

WILLIAM HARVEY—1578-1657 (1)

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the circu'ation of the blood. In this piece of work alone Harvey had made the greatest contribution to science the world had yet known, in that he laid the foundation for the future conception of physiology and lifted this science from a mere hypothesis to an accepted dogma, proven and demonstrated by experimental evidence. Such a discovery as his, would, in itself have been sufficient to place his name among the immortals, yet, as we shall see, this was merely a part of Harvey's contribution to the medical and scientific world.

Since nothing new can be written regarding the life of Harvey, it has occurred to me that rather than bore you by repetition, you might possibly be more interested in a short review of the conditions which prevailed in England during his lifetime. I shall try to give you an insight therefore, not only into the medical aspects of Harvey's life and work, but also into the state of society existing during the period when this work was done, as well as the surroundings and circumstances amidst which it was accomplished.

As the city of London itself was the centre of Harvey's activities, let us begin with a brief picture of this quaint old city as it would appear in Harvey's day. Harvey describes it as:—"A city whose grand characteristic was an immense concourse of men and animals, where ditches abounded and filth and offal lay scattered about." The main features of this old city were its streets, narrow, grimy, picturesque, top heavy with projecting wood and plaster tenements which overhung the dingy stalls and shops, and rough footway below. Inside, their walls unpainted wood, their best rooms hung with musty woolen stuffs, their floors uncarpeted, and the dirt obscured with a convenient wash of small beer and soot. The houses were not numbered; a wise arrangement considering how few could read, but painted signs, suggestive and grotesque, distinguishing them one

from another and contributing a lively variety of the general effect. The footways, undrained and dirty; full of holes and ruts; no part of the city lighted, not till some years after Harvey's death, and not even then, except on moonless nights, on which a lantern was hung out at each tenth door from six to twelve o'clock in winter.

All were dangerous days, and nights of terror; when thieves and footpads abounded, and prowled after dark in undisturbed security. In the more outlying districts there lurked rude prototypes of the coming and more elegant Claude Duval. The city had its aristocratic quarters and its fashionable streets, but also its many dens of infamy seething in the fogs of the riverside. Throngs of gallants and well dressed idlers were to be found in the neighborhood of St. Paul's, exchanging greetings with acquaintances, and showing off the bravery of their apparel. Towards noon they would disperse to the various ordinaries, where food of the good old substantial kind was enjoyed and the task of eating was not encumbered by the presence of plates, cups and saucers, or even forks. Even in Pepy's time, the guests at a Lord Mayor's banquet were expected to bring their own forks, the festive board being laid with knives only. It was at these old inns and taverns that most of the news and gossip of the day was exchanged. Knights, courtiers and gallants rubbed shoulders with templars, justices of the peace, country squires and gay citizens with money in their pouches who wished to cut a dash with the fashionable young men from the Court. Here, as soon as dinner was over, the proper thing to do was to fall to gambling, with dice or cards, until the time arrived to go to the play or other diversion. Naturally enough, the ordinaries were infested with sharpers and cheats of all kinds.

The mode of living of the citizens is manifest by the prevalence of disease in London at this time. Some three quarters of the population lived outside the city walls, and

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Doubtless a great many present are already acquainted with a more or less large

⁽¹⁾ Read before the Malcom S. Woodbury Historical Society June 29, 1925.

part of the life of William Harvey. With the mention of his name one immediately associates the crowning achievement of this great man's life, namely:—the discovery of

were not under even such control and government as the city then possessed. These skirts of the city were merely a ring of crowded parishes composed of foul tenements and stinking lanes. Even in the city itself, the responsibility of cleanliness rested mainly with the householders themselves, except in times of outbreak of plague, when the magistracy appear to have taken it upon themselves to have undertaken certain elementary duties of municipal sanitation, such as cleansing the streets every other day. Gaol fever, typhus and many other vague types of fever were common. There was but little sanitary protection offered to the inhabitants. The plague was a frequent occurrence. Statistics show over 20,000 deaths resulting from plague in the city in the year 1563. In 1578 there were 3,568 deaths, in 1582, 2976 deaths, and in 1593 there were over 15,000 people died from this disease.

Such was the London of Harvey's day, and so it was until soon after his departure, when it was to undergo reconstruction following the disasters of the plague and the great fire in 1666.

In that old London, too, dwelt many well known old inhabitants. Ben Johnson lived there with his mother; also Izaak Walton and Dreyton the poet. William Shakespeare resided in Blackfriars. Francis Bacon was planting trees in Greys Inn Gardens, and Milton's wife moped at her husband's philosophic temperament.

Up to this time the Renaissance had done but little for English letters, and as yet English literature had lagged far behind the literature of the rest of Europe. She was now to claim her part in the new world of the West however. The defeat of the Spanish Armada, and the consequent deliverance from Catholicism and Spain, marked the critical moment in her political, scientific and literary development. The general awakening of national life, the increase of wealth and leisure that characterized Eliza-

beth's reign, was accompanied by a general quickening of intelligence.

The invention of printing had exercised a mighty influence and the study of classical literature had become fashionable throughout the whole of Europe. A new and virgin soil had been opened up and a rank and irrepressible fertility of the most conspicuous magnificence resulted. From the middle of Elizabeth's reign to the Restoration, a short span of seventy years, there were produced nearly all the giant writers of the world. Shakespeare, Bacon, Spencer, Sydney, Raleigh, Napier, Milton, Hobbs, Marlowe, Massinger, Boyle, Ben Johnson, Jeremy Taylor, Beaumont, Fletcher, Corneille and Moliere, not to mention many of less enduring fame.

And alongside men of letters need I mention such undying names found in the records of this time as those of Hawkins, Frobisher, Sebastian, Cabot, Davis, Baffin, Cavendish, Gilbert, Drake, Hudson, Walter Raleigh, and John Knox. Truly this was a wonderful age.

Medical science too had begun to advance in England. The Royal College of Surgeons had been founded fifty years before and the College of Physicians some 20 years before that. France seemed to be the one country where medicine still remained unpopular, but in other continental schools there flourished a most brilliant cluster of men whose names have withstood the test of time and come down to us as the real pioneers of scientific medicine. Among Harvey's immediate predecessors we find such names as Sylvius, Vesalius, Ingrassius, Vidijs, Eustachius, and Servitus; while among those of Harvey's own day were: Ambrose Pare, Fabricius, Julius Casserius, Cesalpino, Malpighi, Wharton, Hoffman, Hildanus, Chaumette, Clowes, Swammerdam, Steno, Vieussens, Willis, and Sydenham. Such an array of names are indeed an evidence of the impetus given to medical research by the Renaissance, and shows a favourable

parallel to the progress which was taking place in other branches of learning.

At this time, however, two powerful auxiliaries were wanting. There was no post office and no newspaper press.

The political times of Harvey were gloomy and unpromising. Twenty years before, and for fifteen years after his birth, Elizabeth occupied the throne of England. Her influence on the people was of a varied character. Her reign is characterized by great advancement in literature, by exploration, discovery and colonization and by a great awakening of national life. Her influence on society, however, was anything but good. Her extreme worldliness, her insatiable love of pleasure made gayety and amusements the keynote of the day. Just as the Queen's gay, pleasure seeking temperament was coarse, so also was Elizabethan society. Neither thought fit to check the expressions of their emotions, and their manners were unbecoming. We are told that Elizabeth spat at a courtier whose coat offended her taste, she boxed the ears of another, she tickled the back of Leicester's neck when he knelt to receive an earldom, she rapped out tremendous oaths and uttered every sharp, amusing word that rose to her lips. Accordingly, the man who could not swear was accounted a peasant, a clown, an effeminate person. Swearing became a privilege of the upper classes and the invention of new and original oaths was the young nobleman's duty. Coarse manners were accompanied by coarser morals and their example was found in Elizabeth's court.

The slave trade is said to have started in this period. English gentlemen of good birth and high character rushed into piracy. In fact, piracy acquired a moral and religious character. To rob Spaniards was to avenge the martyrs of the Inquisition and to spoil the enemies of the Lord.

Following Elizabeth came James VI of Scotland who on his accession as James I of

England united the two kingdoms. A feeble monarch, timid, stammering, pedantic, undecided in religious principles, thoroughly convinced of the existence of witches, priding himself as the first to smell the Gunpowder Plot, talking as if he were erudition incarnate at one time, and at another in the language and style of a clown. James died in 1625 and was succeeded by Charles I, a man of stronger will, literary, good natured in a way, though indiscreet and inclined to dark and crooked paths, and ending his career with his condemnation as a tyrant, a murderer, and an enemy to the nation. Harvey held the office of physician to these two monarchs. And then came the Commonwealth and while it remained the ruling power came Harvey's death.

The nation during these times was turbulent with religious controversies; wars with Scotland, trouble with Ireland, war with Spain, and to crown all, the Civil War which was waged between the Parliamentary and the Royal forces. With all these events Harvey was contemporaneous, and doubtless took part in a good many of them.

Superstition and the practice of magic and alchemy seems to have been characteristic of the period. We are told that some 8000 human beings were burned in Scotland alone and that King James was chiefly instrumental in these murders. Such in fact was the fate of many men of Harvey's type. As a reward for their work they were liable to be classed as fakers and sorcerers and ordered to be burned.

In Harvey's lifetime there had taken place the execution of Mary Queen of Scots, the Earl of Essex, Sir Walter Raleigh, Lord Stafford, Arch-Bishop Laud, and Charles I, not to mention the executions of the Abbots of Glastonbury and Reading, Ridley, Latimer, Queen Catherine Howard, and Lady Jane Grey.

The costume of this period was picturesque, satin doublet and short cloak, befringed breeches meeting beruffled boots,

Flemish hat and plume, hair long and curled and beard peaked, and pointed mustache with an upward curl. Duels seemed to be just as much a daily matter of course as were executions. Although there was no standing army in England, the navy had been in existence for some time as evidenced by the defeat of the Spaniards in 1558 when Harvey was ten years of age.

The physician of Harvey's day considered himself a man of great importance. As had been the case for ages, he accepted with explicit constancy the cherished tenets of his profession, and was shocked and indignant when they were called into question. Physiology, pathology and therapeutics partook of much that was merely exuberant fancy and vivid imagination. Chemistry and anatomy were just beginning to take on a scientific aspect, and hygiene was soon to receive its impetus from the lessons of the great plague and the great fire of London. Surgeons of this day were only the instruments of the physicians, indifferently educated and classed with barbers.

Sir Simond d'Eives, considered a reliable authority, reports the result of a post-mortem examination on the body of James I—"His heart" says Sir Simond, "was very large and soft which argued him very considerate, and therefore too fearful to attempt any great actions. His liver was fresh and one of his kidneys was good; but the other shrunk, so little that it could hardly be found. His lungs, gall and blood were black, which, the physicians argued to proceed from the melancholy under which he latterly suffered. His head was so hard that it could scarcely be broken open with a chisel and saw, and contained so unusual a quantity of brain that they could hardly keep it from spilling," which, a contemporary considered was a mark of his infinite judgment.

William Harvey was born in 1578 at Folkstone, Kent, England. His parents were well to do and were able to give him an

education that was of the best. At the age of 10 years he entered the Grammar School at Canterbury, and at the age of 16 was able to begin a course at Cambridge, from which he graduated with the degree of Bachelor of Arts in the year 1597 when he was 19 years old. As was the custom in those days he next turned his attention towards the continental schools. His choice fell upon the University of Padua where we see him the following year i. e. 1598. Many reasons probably influenced this choice. The university was specially renowned for its anatomical school, which had been rendered famous by the labors of Vesalius, the first and greatest of modern anatomists, and by Fabricius who was to become Harvey's teacher.

Doubtless he was also influenced by his old professor Dr. Caius at Cambridge, who had himself taught at Padua. Padua was the university town of Venice, and the tolerance which it enjoyed under the protection of the great commercial republic rendered it a much safer place of residence for a protestant than any of the German Universities, or even than its fellows in Italy. The fame of Fabricius and his school was, however, no doubt the chief reason which led Harvey to make this choice.

The Paduan student underwent great hardships. The food was scanty and bad; forms were rough; the windows were mere strips of linen, for there was no glass in those days. Artificial light was ruinously expensive, so that studying had to be done early in the morning, and while daylight still remained. The greater part of the work in the university was done between the hours of six and eight in the morning, and some of the lectures were given at daybreak. Indeed the Paduan student seems to have accepted the sun as his signal for rising and retiring, as we doubtless would be doing also, had not the introduction of artificial light partially reversed our habits. The theatre in which Harvey sat while listening

to his master Fabricius still exists. It is now an ancient building with circular seats rising almost perpendicularly one above the other. The apartment is small, and is wainscoted with curiously carved oak. The lectures must have been given in candle light for the building is so constructed that no daylight can be admitted.

Fabricius was at this time engaged in perfecting his knowledge of the valves of the veins. Although a man of sixty-one he seems to have been more than a teacher to Harvey, for we are told that a vast friendship sprang up between them.

Harvey graduated as Doctor of Physic at Padua in 1602 in the presence of Fortescue, Willoughby, Lester, Mounsell, Fox and Darcy. His diploma further recites that "he had conducted himself so wonderfully well in examinations, and had shown such skill, memory, and learning that he had far surpassed even the great hopes of his teachers." He returned to England and obtained the degree of doctor of medicine at the University of Cambridge in the same year. He then lost no time in attaching himself to the College of Physicians. This body had the sole right of licensing physicians to practise in London and within seven miles of the city. He was elected a Fellow in the College of Physicians in 1607 and attached himself to St. Bartholomew's Hospital.

In 1616 at the age of 37 Harvey was chosen to deliver the Lumleian lectures on anatomy and surgery at the College of Physicians. At this time we are told that he was a man of lowest stature, round face, with a complexion like wainscot, his eyes small, round, very black and very full of spirit. His hair was black as a raven and curling, he was rapid in utterance, choleric, given to gesture, and when in discourse with anyone used to play unconsciously with a handle of a small dagger which he wore by his side.

Until the year 1745, the teaching of anatomy in England was vested in a few

corporate bodies and private teaching was discouraged by fine and imprisonment. Subjects for dissection were difficult to procure. In 1565, Queen Elizabeth had granted permission to the College of Physicians that they should have the bodies of four felons each year for dissection purposes. The charter of James I enlarged this grant by allowing them to take the bodies of six felons annually. Anatomy was taught in a series of demonstrations but as there was no means of preserving the bodies, it had to be taught by general survey rather than minute detail. The demonstrations took place only four times a year, and each course lasted three days; a lecture in the morning, a lecture in the afternoon with a feast in between. The first day consisted of a demonstration of the muscles, the second day an osteological lecture, and the third day a visceral lecture. The whole business of these lectures was conducted with much ceremony. The audiences were assigned positions of advantage according to their age and rank. Samuel Pepys in his diary describes one of these lectures which he appears to have attended. The lecturer in anatomy was considered a person of great importance and the greatest care was taken of him. The stewards in anatomy were instructed, "To see and provide that there be every year a mat, about the hearth in the hall so that Mr. Doctor be made not to take cold upon his feet. And further that there be two fine white rods appointed for the doctor to touch the body where it shall please him; and a wax candle to look into the body. And there shall be always for the doctor two clean aprons to be from the shoulders downwards, and two pair of sleeves for the whole arms with tapes for change for the said doctor, and not to occupy one apron and one pair of sleeves every day, which is unseemly." And so it was in this rather pompous manner that Harvey delivered his lectures. He soon built up an important and fairly lucrative

practice. Aubrey tells us that he rode on horseback with a foot cloth, to visit his patients, his man following on foot—as the custom was. The foot cloth was originally a mark of distinction and dignity and is sometimes still seen in full splendour over the backs of horses in a pageant.

Harvey was appointed physician to King James I in 1618 in which office he remained till the king's death. The year 1628 may fairly be marked as the crowning achievement of his scientific life; it was at that time he published his matured account of the circulation of the blood. Three years later he was appointed physician to Charles I. Although Harvey had been intimate with all men of letters of his time, was physician to Lord Chancellor Bacon, had been physician to two kings, both he and his opinions were derided by most of his fellow physicians for a considerable time. Many declared, "They would not give threepence for his prescriptions." They had their own opinions of chin-cough, tissack, tympany, chrisoms, head-mould-shot, horse-shoe-head, and many other ailments not found in our Register-General's Returns, and they desired none of Harvey's interference with them. His book on the circulation was actually rejected by the London publishers and had to be published in a foreign country (Frankfort 1628). He was even held by many to be demented. But Harvey worked and plodded on among all, in the might of his own quiet reasoning and calm convictions.

During his term as physician to Charles he had to discontinue his lecturing, but we are told, was constantly occupied in studying animals, birds, and insects. His achievement in the field of embryology was hardly less great than it had been in anatomy, as evidenced by his extremely valuable work, "De Generatione Animalium" which appeared in 1651. Of his work on this subject more will be said later. The following year (1652) Harvey was looked upon as the most

celebrated anatomist and physician of the age, and the College of Physicians unveiled a statue of him with a great deal of ceremony. It is of interest that, in the printed editions of the "Roll of the Royal College of Physicians," in London appears the name of William Harvey, after which it adds: "This distinguished physician, the greatest physiologist the world has seen and the brightest ornament of our college was born on April 1, 1578."

During the Civil War in England, Harvey suffered serious loss. A number of citizen soldiers entered his lodgings, stole his goods, and scattered his papers. The papers consisted of records of large numbers of autopsies and dissections, also his observations on insects and animals, and a series of notes on comparative anatomy. Harvey bitterly regrets this loss and laments: "Let gentle minds forgive me if recalling the irreparable injuries I have suffered if I here give vent to a sigh, whilst in attendance on his Majesty the King during our late troubles and more than Civil Wars, not only with the permission but by the command of Parliament, certain rapacious hands not only stripped my house of all its furniture, but, what is a subject of far greater regret to me, my enemies abstracted from my museum the fruits of many years of toil. Whence it has come to pass that many observations on the generation of insects have perished with detriment I venture to say, to the republic of letters."

Harvey was incorporated Doctor of Physic at Oxford in 1642, and we find him living quietly here for the next two years making dissections, and carrying on his professional work among the courtiers who thronged the town. The records next show Harvey as being appointed to the position of Warden of Oxford in 1645. He held this position for two years, but as the Civil War was then at its height in England, we are told that the College during Harvey's office, presented more the appearance of a court

than of a seat of learning. The town was besieged, and with its surrender in 1645 marks the period of Harvey's severance from the court and of his practical retirement from public life. He was now a man of 68 years of age, a martyr to gout, childless, and suffering under a series of heavy bereavements, so that he can have had but little heart to re-enter upon an active professional life in London. From this time on he employed his time in putting into shape his treatise on development. Towards the end of his days we are also told that he interested himself greatly in mathematics. This may seem somewhat of a strange diversion for an anatomist and physiologist to have taken up, but after all, when we consider that among the men at Padua who had influenced Harvey was Galileo, it may probably explain his taste in this direction. Of the next ten years of his life there is little recorded. In 1654 he was elected president of the College of Physicians, but on account of advanced age and natural modesty he declined the position. For the past 20 years his hair had been snow white, and we find him at the age of 80 still with the same keen and lustrous dark eyes, and in possession of all his faculties even unto the last. The summer sun of June 3, 1657 rose on the last morning of the old man's life. Aubrey tells us that on this particular morning he awoke and tried to speak "but found that he had the dead palsey in his tongue." Knowing that the end was near he sent for his relatives and next summoned his apothecary to whom he made signs to bleed him in the tongue. This did him but little good and with the evening of the same day on which he was stricken, he passed away, "the palsey giving him an easy passport."

The name of Harvey is by far the greatest in seventeenth century medicine. It may indeed be said that he had lived his life well, and even as he had lived so did he die, meeting the end with the cool self possession and quiet resolution of his race.

While he was not ostentatious in piety, his will, with its liberal legacy to the poor of his native town, reveals the ideal English gentleman, tenderly solicitous of all his intimates, from the highest down to his humblest body servant.

Let us now view some of the work of this man. Although his discovery in connection with the circulation is the chief reason for his fame, there is much else that may be of interest. Harvey was an embryologist, and obstetrician and a gynecologist of considerable note. According to "Burke" he is held also to be the discoverer of the law of embryology: "That all animals are produced out of ova." It had formerly been taught that all life arose out of putrefaction. Harvey was the first to bring forth the theory that the complex animal arises from a relatively homogeneous germ, by gradual differentiation, or epigenesis. Most embryologists accredit this finding to Wolf who lived almost 200 years later and who had the microscope to prove his assertions. Nevertheless, the idea is Harvey's and his statements in regard to this are clear, definite and thoroughly modern. He was, then, a supporter of the doctrine of epigenesis, as opposed to the perforation of the embryo. He was the first to locate the embryo in the cicatrix and refuted the opinion of Fabricius as to its origin in the chalazae.

The bulk of Harvey's "De Generatione Animalium" is made up of his careful observations of the development of the ovum and foetus in all stages in birds, animals and man. He made many dissections of human embryos "from the bigness of a tadpole and so upwards to birth." He had also dissected the human ovum in the second month. It was the size of a pheasant's egg, sometimes he found a foetus, at others none.

Harvey made a discovery of the greatest medicolegal importance when he observed that the lungs of a foetus which had breathed "stretched and dilated by the air, put on a whiter color; and by this observation of

the different complexion you may discover whether a mother brought her child into the world dead or alive, for instantly after inspiration the lungs change color, which color remains, even though the foetus die immediately afterwards." These are all testimonies to his great powers of observation.

To gynecology which in his time was in an embryonic state of development, he made several notable contributions. He gives a good description of the broad ligament. He describes the "green sickness in virgins whose uteri are slender and their terms at a stay." He had seen ectopic gestation and alludes to the displacement of the uterus. He gives a good account of spurious pregnancy. He applied his knowledge of the circulation to surgery and pointed out how by tying the artery going to a tumor, the tumor could be removed with safety, and thus laid the scientific foundation for operations such as hysterectomy, now performed by the same method. For the treatment of intrauterine diseases Harvey invented a dilator, after which he used injections. He discovered a peculiar bleeding tumor of the uterus which he called honey-comb.

Harvey's chapter on labor is the first original English work on midwifery, and justifies Aveling's designation of Harvey as the Father of British midwifery. Harvey was the first to describe accurately the foetal circulation and the great development of the vessels in the pregnant uterus. He gives a careful description of the lie and posture of the foetus in utero.

In considering the practical side of Harvey's work we are handicapped by the loss of his Medicinal Observations. Fortunately we are able to judge of the high esteem Harvey was held as an obstetrician by the writing of his contemporary Willoughby, who acquired a great reputation at this time and wrote two books on the subject. He says, "I know none but Harvey's direc-

tions and methods, the which I want all midwives to follow and observe, and oft to read over and over again; and in so doing, they will better observe, understand, and remember the sayings and doings of that most worthy, good and learned Dr., whose memory ought to be forever a great esteem with midwives and child-bearing women."

In regard to Harvey's main work, I find that it is not quite correct to glibly assert that he was the discoverer of the circulation of the blood, and that this statement has to be modified somewhat. No less than four monuments have been erected in three different countries to perpetuate the memory of four different discoverers of the circulation. The Spaniards regard Michael Servetus, born in 1511, as the true discoverer, and have erected a monument in his honor in Madrid. The Italians have three men to whom the discovery is accredited. Columbus born in 1516, Raine of Bologna where his statue still remains, and Cesalpinus born in 1519 whose statue was erected in Rome and at Pisa. William Harvey has been honored by his statue in London, a second at Hampstead, and a third at Folkstone. The French have also laid claim to the discovery and their discoverer is no less than that incomparable satyric Francois Rabelais. On investigating this latter claim, however, it has been found that Rabelais brings to us nothing new, in fact nothing which had not already been shown by Galen. Also he nowhere mentions dissections or vivisections as a basis for his claims.

It might be well here to trace the discovery of the circulation of the blood from its beginning, for, as a matter of fact, this discovery is actually the work of almost a millenium, from Aristotle, and Galen, up to the time of Harvey and even later to Maephigi.

The old teaching of the Alexandrine school 311 B.C. held that the left portion of the heart and the arteries were empty, and

that they, communicating by means of the small bronchi with the trachea, served to convey the spirit of life (pneuma) to the various parts of the body, and that the veins alone contained blood, with which to nourish the whole body. Almost five hundred years later Galen brought forth the theory as follows: The chyle is formed in the stomach, where it ferments, cooks, rids itself of gross portions, which are taken up by the gall bladder (solid parts), by the spleen (volatile parts) and by the kidneys (liquid parts). By the first operation the chyle becomes transformed into black blood and afterwards converted into red blood. When once elaborated, the red blood becomes charged with a natural spirit in the liver, then goes into all parts of the body, preferably into the gross portions, by the ramifications of the vena cava.

Entering afterward into the right ventricle, the larger portion of the blood immediately passes through the interventricular wall into the left ventricle; the other portion goes to the anterior vein to nourish the lungs. During expiration a portion of the compressed blood returns by the same route into the heart, but prevented from emptying on account of the valves, it passes into the latter and finally into the left ventricle by way of the anastomosis existing between the arterial vein (pulmonary artery) and the venous artery (pulmonary vein.) The left ventricle is the source of innate heat and is fed by the blood. Galen says that the blood is the wood of the fire which burns in the ventricle. In the presence of this innate heat and of the air coming from the trachea, the venous blood becomes ethereal; the natural spirit becomes the vital spirit; which is nothing else than the exhalation of the blood. Thus charged with its vital spirit, the blood goes to the noble parts of the body among others the brain, where the spirit again changes, becoming the animal spirit.

All this is a most ingenious theory, complicated, mostly false, and extremely fanci-

ful. And in this mist of errors, the truth was drowned for fifteen centuries. Then came Vesalius, a man of energy, braving both danger and ridicule, daring not only to discover errors in the teachings of Galen but also to prove them, and to declare himself opposed to them. Following Vesalius there arose a phalanx of young and brilliant anatomists; each one laying a stone in the construction of this beautiful temple which is called anatomy, and each one delivering a blow with his pick into that old fortress of errors which had been constructed by Galen.

First comes Servetus who in 1553 described the lesser circulation and at the same time denied the communication of the two ventricles through the septum. He it was who pointed out the proper course of the blood from the right ventricle to the lungs, where it is aereated. Servetus paid dearly for his daring to disturb the old time-worn teachings however. We recognize him now as one of the world's great martyrs for "the crime of honest thought," since it was he whom John Calvin caused to be burned at the stake for the mere juggling of *verbiage*, a theologic quibble.

The next man to contribute towards the discovery of the circulation was Cesalpinus. A professor of medicine at Pisa and physician to Pope Clement VIII, he also incurred the disfavor of the church by his free thinking and what was considered, his heretic work. He it was who discovered the greater circulation in 1569, but his ideas were not substantiated by any convincing experiments and were thrown out in a purely controversial spirit, as an additional argument against Galenism. He was forced to retract his assertions in order to save his life.

Next comes Fabricius whose main contribution was in completing the knowledge of the valves of the veins.

Doubtless, as was the case with myself, most of you have accepted William Harvey without question as the discoverer of the

circulation of the blood. And it will also doubtless be a disappointment for many to learn that this honor must be shared with others. Harvey did not discover the lesser circulation, this was done by Servetus. He did not discover the greater circulation, this was suggested by Cesalpinus. Nor did he discover the valves of the veins, this work was begun by Silvius, and Sarpi, and finished by Fabricius. Nevertheless, Harvey is the great regius predemonstrator of the blood circulation, the movements of the heart and of the blood. He lifted these from a mere hypothesis of the darkest possibility to the clearest probability, from the individual views of a few favoured ones to a dogma everywhere sanctioned. And in this sense we can indeed say, that: Without the school of Padua, yes, without Erasistrates, Aristotle, Galen, Servetus, Vesalius, Columbo, Fabricius, and Cesalpinus, we would have no Harvey. But, without Harvey we would have no discovery of the circulation of the blood.

In his demonstration of the circulation, Harvey was brought to a standstill on one

point only, viz., the capillary anastomosis between arteries and veins, which, having no microscope, he was unable to see; he knew there was a connection however and ascribed it as due to the pores in the flesh. The invention of the microscope some years later made this part of the circulation clear. This work was done by Malpighi in 1660.

Harvey was placed in the position of a sculptor having before him an unformed mass of rough material, which under the reviving influence of his breath would soon take the beautiful form of an animated being. His great merit is not only in having verified and confirmed the facts already known by his predecessors, by varied and numerous experiments of a precision up to that time unknown, or in having brought forward other facts of importance. No. His merit is above all in having made a synthesis of these facts, in having united and combined the elements, which were dispersed without order, by a common idea; in other words, in having discovered the circulation of the blood.