Clinically and Theoretically Derived Cerebellar Functions

A series of clinically and theoretically derived speculations regarding cerebellar functions are presented. The data is derived from clinical observations of dyslexics as well as neurophysiologic animal investigations. An attempt has been made to assimilate and integrate the resulting insights (Frank and Levinson, 1976–77) so as to explain:

1. the dynamic sensory-motor foreground/background filter function of the cerebellum;
2. the evolution of the cerebellum;
3. sensory-motor cerebellar learning;
4. the role of the cerebellum in processing the total sensory input;
5. the role of the cerebellum in modulating conscious and nonconscious perception;
6. the role of the cerebellum in motion sickness and motion-sickness mechanisms;
7. the neurophysiologic function of the motion-sickness medications.

It is hoped that the application of these clinically and theoretically derived cerebellar concepts might be a small step in a direction predicted by Eccles et al. (1967, p. 315) at the end of *The Cerebellum as a Neuronal Machine*:

We are confident that the enlightened discourse between such theorists [communication theorists and cyberneticists] on the one hand and neurobiologists on the other will lead to the development of revolutionary hypotheses of the way in which the cerebellum functions as a neuronal machine; and it can be predicted that these hypotheses will lead to revolutionary developments in experimental investigation.
The Cerebellum as a Dynamic Sensory-Motor Foreground/Background Filter

Mode III Blurring-Speed Observations and Hypotheses

For c-v normal individuals, the Mode III moving background does not induce a foreground/background tracking nystagmus, the fixated foreground is invariably reported as clear and stationary, and fixation of the moving background does not induce abnormal foreground changes—regardless of stimulus or background direction.

The Mode III testing of DD individuals with significantly reduced Modes I and II blurring speeds often results in a stimulus- and direction-dependent background-induced nystagmus, and foreground movement, reversals, and/or blurring are reported. In other words, the moving scenic background induces or provokes an optokinetic nystagmus, and compensatory attempts to regain foreground fixation and stabilization result in a zigzag foreground/background ENG ocular deflection pattern. This foreground/background nystagmus manifests itself symptomatically and clinically in reversals, scrambling, and blurring.

Fixation of the moving background intensifies or provokes foreground blurring, movement, or scrambling among dyslexics whereas conscious and intentional fixation of the foreground sequence, or single targets within this sequence, minimizes these symptoms. These and related clinical observations clearly illustrate the difficulties experienced by c-v-impaired dyslexics in selectively inhibiting or suppressing background events so as to maintain foreground clarity and prevent foreground/background contamination.

As a result of these clinical observations, it was postulated that the cerebellum plays a vital role in maintaining foreground/background separation by a highly specific and selective process of active background inhibition—thereby acting as a dynamic sensory-motor foreground/background filter.

Evolution of the Cerebellum

Sir John Eccles (1970, pp. 3–4) states:

There is general agreement among neuroscientists that every conscious experience—every perception, thought, and memory—has as its material counterpart some specific spatio-temporal activity in the vast neuronal network of the cerebral cortex and sub-cortical nuclei, that is woven of neuronal activities in space and time in the “enchanted loom” so poetically described by Sherrington (1940).

The cerebellum was postulated by the author to play a silently active role in the function of this mysterious “enchanted loom”—a role not inferior to that of the cerebral cortex. In attempting further to understand cerebellar