METAPHYSICS AND PHYSIOLOGY: MIND, BODY, AND THE ANIMAL ECONOMY IN EIGHTEENTH-CENTURY SCOTLAND

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I. INTRODUCTION

At the beginning of his *Institutions of medicine* William Cullen defined "PHYSIOLOGY, or the Doctrine of the Animal Oeconomy" as "the doctrine which explains the conditions of the body and of the mind necessary to life and health".[1] Commenting on the same definition in his Edinburgh medical lectures in 1770, he noted that while physiologists normally discussed mental conditions it was not usual to include the mind in the definition of physiology. Some people had criticized him for introducing *metaphysics* into medicine. In response, Cullen employed a distinction which was also made by his friend David Hume, between two meanings of 'metaphysics'. It can mean "subtile Disquisitions": like Hume, he wanted to avoid metaphysics in this sense. However,

> if by Metaphysics we understand as I think we should the Operations of the human Mind in thinking, that is, the History of the human Mind, then I say Metaphysics are unavoidable not only in Physick, but perhaps in every Science if a man goes deep.

True metaphysics for both thinkers was concerned with "the Mind and its Operations". Cullen saw this as a particularly important study in medicine because "it is not less certain that the Conditions of the Mind do mutually affect the Body" than that "the Conditions of the Body do affect the Mind".[2]

In proposition 31 of the *Institutions* Cullen adopted the view that there

[1] William Cullen, *Institutions of medicine. Part I, Physiology* [1772], 3rd edn. (Edinburgh 1785), prop. 4.

[2] 'Lectures on the institutes of medicine by Dr Cullen, 1770–71': NLS, MS. 3535 (hereafter, 'NLS Cullen'), fols. 25–6. This manuscript appears to be in Cullen's own hand. On "metaphysics", cf. Hume, E. 12–13. For the friendship between Cullen and Hume, see HL i. 163, ii. 449–50.

is an immaterial mind in a living man and that all thinking is a property of this alone. However, he also insisted that this soul or mind (he used the terms interchangeably) is closely connected with "the material and corporeal part" of man, in particular with the nervous system. While he accepted this connection as a fact, "the mode of it we do not understand, nor pretend to explain". He would probably have included questions about *how* mind and body are interconnected among the false metaphysics which he rejected. At the end of his 1770–71 lecture on this proposition Cullen mentioned three philosophico-theological hypotheses about the nature of this connection—the ancient theory of "Physical Influx", the doctrine of "occasional Causes" which he ascribed to Descartes, and the "pre-established Harmonies" theory of Leibniz. However, he said no more about these except that there are "Difficulties" with each (NLS Cullen, fols. 78–9). In his final course of lectures he stressed that none of these systems "have the least effect or influence in explaining anything. They do not either admit of any application in Physic, or in any part of science that I see." The adoption of one or the other only affects "the business of religion".[3]

Cullen had a very different attitude to the questions concerning the relation of mind and body raised by eighteenth-century physiologists, and discussed these at length in his lectures. They concerned the "degree and extent" of the mutual influence of soul and body, no matter what the soul may be. He noted that his predecessor Robert Whytt had "with great strength of argument shown that the Phenomena even of the body itself, cannot be explained, but upon the supposition of a Soul as . . . a sensible principle" (NLM, II, fols. 25–7). Whytt had maintained that all life functions require a soul or mind. In *An essay on the vital and other involuntary motions of animals* he had formulated the issues of physiological metaphysics of his day rather succinctly. He could not

> conceive the reason why Physicians have laboured so long in accounting for the action of the heart and other vital motions of animals, from the powers and properties of body independent of the mind: if it be not, that in some, the leaven of Cartesianism still continues to work; in others a too great fondness for mechanical reasoning in Physiological matters; and in both, a contempt of the extravagant flights of *Stahl* and his followers, with regard to the manner in which the mind regulates all the actions of the body.[4]

Whytt was opposed to the Cartesian principles that the vital functions take place independently of the mind, that the essence of the mind is to

[3] 'The institutes of medicine by Dr Cullen Oct. 28, 1772' (5 vols.): National Library of Medicine, Bethesda, Md., MS. B4 (hereafter 'NLM'), vol. II, fol. 25.

[4] Robert Whytt, *An essay on the vital and other involuntary motions of animals* (Edinburgh 1751), p. 277. Subsequent quotations are from this first edition except where otherwise indicated.

be conscious, and that the body operates through the same mechanical laws which govern inanimate nature. But he was also opposed to the main alternative—the so-called Stahlian theory, which maintained that the mind controls the body by acting as a "rational" principle (*Essay*, p. 289). Both the Cartesian view and the Stahlian theory were espoused by Whytt's Scottish contemporaries.

In this paper I shall explain the issues concerning the mutual interaction of mind and body which were debated by eighteenth-century Scottish physiologists. Their debates must be understood against the background of a dualism between mental and vital *functions*. This dualism, which we may call *function dualism*, had been clearly set out in Cartesian writings such as the *Description of the human body*, where Descartes rejected the view that the soul or mind is responsible for life processes, and where he limited its functions to those accompanied by self-conscious thought.[5] Such a position was adopted by Hermann Boerhaave, whose thought played an important role in eighteenth-century Scottish physiology. The essential problems posed by the writers we shall look at concern the extent to which the vital processes affect the mind, and the extent to which and manner whereby mental processes, however they arise, affect those vital processes. These problems, though independent, are closely related to the question whether the vital processes can be explained mechanically. But I shall argue that physiologists such as Whytt and Porterfield, who maintained that the life functions require mind or soul, went beyond a bare rejection of mechanism. They conceived of mind and its basic functions of sensation and volition in very different ways from those who subscribed to the basic principles of Cartesian metaphysics, as well as in very different ways from one another.

It may be cause for surprise that major issues in what we should now call philosophy of mind were discussed by medical writers of whom few present-day philosophers have heard. However, I hope to show that our lack of acquaintance may not indicate any lack of profundity in their thought or in the problems they debated. Traditional history of philosophy in addressing the philosophy of mind has perhaps concentrated too narrowly on theological issues which arise from a *substance* dualism. This dualism was also given a seventeenth-century philosophical formulation by Descartes, in his conceptual distinction between two different natures, a thinking and an extended one. But it needs to be

[5] *The philosophical writings of Descartes* (hereafter '*PWD*'), trans. J. G. Cottingham and others, vol. 1 (Cambridge 1985), pp. 314–15. Cf. *Passions of the soul*, arts. 4–5 (*PWD*, vol. 1, p. 329). On the Cartesian programme in physiology see T. S. Hall, *History of general physiology*, vol. 1 (Chicago 1975), esp. pp. 256–7, and his translation of René Descartes, *Treatise of man* (Cambridge, Mass. 1972).

carefully distinguished from what I have called *function* dualism. Many who adopted substance dualism (Boerhaave and Haller are obvious examples) hold that there is a one-to-one correspondence between mental events and brain events, however it is to be explained. Nevertheless, the central issues of mid-eighteenth-century philosophy of mind lie elsewhere—in the problems raised by function dualism. Both a more accurate history, and (in so far as our present-day concepts have their roots in that history) a more fruitful philosophy, will result from taking such problems seriously.

By the time Cullen was giving his lectures in the early 1770s, the Edinburgh Medical School was among the most renowned in Europe. He himself had been a student in its early years in the mid to late 1730s. In his clinical lectures of 1785–86 he commented that during his studies he had "learned the system of Boerhaave" and was taught to think that that medical system was "very perfect, complete and sufficient". When he had returned to Edinburgh some twenty years later he "still found the system of Boerhaave prevailing as much as ever".[6] Cullen claimed to reject important parts of Boerhaave's system—for example, the view of the body as a hydraulic machine.[7] He stressed the centrality of the central nervous system in the production of life processes,[8] and tended to think of it as operating on principles analogous to those of static electricity (*Institutions*, props. 125, 130). However, in section V of this paper I shall argue that Cullen adopted a Cartesian conception of mind which was closer to that of Boerhaave than to that of his own immediate predecessors. It is Cullen's analyses of "sensation" and "volition" which provided his solution to the problem of mind-body interaction posed by them.

Although there are good grounds to question Cullen's retrospective claim about the monolithic teaching of physiology among his predecessors, there is no doubt that Boerhaave's doctrines were very important in the Edinburgh curriculum until about 1760. For this reason I begin in the next section with a study of the central principles of Boerhaave's physiological system. In section III, I examine the metaphysical physiology of William Porterfield and its seventeenth-century anti-Cartesian origins. The fourth section is devoted to the ideas of Robert

[6] John Thomson, *An account of the life, lectures, and writings of William Cullen, M.D.*, vol. I (Edinburgh 1859), pp. 118–19.

[7] NLM, II, fol. 1. Cullen purported to adopt the system of Friedrich Hoffmann, whose *Fundamenta medicinae* was published in 1695. But Cullen exaggerated the extent to which Boerhaave disregarded the nervous system. Indeed, Haller took issue with Boerhaave because he attributed *too much* influence to the nervous power (sect. IV below).

[8] In commenting on proposition 97 of his *Institutions* in 1772, Cullen spoke of the animal power seated in the brain as "the fundamental part of the System without which the Functions cannot long remain". This power was either "a Sentient principle or a Mechanical Energy" (NLM, II, fols. 195–6).

Whytt, the undoubted genius of eighteenth-century Scottish physiology, whose metaphysical ideas are rooted in a very different medical and philosophical tradition from that of Boerhaave. In the final section I examine the synthesis of earlier ideas which was effected by Cullen.

II. BOERHAAVIAN PHYSIOLOGY AT EDINBURGH

While there had been earlier attempts to found a medical school in Edinburgh, it has been traditional to date its beginning from the appointment of four new professors in 1726. Porterfield had been appointed to the first chair in the Institutes and Practice of Medicine in 1724; but while he continued to be an active member of the Royal College of Physicians of Edinburgh, and the Edinburgh Society for the Improvement of Medical Knowledge, there is no evidence that he ever lectured or played any further role in the Medical School. Another earlier appointment was that of Alexander Monro (*primus*) who, as professor of Anatomy, played a fundamental role in the foundation of the faculty.[9] All of these men, including Porterfield, had matriculated in medicine at the University of Leiden between 1718 and 1720, and probably attended the lectures of Boerhaave while they were there.[10] Boerhaave's texts were certainly assigned in Edinburgh in the early 1740s. An advertisement for medical lectures in 1741 announced that Dr Andrew St Clair, professor of the Theory of Physic, would teach "by explaining the *Institutiones medicae* composed by Dr Herman Boerhaave".[11] St Clair had been one of the first professors, so it is possible that Cullen had attended earlier lectures by him, as well as those of the other teachers in the new School.

The topics which interest us are outlined in various propositions of Boerhaave's *Institutiones medicae*. This work underwent a number of editions, beginning in 1708. The numbered propositions often served as little more than a succinct statement of the doctrines developed in Boerhaave's actual lectures. A student's transcription of St Clair's Latin lectures on this work has been preserved and I shall refer to this after examining Boerhaave's own doctrines. These were readily available to students after 1739 with Haller's publication of Boerhaave's lectures.[12] A somewhat free English translation appeared a few years later under the

[9] A. Grant, *The story of the University of Edinburgh*, vol. 1 (London 1884), pp. 298–315, 217–29.

[10] E. A. Underwood, *Boerhaave's men* (Edinburgh 1977), esp. pp. 102ff.

[11] *Scots magazine* 3 (1741), p. 371.

[12] Hermann Boerhaave, *Praelectiones academicae in proprias institutiones rei medicae*, edited with notes by A. von Haller [1739–44], 2nd edn., 6 vols. (Venice 1743–45). Hereafter, '*Praelectiones*': I shall refer to this by volume and page number.

title *Dr. Boerhaave's academical lectures on the theory of physic*;[13] in the following account I shall generally quote from this, supplementing or replacing it where necessary.

Boerhaave's commitment to mechanism in medicine was announced in his *Oratio de usu ratiocinii mechanici in medicina*,[14] delivered in Leiden in 1703, in the third year after his appointment to a lectureship in medicine. He compared the human body to a clock which anyone can see to be faulty, but which can only be corrected by the expert who "from his knowledge of the correct structure, discerns the defects of the parts and the ways and means of repairing them" (*Orations*, p. 111). To the objection that "life, diseases and health derive from non-mechanical principles", since the mind has power over the body, Boerhaave replied that "as soon as the capacity of thinking influences our body, every effect it brings about therein is wholly corporeal, and so subject to mechanical laws". Even if the prime cause were incorporeal, still the physician need only concern himself with corporeal conditions in medicine (p. 114).[15]

The clock image appeared again in Boerhaave's discussion of the natural sources of medical knowledge at the beginning of the *Academical lectures*. He noted that the human body can act as an automaton, and gave a watch as the example of the latter. An automaton is a "Machine that performs various Motions without any other Cause than the Mechanism of its own Parts within itself; which, when once put in Motion, continues so, from the same Cause". The analogy is used to support a view of the animal body as a machine which can operate completely independently, without any cause but the necessary motion of its own inner mechanism. The mainspring in the body is the heart, "which continues its alternate Contractions and Dilations so long as the Animal lives". Boerhaave noted that such motions are independent of the mind: they can be neither produced nor destroyed "by the influence of the Mind or Will" (*Lectures*, 4.1).

The examples of automatic motions which he went on to give indicate that he had in mind a far more complex machine than a clock. In proposition 4 he was primarily concerned with the automatic responses of the body for preserving health and warding off disease. He gave a number of examples of automatic defence mechanisms of the body—which he identified with the Hippocratic *healing power of Nature*.

[13] *Dr. Boerhaave's academical lectures on the theory of physic, being . . . a translation of his Institutes and explanatory comment*, 5 vols. (London 1752–56). Hereafter, '*Lectures*': propositions themselves will appear as a number alone or with a section number in parentheses (e.g. 401(2)); numbered lecture notes will follow a decimal point.

[14] Translated in *Boerhaave's orations*, trans. E. Kegel-Brinkgreve and A. M. Luyendijk-Elshout (Leiden 1983), 85–120.

[15] Cf. Descartes' *Description of the human body* (*PWD*, vol. 1, p. 315).

When Poison, has been taken, the Animal must inevitably perish, if its Force gets into the Blood . . . ; but provident Nature, or this automatic Motion generally does, what every expert Physician ought first to do, i.e. ejects it by Vomit.

Another example used to stress the independence of these defensive motions from the mind is of particular interest. The mind is not

able to suppress these automatic Endeavours of our Machines for Self-preservation. Suppose one Friend tells another that he is only going to threaten him with a Blow upon the Eye, and therefore bids him endeavour not to shut it at the Offer: The Mind is at that Time secure from Danger; but the specious Offer is no sooner made than the Lids of that tender Organ are closed; notwithstanding all the Reasons and Reluctancy of the Mind to the contrary. (*Lectures*, 4.1)

This example had been employed by Descartes in his *Passions of the soul* (sec. 13). It appears that for both thinkers the action of the mind is identified with our conscious effort to keep our eyes open; the action which occurs in spite of our conscious effort is ascribed to the mechanism of the body. Boerhaave stressed that the automatic defence motions of the body are made without any consciousness of the mind (*sine ulla mentis conscientia fiunt*: *Praelectiones*, I, p. 5).

The purely automatic and unconscious action of the body of proposition 4 of the *Institutes* is contrasted in proposition 5 with those actions which arise from an "uneasy Sensation" (*molesta perceptio*) in the mind. Boerhaave stressed that this latter is a principle "quite distinct from that of the automatic Motions of the Body", and that "these Endeavours" to remove a painful sensation "belong to the Mind". But he carefully distinguished these "Endeavours of the Mind for Ease" into two kinds—those which are quite spontaneous, and those which arise from reason and observation. In the first category he places actions such as the rubbing of one's eye to get rid of an itching or the attempt to relieve a muscular pain by trying out different positions of one's body. The second involves a rational observation which determines which of these spontaneous remedies really work. This is regarded as an important source of the art of medicine (*Lectures*, 5.1).

The Cartesian doctrine of soul or mind as essentially conscious—like that of the automatism in a living body—is central to Boerhaave's *Academical lectures*. In proposition 27 of his *Institutes* he asserted that "Man is composed of a Body and Mind, united to each other". He also noted that mind and body have distinct natures. In his lecture he explained that "the essential Nature of the Mind is to be conscious, or to think".[16] For Boerhaave, no less than Descartes, this disjunction does

[16] "*Mentis est, esse conscium sive cogitare*" (*Praelectiones*, I, p. 41). Boerhaave was awarded a doctorate in philosophy for a thesis *De distinctione mentis a corpore* (Leiden 1690). He argued

not indicate a mere tautology. Thought is inherently reflexive: we are not merely aware, but are aware of ourselves as being aware.

Boerhaave wrote that volition (*voluntas*) "is the action of the mind" (*Lectures* 27.6; cf. Descartes, *Passions*, secs. 13, 17). We have already seen that conscious effort played a fundamental role for him in distinguishing the action of the mind from the automatic motions of the body machine. He included volition, along with perception and judgement, as one of the three functions of the mind which constitute its "life", and noted that the life of the mind is nothing but "to be conscious". Later, he describes a voluntary movement (*motus voluntarius*) as one which results from a definition or determination of the mind (*a mente definiente*). He illustrates this by a situation where he has decided to move a limb when the hands of a clock reach a certain position ten minutes hence; this is "certainly a Foresight of something not yet existing: The inclination comes to me (*accedit voluntas*), I will (*volo*), and I define the time". Voluntary action, at least in this case, clearly arises from a conscious effort of the will (*Lectures*, 695.13; *Praelectiones*, VI, pp. 1, 6–7). But while everyone is acquainted with volition, it is what "no one can explain" (*Lectures*, 27.6).

While Boerhaave conceived of the conscious will as a source of motions in the human body, he also thought that the will itself arises from mechanical actions in that body, in particular those arising from changes in the nervous system. He describes the way that external objects, after causing motions in the nerves, transfer those motions to the common sensory in the brain. There they form an idea of the object:

> generally this Idea or Representation of the Object excites something more than the bare Representation, which is not a simple Idea or Perception, but a Determination of the Will with respect to the Idea. (*Lectures*, 572.1)

It is in the "sensorium" in the brain where all the nerves terminate that the impressions of external objects "determine the will either to love or hatred" (574.2). Even when we recall a certain idea in obedience to the will, this results from "nothing more than a *mechanical* Disposition or Change" in the common sensory (581; cf. 580 for the context). The only

that the mind "excludes the body" on the ground that mind is "conscious to itself of its own thought" and that as such it turns back on itself without being divided; this is impossible in an extended thing (chap. 3). He appealed here to the authority of Gerard de Vries, who had argued against Dutch Cartesians that belief in innate ideas is irreconcilable with the principle that all thought must be conscious (G. Lewis, *Le Problème de l'inconscient et le Cartésianisme* (Paris 1950), pp. 140–41, 170). Boerhaave was closely connected with the Cartesian de Volder (G. A. Lindeboom, *Hermann Boerhaave, the man and his work* (London 1968), p. 24), who held that the mind apprehends itself directly in being conscious (Lewis, pp. 117–18). On Descartes' own view see R. McRae, 'Descartes' definition of thought', in *Cartesian studies*, ed. R. J. Butler (Oxford 1972), 55-70; Lewis, pp. 37–103.

hint of an exception to the complete mechanical determination of our perceptions, judgements, and volitions came when Boerhaave suggested that the thinking of a person engrossed in abstract thought, who becomes totally impervious to the state of his body, gives us some evidence that the mind "may live hereafter without any Commerce with its Body" (27.4). But in general, as Cullen later told his students, the stress throughout Boerhaave's discussion was on the dependence of mental processes, including volition, upon the mechanical changes in the body. Boerhaave insisted that there is "such a reciprocal Connection and Consent between the particular Thoughts and Affections of the Mind and the Body, that a Change in one always produces a Change in the other, and the reverse" (27(4)). In fact, at least from the point of view of medicine, he thought that mechanical changes in the nervous system had priority over changes in the mind. He insisted that the physician did not need to concern himself with the condition of mind of his patient, even in mental disorders, since if the body "is set to rights" the mind "will quickly return to its Office" (27.8).

Given his apparent mechanical determinism, we may well ask about the significance of dualism in Boerhaave's lectures, for, as we have seen, he asserted unequivocally that mind and body are of different natures. In fact, he stressed the difference between sensations on the one hand, and the mechanical changes in the brain and the object which cause the sensation on the other:

> The Idea of Pain which we perceive, neither expresses the Burning nor the Dissolution of the Nerve; for there is only one Intelligence given to the Mind of a present Evil, agreeable to the good Will of the Creator. Sensation therefore is nothing either in the Object, or the Nerve affected; but a certain Idea which God had determined or assigned to each particular Change in the corporeal Sensory. (570.7)

It is the fact that these processes are of such a different nature which requires that they be connected by a law established by the Deity. Like Cullen later, Boerhaave briefly outlined the three philosophical theories of the connection of mind and body; but unlike Cullen he opted for one of them, namely the Leibnizian. It is likely, he told his students, that there is "a Harmony establish'd by God, taking it for an infallible Rule, that determinate actions of the Mind must be necessarily attended with corresponding Motions in the Body, and the contrary". But he added that the occasionalist theory was also possible.

However, there is a more important dualism implicit in Boerhaave's lectures which is quite different from his distinction between immediate objects of awareness and the related mechanical changes in the body. This is a dualism between those (brain) processes on which our mental

functions depend and those processes on which life itself depends. At the beginning of his section on pathology Boerhaave made a distinction between "animal" or mind-related functions of the body on the one hand, and "vital" and "natural" ones on the other. An animal function is defined as one which has the power of directly changing thoughts or ideas in the mind or being directly changed by the mind. A vital function is one on which life immediately depends: the beating of the heart is the standard example. The natural functions, like digestion and excretion, are required to maintain the body in a continuous state of health. The animal functions have no direct effect on the vital and natural ones, nor do these directly affect the animal ones:

> The vital Actions do not change the Thoughts or Ideas of the Mind; nor, on the other Hand, are those Actions dependent on, or determined by, the Mind: For the Heart continues to act, whether I am sleeping or waking. Nor are the Ideas of the Mind changed from the Exercise of the natural Faculties by which the Aliments are formed into Chyle. . . . (695.11)

Thus we have no sensation of the operation of the muscles involved in our vital and digestive processes,[17] and these neither directly affect, nor can be affected by, the thoughts of the mind.

This dualism of functions depends on the independence of the organs on which the functions depend. In his discussion of the "Action of Muscles" he noted that when the brain is damaged "in such a Manner as to let the Injury extend to the Medulla" then "the actions of all the voluntary Muscles cease instantly, together with all the Senses and Memory". In spite of this, the "spontaneous Motions of the involuntary Muscles" continue in all the "vital Parts". However, these too are destroyed along with the animal functions, when the cerebellum alone is destroyed. Boerhaave stressed that the nerves to the heart arise only from the cerebellum, not from the higher brain (401(2–3), 401.7). He also distinguished the voluntary muscles from the involuntary ones, even those involved in respiration.[18] Indeed, in his discussion of sleep, Boerhaave went so far as to speak of two distinct machines in the bodies of men and animals. One of these "is dead" through much of our lives (that is, whenever we are in a dreamless sleep), while the other continues to function throughout. He stressed the independent operation of these machines, though he also clearly acknowledged the dependence of the former on the latter (590.1).

[17] Boerhaave did hold (*Lectures*, 301.6) that when the heart and other visceral muscles become inflamed we feel pain. However, he denied that distinct muscles of the heart were sensible.

[18] Boerhaave distinguished the vital from the voluntary causes of respiration and maintained that the former can override the latter. Two distinct sets of muscles are controlled by two different parts of the brain (*Lectures*, 601ff.).

Boerhaave's separation of animal and vital functions is closely connected with his rejection of the notion of a life soul. In his discussion of pathology he identified the soul or *psyche* as that part of us which thinks (*Praelectiones*, VI, p. 5). He opposed those who have taken into account an "animating Principle" in medicine. In particular, there is no evidence for the existence of an "Archeus" or "cogitative Principle". Thus he sets himself clearly against the immaterial physiological and pathological principles of two earlier medical writers, Jean-Baptiste van Helmont and Georg Stahl (*Lectures*, 697, 697.2).

But at least one phenomenon lay, as it were, in the gap between the two functions which Boerhaave tried to hold separate. We have seen that, for Boerhaave, an essential feature of animal functions is that they take place with consciousness. This was clearly true of voluntary actions, which he located in the brain itself and in certain muscles. But in his *Institutes*, when dealing with muscular action, Boerhaave had written that "while the Will remains undetermined" there is no movement of nervous fluid toward the voluntary muscles, and thus they remain at rest (*Lectures*, 40(14); *Praelectiones*, III, p. 202). He noted that in sleep "none of the voluntary muscles will . . . be brought into action" (*Lectures*, 401.23). However, he also felt compelled to note an anomalous phenomenon which does not easily fit his account. Some actions which originally had their source in the will come to be performed by custom without consciousness. We often walk without thinking about what we are doing; and after we wake up in the morning, we sit up and in doing so place our limbs in that position "to which they have been accustomed through the whole Course of Life, without giving them any sensible Command of the Will". The English translation has Boerhaave claiming that in such cases we operate "from Custom *by the Influence of the Mind*, of which by continued Use we are insensible" (401.24, italics mine); but Boerhaave himself did not say that *the mind* acts insensibly.[19] The translation clearly conflicts with what he says elsewhere. Nevertheless, Boerhaave does seem to have a problem, given his insistence that voluntary muscles operate only under the influence of the will. If the mind must operate in order to effect the motion of voluntary muscles, why not say that in the problematic cases it acts unconsciously? This is what certain of Boerhaave's Scottish critics were quite prepared to say.

I have called Boerhaave's distinction between mental and vital functions "Cartesian". He rejects any vital soul and identifies soul with that part of us which is conscious. This is clearly in accord with the conceptual revolution which Descartes proposed at the beginning of his

[19] "*Sunt omnino in corpore musculi voluntarii, qui ex sola consuetudine, injussi & nobis non consciis operantur*", i.e. the voluntary muscles "operate solely from habit, unbidden, and without our consciousness of it" (*Praelectiones*, III, p. 218).

Description of the human body and elsewhere. Boerhaave went on, in accord with the physiological programme which Descartes laid out, to describe bodily processes such as the motion of the heart, as resulting from the mechanism of the parts and as being entirely automatic. Yet it would be wrong simply to call Boerhaave a Cartesian, for his conception of the mind and body differ in certain key respects from that of Descartes. The difference between their theories of mind is not relevant to our present concerns,[20] but it is important for our subsequent discussion to consider briefly Boerhaave's general conception of the body and how it differs from the Cartesian one.

Like Descartes, Boerhaave held that the basic principles operating in the human body were the same as those operative throughout the universe. But Descartes had held that body could be completely characterized by the attribute of extension, and its processes by the mechanical transfer of motion from part to part. In his lecture on *Institutes* prop. 27, Boerhaave adopted the conception of body—then accepted by Locke and Newton, as well as Leibniz—as that which is *impenetrable*, as well as *extended*. Moreover, while he held that the "action" of a body consists in the transfer of motion to another body, he also spoke of all bodies as having a "life". Among those things which constitute the life of bodies he included the force of attraction between the constituent parts. It is commonly said that Boerhaave thought of the body merely as a hydraulic machine; but it is more accurate to say he conceived of the body machine as involving an interaction between the solid elastic vessels and the fluids which were forced through them. The force of elasticity played an important role in his conception of the generation of motion in the living body. Boerhaave described the body as "an Assemblage of small elastic Solids, by whose conjoined and regular Actions, Life and Health are produced". Later he identified elasticity with a "Resistance or Re-action common to all Bodies" (695.2). This force of elasticity is a "universal Principle of Nature", and like the power of gravitation by which planets are attracted towards each other it is not innate in matter itself. It is "to be ascribed only to the Creator of the Universe, who has determined this as a Principle uniting the Parts of Bodies". Boerhaave was clearly drawing on a set of concepts which were richer than those allowed by Cartesian physics.

Boerhaave defined "mechanics" very broadly as the study which teaches one "to apply the general Laws of Motion to all kinds of Bodies" (29.3). The fact that he was willing to allow principles such as elasticity and attraction did not for him constitute any limitation to mechanism.

[20] Against Descartes, Boerhaave held that there is *no more* to mind itself than the thought of the present moment (*Lectures*, 581.1); he also rejected Descartes' view that judgement is a function of *will* (586.14).

However, other writers more firmly planted in the Newtonian tradition were concerned to show that the existence of such "active" principles did indicate the limits of mechanism in nature itself.[21]

By Boerhaave's time most writers on the animal economy expressed reservations about the universal application of mechanical principles. However, it is important to consider carefully the exact nature of the limitations which any given author imposed. Boerhaave commented that "they who think that all physical Appearances are to be explained mechanically, are in my Opinion misled" (19.7). When examined in context, this will be seen to be a comment on the limits of our knowledge, not a remark to indicate that other principles operate in things besides mechanical ones. In his lecture on proposition 40 Boerhaave told his students that "there are many, and considerable Motions performed in Nature, of whose Causes we are ignorant; but the Motions themselves are always subject to those universal Laws which appear true in all sensible Bodies" (40.20). He was particularly critical of attempts to apply geometrical principles taken from "Bodies of particular Dispositions" to the explanation of complex organic processes (19.7).

It is, however, misleading to take Boerhaave's declarations of epistemological scepticism too seriously. He did not hesitate to put forward mechanical hypotheses to support his own mechanical view of the operations of the human body. Throughout his lectures he described how the elastic solids which constitute the "vessels" of the body react to the "dilatation" or expansion caused by the fluids which flow into them. This interaction was employed in his explanation of the operation of the heart. Boerhaave thought that all muscular motion results from the motion of a "nervous liquor" or "spirit" which flows from the brain via the nerves, so that it "*dilates*, fills and alters the Membranes of the Fibres [of the muscles], as to reduce them from an *oblong* to a rounder Figure, increasing their smaller Diameter, and diminishing their larger, so as to bring Tendons nearer to each other" (402(7)). Boerhaave thought that there is a constant pressure of nervous fluid in all the muscles of the body keeping them in a constant state of contraction. However, when the muscle of the heart contracts, the flow of blood into the auricles makes them expand and cut off the flow of fluid from the cardiac nerves "which pass into the Heart by the Side of the Aorta and pulmonary Artery". This makes the muscles of the ventricles "paralytic", allowing them to relax and fill up with blood from the auricles. This releases the pressure on the cardiac nerves and allows nervous fluid to flow into the muscles of the ventricles again, causing them to contract and start the process again. The whole system operates in a purely automatic way, depending only

[21] J. P. Wright, 'Matter, mind and active principles in mid eighteenth-century British physiology', *Man and nature* 4 (Edmonton 1985), 17–27.

on a continuous pressure of nervous fluid through the nerves and a constant supply of blood from the vena cava and pulmonary veins (409). We shall see that Robert Whytt presented convincing arguments to show that this mechanism of the operation of the heart muscles will not work.

It is difficult to draw firm conclusions about the teaching of these doctrines in Edinburgh. It would, of course, be wrong to conclude that just because Boerhaave's *Institutes* was used as a text his views were always taught uncritically. Nevertheless there is some reason to think, both from the statements of Cullen and from the rough set of student notes surviving from St Clair's lectures in 1740,[22] that some version of these doctrines was presented in the 1730s and early 1740s. Like Boerhaave, St Clair held that the only explanatory principles for life phenomena are mechanical ones; however, he showed, if anything, more scepticism about our ability to fathom what these are. Part of the note on proposition 4 reads:

> The greatest mistake is of those who wish nothing to be considered in medicine except what can be explained mechanically. Nothing indeed should be explained except mechanically, but many things may be considered for which no mechanical explanation can be given and for which we can give no a priori cause. (St Clair, I, pp. 15–16)

This scepticism appears to continue in the lecture on proposition 27, where, instead of giving the essence of body and mind as Boerhaave had done, the view is expressed that "the cleverest philosopher does not know the intimate nature of anything" (p. 79). Nevertheless, though in a rather confused way, Boerhaave's central teaching on these topics emerges in the course of the lecture.

What appears to be a more substantial difference occurs at the beginning of the lecture on proposition 27. At first sight St Clair appears totally opposed to Boerhaave's own central doctrine on the independence of cognitive and vital functions. The manuscript reads: "Mind is part of man himself. If the soul is destroyed, this makes the body lifeless and rigid" (p. 79). It would seem that life processes are being ascribed to some sort of vital soul! However, what follows is a Boerhaavian account which clearly separates the mind from any vital functions:

> Let me first overturn the objections of those who argue that the human body without the prop of mind is lifeless and useless. . . . Let such a philosopher order if he can his own heart to move slower or faster. Can he determine the blood through his own body by the power of mind . . . ? From these and many others it is clear that most activities obey the power of mind not at all. (p. 80)

Like Boerhaave, St Clair claimed that "to think is to be conscious" and

[22] 'Praelectiones in Institutiones Boerhavii a Andreo St. Claire M.D.', 3 vols. (1740): RCPE, MS. M9.35–7.

Porterfield's comments on the operations of the mind in the body first appeared towards the end of the initial part of the article, in the course of his discussion of the cause of the fact that our two eyes—unlike those of chameleons and other animals—operate together ('Motions of our eyes', I, pp. 163ff.). He began with an account of what he called "the final Cause of this uniform Motion", or, in other words, the ways in which it is advantageous to us. The first advantage is that it results in a stronger, more lively, and perfect image of the object (p. 184). He also argued that uniform motion is *not* necessary to see a single object with two eyes (pp. 192–252).[27] He rejected Berkeley's theory of vision (which relies on an experienced correlation of sight with touch), arguing that we have a kind of immediate knowledge of externality through sight (pp. 229ff.). Nevertheless, his own account of vision is not purely innatist and, like that of Berkeley, takes account of the role of experience.

The most important advantage of the uniform motion of our eyes, according to Porterfield, is in enabling us "to judge with more Certainty of the Distance of Objects" (p. 187). The most common and reliable method of judging distance is by our knowledge of the angle made by the axis of each of our eyes when they focus together on an object in front of us: the smaller the angle made at the convergence of the lines from each eye at the object, the more distant the object. The judgement is made on the basis of our feeling or sensation of the motion of each eye as it focuses inward on the object (p. 189). His account here closely follows that of Malebranche.[28] Like Malebranche, he held that this sensation incorporates a kind of natural judgement of distance.[29] This depends on an innate principle that "Every Point of an Object appears and is seen without the Eye nearly in a straight Line, drawn perpendicularly to the *Retina*, from that Point of it where its Image falls" (p. 208). Porterfield seems to think that it is by employing this principle that we are naturally able to judge the distance of objects by the uniform motions of our eyes. Malebranche had called such judgements "natural" because they are formed "in ourselves, independently of ourselves, and even in spite of ourselves".[30] He ascribed such judgements to God, who makes them just as we would do if we knew all the laws of optics and geometry as well as everything

[27] He argued that this is effected in cross-eyed people in spite of the fact that their two eyes do not focus together. Porterfield correctly opposes Claude Perrault on this.

[28] Nicolas Malebranche, *The search after truth*, trans. T. M. Lennon and P. J. Olscamp (Columbus 1980), pp. 737–8.

[29] "The Judgment we form of the Situation and Distance of visual Objects, depends not on Custom and Experience, but on an original connate and immutable Law, to which our Minds have been subjected from the Time they were first united to our Bodies." (p. 214)

[30] Malebranche, *De la Recherche de la vérité*, ed. G. Rodis-Lewis, in *Oeuvres complètes de Malebranche*, vol. I (Paris 1958), p. 119; cf. p. 99. My translation. For an account of Malebranche's theory of vision see J. P. Wright, *The sceptical realism of David Hume* (Manchester 1983), pp. 66–7, 225.

that was happening in our eyes and brains. Porterfield, on the other hand, does not claim that the natural judgement takes place entirely independently of our will. What I have called his innate principle is not in itself sufficient to allow us to judge the distance of objects. Indeed our judgement of distance by means of the innate principle depends on a voluntary and rational decision to use our eyes together.

This becomes clear when Porterfield turns to "the efficient Cause" of the uniform motion of our eyes at the end of the first part of the essay (pp. 253ff.). "By what Necessity", he asks, does it happen that "both Eyes are always turned the same way, so that none of us are able at pleasure to give them different Directions?" He rejects the ancient theory which attempted to account for this by the union of the two optic nerves, pointing out that these nerves have no connection with the muscles of the eye which are responsible for this motion. The true cause turns out to be nothing but "Custom and Habit", which operate under the direction of the mind. Whatever necessity there is in the action results from the mind itself. For "it is not to be doubted but these Motions are voluntary, and depending upon our Mind, which being a wise Agent, wills them to move uniformly" (p. 255).

There are really two closely related features of this action which lead Porterfield to ascribe it to the mind—that it is learned and that it is useful to us. Like chameleons, human infants "for some Time after Birth, can look different Ways with their Eyes". Moreover, they continue to do so until "discovering the Advantage of directing them the same way, they come to move them always uniformly" (p. 259). Here experience plays a role: infants make a voluntary decision to employ their eyes together after discovering that this results in the ability to determine the distance of objects. In this also, we see the importance of Porterfield's earlier discussion of the "final cause" of the uniform motion of our two eyes; he clearly regarded the action of moving both together as an intentional action adopted for its utility. The infant acts both freely and with some kind of foresight, based on the experienced result of employing both eyes together.

It is due to the repetition of this action that, after a time, most human beings and other animals cannot move their eyes independently: "This uniform Motion by Use and Habit at last becomes so necessary, that the Eyes cannot be moved differently" (p. 259). That there is no "intrinsical Necessity" in this is clear from cross-eyed children who move their eyes separately. The necessity experienced by most of us arises from the fact that "the Mind has imposed upon itself that Law founded upon the Utility and Advantage that arises from this sort of Motion" (pp. 255–6). Later, in *A treatise on the eye*, Porterfield will refer to this as a "moral necessity" (*Treatise*, vol. 2, p. 154).

In the second part of the original essay Porterfield extended this analysis to motions of the body which most would consider to be quite involuntary. Indeed he includes among them one which, as we have seen, Boerhaave and Descartes considered to be directly contrary to the action of the mind.

> If a Body be hastily moved towards our Eyes, they will shut without our being conscious thereof; neither is it in our Power to do otherwise, because we have accustomed ourselves to do so on the like Occasions; for such is the Power of Custom and Habit, that many Actions which are no doubt voluntary, and proceed from our Mind, are in certain Circumstances rendered so necessary, as to appear altogether mechanical and independent on our Wills. ('Motions of our eyes', II, pp. 213–14)

Unlike Boerhaave, Porterfield did not think that this action actually *is* mechanical and independent of our wills. He asserts that it is voluntary and directed by the mind. Indeed, Porterfield did not identify voluntary with conscious action. For he acknowledges that we are not conscious of the motions of our eyelids. It is clear that we do not have any consciousness even of an effort of the mind in producing those motions: indeed, what I am conscious of is the contrary effort to keep my eyes open. But Porterfield did not think that my current consciousness of an inability to keep my eyes open shows that the action is not performed by my mind. He thinks that the true action of my mind is the one which results in the closing of my eyelids. This arises from a law which I impose on myself through custom and habit.

The most obvious objection to Porterfield's claim that the closing of the eyelids is voluntary is that we cannot do otherwise. However, he thinks that there is an important sense in which this is just false. There are people "who can keep them open, though the Organs subservient to their Motions are the same as in other Men". He appeals to the case cited in Plempius of Roman gladiators, who, through "uncommon Fortitude and Courage, had not accustomed themselves on every trifling Occasion to shut their Eye-lids for the Defence of their Eyes" (p. 215). This and other examples show that the shutting of the lids is preventable even for the rest of us. In his *Treatise* Porterfield held that in "philosophical Strictness of Speech" a "moral Impossibility" such as that which we find in the case of the closing of our eyelids "is indeed no Necessity or Impossibility at all". Custom still "leaves the Mind at absolute Liberty to do as it pleases". One might as well deny the freedom of an honest man who, having formed a "fixt and determined Resolution of acting always agreeably to what he sees to be fit and right", finds it impossible to "do a dishonest Thing". The impossibility is merely that "it is absurd, mischievous and morally impossible for it to chuse to act . . . foolishly

and unreasonably" (*Treatise*, vol. 2, pp. 154–5). Like Boerhaave and the Cartesians, Porterfield thought the shutting of our eyelids contributes to our self-preservation, but he rejected the view of these thinkers that it is automatic—performed by the body without the mind ('Motions of our eyes', II, p. 215). The goal of self-preservation is that of the individual mind itself which freely adopts this way of acting.

It is surprising to discover Porterfield does not even consider the possibility that what is performed through custom and habit is performed mechanically. Descartes, Malebranche, and even Locke, had presented mechanical hypotheses—based on the creation of pathways in the brain—to account for the formation of mental and physical habits. While Boerhaave was troubled by the fact that voluntary muscles can move habitually without the action of the will, he accounted for the associations of ideas on which such habits depend by postulating mechanical connections in the common sensory (*Lectures*, 580.1). Thus he had the basis for the mechanical account of habit developed by his predecessors.

The chief function of custom and habit in Porterfield's explanation of actions such as the uniform motions of our eyes and the shutting of our eyelids was, it seems, that of making them unconscious, and so giving them the appearance of necessity. He wrote that "the Mind, which at first always acted from a Principle of Interest, comes at length to be determined by Habit and Custom, without examining how far such motions may be profitable or hurtful to us, or at least *without being sensible* of any such Examination; and this is the only Reason can be given, why none of us are now able to move our Eyes differently" (pp. 214–15, italics mine). This suggests that even after such actions are performed insensibly they may still involve a rational examination of what is the best motion. Perhaps Porterfield thought that when a hand is thrust in my eyes I make a very quick inference that closing them is the most useful action! In any case, he seems to have recognized that in allowing that the mind could act insensibly he was stepping into philosophically dangerous waters. He knew that "it has been alledged by *Locke* and others, that all the Thoughts and Operations of the Mind, must necessarily be attended with Consciousness", and that this would be thought to tell against his claim that the actions he was describing were performed by the mind. In the article Porterfield did not want to get involved in the "metaphysical Question" of the extent that "Thoughts and Operations of the Mind, may or may not imply Consciousness" (p. 216); though in his later book, he rejected Locke's appeal to direct experience to show that there are times in sleep when the mind is neither "sensible nor active". Porterfield claimed that, while direct experience could not decide the question, there were arguments to show that

animals "are always both percipient and active" when asleep.[31] In the essay he limited himself to the claim that "there are Motions unquestionably voluntary and depending on the Mind, which by Custom and Habit have become so easy as to be performed without our Knowledge or Attention" (II, p. 217). While he drew back from his earlier statement that such actions are performed "without our being conscious thereof" (p. 213), it is difficult not to conclude that he is saying the same in different words.[32]

These views about the unconscious operation of the mind are important when, in the second part of the essay, Porterfield spelled out an earlier suggestion that the mind itself is the efficient cause of the vital and natural operations of the body. He argued that, if the mind can think and be "very little conscious" of it as the Cartesians claimed, "I see not why it may not also be allowed to exert its active Power in the Government of the *vital and natural Motions*, without our Knowledge and Attention". When children first learn to walk, "the whole Mind is employed in conducting the Motions necessary for their Progression", so that if they cease to attend to the activity, they will soon fall down. But when these motions come to be performed easily through custom and habit, "they need but little Attention, and allow the Mind to employ its most serious and anxious Thoughts about other Matters" (pp. 226–7). By parity of reasoning, when a baby is born, its soul is totally involved "in regulating and governing the internal Motions, which are yet difficult, by reason it has not yet been much accustomed to them". But when the soul or mind becomes accustomed to performing vital actions such as the beating of the heart, and natural actions such as the digestion of food, it is progressively able to attend to "external Objects". Thus the baby comes to appear "less and less sleepy and unactive". But what is really happening is that the mind, while it continues to perform them, is able to direct its attention away from the vital and natural operations of its own body (pp. 225–6). Thus Porterfield is suggesting that, just as in the case of the habitual actions which were discussed earlier, these latter continue to be produced voluntarily but without any self-conscious awareness.

What Porterfield has noted is a common process by which actions which are self-consciously chosen come to be performed without our conscious control. Such actions, for example of the muscles in walking,

[31] *Treatise on the eye*, vol. 2, pp. 156–9. Porterfield argues that it is especially clear that birds, which have to grip branches in the wind, perceive and put forth some active power. While Borelli, in *De motu animalium*, had argued convincingly that the "mechanical Disposition of the Muscles" is used to help them "grasp the Branch more forcibly", it is clear, thinks Porterfield, that these muscles alone are not sufficient to account for the phenomena.

[32] Porterfield confuses the issue in his book by claiming that the mind is conscious while asleep. Robert Whytt had no such hesitancy in admitting that the mind acts unconsciously.

come through custom and habit to be performed without knowledge and attention. His suggestion about the control of the vital and natural operations of the body is based on an extrapolation of the common process to explain a phenomenon to which we do not ordinarily think it applies. The legitimacy of this extrapolation was challenged by later Scottish thinkers.

In support of his hypothesis that the vital operations of the body are voluntary, Porterfield also cited evidence which had been presented a few years earlier in George Cheyne's popular study, *The English malady*. Cheyne had described the case of a Colonel Townshend who had summoned him a few days before death to show that he "could at pleasure suppress all the vital Motions, so as in all Respects to appear dead, and yet by an Effort, or some how, he could come to Life again, and restore these Motions" ('Motions of our eyes', II, p. 222). Cheyne had reported that he and two other physicians, while doubtful that any such thing was possible "as it was not to be accounted for from now *common Principles*", agreed to witness the experiment. After a half hour or so the man's pulse was no longer detectable and they assumed he had carried the experiment too far. However, the pulse did finally become detectable again and the man did regain full consciousness. Cheyne "went away fully satisfy'd as to all the Particulars of this Fact, but confounded and puzled, and not able to form any rational *Scheme* that might account for it".[33] In reporting the case, Porterfield wrote that it is "not at all to be accounted for, without allowing the Mind to preside over the vital Motions" (p. 222). He appears to have considered this case parallel to that of the gladiators who can prevent themselves from closing their eyelids when a hand is thrust in their faces. The unusual case supports the hypothesis that even ordinary heart motion is voluntary.

Porterfield and Cheyne seem to have believed that the Townshend case provided a kind of crucial experiment which challenged the claim of Boerhaave and his followers that the mind cannot affect the vital and natural motions of the body. However, as we have seen from St Clair's lectures, the whole medical establishment was not immediately won over. St Clair challenged physicians like Porterfield and Cheyne to show that they could voluntarily control the beating of their own hearts. They seem never to have taken up the challenge!

Our authors also appealed to the evidence that the vital motions of the body are influenced by the passions of fear, grief, joy, rage, etc. ('Motions of our eyes', II, p. 222; *English malady*, p. 68). Boerhaave had

[33] George Cheyne, *The English malady* (London 1733), pp. 307–11. Cheyne was a Scot from Aberdeenshire who had studied medicine in Edinburgh with Archibald Pitcairne, one of the leading figures of European iatro-mechanism. Cheyne went to London in 1702, where, as well as setting up a medical practice, he became a member of the Royal Society.

considered love and hatred to arise in a kind of automatic way from the effect of objects on us. In his pathology he explicitly identified the passions with mechanical changes in the common sensory (*Lectures*, 744.4). This was in accord with the general conception of the passions espoused by Descartes, who regarded the mental aspect of the passion, that is the feeling, as a kind of epiphenomenon.[34] But writers at this time challenged this account and argued that the influence of the passions indicated the effect of the mind on the body.[35]

Porterfield and Cheyne regarded themselves as breaking with the dominant physiological tradition when they presented their accounts of both the nature and extent of the mind's control over the body. At the same time, both writers accepted current mechanical accounts of the bodily processes themselves. Porterfield wrote that "we all know there is nothing in the animal Machine but an Infinity of branching and winding Canals, filled with Liquors of different Natures, going the same perpetual Round" ('Motions of our eyes', II, p. 219). He was repeating the image set out in the introduction of Cheyne's *English malady*. Cheyne told his readers that to understand what he had to say about nervous diseases, they

> need only suppose, that the Human Body is a Machin of an infinite Number and Variety of different Channels and Pipes, filled with various and different Liquors and Fluids, perpetually running, glideing, or creeping forward, or returning backward in a constant *Circle*, and sending out little Branches and Outlets, to moisten, nourrish, and repair the Experience of living.

Cheyne had even sought to give some satisfaction to "those acquainted with first Philosophy, Natural History, the Laws constantly observed by Bodies in their actions on one another, and the established Relations of Things" (*English malady*, pp. 4ff.). Clearly, like Boerhaave, Cheyne and Porterfield thought that the general laws of mechanics were applicable to organic processes; neither thought that any other laws were required. In order to understand how these writers conceived of the limits of mechanism in explaining organic processes, it is useful to examine how they related their own views to those of two of the most important philosophical systems of the seventeenth and eighteenth centuries, namely Cartesianism and Newtonianism.

Porterfield's clear rejection of Cartesianism emerged through his criticism of Descartes' attempt to give a purely mechanical account of animal reproduction from the mixture of fluids of the male and female of each species. In the formation of an animal, Porterfield wrote, "there is a

[34] See *Passions of the soul*, arts. 27, 29 (*PWD*, vol. 1, pp. 338–9).

[35] See the interesting argument in Nicholas Robinson, *A new system of the spleen, vapours, and hypochondriack melancholy* (London 1729), pp. 85–6. This originates with Claude Perrault.

necessity that the Head, Heart, Nerves, Veins and Arteries, should be formed at the same time", not successively, since none of these organs can operate without the others. But this is impossible, "for no Motion of any Fluid or Fluids, howsoever disposed, can ever form all these at the same instant". Porterfield also implicitly criticized the pre-formationist theory which was accepted by most contemporary physiologists.[36] Since, as these thinkers admitted, some "active immaterial Cause" is necessary in the first formation of animals, it is puzzling that "after that, so great Concern should be shewn to reduce all to mere Mechanism". Why not agree that the operations of the living body continue to have "Need of new Impressions from some such vital Principle as first set them a-going" ('Motions of our eyes', II, pp. 219–21)?

Through the use of the expression 'active immaterial Cause' Porterfield placed his own claim that the vital and natural motions of an animal body cannot be explained entirely mechanically in the context of the Newtonian philosophy of his day. He cited (p. 219) a note in *Rohault's System of natural philosophy, illustrated with Dr. Clarke's notes taken mostly out of Sir Isaac Newton's philosophy* (1723), in which Samuel Clarke stated that perpetual motion on purely mechanical principles is impossible. Porterfield argued that there can be no perpetual motion machine, because "there is no avoiding a greater or lesser Degree of Friction, though the Machine be form'd according to the exactest Principles of Geometry and Mechanicks" (p. 218). In making such an appeal he could also have turned directly to the authority of Newton. Newton had claimed in his *Opticks* that the mechanical motion in the universe is "always upon the Decay" owing to the "Tenacity of Fluids, and Attrition of their Parts, and the Weakness of Elasticity in Solids". He concluded that, since

> the variety of Motion which we find in the World is always decreasing, there is a necessity of conserving and recruiting it by active Principles, such as are the Cause of Gravity, by which Planets and Comets keep their Motions in the Orbs, and Bodies acquire great Motion in falling; and the cause of Fermentation, by which the Heart and Blood of Animals are kept in perpetual Motion and Heat.

There are "active Principles" in the universe which are required to recruit the constant loss of motion; these principles are identified as being like those which cause perpetual motion in animal bodies.[37] Even more explicitly, in his famous dispute with Leibniz, Newton's spokesman Clarke stated that any sort of increase in motion in nature must arise from "a principle of life and activity".[38] In insisting on the importance of

[36] Among them, Boerhaave. See S. A. Roe, *Matter, life and generation* (Cambridge 1981), esp. pp. 1–9.

[37] Sir Isaac Newton, *Opticks* (London 1931), pp. 398–9.

[38] *The Leibniz-Clarke correspondence*, ed. H. G. Alexander (Manchester 1956), p. 112.

non-mechanical active principles in animal bodies, Porterfield was appealing to a doctrine at the heart of Newtonian natural philosophy.

But Porterfield also distanced himself from the form of the Newtonian philosophy which we have seen reflected in Boerhaave. According to this the motions of an animate body depend on the same active principles, for example elasticity, as other inanimate bodies in the universe. Porterfield wrote that

> If it should be said, that these Motions do not depend on Mechanism alone, but on Mechanism join'd with certain active Powers or Forces, imprinted by the Author of Nature upon all the Bodies of this Universe, such as are the Powers of Attraction and Repulsion, by which the greatest Phaenomena of Nature are unquestionably produced; it is incumbent on those who entertain this Opinion, to explain particularly how these Motions are thus continued by these active Principles, before they can expect that we should believe them. (pp. 221–2)

In his later *Treatise*, he took issue with what appears to be a variant of this theory which he ascribed to his great Swiss contemporary, Haller. According to Porterfield, Haller held that the irritability which he had discovered to exist in muscle fibres even after they were cut out of the body, like Newtonian gravitation, results from the stimulus acting as a mere occasional cause of the muscular motion. But Porterfield himself held that "transient and short-lived Motions", such as those excited by stimuli applied to muscles when they are cut out, can be explained purely mechanically (*Treatise*, vol. 2, esp. p. 167). It is only the continued operation of these and other motions *in vivo* which requires the existence of an active principle.

The principle postulated by Porterfield is neither the Deity nor some special active material principle under the Deity: it is the individual mind of the organism which acts continually to keep it going throughout life, and even perhaps, as Cheyne had suggested, was responsible for the first formation of the animal's body. Porterfield presents a specific account of the limits of mechanism. Nothing in his account requires any other physical laws besides mechanical ones. However, he clearly rejected the view, supported by Boerhaave as well as Descartes, that the animal body is an automaton. The processes of that body are not self-maintaining: they require the intervention of an active principle peculiar to it, which, as we have seen earlier, possesses both intelligence and will.

The account of this principle places us in the centre of Porterfield's physiological psychology. For, as we shall see in the next section, the Newtonian ideas about the limits of mechanism and about the necessity for active powers which he adopted could be given an entirely different physiological interpretation. What is central in Porterfield's discussion is his anti-Cartesian view that there is a continuous transition from

actions which are consciously chosen to those which are done necessarily and without consciousness. On the Cartesian account such actions were interpreted as undergoing a radical transition from being activities of mind to being purely physical operations of the body machine. For Porterfield, they are considered to have their source in a single principle, the mind itself. Such actions are considered voluntary because they are chosen, at least initially, for their usefulness. We cease to be aware of them because they are performed under the influence of custom and habit. On Porterfield's account, the criteria that an action is under the control of the mind are that it is learned, and that it is originally chosen because of its usefulness.

The anti-Cartesian nature of Porterfield's central ideas is clear from an examination of their roots. Cullen identified Porterfield as a Stahlian, but I have found no evidence in Porterfield's writing of any influence of Stahl himself. On the other hand, some of Porterfield's main ideas are clearly taken directly from an earlier writer, the French physician Claude Perrault.[39] Perrault's ideas, developed in the 1670s, were certainly written against the backdrop of Cartesianism. The close parallel between their arguments reveals that the same concerns which led Perrault to attack Cartesianism in France in the 1670s were still very much alive in Scotland in the 1730s, though in the latter case the philosophical views opposed probably appeared largely within the context of Boerhaave's physiology. Put generally, these include the view that the mind only acts consciously, that the body machine is an automaton, and that the actions of the mind cannot affect the vital and natural operations of the human body. Porterfield, no less than Perrault, directs his theory against these doctrines.[40]

One central doctrine of Perrault does not appear to have been adopted by Porterfield, namely the anti-Cartesian position that the soul is not only located in the brain but is literally spread throughout the nervous system. Indeed, on this issue, Porterfield does adopt the generally accepted view rather than that of Perrault.[41] However, a version of Perrault's position was central in the work of Robert Whytt, to whom I shall now turn. It emerges naturally from his metaphysical commitments and experimental work with animals.

[39] Many authors, including Haller, have considered Perrault to be a forerunner of Stahl (W. Hermann, *The theory of Claude Perrault* (London 1973), p. 196).

[40] See my account of Perrault in 'The embodied soul in seventeenth-century French physiology', forthcoming.

[41] For Perrault's view see 'Du toucher', in Claude and Pierre Perrault, *Oeuvres diverses de physique et de mechanique*, vol. 2 (Leiden 1721), pp. 529ff. Stahl apparently located the soul in the brain. His view is contrasted with that of Perrault in Haller's notes to Boerhaave. See *Praelectiones*, III, p. 228, note 3.

IV. WHYTT AND THE SENTIENT PRINCIPLE

Whytt appears to have entered the University of Edinburgh in 1728 (matriculating Feb. 1729) and to have been a student in the fledgling Medical School in the early 1730s. Some of his student notes have survived and show that at least one teacher associated with medical education at that time was critical of Boerhaave's medical philosophy. Part of Whytt's notebook is based on his studies with Dr George Young, an adjunct teacher who practised as a surgeon in the city. Dr John Boswell, who obtained the notebook after Whytt's death, wrote in the front that he and Whytt were fellow students under Young in 1730–31. According to Boswell, Young was "a great Sceptick in medicine (& empirick) as well as in every other thing", and "confin[ed] himself to good evident common sense". But the notes show that Young went beyond scepticism to suggest that there are absolute limits to the application of mechanical laws in the human body, limits which made the sorts of mechanisms postulated by Boerhaave—or Porterfield—quite superfluous. Moreover, his "common sense" appears to have led him to suggest that there are special laws which apply to animal bodies as a result of their being animated by a spiritual being.[42]

Of particular interest for our present purposes are notes entitled 'Of muscular motion' (pp. 431ff.) and 'Of Sensation' (pp. 467ff.). Whytt headed the first 'An Enquiry into the Cause of muscular Motion, from Mr Youngs papers', and it is a reasonable assumption that, since the second note continues many of the same themes and is written in the same style, it too is from Young's papers.

In the first note Young was concerned with the cause of the motion of voluntary muscles. Writers on this agreed that the "free Influx" of appropriate fluids from the arteries and nerves was a necessary condition for this motion (since when they are tied it cannot occur) and that the "voluntary motion of the act of the will is the ultimate cause". They also assume that the will must use "some Instrument to Dilate the muscle", and only disagree as to "what is the Instrument or Instruments" by which this is effected (pp. 431–2). Young runs through the various mechanical and chemical hypotheses of late 17th- and early 18th-century writers, pointing out that none of them could be supported by any evidence of the senses: "the great Boerhaave himself never saw his greater Influx of the animal Spirits by which he accounts for muscular motion" (pp. 434–5).

[42] RCPE, MS. M9.19. George Young (1692–1757) was a member of an important intellectual society in eighteenth-century Edinburgh called the Rankenian club. See M. A. Stewart, 'Berkeley and the Rankenian club', in *George Berkeley: essays and replies*, ed. D. Berman (Dublin 1986), esp. pp. 36–7.

Young did not reject the existence of all mechanisms which cannot be directly perceived by the senses, but he argued that the only basis for postulating such a mechanism is that it is found together with some other phenomenon which we have discovered to be inseparably connected with it in our experience. Thus he considered the objection that his rejection of unobservables would lead to the denial that the blood circulates, since "we cannot trace it through its smallest vessels". Moreover, "how shall we know that the sun shall rise to morrow or any thing e⟨ls⟩e that is future since they are not yet the objects of our senses? are not these sensible things that are Discoverable by our Reason?" (p. 436). His answer was that the existence of these items can be legitimately inferred, only because the relevant "Phaenomena of Bodys are so Inseparably connected that we never see" one without the other (p. 438). Such inferences are not only sufficient "to Direct our Conduct throughout our Life" (p. 439), but for science as well. Thus the reason we know that the blood circulates through the invisible tubes is that "we perceive it to be a piece of the same order which we have formerly seen, where the whole order was perceivable by our senses" (p. 441). This is like the case of tomorrow's sunrise, only more complex. Since we have observed closed systems wherein fluid circulates, we can conclude that without such intermediate vessels the blood which flows to the extremities "could not flow in such a proportion and not return". Unless there were such vessels we would observe the blood "Springing out of the Extremitys" (p. 444). The evidence of our senses allows us to postulate the mechanism. But there is no such evidence where mechanisms are postulated to account for the motion of the muscles.

Young's conclusion is not merely that we don't *know* what the mechanism is to account for the dilation of the fleshy part of the muscle when we exert our wills, but rather that there might very well *be* no hidden mechanism—that is, any phenomenon which is in principle capable of being sensed. He thought that the search for mechanical causes here is like the case where someone who has traced out the mechanical connections of the parts of a watch finally ends up enquiring into the cause of the elasticity of the mainspring. He might form a hypothesis about the general cause of elasticity and "foolishly conclude" that no other is possible (p. 442). The postulation of a cause in this case would be arbitrary, since the phenomenon has no relation to any known thing. But, more importantly, we need to stop our enquiries somewhere and, if we don't stop at the connections we can observe, we shall end up pursuing the "Invisible mechanism In Infinitum" (p. 443). He asked how we know in the case of the spring "that there is some mechanism in it beyond what we see". He agreed that there is some cause of the elasticity, but "how Do we know its a mechanical cause"? Perhaps it is nothing but

the "will of God" (p. 445). In the case of the muscle, there is a dilation of the "fleshy Belly" of the muscle which follows on the act of the will. Here he is willing to allow that "there must be something which Dilates the Muscle", but "whether this something be a Phaenomenon that would be perceivable by our senses if more acute or if it be only the act of the will is what we know nothing about. i,e, we know not if there be any mechanicall cause of the Dilatation of the muscle" (p. 447). Those who consider that any observable mechanical cause we give is insufficient, and who always seek another, are really demanding a "mechanicall connection betwixt the Soul (or if you please the will) & a Living body". They are really leading us "to the mechanicall operation of the Spirit of man" (p. 449).

In 'Of Sensation' Young made clear his belief that the scientific demand for causal mechanisms is really no more than the demand that a given correlation be subsumed under a more general law: "To Explain the mechanism of any particular Phaenomenon is to reduce it to some common General Law of Bodies own'd to be such By every Body" (p. 470). Young asked why there need be mechanisms in this sense for all phenomena, for there may be a particular order "only agreeing to two or 3 bodies". The particular laws of nervous action may constitute such an order. We know that when a certain nerve is stimulated in a healthy person such and such a sensation follows. But no one has been able to formulate a more general law of nervous action of which these laws of specific nerves can be seen as an instance, and therefore "it would not be absurd to say that perhaps there is no other mechanism in our sensations". It may be "a particular Law which only agrees to animal bodies while connected with a Spirit" (pp. 467–71).

Hence Young combined a rejection of mechanical explanation with a belief that special laws apply to bodies in virtue of their being animated by an immaterial spirit. These philosophical ideas found fertile soil in the mind of Whytt. But there were, no doubt, other important formative influences on Whytt. He subsequently studied in London, Paris, Leiden (where he is said to have heard the lectures of the then aged Boerhaave), finally receiving his doctorate in Medicine at Rheims in 1736. He returned to Edinburgh, where he began a private practice in 1737.[43]

Whytt seems to have begun lecturing on the institutes of medicine in the mid-1740s after St Clair took ill; he was appointed professor in 1747. It is commonly accepted that he used Boerhaave's *Institutes* as a textbook,[44] but he must have treated central Boerhaavian doctrines in

[43] W. Seller, 'Memoir of the life and writings of Robert Whytt, M.D.', *Transactions of the Royal Society of Edinburgh* 23 (1862); R. K. French, *Robert Whytt, the soul and medicine* (London 1969), chap. 1.

[44] French, *Robert Whytt*, pp. 6–9.

a very critical way. Whytt's *Essay*, published in 1751, contained refutations of many of these doctrines, including Boerhaave's accounts of the automatic operations of the heart and lungs. In the Advertisement there was an extended attack on "the hypothetical method of philosophizing" where "causes are usually assigned, which not only cannot be proved to exist, but which are frequently more intricate and complex than even the effects to be explained from them" (*Essay*, p. vi). It seems likely that many readers would have seen this as a challenge to much of the contemporary physiology, pre-eminently that of Boerhaave. Whytt called Boerhaave's explanation of the mechanical operation of the heart a "*hypothesis*" which, "however ingenious", was quite inadequate (p. 28). He presented a series of arguments to show its inadequacy. We have seen how Boerhaave accounted for the diastolic motion of the heart by supposing that the nervous fluids were cut off by the expansion of the auricles at the end of systole. But Whytt pointed out that not *all* the cardiac nerves do pass between the auricles and arteries as Boerhaave supposed, and therefore the nervous impulse to the heart could not be completely cut off. Even if all the nerves did take that route, the external coats of the auricles and arteries are soft and fleshy, and it is not plausible that the nerves would be compressed to such an extent as to cut off their impulse to the heart. There are no other examples in the body of the kind of temporary paralysis of muscles which Boerhaave postulated and, when nerves are cut off by being tied, their effect returns only gradually—not suddenly, as required by Boerhaave's mechanism for the heart. Whytt gave eight arguments based on anatomical and physiological evidence to show that Boerhaave's hypothesis for the mechanical and automatic operation of the heart just won't work.

On the other hand, in the first edition of his *Essay*, Whytt commended the a priori arguments "proposed with great strength and perspicuity by my ingenious friend Dr. *Porterfield*" to show "that the motion of the heart and circulation of the blood, are altogether inexplicable upon principles purely mechanical" (p. 267). Whytt seems to have been referring to those general arguments based on the impossibility of a perpetual motion machine which Porterfield had borrowed from Clarke and Newton. But, since he claimed to have a general distrust of a priori arguments, Whytt added "a variety of arguments *à posteriori*, chiefly of the analogical kind", which not only show the impossibility of purely mechanical explanations of the vital operations, but also that they are due to "the immediate energy of the mind or sentient principle" (p. 268).

To support the view that there can be no perpetual motion in animal bodies, Whytt first appealed to the experiments of Stephen Hales, indicating that "in every circulation, the blood loses 9/10 of the

momentum communicated to it by the left ventricle of the heart". From this Whytt inferred the need for some "cause generating motion" within the animal body: "matter, in its own nature inert, is incapable of this". He also appealed to observations of hibernating animals, which "lie in a dead inactive state in the winter" but can be revived again at any time with a slight stimulus of heat which slowly "excites the heart into action". To support the conclusion that this action cannot be explained mechanically, Whytt appealed to the principle that a cause cannot produce an effect greater than itself. There is "some living principle" in these animals, which is capable of generating motion when certain parts of the body, such as the heart, are aroused by some slight stimulus (pp. 268–9).

While Whytt appealed to experience to show that animals generate motion, he also seems to rely on an a priori principle in drawing the conclusion that such motion cannot derive from the body itself. He assumed with Newton, Clarke, and others that all increase of motion must come from *mind*, and that matter itself is inert and passive. There is no doubt that this is a central thesis of Whytt's book. It begins with a motto from Cicero's *Tusculan disputations* which, according to Whytt, shows that some of the ancients believed that all animal motions derive from "the energy of a living principle wholely distinct from the body".[45] In Section XI of Whytt's book there is a passage which suggests that he had been following the recent controversy in Europe surrounding La Mettrie's infamous *L'Homme machine*. Whytt sees a natural progression from the mechanistic principles of Descartes concerning the motions of animals to the dangerous doctrines of La Mettrie concerning man as a machine (pp. 291–2). The latter had been a student of Boerhaave and had produced the French translation of *Praelectiones academicae*.[46] Whytt piously closed his own book with the hope that, by showing that the motions of our bodies "are all to be referred to the active power of an *immaterial* principle", he will have shown how "unjustly the study of Medicine has been accused of leading men into Scepticism and irreligion" (p. 391). Should we not read Whytt's claim that self-movement of animals is due to an immaterial principle as a mere a priori assumption employed to keep medicine theologically respectable?

However, if we do not go beyond this conclusion, we shall miss what is most distinctive in Whytt's physiological metaphysics. When he ascribed self-motion as well as other specific properties of animate nature to the mind, he was giving a positive account of the phenomena he was trying to explain, based on a careful reading of the physiological

[45] See *Essay*, p. 266, and Cicero, *Tusculan disputations*, trans. J. E. King (London 1966), pp. 64, 70.

[46] A. Vartanian, *La Mettrie's L'Homme machine* (Princeton 1960), pp. 75ff.

evidence. The key to his analysis of the involuntary motions of animals lies in his claim that they depend upon the mind acting as "a sentient principle" (p. 271 *et passim*). We may question the analogies which he used to draw his conclusion that the mind is involved in the involuntary motions of the body, but in order to understand his theory we need to consider with some care the arguments he employed. The core of his belief that the vital and other involuntary motions of a living body cannot be explained mechanically lay in his observation that such motions rely on the reaction of muscles to a *stimulus*. Whytt held that muscular motion was caused either by the will *or* by a stimulus, and that it is the latter which causes all the involuntary motions.

In Section X Whytt carefully examined the current theories of muscular contraction—those based on the elasticity of the muscle fibres themselves, on the elasticity of the unobservable parts of a nervous fluid, on chemical explosions, on electricity, etc.—and pointed out that the actual reaction of the fibres of living tissue to stimuli is quite different from what such theories would lead one to expect (pp. 229ff.). For example, the alleged spring-like properties of the parts of the muscle or the nervous fluid do not explain why the muscle reacts in so much more violent a way when it is lightly touched with a needle than when it is struck much harder with a blunt object. Why should a spring react in a violent way to acids "any more than the mildest milk, or oil of almonds" (p. 231)? We observe no such reaction in springs large enough for us to see. To those who held that muscular contraction results from a chemical explosion or perhaps from "the peculiar energy of some very subtile ethereal or electrical matter residing in the nerves", Whytt replied that none of these hypotheses explains why the muscles react to certain stimuli and not others. Gunpowder requires fire and "electrical *effluvia*" require a charged object: but neither is necessary for the stimulation of a muscle. It makes no difference "whether the stimulating substances be electrics *per se*, or *non*-electrics" (p. 236). Whytt went on, in the first edition, to attack the view of Haller (as expressed in his notes to Boerhaave) that the spontaneous motion of muscles is due to some latent power in the muscles themselves. In this opening shot in his important dispute with Haller about the cause of muscular movement, Whytt calls this postulation of a latent power "a refuge of ignorance" (p. 239). He clearly thought, at least initially, that his own explanation, unlike that of Haller, was based on a principle of which we all have direct knowledge. Finally, Whytt considered the general view of those who say that the "AUTHOR of nature" has endowed the muscle fibres with some matter superior to ordinary matter. Here alone, Whytt's reply seems to be based purely on a priori considerations, when he argues that to claim that matter "can, of itself, by any modification of its parts, be rendered

capable of sensation, or of generating motion, is equally absurd, as to ascribe to it a power of thinking" (pp. 241–2).

Whytt thought that any particular response could be explained by ascribing it to "an active sentient PRINCIPLE animating these fibres". Whytt's sentient principle must be understood as the source of an inherent sensibility in the nerves of the muscles which causes them to react in determinate ways to the stimuli which are applied to them. Whytt thought that this could explain why the application of a stimulus to a bare muscle produces "instead of only one contraction lasting for a considerable time, several contractions and relaxations alternately succeeding each other, which become gradually weaker, and are repeated after longer intervals, as the force of the irritating cause is diminished". When first stimulated, the sentient principle "determines the influence of the nerves" into the muscle fibres "more strongly than usual", in order to remove the pain. However, as the feeling of pain diminishes, the muscle reacts less often; indeed "if by one or two contractions the irritating cause be thrown off, and, together with it, the disagreeable sensation removed, the muscle will return to its former state of rest" (pp. 242–3). Such contractions are not like those of a vibrating body which "performs its vibrations in equal times, whether it be acted upon by a stronger or a weaker force" (p. 247). Thus the particular nature of the response in removing the irritating cause indicates that what is operating is a sensible principle.

In ascribing the response to a sentient principle, Whytt was not merely making the point that the response is generally the most useful one under the circumstances. This was also a common observation among the mechanist writers whom he opposed, and like those writers he held that the involuntary motions of the body could under certain circumstances turn out to be quite harmful (pp. 289–90). Rather, his central point is that the particular nature of the observed response becomes intelligible when it is seen as a reaction to a pain or uneasiness. For example, "if *stimuli* excite the muscles of animals into contraction by acting upon them, rather as sentient than mere mechanical or material organs, it is easy to see, why the mildest aliment is apt to excite vomiting when the coats of the stomach are inflamed" (p. 256). Here the sensibility of the stomach due to the inflammation explains its violent response to the mild food. The muscle reacts in direct response to the feeling. Similarly, the response of a muscle is very different when the feeling is constant from what it is where the contraction of the muscle gives some degree of relief. Thus "the causes which produce the erection of the *penis*, though they be generally excited into action by the *stimulus* of the seed, yet do not act by alternate fits, because the erection has no effect to lessen the stimulating cause". On the other hand, *musculi ejaculatoris seminis* act through alternate contractions and relaxations because through such actions the

irritation is gradually relieved. These muscles relax for a moment because each contraction briefly lessens the uneasy sensation of the stimulus (p. 261). In general, we can understand the nature of muscular action if we consider the muscles to be "endued with feeling, and animated by a sentient principle" (p. 369).

Whytt's sentient principle explains animal motions as a direct response to the degree of pain that is felt. His most important contribution to physiology is generally considered to be his work on reflex action. Through careful experimentation he identified the spinal cord as the locus of the reflex in the limbs of the frog, and discovered that there is a period of inhibition after the frog has been decapitated in which this reflex is delayed. But his explanation of this phenomenon may seem to be more remarkable than the phenomenon itself. In his *Physiological essays* (1755) Whytt wrote that "the great pain occasioned by cutting off the head rendered the animal for some time insensible when its toes were wounded". Thus the frog's mind is too preoccupied with the loss of its head to react to the relatively minor pain of its toes being pinched! In support, Whytt appealed to Hippocrates' principle that "a greater pain destroys, in a considerable degree, the feeling of a lesser one".[47]

Whytt collapsed the distinction which Boerhaave had made between the purely automatic motions of the body and those which arise from some "uneasy sensation". For Whytt, *all* muscular motion must be seen as an attempt to get rid of some "pain or uneasy sensation".[48] This was

[47] Whytt, *Physiological essays*, third edn. (Edinburgh 1766), p. 98. See F. Fearing, *Reflex action* (Cambridge, Mass. 1930), pp. 74–83; G. Canguilhem, *La Formation du concept de réflexe aux XVIIe et XVIIIe siècles* (Paris 1977), pp. 101–7 *et passim*.

[48] *Essay*, p. 243. Cf. pp. 288–9, where Whytt also writes of "a disagreeable perception", and likens the sentient principle to the *moral sense* "whence we approve of some actions, and disapprove of others, almost instantly, and without any previous reasoning about their fitness or unfitness". In *Medicine as culture: Edinburgh and the Scottish Enlightenment* (Ph.D., University of London 1984), Christopher Lawrence concludes from this that Whytt "was drawing on the moral philosophy of Hutcheson or his followers to develop a new conception of the body" (p. 232). Lawrence has misunderstood the significance and context of the parallel which Whytt drew. He bases his interpretation on Hutcheson's assertion that desires arise in us to obtain an agreeable sensation when we apprehend a good object, or "to prevent the uneasy Sensation when it is evil" (Francis Hutcheson, *An essay on the nature and conduct of the passions and affections* (London 1728), p. 7). But there is nothing uniquely Hutchesonian about the concept of *uneasy sensation*. We have already seen the basic idea present in Boerhaave under the heading '*molesta perceptio*' (rendered as 'uneasy sensation' in the English translation of the early 1740s). It was Locke who suggested that "the chief if not only spur to Humane Industry and Action is uneasiness" (*Essay*, II. xx. 6). Indeed, Hutcheson was probably criticizing Locke when he wrote *against* those who held that desire is "*Uneasy Sensation upon the Absence of any Good*". According to Hutcheson, "Desire is . . . distinct from *Uneasiness*" (see D. F. Norton, 'Hutcheson's moral realism', *Journal of the history of philosophy* 23 (1985), at p. 401). The same criticism was levelled explicitly against Locke in Carmichael's dictates on pneumatology at Glasgow *c.*1711–12 (see C. M. Shepherd, *Philosophy and science in the arts curriculum of the Scottish universities in the seventeenth century* (Ph.D., University of Edinburgh 1975), p. 134).

The significance of the parallel which Whytt draws between the operation of his own sentient principle and the moral sense lies in the claim that both operate without reason and reflection. The passage occurs in a context where Whytt is rejecting the Stahlian system which maintains

the principle operating when, under normal conditions, the heart contracts in reaction to the stimulus of the returning blood from the veins: the motions of the heart result from the fact that the nerves of the heart muscles are "highly sensible, and the *stimulus* is immediately applied to them" (*Essay*, p. 311). Boerhaave had rejected just this explanation by denying that there is a distinct sensation in the muscles of the heart; he had noted that if the distinct motions of the muscles were accompanied by sensation we would be in constant pain from their continuous operation. There is, in fact, only a general feeling of pain when the tissues of the heart muscle become inflamed (*Lectures*, 301.6). As we have seen, Boerhaave tried to explain the motion of the heart according to purely mechanical principles which operate independently of the mind.

Whytt argued that his own account of these phenomena was superior to that of the mechanists for two reasons: it avoided multiplying causes unnecessarily, and it explained the phenomena in terms of a principle the properties of which are directly experienced. According to Whytt, the mechanists explained the reaction of different organs of the body to stimuli by means of different mechanisms. Thus on grounds of simplicity alone his explanation of all these motions as resulting from variations in the degree of feeling was superior (*Essay*, p. 265; cf. p. 4). Perhaps even more importantly, while the mechanists and materialists ascribed the movement of muscles from a stimulus to a "hidden property of their fibres . . . or other unknown cause", he claimed to show how these movements are "easily and naturally accounted for, from the power and energy of a known sentient PRINCIPLE" (p. 265). While we may lack theoretical knowledge of how the mind affects the body, "we know from experience, that it feels, is endued with sensation, and has a power of moving the body" (p. 276).

Unlike Young, Whytt did not deny that there was some "material cause in the brain, nerves, and muscular fibres" which the mind uses "as its instrument" for putting the muscles in motion. But he did argue that such speculations were unnecessary, in "a science already labouring under too many *hypotheses*" (pp. 325–6).

There was an obvious objection, at least from the point of view of Boerhaavian physiology, to Whytt's claim that sentience is the principle operating in vital and other involuntary motions. For we are commonly *not conscious* either of the stimulus or the "exertion of the mind's power"

that everything occurs in the body through a rational principle. Like the mechanists, Whytt is concerned to establish that basic life processes occur spontaneously. Elsewhere he stressed that moral *actions* must be accompanied with a consciousness of freedom, and that in this respect they are entirely different from the actions from an uneasy sensation which control our vital functions. See p. 287 below.

in producing the response (p. 299). In breathing, for example, we are not ordinarily conscious of the stimulus, though we are sometimes conscious of an effort of the mind in producing the action. (Indeed this action is clearly sometimes voluntary.) In other cases, such as the widening of the pupil of the eye, we can be conscious of the stimulus—the increase in the intensity of the light—but not the effort of the mind in moving the relevant muscles. In the case of the heart, we are not normally conscious of *either* the stimulus *or* the supposed action of the mind in producing the contraction of the muscles. Is not our lack of consciousness a clear indication that these actions are *not* performed by the mind? Whytt tried to answer this in Section X of his *Essay*.

He suggested that our unconsciousness of the stimuli of our vital motions may be due to the fact that we have become habituated to them and that they are relatively gentle (p. 292). Just as we cease to be aware of the impressions of external objects when they become familiar to us, so we become unconscious of those internal stimuli which have affected us since birth. We always have before us a large number of impressions, though most are so lost among stronger and more novel ones "as to escape our attention and memory" (p. 294n.). But we do become conscious of them when they affect us with greater strength than usual. For example, "the sensation arising from the impetuous course of the blood through the pulmonary vessels" (p. 294)—which is, according to Whytt, the stimulus for the motion of the lungs—is normally "very slight as not to be felt or attended to". But it becomes "very perceptible" to a person suffering from an asthmatic attack, when it is "accompanied with the most painful anxiety" (pp. 295–6).

Similarly, Whytt denied that our lack of consciousness of any effort in the production of the action is proof that it is not produced by the mind. He assumed that anyone would agree that a motion which arises from an *idea* must be produced by the mind, and went on to note that such actions are often performed without any consciousness: "As the erection of the *penis* often proceeds from lascivious thoughts, it must be ascribed, in these cases at least, to the mind, notwithstanding our being equally unconscious of her influence exerted here, as in producing the contraction of the heart" (p. 301). Here one is aware of the idea (memory, etc.) which produces the effort of the mind, but not of the effort itself. Whytt also pointed out that the heartbeat can be increased by certain ideas (e.g. a frightening thought). In such a case the mind influences the motion of the heart, but we are not "sensible of its power being directed to that end" (p. 303). Even voluntary motions "are many times performed, when we are insensible of the power of the will exerted in their production"—for example, when one walks while deep in thought, or while talking to another person.

Whytt's claim that the vital motions are performed by an unconscious action of the mind might make one think that he would be quite open to Porterfield's suggestion that these actions are voluntary. In fact, quite the opposite. While, in the first edition of his *Essay* in 1751, Whytt's remarks on Porterfield's theory were all commendatory, he distanced his views from those of Porterfield in the second edition in 1763. One factor may have been Porterfield's own criticism of Whytt in his *Treatise on the eye* in 1759. In 1763 Whytt in turn criticized Porterfield, "a subtile defender of the Stahlian doctrine".[49]

In his first edition Whytt had criticized the view of the Stahlians that the mind acts as "a rational agent" in bringing about the vital and other involuntary motions:

> We think it a very clear point, that the mind does not, as Dr. *Stahl* and others would persuade us, preside over, regulate, and continue the vital motions, or, upon extraordinary occasions, exert its power in redoubling them, from any rational views, or from a consciousness that the body's welfare demands her care in these particulars.

He denied that the mind can *rationally* control the heartbeat "when life is endangered by the too violent circulation of the blood". Rational action must take place with consciousness, and, since we have no consciousness of bringing about the vital motions, they cannot be performed with reason. According to Whytt, when one acts rationally one compares different alternatives, and "in consequence of this comparison" makes a certain choice. But the comparison of alternatives is a comparison of *ideas*, and "we cannot but be sensible of the ideas formed within us by the internal operations of our minds". Unlike sensations, ideas exist only as long as we are conscious of them (pp. 285–7).

In his first edition Whytt had briefly dismissed the view that our inability to control the muscles of the heart was due to their having become, like the motion of the eyes, "in a manner necessary through long habit" (p. 286). In the second edition he specifically identified this argument as that of Porterfield.[50] Whytt argued for an essential difference between muscles like those which control the movements of our eyes and those like the heart:

> But although custom may enable us to perform some actions with surprising facility and little or no attention, yet it will not render the motions of muscles absolutely involuntary, which were originally voluntary.—There is no instance in the human body of any muscle, whose motion can be fairly proved to have

[49] Whytt, *An essay on the vital and other involuntary motions of animals*, 2nd edn. (Edinburgh 1763), p. 343n.

[50] *Essay* (1763), p. 341, paraphrasing from *Treatise on the eye*, vol. 2, p. 149.

been voluntary in the beginning of life, that has by custom or habit become so far independent on the will, as to be in *no degree* under its immediate controul. (*Essay* (1763), p. 341)

Thus, while I cannot help but move my two eyes together, I still can decide the speed at which to move them, and the direction. I have no such control over the motions of my heart, or the peristaltic motion of my stomach and guts. Thus there is no reason to think that the actions of *these* muscles were originally voluntary.

Whytt also took issue with Porterfield's claim that while there was no physical necessity involved in actions performed by custom and habit, there is a "moral necessity". According to Whytt, morally necessary actions must be sufficiently voluntary to allow one to praise or blame the agent, and in order for this to be legitimate they "must be attended with a consciousness of liberty". This consciousness is lacking in the case of our heartbeat, or the peristaltic motions of our stomach or guts. In his Pathological Lectures Whytt told his students that Porterfield's argument that the mind is not conscious of its volitions in producing such motions was based on a "metaphysical Subterfuge".[51]

But Whytt's chief objection to Porterfield's explanation of our lack of control over the vital motions was based on the fact that there is a much more plausible explanation. Even voluntary muscles come to move involuntarily when their "fibres or nerves are irritated" (*Essay* (1763), p. 342). We find throughout the animal body that stimuli produce involuntary motion through an irritation of their sensitive parts. This is clearly the explanation for the fact that the vital and natural motions of our visceral organs are carried out without any sort of voluntary control.

While Porterfield and Whytt both rejected the Boerhaavian or Cartesian theory which denied that the mind operates in governing the vital and natural operations of the body, their positive accounts are very different. Whytt's view is that the mind

in producing the vital and other involuntary motions, does not act as a rational, but as a sentient principle; which, without reasoning upon the matter, is as necessarily determined by an ungrateful sensation or *stimulus* affecting the organs, to exert its power, in bringing about these motions, as is a balance, while, from mechanical laws, it preponderates to that side where the greatest weight prevails. (*Essay*, p. 289)

Like the mechanists, Whytt held that those motions which take place independently of the conscious will take place necessarily. They follow as a "necessary and immediate consequence of the disagreeable

[51] EUL, MS. Gen. 745D, fol. 4. The lecture notes are bound with notes in the same hand as notes from the midwifery lectures of Thomas Young. The attribution to Whytt is made in the manuscript catalogue, and given the contents this seems to me probable.

perception". Neither the means nor the goal of such actions is chosen by the mind which performs them. Rather, the Deity has so formed the mind-body connection that "in consequence of a *stimulus* affecting any organ, or of an uneasy perception in it" our minds "immediately excite such motions . . . as may be most proper to remove the irritating cause" (p. 288).

Porterfield questioned the significance of ascribing body motions to the "Energy and active Power of the Mind" if those motions occur necessarily.[52] He noted that according to Whytt the vital and natural motions of the body are "altogether involuntary" and are "not subjected to the Will"; that in performing these supposed actions the mind "has no Views, . . . proposes no End, . . . acts without Choice" and "without Preference or Election". Porterfield argued that there is no point in saying that such motions are "*caused by the Mind*" if, in spite of the addition of sentience, they come about "*by a Law* established by the All-wise Creator" (*Treatise*, vol. 2, p. 162).

It is tempting, when one thinks about Porterfield's criticism of Whytt, to conclude that, because he held that the vital motions occur necessarily, there is essentially no difference between his physiological views and those of Boerhaave. In fact, in *a certain respect* Porterfield's physiology is far closer to that of Boerhaave than that of Whytt. As we have seen, Porterfield no less than Boerhaave described the body itself as a hydraulic machine. Whytt, on the other hand, held that one "must not consider the body as an inanimate hydraulic Machine which stops when one pipe is obstructed, but as composed of exquisitely *sensible* tubes".[53] Unlike Porterfield and Boerhaave, Whytt held that the basic principle of animal motion is *feeling*.

The difference between Porterfield's and Whytt's explanations of the motions of animal bodies comes out clearly in their differing accounts of the motions of muscles separated from the brain. In the last section of his *Essay* Whytt had presented a remarkable range of cases describing "the motions observed in the muscles of animals after death, or their separation from the body". He realized that some would think that such phenomena show that muscles operate independently of the soul or sentient principle, but he argued that this is not the case. Since muscles separated from the rest of the body continue to operate in the same way that they do in the body, they "bespeak a feeling, and cannot be explained without it". Unless we assert that feeling is a property of matter we must admit that the sentient principle continues to operate in them (*Essay*, pp. 389–90). Whytt claimed that this is a conclusion supported "by the strongest analogy" (p. 388). But Porterfield argued

[52] *Treatise on the eye*, vol. 2, p. 162; cf. Whytt, *Essay*, p. 302.

[53] 'Whytt's clinical lectures 1762–1764': RCPE, MS. Whytt 2, fol. 2. Italics are mine.

that Whytt's account of such motions was less plausible than that of Albrecht von Haller (*Treatise*, vol. 2, pp. 165–6). Indeed, as we have seen, Porterfield himself argued that such transient and short-lived motions could be explained in a purely mechanical way. In the second edition of his *Essay* Whytt responded by pointing out that some of these motions were hardly ephemeral:

> if the motions of a viper's heart for three days after its head has been cut off, and those of the heart of a tortoise for six months after the loss of its brain, may be owing to a mechanical power resulting from their particular structure, why may not the motions of the heart in these as well as all other animals, from the beginning to the end of life, be owing to mechanism *alone*? (*Essay* (1763), p. 431n.)

Whytt argued that there is an inherent inconsistency in a view which demands the voluntary control of vital actions during the lifetime of the organism, but is willing to allow that they can take place purely mechanically after destruction of the brain.

However, as Whytt himself recognized, his own view that the motions of separated muscles are under the control of the sentient principle was not itself without problems. In Section XI he had favoured the hypothesis that "the involuntary motions in man are not owing to a principle distinct from the rational mind", on two grounds—that the motions of voluntary muscles can themselves become involuntary, and that in man it is clearly the same principle which is conscious of thinking and of feeling (pp. 282–5). In general, Whytt favoured the view that the soul is a unity. But, as we have just seen, he also maintained that the soul or living principle does not leave the body immediately after the brain is destroyed and conscious function ceases. Does this not show the independence of the thinking and sentient principles? Moreover, in holding that the soul is responsible for the motions of separated muscles, Whytt implied that it continues to act in spatially discrete nerves. Should he not have concluded that there were different souls in the discrete parts? But Whytt argued that experiments with hibernating animals showed that the soul acts independently in different parts, even though the brain itself is dormant. Moreover, anyone who examines the structure and function of the brain will find implausible the view that the mind occupies a single indivisible point. Whytt cited an impressive list of authorities—including Gassendi, Newton, and Clarke—who held that a single unified soul can exist in extended parts. Just as the Deity can act independently in different parts of space without in any way losing unity or indivisibility, so there can be independent operation of the same unified soul in the scattered parts of animals after death. Any residual problems with this idea he put down to our ignorance of "the nature of

an immaterial substance, its manner of existing, and way of acting upon, or being present with the body" (pp. 377–84).

Whytt's view that the motions of separate muscles must be due to a soul or sentient principle took on a special significance in the dispute with Haller, which broke out after the publication of Whytt's *Essay*. Haller supported an even more radical form of automatism than his teacher Boerhaave. In the notes to his edition of Boerhaave, Haller had asserted in opposition to his teacher that "the heart is moved by some unknown cause, which neither depends upon the brain nor the arteries, but lays concealed in the very structure of the heart itself".[54] Like Whytt, Haller held that the motion of the heart was due to the irritability of the heart muscle in response to the return of venous blood.[55] But Haller claimed that irritability is due to a "physical cause which depends upon the arrangement of the ultimate particles" of the animal gluten of the muscles—though he maintained that, like gravity, the actual cause of the motion is not perceivable ('Sensible and irritable parts', p. 692). Like Boerhaave, Haller asserted that there is a mechanical cause of the motion of the heart, though he refused to speculate on its exact nature. He also maintained that there can be no feeling without consciousness (pp. 677–8). But he went further than Boerhaave in maintaining that the basic motion of the heart and other such organs is not only independent of the mind, but also independent of the whole nervous system. Taken in this context, Whytt's view that the vital and other involuntary motions of animals are caused by the sentient principle came to have a twofold significance. On the one hand, it signified the dependence of all motions of muscles on feeling; on the other, it signified the general dependence of such motions on the nervous system. Whytt's dispute with Haller touched on both issues.[56]

Much of the argument on both sides turned on the question of the correct explanation of the motions of muscles which were cut off from the influence of the brain. Haller argued that these depended on the irritability of the muscle fibres due to their own *vis insita*, while Whytt argued that irritability depended on the nervous power which remained in their nerves. Each brought an impressive array of experiments to support his view. Whytt distinguished the metaphysical issues involved from the issue concerning the anatomical source of the living principle.

[54] Albrecht von Haller, 'A dissertation on the sensible and irritable parts of animals', with introduction by Owsei Temkin, *Bulletin of the history of medicine* 4 (1936), at p. 694. This is a reprint of the anonymous English 1755 translation of Haller's *De partibus corporis humani sensilibus et irritabilibus*; the Latin original was published in Gottingen in 1753.

[55] Haller, *First lines of physiology* [1786], reprinted with an introduction by L. King (New York 1955), sec. 103.

[56] For a good recent account of this dispute see F. Duchesneau, *La physiologie des lumières* (The Hague 1982), chap. 6; also French, *Robert Whytt*, chap. 6.

The latter issue can be decided entirely on the basis of experiment. In the last edition of his *Physiological essays* in 1766, Whytt noted that even someone who held that the powers of the nerves are "owing to the particular disposition and arrangement of the matter of which they are composed" could adopt his view on the relation of irritability to sensibility (pp. 244–5). He thought that a good portion of his dispute with Haller could be settled by an agreement that life is due to a single nervous power which can be retained for a limited time in the nerves of the muscles after they are separated from the rest of the body.

Nevertheless it is also true that much of the dispute hung on the differing conceptions of mind adopted by Whytt and Haller. Haller's most important metaphysical challenge to Whytt's view was clearly stated in his 1753 paper *De partibus corporis humani sensilibus et irritabilibus*. He noted that Whytt had "found himself obliged to admit the divisibility of the soul, which he believes to be separable into as many parts as the body". Haller observed that when the intestines were quickly removed from a small animal and cut into four or eight pieces, all moved separately and responded individually to an irritation. He did not think it made sense to maintain, with Whytt, that the soul continues to operate in all of them independently. In general,

> The soul is a being which is conscious of itself, represents to itself the body to which it belongs, and by means of that body the whole universe. I am myself, and not another, because that which is called I, is changed by every thing that happens to my body and the parts belonging to it. . . . But a finger cut off from my hand, or a bit of flesh from my leg, has no connexion with me. I am not sensible of any of its changes, they can neither communicate to me idea nor sensation; wherefore it is not inhabited by my soul nor by any part of it; if it was, I should certainly be sensible of its changes. ('Sensible and irritable parts', pp. 677–8)

In this discussion Haller identified self and soul, and denied that there can be activity of soul without consciousness. The soul cannot be operating in the separated muscles of the body as Whytt claimed, for it does not feel the irritation of those muscles.

In response to the first part of Haller's criticism, Whytt repeated his claim that the soul need not be divisible, even though it continues to exist in the scattered parts: an "immaterial substance cannot, like the body, be divided by the anatomical knife, and . . . the indivisibility of the soul does not depend on the unity of that body which it animates, but on its own particular nature" (*Physiological essays*, p. 242). Unfortunately Whytt never really explains the significance of this unity of the soul itself after all conscious functions cease, beyond what he had already set forth in his *Essay*.

In response to the second part of Haller's objection, Whytt made an important distinction between the nature of feeling as it exists in the periphery of the nervous system and as it exists in the brain. He held that it is probable that, even in living animals, the soul is "present every where in the body", and that "there may be some kind of feeling or sensation excited in the nerve itself" which causes the response to a stimulus (p. 155n.). Whytt carefully distinguished the location of "simple sensation" from that of sensation accompanied with consciousness. Thus the soul "can only taste in the tongue, smell in the nose, see in the eyes, hear in the ears, and feel hunger in the stomach". On the other hand, it exercises the power of "reflex consciousness and reason" only in the brain. Consciousness is due to a "reflex act, by which a person knows his thoughts or sensations to be his own". When communication with the brain is cut off, the part of the body can still retain its power of sensation through the peripheral nerves and so react for a time to stimuli. But it is no longer able to communicate that sensation to the brain where it can become conscious (pp. 155–8). In a footnote to the final edition of his *Essay* Whytt referred to the sensation which is retained in the parts of muscles separated from the rest of the nervous system as "*some kind* of feeling or *simple* sensation (such as oysters or other animals of the lowest class, who have no brain are endued with)" (*Essay* (1763), p. 433n.).

The metaphysical issue between Whytt and Haller turns largely on their different conceptions of the soul. For Haller, like Boerhaave, the essence of the soul is to be conscious. For Whytt, the soul is essentially that which gives life to the body and which is only conscious in so far as it performs its operations in the brain. As we have seen, Whytt thought that his contemporaries rejected his view of the soul partly because they still retained Cartesian principles, and partly because they had become too enamoured of mechanical reasoning in physiology. Perhaps Haller's unwillingness actually to give a mechanical account of the *vis insita* blunted the force of the second part of this criticism, but the first remained entirely relevant to their dispute. Whytt rejected that form of Cartesian dualism which maintained that the vital and other involuntary motions of animals are independent of the thinking principle—the view which was most forcefully set out by Haller. In his account of the soul or mind Whytt reaffirmed its essence as the principle of life and maintained the centrality of feeling as the root of all life processes.

V. CULLEN'S GEOGRAPHY OF THE MIND

In 1766, after Whytt's early death, William Cullen resigned his position as professor of Chemistry at the University of Edinburgh, and was

appointed professor of the Theory of Medicine. Over the next seven years he gave five year-long courses of lectures on physiology.[57] In 1772 he published his *Institutions of Medicine*, containing only short propositions, which were discussed at length in his lectures. In the latter, Cullen considered the physiological views of a number of his contemporaries, especially Whytt, Haller, and Jerome Gaub. His own views are not always easy to discover, because he employed a sceptical style of reasoning, balancing one contemporary doctrine against another. But, like Hume, Cullen was an *academic* sceptic who used this type of reasoning to reach conclusions which he thought highly *probable*.[58] He provided a dialectical synthesis of his predecessors' views by applying what Hume had called "mental geography" (E. 13)—that is, through a careful analysis of the powers of the mind. It was through such an analysis of sensation and volition, albeit one which rested partly on Cartesian principles, that Cullen showed the extent and nature of the interaction between mind and body.

As I indicated in section I, Cullen regarded this mutual interaction as of major concern to physiology. In what appears to be a supplementary private note on his lectures from the mid-1760s, he wrote that the problem of the action of the mind on the body reduces to the problem "how one State of the body or of one part can affect another part of it". He identified the mental states or faculties as "thought, Intellect & will". The reason they had been generally ascribed to "a Substance very different from our bodies" is that the mechanism by which they are produced "is not ⟨at⟩ all obvious". Nevertheless, he pointed out that they are clearly "inseparable from some conditions in the body". Cullen adopted the doctrine of two substances and their connection espoused by Boerhaave and Haller, who had never been "Suspected of irreligion", but this dualism and the problems connected with it were of little intellectual concern to him. The important problem concerning the influence of mind on body was a problem of how certain states of the brain—namely mental ones—affect those of other organs such as the heart: "This is a problem to the Solution of which we may hope to attain."[59]

Whytt and Porterfield had opposed Boerhaave's view that the essence of mind or soul is to be conscious. It is therefore striking to discover that, in spite of his alleged opposition to the system of Boerhaave, Cullen

[57] Thomson, *Life of Cullen* (note 6 above), vol. 1, p. 458.

[58] On Cullen's recommendation of "the slow consenting Academic Doubt", see J. R. R. Christie, 'Ether and the science of chemistry', in *Conceptions of ether*, ed. G. N. Cantor and M. J. S. Hodge (Cambridge 1981), esp. p. 92. Christie ties this academic scepticism with that of Hume, stressing the importance of a cautious acceptance of hypotheses—especially that of the aether—for both thinkers.

[59] 'Lectures on physiology': RCPE, MS. Cullen 16(1), preliminary folios.

followed him in holding that consciousness characterizes what is mental. This is clear from his analysis of the concept of *sensation*. In his lectures in the fall of 1770, Cullen said he followed Hume in distinguishing sensations from *ideas*—that is, from the thought of "an Object absent arising from Reminiscence". A sensation is a thought which arises directly from an "external Impression or certain other Changes in the Body". Cullen went beyond Hume (and Whytt) in carefully distinguishing sensations from impressions—that is, from the motions in the body which are their causes.[60] Cullen defined "sensation" in general as "the Mind's being *conscious* of any changes in the State of the body, or more nearly of the Nervous System" (fols. 89–90, my italics). In proposition 49 of his *Institutions* he asserted (with Haller) that the mind can have or attend to only one sensation at a time, thus rejecting Whytt's suggestion that the mind can have a number of unconscious sensations at any given moment. Finally, in his 1770 lecture on proposition 122, he stated plainly that "to say there is Sensation without Consciousness is to me almost a Contradiction in Terms" (fol. 160).

Unlike Whytt, Cullen held that processes of the body can take place purely automatically—that is, without being accompanied by any mental state. Herein we see the significance of his distinction between sensations and impressions. In proposition 80 he asserted that "certain impressions and certain states of the body . . . may . . . act on the nervous system without producing any sensation"; and in proposition 122, that "many impressions have their affects without sensation and volition". Indeed he held that fundamentally our vital and natural motions are of this nature. In proposition 119 he maintained that "the motions of the heart and arteries, of the organs of respiration, of the stomach, intestines and perhaps other parts" are caused by "certain internal impressions . . . which produce no sensation, nor motions of which we are conscious except when exercised in an unusual manner".[61] Cullen did accept Whytt's view (opposed to Haller) that the motions of muscles are always

[60] After distinguishing sensations from ideas, Cullen wrote: "In this point I follow David Hume; he indeed uses the Term *Impression* instead of *Sensation*, but I employ *Impression* in another place I think more properly, nor would Impression convey the whole meaning of Sensation, but only as far as it arises from the body." (NLS Cullen, fol. 80). On Whytt's interchangeable use of 'impression' and 'sensation' see sect. IV above.

[61] In an article which is widely referred to ('The nervous system and society in the Scottish Enlightenment', in *Natural order: historical studies of scientific culture*, ed. B. Barnes and S. Shapin (Beverly Hills 1979), 19–40), C. Lawrence cites this passage to support the conclusion that Cullen "retained all the characteristics of Whytt's sentient principle—purposeful action, coordinating ability, and, *most importantly, unconscious feeling*—without introducing second substances into physiology" (p. 26, my italics). I can see how this passage could be read as Lawrence reads it when taken out of the context of the rest of the *Institutions*, but I cannot see how it can be so read in the context of propositions 80, 122, and numerous comments in the lecture notes. For reasons set out in the last section I also consider quite misleading Lawrence's view that *Whytt* thought the vital motions are carried out through any "purposeful action".

due to some form of nervous power, and he stressed that in the living body they require a constant energy from the brain (props. 96, 97).[62] However, he drew an entirely different metaphysical conclusion from Whytt's. For Cullen, the fact that "some of the Functions of our System can be performed without Sensation or Volition" gives "a strong Proof of the Brain's being a Mechanical Organ" (NLS Cullen, fol. 146; cf. *Institutions*, prop. 116).

In proposition 122 Cullen balanced this against the claim that the mechanism of the brain is insufficient "without being united with a sentient principle or mind that is constantly present in the living System". He argued for this partly on epistemological grounds, because "the mechanism of the brain suited to its several functions is not at all perceived". Unlike Boerhaave, Cullen did not think that mental states are, for practical purposes, reducible to their mechanical causes. But he also gave a more positive reason: very few of the functions of the brain are "carried out without sensation and volition" (prop. 122). Here he appears to agree with Whytt's claim that the sentient principle operates throughout the body. We need to consider how this is reconcilable with Cullen's assertions about vital and natural motions which we considered in the last paragraph.

While Cullen appealed to the authority of Whytt in support of a sentient principle, he took issue with Whytt's view that sensation takes place in the peripheral nervous system, apart from the brain itself (NLM, II, fol. 243). But their different accounts of the operation of the sentient principle go deeper than that. Since Cullen identified mental functions with conscious ones, he held that basic life functions can go on independently of the mind. At the same time he criticized Whytt for holding with Boerhaave that our visceral functions are carried on with an absolute necessity,[63] without any kind of influence by the conscious mind. For Cullen, the sentient principle influences our basic life functions, but as an independently identifiable principle whose effects on those functions can be determined by experience. While he began from a basic acceptance of what I earlier called function dualism, Cullen asked himself just how those states of the nervous system which are mental interact with those on which our basic life functions depend.

Cullen regularly returned to what he called the "Stahlian contro-

[62] Cullen seems to adopt the position suggested by Whytt in the last edition of the *Physiological essays*, discussed in section IV above.

[63] "But to understand Boerhave you must observe this Application of these Doctrines to his System in his Definition of Disease, where he says the Consideration of the Mind is to be neglected. . . . He explains this still more particularly . . . where he expressly says Omne hoc pendet &c.——mechanica dispositio. . . . I join with Boerhave, Dr Whytt, who after taking much pains in his Vital Functions, to prove the Existence of a Sentient Principle . . . thinks that all our Motions are directed by a Physical Necessity." (NLS Cullen, fol. 76).

versy"—the question whether the mind voluntarily directs the vital and natural motions of the body. At the beginning of his lectures on the nervous system, he said he was following Gaub in subscribing to a compromise between the view of Boerhaave and Whytt on the one hand and that of the Stahlians on the other.[64] To understand this we must examine his mental geography of volition—that is, his account of the extent and manner in which the mind can be said to have control over our bodies.

In proposition 119, Cullen listed seven causes of the action of the brain in bringing about changes in the body, five of which are said to be "modes of volition" (NLM, III, fol. 49). These include the operation of the will in performing voluntary actions, the passions, imitation, appetites directed to external objects, and propensities to remove an uneasy sensation. In arguing that "some Volition is concerned" in the last of these, Cullen gave an idea of just what he meant by 'volition'. A typical case of a propensity which arises from an "uneasy sensation" is the voiding of urine and faeces. In such cases the relevant motions "can often be prevented by another volition presenting itself", and we can put forward greater or less effort in exercising them (*Institutions*, 119.5).

> The Excretion of Urine is often very urgent, yet a Lady in company with men will restrain this Propensity; neither will a well bred Man expel wind by the Anus in company with Ladies; he can restrain it. . . . [A] Man in going to Stool . . . in pressing out Faeces . . . holds his Breath in order to give a greater Effort, & if it is still more difficult, he grins most horridly. (NLS Cullen, fol. 152)

The number of muscles which come into play is determined by the degree of effort which is put forth (NLM, II, fols. 271–2). While Cullen did not deny that motions from an uneasy sensation are sometimes caused without any volition—that is, without the ability to do otherwise or to put out greater or less effort—the paradigm is those in which some volition is involved. In contrast, we should remember that Whytt postulated a sentient principle to explain those involuntary motions of the body which, according to him, were necessarily determined by the uneasy sensation.

Volitions, in Cullen's wide sense, constantly affect our vital functions. While the basic motions of my heart and lungs are carried out purely mechanically, they are constantly affected by my passions, i.e. "more general and vehement volitions" (*Institutions*, 119.2). There is "nothing more evident than that the passions of the mind affect the motion of the

[64] NLS Cullen, fols. 76–7. For Gaub's views on mind and body see L. J. Rather, *Mind and body in eighteenth-century medicine* (Berkeley 1965). Rather stresses the difference between Gaub's view of the passions and that of Descartes. For Gaub, like Porterfield and Cheyne, they are actions of the mind. This view seems to be shared by Cullen.

heart"—for example, anger will produce a violent beating of the heart and grief will slow it down (NLM, II, fol. 274). Though Cullen considered the passions to be "modifications of the will", he noted that they are generally instinctive in so far as they arise directly in response to a certain sensation. When we are angry, even the outward motions of our bodies often arise without our having much awareness of them. However, Cullen also stressed that when our passions are not too violent we have some degree of conscious control over the relevant motions.

But it is not only those volitions which are essentially instinctive which affect our vital motions; some are also constantly affected by what are clearly voluntary actions. Cullen wrote that "there is no proof of any one muscle of the body being more under the power of the will, than the action of respiration" (NLM, II, fol. 273). The rate and manner of my breathing is affected by a number of my voluntary actions, including talking. Does this not mean that Cullen followed Porterfield and the Stahlians in holding that we have voluntary control over the vital and natural motions of our bodies?

Cullen's mental geography of the will consisted of two elements, both basically Cartesian. First, he held that the will is a mode of thought and that what we will is only that which we are immediately conscious of willing.[65] In bodily motions subjected to the will "the Mind only wills an End. . . . We know nothing of the particular muscles put in action. When I bend my arm, I commonly only attend to the contraction of the Biceps, but Winslow has shewn that many other Muscles partake in that Action" (NLS Cullen, fol. 161: cf. *Institutions*, prop. 119.1). Cullen denies that we have anything but a very limited and general consciousness of the parts of our bodies moved, and draws the conclusion that we will only the general movements of a limb or muscle.

Related to this is his second Cartesian principle, that "in the moral Administration of the System only a general end or purpose is in view, & *the Almighty Creator has connected certain Motions with the Volition of these Ends*" (NLS Cullen, fol. 161; my italics). Thus there are certain motions of our body naturally or originally connected with the willing of certain general goals or purposes. To take Descartes' own example, "if we want to adjust our eyes to look at a far-distant object, this volition causes the pupils to grow larger" (*PWD*, vol. 1, p. 344). I cannot directly will the bodily motions, but only certain general conscious aims to which they are *naturally joined*. Both Descartes and Cullen held that through custom and habit these original connections of ideas and bodily motions

[65] For Descartes' view see *PWD*, vol. 2, p. 113, Def. 1. This new translation of Descartes' works unhelpfully translates the Latin '*immediate conscii sumus*' by 'we are immediately aware'. As McRae and Rodis-Lewis (note 16 above) show, Descartes was using '*conscii*' in a new and important way which became fundamental in modern philosophy.

could be changed so that the willing of a quite different idea could bring about the relevant bodily change.

From these two principles Cullen concluded that, while my passions or even my voluntary actions affect the vital motions, it is not in the way that the Stahlians thought. In general, we do not directly will the motions of individual muscles, nor do we have any distinct consciousness of bodily sensations. While he accepted Porterfield's and Perrault's claim that the uniform motion of our eyes was originally voluntary (NLM, II, fols. 101–11; cf. *Institutions*, prop. 55), he did not accept that certain motions of muscles were chosen over others in order to achieve the goal of forming a distinct image of the object. Rather, it was merely by willing the general end of seeing objects distinctly that the motions of the muscles became uniform. Moreover, most of us have, through custom and habit, come to perform this action completely without consciousness, and hence the mind is no longer involved in it (NLS Cullen, fol. 153).

Cullen held that many motions which we may consider to be involuntary, including vital and natural ones, are not entirely so. But he showed exactly how such motions can be a matter of voluntary and rational choice. In his 1772 lecture on proposition 119, Cullen told his students that he differed from other physiologists with regard to "the extent of the powers of the mind or with regard to the manner of acting". He distinguished the question whether the visceral motions are affected by the mind from the question whether they are "directed" by the mind. Consideration of the passions and unintended effects of voluntary actions shows that the motions of our internal organs are constantly affected by the mind. However, like Porterfield and Cheyne, Cullen held that vital motions such as those of the heart can be "directed by the mind", though for him it is only "*in one limited sense*" (NLM, II, fol. 287). The mind controls the body through conscious rational choice. The question is how, through conscious choice of a certain means to end relation, we might be able to control the motion of our heart and other internal organs.

'Cullen maintained that when we are calm we have some control over our passions through imagination, and that in so far as the passions are voluntary both these and the internal motions of our bodies are also under our control. Clearly, we can under certain circumstances control our passions by directing our thoughts in a certain way—that is, by choosing to think of certain objects with which our passions are naturally joined. We have "a power whereby we can recall these objects that give us anger or fear". Cullen recalled that

> There is a famous instance of Colonel Townshend by Dr. Cheyne who stopped his heart at pleasure and died when he thot proper. I can explain it. . . . By

recollecting an object of fear we can diminish its action, and [by some such way as this] Colonel Townshend had power over his heart. So have no doubt that we can by recalling one or other of these passions make it voluntary, and if you will a certain end, it has the power of exciting a variety of actions and combining these together, at the same time the heart.

Thus the mind *can* control the motion of the heart. Cullen's idea is that Townshend was able to do it, not by directly desiring that his heartbeat should decrease in frequency, but rather by calling up certain thoughts which have that result. He suggested that perhaps "that power might have been greater and ⟨been⟩ destroyed by repetition". Apparently he thought that many of us have lost the power of controlling our passions and the related motions of our bodies by calling up certain ideas. He concluded that "the heart itself is not clearly separated by the voluntary motions in a certain view of it" (NLM, II, fols. 273–5).

This clearly does not mean that Cullen sided with Porterfield and the Stahlians on either the manner or the extent of the mind's control over the body. He limited such control to our conscious choice, and while, apart from such choice, the motions of the body are affected by the mind, they are not voluntary. Earlier Cullen did consider the possibility that all actions of our internal organs may originally have been voluntary like the motions of our eyes, and only became automatic through custom and habit; but he argued that this is improbable, given that in adults an internal organ can react to new stimuli without their being in any way conscious of it or requiring any process of habituation. Moreover, the kind of control which Cullen envisioned over our internal organs is only of the most general kind—not involving a choice of the operation of specific muscles. This is essentially what was proposed in section 45 of Descartes' *Passions of the Soul*:

> Our passions, too, cannot be directly aroused or suppressed by the action of our will, but only indirectly through the representation of things which are usually joined with the passions we wish to have and opposed to the passions we wish to reject. For example, in order to arouse boldness and suppress fear in ourselves, it is not sufficient to have the volition to do so. We must apply ourselves to consider the reasons, objects, or precedents which persuade us that the danger is not great. (*PWD*, vol. 1, p. 345)

Descartes himself had recognized the importance of such control of our passions for health and disease in his correspondence with Princess Elizabeth.[66] But both Cullen and Descartes, because they limit the

[66] Descartes to Elizabeth, May or June 1645, *Oeuvres de Descartes*, vol. 4, pp. 218–22. Theodore Brown, in 'Descartes, dualism, and psychosomatic medicine' (in *The anatomy of madness*, ed. W. F. Bynum and others, vol. 1 (London 1985), at p. 52), implies that Descartes cannot consistently hold that the mind can affect the passions. Brown is certainly correct that Descartes considered the passions themselves to arise directly from somatic states, but it is also consistent with the central principles of his philosophy that Descartes gives the mind an *indirect* control over the passions.

mind's operations to those of which we are conscious, have a more limited conception of the mind's control over the body than did Porterfield, Perrault, and the Stahlians.[67]

Still, we may want to ask whether, in admitting that the mind can act independently of sensation in voluntary action (NLS Cullen, fol. 78), Cullen was not allowing with Porterfield and Whytt that it has special *active powers* not possessed by inanimate matter. Indeed, at the beginning of his 1772–73 lectures Cullen said that he did not want to deny that "the soul has a power of beginning motion" (NLM, II, fol. 35). He later noted that "Causes that in no part of nature have any tendency to excite motion—but rather diminish it . . . are frequent Causes of it in animal bodies" (fol. 280). (He claimed that when a depressant drug such as opium is given, sometimes the brain is excited instead of relaxed by it.) He regarded the healing power of nature itself as a kind of active power in the animal economy (fol. 276–80). Nevertheless, there are good indications that Cullen thought that such properties resulted from a certain kind of matter, not from a substance entirely immaterial.[68] While he was very cautious in putting forward a theory of animal electricity, he admitted that his important neurophysiological concepts of "excitement and collapse" first occurred to him when he was formulating a "Theory" from "an Analogy I observed in the Phaenomena of electricity" (NLS Cullen, fol. 185). There is reason to think that, like Hume, Cullen asked himself whether "it is more difficult to conceive that motion may arise from impulse than that it may arise from volition?" (E. 73). And like Hume, he appears to have answered by speculating on the possibility of an active matter.[69]

In general, we can conclude that Cullen provided a solution—within the context of a Cartesian metaphysic—to the function dualism which we found so clearly expressed in Boerhaave. Like Boerhaave, Cullen

[67] It is tempting to think of Cullen's account as providing an explanation for a crude form of what today we would call "biofeedback". But for Cullen, like Boerhaave, we never have anything but a general sensation of the motions of the heart and other internal organs. Modern biofeedback phenomena appear to require continuous information about very specific changes in the condition of the body (G. Jones, *Visceral learning* (New York 1973)). Moreover, it is difficult to see how such phenomena could be explained on Cullen's Cartesian model of the will, which is based on the notion of an original correlation between the willed idea and the body motions.

[68] In stating the point in this way I have in mind Cullen's discussion in his lectures on the history of chemistry: "Aether and Inert matter are hence supposed to be the only matters in nature" (RCPE, MS. Cullen 10(1), fol. 87).

[69] On Hume's comments on the aether hypothesis see my *Sceptical realism of David Hume* (note 30 above), pp. 145, 161ff.; also Christie, in *Conceptions of ether* (note 58 above). In his 1772–73 physiology lectures Cullen became very defensive about his claims regarding animal electricity (NLM, III, fols. 15–19), probably in response to the attack on his student G. R. Brown's dissertation in the article on *Aether* in the first edition of the *Encyclopaedia Britannica*. See R. K. French, 'Aether and physiology', in *Conceptions of ether*, at p. 118.

maintained that the basic life functions are carried out independently of the mind. He argued that in one sense the visceral organs are constantly influenced by the mind, though their activity is not voluntarily willed; this influence is clearest in the case of the passions. But Cullen also argued that to a limited degree our corporeal functions can be voluntarily controlled by the mind—that is, by imagining certain objects which are naturally and habitually conjoined with our passions. Thus, while Cullen held that there is a basic dualism between mental functions on the one hand and vital and natural ones on the other, he also showed the nature of the causal relation between them. This causal interaction cannot, according to Cullen, be described in mechanical terms, since descriptions of mental processes are not in practice reducible to physical ones.[70] Thus, in Cullen's physiology, unlike that of Boerhaave, it was essential to discuss the conditions of mind conducive to life and health.[71]

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[70] But such a reduction appears to be possible in principle. In his 1770 lectures, Cullen wrote against the Stahlians that "the force of impression is every where absolute; & it is according to the force of impression, and other mechanical conditions of the System, that the motions excited prove either salutary or pernicious" (NLS Cullen, fols. 159–60).

[71] This paper was written in 1986–87 while I was a visiting member of the Institute for Advanced Study (Princeton) and received a Grant-in-Aid from the Institute. I am grateful to my colleagues in the School of Historical Studies—especially to Professor Morton White—for their support. I am indebted to Roger Emerson, Ed Reed, M. A. Stewart, Paul Wood, and John Yolton for comments on an earlier draft, to Teresa Saunders for her help with translations from Latin, and to the owners of manuscripts quoted for permission to cite from the materials in their possession.