

- 22 Moss NEG, Powers D, Wade DT. The Oxford head injury register. *Disability and Rehabilitation* 1996;18:169–73.
- 23 Moss NEG, Crawford S, Wade DT. Post concussion symptoms—is stress a mediating factor? *Clinical Rehabilitation* 1994;8:149–56.
- 24 King NS, Crawford S, Wenden FJ, Moss NEG, Wade DT. The Rivermead post concussion symptom questionnaire: a measure of symptoms commonly experienced after head injury and its reliability. *J Neurol* 1995;242:587–92.
- 25 Russell WR, Smith A. Post-traumatic amnesia after closed head injury. *Arch Neurol* 1961;5:16–29.
- 26 King NS, Crawford S, Wenden FJ, Moss NEG, Wade DT, Caldwell FE. Measurement of post-traumatic amnesia: how reliable is it? *J Neurol Neurosurg Psychiatry* 1997; 62:38–42.
- 27 King NS, Crawford S, Wenden FJ, Moss NEG, Wade DT. Interventions and service need following mild and moderate head injury: The Oxford Head Injury Service. *Clinical Rehabilitation* 1997;11:13–27.
- 28 Crawford S, Wenden F, Wade DT. The Rivermead head injury follow up questionnaire: a study of a new rating scale and other measures to evaluate outcomes following head injury. *J Neurol Neurosurg Psychiatry* 1996;60: 510–14.
- 29 Goldberg DP, Hillier VF. A scaled version of the general health questionnaire. *Psychol Med* 1979;9:139–45.

## HISTORICAL NOTES

### Robert Whytt and the stretch reflex

The separate structure and functions of sensory and motor nerves were the result of the inspired experiments of Charles Bell, and of Magendie. In the same era Marshall Hall's experiments, executed in his own home, led to his discovery of the reflex arc. It was based on what he called an "excito-motory system"<sup>1,2</sup>—of the spinal cord and nerves, shown in animals after removal of the brain. Hall introduced the term diastaltic, referring to the reflex action *through* the cord. The later extension of the principles of the reflex arc developed into the clinical observations of the tendon and cutaneous reflexes; but, physiologically they were vital to the understanding of the muscle stretch reflex, so brilliantly demonstrated by Liddell and Sherrington.<sup>3,4</sup>

It is of considerable historical interest that the salient physiological features of stretching muscle fibres had been made some 150 years earlier by Robert Whytt.

"Numberless experiments and observations show pricking a muscle causes it to contract, . . . but whatever stretches the fibres of any muscle so far as to extend them beyond their usual length, excites them into contraction in about the same manner, as if they had been irritated by a sharp instrument, or acrid liquor. The motion of stretching the fibres of any muscle will be greater or less, as the muscle is more or less stretched; unless it be so extended as quite to lose its tone and become paralytic."<sup>5</sup>

Whytt observed isolated muscle to twitch after death or after stimulation. Contraction varied with the strength of stimulus,

"but the effects of different stimuli depend very much upon the peculiar constitution of the nerves and fibres of the muscles to which they are applied."<sup>6</sup>

He cited examples such as cold water "agreeable to the nerves of the stomach, yet which excites violent coughing . . . in the windpipe." These observations presage the "doctrine of specific energies of the nerves or senses" (Muller 1801–58).

Experiments in which Whytt stimulated exposed muscle conclude with a clear prescience of the refractory period:

"An irritated muscle does not remain in a contracted state, although the stimulating cause continues to act upon it; but is alternately contracted and relaxed . . . a muscle ought to remain contracted as long as the stimulus or cause of its contraction continues to act upon it; but the fact we see is otherwise; . . . it may continue for some time after it is removed, although these motions become gradually weaker, and are repeated more slowly".<sup>6</sup>

Whytt was one of the most distinguished physicians and neurophysiologists of the 18th century. He wrote of many topics, including pupillary dilatation and contraction related to light and to convergence; dilated pupils in coma due to compression of the thalami nervorum opticorum. His collected writings<sup>7</sup> include treatises: *An essay on the vital and other involuntary motions of animals* (1751); *Observations on sensibility and irritability of parts of men and animals* (1755); *Observations on the nature, causes, and cure of those disorders which are commonly called nervous, hypochondriac or histeric* (1764); *Observations on the dropsy of the brain* (1755).

*Observations on sensibility and irritability* . . . included Hales's famous decapitated frog in which 30 hours later was observed pulsation in the web of the foot, and limb movement when stimulated. After thrusting a needle down the spinal marrow, the animal was strongly convulsed and immediately after became motionless.

He also gave an exposition of the spasm and relaxation of small blood vessels in migraine<sup>7</sup> that foreshadowed the vasospastic theories of Du Bois Reymond and Latham.

Robert Whytt (1714–66) was a Doctor of Medicine at both Rheims and St Andrews. He was Professor of the Theory of Medicine at Edinburgh when he was but 33, FRS at 38, and became President of the Royal College of Physicians of Edinburgh in 1763. He was Physician to George III in Scotland and succeeded to be 5th Baron of Bennoch.

Whytt was the great-great-great-grandfather of Raymond Greene, Endocrinologist and Migrainologist at the Northern Hospital, London and to his brother, the author, Graham Greene.

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- Hall M. *On the reflex function of the medulla oblongata and the medulla spinalis*. *Philos Trans R Soc Lond B*. 1833;123: 635–65.
- Hall M. *Memoirs on the nervous system. Memoir II. On the true spinal marrow and the excito-motory system*. London: Sherwood, Gilbert and Piper, 1837.
- Liddell EGT, Sherrington CS. Reflexes in response to Stretch. *Proceedings of the Royal Society* 1924;96B:212–5.
- Sherrington CS. *Integrative action of the nervous system*. New Haven: Yale, 1906. Revised with new foreword and bibliography, 1947.
- Whytt R. *On the vital and involuntary movements of animals*. Edinburgh. 1763. Cited by Jefferson G. In: Selected papers of Sir Geoffrey Jefferson. pp 73–93. London: Pitman, 1960.
- Whytt R. *The works of Robert Whytt M.D.* (Published by his son). Edinburgh: Balfour, Auld and Smellie. 1768:11–12.
- Whytt R. *Observations on the nature, causes and cure of those disorders commonly called nervous, hypochondriac, or histeric*. Edinburgh: Becket, Pond and Balfour, 1764.