MODERN METHODS OF ORGANIC SYNTHESIS

The fourth edition of this well-known textbook discusses the key methods used in organic synthesis, showing the value and scope of these methods and how they are used in the synthesis of complex molecules. All the text from the third edition has been revised, to produce a modern account of traditional methods and an up-to-date description of recent advancements in synthetic chemistry. The textbook maintains a traditional and logical approach in detailing carbon–carbon bond formations, followed by a new chapter on the functionalization of alkenes and concluding with oxidation and reduction reactions. Reference style has been improved to include footnotes, allowing easy and rapid access to the primary literature. In addition, a selection of problems has been added at the end of each chapter, with answers at the end of the book. The book will be of significant interest to chemistry and biochemistry students at advanced undergraduate and graduate level, as well as to researchers in academia and industry who wish to familiarize themselves with modern synthetic methods.

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Preface to the first edition

This book is addressed principally to advanced undergraduates and to graduates at the beginning of their research careers, and aims to bring to their notice some of the reactions used in modern organic syntheses. Clearly, the whole field of synthesis could not be covered in a book of this size, even in a cursory manner, and a selection has had to be made. This has been governed largely by consideration of the usefulness of the reactions, their versatility and, in some cases, their selectivity.

A large part of the book is concerned with reactions which lead to the formation of carbon–carbon single and double bonds. Some of the reactions discussed, such as the alkylation of ketones and the Diels–Alder reaction, are well established reactions whose scope and usefulness has increased with advancing knowledge. Others, such as those involving phosphorus ylids, organoboranes and new organometallic reagents derived from copper, nickel, and aluminium, have only recently been introduced and add powerfully to the resources available to the synthetic chemist. Other reactions discussed provide methods for the functionalisation of unactivated methyl and methylene groups through intramolecular attack by free radicals at unactivated carbon–hydrogen bonds. The final chapters of the book are concerned with the modification of functional groups by oxidation and reduction, and emphasise the scope and limitations of modern methods, particularly with regard to their selectivity.

Discussion of the various topics is not exhaustive. My object has been to bring out the salient features of each reaction rather than to provide a comprehensive account. In general, reaction mechanisms are not discussed except in so far as is necessary for an understanding of the course or stereochemistry of a reaction. In line with the general policy in the series references have been kept to a minimum. Relevant reviews are noted but, for the most part, references to the original literature are given only for points of outstanding interest and for very recent work. Particular reference is made here to the excellent book by H. O. House, *Modern Synthetic*

Reactions which has been my guide at several points and on which I have tried to build, I feel all too inadequately.

I am indebted to my friend and colleague, Dr K. Schofield, for much helpful comment and careful advice which has greatly assisted me in writing the book.

26 October 1970

Preface to the fourth edition

Some Modern Methods of Organic Synthesis was originally written by Dr W. (Bill) Carruthers, and three popular editions were published that have helped many students of advanced organic chemistry. Unfortunately, Dr Carruthers died in 1990, just prior to his retirement. As his successor at the University of Exeter, it was appropriate that I should take on the task of preparing the fourth edition of this text. In honour of Dr Carruthers, a similar format to previous editions has been taken, although of course the book has been completely re-written and brought up-to-date (through 2003) to take account of the many advances in the subject since the third edition was published. As in previous editions, the text begins with descriptions of some of the most important methods for the formation of carbon–carbon bonds, including the use of enolates and organometallic compounds for carbon–carbon single-bond formation (Chapter 1), methods for carbon–carbon double-bond formation (Chapter 2), pericyclic reactions (Chapter 3), radicals and carbenes (Chapter 4). There has been some re-organization of material and emphasis has been placed on reactions that are useful, high yielding or selective for organic synthesis. For example, Chapter 1 has been expanded to include some of the most popular and contemporary reactions using main-group and transition-metal chemistry (rather than placing reactions of organoboron and silicon compounds into a separate chapter). A new chapter describing the functionalization of alkenes has been devised, covering reactions such as hydroboration, epoxidation and dihydroxylation (Chapter 5). The book concludes with examples of pertinent oxidation (Chapter 6) and reduction (Chapter 7) reactions that are used widely in organic synthesis. The opportunity has been taken to add some problems at the end of each chapter, with answers at the end of the book. References have been compiled as footnotes on each relevant page for ease of use.

In common with the previous editions, the book is addressed principally to advanced undergraduates and to graduates at the beginning of their research careers. My aim has been to bring out the salient features of the reactions and reagents

rather than to provide a comprehensive account. Reaction mechanisms are not normally discussed, except where necessary for an understanding of the course or stereochemistry of a reaction. My hope is that the book will find widespread use as a helpful learning and reference aid for synthetic chemists, and that it will be a fitting legacy to Dr Carruthers.

The majority of the text was written at the University of Exeter before my move to the University of Sheffield and I would like to acknowledge the encouragement and help of the staff at Exeter.

Part of one chapter was written while I was a Visiting Professor at the University of Miami, and I am grateful to Professor Bob Gawley for hosting my visit. My thanks extend to various people who have proof-read parts of the text, including Chris Moody, Mike Shipman, Mark Wood, Alison Franklin, Joe Harrity, Steve Pih and Ben Dobson. Finally, I would like to thank my family for their patience during the writing of this book.

I. Coldham
January 2004