

The Discovery of the Systemic Circulation: Review and Reappraisal

Sistemik Dolaşımın Keşfi: Gözden Geçirme ve Yeniden Değerlendirme

Plinio PRIORESCHI^a

^aMD, Ph.D., 1315 South 79th Street,
Omaha, NE, 68124, USA

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Yazışma Adresi/Correspondence:
Plinio PRIORESCHI
MD, Ph.D., 1315 South 79th Street,
Omaha, NE, 68124, USA
PlinioPioreschi@creighton.edu

ABSTRACT On the background of the long-standing controversy as to whether William Harvey (1578-1657) or Andrea Cesalpino (1519-1603) was the discoverer of the systemic circulation, the author briefly reviews some of the statements of the two authors and concludes that Cesalpino was indeed the first to assert that the blood circulated. Nevertheless, the author agrees with the majority of medical historians and concludes that Harvey was the discoverer because he, contrary to Cesalpino, was able to bring the notion of the circulation to the attention of the scientific community so that it became part of accepted scientific knowledge. The reasons for Harvey's success and Cesalpino's failure are discussed and the latter is recognized as the *primus qui vidit* ("the first who saw") but not the one who discovered the circulation of the blood.

Key Words: Systemic circulation, history of medicine, William Harvey, Andrea Cesalpino

ÖZET Sistemik dolaşımın keşfinin William Harvey (1578-1657) ya da Andrea Cesalpino (1519-1603) olup olmadığına dair bitmek bilmeyen ihtilafın ardından makalenin yazarı, her iki yazarın bazı bildirimlerini kısaca gözden geçirmekte ve aslında ilk olarak kan dolaşımını açıklayanın Cesalpino olduğuna hükmetmektedir. Yine de yazar çoğu tıp tarihçisine katılmakta ve dolaşım kavramını getirmesiyle bilim camiasının dikkatini çekerek bunun bilimsel bilginin bir parçası olmasını sağladığı için Harvey'in kâşif olduğuna hükmetmektedir. Harvey'in başarısı ve Cesalpino'nun başarısızlığının nedenleri tartışılmakta ve kan dolaşımını kimin keşfettiği değil bundan ilk kimin söz ettiği onaylanmaktadır.

Anahtar Kelimeler: Sistemik dolaşım, tıp tarihi, William Harvey, Andrea Cesalpino

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Although it is commonly accepted that William Harvey (1578-1657) was the discoverer of the systemic circulation, this opinion has been the object of lively controversies from the seventeenth century to our days. Hemmeter, in 1905, wrote:

We once more affirm that Harvey, the author of "*De motu cordis and sanguinis*," 1628, did not discover the lesser circulation. This Servetus discovered in 1516. Harvey did not discover the greater circulation. This Cesalpinus discovered in 1569. Harvey did not discover the venal valves. These Jacobus Sylvius, Sarpi, and most accurately Aquapendente discovered in 1574. Harvey did not furnish the clear-sighted proofs of the circulation. These were given by Servetus, Colombo, Valverde, Aranzi, Ruini, Rudio, Sarpi, Cesalpinus, and Aquapendente. Harvey never saw the circulation of the blood. Malpighi saw it several years after Harvey's death (1661).¹

Elsewhere^{2,3} we have reviewed these controversies, which were centered on the notion that Cesalpino (1519-1603) and not Harvey had first discovered the systemic circulation.

We have seen^{2,3} that Harris, in 1911, said that the controversy over who discovered the circulation of the blood was “ancient,” and mentioned that in the seventeenth century Isaac Voss (1618-1688), among others, gave credit for the discovery of the circulation to Cesalpino, whereas Hobbes (1588-1679) and Descartes (1596-1650) gave the palm to Harvey.⁴ Among the supporters of Cesalpino were Henry Stubbe (1632-1676),⁵ as well as the anatomist J. Douglas, the author of *Bibliographiae anatomicae specimen* published in 1715, Hermann Boerhaave (1668-1738) and William Hunter (1718-1783).⁶ Bernardino Ramazzini (1633-1714) held that we owe the discovery to Harvey. Borelli (1608-1679), in his *De motu animalium* (“On the Motions of Animals”) said: “Part of the admirable discovery was made by Cesalpino but later it was made perfect by Harvey;”⁷ and Francesco Maria Lancisi (1655-1720) believed that “Cesalpino was the first to indicate the circulation of the blood.” Other supporters of Cesalpino were Jean Senac (1705-1770), who in *Traité de la structure du coeur, de son action et de ses maladies* (“Treatise on the Structure of the Heart, its Action and its Diseases”) states that there can be no doubt about the authenticity of Cesalpino’s discovery, and Jean Astruc (1685-1766), who calls Cesalpino “inventor and auctor,” and Harvey “promotor and amplificator.” P. Bayle (1647-1706) in *Histoire de la découverte de la circulation du sang* (“History of the Discovery of the Circulation of the Blood”) supports the priority of the Italian and discusses his experiments.⁸

Although more recent supporters of Cesalpino are not lacking,^{8,9} the vast majority of historians have always considered Harvey the discoverer of the systemic circulation. Yet, a review of the writing of Cesalpino shows that there is no doubt that he was the first to realize that the blood left the heart through the arteries and returned to it through the veins. In Volume VI,² we have quoted several passages of Cesalpino which underline his unders-

tanding of the systemic circulation. We will report here only the following:

Of the vessels ending in the heart, some introduce into it their content: the *vena cava* into the right ventricle and the pulmonary vein (*arteria venalis*) into the left;* others carry it out: the aorta from the left ventricle and the pulmonary artery (*vena arterialis*), which brings nourishment to the lung, from the right. At the openings of each one of these vessels are small membranes with the function of preventing the openings leading in from letting [blood] out and preventing the openings leading out from letting [blood] in. So it happens that the heart and the arteries do not dilate and contract at the same time, as they appear to do, but when the heart contracts the arteries dilate and when it dilates they contract... If the heart and the arteries were to dilate and contract at the same time, the arteries would dilate when no material flows out of the heart and would contract when it does. This is obviously impossible.¹⁰

In this quotation, Cesalpino makes the following points: a) the *vena cava* and the pulmonary vein carry their content to the right and left ventricle respectively, and the pulmonary artery and the aorta carry it out from the right and left ventricle respectively; b) at the openings of these vessels there are valves that impede the flow in the opposite direction; c) the systole of the heart coincides with the ejection of its content into the arteries, which at the same time dilate.

In the following quote, Cesalpino mentions the flow of blood from the veins to the arteries through the heart:

The flow is from the veins into the heart... and, at the same time from the heart into the arteries because, due to the position of the membranes [i.e., valves], only this path is open. The same flow opens both the mouths (*oscula*)** of the veins into the heart and of the heart into the arteries.¹⁰

As mentioned above, in Vol. VI we have quoted several other passages confirming the fact that

* Cesalpino, according to the accepted notion at the time, considered the atria part of the ventricles.

** More often Cesalpino uses the words *oscula* (literally, “small mouths”) to indicate anastomoses between arteries and veins at the periphery (see below).

Cesalpino was the first to describe the systemic circulation.

If this is the case, how do we explain the long, drawn out, often bitter controversy about the value of Cesalpino's work on the circulation of the blood?

Cesalpino's total output amounts to more than two thousand pages written in a Latin that is verbose, meandering, full of philosophical references, and often obscure.*** In addition, the experimental basis on which he bases his conclusions is not clear. Also, he did not collect his notions about the circulation of the blood in a single monograph but spread his ideas, one here, one there, in the swamp of his endless Latin prose. This does not help historians who want a clear (and possibly concise) picture of the beliefs of an author. Even during his life, in fact, when authors were familiar with Latin and more accustomed to philosophical prose, only few recognized his accomplishments.

As a result, Cesalpino was not able to have his conclusions accepted by the scientific community.

As for modern times, the frequent insufficient knowledge of Latin on the part of historians of medicine, together with the prolixity and obscurity of Cesalpino's prose, most likely contributed to the noted² mistranslations, misunderstandings, incomplete reading of passages, and confusion concerning his ideas about the circulation.

On the other hand, Harvey succeeded where Cesalpino failed because he expressed his notions about the circulation in a single pamphlet, in a clear Latin prose with solid experimental evidence, which included a convincing quantitative technique.

Concerning the clarity of Harvey's prose, the following quotes are examples:

It is evident, that the blood enters every portion of the body through the arteries, and returns through the veins; and that the arteries are the vessels carrying the blood from the heart and the veins are the vessels.... returning the blood to the heart again; and that in the members and extremities the

blood passes from the arteries into the veins (either by immediate anastomoses, or mediately through porosities of the flesh, or by some other way); as before was made manifest.... thence to move in a circuit.... manifestly from the center to the extremities, and from the extremities back to the center.¹¹

It is absolutely necessary to conclude that the blood in the animal body is impelled in a circle, and is in a state of ceaseless motion; that this is the act or function which the heart performs by means of its pulse, and that it is the sole and only end of the motion and contraction of the heart.¹²

If one compares these and other concise and clear passages of Harvey with the contorted and obscure prose of Cesalpino² it is easy to understand why Harvey was able to bring his discovery into the mainstream of the science of his time and Cesalpino was not.

Harvey also furnishes experimental proofs that confirm the circulation of the blood. For example, that the quantity of blood propelled into the arteries is such that it could not be replenished by the food consumed (hence it had to return to the heart and start again in a circuit); that the blood in the veins flows from the periphery to the center; that if one applies a tight ligature to an arm, the pulsation of the arteries ceases at the periphery whereas a looser ligature will cause swelling of the veins at the periphery.

Nevertheless, the fact remains that Cesalpino was the first to recognize the circulation of the blood. In view of this, must it be concluded that Cesalpino, and not Harvey, was the discoverer? No. We agree with the majority of historians that the Englishman was indeed the discoverer of the circulation. This for the following reasons: if we consider an essential part of the concept of "discovery" to be the bringing of the new entity, observation or conclusion to the attention of the world community so that its importance is understood, then we must distinguish the "discoverer" from the one who first observed or arrived at the new conclusion but did not (or could not) make it known to the world. In other words, we must distinguish between "discovering" something and seeing, observing, or des-

*** The quotes above were chosen for their unusual clarity.

cribing it for the first time.

Whoever made the discovery and was able to bring it successfully to the attention of the world community must be called the “discoverer,” whereas the first who made the observation or arrived at the conclusion (which then remained unknown or unappreciated) should be called *primus qui vidit* (“the first who saw”), or *primus* for short.****

Such a distinction is useful because although often the discoverer and the *primus* are the same person, there are instances in which the *primus* is different from the discoverer. This is the case, for example, of Aristarcus of Samos and Copernicus; Leif Eriksson and Christopher Columbus; and Ernest Duchesne and Fleming. In some cases the discoverer was not aware of the previous observation of the *primus*, in other cases he was, although he may or may not give credit to him.

*****Prima (prima quae vidit)* would refer to a woman and *primi (primi qui viderunt)* to more than one.

If we apply this terminology to the systemic circulation, there is no doubt that the *primus* is Cesalpino. He was not the discoverer, however, because his discovery was forgotten and the notion of the systemic circulation of the blood was not accepted until the publication of Harvey’s *De motu cordis* in 1628.

In conclusion, if we compare the contributions of Cesalpino and Harvey, it would appear that the Italian was the first to identify (that is, “to see”) that the blood circulated from the heart to the arteries, to the veins, and back to the heart but his discovery was not recognized, that is, did not become part of the body of commonly accepted scientific knowledge. For this reason, Cesalpino cannot be considered the discoverer of the general circulation but only the *primus qui vidit*. On the other hand, as Harvey did indeed bring the notion of the systemic circulation into the body of commonly accepted scientific knowledge, he must be considered the discoverer.

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