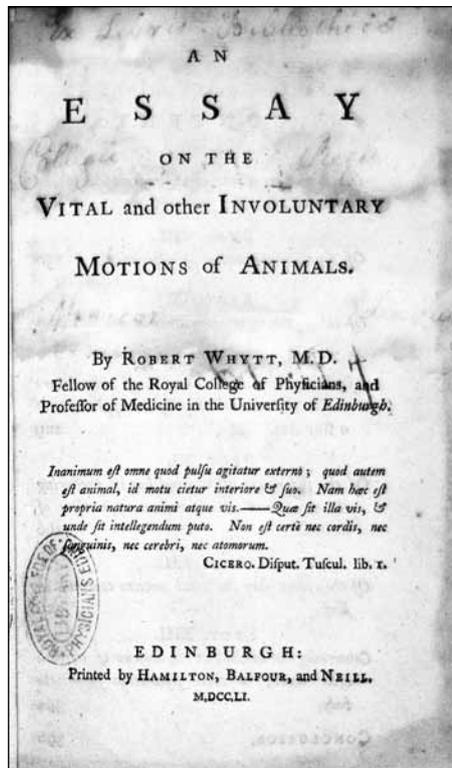


Robert Whytt on the control of movement

Robert Whytt (1714–66) was an Edinburgh contemporary of William Cullen but, unlike Cullen, he has had rather little attention from historians of medicine. The posthumous son of an Edinburgh advocate, he received an MA from St Andrews, studied anatomy in Edinburgh under *Monro primus* and was a pupil of William Cheselden in London. He pursued medical studies in Paris and Leyden but graduated MD in Reims in 1736 and received the same degree from St Andrews in 1737 when he became a Licentiate of the Royal College of Physicians of Edinburgh. The following year he was elected to the Fellowship of the College and began medical practice in and around Edinburgh. In 1747 he was appointed Professor of the Theory of Medicine in Edinburgh, was elected to the Royal Society in 1752 and was the first Royal Physician to be appointed in Scotland (by George III). From 1763 until his death in 1766 he was President of this College. For a more detailed account of Whytt's life and work see the extensive account by French.¹



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An essay on the vital and other involuntary motions of animals. Edinburgh, 1751.

Whytt first attracted notice with the publication of his experiments on the treatment of bladder calculus with lime-water.² This work influenced Joseph Black's studies that led to his discovery of 'fixed air' – carbon dioxide. Whytt's works throw a great deal of light on a number of aspects of contemporary medical practice and, particularly, on its theoretical basis in the physiology of the time which would be interesting to describe. But space does not permit and I shall confine discussion to a topic from one of Whytt's works on neurological subjects³ – the control of movement.

THE BACKGROUND TO WHYTT'S NEUROLOGY

In the eighteenth century the perennial human preoccupations about the nature of the soul and the mind and their relations to the body focussed particularly on questions of how these entities might be involved in the control of movement and the

mechanisms of sensation. Though speculation on these questions had certainly been going on for more than two millennia (probably for much longer) it was only in the seventeenth century that attempts to subject them to examination by experiment were revived; I say revived because in the late afternoon of the ancient world Galen had made some experimental endeavours in this direction. The increasingly precise anatomical observations of the Renaissance had laid a new basis for theorising on the ancient observations that there seem to be some particular relations between the brain and sensation, movement and consciousness – though opinions on this were far from unanimous (with the heart still claiming a prominent role in the emotions). In the seventeenth century this was still a dangerous field, especially in countries where the Holy Office of the Inquisition was active since it was almost impossible not to stray into the territory of the theologians. Descartes's work *On Man* (*De*

homine, 1662; *Traité de l'homme*, 1664) which deals explicitly with mind-body interaction and control of movement⁴ was not published in his lifetime because of his nervousness following the condemnation of Galileo's cosmology by the Italian Inquisition. But by the eighteenth century Descartes's views on the interaction between soul and body and his scheme of motor control were well known, as were Thomas Willis's descriptions of human cerebral anatomy which were much more detailed and accurate than the best descriptions of the sixteenth century. At least in northern Europe it was possible to speculate relatively freely on mind, soul and brain without physical danger, though some care was still needed to avoid charges of atheism and consequent social opprobrium. Whytt was influenced by the work of Descartes and Willis, though he discarded their conclusions.

A difficulty for the modern reader is that the familiar words 'soul' and 'mind' were often used in the eighteenth century in ways now unfamiliar and, confusingly, they were sometimes used interchangeably

– though their meanings were, in fact, generally not interchangeable. It is also important to remember that there was by no means universal agreement among the thinkers of the time about the physical locations (if any) in the body of these entities, on whether soul and mind were separate and on how they might influence the body. Many agreed that there is a particular association of mind, voluntary intention and, indeed, consciousness, with the nervous system but also believed that an insubstantial – that is non-material – entity which is essential to both sensation and movement is not confined to the brain. Serious thinkers, including some who based their conclusions upon careful observation and on the results of experiment, took this view and they chose to call the insubstantial entity necessary for sensation and for movement the ‘soul’. For them, possession of this entity, this immaterial ‘sentient principle’, distinguished living organisms from non-living matter. In this they followed Aristotle, in essence if not in detail. The most extreme example of this doctrine, advocated by Stahl, was called animism in the eighteenth century – but this is most unfortunate because animism can also refer to several other philosophical systems or systems of religious belief in some of which what we would certainly regard as inanimate objects – as well as animals and plants – may be assigned souls.

WHYTT AND THE CONTROL OF MOVEMENT

Whytt was a discursive writer who was anxious to make his meaning, his beliefs and his conclusions absolutely clear; he quotes numerous examples of observations and experiments, his own and others’, and deals in very great detail with objections, real and potential. The result is a text which is fairly easy to follow, and enjoy (though the detail is sometimes a little overwhelming) but whose conclusions are far from easy to summarise. What follows is drawn principally from *An Essay on the Vital and Involuntary Motions of Animals*, published in 1751, with a second edition in 1763 (henceforth *Essay*). Though Whytt has been called an animist he denied that he was a follower of Stahl and repudiated the doctrine that involuntary movements are due to the action of a centrally-located ‘rational soul’. Whytt appears to oscillate between ‘materialist’ explanations of bodily phenomena, and hypotheses relying on an immaterial principle which he sometimes calls the soul. It may well have been that he was happy to follow a ‘materialist’ explanation that depends only upon known properties of matter and on ‘laws’ of physics or chemistry as far as this would lead and only to invoke the immaterial ‘sentient principle’, ‘irritability’ (of muscle) and ‘sympathy between parts’ when he was convinced that ‘material’ explanations were impossible. So, he had a foot in both camps. As to the soul, he inclines to the view that the *anima* or life-force, possessed by all living creatures, and the

supposedly superior *animus* or mind – owned only by ‘rational beings’ – are not separate as many had supposed but that they are ‘...only one and the same principle acting in different capacities’. And this soul he regards as the controller of human involuntary movements since they depend upon the *anima* but can often be influenced by the *animus*. He has no doubt that the soul is entirely immaterial.

At first sight it seems odd that Whytt is very little concerned with voluntary movement. He says:

Although we may be at a loss to explain the nature of that substance in the nerves, by whose intervention the mind seems to act upon the muscles; and though we may be unacquainted with the intimate structure of those fibres upon which this substance operates, yet we have no room to doubt that voluntary motion is produced by the immediate energy of the mind; manifold experience convincing us, that though there be required certain conditions in the body in order to its performance, it is nevertheless owing to the will...(Essay p 2,3).

Thus, the will is, for Whytt, a comprehensible driver of voluntary movement even if he cannot understand how it acts. And there he leaves the subject.

For involuntary or automatic movements such as the heartbeat, respiration, movements of the intestines, changes in pupillary diameter and movements induced by external agents there are no such apparent drivers. Whence, then, is their origin? Again, Whytt is not so much concerned about the actual mechanisms of involuntary movement – though he will try to explain these if he can – as with how, or even why, they are called into action. Where he can find an explanation based on known, or even probable, material properties or physical forces he will pursue it but where he is convinced that no material explanation is possible (or would be possible even if he knew much more than he does about the material properties of tissues or organs) he invokes the immaterial soul with its ‘sensitivity’ and ability to act on the special ‘irritable’ properties of muscle.

So he oscillates between ‘material’ explanations – for example of the control of respiration which he believes to be regulated by the force, pressure or volume of the blood flow through the pulmonary vessels – and those that require an immaterial ‘sentient principle’. Movement induced by, for example, a noxious agent he is convinced can have no material explanation but must involve the detection of the stimulus by the ‘sentient principle’ of the soul present in the peripheral tissue affected and the ‘sympathetic’ action of the soul acting via the brain or the ‘spinal marrow’ upon the ‘irritable principle’ of

the muscle fibres to cause their contraction. He uses the word 'stimulus' to describe the trigger to involuntary movement much as we would now employ it. And he is aware of what would later be called 'local sign' in what we now call reflexes, and of proportionality of response to stimulus in the case of muscle stretching – the greater the stretch the greater the force of contraction.

PUPILLARY REFLEXES

The long section on movements of the pupils (43 pages in the *Essay*) shows Whytt as a shrewd clinical observer. His observations on the pupillary reflexes became so well-known that they were often named after him. He described the direct and consensual reactions of the pupils to light and argued from observations of patients blind in one eye that the constriction of the pupil on exposure to bright light must be due to an effect of the light on the back of the eye – most probably, he believed, on the retina – and not, as had often been argued previously, to a direct action of light on the pupil itself or on its muscles. He also observed correctly the constriction of the pupil on viewing a close object and noticed that this only occurred when the subject stared directly at the near target (and so accommodated to bring it into focus) and not when the near target was simply present in front of the subject.

Important observations ancillary to these conclusions were the presence of circular and radial (as we would now describe them) muscle fibres around the iris and the lack of direct connections or anastomoses between the optic nerves and those controlling the pupils. Since he also believed that there was no connection between the two optic nerves he concluded that the brain, or part of it, must be involved in the pupillary reactions. He says that the pupil of a comatose child was dilated even in bright light and seemed to vary with changes in the depth of the coma and, 'When his head was opened after death we found beneath the corpus callosum about two ounces of water'. From this he concluded that the pupillary dilatation had been due to compression of the *thalami nervorum opticorum* – a view consonant with his belief that the brain is involved in the reactions of the pupils and also that particular parts of the brain might be essential for particular reflexes. Few contemporary physicians would disagree with the accuracy of these observations or disapprove of Whytt's main conclusions from them. But when it comes to the mechanism of constriction of the pupil to light Whytt's views are very unfamiliar to us; he has no 'material' explanation and so he invokes the soul and its sentient principle:

...the uneasy sensation occasioned in the retina by the admission of too much light into the eye, may so affect the sentient principle, which is present and

ready to act, where-ever the nerves have their origin, *as to excite it to determine the spirits more copiously into the orbicular muscle of the uvea,*[§] in order to lessen the pupil, and exclude the offending cause. [my italics]

It would seem that by 'uneasy sensation' – a phrase he uses several times – Whytt was not at all implying what we would mean by the phrase; he does not assume that the *subject* is conscious of uneasiness, or, indeed has any sensation at all of the brightness (though, of course, under some circumstances he might have) but rather that the 'sentient principle' is affected by it. Indeed, his 'sentient principle' does not depend on consciousness but is simply the ability to be 'sensitive' to a stimulus, that is, to detect it and, through its 'readiness to act' to produce a response appropriate to that particular stimulus – in this, and many other cases, to nullify it. For Whytt, then, the pupillary reflexes involved the immaterial soul.

In conclusion, Whytt has been unjustly neglected. I urge anyone interested in the history of neurology or in eighteenth century medical practice, to read his work; it is well worth the effort for the light it sheds both on contemporary practice and on the struggle of a physician to make sense of normal function and of its pathology.

IML Donaldson, Honorary Librarian, RCPE
(email: i.m.l.d@ed.ac.uk)

NOTES

[§] In the second edition (1763, p. 133) the phrase in italics is altered to '...as to excite it to contract the orbicular muscle of the uvea...' By then Whytt no longer believed in the possibility of the contraction of muscle being due to inflation by the injection of 'animal spirits' from the nerve into it, and said simply that the pupil was 'excited to contract' with no suggestion of any mechanism.

REFERENCES

- 1 French RK. *Robert Whytt, the soul, and medicine*. London: The Wellcome Institute of the History of Medicine; 1969.
- 2 Whytt R. *An essay on the virtues of lime-water in the cure of the stone*. Edinburgh: Hamilton, Balfour and Neil; 1752.
- 3 Whytt R. *An essay on the vital and other involuntary motions of animals*. Edinburgh: Hamilton Balfour and Neil; 1751. <http://dx.doi.org/10.1037/11796-000>
- 4 Donaldson IML. The treatise of man (*De homine*) by René Descartes. *J R Coll Physicians Edinb* 2009; 39:375–6. <http://dx.doi.org/10.4997/JRCPE.2009.418>



Robert Whytt FRS (1714–66). Professor in the University of Edinburgh from 1746 or 1747; the title of his chair is uncertain, he is variously described as Professor of the Institutes of Medicine, of the Theory of Medicine and the Practice of Medicine. President of the Royal College of Physicians of Edinburgh from 1763 until his death in 1766. See the article on pages 182–4.

Portrait in RCPE painted by an unknown artist after the school of Bellucci; possibly by Giambattista Bellucci, the son and pupil of Antonio Bellucci. The Wellcome Institute in London has a very similar portrait which is signed by Giambattista Bellucci. Oil on canvas 30" x 26".