Key Note

# Chapter 9: Vestibular and proprioceptive systems

## Key note 9A: Plasticity in the VOR

The vestibulo-ocular reflex (VOR) has attracted attention because its gain – the relationship between input and output – can be modified from feedback about its effects on vision. This note describes the neural sites at which changes may occur and ideas about their form.

The neural plasticity underlying changes in the VOR has been found to occur in two sites, the cerebellum and the vestibular nuclei (e.g. Boyden et al., 2004). The role of the cerebellum has been established from the effects of lesions there which abolish the ability to modify VOR gain (Ito, 1982), but the nature of this role is less clear. One suggestion is that it stores the motor memory for the learned change in VOR gain. Another is that it computes the signal guiding the induction of plasticity in vestibular neurons. However, the available evidence does not support either hypothesis unequivocally (Boyden et al., 2004). Recent work suggests that initial changes occur in the flocculus of the cerebellum, which then gradually reprograms the vestibular nuclei, to become superfluous in the reflex until further reprogramming is needed (Menzies et al., 2010).

Boyden ES, Katoh A, Raymond JL (2004) Cerebellum dependent learning: the role of multiple plasticity mechanisms. *Annual Review of Neuroscience* 27: 581–609.

Ito M (1982) Cerebellar control of the vestibuloocular reflex—around the flocculus hypothesis. *Annual Review of Neuroscience* 5:275–296.

Menzies JRW, Porrill J, Dutia M, Dean P (2010) Synaptic plasticity in medial vestibular nucleus neurones: comparison with computational requirements of VOR adaptation. *PLOS One* 5(10): e13182. doi:10.1371/journal.pone.0013182