Preface

The present volume in the series Progress in Brain Research originates from the 23rd International Summer School of Brain Research, held from 25 to 29 September 2003 in Amsterdam. This event was organized jointly by the Netherlands Institute for Brain Research and the Netherlands Ophthalmic Research Institute, both institutes of the Royal Netherlands Academy of Arts and Sciences. The Summer Schools of Brain Research form a long-standing biennial tradition of the Netherlands Institute for Brain Research, the Proceedings of which have been published in the Elsevier series, *Progress in Brain Research*.

The program of the 23rd International Summer School was dedicated to the theme "Development, Dynamics and Pathology of Neuronal Networks: From Molecules to Functional Circuits". Emphasis was given to key mechanisms in the development of neurons into functional circuits, to the dynamics in neural circuits in relation to cognitive/behavioral processes, and to the implications of abnormal network development for different types of brain disorders. This theme and focus were inspired by the rapid progress in neuroscience and visual science at the different levels of biological organization, from the molecular to the cognitive level. Molecular neurobiology shows unprecedented progress in identifying key genes and genetic mechanisms involved in the normal development, functioning and plasticity of the nervous system, as well as in its pathology. The role of bioelectric activity in neuronal plasticity is a recurring subject in many of the chapters, further underscoring the intriguing role of the specific patterning of firing activity in shaping neuronal networks. Crucial to this progress are technical developments in the use of multi-electrode arrays and voltage sensitive dye imaging, which enable recording and quantification of electrophysiological communication at the network level. These developments, together with progress in computational neuroscience, are also vital to further our understanding of how network structure and firing dynamics are interrelated, and how activity-dependent plasticity mechanisms provide a remarkably robust homeostatic stabilization of neuronal excitability, synaptic connectivity and balance between excitation and inhibition as neuronal networks mature. Our increased understanding of the development and functioning of neuronal networks furthermore is of great potentially practical importance in addressing brain pathologies such as mental retardation, Alzheimer's disease, epilepsy and schizophrenia, which are discussed in this volume.

The chapters in this volume provide a balanced mix between research reports and reviews. Starting with an overview of our current knowledge on network formation in the human brain (Section I), they describe molecular and cell-biological mechanisms of neuronal network development and synapse formation (Section II), synapse rearrangement (Section III), structure and dynamics in neurons and neuronal networks (Section IV), dynamics in neural circuits in cognition (Section V), and deficient circuitry and cognitive/behavioral pathology (Section VI). The volume also integrates in a natural way research of the visual system and of the central nervous system, emphasizing the central role of neuronal networks

in (visual) information processing and illustrating the advanced state of understanding of network development, plasticity and functioning of the visual system.

We are extremely gratified by the enthusiasm with which a great number of scientists participated in the meeting and contributed to this volume. In addition, we wish to acknowledge the generosity of both the Royal Netherlands Academy of Arts and Sciences and the Neuroscience Graduate School Amsterdam for their financial support. Additionally, we are grateful to a number of other generous financial supporters, mentioned on a separate page.

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