The Theory of the Circulation of Blood and (Different) Paths of Aristotelianism. Girolamo Franzosi's *De motu cordis et sanguinis in animalibus pro Aristotele et Galeno adversus anatomicos neotericos libri duo*: Teleology versus Mechanism?*

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Summary

Few discoveries in the history of medicine had a greater impact than William Harvey's discovery of the circulation of blood, and few intellectual milieus of the early modern period had as decisive a part in the rise of 'modern' medicine and the shaping of the western scientific mentality in general than the philosophical and scientific movement of 'Venetian Aristotelianism', which grew up around the University of Padua, where Harvey himself had studied. In this chapter, I aim to explore some aspects of the intellectual movement of 'Venetian Aristotelianism' as well as the debate that ensued upon the discovery of the circulation of blood. My focus, however, is not on any of the major protagonists, but rather on a quite marginal figure in this debate, namely Hieronymus Franzosi.

Keywords: blood circulation, Harvey, Franzosi, teleology, mechanism, Aristotelianism

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Introduction

Hieronymus Franzosi – “*medicus et philosophus Veronensis*”, as he calls himself in his writings – has remained an obscure figure thus far, whose biography is almost completely unknown.¹ His date of birth, which must lie between the end of the 16th and beginning of the 17th centuries,² as well as the titles of his surviving writings – *De divinatione per somnum et de prophetia*, *Expositio paraphrasis Averrois in librum Aristotelis De somniis*, *Tractatus apologeticus de semine pro Aristotele adversus Galenum*, *De motu cordis et sanguinis in animalibus pro Aristotele et Galeno adversus anatomicos neotericos libri duo*³ – nonetheless help us to grasp at least the basic aspects of Franzosi’s intellectual profile.

On the one hand, Franzosi seems to have embodied a traditional Aristotelian intellectual of his time. His works are limited to the explication and dissemination of Aristotle’s biological and psychological theories, as well as their defence against the theories of Galen. In this regard, Franzosi followed the example of the better known Cesare Cremonini, who had written important works defending Aristotelian embryology against Galen⁴ and whom Franzosi regarded as his teacher and model (though we do not know whether Cremonini was in fact Franzosi’s teacher).

1 All we know is that Hieronymus Franzosi was probably born in Polpenazze, a small village on the Lombard shore of Lake Garda, and that he spent most of his life in a Venetian cultural milieu. See Zagata 1745, 179; Jöcher 1787, 156; Maffei 1825, 421; Bonuzzi 1979, 441.

2 See Giovannozzi 1998.

3 Franzosi’s treatise *De divinatione per somnum et de prophetia* is briefly mentioned and introduced by Lynn Thorndike in his *History of Magic and Experimental Science* (Thorndike 1941, vol. 6, 511). Regarding the treatise on the movement of the heart, this text is mentioned in the *Histoire des sciences médicales* by C. Daremberg, where he discusses opponents of Harvey’s theory (Daremberg 1870, vol. 2, 615): “Franzosi, qui proteste à la fois de son respect pour Aristote et Galien et de sa tolérance pour les recherches modernes, pourvu qu’elles ne contraignent pas trop les anciennes, et ‘qu’elles n’aient point la prétention de reposer uniquement sur l’inspection anatomique’ (aussi n’en use-t-il guère de cette inspection pour réfuter Harvey).” The *Tractatus apologeticus de semine pro Aristotele adversus Galenum* is mentioned by P. De Lacy at the beginning of the commentary to his critical edition of Galen’s *De semine* (De Lacy 1992, 208): “In 1645 Hieronymus Franzosi published at Verona a book entitled *Tractatus apologeticus De Semine pro Aristotele adversus Galenum*. He mentions both Galen’s *De usu partium* and *De semine*, the latter several times. He even quotes, from Cornarius’ translation, *De semine*. Averroes is one of the sources that he uses in his examination and refutation of Galen’s views”.

4 In 1634 Cremonini published a treatise *De calido innato et semine pro Aristotele adversus Galenum*. A digitalised copy of this treatise is available at the website of the Bavarian National Library in Munich (<http://reader.digitale-sammlungen.de/resolve/display/bsb10368073.html>). On the work and intellectual profile of Cremonini, the monograph by H. C. Kuhn (Kuhn 1996) and the volume *Cesare Cremonini. Aspetti del pensiero e scritti* (Riondato/Poppi 2000) should be noted as the most important contributions. See also Del Torre 1968, Schmitt 1980 and Mabillean 1881.

On the other hand, Franzosi belongs to the generation of physicians and natural philosophers that had to come to terms with the formation of a new scientific mentality and a new approach to research – what has been called the “scientific revolution” and, with special reference to medicine, “the first biological revolution”. He lived in an age characterised by the development of new investigative techniques in anatomy and the redefinition of the relationship between anatomy and physiology, as well as by the rise of new physiological theories based on a mechanistic representation of the human body, and obviously by the rejection of the ancient medical tradition. The intellectual milieu in which these physicians and philosophers worked is indeed nuanced and difficult to decipher. That is especially true of the way the ancient, traditional sources of biological and medical knowledge were treated. An ancient authority like Aristotle, for instance, could be viewed as a theoretical and methodological reference point by physicians and medical schools, whose theories were at variance with one another. This raises the question of what “being Aristotelian” at this particular point in the history of medicine and philosophy meant, and how Aristotle’s biological, psychological and physiological theories were understood, interpreted and potentially recast according to various research agendas.⁵

Such was the context in which Hieronymus Franzosi was active. In Verona in 1652, he published a text – *De motu cordis et sanguinis in animalibus pro Aristotele et Galeno adversus anatomicos neotericos libri duo* – that polemically imitates the title of Harvey’s revolutionary *Exercitatio anatomica de motu cordis et sanguinis in animalibus*.⁶ Franzosi was not the only natural scientist of his time to reject Harvey’s discovery: other, more influential physicians – for example, I think of James Primrose or Jean Riolan – wrote to dispute this discovery and defend the Galenic – and I stress, the *Galenic* – theory.⁷ Franzosi’s treatise, however, is marked by the systematic attempt to refute the theory of the circulation of blood point for point, primarily on the basis of Aristotle’s doctrine of the movement of the heart and the nature and function of the pulse, and only secondarily on the basis of Galen’s doctrine. In fact, Franzosi cites Galen only insofar as his theories may be presented as agreeing with and confirming those of Aristotle. It is necessary to emphasise

5 The fundamental studies of the various forms of Aristotelianism in the Renaissance remain Charles B. Schmitt (Schmitt 1981, 1983, 1984). See also Copenhaver-Schmitt 1992, 60–126 and Kessler 1988.

6 I have used the digitalised copy of the book available online at the website of the Bavarian National Library: <http://daten.digital-sammlungen.de/~db/0007/bsb00070663/images/>.

7 The history of the reception of Harvey’s *De motu cordis* is complex and nuanced and has been covered in detail by French 1994, 114–309. See also Ongaro 2006, 325–362 (this contribution focuses on the reception of *De motu cordis* in Padua but makes no reference to Franzosi).

a problematic aspect of this strategy in this regard: Aristotle's and Galen's theories of the motion of the heart and blood may have certain points in common, but in general they differ greatly from one another, particularly because Galen distinguishes between veins and arteries as two physiologically and anatomically distinct vascular systems with two specific sources – the liver and the heart, respectively – and two specific functions – the delivery of nourishment and vital *pneuma*, respectively; whereas Aristotle describes the cardiovascular system as a uniform system that originates in and centres on the heart.

Elsewhere Franzosi appears to be well aware of the differences between Aristotle and Galen; in these cases – for instance, in regard to embryological subjects – he is always prepared to defend Aristotle against Galen.⁸ But what Franzosi ultimately does in the case of the theory of the circulation of blood is to misrepresent these ancient scholars' doctrines as a coherent body and then to use this monolithic body to confront the 'new' theories. The more one reflects on Harvey's text and its methodological and theoretical premises, the more surprising the strategy chosen by Franzosi appears. Harvey himself was always very careful to distinguish between Aristotle and Galen. It was in fact Galen's theories of the nature and circulation of the blood that were Harvey's real polemical target, as can be inferred from the fact that he makes explicit references only to Galen and none to Aristotle in the most polemical part of *De motu cordis* – namely, the introduction to the entire text.⁹ As far as Aristotle is concerned, although Harvey does not hesitate to criticise important aspects of the Aristotelian theory of the circulation of blood, he nonetheless remains a "convinced Aristotelian", whose discovery of the circulation of blood was made possible by the fact that his investigations were guided and inspired by certain logical categories and key principles of Aristotelian biology. In this connexion, it is worth recalling two fundamental points of Harvey's revolutionary theory and explaining very briefly how Aristotelian doctrine may be considered as the methodological background and theoretical premise of both these points. Firstly, Harvey explained

8 In this regard, Franzosi's writings are part of the debate that arose in the context of the Paduan Studium between the philosophers, who defended Aristotle, and the physicians, who defended Galen. On this debate, see Schmitt 1985a, 1–15, and Pagallo 2006, 114–122.

9 At least eight direct, polemical references to Galen can be counted in the introduction to *De motu cordis*; the first essential reference appears at the very beginning of the introduction (Harvey 1628, (1995, 1)): "Almost all Anatomists, Physicians, and Philosophers to this day, do affirm with Galen, that the use of Pulsation is the same with that of Respiration, and that they differ only in one thing, that one flows from the Animal faculty, and the other from the Vital [...] But since the motion and constitution of the heart is different from that of the lungs, and the motion of the arteries different from that of the breast, it is probable that diverse uses and utilities should follow, and that the pulse of the heart and the use of it, as likewise that of the arteries, should differ much from the pulse and use of the breast and lungs."

the nature, action and physiological function of the arteries and pulse and described how the heart moves and functions as a pump. Harvey's theory was based on a principle of systematic observation, and his observations were grounded in the method of comparative anatomy that Aristotle had established in his zoological writings and which Harvey's teacher in Padua, Fabrici d'Aquapendente, had revived and refined.¹⁰ Secondly, Harvey proved that the blood circulates in the body and returns to the heart from the extremities of the body: from the vena cava, blood reaches the lungs via the right chamber; from the lungs, it reaches the left chamber via the pulmonary artery, before it is pumped into the arteries once again by the contraction of the heart. It has rightly been stressed many times that this revolutionary discovery was made possible by a mathematical and quantitative calculation. But we cannot overlook the inspirational force that guided Harvey's observations, namely, his adherence to the Aristotelian view of circular motion as perfect motion, as well as the principle of the physiological, anatomical, embryological, ontological and symbolic centrality and priority of the heart in relation to all other parts of the body:

Which motion we may call circular, after the same manner that Aristotle says that the rain and the air do imitate the motion of the superior bodies. For the earth being wet, evaporates by the heat of the Sun, and vapours being raised aloft are condensed and descend in showers and wet the ground, and by this means here are generated, likewise, tempests, and the beginnings of meteors, from the circular motion of the Sun and his approach and removal. So in all likelihood it comes to pass in the body, that all the parts are nourished, cherished, and quickened with blood, which is warm, perfect, vaporous, full of spirit, and, that I may so say, alimentative; in the parts the blood is refrigerated, coagulated, and made as it were barren, from thence it returns to the heart, as to the fountain or dwelling-house of the body, to recover its perfection.¹¹

10 It is thus no coincidence that Harvey acknowledges Aristotle as his teacher and Fabrici as his predecessor in the *Praefatio* to *Exercitationes de generatione animalium* (Harvey 1651, 36): "Prae caeteris autem, Aristotelem ex antiquis; ex recentioribus vero Hieronymum Fabricium ab Aquapendente, sequor; illum, tamquam Ducem; hunc, ut Praemonstratorem." On Harvey's research programme and his agreement with Aristotelian doctrine, see French 1994, 51–70, Lesky 1957, Berti 2006 and Conti 2006. On the Aristotelianism of Fabrici Aquapendente and his revival of comparative anatomy, see Cunningham 1985, 195–222 und 1997, 167–187; Pomata 2005, 105–146; Maclean 2005. On relations between Fabrici and Harvey, see Pagel 1967, 19–20; Cunningham 2006, 129–149; and Olivieri 2006, 175–182.

11 Harvey 1628 (1995, 59): "Quem motum circularem eo pacto nominare liceat, quo Aristoteles aerem et pluviam circularem superiorum motum aemulatus est. Terra enim madida a sole calefacta evaporat, vapores sursum elati condensant, condensati in pluvias rursus descendunt, terram madefaciunt et hoc pacto fiunt hic generationes et similiter tempestatum et meteorum ortus, a solis circulari motu, accessu, et recessu. Sic verisimiliter contingat in corpore, motu sanguinis, partes omnes sanguine calidiori perfecto, vaporoso, spirituosus (et ut ita dicam) alimentativo, nutriri, foveri, vegetari: Contra in partibus sanguinem refrigerari, coagulari, et quasi effatum reddi, unde ad principium, videlicet, Cor; tanquam ad fontem sive ad lares corporis, perfectionis recuperandae causa, revertitur: ibi calore naturali, potenti, fervido, tanquam vitae thesauro, denuo colliquatur, spiritibus, et (ut ita dicam) balsamo praegnans, inde rursus dispensatur, et haec omnia a motu et pulsu cordis dependere."

As a starting point to understand on what Franzosi based his defence of Aristotle against Harvey's theories, which were inspired by Aristotle's model; and so to understand the intellectual process by which Franzosi elaborated his own depiction of Aristotle in contrast to Harvey's, I will first consider the investigative method adopted by Franzosi. Next, I shall inquire in what regard and for what reason Franzosi is dissatisfied with Harvey's view of the heart as the central source of blood and life, although this view is clearly informed by some key principles of Aristotle's natural philosophy.

Franzosi's investigative method

A first fundamental difference between Franzosi and Harvey concerns the investigative methods that underlie their respective interpretations of the movement of the heart and the circulation of blood. To define Harvey's investigative method, we might describe it as a specimen of 'methodological Aristotelianism' in that his method is based on the techniques and principles of comparative anatomy after the model of the zoological treatises of Aristotle. The precondition of Harvey's adoption of the comparative-anatomical method was his recognition of the superiority of direct observation over theory, which explains on what basis Harvey could criticise individual (often important) aspects of Aristotelian theories without having to reject Aristotelianism as a scientific paradigm *in toto*.¹² Overall, Harvey's investigative method appears to be a coherent epistemological unity, the crux of which may be found in the following statement we read in Harvey's *Exercitationes anatomicae duae*: "The deeds of nature, which are manifest to the sense, care not for any opinion or any antiquity, for there is nothing more ancient than nature, or of greater authority."¹³ In Franzosi's case, we cannot identify a definite investigative method, but rather a quite arbitrary, unsystematic, often contradictory and overall superficial utilisation or indeed rejection of anatomical observations. Franzosi's general procedure is to start with a specific claim by Aristotle he intends to defend, and then adopt an

12 Chap. 2 of Harvey's *De motu cordis* offers a perfect example of (implicit) criticism of Aristotelian doctrine. Harvey gives his explanation of the pulse here and redefines the concepts of *systole* and *diastole*. Although Galen is his first and most important polemical target, it is still clear that Harvey's theory contradicts Aristotle's explanation of the pulse, as it is to be found at *Resp.* 20, 479b18–27. Interestingly, Harvey makes no direct reference to Aristotle when he might distance himself from Aristotelian doctrine, but refers to Aristotle's *De respiratione* later in the same chapter in order to reinforce with Aristotle's authority his claim that all arteries pulse simultaneously.

13 William Harvey 1649, 87: "Naturae opera facta manifesta sensui, nullas opiniones, nullamque antiquitatem morari: natura enim nihil antiquius, majorisque auctoritatis."

anatomical observation if and only if this observation, independently of its reliability, stands in agreement with Aristotle. Conversely, if the findings of direct observation contradict the *ipsissima verba* of Aristotle, Franzosi hunts for arguments that would invalidate these findings.

I will present two examples, one for each of these strategies. In the first five chapters of his treatise, Franzosi reviews first the Aristotelian and then the new, Harveyan doctrine of the movement of the heart and the transfer of blood from the heart to the arteries. Franzosi emphasises – critically – the most important novelty contained in Harvey’s *De motu cordis*, that is, the theory that the blood is transferred from the right to the left chambers through the lungs. At the beginning of chapter 6 of his treatise, Franzosi summarises his reasons for rejecting this theory: first, Franzosi claims, the new doctrine of the movement of the heart should be rejected because it is based primarily on anatomical observation, which is totally uncertain and unreliable.¹⁴ In order to undermine the reliability of Harvey’s observations, Franzosi cites the famous passage of the *Historia animalium* (III.2) in which Aristotle explains that it is particularly difficult to observe blood vessels reliably, because they collapse immediately after death and lie too deep inside a living person to be perceived clearly.¹⁵ For this reason – Franzosi concludes – we must be sceptical of the findings obtained through observation in this case, which entails that we cannot accept the new theories that derive directly from these findings, but rather must by all means adhere to the ancient doctrine. Franzosi’s remarks give a perfect example of an ‘argumentative paradox’: Franzosi cites a completely decontextualised passage of the *Historia animalium* in order to assert the complete opposite of the meaning and original purpose of the remark in Aristotle’s argument. To put it briefly, the difference between Aristotle and Franzosi is that Franzosi takes a dogmatic and conservative view that can be summarised as follows: since observation of blood vessels is difficult and uncertain, we must derive our knowledge of them from another source, namely, tradition. Aristotle’s treatment of the whole problem, in contrast, appears ‘progressive’ and observation-oriented: because the structure and function of the blood vessels is

14 Franzosi 1652, 34–35: “Adduximus praecipua fundamenta huius novae opinionis de motu cordis, et de sanguinis transitione a dextro ad sinistrum ventriculum; et quoniam illa maiori ex parte ab observationibus anatomicis eruta sunt, quae valde dubiae plurimam in seipsis semper incertitudinem includunt, ut dixerit Aristoteles in tertio de *historia animalium* cap. II in mortuis animalibus naturam principalium venarum aboleri, et in vivis fieri non posse, ut, quemadmodum se habeant, cernantur; merito et eius auctorum, et experientiae fidem imminuit ista suspicio; quam quoque confirmant diversae auctoritates praestantium viro- rum, qui in dissectionibus anatomicis fuerunt optimi, maximi. Caeterum veritas Aristotelicae sententiae elucescet magis, si his, ad disputationem pro veris admissis, obivam iverimus.”

15 Aristotle, *Historia animalium*, 511b11–24. See Shaw 1972, 355–388 and Harris 1973, 123–176.

difficult to investigate, Aristotle states, our predecessors have made many errors of observation. *For this reason*, new observations must be made and old observations must be partly reinterpreted, in order to obtain a newer, more precise and above all more scientific description of the vascular system. That is the very train of thought that Harvey himself follows. In this light, it is perfectly justified to describe his approach as “methodological and undogmatic Aristotelianism”.¹⁶

Franzosi’s attitude toward anatomical observation changes in other passages of his writing. When defending the theory that the blood flows from the right to the left chamber through the interventricular septum, which Harvey rejects, Franzosi cites various anatomical observations that led ancient and modern physicians to confirm the existence of small, imperceptible passages through the septum.¹⁷ It is worth noting that Harvey himself had remarked that the existence of such a structure in the heart could not be verified by anatomical observation.¹⁸ Yet, in this case, Franzosi does not contrast unreliable observation with universally valid theory: instead, he disputes the evidence of observations – namely, Harvey’s observations, which he considers unreliable and superficial – on the basis of other observations that seem to him endowed with indisputable authority: “Who, therefore, should we believe?” Franzosi asks rhetorically; should we really assume that “so many outstanding anatomists” – like Aristotle, Galen, Vesalius and Gassendi – “failed to observe (*non observarunt*) this error and were so dismally mistaken in the anatomical description of the heart?”¹⁹

16 On Harvey’s reception of Aristotelian investigative techniques and the influence of Zabarella’s empiricism on Harvey’s own methods, see Berti 2006, 4–9 and Schmitt 1985b, 81–111.

17 Franzosi 1652, 62–64: “Nec me ab hac opinione, cui affatim subscribo, absterrent, quae isti dicunt, nullos videlicet in septo cordis esse ductus, nec sanguinem posse per illud exsudare, cum habeat substantiam densiorem, et quavis alia corporis particula magis compactam. Siquidem hic primo non possum non mirari viros doctissimos, negare in carne cordis meatus, et ductus, qui tamen iuxta doctrinam Aristotelis sunt in lignis, et in ipsis metallis: praeterea isti meatus sunt actuales; cur ergo non possunt esse tam in dura substantia, quam in molli? Testantur esse actuales Anatomici insignes, qui illos in septo cordis conspici affirmant, Galenus ante omnes [...] Ideam etiam Andreas Vesalius asserit, et Petrus Gassendus ab istis allatus refert vidisse se Payanum ostendentem septum cordis intermedium per varios maeandros, flexuososque quasi caniculos pervium esse. At illi instant a stylo, et cuspidе cultri esse factos.”

18 Harvey 1628 (1995, 13): “That opinion is less tolerable, which (supposing that an airy and bloody matter is necessary for the making of vital Spirits) does assert, that the blood is drawn through the hidden pores of the septum of the heart, out of the right ventricle into the left, and that the air is drawn through a great vessel, the arteria venosa, out of the Lungs; and for that cause, that there are more pores in the septum of the heart, fitter for the production of the blood. But by troth there are no such pores, nor can they be demonstrated.”

19 “Quibus ergo credendum? Tot insignes Anatomici non observarunt hunc errorem, et in anatome cordis tam misere fuerunt decepti? Non sunt tam magnis viris ista obijcienda.”

These examples clearly show that Franzosi's entire discourse is based on feeble, confused and, so to speak, 'opportunistic' methodological principles. It is above all clear that when he contrasts theories with observations or specific observations with other observations, these are always the theories and observations of other physicians that he limits himself to either confirming or refuting.

Harvey, Franzosi and the heart as the source of life

Here I would like to address the second substantial point that I raised as problematic and also as particularly significant in regard to establishing two different and even contradictory forms of 'being Aristotelian', that is, Franzosi's dissatisfaction with Harvey's depiction of the heart as the central source of blood and life. For Harvey, this depiction serves as the general theoretical premise for the demonstration of the circulation of blood. Harvey's own Aristotelianism in fact shines through most clearly in his formulation of this depiction. The train of thought that Harvey constructs may be sketched in the following way: since the heart is the physiological and ontological centre of a living being, as well as the source and receptacle of life, as Aristotle had largely proven in his zoological works, it is reasonable that blood flows in a circle. In consequence to this circular motion, the blood must always return to the primary source of life and reenter circulation from this same source. The observational experiments and quantitative arguments that Harvey adduces in the second part of his treatise to confirm this theory derive from this original insight, the Aristotelian basis of which Harvey repeatedly and explicitly makes clear, especially in chapter 15 of his text:

First seeing death is a corruption which befalls by reason of the defect of heat, and all things which are hot being alive, are cold when they die, there must needs be a place and beginning of heat (as it were a fire and dwelling house), by which the nursery of Nature, and the first beginnings of inbred fire may be contained and preserved; from whence heat and life may flow, as from their beginnings, into all parts; whither the aliment of it should come, and on which all nutrition and vegetation should depend. And that this place is the heart, from whence is the beginning of life, I would have no body to doubt.²⁰

But here a question arises: How is it possible that a self-proclaimed convinced Aristotelian like Franzosi should be incapable of recognising the genuine

20 Harvey 1628 (1995, 92): "Cum mors sit corruptio propter calidi defectum et viventia omnia calida, morientia frigida, locum, et originem esse oportet caloris, quasi lares focumque, quo naturae fomites, et primordia ignis nativi contineantur, et conserventur, a quo calor et vita in omnes partes tanquam ab origine profluant, et alimentum adveniat, et concoctio, et nutritio, et omnis vegetatio dependeat. Hunc autem locum cor esse, et hoc principium vitae, et hoc quo dictum est modo, nominem vellem dubitare."

Aristotelian inspiration behind the theory of the circulation of blood, to the extent that he considers every argument Harvey adduces in support of the new theory as the blatant error of an opponent of medical Aristotelianism and consequently rejects them? To resolve this dilemma, it is not enough to claim that Franzosi's dogmatic perspective prevents him from accepting the fact that Harvey had distanced himself from Aristotle in many aspects of his theory. I believe an essential reason for Franzosi's polemic derives from a characteristic of Harvey's view that has not yet been sufficiently emphasised: this is the fact that Harvey makes no reference at all to the concept of the soul. Harvey's physiology of the heart is in many regards an Aristotelian physiology, but it is not – at least not obviously – a physiology of an ensouled body. The heart is depicted by Harvey as the primary source of life or of innate bodily heat, but he never refers to the concept of the soul and the region of the heart as the part of the body where the soul or its bodily instrument is located. In the same way, Harvey agrees with Aristotle that nature does nothing in vain,²¹ but in Aristotle a teleological explanation of physiological processes would be inconceivable without presuming the definition of the soul formulated in *De Anima* (II, 1, 412a27) as the “first actuality of a natural body having life potentially in it”. In contrast, it appears that, for Harvey, the teleological understanding of the physiological processes that play a part in causing the movement of blood and the heart depends entirely on the precise determination of their physical, material and, to some extent, mechanical nature. That is not to say that the concept of the soul cannot be found in Harvey's doctrine at all. In Harvey's *Exercitationes de generatione animalium*, the nature and function of the soul is widely debated within the context of an epigenetic explanation of embryogenesis.²² As stated, however, no such use of the concept of the soul is made in *De motu cordis*.

It is no coincidence, I believe, that Franzosi begins his refutation of the theory of the circulation of blood with a review of Aristotle's theory of the soul and an explicit definition of the heart as the “physical seat of the soul”:

21 Lennox 2001, 219: “Harvey is using ‘Nature does nothing in vain’ to lead him from observations of the biological systems he is studying to a specific teleological hypothesis which would explain those observations. As with Aristotle, the explanation is teleological in form: The circulatory hypothesis would explain the observations as consequences of appropriate design for such a cardiovascular system, which, guided by ‘Nature does nothing in vain’, Harvey supposes them to be. In short, “Nature does nothing in vain” is a first principle in Harvey's biological studies, as it is in Aristotle's; and it often plays the role of an explicit premise in Harvey's reasoning. But, at least on certain occasions, Harvey uses this principle in a way not in evidence in Aristotle's biological treatises, as a *constraint on hypothesis formation*.”

22 See, e.g., the references to the soul in *exercitatio* 13 (Harvey 1651, 109), 17 (128), 18 (135 und 142), 26 (174–180), 30 (192–195), 35 (207–209), 37 (214), 38 (218), 40 (226), 43 (240–41), 45 (252), 46 (260–62), 47 (262–270), 49 (278), 50 (286 and 293–95), 51 (299–307), 52 (310 and 318), 53 (329), 54 (343–44), 55 (353), 57 (371), 69 (444).

In order to defend Aristotle's opinion about the movement of the heart and blood, we must explain how the blood enters and exits the heart. From this, there will be a variety of ways to solve the difficulties on which this new theory is based. First, we should recall what is stated in the second book of *De Anima*, namely that the perceiving soul in blood-based creatures is one both in action and in potency; and this is obvious to anyone who considers the unity of the common sense that the other five senses serve, and in which all the senses converge as if to a centre [...] If therefore the soul is a singularity, it follows that there must be a single principle part of the body that first contains it [...] and this part is the heart. But because heat is the primary instrument of the soul [...] it ought to be found and principally reside there where the primary agent is located. Hence, since the soul is undoubtedly in the heart, heat is also located especially in the heart.²³

On the basis of this explicit reference to the soul, its seat and the functions it performs in the heart – the concoction and refinement of the blood – Franzosi disputes two essential points of Harvey's theory: The first is the mechanical interpretation of the heartbeat and arterial pulse (Harvey does not believe in the existence of an attractive force in the arteries, as postulated by Galen, and proved in the third chapter of his treatise that blood is drawn into the arteries, not by attraction, but by a mechanical impulse),²⁴ the second point is the quantitative observation on the basis of which Harvey proves that the heart pumps more blood into the arteries over a definite period of time than could be produced from food.²⁵ With regard to the heartbeat and pulse, the assumption of an active force that regulates the movement of the heart and arteries is a direct consequence of Franzosi's belief in the guiding and shaping power of the soul as the principle of life and form in living beings.

23 Franzosi 1652, 115–117: “Defensuri Aristotelis opinionem de motu cordis, et sanguinis tene-
mur explicare modum, quo sanguis in cor introit, et de corde exit; hinc etiam multiplex
habebitur via solvendarum difficultatum, quibus nova haec innititur opinio. Liceat autem hoc
primum ex dictis in secundo de anima memorare, animam sentientem in sanguineis esse unam
actu, et potentia; idque palam fit consideranti unitatem sensus communis, cui caeteri quinque
sensus famulantur, et in quem veluti in centrum omnes conveniunt [...] Si ergo anima est
una, necesse est in unoquoque animali esse unum membrum principale, quod illam primo
contineat [...] hocque cor est. Sed quoniam calor est principium instrumentorum animae [...]
debebit et ipse reperiri, et praecipue residere, ubi est principale agens, cumque hoc, anima
nempe sit in corde, etiam calor erit praecipue in corde.”

24 Harvey 1628 (1995, 24): “Whilst there is a tension, contraction of the heart, and a percussion
of the breast, and an apparent systole, the arteries are dilated, do beat, and are in their diastole.
In like manner when the right ventricle thrusts out the blood contained in it, the arterious
vein beats and are dilated, together with the rest of the arteries of the body. When the left
ventricle ceases the move, beat and to be contracted, the beating of the arteries ceases; nay,
when the tension is but faint, the pulsation of the arteries is hardly to be perceived, and so
likewise in the arterial vein, when the right ceases.” Galen's theory of the pulse was devel-
oped in the following treatises: *De pulsuum usu*, *De Pulsibus ad Tyrones*, *De Pulsuum
differentiis*, *De dignotione Pulsuum*, *De causis Pulsuum*, *De praesagatione ex pulsibus*,
Synopsis de pulsibus.

25 Harvey describes the quantitative observations by which the circular movement of the blood
was proven in chapters 9 and 10 of *De motu cordis*. On Harvey's quantitative proofs and
their reception in the contemporary scientific debate, see Pagel 1967, 74–82. On Harvey and
experimental philosophy, see French 1994, 310–386.

As he states at the beginning of chap. 7 in the second part of his text, one could accept the new theory of the pulse only in the following case:

If the movement of the heart was not guided by the soul and the vessels and chambers of the heart were functioning rather as inanimate channels rather than as living instruments [...] But since everything that occurs in a body endowed with a soul happens according to the will of nature, [...] we shall have no trouble finding natural faculties by means of which the soul itself accomplishes the entrance and exit of the blood into and out of the heart without any recourse to circulation.²⁶

The soul plays a decisive part yet again in Franzosi's arguments against the quantitative-experimental proof of the circulation of blood. In chapter 8 of the second part of his text, Franzosi claims that the passage of the blood through the heart is not as fast and mechanically quantifiable as Harvey had assumed, since every beat drives only a small amount of the blood contained in the chambers of the heart into the arteries. The rest – that is, most – of the blood is kept in the heart until the refinement of the blood by the soul is completed. But, and here I cite Franzosi's text directly,

for this reason, cavities and chambers were created in the heart in which the blood could be stored until the major transformation (*maior alteratio*) is completed that is necessary for the nourishment of the heart and for other functions. This major transformation, however, takes a longer amount of time than the momentary, exceedingly brief pause that occurs between the expansion and contraction of the heart.²⁷

In and of itself, this argument is nothing but a banal example of how a dogmatic Aristotelian typically reacted to a new interpretation of the body and its physiological processes. Considered from the perspective of the history of the reception of Aristotle, though, this same argument can give us some interesting food for thought that I would like to address in the conclusion.

Franzosi presents the notion of the heart as the “seat of the soul” as

26 Franzosi 1652, 120: “[...] si motus cordis [...] non esset directus ab anima, vasaque cordis inservirent potius tamquam canales anima carentes, quam ut instrumenta vita praedita [...] Sed quoniam in corpore animato quaecumque fiunt, ad nutum naturae fiunt, [...] non multum laborabimus in inveniendis ingeniis, per quae ipsa introitum sanguinis in cor, et egressum molitur absque ulla circulatione”. On page 119, Franzosi had also cited a passage of Galen's *De naturalibus facultatibus*, III, 15, in defence of this theory: “Sed illud minime ignorandum, duo esse tractionum genera, unum, quod successione ad id, quod vacuatur, contingit; alterum, quod qualitatis convenientia fit. Aliter namque aer in folles, aliter ferrum a magnete attrahitur. Praeterea successione ad id, quod vacuatur, prius id trahi, quod levius est; convenientia qualitatis nonnumquam (si ita fors tulit) quod gravius; modo id cognata magis natura fit. Itaque etiam tum cor ipsum, tum vero arterias, quatenus instrumenta cava, et dilatabilia sunt, semper id, quod levius est prius petit.”

27 Franzosi 1652, 129: “Et hinc factum est, ut progenitae sint in corde cavitates, et sinus, in quibus sanguis usque eo detineatur, donec facta sit maior eius alteratio, quae necessaria est ad nutritionem cordis praesertim, et ad alia munia; haec autem maior alteratio requirit spatium longius momentanea, et velocissima quiete, quae inter dilatationem intercedit, et compressionem cordis.”

unambiguously Aristotelian and cites the treatise *De Anima* to confirm this view. Franzosi actually seems ignorant of the fact that not a single passage in the Aristotelian corpus explicitly defines the heart as the seat of the soul: neither in *De Anima*, in which Aristotle presents the concept of the soul as the “perfection of the entire body”; nor in his zoological and minor scientific works, in which Aristotle actually recognises a genuine connection between the functions of the soul and the physical processes at work in and around the heart, without answering in explicit and unequivocal way the question of the location of the soul.²⁸ In this regard, Aristotle’s own doctrines are comprehended quite inaccurately by their dogmatic champion Franzosi.

In contrast, we have Harvey’s understanding of the physiological and ontological centrality of the heart, which is also directly inspired by Aristotle, although it dispenses with the concept of the soul. We should note first that Harvey’s understanding of the activity of the heart does not always coherently combine mechanical and teleological elements. In the first part of *De motu cordis*, it appears that Harvey understands the heart as a mechanical pump, the sole function of which is to drive blood into the arteries by its constant beating. That is also the implication of Harvey’s conviction that life arises rather in the auricles, where blood first pools, than in the chambers of the heart. According to Harvey, the parts of the heart do not beat simultaneously, but rather the auricles are the part where the heartbeat starts as well as the part that is the last to cease beating, after the heart chambers, at the end of life. Consequently, the beating of the heart chambers is the mechanically explicable result of the expansion and contraction of the auricles, which in turn is caused by the initial effervescence of the blood.²⁹ This view precludes the notion of the existence of an innate faculty and self-actuating force in the heart.³⁰ In this regard, Harvey really does seem to be moving toward a mechanistic understanding of the heart, and it is no coincidence that he is furthest from Aristotle on this particular point of his theory of the movement of the heart and blood. Aristotle had alluded to the heart in several passages (*De generatione animalium*, II, 4, 740a2–b8; *Historia animalium*, VI, 3, 561a9–12; *De partibus animalium*, III, 4, 666a20–b1) as

28 That is the case, e.g., in the chapter of *De partibus animalium* dedicated to the heart (III, 4, 665a29–667b14), the last section of *De somno et vigilia* (458a11–32) and the eight chapter of *De respiratione* (474a25–b9).

29 The entire process is described by Harvey in detail in chap. 4 of his *De motu cordis*.

30 Harvey 1628 (1995, 23): “Neither is it true which is commonly believed, that the heart by any motion or distention of its own doth draw blood into the ventricles, but that whilst it is moved and bended, the blood is thrust forth, and when it is relaxed and falls, the blood is received in manner as follows.”

the first body part formed in an embryo and therefore explicitly denied that the blood rather than the heart could be original seat of life in an embryo.³¹

Naturally, Franzosi very carefully stresses the contradiction between Harvey and Aristotle and offers arguments from a teleological perspective in defence of Aristotle's doctrine. He refers especially to the necessity of presuming a formal unmoved-moving force as the logical condition for a consistent explanation of the heartbeat, a force Franzosi identifies as the soul. This statement is followed by the claim that this formal force must have a material seat, and this seat could be none other than the heart (i.e., the chambers of the heart), whereby the heart is to be identified as the source of the essential physical instrument of the soul – namely, innate heat.³² We must add, however, that Harvey's localisation of the beginning of life in the blood rather than in the heart is the precondition only for a mechanistic explanation of the heartbeat, not of the human body and all its processes *tout court*. Harvey's view of the body as a complex physiological system is no less teleological than Aristotle's and that of the 'orthodox' Aristotelians of his time: what is characteristic of Harvey, though, is the redefinition of the hierarchy of parts of the body with respect to the whole system of the four causes and especially with regard to the determination of the final cause. As W. Pagel has remarked, "Harvey sees in the blood the fountain from which the organs and tissues are continually refreshed and indeed built up, both in embryonic and in later life. Blood therefore can be seen as the final cause for the sake of which the organism at large is made; even the heart would subordinate itself as serving for the perfection of blood."³³

Conversely, although Harvey's explanation of the heartbeat clears the way for an explicitly mechanistic depiction of the heart, we cannot really accept the claim that Harvey's theory in and of itself rests on mechanistic principles. This emerges clearly in the second part of his text, where Aristotelian themes are more evident and direct references to Aristotle's writings become more frequent, and where Harvey describes the heart, not as a simple pump, but rather as the centre of all vegetative, sensory and motor activities, and also as the part of the body endowed with the active ability to nourish, preserve and perfect the entire body:

Nor must we disagree from Aristotle concerning the principality of the heart, that it does not receive motion and sense from the brain, nor blood from the liver, but that it is the beginning of the veins and of the blood, and the like; seeing those that endeavour to confute him

31 In *PA* 647b5, Aristotle describes the physiological process whereby nourishment is boiled down in the heart by virtue of innate heat and transformed into blood.

32 Franzosi 1652, 117 (see *supra*, footnote 21).

33 Pagel 1967, 43 (cf. Pagel 1976, 14–18).

omit that chief argument, to wit, that the heart is the first subsistent, and that it had blood, life, sense, and motion before the brain or liver were made, or appeared distinctly, at least before they could perform any function. To this add, that the heart, as a sort of internal animal, consists longer, as if Nature by the making of this first, would have the whole animal afterwards to be made, nourished, preserved, perfected by it, as its own work and dwelling place. The heart is as it were a prince in the Commonwealth, in whose person is the first and highest government everywhere; from which as from the original and foundation, all power in the animal is derived, and doth depend.³⁴

In this specific regard, Harvey's views do not differ so dramatically from Franzosi's. One difference that might explain the absence of the concept of the soul in Harvey has to do with the fact that Harvey makes no reference to *De Anima* at all and cites only Aristotle's zoological writings and the *Parva Naturalia* (especially the text *On Breath*),³⁵ that is, the texts in which Aristotle treated "processes common to the body and soul" and especially the explanation of the physical aspects of these processes.³⁶ On the other hand, the fact that Harvey regularly makes use of the concept of the soul in his *Exercitationes de generatione animalium* need not be considered as contradicting the argumentative strategy and theoretical content of *De motu cordis*. Harvey's use of the concept of the soul in his embryological treatise is the result of at least two factors: on the one hand, Harvey develops his entire embryological theory on the basis of and in constant dialogue with Aristotle's (and Galen's) own theories. In fact, *Exercitationes de generatione animalium* combines the characteristics of a scientific treatise, in which new observations and new knowledge is presented in systematic fashion, with those of a commentary on Aristotle's and Galen's embryological texts. That is why Aristotle plays a double role in Harvey's embryological treatise: both as theoretical model and simultaneously as polemical target. Harvey actually

34 Harvey 1628 (1995, 114–115): "Necminus Aristoteli de principatu cordis assentiendum, an a cerebro motum et sensum accipiat? An a iecore sanguinem? An sit principium venarum, et sanguinis et huiusmodi? Cum qui ipsum redarguire conantur, illud principale argumentum omittunt, aut non intelligunt, quod cor nempe primum subsistens sit, et habeat in se sanguinem, vitam, sensum, motum, antequam aut cerebrum aut iecur facta erant, vel plane distincta apparuerant, vel saltem ullam functionem edere potuerant. Et suis propriis organis ad motum fabricatis, cor tanquam animal quoddam internum antiquius consistit. Quo primo facto, ab ipso postea fieri, nutriri, conservari, perfici, totum animal, tanquam huius opus et domicilium, natura voluisset: et cor (tanquam in republica princeps) penes quem primum et summum imperium ubique gubernans sit. A quo tanquam ab origine in animali, et a fundamento omnis potestas derivetur, et dependeat."

35 An indirect reference to *HA* III appears in chap. 2 of *De motu cordis*; a reference to *Resp.* 15 and *De animalibus* 3 in chap. 3; to *HA* VI, 3 and *MA* 8 in chap. 4; to *De spiritu* 3 in chap. 6; in the 'meteorological' metaphor Harvey uses to explain the circulation of blood in chap. 8, we find an indirect reference to *CG* and *Met.*; in chap. 15, Harvey refers to *Resp.* 2 and 3 several times and quite explicitly to *PA*; further references to *PA* III appear in chaps. 16 and 17; references to *Resp.* and *De spiritu* also appear in chap. 17.

36 *De an.* 433b19–21; *De sens.* 436a8; *De part. an.* 643a35–6.

always represents his own theories and observations quite explicitly as an attempt to put certain aspects of Aristotle's embryological doctrine on new empirical bases or to criticise and develop them in new directions. That, however, is an agenda for which it would have been impossible for Harvey not to refer to the concept of the soul (it is no coincidence that Harvey uses this concept the most in the part of his text dedicated to discussion of all possible solutions to the problem of the respective male and female contributions to generation). On the other hand, the concept of the soul remains central to Harvey's embryological doctrine, in which this concept offers an effective principle that explains the formation and the entire development process of the embryo.³⁷ Yet, in different context, in which Harvey is researching the causes of specific physical processes, not from the perspective of development, but rather from that of their on-going function, the concept of the soul is not strictly necessary and can thus be left in the background and alluded indirectly by other terms.

We thus can imagine that Harvey dispenses with the concept of the soul in his treatise on the movement of the heart because he is following a deliberate reception strategy that is characterised by a flexible and research-oriented utilisation of Aristotelian material. This omission is therefore not the result of Harvey's distancing himself from the Aristotelian paradigm, but rather a deliberate attempt to develop this paradigm toward full depsychologisation and naturalisation, so as to harmonise it with new empirical knowledge and accordingly establish it as the theoretical foundation of nascent 'scientific' and anti-metaphysical physiology: The epistemological originality and historical and cultural importance of this attempt for the history of medicine can be appreciated better if one recalls that the same goal – depsychologised and naturalised observation of nature and the function of the body – was reached in the philosophical discourse of the time by the radical Cartesian deconstruction of the Aristotelian world.

37 On the *Exercitationes de generatione animalium* and Harvey's research programme in embryology, see Pagel 1967, 233–352 and Meyer 1936.

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