

Harvey, clinical medicine and the College of Physicians

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ABSTRACT – This article deals with the problems of seeing Harvey historically, rather than as a construction seen from the viewpoint of modern medicine. It deals with his programme of work, the expectations of his audience, his intellectual training and the political and religious circumstances of seventeenth century Europe. It shows that at the time the impact of Harvey's discovery was negative on clinical medicine and its theory, but also shows ways in which that impact was favourable.

KEY WORDS: Aristotelianism, circulation, Galenism, natural philosophy, seventeenth century culture

Introduction

This year it is four hundred years since the Englishman William Harvey graduated in medicine from Padua and it is appropriate to celebrate this event in this journal. Harvey for the first time exposed the errors of the scheme of physiology adumbrated in antiquity by the Greek physician Galen, doctor to the emperors Marcus Aurelius and Commodus. If modern clinical medicine had a single foundation stone, then Harvey's discovery of the circulation of the blood is it.

Paradoxes

When we look more closely at Harvey, a number of paradoxes appear. He did not begin with a research programme into the motion of the heart and blood. He discovered the circulation by accident and when he had found it he did not know what it was for. He could not justify it by the canons of intellectual knowledge of the day. His study of the heart was part of 'anatomy', which had always had medical-clinical effectiveness low on its list of priorities and self-justifications. (Theology and philosophy always took precedence¹.) His contemporaries reasonably pointed out that the doctrine of circulation destroyed the theory of medicine that had served them pretty well for centuries and made nonsense of

one of the principal therapeutic techniques of the time, phlebotomy. For these and related reasons, medicine was in a crisis as Harvey grew old, and when he died, in 1657, although the circulation of the blood was largely accepted, medicine itself was very different².

Medicine and history

In fact Harvey's discovery exemplifies, perhaps in an extreme form, the problem of dealing historically with medical progress, that is, of evaluating it in its own terms. The discovery of the circulation was so important that historians used to be especially concerned with Harvey's methods³. More recently they have contrasted Harvey's approach with the reluctance of those of his colleagues to see the truth – that is, the circulation – when it was made apparent to them. These two historical attitudes are linked, for it is easy to assume that Harvey made the truth plain in some modern way. But Harvey's colleagues were conditioned by the concerns of the time, and several factors – intellectual, religious, economic and geographical – played their part in determining how they reacted to Harvey's announcement⁴.

Vital spirit

Let us go directly to the main problem that Harvey's discovery presented to the clinical medicine of the seventeenth century, a problem that most of Harvey's opponents found insurmountable. Classical medicine, particularly that of Hippocrates in the form that Galen presented it, said that the physiology of the body was basically a question of the refinement of ingested food⁵. The useful parts of the food were separated off in the intestines and carried to the liver, where the first product was rich, nutritive venous blood. This passed from the liver down through the vena cava and veins to the tissues of the body, where it was assimilated as food to restore what the tissues gradually lost. Galen used the elegant image of fermenting wine to illustrate this process in the liver: the heavy superfluities sank down like the lees of wine and were collected by the spleen as black bile,

[†] We regret that Dr French has died since writing this article.

or melancholy. What was light rose to the surface like the froth on fermenting must and was gathered into the gall bladder as yellow bile. Part of the blood was transferred to the heart, where in the left ventricle it underwent a further process of refinement in conjunction with air brought down from the lungs. The result was arterial blood, endowed with vital spirit, which was carried down through the arteries to give the parts of the body heat, life and motion. Reaching the brain, the arterial blood underwent a third refinement, again with air (drawn in through the nose) to produce animal spirit, the agent of the activity of the brain and nerves. The by-product of this refinement was phlegm.

Thus the body had four humours, black bile, yellow bile, phlegm and the blood itself. Each was related in a natural-philosophical way with the four elements, earth, air, fire and water, and the elementary qualities, hot, wet, cold and dry. Health, said Galen, was a balance of the humours so that the body was a tempered mixture of the qualities. Ill health was consequently seen as an imbalance of the humours so that one of the qualities predominated: for example, fever was preternatural heat. In traditional medicine up to the time of Harvey, these doctrines were expanded. Considerations of qualitative balance were central. The patient's food, circumstances and regimen were qualitative. The body was a microcosm of the world at large, where qualities determined the seasons and the very ways in which matter interacted. The educated doctor had an impressive story to tell the patient about the way he understood the patient's body and its diseases.

Therapy was a question of restoring qualitative balance. Its principal technique was evacuation. A humour that was in excess or tainted in some way had to be removed. The doctor did this in the first place by encouraging natural evacuation. Purging the bowels removed bile. Evacuation of phlegm could be stimulated by medicine that made the patient sneeze. There were other medicines that promoted urine, sweat and vomiting. The chief form of evacuation was the letting of blood. This could be done by draining blood from a vein that was connected to a diseased organ, or by opening a vein that led to the organ and so preventing the disordered blood from reaching it. The physician considered that his knowledge of anatomy was good enough for him to evacuate even small and deep organs by choosing the right vein. He also practised seasonal bleeding as a preventative measure, letting blood for example in the spring, the warm and wet season, to prevent warm and wet diseases. Doctors on contracts to town and cities undertook to do this for the poor free of charge. In some circumstances, an artery was opened instead of a vein, and refinements of technique included scarifications, frictions and the raising of blisters. The brain could be evacuated by the use of a red-hot cautery that burnt the flesh away down to the sutures of the skull, nature's own points of evacuation.

All this was a stable and elaborate system. It depended on the immense reputation of Hippocrates, as interpreted by Galen, and drew its comprehensiveness from the natural philosophy of Aristotle, which was known to every man who had completed a university arts course. It was seen at once that the doctrine of circulation destroyed all this. If the blood circulated round the

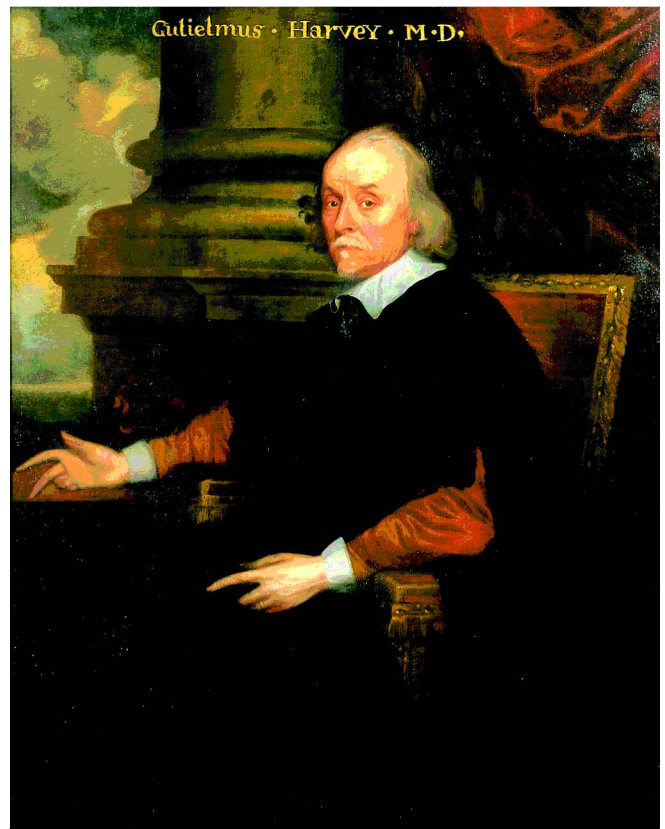


Fig 1. Portrait of William Harvey (1578–1657), artist unknown. The portrait originally hung in the *Musaeum Harveianum*, of which Harvey was the chief benefactor. It was rescued from there during the Great Fire of London in 1666, and now hangs in the Dorchester Library at the College.

body, the humours would be all mixed together, no longer anatomically separate. The two forms of blood-letting, the reversive and derivatory (preventing blood from reaching an organ, and draining the organ) would be impossible. Indeed, evacuation of precisely located organs would be impossible. Circulation would mean that there was only a single kind of blood in the body, not the physically separate arterial and venous kind.

Clinical medicine

These were the criticisms of Harvey's severest critic, Jean Riolan of Paris, the most distinguished anatomist in Europe and physician to the monarchy. The whole point was that in terms of clinical practice, university-trained physicians found that traditional medicine had served them well since the Middle Ages. These men were the elite of their profession. They were employed by popes, emperors and kings, often earning very high rewards: they were *successful*. We have no way of telling how clinically effective they were in modern terms, but it is clear that their patients by and large trusted them and believed in them. This was partly because the doctors had helped to generate the expectations of their patients. They told them a good story about their diseases that related the symptoms to the basis of the

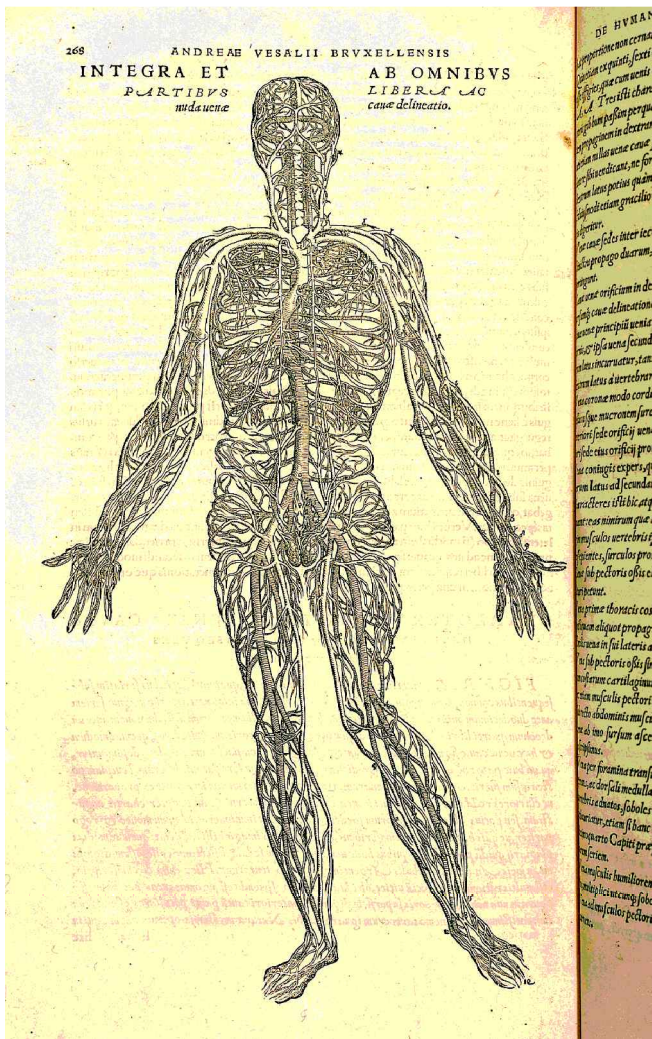


Fig 2. Illustration of the venous and arterial systems from *De humani corporis fabrica* (1543), by Andreas Vesalius¹⁰. This work is considered to be the first modern anatomy.

educated and agreed world-picture. The doctors stressed how long it took to learn medicine. Part of their rationality was anatomical, and the big public dissections of the famous medical schools were demonstrations of medical learning. The form of employment preferred by the educated physician was to be retained, with a contract with either a town or a great family, and the contracts demonstrate what the expectations of the fee-payer were. The doctors did not promise to cure, but to prevent, with control of regimen and seasonal bleeding, and they could claim success when nothing happened.

Harvey's account of the circulation intruded into this is a rude way. The whole theory of medicine was destroyed, along with its power to convince, and the principal therapeutic technique of the time was made into a nonsense; yet Harvey did not offer a new theory or a new therapy. He abandoned Galen, could not find a proper philosophical justification for circulation and could hardly relate circulation to clinical medicine. Many of Harvey's opponents had spent a lifetime practising Hippocratic-Galenic medicine and felt that the circulation was just the kind

of thing thrown up in university disputations, where novelty was at a premium. These were 'controversies' of the sixteenth and seventeenth centuries: an example is that over the pulmonary transit of blood. For anatomical reasons, the anatomist Realdo Colombo held that blood in the left ventricle of the heart could not be exposed enough to air for the production of vital spirit and that the lungs served this purpose⁶. For religious reasons, Michael Servetus thought the same (and was burnt at the stake by Calvin for his religion⁷). It was partly to decide for or against Colombo that Harvey made his experiments; other 'controversies' of his time included the existence of vessels that carried chyle, but not blood. In presenting the discovery of the circulation to the College of Physicians in the anatomy lectures, Harvey was indeed treating it as a thesis to be disputed⁸. Disputations were obligatory in the universities, and the medical and philosophical literature was searched for opposing viewpoints which could be presented as novelties. A successfully defended thesis was essentially new, validated knowledge, and Harvey was looking for justification from authority, argument and experiment.

The generation of knowledge

This point is central: Harvey lived in a world where men had an intellectual system of the world that they held true as much as we hold to ours. To the extent that they believed in it, it was true, and we should not denigrate their beliefs as ignorance or error. They had ways of generating and validating knowledge that were rigorous and elaborate and which served society and their own professional needs fairly well. It is appropriate here to look at these matters in the context of the Royal College of Physicians, for it was here that Harvey made his discoveries, announced them and defended them⁹.

The College of Physicians was not in Harvey's time royal. It had, it is true, royal origins as a small panel of university-trained physicians appointed by Henry VIII to oversee medical licensing in the kingdom. This evolved into a professional elite that secured a monopoly of the practice of internal medicine in London in exchange for a convincing guarantee that Galeno-Hippocratic medicine was the most clinically effective. This was university medicine, as taught in Cambridge and Padua, Harvey's universities. The College had social, professional and intellectual prestige in the same way that the universities had; and Harvey treated the College as a university in setting out his discoveries.

Let us look a little closer at the way in which Harvey generated and validated a piece of knowledge which he did in the most intellectually rigorous way.

In the first place, he was giving a series of lectures. This was the Lumleian cycle of lectures, endowed in the previous centuries by Lord Lumley and intended as instruction for physicians and surgeons, to be delivered partly in English. But Harvey's lectures were all given in Latin and pitched at the philosophical level – that is, in accordance with Aristotle's natural philosophy, in which all parts of the body had a function and true knowledge of a part was knowing what it was *for*.

Secondly, a lecturer in Harvey's time would also have to deal with disputed questions, which generally arose from apparent contradictions in the technical literature. One such problem was associated with the motions of the heart. In an important anatomical textbook, that of the Italian, Realdo Colombo, there was some confusion between the terms 'diastole' and 'systole'. This may simply have been a typesetting error, for Colombo had died before the book was in proof stage. Harvey, then, without any special interest in the heart, had to resolve the problem. He approached it in the traditional manner, by citing the great authorities and looking for the answer to the Aristotelian question of what the heart was for. This was the manner of university disputations, which centred on the authorities cited and the logic used in the defence of a thesis. In theoretical discussions of the nature of the disputation in the seventeenth century we can see that the syllogism was the dominant mode of argument and that its premisses could be taken from authority and sometimes from observation by the senses.

Sensory observation had played a large part in the natural philosophy of Aristotle but was not part of philosophy as taught in the arts courses of the universities since the Middle Ages. In contrast, sensory observation based on experiment had a long history in medicine, initiated by Galen's dissections and vivisections and continued through the human dissection of the Middle Ages and the vivisections of animals practised by Vesalius¹⁰ and Colombo (see Fig. 2). It was natural then that Harvey should turn to vivisection as a means of resolving the terminological doubt in Colombo's book. He exposed the beating heart of an animal and tried to distinguish diastole from systole. He could not do so. In Galenic theory, diastole was a forceful expansion of the heart in which it sucked into itself blood from the vena cava, and systole was a passive contraction when the arteries sucked the blood from the heart during the pulse, itself an active expansion. Harvey could only see that the heart arose with a vigorous motion and then collapsed. Partly from theory he argued that the forceful erection of the heart was its 'proper' motion, that by which it achieved its purpose, in Aristotelian terms. Everyone agreed that the heart was involved in the transmission of blood and so it seemed to Harvey that the rising heart achieved this. He furthered his argument by puncturing the aorta and found that blood spurted from the wound as the heart rose up in its forceful motion.

It now seemed to Harvey that the heart in rising forcibly was in systole, contracting itself and ejecting blood into the arteries. It followed that the arteries passively received the blood in the pulse and that Galen had accordingly been wrong. Harvey was proud of his new discovery and presented it to the College as a thesis to be defended. He had ample opportunity to do so, for he repeated the cycle of lectures over a number of years. He made the discovery in about 1618 and continued to teach it beyond the date of the publication of the book on the circulation, *De motu cordis*, in 1628 (see Fig. 3). But his thesis of the active systole and pulse remained a thesis and had to be defended. Not all of his audience, the Fellows of the College, were convinced. In introducing *De motu cordis*, Harvey reconstructs the situation as a university disputation. He had a thesis and he had opponents.

He drew support from authority and observation. He represented the President of the College, Dr Argent, as the presiding master – the *praeses* – at a university disputation. To support his thesis in subsequent cycles of lectures he drew more arguments from sensory observation from experiments.

This led to a crisis. In order to support his thesis of the forceful systole – his only discovery so far – he emphasised the *force* and *quantity* of blood leaving the heart. His notes for the lectures show that he used stronger Latin verbs to describe how blood leaped from the punctured artery. He did a simple arithmetical exercise to show the quantity of blood leaving the heart. But when he had done his sums he realised that something was wrong. However modest his guess of the amount of blood leaving the heart at every beat, he had to multiply it by seventy or so to get the figure for a minute, and then by sixty for the hour and then by twenty-four to work out how much blood left the heart in a day. The result was impossibly large. Current theory said that all blood leaving the heart was generated from food and was absorbed in a one-way system by the tissues. Harvey wondered where all the blood was coming from to supply the heart and why the arteries did not burst as a result of



Fig 3. The title page of the first edition of *Exercitatio anatomica de motu cordis et sanguinis in animalibus*¹¹, in which Harvey sets out his evidence for the circulation of the blood.

the blood being forced into them. His thesis about the forceful systole was dangerously threatened.

But then he thought of a recent anatomical discovery. His teacher in Padua, Fabricius of Aquapendente, had described in more detail structures in the veins of the legs that looked like little doors that could close to prevent excessive descent of blood in the veins to the feet (in the Galenic scheme). We call these things valves, and the idea was just then growing that all such structures did indeed impose a unidirectional flow upon their contained fluids. Harvey saw that if these structures were indeed valves in this sense, then the direction of flow of blood was up, from the feet to the centre of the body and the vena cava, not down from the liver to the feet. Somehow the blood left the end of the arteries and entered the beginnings of the veins: in a word, it circulated (Figs 4 and 5).

***De motu cordis* and research**

In his work on the motion of the heart and blood Harvey was essentially carrying out a programme of research, 'generating' knowledge. His inspiration here was his Paduan teacher, Fabricius of Aquapendente, who had revived what he saw as an Aristotelian programme of work on animals¹³. Aristotle had looked at how the parts of animals acted in concert for the benefit of the whole and how, for example, the dentition and digestive systems of animals suited their habitat and diet. Fabricius looked at organ systems in animals, where the organs collaborated in a function, like producing the voice. Harvey, in trying to understand the heart, studied it in a large number of animals to see what it had in common in them – what the essence of the heart was. He decided, as we saw, that in all cases the heart served to eject blood in a forceful systole and drive it round the body. This was complicated by the fact that air-breathing animals needed a separate circuit through the lungs; that is, as Aristotle and Fabricius had recognised in other circumstances, organs and their systems varied with the habitats and behaviour of the animals.

Harvey, then, was performing a piece of philosophical, not medical research. The full title of his book is *Exercitatio anatomica de motu cordis et sanguinis in animalibus*. Here, 'anatomy' and 'animals' indicate that the 'exercise' is philosophical; and 'exercise' is an academic procedure. Indeed, Harvey, who followed the full rigours of presentation when defending his thesis before the College as a university, now wrote his book in an accepted academic format. His audience would have expected it, and nothing else would do. He first goes through all the academic preliminaries of giving previous accounts and setting up the problem. It is only about halfway through the book that he mentions circulation. This has led some commentators to suppose that Harvey wrote the book in two halves, the first before he had discovered the circulation and the second after¹⁴. Certainly, we should find more natural to read first a claim for priority and then the evidence. But academic presentations in Harvey's day were formal and rigid in structure and his audience throughout Europe would have found anything else unconvincing. Likewise, when he wrote on

animal motion the necessary preliminaries prevent him from using the word 'muscle' in a significant way until about the halfway stage.

The crisis in medicine

Thus Harvey arrived at a doctrine which was clinically extremely inconvenient and philosophically quite unjustifiable. Disputing the matter with the famous physician Caspar Hofman in Altdorf, Harvey was sternly told that his job as a philosopher was to give the purpose (the 'final cause') of the circulation, which Harvey could not do. Hofman scathingly remarked that Harvey's quantitative argument about the amount of blood leaving the heart was the trick of a mere accountant: had not Aristotle said that numbers never gave the essence of things?

The paradox here is that Harvey was a great admirer of the ancients, especially Aristotle. But Aristotle had suddenly gone out of fashion. Defended somewhat nervously in the arts courses of the universities up to about the middle of the seventeenth century, his natural philosophy had largely elsewhere been replaced by some form of mechanism. Mechanists generally thought of the physical world as composed of particles of some kind, which reacted of physical necessity, not in accordance with purpose. The most notable of the mechanists was Descartes, who held that the physical world was a plenum of particles in contact (that is, not atoms floating in a void). He read Harvey's book (in about 1632) with great interest, for it seemed to him that a whole scheme of medical mechanisms could be based on it. It seemed possible that all motions of the body could be derived from the beat of the heart by particle-to-particle contact, the only permissible form of motion. This had two results. First, Descartes denied Harvey's account of the forceful systole because it was not explicable in terms of particle contact: it was a form of action at a distance, the power of 'attraction' (of the parts of the heart), which was anathema to all mechanists. Second, this form of Harvey's doctrine, because of the fame or notoriety of Descartes as a philosopher, reached a wider audience than Harvey's book alone, perhaps, would have reached.

This was another paradox. Harvey hated the new mechanistic philosophers (and used a very direct Anglo-Saxon terms to describe them). Yet because he in medicine and Descartes and others in natural philosophy had persuaded the world that the ancients had been wrong, medicine lost its theoretical basis. The theory of medicine had been based on Aristotle since the Middle Ages and was the very centre of the learned physicians' case – largely successful – that such a medicine was the best and deserved a monopoly of practice. The law-givers and others who were convinced were all learned men who had been through the Aristotelianism of the university arts course, and the arrangement with the doctors was satisfactory all round. But by the middle of the seventeenth century, and before Harvey died (in 1657), all this had gone. The mechanists agreed in denying the ancients but not on the details of how a mechanical world operated. Philosophical sceptics argued that all theoretical systems were human and erroneous constructions. Practitioners

of the new experimental philosophy likewise argued that experimental results were matters of fact or of observation but should not be built up into systems. Practitioners of medicine had no theoretical justification for their practice and nothing of substance to argue for its superiority over empirical medicine – no justification for its privileged position. Some doctors, particularly in England and Holland, where the new philosophy was strongest, argued that medicine was simply an empirical art¹⁵.

The resolution of the crisis was handled by professional manoeuvring on the part of the medical corporations, by the partial adoption of Newtonianism as a new theoretical system,

by patients gaining the upper hand in the doctor–patient relationship and by the doctors opting for a social rather than intellectual superiority. Circulation remained the one undeniable and rather empirical fact. New medical research in the medical-experimental tradition followed up questions left by Harvey. If the blood was ‘thrown’ out of the heart at each beat, was its momentum enough to propel it into the veins and vena cava? How did respiration relate to circulation? Was the body in fact a machine, in which motion must always be lost in friction, or did the soul play some part, after all, in moving the machine? But at the same time – up to the middle of the eighteenth century – in many parts of the world, including Spain and Italy,

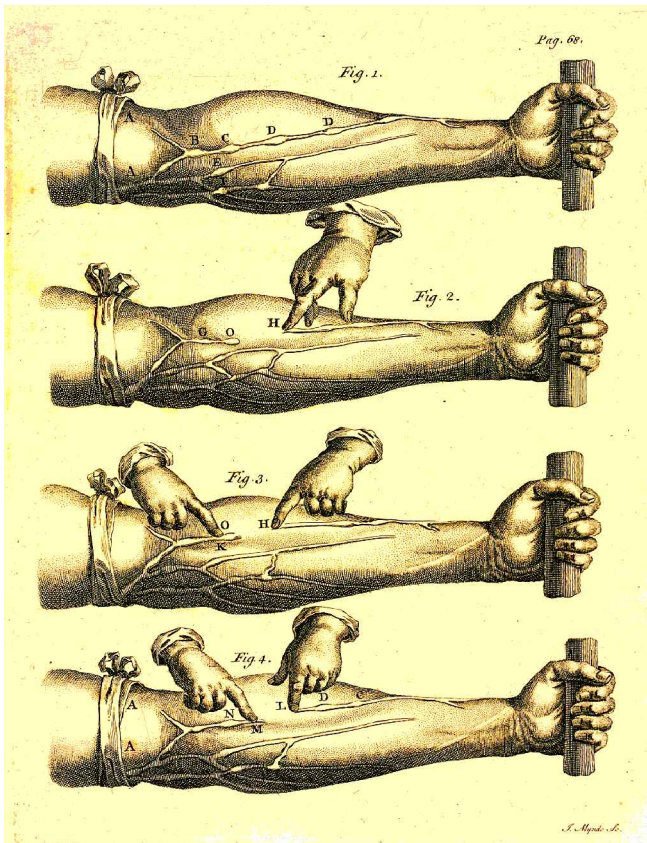


Fig 4. Illustration from Harvey's *Opera Omnia*¹², demonstrating the purpose of the valves to allow blood to flow in one direction only.



Fig 5. One of the anatomical tables which were laid out according to Harvey's theory of the circulation of the blood. They were made in Padua (c 1640) in the following way: a body was dissected down to the required system (in this case the veins); this was washed, mounted on a wooden panel (table) and varnished for preservation. This is one of six demonstration tables now in the Dorchester Library at the College.

traditional Galenic medicine was still vigorous, complete with its doctrine of linear bloodflow and its elaborate clinical technique of phlebotomy. The reasons for this were more closely related to the religion and politics of these parts of Europe than to the clinical significance of the circulation of the blood.

Conclusion

We have seen that contemporary clinical medicine provided the principal arguments against the circulation. As a doctrine within natural philosophy and based on experiment, circulation did not impinge on clinical medicine for a long time. Traditional therapy and pharmacopeia survived the changes in theory remarkably well. Even in 'new philosophy' countries, traditional remedies were still used, even by such a radical figure as Thomas Willis in Oxford. Even Harvey (we are told) indicated shortly before his death that his paralysed tongue should be bled and phlebotomy remained a therapy until the nineteenth century. But this and post-Harveian experimentation had little impact on clinical medicine and remained at the philosophical-experimental level. Likewise, taking the pulse remained a technique of investigation despite its theoretical foundation being totally changed.

It is only in a broad sense that Harvey's discovery is a foundation stone of modern medicine, as suggested in the introduction above. Harvey, and others unlike him, showed that medical progress was not a question of understanding the ancients more completely. New methods of generating and validating had to be explored. While the traditional medical experiment became central to the new natural philosophy, new attempts were made to instil order into the huge growth of technical medical literature. In the late seventeenth and early eighteenth centuries, specialist journals appeared, accepting on the basis of peer-group review brief accounts of observations and experiments and incorporating book reviews and news from the medical world. At the same time appeared vast bibliographies surveying the extant medical literature, and specialist histories, first of anatomy and then of medicine as a whole. All of these recorded the discovery of the circulation as the first major modern discovery, for all doctors liked to feel part of a tradition that was finally bearing fruit. But it was not until the fact of circulation had passed, so to speak, into the medical subconsciousness that the physiology and pathology of the nineteenth century gave rise to modern clinical medicine.

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