

# Michael Servetus: unveiling the secrets of pulmonary circulation

*Miguel Servet: descubriendo los secretos de la circulación pulmonar*

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## ABSTRACT

The 16<sup>th</sup> century, an era marked by turmoil and transformation, witnessed a significant breakthrough in the field of anatomy and medicine. It was during this period that the dissection of human cadavers, previously considered a sacrilegious and forbidden act by the Holy Inquisition, began to be accepted as a fundamental tool for the study of the human body. This new approach enabled anatomists and physicians of the time, such as Andreas Vesalius, to make groundbreaking discoveries that would lay the foundations for modern medicine. Among these advances, the discovery of blood circulation, made by William Harvey in 1628, stands out particularly, revolutionizing our understanding of the human body's functioning. However, it is surprising that very few historians and medical scholars have highlighted the important discovery of pulmonary circulation made by Spanish physician Miguel Servetus in 1553. It is possible that this is due to the fact that his description of pulmonary circulation was embedded in Book V of his theological work "Christianismi Restitutio", which may have reduced the visibility of his contribution to the field of medicine. Nevertheless, it is essential to recognize Servetus' pioneering role in understanding blood circulation and his influence on Harvey's subsequent discoveries. Our attention will turn to the prominent figure of Michael Servetus, a pivotal character in the history of medicine and theology. This article will delve into his life, works, and notable contributions, with particular emphasis on his groundbreaking description of the lesser or pulmonary circulation.

**Keywords:** history, Miguel Servet, Michael Servetus, pulmonary circulation, theology, 16<sup>th</sup> century.

## RESUMEN

El siglo XVI, una época marcada por la convulsión y el cambio, fue testigo de un importante avance en el campo de la anatomía y medicina. Fue en este periodo cuando la disección de cadáveres humanos, hasta entonces considerada un acto impío y prohibido por el Santo Oficio Inquisitorial, comenzó a ser aceptada como una herramienta fundamental para el estudio del cuerpo humano. Este nuevo enfoque permitió a los anatomistas y médicos de la época, como Andreas Vesalio, realizar importantes descubrimientos que sentarían las bases para la medicina moderna. Entre estos avances destaca especialmente el descubrimiento de la circulación sanguínea, realizado por William Harvey en 1628, que revolucionaría la comprensión del funcionamiento del cuerpo humano. Sin embargo, es sorprendente que muy pocos historiadores y estudiosos de la Medicina hayan destacado el importante descubrimiento de la circulación pulmonar realizado por el médico español Miguel Servet en 1553. Es posible que esto se deba a que su descripción de la circulación pulmonar se encontraba inserta en el libro V de su obra teológica "Christianismi Restitutio", lo que podría haber restado visibilidad a su campo de contribución en el campo de la medicina. No obstante, es fundamental reconocer el papel pionero de Servet en la comprensión de la circulación sanguínea y su influencia en los descubrimientos posteriores de Harvey. A continuación, nos enfocaremos en la figura protagónica de Miguel Servet, un personaje clave en la historia de la medicina y teología. En este artículo exploraremos su vida, su obra y sus contribuciones significativas, destacando especialmente su papel como pionero en la descripción de la circulación menor o pulmonar.

**Palabras clave:** historia, Miguel Servet, Michael Servetus, circulación pulmonar, teología, siglo XVI.

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*Qui ambulat in tenebris, nescit quo vadat*

**M**ichael Servetus was a Spanish theologian, physician and humanist. He is considered one of the most important figures in the Protestant Reformation and a pioneer in modern medicine. The relationship between Michael Servetus' discoveries and the work of William Harvey is a topic of debate among medical historians. Although Harvey does not explicitly mention Servetus in his work *De Motu Cordis* (1628), it is possible that he was influenced by Servetus' ideas. Servetus had described the pulmonary circulation in his work *Christianismi Restitutio* (1553), and it is possible that Harvey had access to this information through indirect sources. The discovery of the pulmonary circulation is described in Book V of the *Christianismi Restitutio* by Michael Servetus.

However, this fact went practically unnoticed through time because of its theological content, this work was included in the index of prohibited and censored books by the Holy Inquisition. However, some surviving copies that managed to escape the fire suggest that Harvey may have had access to this document, which reinforces the theory that Servetus was a pioneer in the description of pulmonary circulation.

We will proceed to analyze the chain of events that culminated in this discovery of pulmonary circulation by Michael Servetus.

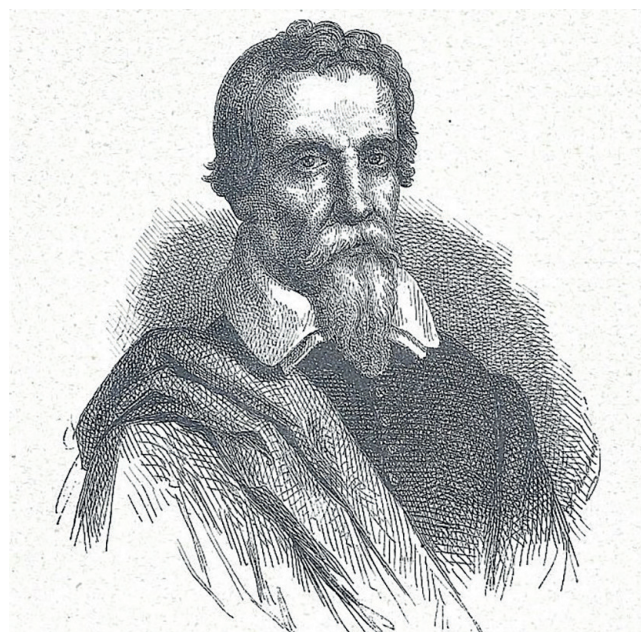
The life of Michael Servetus is an enigma wrapped in contradictions. His birth, a mystery. Aragon or Navarre? 1506 or 1511? Servetus' answers fade away like smoke in the wind, leaving behind a large amount of uncertainty. This ambiguity is largely due to the inquisitorial processes he faced. To protect himself from persecution, Servetus provided changing information about his identity and age at different times, which has led to confusion among historians.

However, according to historical records, *Michael Servetus Conesa* was born in Villanueva de Sijena, a small town in the province of Huesca, in the kingdom of Aragon (Spain) on September 29, 1511.<sup>1</sup> This date and place of birth are considered the most accurate, despite the contradictions and ambiguities surrounding the life of this historical figure (Figure 1).

In 1526 he entered the University of Zaragoza to study philosophy and literature. In 1528 he moved to the University of Toulouse in the province of Languedoc (France) to study Roman and canon law, as well as the Old and New Testament.<sup>2</sup> It should be noted that at that time, the Council of Toulouse prohibited the reading of biblical texts to lay people.<sup>3</sup> He was also interested in theology and the Religious Reformation, developing his own ideas about faith and the Church. In 1529, he suddenly returned to Spain, because the Inquisition in Toulouse issued an edict of persecution against a list of 40 fugitives, spearheaded by Michael Servetus.<sup>4</sup>

From 1525 he had been accepted as a page and personal assistant to Friar Juan de Quintana. Between 1529 and 1530, his presence was requested by Friar Juan de Quintana, confessor of Emperor Charles V, to travel with Charles V's entourage to Bologna (Italy) to be crowned Emperor of the Holy Roman Empire by Pope Clement VII.<sup>5</sup> On October 25, 1530, Servetus arrived in Basel, a vibrant Swiss city that was an important cultural center and a breeding ground for innovative theological debates. This city, located in the heart of Europe, became a key stage for Servetus' intellectual and spiritual development.<sup>6</sup> In 1531, Servetus published "*De Trinitatis Erroribus*", a theological treatise that revealed his profound erudition and his ability to question the established theological doctrines of the time.<sup>7</sup>

In Servetus' time, Strasbourg (region of Alsace, France) was an important center of the Protestant Reformation and had become a refuge for Protestants persecuted in other parts of Europe. Thus, it was the home of many theologians and reformers. In 1532, in Strasbourg he published "*Dialogorum de Trinitate*".<sup>8</sup> Both were signed by Servetus with his real name as "*Michelem Servet, alias Reves ab Aragonia Hispanum*". In both texts he questioned and sharply rejected the concept of the Trinity of scholastic theology. These two productions are important because they constituted the embryo of his major work, the "*Christianismi Restitutio*", which will be discussed later.



**Figure 1:** Portrait of Michael Servetus (Servet-Michele-ritratto).

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The publication of “*De Trinitatis Erroribus*” had serious consequences for its author, since on May 24, 1532, the Spanish Inquisition in Medina del Campo began an investigation against Servetus, prohibiting the circulation of his work and summoning him to appear before the Holy Inquisition.<sup>9</sup>

It was highly likely the persecution of the Spanish Inquisition that pushed him to move and settle in Lyon (France). There, he published in 1535 “*The Geography of Ptolemy*”, now under the name of *Miguel de Villanueva* (*Micheal Villanovani*), making an impeccable translation from Greek to Latin.<sup>10</sup> Servetus’ decision to change his name could be motivated by the edict of persecution of the Spanish Inquisition. This circumstance could have contributed to the confusion about his place of birth, which some historians place in Tudela (Navarre, Spain).<sup>1</sup>

In Lyon he met Symphorian Champier, a physician and humanist, who convinced him to study medicine. He studied the works of Galen, Hippocrates, and Avicenna, among others. He relied heavily on observation as a basic cornerstone of medical practice.

Servetus subsequently moved to the University of Paris, where he enrolled in the Faculty of Medicine in 1537. There, he had the opportunity to learn from leading experts in the field, such as Jacques Dubois, known as Jacob Sylvius, and John Gunther d’Andernach,<sup>11</sup> a renowned German anatomist who had published the treatise “*Institutiones anatomicae*” in 1536, one of the first texts with detailed drawings of dissection on human cadavers, which would become a fundamental classic for the teaching of anatomy in Europe for a quite long time.<sup>12</sup> Sylvius wrote “*I had as assistants Vesalius, a very diligent young man in Anatomy, and then Michael Villanovanus, a man eminent in all letters and none inferior in the doctrine of Galen*”.<sup>13</sup> Under the mentorship of both, Servetus became familiar with the practice of dissection on human cadavers, which instilled in him a deep-seated interest in human anatomy. He also investigated the circulation of blood alongside Vesalius and laid the foundations for the further discovery and publication of pulmonary circulation in 1553.<sup>14-16</sup> He fought against the conventional medical uses and behaviors of the period, such as bloodletting, which was totally useless. He said “*it is necessary to cure the sick without making him suffer*”.

In 1537 published in Paris the *Syruporum universa ratio ad Galeni censuram*, the only book in Servet’s entire oeuvre with an exclusively medical character.<sup>17,18</sup>

The true passion of Michael Servetus was not only medicine, but also theology. He had a great knowledge and mastery of Hebrew, Greek and Latin. It is very likely that from a very young age, Servetus received his basic knowledge through his stay at the monastery of Villanueva, as well as at the monastery of Montearagón, where his mentor, Friar

Juan de Quintana, was the abbot. At that time, the monastic schools were the main cultural centers. The *Seven Liberal Arts* were taught in them: the *Tribium* or sermonical arts (grammar, dialectic and rhetoric), and the *Quiadrivium* or real arts (arithmetic, geometry, music and astronomy/astrology).<sup>19</sup>

Michael Servetus had a deep knowledge in astrology. At the University of Paris in the time of Michael Servetus, astrology was taught in the Faculty of Arts. The Faculty of Arts was one of the four faculties of the University of Paris (Law, Medicine, Theology, and Liberal Arts), and was responsible for teaching the Liberal Arts. Astrology was considered an important part of education in the Middle Ages and the Renaissance, and was taught as a tool to understand the movements of celestial bodies and their influence on human life. All were permitted by the Inquisition. The only one that was not permitted was *divinatrix* or judicial astrology (*qua ex astris praedicat*), which, based on the contemplation of planetary positions, determined conclusions regarding what could happen on a social or political level. It was punishable by burned at the stake.<sup>20</sup>

In his lecture on astrology at the Faculty of Arts of the University of Paris, Servetus predicted the eclipse of the Moon with Mars on February 13, 1538. Obviously, this was an astronomical phenomenon. The problem developed because Servetus turned this fact into judicial or predictive astrology by adding “*princes will be induced to warlike enterprises, and many countries will be devastated....*”.<sup>21</sup>

He was then ordered to discontinue his lecture in astrology at the University of Paris. In response he wrote and published a 16-page pamphlet entitled “*Michaelis Villanovani in quendam medicum apologetica discrepatio pro Astrologia*” (Apologetic Discourse of Michael de Villanova on Astrology against a Certain Physician Objector).<sup>22</sup> All this led to his being denounced before the procurator general of King Francis I. The trial before the parliament of Paris took place on March 18, 1538. The trial is recorded in the minutes of the Faculty of Medicine of the University of Paris, vol. V, 1538, page 97 and 98. Thanks to the influence of John Thiebalut, a Protestant physician and physician to the chamber of Francis I, who had also been physician and astrologer to Charles V, and to the participation in his favor of his friend the physician and astrologer Heinrich Cornelius Agrippa, the condemnation was very light and lenient : withdraw the pamphlets and obey the Faculty of Medicine and its Doctors.<sup>23</sup>

After this incident, he decided to leave Paris and move to Charlieu (France), where he developed as a doctor for almost three years. He did not yet have a medical degree, which he apparently could have obtained at the University of Montpellier in 1540.<sup>24</sup>

However, since 1541 he lived in the Dauphiné of Vienne (France), invited by the Archbishop of the Dauphiné Pierre Palmier, who had attended Servetus’ astrology lectures at the

University of Paris. Archbishop Palmier awarded him the title of physician of the Dauphiné of Vienne from 1541 to 1553.

Servetus met Pagnini in Lyon. Santes Pagnini was a disciple of the reformist and Protestant friar from Ferrara (Italy) Girolamo Savonarola. Pagnini left all his notes to Servetus when he died in 1536. Based on these notes, Servetus proceeded with the aforementioned printing of Pagnini's Bible in seven volumes.<sup>25</sup>

Between 1542 and 1545, Servetus was hired by the Compagnie des Libraires de Lyon, and he produced three editions of Bibles, which he enriched with annotations and new translations from Hebrew and Greek. In 1542, the *Bible ex Santes Pagnini*, in Lyon, and as editor Hugué de la Porte.<sup>25</sup> This was put on the list of books prohibited by the Holy Inquisition in Spain. In 1542, the *Bible Sacra ex postremis Doctorum*, a reduced version of the previous one.<sup>26</sup> In 1545, the *Bible Sacra cum glosis*. It took him 5 years to edit it. This last edition of the Bible is the most enriched by the annotations and corrections of Servetus, who signs under the pseudonym of *Michel De Villeneuve*. It is a reinterpretation of the Bible of Melchior Novesianus published in Cologne (Germany) in 1541.<sup>27</sup>

In 1553, in the Dauphiné of Vienne (France), he published his masterpiece of unparalleled, and the most heretical of all his literary production: the "*Christianismi Restitutio*".<sup>28</sup> It took him almost 10 years to write it. It consists essentially of four parts, two of which are the most relevant: Servetus' theological ideas contrary to traditional theological scholastic doctrine, and the lesser or pulmonary circulation of the blood. The fact that these medical descriptions are within the theological texts of the *Christianismi Restitutio* is because for Servetus, the divine spirit (the soul) is in the blood and spreads throughout the body.

Analyzing this work deeply, Michael Servetus was the first European to discover pulmonary circulation. There is no evidence that he was aware of the discovery of the physician Ibn Al-Nafis in 1212,<sup>29</sup> since the work was forgotten until it was accidentally rediscovered by the Egyptian physician Muhyo Al-Deen Altawi in 1924.<sup>30</sup>

The publication of *Christianismi Restitutio* turned out to be too problematic. It was carried out clandestinely, on the outskirts of the Dauphiné, with Balthazar Arnoullet and Guillaume Guérout taking over as editors.<sup>31</sup>

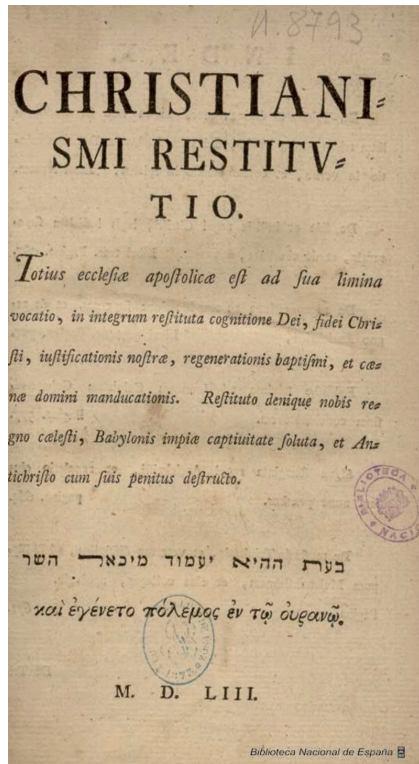
The *Christianismi Restitutio* presents several interesting facts. For example, it circulated in manuscript form from 1546, although incompletely due to the constant additions and revisions it underwent. Later, in 1551, the printers and editors Arnoullet and Guérout agreed to print the book. For this purpose, they established a clandestine printing press on the outskirts of Vienne, in the Dauphiné. Printing began in 1552 and was completed in 1553. The conditions that the printers set for printing were specific: they demanded that the

book be printed in the French Dauphiné of Vienne, possibly to have the support of Archbishop Pierre Palmier, a friend and protector of Servetus. In addition, Servetus took charge of all expenses, personally corrected the proofs and took charge of the distribution and sale of the book.<sup>32</sup>

In an edition of 800 copies, unbound to maintain discretion, the books were distributed as bales of paper. To avoid arousing suspicion, the first shipment was made clandestinely on 03 January 1553, and was sent hidden among bales of hay to the Frankfurt fair. Another was sent to Geneva, both destroyed on the orders of John Calvin. The third bale was sent to Lyon, then returned to Vienne, to be burned by the Holy Inquisition in Toulouse along with the effigy of Servetus. Currently, only two copies of the original first edition of *Christianismi Restitutio* have survived intact to this day. One of these valuable books is in the National Library of Austria in Vienna and another in the National Library of France in Paris. Another book is in the Library of the University of Edinburgh, but this one is missing the title page and the first 16 pages. In 1791, a reprint of *Christianismi Restitutio* was made in Nuremberg. Only four copies of this second edition have survived to this day, one in the Bibliothèque Nationale in Paris, one in the Bibliothèque Nationale in Geneva, and two in the Yale University Library. In addition, another copy is suspected to exist in the Vatican Library, although its existence has not yet been confirmed.<sup>32</sup> The 1553 edition was published anonymously, with no author credits or information about the printer. The only clue is the signature "MSV", believed to be that of *Miguel Serveto de Villanueva*.<sup>31,33</sup> (Figure 2).

To understand Servetus, it is necessary to understand the historical context dominated by Galenic physiology. Claudius Galen (129-216), a physician, surgeon and philosopher of the Roman Empire, was one of the most prominent medical researchers of the Ancient Age, whose ideas dominated European medicine for more than a millennium. According to Galen, the functioning of the body is based on the interaction between three fundamental concepts: spirits, virtues and operations. Spirits (*spiritus or pneuma*) are subtle materials that activate the organs of a cavity. In this context, virtues refer to the forces that drive the functioning of organs, and are identified with the Latin term *vis*, equivalent to the Greek *dy'namis*. The relationship between spirits and virtues is fundamental, since spirits trigger the virtues of organs, which combine to give rise to an operation. This operation is the specific action performed by a certain organ, and may involve several coordinated virtues. In short, the spirits are those that trigger the virtues of the organs, and the virtues are identified with the forces that make the organs function.

Furthermore, Galen classified spirits into three categories, corresponding to the three types of soul (understood as the principle of movement and change in living beings). These three types of *spirits or pneumas* are the natural or vegetative



**Figure 2:**

Cover of  
Christianismi  
Restitutio.  
The reproduced  
work belongs to the  
collection of the National  
Library of Spain.

spirit, based in the liver; the vital spirit, located in the thorax, with the heart as its fundamental organ and which also includes the lungs; and the animal spirit, the highest, based in the brain, and responsible for the most complex mental functions that characterize the human being. The natural spirit would spread from the liver through the veins and reach the heart. There, it would be transformed into the vital spirit, responsible for maintaining life through functions such as breathing, heartbeat and pulse. This would imply that the blood with the natural spirit, which reached the right heart, crossed the interventricular septum through invisible pores to end up in the left heart, where it finally mixed with air and created the vital spirit that was subsequently distributed throughout the body.<sup>34-36</sup>

However, it is important to note that in Galen's time, human anatomy was a little-explored field, as there were no authorized dissections on human cadavers. In fact, Galen's masterpiece, "De anatomicis administrationibus", is a collection of lectures on anatomy given in Rome around 177 AD. In them, Galen based himself on the dissection of monkeys, assuming a close similarity between animal and human anatomy.<sup>37</sup>

In the Middle Ages, the University of Bologna pioneered the practice of dissection of human bodies. Mondino de Luzzi (1275-1326) wrote the first anatomy book based on human dissections, "Anathomia". This groundbreaking work

demonstrated human anatomy in a practical way and lasted for more than two centuries. Mondino describes a three-day dissection, devoting one day to each major body cavity (abdomen, thorax, and head), and mentions the possibility of a fourth day for the extremities.<sup>38-40</sup>

Servetus' work, "*Christianismi Restitutio*", marked a milestone in the history of medicine by questioning the teachings of Galen, which had dominated the field for centuries. However, it was his experience in human dissections, acquired at the University of Paris, that allowed him to make important observations about pulmonary circulation and challenge Galenic theories.<sup>11,13</sup>

Servetus' true passion was theology, and to reduce him solely to a visionary physician who discovered pulmonary circulation is to simplify his legacy. The essence of his work reflects an inquisitive mind and a deep search for truth. In Servetus's vision, medicine and human anatomy were merely tools to discover "divine philosophy" or "sacred physiology", a deeper understanding of creation and the divine design underlying the human condition.

In Servetus's view, the divine breath was the essence of life, residing in the blood. To keep the human organism alive, this vital breath had to circulate freely through the body, carrying with it its vital spirit. It was this passionate search to understand the intrinsic connection between the divine breath and human life that prompted Servetus to discover pulmonary circulation. In this context, Servetus combined his medical-anatomical knowledge with his theological training.

Firstly, Servetus was based on various biblical texts, pointing out that life is in the blood, and that blood is life. However, it is interesting to note that the author was more interested in the journey of the soul than in the route of the blood. Furthermore, for Servetus, the soul resided in the blood, creating a unique and singular vision that combines theological and physiological elements.

Book V of *Christianismi Restitutio* contains the passage describing the pulmonary circulation<sup>28</sup> (Figure 3). The key in establishing the concept of pulmonary circulation was the understanding that blood flows from the pulmonary artery to the pulmonary veins. This implied that blood leaves the right heart through the pulmonary artery, returns to the left heart through the pulmonary veins [et à venâ arteriosâ in arteriam venosam transfunditur....and is transferred from the arterial vein (pulmonary artery) to the venous artery (pulmonary veins)] and then leaves the heart again. In this way, a circuit or circulation is formed or established. It was Servetus who first conceived this revolutionary idea.<sup>41</sup>

He established substantial differences regarding the formation of spirits, compared to the traditional Galenist concept, which we have already described above. Given the historical and medical importance of the text, I faithfully transcribe it in its original version in classical Latin (with its

corresponding translation), taken directly from Book V of *Christianismi Restitutio*<sup>28</sup> (Figure 4).

Servetus begins by giving an explanation, different from the traditional Galenic concept, about the different types of spirits, the soul, and the blood; this is what finally led him to describe the pulmonary circulation: "*Dicitur in nobis ex trium superiorum elementorum substantia esse spiritus triplex, naturalis, vitalis et animalis. Tres spiritus vocat Aphrodisaeus. Vere non flunt tres, sed denuo spiritus distincti. Vitalis est spiritus, qui per anastomoses ab arteriis communicator venis, in quibus dicitur naturalis. Primus ergo est sanguis, cuius sedes est in hepate, et corporis venis. Secundus, est spiritus vitalis, cuius sedes est in corde, et corporis arteriis. Tertius est spiritus animalis, quasi lucis radius, cuius sedes est in cerebro, et corporis neuris. In his omnibus est vnus spiritus et lucis Dei energia.*"

*Quod a corde communicetur hepati spiritus ille naturalis, docet hominis formatio ab utero. Nam arteria mittitur iuneta venae per ipsius foetus umbilicum: itidemque in nobis postea semper iunguntur arteria et vena. In cor est prius, quem in hepar, a Deo inspirata Adae anima, et ab eo hepati communicata. Per inspirationem in os et nares, est vere inducta anima: inspiratio autem at cor tendit. Cor est primus viuens, fons caloris in medio corpore. Ab hepate sumit liquiorem vitae, quasi materiam, et eum vice versa viuificat: sicut aquea liquor superioribus elementis materiam*

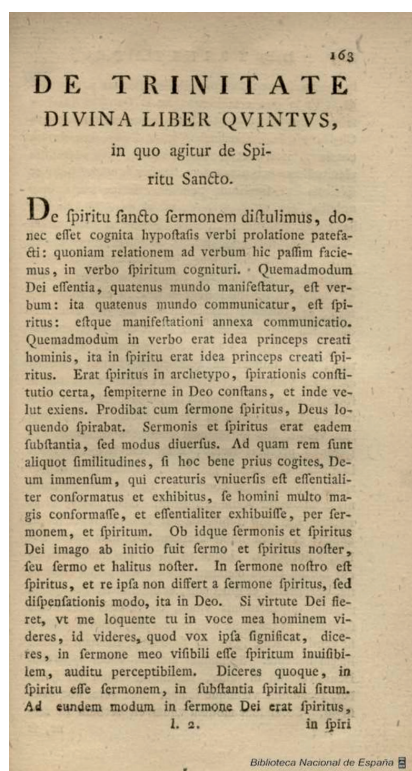


Figure 4:

Page 170 of *Christianismi Restitutio* containing the famous passage describing the pulmonary circulation. The reproduced work belongs to the collection of the National Library of Spain.

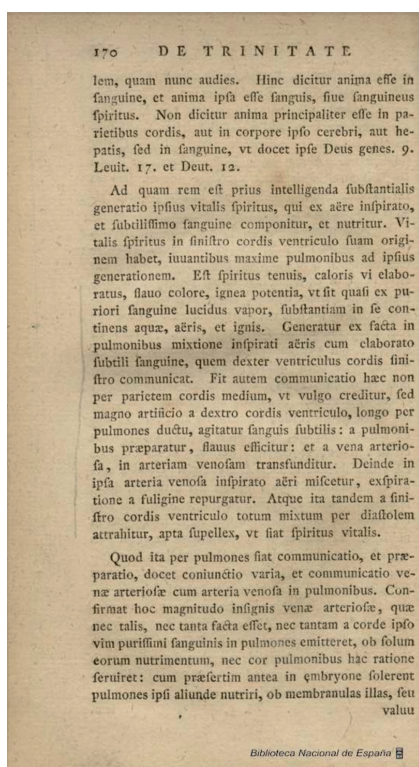


Figure 3:

Book V of *Christianismi Restitutio*. The reproduced work belongs to the collection of the National Library of Spain.

*suppeditat, et ab eis, iuneta luce, ad vegetandum vivificatur. Ex hepatis sanguine est animae materia, per elaborationem mirabilem quam nunc audies. Hinc dicitur anima esse in sanguine, et anima ipsa esse sanguis siue sanguineus spiritus. Non dicitur anima principaliter esse in perietibus cordis, aut in corpore ipso cerebri, aut hepatis, sed in sanguine, ut docet ipse Deus Genes. 9. Leuit. 17 et Deut. 12.*

*Ad quam rem est prius intelligenda substantialis generatio ipsius vitalis spiritus, qui ex aere inspirato, et subtilissimo sanguine componitur, et nutritur. Vitalis spiritus in sinistro cordis ventriculo suam originem habet, iuuantibus maxime pulmonibus ad ipsius generationem. Est spiritus tenuis, caloris vi elaboratus, sicut colore, ignea potentia, ut sit quasi ex puriori sanguine lucidus vapor, substantiam in se continens aqua, aeris, et ignis. Generatur ex facta in pulmonibus mixtione inspirati aeris cum elaborato subtili sanguine, quem dexter ventriculus cordis sinistro communicat. Fit autem communicatio haec non per parietem cordis medium, ut vulgo creditur, sed magno artificio a dextro cordis ventriculo, longo per pulmones ductu, agitur sanguis subtilis: a pulmonibus preparatur, flauus efficitur: et a vena arteriosa, in arteriam venosa transfunditur.*

*Deinde, in ipsa arteria venosa inspiratio aeri miscetur, expiratione a fuligine repurgatur. Atque ita tandem a sinistro cordis ventriculo totum mixtum per diastolem attrahitur, apta supellex, ut fiat spiritus vitalis. Quod ita per pulmones*

*fiat communicatio, et praeparatio, docet coniunctio varia, et communication venae arteriosae cum arteria venosa in pulmonibus.*

*Confirmat hoc magnitudo insignis venae arteriosae, qua nec talis nec tanta facta effet, nec tantam a corde ipso vim purissimi sanguinis in pulmones emitteret, ob folum eorum nutrimentum, nec cor pulmonibus hac ratione seruiret: cum praesertim antea in embryone folerent pulmones ipsi aliunde nutriri, ob membranulas illas, seu valuulas cordis usque ad horam natiutatis nindum apertas, ut docet Galenus. Ergo ad alium ufum effunditur sanguis a corde in pulmones hora ipsa natiutatis, et tam copiosus.*

*Item a pulmonibus ad cor non simplex aer, fed mixtus sanguine mittitur per arteria venosam: ergo in pulmonibus fit mixtio. Flauus ille color a pulmonibus datur sanguini spirituosus, non a corde. In sinistri cordis ventriculo non est locus capax tantae, et tam copiosa mixtions, nec ad flauum elaboratio illa sufficiens. Demum, paries ille medius, cum fit vasorum et facultatum expers, non est aptus ad communicationem et elaborationem illam, licet aliquid residare possit.*

*Eodem artificio, quo in hepate fit transfusio a vena porta ad venam cauam propter sanguinem, fit etian in pulmone transfusio a vena arteriosa as arteriam venosam propter spiritum. Si quis haec conferat cum iis, quae feribit Galenus lib 6. et 7. de usu partium, veritatem penitus intelliget, ab ipso Galeno non animaduersam.*

*Ille itaque spiritus vitalis, a sinistro cordis ventriculo, in arterias totius corporis deinde transfunditur, ita ut qui tenuior est, superiora petat, vbi magis adhuc elaboratur, praecipue in plexu retiformi, sub basi cerebri sito, in quo ex vitali fieri incipit animalis, ad propriam rationalis animae sedem accedens.*

*Iterum ille fortis mentis ignea vi tenuatur, elaboratur, et perficitur, in tenuissimis vasis, seu capillaribus arteriis, quae in plexibus choroidibus sitae sunt, et ipsissimam mentem continent. Hi plexus intima omnia cerebri penetrant, et ipsos cerebri ventriculos interne fucungunt, vasa illa secum complicata, et contexta seruantes, usque ad neuronum origines ut in eos sentiendi et mouendi facultas inducatur. Vasa illa miraculo magno tenuissime contexta, tameffi arteriae dicantur, sunt tamen fines arteriarum tendentes ad originem neuronum, ministerio meningum. Est nouum quoddam genus vasorum.*

*Nam ficut in transfusione a venis in arterias, est in pulmone nouum genus vasorum, ex vena et arteria: ita in transfusione ab arteriis in neuros est nouum quoddam genus vasorum ex arteriae tunica in meninge: cum praesertim meninges ipsae fuas in neuris tunicas seruent. Sensus neuorum non est in molli illa eorum materia, sicut in cerebro. Neuri omnes in membranarum filamenta definunt, exquisitissimum sensum habentia, ad quae ob id semper spiritus mittitur.*

*Ab illis itaque meningum seu choroidum vasculis, velut a fonte, lucidus animalis spiritus veluti radius per neuros essunditur in oculos, et alia sensoria organa. Via edaem, vice versa, aduenientes extrinsecus sensatarum rerum lucidae imagines, ad fontem eundem mittuntur, quasi per lucidum medium intro penetrantes.*

*Hinc quoque fit, ut praedictis vasis communem membranae tunicam in interna cauitate feruent nerui ad fidam spiritus custodiam: idque a tenui meninge, ficut et externam aliam tunicam habent a crassa. Illa etiam ventriculorum cerebri spatia inania, quae, philosophi et medici admirantur, nihil minus continent, quam animam.*

*Sed prima ratione facti sunt ventriculi illi as expurgamenta cerebri recipienda, veluti cloacae, ut probant excrementa ibi recepta, et meatus ad palatum et nares, a quibus desuxiones morbofae nascuntur. Et quando ventriculi ita opplentur pituita, ut arteriae ipsae choroidis ea immergantur, tunc subito genetaur apoplexia”* (It is said that in us, out of the substance of the three higher elements, there is a triple spirit, natural, vital and animal. Aphrodisius calls them three spirits. In truth, they are not three flowing spirits, but they are also distinct spirits. It is the vital spirit, which communicates through anastomosis of the arteries to the veins, in what is called natural. The first, then, is the blood, whose source is in the liver and veins of the body. The second is the vital spirit, whose seat is in the heart and organs of the body. The third is the animal spirit, like a ray of light, whose seat is in the brain and nerves of the body. In all of them there is one spirit and the energy of the light of God.

That this natural spirit communicates from the heart to the liver is shown by the formation of man from the mother's uterus. For the artery is sent united to the vein through the umbilical cord of the same fetus; and in us the artery and vein are always united afterwards. Adam's soul was inspired by God into the heart before it entered the liver, and was communicated by Him to the liver. By inspiration in the mouth and nostrils the soul is truly introduced; but inspiration tends to the heart. The heart is the first living being, the source of heat in the middle part of the body. From the liver it takes the liquid of life, so to speak matter, and in turn gives it life: just as the watery liquid supplies matter to the higher elements, and by them, united with light, is quickened to vegetate. From the blood of the liver comes the matter of the soul, through a wonderful elaboration which you will now hear. Therefore, it is said that the soul is in the blood, and the soul itself is the blood or the bloody spirit. It is not said that the soul resides primarily in the organs of the heart, or in the body itself, the brain or the liver, but in the blood, as God Himself teaches in Genesis. 9. Leviticus 17 and Deut. 12.

To this end, it is necessary first to understand the substantial generation of the vital spirit itself, which is composed and nourished by the inspired air and the subtler blood. The vital

spirit has its origin in the left ventricle of the heart, and the lungs especially assist in its generation. It is a subtle spirit, elaborated by the force of heat, or color, and the fiery power, so that it is like a luminous vapor of the purest blood, containing in itself the substance of water, air, and fire. It is generated from the mixture of the air inspired by the lungs with the blood being produced by the lungs, which the right ventricle of the heart communicates with the left. **This communication is not made by the middle wall of the heart, as is commonly believed, but by a great artifice from the right ventricle of the heart. After a long passage through the lungs, the subtle blood is agitated: it is prepared by the lungs, it becomes yellow and is transported from the arterial vein to the venous artery.**

Then, in the venous artery itself, the inspiration mixes with the air, and the exhalation purifies it from soot. And so finally the whole mixture is drawn out of the left ventricle of the heart through the diastole, a suitable vessel, so that it becomes the vital spirit. That the communication and preparation take place through the lungs is shown by the various connections and communications of the arterial vein with the venous artery in the lungs.

This is confirmed by the remarkable size of the vena arteriosa (pulmonary artery), which could not be made so large, nor could it send such a force of the purest blood from the heart itself to the lungs for their nourishment, nor does the heart serve the lungs in this way, especially since already in the embryo the lungs were nourished from another source, and because of these membranes the valves of the heart are not opened until the hour of birth, as Galen teaches. Therefore, for another purpose, blood is poured from the heart into the lungs at the very hour of birth, so copiously.

In the same way, from the lungs to the heart, not only air is sent, but mixed with blood, through the venous artery: thus, a mixture is produced in the lungs. The yellow color is given to the spirituous blood by the lungs, not by the heart. In the left ventricle of the heart there is no space capable of containing such a large and copious mixture, nor is such a preparation sufficient for the yellows. Finally, this intermediate wall, when it is deprived of vessels and resources, is not suitable for this communication and preparation, although it may perhaps produce something.

By the same way in which in the liver a transfusion is made from the portal vein to the vena cava for blood, in the lung a transfusion is made from the arterial vein (pulmonary artery) to the venous artery (pulmonary veins) for respiration. If someone compares this with what Galen states in Books 6 and 7 on the usefulness of the parts (*De Usu Partium*), he will fully understand the truth, which Galen himself did not notice.

This vital spirit, then, from the left ventricle of the heart, is then transfused into the arteries of the whole body, so that the subtler it is, the higher it seeks, where it is most elaborated,

especially in the reticular plexus, situated under the base of the brain, in which the vital begins to become animal, to approach the proper seat of the rational soul.

Furthermore, this powerful fiery force of the mind is maintained, developed and perfected in the thinnest vessels, or capillary arteries, which are situated in the choroid plexuses and contain the mind itself. These plexuses penetrate all the innermost parts of the brain, and internally line the ventricles of the brain itself, keeping these vessels folded and intertwined with them, up to the origins of the neurons, so that the capacity to feel and move is induced in them. These vessels, interwoven with great miracle, are called arteries, and yet they are the ends of the arteries that tend to the origin of the neurons, serving the meninges. It is a new type of vessels.

Just as in the transfusion of veins into arteries there is a new type of vessel in the lung, from the vein and the artery, so also in the transfusion of arteries into nerves there is a new kind of vessel from the tunic of the artery into the meninges: for the meninges themselves especially preserve their sheaths in the nerves. The sense of the nerves is not in their soft matter, as in the brain. All nerves are defined by filaments of membranes, having the most exquisite sensation, to which the spirit is therefore always sent.

From these small vessels of the meninges or choroid, therefore, as from a fountain, the luminous spirit of the animal, like a ray, pours itself through the nerves into the eyes and other sensory organs. Just as, on the contrary, the luminous images of perceived things arriving from without are sent back to the same fountain, as if they penetrated into the interior through a luminous medium.

From these destinations it follows that that soft and frequent mass is not properly the seat of a rational soul, for it is cold and devoid of feeling. But it is like the dust of these vessels, so that they do not break; and it is the guardian of the animal spirit, so that it does not disintegrate, when it is to be communicated to the nerves; and it is cold to temper that burning heat contained within the vessels. Hence it also happens that the nerves, for the reliable preservation of respiration, form a common membranous layer in the internal cavity of the above-mentioned vessels: and this because of the thin meninges, since they have a different outer layer from the thick one. Even those empty spaces of the ventricles of the brain, which astonish philosophers and physicians, contain nothing less than the soul. But for the first reason, these ventricles were made to receive the expurgations of the brain, like cloacae, as is proved by the excrements received there and the passages to the palate and nasal cavities, from which the discharges of diseases arise. And when the ventricles are so full of phlegm that the very arteries of the choroid are submerged in it, then apoplexy suddenly occurs).

Finally, he ends by saying "... .. *Spiritus ille nequam, cuius potestas est aeris, una cum inspirato a*

*nobis aere, lacunas illas libere ingreditur et egreditur, ut ibi cum spiritu nostro, intra vasa illa, velut in arce collocato, iugiter, dimicet. Imo eum ita undique obsidet, ut vix illi liceat respirare, nisi quando superueniens lux spiritus Dei malum spiritum fugat*” (...That evil spirit, whose power is in the air, together with the air we breathe, freely enters and leaves these holes, to constantly fight there with our spirit, placed within these vessels, as in a fortress. In fact, it besieges it on all sides, so that it is hardly allowed to breathe, except when the light of the Spirit of God, descending upon it, drives away the evil spirit).<sup>28</sup>

This discovery of the pulmonary or lesser circulation went unnoticed for many years because it was found in a fundamentally theological work. The appearance of a scientific discovery in a theological book may seem unusual, but in the context of Servetus' integrative thought, it is perfectly logical. For him, theology, medicine and philosophy were interconnected disciplines that complemented each other. Moreover, since the information on pulmonary circulation was burned together with the theological work of Michael Servetus, the discovery of pulmonary circulation was forgotten, until Sir William Harvey published it, seventy-five years later, in his work *De Motu Cordis* in 1628.<sup>42</sup> All of Servetus' works were entered into the index of books prohibited by the Holy Inquisition of 1559.<sup>16</sup>

Michael Servetus, a man of firm convictions and unwavering courage, was sentenced to death in Geneva in 1553 by the Calvinist Church for thinking differently from the scholastic theological dogmas of the time. The trial was an example of abuse of power and lack of justice. Calvin, who dominated the proceedings at the small Council of Geneva, used his influence to leave Servetus without a defense and presented questionable arguments.

The Sentence of the Minor Council of Geneva, read by Lord Syndic Darlod on October 27, 1553, read as follows: “...This detestable crime of heresy deserves a severe corporal punishment... condemning you, Michael Servetus, to be bound and led to the place of Champel, tied to a stake and burned alive, with the book written by your hand, which you printed, until your body is reduced to ashes; thus your days will end to give an example to others who would want to commit such an act”.<sup>43</sup>

That same day, October 27, 1553, Servetus was taken to the square of Champel, where he was burned alive at the stake. His body was tied with a chain, his neck fixed with five turns of rope, and his head covered with a crown of straw dipped in sulfur. Surrounded by bundles of green firewood, Servetus suffered a slow and painful agony<sup>43</sup> (Figure 5).

The sentence extended to “all” of the books written by Servetus, not just the confiscated edition of the *Christianismi Restitutio*. This is why it is of extreme significance that some copies of the original manuscript have survived to this day. Despite the tragedy surrounding his death, Servetus' legacy has endured. Although Calvin was outraged to read Servetus' work, he chose to preserve it, which allowed valuable copies of the work to be processed and have survived to this day. This copy had previously belonged to German Colladon, Calvin's right-hand man and one of the accusers against Servetus. Colladon underlined the passages he used to accuse Servetus, leaving a tangible mark of his role in the reformer's persecution. Several pages of this volume are charred and blackened by fire, a macabre reminder of the pyre on which Servetus and his work were burned together. The book was later owned by the English physician Richard Mead, who gave it to Boze, who sold it to the Royal Library in Paris for a considerable sum. From this manuscript, as we mentioned above, several copies were made in 1790, which allowed, ironically thanks to Calvin, that some of them have survived

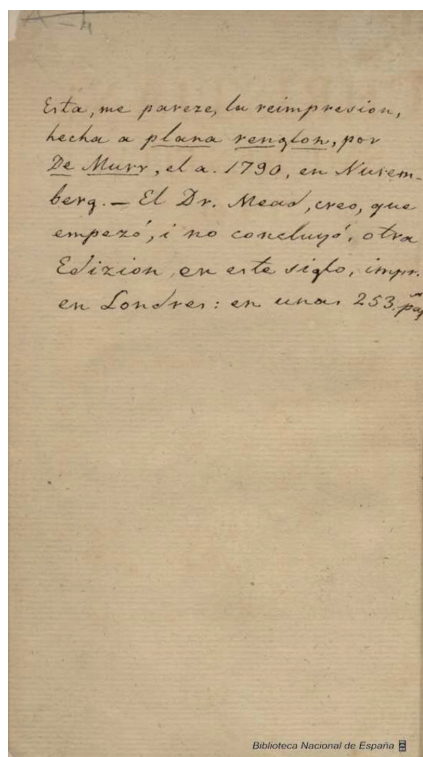
**Figure 5:**

Monument to Miguel Servet,  
Square de l'Aspirant Dunand, Paris.  
(Monument à Miguel Servet, square  
de l'Aspirant Dunand, Paris).

Credit: Chabe01-Own work. Attribution-  
Share Alike 4.0 International license.  
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work.

[https://commons.wikimedia.org/wiki/  
File:Monument\\_Miguel\\_Servet\\_  
Square\\_Aspirant\\_Dunand\\_-\\_Paris\\_  
XIV\\_\(FR75\)\\_-\\_2024-06-02\\_-\\_2.jpg](https://commons.wikimedia.org/wiki/File:Monument_Miguel_Servet_Square_Aspirant_Dunand_-_Paris_XIV_(FR75)_-_2024-06-02_-_2.jpg)





**Figure 6:**

Colophon of *Christianismi Restitutio* from the 1790 reissue in Nuremberg, with personal notes explaining the possible origin of the work. The reproduced work belongs to the collection of the National Library of Spain.

to this day, thus making known Servetus's masterpiece and the discovery of pulmonary circulation<sup>41</sup> (Figure 6).

Michael Servetus died for thinking differently, for questioning the theological dogmas. As he himself said, he died "for reasons other than the truth".<sup>44</sup> Beyond his revolutionary discovery of pulmonary circulation, it is important to remember that Michael Servetus left us an immortal legacy. The monuments dedicated to Servetus in various cities such as Paris, Sijena, Geneva, Zaragoza, among others, are a lasting testimony to his influence and his commitment to tolerance and freedom of thought.

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