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## **EXERCISING IMPARTIALITY TO FAVOR ARISTOTLE AVICENNA AND “THE ACCOMPLISHED ANATOMISTS” (*ASHĀB AL-TAŠRĪH AL-MUHĀSSILŪNA*)**

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**Abstract.** This article analyses Avicenna's *Hayawān* III, 1, which deals with the well-known disagreement between physicians and philosophers on the origination of blood vessels (arteries and veins) and nerves. However, the proposed analysis is not limited to this chapter and its main topic. The more general purpose of this article is to reconstruct the psycho-medical context in which Avicenna's exposition lies, that is, the soul's oneness and the consequent conditions for body ensoulment (i. e. the soul's need for a primary, unitary attachment to the body through the heart and the cardiac pneuma). The article then outlines the strategy through which Avicenna presents medical positions (heart, brain, and liver are all on an equal footing) that challenge his (and Aristotle's) anatomical model, which is coherent with his theory of the soul. In this connection, firstly, the article shows how Avicenna takes physicians' arguments apart in a philosophical context (he usually points at their logical shortcomings). Then, it clarifies the contribution of anatomy to determine the conditions of body ensoulment and, ultimately, how to reconcile medical practice with philosophical truths, if need be.

**Résumé.** Cet article analyse *Hayawān* III, 1 d'Avicenne, qui traite du désaccord bien connu entre médecins et philosophes sur l'origine des vaisseaux sanguins (artères et veines) et des nerfs. Cependant, l'analyse proposée ne se limite pas à ce chapitre et à son sujet principal. L'objectif plus général de cet article est de reconstruire le contexte psycho-médical dans lequel s'inscrit l'exposé d'Avicenne, c'est-à-dire l'unicité de l'âme et les conditions qui en découlent pour l'animation du corps (c'est-à-dire le besoin de l'âme d'un attachement primaire et unitaire au corps à travers le cœur et le pneuma cardiaque). L'article expose ensuite la stratégie par laquelle Avicenne présente des positions médicales (le cœur, le cerveau, et le foie sont tous aussi cruciaux) qui remettent en cause son modèle anatomique (et celui d'Aristote), lequel est cohérent avec sa théorie de l'âme. À cet égard, l'article montre tout d'abord comment Avicenne démonte les arguments des médecins dans un contexte philosophique (il souligne généralement leurs lacunes logiques). Ensuite, il clarifie l'apport de l'anatomie pour déterminer les conditions de l'animation du corps et, finalement, comment concilier la pratique médicale avec les vérités philosophiques, le cas échéant.

## 1. INTRODUCTION, OR BRIDGING THE GAP BETWEEN PHILOSOPHY AND MEDICINE

Avicenna's purpose in the *Kitāb al-šifā*<sup>9</sup> (Book of the Cure/Healing, henceforth *Šifā*<sup>9</sup>) is to rework and update all the Aristotelian sciences (with the addition of mathematics) to conform them to the criteria of demonstration that Aristotle outlined in the *Posterior Analytics*. In the Avicennian system of science, metaphysics has to provide the foundation of all special sciences.<sup>1</sup> The actual realization of Avicenna's project in the *Šifā*<sup>9</sup>, however, seems to cause more than a problem.<sup>2</sup> One of those problems concerns the inclusion of botany and zoology as the seventh and the eighth section (*fann*) of the part (*ğumla*) on natural philosophy of the *Šifā*<sup>9</sup>. Being based on direct observation, the method of botany and zoology diverges from that of the other natural sciences (they stand at the crossroads between natural philosophy and practical discipline)<sup>3</sup>

<sup>1</sup> The editions of Avicenna's works cited in the present article are the following: (1) *Al-šifā*<sup>9</sup>, *al-tabi'iyyāt VIII*, *al-hayawān*, <sup>c</sup>A. al-Halīm Muntasir, S. Zāyid, <sup>c</sup>A. Ismā'īl, eds. (Cairo: al-Hay<sup>a</sup> al-misriyya al-<sup>c</sup>āmma li-l-ta<sup>3</sup>lif wa-l-naśr, 1970); (2) *Avicenna's De anima (Arabic Text), Being the Psychological Part of Kitāb al-shifā*<sup>9</sup>, ed. F. Rahman (London: Oxford Univ. Press, 1959, 1970<sup>2</sup>); (3) *Qānūn fī l-tibb*, 5 vol., (Dilhī al-Čadīda: Ma<sup>c</sup>had tā<sup>3</sup>rīḥ al-*tibb* wa-l-abhāt al-*tibbiyya*, 1402-17 [i.e. New Delhi: Institute of History of Medicine and Medical Research, Čāmī'a Hamdard, 1981-96]); (4) *Adwiya qalbiyya*, in *Min mu<sup>3</sup>allafāt Ibn Sinā al-*tibbiyya**, ed. M. Z. al-Bābā (Aleppo: Ma<sup>c</sup>had al-turāt al-<sup>c</sup>ilmī al-<sup>c</sup>arabī, 1404/1984), 221-294. On the role of metaphysics in Avicenna's system of science see A. Bertolacci, *The Reception of Aristotle's Metaphysics in Avicenna's Kitāb al-šifā*<sup>9</sup>. A Milestone of Western Metaphysical Thought (Brill, 2006).

<sup>2</sup> I have dealt with the epistemological tensions arising from Avicenna's reworking of Aristotelian psychology in his *Kitāb al-nafs* (Book of the soul) in the monograph *Subject, Definition, Activity: Framing Avicenna's Science of the Soul* (De Gruyter, 2021). Another case, which however has received much more attention, concerns the *Categories* and the tensions derived from their being expounded both in logic and metaphysics. On this issue and the possible solution to those tensions see, for instance, A. Kalbarczyk, *Predication and Ontology Studies and Texts on Avicennian and Post-Avicennian Readings of Aristotle's Categories* (De Gruyter, 2018), and A. Bertolacci, "The 'Ontologization' of Logic. Metaphysical Themes in Avicenna's Reworking of the Organon," in M. Cameron, J. Marenbon (eds.) *Methods and Methodologies. Aristotelian Logic East and West 500-1500* (Brill, 2011), 27-51.

<sup>3</sup> On the peculiar status of botany and zoology in Aristotle's classification of the sciences constituting natural philosophy, see *Meteorologica*, I, 1, 339 a5-10. For the fact that Neoplatonic commentators placed Aristotle's zoological writings in a distinct group of writings, that is, the so-called "intermediate works," see Simplicius, *Commentaire sur les Catégories. Traduction commentée sous la direction de Ilse Traut Hadot, fascicule I, introduction, première partie. Traduction de Ph. Hoffmann (avec la collaboration de I. et P. Hadot). Commentaire et notes à la traduction par I. Hadot avec des appendices de P. Hadot et J.-P. Mahé* (Leiden: Brill, 1990), 69-70.

and they do not reach the level of demonstration that, according to Avicenna, is mandatory for science to be included in one of the branches of theoretical philosophy.

Their inclusion in natural philosophy, however, has to serve a specific purpose. When looking for it, we cannot overlook two distinctive features of the *Šifā*<sup>4</sup>, which might help to determine it. First, the *Šifā*<sup>4</sup> is Avicenna's only philosophical *summa* to contain a specific exposition on plants and animals.<sup>4</sup> Second, it has been composed in tandem with a medical encyclopedia, that is, the *Qānūn fī l-tibb* (Canon of Medicine).<sup>5</sup> I thus consider the combination of these two elements as the key to understanding Avicenna's purpose in including botany and zoology in the *Šifā*<sup>4</sup>. In general terms, I would suggest that these disciplines contribute to grounding medicine, which, as a derivative and practical science, is subordinate to natural philosophy,<sup>6</sup> and serve as a bridge between medicine and its remote theoretical background, which is contained in the first six sections of the natural philosophy of the *Šifā*<sup>7</sup>. It remains to determine what exactly their contribution is and how they

<sup>4</sup> In the concise prologue of the psychological section of *Al-mašriqiyūn* (The East-erners, 132.9-21, ed. Özcan), Avicenna seems to consider psychology introductory to botany and zoology. It should be noted, however, that the surviving part on natural philosophy of *Al-mašriqiyūn* ends with psychology, and no attestation of a botanical or a zoological section can be found.

<sup>5</sup> I have already explored the factors highlighting the complementarity of these two works (structural analogies, cross-references, biographical report), and I will not delve into them here. See T. Alpina, "Is Nutrition a Sufficient Condition for Life? Avicenna's Position between Natural Philosophy and Medicine," in R. Lo Presti, G. Korobili (eds.), *Nutrition and Nutritive Soul in Aristotle and Aristotelianism* (De Gruyter, 2020), 222-224.

<sup>6</sup> For Avicenna's division of sciences into fundamental (*aṣlī*) and derivative (*far'ī*), and for the classification of medicine as a derivative natural science (*al-hikma al-tabi'iyya al-far'īyya*), which investigates the states of human body only in terms of health (*sihha*) and sickness (*marad*), their causes, and their symptoms, see Avicenna, *Maqāla fī aqsām al-‘ulūm al-‘aqlīyya* (Treatise on the divisions of the intellectual sciences), 110.7-10 (Cairo ed.). A similar passage can be found at the beginning of the *Qānūn* (I, 1, i, 1, 33.8-9). For the subordination of medicine to natural philosophy a crucial passage is *Burhān*, II, 7, 163.14-20, where medicine is said to be subordinated to natural philosophy because it investigates the subject of the part of natural philosophy that deals with the human body, insofar as the latter is qualified by *health* and *sickness*, which are two *per se* accidents of the human body. On this aspect, see also *Ilāhiyyāt*, I, 2, 14.18 – 15.3.

<sup>7</sup> See *Qānūn*, I, 1, i, 2, 36.8-14. For a thorough analysis of this passage, see D. Gutas, "Medical Theory and Scientific Method in the Age of Avicenna," in D. C. Reisman, A. H. Al-Rahim (eds.), *Before and After Avicenna: Proceedings of the First Conference of the Avicenna Study Group* (Brill, 2003), 145-162.

provide it.

As for botany, I have argued elsewhere that the first and the last chapter of the *Kitāb al-nabāt* (Book of Plants, henceforth *Nabāt*) contain an explicit connection to medicine. In particular, in the first chapter, Avicenna refers to “our big book on the discipline of medicine” (*fī kitābinā l-kabīr fī ṣinā‘at al-tibb*) – which in all likelihood is a reference to *Qānūn*, I, i, vi, 3 – for a thorough explanation of how heat and moisture are essential to preserving life through the process of digestion (1, 7.12-20). In the seventh and final chapter of *Nabāt*, Avicenna directly tackles the issue of the interaction between the temperaments of things possessing the nutritive soul, that is, plants, and our bodies, which is said to be “a principle (*mabda’ mā*) for medicine (*li-l-ṭibb*) and what is analogous to it” (7, 33.16-7), and to serve as a foundation (*asl*) for a particular discipline (*ṣinā‘a ḡuz̄iyya*) (7, 38.4-5).<sup>8</sup> Thus, especially concerning the last chapter of *Nabāt*, botany seems to contribute specifically to the foundation of medical pharmacology.

Singling out the role of zoology is a more complex task. In the prologue to *Nafs*, Avicenna states that the specific discourse (*kalām muhassas*, 3.1) on animals (and plants), which will supplement the general investigation of the soul, will depend on their bodies and the properties of their bodily activities (*muta‘alliq bi-abdānihā wa-bi-hawāṣṣ min af‘ālihā l-badaniyya*, 3.2).<sup>9</sup> The idea is that the formal principle of all organic beings, i.e. the soul, has been already investigated in psychology, independently of their different degrees of complexity. Their specificity, by contrast, is difficult to ascertain from inside, that is, at a formal level, because the specific differences of each instance of soul (and of its bearer) fall outside our cognitive faculties.<sup>10</sup> It can, however, be grasped from outside on the basis of the features observable in the material substratum of animals (and plants).

That the investigation of animals is primarily an inquiry into body

<sup>8</sup> See Alpina, “Is Nutrition a Sufficient Condition for Life?” in part. 248-249; 251-252.

<sup>9</sup> For an English annotated translation of the prologue to *Nafs* and an analysis of its main argument see Alpina, *Subject, Definition, Activity*, 64-68; 191-194, and id., “Knowing the Soul from Knowing Oneself. A Reading of the Prologue to Avicenna’s *Kitāb al-nafs* (Book of the soul),” Atti e Memorie dell’Accademia Toscana di Scienze e Lettere “La Colombaria,” 82 (68), 2018, 443-458.

<sup>10</sup> *Nafs*, prologue, 2.5-17. See also *Ilāhiyyāt*, V, 4, 220.13-18. There, in dealing with the *differentia* that specifies genus, Avicenna says that we cannot grasp what is proper to the specific idiosyncrasies of every genus with respect to every species, nor what is proper to the specific differences of the species of a single genus, because this knowledge escapes our cognitive capacities; rather, we can grasp the rule in virtue of which a *differentia* enters a genus and specifies it.

parts and their properties (functions, locations, etc.) is not surprising: in the *Kitāb al-hayawān* (Book of Animals, henceforth *Hayawān*) body parts seem to be an essential criterion for distinguishing or grouping animals.<sup>11</sup> However, in *Hayawān* Avicenna deals with the parts of the body not only to account for the difference among animals, but also to show how they present suitable locations for certain powers or are the proper instruments for certain activities due to their temperaments. The investigation of the temperament (*mizāğ*) of various body parts, both of the homeomerous parts (like bones, sinews, tissues, flesh, etc.) and the anhomeomerous ones (like skull, eyes, ears, nose, etc.), represents a substantial theoretical achievement of zoology and a crucial contribution to medicine: it connects zoology with the previous sections of the *Šifā*<sup>9</sup> on natural philosophy, which Avicenna devotes to the theory of mixture.<sup>12</sup> It is a proper advancement in this theory itself because it marks a tran-

<sup>11</sup> In *Hayawān*, I, 1 (“[Chapter] on the difference of animals in general with respect to shelter, food, characters, activities, and organs”), Avicenna lists body parts, among other criteria, to account for the differences among animals. However, apart from brief forays into the issue of animals’ shelter, food, and character (see *Hayawān*, VII, 1-2; VIII, 1-4), Avicenna seems to privilege inquiries into body parts and their functions. On this, see T. Alpina, “Translating Method: Inference from Behavior to Anatomy in Avicenna’s Zoology,” in K. Krause, M. Auxent, D. Weil (eds.), *Premodern Experience of the Natural World in Translation* (Routledge, forthcoming).

<sup>12</sup> On this connection, see *Afāl wa-infiālāt*, II, 2, 266.8 – 267.4 and, in particular, the final paragraph: “This (sc. the process of natural generation of composites from things having a temperament) is according to two divisions (*wa-hādā ‘alā qismayni*). [(i)] A division is the second blending (*al-imtizāğ al-tāni*), whose state concerning the unification of what is blended is [similar to] the state of the first blending (*al-imtizāğ al-awwal*, sc. elemental temperament). Among what belongs to this division there is theriac, and fermented creams. [(ii)] What is not in this way. For, it (sc. what is according to this division) is composed of parts whose true nature is not to be united in nature like one single thing; rather, they (sc. these parts) are different, distinct. The majority of minerals and metals is in the first way, whereas the majority of plants and animals, in virtue of the fact that they are composed out of their organs, is in the second way. It is known that the composites of parts that are different in actuality result in simple parts that cannot be divided in actually different parts. For this reason, the body parts of animals and plants undoubtedly result in first, simple parts, which are called homeomerous parts, like flesh, bone, each sensible part of which does not need to dissolve in its division into it, and is sensible just like flesh and bone. Then, the instrumental (sc. organic) parts are made up of these, like leave, bast, fruit [in the case of plants], and like hand and foot in animals. Then, the whole body is made up of those organic parts. These are questions appropriate for the natural science (*fa-hādihi masā‘il mutanāsiba min al-‘ilm al-tabī‘i*), and they themselves are fundamental principles and starting points (*wa-hiya bi-‘aynihā usūl wa-mabādi‘*) for particular disciplines that are below natural science (*li-ṣanā‘i‘i guz‘iyya tahta l-‘ilm al-tabī‘i*)” (emphasis mine).

sition from inquiry into the temperament as resulting from elementary qualities to that of the temperament resulting from humors, which constitute body parts and, ultimately, the whole body. It also represents an essential prerequisite for medicine, which acts upon the temperament of the body (and its parts) to restore health. It is against this background that the transplantation of the treatment of humors from the *Qānūn* to the *Hayawān* must be interpreted: this treatment is moved to the proper realm, in which philosophical principles of medicine are provided, namely natural philosophy.<sup>13</sup>

I shall return to the centrality of the issue of temperament in Avicenna's zoology in a forthcoming paper, and briefly at the end of this article.<sup>14</sup> In the present contribution, however, I would like to focus on another important aspect of zoology. It concerns the disagreement between (natural) philosophers and physicians on shared issues and its solution. In particular, progress in the field of physiology and anatomy challenges the authority of *al-mu‘allim al-awwal* ("the First Teacher," i.e. Aristotle) and his writings, on which Avicenna's zoology is largely based.<sup>15</sup> Indeed, in this field, Avicenna seems to value greatly some of

<sup>13</sup> In *Qānūn*, I, 1, i, 2, 36.8-17, Avicenna includes humors (*al-aḥlāt*) among the topics whose existence the physician must accept on authority (*taqallada*). This explains why he transplants their treatment from medicine to *Hayawān*, XII, 5-6, which in turn contain many references to the previous sections on natural philosophy of the *Šifā* (*Hayawān*, XI can be considered to play a crucial role in introducing the treatment of temperament resulting from the humors into zoology since it ideally links its topic with the principles established in the previous sections. Its title is "[Chapter containing] a reminder of the fundamental principles that have been established"). On a different interpretation of *Hayawān*, XI as a sign of the unfinished nature of the *Hayawān*, see B. F. Musallam, "Avicenna. x. Biology and medicine," in *Encyclopaedia Iranica*, vol. III, fasc. 1 (1987, 2011<sup>2</sup>), 94-99.

<sup>14</sup> T. Alpina, "Are Animals a Matter of Complexion? *Mizāg* as a Keystone of Avicenna's Scientific Project," *Early Science and Medicine*, forthcoming. On the notion of (humoral) balance (*i‘tidāl*), which is connected with that of temperament, and its role in zoology, see R. Kruk, "Ibn Sina On Animals: Between the First Teacher and the Physician," in J. Janssens, D. de Smet (eds.), *Avicenna and his Heritage* (Leuven: Leuven Univ. Press, 2002), 325-341, in part. 330-331.

<sup>15</sup> See al-Ǧuzgāni's Introduction to the *Šifā*, 3.15-16: "He (sc. Avicenna) also composed the [Book of] Animals and the [Book of] Plants, and completed these books. Although in most of the Book of Animals he followed the Book [of Animals] of Aristotle (*wa-hādā fī aktar kitāb al-hayawān kitāb Aristūṭalīs al-faylasūf*), he made additions in them (sc. in the Book of Plants and Animals) beyond that (sc. Aristotle's writing) (*wa-zāda fīhā min qalika ziyādāt*). See also Avicenna, *Hayawān*, I, 1, 1.10-13: "Let us now talk about animals by following in all this book the first teaching as a model (*muḥtaḍīna fī ḡāmi‘ hādā l-kitāb ḥadwa l-ta‘lim al-awwal*), except in the case of the anatomy of the organs of the human being (*illā fī taṣrīh a‘dā’ al-insān*) – actually,

the theories held by Galen (an example being the humoral theory), to whom he refers by the epithet *fādil al-ātibbā*<sup>16</sup> (“the excellent one among the physicians”).<sup>16</sup>

The main two clusters of issues on which philosophers and physicians fiercely disagree are the following: (i) the origin of blood vessels (veins and arteries) and nerves and, consequently, the more fundamental issue of the role and function of the chief organs (heart, brain, and liver), and (ii) the issue as to whether the female and the male have semen, and the stages of the development of the embryo.<sup>17</sup> Concerning these issues in the *Qānūn*, Avicenna generally highlights the points of conflict between the philosophical and the medical account, and usually defers their settlement to philosophy. A passage from the *Qānūn*, later transplanted in the *Hayawān* as part of chapter I, 2, contains a clear example of this attitude. There, with respect to the issue of determining the male and female contributions to reproduction, Avicenna states: “The verification of the discourse on this topic will occur in our books on fundamental sciences (*wa-ammā tāhqīq al-qawl fī hādā l-ma‘nā fa-fī kutubinā fī l-‘ulūm al-asliyya*)” (I, 2, 16.16, cf. *Qānūn*, I, 1, v, 1, 61.14).<sup>18</sup> Given Avicenna’s distinction between fundamental and derivative sciences,<sup>19</sup> and the fact

we prefer to put together anatomy (*al-tašrīh*) and [its] use (*al-manfa‘a*) in one single place (*fī mawdī‘ wāhid*) – and in the case of few [other] things. Then we shall cut off in terms of information that which he (sc. Aristotle) was prolix about. We shall mention of the theoretical discourse (*min al-kalām al-naṣārī*) what is appropriate for our opinion and our collection of these sections (*bi-ra‘yinā wa-ğam‘inā li-hādihi l-funūn*).

<sup>16</sup> An alternative formulation of this epithet is *al-ṭabīb al-fādil* (“the excellent physician”). The epithet by which Avicenna refers to Galen is similar to the epithets by which he refers to Alexander of Aphrodisias, namely *fādil al-qudamā‘ al-mufassirīn* (“the excellent one among the ancient commentators,” *Nafs*, III, 7, 149.5), and *fādil al-mutaqaddimīn* (“the excellent one among the predecessors,” *Ilāhiyyāt*, IX, 3, 393.16-17). More on Galen’s epithets *infra*.

<sup>17</sup> For a thorough analysis of Avicenna’s account of the development of the embryo against the background of his *Samā‘ tabī‘ī*, see the crucial contributions by J. McGinnis: “On the Moment of Substantial Change: A Vexed Question in the History of Ideas,” in J. McGinnis (ed.), *Interpreting Avicenna: Science and Philosophy in Medieval Islam, Proceedings of the Second Annual Symposium of the Avicenna Study Group* (Leiden: Brill, 2004), 42-61, and *Avicenna* (Oxford Univ. Press, 2010), Great Medieval Thinkers series, in part. 239-243.

<sup>18</sup> In this chapter, other conflicts between physicians and philosophers are highlighted. See, for instance, the disagreement concerning the classification of the organs (13.13 – 14.18). However, Avicenna explicitly says that it is not incumbent upon the physician to demonstrate anything as long as he assumes a division between organs according to their function.

<sup>19</sup> See n. 6.

that reproduction is a topic relevant to zoology,<sup>20</sup> here Avicenna might be thinking precisely of zoology as the proper place to settle the controversy. For zoology is considered a fundamental science because it is a subdivision of natural philosophy, that is, a branch of theoretical philosophy.

Indeed, in the *Hayawān* there are chapters where Avicenna explicitly addresses the disagreement between philosophers and physicians. In some cases, the chapter titles immediately convey the nature of the discussions contained in them. For example, *Hayawān* III, 1 is entitled “On the anatomy of internal organs and the disagreement between philosophers and physicians about them” (*fī taṣrīh al-a‘dā’ al-bāṭina wa-l-hilāf bayna l-falāsifa wa-l-aṭibbā’ fīhā*) and is devoted to the topic of the origin of blood vessels (veins and arteries) and nerves. *Hayawān*, IX, 2 is another, remarkable case. It is entitled “On Galen’s objection to the philosopher (sc. Aristotle), on the refutation of that objection, and on considering it (sc. the objection) stupid” (*fī iḥtiġāġ Ĝalīnūs ‘alā l-faylasūf wa-naqd dālikā l-iḥtiġāġ wa-tashīfiḥī*), and is part of a longer discussion of the female and male roles in reproduction in *Hayawān*, IX, 1-3. Both chapters discuss thorny issues that set philosophers against physicians. Generally, Avicenna grants primacy to the philosophical account of the question and ascribes physicians’ different (and thus incorrect) position either to an illegitimate disciplinary trespass (they deal with topics that are off-limits to them),<sup>21</sup> or to a shortcoming in logical argumentation (they are not sufficiently versed in the art of logic),<sup>22</sup> or both.

In what follows, I will focus on *Hayawān*, III, 1, since it provides a unique case study to determine (one of) the purposes of Avicenna’s zoological investigation and, more generally, a specimen of his philosophical practice. In particular, my analysis will begin with outlining Avicenna’s approach to the Aristotelian text and accounting for his criticism of Galen’s arguments on the origin of blood vessels and nerves, but

<sup>20</sup> In *Nafs*, V, 8, Avicenna explicitly connects this topic with the zoological investigation (“as its mention will come to you where we will be dealing with animals (*kamā ya³tīka dikruhū ḥaytu natakallamu fī l-hayawān*, sc. *Hayawān*, XV, 1),” 269.14-15).

<sup>21</sup> As pointed out in *Hayawān*, III, 1.

<sup>22</sup> As pointed out in *Hayawān*, IX, 2. See 150.1-3: “Thus, these are the elements that the man thinks to have advanced as arguments (*annahū yaḥtaġġu biḥī*). However, we are amazed at him. For, after [...] claiming to be good in mastering logic and philosophy (*ba‘da ... wa-da‘wāḥū ḡūdat al-ṭaṣarruf fī l-maṇṭiq wa-l-falsafa*), how could his soul be satisfied with these ridiculous arguments (*bi-hādihi l-ḥuġāġ al-sahīfa*) to the point of firmly believing in any of them or inclining towards it bordering on certainty?” See also n. 47 below.

it will not be limited to that. On the contrary, the analysis of these aspects will provide the cue for explaining the role that Avicenna assigns to medical practice and anatomical procedure in natural philosophy and why he considers it worth including them in his philosophical project. As we shall see, on the one hand, Avicenna argues that the contribution of anatomical procedure to investigating fundamental but controversial issues might corroborate the conclusions reached by reasoning alone (for instance, in psychology). On the other hand, he highlights the limits of such a contribution. Zoology provides a philosophical study of the organic body, on which medicine is grounded. Therefore, this study cannot but be based on philosophical premises. Arguments based on anatomical observation, which physicians use against Aristotle's position on those issues, turn out to be inconclusive because the evidence that they put forward to ground those arguments lacks any demonstrative force.

## 2. SYENNESIS, DIOGENES, AND POLYBUS: A WELL-AIMED SUMMARY OF ARISTOTLE'S DOXOGRAPHY (*HIST. AN.*, III, 2-3)

*Hayawān*, III, 1 shows a very selective approach to its Aristotelian source.<sup>23</sup> The chapter begins with a not very accurate summary of *Historia animalium* III, 2 and the first half of III, 3 (roughly until 513 a9). There Aristotle presents some previous opinions about the nature of veins (ἢ <φύσις> τῶν φλεβῶν, 511 b11) and their arrangement in the body (those of Syennessee of Cyprus, III, 2, 511 b23-4; Diogenes of Apollonia, III, 2, 511 b30, and Polybus, III, 3, 512 b11), and ascribes the defects or shortcomings of their opinions to the difficulty of actually seeing the veins. Veins are difficult to observe (δύσθεώρητον, 511 b13), because they are not manifest (ἄδηλος, 511 b14) both in dead animals, where veins are no longer visible after blood spills out, and in living animals, where they are by nature concealed inside the body (ἐν δὲ τοῖς ζώσιν ἀδύνατόν ἐστι θεάσασθαι πῶς ἔχουσιν· ἐντὸς γὰρ ἡ φύσις αὐτῶν, 511 b18-20). By contrast, Aristotle suggests that veins can be adequately observed only in strangled animals which have been previously emaciated (ἐν μόνοις τοῖς ἀποπεπνιγμένοις τῶν ζώων προλεπτυνθεῖσιν ἐστιν ἰκανῶς καταμαθεῖν, 513 a13-14): for in those animals blood does not spill out and veins remain manifest after death. For this reason, Aristotle considers his description of veins more accurate and reliable than those provided by his predeces-

<sup>23</sup> In this connection, it is hard to say whether Avicenna read the same Arabic translation of Aristotle's zoological writings as we presently know, because he summarizes the text without providing any literal quotation of it.

sors.

Avicenna's summary of the Aristotelian text begins precisely with the remark made by Aristotle about the nature of veins and the observational procedure he suggested which, unlike in his Aristotelian source, Avicenna combines together and places before the doxography on veins: "He (sc. Aristotle) said: the matter of anatomy is difficult in what is dead (*inna amr al-taṣriḥ yaṣ‘ubu fī l-mayyit*), because several blood vessels, which the extinction of innate heat have withered, become invisible (*l-iṣṭihfā’*). Undoubtedly, it is more difficult in what is alive (*fī l-hayy aṣ‘ab*). Anatomy should preferably be concerned with what is dead by strangulation (*bi-l-hanq*), because its blood does not spill out (III, 1, 39.6-8)."

As I said, this summary, which is introduced by the third person singular verb *qāla* ("he said"), as usual when Avicenna paraphrases the Aristotelian text,<sup>24</sup> is not very accurate: distinct excerpts from *Hist. an.*, III, 2-3 are combined together, and the outline of the opinions of Sāysūs al-Qubrusī (Συέννεος ὁ Κύπριος), Dīnāḡānis (Διογένης ὁ Απολλωνιάτης), and Bulūniyūs (Πόλυνβος) is hasty (for example, in the case of Polybus, Avicenna correctly points out that he identifies four pairs of veins, like Aristotle says, but then he lists only two, 39.14 – 40.3). This inaccuracy, however, seems not to depend on the Arabic translation of the Greek text that Avicenna might have had at his disposal. For the translation that Avicenna in all likelihood uses faithfully reproduces the Aristotelian text.<sup>25</sup> Nor, in my opinion, does it reflect an incomplete stage of composition of the *Hayawān*. On the contrary, the summary provides the cue for the main discussion topic of this chapter, which is not only the anatomy of blood vessels and nerves but also (and more importantly) whether it is possible to account scientifically for their origin and, if so, on what ground.<sup>26</sup>

As emerges in the opening line, engaging in the anatomical study of veins is difficult when we observe a dead body because the extinction of the innate heat following death makes the veins wither and, conse-

<sup>24</sup> On the fact that in the *Hayawān* Avicenna introduces his own comments and observations with the formula "I say" (*aqūlu*), whereas Aristotle's position with the formula "The First Teacher said" (*qāla l-mu'allim al-awwal*), see Kruk, "Ibn Sina On Animals," 326-327.

<sup>25</sup> See *The Arabic Version of Aristotle's Historia animalium. Book i-x of the Kitāb al-hayawān. A Critical Edition with Introduction and Selected Glossary by L. S. Filius in Collaboration with J. den Heijer and J. N. Mattock* (Brill, 2019), 162.9 – 166.3.

<sup>26</sup> In this connection, see the numerous occurrences of *mabda’* ("origin," 39.8, 10, 14; 40.2 – Avicenna uses *asl* as a synonym of *mabda’* only once at 39.9) and *ibtada’* ("to originate," 39.10, 12) in Avicenna's summary of Aristotle's doxography.

quently, become invisible to sense perception (*hiss*). This observation is even more difficult in the case of living bodies. The case of veins (but we can extend this remark also to nerves) points to a sub-perception realm whose knowledge, though depending on the body and its properties and not on some formal principle like the soul, cannot be attained through the senses.<sup>27</sup> All this seems to contrast with the beginning of the *Qānūn*, where, concerning the physician's acquaintance with body parts and their uses, Avicenna explicitly connects anatomical procedure (*taṣrīh*) with sense-perception (*hiss*).<sup>28</sup> In any case, this difficulty results in a proliferation of theories about the origin of veins. This proliferation encouraged Avicenna to address and settle the issue once and for all.

### 3. ARISTOTLE VS. GALEN: WHOSE SIDE ARE YOU ON?

Avicenna's hasty summary of the positions of those predecessors of Aristotle who engaged in the study of the venous system is useful for anchoring his treatment of the topic to the Aristotelian source from which it stems (the nervous system was unknown to Aristotle). On the contrary, what follows it is an outline of the theories held by those whom Avicenna considers his direct interlocutors on this subject, that is on the origin of blood vessels and nerves. They are, on the one hand, Aristotle and his followers, and on the other hand, the physicians, especially Galen. Avicenna presents their positions in a precise though concise way because they are the representatives of the two – conflicting – traditions of which he is at the same time the heir and collector.

The First Teacher (sc. Aristotle) believes that the origin (*mabda'*) of blood vessels is from the heart. On the contrary, those who came before him and after him among the physicians who are reckoned of some importance,<sup>29</sup> believe that the origin of blood vessels that do not pulse (= non-pulsatile, i.e. veins) is the liver. Likewise, he (sc. Aristotle) diverged from them on the matter of nerves. For he believes that their origin is the heart, whereas they believe that their origin is the brain. The partisan spirit (*al-ta'assub*) on this issue distressed them so much, and what incited the followers of

<sup>27</sup> There are other similar cases in the *Hayawān*. See *Hayawān*, IV, 2 concerning, in particular, the sense of hearing of fishes. On this chapter, see Alpina, "Translating Method."

<sup>28</sup> *Qānūn*, I, 1, i, 2, 36.15: As for the organs and their uses (*ammā l-a'qā' wa-manāfi'u hā*), the physician must approach them (*an yuṣādifahā*) through sense (*bi-l-hiss*) and anatomy (*wa-bi-l-taṣrīh*, i.e. the practice of anatomy, dissection).

<sup>29</sup> The reference to *fādil al-atibbā'* at 40.9 seems to suggest that Avicenna is counting Galen among the physicians who came after Aristotle.

the First Teacher (*śīrāt al-mū'allim al-awwal*)<sup>30</sup> against that [position] was their positing the heart as the origin of all faculties of the soul (III, 1, 40.3-7).

There are two radically different views about the origin of blood vessels and nerves, whose differences are aggravated by the partisan spirit (*ta'**aṣṣub*) shown by the supporters of these two positions. The different views on the topic trace back to two different anatomical models, namely Aristotle's cardiocentric theory and Galen's tripartite model. The former grants primacy to the heart over any other organ and, consequently, to the connection of the soul with the cardiac pneuma at the moment of generation. The latter, by contrast, maintains that there is no primary organ in the body, but rather heart, liver, and brain are all on an equal footing.<sup>31</sup>

Avicenna presents the rival alternatives apparently in a fair-minded way, allowing one almost naturally to impose on the other under the reader's eye. This exercise of equidistance might have been inherited by Late Ancient exegetical practice.<sup>32</sup> However, upon closer scrutiny, it is clear that the imposing view results from deliberately favoring some

<sup>30</sup> For a radicalization of Aristotle's cardiocentrism in Alexander of Aphrodisias, see P.-M. Morel, "Cardiocentrisme et antiplatonisme chez Aristote et Alexandre d'Aphrodise," in T. Bénatouïl, E. Maffi, F. Trabattoni (eds.), *Plato, Aristotle, or Both? Dialogues Between Platonism and Aristotelianism in Antiquity* (Hildesheim: Georg Olms Verlag, 2011), 63-84.

<sup>31</sup> See Galen, *PHP*, VI, 360.4-13 (ed. De Lacy): Προύκειτο μὲν ἐξ ἀρχῆς ἐπισκέψασθαι περὶ τῶν διοικουσῶν ἡμᾶς δυνάμεων, εἴτ' ἐκ τῆς καρδίας μόνης ὅρμωνται σύμπασι, καθάπερ Ἀριστοτέλης τε καὶ Θεόφραστος ὑπελάμβανον, εἴτε τρεῖς ἀρχὰς αὐτῶν τίθεσθαι βέλτιον, ὡς Ἰπποκράτης τε καὶ Πλάτων ἐδόξαζον. ἐπεὶ δὲ Χρύσουππος οὐ περὶ τῶν ἀρχῶν μόνον ἡμιφιβήτησε πρὸς τοὺς παλαιούς, ἀλλὰ καὶ περὶ τῶν δυνάμεων αὐτῶν οὕτε τὴν θυμοειδῆ συγχωρήσας ὑπάρχειν οὔτε τὴν ἐπιθυμητικήν, ἔδοξε χορῆναι τὴν τούτου πρότερον δόξαν ἐπισκεψαμένους οὕτως ἐπανέρχεσθαι πάλιν ἐπὶ τὸ προκείμενον ἐξ ἀρχῆς, ὡς ἐγκέφαλος τε καὶ καρδία καὶ ἥπαρ ἀρχαὶ τῶν διοικουσῶν ἡμᾶς δυνάμεων εἰσιν.

<sup>32</sup> Late Ancient commentaries on Aristotle's *Categories* list ten points (κεφάλαια) to be treated before beginning to comment on this writing. According to Simplicius' list (*In Cat.*, 3.18-29), the eighth concerns the qualities that the fine exegete must have. The capacity to approach the text objectively seems to be one of them: "Pour ce faire, l'exégète doit être objectif – trait que soulignent tous les commentateurs – et ne pas vouloir trouver des difficultés là où il n'y en a pas, ou au contraire vouloir à tout prix défendre Aristote là où il n'est pas défendable, comme s'il s'était enrôlé dans la secte du philosophe [...], ou comme s'il se trouvait devant un oracle [...]." See Simplicius, *Commentaire sur les Catégories*, 124. For Avicenna's deferent, but not slavish, attitude towards Aristotle and Peripatetism, see D. Gutas, *Avicenna and the Aristotelian Tradition. Introduction to Reading Avicenna's Philosophical Works. Second, Revised and Enlarged Edition, Including an Inventory of Avicenna's Authentic Works* (Brill, 2014), 35-41 (on the Introduction to *Al-mašriqiyūn*), 54-58 (on the *Letter to Kiyā*), and 249-256 (on Avicenna's conception of the practice of philosophy).

(philosophical) assumptions over certain others.

Even though we firmly believe (*na<sup>c</sup>taqidu*) that the source (*munba<sup>c</sup>at*) of all faculties of the soul is the heart, we ourselves are not sold on making (*fa-lasnā bi-śadīdī l-ğidd fī an nağ<sup>c</sup>ala*) the origin (*mabda<sup>3</sup>*) of these organs (sc. blood vessels and nerves) unquestionably (*lā mahālata*) from the heart, even though we are more inclined (*amyal*) to that. Likewise, we do not involve ourselves (*wa-lā aydan nahnu multafitūn*) in what the excellent one among the physicians (sc. Galen) deems in terms of putting excessive efforts into demonstrating that the origins (*min annahū qad bālaǵa fī l-burhān ‘alā anna mabādi<sup>3</sup>*) of blood vessels and nerves are not from the heart [...] (III, 1, 40.7-10).

In this passage, Avicenna sharply distinguishes the ultimate ontological source (*munba<sup>c</sup>at*) of psychic faculties from the actual physical origin (*mabda<sup>3</sup>*) of the organs through which these faculties reach different parts of the body. In doing this, his terminological choices are meaningful. He says that he is firmly persuaded (*i<sup>c</sup>taqada*) that all psychic faculties ultimately come from the heart. On the other hand, he distances himself from all views aimed at determining the physical origin of those organs by using words of caution (*lasnā bi-śadīdī l-ğidd fī ..., lā ... multafitūn*). These views are those held by the followers of Aristotle and by Galen (and his fellow physicians) respectively. The former, who took his master's position to extremes, made the heart not only the origin of the psychic faculties, but also of all those organs (as we learned from the combination of the two passages quoted above). The latter, by contrast, put all his efforts toward demonstrating that those organs do not originate from the heart. Though being more in favor (*amyal*) of the position held by Aristotle's followers, at this stage Avicenna does not commit himself to it, but rather he only subscribes with conviction to the opinion according to which the source of all psychic faculties is the heart. We shall look at the reasons for Avicenna's apparent equidistance from both views in due course. The noteworthy thing here is that the only opinion that Avicenna unquestioningly endorses is a purely philosophical, Aristotelian assumption that brings together physiology and psychology.

The relevance of psychology for zoology, both in general and in this specific context, emerges in *Nafs*, V, 8. In this chapter, which is entitled "On the exposition of the instruments belonging to the soul," Avicenna connects philosophical psychology with its anatomical counterpart, that is, the investigation of the body, which is the other element of the body-soul relationship.<sup>33</sup> Here he deals with the instruments of the soul (the

<sup>33</sup> See the reference to the prologue to *Nafs* quoted at n. 10 above. See also Alpina,

heart and the cardiac pneuma as its corporeal vehicle), argues in favor of Aristotle's cardiocentrism (which perfectly matches with his theory of the soul – one single soul from which several powers ensue, is primarily attached to one single organ or, to be precise, to one *sui generis* bodily vehicle), and refers explicitly to *Hayawān* for detailed anatomical explanations in support of his claim.<sup>34</sup> However, Avicenna's endorsement of the Aristotelian view is not uncritical. It is preceded by an even more fair-minded assessment of the contrasting views on the anatomy of the chief organs than that provided in *Hayawān*, III, 1.

It is appropriate that now we deal with the instruments belonging to the soul. For we say that concerning the matter of the organs to which the chief faculties of the soul are attached, people have much exaggerated on both sides in stubbornness (*afrāta l-nās [...] ifrātan fī ḡanbatay l-lağāğ*), and leaned towards great arbitrariness and vehement partisan spirit (*warrakanū ilà ta<sup>c</sup>assuf katīr wa-ta<sup>c</sup>aşşub şadīd*), to which inclined each one of the two parties (*māla ilayhi kull wāhid min al-farīqayni*), departing thereby from the truth (*hattā harağā min al-haqq*). The one among them who made the soul one in essence and nonetheless affirmed that the chief organs are many committed the biggest mistake (*wa-aktaruhum ḡalaṭan*). For, when he opposed the philosophers on this [issue] (*fa-innahū lammā hālafa fīhi l-falāsifa*), upholding that there are many parts of the soul, but agreed (*wa-wāfaqa*) with those upholding the soul's oneness, he did not realize that it necessarily follows from that that the chief organ to which the soul is firstly attached is made one. As for those multiplying the parts of the soul (*wa-ammā l-mukattirūn li-ağzā<sup>2</sup> al-nafs*), it is not against them (sc. in contradiction with their view) to ascribe to each part of it a specific source (*ma<sup>c</sup>din mahsūs*) and a single centre (*markaz mufrad*) (*Nafs*, V, 8, 262.19 – 263.8).

The issue of the instruments of the chief faculties of the soul is relevant to the general theory of its embodiment. However, determining the conditions of this embodiment or, if you prefer, of the attachment of the soul to the body is not easy and requires a serious discussion with people holding opposing positions. In all likelihood, by the generic word “people” (*nās*) Avicenna is referring to (Aristotelian) philosophers and (Galenic) physicians, because the terminology used to describe their approach to the issue is close to that used in *Hayawān*, III, 1. Nonetheless, here more

*Subject, Definition, Activity*, 106-111.

<sup>34</sup> This chapter contains four explicit references to *Hayawān*: 264.5 (*Hayawān*, XIII, 3); 265.1 (*Hayawān*, XII, 8); 266.4 (*Hayawān*, III, 1); 269.14-15 (*Hayawān*, XV, 1). In these four places Avicenna discusses the highly controversial anatomical issues (the origins of blood vessels and nerves, the male and female role in reproduction, and the anatomy and function of the heart). For the fourth and last reference to *Hayawān*, see n. 20 above.

than in the *Hayawān*, Avicenna clearly expresses his distance from the two opposing parties and points out what a philosophical practice aimed at the attainment of the truth, like his, should avoid. The now-familiar *ta<sup>c</sup>assub* (partisan spirit),<sup>35</sup> which Avicenna here connects with *laḡāġ* (stubbornness) and *ta<sup>c</sup>assuf* (arbitrariness), highlights the misbehaviors that endanger the pursuit of the truth. Again, equidistance and impartial evaluation of predecessors' opinions seem to be Avicenna's antidote to blind adherence and sectarian devotion even to Aristotelianism, which he considered "the sect ... most worthy of such an adherence."<sup>36</sup>

In *Nafs*, V, 8, however, the perspective is different from that of *Hayawān*, III, 1 in the sense that there the starting point of the discussion is the soul, not the body. It is the soul's oneness that requires a first connection with the body through a single, *sui generis* body, that is, the pneuma: "Firstly, we say: the primary vehicle of the bodily faculties of the soul (*al-quwā l-nafsāniyya al-badaniyya maṭiyyatuhā l-ūlā*) is a subtle body (*ḡism latīf*), which passes through the outlets (*nāfid fī l-manāfid*), spiritual (*rūhāni*). This body is pneuma (*rūh*) (263.9-10)." Only once the primacy ("firstly" / *awwalan*) of this philosophical assumption is established does Avicenna mention anatomical procedure, which is called upon to corroborate the favored position: "And if the faculties of the soul, which are attached to the body, did not pass through carried in a body, the congestion of the [bodily] passages would not obstruct the penetration of the locomotive, sensitive, and also imaginative faculties [into the body]."<sup>37</sup> However, it (sc. the congestion of the passages) does cause an obstruction evident to those who have undertaken medical experiments ("inda man ḡarraba l-taḡārib al-tibbiyya) (263.10-13)." I

<sup>35</sup> See the use of *muta<sup>c</sup>assibūna*, which refers to "the partisans of false opinions," in *Ilāhiyyāt*, IX, 7, 429.3.

<sup>36</sup> See the English translation of the Introduction to The Easterners in Gutas, *Avicenna and the Aristotelian Tradition*, 38.

<sup>37</sup> Avicenna refers to the pneuma as the vehicle of the imaginative faculty moving through the cavities of the brain in *Nafs*, III, 8, 153.9 – 154.11. On this passage, see T. Alpina, "Retaining, Remembering, Recollecting. Avicenna's Account of Memory and Its Sources," in V. Decaix, C. Thomsen Thörnqvist (eds.), *Aristotle's De memoria et reminiscencia and Its Reception* (Turnhout: Brepols, 2021), 81, n. 46. A possible reference to the movements of the pneuma accompanying the activities of internal senses, especially those of the imaginative/cogitative faculty, can be found in *Nafs*, V, 5 235.8-9 ("For thoughts and reflections are movements (*fa-inna l-afkār wa-l-ta<sup>c</sup>ammulāt harakāt*) that prepare the soul to the reception of the emanation, [...]"). For the fact that Galen considers the pneuma as the first instrument of the soul, see PHP, VII, 3, 444.12-15 (ed. De Lacy): εὗλογον οὖν [...] τὸ πνεῦμα [...] ὅργανον δ' ὁς ἔφην εἶναι τὸ πρῶτον αὐτὸ τῆς ψυχῆς.

shall return to this peculiar use of *medical experiments* later on.

Avicenna follows the same pattern a few lines below: “If the soul is one, it is then necessary that [(a)] it has a first attachment to the body, from which it governs it and nurtures it, that [(b)] this [first attachment] is by the mediation of this pneuma, and the first thing that the soul performs is performed by the organ through whose mediation its (sc. of the soul) faculties are emitted to the rest of the organs through the mediation of this pneuma, and that [(c)] this organ is the first to be formed among the organs, and the first source (*wa-awwal ma-din*) for the generation of the pneuma, this being the heart (*al-qalb*). This is indicated by what accurate dissection has verified (*yadullu ‘alà dàlika mā haqqaqahū l-taṣrīh al-mutqan*). We shall supply an explanation of what is meant [by that] in the section on animals (*śarḥ fī l-fann alladī fī l-hayawān*; cf. *Hayawān*, XIII, 3). It is, therefore, necessary that the first attachment of the soul is to the heart. [...] As a result, the soul makes the animal live (*fa-l-nafs tuḥyī l-hayawān*) by means of the heart, but the faculties [responsible] for the other activities can emanate from the heart to the other organs, because the emanation must proceed from the first thing to which it is attached (263.20 – 264.11).”

Here Avicenna is more explicit than in the passage quoted above: it is the soul’s oneness, which has been demonstrated through cogent philosophical argument (see *Nafs*, V, 7),<sup>38</sup> that makes necessary its initial attachment to the body via a single organ, that is, the heart, through the mediation of the pneuma, by means of which the soul makes the animal live. Therefore, the heart must be the first organ to be formed and the first source of the pneuma. The language of “necessity” (*yağibu*, 263.20; 264.6) permeates the whole passage. Furthermore, like in *Hayawān*, III, 1 concerning the primacy of the heart, the rationalist conclusion outlined in the passage (soul’s oneness and its consequently necessary attachment to one single organ, the heart) is said to be verified by accurate dissection (or anatomical practice), for which Avicenna refers to the *Hayawān*, in all likelihood to chapter XIII, 3, where the anatomy of the heart is discussed.

Another work should be mentioned to provide an exhaustive exposition of Avicenna’s presentation of the disagreement between philosophers and physicians on the topic of the chief bodily organs and of the most appropriate approach to deal with this disagreement. The treatise

<sup>38</sup> For a global interpretation of this chapter, see M. Rashed, “Chose, item et distinction: l’homme volant’ d’Avicenne avec et contre Abū Hāsim al-Ǧubbāṭ,” *Arabic Sciences and Philosophy*, 28 (2018), 167–185.

in question is *On Cardiac Remedies* (*Maqāla fī l-adwiya al-qalbiyya*, henceforth *Adwiya*).<sup>39</sup> Avicenna himself ascribes a special status to this treatise among his medical writings. For instance, in *Nafs*, he considers it unparalleled in terms of articulation and precision (*tafsīl*), and of the ascertainment and validation (*tahṣīl*) of investigation in this field, that is, the cardiac pneuma and how to act upon its disposition (IV, 4, 201.13-16). Moreover, in the *Qānūn*, Avicenna maintains that, unlike the “standard medical books” (*al-kutub al-tibbiyya al-sādīga*), it combines the knowledge of medicine with that of the fundamental principles (*uṣūl*), which transcends the boundaries of medicine and properly pertains to philosophy (III, xi, i, 7, 406.23 – 407.1).<sup>40</sup>

The first chapter of the *Adwiya* contains a two-layer doxography.<sup>41</sup> Firstly, Avicenna contrasts the opinion ascribed to “the greatest among philosophers” (*ağall al-hukamā'*, 223.2, in all likelihood, Aristotle), according to which the heart is the origin (*mabda'*, plural in the text) of all psychic faculties, and that ascribed to not further specified opponents (*muḥālifūn*, 223.9, probably a reference to Galen and his followers), according to which the origin of at least the perceptive faculties is the brain, whereas their actual perfection occurs in the organs performing their functions (eyes, ears, tongue, and the like by means of their specific temperaments). Secondly, Avicenna addresses the ramifications of these views, which contributed to the further distancing of the two rival parties. A group of the aforementioned opponents (*qawm min hā'ulā'i*

<sup>39</sup> On the peculiar nature of this medical writing and its textual and editorial vicissitudes see T. Alpina, “Al-Ğūzgāni’s Insertion of On Cardiac Remedies in Avicenna’s Book of the Soul: the Latin Translation as a Clue to his Editorial Activity on the Book of the Cure?” *Documenti e studi sulla tradizione filosofica medievale*, 28 (2017), 365-400. See also E. Gannagé, “Between Medicine and Natural Philosophy: Avicenna on properties (*khawāṣṣ*) and qualities (*kayfiyyāt*),” in N. El-Bizri, E. Orthmann (eds.), *The Occult Sciences in Pre-Modern Islamic Culture* (Beirut: Ergon-Verlag, in association with the Orient-Institut Beirut, Max Weber Stiftung, 2018), 41-66.

<sup>40</sup> For a thorough analysis of these two texts, see Alpina, “Al-Ğūzgāni’s Insertion of On Cardiac Remedies,” 374-376.

<sup>41</sup> It is noteworthy that the *Adwiya* begins with the same considerations expressed in *Nafs*, V, 8 concerning the initial attachment of the soul to the heart via the cardiac pneuma (see, in particular, the expression “source for generation”): “God – praise be upon Him – created the left ventricle of the two ventricles of the heart as a depository for the pneuma (*hizāna li-l-rūh*) and the source for its generation (*wa-ma‘din li-tawalludihī*). He created the pneuma as a vehicle (*maṭīyya*) for the psychic faculties through which they (sc. these faculties) spread throughout the bodily organs. He made the first attachment (*al-ta‘alluq al-awwal*) of the psychic faculties peculiar to the pneuma (*muhtasṣ bi-l-rūh*), and then by its mediation to the bodily organs (221.11 – 222.2).”

*l-muḥālīfīn*, 224.1), that is, of the physicians opposing Aristotle, maintains that the cerebral pneuma carries the psychic faculties throughout the body. Furthermore, this group considers the temperament of the organs useful only to performing the activity of a certain faculty, without entering the constitution of the substance (*ḡawhar*) of that faculty. A group of followers of the most eminent philosopher, i.e. Aristotle (*qawm min ashāb al-hakīm al-aġall*, 224.6), holds a similarly radical position, ascribing the same function to the cardiac pneuma and downplaying the role of the temperament of the specific sense-organs.

The refutation of the ramifications of the two contrasting views seems to be easy: once subjected to thorough examination (*al-baḥṭ al-mustaqṣī*, 224.4) and approached with fair-mindedness resulting in a fair judgment (*al-inṣāf*, 224.8),<sup>42</sup> they reveal all their inconsistency: the pneuma carries the faculties, but they can fully exercise their activities only when they arrive at their assigned bodily organ. The practice of subjecting an opinion to thorough scrutiny and, as a consequence, formulating an unbiased judgment upon it captures the gist of Avicenna's philosophical method. As for the two original, rival positions, although the writing will show the centrality of the heart and its pneuma as a vehicle for the psychic faculties, from this first survey an endorsement of an absolute (Aristotelian) cardiocentrism, namely that the heart is the first organ to be generated and the source of all psychic faculties, does not unequivocally emerge.<sup>43</sup>

#### 4. A THREE-LAYER EPISTEMOLOGY: INDICATION, SIGN, DEMONSTRATION

Having set the context of the controversy between philosophers and physicians and having distinguished the firm belief that the heart is the ultimate ontological source of all psychic faculties from the possibility of the physical origination of the blood vessels and nerves from it,

<sup>42</sup> It is worth noticing that Avicenna wrote a treatise entitled *Kitāb al-Inṣāf* (*Book of the Fair Judgment*), of which only fragments are extant. In this treatise, Avicenna undertook a systematic critique of Aristotelian and ps.-Aristotelian texts. For the date of composition, the contents, and the vicissitudes of this work, see Gutas, *Avicenna and the Aristotelian Tradition*, 144-155.

<sup>43</sup> On this as a possible reason why al-Ġuzġānī left the first chapter of the *Adwiya* out of the excerpt of the writing he added between the fourth and fifth book of Avicenna's *Nafs*, see Alpina, "Al-Ġuzġānī's Insertion of On Cardiac Remedies," 379-380. A very similar, though shorter, exposition can be found in *Qānūn*, I, 1, vi, 1, 122.21 – 123.5; and I, 1, vi, 4, 127.10-15.

Avicenna allows Galen's arguments against the genesis of these organs from the heart speak for themselves. The reason for this approach is twofold: Galen is the authority in anatomical matters, and what is more, he threw himself into demonstratively substantiating his position.

Galen's argument against the origination of blood vessels and nerves from the heart is based on the correlation between thickness and origin: something is thicker when it is near its origin, whereas it becomes thinner and changes its physical constitution when it moves away from it. According to Avicenna's reconstruction of Galen's argument, the fact that the vein connecting the heart with the liver (*vena cava*) is thicker by the liver should suggest that the liver is its origin. Since it is the primary vein of our body on which all the other veins depend, this conclusion can be extended to all veins. The same line of reasoning applies to the principal nerve, that is, the one connecting the brain with the heart: “[a] The principle (*asluhū*) of the vein (*warīd*) that brings into relation the heart with the liver (sc. the *vena cava*) is thick near the liver, then in the liver it divides into branches, and one of them, which reaches the heart, penetrates into the heart like something extraneous to its substance [...]. [b] Similarly, his (sc. Galen's) saying about the nerve: near the brain it is thicker and due to the mass of the brain it (sc. the nerve) is stronger in mixture, and more similar to it (sc. to the brain), and near it (sc. the brain) it is softer, whereas [when it gets] near the heart it is harder and more removed from it (sc. the heart), and its contact with it is like agglutination.<sup>44</sup> This is one of several branches (40.10-16).”

Galen argues for the origination of veins from the liver and of nerves from the brain in *De placitis Hippocratis et Platonis* (henceforth *PHP*) VI. There, he states the general rule according to which “the greater is the source of the smaller,”<sup>45</sup> using the analogy with the trees, to which Avicenna himself will return, and he applies it first to the case of veins,

<sup>44</sup> In medicine, ”agglutination” (*ilṣāq*) describes the process of adhesion of something to something else, that is, the clumping of particles. Agglutination, therefore, does not describe a process of origination of something from something else, but a process of the coming into contact of two distinct and previously unrelated things. At 43.7-16, Avicenna will return to the possibility that nerves are simply agglutinated to the heart, being in contact with it without being actually originated from it. This would be similar to warts and glands sprouting from the skin, and to secretions like sweat. In such cases, agglutination does not provide the cause (*sabab*) of something, but rather that there is some matter in a certain place ready for something else to come about from it.

<sup>45</sup> Galen, *PHP*, VI, 3, 378.5-7 (ed. De Lacy): ἀνδρί τε περὶ φύσιν δεινῷ καὶ χωρὶς τῶν εἰρημένων εὔδηλον ὡς τὰ μείζω τῶν ἐλαττόνων ἀρχαί, καθάπερ γε καὶ ἡ πηγὴ τῶν ὁχετῶν εἰς οὓς διανέμεται.

which is considered to be the most evident, and then to the case of arteries and nerves, which is more obscure.

Following his immediate predecessors,<sup>46</sup> Avicenna rejects Galen's argument, considering it not conclusive in unequivocally demonstrating that veins and nerves originate from the liver and the brain respectively. This concise passage contains the outline of a three-layer epistemology which is worth unpacking: "We learned (*sami<sup>c</sup>nāhā*) all those things and what is analogous to them (sc. Galen's arguments), and we found them as indications (*amārāt*), but they are not signs (*wa-laysat bi-dalā<sup>il</sup>*), let alone do they have a way to demonstratively persuade the soul (*fadlan<sup>c</sup>an an yakūna lahā ilà iqñā<sup>c</sup> al-nafs al-burhānī sabil*) (40.16-17)."<sup>47</sup>

The pivotal distinction here is between *amārāt* and *dalā<sup>il</sup>*. At first glance, Avicenna distinguishes a mere indication (*amāra*), taken in the weakest possible sense, from a sign (*dalīl*), whose epistemic force is not explained here (it seems, however, to be distinct from demonstration, *burhān*). Apparently, Galen's arguments stop at the former, failing to provide the latter.

Avicenna's distinction has a distinguished lineage: for it harks back

<sup>46</sup> This argument was considered extremely weak and, consequently, criticized by Avicenna's predecessors. For instance, Rāzī (d. 925) criticizes it in his *Doubts on Galen*. See Abū Bakr al-Rāzī, *Doutes sur Galien. Introduction, édition et traduction par P. Koetschet* (De Gruyter, 2019), section 11, 74-77. See also Koetschet's introduction, cvii-cx. Al-Fārābī (d. 950) also criticizes Galen's argument in favor of the origination of the veins from the liver because they are thicker alongside it in his commentary on Aristotle's *Rhetoric*, of which some excerpts are preserved in Latin translation within the *Didascalia in Rheticam Aristotelis ex glossa Alpharabii*. See M. Aouad, M. Rashed, "L'exégèse de la Rhétorique d'Aristote: recherches sur quelques commentateurs grecs, arabes et byzantins. Première partie," *Medioevo. Rivista di storia della filosofia medievale*, 23 (1997), 43-189, in part. § 27, 104-106.

<sup>47</sup> A similar judgment on Galen's argument can be found in *Hayawān*, IX, 1, which belongs to the other cluster of chapters explicitly addressing the disagreement between philosophers and physicians. See 146.8-11: "Let us assume that only men have semen, that it produces an affection without mingling, that women have but menstrual blood. Then, we shall investigate what this physician (*hādā l-tabib*, sc. Galen) mentions in terms of [Aristotle's] contradictions (*min al-munāqadāt*). Then, we shall show that he did not accomplish anything and was not right to say anything. He often believed [himself] to have demonstrated [something], [but] then he was not convincing (*fa-zanna katīrā annahū yubarhinu tumma lam yuqnī<sup>c</sup>*). [And we shall show] that he was very deficient concerning the principles, even though he greatly expounded the ramifications of medicine (*wa-annahū da<sup>c</sup>if ḡiddan fī l-mabādi<sup>il</sup> wa-in kāna katīr al-bast fī furū<sup>c</sup> al-tibb*). From this passage it also emerges that, although Galen devotes himself to a derivative discipline like medicine, his shortcomings come from his lack of a firm grasp on the principles, i.e. the philosophical principles on which medicine is grounded. This remark gives us an idea of the illegitimate disciplinary trespass mentioned in n. 22.

to Aristotle's distinction between σημεῖον and τεκμήριον in *An. Pr.*, II, 27 and *Rhetic*, I, 2, and its subsequent reworking and use by late Ancient commentators in their commentaries on the *Posterior Analytics*. The following reconstruction of the exegetical vicissitudes of this Aristotelian distinction is based on the excellent study by Donald Morrison.<sup>48</sup>

At the beginning of *Prior Analytics*, II, 27, which is devoted to the enthymeme, Aristotle primarily distinguishes between the probability (εἰκός) and the sign (σημεῖον) on which an enthymeme can be based. The former is a generally admitted proposition (πρότασις ἔνδοξος), which is known to occur or not for the most part. The latter, by contrast, is meant to be a demonstrative proposition (πρότασις ἀποδεικτική), either necessary (ἢ ἀναγκαία) or generally admitted (ἢ ἔνδοξος). Aristotle calls the generally admitted (or probable) sign σημεῖον, and the necessary sign τεκμήριον.<sup>49</sup> The enthymeme based on necessary signs, which is possible only in the first figure, is said to be irrefutable,<sup>50</sup> but the causal relationship between the sign and what is signified remains undetermined.<sup>51</sup> However, apart from these scanty considerations, Aristotle leaves his doctrine of sign-inference unrefined.<sup>52</sup>

The late Ancient commentators elaborated more on the Aristotelian distinction.<sup>53</sup> They saw in it the possibility of introducing a proof different from the scientific one, which is labelled *tekmeriotic* (τεκμηριώδης)

<sup>48</sup> D. R. Morrison, *Philoponus and Simplicius on Tekmeriotic Proof*, in D. A. Liscia, E. Kessler, C. Methuen (eds.), *Method and Order in Renaissance Philosophy of Nature: The Aristotle Commentary Tradition* (Aldershot: Ashgate, 1997), 1-22. See also id., *Alcinous on Methods of Analysis*, in C. Cerami (ed.), *Nature et Sagesse. Les rapports entre physique et métaphysique dans la tradition aristotélicienne. Recueil de textes en hommage à Pierre Pellegrin* (Louvain: Peeters, 2014), 417-428, and J. Allen, *Inference from Signs: Ancient Debates About the Nature of Evidence* (Oxford Univ. Press, 2001).

<sup>49</sup> For this distinction, see also *Rhet.*, I, 2, 1357 b3-5. For this passage and the passage quoted in the following footnotes, see Morrison, *Philoponus and Simplicius on Tekmeriotic Proof*, 3.

<sup>50</sup> On this aspect of the enthymemes based on τεκμήριον see *Rhet.*, II, 25, 1402 b12-21.

<sup>51</sup> Morrison, *Philoponus and Simplicius on Tekmeriotic Proof*, 4. The standard Aristotelian example of an irrefutable inference in the first figure, based on τεκμήριον, is the inference of a woman being pregnant (or: having just given birth) based on the necessary sign (τεκμήριον) that she has milk. See *An. Pr.*, II, 27, 70 a13-16.

<sup>52</sup> For this consideration, see C. Cerami, *Génération et Substance. Aristote et Averroès entre physique et métaphysique* (De Gruyter, 2015), 320.

<sup>53</sup> For a reconstruction of all the phases (1. Theophrastus; 2. Alexander and Themistius; 3. Philoponus and Simplicius) of the transformation of Aristotelian implicit premises into a fully-fledged theory of the demonstration of a cause from its effect based on the τεκμήριον, see Alexander of Aphrodisias, *Commentaire perdu à la Physique d'Aristote (livres IV-VIII). Les scholies byzantines*, ed. M. Rashed (De Gruyter, 2011), 592-595. See also Cerami, *Génération et Substance*, 320-323.

after τεκμήριον, capable of inferring a cause from its effect, and thus fitting perfectly with the method for physical investigation that Aristotle outlines at the beginning of his *Physics*.<sup>54</sup> In Philoponus' commentary on the *Posterior Analytics*, these two different proofs, that is, the scientific one from the cause to the effect, and the *tekmeriodic* proof from the effect to the cause, were connected, respectively, with the knowledge of the “reason why” (τὸ διότι) and the knowledge of the “fact” (τὸ ὅτι), which Aristotle distinguished in *An. Post.* II, 1.<sup>55</sup>

Though going against Aristotle's genuine conception of ἀπόδειξις, this new demonstration moving from the effect to the cause based on the τεκμήριον is particularly useful to disciplines largely dependent on observational data, like astronomy and medicine,<sup>56</sup> and makes it possible to effectively practice them, since it secures the scientificity and the certainty of their conclusions. In this connection, it is not surprising that Galen, who is a philosopher no less than a physician, seems to have used this kind of inference and to have considered it demonstrative.

In *PHP*, by referring back to his logical writings (in all likelihood, his lost *De demonstratione*, as seems to emerge from *PHP*, 116.3), Galen distinguishes the scientific premises (τὰ ἐπιστημονικὰ λήμματα) on which a demonstration (ἀπόδειξις) is based from all other kinds of premises and maintains that they refer to the essence of what is sought after and take it as their guide.<sup>57</sup> In this passage of *PHP*, Galen adds that more remote from scientific premises are those constructed from examples and inductions.<sup>58</sup> However, among scientific premises, Galen seems to count not only those built around first principles or axioms but also those based on sensible, observational data. Closely related to the classification of premises is the Galenic distinction between demonstration (ἀπόδειξις) and indication (ἔνδειξις), both conducive to a necessary conclusion in dif-

<sup>54</sup> See I, 1, 184 a16-21.

<sup>55</sup> See Morrison, *Philoponus and Simplicius on Tekmeriodic Proof*, 9, n. 24.

<sup>56</sup> For this consideration, primarily referred to physiognomy, see Morrison, *Philoponus and Simplicius on Tekmeriodic Proof*, 4, n. 9.

<sup>57</sup> Galen, *PHP*, II, 3, 110.22-24 (ed. De Lacy): οὐκ εἰδότων ὡς τὰ μὲν ἐπιστημονικὰ λήμματα πρὸς τὴν οὐσίαν ἀναφέρεται τοῦ ζητουμένου καὶ τοῦτον ἔχει τὸν σκοπόν. In this passage, Galen reproaches Zeno and Chrysippus for failing to recognize and distinguish such premises. See also *PHP*, VII, 1, 432.30-32 (ed. De Lacy): τίς οὖν ὁ ἐπιστημονικὸς λόγος; ὁ ἀπ' αὐτῆς δηλονότι τῆς τοῦ πράγματος οὐσίας ὀρμώμενος, ὡς ἐν τῇ περὶ τῆς ἀποδείξεως ἐδείχθη πραγματείᾳ.

<sup>58</sup> Galen, *PHP*, II, 3, 110.30-33 (ed. De Lacy): ὅσα δ' ἔτι τούτων ἀποκεχώρηκεν ἔξωτέρω καὶ μάλιστα διὰ παραδειγμάτων ἐνόδευσιν τε καὶ πολιτικῶν ἐπαγωγῶν τέ τινων τοιούτων ἢ μαρτύρων εἰς σύστασιν ἀφικνεῖται, ταῦτ' εὶς βούλοιο πιθανά τε καὶ ρήτορικὰ προσαγορεύειν.

ferent conditions. For, the former draws the conclusion deductively from true premises, whereas the latter is “the discovery of what is sought on the basis of the nature of the matter by way of an evident consequence.”<sup>59</sup> This method of inference is based on a more cogent connection between sign and signified than mere induction or the Empiricists’ trial and error procedure,<sup>60</sup> and it allows the inquirer to draw a necessary conclusion by reference to the essential nature of the thing under investigation.<sup>61</sup> A traditional example of ἔνδειξις is the inference of the invisible pores of the skin from the observable phenomenon of sweating, relying upon the shared, not explicitly expressed assumption that sweat, being a liquid, cannot pour out from a compact body.<sup>62</sup> Although the status of ἔνδειξις is not entirely clear, borrowing Hankinson’s words, we can fairly say that for Galen, it is “a means of penetrating the internal causal structures of things in virtue of which they present the phenomenal aspects they do,”<sup>63</sup> on which such inferences are grounded.

As has been said, Avicenna is a representative of both the Aristotelian and the Galenic tradition. It is therefore not surprising that Avicenna attempts to apply to medical discipline the logical tools elaborated by Aristotle and further refined by Greek commentators as a way to bring medicine (or, better, the medical investigation of anatomy and physiology) to that level of necessity to which Galen failed to bring it. The trend of bringing sign-inference closer to a proper demonstration for epistemo-

<sup>59</sup> Galen, *Institutio logica*, 11.1.5 – 2.1 (ed. K. Kalbfleisch): ἔνδειξιν μὲν γὰρ καλοῦσι τὴν ἐκ τῆς τοῦ πράγματος φύσεως εὑρεσιν τοῦ ζητουμένου κατ’ ἀκολουθίαν τῶν ἐναργῶς φαινομένων, ἀπόδειξιν δὲ λόγον<δι’> ἀληθῶν λημμάτων περαίνοντα. The translation is that of R. J. Hankinson, “Galen on the Limitations of Knowledge,” in Ch. Gill, T. Whitmarsh, J. Wilkins (eds.), *Galen and the World of Knowledge* (Cambridge Univ. Press, 2009), 206-242, 231. See also Galen, *De Methodo Medendi*, 10.126.8-14 (ed. Kühn): Τούτων οὕτως ἔχόντων ἦδη λεκτέον ὑπὲρ τῶν θεραπευτικῶν ἔνδειξεων, αὐτὸ τούτῳ πρότερον ἐξηγησαμένους τὸ τῆς ἐνδείξεως ὄνομα. τὴν γὰρ οἷον ἔμφασιν τῆς ἀκολουθίας ἔνδειξιν λέγομεν. εὑρίσκεται μὲν κάκι τῆς πείρας τὸ ἀκόλουθον, ἀλλ’ οὐχ ὡς ἔμφανόμενον τῷ ἥγονυμένῳ. καὶ διὰ τοῦτο τῶν ἐμπειρικῶν οὐδεὶς ἔμφαίνεσθαι φησι τῷδε τινὶ τόδε τι.

<sup>60</sup> My reconstruction of Galen’s notion of ἔνδειξις is based on Galen, *On the Therapeutic Method: Books I and II*, Translated with an Introduction and Commentary by R. J. Hankinson (Oxford: Clarendon Press, 1991), 202-205.

<sup>61</sup> As Hankinson explains, “the ‘nature of the matter’ is presumably a proper, essential characterisation of what is actually going on; in other words, this sort of indication rests upon theoretical understanding, and hence cannot yield it,” see Hankinson, “Galen on the Limitations,” 232.

<sup>62</sup> On this example and for a masterful outline of Galen’s doctrine of sign-inference, see Abū Bakr al-Rāzī, *Doutes sur Galien*, introduction, ciii-cv.

<sup>63</sup> See Hankinson, “Galen on the Limitations,” 231.

logical reasons is common among other Arabic thinkers who came before Avicenna like Abū Bakr al-Rāzī (d. 925), as P. Koetschet has brilliantly shown.<sup>64</sup> Therefore, Avicenna can be considered the last of a long series, which will however be continued by Averroes.<sup>65</sup>

In *Qiyās*, IX, 24, which is entitled “On sign (*dalīl*), indication (*‘alāma*) and physiognomy (*firāsa*)” and corresponds to Aristotle’s *An. Pr.* II, 27, Avicenna introduces the notion of *dalīl* in a way that makes the reader immediately aware that the topic of the whole chapter has been debated after Aristotle. For, unlike the First Teacher, Avicenna does not begin with the definition of enthymeme, but with that of *dalīl*, which apparently is crucial for the exegesis of the Aristotelian theory: “It has become common practice in this context (*wa-qad ḡarat al-‘āda fi hādā l-mawḍi‘*) to call ‘sign’ (*dalīl*) that which is composed of two premisses, the major of which is a praiseworthy premise, which the multitude (*al-ğumhūr*) believes and holds, and which is taken as an argument (*huġġa*) and a sign (*dalīl*) not such that a part of it is a sign of another part, like smoke [is a sign] of fire, but rather in the sense that the discourse itself, originating from the two parts, which is generally admitted, is a sign (573.4-7).” Then, only after listing other characteristics of *dalīl*, Avicenna defines what enthymeme (*damīr*) means: it is the syllogism of indication (*qiyās al-‘alāma*), “in which the major term is established for the minor through an indication (*bi-‘alāma*), this sign being either necessary (*darūriyya*) or praiseworthy and assumed” (574.2-3). Shortly afterwards, Avicenna deems it more appropriate to refer to the syllogism of the sign, in which the middle term (for example, “having milk”)<sup>66</sup> is predicated of the minor, but not of the major term, by the term *dalīl* (574.4-7). He also considers *dalīl* to be stronger (*aqwā*) than *‘alāma* (or *‘alāma* a weak *dalīl*, 575.11-12). It becomes thus apparent that *‘alāma* corresponds to Aristotle’s general use of σημεῖον as “sign” at the beginning of *An. Pr.* II, 27, and that the further distinction between *‘alāma* and *dalīl* refers to that between σημεῖον as probable sign and τεκμήριον as necessary sign.

Although the notion of *dalīl* seems to have acquired a more substantial role than in Aristotle’s *Prior Analytics*, here Avicenna does not say much more about its demonstrative value. This aspect of *dalīl* is discussed *ex professo* in *Burhān*, I, 7, which is entitled “On absolute demon-

<sup>64</sup> See not only her edition, translation, and commentary of Abū Bakr al-Rāzī’s *Doubts on Galen*, but also her article “Abū Bakr al-Rāzī et le signe: fragment retrouvé d’un traité logique perdu,” *Arabic Sciences and Philosophy*, 27 (2017), 75-114.

<sup>65</sup> See Cerami, *Génération et Substance*, 316-336.

<sup>66</sup> See n. 51 above.

stration and its two divisions, one being the demonstration of the ‘reason why’ (*limā*), and the other being the demonstration of the ‘fact’ (*inna*), which is called ‘sign’ (*dalīl*)” and corresponds to *An. Post.* II, 1.

In this chapter, among other things, Avicenna distinguishes two sub-categories within the Aristotelian demonstration of the “fact” (τὸ ὄτι): the demonstration of the “fact” in an absolute sense (*burhān al-inna* ‘alā *l-itlāq*), and the “sign” (*dalīl*). In the first case, the middle term “is not a cause for the existence of the major term in the minor term, nor an effect of it,” but it simply occurs together with the major term, being correlative to or coextensive with it. In the case of *dalīl*, the middle term “is caused by the existence of the major term in the minor term.” In other words, the middle term is an effect of the major term existing in the minor.<sup>67</sup> After providing some examples of both demonstrations, Avicenna concludes: “All this shows the cause from the caused (*yubayyinu l-‘illa min al-ma‘lūl*), and is called ‘sign’ (*dalīl*). This is evident, and we will not go into its detailed explanation (80.9-10).”<sup>68</sup>

Here, Avicenna singles out an intermediate level between an absolute demonstration of the “fact” and a proper demonstration of the “reason why” or the cause, that is, a “sign” (*dalīl*), which hints at the cause from the effect. In doing this, he is heavily indebted not only to the Late Ancient exegesis of Aristotle’s pronouncements in the *Prior Analytics* and the *Rhetoric* but also to the Galenic reflection on sign-inference<sup>69</sup> and its early Arabic reception.<sup>70</sup>

<sup>67</sup> *Burhān*, I, 7, 79.17-20: “In the demonstration of the ‘fact’ it may happen that [(i)] the middle term in existence is not a cause for the existence of the major term in the minor term, nor an effect of it. Rather, it is something correlative to it or coextensive with it (sc. the major term) in relation to its cause, [the middle term] occurring together with it or [being] something else among the things that happen together with it (sc. with the major term) in nature at the same time. And [(ii)] it might happen that in [its] existence it (sc. the middle term) is caused by the existence of the major term in the minor term. The first is called demonstration of the ‘fact’ (*burhān al-inna*) in an absolute sense, whereas the second is called ‘sign’ (*dalīl*).”

<sup>68</sup> For an outline of the two sub-categories of the demonstration of the “fact,” see J. McGinnis, *Avicenna* (Oxford Univ. Press, 2010), 44-46.

<sup>69</sup> See P. Pellegrin, “Scepticisme et sémiologie médicale,” in R. Morelon, A. Hasnawi (eds.), *De Zénon d’Elée à Poincaré: recueil d’études en hommage à Roshdi Rashed* (Louvain: Peeters, 2004), 645-664, and the bibliography mentioned therein.

<sup>70</sup> See Abū Bakr al-Rāzī, *Doutes sur Galien*, xcixii-cxv, for the reception of the theory of sign-inference in Abū Bakr al-Rāzī, and Cerami, *Génération et Substance*, 316-336, and ead., “Signe physique, signe métaphysique. Averroès contre Avicenne sur le statut épistémologique des sciences de l’être,” in C. Cerami (ed.), *Nature et Sagesse. Les rapports entre physique et métaphysique dans la tradition aristotélicienne. Recueil de textes en hommage à Pierre Pellegrin* (Louvain: Peeters, 2014), 429-474, for

After reconstructing Avicenna's logical apparatus and his sources, we can go back to the criticism of Galen's arguments. Avicenna says that he found the arguments put forward by Galen mere *amārāt*, which I take to mean "indications," "tokens," stopping at the level of probability and completely lacking cogency. For, in spite of Galen's intentions, his arguments fail to be conducive to necessary conclusions because, as we shall see in a moment, they are incapable of hinting at the cause of a thing from its effect. Based on the terminology used in this context, the reason seems to be that Galen's arguments do not depend on the nature of the thing under investigation, which would have allowed him to construct a proper sign-inference, but stop at the thing's appearance. In this connection, *amāra*, which, at least to my knowledge, is a *hapax* in Avicenna's oeuvre, seems to refer to the thing as it appears, from which no necessary knowledge can be derived.<sup>71</sup> In this respect, an argument based on *amāra* is doomed to remain at the level of what is merely probable (*εἰκός*), below the threshold of any causal explanation, be it deductive or from the effect.

However, though bringing *dalīl* closer to the demonstration of the cause, which is useful to medical epistemology, Avicenna is silent about its cogency. Rather, Avicenna seems to reserve the demonstrative (as opposed to doxastic)<sup>72</sup> persuasion, capable of quietening the soul's search for the cause of something, to a higher form of argument, which, in all likelihood, is the demonstration in the proper (or strongest) sense (*burhān*, or *burhān limā*).

its reception in Averroes.

<sup>71</sup> In the *GALex*, *amāratun* is said to translate the Greek τεκμήριον (*indication, token*), either absolutely or in hendiadys (*amāratun wa-<sup>o</sup>alāmatun*). The texts from which this information is drawn are by Hippocrates. See G. Endress, D. Gutus, *Greek and Arabic Lexicon (GALex). Materials for a Dictionary of the Mediaeval Translations from Greek into Arabic*, vol. 1 (Brill, 1992), 396. For τεκμήριον (*Merkmal, Kennzeichen, Beweis*) translated as *amāra*, see M. Ullmann, *Wörterbuch zu den Griechisch-Arabischen Übersetzungen des 9. Jahrhunderts* (Wiesbaden: Otto Harrassowitz, 2002), 437.

<sup>72</sup> Here demonstrative persuasion of the soul, which, as the qualification *burhānī* suggests, is acquired through demonstration, must be distinguished from "doxastic persuasion" (*iqnā<sup>c</sup> zannī*), which has the lowest degree of certainty and is connected with rhetorical syllogisms. See D. L. Black, *Certitude, justification, and the principles of knowledge in Avicenna's epistemology*, in P. Adamson (ed.), *Interpreting Avicenna: Critical Essays* (Cambridge Univ. Press, 2013), 120-142, 122.

### 5. POSSIBLE VS. NECESSARY: BE CAREFUL WHICH ONE TO BET ON

From *Hayawān* III, 1, 40.18 onwards, Avicenna takes the floor with the usual formula “I say” (*aqūlu*) and presents his own position.<sup>73</sup> The feature of Avicenna’s discourse that immediately stands out is the language of “possibility” he uses to tackle the issue of the origin of blood vessels and nerves, which echoes the words of caution we have already encountered at 40.7-10.

I say: first of all, it is not unlikely that (*laysa bi-ba‘īd an*) the brain and the liver send out from themselves to the heart an organ (sc. nerves and veins respectively) by the mediation of which (*bi-tawassuṭihā*) they acquire from the heart something [else], [...]). Moreover, there is not much objection to the fact that (*fa-lā katīr ba’s an*) arteries grow out of the heart to the liver and the brain, so they bring to them (sc. liver and brain) a certain temperament [capable of] receiving life. Then, organs (sc. veins and nerves) grow out of them both (sc. liver and brain) to it (sc. the heart) for the acquisition of powers (*li-stifāda quwā*) whose obtainment is completed only by means of it (sc. the heart). Likewise, it cannot be denied that (*wa-lā aydan bi-munkar an*) [the matter of the origin of] the artery and what is analogous to it is controversial, each [of them] arriving simultaneously [from its origin] at the other organ [it is connected with] (40.18 – 41.4).<sup>74</sup>

Avicenna seems to be aware of the difficulties that solving the issue poses: all the alternatives seem plausible, and their combination in a unitary model not far-fetched.

Firstly, it is not implausible that, like the liver, whose activity of managing nourishment begins with provisions supplied by the stomach and the intestines through the mesenteric vein (*al-māsārīqā*), departing from the liver toward the stomach and intestines (40.19 – 41.1), the brain and the liver send to the heart nerves and veins respectively to get something that they do not have by themselves, for instance, the faculties of sensation and locomotion and the faculty of nutrition, respectively. At the same time, there will be no harm in arguing that arteries growing out of the heart to the liver and the brain bring to these two organs the suitable temperament to receive life,<sup>75</sup> and then that the liver and

<sup>73</sup> See n. 24 above.

<sup>74</sup> See *Hayawān*, I, 2, 11.5-6 (= *Qānūn*, I, 1, v, 1, 57.24-25), and 12.5-9 (= *Qānūn*, I, 1, v, 1, 58.14-18), where, quoting himself from the *Qānūn*, Avicenna maintains that nerves originate from the brain or the spinal cord, arteries from the heart, and veins from the liver.

<sup>75</sup> On the connection between the heart and the *quwwa hayawāniyya*, that is, the vital faculty responsible for making the animal live, see n. 100 below.

the brain send veins and nerves to the heart to acquire from it faculties (*quwā*) that can be only received after the heart has bestowed life upon them.

The difficulty of deciding the issue is due to the primary function of blood vessels and nerves. They simultaneously connect two different organs, and this makes it hard to establish from which organ they originate and at which organ they arrive. Aristotle combines the simultaneity of something reaching two different places, like a road or a line, with the difficulty of establishing the origin of that something in presenting the first meaning of ἀρχή (origin) at the beginning of *Metaphysics* V, 1.<sup>76</sup> It is also noteworthy that the third meaning of ἀρχή mentioned by Aristotle is the immanent part from which something first arises whose identification, in the case of animals, is disputed, be it the heart, the brain, or some other part.<sup>77</sup>

We find the same language of “possibility” concerning the same topic in *Nafs*, V, 8, which should be read in close connection with *Hayawān* III, 1, as we have already seen. There, Avicenna says: “If the faculty of forming and creating (*quwwat al-takwīn wa-l-tahlīq*) emanates from the heart to the brain, and then the brain is formed, there is not much objection to the claim that (*fa-lā katīr ba’s bi-an*) the brain sends from itself an organ (sc. in all likelihood, the nerve) through which it derives sensation and locomotion from the heart, or the heart conveys to it an organ by the mediation of which sensation and locomotion are conveyed to it. And there need to be no distress (*fa-lā yağibu an yaqa‘a min al-muḍāyaqa*) about the issue of the creation of the nerve, [whether] its origin is from the heart or from the brain, as long as this (sc. the nerve) comes about. Rather, we concede (*bal nusallimu*) that it is from the brain and [ultimately] derives from the heart, just as the liver sends to the stomach what in it (sc. in the liver) is derived from it (sc. the stomach), and it (sc. the stomach) likewise has blood vessels (sc. veins) by which it supplies other [organs] than the stomach (265.4-11).” Once Avicenna has secured that the ultimate source of the psychic faculties is the heart and

<sup>76</sup> 1012 b34 – 1013 a1: Ἄρχὴ λέγεται ἡ μὲν ὅθεν ἂν τις τοῦ πράγματος κινηθείη πρῶτον, οἷον τοῦ μῆκους καὶ ὁδοῦ ἐντεῦθεν μὲν αὕτη ἀρχὴ, ἐξ ἐναντίας δὲ ἔτερα.

<sup>77</sup> 1013 a4-7: ἡ δὲ ὅθεν πρῶτον γίγνεται ἐνυπάρχοντος, οἷον ως πλοίου τρόπις καὶ οἰκίας θεμέλιος, καὶ τῶν ζώων οἱ μὲν καρδίαν οἱ δὲ ἐγκέφαλον οἱ δ’ ὡς τι ἂν τύχωσι τοιούτον ὑπολαμβάνουσιν. It is worth noticing that, in commenting upon this passage, Alexander refers exclusively to the heart as the principle of animals. See *In Aristotelis Metaphysica commentaria*, 345.36 – 346.1: ἀρχὴ λέγεται καὶ ὅθεν ἄρχεται τι γίγνεσθαι ἐνυπάρχοντος τῷ γιγνομένῳ. οὕτως ἡ καρδία ἀρχή· ἀπὸ ταύτης γὰρ ἡ τοῦ ζώου σύστασις. See also n. 30 above.

that there are connections between it and all the other organs generated after it, through which the heart provides those organs with their specific faculties, whose activities are either performed there (like in the case of internal sensation or nutrition) or in other organs (eyes, ears, muscles, etc.),<sup>78</sup> the anatomy of those connections can remain undetermined, as long as we are satisfied that they exist. In other words, in the case of these organs, Avicenna limits himself to acknowledging their existence, that is, the “fact” ( $\tau\ddot{o}\ \sigma\tau\iota\tau$ ), abstaining from providing the “reason why” ( $\tau\ddot{o}\ \delta\iota\sigma\tau\iota$ ).

In *Hayawān*, III, 1, after presenting his position, Avicenna directs his attention to Galen’s arguments for the origination of veins from the liver and nerves from the brain. As we have seen, these arguments are based on thickness and thinness observed in those organs and considered as indicators of the direction of the source from which they originate. Here Avicenna, who has already judged these arguments to be inconclusive, provides some counterexamples to Galen’s arguments: the optic nerve becomes thicker when it is remote from its alleged origin, i.e. the brain, but closer to the crystalline humor, i.e. where sight occurs. Similar is the case of the veins sprouting in the uterus, and of nerves in the intestines (41.4-11). Likewise, the analogy between nerves and veins in the animal body and branches in trees, which Galen uses in *PHP*,<sup>79</sup> is considered weak and lacking in any demonstrative force.<sup>80</sup>

The primary fault of Galen’s argument, according to Avicenna, was to consider thickness and thinness themselves as indicators of the direction from which something derives. However, being thick or thin is a quality of bodily matter, which it does not have by itself. A principle enacting that thickening or thinning is required, which must serve some purpose or use. That principle is the formative faculty (*al-quwwa al-muṣawwira*), that is, a faculty of the soul that shapes the bodily matter for a specific use or purpose: “However, thickness and thinness do not follow the flow (*wa-laysa l-ḡilaż wa-l-diqqa tābi‘ayni li-l-sayalān*), but rather the shaping [activity] of the formative faculty (*bal li-taṣwīr al-muṣawwira*). For, when the formative faculty is required to thicken a part [of the body] for a certain use or goal (*li-manfa‘a wa-ġarad*), it attracts to it from the first

<sup>78</sup> See *Nafs*, V, 8, 264.11 – 265.4; and 266.19 – 267.6.

<sup>79</sup> Galen, *PHP*, VI, 3, 376.11 – 378.5 (ed. De Lacy).

<sup>80</sup> This analogy drawn by Galen has already been criticized by Abū Bakr al-Rāzī: see Abū Bakr al-Rāzī’s *Doubts on Galen*, cviii-cix. For Avicenna’s position on analogy (*tamtil*), which, however, is not explicitly referred to here, see *Qiyās*, IX, 23, 568.4 – 569.8.

nourishment that by means of which it thickens that part (41.6-8)." In this passage, Avicenna stresses several times the necessity of the formative faculty as opposed to matter or sheer nature in order to make body parts suitable to perform their functions.<sup>81</sup> If the body parts are shaped by the activity of the formative faculty aiming at some goal, their quality has nothing to do with how close (or far) something is to (or from) its alleged source and, consequently, cannot unequivocally indicate which this source is. Avicenna can, thus, conclude that "what germinates (*al-nābit*) [from something] is different (*muhālif*) from the thing from which it germinates (*li-l-manbūt ‘anhu*)" (42.6).

Abandoning the language of caution and plausibility used to speak of the issue of the origin of blood vessels and nerves, Avicenna firmly opposes his concept of a faculty stemming from the soul, in all likelihood the formative faculty, to Galen's natural faculty concerning the principle responsible for shaping body parts, the organs: "This and what is similar to this is not objectionable (*wa-laysa ... bi-mustankar*), when [the activity of] fashioning [the organs] is ascribed not to a sheer natural faculty (*lā li-quwwa tabī‘iyya sirfa*), but to a psychological faculty, multiform in terms of activities (*bal ilā quwwa nafsāniyya mutafanninat al-af‘āl*) (42.10-11)."

It is no coincidence that here Avicenna refers to the formative faculty (*al-quwwa al-muṣawwira*),<sup>82</sup> which in the *Qānūn* is also called *al-tābi‘a*

<sup>81</sup> See *Hayawān*, III, 1, 41.15-16: "The enactor (*wa-fā‘il*) of this thickening, thinning, hardening, and softening is the formative faculty, not matter (*al-quwwa al-muṣawwira lā l-māddā*). We find a similar state in trees." It is worth comparing with *Nabāt*, 7, 33.7-8: "[...] for none of those things (sc. colours and fragrances of plants) follows the need of natures and the necessity of matter; rather, they follow the managing of the vegetative soul and its distribution [in the plant] (*fa-innahū laysa šay’ min tilka yatba‘u mügib al-tabā‘i‘ wa-darūrat al-hayūlā bal yatba‘u tadbīr al-nafs al-nabātiyya wa-tawzī‘ahā*), even though they do not occur except through the mediation of these natures (*wa-in kāna lā yaḥṣulu illā bi-tawassuṭ hādihi l-ṭabā‘i‘*). See also 42.1-4: "Yet, these things follow the suitability and the activity of the formative faculty, not proximities. It is not necessary that, if the nerve is harder than the heart, its origin is not from it. For something hard may sprout from the soft and moist earth, like the corals in the depth of the sea." and 42.7-8: "[...] in accordance with what suits the goal [of the formative faculty] and what the formative faculty performs."

<sup>82</sup> It is noteworthy that the term *musawwira*, by which here Avicenna refers to the formative faculty, is the same term by which in the *Nafs* Avicenna refers to one of the internal senses, namely the form-bearing faculty, also called imagery (*hayāl*). For the same consideration, see R. E. Hall, "Intellect, Soul and Body in Ibn Sina: Systematic Synthesis and Development of the Aristotelian, Neoplatonic and Galenic Theories," in J. McGinnis, D. C. Reisman (eds.), *Interpreting Avicenna: Science and Philosophy in Medieval Islam. Proceedings of the Second Conference of the Avicenna*

(imprinting). It is one of the two species into which physicians divide the Aristotelian generative faculty (*al-quwwa al-muwallida*). It is responsible for shaping and setting up the bodily organs.<sup>83</sup> In doing so, Avicenna connects this faculty with philosophical (that is, Aristotelian) psychology, so as to use this concept elaborated in the medical context against physicians (Galen, in particular).

In *Hayawān*, III, 1, Avicenna's target seems to be the notion of "nature" to which, in "On the Natural Faculties" for instance, Galen ascribes the activities that Aristotelian philosophers would normally ascribe to the psychic faculties. There, Galen considers nutrition, growth, and generation as effects of "nature," which constructs the body parts using a faculty called "in general terms, generative and alterative, and, in more detail, warming, cooling, drying, or moistening."<sup>84</sup> In *Samā' tabī'i*, I, 5, Avicenna clearly distinguishes between nature, which is a uniform, one-way capacity, capable of producing one single effect, and sublunar soul,<sup>85</sup> which is a non-uniform, two-way capacity,<sup>86</sup> capable of producing contrary effects in living beings.<sup>87</sup> The organic living beings are gov-

*Study Group* (Brill, 2004), 62-86, 82.

<sup>83</sup> *Qānūn*, I, 1, vi, 2, 124.8-10: "As for the formative, imprinting faculty, it is that from which there comes, with the permission of its Creator, the outline of the organs, their shaping, the making of their hollows, their perforation, their smoothness, their roughness, their setting up, and their cooperations, and, in general, the activities depending on the limits of their dimensions."

<sup>84</sup> *De nat. fac.*, 2.10.6-15 (ed. Kühn): "Εργα τοίνυν τῆς φύσεως ἔτι μὲν κυομένου τε καὶ διαπλαττομένου τοῦ ζώου τὰ σύμπανταν ἔστι τοῦ σώματος μόρια, γεννηθέντος δὲ κοινὸν ἐφ' ἄπασιν ἔργον ή εἰς τὸ τέλειον ἑκάστῳ μέγεθος ἀγωγὴ καὶ μετὰ ταῦθ' ή μέχρι τοῦ δυνατοῦ διαμονής ἐνέργειατ δ' ἐπὶ τρισὶ τοῖς εἰρημένοις ἔργοις τρεῖς ἐξ ἀνάγκης, ἐφ' ἑκάστῳ μίᾳ, γένεσίς τε καὶ αὔξησις καὶ θρέψις. ἀλλ' ή μὲν γένεσίς οὐχ ἀπλῇ τις ἐνέργεια τῆς φύσεως, ἀλλ' ἐξ ἀλλοιώσεώς τε καὶ διαπλάσεώς ἔστι σύνθετος. And 2.12.15 – 13.3: δόστοιν δὴ καὶ χόνδρον καὶ νεῦρον καὶ ὕμενα καὶ σύνδεσμον καὶ φλέβα καὶ πάνθ' ὅσα τοιαῦτα κατὰ τὴν πρώτην τοῦ ζώου γένεσιν ή φύσις ἀπεργάζεται δυνάμει χρωμένη καθόλου μὲν εἰπεῖν τῇ γεννητικῇ τε καὶ ἀλλοιω τικῇ, κατὰ μέρος δὲ θερμαντικῇ τε καὶ φυκτικῇ καὶ ξηραντικῇ καὶ ὑγραντικῇ [...].

<sup>85</sup> I add "sublunar" because the celestial soul is a uniform psychological principle, performing one single effect through volition. See *Samā' tabī'i*, I, 5. See also T. Alpina, "Is the Heaven an Animal? Avicenna's Celestial Psychology between Cosmology and Biology," in R. Salles (ed.), *Biology and Cosmology in Ancient Philosophy: from Thales to Avicenna* (Cambridge Univ. Press, 2021), 261-278.

<sup>86</sup> For the Aristotelian background of this distinction between one-way, or irrational, and two-way, or rational, capacities, see *Metaph.*, IX, 2, 1046 a36-b7.

<sup>87</sup> In *Samā' tabī'i*, IV, 9 Avicenna says that by "natural power" (*quwwa tabī'iyya*) he refers to every power belonging to a thing that produces motion without volition, be it either natural in an absolute sense (*tabī'iyya sirfan*) or the soul of plants (*nafs al-nabāt*). For a discussion of these texts, see Alpina, "Is Nutrition a Sufficient Condition for Life?" 221-258, 236-237.

erned by a psychological principle, not by nature (or a natural power), from which derive several faculties capable of performing different activities through the body. Whereas the physical origin of blood vessels and nerves is debatable, the psychological principle of organic living beings is non-negotiable for Avicenna: he grounds on it his anatomical investigation, as we already suggested above, and as we shall see in what follows.

In the end, nothing of what Galen said concerning the origin of blood vessels and nerves is necessary. It is all simply possible, although he was quite literally ready to bet his money on it.<sup>88</sup> Galen's arguments can be easily overturned even on a dialectical level, using the same premises that he conceded: "There may (*wa-qad yumkinu*) come to him (sc. to Galen) someone who establishes that (sc. that nerves are from the heart) against him in a dialectical manner (*min tariq ḡadali*), admitting that its (sc. of the nerve) origin is from it (sc. the heart). He (sc. Galen) has already conceded that (*fa-kāna yusallimu anna*) the origin of the organ is where the origin of the power is (*mabda<sup>o</sup> al-āla haytu mabda<sup>o</sup> al-quwwa*). Then, when this premise is conceded by him (sc. Galen), it can be demonstrated (*amkana an yubarhina*) against him that the soul in the human being is essentially one (*dāt wāhidā*), from which the other powers flow, and that the first attachment (*awwal ta<sup>c</sup>alluq*) of that single essence [with the body] occurs where the first organ for life (*awwal <sup>c</sup>udū li-l-hayā*, sc. the heart) is. Then, he (sc. Galen's opponent) will close the gap to impose on him that blood vessels and nerves are from the heart, and he (sc. Galen) will unquestionably lose his money (44.2-6)."

To show that Galen's arguments are not conducive to necessary conclusions, Avicenna turns Galen's premises against him. The background

<sup>88</sup> *Hayawān*, III, 1, 43.18 – 44.1: "Thus, nothing of what the excellent one among the physicians (*fādil al-ātibbā<sup>o</sup>*) says is necessary (*bi-ḍarūri*), even though he would bet [on this] and put down the money for the soothsayer of the temple as a payment for the one who establishes for him that nerves are from the heart." Cf. *Qānūn*, I, 1, vi, 1, 123.6-9: "When one looks for what is necessary and ascertains it, he will find that the matter is as Aristotle believes, not the others (sc. the physicians). Their sayings are derived from persuasive (dialectic?), unnecessary premises (*min muqaddimāt muqnī<sup>a</sup> ġayr darūriyya*). In those premises, they only follow the seeming aspect of matters (*zāhir al-umūr*). However, the physician insofar as he is a physician should not explore the truth of these two matters (sc. those concerning the heart and the brain). This is incumbent upon the philosopher or, to be precise, the natural philosopher." A similar passage can be found in al-Fārābī, *Kitāb al-ḥitāba* (Book of rhetoric), 79.9-11 (ed. Langhade). This information is also reported by G. Strohmaier, *Avicenna between Galen and Aristotle*, in P. Bouras-Vallianatos, B. Zipser (eds.), *Brill's Companion to the Reception of Galen* (Brill, 2019), 215-226, in part. 219-220.

of his criticism is the beginning of the eighth book of Galen's *PHP*. There, we are informed that the purpose of examining the teachings of Hippocrates and Plato was to determine the powers that govern us and their seat.<sup>89</sup> The investigation of those powers begins with the part of the soul called governing (ἡγεμονικόν), and with the only scientific argument formulated about it, whose premises are derived "from the essence of the very thing being investigated."<sup>90</sup> This argument reads as follows: "Where the origin of the nerves is, there is the governing part [of the soul]. The origin of the nerves is in the brain. Therefore, the governing part is there," i.e. in the brain.<sup>91</sup>

We are already familiar with Galen's classification of the premises (and, in particular, with his distinction of scientific premises from all other premises),<sup>92</sup> and with his concept of indication (ἐνδειξις), where a necessary conclusion about something is drawn on the basis of its essential nature. This argument is not based on scientific premises and does not yield necessary conclusions. As Peter N. Singer has shown, that the origin of nerves is the physical seat of the governing part of the soul does not stem from the definition of the nature itself of the ἡγεμονικόν, which is "the source of perception and of voluntary motion,"<sup>93</sup> nor is it immediately evident to the senses.<sup>94</sup> Rather, as is apparent from what Galen himself says, it is simply an ἔνδοξον, a proposition generally admitted by all physicians and philosophers, including his opponents.<sup>95</sup>

Avicenna's criticism captures exactly this weak aspect of Galen's argument: "However, this [premise] also which Galen conceded (sc. that the origin of the organ is where the origin of the power is) is not necessary in the essence of the things [under investigation] (*qayr wāgib fī dāt al-umūr*). The intelligent person should not deem it appropriate to make an apodictic judgment (*hukm ġazm*) about this subject in any respect. For, several explanations might be advanced concerning that [sub-

<sup>89</sup> *PHP*, VIII, 1, 480.4-9 (ed. De Lacy).

<sup>90</sup> *ivi*, 480.16-21: ἀλλ' ἀπό γε τῶν προαιρετικῶν ἀρξάμενοι καθ' ἄς καὶ τὸ καλούμενον ιδίως ἡγεμονικόν ἐστι τῆς ψυχῆς, ἔνα λόγον ἐδείκνυμεν ἡρωτήσθαι μόνον ἐπιστημονικῶς ἀπ' αὐτοῦ τοῦ ζητουμένου τῆς οὐσίας ἔχοντα τὰς προτάσεις, δύντα τοιούτον· "ὅπου τῶν νεύρων ἡ ἀρχὴ, ἐνταῦθα καὶ τὸ τῆς ψυχῆς ἡγεμονικόν."

<sup>91</sup> *ivi*, 484.35 – 486.2: ἔνθα τῶν νεύρων ἡ ἀρχὴ, ἐνταῦθα τὸ ἡγεμονικόν· ἡ δ' ἀρχὴ τῶν νεύρων ἐν ἐγκεφάλῳ[ἐστίν]· ἐνταῦθα ἄρα τὸ ἡγεμονικόν.

<sup>92</sup> See nn. 57-58 above.

<sup>93</sup> *PHP*, VII, 1, 430.1-4: τὸ κατάρχον αἰσθήσεώς τε καὶ τῆς καθ' ὄριμὴν κινήσεως.

<sup>94</sup> See P. N. Singer, "Galen," <https://plato.stanford.edu/entries/galen/>, 2016, in part. § 3.1.

<sup>95</sup> *PHP*, VIII, 1, 480.20-21 (ed. De Lacy): αὕτη μὲν ἡ τοῦ λόγου κυριωτάτη πρότασις ὀμολογημένη πᾶσιν ιατροῖς τε καὶ φιλοσόφοις.

ject] until one will eventually arrive at the truth that makes it necessary (44.6-9).<sup>96</sup> Avicenna does not limit himself to claim that the judgment formulated by Galen is not based on “the essence of things” (*dāt al-umūr*) and, consequently, that its conclusion is just plausible, not necessary.<sup>97</sup> He also suggests that no apodictic, decisive judgment can be formulated on the origin of nerves (and blood vessels), thus repeating the attitude of caution displayed at 40.7-10 and echoing the language used at 40.18 – 41.4.<sup>98</sup>

Again, in *Nafs*, V, 8, Avicenna provides the reader with the same perspective, but by way of a more refined thought about what can (or cannot) be argued with certainty in this case: “Thus, concerning its (sc. the nerve’s) getting from the brain to the heart, there is also no argument nor anything similar to an argument (*fa-lā yakūnu ... huğğa aydan wa-lā sibh huğğa*). Rather, as soon as the brain is created, together with it something is created from its matter that reaches the heart, extraneous to the heart, from which sensation and locomotion derive. However, the germination of this nerve from the brain and its getting from it (sc. the brain) to the heart is not something as evident as believes the one who claims (*laysa šay<sup>3</sup> yažharu l-zuhūr alladī yažunnuhū mud-da<sup>4</sup>i*) that the nerve between the brain and the heart germinates from the brain to the heart, not from the heart to the brain, as we shall explain in its proper place of our discourse about the natures of animals, where we shall speak at length in a way that will satisfy and persuade (*‘alà mā sanūdihuhū fī mawdi<sup>5</sup>ihī min kalāminā fī ṭabā<sup>6</sup>i<sup>6</sup> al-ḥayawān wa-nuṭawwili l-kalām fihi ṭūlan yašfī wa-yuqni<sup>7</sup>u*, cf. *Hayawān*, III, 1)

<sup>96</sup> Cf. *Hayawān*, XII, 8, 225.2-5: “According to this perspective (sc. that all psychic faculties arrive at the organs originated after the heart through the cardiac pneuma), it is correct to pursue the discourse that the soul is one and that its first attachment [to the body] is through a first organ (sc. the heart) (*anna l-nafs wāhidā wa-anna awwal ta<sup>8</sup>alluqahā bi-awwal ‘udw*). The *Books of Appendices* (*kutub al-Lawāhiq*) – if God preserves [us] alive – will reach the outermost degree in the explanation of this topic (*fī šarḥ hādā l-bāb*), and it is not unlikely that an increase in the investigation will lead us to an apodictic judgment on these topics (*ilā hukm ġazm fī hādihi l-abwāb*).”

<sup>97</sup> For a similar criticism of Galen’s arguments in Abū Bakr al-Rāzī and al-Fārābī, see the studies referred to in n. 46 above. See also L. Richter-Bernburg, “Abū Bakr al-Rāzī and al-Fārābī on Medicine and Authority,” in P. Adamson (ed.), *In the Age of al-Fārābī: Arabic Philosophy in the Fourth / Tenth Century* (London: Warburg Institute, 2008), 119-130.

<sup>98</sup> In this connection, see also 43.7-16, where Avicenna refers to “agglutination” as a possible explanation of the close contact between the heart and nerves, which however does not account for the origination of the latter from the former. On this passage, see n. 44 above.

(265.19 – 266.5)."

Ultimately, concerning the origin of the nerves, there is no argument, nor even anything resembling an argument, and their alleged origination from the brain is far from evident (the same holds true for the veins). The target of Avicenna's criticism seems to be Galen, who upheld the origination of nerves from the brain. This interpretation appears to be confirmed by the reference to *Hayawān*, III, 1, where Avicenna discusses the same topic using the same language. Therefore, the weakness of Galen's (quasi-)arguments emerges almost by itself as soon as Avicenna outlines them. However, the reason for Avicenna's criticism goes beyond Galen. It concerns the nature of those organs, which prevents any apodictic judgments from being passed on them.

## 6. WHAT IS THE ROLE OF MEDICAL PRACTICE? AVICENNA AND THE "ACCOMPLISHED ANATOMISTS"

After arguing that there might be different ways, all plausible, to arrive at the truth of the origination of blood vessels and nerves, which will then make that origination necessary for them, the question remains how to translate into practice this consideration concerning the issue at hand and, consequently, what the contribution of medical practice to this transition should be.

In this connection, after making the aforementioned general remark, Avicenna immediately says: "It is not unlikely (*lā yab<sup>c</sup>udu*), from the beginning of the investigation until the time in which one attends to what anatomy requires, that the first formative faculty that is in the semen is what firstly distinguishes thereupon matters in [different] directions to receive the forms of the first organs, and matters to receive the forms of the connections between them. The cardiac matter is among the things that primarily receive the form from the formative faculty, with no need of another faculty than the generative, since the accomplished anatomists acknowledge that the heart is the first [organ] to be generated (*id yašhadu ašhāb al-tašrīh al-muhaṣṣilūna anna l-qalb awwal mutakawwin*). As for the other organs, the formative faculty belonging to the generative faculty needs the mediation of the faculty that is in the heart to perfect its fashioning [activity] (44.9-14)."

At the beginning of an inquiry into the origination of blood vessels and nerves and before engaging in any anatomical procedure, Avicenna considers it not counterintuitive (*lā yab<sup>c</sup>udu*) to suppose that, at the moment of conception, the formative faculty (*al-quwwa al-muṣawwira*),

which is in the semen, shapes the matter of the embryo to receive the forms of the primary organs (i.e. heart, brain, and liver) and the connections between those organs (i.e. blood vessels and nerves). Here, Avicenna refers again to the concept of a “formative faculty” of the soul. It is the branch of the generative faculty in the semen that is responsible for shaping the matter of the embryo and making it disposed to receive the forms of the various organs.<sup>99</sup> The cardiac matter is then said to be among the first things to be shaped by the formative faculty without the assistance of any other intermediate faculty, as happens in the case of other primary bodily organs (brain, liver, and testicles). For, their shaping is accomplished through the mediation of the faculty that is in the heart. For the identification of the faculty in the heart, we should refer to the *Qānūn*, where Avicenna speaks of the *quwwa hayawāniyya* as the vital faculty, that is, the faculty responsible for making the animal live and connected with respiration and blood circulation.<sup>100</sup> However, that the heart, not the cardiac matter, is not just among the first things but is the first organ to be generated is acknowledged by the *accomplished anatomists* (*ashāb al-taṣrīh al-muḥassilūna*).<sup>101</sup>

Who are these *accomplished practitioners of anatomy*? Of what does their activity consist?

Let us begin by answering the second question. The anatomists to whom Avicenna refers here are said to bolster a hypothetical conclusion drawn on the basis of a philosophical assumption and, ultimately, to acknowledge it, that is, that the heart is the first organ to be generated in the embryo. This conclusion is crucial for Avicenna’s philosophical psychology because, as we have seen, it is the necessary counterpart of his theory of a unitary soul animating the body through its initial connection to a single bodily organ, from which the psychic faculties flow to their proper organs (see *Nafs*, V, 8).

That anatomical procedure lends additional support to the philosophical intuition emerges from *Hayawān*, XVI, 1, which is entitled “On how the engenderment of the animal from the semen and the egg occurs, the difference among animals concerning this, and how the semen and what is analogous to it receives the psychic faculties,” and belongs to the part of the writing corresponding to Aristotle’s *De generatione animalium*. “Let us now investigate the state of the semen and whether or not

<sup>99</sup> See p. 166ff. above and nn. 81-83.

<sup>100</sup> See *Qānūn* I, 1, vi, 4, 127.4-9. For a thorough analysis, see Alpina, “Is Nutrition a Sufficient Condition for Life?” 242.

<sup>101</sup> See McGinnis, *Avicenna*, in part. 239.

there is a part of the soul, that is, a faculty, in it (*wa-hal fīhi ġuz<sup>9</sup> nafs a<sup>10</sup>nī quwwa am laysa fīhi*). When the semen moves to form (*ilā takwīn*) the embryo, not due to an extraneous, external cause, but due to its nature, which is subject to the permission of God, the Highest, in it there is the principle of the nutritive soul (*fa-fīhi mabda<sup>9</sup> al-nafs al-ġādiya*). However, the organs do not come to be from it at the same time. For, experience shows the priority of the heart in generation (*fa-inna l-taġriba tadullu <sup>11</sup>alā taqaddum al-qalb fī l-takawwun*), and there is no doubt that what does not have heart has another organ in lieu of the heart. The heart is also the last thing to die (401.7-11)."

This passage concerns the connection between Avicenna's theory of the soul or, to be precise, of the ensoulment of the embryo, and anatomical practice. Here, by following *De gen. anim.*, II, 1, 735 a12-26, Avicenna maintains that in the semen there is a faculty of the soul which is responsible for the formation of the embryo and all its bodily parts, which however are not created simultaneously. This faculty is said to be the principle of the nutritive soul (*mabda<sup>9</sup> al-nafs al-ġādiya*), which performs this activity of formation and shaping. Though he follows the Aristotelian terminology, it is not difficult to see behind the "principle of the nutritive soul" the *formative faculty*, which in *Hayawān*, III, 1 is said to be in the semen and to perform an analogous function.<sup>102</sup>

In this chapter, Avicenna describes the ensoulment of the embryo in a way that perfectly jibes with his psychological tenets (in particular, with *Nafs*, V, 8). Here, the pneuma (*rūh*), a quasi-divine substance similar to celestial bodies, is said to be the first substance in the body to receive life because it is the first thing to carry heat.<sup>103</sup> I do not want to delve into the issue of the pneuma, its characteristics, and its importance for life. However, being the first thing to receive life, the pneuma must be primarily in the heart since it is the first organ to be generated.<sup>104</sup> The relevant aspect of this description here is that the knowledge of the pri-

<sup>102</sup> It should be noted that the text of *De generatione animalium* made modern scholars think that Aristotle ascribed a formative power to the nutritive, vegetative soul. In a recent, enlightening contribution, D. Lefebvre shows that this is not the case: in *De an.*, II, 4 and *De gen. an.*, II, 1, 4, and 6, Aristotle remains consistent about the function he ascribes to the nutritive soul, that is the use of nourishment. See D. Lefebvre, "Looking for the Formative Power in Aristotle's Nutritive Soul," in R. Lo Presti, G. Korobili (eds.), *Nutrition and Nutritive Soul in Aristotle and Aristotelianism* (De Gruyter, 2021), 101-125.

<sup>103</sup> *Hayawān*, XVI, 1, 403.5 – 404.8.

<sup>104</sup> On this aspect and the general exposition of the anatomy of the heart, see *Hayawān*, XIII, 3.

ority of the heart in generation, to which Avicenna's psychological theory is anchored, is acquired through "experience." In all likelihood, Avicenna is referring to knowledge resulting from the observation and, possibly, the dissection of the embryo: this is evident in the *Hayawān*, XIII, 3, where Avicenna speaks of the heart and the arteries sprouting from it and makes many references to the embryo.<sup>105</sup> That Avicenna uses "experience" in this sense seems to emerge also elsewhere. In *Hayawān*, IV, 2, for instance, Avicenna argues that corroboration that fish have the sense of hearing is provided by the "people of experience" (*ahl al-taḡriba*).<sup>106</sup> As I have shown elsewhere, in this context experience seems to indicate a more structured procedure than mere occasional observation, which in all likelihood is based on repeated acts of perception and results in a firmer understanding of a certain phenomenon.<sup>107</sup> In other words, Avicenna might have in mind the concept of *taḡriba* as "methodic experience," which he has outlined in his logical works.<sup>108</sup> This might also be the reason why Avicenna says that these people can acknowledge (*šahida*) the conclusion that fish have the sense of hearing: their observation on which the inference is based is not some random perceptive act. It is a more structured and, thus, conclusive form of experience.

In the passage from *Hayawān*, III, 1, we can find almost all the elements we detected in *Hayawān*, XVI, 1 and IV, 2. From the former, we inferred the possibility of connecting the anatomical practice referred to in III, 1 with methodic observation and, ultimately, with the Avicennian concept of *taḡriba*. Moreover, from the latter, we gathered that the main achievement of a regulated observation, like the one on which anatomy is based, is a kind of corroboration. In III, 1, this corroboration concerns

<sup>105</sup> For the Aristotelian background of this discourse, see *De part. an.*, III, 4, 666 a7-11: αὕτη (sc. καρδία) γάρ ἔστιν ἀρχὴ ἡ πηγὴ τοῦ αἷματος καὶ ὑπόδοχὴ πρώτη. Ἐκ τῶν ἀνατομῶν δέ κατάδηλα μᾶλλον ταῦτα, καὶ ἐκ τῶν γενέσεων· εὐθέως γάρ ἔστιν ἔναιμος πρώτη γινομένη τῶν μορίων ἀπάντων.

<sup>106</sup> It should be noted that here "people of experience" translates the Aristotelian "people living by the coast" (διατριβοντας περὶ τὴν θάλατταν, *Hist. an.*, 534 a7). Therefore, the Arabic translator, who firstly used this circumlocution, might have wanted to emphasize why the place where they live is relevant.

<sup>107</sup> Alpina, "Translating Method."

<sup>108</sup> See, in particular, *Burhān*, I, 9, and III, 5. On Avicenna's notion of *taḡriba*, see J. McGinnis, "Avicenna's Naturalized Epistemology and Scientific Method," in S. Rahman, T. Street, H. Tahiri (eds.), *The Unity of Science in the Arabic Tradition. Science, Logic and Epistemology and their Interactions* (Springer, 2008), 129-152, and J. Janssens, "'Experience' (*tajriba*) in Classical Arabic Philosophy (al-Fārābī – Avicenna)," *Quaestio*, 4 (2004), 45-62. For the Aristotelian background of Avicenna's concept, see D. Gutas, "The Empiricism of Avicenna," *Oriens*, 40 (2012), 391-436, in part. 399-400.

the working hypothesis that the formative power in semen shapes the matters of the primary organs, including cardiac matter. This hypothesis, in turn, is based on a non-negotiable philosophical truth, that is, the soul's oneness and its consequently necessary connection with the body through one single bodily organ (otherwise, the soul would be divided). Avicenna exhibits a similar attitude towards medical experiments (*al-taḡārib al-tibbiyya*) in a similar context in *Nafs*, V, 8. There, as we have already pointed out, medical experiments are used to make evident that the pneuma is the primary, corporeal vehicle of the bodily psychic faculties, again based on the fact that the soul is one and needs a single bodily attachment.

We can now turn to the first question concerning the identification of the “accomplished anatomists.” Let us begin with a remark about the qualification of those anatomists as *muḥaṣṣilūna* (*accomplished*). This qualification is reminiscent of *tahṣīl*, a crucial concept in Avicenna’s philosophy, which can be translated as “validation.”<sup>109</sup> *Tahṣīl* refers to the process of knowledge acquisition that does not depend on authority but rather is the result of independent, rational analysis. As Gutas explains, this process also applies to transmitted philosophical knowledge: before accepting what one’s predecessors have said about anything, their opinions and reasonings should undergo careful, rational scrutiny. A scholar acquiring knowledge in this manner is called *muḥaṣṣil*.<sup>110</sup> Thus, the concept of *tahṣīl* points to what Avicenna considers the best philosophical practice aimed at the attainment of the truth, and opposes the attitude of blind adherence and partisan devotion expressed by the concept of *ta<sup>c</sup>aṣṣub* (partisan spirit), which jeopardize the pursuit of the truth, as we have already shown.<sup>111</sup> In general, we could say that any scholar displaying a critical attitude towards his sources or the philosophical affiliation to which he belongs can be called *muḥaṣṣil*. In this connection, Avicenna would definitely consider himself a *muḥaṣṣil*. What is more, in *Hayawān*, XII, 6, which is the chapter containing the classification of humors, Avicenna refers three times to Galen as *muḥaṣṣil al-*

<sup>109</sup> See Gutas, *Avicenna and the Aristotelian Tradition*, 214.

<sup>110</sup> See n. 112. For example, Alexander of Aphrodisias and Themistius are referred to as “the Peripatetic scholars who came after him (sc. Aristotle) and validated [his opinion] (*wa-man ba<sup>c</sup>dahū min muḥaṣṣilī ‘ulamā<sup>o</sup> al-maṣṣā‘īna*)” in *Ilāh.*, IX, 2, 392.9-10. On Galen as a source for this critical use of authority and al-Gazālī as another example of it, see S. Menn, “The Discourse on the Method and the Tradition of Intellectual Autobiography,” in J. Miller, B. Inwood (eds.), *Hellenistic and Early Modern Philosophy* (Cambridge Univ. Press, 2003), 141-191.

<sup>111</sup> See n. 35 above.

*atibbā<sup>9</sup>*.<sup>112</sup> To my knowledge, this is the only chapter of *Hayawān* where Avicenna refers to Galen using this epithet. It seems no coincidence that he is using it in connection with humoral theory: unlike the issues of the origination of blood vessels and nerves or the male and female role in reproduction, which are deeply rooted in philosophical psychology, and only derivatively medical, the issue of humors is primarily medical and Galen, who critically revised Hippocratic teachings, was considered an authority on it. Moreover, as has been said at the beginning, the medical theory of humors represents a bridge between natural philosophy and medicine, and an actual migration of principles from medicine to natural philosophy.

Therefore, in the context of *Hayawān*, III, 1, Avicenna might refer to those anatomists who, in pursuing the truth, challenge the opinions of their master physicians, subject them to rational scrutiny, and arrive at independent conclusions based on logical reasoning. However, the reader cannot help noticing that here the anatomists end up validating the opinions of philosophers (read: Aristotle) concerning the primacy of the heart and, ultimately, the active role of the faculty in it in originating blood vessels and nerves, a way of thinking to which Avicenna somewhat inclined from the beginning (see the use of *amyal* at 40.7-10). However, here Avicenna does not conclude that those organs physically sprout from the heart. He has already said that no apodictic judgment can be made on this issue. Rather, he claims that the formative faculty that is in the semen shapes the matters of the primary organs and their bonds. The first matter to be shaped is the cardiac matter, which is the only matter the formative faculty shapes by itself. The matters of all other organs, by contrast, are shaped by the formative faculty with the assistance and mediation of the (vital) faculty in the heart. The heart is therefore the ultimate derivation of all bodily organs, blood vessels and nerves included.

<sup>112</sup> See 210.16-17, where Galen is said to argue that, unlike the yellow and the black bile, the sweet, natural phlegm has not been assigned a specific organ for its discharge because, being similar to blood, all organs need it (cf. Galen, *Nat. fac.*, II, 9); 212.2, where Galen is said to maintain that the phlegm is salty (cf. Galen, *In Hipp. De nat. hom. comm.*, 80.8, ed. Kühn), and 217.6, where he is said to be against the claim that only the blood is a natural humor, whereas the rest of humors is a surplus (cf. Galen, *In Hipp. De nat. hom. comm.*, 42.1-11, ed. Kühn). In all three cases, Avicenna adds his own contribution to Galen's position. It is noteworthy that in the same passages of the *Qānūn*, from which this chapter is transplanted, *muhaṣṣil al-atiibbā<sup>9</sup>* is replaced by *Ǧālinūs* (Galen), see *Qānūn*, I, 1, iv, 1, 49.11, 50.8, 53.18. It should be added that Avicenna uses *muhaṣṣil al-atiibbā<sup>9</sup>* to refer to Galen also in *Hayawān*, XII, 4, 201.17, where he endorses Galen's view on the temperament of children and young people.

The reason for the anatomists' acknowledging (*sahida*) philosophical positions might be that, as I have suggested, those issues are primarily philosophical and thus it belongs to philosophers to ascertain them. The anatomical procedure in which physicians engage cannot challenge philosophical conclusions or even add the final proof, because medicine relies on philosophical principles in those issues and cannot rise to the level of philosophy.<sup>113</sup>

## 7. CONCLUSION

In the part of *Hayawān* corresponding to Aristotle's *Historia animalium*, Avicenna addresses the main points of conflict between philosophers and physicians. This article focused on the issue of the origination of blood vessels and nerves dealt with in chapter III, 1 and only cursorily on the issue of the male and female role in reproduction dealt with in chapters IX, 1-3.

Avicenna approaches the two conflicting views about the origin of blood vessels and nerves in a fair-minded way. He presents them simply letting the arguments supporting them speak for themselves. Fair-mindedness is a distinctive feature of Avicenna's philosophical practice: before accepting any transmitted opinion, it must be subjected to independent verification (*tahṣīl*), which enables the philosopher to pass unbiased judgment upon it (*inṣāf*). This approach is even more necessary in the case of the doctrines of Aristotle and Galen, who were Avicenna's own authorities.

Upon thorough scrutiny, it emerges that, despite all Galen's efforts to build a necessary proof for the origination of blood vessels and nerves from the liver and brain respectively, which is based on the observable features of those organs, all his arguments turn out to be merely probable, failing to reach the level of demonstrative certainty. For, they are unable to go beyond the phenomenal level and grasp the causal structure of things.

The fundamental reason why Galen did not manage to say anything conclusive about the origin of blood vessels and nerves is that their nature is elusive and cannot be grasped, even through regulated, controlled observation. Settling this issue requires more solid principles, on the ba-

<sup>113</sup> As emerged above, the case of humoral theory is different. Though formulated in a medical context, this theory, being a principle for medicine, must be treated outside it, in a higher science. This fact justifies the exposition of humors in zoology since zoology is a part of natural philosophy.

sis of which firmer conclusions can be drawn. These principles, however, are given to the physician by the philosopher, and this is Avicenna's insuperable bias. In the end, the concept of a medical discipline subordinated to higher (philosophical) principles inevitably ends up favoring the philosophical perspective (in other words, that of Aristotle). The topics that set philosophers against physicians are not (and cannot be) equally tackled by both groups because, ultimately, these are issues that are incumbent upon the philosopher to investigate with his own principles and theoretical tools. In the case of the origination of blood vessels and nerves, the philosophical principle at the basis of the investigation is the soul's oneness, in turn necessitating a single bodily organ to which it is firstly attached, that is, the heart. The formative faculty of the soul in the semen shapes the cardiac matter of the embryo, in which the principle of life primarily inheres. Then, all the other bodily organs are shaped by the formative faculty together with the vital faculty in the heart. Ultimately, all organs depend on the heart and derive from it, although it would be hazardous to speak of physical origination.

Philosophical principles thus guide the anatomist's hand, who cannot but corroborate the philosophical assumptions from which his activity has begun.

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