Andreas Vesalius and De Humani Corporis Fabrica

MARK E. SILVERMAN, M.D.
Department of Cardiology, Emory University School of Medicine, and Piedmont Hospital, Atlanta, Georgia, USA

They ought to be grateful to me as the first who has dared to attack man's false opinions, to lay bare the extraordinary frauds of the Greeks, and to provide our contemporaries with an unusual opportunity for searching out the truth.

Andreas Vesalius
Letter on the China Root, 1546

Andreas Vesalius was born in Brussels in 1514 or 1515, the son of the imperial apothecary to Margaret of Austria and Charles V. Several ancestors were prominent court physicians. Because his father was frequently absent, the young Vesalius was greatly influenced by his mother who encouraged him to read the extensive family collection of ancient medical treatises. Little is known of his childhood until age 15 when he entered the University of Louvain where he studied Greek, Latin, Hebrew, rhetoric, and philosophy and displayed a precocious interest in anatomy by dissecting mice, moles, rats, and dogs.

In 1533 Vesalius enrolled at the medical school of the University of Paris where he learned anatomy under the tutelage of John Guinter and the celebrated Jacobus Sylvius. Their teaching was based on animal and infrequent human dissections using the medieval approach—barber surgeons, often unskilled, performed the dissection while the instructor, sitting above, read from the writings of Galen whose teachings were held to be divine and indisputable. Frustrated by limited access to human material, Vesalius made unauthorized trips to charnel houses outside the walls of Paris to obtain skeletal material and bodies of executed criminals left hanging for dissolution. From these remains, he became so expert on osseous anatomy that he could identify each bone when blindfolded. These human dissections led to a growing realization that the anatomy of Galen was based primarily on monkeys and dogs. His anatomical prowess was recognized by his instructors, who gave him the unusual opportunity to perform a public anatomy where he displayed skills that far surpassed the usual dissector. Vesalius was later described by Guinter as "... a young man, by Hercules, of great promise, possessing an extraordinary knowledge of medicine, learned in both languages (Greek and Latin), and very skilled in dissection of bodies."

The outbreak of the Franco-German war in 1536 forced Vesalius, an enemy-alien, to leave Paris before finishing his medical degree. He returned to the University of Louvain where he continued his countryside forays and was able to procure an almost completely articulated skeleton. His growing reputation led to an invitation to conduct the first public anatomy in Louvain in eighteen years at which time he performed both the lecture and the dissection. His first book, Paraphrase on the Ninth Book of Rhazes, which deals with illness from head to foot, was published in 1537. A public dispute arose between Vesalius and Jeremiah Drevère, his instructor and an influential teacher, over the proper method to perform a venesection. Drevère vociferously supported the medieval practice that blood...
Andreas Vesalius. (Reproduced courtesy of the New York Academy of Medicine Library.)

must be drawn from a vein opposite the affected side; Vesalius strongly argued the classical view that the vein on the same side should be chosen. In defending himself, Vesalius revealed his contempt for Dreverre, his loyalty to his Paris professors, and his belief in Galen.

Having finished his baccalaureate, Vesalius moved to the famous University of Padua near Venice where he received his Doctor of Medicine with honors in 1537. Shortly thereafter, at the age of only 23, he was appointed to the chair of surgery and anatomy (Fig. Padua was the recognized center of intellectual discourse and the rebirth of the humanistic spirit where opportunities for original thought and experiment could flourish. In his role as Professor of Surgery and Anatomy, Vesalius had the opportunity to perform public dissections. These events consisted of detailed human and animal dissections demonstrated daily over several weeks in front of a large audience who paid fees to attend. These dissections were enlivened by Vesalius through the novel use of accurate drawings. Prior to Vesalius, illustrations were felt to detract from the printed word. With the artistic help of John Stephen van Calcar, Vesalius assembled a set of anatomical plates for the aid of his students—The Tabulae Anatomicae Sex—published in 1538. The same year he revised Gunter’s Institutiones Anatomicae to be used as a text to accompany his lectures and demonstrations. The revision included the following insight into the motion of heart:

When [the heart] is dilated it draws spirit from the lung by way of the pulmonary vein for the sake of refrigeration, and blood from the vena cava; when it is contracted it expels the sooty vapors through the pulmonary vein, blood into the lungs through the pulmonary artery, and spirit through the aorta into the whole body. For the heart is the source and origin of native heat, pulsation, and the animal faculty. Therefore it is proper to inquire whether the pulse is the same in the heart and in the arteries: that is, whether the transmission of material from the heart occurs on its contraction, and the introduction of material on its distention.

In 1539 Vesalius published his views on bloodletting in the “Venesection letter.” Although the letter indicates his continuing support for the authority of Galen, he also incorporates his opinion that a scientific approach based on dissection merits respect.

Over the next several years Vesalius labored over the production of his magnum opus, De Humani Corporis Fabrica (On the Structure of the Human Body). The expository Latin text and the accompanying magnificent illustrations represent the fruition of his anatomic experience, his willingness to present anatomy with an unbiased eye, and the independent spirit of an undaunted man who was willing to challenge the ancient dogma of Galen despite the acerbic opposition of his teachers and other authorities. Prior to De Fabrica, anatomical illustrations were crude, with the notable exception of Da Vinci (1452–1519), whose sketches lay unavailable for centuries. The spirit of the Renaissance, which taught that art is a reflection of nature, is represented by background countryside landscape seen in the renowned “muscle-men series.” The true identity of the artist has never been determined; the major considerations include van Calcar, Titian, artists supervised by Titian, or Vesalius himself. Published in 1543 by Operinus of Basil, the final work is a masterpiece, referred to by Osler as “the full flower of the Renaissance... a sumptuous tone... the chef d’oeuvre of any medical library” and by others as the foundation of modern anatomy. One of the more interesting and controversial aspects of the work is the title page (Fig. 2) depicting Vesalius in the center performing a dissection in front of an excited crowd of students, clergy, officials, and laymen who are pressing forward to glimpse the human dissection. Animals at the extreme sides and barber surgeons placed under the dissecting table indicate symbolically that the medieval approach is no longer suitable. An articulated skeleton, serving for reference and as a symbol of death, hangs over the fe-
male cadaver. A compact version for beginners, The Epitome, was also published in 1543.

The significance of De Fabrica lies in its insistence that anatomy must be based on findings verified by human observation, not on the teaching of Galen and other ancient authorities. Many of the errors of Galen are corrected and new information is picturesquely provided about structures not previously discussed in detail. For example, in his description of the cardiac valves, he provides a name for the left atrioventricular valve by suggesting that it resembles a bishop’s mitre (head dress). While correcting the anatomy of Galen, Vesalius does not dispute Galenic physiology. According to Galen, chyle was transformed into blood in the intestine and then transported to the liver by a dynamic process of attraction inherent in the fibers of all vessels. A “natural spirit,” necessary for organ function, was added in the liver. A portion of this enhanced blood was then attracted into the vena cava and traveled to the right ventricle where impurities were carried off to the lung to be expelled. A small portion of the blood also moved through invisible pores in the ventricular septum into the left ventricle where it combined with inspired “pneuma” and formed the “vital spirit.” The vital spirit was drawn into the aorta and arterial system to be distributed throughout the body. Vesalius considered the heart to be a two-chambered structure; the right atrium was an expansion of the superior and inferior venae cavae and the left atrium a part of the pulmonary vein. He was dubious about the existence of pores in the ventricular septum. In the revised edition he expresses further doubts:

In presenting reasons for the construction of the heart and the use of the parts I have in large degree fitted my discourse to the teachings of Galen, not because I believe them to be in entire agreement with the truth but because I am yet hesitant to present a completely new use and function for those parts.

The book is not without significant error; at times Vesalius inexplicably depends upon animal anatomy. The reaction to De Fabrica was severe, especially from Sylvius, his former teacher and an ardent Galenist, who said “Let no one give heed to that very ignorant and arrogant man who, through his ignorance, ingratitude, impudence, and impiety denies everything his deranged or feeble vision cannot locate.” Bitter over the acrimonious reception, Vesalius burned his notes for a manuscript on Galen and other works. In 1546 in “The letter on the China Root,” he brilliantly defended his criticisms of Galen. Despite his stunning achievement at the age of only 29 and a revision of De Fabrica in 1555, Vesalius contributed very little else of importance. While he was away from Padua attending to the publication of De Fabrica, Realdus Columbus, his former pupil, joined with others in criticizing him and replaced him as lecturer in anatomy. Dispirited and frustrated over the turn of events, Vesalius left academic life and became physician to Charles V, the Emperor of Spain. As an imperial physician, he traveled extensively and gained further fame for his ability to drain empyema and to prognosticate. After the abdication of Charles V to his son Phillip II of Spain in 1559, Vesalius moved to Madrid where he served in the imperial court despite jealousies shown to him by the Spanish physicians.

In 1564 he embarked on a pilgrimage to Jerusalem. The reasons for his trip are uncertain. He may simply have tired of imperial life and the envy of the Spanish physicians or desired to return to Padua where the chair of anatomy was vacant following the death of Fallopius. There is also an unconfirmed and probably erroneous story that he began a dissection only to discover that the person, a nobleman, was still alive. It is conjectured that he consented to a pilgrimage to expiate the Inquisition. After traveling to Jerusalem, where he learned that he could return to his former position at Padua, he apparently became ill during an extended stormy voyage in which food and water supplies were depleted. He died of an unknown
cause October 15, 1564 at the age of 50, shortly after reaching the island of Zante, near Greece. A contemporary wrote, "But what shall I say of the great Vesalius, so excellent and unusual for our times?... He was a very great philosopher and physician, but in matters of anatomy so rare and singular that it can deservedly be said that he was almost the founder, and marvelously illustrated and brought that very noble science to perfection.""