

Neuronal Growth Cones

“I had the good fortune to behold for the first time that fantastic ending of the growing axon. In my sections of the spinal cord of the three day chick embryo, this ending appeared as a concentration of protoplasm of conical form, endowed with amoeboid movements. It could be compared with a living battering ram, soft and flexible, which advances, pushing aside mechanically the obstacles which it finds in its path, until it reaches the region of its peripheral termination. This curious terminal club, I christened the growth cone.”
(Santiago Ramón y Cajal, *Recollections of My Life*, 1937)

In *Neuronal Growth Cones*, Phillip Gordon-Weeks presents the molecular biology of the behaviour of growth cones. The book discusses the history of the discovery of growth cones and their importance in the development of a properly connected nervous system. This book is the first detailed, critical analysis of all aspects of growth cone biology.

Neuronal Growth Cones covers the basic morphology and behaviour of growth cones, motility and neurite extension via the growth cone cytoskeleton, pathfinding, intracellular signalling, and synaptogenesis.

This detailed treatment of our current knowledge of the growth cone is intended for advanced graduate students, postgrads, and researchers in cellular and molecular neuroscience, developmental biology, and anatomy.

Phillip R. Gordon-Weeks is in the Developmental Neurobiology Centre of King's College London.

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Preface

I had the good fortune to behold for the first time that fantastic ending of the growing axon. In my sections of *the spinal cord of** the three day chick embryo, this ending appeared as a concentration of protoplasm of conical form, endowed with amoeboid movements. It could be compared with a living battering ram, soft and flexible, which advances, pushing aside mechanically the obstacles which it finds in its path, until it reaches the region of its peripheral termination. This curious terminal club, I christened the **growth cone**.

Santiago Ramón y Cajal, *Recollections of My Life*, 1937 and 1989

If I had known how long it would take me to write this monograph on neuronal growth cones for Cambridge University Press, I would never have started it! I agreed to do so over seven years ago at a time when the task seemed considerably less daunting than it would be if I were starting now. However, as the years passed and the annual rate of publication of papers on growth cones became exponential, I began to feel I was facing a Herculean task. Of course, I did manage to get in a few games of tennis between writing chapters. I have tried to cover all topics concerning growth cones with the exception of regeneration, and I hope that the book is useful to both those entering the field and those who already work in it.

Many people have helped me to write this book, and I only have space to thank a few. David Tonge, Philip Beesley and Max Bush read large chunks and made many helpful and constructive suggestions for improvements; I owe them a debt of thanks. I would also like to thank Kate Kirwan for many of the line drawings and Leon Kelberman for photography, my family for tolerating my neglect, and the members of my lab for reading and commenting on earlier versions. Finally, I would also like to say a special thank you to Robin Smith, my commissioning editor at Cambridge University Press (now with Springer), for his elastic patience and seemingly limitless ability to tolerate my repeated breaking of deadlines and for his imaginative and practical suggestions on reading my efforts.

Phillip R. Gordon-Weeks

* As pointed out by Jacobson (1991, p. 195), the Craigie (Ramón y Cajal, 1937) English translation from the French omitted the words in italics.

Abbreviations

ADP	adenosine diphosphate
AMP	adenosine monophosphate
ATP	adenosine triphosphate
cAMP	cyclic adenosine monophosphate
DC	direct current
DRG	dorsal root ganglion
ECM	extracellular material
F-actin	filamentous actin
G-actin	globular actin
GABA	γ -amino butyric acid
GAP-43	growth-associated protein 43
GDP	guanosine diphosphate
GTP	guanosine triphosphate
MAP	microtubule-associated protein
micro-CALI	micro-chromophore-assisted laser inactivation
MTOC	microtubule-organising centre
MuSK	muscle-specific kinase
NCAM	neural cell adhesion molecule
NgCAM	neuron-glia cell adhesion molecule
NrCAM	neuronal cell adhesion molecule
NGF	nerve growth factor
PC12	phaeochromocytoma cells
RAGS	repulsive axon guidance signal
VASE	variable alternative spliced exon