

# 'DISCOURSES ON THE HUMAN PHYSIOLOGY' BY ALEXANDER MONRO *PRIMUS* (1697-1767)

by

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## INTRODUCTION

Historians have long taken it for granted that the teaching in the early Edinburgh medical faculty was founded on the system of Boerhaave, which was in turn based on Newtonian mechanism. All of the first-appointed teachers had studied at Leyden, and they brought its traditions back with them.<sup>1</sup> My own examination of the evidence, particularly that provided by surviving student lecture-notes, amply confirms this. Monro *primus* was quite explicit on the point. We find him saying, for example, in 1731/2, "I shall as much as I can follow Dr Boerhaave's method which may perhaps be of the more use to you who are att and to be att his Institutions"; and again in the later 1740s, "I shall follow Dr Boerhaave's method in his Institutiones, excepting some small variations . . .".<sup>2</sup> St Clair's lectures were year after year a commentary in Latin on the *Institutiones*.<sup>3</sup> Plummer and Innes commented on the *Aphorisms*.<sup>4</sup> Notes taken

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A preliminary and much shorter version of this paper was read to the 7th David Nichol Smith Seminar held in Dunedin in August 1986. In its present form it owes much to Dr Christopher Lawrence, Wellcome Institute for the History of Medicine—to his generosity in presenting to the Medical Library of the University of Otago a copy of his doctoral thesis, and to the discussions I was able to have with him on a visit to Dunedin that was prolonged well beyond his original intentions.

<sup>1</sup> See E. Ashworth Underwood, *Boerhaave's men at Leyden and after*, Edinburgh University Press, 1977, pp. 119 and 123.

<sup>2</sup> See ES Haswell, p. 326 and DU:M [A20] f2<sup>r</sup>. I use the same abbreviations as in my paper, D. W. Taylor, 'The manuscript lecture-notes of Alexander Monro *primus* (1697-1767)', *Med. Hist.*, 1986, 30: 444-467, viz: AU = Aberdeen University Library; DNLM = National Library of Medicine, National Institutes of Health, Bethesda, Maryland; DU:M = Dunedin, University of Otago Medical Library; EPH = Library of the Royal College of Physicians, Edinburgh; ES = Library of the Royal College of Surgeons, Edinburgh; EU = Edinburgh University Library; GD = Innes of Stow Papers, Library of the General Register Office (Scotland); MSL = Library of the Medical Society of London.

<sup>3</sup> I know of three sets of notes from St Clair's lectures on the *Institutiones*, viz: (i) EPH M.7.60-62 and M.8.1-9, A. St Clair: *Praelectiones medicinae theoreticae*, 12 vols; (ii) EPH M.9.35-37 *Praelectiones in Institutiones Boerhaavii* A. Andrew St Clair M:D; and (iii) EPH Fc\* 8.32. The first is part of the Duncan series (see D. W. Taylor, 'The manuscript lecture-notes of Alexander Monro, *secundus* (1733-1817)', *Med. Hist.*, 1978, 22: 174-186), and was probably written in 1737 or 1738; the second has on the fly-leaf "Ed<sup>wd</sup> Lynes' Book February the 1739/0"; the third has no date but the hand is the same as that of EPH Fh\* 9.26 (see note 4 below) and it is thus presumably earlier than 1733. The three texts are for practical purposes the same except that Fc\* 8.32 starts at para. 317.

<sup>4</sup> See EPH Fh\* 9.26, notes on Boerhaave's *Aphorisms*, paras. 558-1493 where we find such statements as: ". . . quorum exempla ex auth: ipsis protulit Dr Innes" (p. 2); "Post hoc capitulum tradidit Dr Plummer quaedam de Catarrho" (p. 175); and "Historiam morbillorum dein tradidit Dr. Pl;" (p. 206). Innes died in 1733. According to Donovan, Plummer taught only chemistry (A. L. Donovan, *Philosophical chemistry in*

from Rutherford's lectures in 1737 start thus: "Pro norma sequar illos Aphorismos Doctissimi Boerhaave editos Lugduni Batavorum annis 1722 and 1728".<sup>5</sup>

If we look ahead fifty years, then by the 1770s Boerhaavian teaching had been replaced primarily by the system of William Cullen. In physiology, this involved a change in emphasis from the fluids and solids of the body, interacting in terms of the laws of hydraulics, to the nervous system, and generally from mechanism to vitalism. The whole flavour of Monro *secundus*'s lectures at this time is quite different from that of his father's.<sup>6</sup>

Theodore Brown sees in British physiology in the years 1730-70 "the dramatic indeed precipitous decline of varieties of mechanism and the rapid rise to prominence of alternate varieties of vitalism".<sup>7</sup> For Schofield, the latter half of the eighteenth century is a period of escape, both in chemistry and physiology, from mechanical reductionism to an autonomy achieved in the case of physiology "by developing an empirical nosology—i.e., a taxonomy of diseases—and by erecting a barrier of vitalism behind which it defined its own problems and modes of investigation".<sup>8</sup> Looking farther afield than Britain, we need think only of Haller or of the teaching of the Montpellier school.<sup>9</sup>

The whole process in Edinburgh has been analysed authoritatively and at length<sup>10</sup> by Christopher Lawrence, who dates the critical transition period from about 1746 to 1766, and stresses particularly the work of Robert Whytt, who was appointed to the Chair of the Institutes in 1747. Whytt, according to Lawrence, "brought the nervous system to Edinburgh and with it the death sentence for Boerhaavian physiology".<sup>11</sup>

Cullen, it is true, complained bitterly that on his return to Edinburgh in 1755 he found the Boerhaavian system unchanged,<sup>12</sup> but this may have been a harsh judgement

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*the Scottish Enlightenment*, Edinburgh University Press, 1976, p. 36), but this cannot be so in view of the above. See, too, Underwood, op. cit., note 1 above, p. 117, and EPH MS Boswell, p. 14, a reference I owe to Christopher Lawrence.

<sup>5</sup> See EU Gen 1928, p. 21. Although student Latin is often garbled, the meaning here is obvious, viz., "I shall normally follow those Aphorisms of the most learned Boerhaave published at Leyden in 1722 and 1728."

<sup>6</sup> To take only one example, nowhere in student notes from lectures by *Primus* do we find anything like *Secundus*'s statement in 1774/5. "[Boerhaave], besides, was far from being sufficiently aware of the powers of the living principle, and attempted to reduce everything to mechanical principles . . ." (DU:M M241, f11, Lect 121). However, in the MS I am about to discuss, *Primus* makes essentially this criticism of Boerhaave. (See below p. 76).

<sup>7</sup> Theodore M. Brown, 'From mechanism to vitalism in eighteenth-century English physiology', *J. Hist. Biol.*, 1974, 7: 179-216, see p. 179.

<sup>8</sup> Robert E. Schofield, *Mechanism and materialism. British natural philosophy in an age of reason*, Princeton University Press, 1970, pp. 191-192.

<sup>9</sup> Elizabeth Haigh, *Xavier Bichat and the medical theory of the eighteenth century. (Medical History, Suppl. No. 4)*, London, Wellcome Institute for the History of Medicine, 1984, see especially ch. 2.

<sup>10</sup> Christopher John Lawrence, 'Medicine as culture: Edinburgh and the Scottish Enlightenment', University of London PhD thesis, 1984. See, too, his 'Ornate physicians and learned artisans: Edinburgh medical men 1726-1776', in W. F. Bynum and Roy Porter (editors), *William Hunter and the eighteenth-century medical world*, Cambridge University Press, 1985, pp. 153-176.

<sup>11</sup> Christopher Lawrence, 'The nervous system and society in the Scottish Enlightenment', in Barry Barnes and Steven Shapin (editors), *Natural order. Historical studies of scientific culture*, Beverley Hills, California, Sage Publications, 1979, pp. 24-25.

<sup>12</sup> John Thomson (editor), *The works of William Cullen, M.D.*, 2 vols., Edinburgh and London, William Blackwood & T. & G. Underwood, 1827, p. 119.

and one made with an eye on posterity. One great difficulty in assessing Whytt's early impact on Edinburgh medical teaching lies in the dearth of student lecture notes and similar material from the 1750s. I know of no MS of any of Monro's lectures that can be firmly dated after 1753, apart from his clinical lectures of 1766. There are extant notes from Rutherford's clinical lectures from 1749-55.<sup>13</sup> I have also examined notes taken from Whytt's clinical lectures, but these are dated 1762-64.<sup>14</sup> Lawrence knows of only one copy of his physiology, dated 1756 and very scrappy.<sup>15</sup> Although French alludes to the accuracy and elegance of the Latin of Whytt's lectures,<sup>16</sup> David Skene, at least, was not impressed and saw them as no better than reading Haller. On the other hand, he was aware that the *Essay*,<sup>17</sup> published in 1751, had caused quite a stir.<sup>18</sup>

THE MS DU:M M181-182 IN THE MONRO COLLECTION IN DUNEDIN<sup>19</sup>

I think that the two volumes M181-182 together comprise one of the most important MSS in the Monro Collection. As I hope to show in detail below, they provide evidence of a change of mind on the part of Monro *primus* in that in the early 1750s he substantially discarded virtually pure mechanism as a mode of physiological explanation in favour of a quite obvious variety of vitalism.

*Primus*, in his autobiography, gives a list numbered 1-13 of the titles of treatises composed by him in addition to his medical books.<sup>20</sup> I think there is good evidence that M181-182 is in fact item 9 in this list. 'A system of the subtler animal physiology in a new order'. Each volume is entitled 'Discourses on the Human Physiology'. M182 contains a detailed paginated index of its contents; M181 has a similar index to both the volumes but then stops short with "Contents of Vol. 3 Art XV" and no page number. This might suggest that Vol. 3 was never written. However on p. 650 in Vol. 2, Monro *primus* has glossed an already substantial annotation in his own hand instructing that it be put on p. 1103 "in the account of the digestion of the aliment". Such a reference could hardly have been given in the absence of a third volume. Vol. 2 ends on p. 1054.

The main text is, in my opinion, written in the youthful hand of Monro *secundus* (plates 1 and 2). The index and almost all of the many annotations are without any

<sup>13</sup> EU Dc 3.90-92 is the most orderly set known to me and covers the period 1749-53. The notes have been glossed, cross-referenced and corrected in the hand of J. A. H. Reimarus, who also wrote Dc 3.93, dealing with the years 1754-55. There is substantial overlap with EPH Rutherford 4(1-3) and 5.

<sup>14</sup> EPH Whytt 2.

<sup>15</sup> Lawrence (1984), op. cit., note 10 above, p. 161.

<sup>16</sup> R. K. French, *Robert Whytt, the soul, and medicine*, London, Wellcome Institute of the History of Medicine, 1969, p. 8. He is, however, quoting a secondary source.

<sup>17</sup> Robert Whytt, *An essay on the vital and other involuntary motions of animals*, Edinburgh, Hamilton, Balfour, & Neill, 1751. I refer to it henceforward simply as *Essay*.

<sup>18</sup> AU David Skene papers MS 38/1-176, No. 26. Skene does not indicate which of Haller's works he has in mind to read. About half of Monro's many references to Haller are to the *Præmae lineae*, presumably the 1751 edition (*Præmae lineae physiologiae in usum praelectionum academicarum*, Göttingen, Widow of A. Vandenhoek, 1751). Skene, we might suppose, was more likely to possess that than the Notes on Boerhaave's Institutions (*Praelectiones academicae in proprias institutiones rei medicae*, 5 vol. in 6, ed. A. Haller, Göttingen, A Vandenhoek, and Amsterdam, J. Wetstenius, 1739-44).

<sup>19</sup> See Douglass W. Taylor, *The Monro Collection in the medical library of the University of Otago*, Dunedin, University of Otago Press, 1979.

<sup>20</sup> *Life of Dr A. Monro in his own handwriting*, p. 24. See item [A21] in Taylor, op. cit., note 19 above.

doubt in the hand of *Primus*, and from internal evidence it is reasonable to assume that the treatise was written in 1753 or 1754 and corrected and amplified by *Primus* a few years later.<sup>21</sup> Right at the beginning, the author's purpose might seem to be made explicit in what appears to be the first of a series of lectures on physiology to students whom Monro has already taught.

Gentlemen

When I showed you the Parts of the Human Body and of several kinds of Animals, which were dissected in your presence, I endeavoured to explain the mechanism and offices of each organ, that could be easily deduced from what you saw in the Dead Body. But wherever an Account of the Uses, Functions and actions of the organs, could not be understood without an accurate Detail of numerous phenomena and of various experiments on living animals, or without assistance from chemistry or other parts of natural philosophy, or without long consequential reasoning on subjects so obscure as to have occasioned tedious Disputes concerning them, I omitted the consideration of such subtle intricate parts of the Human Physiology, with the promise of giving you a short summary of the debates concerning these subjects, when your attention was not otherwise to be engaged by examining the structure of the organs, and I could follow out the arguments upon each subject without being interrupted by the demonstration I was obliged to make of the Parts themselves.

There are, however, a number of reasons for not taking this *apologia* at face value. First, we might ask how *Primus* comes to be teaching physiology at all. While his excuse was the promise referred to above, he admits that it was not really his job to do so, but that of a colleague. He goes on to say (p. 1),

This part of my task I now propose to perform in a few discourses, ['8 or 10' has been added by *Primus*] but must previously call to your remembrance what I formerly said was my intention in mentioning this subject at all, which is not properly my province, being fully and with great accuracy taught by my colleague the Professor of the Theory of medicine, and therefore I told you that I proposed only to describe a few outlines of a great picture which may raise a desire in such of you Gentlemen, as are unacquainted with this part of Physick, to acquire a more compleat knowledge of it, and may serve as a sort of Syllabus, for those among you who have had the advantage of hearing the same Subjects treated by a Gentleman, who does honour to his profession.

If the MS is correctly ascribed to 1753/54, then that colleague was Whytt. In fact, Monro's course had from the earliest days included a physiological component and in several of the surviving student MSS the existence of a physiological colleague is clearly implied. For nearly twenty years from 1726, the topic had been taught by Whytt's predecessor, Andrew St Clair, who, as we have seen, delivered a Latin commentary on Boerhaave's *Institutiones*. Students may well have found Monro's exposition more rewarding.

We should remember too that Monro taught for six years prior to the foundation, in the strict sense, of the Medical Faculty. It is true that in 1724 William Porterfield was

<sup>21</sup> The latest reference in the main text (p. 85) is to Donald Monro's MD thesis (Donald Monro, *De hydrope*, Edinburgh, Hamilton, Balfour & Neill, 1753). There is also on p. 83 the statement "Hambergerus has lately published"; the reference must be to Georgius Erhardus Hambergerus, *Physiologia medica seu de actionibus corporis humani sana doctrina* . . . , Jena, Sumptibus Theod. Wilh. Ernest. Güth, 1751. The latest references to be found in the annotations in *Primus*'s hand are all dated 1757, viz: Alexander Monro, *De venis lymphaticis valvulosis et de earum in primis origine*, Berlin, C. F. Henningius, 1757; A. Von Haller, *Elementa physiologiae corporis humani*, Tomus primus, Lausanne, Sumptibus Marci-Michael Bousquet & Sociorum, 1757; and Antonius de Haen, *Ratio medendi, in nosocomio practico* . . . , Vienna, Typis Joannis Thomae Trattner, 1757.

appointed Professor both of the Institutes and of the Practice of Medicine, but it is not clear that he ever gave any lectures.<sup>22</sup> Monro, being thus on his own, may simply have decided to fill the gap and, once started, continued along the same lines over the years.

In the second place, and more obviously, the 'Physiology' of M181-182 is an undertaking of a magnitude quite different from that presented in his standard course of lectures. The text is much longer, twice as long as any surviving student text. Despite what is said about 8-10 discourses, the two volumes comprise more than 300 written pages, leaving aside all annotations. At about 300 words per page that means 100,000 words, say 16-20 lectures. Furthermore, comparison with the scheme outlined in the text and with *Primus's* usual course shows that the missing topics comprise a substantial part of physiology that could easily have occupied a third volume and thus another 8-10 lectures. There are roughly 300 references in the form of footnotes, most of them in the hand of the writer of the main text, i.e. Monro *secundus*, many of them incomplete, not at all the sort of thing we would expect to find in a standard lecture-course, whether actually delivered or merely contemplated.

Finally, we ought not to ignore the evidence of M187-188 in the Collection. I have set out elsewhere the evidence suggesting that these volumes may have been written by Monro *secundus*.<sup>23</sup> They certainly belonged to, and were used by him and are notes taken from his father's lectures on physiology. The text of Vol. 2 is, however, followed (pp. 775 and 777) by some very critical comments written by *Primus* and then by a suggested introduction to an exposition which he hoped he would find more satisfactory. The whole passage is sufficiently interesting to be quoted in full:

When you desired me to correct the preceding Physiology, you proposed an Herculean labour to me, it is a downright Aугаean Stable, full of so many blunders and absurdities that I would sooner undertake to compose a new System of the Animal Oeconomy than be obliged to make common sense of this one. That it may however be converted to some use, I shall employ it as a sort of Index for collecting materials out of which a reasonable Physiology may be formed. If you will engage to rear the building I shall furnish the Materials after giving you the plan.

To show how much readiness I am in to perform my part I shall here write the Substance of the Discourse with which I commonly introduce the Physiology and in which I mention the Plan I commonly follow and the one I prefer to it. To this I shall subjoin the manner in which I would have you to compose a Physiology out of the Material I shall furnish on your promising to employ them in the manner I direct.

There are a number of puzzling features about this statement. The text of M187-188 strongly resembles that of most other surviving versions of the physiological part of Monro's course. Thus, he can hardly be criticizing the matter since it was provided by himself, but rather the way in which it had been committed to paper; yet in this respect, too, the text does not differ substantially from others in its category. The general tone of this sample "Introduction" is the same as that of M181-182 but the wording is different and the text stops short with Monro's excuse for venturing at all upon the subject, once more in words different from those used in M181-182 although the sense is the same.

<sup>22</sup> Underwood, op. cit., note 1, above pp. 110.

<sup>23</sup> Taylor, op. cit., note 19 above, pp. 103-104. Whether the notes are, in fact, in the hand of *Secundus* or that of a scribe does not affect the main argument. However, I am grateful to Dr Richard Palmer, Wellcome Institute for the History of Medicine, who, from examination of appropriate excerpts, shares my opinion that *Secundus* did indeed write them.



This Physiology, must not only be incomplete on account of what I have already done, but seeing I propose to treat the Subject I am to discourse of only in such a way as may be a sort of summary Introduction to the better understanding the Physiological Lectures of the Gentleman whose proper Province it is to explain the Animal Oeconomy, and who fills his Chair with honour to himself and to our University and to the greatest Advantage and satisfaction of the young Gentlemen who attend him.

He makes no mention of either the plan he has been wont to follow or that which he prefers. The onus, then, of constructing a satisfactory physiological text appears to be placed on the writer—or owner—of M187-188, but it is very hard to see how M181-182 could possibly be the work of a student, irrespective of any help he might have received—quite apart from the fact that the whole text is written as if *Primus* himself were the speaker.

We should not forget, however, that by 1754 Monro *secundus* was assisting his father in the conduct of the now very large anatomy classes in Edinburgh and there is little doubt that even earlier the father was already taking steps to ensure that the son should succeed him. In the late 1750s, *Secundus* regarded some eight lectures in physiology as an integral part of the anatomy course.<sup>24</sup> This gradually changes. By the middle 1770s three formal lectures on physiology wound up his course, although a good deal was incorporated into the earlier lectures. Twenty years earlier, however, anyone planning to teach in the tradition of *Primus* might well have felt obliged to equip himself with a modicum of physiological knowledge, and M181-182 may be the fruits of *Primus*'s intention that his son should be so equipped. It is plain from the early pages of the MS that *Primus* had serious objections to the schemes adopted in their respective texts by Boerhaave, Haller, and Hamberger, and may have felt that there was no suitable book whereby an instructor might get that part of the subject up, unless he himself were to provide one. The text was certainly used later by *Secundus*, as glosses in his more mature hand show. The uncertainty is unfortunate, in view of the contents of the MS to which I now turn.

#### THE CONTENTS OF THE MANUSCRIPT

Monro starts his 'Discourses' with an extended criticism of the plan of Boerhaave, Haller, and Hamberger. "People", he maintains, "ought to bring all sciences as near as possible to the demonstrative order which geometricians follow", beginning with the simple, plain and evident, and proceeding to the complex and obscure. This is admittedly difficult in physiology, since "το σωμα κικυλος εστι"<sup>25</sup> and all parts of the

<sup>24</sup> DU:M M174, note on fly-leaf.

<sup>25</sup> In the form given, the quotation is impossible Greek, and may be a later reworking of *On places in man I* (VI, 276, 1-3 Li) which together with *On the nature of bones II* (IX, 182, 3-6 Li) was often cited in post-Harveian physiology to prove that Hippocrates knew of the circulation of the blood. See I. M. Lonie, 'Hippocrates the intromechanist', *Med. Hist.*, 1981, 25: 113-150, especially pp. 136-140 and note 71. The business of Harvey's priority is, in fact, treated at some length in the various student recensions of the History of Anatomy, although Monro himself plainly has no doubt about it. I have noted seven different versions of the Greek, all incorrect in different ways; two include the word κικυλος, the proper Greek equivalent of the Latin "circulus" and the word used in the two *loci* noted above, and two are immediately followed by the translation, doubtless given by the lecturer, "our body is a circle".

The question is also discussed in Monro's own *History of anatomy* (DU:M M166, p. 77, in Taylor, op. cit., note 19 above) where he says "Numbers of tracts were writt. to prove Hippocrates to have known this motion of the blood and to have described it because he says the blood is driven in a circle, but this very

machine are interconnected and independent. Even so, all previous writers have failed more than was necessary.

Boerhaave, because growth of the parts is due to nutrition, started with digestion (first concoction) and then circulation, which got the alimentary particles to the site of their incorporation (second concoction); then, since more is ingested than is built in, he proceeded, after chylication and haematopoiesis, to deal with secretion and excretion; next in order came active organs, growth and nutrition, special senses, motion, and finally generation. Thus he began with the most complex part assuming as data almost every operation in the body.

Haller in his *Primae Lineae* left chylopoiesis until later, and started with the solids of the body but went on to discuss their action on the fluids before saying anything about the nature of the latter. He also treated the action of the heart before blood, organ sensibility, or muscle function.

Hamberger dealt with the fluids before the solids, but then accounted for organ function in terms of sensation and muscle contraction before explaining these.

Correct method was important and Monro goes on to outline his own plan which he will now attempt to execute, instead of following Boerhaave's order as he used to do. This plan (pp. 11-13),

may be under the following articles,

- 1.<sup>st</sup> The General Characteristics and Composition of Animals, whereby they can be distinguished from Vegetables.
- 2.<sup>dly</sup> The nature and qualities of our general liquors that is such as are generally diffused thro' the several organs of the Body whether of the compound mass called Blood, or of the different parts into which it can be separated.
- 3.<sup>dly</sup> The form and texture of the most simple solid parts and their different powers of action.
- 4.<sup>ly</sup> The disposition of these simple parts in composing pipes or vessels for the liquors to move in.
5. The phenomena of the liquors moving in these pipes, and the action of the pipes on the liquors.
6. The consequences and effects of these phenomena both on the liquors and on the pipes.
7. The operation and effects of whatever other active organs can affect either the liquors or pipes.
8. The general manner of discerning different liquors from the common mass.<sup>26</sup>
9. The particular contrivance for the secretion of the principal liquors found anywhere in the body and the nature and qualities of these liquors.
10. The manner how feeling or sensation is excited.
11. What the moving organs are and how they act.
12. An account of the Action of the particular moving organs of the body.
13. The organs of the Different Senses and their manner of conveying the Impressions of objects.

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passage when all the sentence is read is unfavourable to them and in other parts Hippocrates is very expressly of a different opinion." There is no Greek phrase, but the facing verso has no fewer than eight sizeable Hippocratic quotations, all in Latin, without any edition being specified.

The underlying sentiment is emphasized at the beginning of the physiological sections of ES Haswell and MSL No. 74 and was clearly of considerable significance for Monro, for whom one of the great difficulties about physiology was knowing where to begin, since each aspect of the animal economy interacted with every other.

It is a little surprising that the quotation in M181 went uncorrected. *Primus* studied Greek in his youth as he tells us in his autobiography (see *Life*, note 20 above, p. 3), and Greek quotations, especially from Galen, are quite common in the *Commentary on the Osteology* and amongst the interleaved additions to the 5th and 6th editions of the printed text (see Taylor, op. cit., note 19 above, M163 and M160-1, i and iii).

<sup>26</sup> "To secern—to separate from the blood. To secrete. Now rare" (*OED*) In eighteenth-century physiology, the discerning arteries were those open-mouthed branches of the serous or lymphatic arteries, the liquors from which were believed not to pass into the veins but to be discharged from the body or into the body cavities; to them corresponded the absorbent veins.

14. The state in which all the organs of the senses are unemployed, and most of the moving organs are unactive, and the effects of such a state.
15. The Supply of the liquors consumed in or thrown out of the Body and of the solids abraded in its actions.
16. The manner of this new supply either taking up the place of what is carried off, or increasing the volume of the parts, or how these may decrease notwithstanding the supply.
17. How the species is continued.

The prologue on the general characteristics of animals and vegetables is interesting. They share the same basic structure of liquors and vessels, but there are obvious anatomical differences and in vegetables the juices move to and fro. As opposed to plants, animals, even the most insensible, have feeling and will (the behaviour of *Mimosa* notwithstanding). In them, an internal principle commonly called “mind” operates.

In general, the topics discussed in Vol. 1 are explained in mechanical terms. This is acknowledged by Monro (p. 301): “Hitherto I have considered such parts of the animal economy as are performed mostly in a mechanical way, I can proceed no further without taking in the cooperation of the mind . . .”.

A gloss to p. 23 says that there is no longer unanimity about Leeuwenhoek’s description of the blood particles, namely that each red globule under a microscope is seen to divide into six smaller globules that reflect some yellow rays of light, and each of these in turn subdivides into pellucid particles. Debate or no, Monro accepts the doctrine of repeated subdivisions “tho possibly the precise number is not yet determined. There are frequent references to microscopic appearances and seemingly to demonstrations with, if not to student use of the instrument. For example (p. 39), when any apparently simple fibres are seen with the microscope “you observed it composed of smaller threads . . .”<sup>27</sup>

Animal heat is due to a combination of putrefaction and mechanical agitation and attrition. We should, however, note (p. 97) that “it is not merely by Elasticity the arteries of living animals act, they have also an energy which Life communicates to them as well as to the other contractile parts of the body”. The same sort of statement is made about the capillaries (p. 48β).

There is a long section on the lung air. Its effects are not just mechanical as Boerhaave, Hales, and Haller maintain. The lungs discharge noxious particles from the blood, but there is also a “somewhat” absorbed that is necessary for life. What it is may be hard to determine. Some say rarified sal nitre, but it is more likely to be (p. 177) “that general principle which goes to the composition of all the natural salts, to wit, the acid in them which is now found by Expt to be capable of producing anyone of them by being combined with its proper alcali or substratum of earth, this acidum vagum I say whose operation in the decay of wood, the rusting of metals, etc. Sir Is. Newton has so well described, seems to me the Principle most general and of the greatest energy in the preservation of animals if admitted into their blood”.<sup>28</sup>

<sup>27</sup> The microscopic appearances of the blood remained a source of argument for another generation. Monro *secundus* in his lectures of 1773/4 devoted considerable space to the matter and gives a particularly clear account of Leeuwenhoek’s doctrine and its subsequent modifications, but himself unhesitatingly rejects any notion of subdivision of the red corpuscles (M175, pp. 125-130, in Taylor, op. cit., note 19 above).

<sup>28</sup> A very brief reference to a *pabulum vitae* and to Newton’s *acidum vagum* occurs in the section on respiration in the various student versions of the Physiology except GD 113 V. 38 where the question of air in the blood is treated under ‘Circulation’. For these versions see Taylor, op. cit., note 2 above.



Vol. 2 begins at "Art: 10th, the manner how feeling or sensation is excited", which opens with a long philosophical discussion (pp. 305-337).<sup>29</sup> Most men consider that things really exist. Since the body, outwardly unchanged, may clearly be in a condition to receive no ideas (e.g. sleep, under drugs), there must be some other principle to permit perception, memory, etc. "Whatever is inert and insensible they call body, the sensible thinking part they name spirit, mind or soul . . .". Each affects the other. "When the mind wills the body is set into a suitable motion, when the body is out of order the mind suffers". However, the natural essence and constitution of both are unknown, as must therefore be their interaction. Monro makes much sarcastic fun of the Idealists and dismisses the Materialists rather brusquely, hoping that they do not intend men to draw the obvious conclusions "relating to a future state". He aligns himself with the common throng. External things excite ideas in a person by a law fixed at that person's creation, one amongst many relating to self-preservation and generation, and which are shared by animals. In the chain of cause and effect we come eventually to the supreme cause of all on whose will the first of those causes which we can discover must depend. But to go straight to that supreme cause by way of explanation would result in our being "deprived of the entertaining useful knowledge which the discovery of intermediate causes leads to".

All sense objects have one general effect, viz., impulse, and nerves are the only organs fit to be so impressed by the impulse of objects as to excite ideas. "Nerves are where we have sensibility" and the sensibility of a part is lost if the nerves are disordered. Impulse probably acts by stopping fluid flow in nerves but at this point the student is advised to consult the *Treatise on the Nerves*.<sup>30</sup>

Pain causes an instinctive reaction, exerting the mind to get quit of it. The mind is subject to the law of self-preservation and cannot prevent certain actions even if they are contrary to the will; for example, we can face a bright light without shutting the eyes but not without contracting the pupils.

On p. 333, a paragraph on sensation which produces involuntary actions and is called stimulus or irritation has been crossed out and replaced by a long excursus in the hand of *Primus* (pp. 332 and 334). He defines stimulus: "Whatever changes or causes an effect to change the then tone of any organ in the body must cause the attention of the curatrix of the body, the mind, therefor may strictly be called a stimulus." A stimulus to one organ may be removed by the actions of another, hence a sympathy between the two, most efficiently mediated by the mind. Nerves from skin and muscles form common trunks or have some connexion so that a change induced in any of them may affect the rest, and the organs to which they are distributed, the mind choosing amongst these the most proper. However, sympathy depending entirely on mind does not make sense in practice because many manifestations of nervous connexions give rise to untoward responses, like sneezing on looking at a bright light. In all this section, of about 2,500 words, there is no explicit mention of Whytt or indeed any other author.

<sup>29</sup> Vol. 2 (M182), although continuously paginated, is written only on the rectos of every second leaf. The discussion in question thus comprises eight foolscap pages.

<sup>30</sup> All editions except the first of Monro's *Anatomy of the human bones . . .* (which he almost always refers to as the *Osteology*) had added to them a "treatise of the nerves" and "an account of the reciprocal motions of the heart". See K. F. Russell, *British anatomy 1525-1800*, Melbourne University Press, 1963, for a full description of all the editions.

Stimuli may be ideal as well as corporeal, for example, fear, anger, or grief; and the organs of sense cannot be discussed individually until after the organs of motion. Muscles “are brought into contraction not only by the will but by everything that raises an uneasy sensation in them or in parts which by sympathy have an influence on them”. Where a stimulus is familiar to the mind, the will continues the contraction as long as necessary; where not, the contraction is momentary and frequently repeated, the alternation being in some proportion to the stimulus. Interestingly, while the response of a muscle pricked with a pin comes into the second category, pupillary constriction for Monro falls in the first. Isolated muscles behave as if they were acted on by an unknown stimulus. All these phenomena depend on a being, the soul; but, says Monro, we are dealing here with the most disputed area in the whole of physiology.

There then follows a lengthy critique of various views of muscular contraction, including those of Borelli, Haller, Thomas Morgan, Alexander Stuart, Daniel Bernouilli, James Keill, and Bryan Robinson.<sup>31</sup> Finally, “the most simple plain account of muscular motion yet given and which serves best to account for the greatest number of the phenomena observed in muscles is my celebrated master Dr Boerhaaves” (p. 389). On the opposite page, however, *Primus* has added: “. . . This was the simple doctrine which he taught and from it endeavoured to account for all the phenomena of muscles which I shall now attempt on the foundations already laid relating to the motion of our fluids and of our sensations.”

The Boerhaavian doctrine to which *Primus* refers supposed muscle fibres to be pipes, cylindrical rather than vesicular, the sides of which were not capable of being stretched (Monro’s term, used repeatedly, is “not distractile”), by the force of the fluid which flowed through them. This fluid was “the very subtile incompressible unelastic liquor of the nerves” (p. 389) together with the liquor poured into the fibrils from the ends of the arteries supplying each muscle. The fibrils were connected by fine threads of the *tela cellularis*, and covered by a network of vessels. They possessed a certain tone leading them to resist any attempt to make them longer or shorter.

He himself supposes that during life these liquors like the others of the body have “a nisis [i.e., effort, endeavour, impulse—*OED*] from the axis to the circumference superior to the tonic contraction of the side of the pipes” (p. 395), and as these are supposed not distractile, the liquors must exert their whole force in making the pipes wider and shorter. Thus there is a tendency for living muscles to shorten; this is called the natural contraction of muscles.

The muscular pipes can, however, only be made wider by lessening the spaces between them, which, since these latter are filled with soft material, can indeed be done within limits. But when the pipes become too rigid or the surfaces too diminished, the transverse diameters cannot be enlarged nor can shortening take place from the effort of the fluid in them. “While the causes of the contraction of a muscle flow equally

<sup>31</sup> It is often impossible to follow up Monro’s references. Although some are given in full, down to the very page or paragraph, frequently an author is mentioned in the text with an identifying letter, but at the foot of the page only the author is named—and not always he! One is left to guess the work and date. Doubtless there was an intention to fill in the missing details later. In lecturing to students, Monro devoted a relatively large proportion of his time to muscular motion and dealt with the opinions of Borelli, Keill, Morgan, and Bernouilli at some length in rejecting them.

through its fibres, with the quantity received into the fibres and that going out of them upon a par the muscle remains with an equal uniform nisus to contraction." (p. 399).

Muscles long contracted acquire rigidity and sudden elongation leads to tearing—a strong argument “for the indistractile nature of muscular fibres beyond the bounds in which they are ordinarily placed and yet they may be so flexible as to have their transverse diameter increased and their lengths diminished by the influent liquors.” (p. 403).

But now, “Seeing (p. 403) it is granted by all parties that the mind can direct the influence of a great many of the nerves as it wills it may be allowed to be capable of increasing or diminishing the flow of liquor in the nervous pipes and so may cause an influx of that liquor into a particular muscle with such celerity as is sufficient to increase the extensile power of the liquid there.” However, since the fibres are already full, only infinitesimal changes are necessary.

This in fact, gets round the time problem of Cartesian hydraulic theory. (The statement recurs on p.419 with a marginal comment in *Secundus's* mature hand: “Is inconceivable”.) Muscles are amongst the most sensible parts of the body by the numerous nerves bestowed upon them” and are readily affected by stimuli (p. 407).

Contraction must occur from flow to an irritated part and the necessity for mind to remove the uneasy sensation in a way dependent on its knowledge or ignorance of the stimulus. An unknown stimulus leads to tremor. (Here, a later note by *Secundus* says “Is erroneous”.) Exhaustion of the secretory springs in encephalon and medulla leads to faintness (p. 423).

I do not find this long section on muscle physiology always clear. In particular, the notion of muscle fibres as pipes with non-distractile sides which can nonetheless be widened and shortened would seem to be contradictory unless one assumes that the property refers only to the length and not to the circumference of the pipes, a point taken in earlier and later editions of the *Treatise on the Nerves*, and in my view nowhere answered convincingly by Monro. Be all that as it may, he seems to be conducting his exposition on two levels, so to speak—at the level of the fibre, in terms of its minute structure and the forces exerted by fluids and solids on each other, that is, in a more or less Boerhaavian and certainly mechanistic way; and also at a more general level, that of the control of the conditions under which these forces are developed or altered, which brings in consideration of nerves and sensations, in fact of mind, and which can thus be regarded as vitalistic.

According to Monro, one unanswerable objection to the Boerhaavian and every other scheme is the fact that isolated muscles remain excitable to stimuli. Decapitation does not prevent motion, as witness the experiments quoted by Whytt in Sec. 13 of the *Essay*. But (p. 431) “arguments on this subject are founded so much upon the nature of the mind and the connection of the mind and body of which I have declared myself entirely ignorant that I need not enter into any explanation of them and must confess I can give none myself”. On the facing page (p. 430) an addendum in *Primus's* hand refers and objects to Haller's concept of irritability inherent in animal fibres—how can there be irritation without feeling and feeling without mind?—and also apparently to Whytt's notion of the mind subsisting in the individual parts of animals separated from the whole.<sup>32</sup>

Voluntary action is that in which mind directs strength and duration; other muscles act without any consciousness of mind. The functions called vital and natural are performed thus; they are generally named “involuntary”. Other actions are performed consciously but without or contrary to the will, being excited by stimulus of body or mind, for example changes in facial muscles or heartbeat from fear or anger (p. 431).

The next Section, Art: 12th (p. 455), deals with particular moving organs of the body, but there are some general preliminary remarks. Boerhaave is again referred to. Muscles act only with their weak natural tonic motion unless mind propels nerve fluid with unusual celerity into the fibrils therefore “all such motions depend on the direction of the mind but some of these motions being performed with a conscious choice are called voluntary, those that are done without conscious choice are named natural [the words “vital and by some involuntary” have been inserted by *Primus*] and there is a third class with consciousness but without or even contrary to choice. These are [“most properly” has been added] called involuntary.” The natural and vital motions are all excited by corporeal causes directed by the laws of self-preservation and utility to which mind is subject. These are not voluntary motions now become automatic.

At this point the movement of the iris muscle in response to light is discussed, and both Haller and Whytt are referred to. The cause (p. 483) is “the mind’s being influenced by the impression of light upon the sensible parts of the eye; and this only it is that can account for that sympathy which is observed between the irises of the two eyes”. Attention is drawn to the actions of the two small muscles of the middle ear, tensor tympani and stapedius. Of these we are not conscious, but “it is necessary to allow here as well as in the motions of the pupil not only a sentient but a judging or rational principle governing the actions according to the benefit we are to receive from them”.

Boerhaave’s explanation for the alternate respiratory motions had long come under Monro’s criticism although on rather different grounds from those now adopted. We find in student notes of the 1730s that “It is impossible to account for respiration in Boerhaave’s way”, although his way had the merit of simplicity. According to Boerhaave, the blood in the extremities of the pulmonary artery was stopped at the height of inspiration, hence the ventricle sent out less blood and thus there was less blood and nerve juice entering the inspiratory muscles, which relaxed, while the rib cage and overstretched abdominal muscles recoiled from elasticity. With the expulsion of air the passage of blood through the lungs became free again. Boerhaave, however, had been caught up in the stream of iatromechanism, whose philosophers (p. 543) are “in such admiration of the machinery of the body as almost to forget that there was such an active being as a mind joined to it”. The alternate motion according to Monro is due to the connate law of self-preservation to which the mind is originally subject (p. 567). Normally it is directed by instinct and little attention is required.

Monro’s account of the motions of the heart is interesting. In various versions taken by students from his lectures, the account is that of Boerhaave, namely that the

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<sup>32</sup> There are two references at the foot of this page, the one to “Haller, *Primae Lineae*” and the other to “Whytt, *Essay on the Vital motions*”; neither proffers any further information.

distention of the arteries and auricles in ventricular systole resulted in pressure on the cardiac nerves so that the ventricles were now weakened and at the same time the aortic valves prevented coronary flow. The distended veins and auricles were thus able to throw enough blood into the weakened ventricles to distend them, while as the aorta contracted the semi-lunar valves ceased to block the coronary orifices. The pressure on the cardiac nerves being simultaneously removed, a fresh flow of nervous liquor permitted the ventricles to contract once more. This is the doctrine that we find promulgated in successive editions of the *Osteology*, although there is a remarkable disclaimer in the preface to Monro's copy of the 5th edition as he corrected it for the 6th which was published in 1758.<sup>33</sup> The disclaimer in M182 (p. 611) is even more remarkable.

You see this Doctrine illustrated more than Mr Boerhaave himself had done in the little Essay tacked to my *Osteology*, which is published there not on account of my persuasion of the truth of this Doctrine, for I have redargued<sup>34</sup> it every year since the 1735 and endeavoured to prove another one more probable. My design in printing it was chiefly to save myself from the imputation of having given a very imperfect account of what my Master taught me and of having assumed it as my own which the readers of Mr Cheseldens anatomy might probably be led to think, because that gentleman had inserted the account he has of the alternate motions of the auricles and ventricles of the heart with my name prefixed to it and without the least mention of Dr Boerhaave contrary to my repeated desire.

Monro proceeds to discuss the valid and invalid arguments against Boerhaave and then (p. 631) to give his own theory:

The cause of the heart's motion appears to me the same as of Respiration, to wit, the mind exerting herself in removing the destructive stagnation of blood which would happen if this organ the heart did not play in the manner it does and this she performs, not in consequence of free will or choice or knowledge of what the consequences would be of doing otherwise but is under an obligation to perform this office by the indispensable law of self preservation to which she is originally subjected, and to the obedience of which she is excited by the sensation which the blood and distension of the muscular fibres, or its acrimony vellicating them created, a sensation however which in the natural healthy state of things she is so accustomed to that she acts in consequence of them without being conscious either of the impression they make or her own energy in causing the organs to play.

Distention of the ventricles leads the mind to exert its influence so as to cause an increased flow of nervous liquor into the muscle fibrils and hence a constriction and filling of the auricles, speed and strength depending on the quantity, volume, or acrimony of the blood. After the heart has stopped, any irritation may restart it. This theory, however, he admits, cannot explain the motions of the isolated heart nor the effects of the passions.

In the alimentary tract "the mind directed by Instinct or instructed by experience is what determines the manner of the constriction from the Stimulus to be such as to push the contents from the pylorus towards the anus" (p. 647). In an annotation, further proof of "the Mind's determining peristaltic motion" is provided by rumination (p. 650).

<sup>33</sup> See Taylor, op. cit., note 19, above, plate facing p. 48.

<sup>34</sup> "To redargue—to refute or disprove (an argument, statement, etc. Since c. 1700 only in Scotland chiefly Law)" (*OED*).



BOERHAAVE, THE 'DISCOURSES', AND WHYTT'S *ESSAY*

What can we conclude from this analysis? To what extent did Monro clearly dissent from Boerhaave? To what extent did he accept, or even promote, a change in Edinburgh medical thinking, triggered off, as Christopher Lawrence has shown, by Robert Whytt's work on the nervous system?<sup>35</sup>

It seems to me that Monro's willingness to depart from orthodox Boerhaavian teaching where he thought it necessary to do so is perfectly plain. His exposition of physiology in these 'Discourses' ostensibly arises from a disagreement about order wherein he differs from Boerhaave and others, and it is true that this need not entail differences in detailed explanation. In fact, there are very substantial differences, and in all those sections from which I have quoted the language is much nearer to that of Whytt than to that of Boerhaave. Much of the whole MS is devoted to the detailed criticism of views that Monro thought were mistaken, and most certainly included in these are Boerhaave's explanations of the reciprocal motions of the heart and the alternate motions of respiration. Even where he accepts Boerhaave's theory of muscular motion as "the most simple plain account . . . yet given and which serves best to account for the greatest number of the phenomena" he is doing so really at the level of the muscle fibre rather than at that represented by the Haller-Whytt debate.<sup>36</sup> The two were by no means seen as mutually exclusive, and other parts of Monro's discussion are in precisely those latter terms.

All this is in strong contrast to the student lecture notes of the 1730s and 1740s. There, the explanations are Boerhaavian throughout and any criticisms of Boerhaave are very minor. For the motion of the heart the students are simply referred to the end of the *Osteology*, and I know of no evidence to support Monro's claim that he had "redargued it every year since the 1735". His inability to account for respiration in Boerhaave's way depends on the observation "that the cellulae of the lungs are never circular, but rather like those of honeycombs that is sexagons",<sup>37</sup> and his own explanation is equally mechanical. "Soul" features only in the treatment of muscular action, in that it is the one thing that has any effect upon the very slow movement of the nervous liquor; the discussion otherwise is once more in mechanical terms. Heart muscle continues to contract after removal from the body because "tho' the impulse of the brain has ceased yet the fluids are still going on in the nerves." "Warm water and breath only act in a mechanical way". Certainly, "the soul has a care for the body" and vice versa, hence on the one hand pains in a phantom limb and on the other "shivering after the soul has gone", but there is no equation anywhere of soul with mind or sentient principle. The vital functions continue in sleep because, in contrast to the nerves to muscles which come from the cerebrum, those that serve the vital functions come from cerebellum, which has no cavities and therefore the juice goes along the nerves as it is manufactured.<sup>38</sup> Peristaltic movements occur because "the gross part of the food . . . by its acrimony stimulates the gutts and helps its own promotion."

<sup>35</sup> Lawrence, *op. cit.*, notes 10 and 11 above.

<sup>36</sup> French, *op. cit.*, note 16 above, ch. 6.

<sup>37</sup> This criticism and Monro's own explanation occur, couched in virtually the same terms, in all the extant notes of the *Physiology* except GD 113 V.38 in which the relevant pages (112-115) are missing. See note 28 above.

<sup>commonly divided  
to Branches and  
cellular and  
medullary Marrow</sup>
 The Cranium & vertebra contain a soft pulpy substance  
~~within them~~ in which the arteries are disarticulated into such extremities  
 by subtle branches, that no art has yet been able to prosecute them to  
 their Terminations & these vessels have a particularity which is to  
 be found no where else in the body, except within the Bones, which  
 is, their not being assisted by the pressure of the atmosphere to resist  
 the expansile power of their liquors, on w<sup>ch</sup> acc<sup>t</sup>. They can have no  
 Systole & therefore the liquors must move in them more slowly &  
 equally than elsewhere, which is still more increased by the Croo-  
 :ked Turns which these arteries make in their course to these Organs,  
 & by the more than ordinary weakness of their Coats owing either to  
 the want of a firm Tela Cellularis round them or to their muscular  
 Coat being thinner or to Both. — It is true that some would have  
 us to believe the want of these compressing Instruments is sup-  
 plied by the Activity of the Dura Mater, but whoever sees  
 the Connection of this membrane to the Bones must know  
 that this membrane always is contiguous to the Cranium and  
 therefore can make no Compression on the Parts it contains  
 From this want of Compression and Agitation it will follow that the Blood in  
 these Vessels will become less dense and more watery than any other Blood in  
 the Body. It will be in nearly the same Situation as that of fishes after it  
 returns from their Bronchi into the Vessel Analogous to an Aorta, which I told  
 you formerly melts down so much as to be seen of a red colour in very few and  
 those strongly agitated parts of their Body. — It might therefore be expected  
 that Organs which have such Vessels should be among the most cold and  
 moist of things; Was not the want of compression and agitation necessary for genera-  
 ting Heat in some measure compensated by the Contents of the Skull and Spine  
 being well defended from any access of cold from the external Air

Plate 1. The upper part of the page, taken from DU:M M181, is in the hand of the writer of the main text and should be compared with plate 2. It is one of the few annotations not written entirely by *Monro primus*, whose quite distinctive hand is shown in the last 10 lines.

Dr Whites Essay on vital & Involuntary Motions. 205.

Sect. 1.

Influence proceeding from the Brain proved by 1. Irritating  
Mediciny parts — Cutting nerves. — Slight Inflam. causing Madnes,  
or Compressin an Apoplexy of Pulv. — It is easier to conceive the  
nerves nourished by a porous, ossified Brain, than that a Tree should  
be nourished by a Stone & lime Wall. —

The Power of Stimuli greater than that of the Nerve.  
The mind by Disease loses the power of moving even the volun-  
tary Muscles, <sup>except</sup> in a particular way, or even of Contracting <sup>at all</sup>.

Sect. 2.

of Opinions about Motion of the Heart.

Cartes from Rebellion. — Boerh. acct. — Objections to it. as  
1. All of nerves don't pass as he supposes. — 2. Other nerves, such  
as the Interostal don't suffer such alteration from a stronger Pressure.  
3. The Uterus requires a much greater Pressure. — 4. Other Nerves  
from Pressure are not instantly made Paralytic. — 5. Allowing  
the Compression the Heart ought from it to be most strongly  
contracted when it's Diastole begins. — 6 It does not acc<sup>t</sup> for  
the Contraction of the Auricles, — nor in Those Animals w<sup>h</sup> One ventricle  
— 7. Does not acct. at all for the Succession of Contraction in  
dying Animals, nor of Heart is taken from y<sup>e</sup> Body. — 8. It  
does not assist to explain other Spontaneous Motions. —  
nor can it be from y<sup>e</sup> Interc. n. compressed in it's passage  
along w<sup>th</sup> the Carotid. 1. y<sup>e</sup> other Arteries are not contrac-  
ted at the same time. — 2. The aur. & ventr. shoud be  
Both contracted & relaxed at y<sup>e</sup> same time. Because unless the  
Influence of y<sup>e</sup> nerves is allow'd to take place w<sup>th</sup> partly it's own  
power.

By the time the main text of the 'Discourses' was written, *Primus* had without any doubt read Whytt's *Essay*. There are eight references to it, all in that part of the MS to which it is most relevant. Of the 126 authors referred to in the whole MS most are mentioned once or twice. Only Haller, Hales, Hamberger, and Keill, in that order, achieve double figures. And while nearly all are referred to only to be criticized, this does not apply to Whytt except in the one instance (see p. 75 above). Moreover, an appreciable number of passages in which there is no ascription seem to me to be as redolent of the doctrines of Whytt, for example in their use of terms like stimulus, sympathy, and mind (= soul, sentient principle), as do the paragraphs on the heart and on respiration. Indeed, one or other of all of Whytt's premises<sup>39</sup> come strongly to mind at various points in the 'Discourses'.

Two very interesting passages suggest almost an element of conversion on the part of Monro. Thus, on pp. 671-675, "Dr Whytt again would have it [penile erection] to depend on an increased oscillatory contraction of the small arteries of the penis . . .", but for lack of positive proof, "I can't say that any of these opinions yet are better than ingenious conjectures . . .". In contrast, in a long annotation in his own hand (p. 48β<sup>v</sup>) he writes: "A certain somewhat which is the principle of Life is however necessary towards the capillary tubes of animals and vegetables doing their office right . . . We may call this vital energy of the small Pipes Oscillations or whatever name else we please, but we know not fully the Laws of its Operations tho' we see its effects."

However, there are also clear differences, as when Monro insists on the operation of "not only a sentient but a judging or rational principle" in the contraction of the iris muscle or those of the middle ear, and in the prominence which he gives to the "connate law of self-preservation" and to instinct in relation to the mind. Whereas Whytt writes of a certain *power* or *influence* [my italics] proceeding originally from the brain and spinal marrow, lodged afterwards in the nerves and by this means conveyed into the muscles, and of the mind determining "the influence of the nerves more copiously into the intercostal muscles",<sup>40</sup> and whereas to him it seems "quite unphilosophical to ascribe the motions of the muscles of animals from a stimulus to any hidden property of their fibres, peculiar activity of the nervous fluid or other unknown when they are so easily and naturally accounted for from the power and energy of a known sentient principle",<sup>41</sup> Monro still seems to be thinking fairly concretely of a nervous fluid. We cannot automatically assume the identity of Whytt's statement that motions performed in consequence of an irritation "are owing to the original constitution of our frame and law of union established by the all-wise CREATOR between the soul and body"<sup>42</sup> and Monro's attributions to instinct and the inborn laws of self preservation. Monro has no role for the spinal marrow in the movements of

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<sup>38</sup> Interestingly, this view is explicitly contradicted in M182, p. 1003, on the grounds that the eighth pair of nerves also sends fibres to the tongue and larynx, but these do not continue to move during sleep. The argument is not clear, however, because this pair "owes not all its substance to the cerebellum alone". It is clearer a little later because "there are several nerves which undoubtedly have their rise from the cerebellum such as the 5th and the 7th which are not eximied from the effect of sleep."

<sup>39</sup> Whytt, *Essay*, p. 5 *et seq.*

<sup>40</sup> *Ibid.*, p. 185.

<sup>41</sup> *Ibid.*, p. 265.

<sup>42</sup> *Ibid.*, p. 309.

decapitated animals, in contrast to Whytt.<sup>43</sup> And while the contraction of isolated muscles is seen as an insuperable objection to the Boerhaavian theory, and is to Monro inexplicable, it is not so to Whytt since the immediate cause of motion remains for a time after death or amputation excitable by a stimulus; this is corroborated by the revival of hibernating or frozen animals. Nevertheless, all this does not imply that the soul is necessarily extended and divisible<sup>44</sup> although Monro seems to think that it does.

#### CONCLUSIONS

An attempt to answer my earlier question “What can we conclude?” seems to me to take us back to the beginning. Why was the MS written and to whom was it directed? By 1758-9, *Secundus* had taken over his father’s teaching. He had certainly read and summarized Whytt’s *Essay* not later than 1756 and presumably drawn his own conclusions.<sup>45</sup> On the other hand, he made comments in the margins of M181-182, suggesting that he used it, and many physiological passages in his lectures of the 1760s and 1770s are strongly reminiscent of the ‘Discourses’.

Unfortunately, we know very little about the actual mode of transfer of responsibility between father and son. *Secundus* did some teaching in 1754 and again in 1757 before completely taking over in session 1758-9.<sup>46</sup> Did he initially act simply as his father’s mouthpiece? Is the MS analogous to the *Commentary on the Osteology*, written by *Primus* for the use of his son, but also used in teaching,<sup>47</sup> both documents thus playing a part in the grooming process by which the succession was to be accomplished? Monro *primus* was a man of great foresight, not least in the furtherance of his own interests. In addition, father and son shared a very strong sense of priority and were quick to claim credit in large matters and small. *Secundus*, indeed, was notorious for his various disputes about priorities. Years later, he emphasized that his father had seen the disadvantages of Boerhaave’s method, although following it in his lectures, and “at that time pointed out a method which is more proper”.<sup>48</sup>

Whether Cullen’s complaint was justified in the case of Monro *primus* as far as the teaching of students was concerned thus cannot easily be answered one way or the other. Throughout the text of M181-182 there is very clearly an audience in mind somewhere along the line, an audience that was already familiar and that was adjured (p. 3) to read the *Medical Essays*<sup>49</sup> and the *Osteology*, and later (p. 301) “the little treatise on the nerves tacked to your osteology”. Equally clearly, there is no escaping the fact that as late as 1758, Monro was promulgating Boerhaave’s doctrine of the motions of the heart, although with explicit qualification, as we have seen.

<sup>43</sup> *Ibid.*, p. 332.

<sup>44</sup> *Ibid.*, p. 344 *et seq.*

<sup>45</sup> The evidence is in DU:M M174, pp. 201-216, where *Secundus* has carefully summarized Whytt’s *Essay*, section by section.

<sup>46</sup> R. E. Wright-St Clair, *Doctors Monro: a medical saga*, London, Wellcome Historical Medical Library, 1964, pp. 70-73.

<sup>47</sup> See Taylor, *op. cit.*, note 19 above, pp. 84-85.

<sup>48</sup> See DNLM 114257, p.1. This MS is said to be c. 1792; in fact, the attribution of the lectures to Alexander Monro junior, and the phrase (p. 85) “Dr Whytt thinks . . .” in contrast to statements elsewhere (p. 80) that Boerhaave—and also Simpson—was of the opinion, suggest a date earlier than 1766. The criticisms of Boerhaave’s and Haller’s methods are extremely reminiscent of M181-182.

<sup>49</sup> *Medical essays and observations, published by a society in Edinburgh*, vols. 1-5 [Vol. 5 in 2 pts], 6 vols., Edinburgh, Ruddimans, 1733-44.



Furthermore, *Monro secundus* published in 1781 a collection of his father's writings, which includes the *Anatomy of the human nerves*.<sup>50</sup> The edition which he used is not stated but it represents presumably *Primus's* latest word on the subject. Nevertheless, of the twenty-seven pages of text which cover the nerves in general as opposed to particular nerves, little more than the equivalent of three pages differs from the printed text of the fifth edition published in 1750. A copy of the latter in the *Monro Collection*, DU:M M161, is interleaved and contains many marginal corrections and substantial annotations in the hand of *Primus* in preparation for the sixth edition, which appeared in 1758. In a note (facing p. 1) he states that all quotations were checked as late as possible before sending the script to the printer and so one must suppose that these additions represent the opinions that he was willing to put into print as late as, say, the end of 1757. They contain, in fact, almost all the new material wherein the text reprinted in 1781 differs from that of 1750. Of that part of the new material, and of the even smaller amount added later, only a very little suggests Whytt in any way, and does so in the form of tentative questions rather than the firm and extended statements of M181-182.<sup>51</sup> Thus there seems to be an appreciable difference between what *Monro* was prepared to put his name to in public and say in the lecture-theatre. Perhaps this should not surprise us. We may recall his attitude to his early lectures on wounds and on tumours,<sup>52</sup> or his views about the difference "between instructing Youth in private, and pretending to inform the public".<sup>53</sup> I, at least, have a very strong impression that both *Primus* and *Secundus* were men who liked to be seen to have been right, but who were very careful, in the current phrase, about sticking their necks too far out at the actual time.

Whatever the answers to all these questions, I think that the evidence compels us to ascribe to *Monro primus* views that, changing as they did through the middle 1750s, would undoubtedly have helped to confirm, although they may not have more directly created, that changing climate of physiological opinion in Edinburgh to which reference was made at the beginning of this paper.

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<sup>50</sup> *The Works of Alexander Monro, M.D. . . published by his son, Alexander Monro, M.D. . .* Edinburgh, Charles Elliott & George Robinson, 1781, pp. 317-367. See also note 28 above.

<sup>51</sup> The critical passage occurs on p. 340 of the *Works* and reads as follows: "Is it this necessity which obliges the mind to exert herself in respiration, or in the action of the heart, when the lungs or heart are gorged with blood? or the *iris* to contract the pupil, when the eye is exposed to strong light? or sneezing to be performed when the nose is tickled? [These lines are in *Primus's* hand in DU:M M161 facing p. 378] Will not a *stimulus* of any nerve more readily affect those with which it is any where connected than the other nerves of the body? May not this sympathy serve as a monitor of the mind, rather to employ the organs furnished with nerves thus connected, to assist in freeing her of any uneasy sensation, than to make use of any other organs?—Will not this in some measure account for many salutary operations performed in the body, before experience has taught us the functions of the organs performing them [these lines must have been added after 1758]."

<sup>52</sup> Taylor, op. cit., note 2 above, p. 447.

<sup>53</sup> Alexander Monro, *The anatomy of the human bones . . .*, 5th ed., 1750, preface, p. vi. See note 28 above.