The life of william harvey

William Harvey an English physician, was the first to describe the circulation of the human body and properties of blood being transported throughout the body by its ‘ mechanical pump’, the heart.

He studied medicine at the University of Padua in Italy and was tutored by surgeon Hieronymus Fabricius. Fabricius, was fascinated by anatomy, and discovered that the veins in the human body had one-way valves, but was not too sure as to what their function was. Harvey went on, based on Fabricius’s findings, to figure out the role valves play in circulation of the body.

He returned from Italy in 1602 and established himself as a physician. His career was taken to a whole new, better level when he married Elizabeth Browne, the daughter of Elizabeth I’s physician. They were married in 1604. He became a fellow of the Royal College of Physicians in 1607 and, in 1609, was appointed physician to St Bartholomew’s Hospital. The highlight of his career, however was probably when he became physician to Elizabeth’s successor James I and to James’ son Charles when he ascended to the throne, in 1618. Both King James and King Charles took a close interest in and encouraged Harvey in every step of his research.

Harvey’s research was furthered through the dissection of animals. He first revealed his theories at the College of Physicians in 1616. In 1628 he published these theories in a book titled ‘ Exercitatio Anatomica de Motu Cordis et Sanguinis in Animalibus’ (‘ An Anatomical Study of the Motion of the Heart and of the Blood in Animals’). Here was where he explained how the heart pumped the blood in a circular course through the body. His

discovery received great accolades and interest in England, although it was greeted with some scepticism on the Continent.

Harvey was also the first to theorize that humans and other mammals reproduced via the fertilisation of an egg by sperm. It took another two centuries before a mammalian egg was finally observed, but Harvey’s theory still won credibility during his lifetime.

Harvey held a close relationship with the royal family through the English Civil War and also witnessed the Battle of Edgehill.

Harvey is often credited as the Father of Cardiovascular Medicine. His observations of dissected hearts showed that the valves in the heart allowed blood to flow in only one direction. Also, even though he lacked a microscope, he theorized that the arteries and veins were connected to each other by capillaries, which were later be discovered by Marcello Malpighi some years after Harvey’s death.

William Harvey’s work became the foundation for all modern research on the heart and cardiovascular medicine. It has been said that Harvey’s proof “ of the continuous circulation of the blood within a contained system was the seventeenth century’s most significant achievement in physiology and medicine.”

He is also often referred to as the Father of Scientific Method. Harvey believed that direct observation was the correct way to draw conclusions about scientific facts. He kept records of his experiments. He did not record his findings until he proved them. This practice became known as the

scientific method, and Harvey has received much credit for having promoted its use.

Historical background

William Harvey was the eldest child of merchant Thomas Harvey and Joan Halke and was born in Folkestone, Kent on the 1st of April, 1578 . His father was known to be a styled gentleman, who upon referring to the register of William’s matriculation at Cambridge, was designated a yeoman of Kent. He must have been a man of some substance and position, as all of his seven sons followed careers, and attained positions necessitating the possession of capital at the outset. William had five brothers who were all merchants of repute in the city of London. They traded extensively with Turkey and the Levant. John, the second son, was at one time Member of Parliament for Hythe, and afterwards became King’s Beceiver for Lincolnshire, and Footman to His Majesty. Of Joan Halke, Harvey’s mother, but little has been preserved to us, and that little has been derived from the inscription on a monumental slab in Folkestone Church. She is there described as having died in her 50th year, the mother of seven sons and two daughters. ” A Godly harmles Woman: A chaste loveing Wife: A charitable quiet Neighbour: A co’fortable frendly Matron: A p’evident diligent Huswyfe: A careful te’der-harted Mother. Deere to her Husband: Eeverensed of her Children: Beloved of her Neighbours: Elected of God. Whose Soule Best in Heaven: her Body in this Grave: To Her a Happy Advantage: To Hers an Unhappy Loss.” Conjecture has attributed the authorship of the inscription to her son William. There were two daughters, one of whom died young, and of the other nothing beyond her name is known. Harvey attended King’s School in Canterbury

from 1588 to 1593. There he worked at the ordinary subjects of an English education, and acquired a good knowledge of both Latin and Greek. This was essential at a time when the influence of authority was triumphant, and when even contemporary literature, to appear learned, must needs be expressed in Latin. He then studied at Cambridge University and Gonville and Caius College from 1593 to 1599. He spent these years in the study of classics, dialectics and physics. Such a course of training was then, as now, considered a fitting prelude to the study of the science and art of medicine. In 1597, being then nineteen years of age, he was made a Bachelor of Arts of his university. At that time, and indeed until quite recently, the University of Cambridge was in a very different position with regard to the teaching of medicine from what we now find. Divinity was its chief glory, and the well equipped medical school of the present was almost unrepresented, one or two professorships only being devoted to medical subjects. Hence he decided to attend one of the premier institutes of Medicine in the Continent, located in Padua, to pursue his career in medicine. It was there that he worked with Hieronymus Fabricius, who was a well known anatomist and had observed the one-way valves in blood vessels. After graduating from Padua, he returned to England to establish himself as a physician and joined the College of Physicians on the 5th of October, 1604. After marrying Elizabeth Browne, daughter of physician Lancelot Browne, he accepted his position at St. Bartholomew’s Hospital, succeeding a Dr. Wilkinson, as the physician in charge of the hospital. At this point, the physician’s function consisted of a simple but thorough analysis of patients who were brought to the hospital once a week and the consequent writing of prescriptions.

– Hieronymus Fabricius

The next important phase of Harvey’s life began when he was appointed to the office of Lumleian lecturer on 4 August 1615. The Lumleian lectureship, consisted in giving lectures for a period of seven years, with the purpose of enlightening and increasing the general knowledge of anatomy throughout England. Harvey began his lectures in April 1616. At this time, at the age of thirty-seven, he was described as “ a man of lowest stature, round faced; his eyes small, round, very black and full of spirit; his hair as black as a raven and curling” (Book : William Harvey; author : Sir D’Arcy Power; year: 1897) . Some of the notes which he used at the time are preserved in the British Museum (the manuscript notes of which contain the first account of blood circulation). At the beginning of his lectures, Harvey laid down the canons for his guidance:

“ To show as much as may be at a glance, the whole belly for instance, and afterwards to subdivide the parts according to their positions and relations.

To point out what is peculiar to the actual body which is being dissected.

To supply only by speech what cannot be shown on your own credit and by authority.

To cut up as much as may be in the sight of the audience.

To enforce the right opinion by remarks drawn far and near, and to illustrate man by the structure of animals.

Not to praise or dispraise other anatomists, for all did well, and there was some excuse even for those who are in error.

Not to dispute with others, or attempt to confute them, except by the most obvious retort.

To state things briefly and plainly, yet not letting anything pass unmentioned which can be seen.

Not to speak of anything that can be well explained without the body or can be read at home.

Not to enter into too much detail, or in too minute dissection, for the time does not permit.

To allot a definite time to each part of the body i. e. first day's lectures dedicated to the abdomen, the second to the thorax, the third to the brain and so on." (Book: William Harvey; author: Sir D'Arcy Power; year: 1897) .

He soon attained a practice of great importance, when he was appointed the " Physician Extraordinary" to King James I, on the 3rd of February 1618. Although Harvey's practice suffered because of his radical views, he was also in the picture during King Charles I's reign. Harvey accompanied King Charles I wherever he went as ' Physician in Ordinary.' In particular, Charles' hunting expeditions gave Harvey access to many deer carcasses. Harvey made use of these deer carcasses by conducting most of his experiments on them; from these, he made his many observations and consequent theories.

– King James I

– King Charles I

During the English Civil War a mob of citizen-soldiers against the King entered Harvey’s lodgings, stole his goods, and scattered his papers. The papers consisted of the records of a large number of dissections… of diseased bodies, with this observations on the development on insects, and a series of notes on comparative anatomy. (Book: William Harvey; author: Sir D’Arcy Power; year: 1897). Harvey continued to maintain his position and helped the wounded on several occasions. He also protected the King’s children.

The conflicts of the Civil War soon led King Charles to Oxford, with Harvey attending, where the physician was made ‘ Doctor of Physic’ in 1642 and later Warden of Merton College in 1645. “ In Oxford he (Harvey) very soon settled down to his accustomed pursuits, unmindful of the clatter of arms and of the constant marching and countermarching around him, for the city remained the base of operations until its surrender… ” (Book: William Harvey; author: Sir D’Arcy Power; year: 1897)

– Merton College

The surrender of Oxford in 1645 marked the beginning of Harvey’s gradual retirement from the medical world. Now sixty-eight years old and childless, Harvey had lost three brothers and wife at this time. He decided to return to London and live with his brothers Eliab and Daniel separately and in different periods of time. Having retired from St BartholomewHYPERLINK “ http://en. wikipedia. org/wiki/St_Bartholomew’s_Hospital”‘ HYPERLINK “ http://en. wikipedia. org/wiki/St_Bartholomew’s_Hospital” s Hospital and his various

other aforementioned positions, he passed most of this time reading general literature. Several attempts to bring Harvey back into the ‘ working world’ were made, however; here is an excerpt of one of Harvey’s answers:

“ Would you be the man who should recommend me to quit the peaceful haven where I now pass my life and launch again upon the faithless sea? You know full well what a storm my former lucubrations raised. Much better is it oftentimes to grow wise at home and in private, than by publishing what you have amassed with infinite labour, to stir up tempests that may rob you of peace and quiet for the rest of your days.” (Book: William Harvey; author: Sir D’Arcy Power; year : 1897)

He died of a stroke on June 3, 1657, and, “ lapt in lead,” was buried in Hempstead church. Apparently, he died of a cerebral hemorrhage from vessels long injured by gout: it is highly probable that the left Sylvian artery malfunctioned, leading to a gradual accumulation of blood to the brain which eventually overwhelmed it, resulting in his death. There exists a fairly detailed account of what happened on that day; according to the information at hand, Harvey:

“…went to speak and found that he had the dead palsy in his tongue; then he saw what was to become of him. He knew there were then no hopes of his recovery, so presently he sends for his young nephews to come up to him. He then made signs (for seized with the dead palsy in his tongue he could not speak) to let him blood his tongue, which did him little or no good, and so ended his days, dying in the evening of the day on which he was stricken,

the palsy giving him an easy passport.” (Book: William Harvey; author: Sir D’Arcy Power; year: 1897)

Experimental Procedures

Harvey was well trained in anatomy, and he, like his idols Versalius and Fabricius, was convinced that the interventricular septum was not leaky to blood. Also, he was born into an era in which experimentation, computation and simple observation, became recognized as essential tools of the “ scientific method.” He was well aware of the works of Copernicus and Kepler, and of his contemporary Galileo, for whom the combination of careful observation and computation resulted in nothing less than a switch between the earth and the sun as the center of our universe; Galileo’s dictum “ Measure all that is measurable, and make those things measurable which have hitherto not been measured” (Book: William Harvey’s Biological Ideas; author: W. Pagel; year: 1967) was deeply impressed upon him. He was also familiar with the somewhat earlier writings of Santorio Santoro, who, sitting on an exquisitely sensitive balance, compared his body weight and the difference between the ingested food and his excreta and was capable of observing that the body lost a certain amount of weight continuously in the form of “ insensible perspiration” (Book: History of Physiology; author: E. Rothschuh; year: 1973).

But Harvey himself was a pioneer (Book: Handbook of Physiology: Circulation; author: CD Leake; year: 1962). Unlike the great Kepler, who improved upon Copernicus’ observations, and Galileo, whose telescope

unequivocally established the Copernican revolution, Harvey did not build on anything, revise anything, or improve on anything.

This revolution was set forth in his book entitled “ Exercitatio Anatomica de Motu Cordis et Sanguinis in Animalibus” or “ Anatomical Essay on the Motion of the Heart and Blood in Animals” (Book: On the Motion of the Heart and Blood in Animals; author: William Harvey, translated by Keynes G; year: 1978), commonly referred to as “ De Motu Cordis” or simply “ De Motu.” It was published in 1628 when Harvey was already 50 years old.

Knowing that he was challenging a “ big fish”, he opened the monograph with a letter to the King, Prince Charles, with the statement :

The heart of animals is the foundation of their life, the sovereign of everything within them…from which all power proceeds. The King, in like manner, is the foundation of his kingdom, the sun of the world around him, the heart of the republic, the foundation whence all power, all grace doth flow. (Book: Scientific Papers: Physiology, Medicine, Surgery, Geology, with Introductions, Notes and Illustrations; author: William Harvey, translated by Willis R; year: 1910)

His dedication to the President of the Royal College of Physicians reads like: “ Hey, I’m really not out to get anyone, all I want to do is tell the truth!” For example, in this “ dedication” he states

…the studious and good and true do not esteem it discreditable to desert error, though sanctioned by the highest antiquity, for they know full well that to err, to be deceived, is human.… I would not charge with willful falsehood

anyone who was sincerely anxious for truth, nor lay it at any one’s door as a crime that he had fallen into error. I avow myself the partisan of truth alone…. (Book: Scientific Papers: Physiology, Medicine, Surgery, Geology, with Introductions, Notes and Illustrations; author: William Harvey, translated by Willis R; year: 1910)

He closes: “ Farewell, most worthy Doctors, and think kindly of your Anatomist” (Book: Scientific Papers: Physiology, Medicine, Surgery, Geology, with Introductions, Notes and Illustrations; author: William Harvey, translated by Willis R; year: 1910), suggesting that he feared the worst.

Harvey’s revolutionary conclusion that blood is conserved and circulates was based on only a few observations, the major ones were as follows:

First, he measured the total amount of blood that could be drained from sheep, pigs, and some other subprimate mammals.

He then measured the volume of the left ventricles of these animals and calculated that, if the left ventricle were to empty with each beat, in one hour the total volume of blood pumped would be much greater that in the ingesta(material taken into the body by means of the digestive tract) or even that contained in the entire animal. Indeed, this would be true even if one-tenth of the blood contained by the ventricle were ejected per beat. Therefore, he concluded, “…it is a matter of necessity that the blood perform a circuit, that it returns to whence it set out.”

He then demonstrated, publicly, that when a live snake is “ laid open,” compression of the vein entering the heart leads to a small heart that is devoid of blood upon opening it.

If on the contrary, the artery instead of the vein be compressed or tied you will observe the part between the obstacle and the heart, and the heart itself to become largely distended and, in the end, to become so oppressed with blood that you will believe it about to be choked. (Book: Scientific Papers: Physiology, Medicine, Surgery, Geology, with Introductions, Notes and Illustrations; author: William Harvey, translated by Willis R; year: 1910)

He also showed that, following light application of a tourniquet to the arm, the veins become engorged and that blood can only be milked from an engorged vein in the oral direction – toward the heart – but when the vein is thus emptied it only fills from the periphery. Also, when one knows the diameter and length of the cylinder of vein, one can calculate the volume of blood that flows through the vein during rapid emptying and refilling. Harvey showed that in a day more blood flows through that segment alone than the quantity of food ingested.

Harvey’s experiment illustrating the venous valves (nodes or portals) and the unidirectional nature of emptying and filling. He also states: “ Now if you reckon the business, how much by one compression moves upwards by suppression of the portal, and multiplying that by thousands, you shall find so much blood pass’d by this means through a little part of a vein, that you will find yourself perfectly persuaded concerning the circulation of the blood, and of its swift motion” (Book: Scientific Papers: Physiology, Medicine,

Surgery, Geology, with Introductions, Notes and Illustrations; author: William Harvey, translated by Willis R; year: 1910).

Harvey also possessed a lifelong obsession with animal generation. His fascination with the perfection of animals brought about his desire to find out how the organisms arise. This is described in his introduction to his Essays on the Generation of Animals. His fascination sprouted from his study of Aristotle’s ideas of generation. Harvey decided to further investigate Aristotle’s views by studying a hen’s eggs in order to understand the meaning of generation in animals. He justified his decision and his plan of pursuing his research in “ Of the Method to be pursued in studying Generation” passage of the introduction to Essays of the Generation of Animals. First of all, a hen’s egg had a simple structure and readily available for frequent experimentation. In the introduction to his essays, he further explained that his choice of using a chicken egg was acceptable because the other animals had similar means of generation. Results drawn from the experiment he would conduct on a hen’s egg could be related to the reproduction in more complex animals; even animals that did not produce eggs. All animals reproduce with some form of an egg, which he considered to be a metaphor for the simple origin of any new life form. Harvey considered it necessary to start with the less complicated animals because this would allow him to repeat the tests many number of times to ensure accurate results. His strategy was to observe the formation of a chick to create a history of its development. Harvey would then use this information to show the cause of generation and the order in which it proceeded in.

Before Harvey's research, scientists believed in a theory known as pre-formation, which assumed that an animal already possessed the traits of the mature mammal and grew in size in the mother's womb. William Harvey refuted these prior theories in his consideration of the history of an egg's development. He noticed that the fetus began as a single drop of blood and then further differentiated into an egg which later became the chick. As a result, he rejected the idea that an exact replica of the organism could be found in reproductive material of either the male or the female. Harvey, however, learned by investigating the stages of development in the eggs that some parts of the animal are engendered before others. (Book: William Harvey and the Purpose of Circulation; author: Walter Pagel; year: 1951).

Another concern of Harvey's was the theories of previous scientists on the role of the male and the female in animal generation. Scientists before attempted to find an answer to this mystery. Galen assumed the yolk in a hen's egg was a joint of male and female secretions (Book: Investigations into Generation; author: Elizabeth Gasking; year: 1967). Aristotle hypothesized that the cause of generation was the male's semen acting on the menstrual blood of the female making the menstrual blood the source of matter and the semen the efficient source (Book: William Harvey and the Primacy of Blood; author: John White; year: 1986). Fabricius presumed the male caused the material and the female provided the nourishment.

Harvey wanted to solve the mystery of the purpose of each sex, so he examined the male and female genital systems of the deer carcasses he found in King Charles' Royal Parks (Book: Investigations into Generation; author: Elizabeth Gasking; year: 1967). Through Harvey's investigation, he

disproved Aristotle’s theories and clarified this in the passage “ Of the manner, according to Aristotle, in which a perfect and fruitful egg is produced by the male and female fowl” in his essays (Book: The Works Of William Harvey; translated by Robert Willis; year: 1847). He did not consider Aristotle’s ‘ efficient cause’ as relevant in the discussion of reproduction because Aristotle’s agent of the efficiency was only semen from the male. According to Harvey, semen was an external cause and could not produce an effect on the soul of the offspring because it was not with it throughout its lifetime of the offspring (Book: Investigations into Generation; author: Elizabeth Gasking; year: 1967). Also, Harvey explained the female must have a role in the efficiency when he stated, “ The earth, too, spontaneously engenders many things without seed, and among animals, certain females, but females only, procreate of themselves and without the concurrence of the male: hens, for example, lay hypenemic eggs; but males; without the intervention of females, engender nothing” (Book: The Works Of William Harvey; translated by Robert Willis; year: 1847). He deduced that if the female can reproduce without the male, then the male must not be the only agent to produce the efficiency. He was able to develop this view by looking at less complex organisms and extending it to more evolved animals because he considered all animals to share similar reproductive processes. Accordingly, he allowed himself to make broad generalizations about generation through species barriers. One of the many reasons for William Harvey’s success was his meticulous experimentation, now known as the scientific method. Scientists preceding William Harvey used experimentation in order to investigate; however, Harvey set a new standard for testing. He made precise calculations before and during experiments. For example, in

his study of circulation, he calculated the exact amount of blood released from the heart with every thrust (Book: Early Reactions to Harvey’s Circulation Theory: The Impact on Medicine; author: Steven Lubitz; year: 2004). Harvey closely examined and dissected various animals. While many scientists such as Galen used only careless observation, Harvey tested physically and then retested numerous times to ensure his results lacked error. In fact, William Harvey was the first to apply quantitative and observational methods simultaneously within his research. He picked test subjects that would be immediately available for many experiments. In the examination of blood and animal generation, Harvey used hen’s eggs because they were cheap and available in abundance. As the King’s physician, Harvey examined deer in his studies of animal generation. King Charles was fascinated by Harvey’s research, so he gave the carcasses of his weekly deer hunting to Harvey to dissect (Book: Where Do Babies Come From? ; author: R. V. Short; year: 2000). The substitution of the mammal into testing greatly advanced Harvey’s research because he could relate his concepts of reproduction to an organism that did not produce an actual egg.

Contributions

Harvey was awestruck by the way blood flowed through the human body. Most people of the day believed that food was converted into blood by the liver, and then was consumed as fuel by the body. Harvey knew this was false by the understanding of his firsthand observations of the human and animal dissections he made earlier to study on. In 1628 Harvey published An Anatomical Study of the Motion of the Heart and of the Blood in Animals which explained how blood was pumped from the heart throughout the body,

then returned to the heart and re-circulated. This book expressed views that were very controversial and lost Harvey many patients, but it ultimately became the basis for all modern research on the heart and blood vessels. Unlike the other anatomical textbooks written in the past, Harvey's book has only one illustration with a set of four related figures. This absence of pictures was probably deliberate to show Harvey's dedication to the scientific experimental method. The reader by actually recreating Harvey's experiments was forced to follow each step of Harvey's methods specifically, in a way that a general examination of illustrations did not require. The four figures depict a simple but persuasive experiment that can be performed on a human arm without dissection. The experiment involves tying the arm with a tourniquet and adjusting the tightness to demonstrate that the blood can either be cut off from the arm or permitted to overfill the arm, causing the veins to bulge. This procedure was also used for bloodletting: the removal of blood from the vein in the arm was a common treatment for a variety of medical conditions and was also a means of preventing disease.

Bloodletting was a common therapy of early medicine. It was done by cutting into a vein, called venesection or phlebotomy. This work was often done by a surgeon or a barber-surgeon. The veins near the elbow were commonly used.

In this book, Harvey proves the following:

that it is the contraction, not the dilation, of the heart which coincides with the pulse, and that the ventricles as true muscular sacs squeeze the blood which they contain into the aorta and pulmonary artery;

that the pulse is not produced by the arteries enlarging and so filling, but by the arteries being filled with blood and so enlarging;

that there are no pores in the septum of the heart, so that the whole blood in the right ventricle is sent to the lungs and around by the pulmonary veins to the left ventricle, and also that the whole blood in the left ventricle is again sent into the arteries, around by the smaller veins into the vena cava, and by them to the right ventricle again — thus making a complete “ circulation”;

that the blood in the arteries and that in the veins is the same blood;

that the action of the right and left sides of the heart, auricles, ventricles and valves, is the same, the mechanism in both being for reception and propulsion of liquid and not of air, since the blood on the right side, though mixed with air, is still blood;

that the blood sent through the arteries to the tissues is not all used, but that most of it runs through into the veins;

that there is no to and fro undulation in the veins, but a constant stream from the distant parts towards the heart;

that the dynamical starting-point of the blood is the heart and not the liver.

This demonstration of the circulation was incomplete in one point only, though. Harvey could not discover the capillaries through which the blood passes from the arteries into the veins. This gap in the circulation was filled in several years later by the great Italian anatomist Marcello Malpighi, who in 1661, a few years after Harvey’s death, observed in the lungs of a frog, by

the newly invented microscope, how the blood passes from the one set of vessels to the other. Harvey saw all that could be seen by the naked eye in his observations on living animals; Malpighi, four years after Harvey’s death, by another observation on a living animal, completed the marvelous chain of evidence.

A second ground-breaking book published by Harvey in 1651, Essays on the Generation of Animals, is considered the basis for modern embryology.

In the seventeenth and eighteenth centuries, theories of embryology and development were superimposed with theories of sexual reproduction, along with a number of theories on the origins of life, most of which supported the idea of spontaneous generation. During this period debates raged over spontaneous generation, the idea that life was spontaneously created out of inanimate matter. The popular belief that living organisms propagated from mud in streams, dirt, or environments such as rotting meat was supported by a number of scholars. William Harvey’s research into reproduction, published in 1651 as Exercitationes de Generatione Animalium (Essays on the generation of animals), began to cast doubt on spontaneous generation. Harvey believed that all life reproduced sexually, a view that he stated with his famous dictum Ex ovo omnia (“ Everything comes from the egg”).

Although he was taught by Fabricius, William Harvey criticized his teacher’s views about reproduction. In fact, the inaccuracy he saw in Fabricius’s beliefs prompted his investigation of animal generation (Book: The Ovary of Eve: Egg and Sperm and Pre-formation (The organism is preformed as a complete miniature structure in the sperm or the egg and simply grows larger as it

develops. This means that the first reproducing human would have had to have all succeeding generations within itself. Sort of like Russian dolls.) ; author: Pinto-Correia, Clara; year: 1997). The flaws Harvey detected were in Fabricius’s idea of the role semen played in reproduction. His teacher thought that after the male had been in contact with the female, all the eggs are made fertile. But upon his experimentation, Harvey discovered that the hen laid an egg ten days after interaction with the male, and then another thirteen days after. Hence, he concluded that the male did fertilize more than one of the yolks.

Awards/ Prizes

William Harvey never won any awards or prizes, al