joint efforts of an experimental group (Arthur Suits) and a theoretical group (Joel Bowman). The first paper on roaming radical mechanism in formaldehyde decomposition was published in *Science*[1] in 2004. It is interesting to note that the original experimental observation of this alternate pathway for formaldehyde decomposition was made by Moore's group in 1993, though at that time it was not clear how this alternate channel worked[2]. Now there are several reactions for which a roaming pathway has been observed, including in shock-tube experiments that provided an indirect evidence for a roaming pathway in acetaldehyde decomposition[3]. Incidentally, the two reviews on shock-tube techniques in chemical kinetics published in volumes 41 (Tsang and Lifshitz) and 44 (Michael and Lim) were indeed quite useful when we started building a shock-tube laboratory. Shock waves are still widely in use as they offer a unique method of producing high temperature and pressure without a wall. In this volume, Dana Dlott reviews the new developments in the physical chemistry of shock compression. His review focuses on shock propagation in condensed media. Among other things, it discusses the use of femtosecond lasers to generate a shock wave and also the generation of terahertz radiation by shock compression of a dielectric crystalline solid (NaCl).

While Klemperer reviews astronomical chemistry, Simons reviews theoretical studies on negative molecular ions. Only recently, negative ions have been found in the interstellar space. Klemperer's review points out the importance of rotational spectroscopy and radio-astronomy in detecting polar molecules in interstellar space. It is interesting to find that HCN and HNC are equally abundant in interstellar space, though HNC is not present in the earth. More interestingly, CO is the second most abundant molecule after H_2, though the equilibrium constant for the $CO + 3H_2 \leftrightarrow CH_4 + H_2O$ is 10^{400} at 20 K. As Klemperer points out, this implies that there should be less than 1 molecule of CO in the observable universe. Chemical kinetics is indeed the key. Simons discusses the challenges posed by anions to theory. His review also gives links to the websites of practising theoretical chemists working on anions, which should prove useful to others working in this area.

Richert reviews work on nanoconfined super-cooled liquids and Castner Jr *et al.* review recent work on ionic liquids. Thompson reviews solvation dynamics and proton transfer in nanoconfined liquids. The most common and perhaps not as well understood liquid, water, features in the review of Laage *et al.* The reorientation dynamics of a water molecule influenced by the dynamic hydrogen bond network is discussed in this review. Indeed, much of the useful criteria for detecting the hydrogen bond today are based on dynamics. As is well known, H_2O is a liquid and H_2S is a gas at ambient conditions, though H_2S is heavier of the two. It is also well known that the vapour pressure decreases with molecular size in general. These observations led to the belief that intermolecular interaction in water is dominated by 'hydrogen bonding', and that in H_2S is dominated by 'van der Waals forces'. No one knew the physical origin of these two different intermolecular interactions. We have recently shown that there is indeed no difference in physical forces between the two, and the main difference between H_2O and H_2S is the barrier for torsional motions in comparison to the zero point energy along torsional coordinates[4].

I was fascinated to find something similar in metal clusters in the review on

beryllium clusters by Heaven, Merrit and Bondybey. They point out that the binding energy for Be_2 is 930 cm^{-1} and that for the heavier Mg_2 is less than half at 430 cm^{-1}. These can be compared to the covalently bound Li_2 having binding energy of 8517 cm^{-1}, and the van der Waals dimer Ne_2 with a binding energy of 29 cm^{-1}. More interestingly, the optimum internuclear distance in Be_2 (2.54 Å) is shorter than that found in Li_2 (2.67 Å). Of course, chemists do not worry much about metal clusters, and if not, a 'beryllium bond' may have been defined to highlight the uniqueness in its interaction in comparison to magnesium (van der Waals) and lithium (covalent). The internuclear distance in Ne_2 and Mg_2 is closer to the sum of their van der Waals radii. Aguado and Farrold discuss melting and freezing of metal clusters. Another fascinating fact from their review: The melting point of Au clusters (Au_n) decreases with the size and it could be liquid-like if n is small. Indeed, there are molecular clusters which behave either like liquid or solid, and benzene clusters are a good example. Theoretical predictions of their behaviour is probably still in its infancy.

Multidimensional spectroscopy has been developed in all spectral ranges beyond the traditional radiofrequency NMR spectroscopy. Wright reviews the recent progress in multiresonant coherent multidimensional spectroscopy. Min *et al.* review imaging techniques based on coherent, nonlinear optical spectroscopy. He and Marguet outline results from fluorescence correlation spectroscopy used to detect nanodomains in living cell membrane. Digman and Gratton review 'lessons in fluctuation correlation spectroscopy'. While these reviews are about the ever-expanding advances in analytical and spectroscopic techniques, Sanchez-Ruiz discusses the importance of the 'classical' differential scanning calorimetry in probing free-energy surfaces. Molecular biophysics is an important area in physical chemistry today and nearly half the articles in this volume are related to this area. In particular, amyloid fibrils which are involved in neurodegenerative and other diseases are the focus of two reviews. Tycko reviews the solid-state NMR studies on their structure, and Straub and Thirumalai review a molecular theory of their formation.

Each of the reviews ends with useful summary points and future issues. The 30 reviews collected in this volume point to the wide-ranging interests in physical chemistry today. Chemistry is considered the molecular science and clearly physical chemistry is concerned with molecular-level understanding of nature. Whether it is the abundance of CO in the universe, or the molecular theory of amyloid fibril formation, this volume covers it. Indeed, this volume should be in the library of every academic institution involved in teaching and research.

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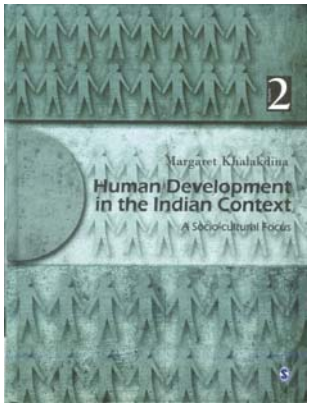

Human Development in the Indian Context: A Socio-Cultural Focus, Vol. II. Margaret Khalakdina, New Delhi, Sage Publications India Pvt Ltd, B1/I-1, Mohan Cooperative Industrial Area, Mathura Road, New Delhi 110 044. 2011. xxxv + 402 pp. Price: Rs 795.

In this book, the author presents the concept of socialization in alternative paradigms. She writes based on an extensive literature review from various disciplines and presents the material in an exclusive yet cohesive manner. The perception of inherent processes from alternative paradigms gives a completely new view and brings to fore issues so far subliminal and concealed.

The process of socialization in the final analysis moves toward an understanding of self and identity. This in turn leads to further vicissitudes in the psychological, economic, social, demographic, political and other fields of human relevance. The author places the emphasis thus on the process of socialization which occurs right from the neonatal stage. The spiritual and cultural values imprint in the social values acquired and these in turn influence other actions as well as are influenced by cognitive, environmental and psychological factors.

Other important impacts are through the processes of globalization and technological advances which have led to and are leading to several key changes in family structure and perceptions of awareness of the self. With the tremendous changes taking place in social structures, in family, relationships and other social institutions like marriage, it is only natural that the traditional processes of socialization undergo changes and bring fundamental shifts in the way people acculturate themselves. Acculturation, assimilation, amalgamation, integration, adaptation and various other mechanisms are intricately braided into the socialization process. The author traces these and many other influences on the socialization process and overall human development, especially with reference to the Indian context.

The initial chapters set the tone for the keener aspects of the process of socialization, the key players and the interactions between them and the dominating features influencing an individual throughout his/her lifetime. In the first chapter the anthropological derivations of the socialization process and the validity of trying to find similarities among societies in the framework of changing emphasis on socialization concepts are discussed. In the Indian setting various factors such as caste, ethnicity, religion, education, occupation, etc. impact the socializer. The interactive process in socialization regarding the individual and mature adult underlines the cognitive reconstruction of the socio-emotional environment monitored by innate phylogenetic characteristics and epigenetic rules of internal motivation. This modifies constructs of the received messages according to the verbal and nonverbal