

Texts and Documents

A DISCOURSE OF THE HEART BY JAMES DE BACK

by

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THIS paper reviews the *Discourse of the Heart* by James de Back, which was included in the English language edition of *The Anatomical Exercises* of William Harvey of 1653. The edition used for this review is a 1673 reprint published at London. There are no illustrations. Its contents include the anatomical exercises concerning the motion of the heart and blood by Harvey (of 1628) with the preface of Zachariah Wood, physician to Rotterdam, to which is added *The Discourse of the Heart* by James de Back, Physician in Ordinary to the town of Rotterdam. There follow the *Two Anatomical Exercitations concerning the Circulation of the Blood* (of 1649) to John Riolan, the son.

The Harvey writings are so well known and have been so widely and wisely commented upon as to require no further amplification in terms of their significance and their historical setting. They are the very fabric of modern cardiac and circulatory physiology, and more broadly of the establishment of experimental method, especially with regard to 'ocular testimony' in medicine. To read these writings is sufficient to impel one into that heuristic attitude which is so characteristic of them; an attitude so vital to the proper conduct and establishment of the sciences with its acute open-mindedness guided only by observation prepared to constant scepticism and seeking to be tested and modified if necessary by further observation.

Nonetheless, it is pertinent to the consideration of de Back to present Harvey's apologia as this forms the conceptual proscenium from which subsequent actors declaimed.

At last using daily more search and diligence, by often looking into many and several sorts of creatures, I did beleieve I had hit the nail on the head, unwinded and freed my self from this Labyrinth, and thought I had gain'd both the motion and use of the heart, together with that of the arteries, which I did so much desire; since which time I have not been afraid, both privately and to my friends, and publicly in my Anatomy Lectures to deliver my opinion.

'Which, as it commonly falls out, pleased some, and displeas'd others; some there were that did check me, spoke harshly, and found fault that I had departed from the precepts and beliefs of all Anatomists; others avouching that it was a thing new, worthy of their knowledge, and exceeding profitable, requir'd it to be more plainly delivered to them. At last, mov'd partly by the requests of my friends, that all men might be the partakers of my endeavours, and partly by the malice of some, who being displeas'd with what I said, and not understanding it aright, endeavoured to traduce me publicly, I was forced to recommend these things to the Press, that every man might of me, and the thing it self, deliver his judgement freely. But so much the more willing I was to it, because Hieronym ab Aq. P. having learnedly and accurately set down in a particular Treatise, almost all the parts of living creatures, left the heart only untouched. Lastly, if any profit or advantage might be my industry in this accrew to the republick of Literature, it might perchance be granted that I had done well, and others might beleieve that I had not spent my time altogether to no purpose, and as the old man says in the Comedie:

Texts and Documents

No man so well e'r laid his count to live
But that things, age and use, some new thing give,
That what you thought you knew, you shall not know,
And what you once thought best, you shall forgoe.

This may perchance fall out now in the motion of the heart, that from hence the way being thus pervious, others trusting to more pregnant wits, may take occasion to do better, and search further.'

James de Back was born in 1594 and died in 1658. De Back took his M.D. in 1617 having studied in Leiden and later in Franeker. It was here he received his degree. His *Discourse* was first published in Latin at Rotterdam in 1648, and was later translated into English under the present title for the London edition in 1653.¹

. . . I did set down and resolve in my mind, having taken the degree of Doctor, to essay nothing in the practick, unless being induced to it by the tryall of reason, or if I heard any thing well done or spoken by another, that I should endeavour to search the reasons of the thing as it came to hand, that I might at least satisfie my self; I thus being prepared in mind, it so happened about fifteen years agoe that the Anatomical exercise of William Harvey, concerning the motion of the heart and blood, did fall into my hands, after it had been out about five or six years. . . .

Thus de Back had been in practice some sixteen or seventeen years when he first became acquainted with the new notion of the circulation of the blood. Apparently over the next sixteen years he stated that he made his own observations, had frequent conversations with colleagues and the ideas 'were in our Anatomical demonstrations handled and canvas'd. . . .' Finally his friends entreated him to

. . . publish for common use such things [as] in this matter I had studied: which although it was troublesome to me now growing old, it being two and thirty years past, since I gave myself to practice, and (as it is usuall) I had in a manner left all the Theorick part (if this matter concerning Circulation had not waken'd it) there could not be time enough for me (being both busied with my own affairs, and with my practice) to bestow upon this work.' [The oft heard plaint of a busy physician has not changed it seems in 300 years!] 'Yet that I might please my friends, I suffer'd . . . that I might adde something to the Treatise of Doctor Harvey of the heart and blood, which might be to the same purpose; which book Arnoldus Leers a vigilant Stationer hath lately given to the Press; I did therefore undertake to write a Discourse concerning the heart, partly because it agrees with Doctor Harvey's purpose, and partly because I thought that the scrutiny of the heart was more accurately to be handled, and with a more diligent care to be enquir'd after.

By the time de Back was writing his speech to the Readers ' . . . you shall scarce find a Doctor created, who knows not, yea does not approve of the Circulation of the Blood.' The latter was not, however, true.² Alexander Reid, a lecturer at the Barber-Surgeons in London continued to teach an undiluted Galenic doctrine, publishing in 1637, and frequent editions of his work continued unchanged to 1658. The French anatomists led by de Riolan (who published his *Enchiridion* in 1648, and sent a copy to Harvey) also expressed the old doctrine. This must have continued in vogue for it was not until 1672 at the authoritarian behest of Louis XIV that public demonstrations in anatomy were undertaken by Dionis in the Jardin Royal against much opposition from the Faculty of Medicine of the University at Paris, which had ostracized the new views on the circulation of the blood. Dr. Dionis was then aged thirty-one and Le Roi Soleil thirty-five years, and the successful tussle appears to have been a

triumph of youth over crabbed age. What stars from the Republic of letters attended the demonstrations and then illuminated the word—Molière, Boileau, La Fontaine and Racine all became publicists of the 'new' circulatory school as a result of this inspired social interference in medical affairs.

One of the greatest nonmedical influences in the spreading and acceptance of the new doctrine was that of the widely acclaimed French philosopher and mathematician, René Descartes, who came to know of Harvey's work about 1632. This was the year of Galileo's denunciation. Descartes was at the time engaged in finishing his *Traité du Monde*, intending it to be published in 1633. However, he was so dismayed by the treatment accorded Galileo that he dared not publish the work. He extracted the more innocuous passages from the work and five years later, published these as his famous *Discours de la Méthode*. The *Traité du Monde* was not published until fourteen years after his death in 1664, and again (with the *Traité de l'Homme*) in 1677. Descartes had taken up residence in Holland in 1629 and remained there for more than twenty years. Thus, he was a close contemporary of de Back. Although there is no indication in de Back's treatise of personal acquaintance, his proximity as well as his ideas were well known to him.

Whilst Descartes fully acknowledged the priority and importance of Harvey's work as a whole with regard to circulation, by a master-stroke of irony he took issue with Harvey over the action of the heart, reversing the rationale of systole and diastole—this by pure reasoning and by the following invocation: ' . . . for he (Harvey) imagines against the opinions of other physicians, and against the common judgement of the eye. . . .' As Chauvois puts it, 'It is not a little amusing to find Descartes, the man who overthrew Scholasticism and the errors of sense invoking "the common opinion of physicians" and the "judgement of the eye".'² His espousal of Harvey's work was not altogether a felicitous marriage in other ways. His attitude to biology was obsessively directed from his attempts to geometrize all nature. The inception of the mechanical theory of heat was due to him. In transposing this to the animate he had a thorough going mechanistic conception of the physiology based on the properties of space and motion (the latter including heat). Thus the action of the ventricles he regarded as being due to their heat expanding the large drop of cold blood they received from the auricles. This distended them, forcing a diastole and also causing the opening of the semilunar valves.

Harvey, in the 1649 *Exercices* addressed to Riolan, took an able side-swipe therein at 'a man remarkable for his brilliant genius, René Descartes, whom I thank for the eulogistic mention he has made of me' in respect of his wrong concept of systole and diastole. Harvey also placed the source of heart movement as the inherent contractile ability of the muscle itself. However, Harvey was not himself fully clear on the functions of the blood and in line with current views supposed that the blood carried 'heat' and 'vital spirit'. Thus it would follow that blood leaving an organ would be depleted of both. It therefore became necessary for him to suppose that some form of fermentation occurred in the vena cava in order that the observed heated blood returning in it caused the auricles and then the ventricles to contract. This would then tie up with the passage of the blood through the lungs where the inspired air would cool the overheating that had taken place. Chauvois shows how Harvey was

caught up in the common pattern of thought in the widely held analogy between wine and blood. Harvey, therefore, sited the origin of the circulation in the vena cava, due to this fermentation-like process.

Such, then, is a brief and superficial sketch of the setting, with particular emphasis on the French–Dutch setting; this, because the thrust to which Harvey made public retort was from the French anatomist, de Riolan, and because of Descartes' contribution to the polemic. Except for odd occasions over the past three hundred years, de Back's writing appears either to have escaped attention altogether or to have been considered purely as a superfluous appendage to Harvey's work. Chauvois' otherwise valuable work makes no mention of de Back at all. However, Bayon³ recognised that in criticizing Descartes, de Back had suggested that the heat of the blood was due to its movement and did not originate from the heart.

We come then to a consideration of the treatise itself of 104 pages. It is divided into three sections: the nullity of spirits, sanguification and the heat of living things. It is dedicated to Harvey and there is a preliminary address to the readers. In this address is a very lucid account of seventeenth century epistemology:

I call the generall doctrine of man Anthropologie, the parts of which, I do ordain to be, according to this division, Psychologie, Somatologie, and Haematologie, into the doctrine of the soul, bodie and blood, for in man all functions which are seen, as well hidden as open, are perform'd by the soul, as impulsor, by the body dispos'd operating, by the blood helping and concurring as a medium. . . . It [the soul] bestows a better life upon the body when it adorns it with motion, sense, and most of all with benefit of reason. . . . The soul, since it cannot preserve life in the Individuall, by reason of the unfitness of the substance of which it is compos'd, it does endeavour to perform that in another, which faculty we call Procreative. . . . I do think that this Anthropologick Science, because it is meerly Physical, is to be called Physiological, but that which does comprehend the doctrine of Diseases, whether they be natural or preternatural is to be called Pathology. By the one the actions of the body are very well perform'd, by the other they are hurt. . . .

Section I, the nullity of spirits, is then devoted to a critical examination of the widely held notion of vital spirits with a resounding conclusion that these do not exist. He begins with the premise that one must 'only trust those things which are seen with his eyes; known by his touch and confirmed by reasons drawn from ocular testimony. . . .' Next, he defines the notion of spirits as then held. 'From which Definitions is gathered, that the spirit is a certain substance divers from the blood, subsisting apart, and by it self; because it is made up of its finest and thinnest part, or because it is said, that it is made up of its vapour and its air. But I beseech you where was there ever any such thing found in the body?'

He then examines the content of blood vessels and finds that they contain nothing but blood and shrewdly concludes that spirits are confounded with heat. Why, indeed, need spirits be postulated for the functions of the various parts, for this multiplies entities without cause.

They that postulate spirits do so as well because they consider that something so subtle is required to explain the conjoining of (mortal) body to (immortal) soul. But the soul is distributed through every part. The brain, spinal marrow and the nerves along with the blood which is distributed to them, explain the reactions that are observable, by medium of their nutritive juice 'which the nerves have in common

Texts and Documents

with the brain and spinal marrow, Insomuch that you would say that the brain extended all over the body. . . . Scarce is either any part touch'd nor the net of the eye affected with any visible object, but from thence the motion of the brain is alter'd. . . .'

There is then no need to formulate other entities as spirits apart from that which is observable and explicable in terms of observation.

Section II deals with the sanguification (or haematosi) of the blood, i.e., with the elaboration of the blood. 'Blood is an humour . . . contain'd in the veins and arteries, containing in it matter fit for the nutrition of the parts administring heat to the whole body, together with nourishment for the sustentation of life.' The first and third functions appear to distinguish intermittent and continuous functions.

Haemopoiesis, to use our current term, is perfected in two ways. In the first 'it is perfected in the parts themselves or in the habit of the whole body, when the blood again and again passing about the body in a circular motion and affording recruits to many places, and at last receiving a similitude of the parts (for it cannot receive a similitude from any better than from those to which it is to be assimilated) it is prepared that it may be fitted into its substance.

In the second, it is derived from 'nutriment' or meat and drink newly receiv'd, that being mix'd with the other, it may pass without hurt to the innermost parts of the body, that it may be fitted to nourish and perform the rest of the functions of the blood.'

Chapters 2–6 of this section deal with this conception of the formation of blood from food and because they give such a fascinating account of gastro-enterology, they will be considered in more detail below. Chapter 6 discusses the opinion of Columbus who first opined 'that the mixture of the blood with air was done in the lungs and that this blood was made vital', and agrees with him. Chapter 7 considers the embryology of the heart with the conclusion that this organ is formed with no greater pre-eminence over the other organs. Chapter 8 considers the arguments of Corringius for haemopoiesis occurring in the heart and refutes them. Chapter 9 covers the same ground but bases the argument upon the method of Descartes and extends the previous refutation to exclude the heart as well from destruction of the blood.

The nutriment being received and is little imbued with the spittle of the mouth that so it may more easily receive the moisture of the mouth by the help of the tongue, and parts of the mouth, it is sent into the Oesophagus and by the help of its muscles and fibers, down into the stomach, there is it besprinkled with the moisture which sweats always out of the inner tunicle and mixed by the force of the contraction of the stomach and jumbled as much as it can be.

Apparently, it was sometimes held that the milt (spleen) contributed this sour juice 'truely without reason . . . the reason is, because there is no way, nor no immediate passages from the milt into the stomach.' He did not know the function of the spleen but felt that it must be in some way necessary for dilution of the blood carried by the portal vein to the liver, for when the spleen is obstructed and the passage of the blood stopped so that the chyme was not well diluted, the whole body was deprived of nourishment.

'The chyle is then let down into the intestines and peristaltic motion renders it very fine.' He postulates that the main pancreatic duct must be the prime lacteal

vessel because of its size and because it contains milky fluid in it after a meal. The numerous lacteals (lymphatics) carry the rest of the chyle, squeezed through by the forcible contractions of the intestines, the compressive weight of the bowels lying upon them and also by the continual motion of the abdominal muscles. These then run to the glandules of the mesentery where blood is formed. This passes then into the capillar veins and thence for further dilution into the portal vein. Here he is careful to point out this is only the first stage in preparation and calls this chymous for it is really the preparation of the chyme. This may then be carried to the liver to be dyed crimson there. (This chyme is similar to the preparation of blood in the placenta, for maternal and foetal circulations do not come together, the mother's not beyond the womb and the child's not beyond the placenta.) The liver then acts as yet another sieve for the final correction of the altered food 'being sifted through the small and innumerable windings of the liver' before delivery as blood to the vena cava.

He next tackles the status of choler (bile) and decides that bile is not an excrement of the liver (contrary to Ancient and Modern thought) because the spiral valve of the gall bladder only allows exit of its contents. Therefore, the only other way it may obtain bile is from the cystic artery, acting as a storehouse from which later it is disgorged to help haemopoiesis as needed, both by acting as a seasoning for the chyle in the gut and also because some of it is strained back into the liver. De Back was largely against the idea that any matter produced within the normal functioning body was primarily excrement.

Section III deals with the heat of living things. It is in seven chapters with an addition. Chapter I discusses and rejects the old notion that there is greater heat in the heart than in other organs, on the basis of the characteristics of its muscle and the fact that it is merely the propulsor of the blood and that it is the blood which contains and distributes the heat of the body, including that of the heart by the coronary arteries. Descartes's (variously referred to as Renatus de Chartes and Cartesius) theory of the ebullition of blood, with its differential amounts of blood heat affecting the auricles and ventricles separately, and his reversed notions of systole and diastole, are mentioned. Chapter II enlarges on the absurdities that follow Descartes's theory of the ebullition of the blood. Heat cannot then be called the cause of this contraction. De Back believes the live body is driven to contraction by the soul. And as the soul is dimensionless and yet everywhere, it still causes contraction of dissected heart muscle pieces. The soul, for Descartes, was indivisible and therefore could not be responsible for such movement.

Chapter III is an analysis of the definition of heat and its place in blood. 'All things consist of four Elements.' To de Back, heat is thus an effect of the element of fire. Philosophers define heat as an active quality either gathering classes of particles together (Homogeneals) or separating them (heterogeneals) by means of motion. All heat is of the same type though it varies in degree, whether in things animate or inanimate. Under its influence, particles must return to their own beginnings before junction or disjunction occurs. Heat is produced outside of the body and its motion is transferred and finally 'educted out of the nutriment' and then distributed widely by the actions of 'the fiery atomes' which 'make their strength to appear by a manifest heat'.

Chapter IV considers what things are necessary to the heating of the blood, the source of blood mobility, how nutrition is caused. The first part is glossed over. The source of blood mobility is partly from the wheyish humour (serum or plasma) but mostly from the air added to the blood by mediation of the lungs as it is divisible into infinite parts and so can pass through even the 'most thickest parts'. There is a very strong correlation between its mobility and divisibility. 'Nutrition is the union and assimilation of the nutritive humour to every part.' In order that this occurs, it (the nutritive humour) ought to pass the least particles of the members. He is very much aware that blood must be composed of many parts.

Chapter V insists that the mobility of the blood is not sufficient alone for the production of heat. The heart is the chief impulsive agent assisted by the arteries. In addition, however, the movements of the parts themselves are contributory. He also makes the fascinating comment: 'For all action proceeds from the soul, nor can anything but that which has a Soul move it self, or be sensible, it only vivifies the body and its parts, which being orderly fitted, it empowers them with its faculties.'

Chapter VI is a consideration of the famed and vexatious communicating system between arteries and veins. Descartes espouses the widely held view of direct anastomoses but '... the habit and substance of the body, which being pervious everywhere with pores gives passage to the blood through its most hidden recesses, it first being subtilised and made movable by the lungs, that the very least portions of any particle might be nourished according to all its dimension.' He cites tissues wounded where no visible vessels are damaged yet still ooze blood—even bones 'the driest and most solid parts of the body.'

Chapter VII is a recapitulation of the circulation of the blood and of the source of its heat. The heart only performs the office of a steward in regard to blood heat. He believes that at whatever site nutrition is performed, the nourished parts are thereby heated by extraction from the blood. 'But if it be performed according as the temperature does require, as may be endured by the composition and union of the parts, a gentle and natural heat is thereby excited. . . .' Thus he considers heat is both lost and gained at the tissue level.

The addition is an extended analysis of the Harveian versus Cartesian notions of the systole and diastole of the heart, concluding that Harvey's concept must stand unopposed on overwhelming evidence. It remained for Dionis—the same Dionis of the Jardin Royal anatomical demonstrations of 1672—to deliver to Descartes the *coup de grace*. In his *The Anatomy of Man according to the Circulation of the Blood* (1698), he says of Descartes's hypothesis:

Nonetheless, we must say that this hypothesis is contrary both to reason and to experiment, but at this we should not be astonished. He did not know enough about the structure of the heart, and his meditations took up so much of his time that he was not able to obtain any great knowledge of that structure. All the same we must say that he did all a man could do, who knew nothing of the heart beyond what he knew of it. (Chauvois, *loc. cit.* p. 239.)

Thus the content of de Back's discourse of the heart. What, if anything, did it add to Harvey's circulation? Was it merely a re-iteration of the magnificent series of observations, a sort of portmanteau review of the situation largely established in 1628, a quarter century before?

Texts and Documents

Perhaps this may best be considered in relation to Harvey's texts. The original 1628 contribution was based on numerous observations of the circulation in humans and animals. The spread of comparative anatomic observation must have been unique ranging as it does through invertebrates and vertebrates, poikilo- and homeothermic. Of course, it had one prime motivation, carried clearly and continually with it, namely, to establish that the blood does in fact circulate, and to explain the adaptation of the circuit to the means whereby circulation is made possible. At one stroke, it destroyed the myth that man is significantly removed from the 'lower orders' of life.

When a new observation disturbs the current corpus of knowledge, it disturbs all over for it is an affront to its integration. Either the new facts must be bedded without disturbing the remainder so that cross fertilization will not occur, or else attempts will be made to introduce them to previously held notions with the aim of uniting new and old. Harvey's circulation, even when accepted, went a long way but, in the current cliché of investigation, raised as many problems, or more, as it answered. In the old Galenic system, everything was tied up, albeit untidily, but at least once one accepted its basic premises, existence could be satisfactorily and totally rationalized. Words and logic are powerful substitutes for observation. 'Grant one angel and theology blooms.' After Harvey physicians could begin to believe their own eyes for a few centuries (unblinkingly at least until the advent of scientific psychology).

The difficulties therefore on both sides, pro and con, were now legion because the purpose(s) of the circulation had now to be established. Harvey having gone so far, had then to bear the brunt for not having gone further. His 1649 exercises reveal a modicum of desperation in the wrangling for he is all too well aware that he has not pulled all stops out on Nature, sufficient at least for him to be able to state as comprehensively the purposes of the circulation as his enunciation of its actuality. He made no claim to be omniscient and was criticized because he was not. However, in the 1649 exercises addressed to the criticisms of the anatomist, Riolan, he does jump past the careful observations and deductions that characterize those of 1628 to informed speculation.

This indeed is the chief use and end of the Circulation of the blood . . . that all the parts depending on it by their first innate warm moisture might be retain'd in life, and in their own vital and vegetative essence, and perform all their functions whilst (as the Naturalists say) they are sustain'd and actuated by natural heat, and vital spirits; so by the heat of two extremities, heat and cold, the temper of the bodies of creatures is kept in its mediocrity [?equilibrium]: for as the breathing in of air does temper the too much heat of the blood in the lungs, and in the centre of the body, and causes the eventilation of suffocating fumes; so also the blood being hot, and cast out through the arteries into the whole body, does foment and nourish the extremities in living creatures and hinders them to be extinguish'd by the force of outward cold.

He later criticises the notions of spirits but cannot fully divest himself of the old teachings inasmuch as he was not experimentally able to refute them. His summary then becomes a sophistic compromise.

Those Spirits which passe out through the veins or the arteries, are not separable from the blood, no more than flame from the flakes about it. But the blood and the Spirit signifie one and the same thing, though divers in essence, as good Wine, its Spirit. For, as Wine is no more Wine after it has lost its Spirit, but flat stuff or Vinegar, so neither blood without Spirit is blood, but equivocally goar; as a hand of stone or a dead hand is no more a hand, so blood without vital spirit is no more to be esteemed blood.

Texts and Documents

Retrospectoscopy is subject to much mischievous use and there is no present intention to use it here. The texts make quite clear the difficulties of the intrepid synthetic approach – indeed Harvey had begun his 1628 exercises with that relevant and ancient quatrain of Terence. The remove from supposition by the sweep of further knowledge is often much greater than even the most critical might suspect beforehand and concepts can do no more than attempt to render meaning consonant with the facts. The mistaken notions in both Harvey and de Back are easy enough to spot so far as we have advanced from them. Judgement about relative merits should necessarily include the relativity of their own time patterns.

Bayon³ has given a comprehensive bibliography with brief analyses of the vast volume of literature which developed about the circulation of the blood, and reference to this should be made for further details as to the general picture. It is the methodology of one small voice and the effect on its owner with which this paper is concerned.

The inclusion of de Back's work in the edition of 1653 must have involved some process of selection, for there were many other commentators available. A work of such far-reaching implication as Harvey's disturbed in wavelike fashion the whole corpus of medical thought; it remained the sort of event on which everyone with pretensions to be sentient and/or up to date needs must have an opinion.

It remains a matter of some psychologic interest as to the reason for the inclusion of de Back's discourse, along with that of the great Harvey. If his comments are those of a feather-weight, why detract from the greater by such approximation? Was a need felt to bolster the Harvey doctrine with an external, and foreign, support, and why, of the commentaries available, was de Back's chosen? As presented, it would appear to be of sufficient stature to have been included on its own merits. It takes off speculatively from many points where the Harvey observations stop short, for much of the later criticism of the period appears to have been directed not quite so much at the fact of the circulation, but the still occult reasons for it. Further, de Back provides a working hypothesis as to the application of the circulation to systematic physiology.

De Back's analysis has a fine thorough-going pace to it. Even if it be merely a summary of current views, his writing carries the weight of a frank man—one who will grant no spirits for no better reason than that they cannot be demonstrated, and his basic premise is that all the data must be sense perceptible. He was on the side opposite the angels. If premises be validly shaken, then their superstructure of logic tumbles into nonsense even when internally quite consistent. As yet the capillary circulation could be no more than a guess. The fore and aft effects of the circulation had been demonstrated so a middle must be postulated as occurring through 'pores' or the 'sieve of the liver'. Under these circumstances, the traditional stand with its insistence on the link through things invisible as spirits or on pores between right and left side of the heart, are less blatantly obstinate than at first glance. However, where the traditionalists were content with their purely conceptual premises, the circulators could point to a series of solid observations on which to base further speculation.

It is in terms of this speculation that de Back shows himself original and proficient for his *Discourse*, especially in the second and third parts, establishes significant

Texts and Documents

hypotheses for the function of the blood based upon the new concept of the circulation. Even where he goes wrong, as with the origin of bile, his reasoning is admirable and his final assessment of the functions of bile are not far from the mark. His grasp of the functions of the nervous system and its integration take one to a near modern view, and although he could not get past the concept of the soul as distinct from the body, his notions of soul, if considered as notions of integrated nervous function, show great insight.

Further, his concept of the conveyance of heat by the blood and the production of heat by the tissues with the blood as exchange and equilibrating mechanism, is a clear answer to one of the most vexatious of the controversies about the purposes of the blood; as also, is his rejection of haemopoiesis and haemolysis occurring regularly in the circulatory system.

Finally, his resounding criticism of Cartesian views of the circulation must have been a force to mitigate an otherwise strong temptation, by those bent in deciding what was true or false, to side with the great philosopher as against the physician.

It seems fair to surmise that even a generation following Harvey, with its blasts and counterblasts on the circulation, the contribution of James de Back was a substantial one. He had obviously accepted the full doctrine and by observation, reason and intuition was able to rationalize and re-orientate a great deal of physiology as a result of it. If what he added to the circulation was old surmise, then at least its testing for compatibility did not fault it. If his *Discourse* was largely the result of his own observation and thought, then the result is more remarkable.

Thus it seems that de Back's *Discourse* is a masterfully executed setting to the Harveian jewel. The jewel is the centrepiece certainly but it gains from the clear and comprehensive treatment of physiology set about it. At least, it is a fascinating addition to that exciting intellectual turmoil of the seventeenth century when the Sciences found such feet as they still stride on today.

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