Preface

Life and chirality have become invariably interlocked. This association is based on the assumption that key biological processes such as replication and translation would have been extremely difficult and inefficient in a racemic world. Conversely, enantiopure building blocks represent evolvable and self-replicating forms of life, an argument that has driven considerable experimental research since the early 1990s. With these exciting premises, it is not surprising that previous volumes of *Topics in Current Chemistry* were devoted to particular domains in the field such as asymmetric crystallization, amplification mechanisms, or chiral supramolecular architectures in an attempt to gain insights into the origin of chirality. The present volume constitutes a step forward, examining biochirogenesis from a multifaceted perspective. Far from being distracting, it is hoped that many readers will greatly appreciate the effort to cover the breadth of the origin and evolution of chirality through different scales and approaches.

An introductory chapter, the heading of which may certainly be *Retournons à Pasteur*, informs us about the seminal work of a few pioneers who discovered the molecular basis of enantiodiscrimination, often aided by no more than observation and intuition. Meierhenrich and associates then focus on the early incarnation of chirogenesis beyond our modest planet and the solar system itself. A collection of astrophysically relevant experiments opens the door to mechanisms capable of generating the small enantiomer imbalances found in interstellar bodies, thus serving as seeds of molecular diversity and, why not, life. Blackmond and co-workers have sought important answers from simple physico-chemical models, such as those involving attrition-enhanced deracemization, where the interplay of thermodynamic and kinetic factors exerts a decisive influence on enantioselection. González-Campo and Amabilino deal with mirror-symmetry breaking at surfaces and interfaces, unveiling potential routes to enantiodiscrimination in natural scenarios, leaving aside the impact of chirality on processes like biomineralization. Blanco and Hochberg move the discussion to their theoretical territory and provide a sound rationale that accounts for mirror-symmetry breaking and amplification in amino acid systems at the air/water interface and lattice-controlled formation of homochiral peptides.

Excursions into the biological machinery are well exemplified by two concluding chapters. Percec and co-workers use dendritic dipeptides as simplified models of larger peptide assemblies and show how the helical self-assembly of homochiral

sequences is thermodynamically more favorable than that of their heterochiral and racemic counterparts. Finally, Dutta Banik and Nandi shed light, with the aid of experimental and computational studies, on the enantiodiscrimination of protein biosynthesis, which involves aminoacylation in the active site of t-RNA synthetase coupled with peptide bond formation at the ribosome.

I am grateful to my esteemed colleagues who have contributed to this volume. They have filled the pages that follow with their unique approaches and achievements, all directed to the unveiling of the origin of enantioselection that characterizes living systems. Chirality certainly predates life, and, like the origin of life, no one was around to witness such historical events. Some hold that nothing regarding chirogenesis can ever be proven. However, science creates methods, interprets results, formulates mechanisms, and introduce strategies to mimic the ways of nature. Probably, Confucius (551–479 BC) put it better: *I hear and I forget, I see and I remember, I do and I understand.*

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