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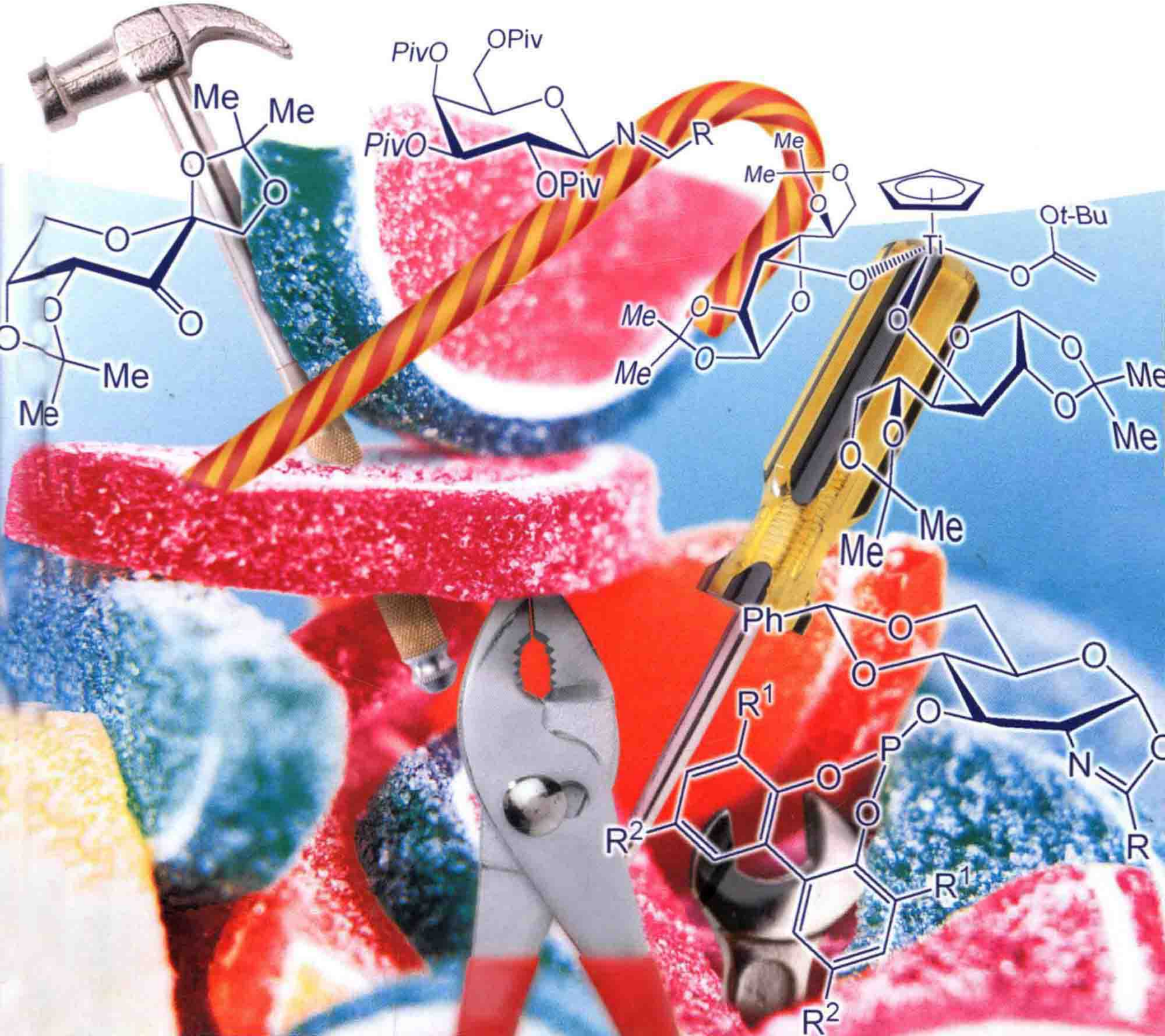
Carbohydrates – Tools for Stereoselective Synthesis



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Carbohydrates – Tools for Stereoselective Synthesis

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Foreword

Among the organic compounds provided by nature, carbohydrates are those which contain the highest density of stereochemical information. In addition, carbohydrates are cheap and readily available in large quantities. Logically, carbohydrates, in particular monosaccharides, emerged as valuable enantiomerically pure starting materials for numerous total syntheses of interesting natural products and drugs. In spite of these attractive properties, carbohydrates have almost been ignored as tools for stereodifferentiation in stereoselective syntheses for a long time. This may be traced back to some frustrating experiences of leading researchers in the field as well as to the widespread impression among chemists that carbohydrates, although they can be sweet, sometimes tasting and even convertible to stimulating liquids, are difficult to handle and to purify if they do not crystallize.

It is a great benefit of the book *Carbohydrates–Tools for Stereoselective Synthesis* and a particular merit of the editor Mike Boysen and the authors he invited that they convincingly show how useful and efficient carbohydrates actually are as stereodifferentiating tools in a broad range of stereoselective reactions. In a number of cases, these stereoselective conversions finally paved an elegant way to access interesting enantiomerically pure products of quite different structures.

In the chapters of the book, the authors describe briefly, but comprehensively, carbohydrates in their function as chiral auxiliaries in diastereoselective reactions (Part I), as stereoselective reagents (Part II), as the decisive chiral ligands of enantioselective catalysts (Part III), and as organo-catalysts in enantioselective syntheses (Part IV). The subdivision according to the type of reaction provides a profound survey over the accomplishments achieved so far. Clear schemes displaying the reactions and all required information concerning conditions, yield, stereoselectivity, and original literature enlarge the profit the reader can gain from this book. In many cases, the interpretation of the stereodifferentiating effects induced by carbohydrate is also outlined, thus stimulating interested chemists to let their own ideas climb up the dense chirality of the carbohydrates. The book is a competent and inspiring source for preparative chemists aiming at demanding chiral target compounds on innovative paths.

Mainz, November 2012 *Horst Kunz*

Preface

Carbohydrates are arguably one of the most important classes of natural products. They serve as important energy sources and energy storage compounds in both animals and plants, and are essential as integral parts of structural fibers for plants, fungi, insects, spiders, and crustaceans. Apart from this, glycoconjugates – carbohydrate structures covalently bound to proteins and lipids – have been recognized to play a fundamental role in biological recognition and signaling processes on a cellular level.

From the point of view of synthetic organic chemistry, carbohydrates are primarily of interest to scientists working in the fields of glycoconjugates and glycomimics. As far as total synthesis of complex natural products and medicinal chemistry are concerned, simple carbohydrates – mainly monosaccharides – are occasionally used as inexpensive enantiopure chiral starting materials. In these ex-chiral-pool syntheses, some or all of the stereocenters of the carbohydrates are incorporated in the target structure. Application of carbohydrates as starting materials for the design of chiral auxiliaries, reagents, complex ligands, or organocatylsts, that is, as synthetic tools for de novo setup of stereocenters, on the other hand, has long been avoided by chemists. This may be due in part to some deeply rooted prejudices against carbohydrate chemistry, which I have encountered myself ever since I started working with carbohydrate compounds during my PhD time: carbohydrates are frequently believed to be "difficult" substrates because of their manifold functional groups, and I have even been asked whether it is at all possible to purify these "sticky" and "over-functionalized" compounds. Thus, carbohydrates have often been regarded as unsuitable or impractical for the design of stereodifferentiating agents for asymmetric synthesis. The foundation of these prejudices is, however, quickly dispelled by proper research of the literature, revealing highly successful examples of all kinds of carbohydrate-based tools for the setup of new stereocenters.

In this context, we set out to collect successful and instructive examples for carbohydrate tools in stereoselective synthesis for this book. It is the first publication to give the reader a comprehensive overview of today's scope and limitations of these tools, which in some areas have already become indispensable supplements to the arsenal for modern stereoselective synthesis. This book covers all four types of carbohydrate tools comprising a furanose- or a pyranose-type

scaffold; open chain structures and derivatives of tartaric acid are only included in some exceptional cases. Our aim is not only to bring carbohydrate tools to the awareness of the readers, but also to encourage them to apply these to their advantage in their own synthetic efforts as they often complement the scope of more traditionally used stereodifferentiating agents. Further, we would like to motivate especially young researchers to use their creativity and skills to add their own contributions to the toolbox of carbohydrate-derived stereodifferentiating agents: carbohydrate scaffolds offer unique opportunities for both the design and optimisation of novel synthetically useful tools.

I would like to thank Ms. Elke Maase, who helped me to initiate this book project, and Ms. Lesley Belfit, whose help during the editing and production process was invaluable. Finally, I would like thank all authors who contributed to this venture!

Hannover, October 2012 *Mike Boysen*

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