Neither editor is alive. D. Papahadjopoulos died in 1998. After the 'founder' of liposome research, Sir Alec Bangham, he was the scientist with the highest impact on liposome research. D.D. Lasic, who was in the liposome community the most important reviewer, critical evaluator and restless designer of concepts, died unexpectedly in November 2000. This book with a careful selection of contributions in the large field of liposome research and development is a great legacy of both outstanding liposomologists for all scientists in this fascinating area of research.

Rolf Schubert*
Department of Pharmaceutics, Albert-Ludwigs-University Freiburg, Freiburg, Germany

* Pharmazeutisches Institut, Lehrstuhl für Pharmazeutische Technologie Hermann-Herder-Strasse 9, 79104 Freiburg, Germany. Tel.: +49-761-203-6337; fax: +49-761-203-6366.
E-mail address: rolf.schubert@pharmazie.uni-freiburg.de (R. Schubert).

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"Freeze-Drying"
Georg-Wilhelm Oetjen, Wiley-VCH, 1999, 276 pages, Euros 119, ISBN 3-527-29571-2

Covering both food as well as mechanical applications, the author describes the rules of freeze-drying. Oetjen, who worked for many years in the freeze-drying business, presents important processing steps and process data not only theoretically but explained with regard to practical examples. He states in the preface of his book: "I have tried to show the interconnection between the property of the product, the goal to make it stable and the necessary processes to achieve this". It cannot be denied that he reached his aim.

This volume of the book, published first in 1997 only in the German language, was extended in 1999 by this English version. As in this relatively short interval great progress has been made in the field of freeze-drying, the interested reader might question whether this book is a simple translation of the 1997 volume. Many of the chapters are virtually unchanged over the German edition, but in two integral parts this textbook has been replenished.

Firstly, the initial number of nearly 220 references in the German edition was supplemented by approximately 50 new ones (most of them in the first part) which gives a comprehensive selection of actual information. With this, the reader has a variety of references at one's disposal, having the ability to apply them to his tasks and working out individual problems. Secondly, part 6 was extended with a chapter entitled 'Trouble shooting' (4 pages). In contrast to the 1997 volume Oetjen gives a brief overview about a selection of unexpected or undesirable events during freeze-drying processes. In my opinion it seems to be a completion to the classification of possible failures discussed in part 2. This information is commonplace for an experienced reader, but for a beginner it might be too short to offer first aid, and no literature references are given.

The book is divided into six parts (266 pages), each with up to five chapters. The first part is entitled 'Foundations and Process Engineering' and it is the most extensive one compared with those following. There are chapters of fundamental importance, because they present basic knowledge of the freeze-drying process serving as a basis for understanding the following chapters. At very best, part 1 contains roughly 50% of all references: the other parts have much fewer. The chapter 'Freezing' (56 pages) gives a detailed overview of heat transfer, cooling velocity, structure of ice, influence of excipients, freezing of cells, structure analysis and finally possible changes of structure. For freshmen who are not familiar with pharmaceutical process engineering, the author gives many examples and illustrations for the presented equations and freezing regimes. The principles of primary and secondary-drying are presented in the chapter 'Drying' (51 pages). Also, an excellent overview about temperature and pressure measurements for process monitoring is given in this chapter, discussing their advantages and limits. Sections about collapse or re-crystallization of a product, illustrated by cryomicroscopy, complete this chapter. The conclusion of part 1 is the chapter 'Storage' (7 pages) giving brief examples for measurements of residual moisture, influence of vial stoppers on residual moisture, as well as changes of product structure by time.

The second part combines several chapters dealing with 'Installation and equipment technique' presented with many illustrations and figures. One can read the chapters, and even the single sections, independently of each other. This part can be mostly recommended for experienced readers with a more technical orientation. Chapter 1 (7 pages) gives general ideas concerning large-scale freezing possibilities of pharmaceuticals and food. The second chapter, entitled 'Components of a freeze-drying plant' (40 pages) provides useful information about drying chambers, shelves, water vapor condensers, refrigerating systems, vacuum pumps and control systems. As well as a list of minimum requirements of freeze-drying plants and their control system, Oetjen concludes this chapter with a short overview and explanation of possible problems during freeze-drying processes. In the following chapters the author makes a common division into three categories of freeze-dryers, regarding capacity and freeze-dried product. The chapter 'Installations up to 10 kg ice capacity' (11 pages) deals with laboratory and pilot plants enumerating general guidelines. The short chapters 'Chamber production plants' (7 pages) and 'Production plants for food' (7 pages) conclude this subdivision without allowing the reader to gain a deeper

insight into this field. At this juncture I miss a separate chapter on scale-up discussions to be included.

Part 3, devoted to 'Pharmaceutical, biological and medical products' (25 pages), enumerates a host of practical issues concerning prevention of product denaturation, inactivation or destabilization during freeze-drying. There are, for example, chapters on proteins and hormones, viruses and bacteria, antibiotics, liposomes and transplants. Only freeze-drying of viable products is not discussed here. The following two parts give a comprehensive overview of difficulties in lyophilization of foodstuff (10 pages) and technical products like metal oxides and ceramic powders (2 pages). The presentation of these parts is a structured summary of research articles (most of them from the beginning of the 1990s) which enables a reader concerned with these problems to fall back to the references interesting for him.

The remaining part is thematically split into the chapter 'Trouble shooting' (4 pages) and a chapter about process qualification and validation (10 pages). The reader might question why Oetjen resumes the discussion of these trouble-shooting strategies at this point and not, what could be advantageous, at the end of chapter 2.2 (mentioned above).

Oetjen's English edition of 'Freeze-Drying' is a well written textbook with many monochrome images which provides a summary of the latest information in a clear and accessible style. This book reaches a high standard of presentation, assuming that its readers have basic knowledge of mathematics and physics. Despite its relatively high price it can be recommended not only to undergraduate or graduate students getting deeper into the field of freeze-drying but also to experienced readers interested in product development.

Henning Gieseler*
Department of Pharmaceutics, Friedrich-Alexander-University Erlangen-Nürnberg, Erlangen, Germany

* Tel.: +49-9131-852-9547; fax: +49-9131-852-9545.
E-mail address: gieseler@pharmtech.uni-erlangen.de (H. Gieseler).

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