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ARTICLE

Logic, geometry and visualisation of the body in Acquapendente's rediscovered Methodus anatomica (1579)

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Abstract

The article provides the first description and analysis of the recently rediscovered manuscript titled *Methodus anatomica* by Girolamo Fabrici da Acquapendente (1533–1619). Acquapendente was one of the most important anatomists in late sixteenth-century Europe and played an instrumental role as Harvey's teacher in Padua towards the latter's discovery of the circulation of the blood. The manuscript provides first-hand testimony as to how anatomy was administered in Padua in the post-Vesalian era and sheds light on a number of otherwise unknown aspects of the development of the anatomical method. Chiefly among these is the attention devoted by Acquapendente to *historia*, as a way to order sensory data in a consistent way, which draws widely from the geometrical method and from the contemporary debate on the discretisation of continuous quantities.

Keywords: Girolamo Fabrici da Acquapendente; *Methodus anatomica*; Padua; Galen; Anatomy; Geometry

Introduction

As a means to organise pre-existing knowledge, method has been the object of keen interest in sixteenth-century arts and sciences. Renaissance scholars devoted their efforts particularly to explore and expand the links between the logical organisation of discourse and different areas of knowledge.[1] Anatomy was no exception. The logical procedures of 'analysis' (*resolutio*) and 'synthesis' (*compositio*) seemed to fit particularly well with anatomical dissection. This began from the outer surface of the corpse down to its elemental constituents (ie. bones, ligaments and cartilages) and then moved back to the totality, by showing the interconnection of the bodily parts as obeying particular functions (*actiones*) and serving specific utilities (*utilitates*) for the preservation of the entire organism.[2] However, during the sixteenth century, the understanding and meaning of anatomical method changed significantly. Whereas early authors such as Andres De Laguna (1499–1559) saw method as more or less the collection of the best

[1]Renaissance method has been the object of comprehensive study since at least the work of Neal W. Gilbert, *Renaissance Concepts of Method* (New York and London: Columbia University Press, 1963). By far, the most important contribution to date is that of Ian Maclean, *Logic, Signs and Nature in the Renaissance* (Cambridge: Cambridge University Press, 2002). For the development of method in relation to Aristotelian commentaries, see also Daniel A. Di Liscia, Eckhard Essler, Charlotte Methuen (eds), *Method and Order in Renaissance Philosophy of Nature. The Aristotle Commentary Tradition* (Alderhot: Ashgate, 1997). On method and anatomy in Renaissance Galenism, see Fabrizio Bigotti, *Physiology of the Soul. Mind, Body, and Matter in the Galenic Tradition of the Late Renaissance (1550–1630)* (Turnout: Brepols, 2019), 33–48.

[2]For the use and context of *compositio* and *resolutio* in anatomy, see Domenico Laurenza, *La Ricerca dell'Armonia. Rappresentazioni Anatomiche nel Rinascimento* (Florence: Leo Olschiki, 2003), 30–2.

practices suggested by famous authors,[3] by mid-century, the publication by Andreas Vesalius (1514–64) of *De humani corporis fabrica* (1543) had introduced a rift between authority and empirical enquiry that challenged the possibility of relying on tradition at its very roots. While the challenge was not such to actually overthrow Galen, whose authority still provided the main theoretical framework within which anatomy was conducted, empiricism became the dominant approach. It was partially as a response to this, that authors such as Girolamo Capivacci (1523–89) came back to Aristotle and Galen, seeking to integrate logic and anatomical dissection more closely.[4]

From a more practical viewpoint, methods were also meant to provide medical trainees with the rudiments of logic required to recognise and cure diseases by grounding their diagnoses on general knowledge of anatomy and the peculiarities of the 'affected parts' (*loci affecti*). In this sense, the question of method, how to define and follow it, cut across a variety of fields and remained as lively a question as any other. However, as opposed to methods of treating diseases, which were available in different kinds and formats, anatomical method presented Renaissance physicians with a bit of a puzzle. The rediscovery of Galen's anatomical work (*Anatomicae administrationes*) proved somewhat of a disappointment for, although it provided first-hand testimony of Galen's discoveries and detailed anatomical observations, the text lacked that fully fledged method that Renaissance scholars were so eager to find.

For his part, Galen's take on method and on how logic could be used in medicine and natural philosophy to gain apodictic knowledge had been presented in the work 'On Demonstration' (*De demonstratione*), which has not survived.[5] As the scattered references to it in Galen's extant output did not provide a full picture of what his method was like, scholars and physicians were motivated to collate it from other sources, primarily Aristotle, but also Plato, Celsus, Pliny the Elder, Soranus as well as others. They found themselves in the condition that Galen had described with regard to the nature of medical knowledge: they had to restore a damaged house.[6] The analogy was meant to instruct physicians as to the necessity to approach the body *a posteriori*, by familiarising themselves with the single parts of it before considering their interconnection and dependence upon the faculties of the soul, and it was recurrent in the medical literature on method, both as a means to introduce the subject matter and to justify a departure from Galenic teachings. Indeed, lacking a direct reference in Galen, Renaissance anatomists were somewhat forced to 'restore' his method with different and often original contributions.

In this paper, I deal with one of these contributions, a newly discovered *Methodus anatomica* dictated by Girolamo Fabrici Da Acquapendente (1533–1619), which offers valuable insights on the private anatomical teachings offered at the University of Padua and on the development of anatomical method in the second half of the sixteenth century. Michael Stolberg, who first discovered and briefly described the manuscript, has rightly highlighted the necessity of a thorough assessment of its content, which I undertake here.[7] By offering a close reading of the manuscript, I argue that it provides new material to historians of method and medicine to reassess the development of the Galenic tradition in the Late Renaissance and the new directions this took. Most notably, I show that Acquapendente's method draws on contemporary philosophical discussions on the discretisation of continuous quantities and provides a kind of 'geometrical approach' to the body and its parts, although he eventually revised this to fall in line with a more traditional approach to anatomy as practised in Padua at the time.

Authorship, relevance and context

The manuscript bears the title 'METHODUS ANATOMICA D.[omini] Hieronymi Fa|bricii ab Aquapendente' and is kept at the Research Library in Gotha (Chart. A 629, ff. 221r–240v; Figure 1). It consists

[3]See Andres De Laguna, *Anatomica methodus seu de dissectione humani corporis contemplatio* (Paris: apud Lodovicum Cyaneum, 1535).

[4]Girolamo Capivacci, *De methodo anatomica liber* (Venice: apud Ioannem Baptistam Ciottum Sensem, 1593).

[5]For a reconstruction of the lost content and purpose of Galen's *De demonstratione*, see Matyaš Havrda, 'The purpose of Galen's Treatise "On Demonstration"', *Early Science and Medicine*, 20 (2015), 265–87.

[6]Galen, *De constitutione artis medicae*, K 230.

[7]Michael Stolberg, 'Learning Anatomy in Late Sixteenth-Century Padua', *History of Science,* 56, 4 (2018), 381–402.

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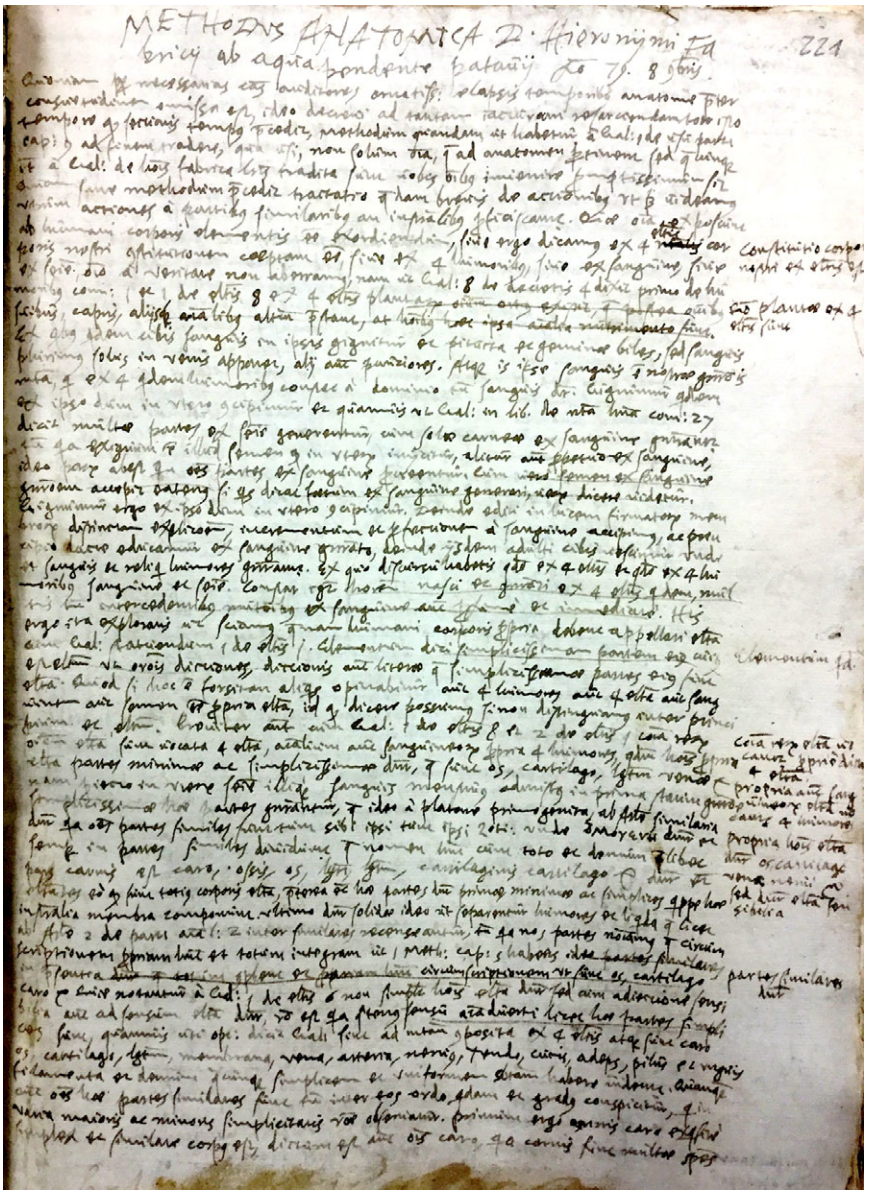

Figure 1. Mattenberg's manuscript of Acquapendente's *Methodus anatomica* – Gotha Research Library, Chart. A 629, f. 221r.

of twenty *folia* of dense Latin notes of Acquapendente's anatomical lectures taken by the German physician Johann Mattenberg (1550–1631) as a student of the *Natio Germanica* in Padua, from 8 November to 7 December 1579.[8]

[8]Johann (or Johannes) Mattenberg was born in Hann, Münden, on 26 May 1561 and died in Gotha on 6 June 1631. He first studied in Marburg (1568) and moved to Padua in 1578 where he graduated with Acquapendente the following year (31 August 1579). After serving for a short period as the personal physician of Henry IV in France, Mattenberg moved back to Germany and in 1586 he first was appointed town physician of Gotha where he was later elected mayor (1597) and inspector of the local Gymnasium; source NDB/ADB-online DbA I 812.71-74 (Mattenburg, Johannes).

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A celebrated physician and professor, during the late sixteenth and early seventeenth centuries Acquapendente was arguably the most important anatomical authority in Europe, second only to Vesalius. He started lecturing on anatomy in Padua in 1565 and retained that chair up to the end of his life, counting William Harvey (1578–1657) among his most famous pupils.[9] He published only late in his life, although then extensively, with his first work dating as late as 1600. His medical output stands out both in terms of quality and quantity, often providing first-hand observations on the comparative anatomy of sheep, fishes, birds and monkeys, with a distinctive interest in embryology. Of special importance for anatomy are his *Tabulae pictae*, being a collection of coloured plates – some engraved in the published works – which represent the best examples of their kind in the early modern period and one of the best atlases of the nervous system before 1700.[10] While not all the discoveries which he took credit for can always be ascribed to him with certainty, Acquapendente was most certainly responsible for their first dissemination in printing. This includes the description of the valves of the veins, related by Acquapendente in *De venarum ostiolis* (Padua 1600), which was later to play an instrumental role in Harvey's discovery of the circulation of the blood.[11]

Beyond the repute of the author, other elements make an analysis of the rediscovered *Methodus anatomica* particularly worthwhile. As Michael Stolberg has pointed out, a sixteenth-century anatomical manuscript can provide first-hand evidence as to what students could learn and handle during an anatomical dissection in Padua.[12] Hitherto, our knowledge has been based almost exclusively on indirect and contextual accounts found in the surviving documents of the *Natio Germanica*.[13] Moreover, the date of the manuscript (1579) and its differences from the latter anatomical treatises allow us to get a glimpse into Acquapendente's early teachings, otherwise unknown, thus representing an important contribution to the history of anatomical method *per se*.

As opposed to his published output, where Acquapendente is mostly concerned with showing how the connection between the different parts of the body follows a strictly teleological order (*actio* and *utilitas*), the early *methodus anatomica* sheds lights on the little-known details of the *historia*, meant as an ordered collection of anatomical observations, conceived in a Galenic, yet original fashion. More generally, the *methodus anatomica* dwells on the way to recognise, distinguish, name and classify the parts of the body in an order that could be easily graspable to students and would have enabled them to practice dissection for themselves.

Acquapendente's approach to *historia* before 1590

An example of the difference in approach between Acquapendente's *Methodus anatomica* and his latter writings is provided by the opening chapter of the *De visione, voce, auditu* (Venice 1600), wherein Acquapendente provides what has hitherto been considered his final word on anatomical method.

The chapter begins with the statement that the anatomy of the eye ought to start with the description of the dissected parts (*historia*), then moving to account for their function (*actio*) and

[9]See Antonio Favaro, 'L'Insegnamento Anatomico di Girolamo Fabrizio da Acquapendente', in *Monografie Storiche sullo Studio di Padova, Contributo del R.[egio] Istituto Veneto di Scienze, Lettere ed Arti alla Celebrazione del VII Centenario della Università* (Venice: Premiate Officine Grafiche C. Ferrari, 1922), 111.

[10]See Alessandro Riva, 'Priorità Anatomiche nelle *Tabulae Pictae*', in Maurizio Rippa Bonati and José Pardo Tomás (eds), *Il Teatro dei Corpi. Le Pitture Colorate di Anatomia di Girolamo Fabrici da Acquapendente* (Milan: MediaMed, 2001), 149 and Giorgio Zanchin and Raffaele De Caro, 'The Nervous System in Colours: The *Tabulae Pictae* of G.F. da Acquapendente (c. 1533–1619)', *Journal of Headache Pain*, 7 (2006), 360–6.

[11]William Harvey, *Exercitatio Anatomica de Motu Cordis et Sanguinis in Animalibus* (Frankfurt: William Fitzer, 1628), 21, 55. On the relation between Acquapendente and Harvey, see Stolberg, *op. cit.* (note 7), 394–7.

[12]Stolberg, *op. cit.* (note 7), 384.

[13]See, for example, Cynthia Klestinec, 'Civility, Comportment, and the Anatomy Theater: Girolamo Fabrici and His Medical Students in Renaissance Padua', *Renaissance Quarterly*, 60, 2 (2007), 434–63 and her monograph Cynthia Klestinec, *Theaters of Anatomy: Students, Teachers, and Traditions of Dissection in Renaissance Venice* (Baltimore: Johns Hopkins University Press, 2011).

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utility (*utilitas*).[14] The order of dissection is suggested by the parts themselves in their appearing to the sight, and thus 'from the without to the within' (*ab extra ad intus*). While seemingly abiding by this statement, Acquapendente ends up listing as 'apparent to the sight' also parts that are difficult to recognise as to their exact surface and position. This is the case with the tunics of the eye, whose number – Acquapendente acknowledges – ranges from seven to two depending on authors' classification. However, when presented with the possibility of explaining how and why the tunics can be numbered the way he does, Acquapendente fails to expound a method and only provides the reader with a sketch of his 'art' of dissecting the eye.[15]

As opposed to such an approach, the early Acquapendente had been more adventurous, regarding the problem of finding a method to guide the discovery and naming of the various parts of the body as something more than a skill in which to take pride. In this sense, the *Methodus anatomica* can be construed as an attempt to develop a method of inquiry whose focus rests less on physiology than on morphology. By presupposing the function and the organ as already known (f. 234v: *actione ergo organi per suppositione[m] perspecta et cognita*), Acquapendente seeks out a way to explore the qualitative (*colour* and *odour*), three-dimensional (*magnitude* and *position*) and geometrical features (*shape*, *number* and *connection*) of the body. In his commitment to making up for the absence of a Galenic method, the focus rests on how to 'restore the house' of anatomy by providing order to the findings of the *historia* before they are locked into the theoretical framework of the rigorous Aristotelian teleology of *actiones* and *utilitates*.[16]

Hardly the work of a logician, Acquapendente's contribution to the development of method was limited. The manuscript clearly lacks an overall unifying exposition coordinating the different arguments which renders it rather weak if compared to more organic attempts such as Capivacci's, grounded in a sound reading of Aristotle's *Analytics*.[17] However, the emphasis on *historia*, which occupies most of the manuscript, makes the work both original and important. The central issue for Acquapendente is the transition from tissues and cartilages to the organs, the apparatuses and the external limbs of the body, namely the way in which complex parts consist of, and can therefore be resolved into simpler ones. Overall, the issue seems to be framed from two different perspectives, to which in turn correspond different approaches: we may call one *spatial*, the other *formal*.

As to the 'spatial approach', Acquapendente first considers matter and how the body is generated out of it, with the four elements arranged by nature to give rise to temperaments, humours, tissues and cartilages, and then apparatuses, organs and limbs. The order of the exposition proceeds from the simplest to the most complex parts and thus from the smallest to the largest ones. Generation, however, only introduces a criterion of succession for, in keeping with an old Hippocratic classification, Acquapendente frames the relation between the various bodily structures *spatially* as the inclusion of 'content parts' into 'containing ones' (*contenta – continentia*). As an example, an organ like the leg contains other three parts, that is, femur, tibia and foot, and therefore is a fourth-order organ (f. 221v). The same, as we shall see later, applies to the hand.

[14]On the role of *actio* and *utilitas* in Acquapendente, see Nancy G. Siraisi, '*Historia, Actio, Utilitas*: Fabrici e le scienze della vita nel Cinquecento', 63–73, trans. Laura Zanella in Rippa Bonati and Pardo Tomás (eds), *op. cit.* (note 10), 65–6.

[15]Girolamo Fabrici da Acquapendente, *De Visione, Voce, Auditu* (Venice: Francesco Bolzetta, 1600), *De oculo visionis organo*, ch. X, ff. 15–16.

[16]On the medical uses of *historia* and its wider methodological implications, see Ian Maclean, 'White Crows, Greying Hair and Eyelashes: Problems for Natural Historians in the Reception of Aristotelian Logic and Biology, from Pomponazzi to Bacon' in Gianna Pomata and Nancy G. Siraisi (eds), *Historia. Empiricism and Erudition in Early Modern Europe* (Cambridge: The MIT Press, 2005), 147–80.

[17]On Capivacci's method, see William Wallace, 'Circularity and the Paduan *Regressus*: From Pietro D'Abano to Galileo Galilei', *Vivarium*, 33, 1 (1995), 85, 89; Simone Mammola, *La Ragione e L'Incertezza. Filosofia e Medicina nella Prima Età Moderna* (Milan: FrancoAngeli Editore, 2012), 155–61 and Fabrizio Bigotti, 'Beyond Galen: Image, Geometry and Anatomy from Vesalius to Santorio' in Antoine Pietrobelli (ed), *Contre Galien. Critiques d'une Autorité Médicale de l'Antiquité à l'Âge Moderne* (Paris: Honore Champions, 2020), 254–5.

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The 'formal approach' takes on the spatial one and clarifies it. The relation between the contained and containing parts is considered from the viewpoint of the Aristotelian rapport of matter and form, seeking to clarify how complex parts that are provided with both shape and function can be generated out of elements that are shapeless or 'homogeneous'. In an original and interesting move, Acquapendente comes to identify *matter* with a continuous quantity while *form* is treated as a discrete quantity. As the question hinges on a very complex philosophical issue, it makes sense to consider it separately in more detail.

Matter and generation: the question of *dimensiones indeterminatae*

Most sixteenth-century natural philosophers who expounded on Aristotle's work conceived of the rapport between matter and form in terms of *potentiality* and *actuality*, that is, the possibility for one thing to become what it should be while it is not yet it. This way of framing matter and form becomes handy when conceptualising change. When something transitions from one condition to another (eg. from cold to hot, from here to there etc.), it is clear that it had 'the capacity of becoming' (δύναμις, *potentia*, *capacitas*) what previously it was not. In this sense, then, the state towards which something is changing is a positive state while the potentiality of reaching that state is considered a negative state (ie. a '*not-yet* state'). Hence, matter and form relate to each other as the privation and the acquisition of a particular property (x), and their rapport can be rendered logically as one of negation ($\neg$ Ax) and affirmation (Ax). An example which Aristotelian philosophers turned to many times was that of a lead sphere, lead being the matter which has the potentiality to become a sphere once moulded by the artisan, while another would be the body in its being shaped through different stages, from the undefined matter of the embryo to the fully shaped human being.

As Aristotle himself had made clear, however, this way of conceiving the rapport between matter and form is *inductive*, that is, can be clarified by examples but not quantified, for there is never a moment when, properly speaking, 'potency' develops into an 'actuality'.[18] Potentiality and actuality were co-essential to the Aristotelian conception of matter as a primordial, homogeneous and continuous substrate (*materia prima*), one in which all parts are defined by an identical property. As an example, the physical division of a leaden body into smaller parts always results in like-parted bodies of the same material and texture.[19] Furthermore, as obtained by subdividing a single body, each subpart shares with the next one or more surfaces and is therefore continuous with it.

Much as it holds on a philosophical level, troubles start as soon as we have to apply this theory to explain transformation in more detail. In that case, it becomes clear that when something is transformed into something else, the transformation takes place within a given time and entails a quantitative proportion between what is transformed and the transformation's final product. A case in point is the distillation of water. When an element like water is transformed into air (ie. water steam), the quantity of air resulting out of water is in a proportion of 1–10, which means that in a single unit of water there are potentially contained ten units of air. Considered this way, matter must be a quantifiable substratum for otherwise the transformation of water into air would give a different result each time. But then again, the thesis that matter is quantifiable is at odds with its definition as an undefined and continuous substratum. One way of framing the issue was to consider matter as potentially quantified, that is as provided with certain quantitative characteristics still undefined, such as magnitude or being a

[18]The reason why categories such as *potency* and *actuality* are not discrete states and cannot lead to quantification is that they define 'process' not motion, whereby change is conceptualised in the former case as a continuity and in the latter as the progressive addition of units. As such, at any given time of the process, the *potentiality* of being something next in the order of becoming is already *the act* of the states that has preceded, see Aristotle, *Metaphysics*, IX. 6, 1048b, 18–25 and XI. 9, 1066a, 10–25.

[19]On physical division in Aristotle and the concept of like-partedness, see Brad Berman, 'Aristotle on Like-Partedness and the Like-Parted Bodies', *Early Science and Medicine*, 20, 1 (2015), 27–47.

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three-dimensional body of indefinite extension and shape.[20] Partly in rejection of Aristotle's claims, this solution was developed and applied by the medieval philosopher John Philoponus (490–570 AD). Philoponus conceived of a prime matter as a three-dimensional body of undefined extension, out of which extended matter could be generated by division. Once divided, parts of matter are spatially delimited and thus no longer continuous with each other. The causal agent bringing about the division is the form (*forma*) that confines matter, therefore defining it as a discrete quantity to which is associated one or more properties in the perceived world. As a consequence of this, the world consists of qualities that are generated as part of an 'information process' wherein matter is first in-formed then spatially located and quantified in an order of increasing complexity stretching from the elements up to living beings.

Both in contrast and in keeping with Philoponus' solution, this way of framing the problem of the generation of matter was refined in medieval philosophy as the 'question of undefined dimensions' (*Quaestio de dimensionibus indeterminatis*). In sixteenth-century Padua, it was reawoken by Acquapendente's colleague Jacopo Zabarella (1533–89), probably the most important logician of the sixteenth century, who collected the lecture notes he held on such topics from 1577 to 1589 in a work called *De naturalibus rebus libri XXX* that was published after his death.[21] As we shall see, Zabarella seems to have exerted a considerable influence on Acquapendente both in terms of how the latter set the question of undefined dimensions in anatomy and how he eventually turned away from it.

Uses of spatialisation and quantity in Venetian medicine and natural philosophy

One reason why the debate on undefined dimensions took off again in importance at the end of the sixteenth century is that it seemed to make sense of several issues with which natural philosophers and physicians were then grappling. The sixteenth century was an intensely experimental epoch, and nowhere more so than in Venice, where a thriving economy and a dynamic society attracted philosophers' attention to how substances such as spices or glass could be mixed and transformed so as to create vital remedies and precious commodities. By the same token in medicine, the body started being seen as an aggregate of parts. Limbs yielded to pieces and the most important question physicians could ask about the body was not how it mirrored the divine wisdom, but how parts worked together in order to generate life. In this setting, the possibility of looking at matter as always potentially quantified opened up the possibility of looking at material transformations from an experimental angle. This meant conceiving the emergence of new properties 'spatially', as the changing position of 'little bodies' (*corpuscula*), a solution that was upheld by some of the most important acquaintances of Acquapendente in Venice, first and foremost Paolo Sarpi (1552–1623) and then Santorio Santori (1561–1636) and Galileo Galilei (1564–1642).[22] In medicine, it suggested a new way to explain how nature shaped the body out of elements and humours, a body which

[20]For an introduction to the problem of the *dimensiones indeterminatae*, see Silvia Donati, 'The Notion of *Dimensiones indeterminatae* in the Commentary Tradition of the *Physics* in the Thirteenth and in the Early Fourteenth Century' in Cees Leijenhorst, Christoph Lüthy, Johannes M.M.H. Thijssen (eds), *The Dynamics of Aristotelian Natural Philosophy from Antiquity to the Seventeenth Century* (Leiden: Brill, 2012), 189–92; for the development of the question in Philoponus, see Frans A. J. De Haas, *John Philoponus' New Definition of Prima Matter. Aspects of Its Background in Neoplatonism and the Ancient Commentary Tradition* (Leiden: Brill, 1997).

[21]Jacopo Zabarella, *De Naturalibus Rebus libri XXX* (Venice, Paolo Meietto, 1590), *De Prima Rerum Materia*, Bk II, Chs 6–21, ff. 129–58.

[22]On the impact of the *dimensiones indeterminatae* on the Venetian circle of Sarpi, see Fabrizio Bigotti, *Gears of an Inner Clock. Santorio's Theory of Qualities and Its Applications* in Jonathan Barry and Fabrizio Bigotti (eds), *Santorio Santori and the Emergence of Quantified Medicine. Corpuscularianism, Experimentation and Technology (1614–1790)* (London: Palgrave MacMillan and Springer, 2021), forthcoming.

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Table 1. Acquapendente's classification of the parts of the human body in the *Methodus anatomica* (1579)

Name	Species	Features	Corresponding parts of the body
Homogeneous parts (*partes similares* and *homogenea*)	Simple (= *homogenea simplicia*)	Shapeless Like-parted Fluid/solid	Flesh, cartilage and bones
	*Instrumental parts (= *homogenea mixta*)	Provided with a 'delimiting surface' (*circumscriptionem propriam habent*)	Tongue, nerves, veins, arteries and lens in the eye
Non-homogeneous parts (*partes dissimilares*)	*Instrumental parts (*partes instrumentales*)	Shape	Tongue, nerves, veins, arteries and lens in the eye
	Organic (*partes organicae*)	Shape Number Position Magnitude Place Function	any of the above mentioned instrumental parts, depending on their shape and relation to each other
Organs (*ogana* and *instrumenta*)		Shape Number Position Magnitude Place Function Utility (finality)	Hand, eye, leg and so on

could now be conceived as an interlocked series of parts with the simplest contained in the more complex whereby the latter were generated out of the former by separation, much like the knife of the anatomist performing a dissection on the anatomy table.[23]

Acquapendente borrows from this debate to frame what we have called his *formal approach* to the question of how complex parts are generated out of simple ones in terms of matter and form. In general, he acknowledges three different kind of parts: *homogeneous*, *non-homogeneous* and *organs* (Table 1).

Homogeneous parts (*partes similares*) are those which are not provided with a shape (*figura*) of their own and can be divided into elements of the same kind and property, being continuous to each other. These can be either fluid or solid, and can be classified according to their being more or less complex, for example, while humours and temperaments are simpler, cartilage and flesh are more complex. Partly homogeneous and partly non-homogeneous are those which Acquapendente calls 'instrumental parts' (*partes instrumentales*), a case in point being the lens in the eye. All in all, he admits no clear distinction between them, listing the same parts once under homogeneous parts and again under instrumental parts, because their classification depends on whether or not the anatomist recognises a particular part as provided with shape (f. 222v). Non-homogeneous parts (*partes dissimilares*) are those which are provided with their own shape (*figura*), and thus cannot be divided into subparts without losing their specific arrangement (f. 222r). These can be defined by shape only, like the lens in the eye, or can be 'organic parts' (*partes organicae*) which are provided with a specific position in the body and are connected in a particular way to others. Finally, there are organs (*organa*), such as the liver, the eye or the leg, that are fully functional and instrumental to the preservation of the body as a whole.

[23]On anatomical dissection as an act of seeing, see Rafael Mandressi, 'Dividere per conoscere. La "parte" come concetto nel pensiero anatomico di età moderna', in Giuseppe Olmi and Claudia Pancino (eds), *Anatome: sezione, scomposizione e raffigurazione del corpo nell'età moderna* (Bologna: Bononia University Press, 2012), 117–36.

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An important aspect that helps to differentiate between homogeneous and non-homogeneous parts is 'shape' (*figura*), for it spatially confines the homogeneous parts within an 'outline' or 'delimiting surface' (*circumscriptio*). Depending on its complexity, the 'delimiting surface' may provide instrumental parts also with a specific 'position' (*situs*) within the body, so as to better distinguish them from other instrumental ones, and with 'number' (*numerus*) as in the case of veins or arteries. It is by virtue of these spatial features that Acquapendente claims that instrumental parts are related to homogeneous ones as discrete quantities are to continuous ones. He comes back to the definition of matter as a quantifiable yet numerically undefined substratum, which he likens to the property of being extended or 'magnitude' (*magnitudo*). This is a property co-eternal to prime matter, so that when the form comes to confine it within prescribed limits, 'a determined quantity is generated' (f. 228v: *cui adveniens forma fit quantitas determinata*). By 'determined quantity', Acquapendente means that, being moulded into a form, the part is now numerically distinct from the original homogeneous substrate. Rather than to Philoponus, however, he attributes the identity of prime matter and magnitude to Galen himself, for according to him Galen had defended the view that quantifying something means locating it as a spatially distinct unity, so that 'every time matter is spatially located, it is also quantified' (f. 231v). Acquapendente goes on applying this conception to the whole body in an effort to explain how non-homogeneous parts and organs are generated out of simple humours and temperaments. This comes about by 'confinement'. In fact, just as the advent of a shape (*figura*) segregates the infinite number of units potentially contained in the prime matter as continuous to each other, and in so doing extracts out of matter properties such as *number*, *magnitude* and *connection*, so in the body it marks the passage from homogeneous to non-homogeneous parts (229r: *<r[espondetur]> o[mn]em partem similare [m] reddit dissimilare[m] potiss[imum] et maxime p[er] figuram*).

Once shaped, non-homogeneous parts become discrete and visible, and can be identified by their 'position', 'number', 'connection' and 'magnitude', so that each part locks into the other according to the order of contained and containing parts. An important question to which I shall return later is to what extent, if any, this way of conceiving the succession of parts impacts on the order of dissection, and thus on the visualisation of the body and its rendering as an image.

We have now sufficient background to focus on the structure and content of the manuscript.

Structure and content of the manuscript

In terms of structure, the manuscript can be divided into three seemingly homogeneous sections, not marked as such in the manuscript. These are:

I. Introductory section (ff. 221r–226v);
II. Exposition of the method itself (ff. 226v–237v);
III. Practical application of the method to the anatomy of the spleen (ff. 237v–239r).

The first two sections can be further subdivided each into two subsections, the former dealing with morphology and the latter with physiology proper. If Sections I and II offer similar arguments with regard to the nature of temperaments and humours, the second occurrence usually deepens or clarifies the previous one. To avoid overburdening the analysis of the manuscript, repetitions will be discussed below only when strictly relevant.

I. Introductory part (ff. 221r-226v: *Quoniam p[ro]p[ter] necessarias causas…. et ult[imum] venas is admittere p[ro] cerebri nutritione*). Acquapendente begins by declaring the circumstances which moved him to provide his students with a method, due to an unusual interruption of anatomical teachings.[24] In its essence, the method provides an elucidation of Galen's *De usu partium* I.9 and is intended as a guide to the whole of anatomy. Considering the conditions of natural generation at

[24]This was due to adverse weather conditions (*temporum inclementia*) and to delays or controversies in appointing the assistants to the anatomy (*massari*); see Favaro, *op. cit.* (note 9), 112–13.

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large – including those of plants and animals, alongside their interdependence in the food chain – Acquapendente defends the view that blood is the most fundamental of the four humours and the ultimate matter of generation. Generation is introduced to discuss the parts of the body that come to being 'first' (*primae*), and are therefore also 'minimal' (*minimae*), and 'simple' (*simplices*). As presented in this context, generation stands as the process wherein what is first in terms of 'appearance' is the last in terms of complexity and perfection. Furthermore, the order in which bodily parts appear can be considered in two directions. A first direction follows the order of generation and occurs when simple parts are seen as 'components' of complex structures, thus leading to increasing complexity. An example of this are flesh, bones and cartilages which become 'components' of organs, limbs and articulations. A second direction, which may be called 'analysis or dissolution',[25] follows the reverse process in which complex structures are dissolved into their elemental ones. The first parts to be generated (*primae*) are so differentiated into 'solid' (*solidae*) and 'liquid' (*liquidae*). They are both 'homogeneous' (*similares*), an example being the cartilage, each part of which is composed of the same material as the whole. Solid parts, however, are defined by their specific outline or 'delimiting surface' (*circumscriptionem propriam habent*) and thus are not properly conceivable as purely homogeneous: an example Acquapendente comes back to many times is the lens in the eye. This distinction between two types of homogeneous bodies recovers tacitly – as Acquapendente never actually expands on it – the medieval classification of *homogenea* into *simplicia* and *mixta,* and will play an important role later on, when Acquapendente will introduce a criterion to distinguish between simple and complex parts on the basis of their position and shape. *Circumscriptio* is also a term deserving attention in this context. It mimics the Greek περίγραφη, and Acquapendente borrows it directly from the opening chapter of Galen's *De usu partium*, where the term points to the fact that both the organs individually and the body as a whole are defined by a delimiting surface.

In this context, Acquapendente introduces an analogy closely associated with the Galenic one: not unlike those who are building a house, doctors need to know these very parts beforehand in order to be able to understand the organism. The quote serves as a reminder that the discussion about homogeneous and non-homogeneous parts belongs to the *historia* which, accordingly, proceeds by introducing Galen's classification of homogeneous parts into four orders of increasing complexity (221v).

The anatomy of the leg and the hand offer an example of how such a classification works. In dissecting the leg, we find that it contains three parts, that is, femur, tibia and foot. Being a 'containing organ', the leg is classified as a fourth-order organ. Similarly, the hand is 'a fourth-order organ', in that it contains and can be divided into three parts, that is, arm, elbow and the upper part of the hand. The criterion to be followed in discriminating the order of each part is the formal inclusion of simple organs into more complex ones. As such, the greater the number of parts an organ is composed of, the greater its fitness (*perfectio*) in implementing the function for which it was intended.

It is important to highlight that, already at this stage, Acquapendente is singling out elements of Galenic thought that are most suited to his anatomical method which consists in approaching the body from the standpoint of the spatial and geometrical arrangement of its parts. When actually mentioned, the teleological element of function (*actio*) is introduced only to justify the correspondence between the number of parts in the organ and the complexity of the task being fulfilled. Movement (*motus*) is accordingly stressed as the most important element discriminating between perfect and imperfect organs: those allowing for a motion to be carried out within themselves are accordingly considered as the fittest to their task. Surprisingly for a modern reader – yet consistent with an overall Aristotelian framework – Acquapendente outlines that the number of parts implied by a function relates to evidence, making clearer (*clarius*) the goal each part was intended for. The function being equal, in fact, a greater number of parts implies that each is assigned with a limited set of tasks, which makes them recognisable and clearly distinct from each other. In turn, more specialised functions imply more specific forms of life (eg. animals and humans). Conversely, functions like nutrition and reproduction, which are shared across a variety of different species, require fewer organs allowing less distinction between them, thus

[25]As introduced in f. 221v by the words 'Quod si notitia huiusq[ue] rei velitis dissolvatis totum organum in suas partes'.

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making the process of understanding how they operate comparatively more difficult. This is indeed the case with plants, whose vegetative soul operates with fewer instruments making the process of recognising their function obscure (f. 222r: *obscurior*).

The discussion then moves to the criteria distinguishing between homogeneous and instrumental parts. These are number (*numerus*), shape (*figura*), magnitude (*magnitudo*) and position (*situs*). Acquapendente extends the application of these criteria to the homogeneous parts with a reference to Galen (*De sanitate tuenda* I.1, I.4). And yet, this move stands in opposition to the traditional understanding of what Galen does in *De usu partium.* As seen, Acquapendente classifies the instrumental parts apart from the homogeneous ones, because they have an outline of their own. Again, the lens in the eye is a case in point. If we consider its substance (ie. material texture), then the lens must be classified as a homogeneous part (*pars similaris*), yet, insofar as it is provided with a shape and a magnitude of its own, it must be considered as an instrumental part. Hence, Acquapendente classifies as 'organic parts' (*partes organicae*) those which medieval scholars had called 'mixed homogeneous' (*homogenea mixta*) which compels him to introduce a third-order classification, identified in the 'organ'. This innovation is introduced despite Acquapendente being fully cognizant of the fact that Galen himself never clearly distinguished between 'organic parts' and 'organs'.

The distinction between organic parts and organs concludes the subsection of the *Methodus* dealing with 'the order and degree by means of which parts differ from each other' and the physiological subsection begins. Acquapendente considers now how functions (*actiones* and *functiones*) are carried out by each organ. Like the previous one, this section introduces important innovations with regard to Galen's doctrines. For instance, the action carried out by an organ is assumed by Acquapendente as provided with a double finality, one *internal*, arising from the temperamental make-up of the organ, the other *external*, coinciding with instrumental use of it for the whole economy of the body. An example is introduced to explain how functions are 'finalised' in the former sense, namely to their temperaments, in what appears to be an inversion of a more traditional Aristotelian teleology. Relying on Galen, Acquapendente explains that the liver attracts blood, not for the sake of the preservation of the organism as such, but because this is the task which 'necessarily' results from its temperamental make-up. As a result, the more blood is attracted by the liver the more of it will remain at the disposal of the organism for it to be nourished. Finality is thus inverted, and bodily actions are due primarily to the temperamental make-up of the bodily organs and only secondarily with a view to the conservation of the organism. Acquapendente would later comment (Section II, f. 232v) that this way of conceiving finalism is useful to explain certain actions of the body which are apparently unrelated to any direct purpose. This is the case with the stomach, which keeps attracting food even when the animal has nothing to feed up, but stops doing so, although the animal keeps eating, as soon as the body suffers from an illness.

II. Exposition of the method (ff. 226v–237v: *Haec ergo dicta sint de partib[us] similarib[us] et dissimilarib[us]…iecur sic calidum et humidum excedat in caliditate et humiditate*). All the topics that have already been presented in Section I are summarised again, if under more general headings. Bodily parts are now seen as a composition of matter and form.

To know the body, we have to know its elemental parts and, to that end, we must consider temperaments along with the external and internal parts (*secundum partes exteriores et interiores*). The external parts are those which offer themselves first to the eye and are delimited by their surface (*corporis superficies*). Internal parts, conversely, are those which Hippocrates categorised as 'content', 'containing' and 'moving parts' (*contenta, continentia et impetum facientia*). Temperaments, on the other hand, consist of a specific blending of primary qualities, whose degree is unknowable to us directly but is appreciable by means of its effects on things and thus by the senses. Although the exact degree of blending of first qualities is a prerogative of God alone to know, temperaments are the substance of the body out of which all other properties emerge.[26]

[26]Among these very properties, there are position, magnitude, connection and formation which, as seen, also play out as criteria to discriminate between homogeneous and instrumental parts. Compared to the list provided in Section I

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The emergence of these properties from the temperaments poses a problem as to how matter and form relate to each other. In an original move, Acquapendente frames the relation between matter and form as part of the greater problem of how continuous quantities relate to discrete ones. Matter is considered by Acquapendente as a homogeneous substratum whose parts are different in number but not in quality. Temperaments reflect the definition of homogeneous substrate in that each part of them is qualified by the same quality and degree of intensity and are thus seen as continuous quantities. Instrumental parts, on the other hand, are provided with a form, and thus they are regarded as discrete quantities defined by characteristics such as *magnitude*, *number*, *position* and *shape*. In this sense, the way in which instrumental parts originate from the homogeneous ones mirrors that in which discrete quantities originate from continuous ones.

While homogeneous parts *per se* are shapeless, the intervention of form in the corporeal substratum can either add *shape only*, in which case parts are called 'organic' or 'instrumental' (*organikon*), or also *number*, *position* and *connection*, in which case the parts are called 'organs' (*organa*). As to the notable aspects (*differentiae*) pertaining to non-homogeneous parts, these are either apparent or can be inferred from an impairment of function. Acquapendente ascribes the capacity to mould matter according to *shape*, *number*, *position* and *magnitude* to a 'modelling faculty' (*facultas formatrix*) endowed with a special kind of knowledge, unconscious and different from the human mind, but equally wise (ff. 230r–v).

Among the essential properties pertaining to instrumental parts, 'position' occupies the first place. Hence, in analysing the internal parts of the body, we ought to consider their order, that is, whether they are up or down, left or right and within or without. The entire set of these positions, however, can be reduced to the *within* and the *without*.

The second important difference is 'magnitude', which consists of width (*latitudo*), length (*longitudo*) and depth (*profunditas*) of the organ, as is clear when considering the case of the leg.

The final difference, which includes number as a subcategory, is 'formation' or 'figure' (*formatio sive figura*), which includes interstices, roughness and other such characteristics pertaining to shape. Summing up all the foregoing, and again in direct reference to the question of the *dimensiones indeterminatae*, Acquapendente remarks that it is by looking at these discrete quantities that we will be able to recognise the main features of organic bodies and to distinguish them from their connections to other apparatuses and organs (f. 231v). Indeed, by recognising that a certain colour, or asperity, is in this or that position, in this or that number of parts and so on, we will be able not only to distinguish the main organs but also whether they are healthy or not. Should these differences not to be enough to draw a clear conclusion as to the characteristics of the organ, we shall then move to inquire into the impaired actions and determine the essence of the organ not according to its shape but according to its function. Function (*actio*) and utility (*utilitas*), Acquapendente declares, will always rank among the most fundamental criteria of analysis in anatomy, for they must be presupposed and foreknown in order to inquire into the shape and nature of the organs. Most importantly, a distinction between the entire organ and the part of it out of which the function of the organ arises is introduced; in the eye, for instance, the specific part responsible for vision is the optical nerve. Although many examples are offered as to how to recognise and define the various utilities and movements corresponding to each organ, this aspect of the method remains substantially faithful to Acquapendente's position as later expressed in the *De visione, voce et auditu* as well as in other printed works.

III. Practical application of the method (ff. 237v-239r: *Methodi iam p[ro]positae declaratio ex[em]plo lienis facta…Finis*). Acquapendente declares that he would have preferred the head as a case for the application of the method, but this dissection would have required several days and many parts to analyse; in comparison, the spleen stands as a simpler and more practical organ to dissect. Contrary to

(ie. magnitude, number, form and position), this might appear as an odd set of properties, but Acquapendente himself will later note that 'formation' is synonymous with 'form', while 'connection' at times either disappears from the list or is replaced by 'number', insofar as the connections among the organs are regarded as an aspect of 'number'.

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what was claimed in Section II, where position is named as the first criterion to be evaluated, the analysis starts with the number of parts of the spleen (ie. arterial vein, nerve, the membranes of the peritoneum and the membranous nexus), and then it moves to consider its function (*actio*). This consists in attracting, by virtue of its 'prevailing temperament' (*temperamentum per exuperantiam*), the melancholic humour of the body, as the magnet does. The specific part responsible for carrying out this action is its black and lax flesh, which cannot be found anywhere else in the body. This part, in turn, features characteristics which must be properly investigated; these are its prevailing temperament, texture (*caro rara et mollis*) and weight (*caro gravis*). The analysis moves to illustrate the *utilities* of the various parts of the spleen and then to consider the distinctive properties of each and the organ as a whole. Being shared between the organ and its constituent parts, features such as *position*, *magnitude* and *number* are dealt with a view to their overall utility. The fact that the spleen is placed in the left-hand position, for instance, is useful to balance the entire body – as a single organ, it is placed in its weakest part – and is located under the diaphragm in order to send out to the stomach its acidic humour which stimulates the appetite. Its shape is oblong in order not to compress the other parts. The analysis ends with a suggestion to apply the method and to integrate it with readings of Vesalius (*Epitome*?), Colombo (*De re anatomica*) and Falloppia (*Observationes anatomicae*).

Visualisation, quantification and the use of new form of finalism

As it emerges, Acquapendente's approach singles out those features that help the physician in cutting the body from the without to the within, following the reverse path taken by nature in generating and then connecting the different parts.

Most notably, three elements emerge as central in the analysis of the *Methodus anatomica*:

1) An emphasis on morphology (ie. as the study of the necessary relation between organs' shape and function) consisting in an attempt to expand Galen's anatomical classifications into an extensional order of content-and-containing organs;
2) A distinction between homogeneous and instrumental parts operated on the basis of the contemporary debate on the discretisation of continuous quantities;
3) The use and enhancement of an 'inverted finalism', whereby the actions proper of each organ are determined not only by their utility for the organism but primarily by their temperamental make-up.

The first element (1) crops up repeatedly in the *Methodus*, particularly in the introductory section, wherein Acquapendente establishes a direct correlation between the complexity of a function and the plurality of bodily instruments required to implement it. Significantly, he uses clarity and distinction as a physiological discriminant: the more complex the function is, the greater the number of instruments that will be required to implement it, so that each is assigned with a specific and distinct task, making the process of recognition simpler and clearer. Such an approach is in line with the then common Aristotelian doctrine according to which nature groups different functions in the same organ only when hindered in its aim to assign each organ with a clear and different task.[27] In this sense, Acquapendente emphasises the need to distinguish and number the organ's constituent parts, in order to ascertain whether a certain function that has been presupposed in theory can actually be implemented and, if so, how well. This latter claim goes hand in hand with an attempt to ground the appearance of instrumental parts in the contemporary discussion on *undefined dimensions* (*dimensiones indeterminatae*), which represents the core argument of element (2), expounded at some length in the previous section.

The use of an 'inverted finalism' (3) adds a final touch of novelty to the *Methodus*, which in this regard borrows from the contemporary discussion of Galen's psychology, especially to the causal connection between temperaments and the faculties of the soul. Francesco Piccolomini (1523–1607) had discussed

[27] Aristotle, *De partibus animalium*, IV.6. 683a, 22–5.

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this relationship in his *Universa philosophia de moribus* (1575) and Cesare Cremonini (1550–1631) devoted several lectures to the topic of the 'internal finalism' (*finis gratia cuius*), later included in the manuscript *Quaestio utrum animi mores corporis temperamenta sequantur* (ante 1600).[28] In a nutshell, 'internal' or 'inverted finalism' was a specific development of Galen's thesis according to which functions and faculties of the soul emerged not as a need of the organs to which they would pertain but directly from the temperaments. As opposed to Aristotle's stance, whereby an inner potentiality drives simple parts to develop into more complex ones, Galen's finalism – at least as perceived in the late sixteenth century – entails that the functions are determined by their material substratum alone, with the consequent abandonment of the very category of potentiality, in Galen as well as *a fortiori* in the tradition drawing from his teachings.[29] Developing out of necessity, rather than according to a purpose, functions serve an inner finality which is 'inverted' with respect to the Aristotelian one, but also, significantly, stronger. Acquapendente retains both forms of finalism, and yet, by focusing on the temperamental composition of the organs rather than simply on their supposed finality and utility, he puts a greater emphasis on how parts are presented to the eye during a dissection, with temperaments that are scrutinised by the anatomist as a specific aspect of the internal organisation of the body.

These elements altogether help characterise the novelty of Acquapendente's approach to *historia*, as a means to order the sensory data provided by anatomy, which makes Acquapendente's method both unusual and important.[30] Most notably, the *Methodus anatomica* bears witness to a trend towards a progressive geometrisation of the body which had started with Vesalius and was developed strongly by his epigones in Padua.[31] This trend consisted in providing a theoretical and practical foundation for anatomy, relatively independent from *a priori* deductions and, accordingly, from large philosophical commitments. It was not a move away from Galen but an attempt to beat him at his own game, by bringing into relief those elements of his anatomical procedures which, assisted by new and advanced engraving techniques,[32] could help to establish anatomy as an autonomous field of study. Vesalius had originated this trend with his *Fabrica*, which dealt with the close inspection of the pieces and fragments of the body and in which no engravings of the entire human body were ever included.[33] This was perceived already by Vesalius' contemporaries as a decisive turn away from 'synthesis' (*compositio*) as the integrated study of anatomy and physiology, towards 'analysis' (*resolutio*) meaning the progressive dismembering of the human body for the sake of its naked-eye inspection (*historia*).[34] If still important as a theoretical framework able to reconnect the different parts of the body that the knife had separated, the impact of synthesis was now limited in scope and relevance to that of a necessary presupposition (*actio autem supposita/perspecta*). Such an approach, of course, required the development of specific methodological tools so as to deal with the parts themselves. By classifying the organs according to their *position*, *shape*, *number* and *magnitude*, Galen had provided some of these instruments to his followers, but they needed to further refine them, if the aim was eventually to overcome Galen's authority. Documents such as those of Acquapendente gives us a glimpse as to how this 'overcoming project' worked in detail, and how it led to a progressive geometrisation of the body. More complex is to understand if and how this move affected the anatomical rendering of the body in print. As he published only late in his life, sources documenting Acquapendente's early approach to method are difficult to find. The *Tabulae pictae*, which Acquapendente started collecting as early as 1590 and largely kept for his

[28]See Bigotti, *op. cit.* (note 1), 57–8, 189–211.

[29]*Ibid.*, 55.

[30]On the medical uses of *historia* and its wider methodological implications see Ian Maclean, 'White Crows, Greying Hair and Eyelashes: Problems for Natural Historians in the Reception of Aristotelian Logic and Biology, from Pomponazzi to Bacon' in Gianna Pomata and Nancy G. Siraisi (eds), *Historia. Empiricism and Erudition in Early Modern Europe* (Cambridge: The MIT Press, 2005), 147–180.

[31]See Bigotti, *op. cit.* (note 1), 244ff.

[32]On which see Akiko Kusakawa, *Picturing the Book of Nature: Image, Text, and Argument in Sixteenth-Century Human Anatomy and Medical Botany* (Chicago, University of Chicago Press, 2011).

[33]Laurenza, *op. cit.* (note 2), 82–92, 101–113.

[34]Bigotti, *op. cit.* (note 1), 41.

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private teaching, may well represent a reliable document in this sense. Indeed, not all the *tabulae* were engraved as anatomical plates in the latter works, and the selection operated with respect to this early material may reflect a shift in the overall epistemic approach. A case in point is again that of the anatomy of the eye, which in the extant *tabulae* is covered by six large drawings (BNM, Rari 111.07, 120.01-05) against only four in the printed work (*De visione*, ff. 29, 31, 33, 35). While three engravings in the *De visione* are the same as the corresponding *tabulae* (Rari 120.02 = *De visione* f. 31; Rari 120.03 = *De visione*, f. 33; Rari, 120.4 = *De visione*, f. 29, no. 2), the representation of the eye changes dramatically in the remaining three.

In the printed work, Acquapendente follows a strictly analytical order of dissection, from the external structure to its constituent parts (Figure 2), while in the *tabulae*, the dissection dwells on the minute details of the eye, with the entire organ positioned in the second row and numbered as fifth with regard to other parts (Figure 3). Interestingly enough, the figure of the head used by Acquapendente in the *De visione* (f. 29r) and numbered as 2 belongs to a completely different group of *tabulae*, which is concerned with the anatomy of the head's bones (Rari 111).

The reason for such a shift becomes clear by reading it against the teachings exposed in the *Methodus anatomica.* In dissecting the eye (Figure 3), we ought to start from without to within, and thus the eye itself comes first (1). As a 'containing organ', the eye is divided into all its 'contained parts' (2–4), and only when the containing-contained series of parts is exhausted, does Acquapendente go on to show how the eye is 'connected' to the surrounding structures (5 and 6). Connection is thus followed by 'position', and the eye is isolated from its natural place and exposed in all directions of the Aristotelian space, that is, front and rear, up and down and left and right (Rari 120.02; Figure 4). Then, the visualisation of the other parts and their corresponding number is the same as in *De visione* up to the dissection of the lens of the eye.

The *Methodus anatomica* in the context of post-Vesalian anatomy

Projected in the framework of post-Vesalian anatomy and especially compared to more traditional approaches to Galen's anatomy, the above-mentioned elements define Acquapendente's *Methodus anatomica* as an original endeavour, whose novelty did not escape the notice of contemporary physicians.[35]

A letter by Jacob Zwinger (1569–1610) to Gaspard Bauhin (1560–1624) dated Padua 31 December 1592 testifies to the admiration (*cum admiratione*) which students and onlookers felt for Acquapendente's anatomical demonstration and his way of explaining the movements of the muscles of the eye (*palpebrarum motus*) as a result of its shape.[36] Commonly – Zwinger remarks – scholars would expect that the five movements of the eye (up and down, left and right and circular) should require as many muscles to drive them, yet Acquapendente had shown that they all are caused by two muscles, by virtue of their position and connection to the rest of the eye, thus contradicting both Galen and Vesalius. Once again, we are presented with a clear testimony that Acquapendente's physiological anatomy took *shape*, *position* and *number* as primary factors in accounting for the movements of the various bodily parts.

As anticipated earlier, however, the trend Vesalius had generated with his *Fabrica* would be partly abandoned by Acquapendente after 1590 in favour of a more logically rigorous, but arguably less groundbreaking approach.

While no written testimonies remain as to the reasons for such a shift, correlation with some philosophical and didactical trends, occurring about the 1590s, may help to explain what happened. We know that, after an interval in the 1580s, Acquapendente resumed the task of teaching method from 1590 onwards, significantly shifting the focus of his lectures from dissection to vivisection and

[35]For the definition and context of post-Vesalian Anatomy, see Michael Stolberg, 'Teaching Anatomy in Post-Vesalian Padua: An Analysis of Student Notes', *Journal of Medieval and Early Modern Studies*, 48, 1 (2018), 61–78; Bigotti, *op. cit.* (note 1), 33–61 and Vivian Nutton, 'Renaissance Galenism, 1540–1640: Flexibility or an Increasing Irrelevance?' in Petro Bouras-Vallianatos and Barbara Zipster (eds), *Brill's Companion to the Reception of Galen* (Leiden: Brill, 2019), 472–86.

[36]Universitätsbibliothek Basel, Ms G2 I 13b:Bl. 196.

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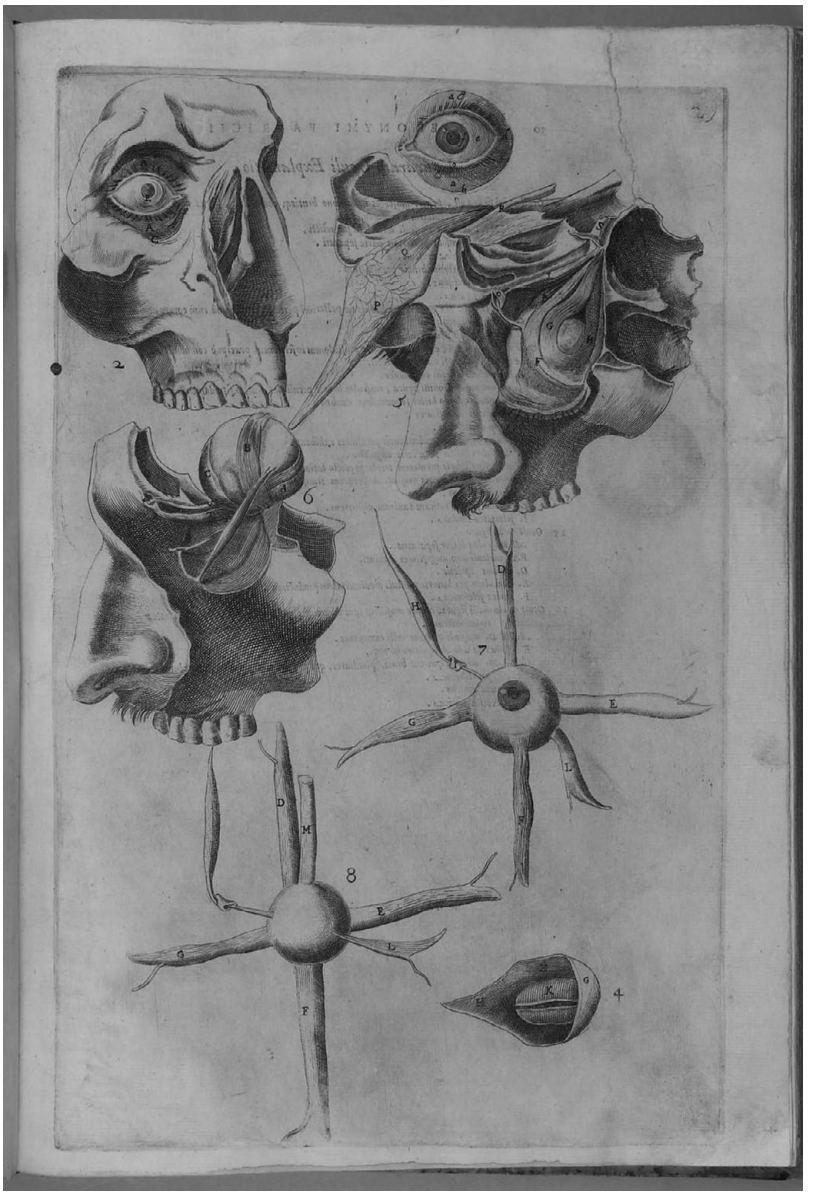

Figure 2. Anatomy of the eye in the *De visione, voce, auditu* (Venice 1600), f. 29r.

physiology more generally.[37] On the one hand, this change seems to be a consequence of philosophical concerns. The influential Jacopo Zabarella had serious criticised Galen and contemporary Galenists for their unwarranted use of generalisation in anatomy.[38] Zabarella took issue particularly with the

[37]Favaro, *op. cit.* (note 9), 121–2.

[38]Zabarella's arguments relate particularly to Galen's argument on the localisation of the soul; see Jacopo Zabarella, *op. cit.* (note 21), *De partitione animae liber*, ch. VII, ff. 509–24. For the context and the wider motifs of Zabarella's criticisms, see Giulio Pagallo, 'Cesare Cremonini Maestro di William Harvey a Padova' in Giuseppe Ongaro, Maurizio Rippa-Bonati and Gaetano Thiene (eds), *Harvey a Padova, Atti del Convegno celebrativo del Quarto Centenario della Laurea di William Harvey, Padua, 21–22 November 2002* (Treviso: Antilia, 2006), 105–6. On Zabarella's method in the *De Rebus Naturalibus Libri*, see

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Figure 3. Anatomy of the eye in the *Tabulae pictae* (1590) – BNM, Rari 120.01.

presupposition that the functions of the soul could be 'partitioned' in different seats like the parts of the body (*de partitione animae*). He finds that this way of going about anatomy mixes two different methods of analysis, 'the order of description' (*historia*) proper to anatomy, which consists in expounding the connections of the different parts of the body and their reciprocal connections, and 'the order of

José Manuel García Valverde (ed.), *Giacomo Zabarella De Rebus Naturalibus* (2 Vols) (Leiden: Brill, 2016), especially Vol. 1, *Introduction*, 1–45. For a general introduction to Zabarella's philosophy and its intellectual context, see Heikki Mikkeli, *An Aristotelian Response to Renaissance Humanism: Jacopo Zabarella on the Nature of Arts and Sciences* (Helsinki: SHS, 1992), 135–59.

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Figure 4. Anatomy of the eye in the *Tabulae pictae* (1590) – BNM, Rari 120.02.

deduction' (*demonstratio*) in which the shape of an organ is deduced from the physiological action it fulfils and this, in turn, is deduced from its fitness to the body's overall purpose of self-preservation. According to Zabarella, the methodological mismatch becomes particularly evident when Galen and his followers seek to deduce the presence of a particular faculty, that is, the rational faculty, in a specific organ such as the brain, because the nerves originate from it.[39] This way of thinking can lead someone 'to believe' (*arbitratur*) that the connections between structure and function thus witnessed at the naked eye

[39]Zabarella, *op. cit.* (note 21), f. 517.

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are necessary, but is logically invalid: it will always be possible to defend the claim that the soul is in fact a single substance whose functions, while located in specific bodily seats, are not partitioned as the parts themselves, which is actually what Zabarella himself contends. Such a criticism played an important role in shaping the epistemic attitude of Acquapendente's latter works, thus inducing him to include elements of the *Methodus anatomica* only selectively and with a stronger emphasis laid on the deductive-teleological reasoning granted by *actiones* and *utilitates*.

On the other hand, however, Acquapendente's attitude also reflects how early modern anatomical knowledge was communicated and how oral/private accounts could differ – sometime greatly – from the printed/public ones. In the printed tracts, authors such as Falloppia, Acquapendente or Casserio sought to present their anatomical findings as already obtained according to a method which they would either be unwilling to reveal or could afford not to go into detail about. Private anatomical lectures were meant to satisfy students' desire for those 'trade secrets' which would allow them to become skilful anatomists.[40] Unsurprisingly, therefore, methods were in high demand but an organic exposition was relatively rare. Elements of method were introduced when strictly necessary to deal with anatomical specimens,[41] being rather the subject matter of theoretical medicine if not of philosophy as such. When anatomists were concerned with an organic exposition, the inevitable result was a collection of notes which – despite the unifying topic – consisted in musings dictated by a long-career experience and in rather circumstantial settings. These motifs might help explain why, partly because of his academic status and partly not to challenge logicians on a topic he clearly felt not his own, in his printed tracts Acquapendente chose to embody only selected elements of his method, sticking to more traditional expositions grounded in Aristotelian logic. In a sense, the shift towards a more traditional approach was already reflected from within Acquapendente's scholarship, by the teaching of his pupil Paolo Galeotti.

In 1590, Galeotti had the chance to replace Acquapendente, due to a dispute the latter had had the previous year with the students of the *Natio Germanica* for mocking their way of pronouncing Latin,[42] and he dictated a method, which is also available in manuscript form.[43] Galeotti's method manifestly bears witness to a U-turn in anatomical teaching with regard to *historia*, seen by now as an empirical discipline impossible to be ordered under a method and accordingly diminished in value and displaced in centrality compared to the more logical and philosophical concerns proper to an Aristotelian discipline.[44]

In this sense, Acquapendente's *Methodus anatomica* testifies to an extremely complex and early phase of development in post-Vesalian anatomy that remains little known to scholars but that might help us to

[40]Klestinec, *Theaters op. cit.* (note 13), xii.

[41]See Girolamo Fabrici Da Acquapendente, *De Brutorum Loquela* (Padua: Lorenzo Pasquato, 1603), ch. 5, 18: *Auctoris methodus qua pervenire quisque possit ad intellectione loquelae brutorum.*

[42]See Favaro, *op. cit.* (note 9), invert: 126–127, 130 and Klestinec, *Theaters op. cit.* (note 13), 116–18.

[43]Universitätsbibliothek Erlangen-Nürnberg, Ms 913, ff. 33r-37r: 'METHODUS ANATOMICA Excell[entissimi] Pauli | Galeoti proposita A[nno] 1590 Januari Padua'. On Galeotti's anatomical method, see Klestinec, *Theaters op. cit.* (note 13), 79–85.

[44]Galeotti, *op. cit.* (note 43), ff. 33v-34r: 'Cum [e]n[im] duo sint q[uae] de structura cognosci possint: unum quia est: alterum: propter quid: quia est perficitur corporum dissolutione: propter q[ui]d cognitione actionum et usum. Scire quia est potius e[st] laboriosum, q[u]am ingeniosum: at tum vere scimus cum causam propter quid cognoscimus. *Verum ut scire quia est nihil fere est scire, ita e[st] principium doctrinae, sine qua structurae potior pars dignosci nequit. Hanc partem Vesalius, Fallop[ius] et Moderni absolutiss[im]e tractarunt.* In caeteris quae ad actiones et usus pertinent, pauca et ea a Gal[eno] mutuata *historice et sine ordine proposuerunt.*[…] *Nam sectio ducit nos in cognitionem quia est.* Quia artificiose secando sub oculus ponuntur q[uae] in intimo corporis sunt: cognitione actionum et usuum faciunt ad cognitionem naturae humanae, q[u]atenus sunt medium per q[u]od oste[n]dunt[ur], tamquam per suam causam finalem, conditio[n]es naturae humanae. *Ars secandi est peritia corpora dissecandi, ut ea q[uae] sub cute et intimo corpore sunt, dignoscantur. Haec non consistit certis regulis neq[ue] rationibus finita est, sed potius iteratis actionibus acquiritur. Neq[ue] enim e[st] scientia sed peritia*'. Italics added.

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understand how anatomical findings from Galenic and Aristotelian doctors, such as Acquapendente, could later be adopted and integrated in seventeenth-century iatromechanism, to conceive the body as an assemblage of moving parts whose properties were determined exclusively by shape, number and position of the organs.

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