Chapters 3 and 4 present the physical principles of potentiometry, ion-selective electrodes, and redox titration. The concepts of electrode potentials and electromotive force (emf) are introduced using an empirical rather than a theoretical approach. Many experimentalists may appreciate that, but there is a risk that readers will, for example, regard an ion-selective electrode as a "black box". Potentiometric titrations are robust and accurate methods widely used in industry, and these two chapters may certainly be of use for many laboratory technicians. Perhaps a short presentation of the concept of Pourbaix diagrams would have been useful.

In Chapter 5 the author treats coulometry in a rather superficial way, completely omitting some important analytical techniques such as Karl Fischer titration or quantitative analysis of metal ions by electrogravimetry. Instead, different concepts such as stripping voltammetry or microelectrodes are included in this chapter, together with some concepts of the Goüy – Chapman theory.

Amperometric methods are described in Chapters 6 and 7 under the titles "Analysis by dynamic measurement, A: System under diffusion control" and "Analysis by dynamic measurement, B: System under convection control". This separation of the methods is rather puzzling and can be a source of confusion. For example, polarography, where the convection linked to the fall of a mercury drop plays an important role in resetting the concentration profiles near the electrode, is placed in Chapter 6, whereas diffusion-controlled redox reaction on a rotating disk is placed in Chapter 7. However, the two chapters review the major techniques such as polarography, cyclic voltammetry, pulsed methods, rotating disk electrodes, etc., with emphasis on the experimental aspects. It is regrettable that the illustrations of polarograms are taken from the textbook *Electrochemical Methods: Theory and Applications*, by A. J. Bard and L. Faulkner, which were themselves taken from earlier works. Those should have been cited directly.

Modern instrumentation yields much better results than those presented here. The part on cyclic voltammetry is nicely complemented in Chapter 10 by a description of some simulation packages.

A series with the title *Analytical Techniques in the Sciences* should certainly have included a section on amperometric detection in chromatography, and the part devoted to enzyme electrodes (several billions of which are being sold every year) is much too brief. Additional methods such as impedance or spectro-electrochemical techniques are presented in Chapter 8, while Chapter 9 provides some tips on electrode fabrication. Usually, analytical chemists rely on commercial electrodes and this chapter only concerns those interested in DIY.

The bibliography lists the major textbooks in the field, accompanied by brief personal comments. The glossary at the end is useful for all newcomers to the field of electroanalytical techniques, as electrochemists have, over the years, developed a jargon that repels many chemists from using any electrochemical method.

The originality of the book lies in the combination of practical tips with the descriptions of the different methods. However, the main criticism is that the author writes perhaps too much from a physical chemist's perspective rather than as an analyst. To conclude, this book is recommended for all those who wish to learn about the different electroanalytical methods by themselves.

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Kinetics of Homogeneous Multistep Reactions. By *F. G. Helfferich*. (Series: Comprehensive Chemical Kinetics, Vol. 38. Series editors: R. G. Compton and G. Hancock.) Elsevier Science, Amsterdam 2001. 426 pp., hardcover $ 244.00.—ISBN 0-444-82606-8

This volume is the latest in a long-running series which has taken on the ambitious task of covering all aspects of the field of chemical kinetics, both theoretical and practical, and both historical and modern. The current volume is part of a section entitled "Modern Methods, Theory, and Data".

Although Professor Helfferich intends this volume to be a practical hands-on guide for chemists and engineers working in commercial development, he makes it clear in the introduction that he wishes to address what he calls "fundamental kinetics". Defined as the study of reactions as composites of elementary steps, this view of kinetics differs from what physical chemists, organic chemists, or chemical engineers typically mean by kinetics. Pioneering work in this area dates back to the beginning of the twentieth century and is associated with names such as Michaelis and Bodenstein, familiar even to chemists who are not kinetics practitioners. The relationship between fundamental studies and practical applications is more intimate in this area of kinetics than in many areas of research in chemistry, fueled by advances in in situ measurement techniques. This is, I believe, one of the main reasons behind the "resurgence of interest in reaction kinetics" noted by the author.[*] Although his background and experience stem from bulk chemical applications, this resurgence is also strongly evident today in the pharmaceutical and fine chemicals industries.

The first five chapters of this book are devoted to fundamental concepts, definitions, and general descriptions given in a style such as might be found in a standard textbook of chemical engineering kinetics. It is the remainder of the book, and in particular Chapters 6 and 7, that sets this book apart from such standard texts. Chapters 6 and 7 discuss mathematical descriptions of multistep reactions and elucidation of reaction networks, providing a unique translation of chemical information into mathematical description. Chapters 8 – 10 apply these concepts to the topics of homogeneous catalytic reactions, chain reactions, and polymerizations, respectively.

[*] In that context, I found it odd that recent developments in the area of microkinetic analysis are not mentioned in this work. Although published examples to date have involved heterogeneous catalytic reactions (which are not covered in this book), the concepts are general and undoubtedly will soon be applied more generally to complex reaction networks. (For background on microkinetic analysis, see G. Yaluris, J. E. Rekoske, L. M. Aparicio, R. J. Madon, J. Dumesic, *J. Catal.* **1995**, *153*, 65.)

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The use of mathematical modeling is discussed in Chapter 11. The last chapter in the book treats the more advanced topic of the ways in which competing thermal and mass-transfer rate processes may affect observed kinetics. Heterogeneous catalytic reactions are not treated in this volume.

This book will be useful as a handbook to guide development chemists and engineers seeking to scale-up chemical reactions, and it certainly fills a gap in this area in the kinetics literature. I fear that in places the notation might be intimidating to scientists not comfortable with mathematics. For example, Helfferich assigns proper credit to the work of Christiansen in developing methods to describe intermediate species in multistep reactions, noting that later authors in this field have received greater attention. However, I believe that the popularity of this later work, and in particular the pictorial approach developed by King and Altman, arises from the fact that it is much more accessible to chemists and biologists than is Christiansen's use of matrix notation. In general, however, Helfferich's text is well-written and readable. This valuable feature will make it an enabling tool for practical kinetics, even in areas of research not discussed in the text but which are growing in importance. It is easy for the reader to see how the treatment of parallel reactions in Section 5.2 may be applied to asymmetric catalytic reactions. Similarly, the discussion of coupled reactions in Section 5.3 may be extended to examples of dynamic kinetic resolution.

There is one aspect of the treatment in this book that I believe may be misleading to chemists who are familiar with qualitative aspects of reaction networks but are new to a quantitative kinetic approach. This concerns the relationship between stoichiometric and catalytic reactions. The distinction between the two is defined in Chapter 1, but becomes blurred in later discussions. While it is noted that the mathematical basis for quantitative network elucidation given in Chapters 6 and 7 applies to stoichiometric and not catalytic systems, several of the examples treated in those chapters refer to catalytic reaction networks. Thus, Example 7.4 discusses several proposed pathways for the hydrocarbonyl-catalyzed hydrogenation of aldehydes, one of which is given below:

$$\text{ald.} \underset{\text{CO}}{\overset{\text{cat.}}{\rightleftharpoons}} X_1 \rightleftharpoons X_2 \underset{\text{cat.}'}{\overset{H_2}{\rightleftharpoons}} \text{alc.}$$

X_1 and X_2 are intermediates in the conversion of the aldehyde to the alcohol. However, closure of the catalytic cycle is not considered in this mechanism. This is stated simply as a caveat given in parentheses in the text:

(step: cat.′ + CO → cat. – not shown)

This statement defines the essential difference between a stoichiometric reaction, which is open-ended, and a catalytic reaction, which closes back on itself. The important implications of this distinction may not be clear to a nonspecialist reader.

The conditions for the extension of rules governing stoichiometric reaction networks to catalytic cycles are given in Chapter 8. These are that one reaction step dominates the network and that the catalyst exists predominantly in the form of one intermediate alone. In real catalyst systems these conditions are very often not satisfied, and it is impossible to predict a priori whether or not they will be. The introduction in Chapter 6 of "one-plus" rate equations as an empirical approach to reaction networks adds to this confusion between stoichiometric and catalytic reactions, since the most common examples of this form of rate equation are found in catalytic networks.

In conclusion, I believe that Professor Helfferich has made an important contribution to the kinetics literature with *Kinetics of Homogeneous Multistep Reactions*. The issues I have raised concerning stoichiometric versus catalytic reactions will undoubtedly receive further discussion as more and more examples are treated as part of the current resurgence in interest in fundamental reaction kinetics.

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Heinrich Caro and the Creation of Modern Chemical Industry. By *Carsten Reinhardt* and *Anthony S. Travis*. (Series: Chemists and Chemistry, Vol. 19.) Kluwer Academic Publishers, Dordrecht 2000. 453 pp., hardcover $ 189.00 (ca. € 208).—ISBN 0-7923-6602-6

More lies behind this title than one would suppose at first glance. In their book Reinhardt and Travis have gone beyond the discussion of the role played by Heinrich Caro in the formation and development of the modern chemical (including dyestuffs) industry. The middle chapters are concerned with the years that Caro spent in Manchester (1859 – 1866) and with BASF in Ludwigshafen (from 1868 onward). In addition the first two chapters give insights into the sociocultural background of his early years in Posen and Berlin, and his professional and (uncompleted) academic education, as foundations for his subsequent career. Furthermore, the biography ends with three chapters in which the authors put the work of Heinrich Caro into context and also quote critical comments by contemporaries such as Carl Glaser, who was a colleague of Caro in BASF from 1869 onward. The authors also consider the question of how Caro and his achievements were viewed in later years up to the 1920s, when he became something of a legend. They also discuss contemporary views about the decline of the British chemical industry in that period.

The structure of the book is partly systematic and partly chronological, and Reinhardt and Travis have also included in it some of their earlier historical researches. Both are recognized experts on the German and British dyestuffs industries, having many publications to their credit, but in this book they also look beyond that special field. Their study has been primarily based on Heinrich Caro's bequests to the Deutsches Museum in Munich, which have proved to be a very rich source of information and insights regarding the beginnings of the dyestuffs industry and of patent protection in Germany and Great Britain.

The best chapters are those dealing with Caro's work in Manchester and Ludwigshafen (Chapters 3 – 9). Here the

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