CHAPTER SIXTEEN
THE WORKINGS OF MAN: MEDICINE AND ANATOMY

From *The Genesis of Science: How the Christian Middle Ages Launched the Scientific Revolution* by James Hannam. Regnery Publishing, 2011.

As a doctor, Jerome Cardan had proved more successful than the practitioners of orthodox Galenic medicine by discarding bleeding and purgatives. But he never rejected medical orthodoxy outright. This meant that he could only provide palliative care to help the body heal itself. Any direct treatments he prescribed would have been useless at best. In contrast to Cardan, other dissenting doctors were not afraid to attack conventional medicine vigorously and directly. Foremost among them was Theophrastus Bombastus von Hohenheim (1493– 1541) who, despite a chaotic lifestyle and idiosyncratic ideology, managed to found his own school of medicine.

AN UNORTHODOX PHYSICIAN

Theophrastus von Hohenheim has always been better known by his Latin name, Paracelsus. His family was German, but he came from Switzerland. He led the life of a wanderer, forced to keep moving as his loudly voiced opinions made him unpopular in place after place. However, Paracelsus was no quack. He claimed to be a fully qualified physician, and, despite the lack of documentary evidence, there is little reason to doubt him. Scorning Galenism, he used his skills as an alchemist in his medicine. And his work went much further than that. He invented an entire system of thought that blended ascetic Christianity with mysticism and alchemy to produce what came to be called the chemical philosophy.

To Paracelsus, all materials comprised the three elements of salt, sulphur, and mercury. He had added salt to the traditional alchemical pairing of sulphur and mercury to act as the third part of the neo-Platonic trinity of body, soul, and spirit. As he put it in a typically opaque way:

> All metals can be produced from the three types of matter– mercury, sulphur and salt… Mercury is the spirit, sulphur the soul and salt the body. But a metal is the soul in the middle, between the soul and body, as Hermes Trismegistus says. The soul in sulphur unites the two opposites, body and spirit, and changes them into a single essence.

The Hermetic wisdom translated by Ficino was just one of many sources for Paracelsus' thought. The result is a hotchpotch of magic, religion, natural philosophy, and medicine. A constant theme running through it all is hostility towards the Galenic academic medicine of the day. Paracelsus urged the use of the drugs he had devised rather than traditional treatments such as bleeding. He believed that illness was caused by individual diseases rather than an imbalance of the humors. This led him to look for specific drugs to treat particular conditions, but unfortunately he had no idea what might work. Paracelsians, as his followers became known, were especially keen on prescribing antimony and mercury, both deadly poisons. Nevertheless, he scored some notable successes as a healer, in all likelihood because doing nothing would always be more effective than the customary methods.

Paracelsus' reputation peaked when the town council of Basle in Switzerland appointed him to the prestigious post of professor of medicine at their university in 1527. He responded with some scandalously original lectures and an outright rejection of the traditional authorities. On 23 June he burnt a medical textbook– allegedly a copy of Avicenna's *Canon of Medicine*, the enormous tome that formed the backbone of academic study– in the market square. Needless to say, his colleagues ensured that he was quickly expelled from the town. A companion during those years later painted an extremely unflattering portrait of the man.

> As to Paracelsus, while he was living I knew him so well that I should not desire to live again with such a man. Apart from his miraculous and fortunate cures in all kinds of sickness, I have noticed in him neither scholarship nor piety of any kind…. The two years I passed in his company he spent in drinking and gluttony, day and night. He could not be found sober an hour or two together, in particular after his departure from Basle.

When he died in 1541, Paracelsus was a famous but not influential figure. Few of his works had even been published. Gradually, however, books by him appeared and stories about him multiplied. Soon he had become the founder of a new school of medicine. His followers fleshed out his philosophy and developed treatments on its basis. Some highly placed physicians championed his thought in the universities, and it seemed for a while that the chemical philosophy might be able to overthrow Galenism. The Galenists fought back, and a pamphlet war developed that led to a ban on Paracelsian medicines at the University of Paris in 1615.

It would be a mistake to see Paracelsus as a precursor of modern medicine. His thought was suffused with theological and mystical speculation. His main objection to Galen was that he was a pagan. Christianity, Paracelsus said, should have its own medicine that showed a proper understanding of God's work in the world. He reinterpreted the book of Genesis according to his own insights and also subscribed to the doctrine of signatures. He believed that God had shown which herbs and chemicals could be used as cures by giving them a recognizable signature that pointed towards the nature of the ailment they treated. Careful observation of nature was an important aspect of his thought, but the doctrine of signatures meant he often ended up looking for the wrong things. This demonstrates that almost no amount of observation will lead to significant headway in science unless it is buttressed by some sort of valid theory to which the observations can be applied. Meticulous empirical examination was standard practice in Greek and medieval medicine. It didn't stop doctors from killing people.

GOING UNDER THE KNIFE

During the Middle Ages, it was the surgeons, whom you might expect to have been the real butchers, who achieved some of the most notable successes in saving lives. Professional physicians looked down on surgeons as manual workers because they used their hands. Even the frequent bleedings demanded by Galenic medicine were usually carried out by a barber-surgeon and not the physician himself. Perhaps this lack of official respect gave the surgeons freedom to innovate. When it came to dressing wounds, they had sole charge of the process and by the thirteenth century were challenging the wisdom of the Greeks over the healing process. The Greeks had believed that inducing putrefaction was a necessary prerequisite for a wound to heal, rather than a way to encourage gangrene or at least leave a nasty scar. Instead, radical surgeons advocated cleaning wounds with wine, drying them and binding them shut immediately. Another good and easily available antiseptic was urine. One doctor recalled how he saw a man's nose cut off in a duel. Picking up the severed organ, the doctor explained that he urinated on it and then successfully bandaged it back onto the victim's face.

In fifteenth-century Italy, surgeons offered skin grafts as a way of healing burns and other serious wounds. Strictly speaking, this technique was a rediscovery because it had been used in ancient Rome. One particularly impressive application was rhinoplasty, perfected by Gaspare Tagliacozzi (1545– 1599) in the late sixteenth century. The procedure involved the complete reconstruction of the client's nose. There was more demand for this than we might think. At the time, syphilis was endemic and one of its more gruesome effects was to cause the sufferer's nose to rot away. The medical textbooks preferred to avoid any references to the pox and instead noted that rhinoplasty was ideal for when the lost nose had been eaten by dogs.

Tagliacozzi set about repairing a lost nose by cutting a flap of skin from his patient's arm and sewing it over the nasal cavity. The arm was strapped in place until the flap had grown onto the face, whereupon it was cut from the arm and remolded into a new nose. The whole process could take months.

Not all of Tagliacozzi's surgical interventions were a success. A story was told soon after he died of a case where his patient was a nobleman from Brussels who wanted a new nose to replace the one he had lost in a duel. However, he was unhappy about having the necessary incision made in one of his arms. He suggested, therefore, that the strip of skin be taken from the arm of a servant rather than his own. The treatment progressed as usual except that it was the servant's arm that the patient had tied to his face. When the servant was released from this rather intimate bond to his master, the rest of the operation to reshape the replacement nose continued as usual. Everything seemed to be going well but then, after a year, the slave died from unrelated causes. At the same time the new nose, fashioned from the living flesh of the servant, began to putrefy and before long it dropped off.

Such stories led Tagliacozzi's contemporaries to draw completely the wrong conclusion. In the sixteenth century, the doctrine of sympathy taught that magical threads linked objects that had been united even after they were separated. Like many apparently superstitious beliefs, this was based on impeccable if flawed logic and buttressed by apparent successes. In the case of Tagliacozzi's failed rhinoplasty, the obvious explanation was not that donated organs will tend to be rejected by their hosts, but rather that the new nose remained somehow attached to the servant after it had been detached from his arm. Thus, when the slave died, the nose died too. You could hardly ask for better proof of action at a distance and the attendant doctrine of sympathy. Again, this illustrates just how important it is that empirical results are anchored to a reliable theory before they can be extrapolated into a general law.

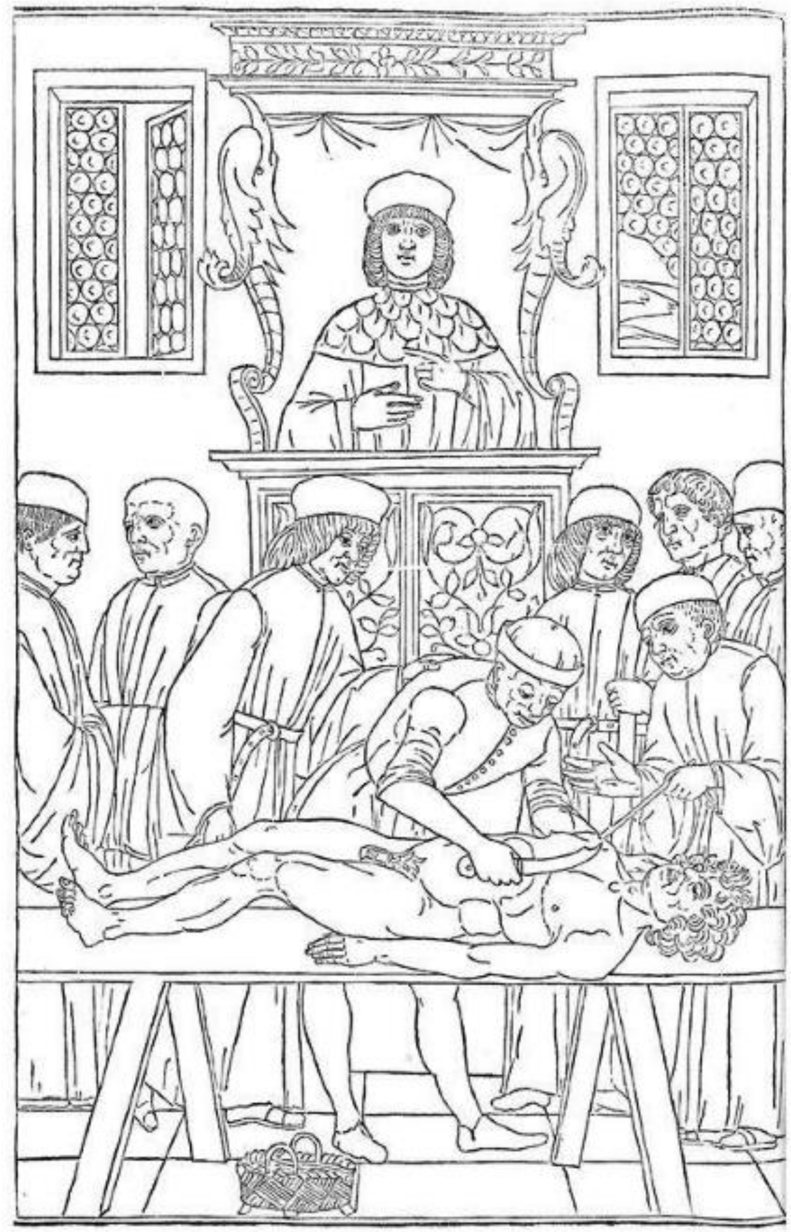
THE BEGINNINGS OF HUMAN DISSECTION

Neither Galenic nor Paracelsian medicine could mount any serious attack on disease as long as doctors had no real idea what caused it. The theories behind both schools of medicine were so erroneous that it is an understatement to call them merely wrong. Among other things, the acquisition of true knowledge about disease required an accurate understanding of how the human body worked. Here, at least, the Middle Ages did provide the setting for a massive step forward, beginning in Italy with the advent of the practice of human dissection. This would eventually destroy Galen's reputation by showing that even the basic building blocks of his theories were mistaken.

The introduction of human dissection in western Europe is one of the most surprising events in the history of natural science. It was practically unheard of in any other culture due to strong taboos against cutting up bodies and not giving them the proper respect demanded by tradition. In the ancient world, it was briefly allowed in Alexandria in the third century BC, perhaps because embalming bodies for mummification already involved the removal of most of the soft organs. Hence, cutting open dead bodies was not as shocking in Egypt as it might have been elsewhere. If we are to believe one ancient writer on medicine, the practice in Alexandria even extended to the vivisection of live prisoners. However, any sort of dissection of humans was forbidden by the pagan Roman authorities. In the second century AD, Galen had to do all his work on animals, especially pigs and Barbary apes. This caused errors in his work on anatomy because he assumed that the physiology of animals would be mirrored in humans.

When Galen's works were transmitted to the Arab world after 800, Muslims were not about to start dissecting humans. Although there was no direct prohibition against such activity in Islam that we know of, this is probably because it never occurred to anyone that it might be permitted. We do know of a Christian who lived under the Caliphate and dissected monkeys, but there is no hint that he ever got to try his hand on humans. Unable to check the facts for themselves, the Arabs assumed that Galen was right and did not realize that he too had got no further than using primates.

Once Galen became well-known in the Catholic West, it was natural for everyone to continue assuming that he was correct in almost every detail. Then, in northern Italy towards the end of the thirteenth century, something revolutionary happened– human dissections restarted. Many modern scholars think this had something to do with Bologna's pre-eminent position as the place to study law. The first dissections may actually have been post-mortem examinations intended to ascertain cause of death for legal purposes. Even Pope Innocent III is on record ordering the forensic examination of a murder victim. These autopsies broke the taboo against cutting up human bodies and, shortly afterwards, the medical faculty in Bologna was carrying out dissections as part of doctors' training.



11. Woodcut showing a dissection from a fifteenth-century medical textbook

The anatomy theatre that now stands in Bologna dates from the seventeenth century and incurred serious damage during the Second World War. However, its design is similar to that of the earlier theatres that developed in the fourteenth century for educational dissection. In the centre of the room is a marble slab upon which the cadaver was laid. Surrounding it is an ascending array of benches so that everyone was able to get a good view. Set over the benches is what can only be described as a throne, complete with a carved wooden canopy supported by two statues of flayed men. The professor sat on this seat when he was delivering his lectures and did not actually do the dissecting himself. Instead, his assistants carried this out while he stayed well away from the messy business of actually chopping up the body. As he read out sections of his textbook, the assistants would point out each organ. Alternatively, the professor might be armed with a long stick with which to point out the features of the corpse's interior as his assistant revealed them.

In 1316 a Bolognese physician, Mondino dei Luzzi (who died around 1326), wrote a manual on how to proceed with human dissections which became a standard work through the rest of the Middle Ages. Mondino had gained his expertise from carrying out post mortems, most interestingly, of two pregnant women. He was not universally popular, however. His slight deviations from Galen were too much for at least one German university, which would not allow his textbook to be used.

One of the more prevalent myths about the medieval Church is that it opposed human dissection. As we have seen, most societies and cultures did have a strong aversion to this activity, so it is surprising that the Church allowed dissections to go ahead with barely a whimper of opposition. A papal bull of 1300 entitled *De Sepulturis* is often cited as evidence for a Church prohibition as it forbids the boiling of bodies. This practice had become common during the crusades when those who died on campaign wanted to be interred in the family tomb back home. Boiling separated flesh from the bones so that they could be easily repatriated for burial. The papal bull did have the unintentional effect of preventing anatomists from boiling heads to reveal the structure of some bones under the skull. Mondino admits in his manual:

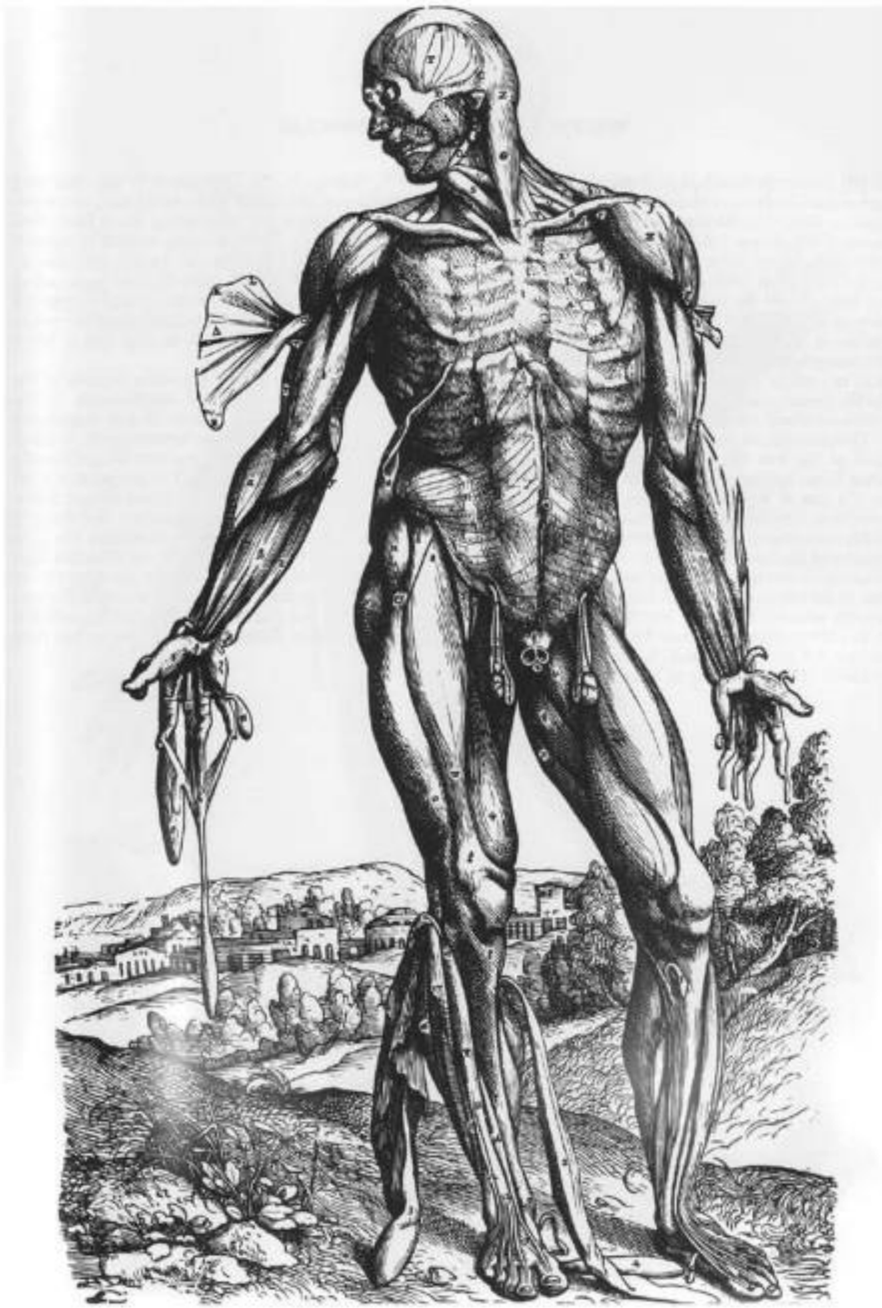
> The bones which are below the basilar bone cannot be well seen unless they are removed and boiled, but owing to the sin involved in this, I am accustomed to pass them by.

If the Catholic Church had really objected strongly to human dissections, they would not have rapidly become part of the syllabus in every major European medical school.

Human dissection in the late Middle Ages was intended to be pedagogical rather than for the purposes of research. This meant that if any discrepancies with Galen's account of anatomy were noticed, they were not followed up. Instead, students tended to interpret what they saw in terms of what was in their books. Senior professors may have had the experience and prestige to question Galenic orthodoxy, but they did not actually get their hands dirty with the business of cutting up corpses. They were paid good fees to teach and to treat live patients, so they had no reason to deal with dead people. Then, in the first half of the sixteenth century, several anatomists began to question what they really saw inside our bodies.

ANDREAS VESALIUS

Andreas Vesalius (1514– 1564) is the most celebrated of all anatomists. He came from the Spanish Netherlands and studied at the new university in Louvain before moving on to Paris to train as a physician. He completed his studies in Italy, then the country in which the premier medical schools were found. Once qualified, he continued to work as a lecturer in surgery. His method of teaching was rather unconventional because rather than seating himself in the professor's throne while flunkies dissected the cadaver, Vesalius got down in the pit and did it himself. Because of his showmanship and enthusiasm, his lectures were extremely popular, and they also made him realize that Galen's books were not the last word on human anatomy. He suggested that the key to understanding Galen's omissions and mistakes was that the ancient master had only dissected animals and not human beings. Thus, Vesalius himself could complete Galen's work by carrying through his project to its logical conclusion– investigating man himself, the summit of God's creation. Vesalius did not wish to refute Galen's work but to perfect it.



12. A woodcut of a standing flayed figure produced by the studio of Titian for Vesalius' *On the Fabric of the Human Body* (1543)

Vesalius had all the necessary skills to carry out his aims: he had a good eye, he was a fine draughtsman and also an astute businessman. His masterwork was *On the Fabric of the Human Body*, first published in 1543. Vesalius provided the text, and the illustrations were based on his own drawings. The actual woodblock artwork was supplied by the workshop of the great Venetian artist Titian (d. 1576). As well as their anatomical detail, the pictures showed great flair in arranging the flayed and opened bodies in classical poses as if they were still living. The book's fame and success were as much due to the fantastic artwork as its indubitable scientific value. The entire work was a paean to the magnificent handiwork of the Creator as uncovered by his servant Vesalius.

Of course, *On the Fabric of the Human Body* is not perfect. For example, its treatment of the female genitalia leaves a lot to be desired, being based on observations made with a sixteenth-century eye. Even today, we speak of men producing semen (from the Latin for seed) and women being fertile. This language derives from the ancient view that all a woman did was to provide a place where the man could plant his seed until it grew into a baby. The reproductive organ of a woman was thought of as passively accepting what the man thrust into it. Vagina is Latin for the sheath of a sword. Consistent with this view, Vesalius' illustration of the vagina is just an inverted penis designed to furnish a comfortable berth for the man's organ. It was not until the work of his student Gabriele Fallopio (1523– 1562) that the eponymous tubes were discovered connecting the uterus to the ovaries. A human egg was not observed until the nineteenth century, when it was finally realized that the seed came from the woman and fertilizing it was the function of the man's sperm.

For anatomists, the shortage of bodies was a major problem. Vesalius openly admitted that he resorted to grave-robbing. In one case, he flayed the skin from the body of a dead woman so that her relatives, who had gone to court to retrieve it, would not recognize her. And, notwithstanding the ancient papal prohibition, he had no compunction boiling bodies to remove the flesh from the bones. The sixteenth century being what it was, anatomists could count on the occasional free cadaver. Vesalius wrote about how he had discovered the corpse of a criminal who had been burnt at the stake:

> We went to the place where, to the great advantage of students, all those who have suffered the death penalty are displayed on the public highway for the benefit of the rustics… I climbed the stake and pulled away a femur from the hip bone. And when I pulled at the upper limbs, the arms and

hands came away. I took the legs and arms home in several secret journeys leaving the trunk and the head. The thorax was tied with a chain high up and in order to take it, I allowed myself to be shut outside the city at nightfall.

13. A woodcut of a uterus from Vesalius' *On the Fabric of the Human Body* (1543)

Vesalius went on to relate how he climbed up the stake in the darkness to acquire the prizes. He hid the bones nearby until he had an opportunity to smuggle them into the city. Fallopio did not have to sink to such subterfuge. A local ruler gave him a live prisoner to experiment on, although mercifully the anatomist euthanized the subject with opiates before he got to work. It was probably a kinder end than the victim would have expected.

Vesalius' success and popularity with students did not go down well with his fellow faculty members. Nor were some of them pleased to be told that when it came to anatomy, they were not just wrong but had been too lazy to check the facts for themselves. Jacobus Sylvius (1478– 1555), a physician from Paris, had a novel reason for rejecting Vesalius' discoveries. He claimed that we should believe the works of Galen were true even when they conflicted with the evidence of our own eyes. Sylvius' extreme humanism had led him astray. Like many humanists, he was a bookworm and an admirer of the classical world who could not accept that Europe had long ago overtaken ancient civilization.

Eventually, Vesalius left Padua and was employed by Philip II (1527– 1598) of Spain as his personal physician. This lifestyle did not please the anatomist, and he had no opportunity to continue his research. As simply resigning from a royal appointment was out of the question, he contrived to escape by obtaining permission to go on a pilgrimage to Jerusalem. Tragically, his ship was wrecked on the return voyage and Vesalius drowned.

PERSECUTED ANATOMISTS?

Shortly after Vesalius' death, rumors were circulating that he had been sent on his pilgrimage after a run-in with the Spanish Inquisition, and this was later used as further evidence to paint the Catholic Church as an opponent of dissection. In fact, there is no evidence at all that the Inquisition was involved in Vesalius' wish to leave Spain. He was, after all, a man of great piety who saw his life's work as a way of glorifying God. Vesalius suffered from no religious persecution. We have already seen that one of his fellow anatomists, Michael Servetus, was not so lucky, even though his dreadful fate had nothing whatsoever to do with natural science. [Servetus was burned as a heretic in Geneva under John Calvin for denying the Trinity.]

Besides producing two highly regarded editions of the ancient *Geography* by Ptolemy, Servetus' scientific fame rests on his study of the heart and lungs. Galen's picture of the system by which blood is transported around our bodies suffered from several major flaws. For instance, he mistakenly believed that veins and arteries were not connected at any point except through the heart. This was hardly his fault. He lacked any sort of magnifying instruments with which to observe some of the tiny capillaries in the muscles and lungs that link the veins to the arteries. Instead, he postulated the existence of pores in the thick interior wall of the heart that separates the left and right ventricles. Because the veins and arteries were not connected in Galen's schema, there was no complete circulation of blood. He believed that blood was being continually created and destroyed by the body. It was produced by the liver, he claimed, and carried around the body where it was used up as fuel.

Historians have long been puzzled about why Galen, with all his experience of the anatomy of the higher mammals, got the function of the heart and circulatory system so utterly wrong. It is a difficult question to answer but serves as a warning that to look at something completely objectively is almost impossible. Galen had his own axes to grind with the philosophical schools of his time, and this made him no less vulnerable to misconstruing evidence than Christians might be due to their preconceptions.

Michael Servetus was troubled by the inconsistencies in Galen's system. He noted that Galen's pores in the heart's interior wall must be very small and that the pulmonary artery between the heart and lungs was very large. He correctly deduced that this artery does not just carry the blood that the lungs need to function as Galen thought, but that all the blood in the body passes through it. Air, he thought, might be absorbed into the blood in the lungs before being transported around the body. Unfortunately, he made this observation as an aside to his theological book *The Restoration of Christianity* in order to demonstrate his views about the spiritual qualities of the air. While the theory may be garbled, Servetus is certainly correct in his observation. "By a very ingenious arrangement," he wrote,

> the subtle blood is urged forward by a long course through the lungs… then in the pulmonary vein it is mixed with inspired air and through expiration it is cleansed of its sooty vapours.... The notable size of the pulmonary artery confirms this.

His insight, hidden within what was considered a notorious work of heresy, did not gain much exposure and was later independently reached by the Italian Realdo Columbo (c. 1515– 1559). Even Servetus was only repeating work done by a Muslim physician called Ibn al-Nafis (1213– 1288) in the thirteenth century. In the end, it was through Columbo's work that the idea became well known among European anatomists.

WILLIAM HARVEY AND THE HEART

With their exploration of the human body, it was anatomists rather than doctors who chipped away at the Galenic edifice, even if many of them never really meant to damage it. But at the start of the seventeenth century, there was a breakthrough that dealt a crippling blow to Galen's reputation as a reliable source on the workings of the human body– the discovery of the circulation of the blood by William Harvey (1578– 1657). He showed that Galen was not just wrong in the details. His entire system that explained the basic mechanics of life was flawed. And, as Harvey's experiments on the heart were done on animals, Galen lost the defense that he had no access to human cadavers.

William Harvey began his education at Cambridge University where he attended Gonville and Caius College in the 1590s. John Caius (1510– 1573), the London physician and translator for whom the college was named, had re-founded it a generation earlier. Caius was an old school Galenist who devoted most of his scholarly energy to preparing new critical editions of the ancient master's works. As medical instruction at Cambridge was rather thin on the ground, Caius had also endowed a scholarship that allowed a promising student to go to Padua to finish his course. Although Padua was in the territory of devoutly Catholic Venice, the Venetians did not let differences of religion deter fee-paying students, and in any case Harvey had Catholic sympathies. After qualifying as a medical doctor in 1602, he returned to England and used his prestigious degree to start a respected medical practice. He eventually came to count King James I (1566– 1625) among his clients.

Harvey confined his research on the heart to his spare time. His wife must have been an extremely forbearing woman who tolerated her husband's habit of vivisecting dogs. His key insight was that both the heart and veins contained valves, which prevented blood from moving in the wrong direction. This might be where Galen was lacking in background knowledge because, while valves were well understood by the seventeenth century, they do not appear to have been common in Roman technology. Harvey also described the heart as operating like a machine. He compared its workings to rapidly turning gears or a flintlock musket. Later in his life, he witnessed a fire engine spraying water through a hose. The water was ejected by a pump powered by the firemen, and Harvey noted the analogy with the heart pumping blood around the body.

Despite these modern touches, he couched his analysis within the Aristotelian tradition. He assumed that the heart had been designed by God, and set out to discover what it had been created to do. Echoing Hermetic thinkers, he declared that the heart "deserves to be styled the starting point of life and the sun of our microcosm, just as the sun deserves to be styled the heart of the world."

Our understanding of the heart and circulation is still based on Harvey's work. When blood leaves the heart through a pipe called the aorta, it is full of oxygen which makes it bright red. The oxygenated blood is carried all the way around the body by the arteries, which in turn branch into ever-smaller vessels until they become too tiny to see with the naked eye. These microscopic capillaries are so narrow that the blood cells can only get through them in single file. The capillaries pass the blood through the tissues of the body where the oxygen is unloaded. They then carry the deoxygenated blood, now a purple-blue color, into broader veins. These connect together like tributaries of a great river, which eventually flows back into the heart.

The heart itself is divided into two halves, separated by a thick impermeable muscular wall. In each half there are two interconnected chambers, an atrium and a ventricle. The atriums provide a reservoir for blood that is waiting to be pumped by the respective ventricles. The blood that has circulated around the body flows into the right-hand atrium and is then pumped by the right ventricle to the lungs through the pulmonary artery. There it is re-oxygenated and returns to the left atrium to be pumped back through the aorta by the left ventricle.

For the reader who can cope with the gory descriptions of vivisections, the logic of Harvey's *On the Motion of the Heart* (1628) remains impressive. Calculating how much blood the heart was moving around the body, he found that it was an amount that far exceeded the quantity of blood that could realistically be produced by the liver. It was clear that the body reused blood and, as the valve meant it could only move in one direction, it must be circulating. Granted, it was still impossible to trace the full circuit as capillaries remained invisible without the aid of a microscope, but Harvey's treatise was convincing enough to persuade many. Not everyone was willing to be swayed though, and he complained of losing patients after the publication of his book because they were not willing to trust their health to a man with such novel ideas.

Sadly, although the authority of Galen had been seriously weakened by the likes of Paracelsus and Harvey, there was as yet little effective improvement in clinical practices. Undermining the theoretical basis of medicine was no good if there were no new theories to replace them which could lead to new treatments. The four humors remained the basis of diagnosis because there was no alternative. Attempts to use Harvey's insights to carry out blood transfusions failed because of the existence of blood groups. If a patient is transfused with blood from a group different from their own, he or she will die. As doctors had no conception of what a blood group was, let alone a way to identify them, the treatment was often fatal for no apparent reason.

Given the demise of the magical worldview in polite society, the doctrine of sympathy and other alternatives also fell from favor. Protestants even tended to reject religious miracles. Somehow, scientific medicine had seen off its main rivals while actually being less effective than either of them. Thus, the history of medicine until the mid-nineteenth century, with the significant exception of smallpox vaccination, is a history of failure. Most doctors were comfortably oblivious to the damage they were doing by bleeding their patients, but there were a few early critics of the practice. For instance, in 1806 Thomas Jefferson (1743– 1809), third president of the United States and a notable polymath, wrote morbidly:

> Harvey's discovery of the circulation of the blood was a beautiful addition to our knowledge of the animal economy, but on a review of the practice of medicine before and since that epoch, I do not see any great amelioration which has been derived from that discovery.

Thankfully, in the field of physics and astronomy, the natural philosophers of the sixteenth century were able to build much more profitably on the foundations laid in the Middle Ages.

Some Other Notable Catholics in the History of Medicine

Guy de Chauliac (c. 1300 – 1368), author of *Chirugia Magna* (*Textbook of Surgery*) was a priest and surgeon, who made many advances in orthopaedics. He led by example, staying at his post to investigate the plague and treat its victims when many of his colleagues fled.

Thomas Linacre (1460 – 1524) was born in Canterbury and entered All Souls College, Oxford in 1480, distinguishing himself in Greek. He then studied in Rome, gaining a knowledge of Greek and Latin which made him one of the foremost humanistic scholars of his time. He also studied medicine at Vicenza, receiving his medical degree at Padua. Ten years later, back in England, Linacre became physician to King Henry VIII and regular attendant to many of the most prominent people in the country. He was also the close friend of Sir Thomas More and Erasmus. After 11 years as a physician, Thomas Linacre resigned to become a priest.

Marcin of Urzędów (ca. 1500–1573) was a Polish Roman Catholic priest, physician, pharmacist and botanist known especially for his "Polish Herbal".

Christophe Scheiner (1575-1659), Jesuit priest, made important advances in the development of ophthalmology, in relation to refraction of light and the retinal image.

Athanasius Kircher (1602 – 1680), Jesuit priest was a pioneer in the field of bacteriology having first proposed that living beings enter and exist in the blood (a precursor of germ theory).

Nicholas Steno (Niels Stensen) (1638 – 1686) Catholic convert, bishop, beatified by Pope Saint John Paul II in 1998. Steno discovered a previously undescribed structure, the "ductus stenonianus" (the duct of the parotid salivary gland).

Abbe Spallanzani (1729 – 1799) was an Italian Catholic priest, biologist and physiologist who made important contributions to the experimental study of digestion and reproductive physiology.

René Laennec (1781 – 1826) was a French physician. He invented the stethoscope in 1816, while working at the Hôpital Necker, and pioneered its use in diagnosing various chest conditions. n Sir John Forbes' annotated translation of Laennec's treatise, it is reported: Laennec was a man of the greatest probity, habitually observant of his religious and social duties. He was a sincere Christian, and a good Catholic, adhering to his religion and his church through good report and bad report.

Gregor Johann Mendel (1822–1884) was a scientist, Augustinian friar and abbot of St. Thomas' Abbey in Brno, Margraviate of Moravia. Though farmers had known for millennia that crossbreeding of animals and plants could favor certain desirable traits, Mendel's pea plant experiments conducted between 1856 and 1863 established many of the rules of heredity, now referred to as the laws of Mendelian inheritance.

Louis Pasteur's (1822 – 1895) was a French biologist, microbiologist and chemist renowned for his discoveries of the principles of vaccination, microbial fermentation and pasteurization. He is remembered for his remarkable breakthroughs in the causes and prevention of diseases, and his discoveries have saved many lives ever since. He reduced mortality from puerperal fever, and created the first vaccines for rabies and anthrax. His medical discoveries provided direct support for the germ theory of disease and its application in clinical medicine. He is best known to the general public for his invention of the technique of treating milk and wine to stop bacterial contamination, a process now called pasteurization.

St. Joseph Moscati (1880 – 1927) was celebrated physician of Naples, Italy, noted for medical research. Joseph gave his wages and skills to caring for the sick and the poor and was a model of piety and faith. He was beatified in 1975 and canonized in 1987.

Agostino Gemelli, O.F.M., (1878 – 1959) was an Italian Franciscan friar, physician and psychologist, who was also the founder and first Rector of Catholic University of the Sacred Heart. Gemelli's Institute of Psychology was the most prominent institution of its kind in Italy. In 1921 he founded a teaching hospital for the Medical School of the University, located in Rome, the Agostino Gemelli University Polyclinic, which is now named after him. He focused some of his research on the psychology of the workplace.

Saint Gianna Molla (1922 – 1962) was a heroic wife, mother and pediatric physician. She is celebrated as a great patron of the unborn for, when she became pregnant with her fourth child, doctors found a tumor in her uterus. She chose to have the tumor removed rather than any treatment that would have resulted in her baby’s death. A week after her daughter was delivered by cesarean, however, Saint Gianna died from an infection.