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PSYCHIATRY WITHOUT MIND IN THE EIGHTEENTH CENTURY: THE CASE OF BRITISH IATRO-MATHEMATICIANS *

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Introduction

Recent progress in the research into the history of British medicine in the early eighteenth century, a period once called 'the lost half century', has thrown light on a highly characteristic scientific group which was active and prominent in the English and Scottish medical scene from around 1690 to 1720. [1] The pivotal figure of this group was Archibald Pitcairn, shortly to become professor of physic at Leiden and later on at Edinburgh. Recasting the Italian iatro-mechanism of Giovanni Alfonso Borelli and Lorenzo Bellini into 'mathematical physic', Pitcairn initiated many English and Scottish medical students into his idiosyncratic school at Leiden and Edinburgh, and later lent his patronage to some of his Scottish students who were trying to build a scientific reputation in London [2]. He developed in Edinburgh in the 1690s such a close association with George Hepburn, Jacobus Johnstone, and George Cheyne (all formerly students of his at Leiden), that one of their opponents used the phrase "Dr. P. and his club" [3]. In addition

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[1] Anita Guerrini, "The Tory Newtonians: Gregory, Pitcairne, and Their Circle", *Journal of British Studies*, *25* (1986), 288-311.

[2] Anita Guerrini, "Archibald Pitcairne and Newtonian Medicine", *Medical History*, *31* (1987), 70-83; *id.*, "The Tory Newtonians ...", cit. Other useful materials about Pitcairn include: Charles Webster, *An Account of the Life and Writings of the Celebrated Dr Archibald Pitcairne*, Edinburgh, Gordon and Murray, 1781; *The Best of Our Own: Letters of Archibald Pitcairn 1652-1713*, collected and annotated by W.J. Johnston, Edinburgh, Saorsa Books, 1979; G.A. Lindeboom, "Pitcairne's Leyden Interlude Described from the Documents", *Annals of Science*, *19* (1963), 273-284.

[3] [Charles Oliphant?], *A Refutation of the Short Answer to the Examination of Dr. Pitcairn's Dissertations* (Edinburgh: n.p., 1702), 16.

** History Programme

to this 'club', many prominent medical writers influenced by Pitcairn were active in London and Oxford. These include Richard Mead, William Cockburn, James Keill, John Quincy, and John Freind [4].

The most prominent hallmark of this school was its commitment to the model of mathematics [5]. As has been pointed out by Theodore Brown, their program of reforming medical theory and practice was of a very different nature from the late seventeenth-century medicine at Oxford, which developed under the influence of Harvey, Descartes, Gassendi, and so on [6]. The enemies and critics of the group, too, perceived its medicine as 'mathematical': Pitcairn was depicted in a satirical pamphlet as "Apollo mathematicus", and later Albrecht von Haller wrote "Archibaldus Pitcairne dictus est inter physiologos iatro-mathematicus" [7]. The influence of Isaac Newton was crucial in the making of this iatro-mathematical school, as has been pointed out by Anita Guerrini, Arnold Thackray, and Robert Schofield [8]. Just as Newton wrote *Principia* to give a mathematical description of the macrocosm, Pitcairn and his disciples looked at the microcosm of the human body in terms of the laws of motion, which were to be described in the language of mathematics.

[4] For biographical information about those figures, see A. Guerrini, "The Tory Newtonians", cit.; Matthew Maty, *Authentic Memoirs of the Life of Richard Mead*, London, J. Whiston *et al.*, 1755; Richard H. Meade, *In the Sunshine of Life: a Biography of Dr Richard Mead 1673-1754*, Philadelphia, Dorrance & Company, 1974; Arnold Zuckerman, "Dr Richard Mead (1673-1754)", University of Illinois, Ph.D., 1965; Roy Porter, 'Introduction' to George Cheyne, *The English Malady*, London, 1733 (repr., London: Tavistock/Routledge, 1991); F. Valdez and C.D. O'Malley, "James Keill of Northampton, Physician, Anatomist, and Physiologist", *Medical History*, *15* (1971), 317-335; R.W. Innes Smith, *English-Speaking Students of Medicine at the University of Leiden*, Edinburgh, Oliver and Boyd, 1932.

[5] Anita Guerrini, "Isaac Newton, George Cheyne and the *Principia Medicinae*", in Roger French and Andrew Wear (eds), *The Medical Revolution of the Seventeenth Century* (Cambridge: C.U.P., 1989), 222-245. See also Richard Mead, *A Mechanical Account of Poisons* (London: R. Smith, 1702), 'Preface', which says: "introducing mathematical studies ... into medicine ... is so much moment to the welfare of mankind".

[6] Theodore M. Brown, "The Mechanical Philosophy and the 'Animal Oeconomy': a Study in the Development of English Physiology in the Seventeenth and Early Eighteenth Century", Ph.D., Princeton University, 1968, Chaps. 4 and 5. For the Oxford school, see Robert G. Frank, *Harvey and Oxford Physiologists*, Berkeley, University of California Press, 1980.

[7] Edward Eizat, *Apollo mathematicus: or the Art of Curing Diseases by the Mathematics According to the Principles of Dr. Pitcairn*, [London], n.p., 1695; Ch. Webster, *Dr. Archibald Pitcairne*, cit., 26.

[8] A. Guerrini (see fn. 1, 2, and 5); *id.*, "James Keill, George Cheyne, and Newtonian Physiology, 1690-1740", *Journal of the History of Biology*, *18* (1985), 247-266; Th. M. Brown (see fn. 6); *id.*, "Medicine in the Shadow of the *Principia*", *Journal of the History of Ideas*, *41* (1987), 629-648; Arnold Thackray, *Atoms and Powers: an Essay on Newtonian Matter-Theory and the Development of Chemistry* (Cambridge, Mass.: Harvard U.P., 1970), 43-85; Robert E. Schofield, *Mechanism and Materialism: British Natural Philosophy in an Age of Reason* (Princeton: Princeton U.P., 1970), 40-72.

Their mathematical medicine not only meant quantifying medicine, stuffing their publications with ostentatious numerical formulae and apish adoption of the ideas of Newton. I shall argue below that the research programme of the British iatro-mathematicians also involved a radical recasting of the sphere of medical knowledge by a deliberate restriction on the way this knowledge is obtained. By both heavily employing and significantly modifying late-seventeenth-century English epistemology epitomized by John Locke, they attempted at purifying medical knowledge, stripping it of uncertainty, and securing an area of infallible certainty [9]. In so doing, they systematically and entirely excluded the problematics of soul/mind from the scope of medical knowledge. Their rigorous restraint on the extent of medical knowledge and expulsion of problems of human soul/mind produced a most interesting effect on their notions of 'mental' diseases, such as mania and melancholia [10]. In strict accordance with fundamental principles of their research programme, there was hardly any space for soul/mind in their notions on madness. The British iatro-mathematicians thus constructed an idiosyncratic and out-and-out 'somaticist' approach to madness.

In the following sections I shall examine this attempt to create a medicine without the problematics of human soul, in which the discourse on madness excluded any issues related with disorders in mind. The first section will examine how Pitcairn and his followers tried to achieve infallible certainty in medicine and why they came to embrace such an ambitious research programme. I will argue that the impetus for their attempt came not solely from Newton: the epistemology and scientific methodology put forth by late seventeenth-century English writers like Robert Boyle and John Locke played an important part in the formulation of their tactics, as well as their desire to combat medical 'empirics' and to differentiate themselves from traditional elite physicians. The second section is concerned with their exclusion of the soul/mind from the realm of medical knowledge, and their assertion that 'pure body' is the only proper object of medical inquiry. The third section will examine their recasting of 'mental' disorders like mania and melancholia. The major source I have consulted for this section is Richard Mead's account of the physical effects of tarantula bites and of rabies. I will show how Mead and others adapted the clinical observations on madness to their mathematical and purely bodily medicine, and managed to explain madness without any recourse to mental issues.

[9] For the problem of philosophical foundation of medicine in the eighteenth century, see Lester King, *The Philosophy of Medicine: the Early Eighteenth Century*, Cambridge (Mass.), Harvard U.P., 1978.

[10] For an overview of the medical concept of melancholia at that time, see Stanley W. Jackson, *Melancholia and Depression: from Hippocratic Times to Modern Times* (New Haven: Yale University Press, 1986), 104-146.

'Mathematical physic': in quest of certainty

Pitcairn was very confident and innovative right from the beginning of his teaching career. In his inaugural lecture at Leiden in 1692, titled "An oration proving the profession of physic free from the tyranny of any sect of philosophers", he announced that his principal and ultimate goal was to establish firm and stable principles on which medical theory and practice should be based. To achieve this aim, Pitcairn wrote, it is necessary to get rid of what he thought speculative "philosophical sects" from medicine: "let the infamous mark of uncertainty, ... be at last wiped off, and removed from our profession" [11]. The key word of his reform in medicine was 'certainty'. Terms like "solid principles", "certain foundation of medicine", "infallible ground", and so on, were often used to describe his attempt, both by his friends and foes [12]. Of course, he was not alone in his pursuit of certainty. Little doubt inspired by Descartes' quest of infallible principles in philosophy, some medical theorists on the Continent, such as Friedrich Hoffmann, expressed a similar concern with Pitcairn's and sought to provide medicine with certain and firm foundations [13].

Pitcairn's attempt to establish the unshakable basis of medicine, however, came from a different intellectual tradition from Hoffmann's Cartesian one. Indeed, Descartes was one of Pitcairn's targets of criticism. As the title of his inaugural lecture shows, Pitcairn stated that to achieve certainty it was necessary to get rid of all speculative hypotheses of "any sect of philosophers", and in which he included not only Aristotelians and Helmontians, but also Cartesians. Cartesian

[11] Archibald Pitcairn, *The Whole Works of Dr. Archibald Pitcairn*, 2nd ed., transl. by George Sewell and J.T. Desaguliers (London: E. Curll *et al.*, 1727), 5-22: the quote is from p. 17. There are two other collected works of Pitcairn, i.e.: Archibald Pitcairn, *The Works, Wherein Are Discovered the True Foundation and Principles of the Physick*, London, E. Curll, 1715, and *The Philosophical and Mathematical Elements of Physick in Two Books*, London, A. Bell, 1718. Below I shall refer to these works as *The Whole Works*, *The Works*, and *The Philosophical and Mathematical Elements*. As for the background and the reception of the lecture, see G.A. Lindeboom, cit. fn. 2.

[12] A. Pitcairn, *The Works*, vii; *id.*, *The Whole Works*, 'Translators' Preface', by George Sewell (d. 1726) and J.T. Desaguliers (1683-1744). For criticism against his abuse of the idea of certainty in medicine, see E. Eizat, *Apollo mathematicus*, 'A Discourse of Certainty', 1-25.

[13] Friedrich Hoffmann, *Fundamenta Medicinae*, transl. and introd. by Lester S. King (London: MacDonald, 1971), 3. See also Herman Boerhaave, *Institutions in Physick*, transl. by Joseph Browne (London: Jonah Browne, 1714), xii. As for the social and intellectual background of Boerhaave's quest for 'fundamentals', see Lester King, *The Background of Herman Boerhaave's Doctrines*, Leiden, Universitaire Pers, 1965; Andrew Cunningham, "Medicine to Calm the Mind: Boerhaave's Medical System and Why It Was Adopted in Edinburgh", in Andrew Cunningham and Roger French (eds), *The Medical Enlightenment of the Eighteenth Century* (Cambridge: Cambridge U.P., 1990), 40-66.

subtile matter, as well as the Aristotelian fear of vacuum and Helmontian fermentation, were for Pitcairn all speculative occult qualities and stained by the "infamous mark of uncertainty" [14]. In contrast, Hoffmann thought Descartes' mechanical philosophy would provide the solution to the present chaotic struggle of medical sects, rather than the cause of it: "without natural philosophy the whole science of healing is maimed and weak ... the origin of sects must be attributed to ignorance of natural philosophy". Cartesian natural philosophy, Hoffmann expected, would help medicine as it "peers into the recesses of nature, examines the hidden structures, proportion, and mixtures" [15].

In his hostility towards "philosophical sects" and their use of speculative "occult qualities", Pitcairn shows a striking similarity with the major English advocates of the new natural philosophy in the late seventeenth century. The supporters of the Baconian research programme who flocked into the Royal Society of London thought that knowledge about the natural world should be freed from the preoccupations of speculative philosophical schools (*idola theatri*). This could only be done by replacing philosophical doctrines based on occult qualities with mechanical principles based on observation and experiment, through which they hoped to achieve the widest assent [16]. Robert Boyle, for example, attacked Aristotelian and Paracelsian doctrines, as well as the Hobbesian version of Epicurean atomism as being speculative and unfounded on observation, and Joseph Glanvill, another spokesman of the Royal Society, rejected philosophical speculations in his *Vanity of Dogmatizing* (1661). [17]

Pitcairn was surely well aware of what was going on in London's scientific community, for Edinburgh in the 1680s saw a vigorous infusion of scientific culture

[14] A. Pitcairn, *The Whole Works*, 14 and 17. See also *id.*, *The Works*, 34; *id.*, *The Philosophical and Mathematical Elements*, vi.

[15] F. Hoffmann, *Fundamenta Medicinae*, cit., 1-2.

[16] The strategy of the Royal Society has been studied extensively. See, for example, Peter Dear, "*Totius in Verba*: Rhetoric and Authority in the Early Royal Society", *Isis*, *76* (1985), 145-161; Steven Shapin, "Pump and Circumstance: Robert Boyle's Literary Technology", *Social Study of Science*, *14* (1984), 481-520. For the continuous use of occult qualities at the Royal Society, see K.T. Hoppen, "The Nature of the Early Royal Society", *British Journal for the History of Science*, *9* (1976), 1-24, 243-273; John Henry, "Occult Qualities and the Experimental Philosophy: Active Principles in Pre-Newtonian Matter Theory", *History of Science*, *24* (1986), 335-381.

[17] Boyle's and Glanvill's hostility to ill-founded philosophical opinions is discussed in Henry G. van Leeuwen, *The Problem of Certainty in English Thought 1630-1690* (Hague: Martinus Nijhoff, 1963), 71-89. For a recent assessment of Boyle's construction of observed data, see Steven Shapin, *Social History of Truth*, Chicago, University of Chicago Press, 1994. More nuanced pictures of Boyle, with emphasis on his Christian and moral conscience, as well as alchemical and magical traditions, have been presented in Michael Hunter (ed.), *Robert Boyle Reconsidered*, Cambridge, Cambridge U.P., 1994.

and the establishment of scientific communities modelled mainly after the Royal Society of London [18]. Pitcairn was one of the members of the Royal College of Physicians of Edinburgh when it was founded in 1681, and was well acquainted with some of the key figures of the early Scottish Enlightenment, such as David Gregory and Sir Robert Sibbald. Pitcairn's attempt to reform medicine by getting rid of philosophical speculations, which is best exemplified in his Leiden inaugural lecture, was a product of the early Scottish Enlightenment, which was itself a descendant of the English scientific and intellectual milieu of the late seventeenth century.

Pitcairn's debt to the Royal Society research programme is rendered clearer if one looks at the rationale of his attempt to do without any speculative philosophy. His logic of reform in medicine was construed along the line of the epistemology and scientific methodology of the proponents of the early Royal Society, which was codified into John Locke's *Essay concerning Human Understanding* (1690). In brief, the proponents of the Royal Society were keen to establish the limit of human knowledge; to distinguish certain knowledge (if such a thing is possible for man) from probable knowledge and dubious opinion; and to adapt their scientific study of the natural world to the compass of the human mind. In Locke's words, "before we set our selves upon enquiries of that nature, it was necessary to examine our own abilities, and see, what objects our understandings were, or were not fitted to deal with" [19]. They largely agreed that with the exception of mathematics, which gives absolute certainty, immediate sensory knowledge could achieve the highest probability and therefore should form the most reliable basis of our knowledge of natural world [20]. Accordingly, they were often reluctant to trespass across the boundary between what is given directly to the senses and what is not, and they wanted to do without dubious opinion about the hidden nature of things [21]. An

[18] John Christie, "The Origin and Development of the Scottish Scientific Community, 1680-1760", *History of Science*, *12* (1974), 122-141; Roger L. Emerson, "Science and the Origins and Concerns of the Scottish Enlightenment", *History* of Science, *26* (1988), 333-366; *id.*, "Sir Robert Sibbald, Kt, the Royal Society of Scotland and the Origins of the Scottish Enlightenment", *Annals of Science*, *45* (1988), 41-72.

[19] John Locke, *An Essay Concerning Human Understanding*, ed. by P.H. Nidditch (Oxford: Clarendon Press, 1975), 7. See John Yolton, *Locke and the Compass of Human Understanding* (Cambridge: Cambridge U.P., 1970), chaps 2 and 3.

[20] The problem of the certain and probable knowledge has been discussed in H.G. van Leeuwen, *The Problem of Certainty*, cit.; Barbara J. Shapiro, *Probability and Certainty in Seventeenth-Century England*, Princeton, Princeton U.P., 1983.

[21] See, for instance, J. Locke, *Essay*, 4.3. Although one is tempted to say that Pitcairn imbibed Lockean agnosticism about the nature of things *via* the first edition of Newton's *Principia* (1687), Lockean epistemology had not become evident in Newton's writings until the second edition of *Principia* (1713). The correspondence between Locke and Newton in 1690-1692 was mainly concerned with their biblical study, not epistemology. See H.W. Turnbull (ed.), *The Correspondence of Isaac Newton*, vol. 3 (Cambridge: Cambridge U.P., 1961), 71, 79, 82, 129-149. The influence of Lockean epistemology upon Newton's later methodological argument (*Hypotheses non fingo*) is discussed in G.A. Rogers, "The System of Locke and Newton", in Zev Bechler (ed.), *Contemporary Newtonian Research* (Dordrecht: Reidel, 1982), 215-238.

ideal student of experimental natural philosophy should, therefore, abandon or minimize speculation about the hidden nature of things and should concentrate on their 'qualities' and 'powers', which were directly given to senses. Boyle wrote succinctly:

> For the knowledge we have of the bodies without us, being, for the most part, fetched from the informations the mind receives by the senses, we scarce know anything else in bodies, upon whose account they can work upon our senses, save their qualities. [22]

Given that human knowledge about the natural world was drawn from sense experience, direct sense information should be given priority over speculations about the hidden nature of things. Although Pitcairn did not make any reference to the source of his ideas about the restriction on the limit of medical knowledge, it is obvious that he owed a lot to what was claimed by the English proponents of the methodology of new experimental philosophy and its epistemological justification. Indeed, he radically simplified the views of the English proponents of mechanical philosophy, completely purging them of any reference to occult qualities, the vital role of which have been reinforced in the recent revisionism in the history of the English mechanical philosophy [23].

Applying the argument on certainty and probability, Pitcairn maintained that an infallible principle of medicine is possible only by adjusting the limit of medical discourse to the sensory boundaries of human knowledge: "nothing ought to be used as a principle in physic, which is not as certain as the object of our senses" [24]. In his Leiden inaugural lecture, he maintained:

> It is evident to any one who has been a little more than ordinary conversant in the mathematics, or the practice of physic, that our knowledge of things is confined to the relations they bear to one another, the laws and their

[22] Robert Boyle, *Origin of Forms and Qualities According to the Corpuscular-Philosophy* (1666), in *Selected Philosophical Papers of Robert Boyle*, ed. and introd. by M.A. Stewart (Manchester: Manchester University Press, 1979), 13.

[23] For the recent revisionism, see, *inter alia*, M. Hunter, *Robert Boyle Reconsidered*, cit.; M. Hunter, "Alchemy, Magic, and Moralism in the Thought of Robert Boyle", *British Journal for the History of Science*, *23* (1990), 387-410.

[24] A. Pitcairn, *The Whole Works*, 14.

> properties or powers. [...] a physical cause, and the nature of things which the philosophers so much enquire about, is that unknown something in things from whence they will have all its powers and properties derived. [25]

Pitcairn's plea for certain medicine was based on the same epistemology that was expressed in Boyle's passage quoted above. It was necessary to rid medicine of speculations of 'philosophical sects', because human mind could never penetrate into the hidden nature of things beyond observing their external operations on our senses or on other things, or, "powers and relations". Since any doctrine about the hidden causes of phenomena was beyond the direct access of the human mind, a solid basis for medicine could be established only by discarding all doctrines about the hidden nature of things [26]. Only those investigation of the operations of things which could be confirmed by the evidence of senses would serve as a certain basis of medicine. Unlike Hoffmann, who believed in the use of Cartesian philosophy, Pitcairn was indebted to the English empirical tradition of epistemology.

Pitcairn's indigenous empirical scientific methodology appealed to many of his English and Scottish disciples, who closely replicated it in their writings. James Keill rejected Descartes' philosophy on the hidden nature of things because it was not certain but "merely possible". If one follows Cartesian philosophy, Keill warned, the only result is an uncertain medicine:

> Most theories of diseases are built upon such [dubious] principles, and therefore we never can have any certainty, or indeed so much as a degree of probability, that the indications drawn from them are right. [27]

Likewise, John Quincy justified his limiting medical knowledge within the properties of things, by a long argument on the various degrees of certainty and by citing Locke's arguments on qualities and the human mind [28]. Any search after hidden causes of phenomena was scornfully dismissed. In one of his bitter controversial pamphlets with Charles Oliphant over Pitcairn's tract on fever, Jacobus Johnstone wrote that "Mr. Newton has taught us, that no man ever knew a physical

[25] *Ibid.*, 9-10. This aspect of Pitcairn's was paid attention first in Lester King, *The Philosophy of Medicine*, cit., 112-114.

[26] A. Pitcairn, *The Whole Works*, 17. As Guerrini has pointed out, Pitcairn shared with Boyle, Newton, and others the room for devine intervention in the mechanism of Nature. See A. Guerrini, "Archibald Pitcairne and Newtonian Medicine", cit., 80.

[27] James Keill, *Essays on Several Parts of the Animal Oeconomy*, 2nd ed. (London: G. Strahan, 1717), xx. For detailed analysis of the shift in Keill's matter theory, see A. Guerrini, fn. 1, 2, and 5.

[28] John Quincy, "An Introduction Concerning Mechanical Knowledge, and the Grounds of Certainty in Physick", in John Quincy (ed.), *Medicina Statica: Being the Aphorisms of Sanctorius Translated into English with Large Explanations Wherein Given a Mechanical Account of the Animal Oeconomy* (London: W. Newton, 1712), xxxvi-xlii.

cause, neither will you find any mention of a final cause in this dissertation of Dr. P's" [29]. William Cockburn wrote that it was only "quacks and mountebanks" who claimed to have knowledge about "these first qualities, or physical causes" [30]. The supporters of Pitcairn's reform in medicine all agreed that certain medicine must be achieved only by the sacrifice of any discourse on hidden causes, which were essentially not reachable for human mind.

So far I have argued that the attempts by Pitcairn and his followers was a product of late-seventeenth-century English epistemology. However, they made an important departure from the contemporary English argument on certain and probable knowledge. Pitcairnians claimed that they could achieve the same extent of certainty in the field of medicine as one could in mathematics and geometry, while Locke and many others maintained it was simply impossible, because mathematical and geometrical demonstration and empirically based sciences belonged to fundamentally different categories of knowledge [31]. Why, then, did the iatro-mathematicians try to base medicine on mathematics, ignoring the different statuses of medical and mathematical knowledge?

Part of the answer lies, as has been already pointed out, in the excitement Newton produced in the minds of Pitcairn and his followers [32]. Imitating Newton, they started from the high probability of sensory data, reduced them to laws, and expressed the laws in the manner of mathematical and geometrical demonstration. Pitcairn explained:

> The business of a physician is to weigh and consider the powers of medicines and diseases as far as they are discoverable by their operations, and to reduce them to Laws. [...] Physicians ought to propose the method of astronomers as a pattern for their imitation. [33]

Establishing the laws described in mathematical terms, Pitcairn perhaps thought, would give his medical system a certainty as absolute as that enjoyed by geometrical

[29] J[acobus] J[ohnstone], *A Short Answer to a Late Pamphlet against Doctor Pitcairn's Dissertations* (Edinburgh: Thomas Carruthers, 1702), 11. Attribution of the pamphlet to Johnstone is mine.

[30] William Cockburn, *The Present Uncertainty in the Knowledge of Medicine* (London: B. Barker, 1703), 'Preface'.

[31] See, for example, J. Locke, *Essay*, 4.3.26; B.J. Shapiro, *Probability and Certainty*, cit.; H.G. van Leeuwen, *The Problem of Certainty*, cit.

[32] A. Guerrini, cf. fn. 2 and 5. That the iatro-mathematicians modelled their works after Newton's is obvious from just looking at their books: many of them adopted a *Principia*-like format of geometrical demonstration and included numerous mathematical formulae. See G. Cheyne, *A New Theory of Acute and Slow Continued Fevers*, 2nd ed., London, G. Strahan, 1702; J. Keill, *Essays on Several Parts of the Animal Oeconomy*, cit.

[33] A. Pitcairn, *The Whole Works*, 10-14. Pitcairn used the term 'powers' here in the same way as Boyle and Locke used. See R. Boyle, *Selected Philosophical Papers*, cit., 1-96; J. Locke, *Essay*, 2.21.

demonstration, defying the rigid barrier between certain mathematical knowledge and probable sensual knowledge [34].

Another reason why the iatro-mathematicians insisted on the certainty of mathematical medicine was that they needed an effective theoretical device of distinction in their struggle with another offshoot of British empiricism, namely 'empirical medicine', as proposed by Thomas Sydenham, who argued that medical knowledge should be based on the mere accumulation of empirical observations, without any theory-building [35]. Their hostility to empirical medicine was best expressed in the fever dispute of the 1690s in Edinburgh, of which Andrew Cunningham has made a penetrating account [36]. The pattern of 'Sydenham versus Newton' established there can also be found elsewhere, especially in London in the early eighteenth century.

Newtonian mathematics was thus used as a point of superiority of Pitcairn's research programme over Sydenham's: mathematical and geometrical format in which their medical knowledge was expressed ensured the higher status to the former. In his lecture at Leiden entitled 'A Solution of the Problem Concerning Inventors', he formulated the polemical epistemology against the Sydenhamians. In the lecture, he divided the whole of human knowledge into two kinds: one is "historical", the other "demonstrative". The former could enjoy only limited certainty, as it was confirmed only "by the light of other things", i.e. "upon the credit and ability of the reporter". The latter, for example, "the whole is greater than the part", was the superior one, as it was "demonstrated by its own evidence" [37]. And the goal of medicine should be the latter kind of knowledge, rather than Sydenhamian 'historical' knowledge. What matters was, Pitcairn maintained, whether a piece of knowledge was demonstrated or not: "There is no one who will allow a geometrician to be the author of a theorem, which he has not demonstrated" [38]. Pitcairn was here saying that the empirical medicine lacked demonstration, the distinguishing sign of real knowledge, and was less reliable than the mathematical medicine.

[34] Pitcairn was not the only figure that tried to follow Newton and to provide non-mathematical knowledge with the certainty of mathematics. A lot of philosophers and theologians became optimistic about the prospect of making philosophy and theology infallible. See Mordechai Feingold, "Partnership in Glory: Newton and Locke through the Enlightenment and Beyond", in P.B. Scheurer and G. Debrock (eds), *Newton's Scientific and Philosophical Legacy* (Dordrecht: Kluwer Academic Publishers, 1988), 291-308.

[35] For Sydenham, see Kenneth Dewhurst, *Dr. Thomas Sydenham (1624-1689): His Life and Original Writings*, London, The Wellcome Historical Medical Library, 1966; Andrew Cunningham, "Thomas Sydenham: Epidemics, Experiment and the 'Good Old Cause'", in R. French and A. Wear (eds), *The Medical Revolution of the Seventeenth Century*, cit., 164-190.

[36] Andrew Cunningham, "Sydenham versus Newton: the Edinburgh Fever Dispute of the 1690s between Andrew Brown and Archibald Pitcairne", *Medical History*, Supplement No. 1 (1981), 71-98.

[37] A. Pitcairn, *The Whole Works*, 139-167. The original intention of this work was to establish Harvey's priority in the discovery of the circulation of blood.

Pitcairn's followers adopted the same strategy of degrading the medicine of the enemy as uncertain collection of hearsay, and glorifying the medicine of their own as demonstrated and infallible scientific knowledge. Cockburn followed Pitcairn's dichotomy of knowledge by dividing it into "experimental" and "sciential"; the example given for the former was "such and such medicines are recommended for, and are good or bad in particular diseases" and it was "the lowest piece of knowledge that can be expected from physicians". The latter sort of knowledge would be achieved when the statement was established in a demonstrative manner, which was, thought Cockburn, "as noble a piece of science as physick can be supposed to admit of". John Quincy also followed the same strategy as Pitcairn's and Cockburn's, and made a tripartite distinction between "historical" certainty, "moral" certainty and "demonstration", among which the last should be "our only guide" in the study of human body [39]. As Richard Mead put it in a straightforward way, mathematical demonstration in medicine was "the distinguishing mark of a physician from a quack" [40].

Their attack against unlearned quacks also seems to have another effect of embarrassing at least some part of learned physicians, who thought that classical learning, rather than mathematics, should be the distinction and the guide of physicians. Pitcairn's barely concealed message was that those who relied on classical medical writings were basing their medicine on mere hearsay, which could achieve only the lowest degree of certainty: anyone who wanted to make proper use of classical medical writings could do so only by giving it a mathematical and demonstrative format. This mathematical reformatting of Hippocrates was done precisely by John Freind, another supporter of Pitcairn, in his polemical edition of Hippocrates' fever tracts, as R.J.J. Martin has perceptively pointed out [41]. James Harvey (fl. 1708), another iatro-mathematician, also tried to introduce mathematical reasoning into the field of prognosis: Harvey accused the blind followers of Hippocratic prognosis as "neglecting to inquiring into the reasons of observation, ... unalterable laws of motion and mechanism" [42].

[38] *Ibid.*, 156.

[39] W. Cockburn, *The Present Uncertainty of Medicine*, cit., 2; J. Quincy, *Medicina Statica*, cit., xi, xiv-xviii.

[40] R. Mead, *A Mechanical Account of Poisons*, cit., 'Preface'.

[41] R.J.J. Martin, "Explaining John Freind's *History of Physick*", *Studies in History and Philosophy of Science*, 19 (1988), 399-418.

[42] James Harvey, *Praesagium Medicum or the Prognostic Signs of Acute Diseases* (London: G. Strahan, 1706), ix. There Harvey also wrote: "How conductive soever towards the improvement of medicine observations may be, yet they must be much more so, when founded upon solid reasoning", i.e. "the unalterable law of motion and mechanism".

Small wonder this aggressive re-definition of proper medical knowledge upset other physicians, many of whom fought back, capitalizing on the then ongoing Hippocratic revival [43]. In the 1700s Pitcairn went through bitter controversies with fellow physicians of the Royal College of Edinburgh, who were his former allies in the fever disputes in the 1690s. [44] Neither in London was the mathematical medicine wholeheartedly accepted: Pitcairn's disciples in London did not find an easy path to the Royal College of Physicians, although the Royal Society, where Newton had already achieved eminence, welcomed their mathematical and Newtonian physic [45]. In his *Apollo mathematicus*, Edward Eizat ingeniously argued that Pitcairn's quest for 'demonstrated' knowledge at the cost of 'historical' one would lead to deism, for a deist denied revealed religion and the authority of the Bible by claiming that "nothing is certain but a mathematical demonstration, and that all historical certainty amounts to no more but a meer conjecture, and that the best attested history is little better than a romance". Pitcairn's denial of the authority of historical writing would, warned Eizat, "strike at the root, and shake the foundation of all historical certainty, whether the history be sacred or profane" [46].

Despite these protests, mathematical medicine *à la* Pitcairn was vigorously preached in the 1710s and 20s. It was in this radically new scheme of mathematical medicine that the total elimination of the problems of the soul/mind was pursued.

Formulation of the 'pure body' as the medical object

In England in the late seventeenth and early eighteenth century, the scope of medical knowledge was in most cases dualistic, in the sense that medical writers framed the twofold compound of the soul and the body as a phenomenon which they had to examine, explain, and treat. There was almost universal agreement among medical writers of the time that man is made up of the soul and the body,

[43] There were attempts to revive Hippocrates during the late seventeenth and early eighteenth century, through Sydenham, Baglivi, Hoffmann, and Boerhaave. See Giorgio Baglivi, *The Practice of Physick. Reduc'd to the Ancient Way of Observations*, London, A. Bell *et al.*, 1704; Iain M. Lonie, "Hippocrates the Iatromechanist", *Medical History*, *25* (1981), 113-150; A. Cunningham, cf. fn. 13. For Baglivi's interest in English medical scene, see Thomas Apperly, *Observations in Physick, Both Rational and Practical* (London: W. Innys *et al.*, 1731), xviii.

[44] A. Cunningham, cit. fn. 35.

[45] R.J.J. Martin, "Thomas Sydenham ...", cit. fn. 41. Th. M. Brown, "The Mechanical Philosophy...", cit., 238-307.

[46] E. Eizat, *Apollo mathematicus*, cit., 5 and 13. We know relatively little about the criticism against iatro-mathematicians. See a valuable exception of Philip K. Wilson, "'The Greatest Lies Can Be Invented': Daniel Turner on Mechanists, Quacks, and Atheists in Newtonian London", an unpublished paper read at 'Day of Enlightenment', a Conference held by the London Centre for History of Science, Medicine and Technology, 1st March, 1991.

although where the soul actually resides in the body was hotly disputed [47]. As Walter Charleton put it in his anatomical lectures at the Royal College of Physicians in London, published in 1680, the broadest object of medicine was man, "composed of two principal parts, a soul and body" [48]. Medicine then was a study of man, which was called 'anthropology' [49].

The object of 'anthropology', however, did not entirely square with that of medicine. As man is composed of two things, the soul and the body, 'anthropology' consisted of two parts, the study of the soul and the study of the body, which were often named 'psychology' and 'somatology' [50]. 'Psychology' was not a proper medical concern, and medical writers confessedly neglected purely mental phenomena which the body has nothing to do with, leaving them to philosophers and metaphysicians [51]. English medicine at that time did not take a whole man as the object of its study; the whole man minus purely mental phenomena was the proper object.

For many medical writers of the Restoration period, the rest of the human actions was still essentially the phenomena which were simultaneously bodily and psychic, in the sense that many physiological functions such as digestion and movement of the heart were regarded as under the guidance of the controlling soul [52]. By the turn of the century, however, English medical writings had slid into

[47] The argument over the seat of soul was very extensive in late seventeenth- and early eighteenth- century English medical scene. Major contributors to the dispute include: Descartes, Helmont, Willis, and French anatomists such as Daniel Duncan (1649-1735), Daniel Tauvry (1669-1701), and Raymond Vieussens (1641-1716). For an overview of the dispute, see Edwin Clarke and Kenneth Dewhurst, *An Illustrated History of Brain Function* (Oxford: Stanford Publications, 1972), chaps 7 and 9.

[48] Walter Charleton, *Enquiries into Human Nature in VI Anatomic Praelections in the New Theatre of the Royal College of Physicians in London* (London: R. Boulter, 1680), 'Preface', p. 1.

[49] See, for instance, *Anthropology Abstracted: or the Idea of Humane Nature*, London, Henry Herrington, 1655. For the genre of 'anthropology', see Christopher Fox, "Defining Eighteenth-century Psychology: Some Problems and Perspectives", in Christopher Fox (ed.), *Psychology and Literature in the Eighteenth Century* (New York: AMS Press, 1987), 1-22.

[50] See *Oxford English Dictionary*, 'Anthropology', 'Pychology', 'Somatology'.

[51] See, for example, W. Charleton, *Enquiries into Human Nature*, cit., 1. As for the dualism of seventeenth-century medicine, see John Henry, "The Matter of Souls: Medical Theory and Theology in Seventeenth-century England", in R. French and A. Wear (eds), *Medical Revolution of the Seventeenth Century*, cit., 87-113; Johanna Geyer-Kordesch, "Passions and the Ghost in the Machine: or What Not to Ask about Science in Seventeenth- and Eighteenth-century Germany", *ibid.*, 145-163; Theodore M. Brown, "Descartes, Dualism, and Psychosomatic Medicine", in W.F. Bynum, *et al.* (eds), *The Anatomy of Madness*, 3 vols (London: Tavistock, 1985-1988), vol. 1, 40-62.

[52] The most prominent proponent of this direction of thinking was Thomas Willis. See Thomas Willis, *Two Discourses Concerning the Soul of Brutes*, transl. by Sydney Portage, London, Thomas Dring, 1683 (repr. with introduction by Solomon Diamond, Gainesville, Florida:

the Cartesian scheme of severing the somatic and the psychic, curiously without explicit mention to the French philosopher. Descartes distinguished three modes in human actions: purely mental phenomena (like thinking), purely bodily phenomena (like the movement of the heart), and the interaction on between the mind and the body (sensation, imagination, and voluntary locomotion) [53]. The soul was no longer omnipresent in physiology but was confined in a limited area of faculties, which was often referred to 'animal', and the rest was 'pure body', which has nothing to do with the soul. In his *Anatomy of Human Bodies* (1698), William Cowper (1666-1709) implicitly embraced the Cartesian scheme in dividing all function of animal body into "natural functions which terminate in the body" and "animal functions", i.e. sense and voluntary motion, "in which the soul is concerned", and many others expressed the same scheme [54]. English medical writings around 1700, unlike those in the Restoration period, formulated the object of medicine in a strictly Cartesian manner.

Within this Cartesian framework, the mechanism of the interaction between the mind and the body was a medical problem to be solved. Here again, however, one can detect an obvious departure from the Interregnum and Restoration Oxford medicine, which invested so much energy in solving the problem of the interaction and gave the intermediate agent the central position in their physiology. Cowper was, for example, reluctant to touch the issue, abandoned any explanation, and were ready to skip the question:

> the manner [...] how a material substance can affect and be affected by an immaterial, is obscure and scarce to be conceiv'd. Wherefore waving all precarious hypothesis, I shall confine myself to the description of such phenomena as are matters of fact, and undeniable, and leave the reader at liberty to erect what system he believes. [55]

Scholar's Facsimiles & Reprints, 1971). See R.G. Frank, *Harvey and Oxford Physiologists*, cit.; Antonio Clericuzio, "The Internal Laboratory: the Chemical Reinterpretation of Medical Spirits in England (1650-1680)", in P. Rattansi and A. Clericuzio (eds), *Alchemy and Chemistry in the 16th and 17th Centuries* (Dordrecht: Kluwer Academic, 1994), 51-83.

[53] John Cottingham, "Cartesian Trialism", *Mind*, *94* (1985), 218-230. For Descartes' physiology, see René Descartes, *Treatise of Man*, transl. and commentary by Thomas Steel Hall, Cambridge (Mass.), Harvard U.P., 1972. For the epistemological concern of the Cartesian mechanical physiology, see Phillip B. Sloan, "Descartes, the Sceptics, and the Rejection of Vitalism in Seventeenth-century Physiology", *Studies in History and Philosophy of Science*, *8* (1977), 1-28.

[54] William Cowper, *The Anatomy of Human Bodies* (Oxford: S. Smith *et al.*, 1698), 'Introduction'. For similar expression of Cartesianism, see Thomas Nevett, *The Rational Oeconomy of Humane Bodies, Wherein the Nature of the Chyle, Blood, Lymph, and Other Juices Is Discovered* (London: T. Parkhurst, 1704), 27-28; Gideon Harvey, *The Vanity of Philosophy in Physick* (London: A. Roper, 1699), esp. 141-166; Humphrey Ridley, *The Anatomy of the Brain Containing Its Mechanism and Physiology* (London: S. Smith *et al.*, 1695), 157-200; Michael Ernst Etmueller, *Etmueller Abridg'd: or a Complete System of the Theory and Practice of Medicine* (London: E. Harris *et al.*, 1699), esp. 487-556; Giorgio Baglivi, *The Practice of Physick*, cit., esp. 177-189.

Cowper here stated that explanation of the mind-body interaction was beyond the scope of medicine. Interactive phenomena like sense and voluntary motion were proper objects of medical study, but the underlying hidden mechanism was not [56].

We can, therefore, find two major shifts in dualism in English medicine from the Restoration period to the turn of the century. One is the appearance of 'pure' body purged of psychic issues as an object of medical study, and the other is the disappearance of the problem of explaining the way in which mind-body interaction takes place. Although these shifts seem to have been largely silent ones, the figure behind them was certainly Descartes. English medicine, which during the Restoration produced such powerful opponents to the Cartesian programme, seems by the end of the century to have silently conformed to the basic scheme of Descartes.

Despite their hostility to Descartes' speculative physiological theories, the iatro-mathematicians adopted a Cartesian formulation of the fundamental object of medicine, i.e. life. Unlike many of his contemporary medical writers who, despite their belief in Cartesian dualism, still expressed the pre-Cartesian idea that life consisted in the union of the soul and the body [57], Pitcairn made life a purely bodily phenomenon, identifying it with the circulation of blood. In so doing, Pitcairn deprived Harveian circulation of both its initial Neo-Aristotelian content and of the chemico-psychic substructure provided by the Oxford physiologists, transforming the circulation into a matter of simple hydraulics. Pitcairn's hero was not the Harvey who claimed that the soul is in the blood, but the Harvey who did the mathematical calculations of the amount of circulated blood [58]. Pitcairn

[55] W. Cowper, *The Anatomy of Human Bodies*, cit., 'Introduction'. See also G. Baglivi, *The Practice of Physick*, cit., 182-183.

[56] For the concept of the interactive agent in the mind-body relationship, see Roger K. French, "Ether and Physiology", in G.N. Cantor and M.J.S. Hodge (eds), *Conceptions of Ether: Studies in the History of Ether Theories 1740-1900* (Cambridge: Cambridge U.P., 1981), 111-134. Some Parisian anatomists in the late 17th century adopted Malebranche's occasionalism and used it as a rationale for omitting the problem of the interaction. See, for instance, John Baptist Verduc, *A Treatise of the Parts of Humane Body* (London: W. Turner, 1701), 38; Daniel Tauvry, *New Rational Anatomy* (London: D. Midwinter *et al.*, 1701), 184.

[57] See, for instance, Giovanni Alfonso Borelli, *On the Movement of Animals*, transl. by Paul Maquet (Berlin, Heidelberg: Springer Verlag, 1989), 7-8 and 285; F. Hoffmann, *Fundamenta Medicinae*, cit., 11; J.B. Verduc, *Treatise*, cit., 38. The role of the soul in Borelli's explanation of the motion of the heart is discussed in Roger K. French, "Sauvages, Whytt and the Motion of the Heart: Aspects of Eighteenth-century Animism", *Clio Medica*, *7* (1972), 35-54.

[58] See A. Pitcairn, *The Whole Works*, 139-167. For Harvey's Neo-Aristotelianism and its chemical remaking, see R.G. Frank, *Harvey and the Oxford Physiologists*, cit.

declared, "Those who enjoy this circulation [of blood] have life. Life itself is either this circulation, or this the measure of it" [59]. As is often the case with him, his remark was brief but precise, destroying the dualistic idea of life at one blow: life was no longer the soul-body compound, but the mechanism for keeping the soulless hydraulic machine going. Few medical theorists in his time were as thorough-going a Cartesian.

What did the iatro-mathematicians think about the other Cartesian mode of human action, i.e., dualistic interactive phenomena? In their writings, there is a visible concern to avoid anything related to the issues touching the mind-body interaction, as was the case with their contemporary medical writers. What made the iatro-mathematicians special was, however, that they not only avoided and ignored the issues related with interaction but also codified the omission of psychic issues, by building a framework deliberately stripped of psychic issues, in which they could concentrate on the hydraulics of the body. The iatro-mathematicians thus recast the ideas of the 'animal' faculty, depriving it of any relation with *animus* or *anima*: it was no longer a special domain where the soul and the body interact, but just another kind of hydraulic operation. When Pitcairn defined animal faculties, he did not relate them to the operations of the soul, as had been commonly done; they were, for him, simply "that power, which whilst the blood circulates within the brain, is exerted for the separation of a liquor [i.e. animal spirits] to be derived into the nerves" [60]. The brain was, for them, simply a part of the hydraulic machine of the human body: James Keill wrote that "all the use we know of the brain" was the secretion of the animal spirits from the circulating blood [61].

This does not mean that the iatro-mathematicians were Hobbesian materialists who denied the existence of the soul [62]. Indeed, they explicitly admitted the existence of soul in a human being. After claiming that the human body is a pure machine, Quincy wrote "there is something further, besides physical agents, which has to do in a human body ... and that is the mind, soul, or power of thought, whatsoever is called"; Cheyne maintained that, "voluntary motions of rational creatures are altogether unaccountable from the laws of mechanism" [63]. Although man's body is a pure hydraulic machine, man itself is not a Hobbesian pure mechanism. They did not, therefore, *identify* the interactive phenomena with bodily ones, neither did they *reduce* the former to the latter.

[59] A. Pitcairn, *Philosophical and Mathematical Elements*, 7.
[60] *Ibid.*, 50.
[61] James Keill, *The Anatomy of the Human Body Abridg'd*, 1st ed. (London: Keblewhite, 1698), 151.
[62] Thomas Hobbes, *Leviathan*, ed. by C.B. Macpherson (Harmondsworth: Penguin, 1968), 85-99.
[63] J. Quincy, *Medicina Statica*, cit., l-li; George Cheyne, *Philosophical Principles of Natural Religion: Containing the Elements of Natural Philosophy* (London: G. Strahan, 1705), 29.

What they actually did was to put the psychic side of the interaction into brackets and to limit their concern to the bodily and hydraulic part. At issue here was the question of how to delineate the proper scope of medical discourse, purging it of the metaphysical subject of the soul. George Cheyne, in his second edition of *A New Theory of Fevers* (1702), wrote, "whatever be the principle of perception in human, ... all sects of philosophers and physicians will agree that the diseases should be caused by changes in bodily fluid or solid" [64]. The hydraulic pathology was independent of psychic issues, hence there was no need to probe into them. Accordingly, only the bodily changes involved in the mind-body interaction constituted a proper object of medical study. In brief, they put the role of the soul in parentheses and devised, so to speak, a black-box theory of soul. To know the role of the soul itself in the interaction is unnecessary; the knowledge of its bodily effects should be enough for the purpose of medical theory and practice. The soul no longer existed in the human being as a substance which required special attention by physicians, so their object of study consisted in purely bodily phenomena and the strictly bodily side of the interactive phenomena. The iatro-mathematicians' strategy to bracket the soul off is most obvious when they talked about the passions of the soul [65]. The problematics of the passions had been the major battlefield between Descartes and the Oxford physicians [66]. The iatro-mathematicians were on the Cartesian side, in that they did not see anything like Willisian corporeal soul, a special intermediary substance between the soul and the body. As the translators of Pitcairn's works wrote, "the nature of matter in all bodies is certainly the same, ... and therefore all bodies, how great or small soever, are liable to the common influences of motion and alteration" [67]. However, they did not take an entirely Cartesian viewpoint, for they did not see two things in the passions. They deliberately turned a blind eye to the role of the soul, and confined themselves to the bodily and hydraulic aspects of the passions. Pitcairn wrote, "all

[64] G. Cheyne, *A New Theory of Fevers*, cit., 5-6. Later Cheyne wrote that this work had been suggested by Pitcairn as a blow against his opponents in his controversy with Charles Oliphant. See George Cheyne, *Dr. Cheyne's Own Account of Himself and His Writings, Faithfully Extracted from His Various Works*, London, J. Wilford, 1743.
[65] For the psychological use of the passions, see Stanley W. Jackson, "The Use of the Passion in Psychological Healing", *Journal of the History of Medicine and Allied Sciences*, *45* (1990), 150-175.
[66] See, R. Descartes, *The Passions of the Soul*, in *Philosophical Writings of Descartes*, ed. by John Cottingham *et al.*, 3 vols (Cambridge: Cambridge University Press, 1984-1991), vol. 1, 325-404; Walter Charleton, *Natural History of Passions*, London, James Magnes, 1674. For intellectual and political implication of Charleton's criticism of Descartes, see Akihito Suzuki, "'Duumvirate of Rulers Within Us': Politics and Pneumatology in Restoration England", in Gerald Marshall (ed.), *The Restoration Mind* (Newark, Delaware: University of Delaware Press, 1997), 111-131.
[67] A. Pitcairn, *Philosophical and Mathematical Elements*, xxvii.

the affections [of the mind] are then to be considered as the cause of distempers, when they may increase or diminish the bloods' circulation" [68]. James Keill went even further in claiming that it was possible to find bodily equivalents of the passions and the physicians could look at them instead of the passions themselves. In the first edition of *An Account of Animal Secretion*, he wrote that the soul acts in the body only in "the same way as if they had proceeded from other [bodily] causes" [69]. In the second edition of the same book, he developed the idea and devised an interesting metaphor:

> tho' it [the soul] does excite motions which disturb the oeconomy, [...] yet we know how to rectify their irregularities without any regard had to the soul; in the same manner exactly, as any one strikes back a ball sent from another's hand, with a force opposed to the ball, not to the hand that moves it. [70]

This metaphor says that physicians don't have to look at the soul (the hand), the original cause of the bodily change, but can do without it. The object of medical study and treatment is the bodily change (the ball). The game of medicine, claimed Keill, consisted in hitting the ball, not the hand that has thrown the ball [71]. By replacing the psychic agent *per se* with its virtual reality of the bodily change, Keill secured a field of demonstrated, certain and mathematical medical knowledge consisting in that of pure body which followed the law of motion. For Keill, the certainty of his mathematical medicine was thus "not in the least altered, by that we have a principle within us, not subject to the law of motion" [72].

John Quincy proceeded still further in specifying the bodily equivalents of the passions. Quincy stated that man's passions and dispositions of the mind gave "that particular modification likewise, and degree of tension to the fibres, as cold bathing, a cold air, a moderate exercise, when we see them attended with the same consequences". Since such physical causes were known to "draw up and shake the constituent machinulae of the fibres, promote their elastic powers, break the nervous juice finer", a physician must postulate that "these passions of the mind do also give the same modifications to the fibres, by which the same effects are

[68] *Ibid.*, 75.
[69] James Keill, *An Account of Animal Secretion, the Quantity of Blood in the Humane Body and Muscular Motion*, 1st ed. (London: G. Strahan, 1708), 'Preface', vii.
[70] J. Keill, *Essays on Several Parts of the Animal Oeconomy*, 2nd ed., cit. The shift of Keill's idea about the attractions is quite well surveyed in Guerrini (cf. fn. 8).
[71] For a different approach to the passions, see, for example, G. Baglivi, *The Practice of Physick*, cit., 187.
[72] J. Keill, *Essays on Several Parts of the Animal Oeconomy*, 2nd ed., cit., xv.

produced" [73]. For Quincy, a physician had only to look at the bodily analogue of the passions, which were reproducible by mechanical causes: "When any passions of the mind is said to have this or that effects upon the body, we ought to consider that passion only as a physical agent" [74].

Their pursuit of rigorous certainty was behind their formulation of the object of medical inquiry as the pure body and their systematic expulsion of psychic issues *per se* from the medical realm of knowledge. Being invisible, intangible, and outside the mechanical laws of motion, the soul was the last thing that would occupy a solid place in their sense-based, demonstrative and mathematical medicine. Small wonder that Quincy claimed that any argument about soul/mind could not achieve the same certainty as that about pure body:

> Insomuch as a human body can be considered as a machine, and so far as the properties of all those things with which it may be influenced, can be known upon the same principles, so far it is attended with certainty; But as for what concerns it otherwise, with relation to such causes as cannot be brought about sensible evidences, it must always remain doubtful, beyond what common observation does assist us. [75]

As one could not expect mathematical certainty from any argument about the soul, so any knowledge concerning the soul was to remain inferior and observational, and, therefore, must be excluded from the realm of medical knowledge.

There was, therefore, no room for the soul/mind in their carefully drawn out scope of medicine. Our next question is: how did they manage to explain 'mental' disorders in their rigorous research programme consisting in pure body?

Madness without mental disorder

Pitcairn's account of madness was in keeping with his research programme of purely bodily medicine: to understand madness he departed from the dualistic framework and cut off the mental part of the composition of madness. First of all, he did not recognize a category of diseases of the 'mind', and transformed madness into a mere problem of hydraulics. In one of his Leiden lectures, he criticized the classification of diseases propagated by Sennert and others, and reformulated the classical ideas about the causes of diseases around his notion of body as a hydraulic machine: "all these affections are then to be considered as the cause of distemper

[73] J. Quincy, *Medicina Statica*, cit., 264-265.
[74] *Ibid.*, 265.
[75] *Ibid.*, li.

when they may increase or diminish the blood's circulation [76]. In this sweeping reduction of diseases to hydraulic problems, he did not allow any special independent status to what had been recognized as 'mental' diseases:

> Therefore to the diseases of the excretory ones belong sleepy symptoms, which are owing to the defect of the excretion in the brain, and the palsy from the same reason: but the epilepsy arises from the increase, and the vertigo from the defect. Madness from the increase. [77]

Madness, which had been the key species among the mental diseases, was nothing but a disease caused by the increase of fluid in the brain. In Pitcairn's new classification of diseases, there was no disease in which damage to the 'mind' was explicitly delineated.

Pitcairn not only abandoned the independent category of 'mental' diseases; he also gave significantly different definitions to diseases which had previously been classified as such. In his lectures on pathology at Leiden, he allotted one chapter to 'madness' in which he compared mania and melancholia to dream [78]. In dream, Pitcairn wrote, one has ideas of things "wherewith we have been acquainted", variously compounded and mixed with each other, and caused by the "various repercussions of the animal spirits" [79]. This was also the case with madness:

> A delirium therefore is the dream of waking persons, wherein ideas are excited without order or coherence, and the animal spirits are drove into irregular fluctuations. If the cause inducing a delirium be of that nature, it can excite idea or motions of a lively and considerable impetus without any manner of certainty and order [80].

There was nothing new in comparing madness to illusion/dream, for it had long been maintained by a host of post-Cartesian medical theorists [81]. The passage quoted above, however, is saying two new things: one is the addition of the problem of motion, and the other is the omission of any damage to the higher faculty.

[76] A. Pitcairn, *Philosophical and Mathematical Elements*, 72 and 75. See also *id.*, *The Whole Works*, 252.

[77] A. Pitcairn, *The Whole Works*, 252-253. Latin original for the term 'madness' is 'mania'. See Archibald Pitcairn, *Opera Omnia Medica* (Leiden: J.A. Langerak, 1737), 319. Pitcairn's idea of classifying whole diseases only along the hydraulic mechanism seems to have come from Bellini. Bellini, however, wrote: "a delirium happens from the same diminution of the spirits in quantity": Bellini, *A Mechanical Account of Fevers*, cit., 255.

[78] A. Pitcairn, *Philosophical and Mathematical Elements*, 'Of Madness', 186-193.

[79] *Ibid.*, 186.

[80] *Ibid.*

[81] Descartes' model of madness as illusion was put forth in René Descartes, *Optics*, in *The Philosophical Writings of Descartes*, cit., vol. 1, 167-168 and 172.

First, the new dimension of disordered motion in madness needs special attention. It had long been noted that a madman shows disorderly motion with extraordinary strength, yet it had not constituted the central problematics of medical theory on madness: madness had been first and foremost a problem of intellectual disorder. For Pitcairn, incoherent and violent motion in delirium shared a central place with disordered idea: delirium consisted in "*idea* or *motions* of a lively and considerable impetus without any manner of certainty and order" [my emphasis]. This binary characterization of madness as disordered idea and/or motion fitted in very well with the role of the animal spirits in the physiology of the iatro-mathematicians, for they were regarded as the vehicle of both sensation and muscular motion. When they flows from the sensory organ to the brain, sensation takes place and when from the brain to muscles, motion is effected [82]. If one suffered, the other would naturally share the disorder.

Moreover, a mechanical account of muscular locomotion and its strength was one of the foremost achievements of mechanical and mathematical medicine, best exemplified in Borelli's *De motu animalium* and in Mead's and Henry Pemberton's 'Introduction' to the posthumous edition of William Cowper's *Myotomia reformata* [83]. The mathematical characterization of mad motion in Edward Strother's *Criticon febrium* (1718) sounded almost like a joke. In the work, Strother constructed a hydraulic pathology of various disorders, based on the quantity and pressure of blood flowing, and gave the following account of madness:

> If the blood be so vitiated, as that the strengths are augmented or diminished, 'tis the same thing as if the blood offended in quantity. Suppose a person under a disease where the strength are much augmented, as madness, and such-like, from some acrimony of the blood; 'tis the same thing as if the blood were augmented. So that, suppose a person has in his vessels 20 pounds of blood, and the strengths equivalate 5 pounds; then if we consult Sir Isaac Newton's Law of Motion, it will stand thus ac = m, or 20 multiplied by 5, is equal to 100lb. which this person can lift. If then any one falls ill of Madness, and can lift up 140lb. then the Moment of Strength in each pounds of Blood, amounts to 7lb. for 20 multiplied by 7, is 140. [84]

[82] See, for example, A. Pitcairn, *Philosophical and Mathematical Elements*, 59: "animal motion is effected by an efflux of spirits into the muscles, but sensation is performed by a reflux of those animal spirits towards the brain, the origin of the nerves".

[83] G.A. Borelli, *On the Movement of Animals*, cit.; William Cowper, *Myotomia reformata: or an Anatomical Treatise on the Muscles of the Human Body* (London: P. Knaplock, 1724), 'Introduction', by Henry Pemberton.

[84] Edward Strother, *Criticon febrium* (London: C. Rivington, 1718), 20. The work was unashamedly mathematical, but Quincy was extremely hostile to Strother's work. In his

In this unashamedly Newtonian account of madness, the only aspect of madness taken into account was its extraordinary strength, which could be calculated. It is an example of the iatro-mathematical explanation of madness in its extreme form.

Secondly, an implicit and silent shift in Pitcairn's formulation of madness was the absence of issues related to the higher mental faculties, such as reasoning. It is true that Pitcairn was not very much different from earlier medical writers: madness had long been a disorder in the activity of image-making, or 'imagination'. However, Pitcairn omitted any damage to reasoning, which had been involved in the former accounts of madness. For example, in the early seventeenth century, John Jonston (1603-1675) wrote as follows:

> A Deliry is a depravation of the phantasie, and the rationation faculty, arising from the bringing and presenting of an absurd and inconvenient phantasme [85].

Although both Pitcairn and Johnston claimed that in delirium false and confused ideas were excited in the mind, Pitcairn did not mention the deprivation of any mental faculties, which constituted the principal part of Johnston's statement. Johnston's language was framed around the faculties of the soul, while Pitcairn's was that of hydraulics. The iatro-mathematician's explanation of madness stopped just when the false ideas are produced in the mind, and therefore omitted the consequent depravation of the mental faculties.

Pitcairn's disciples seem to have followed their mentor and kept silence on the issue of mental faculties [86]. This "madness without mental disorder" was epitomized by Richard Mead, one of the most prominent physicians of his age and in his youth the most staunch supporter of Pitcairn's mathematical physic. In the second essay of his extremely successful *Mechanical Account of Poisons in Several Essays*, he gave an account of the effect of poisons present in the bites of the tarantula spiders and mad dogs, both of which he understood as species of delirium [87]. Mead put these two sorts of poisons under the same head, since both of them "induce a particular delirium *sui generis*, attended partly with maniacal, partly with melancholy symptoms" [88]. Mead's idea of madness was in strict keeping

Lexicon Physico-Medicum: or, a New Physical Dictionary (London: A. Bell, 1719), xv-xvi, Quincy maintained that *Criticon febrium* is as hypothetical and "vague and delusory" a book as "Agrippa's Occult Philosophy".

[85] John Jonston, *The Idea of Practical Physick in Twelve Books*, transl. by Nicholas Culpeper (London: Peter Cole, 1657) 19.

[86] See, for example, James Harvey, *Praesagium medicum*, cit., 'Of a Delirium and Frenzie', 4-14.

[87] As Mead admitted himself, his description of the bite of the tarantula owes substantially to Giorgio Baglivi's account of it found in Baglivi, *The Practice of Physick*, cit., 345-409.

[88] R. Mead, *A Mechanical Account of Poisons*, cit., 57-58.

with that of Pitcairn, stressing both false ideas and disorderly motion. Moreover, establishing a close tie between the two elements, Mead employed the notion of involuntary motion, which had been forcibly propagated by, *inter alia*, Descartes as a key to the mechanical understanding of human motion [89].

Mead started by making a mechanical account of perception and voluntary motion, in which the soul is conscious of perceiving the idea, and, in response to this perception, commands the animal spirits to flow into muscles to perform some desired actions. When a certain set of the perception and the motion is repeated and becomes a habit, Mead continued, the mind retreats from the scene and the motion comes to be performed unconsciously and involuntarily:

> at length by a kind of natural habitude, without the intervention of the reasoning faculty, representations made to the mind do immediately and necessarily produce suitable motions in the bodily organs. [90]

In accordance with the general physiology and pathology of the iatro-mathematical school, Mead framed his explanation of the symptoms of the bites of the tarantula and mad dogs around the issue of hydraulics. When the poisons were infused into the blood vessels, a cohesion of globules took place, forming numerous clusters. This makes the blood pressure unequal and irregular and "the fluid of the nerves must necessarily be put into various undulatory motions" [91]. Under such a circumstance:

> the most light occasion will make as real a reflux and undulation of [the nervous fluid] to the brain; that is, will present as lively and vivid species there, as the strongest cause and impression can produce in its natural state and condition. Nay, in such a confusion, the [animal] spirits cannot but sometimes, without any manifest cause at all, be hurried towards these organs, to which at other times they have bin most frequently determined.

Hence, the patient shows such incoherent symptoms such as "extreme pleasure at what is but a trivial entertainment, ... wonderful sadness at anything, ... ridiculous laughter, obscene talks" [92].

Mead's originality lies in connecting this senso-motory account of madness and the well-established concept of involuntary 'reflex' movement. The involuntary

[89] Probably Mead's direct source of the notion of involuntary motion was Borelli's *De motu animalium* (1680-81), which he mentioned several times. See G.A. Borelli, *On the Movement of Animals*, cit., 285-286. As for Descartes' and Willis's notion of involuntary 'reflex' motion, see Georges Canguilhem, *La formation du concept du réflex aux XVII^e et XVIII^e siècles* (Paris: J. Vrin, 1977), 27-78.

[90] R. Mead, *A Mechanical Account of Poisons*, cit., 63.

[91] *Ibid.*, 67-68.

[92] *Ibid.*, 69-70.

motion triggered by the representation of an idea was, Mead claimed, exactly what happened in a madman. The irregular representation of the ideas, triggered by disordered flow of the animal spirits, generated incoherent bodily motions:

> [...] a delirium is the representation and various composition of several species to the mind without any order or coherence; together, at least most commonly, with irregular, or as it were, undesigned motions of the body; that is, such a wandering and irregular motion of the nervous fluid, whereby several objects are represented to the mind, and upon this representation divers operations performed by the body, tho' those objects are not impressed upon the organs, not those operations or motions deliberately commanded by the soul. [93]

Delirium was, for Mead, a disordered involuntary motion, which was produced without any intervention of the mind. In this scheme for understanding madness, there was precisely no place for the soul/mind at all. Accordingly, Mead claimed that although delirium was called "perturbation of the mind", "it is very manifest that in reality the defect is not in the rational but corporeal part", or, in other words, delirium was "not a distemper of the mind but of the body" [94].

This point of non-existence of mental disorder in madness was made clearer in his account of rabies, the delirious disease caused by the bite of a mad dog. Mead admitted that there was a dispute among physicians over the question of whether rabies could be properly called a delirium. The main objection against classifying rabies as a delirium was, Mead wrote, that the patients who suffered from rabies or hydrophobia did sometimes show the sign of reason. For Mead, who recast the model of delirium into a disordered reflex action with no place for the soul, the argument of the opponents provided another reason to count rabies as delirium and to enforce his purely bodily model of delirium:

> I know indeed that the main and most plausible abjection against delirium is this, that the patient himself does reason against his timorousness, [...] Which from what I have already said concerning a delirium, appears to be very consistent with it, nay, convinces that there is the greatest degree of it in this case: in as much as that is not a distemper of the mind but of the body. [95]

[93] *Ibid.*, 64.

[94] *Ibid.*, 64 and 82. There was, however, long tradition of locating madness strictly in the body and of maintaining the intactness of the soul, motivated by doctors' desire to defend the doctrine of the immortality of the soul. See Akihito Suzuki, "Anti-Lockean Enlightenment?: Mind and Body in Early Eighteenth-century English Medicine", in Roy Porter (ed.), *Medicine and the Enlightenment* (Amsterdam: Rodopi, 1995), 336-359.

[95] R. Mead, *A Mechanical Account of Poisons*, 82.

This claim, that delirium is not a distemper of the mind but of the body, is repeated again and again in the *Mechanical Account of Poisons*, and provides a sharp contrast to the earlier idea that madness was a disorder in which the higher mental faculty of reasoning is damaged [96].

Conclusion

The research programme of the 'mathematical physick' and the model of madness without mental disorder did not last long. Even in the heyday of the school, about 1700-1720, a considerable number of medical publications in England did not conform to the aims of the school and Pitcairn was a target of open criticism by some of his Scottish fellow physicians. Towards the end of this period, the militant proponents of mathematical physic were leaving the scene: Pitcairn, their leading star, died in 1713, and Keill in 1719.

By 1730, the impetus to do medicine in a rigorous mathematical way had declined. In 1731, Thomas Apperly, an M.D. from Cambridge, stated that "mathematical learning has added little to the most useful, i.e. the practical part of physick", although he still showed some reverence to Pitcairn [97]. Thomas Morgan, a self-styled M.D., went still further, turning a scornful shoulder to Bellini as "the principal corrupter of medicine" [98]. Francis Clifton, an M.D. from Leiden, epitomized the way in which the iatro-mathematical bold research programme turned sour. He wrote that, "the knowledge of the circulation, and some other things lately discovered, is not of so much importance as was at first apprehended; ... we are but little the better for these discoveries, and in some degree worse" [99]. John Burton, a student of Boerhaave, wrote in 1738:

[96] Likewise, Locke argues that madman does not lose his reasoning. See *Essay*, 2.11.13; Kenneth Dewhurst, *John Locke (1632-1704), Physician and Philosopher* (London: The Wellcome Historical Medical Library, 1966), 70, 71, 89-90. Dewhurst's misleading translation in one of the passages related with the issue of madness has been pointed out by John P. Wright, "Association, Madness, and the Measures of Probability in Locke and Hume", in Ch. Fox (ed.), *Psychology and Literature in the Eighteenth Century*, cit., 103-127, esp. note 12.

[97] Th. Apperly, *Observations in Physick Both Rational and Practical*, cit., 13. Although Apperly admitted that Pitcairn "is almost everywhere, and often justly exploding the ancient definitions in physick", he could not see that "medicine, strictly speaking, will be much advanced thereby". For a criticism in the same vein, see [Charles Oliphant?], *A Refutation of the Short Answer*, cit., 15-16.

[98] Thomas Morgan, *The Mechanical Practice of Physick* (London: T. Woodward, 1735), xiii. For biography of Morgan, see *DNB*. Morgan was a prolific Deistic writer, whose medical and philosophical ideas remain to be studied.

[99] Francis Clifton, *The State of Physick, Ancient and Modern, Briefly Consider'd* (London: John Nourse, 1732), 122. Clifton got an M.D. at Boerhaave's Leiden and became an F.R.C.P. in 1729. He was an admirer of Hippocrates and Baglivi for their collect observation (*ibid.*, 125-127, 163-164), and proposed for printing all the works of Hippocrates in 1732. For the reason of the decline of the school, see Theodore Brown, "Animal Oeconomy", cit., 354-366.

> I can't agree with a very great man, who says, that a thorough knowledge of the mathematics, ought to be made the distinguishing characteristic of a physician from a quack; for mathematics can give us no more help in the cure of disease, than they can in explaining the mysteries of revealed religion. [100]

Mathematics was any longer neither beneficial to the therapeutics, nor a proper model of medicine.

With the decline of iatro-mathematics in the 1720s, the argument about the soul/mind made a revival into medicine, and a dualistic formulation of the object of medical study was re-introduced. One of the clearest signals of this shift came from Nicholas Robinson, who was as staunch an admirer of Newton as Pitcairn and his followers had been, but did not conform to the rigorous research programme of the school [101]. In his *A New System of the Spleen, Vapours, and Hypochondriack Melancholy* (1729), published four years later, the challenge to Pitcairn's quest of infallible and purely somatic medicine took an unmistakable form: Robinson introduced the discourse on the mind, and defied the former rigorous requirement of certainty. About one-third of this book is dedicated to the consideration of "the nature of thought", e.g. perception, reason, understanding, memory, will, all of which were removed by the iatro-mathematicians from the scope of medicine. In so doing, Robinson was well aware that he

> had got into a scene of nature, where it was highly difficult to discover the least sure footing, ... and where *the nature of the subject itself scarce admits of evidence, much less demonstration*. [My emphasis.] [102]

He was, however, resolute in his attempt to do medicine where the iatro-mathematicians dared not tread. He claimed that one should be content with "the most seeming *probability* [my italics], where I cannot discover demonstrative evidence" [103]. Thus Robinson departed from the rigorous mathematical medicine which was modelled after geometrical demonstration and which had excluded everything that could not be expressed in terms of the laws of motion. In its place,

[100] John Burton, *A Treatise on the Non-Naturals, in Which the Great Influence They Have on Human Bodies Is Set Forth and Mechanically Accounted For* (York: A. Staples, 1738), 10-11. Burton learned under Boerhaave in 1730, and the book is aggressively Boerhaavean. He dedicated the book to Boerhaave himself, and wrote in the preface that "the book is a mere collection from others, or what I have pick'd up from Boerhaave's lectures and conversation".

[101] Robinson was a protégé of now established Mead, and his first work was unashamedly Newtonian. See Nicholas Robinson, *A New Theory of Physick and Diseases Founded on the Principles of the Newtonian Philosophy*, London, C. Rivington, 1725.

[102] Nicholas Robinson, *A New System of the Spleen, Vapours and Hypochondriack Melancholy* (London: A. Bettesworth, 1729), 3.

[103] *Ibid.*, 3 and 9-10.

he claimed "probable" knowledge about the mind and madness. English medicine regained the language about mind and mental disorders.

The rise and fall of the iatro-mathematical school and its idiosyncratic model of madness tell both the importance and limit of the role of theoretical concern for intellectual foundation of medicine. On the one hand, Pitcairn and his followers tried to follow the fundamental principle of certainty in medicine and to recast the whole realm of medical knowledge according to the principle. The iatro-mathematical research programme was, therefore, remarkably consistent in its explanation of various diseases. On the other hand, it did not provide any tangible merit for medical practice, especially for curing diseases, as is best exemplified by the statements of Francis Clifton and John Burton quoted above. Being highly esoteric and technical, mathematical medicine looked fine on the printed pages of medical books and impressed audience at meetings of the Royal Society [104]. The problem was that its intellectual rigour did not pay off from the viewpoint of practice at medical market [105]. The point is nicely illustrated by the career of Mead and Cheyne, after the period of their attachment to the school. While young and unestablished (partly because of his being a dissenter), Mead sold his name as a brilliant iatro-mathematical theoretician. After that, however, he established a lucrative medical practice in London and fashioned himself more as a gentleman-connoisseur than as a radical theoretician [106]. Cheyne's apotheosis was more dramatic. After physical (and, perhaps, mental) breakdowns in 1705 or 1706, he stayed away from the scientific community of London, and wrote books addressed to a lay audience rather than to his professional colleagues [107]. In his *Essay of Health and Long Life* (1724), Cheyne wrote that although books about mathematical knowledge might help invention and mechanical arts, they would do more harm than good; they don't "rectify the will, sweaten the temper, or mend the heart", and they "often leave a stiffness, positiveness, and sufficiency" in the mind of the readers. In a word, they would make arrogant, ill-mannered and unsociable people [108]. Accordingly, Cheyne switched to the strategy of selling his rhetorical skill

[104] For Cheyne's presentations at the Royal Society, see A. Guerrini, cit. fn. 5 and 8.

[105] For the importance of medical market-place and the role of clientele in the making of medical knowledge, see Dorothy Porter and Roy Porter, *Patient's Progress: Doctors and Doctoring in Eighteenth-century England*, Oxford, Polity Press, 1989; N.D. Jewson, "Medical Knowledge and the Patronage System in 18th-Century England", *Sociology*, *8* (1974), 369-385.

[106] See A. Zuckerman, "Dr. Richard Mead", cit., 132-185; R.H. Meade, *In the Sunshine of Life*, cit., 83-100.

[107] Roy Porter, 'Introduction' to G. Cheyne, *The English Malady*.

[108] G. Cheyne, *An Essay of Health and Long Life* (London: George Strahan, 1724), v-vi.

and suave persuasion, instead of rigorous scientific expertise expressed in esoteric jargon [109].

As for the iatro-mathematical model of madness without mental disorder, it was even more unlikely that practitioners of early psychiatry found it useful. Emerging specialists in the care of the insane around that time were, more often than not, unlearned owners of profit-making madhouses, and hence inclined less to scientific aspiration than to economic gain [110]. At that time, there seems to have been almost no reason for them to adopt the hyper-learned theory of madness expressed in terms of the Newtonian laws of motion, which must have been hardly reachable to them. The hydraulic model of madness was, most probably, preached in printed pages without being used in the practical context. The iatro-mathematicians' account of madness was formulated in a purely intellectual sphere: it could not go out to the realm of practice. For the practice of caring for the insane and the learned discourse on madness to be fused into 'psychiatry' as a medical branch, it turned out that both a host of intellectually aspiring practitioners and a set of user-friendly discourse on madness were necessary.

[109] For Cheyne's strategy, see Akihito Suzuki, "Anti-Lockean Enlightenment?: Mind and Body in Early Eighteenth-century English Medicine", in Roy Porter (ed.), *Medicine and the Enlightenment*, cit., 336-359. For the early eighteenth-century struggle between rigorous and scholarly learning and persuasive and gentlemanly one, see James Levine, *The Battle of Books: History and Literature in the Augustan Age*, Ithaca, Cornell University Press, 1991.

[110] R. Porter, *Mind-Forg'd Manacles* (London: Athlone Press, 1987), 136-160 and 206-228; William L. Parry-Jones, *The Trade in Lunacy*, London, Routledge and Kegan Paul, 1972.