

# Andreas Vesalius

## The Resurrection of Anatomy

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*La resurrección de la anatomía*

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Until the first decades of the 16th century, although the teaching of anatomy had been the object of some contributions, in general it remained static, subject to the rigidity of the medieval legacy and the Galenic tradition. The texts used were mediocre translations of the classical works, which had been translated from Greek into Arabic and then into Latin. It was not until the beginning of this century that direct translations from Greek into Latin were made, such as Galen's text *De usu partium*. At that time, the teaching of anatomy was scholastic. In his "*Cátedra*", the professor read a text by Galen, Mondino di Luzzi, Rhazés or Avicenna, while the surgeon (barber) cut the corpse. This circumstance only evidenced a bookish, theoretical knowledge, without removing from the ancient authors. There was no communion between the anatomist and the studied human body. To this must be added the existing limitation to obtain corpses for dissection, which were authorized in number of one for each sex and only during the winter period. All these inconveniences, added to a very poor and incorrect medical terminology, with illustrations that contributed little to clarification, and coupled with a dogmatic attitude regarding the transmission of knowledge, made anatomy an uncertain subject. The positive side was given by the appearance of a greater number of universities and the contribution of progressive authors such as Berengario da Carpi (circa 1460-1530) and *Giambattista Cannano* (1515-1579), the latter mentioned by Vesalius in his *Anatomicarum Gabrielis Fallopii Observationum Examen* (1564).

Berengario da Carpi graduated in Bologna and had experiences with human dissections, which allowed him to publish in 1521 *Commentaria cum amplissimis additionibus hiperanatomian mundini*. Taking a pragmatic position in relation to Aristotle's triventricular heart and Galen's biventricular heart, he expressed that the pores constituted the third ventricle. He also detailed the pericardial fluid and the oblique position of the heart.

In relation to the importance of the pulse, given in this period of the Renaissance, Joseph Struthius (Polish, 1510-1568) speaks of rediscovering its value in diagnosis, "*after twelve hundred years of being lost*",

as he says in his work *Ars sphygmica* (Basel, 1540). This affirmation of Galenism is also found in the text *De pulsus arte et harmonia* (Valladolid, 1584) by the Spanish Luis Mercado (1520-1606).

Andreas Vesalius had the virtue of establishing a new order in anatomy. He did not lack a humanistic education nor of respect for classical figures, but he did endow his knowledge with the spirit of research and direct confirmation on the corpse. His own words: "*anatomical dissection can be used to test speculation*" represent a change in the objectivity of the scientific method of that time. Thus, he established with his work a dividing line in the study of anatomy between the Middle Ages and the Modern Age.

With regard to circulation, his achievements were not outstanding even from an anatomical point of view, while in physiological concepts he was a faithful follower of Galen. However, the scientific honesty of the method used to achieve anatomical reality through human dissection lit the path towards the great goals of a period of splendor as the Renaissance.

Vesalius was born in Brussels on December 31, 1514. Belonging to a family of physicians for several previous generations, he had a careful education, first at the famous Jesuit college in Louvain and then in Paris (1533). In Louvain he wrote *Paraphrasis in nonum librum Rhazae ad regem Almansorem* (1537), where he makes a comparison between Galenic and Arabic medicine. In Paris he studied with Jacobo Dubois "Silvio", Günther von Andernach and Jean Fernel. He also cultivated the friendship of the Florentine Guido Guidi, (deceased in 1569) author of a work called *Chirurgia* who developed a prominent action in Pisa,

In Paris he stood out as a precocious dissector with an observant spirit, despite studying at a dogmatic university impervious to renewal. This characteristic led him to move to the University of Padua, which illuminated the Renaissance with its own light, and which would later be called by Vesalius "*true nurse of geniuses*". In this university he graduated as a doctor on December 5, 1537 before turning 23, immediately occupying the position of *explicator chirurgicae* (professor of surgery) for five years, inaugurating the line

of the great Padovan anatomists (Realdo Matteo Colombo, Gabriele Falloppio, Fabrizio d'Acquapendente, Giulio Casserio). In his "*Cáthedra*" he worked ceaselessly. He meticulously studied, dissected and recorded his observations, having the executed criminals as material, according to a provision granted by Judge Marcoantonio Contarini. At first he accepted the morphology emanating from Galen, but he discovered his errors as he expanded his dissections, coming to understand that the Pergamene had described anatomy based on animal dissection ("*Ah, Galen, what did you do with your monkeys!*") he would later say in his magnum opus). He personally carried out dissections in classes of up to five hundred students, placing special emphasis on clarifying anatomical terminology. This indefatigable work determined that he published his *Tabulae anatomicae sex* (1538) in Venice, consisting of a series of images derived from his observations.

In 1538, in a dissection manual called *Institutiones anatomicae secundum Galeni sententiam... per Joannem Guintherium Andernachum... ab Andrea Vesalio... auctiores et emendationes redditae*, he recounted a brief observation in which he synchronized the cardiac systole with the arterial pulse, contrary to Galen's opinion. In 1539 he published in Basel *Epistola dolens venam axiliarem dextri cubitii in dolore laterali secundam* ("*Letter on bleeding*"), on the occasion of a discussion that arose on this subject with the Bologna professor Matteo Corti (1495-1542), on the spot where bleeding should be performed.

Vesalius' fundamental work, the one that would change traditional medical concepts, was *De humani corporis fabrica, libri septem* (Basel) dedicated to the King of Spain Charles V, when the author was only 28 years old. This 663-page text, written in Latin, consists of VII Books and 300 illustrations apparently made by Johann Stephan Van Calcar (circa 1546), who was a disciple of Titian (Italian, 1477-1576). The printer of the *Fabrica* was Juan Oporino, and the work was published in the year 1543, thus splitting the Galenic hegemony of almost fourteen centuries. Vesalius himself traveled to Basel to oversee the printing. During his stay in that city, at the local University he prepared a skeleton that is still preserved in the Anatomical Museum, this being the oldest anatomical preparation that has come down to our days. Also, in 1543 he published the *Epitome*, which can be considered a condensed selection of the *Fabrica*. It has been speculated about the possibility that Vesalius could have known some of Leonardo's drawings, but no confirmation has been reached in this regard.

Paradoxically, the other monumental work of the Renaissance, *On the Revolution of the Celestial Spheres* written by Nicolás Copernicus (Polish, 1473-1543), breaking the cosmic structure of the Greek astronomer Claudius Ptolemy (2nd century AD), was published during the same year.

Vesalius enjoyed great fame, despite criticism from Galenists, since they reacted to his assertion that Ga-

len never dissected a human corpse by himself. This challenge to his work caused him a great depression, which led him to burn much of his medical writings. Disputed by various universities, he nevertheless accepted the position as Charles V Physician in 1544, which benefited him financially, and led him to become a consulting professional for the wealthy class. Among them he attended King Henry IV, who during a tournament organized to celebrate the marriage of his daughter Elizabeth of Valois with Philip II, suffered the impact of a spear on his skull (1559). He recognized in the trauma a kickback mechanism in the King's brain, the outcome of which would be fatal, evidencing a special diagnostic sensitivity.

In 1547 he published *Chinae radix* ("*Letters on the Chinese root*"), with a violent attack on the Galenists, describing an anti-syphilitic therapeutic action in this plant. In response to some ardent observations coming from Falloppio (circa 1523-1562) in his only work *Observationes anatomicae* (1561), Vesalius published in 1564 the *Anatomicarum Gabrielis Fallopii observationum examen*. In it he describes the venous valves, from an account that Giambattista Cannano gave him in Regensburg in 1546 and to which he assigns only a support function, ignoring their true meaning. In this text he also mentions the "*ductus arteriosus*" and the foramen ovale. Vesalius died in 1564, returning from a trip he made to the Holy Land, being buried on the Ionian island of Zante or Zacynthos, in a church where Cicero was reburied. For some testimonial groups of history, the reason why he undertook such a trip would be originated by mandate of the Spanish Inquisition, when he inadvertently dissected a corpse whose heart was still beating.

We will now consider the value of Vesalius with respect to blood circulation. There were two editions of the *Fabrica*. In the first one published in 1543, in book III referring to the vascular system, he describes the inferior mesenteric veins and the hemorrhoid vein. Book VI includes the study of the intrathoracic organs. In it, when talking about the heart and expressly referring to the left atrioventricular valve, he writes, it can be "*very well compared to a bishop's miter*". He describes the heart as consisting of two chambers or ventricles, since he considered the right atrium as part of the vena cava and the left atrium as a cavity belonging to the pulmonary veins.

Although he expresses not having observed the septal pores, he admits them when writing: "*the interventricular septum is formed by the most compact substances of the heart. On its two faces certain excavations abound. Of these, as far as the senses manage to perceive, none passes from the right ventricle to the left ventricle... we must therefore be astonished at the activity of the Creator, who makes the blood transpire from the right to the left ventricle through passages that are beyond our view*". On the other hand, in the second edition of the *Fabrica* published in 1555, he emphatically denies that such communication exists, writing

verbatim: “*although these dents are sometimes evident, none, as far as the senses can reach, passes from the right ventricle to the left ventricle.*”

In this second edition he details that in the lumen of the vessels there is a “*substantia eminens*”, which is a description of the venous valves that, as we said before, was communicated to him by Giambattista Cannano in Regensburg. Vesalius does not understand the real meaning of the function of these structures, assigning them only a support function.

His work dethroning concepts of Galenism caused violent reactions in some authors of the time, who displayed a conservative spirit. They were his teacher in Paris Jacobo Dubois “Silvio” who attacked his ideas in *Vaegem cujusdam callumiarum in Hippocratis Galle-*

*nique rem anatomicam depulsio* (1551), Francisco del Pozzo (deceased in 1564) author of *Apology in anatomy pro Galeno contra Andream Vessalium bruxelliensem* (1562) and Girolamo Capivaccio (1523-1589) who came to the controversy with his text *De methodo anatomica* (1593).

The value that should be sought in Vesalius’ work on circulation is inferred from the methodological contribution that he achieved for its future description. This importance is given by the attitude of rupture that he carried out with Galenism. The prudence and firmness with which he performed his work makes it even more grandiose, since he used incontrovertible elements such as direct observation and experimentation on the corpse.