[*From the Proceedings of the Physiological Society*, 18–19 December 1953.]
Journal of Physiology, **123**, 46–47*P*.

Proprioceptive control of muscular contraction and the cerebellum.

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When activity in γ motor efferents causes contraction of the intrafusal muscle fibres, excitatory afferent impulses are sent back to the spinal cord where they may facilitate or initiate discharge of the main motoneurones. In decerebrate cats this sequence may be observed in a muscle by listening in to a single spindle afferent in a small dorsal root filament (innervation otherwise intact). Owing to their 'in parallel' attachment, spindles slow during muscle shortening unless γ activation occurs. In various reflexes, however, spindle acceleration preceded contraction of the main muscle, and acceleration continued during contraction. This shows that spindle activation is facilitating the contraction. De-afferentation of the muscle confirmed this view for then acceleration of the spindle occurred as before, but muscular contraction was abolished (Eldred, Granit & Merton, 1953*a*, *b*).

We have now found that elimination of the anterior lobe of the cerebellum completely alters this picture. The rigidity of the preparation is no longer abolished by dorsal root section (cf. previous work reviewed by Moruzzi (1950)), as it was with decerebration alone. In reflex action too the α motoneurones are independent of proprioceptive support; when contraction takes place, the spindles slow as if they were passive. A loss of tonic γ control is also noticeable in the slower and more regular spindle discharge when the preparation is at rest. Despite this the animal is no less active reflexly than it was before, and may be more so. The accessibility of the motoneurones to non-proprioceptive influences has apparently increased.

The cerebellum seems to control the extent to which contraction is initiated via the γ servo-mechanism or by excitation playing on the α motoneurones more directly. In these experiments the balance is shifted towards excitation by the α route, and the γ spindle mechanism fails to provide the normal pattern of proprioceptive inflow. Similar disturbances may underlie the dysmetria of cerebellar disease.

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