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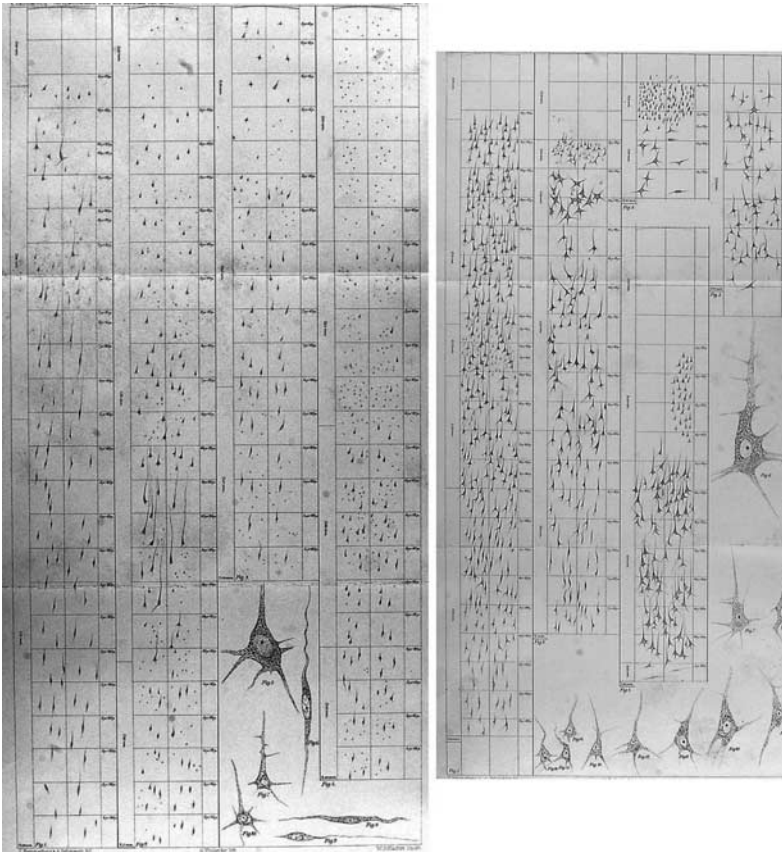
978-0-521-88975-9 - The Newborn Brain: Neuroscience and Clinical Applications, Second Edition

Hugo Lagercrantz

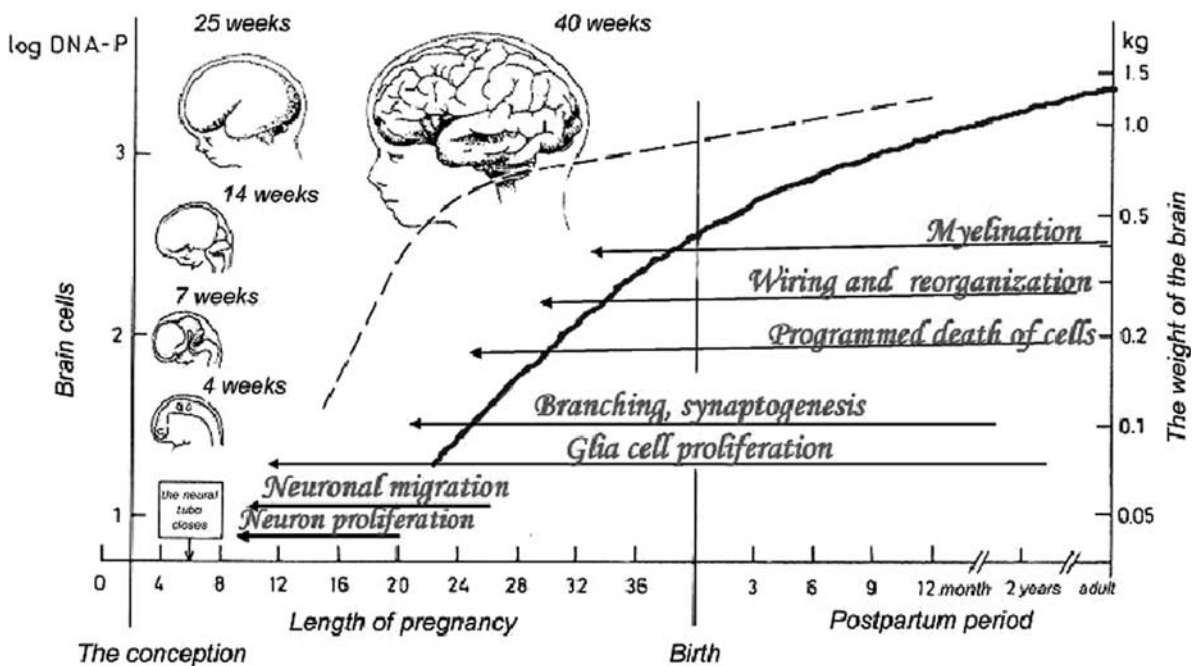
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The Newborn Brain



Laminar patterns in microcephaly vera. Architectonic patterns of normal cortex (left panel) and cortex from microcephalic subjects (right panel). The Betz cells in column 3 and 4 of the left and right panels identify the pre-Rolandic gyrus in normal and microcephalic brains. The other columns in each panel illustrate corresponding regions of frontal, parietal, and occipital association cortical regions. The microcephalic cortex is laminated with attenuation of superficial layers. (From Hammarberg, 1895; Caviness *et al.*, 2008, with permission from S. Karger AG, Basel.)



Milestones of brain development. Based on Dobbing, J. and Sands, J. Timing of neuroblast multiplication in developing human brain. *Nature* 1970; **226**: 639–40 and Rakic, P. Specification of cerebral cortical areas. *Science* 1988; **241**: 170–6.

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The Newborn Brain Neuroscience and Clinical Applications

Second Edition

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Preface to the First Edition

For ages philosophers have discussed how the brain and the mind are created. Descartes and Kant thought that true ideas are innate, while Locke and Hume claimed that the brain is a blank slate at birth. William Harvey opposed the idea that the organs, e.g., the brain, are preformed and maintained that the organs develop successively – epigenesis. Sigmund Freud who can be regarded as determinist wrote that our ideas and psychology are based on small substructures (genes). The mapping of the human genome has reinitiated a debate on the concept of preformation – today genetic determinism vs. environmental instructionism. A third alternative is the idea of selectionism or neuronal darwinism. The premature brain is a jungle according to Gerald Edelman with redundant neurons and pathways and due to environmental influences only the most suitable neuronal circuits survive (see chapter by Changeux). “Cells that fire together wire together – those that don’t won’t.” (see chapter by Penn & Shatz).

The busy obstetrician scanning the fetal brain by ultrasound or the neonatologist monitoring the newborn brain may have limited time to ponder these eternal questions. The main reason for publishing this book is to present the state of the art on how the brain is formed. The recent breakthroughs in our understanding of the development of the brain originate from studies of invertebrates like fruit-flies or nematodes, mice or ferrets. It is difficult for the hard-working clinician attending the delivery, neonatal or neuropsychiatric ward to grasp this literature. On the

other hand, the basic scientist may have only a vague idea of the clinical expression of mutations or disorders of neuronal migration and synaptogenesis, pre-term birth or perinatal asphyxia.

Jean-Pierre Changeux commences the book with some reflections on the origin of the human brain. The chapters then follow the major milestones of brain development: formation of the neural tube, neurogenesis, migration of neurons, synaptogenesis and organization of the brain wiring. Special chapters are devoted to neurotrophic factors, neurotransmitters, glial cell biology and cerebral circulation. Then the development of sensory functions is described.

The second part of the book deals with more clinical aspects, particularly methods to investigate the infant brain by imaging and electrophysiological techniques. Two chapters deal with clinical aspects of the brain of the full-term infant and one with the preterm infant. The authors have specially emphasized how the knowledge from basic science can be applied in clinical practice.

We hope that this book is of interest for a broad readership from the more theoretical biologist, molecular geneticist and the biophysicist to the clinical fellow in obstetrics, neonatology or neuropsychiatry as well as the neuropsychologist. The book can also be recommended as a textbook for graduate courses.

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The Editors

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Preface to the Second Edition

Understanding the development of the human brain and the emergence of consciousness is a fundamental quest, of similar magnitude to the study of the origin of life from inorganic matter. We can talk about a “big bang” of brain development, when hundreds of thousands of new neurons are formed every minute in the fetal brain and up to one million synapses are generated every second in the child’s brain. Jean-Pierre Changeux opens this book with a reflection on the origin of the human brain. The main milestones – such as the proliferation and migration of neurons, synaptogenesis, formation of glial cells – are presented in separate chapters by leading authorities in the field. The selection of neuronal pathways and the organization of the neuronal circuits are discussed by Carla Shatz and others. The development of somatosensory, visionary, and auditory modalities are described in detail. There are also separate chapters on neurotrophic agents and neurotransmitters/neuromodulators.

The remainder of the book deals more with clinical matters, while also presenting the basic science

necessary to understand these problems. These chapters encompass imaging the brain, biophysical assessment of the brain, hypoxic–ischemic encephalopathy, the vulnerable preterm brain, and infections of the brain. The mechanisms leading to abnormal neuropsychological outcome are also discussed in detail.

In this second edition most of the chapters from the first edition have been completely rewritten in line with modern science and clinical practice. Some new chapters have been added, for example on behavior and the emergence of consciousness.

We hope that this book will be of interest for a broad readership from theoretical biologists, molecular geneticists, and biophysicists to clinicians in obstetrics, neonatology, and neuropediatrics, as well as neuropsychologists. The book can also be recommended as a textbook for graduate courses.

Stockholm, New Haven, Southampton, and London

October 13, 2009

The Editors