The 'Application of Capillary Electrophoresis to Pharmaceutical Analysis,' is reviewed in chapter 18 by K.D. Altria. This is a well written chapter listing 60 references, and describing systems for the separation of a variety of pharmaceutical compounds. In addition, chapter 18 shows how impurities in drugs can be determined readily by CE at the 0.05 to 0.1% levels, and emphasizes chiral separation of enantiomeric drugs. Chapter 19 (38 references) by Herold et al. reviews the 'Separation of Peptides and Protein Digests by Capillary Electrophoresis.' This chapter covers in detail the effects of buffer and sample handling on peptide mapping by CE, and describes the use of photodiode array detector in peak identification. In addition, chapter 19 reviews approaches for micropreparative peptide separation and identification by MALDI-TOF-MS (matrix assisted laser desorption ionization-time of flight-mass spectrometry), and discusses important applications including purity confirmation and characterization of recombinant proteins. Finally, and for completeness, K.D. Altria reviews in chapter 20 'Additional Application Areas of Capillary Electrophoresis' including the analysis of small ions, agrochemicals, carbohydrates, vitamins, biomedical applications, amino acids, particulates, bacteria and dyes. This chapter review 139 recent references.

In summary, the book is a very useful guidebook for CE practitioners as well as a reference book for researchers and graduate students. I highly recommend this book for libraries and individuals active in the field of CE.

Ziad El Rassi

Basic DNA and RNA Protocols. Methods in Molecular Biology, vol. 58; Edited by A.J. Harwood. The Humana Press; Totowa, 1996. xiii+514 pp. $ 99.50 (pb). ISBN 0-896-03331-X

The profound expansion in the sequence information of genes and their function in, e.g. human, makes detailed DNA and RNA analysis very important for many scientific and routine investigations. The context of this book (514 pages) includes protocols that cover some frequently used techniques for DNA, RNA analysis, gene cloning and subcloning, PCR techniques, DNA sequencing, site-directed mutagenesis and protein synthesis. Each of the 58 chapters/protocols begins with a brief introduction followed by materials, methods and notes sections. As a technical laboratory manual this handbook serves its purpose well by being easily readable and in contrast to most other handbooks, manuals and methodological manuscripts this handbook includes note sections for each chapter. These sections give the reader a series of valuable hints for establishing successful experiments or even pinpointing handling errors. However, since no discussion section is present, it would have been of convenience for at least some readers, if a few of the introductions were extended beyond their few lines to include a description of the potentials of the described method. In other words, although it is a technical handbook, brief orientations of questions/problems that have been solved using the particular technique may improve the practical applications of the book.

While the PCR technique in particular has revolutionized the possibility for gene specific mutation analysis, a broad set of RNA and DNA analyses are used whenever new mutations are described as plausible disease causing determinants. However, it seems that the book suffers from a lack of powerful techniques, e.g. single strand conformation polymorphism analysis and denaturing gel analysis, for finding and analysis of DNA for sequence variations. Furthermore, since PCR-based assays for detection of known point mutations are becoming central for many scientific and clinical projects many readers might have benefitted from a chapter describing the principles for establishing such assays.

In conclusion, this handbook adds to the number of comprehensive books dealing with methods used in molecular biology. However, since some central methods for RNA and DNA analysis have been left out of the book, it probably will not be selected as *the* laboratory handbook.

Niels Rüdiger

The Natural Selection of the Chemical Elements; Edited by R.J.P. Williams and J.J.R. Frausto da Silva. Oxford University Press; Oxford, 1996 xxvi+646 pp. £75.00 (hc). ISBN 0-19 855843-0

Chapter 1. The development of man's ideas concerning nature – gives an impression of the classical western (i.e. Greek) attempt to understand the environment by relating all natural manifestations to a few (i.e. four) basic elements: earth, water, and fire. The authors try to explore the possibilities of this four-element universe by substituting with: solid, liquid, gas, and energy; and they use this idea as an organizing principle for the following treatment. This is a brilliant idea that gives the reader an opportunity to rethink the path from our senses to our statements.

Less interesting is an account of ideas developed in China that contribute little if anything to the understanding of modern chemistry. It would have been more interesting to learn about the theoretical problems for the Greek philosophers induced by a scientifically inadequate language, or to learn about experiences from the applied chemistry harvested in the rich Arab culture.

The rest of the chapter deals with the development of modern views, including hard facts such as atomic structure in relation to the periodical system and an introduction to kinetic gas theory and different forms of energy. This account posed no problems for this reviewer (with a background in chemistry), but he reached his limits to understanding when he was confronted with the following sentence: "It is generally accepted that gravitational and electrical fields have been generated in the universe by the big bang expansion of rest mass into simultaneously created space, and their distribution has been affected by its subsequent non-homogeneous development."

Chapter 2. Order in chemical systems: elements and their combinations – contains a general description of intramolecular binding of atoms to molecules and intermolecular binding of the latter to condensed phases. The authors have chosen a non-mathematical approach, and for this reason (?) they have ignored molecular orbital theory, which even in its simplest version (LCAO) could have given a more clear background of molecular morphology. The present account based on valence shell electron pair repulsion theory gives rise to several blunders such as a dioxygen molecule with a double bond instead of being a biradical (of extreme importance for survival of life), and a lack of clear distinction between the little molecule CO_2 and the infinite molecule SiO_2 – and why it has to be so (also of some importance to the development of life!). There are other peculiarities such as two tables with data about the size of cations, but none for anions, and a sizeable gap between the level of information in the main text and in a figure such as Fig. 2.26. But, given the space, the description is from workable to useful – the latter applied for the condensed phases, and the chapter concludes with an excellent summary.

Chapter 3. The balance between order and disorder – re-introduces the idea of balanced systems between order and disorder, that is between solids, liquids, and gases and connects this with energy. This particular view on order and disorder is followed consistently, but readers, tending to think in structural terms, should remember that order in this book means chemical bonds. Thermodynamic criteria for equilibria and non-equilibria are well treated, but the topic remains difficult. It adds to the difficulties that the conventions used differ slightly from what is common for this reviewer and for authors of newer textbooks for undergraduates.

Chapter 4. Phase equilibria – illustrates such balances for bulk phases for people, highly experienced in analyzing multi-component phase diagrams for rocks and alloys. Maybe they will benefit from the fact that the authors have given up the non-mathematical approach

from chapter 2 and frankly uses partial differentiation in their analysis of the phase rule. This reviewer did not succeed in understanding but a fraction of the chapter, giving up at page 131.

Chapter 5. Equilibria in dilute solutions in water – covers chemical equilibrium as applied to solubility, acid-base, and redox chemistry. The chapter also contain several summaries on interrelations of these chemical properties such as reduction potential versus pH. These summaries are valuable but certainly not easy reading, and they are not always easy to find due to a lack of consistency between headings and content. Thus, section 5.5 claims to cover equilibria between acids and bases in aqueous solutions. There is nothing of this kind except for a few lines about hard and soft acids and bases – a hot topic thirty years ago. Acid-base chemistry is in fact treated (and treated well) in section 5.6, called competitive equilibria.

Chapter 6. Limited phases, fields and compartments – describes the restrictions imposed on chemical equilibria by the presence of surfaces, barriers, and electric (and other) fields. This heading tries to unify topics from a lake barred from the ocean by a dam to organic compound barred from inorganic minerals by chemical bonds! This strategy more or less ignores the useful hypothesis that properties are related to structure such as chemical bonds. This reviewer was not convinced that treating macromolecules as a conglomerate of phases such as a crystal lattice or a glass is a more useful approach, and he definitely disagrees in explaining membrane potential by the stoichiometry of the Na^+-K^+ATPase, ignoring the importance of membrane structure (i.e. different permeability for K^+ and Na^+ ions).

Chapter 7. The evolution of kinetic control and organization – claims to discuss the rate, at which balance is approached or inhibited by barriers to change of both compartments and chemical combinations. By working through this 70 page chapter, the reader may recognize a few concepts from chemical kinetics such as diffusion rate, collision complexes, catalysis, and activation energy, but a conventional treatment of the influence of concentration on reaction rate (rate expression) is not available. An understanding of our material world as a highly heterogeneous system, exposing steady states, metastable intermediates, and local equilibria confined by kinetic barriers and traps – evolving organization far from end state equilibrium – is hampered by a lack of discipline regarding references to a bewildering variety of phenomena including electron transmission in photosystem II and a door bell. Analogous to Joyce's Finnegan's Wake there is probably nothing imaginable to the authors that is not mentioned, but this reviewer shall never be able to predict where and why!

Chapter 8. The evolution of inorganic chemicals on Earth – goes back to the formation of the chemical elements in the universe. It describes the selection of the chemical elements, first at the level of the stability of nuclei, then of atoms in combination, then by the physical properties of the compounds formed. The composition of the dynamic relations between the different zones of our earth at an early stage and today is described as well as possible chemical processes connecting these stages. This reviewer was also looking for a biological rational (corals?) of transforming the enormous amount of CO_2 in the primitive atmosphere to mountains of carbonate minerals, but did not succeed – he may be wrong. Compared to the latter this chapter is a relief, being very well organized.

Chapter 9. The evolution of organic compounds – describes the chemistry made possible in the atmosphere and at the surface of our earth. New processes of element selection, physical and chemical, then generated abiotic organic chemistry. The thermodynamic instability of organic compounds relative to carbon dioxide contrasted by a relative kinetic stability is stressed, but not explained since the biradical nature of oxygen is ignored. Then follows a much abbreviated (of course) version of organic and bioorganic chemistry. (It is evident that organic chemistry does not belong to the core of the author's chemical universe, and it is easy, but not important, to point out weak spots.) The presentation of the different chemical families includes considerations on potential energy of organic compounds in a reducing and an oxidizing environment. Behaviour in aqueous medium is touched upon only lightly – although it would have been relevant to say something about amphipathic molecules and hydrophobic aggregation. For good reasons organophosphorus compounds are also treated, including hydrolysis of phosphate esters. However, regarding the scope of chapter 7 it is a mystery that the contrast between thermodynamic instability and kinetic stability of the ester bond is not stressed and explained.

Chapter 10. Early biological chemistry: the uptake and incorporation of elements in anaerobic organisms – describes processes of element selection, physical and chemical, based on availability in flowing systems, with the intention (stated at page 414) "to show the advance from prebiotic to primitive biotic and then to more sophisticated anaerobic cell chemistry." This intention is not fulfilled. Rather, the authors follow the heading 'uptake and incorporation of elements' literally. This reviewer was rather disappointed to find nothing about prebiotic chemistry as an entrance to the molecular logic of living organisms. In particular, it is surprising that a build-up of polymers through condensation reactions in an aqueous environment does not call for a discussion on energy. The authors have chosen to give snapshots of the chemical possibilities before life – supplemented by excellent tables – and the chemical realities as they appear in every ordinary textbook in biochemistry. The gaps between the illustrations – including glycolysis and the Calvin cycle – and the related text are very wide, and the structural background for the reactions are never reasoned. Most unfortunately, there are only a few hints about adaptation to environment (more information in the next chapter), and the chemical evolution is reduced to 'through some fluctuation – of unknown probability – life started and then moved forward'.

Chapter 11. Early cellular organization in anaerobes – is closely connected to the topics from the previous chapter. There is even an attempt (under the heading 'control of shape') to describe possible aspects of development of coacervates. But focus is on general principles of regulation – occasionally in details (citric acid cycle) that hardly fits with early anaerobic conditions. As before, we do not miss sketches of different macromolecules, but the authors are very reluctant to use structures for the organic building blocks. This seems unfortunate for this reviewer, because it is the structure (rather than being composed of C, H, O, N,...) of these few biomolecules that constitutes the link between the different types of cell constituents and their interconversion. Incompetence in this matter is further indicated by the sad fact that glutathione is drawn without a thiol group (page 448). The discussion of the properties of RNA and DNA does not reveal the importance (anchimeric assistance) of the 2′-hydroxyl group during hydrolysis of RNA – and by implication the stability of DNA lacking this group. It is also a serious omission that the authors, after an interesting account of Manfried Eigen's hypothesis on the development of the genetic code, do not mention the variation in code between mitochondria and nucleus. As a corollary (?) the chapter is a rich source of information on different metal ions' contributions to catalysis, and there is interesting information on possible interchange of metal ions as prosthetic groups due to changes in the environment. The chapter concludes with a general description of the development of organization – implying flow of material and energy in dissipative systems – in order to protect early coacervates from dilution and degradation.

Chapter 12. The structure and chemistry of organisms after the advent of dioxygen – describes the ongoing development of organization as a result of an interaction of the chemistry of the atmosphere, the Earth and living organism. It is clearly demonstrated that there is an inevitable overall direction of life towards higher organism, which provides greater survival strength as long as more energy is put in to move it away from equilibrium – while the Earth's chemical systems tend toward equilibrium. In the authors formulation: "The system of living things increases fitness, a chemical kinetic stability of flowing materials; the system of inanimate things increases in entropy, a thermodynamic stability." As indicated in the heading focus is on oxygen, but due to a less adequate organization of topics the reader may not be aware of the following sequence of events:

Photoreduction with hydrogen sulphide – generating sulphur.
Photoreduction with water – generating oxygen.
Slow build-up of oxygen in the oceans – due to the presence of Fe^{2+}.
Scavengers of (the poisonous) oxygen.
Respiration – using oxygen.
Fusion of aerobic (mitochondria) and anaerobic organisms.
Evolution of multicellular eukaryotes.
Generation of an ozone layer in the upper atmosphere.
Migration of life from the sea to the land.

(I had also welcomed a chemical commentary on the massive extinction of species in late Perm period, but maybe nobody knows?).

It would be grossly unfair, however, not to mention that this chapter is packed with interesting information about the evolution of bio-

inorganic chemistry – a topic little known to this reviewer. And most helpful for the same person the chapter concludes with a clear and instructive summary.

Chapter 13. Organization in advanced organisms – examines the organization that is necessary to maintain cellular and organism structures and chemical patterns. The authors give a detailed account of intra- and intercellular control and regulation – occasionally expressed in terms of electrolyte messengers (e.g. Ca^{2+}) and organic messengers (e.g. acetylcholine). There is even a review on endocrine regulation – with a bias to hormones dependent on Zn, Cu, and Fe; and by relating mismanaged phosphorylation to the aetiology of cancer and Alzheimer, inorganic chemistry is certainly put on the stage. The chapter concludes with a provocative reflection over man's attempt to escape from the ecosystem in which he was born.

Chapter 14. Man's selection of the chemical elements – a highly readable essay on man's application – later supplemented by partial understanding – of chemical principles with the purpose of feeding, protection, and comfort. Areas of activity include agriculture, medicine, manufacturing of tools, forestry, mining, clothing, housing, and communication.

Chapter 15. Element cycles and their evolution – this important topic is introduced by pointing out that cycling of matter depends on an input of energy, that may come from global heat and/or solar radiation. With another reference to the classical four-element concept of the natural world, the cycles of the rocks (solid), of water (liquid), and of air (gas) – driven by energy (fire) – are briefly outlined. This is followed by a conventional description of the cycling of the basic elements: oxygen, hydrogen, carbon, nitrogen, sulphur, phosphorus, etc. There are considerations on the significant interrelation between life and these cycles, and the chapter concludes with the expected reflections on the impact of man on the same cycles. Irrespective of probability, this reviewer should have welcomed estimates of influence from fluctuations in solar radiation as well as major volcanic eruption and major meteorite impact.

Chapter 16. The evolving natural selection of the chemical elements and the senses – is excellently introduced with a summary of important conclusions from the previous chapters regarding selection through equilibrium distribution, selection by kinetic trapping, selection for functional value in living organisms, and man's selection of elements for his own purpose. (These headings are also found in the preface of the book, but less clearly expressed.) Then follows a rather theoretical account of the chemical constraints that have brought about separate species. The last part of the chapter deals with an analysis of the balance or conflict between man's activities and prospects for a long-term steady state in the biosphere. This analysis includes a highly readable discussion of the so-called waste products from (naturel and) human activities and the different categories of advantages of the simplicity of bacteria and of complexity in higher organisms respectively. The chapter concludes with an essay (stylistically linked to the introductory chapter) discussing philosophical problems regarding sensation, perception, understanding – and limits to understanding.

References to further readings – and the Index: The references (after each chapter) are exceptionally comprehensive with a short but clear presentation of each reference. For a book attempting to set the holistic nature of the world in a materialist manner, the index is far from comprehensive. However, together with the very detailed list of contents (12 pages+repeats before each chapter) it works.

General conclusion: The preface states that "the main objective of the book is to show the relationship of every kind of material around us, living and non-living, to the properties of the chemical elements of the periodical table. The book must bring together, therefore, all the relevant subject matter that are based on chemistry, including not only inorganic and organic chemistry, but also geochemistry, environmental chemistry and biological chemistry". This is a Herculean ambition, and we should not be surprised that not all topics are covered equally well. As mentioned before, this is particularly evident for organic chemistry, and this reviewer does not accept the authors' explanation that they prefer the physicists' approach to materials through phase structure rather than the stoichiometric approach through chemical bonds. By ignoring structural organic chemistry we lose information on structure-function relations, which is of considerable importance to the understanding of the chemical evolution. But few, if any, people cover an extremely broad subject on a professional level, and the above weaknesses do not invalidate the end result: They did it!

The style of the book (probably a combined effort of the authors and the publisher) is pleasant. There are curiosities, such as the cover (why is Mg but not Ca ionized?) and the 'de rigueur' citations that initiate each chapter: Is it the sad beauty of a nearly eclipsed empire (including Hong Kong) that mediates the authors' fascination of Chinese spirituality? This reviewer does not share this ecstacy, and he would have appreciated more solicitude when citing Galileo Galilei! In conclusion, this book is very readable – even useful, but who will read it? I doubt that students have a background that enables a reasonable yield at a reasonable cost. The authors suggest teachers in the hope that they may initiate a growing understanding of chemistry among students and in the society for the better of mankind. I wish this were true!

Anders Overgaard Pedersen