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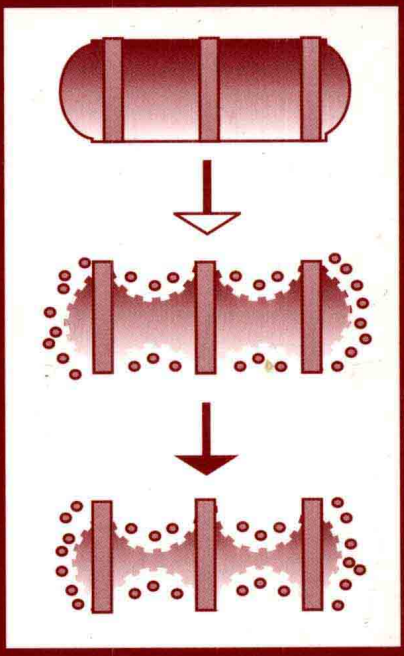
Modified-Release Drug Delivery Technology



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To my daughter Jenna

—*M.J.R.*

Preface

For over 50 years, interest has been expressed in optimizing drug therapy through delivery system design. For many years this revolved around incorporating drugs into erodible or inert polymers, which then acted as platforms for controlled release, an approach that has been well reviewed in the literature. In more recent times there has been a move away from simply formulating drugs into erodible or inert polymers toward the design and development of more advanced drug delivery systems that utilize sophisticated designs and manufacturing techniques and rely on novel means for controlling the release of drug from the delivery system. Over the last few decades, rapid developments have occurred in this area and we have witnessed the evolution of commercially successful companies that specialize in the design, development, and commercialization of specific (in-house) modified-release drug delivery systems.

This is an exciting and growing area of pharmaceutical research. However, to date no single volume provides detailed and specific information on even a handful of individual modified-release drug delivery systems. Therefore, we decided to edit a book comprised of chapters that collectively address this void and provide an insight into the various approaches currently adopted to achieve modified-release drug delivery.

The book is divided into parts, each of which addresses a particular route for drug delivery. Although it is assumed that the reader is already familiar with fundamental controlled-release theories, each part opens with an overview of the anatomical, physiological, and pharmaceutical challenges in formulating a modified-release drug delivery technology for each route for drug delivery. The

chapters in each part provide examples of the different approaches that have been taken to design and develop an innovative modified-release drug delivery system. Each chapter presents a detailed account of a specific modified-release drug delivery technology, written by experts on that technology.

Our challenge in editing this book was that no single volume could be expected to describe every modified-release drug delivery technology currently marketed or under development. This is because of the vast and evolving nature of the area, and the lack of availability of the innovators to write a monograph on their particular technology, due to either time constraints or the proprietary nature of their work. Instead of using this as an excuse to reject the challenge, we set ourselves the aim to provide in the book as many examples of modified-release drug delivery technologies as possible.

Susan Charman and Bill Charman were the leaders of the first part of the book, which is devoted to the oral route. The Charmans provide an excellent overview of the challenges of this popular route for modified-release durg delivery. Their introduction is followed by 15 chapters that provide an insight into the novel and innovative approaches that have been taken for this route for drug delivery. These range from novel manipulations of tableting technologies (including geometric designs and osmotically driven technologies) through three-dimensional printing to the use of lipids. The second part, led by Professor Clive Wilson, discusses several diverse approaches that may be used to deliver compounds to the colon. Chapters demonstrating the innovativeness of workers in this field complement an incisive introduction that highlights the unique challenges associated with this site of absorption. The leader of Part III, Bernard Plazonnet, includes in his introduction a thorough review of currently available and emerging modified-release ophthalmic drug delivery systems. Since most of these systems are in the developmental stage and have not yet reached the commercial stage, this part contains only three chapters on specific technologies. Part IV focuses on the oral cavity as a site of drug delivery. The part leader, Professor Ian Kellaway, together with invited coauthors, provides an overview of the issues relating to the development of modified-release drug delivery systems for this route. The associated chapters highlight technologies developed for specific regions of the oral cavity, including sublingual, buccal cavity, gingiva, and periodontal pocket.

A diverse range of technology approaches are associated with the dermal and transdermal route. Part leader Professor Jonathan Hadgraft not only has written a thorough overview but has also organized a series of chapters that cover a wide range of diverse technologies from wound dressings to sprays, to propulsion of solid drug particles into the skin by means of a high-speed gas flow, to patches that deliver drugs via diffusion, iontophoresis, sonophoresis, or microprojections. The sixth part of this book addresses implant and injection technologies. In their introduction, part leaders Franklin Okumu and Jeffrey Cleland offer a comprehen-

sive overview of this evolving and challenging area of drug delivery. They complement their efforts with chapters that cover a diverse range of technologies. Part VII, compiled by leaders Daniel Wermeling and Jodi Miller, offers a revealing look into the nasal route of drug delivery. Professor David Woolfson, leader of Part VIII, presents a comprehensive account of the biological and pharmaceutical challenges to the vaginal route of drug delivery, which is restricted to 50% of the population and is limited by cultural and societal constraints. The chapters dealing with this route provide an insight into the different approaches that can be employed to deliver drugs via the vaginal passage.

In Part IX Igor Gonda provides an informative overivew of the unique challenges in delivering via the pulmonary tract. This part contains chapters describing various systems, devices, formulations, and methods of delivery of drugs to the lung. It differs somewhat from other parts in the book in that the focus of pulmonary drug delivery systems is not on the control of release of the medicaments once they are deposited within the respiratory tract (although some chapters in this part do describe such approaches) but on the ability of inhalation systems to deliver drugs practically instantaneously to the target organ that is the "release" part of therapeutic activity for many of the currently approved products for inhalation. Numerous technological approaches are described in the chapters in this part, each of which provides descriptive comments on the complexity of this route for drug delivery. In the final part of this book the regulatory issues pertaining to these diverse and often complex drug delivery systems are addressed by Patrick Marroum of the United States Food and Drug Administration, who provides a regulatory overview for one of the most highly legalistic markets.

We would like to express our thanks to each of the part leaders, who spent so much time identifying technologies, communicating with contributors, writing informative overviews, and editing the chapters. We also thank all the chapter authors. Their individual innovative research activities have contributed greatly to the current modified-release drug delivery technology portfolio that exists today within the pharmaceutical industry. We are grateful to them for taking the time to share their experiences and work. Finally, we wish to express our sincere thanks to Dr. Colin Ogle. We are indebted to Colin for giving up so much of his spare time to proofread final drafts and offer many constructive suggestions for improvement of this volume.

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