throughout the book and make for an interesting read.

Not surprisingly, a good part of the book deals with famous names like Black, Priestley, Proust, Lavoisier, Dalton, Avogadro and others, which are familiar to high-school students. How appropriate that the textbook of chemistry by the Frenchmen Lavoisier contains the chemical process involved in the fermentation of grapes! I did not know that in 1813, Davy, 'discoverer of Faraday', had scientific immunity which allowed him to visit France despite the Napoleonic wars. Seems like the early 19th century displayed more enlightened times compared to the current visa practices for scientific visits. The last forty pages of the book provide a quick tour of the developments in organic chemistry and physical chemistry. Starting with Wöhler's synthesis of urea, Liebig's contributions to analytical organic chemistry, and ideas of a molecular structure due to Kekule, van't Hoff and Le Bel, one gets a good glimpse of the foundations of modern chemistry. It is of course entirely appropriate that several pages of the book are devoted to the work by Berzelius, Meyer and Mendeleev that led to the formulation of the periodic table. I must, however, point out that the author's statement that Lothar Meyer and Mendeleev simultaneously proposed the periodic table is not very accurate (see, Gordin, M. on periodicity, priority, pedagogy: Mendeleev and Lothar Meyer, at http://osulibrary.oregonstate.edu/specialcollections/events/2007paulingconference). At the same time I am glad that the author has wisely chosen not to go into the details of priority in a book of this nature. There is also a plausible connection between Mendeleev's usage of the *eka*, *dvi* and *tri* suffixes to the then unknown elements and sanskrit grammar. An interesting account is given by Subhash Kak, which can be found at the Los Alamos preprint server (http://uk.arxiv.org/abs/physics/0411080).

The development of physical chemistry due to Wilhelmy, Arrhenius, Ostwald, Clausius, Nernst, Gibbs and Boltzmann among others, has been described in a succinct fashion. However, certain facts, perhaps in the interest of space, have not been mentioned. For example, Ostwald is credited with the introduction of the mole concept and Arrhenius had studied the greenhouse effect due to CO_2 gas as early as 1896! The last part of the book deals with the creation of quantum mechanics, radioactivity, Pauli's exclusion principle, bonding and spectroscopy. The last few pages provide a glimpse of the relatively recent work on buckminsterfullerene (unaware that Smalley died in 2005), scanning tunnelling microscope and femtosecond spectroscopy. It would only be fitting, in my opinion, to show the vitamin B12 structure, since it is an example of the most complex natural compound synthesized in the laboratory and a tribute to the wizardry of Woodward.

There are a few points that could lead to an improvement of the book. For example, I was surprised that the Avogadro number was not shown while discussing Avogadro's work. The blurb about Arrhenius is misplaced by several pages. The figure of Berzelius is also on the wrong page. The picture of Max Born is shown but his name is not mentioned! The author states that C. V. Raman studied the phenomenon of Raman spectroscopy – an unfortunate choice of the word. Raman discovered the phenomenon and got the Nobel prize (not mentioned). In the description of the Maxwell–Boltzmann velocity distribution, it is perhaps apt to mention that Miller and Kusch provided experimental verification in 1955. Infrared and ultraviolet spectroscopies, which have their own applications, have not even been mentioned. There are also typographical errors that need to be corrected – Schrödinger seems to have died in 9161!

Certain features of the book are particularly troubling to me and I will also mention a few glaring mistakes. It was disturbing to see that the names of Emil Fischer and Alfred Werner are nowhere to be found in the book. There is little doubt that the pioneering works by both should have appeared with those of van't Hoff, Kekule and Le Bel. The absence of Fritz Haber, pioneer of ammonia synthesis and motivator for the recent Nobel Prize-winner Gerhard Ertl, is equally surprising. Along the same lines, there is no mention of the names associated with the development of transition state theory – Eyring, Wigner, Polanyi and others. After all, the great triumph of Zewail's femtochemistry experiments had to do with observing the elusive transition state. Transition state theory is a cornerstone of chemistry and a look at the Faraday discussions of 1938 will convince anyone of the intense activity that led to its formulation. Similarly, in the part on bonding and quantum chemistry, there is no mention of Heitler and London. This, in my opinion, is unfortunate since their names should be mentioned along with those of Hund, Mulliken, Hartree and Fock. Indeed Pauling and Wilson in their celebrated book state that the work by Heitler and London is the greatest single contribution to the chemist's conception of valence. One cannot help but think if there were any chemists of Indian origin who made significant contributions. The name P. C. Ray immediately comes to my mind, but the book does not mention about him.

There are also other errors that need to be corrected. The second law of Clausius is stated as 'entropy tends to a maximum', whereas it is the entropy of the universe that tends to a maximum. A statement like 'much of kinetic theory of gases followed from statistical thermodynamics' is misleading. The field of kinetic theory of gases started much before, with Daniel Bernoulli (1738) being one of the chief architects. Extreme care should be taken to make sure that such erroneous statements do not appear in a scientific book (popular or technical). Despite the criticisms made above, I did enjoy reading the book and hope that the high-school students would read it as well. A lot of effort must have gone into writing and providing illustrations for the book. Perhaps the next version would take care of some of the shortcomings and become a must-read for all students of chemistry.

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Annual Review of Physiology, 2007. D. Julius (ed.), Annual Reviews Inc, 4139 El Camino Way, P.O. Box 10139, Palo Alto, California 94303, USA. vol. 69. 591 pp. Price not mentioned.

For a membrane biologist, the 2007 *Annual Reviews of Physiology* is bound to become a classic – so go and get your copy today. This is the last volume organized by David Garbers, who died in September 2006. It forms a fitting tribute with excellent reviews covering a variety of transporters, respiratory physiology and hypoxia responses, and introduces the spe-

cial topic of β-arrestins. Starting with a 'Perspective' by Clay Armstrong, the volume goes on to present mitochondrial transporters, transport of iron and the sensing of oxygen, signalling through steroid hormone receptors, retinal circuitry and an overview of central pattern generators, with stops on the way for renal and respiratory physiology.

Armstrong presents a personal overview of ion-channel physiology from Hodgkin and Huxley through the cloning era to the present post-structural era. His insightful analysis of data from the pre-cloning and (more recently) pre-crystal structure days, together with his prescient speculations along with Pancho Bezanilla and Eduardo Rojas, are models of how much information can be abstracted from rigorously collected data. It will also rekindle a debate about the choice of the Nobel Committee in 2003.

Mitochondrial ion transport is as much subject to fashion as hem lines. Currently, they are IN, and two reviews in this volume highlight transporters in both inner and outer membranes, and their involvement in both physiological and pathological states of the mitochondrion. Part of the reason for the renewed interest is the role of mitochondria in cell-death processes. The review by Brian O'Rourke is particularly comprehensive, with a detailed discussion of the so-called mitochondrial permeability transition pore complex. The reviews do not weigh in strongly on either side of the controversies of transporter involvement in apoptotic processes, but do present a background on their normal physiological activity.

The sections on hypoxia tolerance are quite illuminating, especially to the non-specialist. The mechanisms by which cell and tissue damage by reactive oxygen species are ameliorated are described – mainly by metabolic suppression and tolerance to metabolite accumulation, coupled with free-radical scavenging mechanisms. It reminds us that the appearance of atmospheric oxygen presented an opportunity for the evolution of complex physiological and biochemical processes, but was a two-edged sword creating also the necessity of dealing with the toxicity of oxygen and its reaction products. The remarkable ability of some turtles and fish to survive for long periods without oxygen is sketched, indicating vistas still to be explored. Recent reports of emperor penguins diving for over 20 min and surfacing with even lower partial oxygen pressures than have been reported for turtles, demonstrate that there are insights still to be gained from looking at yet more organisms.

By far, the most provocative review is one by DeFelice and Goswami, putting forward the heretical notion that some transporters can also function as channels under specific circumstances. The dogma is that these two modes of transporting polar solutes across membranes have distinct mechanisms of action. Channels stabilize a column of water across the membrane through which ions like Na^+ and K^+ can zip along at rates comparable to diffusion in bulk cytoplasm. Transporters, on the other hand, have specific binding sites for solutes on a location which can be exposed to either surface of the membrane alternately – but not to both simultaneously. Thus, the solute can be bound from one surface of the membrane, and then a conformational change of the transporter exposes the binding site to the other surface, for release of the solute. This transition takes around a millisecond. The two modes of transport thus have very different rates, as channels can allow the passage of up to 10^8 ions per second. To misquote Kipling, channels is channels and transporters is transporters and never the twain shall meet.

DeFelice and Goswami point out that the well-characterized transporter (Na^+, K^+) ATPase can be converted to a channel by the action of a marine toxin, palytoxin. This is not surprising as work in the 70s had shown that reconstitution of the purified protein under specific conditions could generate channels. However, they go on to suggest that this is true of many other transporters and present evidence for NCX1 (Na^+/Ca^{++} antiporter in cardiac myocytes), glutamate and glucose transporters, among others. The most convincing data are for the divalent cation transporter DMT1, where simultaneous current measurements of charge translocation and radioactive ion measurements of solute transport suggest as much as ten charges being transported per ion. The argument for pore formation and consequent passage of ions other than the specific solute is strong in this instance.

The case of serotonin transporters is particularly intriguing, as a large number of psychopharmacological drugs operate by inhibiting serotonin re-uptake transporters. Their mode of action is generally assumed to be post-synaptic, as they affect the concentration of serotonin in the synaptic cleft. However, if they also affect the transporter-to-channel transformation, the effect on the pre-synaptic terminal could be substantial. I should emphasize, however, that the evidence presented for such a transformation is not as strong as that for DMT1.

The sections describing the transport of iron and its complexes provide a wealth of information. However, an indication of how fast the field is moving comes from the citation of work describing the cloning of HCT1, described as the heme transporter. It has since been shown that HCT1 is probably a folate transporter with limited affinity for heme. But the heat is on and the odds are good that heme transporters from a number of organisms will have been cloned and characterized by the time this review appears in print. Indeed, Hamza and colleagues have a manuscript in press in *Nature*, describing the cloning of a candidate heme transporter from *Caenorhabditis elegans* and a human homologue.

Eve Marder and Alan Roberts have pioneered the study of central pattern generators, and Marder's analysis of the crustacean stomatogastric system is classic. Her review with Dirk Bucher covers 40 years of the field, starting with the classic tri-phasic motor pattern of the pyloric rhythm. Their succinct summary of a mature field makes good reading and will upset some stereotypes. For instance, inhibitory synapses in the pyloric CPG are mediated by acetylcholine and glutamate, which are normally excitatory neurotransmitters. This use of the same transmitter at both excitatory and inhibitory synapses appears common to CPGs. Further, they describe neurons that participate in more than one circuit – in the generation of the pyloric rhythm as well as the gastric mill, sometimes simultaneously.

Cilia and modified cilia are widely distributed in the mammalian system. Cilia with nine double microtubules surrounding two singlet microtubules (9 + 2) are motile and known to play significant physiological roles in, say, moving mucus in airway epithelia. On the other hand, (9 + 0) cilia which do not have the central pair of microtubules, are not normally motile and have received much less attention in the past. Exceptions abound – the best studied cilium is the immotile rod outer segment in the mammalian retina. Indeed, these primary cilia are now known to play a sensory role in many systems, including the chemosensory and

proprioceptive sensible in invertebrates. Satir and Christensen review work in primary (9 + 0) cilia and point out that much of the molecular insight in this area has origins in work on *Chlamydomonas*, *C. elegans* and *Tetrahymena*.

Cilia operate in the viscous regime of low Reynolds numbers and their mechanics has been extensively studied. While ciliary mechanics is not reviewed in this volume, the regulation of ciliary beating has been reviewed, as have diseases associated with ciliary malfunction.

The reviews also feature a special section on β-arrestins, which were originally identified as proteins that desensitized second-messenger signalling initiated by seven transmembrane receptors that couple to GTP-binding proteins. A collection of five reviews introduces the reader to a variety of functions of these proteins that had not been imagined at the time of identification – signalling, especially in regulating the actin cytoskeleton during processes such as chemotaxis; the endocytosis of transmembrane receptors; their involvement as bona-fide signalling molecules both in G-protein-mediated cascades and in other systems; and their involvement in mediating crosstalk between G-protein and receptor tyrosine kinase systems. *In vivo* studies on genetically modified mice are also reviewed.

The *Annual Review* series has maintained its tradition of presenting timely and extensive reviews, enhanced over the past decade with excellent illustrations. This volume will be referred to often, and with pleasure, for a long time.

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Blind Men and the Elephant: Demystifying the Global IT Services Industry. Was Rahman and Priya Kurien. Sage Publications India Pvt Ltd, B1/11, Mohan Cooperative Industrial Area, Mathura Road, New Delhi 110 044. 2007. 317 pp. Price: Rs 395.

The book, *Blind Men and the Elephant: Demystifying the Global IT Services Industry*, was sent to me for a possible review. I applied the same test to this book that I apply to any book before deciding if I want to buy it or not: read the first chapter. In this case, the first chapter is Chapter 0 and I found that it presented an interesting and intriguing picture of the book. I agreed to review the book.

The next four months saw an epic struggle between my sense of duty that was piling on the guilt for not having completed the review and my reading mind that found it impossible to read through the next two chapters of the book. The breakthrough happened when, triggered by persistent reminders from *Current Science* that I complete the review, I decided to skip a few chapters. Then my progress was rapid. So let me first instruct the reader of this review on how to get the best out of the book.

Read chapter 0 first to get a good motivational overview of the book. The conflicts and paradoxes in the IT services industry are well brought out. Then move to chapter 4, and read in sequence till the end of chapter 6. These three chapters present a quick overview of the history of business computing, and are among the most interesting chapters of the book and the most informative. The relatively unknown origins of the IT services industry at the UK-based Lyons teashop family business makes compelling reading, as well as lays the foundation for understanding the industry today.

Now, go back to chapter 3, the best chapter of this book and a must read for anyone connected with the IT services industry. A sample of the text will convey the directness with which the reality of the industry is being addressed: '...Why does IT consume billions of dollars of customers' money, often to replace obsolete systems that only a few years previously were touted as the ultimate answer to business problems? Why do customers allow people who have never managed a business like theirs to fundamentally change parts of their organizations on the basis of presentations and promises that things will run much better?'.

Proceed to chapter 8, a good summary of the top-three IT services companies in the world. Tracing the historic evolution of these three very different companies is helpful in understanding the complexities of the industry today. The rest of the book can be read quickly by browsing through chapters 1 and 2 and reading the remaining chapters 9 through 12 in order. Of course, I read the entire book before arriving at the above set of instructions.

There are three key problems with the book that reduce its impact. First, the target audience, for obvious reasons, is difficult to pin down and hence the authors lose their way in many places. At some places they assume the reader knows nothing about IT and a few paragraphs later they address an industry veteran.

It is neither a textbook, since it is subjective and speculative at many places, nor is it an authoritative reference, since there are many gross simplifications. For example, the early success of the IT services companies in India is attributed to the facts of historic affinity of Indians to mathematics and logic, and the presence of famed universities like Nalanda. There is no mention of the key factor, the dollar–rupee arbitrage and the resulting very low cost to customers in the US. There is no mention of efforts of early pioneers of the Indian industry, who used this cost advantage to slowly claw their way up the value chain. The book hardly touches upon the two core facets of the top Indian IT services companies: their astounding HR management expertise and impressive software development processes, that take as input a large number of graduates from any discipline and with diverse levels of skills, and deliver high quality, predictable, low-cost software services as output.

The second problem is simpler to address, and that is verbosity. The real insights from this book, and there are several, could have been packed in a book half its size. The third problem is that it leaves the reader hanging loose at the end of the book: richer with valuable insights and facts about the global IT industry, but as mystified as at the start.

In spite of these problems, the book should be read by anyone with more than a passing interest in the IT services industry. The book is especially accessible and valuable to decision makers in both government and industry in India at the current juncture, when hundreds of crores of taxpayers money is being spent to create IT solutions across diverse domains.

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