C. elegans II
Monograph 33
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Studies of the cells and genes of the nematode C. elegans have become a cornerstone of current biology. A classic 1988 Cold Spring Harbor monograph described the basic genetics, anatomy and development of the organism. Now, in that authoritative tradition, comes C. elegans II — not a second edition but a book that breaks new ground and defines the current status of the field, providing a detailed molecular explanation of how development is regulated and the nervous system specifies varied aspects of behavior. This volume is a must for any investigator doing worm studies but it has been written and rigorously edited to illuminate for a wider community of investigators in cell and molecular biology who should know how new knowledge of C. elegans relates to their own specialty.

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Bibliography
1997, 1222 pp., illus., color plates, index

Also available:
The Nematode Caenorhabditis elegans
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Edited by William B. Wood, University of Colorado, Boulder
1988, 667 pp., illus., appendices, bibliography index
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Cover  Dissociation of cerebellar attention (yellow and blue) and motor (green and red) activation (yellow and green = overlap in activation of 3 or more subjects; blue and red = overlap of any 2 subjects). Three-dimensional volume rendering of the cerebellum and brain stem demonstrates that during an attention task, the most common site of activation was in the left superior posterior cerebellum, while during a motor task, the most common site was in the right anterior cerebellum. (For details, see Courchesne and Allen, volume 4, p. 1; image rendered using VoxelView 2.5.)
Coming next month in Learning & Memory, vol. 4, number 1, May/June 1997, the second special issue devoted to the cerebellum

Review

Prediction and Preparation, Fundamental Functions of the Cerebellum
Eric Courchesne and Greg Allen

Research Papers

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Lateral Cerebellar Hemispheres Actively Support Sensory Acquisition and Discrimination Rather Than Motor Control
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Cerebellar Guidance of Premotor Network Development and Sensorimotor Learning
Sherwin E. Hua and James C. Houk

Role of Cerebellum in Adaptive Modification of Reflex Blinks
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Single-Unit Evidence for Eye-Blink Conditioning in Cerebellar Cortex is Altered, but Not Eliminated, by Interpositus Nucleus Lesions
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Conditioned Response Timing and Integration in the Cerebellum
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A Model of Pavlovian Eyelid Conditioning Based on the Synaptic Organization of the Cerebellum
Michael D. Mauk and Nelson H. Donegan

Local Dendritic Ca$^{2+}$ Signaling Induces Cerebellar LTD
Jens Elers, Hajime Takechi, Elizabeth A. Finch, George J. Augustine, and Arthur Konnerth

Absence of Cerebellar Long-Term Depression in Mice Lacking Neuronal Nitric Oxide Synthase
Varda Lev-Ram, Zuryash Nebyelul, Mark H. Ellisman, Paul Huang, and Roger Y. Tsien
The cerebellum has intrigued neuroscientists for more than a century. This fascination is in part due to its unique macroscopic appearance and the fact that it occupies a significant percentage of the brain. At the microscopic level, the beauty of its cellular architecture is universally appreciated. The limited number of cell types and the apparent modularity of its cellular organization have raised the possibility that the cerebellum will be the first brain structure to be understood completely. The structure is intrinsically appealing, but what is its function and importance? Based on evolutionary considerations alone, it appears to be quite important. For example, during the past 10 million years, the size of the cerebellum has increased in greater proportion to other brain structures, including the cerebral cortex. The question of its function is less clear. Historically, the cerebellum was considered to be important for motor function. Based on the comparison of the sizes of cerebella in different species having different postural demands, the prevailing view in the early part of this century was that the cerebellum was critical for the control of posture. In reviewing these considerations, Cajal, in 1914, concurred with this view. Moreover, he stated “It should be obvious already that the cerebellum has nothing to do with consciousness or other higher functions.”

However, over the past 20 years, research has seriously challenged the traditional views of the cerebellum’s exclusive role in postural control. Beginning with the theoretical work of Marr, and the empirical work of Ito, Thach, and their colleagues, it became clear that the domain of the cerebellum extends beyond postural control. It is involved in motor learning, as well. Moreover, a specific form of synaptic plasticity, long-term depression (LTD) at the parallel fiber–Purkinje cell connection, has been implicated in the motor learning mediated by the cerebellum. But studies of patients with cerebellar dysfunction, as well as recent positron emission tomography (PET) and functional magnetic resonance imagery (fMRI) studies, raise the possibility of a greatly expanded range of cerebellar function. These include attention, associative learning, practice-related learning, procedural learning, declarative memory, working memory, semantic association, conditioned anxiety, mental exploration, and complex reasoning and problem solving, as well as sensory, motor, and motor skill acquisition.

Despite the tremendous advances in cerebellum research at the anatomical, biophysical, and systems levels, there is still no general theory that encompasses and explains the functional role played by the cerebellum in these diverse motor and nonmotor domains. Indeed, there is significant debate whether the cerebellum does in fact subserve all of these diverse functions. Even the role of the cerebellum in motor learning itself has been questioned. Because of the intense interest in the cerebellum in general, and its role in motor learning in particular, Learning & Memory has devoted two special issues to this topic. We cover the cerebellum’s role from the molecular to systems approaches, with techniques ranging from cell culture to brain imaging. The approaches of mathematical modeling and computer simulations are also represented, because these raise the possibility of generating testable models of cerebellar function and tests of theories of the computations that are performed by the cerebellum. These special issues certainly advance the understanding of the cerebellum, but as these issues illustrate, the field has not yet matured to the point of a general framework of cerebellar function. Learning & Memory will serve as a vehicle to foster the continued exchange of information and debate in those areas.

John H. Byrne
Editor