

Preface

This volume, entitled *Nucleation, Aggregation and Crystallization — Beyond Medical and Other Implications*, is a compilation of articles written based on the lectures presented by leading experts during their participation in the homonymous “International Course”^a held at the Karolinska Institutet (2007) and in the scientific meetings of the MARIE Network of the European Science Foundation (2004–2006) on “Myelin structure and its Role in Autoimmunity.”

The word “nucleation,” derived from “nuclear family,” is based on the concept of a progenitor, or the mother and father of any family. As a physico-chemical process, *nucleation* is followed by two poorly understood phenomenon: *aggregation and crystallization*. *Aggregation* underlies disorders like

^a The following organizations supported/sponsored the course “Nucleation, Aggregation and Crystallization — Beyond Medical and Other Implications,” (in alphabetical order): BioVectis Sp.z.o.o www.biovectis.com, CHEMILIA AB www.chemilia.com, GE Healthcare Life Sciences www.gehealthcare.com/lifesciences, HAMPTON Research www.hamptonresearch.com, International Organization for Biological Crystallization www.iobcr.org, Japanese Society for the Promotion of Science, Stockholm Office www.jsps-sto.com, Karolinska Institutet Education AB www.karolinskaeducation.ki.se, ESF MARIE Network, Molecular Dimensions Ltd. www.moleculardimensions.com, Oxford Diffraction Ltd. www.oxford-diffraction.com, PCF-CRYSTALLOMIC™ www.crystallomic.eu, Protein Wave Corp. www.pro-wave.co.jp, RIGAKU www.rigaku.com, Tekno Optik AB www.teknooptik.se, Wenner-Gren Foundation www.wennergren.org, Åke Wiberg Foundation www.ake-wiberg.com.

Alzheimer's and "mad-cow" disease (aggregation of amyloid plaque), and cardiovascular diseases (deposition in coronary vessels of cholesterol and lipids). *Crystallization* refers to the appearance of crystals under physiological conditions (gout, silicoses, and liver or kidney stones).

Crystallization is a physicochemical process appearing in nature or artificially in test tubes, leading to formation of solid crystals from a uniform concentrate of slightly supersaturated solutions. In biological crystallization, crystals are usually needed for the determination of the three-dimensional structure of proteins and other biological macromolecules by X-ray crystallography. The structure is needed for a better understanding of protein function and in order to design effective drugs. If the structure of a protein is precisely solved, the designed drug is supposed to be more effective.

The selection of 20 chapters in this book covers important topics on the principles and methods of the crystallization procedures in one-, two- and three-dimensions, including those regarding organic fine chemicals and pharmaceutical compounds. Moreover, the book describes the use of oils and magnetic fields to grow better quality protein crystals. Other chapters deal with the relevance of bioinformatics and mass spectrometry in crystallography, and discuss both the role of molecular mimicry and the structure of amyloid proteins and myelin proteins in diseases such as polyneuropathies, Alzheimer's disease and multiple sclerosis.

In recent years, the MARIE Network, funded by the European Science Foundation, re-introduced the concept that recognition of biological structures such as the myelin sheath, is fundamental for the understanding of specific diseases and the design of better therapies. Through MARIE, structural studies on myelin and multiple sclerosis are now enjoying a renaissance after a period of low interest. This can be ascribed to new theoretical or technological developments and to the progress in several fields, including bioinformatics, X-ray crystallography, and proteomics, but also to the MARIE idea to encourage the integration of different kinds of expertise in the fields of biophysics, biochemistry, molecular biology, neurology, neuroimmunology, and bioinformatics. This cooperation between experts in structural studies and specialists in

cell biology and neuroimmunology has enabled deeper probing into the underlying structure of the myelin sheath and to understand the processes by which various components involved in immune response, such as cytokines, antibodies, proteinases, and free oxygen radicals, may degrade the myelin over time, causing multiple sclerosis.

MARIE has helped to revive multiple sclerosis research at the structural level. Some aspects of this renaissance, in particular those regarding crystallization, form the fundamentals of this book, which provides a unique perspective of the physical and chemical sciences on one hand, and the biological and medical sciences on the other, and should be of considerable value to scientists, physicians, students.

One of our teachers, Nobel Laureate Dr. Gajdusek, passed away on December 12, 2008, few weeks after the 2nd proofs reading. The 3rd proofs were planned in January 2009. We have decided to treat his chapter, entitled, "From Kuru to Nucleation, Aggregation, Polymerization and Crystallization in Biology and Medicine" as his "scientific testament," and to leave a few very minor mistakes in the text. Chapter I of this book is probably the last scientific writing of Dr. Gajdusek.

I (JS), met Dr. Gajdusek for the first time in Chengdu, Sichuan, China, June 25–28, 2006, during the "First International Conference of Nanobiomedical Technology and Structural Biology." He gave a lecture "Nucleation, Medical Diseases and Beyond." It was a beautiful and informative lecture. He told us why he went to study kuru among the Fore people of New Guinea. New Guinea is the place he loved so much. His research on kuru was never supported financially by any organization, except his own funds. He never wrote any grant application for the whole of his life. From China (2006), at the age 82, he left for Tibet to continue his research. He was an old fashion scientist; he never used a computer for word processing, and he never had a secretary. He wrote this chapter by hand. I will remember him as a very energetic person, full of new ideas and new concepts, very friendly and supportive of teaching. We will miss him in other courses we will organize in the years to come.

We would like also to thank the publisher World Scientific Publishing, in Singapore, especially Ms Sook-Cheng Lim, for their support, encouragement

Preface

and to take on the “board” publication of our book. I would like to thank Prof. Gösta Winberg (KI, MIT) for introducing me to Dr. Gajdusek and for his support for the course; Prof. Zhang Shuguang (MIT) for inviting me to China, where I met for the first time, Dr. Gajdusek.

This book is dedicated to all interested in the subject of nucleation, aggregation and crystallization of proteins, particularly to potential course leaders who may use this book during their teaching.

Jan Sedzik

Editor

Associate Professor

Protein Crystallization Facility

Department of Neurobiology

Care Sciences and Society

NOVUM

Karolinska Institutet, Stockholm

Sweden

Paolo Riccio

Co-editor

Professor

Università degli Studi della Basilicata

Department of Biology D.B.A.F.

Campus Macchia Romana

85100 Potenza, Italy

Chair of the ESF MARIE Network

and

Associate Professor

Protein Crystallization Facility

Royal Institute of Technology

Department of Chemical

Engineering and Technology

KTH, Teknikringen 28

SE 100 44 Stockholm, Sweden

Board Member, ESF MARIE Network

Chair, JSPS Alumni Club Association

Stockholm, Sweden

Stockholm, Potenza,

February 12, 2009

viii