

Preface

The phenomenon of adult neurogenesis, or persistent generation of neurons in the adult brain, is attracting more and more attention every day. Adult neurogenesis has become increasingly important to studies of brain development and diseases, learning and memory, and aging. A considerable number of papers on the mechanism of adult neurogenesis or linking this process to various physiological and pathological events are published monthly. Most recent popular textbooks in the neurosciences also provide ample coverage of basic principles of adult neurogenesis, a topic which just 20 or 30 years ago was considered tangential, controversial, or unimportant.

The discovery that some populations of neurons continue to be produced postnatally has dramatically changed previous fundamental concepts of neuroscience. For example, it was widely believed that once development is complete and the embryonic and fetal scaffolding for neuronal generation, migration, and integration are dismantled, these processes cannot be reenacted; therefore, once neurons die they never regenerate. This dogma has been overturned, and studies on adult neurogenesis have opened up the possibility of newborn neurons participating in brain tissue repair and processes of learning and memory. Investigations of adult neurogenesis have also led to basic new principles on the identity of neural stem cells, the function of transit amplifying progenitors, and new forms of neuronal migration. Furthermore, some neuropsychiatric disorders are suspected to be associated with defects in adult neurogenesis.

Despite the existence of such a broadly applicable and fundamentally important phenomenon, 20 years ago only a few groups in the world studied adult neurogenesis. It was the pioneering [^3H]-thymidine autoradiography studies of Joseph Altman that showed in the 1960s how newborn neurons continue to be formed postnatally in the rodent hippocampus and olfactory bulb. Adult neurogenesis, however, did not become widely accepted and remained a controversial field for more than a decade. In the 1980s a series of rigorous studies, inspired by the neurobiology of song learning in birds, led Fernando Nottebohm and his group to demonstrate the origin, migration, and recruitment of new neurons in song-control nuclei and the rest of the telencephalon of adult canaries. Unfortunately, the history of the field is either ignored or underappreciated by the many neuroscientists who are now interested in or working on adult neurogenesis. To redress that, this book contains historically crucial and memorable articles by Drs. Altman and Nottebohm describing from a

very personal perspective the motivations and excitement that triggered these seminal discoveries. They also highlight some of the scientific and funding challenges posed by the strong early opposition to adult neurogenesis. Their two articles should not only be the primary source for neuroscientists interested in the initial discoveries in adult neurogenesis and how they came about, but should also be of value to those interested in science history, funding, and policy.

Novel methods for labeling new neurons – new thymidine analogs such as BrdU, immunohistochemical markers for immature neurons, retrovirus and genetic tagging techniques – resulted in the 1990s in an explosion of studies on the mechanism and function of adult neurogenesis. Stunningly beautiful preparations revealed the entire process of neuronal formation in the adult and revealed the nature and connectivity of individual newly formed neurons. Physiological studies have begun to decipher the unique contribution of new neurons to adult neural circuits. Despite the enormous progress made over the past decade, it is clear that we are still in the early days of understanding the functional meaning and molecular mechanisms of adult neurogenesis. In preparation for this next stage of discovery, we thought it was fitting to compile a collection of thoughtful reviews from leading laboratories working in this area of research.

Contributing researchers describe their current work in 27 chapters that are grouped into two volumes, which cover a wide array of topics concerning adult neurogenesis. The first volume, in addition to the two articles by Drs. Altman and Nottebohm on the history of adult neurogenesis, comprises a comprehensive presentation of the basic biology of adult neurogenesis: basic aspects of neurogenesis, adult neurogenesis in non-mammalian vertebrates, in the mammalian hippocampus and olfactory bulb. In the second volume, clinical implications of adult neurogenesis are considered, including neurogenesis in the adult monkey and human brain, Parkinson's disease, epilepsy, stress, depression, schizophrenia, stroke, brain injury, and neurodegenerative and neuropsychiatric pathology.

A small research group in Japan, the Adult Neurogenesis Kondankai (Conference), working on various aspects of adult neurogenesis initially conceived these volumes. Later, two new editors (A.A.-B. and J.M.P.) joined the project and the original idea was expanded and appropriately shaped. Our goal is not only to provide a comprehensive knowledge base on adult neurogenesis, but also to share our excitement and motivation for an extraordinary field in the neurosciences. We believe that these ingredients will be fundamental to future research in this exciting field towards a better understanding of how adult neurogenesis is maintained and regulated, and how it contributes to plasticity and possibly one day to brain therapy.

During the editing of these two volumes, a massive 9.0-magnitude earthquake struck northeastern Japan on March 11, 2011, and tens of thousands of people died in the resulting tsunami. We dedicate this book to their memory, and offer our deepest condolences to those who lost loved ones.

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Neurogenesis in the Adult Brain I

Neurobiology

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