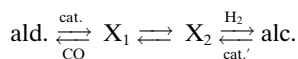


The use of mathematical modeling is discussed in Chapter 11. The last chapter in the book treats the more advanced topic of the ways in which competing thermal and mass-transfer rate processes may affect observed kinetics. Heterogeneous catalytic reactions are not treated in this volume.

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:



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: $\text{cat.}' + \text{CO} \rightarrow \text{cat.}$ – 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 non-specialist 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.

Donna G. Blackmond
Department of Chemistry
University of Hull (Great Britain)

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

authors write about the history of the science and technology with much detailed knowledge, including Caro's activities as an inventor, his scientific contributions in the dyestuffs field, and the technological development of these ideas. They emphasize the importance of the development of research within the industry as a complement to academic research in universities, a trend which became a part of the research philosophy in BASF, mainly through Caro's influence. Closely related to that was the exchange of scientific knowledge and cooperation between industrial research and university chemistry, which Heinrich Caro cultivated through a network of contacts with the holders of key university professorships in chemistry, often leading to contractual agreements for collaborative research. The cooperative relationship in basic research at the universities, which had in fact developed earlier in other chemical companies as well, is at present a particular characteristic of the German chemical industry.

Whereas the chapters mentioned above follow a systematic approach, the others tend to keep very close to the source material, too close in my view. In Chapters 10 and 11 especially, in

discussing the personal qualities of Heinrich Caro it would have been better to do so from an objective distance and to put these aspects into context. One cannot entirely avoid the feeling that the authors have allowed themselves to be carried along by the eloquence of their sources. That is also true to some extent of Chapter 1, the central part of which comes from an autobiography written by Caro in 1852. Here, because the authors have failed to treat their source material critically enough, they reach unsubstantiated conclusions about Caro's social relationships and personality that could only be properly considered by an approach based on the intellectual history of the time. One sometimes gets the impression from the evident efforts of the authors that they have been determined to fit as much as possible of their source material into the discussion. In particular, the evidence presented to emphasize the role played by Caro in the early history of the chemical industry, important though it undoubtedly was, seems rather overdone. This wish to use all the available material seems to be the only explanation for the section on "Jews in the German Empire" (pp. 325–328). It contains lengthy extracts

from a correspondence about the Jewish origins of some German chemists, but these do not seem to be very relevant to the authors' speculations about whether or not Caro was subjected to animosity by antisemitic elements. It might also have been worthwhile to consider Caro's Jewishness from a more positive viewpoint, by enquiring into whether his wide contacts came at least partly from belonging to an ethnically defined network. The formation of networks and its causes is a topic that has received much attention from researchers into economic history.

This book about Heinrich Caro is a valuable contribution to the history of science and of chemistry in particular. For industrial and economic historians it leaves some important questions unanswered, but it appears that the book is not mainly intended for them. As is evident from the fact that it is published in the series *Chemists and Chemistry*, it will be of interest mainly to readers concerned with the history of chemistry.

*Hans-Jürgen Quadbeck-Seeger,
Susan Becker
BASF AG
Ludwigshafen (Germany)*