Book Reviews

Ionic Equilibrium: Solubility and pH Calculations. By J. N. Butler (Harvard University); with a chapter by David R. Cogley. Wiley & Sons, Inc.: New York. 1998. xi + 559 pp. ISBN 0-471-58526-2.

This book evolved from two earlier books by Butler. According to the author, the material covered in the book is intended for use by students in a variety of disciplines: chemistry, earth and ocean sciences, engineering science, and environmental engineering. The book even contains a case study involving physiological fluids. The material has actually been used for about 30 years in classes with students from all these disciplines. There is a plethora of examples ranging from simple applications of the theory to case studies with more complex calculations and comparisons with data from the literature. However, the book should not be viewed as a collection of recipes. On the contrary, the principles and key concepts are also presented and are always accompanied with examples. I find this to be one of its most attractive features. Another strong point, in my view, is related to the solution method. Solutions with simplifying assumptions and approximations are frequently made and the impact on the final outcome is assessed. This gives the reader and/or student a "feel" about the quantities involved. Problems without solution as well as extensive bibliography are provided at the end of each chapter. In addition, tables with data are found frequently and references to the complete databases are given. The book does not cover the following topics: surface reactions, ion exchange, kinetics, and transport phenomena.

Chapters 1 to 8 (pages 1 to 317) comprise the first part of the book. Chapter 1 discusses *Basic Principles*: equilibrium, equilibrium constant, mass, and charge balances. In addition, it discusses a methodology for setting up and solving equilibrium problems as well as some simple numerical procedures such as the Newton method to solve a nonlinear algebraic equation. Chapter 2 deals with *Activity Coefficients and pH*. It employs the Debye−Huckel and the Davies equations for the estimation of the activity coefficients. It concludes with a presentation of the pH scale, the glass electrode, the Harned Cell, and the measurement of equilibrium constants. Obviously, the topics covered briefly in this chapter are vast subjects on their own. I think the extent of the coverage is satisfactory. References to extensive treatments are given. Chapter 3 deals with *Strong Acids and Bases*. Most of the material covered here is familiar from General and Analytical Chemistry. The pH values of a strong acid, base, and mixtures of the two are discussed. Material on the titration of acids and bases including calculation of errors is nicely presented. Chapter 4 deals with weak *Monoprotic Acids and Bases*. The pH values of a weak acid, base, mixtures of acids and bases, and salts of a weak base and a strong acid are discussed. The Silen's diagram (logarithms of species concentrations versus pH) is the preferred way to present the relevant calculations. The chapter also discusses indicators as weak acids, buffer solutions, and titrations. Most of the material is common in General Chemistry, but I found the discussion on titration errors very useful. Chapter 5 deals with *Polyprotic Acids and Bases*. Consequently, this is an extension of the material in the previous chapter. It also has a brief discussion on amino acids and on amines. Chapter 6 discusses *Solubility*. The topics covered include solubility product, precipitation titrations, and the effects of complex formation and acid−base reactions on solubility. Chapters 7 (*Complex Formation*) and 8 (*Organic Complexes*) deal with inorganic and organic complexes, respectively. Species distribution diagrams are calculated and presented for several examples. Among the examples is a case study dealing with mining wastes containing sulfide minerals. The Davies, Debye−Huckel, or Guggenheim equations are used for activity coefficient calculations. The chapter on organic complexes also contains sufficient examples to illustrate how calculations are performed on a number of topics: amino acid complexes, chelates, complexometric titrations, and solvent extraction. The calculations have become increasingly complex especially when the equilibrium between an aqueous solution containing a metal ion and an organic solvent that extracts the complex from the aqueous phase is discussed. The presentation of the material is straightforward and easy to follow.

Part two of the book begins with Chapter 9 entitled *Oxidation−Reduction Equilibria*. The topics covered here included: oxidation−reduction reactions, electrochemical cells, redox potentials, **pH** versus **p**ϵ diagrams, and redox titrations. There are 16 examples that help digest the vast subject that is covered briefly in this chapter. The next chapter on *Carbon Dioxide* is by far the largest one of the book (95 pages). This is an extensive treatment of equilibrium in systems containing carbon dioxide. Most of the principles needed have been covered in previous chapters and the emphasis is on examining specific cases ranging from simple aqueous solutions to natural waters with several sources of alkalinity. Two case studies are discussed in great detail and with many references to the literature: physiological fluids and seawater. The terminology regarding the form of the equilibrium constant is sometimes "tailored" to that of the target audience and knowledge of the precise definition of some terms (e.g. salinity) is assumed. In spite of that, however, the book does a very good job in presenting the various aspects relevant to equilibrium in systems containing carbon dioxide. Chapter 11 entitled *pH in Brines* is a brief one covering topics such as glass electrode with liquid junction, hydrogen electrode (Harned cell), spectrophotometric method, glass electrode, and chloride ion selective electrode. A comparison of the accuracy of the methods is discussed and the chapter ends with brief notes on hydration theory. Chapter 12, *Automated Computation Methods*, was written by David Cogley. It discusses computational aspects of equilibrium calculations and presents a survey of available computer programs with example calculations.

The book has some obvious typographical errors especially in the legends. Although I did not check the derivation of all equations, equation 31 in chapter 3 should be corrected. One criticism of the book that I have is the fact that the book does not discuss recent work from the literature that describes methods for the measurement and correlation of single ion activity coefficients (Khoshbarchi and Vera, *AIChEJ*, **1996**, *42*(1), 249−258; Khoshbarchi and Vera, *Fluid Phase Equilibria* **1996**, *121*, 253−265; Marcos-Arroyo et al. *Journal of Solution Chemistry* **1996**, *25*(10), 983−1000). It would be beneficial to the reader if the author would offer his perspective on this issue in view of the recent published work. In spite of that, however, I consider that the book has met its objective and will be useful to students, scientists and engineers in a variety of fields.

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Modern Techniques in Applied Molecular Spectroscopy: Techniques in Analytical Chemistry. Edited by Francis M. Mirabella (Equistar Chemicals, LP). John Wiley & Sons: New York. 1998. xvi + 410 pp. $59.95. ISBN 0-471-12359-5.

This book is an excellent reference and good starting point for any research scientist, associate, or analyst who has been charged with responsibility for solving problems using molecular spectroscopy. Although some basic theoretical principles are provided, the book's orientation is clearly toward the practical user. Those readers desiring more depth on a particular topic can easily find it in the references included at the end of each chapter. The introductory chapter by Mirabella provides a brief overview of the following nine chapters which cover transmission spectroscopy, specular reflectance spectroscopy, attenuated total reflectance (ATR) spectroscopy, diffuse reflectance spectroscopy, photoacoustic spectroscopy (PAS), infrared (IR) microspectroscopy, Raman microspectroscopy, emission spectroscopy, and fiber optics techniques. Each chapter concludes with a few practical examples illustrating how each technique can be applied.

The first chapter by Duerst, Duerst, and Stebbings provides an interesting historical overview and introduces the fundamentals of mid-infrared absorption spectroscopy which are developed further in the subsequent chapters. The chapter on specular reflectance, by Lippert, Lamp, and Porter, contains the most detailed theoretical treatment of all the chapters, illustrating how differences in the optical constants can affect the way reflectance spectroscopy is performed and interpreted on metals vs more weakly reflecting surfaces. An excellent chapter on

ATR by Mirabella thoroughly points out all the nuances and pitfalls of this powerful sampling technique. The diffuse reflectance chapter by Blitz is the best presentation I have seen contrasting the way the technique is traditionally performed in the near-IR and visible regions (using an integrating sphere) with the much different accessories generally used on commercial Fourier transform infrared (FT-IR) instruments. The chapter by McClelland, Bajic, Jones, and Seaverson introduces PAS, including how it can by applied in conjunction with step-scanning FT-IR spectrometers to obtain uniform depth-profiling information at all wavelengths. The IR microspectroscopy chapter by Katon describes the historical evolution of IR microscopes and emphasizes the importance of good sample preparation. Sommer's chapter on Raman microspectroscopy provides a brief review of the Raman effect and addresses experimental considerations and capabilities of this technique. Emission spectroscopy is described in a chapter by Zhang, Franke, and Niemczyk. The final chapter on fiber optics in molecular spectroscopy is nicely developed by Brown.

The practical utility of the book is enhanced, in part, due to the fact that several of the authors have industrial experience and/or have worked closely with industry during their careers. In each case, the authors are experts in their areas and have provided an excellent overview along with information that is practically useful to those not as familiar with the technology. There are some errors and oversimplifications, and occasionally nomenclature changes from one chapter to another. For example, IRS is an abbreviation for infrared spectroscopy in Chapter 3, while it refers to internal reflectance spectroscopy in Chapter 4. Overall, the book is excellent. I have no hesitation in recommending it to research associates or analytical chemists with a need or interest in learning more about any of these applications of molecular spectroscopy.

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Food Lipids: Chemistry, Nutrition and Biotechnology (Food Science and Technology Series/88). Edited by Casimir C. Akoh (University of Georgia) and David B. Min (University of Ohio). Marcel Dekker: New York and Basel. 1998. xi + 816 pp. $225.00. ISBN 0-8247-9985-2.

This valuable resource provides a state of the art overview of the field of Food Lipids from the point of view of their Chemistry and Analysis and their Biotechnology, together with their role in Nutrition and in certain disease states, particularly Cardiovascular disease. The volume is organized into 28 chapters, written by individuals, or groups of individuals who are nationally and internationally recognized experts in their particular fields. Consequently the book represents an authoritative and up-to-date treatment of many topics of current importance in the field of Food Lipids, and provides a comprehensive reference resource for workers in a number of related areas. These include human and animal nutrition, lipid biochemistry and metabolism, food processing and storage, lipid analysis, dietary lipids and cardiovascular disease and obesity, antioxidants and agricultural applications including genetic engineering of crops producing vegetable oils.

Part I comprises seven chapters dealing with the Chemistry and Properties of lipids. It includes a very useful introductory chapter on the Nomenclature and Classification of lipids that includes review of the IUPAC nomenclature for fatty acids, and an overview of the conversion of essential fatty acids to the metabolically important prostaglandins and leukotrienes. The clarity and high quality of the figures and diagrams in this chapter set the high standard for the remainder of the book, although, somewhat disappointingly for a text of this quality, no use is made of color. Other chapters in this section deal with the Chemistry and Function of Phospholipids, Lipid-based Emulsions, Chemistry of Waxes and Sterols, Lipid Extraction and Analysis including Trans Fatty Acids and the Chemistry of Frying fats.

Part II deals with Industrial Extraction and Processing of Food Lipids and includes chapters on Recovery, Refining, Converting and Stabilizing Edible Fats and Oils, the Crystallization and Polymorphism of Fats, and the Chemical Interesterification of Food Lipids particularly as applied to the physical properties of edible fats such as margarines and the production of fat substitutes such as Olestra.

Part III covers what has always been a major problem for the food industry, the oxidation of lipid components in foods and edible oils, with the accompanying implications for food storage, quality, and safety. This section includes chapters on Lipid Oxidation of Edible Oils, Fatty-acid Oxidation in Plant Tissues, Methods of Measuring Oxidative Lipid Oxidation, and Antioxidant Mechanisms and a chapter on Lipid Oxidation of Muscle Foods in which it is noted that lipid oxidation is one of the major causes of quality deterioration in frozen meats. This also describes examples where oxidation leads to enhancement of product quality, for example, in the production of fresh fish aromas. This phenomenon is also known to consumers of fine wines.

Part IV deals more specifically with some of the Nutritional Aspects of Lipids, and comprises seven chapters on a diverse range of topics including both synthetic and natural Antioxidants, and an authoritative overview of the role of Fats and Oils in human Health, that includes discussion of the now largely discounted role of trans fatty acids in CHD, and relationships between dietary lipids and cancer. This section also includes a very well referenced and topical chapter on the Omega Fatty Acids, including mechanisms of biosynthesis and desaturation, the role in membranes and cell physiology, and dietary sources and possible nutritional importance of the numerous PUFA's. Additional chapters cover the topics of Dietary Fats, Eicosanoids, and the Immune System, Dietary Fats and Coronary Heart Disease, and Dietary Fats and Obesity. The final chapter in this section, Lipid-Based Fat Substitutes, presents an extensive and timely description of what is arguably the most significant nutritional substitute since the introduction of artificial sweeteners. This chapter includes sections on the classification of fat replacers, and descriptions of the different types of lipid based fat substitutes, including those such as the sucrose polyesters (Olestra), that are already on the market, and others that are currently under review by the FDA. The chapter concludes with sections on side effects and safety, and FDA regulatory updates, that will be of considerable interest to clinicians, nutritionists, dietitians and others.

The final section, Part V, contains six chapters devoted to the Biotechnology and Biochemistry of Food Lipids. It includes an overview chapter, Lipid Biotechnology and additional chapters on Microbial Lipases, Enzymatic Interesterification, Structured Lipids, Biosynthesis of Fatty Acids and Storage lipids in Oil-Bearing Seed and Fruit tissues and a final Chapter on Genetic Engineering of Crops that Produce Vegetable Oils.

As a minor fault, the main index for the book is not particularly comprehensive, or complete. For example, a search for the term "atherosclerosis" yields only a single reference (p 452), and completely misses the 30-page chapter entitled Dietary Fats and Coronary Heart Disease. Similarly, the term "prostaglandins" is referenced only once (p 704), despite a detailed review of the topic (pp 9−12 in chapter 1) and again in chapter 19, Dietary Fat, Eicosanoids and the Immune System. In compensation, however, the references for the individual chapters are comprehensive and up-to-date, and provide a valuable resource for further readings on specific topics.

In summary, this is an important and timely volume that will be of interest to a broad spectrum of readers. It amply fulfills its stated objectives of providing a textbook of food lipids, although probably more suited to graduate than undergraduate instruction. In addition it will provide a valuable reference text for researchers and practitioners in a variety of fields, encompassing the food industry, agriculture and biomedical disciplines, including particularly those with nutritional and biochemical interests.

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