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Book Reviews

The cerebellum: Learning movement, language, and social skills, D.M. Broussard (Wiley-Blackwell, UK) 2014. 240 pages. Price: not mentioned
ISBN 978-1-118-12563-2

This monograph on the cerebellum written by Dianne M. Broussard is an in-depth revelation of what the cerebellum is and can be. This often neglected part of brain has been given its due respect. The book, divided into four sections, starts with a thorough description of macro and micro anatomy along with a histological perspective as well as physiological correlations of the cerebellum. The second chapter describes cerebellar operations as either a linear system versus a discrete timing system. Paralleled to the functioning of a super computer hard drive, the crerbellum is described to function in learning, identifying patterns and recoding information. Synaptic plasticity gives it the capacity to learn accurately-timed responses to particular patterns of input activity. It can also optimize adaptive fitters that determine how time varying signals are transmitted by the cerebellum and pattern recognition devices that encode patterns as pauses in P-cell discharge. Using all its tools, the cerebellum can learn to recognize situations and to generate optimized behavioural responses to them. Thus, the cerebellum helps to perfect and speed up the motor activity and behavioural repertoire. Chapters 3 and 4 deal with cerebellar long-term depression (LTD) and describe how plasticity works at the cellular level and how the different mechanisms may interact to cause learning between synaptic long term potentiation (LTP) and LTD at excitatory and inhibitory synapses and intrinsic plasticity. The cerebellar cortex has a large toolbox at its disposal. The cortical circuitry may carry out expansion recoding by generating a variety of temporal patterns in the granular layer.

Chapters 5 and 6 describe the actual evidence linking some of these mechanisms to learning. Chapter 5 describes the nictitating membrane response (NMR) and the evidence from the NMR system regarding the hypothesis that crebellar cortex may be the first site of memory encoding and that consolidation may rely on re-endcoding of the memory in deep crebellar nuclei (DCN). Mauk's hypothesis has also been described which requires two sites for memory encoding, one for generating the NMR and another for timing it, which is more complex but may provide a better fit to the data.

Chapter 6, describes the cerebellar multiple cellular mechanisms not restricted to LTD, to correct the amplitude, and speed of eye movements. Chapter 7 enumerates the mechanisms and available proof for the importance of posterior lobe of the cerebellar cortex to encode memory for several kinds of skill learning involving the limbs, especially if the skill requires cognition or explicit learning.

The anterior lobe may be required for improving motor performance and for carrying out the task in a co-ordinated fashion. Chapter 8 covers in detail the function of cerebellum in interaction with environment for precise and accurate movements in relation to objects of outside world. It is summarized that it is cerebellar action that ensures performance of astonishing feats of precision control for balance and locomotion. In chapter 10 the author returns to "timing" and the paramount importance of how "timing is everything". Timing may be accomplished using a reference clock that is based on synchronous climbing-fiber activity and on reverberating activity in the cerebellar loops. Both complex and simple spike synchrony can be used to associate information that relates to a particular movement.

Section IV deals with a view on how cerebellum is essential for interpreting the world. Chapter 11 deals with cerebellum as the seat for intelligence, executive

function, memory, problem solving, speech and language and the possible mechanisms thereof. The author's view that the cerebellum has in many ways enhanced the cerebral higher functions of cognition, memory, language and adaptability is explained in detail. Chapter 12 deals with crebellar and emotional expression, in particular the role of posterior lobe of cerebellum has been highlighted.

The book ends with a succinct yet clear synopsis of the entire book with the quote "the cerebellum does everything!"

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