WILLIAM HARVEY, SOUL SEARCHER: TELELOGY AND PHILOSOPHICAL ANATOMY

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The goal of this dissertation is to understand the ways in which teleology structures the natural philosophy of William Harvey (1578-1657), who announced the circulation of the blood in his *De motu cordi*s (1628). I shall incorporate new archival research, as well as the study of a number of texts that have not yet received due attention, including the *Prelectiones anatomie universalis* (1616-1627) and the *De generatione animalium* (1651). My study is divided into three parts. The first two parts focus upon on the role of two sorts of teleology. I first discuss the teleology of being, which characterizes the functioning and material organization of the parts of the body, what one would call today 'physiology and anatomy'. I then turn to examine the teleology of becoming, which characterizes the process of the generation of those parts, what one would call today 'embryological development'. The third section shifts to examining Harvey's methods in light of this conception of the subject matter. I start by articulating how, in general, Harvey conceives of anatomy not as a body of pre-existing knowledge, but rather as an active ability, combining skills of hand, eye, and mind. I then turn to look in detail at Harvey's particular methods. Harvey's methodology was an innovative reinterpretation and extension of Aristotle and Galen, mediated by certain Renaissance trends in medicine and natural philosophy. I focus specifically on how experience and experiment are used to determine final causes.

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PREFACE

Jim and Peter, *duces et praemonstratores praestantes.*

1.0. INTRODUCTION

William Harvey's 1628 *Exercitatio anatomica motu cordis et sanguinis* laid the foundation for modern physiology. His doctrine of the circulation of the blood ushered in a new era of physiological investigation by undermining the outdated views of Galen and his followers. A new era was born, an era of science, of experimentalism and observation, humanity finally shaking free of the shackles of dogmatic thought.

This isn't that story.

It's a good story, and, like many good stories, it has a kernel of the truth. But it's almost as if it's true for all the wrong reasons. Harvey *was* an experimentalist; he *did* tout the virtues of experience. But these words do not mean what one might think they mean. His work *did* have a profound influence on the development of biological science; it did spell the end for parts of Galen's thought. But these events did not happen in the way Harvey actually advocated, or would have liked; and Harvey's natural philosophy and methodology owe much to Galen's work. Harvey's history is a history of misinterpretation, though of course this isn't necessarily a bad thing. One cannot be entirely responsible for the ideas one proposes. And so it is that creative misinterpretation and appropriation of ideas past has formed a central component in Western philosophy. Sometimes, however, as Marx might have predicted, philosophers are made members of clubs they would never want to join.[1]

And so there are many images of Harvey, and though all of them are worth investigating, it is important to keep them distinct. Here I shall focus on just one part of Harvey's image: his own self-image, or at least the philosophical part. So, unlike most of histories written about Harvey, mine does not concern his momentous discovery of the circulation. I do not deny its importance, and I will discuss the *De motu* in the chapters to come. But I hope that by letting

[1] Marx, Groucho 1967, "Mystery Guest," On: *What's My Line,* April 23, www.youtube.com/watch?v=kJHUres_2xU.

this part of the great Englishman's intellectual history fade into the background, I can arrive at a deeper understanding of Harvey's philosophy, a better image of this fascinating, complex, and important moment in European philosophy. I am not saying that I can show exactly why Harvey was the one to discover circulation and in the way he did. But I do think that by *not* focusing on this aspect of Harvey's history, I can show how the *De motu* is a note in the grander harmony of Harvey's philosophical song.

1.1. DEEPER THAN *DE MOTU*

In Galenic physiology, bodily functions were thought to be centered on three faculties or powers, a deliberate echo of the tripartite Platonic soul. Each faculty was associated with an organ: the brain was the seat of reason, the source of the nerves and psychic pneuma; the heart was the seat of the passions, the source of arteries and life giving vital pneuma and arterial blood; and the liver was the seat of nutrition and appetite, the source of the veins and nourishing venal blood. The various organs and their functions were then understood through the faculty they were anatomically connected to and functionally associated with. To give a rather oversimplified example, the nerves are connected to and related to the brain and the faculty of reason, and were thus understood as carriers of the rational faculty's commands. The liver, meanwhile, as the seat of the nutritive faculty, was thought to produce the blood, which was then sent to the heart for "vivification," before moving on to the rest of the body for growth and nutrition, eventually consumed by this processes, necessitating new blood be produced.

Harvey's discovery of the circuit of the blood undermined this Galenic system through the relentless and bloody logic of anatomy. After Harvey, the action of the heart was seen as being designed for the forceful systole. Investigating the circulation and the purpose of blood

became a foundational topic of physiological research, especially in England: did the heart heat the blood, add vital spirits, or merely push it like a pump? Only the faculty of reason in the brain remained intact after Harvey's assault, though it too would be reinterpreted in the coming decades by those heavily influenced by Harvey such as Thomas Willis.[2] By upsetting the foundational faculties of the Galenic system, Harvey had rendered the interpretation of the function of *all* the parts questionable.

By the time of Harvey's death on the third of June 1657,[3] the doctrine of circulation had already begun to spread through Europe, championed by neoterics such as Rene Descartes[4] and Robert Boyle,[5] and even by more conservative physicians like Vopiscus Plemp[6] and Johann Vesling.[7] Thomas Hobbes was already celebrating his achievement:

> … the Science of Mans Body, the most profitable part of Natural Science, was first discovered with admirable sagacity by our Countryman Doctor Harvey, prinicipal [*sic*] Physician to King James and King Charles, in his Books of the Motion of the Blood and of the Generation of Living Creatures: who is the onely man I know, that conquering envy hath established a new Doctrine in his life time. Before these, there was nothing certain in Natural Philosophy….[8]

Hobbes is among the first to praise Harvey in such terms, one of the first to understand him as a hero of the new mode of philosophizing. Harvey, famous in his own time, in the years ensuing would become a here of the Scientific Revolution. And thus *De motu cordis* is mentioned in the same breath as Copernicus' *De revolutionibus orbium coelestium* and Vesalius' *De humani*

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[2] Willis, Thomas 1664, *Cerebri anatome: cui accessit nervorum descriptio et usus.* London. Note that Willis uses a word that will be central to the project of this dissertation: "usus," that will be discussed in more detail below.
[3] It is interesting to note that in this same year the Accademia del Cimento was founded in Florence.
[4] Descartes, Rene 1643, *Discours de la methode*. Leyden: chapter 5.
[5] Though Boyle cites Harvey's *De generatione animalium* no less than 12 times, there is no direct evidence he was familiar with *De motu cordis*, though he did, of course, know and accept the circulation of the blood (that is, there is no record of him owning the book, nor any direct quotation from it). Hunter, Richard and Ida Macalpine 1958, "William Harvey and Robert Boyle," *Notes and Records of the Royal Society of London*, 13(2), 117. The most famous passage from Boyle on Harvey concerns the valves and the method of discovery of the circulation: Boyle, Robert 1688, *A disquisition about the final causes of natural things,* London. Determining whether or not Boyle read the *De motu* is something I hope to do for the dissertation, either through archival research or through a comparison of his writing on the motion of the heart to Harvey's language in the *De motu* (or both, of course).
[6] Plemp, Vopiscus Fortunatus 1644, *Fundamenta medicinae libri VI.* Louvain.
[7] Vesling, Johannes 1647, *Syntagma anatomicum, locis plurimis*. Padua.
[8] Hobbes, Thomas 1656, "Epistle Dedicatory," In: *The Elements of Philosophy, the First Section Concerning Body,* London: R&W Laybourne, B.

corporis fabrica. But here the story must leave the *De motu* behind in search of something deeper. For, whatever he thought was valuable about this work, Harvey would never think himself the first to discover the science of men's bodies, nor that natural philosophy heretofore had been entirely uncertain. And it is this fact, the story of how this is so, that I hope to explicate. Even before his death, Harvey was consistently misunderstood, by both those who rejected the circulation because its final cause was obscure (like Riolan), and by those who accepted it despite rejecting Harvey's picture of its motions (like Descartes). And he has been misunderstood as much by later historians as by his fellow natural philosophers, in part because of these latter.[9] This is an old trick: it is how some of Harvey's mechanically minded contemporaries viewed him, from Hobbes to Boyle and to the Oxford Physiologists:[10] never mind the bollocks, here's the new experimental method (apologies to the Sex Pistols). But what is commendable in the scientist is a sin for the historian.

I aim in this dissertation to correct these misunderstandings. They stem, I surmise, from three interrelated historiographical problems:

1. Harvey has not been understood and treated as a *philosopher.*[11]
2. Harvey's *philosophical self*-image has been conflated with the image of him found in others' works.[12]
3. Harvey's *De motu cordis* and his cardiac doctrines have been studied to the exclusion of his other writings and ideas.

These problems are not paradigm shattering, based upon new fashionable methods, nor are they the result of divine inspiration. They are quite pedestrian. But though these crimes are naught to stir the heart, they are nonetheless responsible for serious and systematic misunderstanding of

[9] Although, if we are assigning demerits, the most would go to late nineteenth and early twentieth century doctors (retired) writing about the glorious history of their discipline.
[10] This was a group of natural philosophers and physicians, whose early work centered on Harvey and his discovery during the English civil war. For which, see: Frank, Robert 1980, *Harvey and the Oxford Physiologists,* Berkeley: University of California Press. I cannot recommend this book highly enough, it's one of the most underrated texts on early modern philosophy and science.
[11] This despite Roger French's 1994a, *William Harvey's Natural Philosophy,* Cambridge: Cambridge University Press.
[12] I shall from here on use just 'self image' to refer to his philosophical self-image.

Harvey and his place in early modernity. In the next two sections, I first set up some of the larger historical and conceptual background to my project, before going on to discuss these historiographical mistakes.

1.1.1. The Paradox of Padua

Harvey has often been used as a symbol. He represents a turning point, a critical juncture so to speak, in the construction of European science and modernity.[13] He figures prominently in these stories,[14] but, like many transitional figures, he fits but awkwardly into our categorizations and conceptualizations of early modernity. Central to these categorizations is the idea that modernity involves the rejection of the Ancients, their methods and their doctrines, and the replacement of this old fashioned nonsense with respectable (scientific) methods and theories. There is truth in this account, perhaps, but it is not the whole truth.

There is, in fact, a particular Italian university that, like Harvey himself, seems to laugh at our naïve historiography: the University of Padua.[15] Padua, as even Herbert Butterfield noted some time ago,[16] deserves to be called a major home and inspiration for the Scientific Revolution, seeing fit to host Copernicus, Galileo, Vesalius, and, of course, dear Harvey. But it was also home to Zabarella, Cremonini, Fabricius and to others deeply enmeshed in what we now call

[13] I cannot offer an account of what modernity means, of course, or even argue whether this is a category that should remain in our historiographical vocabulary. *Pace* Bruno Latour and Steven Shapin, I think that there is something important in this concept and the related one of the Scientific Revolution. These ideas are worth keeping because they help us understand the large shifts in European thought occurring over the course of the sixteenth and seventeenth centuries. See (but resist): Latour, Bruno 1997, *Nous n'avons jamais été modernes*, Paris: La Découverte; and Shapin, Steven 1996, *The Scientific Revolution,* Chicago: University of Chicago Press.

[14] Although it must be said that, until recently, many accounts of the European Scientific Revolution almost always focused on physics and chemistry to the exclusion of much else.

[15] For those of you who did not grow up forced to listen to Cole Porter, I envy your ability not to think 'wive it weathily!' whenever Padua is mentioned.

[16] Butterfield, Herbert 1953, *The Origins of Modern Science 1300-1700,* Great Britain: G. Bell and Sons. What is interesting is that, though this book shows its age, it is in many ways a better model for an overview of this period of European intellectual histories than other, more contemporary attempts, as many of these works ignore entirely Harvey and the life sciences.

Aristotelianism, but which was, in fact, a multiplicity of different hybrid positions encompassing, of course the Peripatetic, but also Galen, Plato, and a host of other Ancients and some moderns as well.[17] One might call this the 'paradox of Padua,' although Padua is perhaps just the best example of much wider phenomenon. What is this paradox? I state it simply: if Modernity and the Scientific Revolution are in part understood as *rejections* of Ancient authorities, how can so many heroes of the revolution have called Padua home?

Of course it is not a real paradox, and, indeed, it is not a hard conundrum to solve: what must be rejected is the outdated idea that the Scientific Revolution—howsoever we understand it—can be understood as involving a rejection of Aristotle across the board. Indeed, J.H. Randall argued some time ago that these Aristotelians, Zabarella in particular, were essential to the creation of the scientific method. Though this thesis has not fared well in the ensuing years, Randall has, I think, the right idea.[18] What is needed is a weaker version of the Randall thesis, where Paduan Aristotelianism (and other Arisotelianisms, for it was not a monolith) is seen neither as the one true source of *the* scientific method in early modern Europe, nor as some sort of aberration that must be explained away. Instead, one must come to see Paduan

[17] It is difficult, I think, for modern scholars to come to grips with the degree of eclecticism among Renaissance philosophers, and which is even more profound in the work of the physicians. There, one might trace this back to the late fifteenth century, as does Scaliger in his *Epistolae* of 1627. There he wrote that Leoniceno was the first to link medicine and philosophy with humane letters, and the first to show that doctors who know no Greek are like lawyers working in an alien court, lost before they begin. Leoniceno's *De Plinii et plurium alorium medicorum in medicina erroribus* (1492) was a landmark publication, and marks the start of a switch from Aristotle and Avicenna to Pliny, Dioscorides, Hippocrates, and Galen in the curricula and works of physicians. Of course, this only exacerbated eclectic tendencies, as it was impossible to get entirely rid oneself of what we might call 'background Aristotelianism.' And of course, many eclectic philosophers followed the Peripatetic as well. I do not mean to imply here that eclecticism is in any way bad, indeed, I think it has a great deal to do with the vibrancy of the Renaissance medical and philosophical traditions. However, it does make it difficult for scholars of this period, who must know not just Aristotle, but his interpreters, and also Plato, Galen, Dioscorides, and a host of other figures and traditions. This eclecticism shall be a constant theme in my discussion of Harvey, though, due to reasons of space and competency, I limit myself to only a few of his influences, namely, Aristotle, Galen, and, to a much smaller degree, Plato.

[18] Randall, J.H. 1961, *The School of Padua and the Emergence of Modern Science*, Padua: Editore Antenore. I have been influenced here by the work of John McCaskey, who is preparing a translation and commentary on Zabarella. For a more recent take see: Reiss, Timothy 2000, "Neo-Aristotle and method: Between Zabarella and Descartes" In: *Descartes's Natural Philosophy*, Eds John Schuster and John Sutton, New York: Routledge, 195-227. The literature here is quite voluminous, but Reiss' essay is a good place to start.

Aristotelianism—and Harvey in particular—as part of a great maelstrom of intellectual currents out of which the scientific method gradually emerged. Indeed, it is clear that even those who seemed to reject Aristotle most fervently, such as Descartes and Hobbes, cannot be understood except in relation to various strands of earlier Aristotelian thought.[19] Evolution is a helpful analogy here, for what becomes science need not start out as anything recognizable as such, just as the lineage of chicken-kind begins with something distinctly un-chicken-like.[20] Ideas, however, are even harder to trace, as the proponents of ideas often do much to obscure their origins. Such is the case with the origins of science: later scientists and historians radically reinterpreted their forbearers, unintentionally for the most part, such that they had always been doing the same thing, or such that, as Hobbes might have it, some illustrious ancestor was the discoverer of the new true science.[21] Thus the history of chemistry (alchemists, macrocosms/microcosms, and God, oh my!) has not been well understood until recently.[22] And so has Harvey fared: while it has been long acknowledged that Harvey was an Aristotelian, and follower of obscure teleologies, historians have insisted upon placing him in either the *camp of modernity* or that of *the Renaissance,* or upon sorting his methods and doctrines into *scientific* (and good!) or *Aristotelian* (bad!).

The paradox of Padua, then, and the problem it poses to the historiography of science and philosophy in early modern Europe, is the background against which one must understand this dissertation. I hope to show how to resolve this conundrum, at least in the particular case of Harvey. For, while the nature of this situation has been recognized, it has not been adequately

[19] In the case of Descartes, the best place to begin is perhaps found in the work of Dennis Des Chene, especially his 1996 *Physiologia,* Ithaca: Cornell University Press. As for Hobbes, an excellent examination of the Aristotelian context can be found in Cees Leijenhorst's 2001, *The Mechanization of Aristotelianism*, Leiden: Brill.
[20] But don't take this evolution analogy too seriously.
[21] Indeed, this sort of attitude to the history of one's own discipline might even be a necessary element in scientific activity, for the reasons Kuhn discusses in his 1962 *The Structure of Scientific Revolutions,* Chicago: University of Chicago Press.
[22] The work of Walter Pagel here is of course very important, but I have in mind more specifically the work of Bill Newman and Lawrence Principe, for instance their 2002, *Alchemy Tried in Fire,* Chicago: University of Chicago Press. For Pagel's work, see, for example, his 1982 *Paracelsus,* Basel: S. Karger.

accounted for—to misquote William Gibson, good historiography is here, it's just not distributed very evenly.[23]

1.1.2. Historiographical Problems

Thus one is led to the first historiographical problem: Harvey has not been grappled with *as a philosopher*. Unpacking what it means to treat Harvey 'as a philosopher' is difficult,[24] but instead of describing what this might mean in detail here, I hope to demonstrate it through the analysis of Harvey's concepts and ideas offered in the following chapters. There I shall show that Harvey's ideas, especially those having to do with teleology, have not been properly interpreted or understood, stemming from the lack of philosophical sophistication on the part of historians, as well as a great deal of misunderstanding of Harvey's sources (worsened further by the further historiographical problems I detail below). This is not to say that the work of these historians is worthless or wholly incorrect, but only that those aspects of their interpretations and explications of Harvey's *philosophy* are lacking.

A brief example will illustrate the point. Walter Pagel, perhaps the preeminent twentieth century scholar of Harvey, argued that Harvey's philosophy must be understood as being based upon, and motivated by, an Aristotelian cosmology of circles and cycles.[25] Pagel's contention is

[23] Gibson's line is actually: "The future is here, it's just not distributed very evenly." Quote from: "The Science in Science Fiction" on *Talk of the Nation*, NPR (30 November 1999, Timecode 11:55), www.npr.org/templates/story/story.php?storyId=1067220.

[24] I suppose that it's somewhat like pornography: I know it when I see it.

[25] This is discussed in many of Pagel's works including his 1967 *William Harvey's Biological Ideas,* Basel: S Karger, and his 1976 *New Light on William Harvey,* Basel: S. Karger. The idea is taken up in extended by Thomas Fuchs in his 2001 *The Mechanization of the Heart,* Trans. Marjorie Grene, Rochester: University of Rochester Press. I note with no small amusement that Grene, in her translator's foreword that she, "…cannot really agree with him in his Pagelian reading of Harvey on circles" (xiv). Fuchs work is further undermined by his insistence on understanding Harvey's Aristotelianism as being 'vitalism', a kind of Aristotelianism he contrasts with Scholastic Aristotelianism. It is surely correct to compare Harvey's Aristotelianism with other's on offer; but using an eighteenth century concept (vitalism) to understand sixteenth and seventeenth century doctrines is unenlightening at best. Further, the difference in Harvey's Aristotelianism and that of Scholastics is not based upon some fundamental

that Harvey was, as it were, 'primed' to discover the circulation because of his adherence to this philosophy of circles. I do not deny that that circular motion is important in Aristotle's cosmology, or that the cycle's are to be found in his account of the weather. But there is absolutely no sense in which it can be said that Aristotle has a 'philosophy of circles' or that the symbolism of the circle is fundamental to his work—this is, as best I can determine, a sort of neo-Platonic reinterpretation of Aristotle in which the microcosm-macrocosm analogy is of prime importance. To name just one grievous philosophical misunderstanding: in running together Aristotle's account of heavenly circles with terrestrial cycles like the weather, Pagel is conflating two very different realms of nature. This is not to say that the heavens and the earth do not interact, or that circles are unimportant in understanding this interaction—Aristotle discusses just these ideas and their consequences in the first book of *Meteorology.* But the kind of circles found in the heavens, and the eternality of those kinds of motions, are of an entirely different metaphysical kind than the circle-like motions of terrestrial things. The eternity found in the water cycle is only an eternality of a kind, but a kind of eternality to be found only in the terrestrial realm. And there is no evidence that Harvey interprets Aristotle as being terribly interested in the heavens and their motions, indeed, there is precious little evidence he gave much credence to the idea of microcosm-macrocosm correspondence. In any event, what Pagel is pointing to is some supposedly profound and central metaphysical-cosmological principle of circularity that undergirds both Aristotle's and Harvey's philosophies, and which motivated Harvey in his discovery.[26] And while it is true that Harvey does use the word 'circulo' and various forms at certain points in *De motu cordis,* there are few other ways to express such round

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or essential difference in style, textual reverence, or modes of argument, for the traditions of what I call Harvey's 'eclectic Aristotelianism' and that of the Scholastic's interacted a great deal. I discuss these issues in detail in the following chapter.

[26] Why Harvey discovered the circulation, and not some other purportedly circle-obsessed Aristotelian, such as Cesalpino, is something even Pagel admits is unanswerable. This, I think, provides further reason to dismiss Pagel's thesis. See Pagel 1976, 39-41.

ideas; it is not a concept of real philosophical importance in and of itself. The theoretical consequences of such a physical circuit, however—*those* are of true importance. Now, I do not take this short discussion to demonstrate the fundamental error of Pagel's approach, nor shall I take further time discussing it. In truth, it's not even false, and perhaps the interpretation of Harvey's philosophy offered in the following chapters shall be enough to demonstrate this.

But there are further problems in the existing histories. One problem here, affecting Harvey and others at Padua and further afield too, is the problem of how to understand change. These philosophers were involved in a period of substantial intellectual change, of massive social and religious upheaval, and of the birth of a new mode of philosophizing. But history is so often a reflection of the historian—thus Harvey was, to his first, mechanically inclined interpreters, thought to be a mechanist arguing for the heart-as-pump.[27] To those fond of Lord Verulam, Harvey was a deep searcher into Nature of the Baconian stripe, down even to the rather repugnant metaphor of natural inquiry as rape:

> Coy Nature, (which remain'd, though Aged grown,
> A Beauteous virgin still, injoyd by none,
> Nor seen unveil'ed by any one)
> When Harvey's violent passion she did see,
> Began to tremble and to flee,
> Took Sanctuary like Daphne in a tree:
> There Daphne's lover stop't, and thought it much
> The very Leaves of her to touch,
> But Harvey our Apollo, stopt not so,
> Into the Bark, and root he after her did goe:
> No smallest Fibres of a Plant,
> For which the eiebeams Point doth sharpness want,
> His passage after her withstood. [28]

[27] It is usually thought that Harvey makes this analogy in the *De motu cordis*. He does not make this comparison, however, until the 1649 *De circulatione sanguinis*. And, as should become abundantly clear, if Harvey is a mechanist, then so too was Aristotle, which would, however, force one to adopt a rather fantastically wide scope for a 'mechanism', though perhaps not without profit; for which see: Aryeh Kosman 2004, "Mechanisms in Ancient Philosophy of Science," *Perspectives on Science* 12(3), 244-261.

[28] Cowley, Abraham 1663, "Ode to Harvey," In: *Verse written upon Several Occasions*, London, 18-21. I recommend not reading it, as it's a rather dreadful poem.

So too some historians have seen his arguments involving the amount of blood in the body as anticipations of quantitative methods in the life sciences. Thus, Harvey's image has been marked by substantive tensions: a vitalist mechanist, a past-obsessed forward thinker, a credulous experimentalist, an Aristotelian Revolutionary. These tensions are a result of the second of the historiographical problem relevant to my study: historians have consistently mistaken the image of Harvey found in the works of his peers and influences (including later historians) for Harvey's own *self* image.[29] In so doing, Harvey's distinctive philosophical position has been lost amid the cacophony that is early modern philosophy and science.

This lack of focus on Harvey's self image has led to a schizophrenic characterization of Harvey's philosophy. Walter Pagel viewed Harvey in just this piecemeal way:

> Harvey the cool and rational man of science, the comparative anatomist, the keen explorer of form and function in health and disease, the shrewd physician and experienced pathologist. On the other hand there is Harvey, the staunch Aristotelian, the life-long thinker about the purpose of the movements of the heart and blood, the believer in analogies between macrocosm and microcosm, accessible to him through the symbol of the circle. There is finally Harvey following up blind alleys and, in spite of all his admiration and piety towards Aristotle…Harvey the critic of Aristotle.[30]

On the other hand, Pagel treats these different aspects as Harvey 'as he really was'.[31] But it is never clear to the reader how to integrate these various Pagelian Harveys. It is simply wrong to present Harvey as being to himself so divided, as it misrepresents certain basic features of his philosophical outlook, and mistakes later evaluations of Harvey's philosophy (and its errors and inconsistencies) with Harvey's own self evaluation. In particular Harvey's Aristotelianism was a fundamental part of anything he would label scientific (that is, leading to *scientia*). And Harvey 'the cool and rational man of science' would be, according to Harvey himself, the very same man who was a 'staunch Aristotelian' and who was a lifelong thinker about the purpose and function

[29] Such are the minds of human scholars that they are dangerously prone to feedback loops, and thus the more Harvey's mechanism was affirmed, the more later historians were forced to take this position seriously. It is a subtle thing.
[30] Pagel 1967, 229.
[31] Though he does note Harvey was 'unified' in some sense. See, for instance, Pagel 1967 327,-329, 331, 351-352.

of the heart and the blood. And the Aristotelian Harvey would have no issue with the Harvey who criticized Aristotle—for Harvey was self-consciously not a dogmatic follower of Aristotle's philosophy but a follower, rather, of his method[32]: and criticism due to differences based on experience and reason are most certainly a part of Aristotle's methods. And so it is not clear from Pagel's work (excellent and useful though it be) *exactly* what the relation between Harvey's Aristotelianism and his work exactly is: one is often treated to a 'constant conjunction' wherein Pagel juxtaposes various similar doctrines and methods from other Aristotelians with Harvey's work itself, but, again, Harvey's own conceptualization is never articulated.

Thus, in an ironic twist, what has been missing from much of Harveian historiography has been Harvey himself. Thus his status and contributions as a methodologist and philosopher of science have gone almost entirely unnoticed.[33] Historians seem to remain content with contextualizing his ideas in the simplest way possible, by comparing it to surrounding doctrines, some sources, some influences. Indeed, though Roger French's scholarly tome *William Harvey's Natural Philosophy* (1994) provides a wealth of information on the institutional and intellectual context and reception of Harvey's work, as well as those of his followers and opponents, Harvey's own words appear very rarely in the course of his discussions. And so French often articulates an interpretation without necessarily supporting it through detailed textual evidence, or relegating that evidence to a footnote. For instance, Chapter 4, "The anatomy lectures and the circulation," is twenty two pages long and contains numerous *references* to Harvey's lecture notes, the *Prelectiones anatomie universalis*,[34] but only contains five actual *quotations* from Harvey's notes, and these are often very short, no more than a sentence or two;

[32] This is not to deny that Harvey uncritically accepted many Aristotelian positions.
[33] Which is not to say that this historiography is not worthwhile!
[34] Harvey, William 1616-1626 *Prelectiones anatomie universalis,* Ed. Gweneth Whitteridge, London: Royal College of Physicians. I shall introduce this text in more detail below.

the longest quote not from the lectures at all but from *De motu cordis*.[35] One must therefore be careful in considering the support of French's conclusions regarding Harvey in light of the often quite slight evidence provided.

There is, clearly, a very important task here: understanding the *reception* and *interpretation* of Harvey's works. Indeed, this is, I think, the best way to understand Roger French's *William Harvey's Natural Philosophy,* a book that, despite it's title, spends most of its pages discussing the reception and interpretation by others of the theory of circulation.[36] Most relevant to the current study, French argues there that Harvey has a 'principle of limited explanation.' The idea is that Harvey is thought to ultimately reject the need for final causal explanations, his *De motu* an illustration of this idea. But this is to conflate Harvey's self image with the image of him to be found in the work of others, in this case, the work of both those who rejected *De motu* for not having put forward a final cause for the circulation and those who championed it for the very same reason. Thus understanding Harvey as simply as a mechanist, a Baconian, as a follower of the 'way of the anatomists,' or even as an Aristotelian, is ultimately of little help when Harvey's own distinctive ideas are put into a foreign mold.

This leads directly to the third and final historiographical problem: the (almost) exclusive focus on the *De motu cordis* and Harvey's cardiac doctrines. This has resulted in a seriously lopsided conception of dear Mr. Harvey. For instance, until recently there have been no real attempts at understanding Harvey's *De generatione animalium* outside of its connections to his circulatory doctrines, nor any real body of literature dealing with his lecture notes.[37] Consider the

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[35] French 1994a, 91.

[36] This claim is, again, one I hope to justify, not head on, but in the course of my interpretation of Harvey. But to at least motivate this claim, note the following: the last two thirds of the book focuses directly upon the reception and interpretation of Harvey's theory in England and around Europe. Important information, to be sure, but it is hard to see how this helps one understand *Harvey's* philosophy, and not just the reception thereof.

[37] Harvey 1651, *Exercitationes de generatione animalium,* London. Recently, however, Karin Ekholm has published a number of interesting papers on *De generatione,* for instance: Ekholm, Karin 2008, "Harvey's and Highmore's Accounts of Chick Generation," *Early Science and Medicine* 13.

former, for it is here that one sees the least hagiographical descriptions of Harvey: Joseph Needham writes, "He did not break with Aristotelianism, as a few of his predecessors had already done, but on the contrary lent his authority to a moribund outlook which involved the laborious treatment of unprofitable questions."[38] And take Pagel, who seems to think Harvey's methods can be safely extracted from his Aristotelianism: "Harvey, the Aristotelian, died in 1657, while Harvey, the discoverer and physiologist, was to remain immortal."[39] This problem, I would surmise, is a prime contributor to the previous one, for by concentrating only upon Harvey's novel discoveries—and they are novel, if not entirely so—it becomes easier to mistake Harvey's self image for the image of the heroic discoverer of the circulation found in the work of others.[40] Let me put this somewhat more pithily: what historians have been doing is trying to fit Harvey's philosophy and practice into their conception of the *De motu cordis*[41], when really what they should be doing is trying to fit *De motu cordis* into Harvey's larger philosophical system.[42] Thus, mistakenly as I shall argue, the *De motu cordis* has often been read as a work lacking both teleology and much methodological import beyond what has been interpreted as modern experimentalism. This mistake has proven most harmful in the analysis of the *Prelectiones anatomie universalis* (1616-1627), Harvey's lecture notes for his anatomical course presented to surgeons and doctors on behalf of the Royal Society (more on this and Harvey's other works below). Walter Pagel writes that the *Prelectiones*,

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[38] Needham, Joseph 1959, *A History of Embryology*, Second Edition, and Cambridge University Press: Cambridge, 149. Those unprofitable questions, I might add, are exactly those teleological ones that I take to be central to Harvey's whole natural philosophy.

[39] Pagel, Walter 1957, "The Philosophy of Circles," *Journal of the History of Medicine*, xii, 156.

[40] For instance, Robert Boyle refers to Harvey as 'our English Democritus', even though Harvey explicitly rejects materialist philosophies. Boyle, Robert 1660 [1999-2000], *New Experiments Physico-Mechanicall, Touching The Spring of the Air, and its Effects,* In a letter to the Lord of Dungarvan, "A Digression containing some Doubts touching Respiration," In: *The Works of Robert Boyle*, Vol. 1, Eds. Michael Hunter and Edward B. Davis, London: Pickering and Chatto, 287.

[41] Or, which is no better as a way of understanding Harvey on his own terms, into Harvey's contemporaries' conception of the *De motu cordis*.

[42] This is not to claim Harvey's system is mutually consistent, nor is it to claim Harvey's positions did not develop over time, but only to claim that *De motu cordis* should not be seen as part of Harvey's project, and not, in some way, methodologically exceptional or unique in terms of Harvey's other works.

> …retain their historical value as a prime source of our knowledge of the development of Harvey's ideas. First and foremost in a positive sense: the ideas and observations which form the substructure of *De motu*…are indeed essentially found in the *Lecture-notes*. Of his discovery itself, the circular movement of the blood, as based on the correct appraisal of the venous blood flow, we have no such evidence. Harvey himself intimated in 1628 that he had demonstrated and confirmed his personal view not only for the motion and use of the heart, but also of the circuit of the blood…for nine years and more, taking us back to 1618….[43]

Pagel here demonstrates this very problematic idea that the *Prelectiones* are of prime historical importance by virtue *only of what they can tell us about the discovery of the circulation*—indeed, the way in which Pagel uses the phrase 'Harvey's ideas,' one might be led to think that Harvey's ideas only ever concerned the heart and the blood. Roger French begins his discussion of the *Prelectiones* in a similar manner, concerned first and foremost with what they reveal about Harvey's cardiac investigations—indeed, the chapter is entitled "The Anatomy lectures and the circulation." But the lecture notes contain so much more than just investigations into the heart!

Indeed, this focus on Harvey's cardiac ideas has been nowhere more detrimental than in historians' evaluations of his methods. A quote from Gweneth Whitteridge aptly sums up this problem: "…I believe that Harvey falls into the category of the great scientist who is not conscious of any philosophical method underlying his actions…."[44] When I first read this evaluation of Harvey by one of the most important figures in Harvey studies, the editor, transcriber, and translator of much of Harvey's corpus, I was quite frankly staggered.[45] Because nothing was so clear from reading *all* of Harvey's works that he *did* have a very particular conception of natural philosophical method, which in turn was founded upon a very particular conception of the ways in which nature operated.

In sum, then, I have tried to show here how three historiographical problems have led to serious misinterpretations of Harvey, despite their prosaic nature. I shall return to these issues in

[43] Pagel 1967, 219.
[44] Whitteridge, Gweneth 1971, *William Harvey and the Circulation of the Blood*, London: Hazell Watson and Viney Ltd., xi.
[45] Indeed: flabbergasted.

the conclusion. I now introduce what I mean to replace these accounts with, and overview the argument of this dissertation.

1.2. SOUL SEARCHING

I have chosen a rather curious title: William Harvey, *Soul Searcher.* What, one might ask, the heck am I talking about? My response is simple: soul, *anima,* is the primary explanatory concept around which Harvey's whole philosophy revolves.[46] Harvey must not be understood as an anatomist in our modern sense. Oh, he did cut up bodies, and he did attempt to understand the layout and structure of our squishy, slimy, inside bits. But he was no materialist. Matter is important, no doubt! But what animated Harvey's philosophical anatomy was *soul* (pun intended, unfortunately). The parts of animals were to him *manifestations of soul*, as Gweneth Whitteridge wonderfully translates from Harvey's notes.[47] To understand Harvey is to understand him as a soul-searcher, an investigator into the causes and purposes of living things and their organization.

Soul at the start of the seventeenth century was an extremely complex conceptual cluster, involving a variety of philosophical ideas inherited from the Greeks and Arabs, as well as from Christian reinterpretations and Scholastic disputations. In general, and in the anatomical context, soul denoted the complex and multi-part, but somehow still unified, totality that is a living being. More specifically, soul refers to that set of goal-oriented powers the functioning of which is called the life of a creature. These creatures are carefully arranged into functional units, parts, organs, systems, all of which are organized in pursuit of the creature's continued survival and thriving. Parts and wholes, organs and organisms, body and soul. Knowledge of soul and its union with the body is the goal of anatomy.

[46] No, wait, I must have been wrong about Pagel's circles…
[47] This is her translation of Harvey's 'signum animae', for which see: Harvey 1616, 12.

Because of the problems discussed in the previous sections, historians have misunderstood the degree to which Harvey's natural philosophy is revolutionary and modern. Even careful and extremely erudite historians such as Roger French have been misled by their focus on the *De motu:* thus French argues that Harvey's real contribution was his demonstration that one could have purely observational knowledge. That is, Harvey could describe the circulation without providing its final cause, and that this was a worthy goal in and of itself.[48] Even those who stress Aristotelianism and teleology, such as Pagel, don't actually take it seriously. There is an assumption that Harvey was a great scientist and made his discovery *despite* his embarrassing metaphysics. In response, I hope to demonstrate exactly how Harvey's conceptualization of his subject matter is deeply informed by teleology, and, in complement, how his methods are carefully aimed at producing such knowledge of ends and goals. In the following pages, then, I hope to paint a new, and truer, account of this natural philosopher and physician by articulating the ways in he is a teleologically minded searcher into soul and body. Let me then introduce some of these concepts in somewhat more detail.

There are two sorts of teleology operating in my analysis: there is first *substantial* teleology, which characterizes Harvey's explanatory project concerning the ends and processes that achieve those ends in living bodies. Then there is *methodological* teleology, which characterizes the structure of Harvey's activities that attempt to determine substantial teleology. Let me begin with substantive teleology. Harvey's anatomy is the business of determining a particular kind of *definition,* ones that are statements of the form and nature of the objects so defined. Following Aristotle and Galen, Harvey thinks that these sorts of definitions are the only kind appropriate for natural philosophy. In Harvey's context, these definitions delineate the very

[48] This line of argument is also to be found in the work of Andrew Wear. The exact meaning of 'observational knowledge' and contrasting categories are unclear, as no one denied that observation ended in some kind of knowledge. The real questions were: what kind of knowledge? and was it worth anything much at all? Wear, Andrew 1983, "William Harvey and 'the Way of the Anatomists'," *History of Science* xxi, 223-249.

subject matter[49] of his anatomical investigations, for, in the case of living animals, the essence of the body must be understood as *soul.* And, as mentioned above, not just soul but soul in union with its body. Thus one can further characterize Harvey's subject by a two-fold distinction in substantive teleology: between the teleology of being and that of becoming.

In Chapters 2 and 3, I focus primarily on interpreting Harvey's lecture notes, the *Prelectiones anatomie universalis,* which, though long known, have never before been central to any interpretation of Harvey's natural philosophy. These chapters deal with how Harvey understands the functional and material organization of living creatures into their parts: the teleology of *being*. This teleology characterizes the relationship between one part and another, or between one part of a system and the whole, or between a whole system and the rest of the body. These relationships are expressed in terms of the one thing *being for the sake of* the other. The final cause, as a concept, is not fine grained enough to do justice to this complex set of teleological relations and dependencies, and thus Harvey, following in the Galenic tradition, employs a number of terms (action, use, utility) to categorize these relations into what I describe as different teleological 'levels.' These levels can be ordered in two ways: they can be ordered by way of explanation, so that the more teleological concepts (such as use) are used to explain lower level concepts (such as action). On the other hand, these concepts can also be ordered by inferential sequence, which has the opposite order: one infers from lower level concepts the higher, a process dealt with in the section on Harvey's methods. Furthermore, I show how, having established that Harvey's teleology is much more nuanced than can be accounted for by 'final causality' alone, the *De motu cordis* can, and indeed, must, be understood as deeply teleological in exactly this more complex sense.

[49] That is, these definitions are definitions of substances.

It might, at this point, be responded that Harvey as much as admits that he does not give the final cause of the circulation in *De motu cordis,* something borne out by the reception of this work. Wither teleology? In fact, no: for, while this is true, it is besides the point, for the underlying teleology is more far reaching than could be undermined by the failure to find a particular final cause. This leads, in fact, to the second kind of teleology that characterizes Harvey's subject matter, for now the deep connection between *De motu cordis* and the *De generatione animalium* shall become clear. This is noteworthy as the relationship between these works has sometimes been seen as nonexistent, *De generatione* understood as some sort of failure to live up to the standards of science set by Harvey in his earlier work.[50] Thus I discuss in Chapter 4 the second kind of teleology, which figures in those definitions used in accounting for the *coming into being* of creatures and their parts: the teleology of *becoming*. Here the fine grained concepts discussed in Chapters 2 and 3 will not do, for what is being explained is exactly the emergence of a living animal and its attendant teleology, that is, the emergence of a soul in union with its body. Instead, Harvey here uses the more general category of final causes, deploying large scale features of Aristotelian physics like form, soul, and (importantly) actuality and potentiality in order to account for the properties of generative processes.

Finally, in Chapters 5 and 6, I shift to methodological teleology, which characterizes not the structure of Harvey's objects of study, but rather the structure of his scientific activity itself. I start by articulating how Harvey conceives of anatomy not as a body of pre-existing knowledge, but rather as an active ability, a skill, whose goal is to understand the body in its union with the soul by means of the actions and uses of its parts. Anatomy aims at acquiring the kind of knowledge and explanations about the body and its generation discussed in the preceding chapters. In order to understand how anatomy is meant to achieve such teleological knowledge,

[50] For which, see Joseph Needham 1959, cited above.

I trace part of the history of definitions of anatomy among Western physicians and philosophers starting from Galen. I argue that there had long been a traditional division between the experiential-artistic side of anatomy and the rational-scientific side. The former was conceived of as the skill of hand and eye by which one cuts up the body, the latter as the knowledge of the causes of the parts of the body. This latter was thought to be the most noble for much of the history of anatomy, especially when considering final causes. Starting during the medical Renaissance of the sixteenth century, however, there was a new emphasis on the experiential side of anatomy, and an increasing stress on the actual practice of dissection. Harvey, following in the footsteps of his Paduan teacher Fabricius ab Aquapendente, attempts to unify the experiential and rational aspects of anatomy such that it is *through experience* that the anatomist comes to learn the causes of the body, most importantly the final cause.

However, I argue further that Harvey's conception of experience (*experientia*) has been completely misunderstood: it is not about a perception based epistemology, though observation plays a key role, but rather it is about the development of *expertise* through repeated experiences of performing anatomies. Anatomy is, as Harvey himself characterizes it, *a faculty,* in particular, a faculty of judgment about the concepts and definitions arrived at through anatomical observations. Thus Harvey's claim that his experience leads straightaway to knowledge of final causes is not as mysterious as it might sound. He is not arguing that he can, as it were, *see* final causes operating in nature, but rather only that his long experience has granted him the power to judge truly about the final (and other) causes of the parts and their organization—and if you don't believe him, go and check for yourself.

Finally, in Chapter 7, I return to the historiographical discussion started above. I go into detail about the three historiographical problems discussed, offering specifics about how the results of this dissertation force reevaluation of some Harveian scholarship. Finally, I move on

to some larger reflections on Harvey's place in the history of philosophy, as well as some thoughts on the methods of history and philosophy of science, concluding with some thoughts on directions for new scholarship.

In the remainder of this chapter, I hope to accomplish two things: first I discuss certain intellectual currents from Humanist philosophies of the Renaissance that are important for understanding Harvey and for setting up the discussions contained in the following chapters. Second, I provide some minimal background and context on Harvey's treatises, focusing especially on the *Prelectiones*.

1.3. HUMANISM

To be a good philosopher according to Harvey, one must learn from the Ancients.[51] Relevant here is a statement by Harvey found in John Aubrey's *Brief Lives*, a stunningly trenchant and apt quote expressing this very position: after asking Harvey for advice on what books to read, Aubrey writes that, "…he bid me to goe to the fountain head, and read Aristotle, Cicero, Avicenna, and did call the neoteriques shitt-breeches."[52] In keeping with this attitude expressed here so (uncharacteristically) vulgarly,[53] Andrew Cunningham has argued that the Aristotelianism of Harvey's teacher Fabricius ab Aquapendente at Padua was, in distinction to that of, say, Cambridge or Paris, one where they were attempting not to follow Aristotle's teachings but rather his methods. Cunningham calls this 'the Aristotle project', and describes it as,

[51] And from experience, but more on that in Chapters 6 and 7.
[52] Aubrey, John 1898, *Brief Lives Vol. I,* Ed. Andrew Clark, Oxford: Clarendon Press, 300. One might think the referents of 'neoteriques' are new corpuscular philosophers such as Gassendi or Descartes, but Harvey clearly uses this term ecumenically, and includes also post-Vesalian physicians of many sorts.
[53] Even at his most vicious, Harvey hardly rises above the level of light sarcasm or gentle mockery in his published works. He was, however, reputed to carry around a dagger, and was not hesitant (or unskilled) in its use.

> …an open-ended research programme on animals, devoted to the acquisition of true causal knowledge (*scientia*), on certain kinds of topic (not research 'problems'), such as parts, organs and processes, and employing a thought-through and consistent methodology and epistemology, a suitable technical vocabulary, and the like. And when I talk of such an 'Aristotle project' being practiced in the late sixteenth century, I am referring to a deliberate and self-conscious attempt to model new anatomical research on this kind of view of Aristotle's own practice.[54]

Cunningham's thought here is basically correct—but, rather than being something entirely original to Fabricius, this 'Aristotle Project' is an outgrowth of intellectual trends stemming from the works Renaissance Humanists.[55] It is important to understand Humanism, then, for it provides an essential philosophical context by which to understand Harvey.

Humanism was a new way of thinking centered not upon certain knowledge but upon wisdom and eloquence. It spurred a new interest in rhetoric modeled on Cicero, as well as a new commitment to philologically accurate texts and translations. Starting in Italy in the fourteenth century, it soon spread throughout Europe. As Paul Kristeller argued long ago, Humanism is best seen as a movement to revive the language and literature of classical antiquity.[56] The reasons for this are quite complex, but Cesare Vasoli nicely summarizes the situation:

> The social, political and economic ferment of late thirteenth- and early fourteenth-century Italy was generating new forms of government and public institutions, and traditional professional training was becoming increasingly inadequate. The mercantile culture posed moral and theological problems which could no longer be handled by theologians trained in biblical exegesis and by students of Peter Lombard's *Sententiae* and of the various summae. The traditional legal education was insufficient for princely secretaries and the chancellors of the new communes, particularly those of more than local ambition. They needed training in history and some literary and rhetorical polish. Medical training was also moving towards a more critical analysis of the ancient authorities, increasingly demanding empirical evidence. The more radical tendencies in scholastic thought—

[54] Cunningham, Andrew 1985, "Fabricius and the 'Aristotle project' in anatomical teaching and research at Padua," In: *The Medical Renaissance of the Sixteenth Century*, Eds. A. Wear, R.K. French, and I.M. Lonie, Cambridge: Cambridge University Press: 198.

[55] If Fabricius had such an Aristotle Project, than one could fairly categorize Vesalius' work as the 'Galen Project,' for though he is critical of Galen (like Fabricius and Harvey of Aristotle), his anatomical scheme is deeply Galenic in its methods, and, as I shall argue in Chapter 5, even sometimes its rhetoric.

[56] Kristeller, Paul O. 1966, "Philosophy and Humanism in Renaissance Perspective," In: *The Renaissance Image of Man and World,* Ed. Bernard O'Kelly.

> Ockhamism and the like—were undermining the unified notion of sapientia which had so far resisted the thirteenth century's cultural transformations.[57]

Ferment was in the air. Humanist's began to reject Aristotle and Averroes in favor of Plato and Galen, and more broadly speaking, there was a rejection of natural philosophy in favor of civic and ethical philosophy. Consolation and not understanding became paramount. And though it did not start out as such, this movement to revive the literature of the Ancients also became a movement to revive their *projects,* as Cunningham has noted. From vivification came imitation.

A hallmark of Renaissance thought, at least in the eyes of the modern historian, is its deep and serious eclecticism. So while on the one hand there was, at least in rhetoric, a great many philosophers who rejected Aristotelian natural philosophy, on the other hand, the period also saw some of the finest and most philologically sophisticated translations of the Philosopher's natural philosophical texts. As Robert Black has argued, Renaissance training in philosophy always involved Aristotle (at least the *Physics* and *De anima*), but now began to include many other philosophers from Plato to Pliny to Plotinus, as well as many Ancient and Medieval commentators, perhaps most importantly (in the sixteenth century at any rate) Alexander of Aphrodisias. It was quite an eclectic mix.[58] And what was true of the philosophers was true of the physicians. Indeed, Nancy Sirasai noted that, "In Renaissance medicine, as in Renaissance philosophy, concepts of reform— and actual innovations—often went hand in hand with a search for the most ancient and authentic wisdom."[59] In this same vein, Jerome Bylebyl argued that, "…medical humanists, led by such men as Nicolao Leoniceno of Ferrara, therefore called for a thorough reform of the arts universities, to be based on an ambitious programme of recovering, editing, translating, and above all studying, the texts of the ancient Greek

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[57] Vasoli, Cesare 1988, "The Renaissance Concept of Philosophy," In: Ca*mbridge History of Renaissance Philosophy*, Eds. Charles Schmitt, Quentin Skinner, Eckhard Kessler, Jill Kraye, 58

[58] Black, Robert 2007, "The philosopher and Renaissance culture," *The Cambridge Companion to Renaissance Philosophy,* Ed. James Hankins, Cambridge: Cambridge University Press, 18

[59] Sirasai, Nancy 2001, "In Search of the Origins of Medicine: Egyptian Wisdom and some Renaissance Physicians," In: *Generation and Degeneration,* Eds. Valeria Finucci and Kevin Brownlee, Durham: Duke University Press, 235.

physicians."[60] Central to Humanism, medical and philosophical, was a commitment to *both* the new and the old. Indeed, Humanism may justly be characterized as the finding the new *through* the old. That is, by not just commenting on the Ancients, but, truly, resuscitating their projects, Humanists believed they could reform philosophy (and society as a whole). In the case of the physicians, their ultimate goal became the desire,

> … to be able to practise medicine in the manner of the ancient physicians. The message had a ring of urgency to it precisely because in medicine a failure to establish the proper relationship between words and things could have dire consequences for human life and health. Leoniceno, the founding father of the movement, had singled out three areas of particular concern in this regard, namely medicinal herbs, specific diseases and anatomical structures. Thus it is not surprising that his disciples should have played leading roles in introducing new forms of botanical, anatomical and clinical teaching into the medical curriculum, along with their efforts to reform the content of the existing lecture courses. Moreover, from teaching these subjects through demonstration of the phenomena themselves it was a relatively short crucial step to the beginnings of substantial new observations. And while in retrospect the latter may seem to mark the beginning of the decline of ancient authority, originality and innovation within certain limits were readily construed as emulating the spirit of the ancients, and therefore proved quite compatible with the ideals of medical humanism.[61]

Bylebyl urges us, rightly I think, not to take the Humanists' penchant for new observations to be in conflict with deep respect and, indeed, *veneration* of the Ancient's. This is something deeply true of Harvey, following the Humanist model: he too respects the Ancients, sincerely but not dogmatically. Harvey's training at Padua could not but instill these Humanist ideals for, though the movement took its first form at Ferrara, "…it was at Padua that it achieved its greatest success…."[62] From the 1530s to the 1540s, a number of important changes occurred here under the Humanists' guiding hand, including the transformation of anatomy into a major, and permanent, subject, no longer relegated to a short annual event.

But there seems to be some deep problems here: for, if Renaissance humanism was about, well, *humans,* and involved a rejection of Aristotle, how could Harvey possibly fit in? For his

[60] Bylebyl, Jerome 1979, "The School of Padua: humanistic medicine in the sixteenth century," In: *Health, Medicine, and Mortality in the Sixteenth Century,* Ed. Charles Webster, Cambridge: Cambridge University Press, 340
[61] Bylebyl 1979, 341.
[62] Bylebyl 1979, 342.

concerns were *in animalibus,* and his love for Aristotle is well known. The answer is the same as I discussed above regarding the emergence of science and modernity, for Humanism, too, is important to the Paradox of Padua. The basic idea is the simple one that Harvey could be influenced by Humanists even if he himself was not one, just as he could influence mechanists and experimentalists when he was not one.[63]

Here I shall emphasize three little threads running through Renaissance Humanism that are of central importance to understanding Harvey, but without implying that Harvey is adequately categorized as a Humanist (medical or otherwise). This is extremely important, because I think that the history of philosophy and medicine in the early modern period has suffered from not paying enough attention to the influence of Humanist thought. One is led far astray if one follows Walter Pagel in thinking that Humanism is just a historically preparatory handmaiden for more important things to come.[64]

The first thread has already been discussed: the Humanists' ability to combine old and new in a heady mix of respect for authority and desire to supersede (or at least equal) those authorities. As I shall discuss in more detail in Chapter 2, this is exactly how one should understand Harvey's training under Fabricius ab Aquapendente during his time at Padua. The next thread is one related to this, for respect for authority necessitated paying closer attention to translation, and resulted in new—and better—versions of texts which had long formed the traditional curriculum. Throughout this dissertation, I have taken the time whenever possible to immerse myself in the these translations, specifically those used by Harvey, as these are a good guide to certain concepts and terms central to understanding his philosophy. Of course, early Humanists reacted strongly against the excesses of Medieval Aristotelianism, and often rejected the use of technical terminology or arcane debates over interpretations of the Peripatetic.

[63] At least, not one in the same sense.
[64] Pagel, Walter 1977, "Medical humanism—a historical necessity in the era of the Renaissance," In: *Essays on the Life and Work of Thomas Linacre,* Oxford: 375-386.

However, over the course of the sixteenth century, through interactions with more traditional Scholastic philosophers as well as through reappraisal of the Medievals, Humanists, and those they influenced, came to not only embrace technical terminology, but returned to Aristotle, and, importantly, came to fundamentally change how he was understood, as I shall discuss in detail in Chapter 2. Thus later thinkers, like Augustino Nifo and especially Pietro Pomponazzi, returned to an Aristotelian philosophy that was opposed to the rhetorical and consolatory devices, but which still benefited from the philological and translational prowess of earlier Humanists. Harvey's philosophy is deeply related and influenced by these later traditions of Renaissance Arisotelianisms, for he too was interested in, as it were, the things of nature in themselves and not one's rhetorical devices and eloquent speeches praising them. While it is important to keep these later philosophers distinct from earlier Humanists, I do not think one must go as far as Kristeller in reifying these groups of philosophers into completely separate traditions.[65] For, as Anthony Grafton has argued, Humanist activities continued well into the seventeenth century, and there were deep and lasting interactions and influence between all the traditions which Kristeller argues we must keep entirely distinct.[66]

The final thread I want to pull upon to help unravel the knot of Harvey's philosophy is that Humanists, interested as they were in the things themselves, became collectors. Grafton traces this fascination with natural history back to Pliny's work:

> …this great encyclopedic work, though itself mostly compiled from written sources, offered a wealth of information about the development of sculpture and the range of natural objects and species. Though Pliny remained the richest source of information about the arts in antiquity, Aristotle's works on animals and Theophrastus' on plants, translated into Latin in the mid fifteenth century, complemented it with further material, much of it derived from direct inspection of the natural world. Humanists collected gems, fragments of ancient sculpture and modern art objects, shells and fossils. Connoisseurship became almost as central a skill of the educated young man as Latin eloquence.[67]

[65] Kristeller 1966, 35.
[66] Grafton, Anthony 1996, "The new science and traditions of humanism," In: *The Cambridge Companion to Renaissance Humanism,* Ed. Jill Kraye, Cambridge: Cambridge University Press.
[67] Grafton 1996, 214.

Thus natural history—*historia*—became a fundamental aspect of their intellectual life and practices, a theme of deep importance and which I shall return to and discuss in detail in Chapters 5 and 6. This curiosity is important because it led not just to more philosophizing *a la* Pliny or Aristotle, but it led also to *observation*. These observational practices do not, of course, lead by any straight path to science and modernity, but their institution into the conceptual scheme and intellectual activities of the Humanists is of fundamental importance for understanding Harvey. For these lessons of personal observation—what the physicians called *autopsia*—lay the grounds and provided the inspiration for aspects of Harvey's experimental and experiential practices.

What Harvey learned from Fabricius in Padua was thus not Scholastic Aristotelianism, or Humanist philosophy, or anything that historians can easily label. It is easier for those of a philosophical bent, for what Harvey learned was a profoundly important philosophical methodology, a way of performing investigations into nature. This places Harvey in a curious position where he views the long-dead Aristotle as more of a colleague than a contemporary and still-living physician practicing in the traditional Galenic mold. This collegiality has been often misunderstood by historians. Historians often take Harvey's respect for Aristotle and Galen as obsequiousness, and so we see Christopher Hill arguing that Harvey spared Aristotle as much as he could, and that "In his early lectures Harvey had been equally deferential to Galen…."[68] The implication is that Harvey's respect for the ancients was somehow too deferential, and that he was somehow irrational to continue in these beliefs. What is missing from these views, however, is that, in the context of the Humanism and various Renaissance Aristotelianism, Harvey's respect for the Ancients and Aristotle goes hand in hand with his desire to fix their mistakes and reform their philosophies. James Bono, in contrasting the philosophies of Jean Fernel and

[68] Hill, Christopher 1964, "William Harvey and the Idea of Monarchy," In: *Past and Present* 27, 57-58.

Harvey, argues that Harvey not only opposed the doctrines of Fernel (particularly his theory of spirits and his invocation of transcendental causation), but also the very theoretical language in which Fernel expresses himself. Bono goes on to describe Harvey in the following way,

> Finding words is easy enough, of course. Defining words, in a manner suited to reflect some aspect of nature properly, is more difficult. Harvey the quiet, even conservative, "revolutionary" still chose to mine classical sources and their offspring for words; his vocabulary is still the vocabulary of Renaissance theoretical medicine - of Aristotle, Galen, Fernel. Yet, if Fernel in his attitudes toward language and the interpretation of nature conforms most closely to the esoteric traditions of Florentine Neoplatonists Ficino and Pico della Mirandola, Harvey instead follows critical tendencies like those of the Italian humanism exemplified by Lorenzo Valla. Harvey, in short, looks upon his Greco-Roman and medieval-Renaissance sources as rich lodes to be mined, but ones whose ores the scientist must assay in order to determine their authenticity.[69]

Anyone deeply influenced by the Humanists would learn to value deeply the work of the Ancients, but, importantly, such a philosopher would be unwilling to take this work at face value and accept it uncritically. Though he has been accused of being not just a Royalist but also a deeply *conservative* thinker, Harvey was but guilty of going with the flow of Renaissance intellectual currents.

1.4. SOME BACKGROUND ON HARVEY'S TREATISES

The goal of this section is to briefly review Harvey's understudied works, focusing primarily on the *Prelectiones anatomie universalis* and the *De motu locali animlaium,* as these two have much in common and are the least understood. I also briefly discuss the *De generatione animalium.* I

[69] Bono, James (1990), "Reform and the Languages of Renaissance Theoretical Medicine: Harvey versus Fernel," *Journal of the History of Biology*, 23(3): 369-370. In this interesting paper, Bono maintains that what was at stake in the conflict between Harvey and Fernel was a matter of language: both were reformers of medicine in a linguistic sense (among other senses). I will not discuss Bono's position, but I must note that there is agreement here insofar as we both stress the importance of definition. However, in terms of 'definition', I am concerned less with the linguistic aspect that Bono stresses, and rather more with the empirical aspect of the process that involves anatomy and determining the essences of living creatures and their parts, as I discussed above. Bono, in his paper, attempts to downplay the actual empirical aspect of Harvey's work in favor of certain philosophical and methodological assumptions about the role of observation in philosophy and medicine..

choose not to discuss his well-known works, the *De motu cordis* and the *De circulatione sanguinis,* as these works have already received a great deal of attention.[70]

The ability to dissect human bodies was ensured by Queen Elizabeth I in 1565, who gave the College of Physicians the right to dissect annually the bodies of up to four criminals hanged in London, in Middlesex or in any county within a radius of 16 miles. From roughly this point on, the College appointed one of their fellows to give a public lecture on an anatomy. These were called the Lumleian Lectures, founded by John Lumley in 1582, having been given the seal by Queen Elizabeth.[71] Geoffrey Keynes, in his *Life of William Harvey*, describes Lord Lumley as having had,

> …a distinguished, though chequered, career in court circles, and was High steward of Oxford University for fifty years. He was imprisoned in the Tower of London from 1569 to 1572 for taking part in a Catholic conspiracy, but a few years after his release…he acquired great wealth b y becoming sole legatee of his father-in-law, the twelfth Early of Arundel. Lumley was troubled because abuse of the good name of surgery by quacks and wise-women was still rampant in spite of King Henry's efforts to suppress them; he therefore sought to raise the repute of both surgery and anatomy by founding, at the suggestion of Dr. Richard Caldwell, a senior Fellow of the College, 'A publicke lecture or lesson in Surgerie', as it is called in Holinshed's *Chronicles*. The lecturer's stipend was to be equal to that awarded in the Universities.[72]

The duty of the lecturer was to provide, over the course of six years, a twice weekly lecture, in both Latin and English, concerning the 'whole art of surgerie.' Thus through a tripartite indenture between Lord Lumley, Richard Caldwell and the President of the Royal College of Physicians, the lecture was established in a letter found today in the Royal College of Physicians.[73] This letter describes in detail the rules and regulations for the Lecture. The letter

[70] Though do see: Keynes, Sir Geoffrey 1966, *The Life of William Harvey*, Oxford University Press: Oxford, and especially Pagel 1967 and 1976. These works provide an a great deal of information on Harvey and his intellectual, social, and cultural context.
[71] See: Lumley, John 1582, "Lumleian Lecture, letter re: Seal by Elizabeth to Lord Lumley," Manuscript, Royal College of Physicians Library: 1022/21.
[72] Keynes 1966, 84-85
[73] Transcribed copy 1979 [1582], "Lumleian Lectures, Indinture tripartite between Lord Lumley Dr. Caldwal and President of College re: surgery lecture," Royal College of Physicians Library: 1022/22. The letter begins, "Ad honorem Ominipotentis Dei, qui omnis doctrinae & scientae laudabilis fons est & origo; & ad publicam Regiae Maejestatis subditorum utilitatem; quibus vel in praesenti prodesse poterit, vel posthac etiam ullo modo usui futura

assigns the following works as textbooks: Horatius Morus' *Tabulae universam,* Tagaultius' *De chirugica,* Aegineta's *De re medica,* and Holerius' *De morborum curatione*.[74] The Lumleian Lectures were thus a matter of import, and the course was taken quite seriously and planned out in some detail, even down to stipulating the chronological sequence of the course.

However, it is clear that Harvey's lecture notes do not, except perhaps by chance, follow the proposed plan for the content of the lectures: his sources are entirely different. Harvey did not, then, just blithely agree to give these lectures without any intention of giving his considered opinions, without instructing the students in what he deemed to be the best and most important methods for anatomizing. Harvey could just have easily followed this course of material, and not bothered to update or expand the course as he did, and, while it is obvious that Harvey was careful to plan his lectures with due propriety and respect towards the body and rules of the College of Physicians, avoiding those topics too controversial, it is also obvious that he was committed to giving the students the most update information possible (as evidenced by his choice of the most up-to-date and complete anatomical texts as sources[75]) and to teach them the methods he thought best suited to a properly philosophical anatomy. One can thus not overemphasize the *pedagogical* purpose of Harvey's lectures: this was not only their intended goal, but one that Harvey took seriously enough to replace an existing curriculum and set of reference materials with one of his own devising. He not only created this course anew, but modified and added to the course over the decade in which he gave the lectures, as is evidenced by the state of the notes (discussed below). Indeed, John Aubrey in his *Brief Lives* notes that

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est nobilis illa Chirurgiae scientia; et ad omnium hujus regni Chrurgorum faman et aestimationem adagendam: Nos Johannes Lumley Dominus Lumley, et Richardus Cladwall Armiger in Medicina Doctor Londinensis, ut Lectura quaedam in re Chirurgica et habeatur publice, et in perpetuum firmetur in Collegio Medicorum Londinensi, haec nostra Statuta et Decreta in hac quae sequitur forma ordinamus et statuimus."

[74] Horatius Morus of Florence 1584, *Tabulae universam chirugiam miro ordine complectens*, London; Tagaultius of Paris 1560 (the original edition is 1543, *De chirugica institutione*, Paris; Paulus Aegineta (1532), *De re medica*, Paris; Jacobus Hollerius (1565), *De morborum curatione, Ejusdem de febribus, de peste, de remediis KATA TOPOS in Galeni libros de material chirurgica*, Paris.

[75] Most importantly: Bauhin, Caspar 1605, *Theatrum anatomicum*, Frankfurt; and Laurentius 1600, *Historia Anatomica,* Paris.

Harvey cared about teaching, at least to those who were polite and deferential: "He was very communicative, and willing to instruct any that were modest and respectfull to him."[76] One must try to keep in mind the pedagogical purpose of the lectures in mind.

Harvey was appointed Lumleian lecturer in August 1615 and in the following spring conducted his first public anatomy, the fourth such Lecturer. Harvey's notes seem intended to be given during an actual dissection,[77] as opposed to a mere lecture on anatomy from various authoritative texts, though there is an element of this in the notes. Harvey gave these lectures every two years until at least 1626, which we know from the diligent research of Gweneth Whitteridge. She argues that,

> If…the practice begun in 1599 by which the annual anatomy was given alternately by the Lumleian lecturer and a Fellow of the College, still obtained after 1616, and if the scope of this anatomy was identical with that adumbrated in Harvey's *Prelectiones*, then it follows that Harvey used these notes on more than one occasion. In 1617 he was officially informed that it was his turn as a Fellow to give the annual anatomy in the spring of 1618. If, in addition tot his we may assume that he demonstrated every year in which no Fellow of the College is named as having been instructed to hold the anatomy, then it is likely that he did so in 1620, 1622, 1624, 1626 and 1627. Although this is conjecture, the notes themselves show that they were used on several occasions for they contain numerous additions, some of which are dateable. For the fundamental basis of his lecture, Harvey used the text-book of Caspar Bauhin, the *Theatrum anatomicum,* which was published in 1605. A second edition of this work was printed in 1621 and some of the additions to Harvey's text are traceable to this source. A reference to a post-mortem finding in his own father cannot have been added until the after the death of Thomas Harvey in 1623. A post-mortem finding on Lord Chichester cannot have been recorded until after 1625. Latest of all, there are in the *Prelectiones* some four references to the edition of Jean Riolan's *Anthropographiae* which was published in 1626.[78]

So, while the notes were added and changed up until at least 1626, this does not mean that they represent accurately and completely Harvey's opinions on matters anatomical and philosophical. In fact, quite the contrary is true: the notes, as we have them are incomplete, as they are missing

[76] Aubrey, John 1898, *Brief Lives Vol. I.,* Ed. Andrew Clark, Oxford: Clarendon Press, 300. The point about respectfulness serves to underscore the fact that Harvey's view of authority was, at least sometimes, traditional and conservative.
[77] See: Whitteridge, Gweneth 1964, *The Anatomical Lectures of William Harvey,* London: Royal College of Physicians, xxv.
[78] Whitteridge 1964, xxviii-xxix.

an account of the skeleton, which Harvey said he would deal with, as well as any material about the sense organs, the female genital organs, or the visceral nerves. It is unknown, and most likely impossible to determine, whether or not Harvey covered any of these topics in his actual lectures, or whether he stuck more closely with the material covered in the notes. Indeed, the relation between his notes and his actual lectures is impossible to determine. Even if these lacunae in our knowledge did not exist, it would still be doubtful that the notes and lectures represented Harvey's state of anatomical knowledge. This is because the College of Physicians kept watch over its fellows, making sure that none of their behavior was untoward with their standards and principles. Thus Whitteridge writes,

> The College of Physicians kept a strict watch on what was taught by its Fellows, and anyone propounding theories contrary to the teaching of Galen was liable to be fined. Harvey's contemporaries, and Harvey himself in the *Prelectiones*, excused the errors of Galen and the ancients on the grounds that the body had changed since the days of antiquity. This whole attitude sums up in his letter to Slegel, written in 1651, when he excuses Riolan's obstinate refusal to accept the circulation of the blood by saying: 'As Dean of the College of Paris, he was bound to see the physic of Galen kept in good repair, and to admit no novelty into the school, without the most careful winnowing, lest, as he says, the precepts and dogmata of physic should be disturbed, and the pathology which has for so many years obtained the sanction of all the learned in assigned the causes of disease to be overthrown'.[79]

Harvey, as a fellow of the College (1607) and as its Censor (1613, 1625, 1629**)**, would surely have kept in mind the duties of his status, of which ensuring the 'good repair' of various aspects of traditional medical doctrine was surely one. But recalling the importance of Humanism, I note that Harvey does point out errors in the work of the Ancients, though in sum his notes contain little that might have earned him the wrath of the College Fellows.[80] Indeed, one could use Harvey's notes here to delimit the most hotly debated topics. Whitteridge writes that,

> For the most part the notes seem to be relevant to an actual dissection where the demonstrator was required not only to show anatomical structures but to discuss function in health and disease. Sometimes, however, they do seem to belong more nearly to the

[79] Whitteridge 1964, xxxi-xxxii.
[80] And, again, not knowing the relationship between the notes and the lecture's, it is impossible to determine if Harvey avoided even those small controversial topics contained in the *Prelectiones*.

> lecture room than to the anatomy theatre and these long discussions perhaps Harvey omitted or, at least, summarized. Controversy he certainly avoids, but leaves no doubt as to the topics which were most hotly debated. [81]

So, for instance, while Harvey had surely performed most of the work needed to demonstrate his conclusion that the blood flows in a circuit around the body was surely done by 1626, Harvey's discussion of the function of the valves is in complete agreement with pre-circulatory ideas.

However, even though Harvey does avoid controversial topics, this aspect of the notes should not lessen one's interest in them. For, despite the expectation that the notes might lack in novelty, I shall show in great detail in Chapters 2 and 3 that Harvey's conception of anatomy was *not* a traditional one, and that his methodological prescriptions, most importantly the 'Rule of Socrates' which will figure prominently in Chapter 6, are both novel in content and in the mode in which they are expressed. The notes are most worthy of our collective scholarly attention.

On to the actual state of the notes. The notes are just that: *notes*. They are organized, in some places quite complexly, but they are also disorganized, written over, marked on, with parts crossed out, lines drawn to place added bits, and various notes written in the margins. Indeed, on some pages there are even doodles![82] The following is a sample of the text, just to give you an impression of their state and circumstances:

[81] Whitteridge 1964, xxxv.

[82] In particular, Harvey seems to like drawing hands.

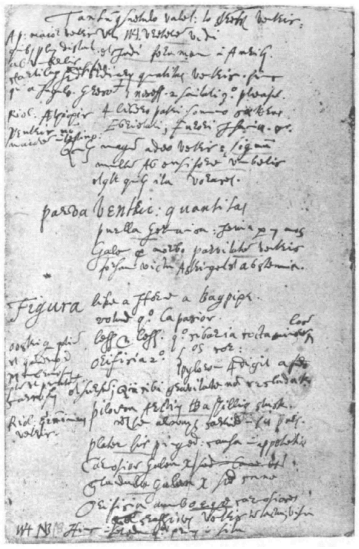

Figure 1: A sample page (f.31) from Harvey's notes, taken from the 1886 Royal College of Physician's transcription.

They are, to say the least, messy: Harvey's handwriting is notoriously terrible—even with the low standards set for the writing of physicians—and his Latin is often mixed with bits of English. His sentences are often no such thing, mere fragments, phrases, or words. Yet Whitteridge's translation, the only modern one with scholarly apparatus available, does not reflect the state of the notes. Her translation is in complete sentences, and the Latin of the notes often does not warrant this expansive translation, or at least not the translation offered by Whitteridge. Thus Whitteridge's translation, when quoted without attention to these issues, hides the fact that she is often offering substantive interpretations of Harvey's text.

Note too a further act of interpretation: Whitteridge's transcription of these notes. Harvey's writing was terrible, and often the text can only be guessed at. I have encountered this first hand while doing archival research at the British Library: without Whitteridge's translation as a guide, I would not have been able to slowly piece together how to read Harvey's handwriting. There are numerous instances where Harvey's handwriting is so illegible as to make transliteration no more than guesswork, or where his writing leaves at least two

possibilities for transcription, both of which make some sense of the passage. After having the pleasure of reviewing the original manuscripts, and comparing them with their transcriptions as rendered both by the Royal College of Physicians and by Whitteridge, I have found a number of mistakes and errors, some of which shall prove important and will be discussed as they become relevant. Thus, in offering my own translations of Harvey's lecture notes, I want to emphasize their nature as *interpretations* not only of the content of Harvey's writing, but often, in fact, of the very transcription of that writing itself!

I now turn to the *De motu locali animalium.*[83] In many ways this work is much the same as the *Prelectiones* in that parts are scribbled out, incomplete, and written over. Much of what I say above regarding the *Prelectiones* holds here too, in terms of transcription and translation. However, this manuscript is more highly structured, and there are at least the beginnings of a serious effort to organize his thoughts on the movements of animals in a publishable form. What is so interesting about these notes, and which I will discuss in Chapter 2, is that Harvey here expresses a conception of anatomy here almost exactly in accordance with the interpretation I hope to offer in this dissertation, one deeply indebted to the conception of the soul as the form of the organic body, one where soul and nature are the primary explanatory concepts of the anatomist. Further, though I do not deal with this here, the work contains some extremely interesting and innovative attempts to grapple with the pseudo-Aristotelian *Mechanica* tradition. Finally, from a reference to Harvey's own *De motu cordis,* it is easy to determine that the notes were most likely written in 1627, though exactly when he started and stopped working on them are more difficult to determine.

I turn finally to Harvey's *De generatione animalium.* This work was probably completed in the 1640s, but was not published until 1651 at the behest of George Ent (who had to

[83] See: Whitteridge's Wilkin's Lecture 1979, "Of the Movement of Animals," *Proceedings of the Royal Society of London* (Biological Sciences), 206(1162), 1-13.

practically beg Harvey to provide the manuscript to him). During the civil war in England, Harvey's notes on the generation of insects, which were to be a centerpiece of his treatise on generation, were stolen from his home in Whitehall, part of the reason for his initial unwillingness to publish. This work is in many ways quite different than the *De motu cordis:* where the latter is small and concise, the former is large and verbose; where the latter contains obviously radical new doctrines, the former seems of a piece with Renaissance works on the matter. The *De generatione* is a long and complex work, and though it has been discussed, it has not really seen any serious analysis until recently. But, as I show in Chapter 4, this work is deeply important if one hopes to understand the full scope and range of Harvey's philosophy. For, while it is different than *De motu,* they both, as I shall argue, share a common teleological grounding.

These facts now in hand, I move on to heart of my interpretation of Harvey: anatomy as the investigation of soul and body.

2.0. BODY, SOUL, AND THE TELEOLOGY OF BEING

While a physician practicing today might label Harvey's work as functional anatomy or physiology, this will not do for the careful historian.[1] Harvey understood his subject matter in a quite different manner: as an investigation into the teleological union of soul and body. It was an investigation into 'what is *common* to body and soul,' as Aristotle describes his approach in *De sensu*, his treatise on sensation.[2] As R.A.H. King notes in his introduction to a volume on body and soul in the ancient world,

> The phrase 'common to body and soul' refers to a central group of problems in ancient philosophical psychology, including not merely interaction between soul and body, but parallelism and teleological or functional relations. Furthermore, it marks the point where philosophy and more empirically minded approaches meet, including both those of Aristotle in *Parva Naturalia* and of medical writers.[3]

Harvey's work thus fits into a long tradition of philosophical and medical investigation into soul and body done in the spirit of *De sensu* and the rest of Aristotle's *Parva naturalia*. James Lennox describes this Aristotelian conception of soul as a, "…set of goal-oriented capacities—nutritive, reproductive, locomotive, and cognitive."[4] Soul, then, was a fundamentally teleological concept. And though historians and philosophers from Walter Pagel on have stressed that Harvey was a

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[1] Of course, a great deal of Harveian historiography makes this mistake, seeing Harvey as modern, scientific, the founder of modern medicine; for instance, see Walter Pagel's 1981, "'*Circulatio*' - its unusual connotations and William Harvey's philosophy," in Cohen, I.B., *Studies on William Harvey*, New York: Arno Press. For a similar point, see French 1994a, 92f.41.

[2] Aristotle *De Sensu* Cap.1; The meaning of this phrase in Aristotle is complicated and obscure, but, according to Pierre-Marie Morel, it means something like 'states or properties of living beings,' such as youth, old age, sleep, etc., and to which I add, the natures of the parts of animals. See: Morel, Pierre-Marie 2006, "'Common to Soul and Body' in the *Parva Naturalia*," In: *Common to Body and Soul*, Ed. R.A.H. King, New York: Walter de Gruyter, 121-122.

[3] King, R.A.H. 2006, "Introduction," In: *Common to Body and Soul,* Berlin: Walter de Gruyter, 3.

[4] Lennox, James 2001b, "Matter, Form, Kind (Introduction to Part II)," In: *Aristotle's Philosophy of Biology*, Cambridge: Cambridge University Press: 128. Cf. Pierre Pellegrin 1982, *La Classification des animaux chez Aristote: statut de la biologie et unite de l'arisotelisme*, Paris; Pellegrin 1987, "Logical and biological difference: the unity of Aristotle's thought," In: *Philosophical Issues in Aristotle's Biology*, Eds. Allan Gotthelf and James Lennox, Cambridge: Cambridge University Press.

lifelong thinker about purpose,[5] there has not been a *systematic* attempt to understand exactly how teleology operates in the full range of his works.[6]

John Aubrey wrote: "All his profession would allowe him to be an excellent anatomist, but I never heard of any that admired his therapeutic way."[7] This quote from Aubrey illustrates two points: one, Harvey was a great anatomist, recognized as such by his peers; and two, anatomy and therapy can be sharply distinguished from each other, at least for Harvey. This is puzzling: if anatomy and therapy are sharply distinguished, and being good at one did not lead to proficiency in the other, what, then, was the purpose of anatomy?[8] The term anatomy is ambiguous between three senses of the word: it might refer to the *activity* of an anatomy, that is, the cutting up and of the body; it might refer to the *ability* to perform that activity, that is, one's skill at dissection; or it might refer to the *results* of that activity, that is, knowledge of the parts of the body. A careful look at meaning of these words in Harvey's time gives one good reason to think that all three aspects of anatomy are important. The first two are most important if one is interested in the *method* of doing an anatomy, while the last aspect is most important if one is interested in understanding the *product* of doing an anatomy. It is the latter which I explore in this and the following two chapters, turning to method in Chapters 5 and 6.

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[5] Pagel 1967, 25, 211.
[6] I would also add that historians have systematically misunderstood Harvey's teleology.
[7] Aubrey 1898, 302.
[8] Though perhaps one should not be puzzled, if John Locke's position in the *Anatomia* manuscript is any guide on this issue (or perhaps Sydenham's position, insofar as there is a difference, as it is possible it was dictated to Locke by Sydenham). See: Locke, John 1668 [1958], *Anatomia*, In: "Locke and Sydenham on the teaching of anatomy," *Medical History*, 2: 1-12. He writes, "Anatomie noe question is absolutely necessary to a Chirugen and to a physitian who would direct a surgeon in incision and trepanning and severall other operations. It often too directs the physician's hand in the right application of topicall remedys and in his judgment in the prognostique of wounds, humours and severall other organicall diseases too...But that anatomie is likely to afford any great improvement in the practice of physic, or assist a man in the findeing out and establishing a true method, I have reason to doubt. All that Anatomie can doe is only to shew us the gross and sensible parts of the body, or the vapid and dead juices all which, after the most diligent search, will be not much able to direct a physician how to cure a disease than how to make a man; for to remedy the defects of a part whose organicall constitution and that texture whereby it operates, he cannot possibly know, is alike hard, as to make a part which he knows not how is made" (3-4). See also: Wolfe, David E 1973, "Sydenham and Locke on the limits of anatomy," *Bulletin of the History of Medicine* (35): 193-220. Roger French's 1999 *Dissection and Vivisection in the European Renaissance* is also very helpful in understanding why anatomists were producing so much 'useless' knowledge. French argues that understanding not just the philosophical context (with which I am mainly concerned) but the religious context of anatomy is quite important for understanding this issue.

Harvey defined anatomy as, "…the ability which by occular inspection and cutting teaches the uses and actions of the parts."[9] The goal of this and the following two chapters is to examine and characterize how Harvey conceived of the subject matter of anatomy and the teleological explanations proper to it. In this chapter I discuss the history and philosophical background to Harvey's works, before fitting Harvey's own unique philosophy itself into this philosophical tradition. In the following chapter I expand upon this conception of Harvey's work by adding his conception of the meaning of a 'part' of the body and the system of hypothetical necessity that governs them, as well fitting in the *De motu cordis* into this conception of Harvey's anatomical work and explanations. I argue that Harvey understood these explanations in terms of the teleology of being, or '*being for the sake of*'. Here I focus especially on two understudied texts: the *Prelectiones anatomie universalis* (1616-1626) and the *De motu locali animalium* (1627), as well as Harvey's most famous work, the *De motu cordis* (1628). Harvey's last treatise, the *De generatione animalium* (1651), merits its own discussion in the following chapter, as it involves the teleology of becoming, or '*coming to be for the sake of*'. As I argue in Chapters 5 and 6, both of these sorts of teleology are essential for determining the definitions of the parts and of whole organisms, definition being the central goal of Harvey's Aristotleian methods.

The organization of this chapter will be as follows. The first section (**Section 2.1**) deals with how Harvey's philosophical predecessors conceptualized the subject matter of anatomy, the ensouled bodies of living animals, as characterized by the teleology of 'being for the sake of'. I discuss first the conception of Aristotle (**Section 2.1.1**), then that of Galen (**Section 2.1.1**), then those of a number of important Renaissance figures (**Section 2.1.3**), before finally discussing Harvey (**Section 2.2**).

[9] Harvey 1616, 4. "Anatomia est facultas quae occulari inspectione et sectione partium usus et actiones." This is a tricky line to understand, I shall discuss it in detail in Chapter 5.

2.1. COMMON TO BODY AND SOUL IN THE PHILOSOPHICAL TRADITION

Soul was an important object of inquiry for philosophers and physicians from the ancient to the early modern periods. [10] Part of the project of Aristotelian Scholastic philosophers across Europe was, according to Dennis Des Chene, "…to establish the principles of a science of life,"[11] here following Aristotle, for whom the soul *just was* the principle of life.[12] In this tradition, the organs of animals, and, indeed, the whole bodies of animals, were understood as the *instruments* through which the soul acts. Etymology is helpful here. The Latin words *instrumentum* and *organum*, like the Greek word, *organon*, mean 'tool, or instrument.' This concept of instrumentality was characterized as a teleological relation where the organic body and its parts are said to be 'for the sake of' the soul. Thus the natural philosopher or physician could

[10] I am not suggesting that philosophy and medicine were coextensive, or that, institutionally or epistemologically speaking, there are no lines to be drawn between the two disciplines. Rather, as has been stressed by many writing on the history of medicine and philosophy, there is a great deal of overlap and exchange between these traditions. Harvey himself is more explicitly philosophical than many among the *medici*, but all were familiar with philosophical doctrines. Though literature on the interaction between medicine and philosophy is vast, there is still much work to be done especially in the late Renaissance and early modern periods. Some highlights of the relevant literature, which focuses mostly on earlier periods, include: Bylebyl, Jerome 1990, "The Medical Meaning of *Physica*," *Osiris* 6, 16-41; Kristeller, Paul Oskar 1945, "The School of Salerno: Its Development and Contribution to the History of Learning," *Bulletin of the History of Medicine* 17, 138-194; and, of course, much of the work of Nancy Sirasai, including 1973, *Arts and Sciences at Padua: The Studium of Padua before 1350*, Toronto: Pontifical Institute of Mediaeval Studies; and 1981, *Taddeo Alderotti and His Pupils: Two Generations of Italian Medical Learning*, Princeton: Princeton University Press. See also: Wear, French and Lonie 1985, *The Medical Renaissance of the Sixteenth Century*, Cambridge: Cambridge University Press, especially Charles Schmitt's "Aristotle Amongst the Physicians"; Schmitt, Charles 1981, *Studies in Renaissance Philosophy and Science,* Variorum Reprints.

[11] Des Chene, Dennis 2000, *Life's Form,* Ithaca: Cornell University Press, 6. One should be careful, of course, not to read 'science of life' as being equivalent to modern life sciences.

[12] Aristotle 1552, *De anima…Michaele Sophiano interpretate,* Lib.I, Cap.1, In: *Aristotelis libri omnes…cum Averrois Cordubensis variis in eosdem commentariis*, Volume 11, Venice, 1v. Aristotle says that the soul here is the "…principium animalium." In order to trace some terminological and philosophical relations between the Philosopher and Harvey, all quotations and references to Aristotle are from the edition of Aristotle that Harvey used, the Aristotle-Averroes Giunta edition of 1552; similarly, with Galen, all references are to the 1549 *omnia* edition of his works. I hope also in this way to make plausible that, in addition to getting Aristotle 'right', I am offering an interpretation that would be available to Renaissance scholars, including Harvey.

investigate—and indeed, as many would come to believe, *should* investigate—soul as it operates and organizes living animal bodies.[13]

2.1.1. Body and Soul in Aristotle

In this section I elaborate those aspects central to Aristotle's understanding of the soul. I emphasize that an investigation into soul is, of necessity, an investigation into body as well. Here body and soul are *unities* of matter and form, tied together by teleology.[14]

I start, naturally enough, with the first book of Aristotle's treatise on the soul, *De anima.* For Aristotle, as for the Greeks since at least Homer, the soul was understood as the *principle of life,* though Aristotle's account was much more sophisticated than the Pre-Socratics' or even Plato's.[15] For Aristotle, as noted above by Lennox, the soul consisted of a number of goal-oriented capacities whose performance completed the different life functions necessary for a creature's existence. The most basic of these, the nutritive or vegetive soul, was possessed by all living creatures, including plants. In the first part of *De anima,* Aristotle argued that souls were effectively 'enmattered structures.' That is, because affections of soul like anger always affect a particular part of the body (e.g., one's heart beats faster),[16] the soul must be ontologically inseparable from that body. As Mariska Leunissen describes it in her book on Aristotle's teleology, "Form and matter cannot be separated in a definition of the affections of the soul, because if the affection is to be what it is, it needs to be realized in a particular kind of

[13] The best starting place for some of the relevant history is: Park, Katherine "The Organic Soul," Ch.14, In: *The Cambridge History of Renaissance Philosophy*, Eds. Charles B. Schmitt, Quentin Skinner, Eckhard Kessler, Jill Kraye, Cambridge: Cambridge University Press. See also: Deer [Richardson], Linda (1980) *Academic Theories of Generation,* Dissertation presented to the Warburg Institute, 457-458.
[14] As I shall repeatedly emphasize, the unity of body and soul is a *teleological* unity. As is the way with such unities, understanding the one requires understanding the other.
[15] Bremmer, Jan 1983, The *Early Greek Concept of the Soul*, Princeton: Princeton University Press. See also: Burnet, John 1916, "The Socratic doctrine of the soul*," Proceedings of the British Academ*y 7, 235–59.
[16] With the possible exception of the organ for the soul faculty of reason.

body…."[17] Leunissen notes that Aristotle's basic assumption in this first chapter was the fundamentally teleological one that the body is for the sake of the soul: "…living beings have the kind of bodies and bodily parts they have *for the sake of* performing all their characteristic life functions."[18] Note the distinctive language of 'being for the sake of' which Aristotle used to describe the relation between a part and its function. This terminology of 'that for the sake of which' is the most literal translation of Aristotle's *to hou heneka,* what becomes known as the final cause.

Aristotle argued that in order to understand why a natural object comes into existence and exists in the way that it does, one must understand the end towards which that thing acts.[19] For it was obvious to Aristotle that natural change was purposeful and proceeded toward some end, when not interrupted: all natural objects act for the sake of something.[20] In order to explain the coming to be and being of, say, the teeth of an animal, one must understand the reason why teeth are needed in an animal body, i.e., they are needed in order to mash food and assist in the process of nutrition. For Aristotle, the final cause was essential in accounting for the regularity and harmony displayed by natural things. And a prime example of this regularity is found in the parts of animals: these parts all come to be in certain regular ways,[21] and, as I shall discuss below, their material natures are constructed in order to serve the harmonious functioning of the organism. Indeed, it is essential to understanding Aristotle's account of the final cause to

[17] Leunissen, Mariska 2010, *Explanation and Teleology in Aristotle's Science of Nature,* Cambridge: Cambridge University Press: 52. My conception of Aristotle's teleology is greatly indebted to Leunissen's work, as well as the work of, and conversations with, James Lennox and Allen Gotthelf.
[18] Leunissen 2010, 53.
[19] Aristotle's most general defense of final causality is found in 1552 *Physica,* Lib.II, Cap.3 (pars secunda), In: *Aristotelis libri omnes…cum Averrois Cordubensis variis in eosdem commentariis*, Volume 4, Venice, 36. Modern editions have this as *Physics* II.8.
[20] For instance, see Aristotle 1552, *De partibus animalium,* Lib.I, Cap.1, In: *Aristotelis libri omnes…cum Averrois Cordubensis variis in eosdem commentariis*, Volume 6, Venice 63v.
[21] This process of coming to be, or generation, is discussed in the Chapter 4.

understand that an end (*telos*) of this sort must be *for the good*: for, as Aristotle notes, not all things that come last are truly ends.[22]

In the second book of *De anima* Aristotle argued that soul is the first actuality of a natural body having life potentially in it, when that body is instrumental or organic (that is, divided into functional parts). Let me unpack these notions. As Aristotle defined it, the first actuality of the body is a sort of potentiality. It is a capacity to do those things that are characteristic of living things: growing, moving, perceiving, etc. A first actuality is, to use a common example, an adult who can speak (or understand) French but who is currently silent. The second actuality, to continue with the example, would be an adult who is currently speaking French (or understanding it). Meanwhile, the first potentiality would be a child who can speak no French at all, but who could, in time, acquire the ability to do so. Moving to a biological context, Aristotle wrote that if an eye were an animal, the soul of the eye would be seeing. In other words, the actuality (activity) of the eye would be sight, and thus the eye would have the power (potentiality, capacity) to see, though sometimes, when asleep for instance, this power is not activated.[23]

Aristotle thus argued that soul is the very substance of the body according to its *logos.* So in the Latin translation of *De anima,* the soul is the,

> …substance [of the body] according to its definition [*rationem*]: moreover this is the essence [*quod quid erat esse*] of such a kind of body, just as if some instrument, like an axe, were a natural body: namely, this is the essence of the axe, its very substance, and this soul having been separated from it, it would no longer be an axe, but rather only so in name...[24]

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[22] Aristotle 1552, *Physica,* Lib.II, Cap.3 (pars prima), 27-27v. Modern editions have this as *Physics* II.2.

[23] The terminology here, and the best way to translate it, is a vexed issue, both in Aristotle scholarship and in other areas of the history of philosophy, ancient and early modern. I take no stand here, and will use activity and actuality interchangeably; capacity, power, and potentiality I also use synonymously. This is partially a reflection of the fact that Harvey especially uses a variety of words, for instance, he uses *facultas*, *actus* and *potens* to refer to the soul capacities. Plus I like synonyms.

[24] Aristotle 1552, *De anima,* Lib.II, Cap.1, Volume 11, Venice, 52. "...est enim substantia quae secundum rationem: hoc autem est quod quid erat esse huiusmodi corporis sicut si aliquod organorum physicum esset corpus ut dolabra: erat quidem enim dolabrae esse, substantia ipsius & anima haec divisa autem haec non utique amplius dolabra erit, sed aut aequivoce…." Note that '*quod quid erat esse*' and the shortened '*erat esse'* is the translation of '*to ti en*

The soul, then, is what makes a living animal what it is, it is the substance of the body of the animal *qua logos*, its essence, and importantly, what it is to be a living being depends upon the kinds of soul functions that can be performed. Soul is the *form* of a living body; it is the formal nature of and source of change in the body. An animal without soul would no longer be able to perform its characteristic functions, and would not be the sort of creature it is.[25] In this way the soul is a principle of individuation, insofar as different sorts of living creatures are coextensive with different kinds of souls.[26] Note the terminology here. Of prime importance is the term *ratio,* meaning definition or account. The term reinforces the Aristotelian doctrine that what something *is,* is what it *does*: essence, definition, and function are tightly bound together. The functions of the parts, then, are essentially bound up with the work of defining the parts and the whole being of the animal.

Another work of Aristotle's also put together form, function, and essence, one central to the Renaissance medical tradition: the *Meteorology*.[27] *Meteorology* IV.12 puts function and form together in the specific case of the homogenous parts of animals:

> The homogenous parts are made from the same elements, and all works of nature are made from these as matter. All these bodies so described, as from matter, are [determined] according to their substance, their definition [*rationem*]. This is always clearer in those posterior things, and in whatsoever is like an instrument and is for the sake of something. It is most clear that a dead man is only equivocally a man. Thus a dead hand is said equivocally just as stone flutes might still be called flutes, for these seem to be instruments of some kind.[28]

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einai,' a very difficult phrase and concept in Greek, and which gave the Latin translators much trouble, hence their neologism of '*essentia*.' Later, Humanist, translators, however, tended to avoid '*essentia*,' and instead one finds that translators as diverse as Melanchthon and Cardinal Bessarion understood '*quod quid erat esse*' as 'essence,' the 'what it is to be' of a thing. I choose here to use the term essence instead of this more literal and cumbersome phrase, though essence too is not without its semantic problems. All translations in this chapter are my own unless otherwise noted, though I have, of course, consulted modern translations when available.

[25] See also Aquinas, *Quaestiones Disputatae de Potentia Dei*, Q.III.9.

[26] C.f. Leunissen 2010, 51. This also comes out clearly in the first chapter of Galen's *De natura facultatibus,* though Galen uses soul only in reference to animals.

[27] Martin, Craig 2002, "Francisco Valles and the Renaissance Reinterpretation of Aristotle's *Meteorologica* IV as a Medical Text," *Early Science and Medicine* 7(1).

[28] Aristotle 1552, *Meteorologicorum*, Lib.IV, Cap.12, In: *Aristotelis libri omnes…cum Averrois Cordubensis variis in eosdem commentariis*, Vol. 5, Venice, 222. "Ex elementis enim ea, quae similarium partium: ex his autem, ut materia, omnia opera naturae. Sunt aut omnia, ut ex materia quidem, ex dictis: ut autem secundum substantiam,

Aristotle added that, "Moreover, everything is determined by its work [*opere*]: everything is itself when it can perform its function [*opus*]; an eye, for instance, when it can see."[29] For Aristotle, one thus understands a part when one knows its function. What something is, is what it does—for this reason a dead man is not truly a man, in the same way that a stone flute, since it cannot be played, is not truly a flute.[30] One can then explain that thing by making reference to its essence (its soul), for this accounts for its nature, including why it has the parts it has.

This brings us back to soul as substance, for, given this account, Aristotle argued that soul must be, "… the cause and principle of the living body…the soul is defined by the three ways something is called a cause: it is the cause of movement, it is the cause for the sake of which, and the soul is the cause of the living body, as its substance."[31] Soul is thus an explanatory concept of prime importance, understood as the efficient, final, and formal cause of the body. Emphasizing especially the importance of the final cause, Monte Johnson summarizes Aristotle's position here, noting that, "…the various bodily organs exist for the aim of…the various functions of the soul (roots for nutrition, feet for locomotion, eyes for perception)…."[32] So the organs exist for the sake of the soul and its functioning—this is just what it means to be an instrument. An example will be helpful here. Take the soul capacity of nutrition, which has the

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rationem. Semper autem magis manifestum est in posterioribus, & omnino, quicunque ut instrumenta, & alicuius gratia. Magis enim manifestum est quam mortuus hominem aequivoce. Sic igitur & manus mortui aequivoce, quaemadmodum & si fistulae lapideae dictae fuerint ut enim & haec, instrumenta quaedam vident esse."

[29] Aristotle 1552, *Meteorologicorum,* Lib.IV, Cap.12, 223. "Omnia autem sunt terminata opere omnia enim quae possunt facere suum opus, vere sunt, ut oculus, si videt." Though it is not perhaps obvious, function is the best translation here for 'opere,' as 'work' was used, especially by physicians, to denote the product of a function and thus often used to denote the function itself. Harvey explicitly uses 'opere' in this way, for which see Harvey 1616, 22.

[30] I assume that jazz great Herbie Mann was not a reader of Aristotle, or else his classic 1970 album would not have been titled 'Stone Flute.'

[31] Aristotle 1552, *De anima,* Lib.II, Cap.4, 68. "Est autem anima viventis corporis causa & principium…anima secundum determinatos tres modos causa dicitur: etenim unde motus causa est & cuius causa & sicut substantia animatorum corporum anima causa." Or as Averroes wrote, "…the soul is a cause according to the three determined senses: it is the moving cause, it is the final cause, and it is the formal cause." Averroes commentary in Aristotle 1552, *De Anima* Lib.II, Cap.III, 68v. "…anima est causa secundum tres modos determinatos, scilicet causa movens, finalis, & formalis…"

[32] Johnson, Monte 2005, *Aristotle on Teleology*, Oxford: Clarendon Press, 75.

goal of maintaining the living body. In order for this soul faculty to operate and achieve this end, certain organs are needed that help to bring this goal to fruition. The overall function is broken down into various sub-functions, and thus various parts: mouths for food to enter, teeth to mash it, a stomach to concoct it, a liver to turn it into blood, and so on. So while the ultimate end of each of these parts is nutrition (what Renaissance physicians called the *use* or *utility* of that part) the end of each part more specifically refers to whatever intermediate end it accomplishes, chewing, concocting, and so on (what was called in the Renaissance the *action* of a part). In fact, the terminology here is a good deal more complicated. Indeed, many authors (including Harvey) used action and use indiscriminately and interchangeably. But for now these definitions are more than adequate (I discuss in detail this terminology below). Note that action is here both a final and an efficient cause—it is the end of the part to perform its action, such as concocting, and these actions are the efficient causes of the ultimate end of the part, its use, such as nutrition. The living body is thus understood as a complicated hierarchical network of ends, powers, and parts.

This network and the instrumental relationship between body and soul are governed by *conditional necessity*. That is, given a particular soul function (nutrition), certain bodily parts become conditionally necessary (mouths, stomachs, etc.), and the structures and material composition of these parts in turn are conditionally necessitated by the sub-function they are meant to accomplish—e.g., teeth must be made of a hard material to mash food.[33] Given this conception of souls and bodies, we find that, "…the majority of bodily features a living being possesses will be explainable by reference to the life functions for which these features are instrumental (and hence conditionally necessary) and the possession of which constitutes the

[33] At least when things are running normally and circumstances are conducive to their flourishing, so ignoring cases of monstrous births with malformed parts and ignoring disastrous occurrences such as volcanoes when few forms of life can survive.

living being's substantial being."[34] I discuss conditional necessity in more detail below, but for now note that soul as the substantial being was the primary method of explaining living creatures for Aristotle, an explanatory framework preserved well into the early modern period. Soul thus explains both the formal and material nature of a part, as well as a part's variation across animals.[35] Furthermore, as James Lennox has argued, understanding a function (the formal nature of a part) requires understanding that, "…the actions of a substance's formal nature are severely constrained by its material nature."[36] For instance, while the matter of the eye, the so called 'crystalline humor,' must be, given the function of seeing and by conditional necessity, transparent, the functionality of the eye is in turn constrained by the actual make up of these humors: an eye cannot see infinite distances, nor at night[37], nor when suffering disease which clouds the transparency of the humor and so on. Just as the formal nature of the body must be investigated, so too must the matter be investigated as a constraint on the formal nature. Understanding the living body necessitates understanding form *and* matter.

Where, in all of this soul-business, does anatomy enter? This is, in many ways, a difficult question to answer. Aristotle never directly discussed anatomy, though he did make numerous references to dissections, especially in the *Historia animalium,* where it is clear that he performed or witnessed them.[38] He noted there that the internal parts of mankind being unknown, one must look to similar animals in dissection to understand them, a line which Harvey quotes at the beginning of his lecture notes.[39] But the relation between Aristotle's

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[34] Leunissen 2010, 55.
[35] For the purposes of this chapter, I don't get into much detail about variation. However, this is an important feature of Harvey's method, following Aristotle, and I discuss it in detail in Chapter 4.
[36] Lennox 2001b, 183.
[37] Well, except for cat eyes (and the like)—but Aristotle would certainly be aware that though the function of human and cat eyes is the same, they have different material natures. Thus cat's eyes are better designed for nighttime mischief.
[38] For modern citations see: *De partibus animalium* II.7, III.4, III.5, IV.5 and *Historia animalium.* I.17. My thinking here follows some unpublished work of James Lennox, though any and all mistakes here remain my own.
[39] Aristotle 1552, *Historia animalium*, Lib.I, Cap.16, In: *Aristotelis libri omnes…cum Averrois Cordubensis variis in eosdem commentariis*, Vol. 6, Venice, 4v. Harvey quotes this as: "Hominum partes interiors incertae et incognitae quamobrem ad caeterorum animalium partes quarum similes humanae referentes eas contemplare." The original

concept of the soul and anatomy is found, not in anything he wrote specifically on the matter, but rather in how his conception of soul shaped his and later conceptions the appropriate means of studying it. That is, while Aristotle's account of soul and body was not specifically medical or anatomical, it was eminently suitable for such purposes. Aristotle argued in the *De partibus animalium* that the natural philosopher *must* study ensouled things *qua* ensouled.[40] Indeed, the *De sensu,* the first treatise in the collection that became known as the *Parva naturalia,* begins with the following line:

> Moreover, having considered the soul as it is determined itself, and its several powers according to the parts of which they are, next we perform a survey of all animals, indeed of everything that has life, and determine which functions are had singular and which are common to them. What has been sad about the soul as the subject, and the rest of what we said, must especially come first.[41]

In other words, it is fundamental to understanding living creatures to understand soul as characterized in *De anima*. Further, as just discussed, body and soul must be understood and investigated together; they are, in fact, an ontological *unity*.[42] For Aristotle, body and soul, matter and form, were not truly separate from each other:

> If, then, something universal must be designated in every kind of soul, it must be that it is the first act of a natural organic body, from which we ought not question whether the body and soul are one: just as we ought not question whether the wax and its shape are one, nor whether the matter of a thing and that of which it is the matter are one.[43]

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text, however, is: "At vero interiores contra; sunt enim hominum in primis incertae atque incognitae. Quamobrem ad caeterum animalium partes, quarum similes sint humanae referentes eas contemplari debemus."

[40] I shall discuss in more detail below the *De partibus animalium* in the section on Harvey on the organic soul, for one cannot understand what Harvey writes without understanding Aristotle's works, the *De partibus* in particular.

[41] Aristotle 1552, *De sensu et Sensibilibus,* Cap. 1, In: *Aristotelis libri omnes…cum Averrois Cordubensis variis in eosdem commentariis*, Vol. 5, Venice, 187. "Quoniam autem de anima secundum seipsam determinatum est prius, & de virtutum qualibet secundum partem ipsius, consequies est facere considerationem de animalibus, & vitam habentibus omnibus, quae sunt propriae, & quae communes operationes eorum. Quae igitur dicta sunt de anima subijciantur, de reliquis autem dicamus, & primum de primis."

[42] van der Eijk, Philip 2000, "Aristotle on the Soul-Body Relationship," In: *Psyche and Soma,* Eds. Paul Potter and John P. Wright, Oxford: Clarendon Press. Van der Eijk stresses especially the way in which Aristotle recognizes the importance of the soul-body relation in understanding psychosomatic phenomena, such as emotions like anger.

[43] Aristotle 1552, *De anima,* Lib.II, Cap.2, 51v. "Si autem aliquod comune in omni anima oportet dicere, erit utique actus primus corporis organici physici unde non oportet quaerere si unum est anima & corpus: sicut neque ceram & figuram, neque omnino uniuscuiusque materiam, & id cuius est materia…."

The example Aristotle uses is most clear: in the same way that one does not ask if the shape of the wax is separate from the wax, one does not ask if the soul is separate from the body; the soul just *is* the actuality of the body, its form, as Aristotle noted immediately after the passage cited. Indeed it is an important characteristic of living things that their bodies are unified. Because of this, all the functions of their parts serve the good of the animal, and they work together harmoniously: it is a *teleological* unity that ties body to soul. Aristotle's conception of especially those most basic aspects of soul, the nutritive or vegetative faculty shared by all living things, is thus apt for anatomists interested in understanding the activity and functionality of animal bodies. As I demonstrate in the following sections, Aristotle's account of soul serves as the basis for much of the natural philosophy of living things in the ensuing centuries.

In sum anatomy, on an Aristotelian model, must be understood as an investigation into those things *common to body and soul*. It is inherently an investigation into unities of form and matter, function and structure. As I discuss in the following sections, it became increasingly obvious to medical writers that the best way to understand these complex relations between soul and body, form and matter, function and part, was to go and observe it, to anatomize and cut open bodies.

2.1.2. Body and Soul in Galen

Galen's conception of soul was deeply indebted to Aristotle's, as were many thinkers after the Peripatetic.[44] However, Galen, following Herophilus and the Stoics, sometimes distinguished between soul and nature. The natural faculties, as discussed in the opening chapter of the *De*

[44] Indeed, even though Galen argues for a tripartite soul in the *De placitis Hippocratis et Platonis,* the conception of soul he uses is one in which the unity of soul and body is of paramount importance, *pace* Plato's beliefs on the separability of soul. For an excellent overview of the differences between various ancient theories of soul, see: Lorenz, Hendrik 2009, "Ancient Theories of Soul", In: *The Stanford Encyclopedia of Philosophy* (Summer Edition), Ed. Edward N. Zalta, URL = <http://plato.stanford.edu/archives/sum2009/entries/ancient-soul/>.

natura facultatibus, consist in that set of activities common to animals and plants, namely growth and nutrition, what Aristotle called vegetative soul.[45] The faculties of soul, properly speaking, are restricted to those creatures possessing sensation and voluntary movement. However, over the course of his long career and many written works, Galen expressed his opinion on the soul in several different ways, and he didn't always respect the terminology of 'nature' vs. 'soul'.[46] In fact, he says in *De propriis placitis* that he adapts his terminology based upon his audience: with philosophers he uses 'soul,' with physicians, 'nature.'[47] Again, some etymology will prove helpful. The Greek word *dunamis,* translated as *facultas* in the Latin editions of Galen, is a word used also by Aristotle. Aristotle distinguished a variety of senses of *dunameis*, and the word is generally translated as the more expansive *capacity* or *power*, whereas Galen's sense of the term is (often) more restricted, and (often) applies just to the proper functioning of the parts of the body.[48] Furthermore, these terms and distinctions, if they are reasonably perspicacious in Galen, are entirely muddled by the early modern period. But let me turn now to examine Galen more carefully.

For Galen, as for Aristotle, understanding soul requires understanding body, for here too body and soul are *unities*. The nature of the body is the foundational principle of medicine, understood so as to include both formal and material natures.[49] What is more, in a work of importance to Harvey and his fellow physicians, the *De usu partium*, Galen expressed a conception of soul very close to Aristotle's, in which the body is seen as the instrument of the

[45] I note that, too, Plato thought plants had souls; indeed, he even attributes desire and sensation to them! See: Plato, *Timaeus,* 77b. I here cite modern editions, since it is unclear what version of Plato Harvey might have read, though he was obviously familiar with at least some of Plato's work and doctrines.
[46] See for instance Galen 1549, *De usu partium* Lib.IV, Cap.13, In: *Galeni Peragameni…opera quae nos extant omnia*, Vol. 1, Basle, 520; and *In Hippocratis de Morbis Vulgaribus,* Lib.I, Cap.17, Vol.2, 395.
[47] See: Galen, *De propriis placitis* (=*De sentiis*), III.3; this work is not contained in the 1549 edition of Galen that Harvey used. For the strange and interesting history of this work, see Vivian Nutton's 1999 translation, *On My Own Opinions*, Corpus Medicorum Graecorum 5.3.2. Galeni De Propriis Placitis, Berlin: Akademie Verlag; see also, Donni, Pierluigi 2008, "Psychology," In: *Cambridge Companion to Galen,* Ed. R.J. Hankinson, 184-185.
[48] See also: von Staden 2000, "Body, Soul, and Nerves: Epicurus, Herophilus, Erasistratus, the Stoics, and Galen," In: *Psyche and Soma,* Eds. Paul Potter and John P. Wright, Oxford: Clarendon Press, 107.
[49] Galen 1549, *Si quis optimus medicus est eundem esse philosophum*, Lib. I, In: *Galeni Peragameni…opera quae nos extant omnia*, Vol. 0, 20.

soul. Galen, here at his most philosophical, wrote: "The usefulness of all of them [the parts of the body] is of the soul. For the body is the instrument of the soul, and for this reason animals differ greatly from one another in respect to their parts because their souls also differ."[50] First note that, here as in Aristotle, the body is for the sake of the soul—again, this conception of teleology undergirds the entire system of interpreting the nature and functionality of the living body. Further, the soul is again a principle of individuation, and, as in Aristotle, instrumentality is central to understanding the relation between body and soul. Soul is here too the substantial being of the body.[51] Indeed, Galen praises Aristotle in the *De placitis Hippocratis et Platonis* for having argued that the substance, the 'being,' of the eye is *seeing*: "…Aristotle does not intend that the formation of the eye from moist bodies and tunics and membranes and muscles, so many in number, of such and such kinds, and arranged in such and such a way, is the very 'essence' of the eye…."[52] In other words, the material nature of the parts cannot serve in any way as the essence and substantial being of the body—the substance of the body is rather its function. Here too essence, definition, and function are bound together. Thus in Galen, as in Aristotle, the nature of the body is its form, its soul, and thus Galen argued that the proper starting place for natural philosophical investigations into animal bodies should be definitions of their essence, statements about their souls (or natural faculties as he sometimes terms them).[53] Thus, again, one finds definition central to the task of anatomy.

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[50] Galen 1549, *De usu partium*, Lib.I. Cap.II, Vol.1, 418, "Utiles autem sunt hae omnes ipsi animae, quippe cuius organum corpus est & propterea multum differunt a se invicem particulae animalium quoniam ipsae animae differunt." The translator of the modern edition of the *De usu*, Margaret May, notes that Galen follows Aristotle in thinking that the soul is the efficient formal and final cause of the body. See: May, Margaret 1968, *On the Usefulness of the Parts,* Bk.I, Ch.2, Ithaca: Cornell University Press, 68n.4.

[51] See also Galen's *De institutio Logica*, where, in the course of giving examples of valid arguments, Galen argues for a variety of positions that an Aristotelian would find amenable, such as the soul being better than the body, and that the soul is said to be just because its parts perform their characteristic functions.

[52] Galen 1549, *De Placitis*, Lib.I, Cap.8, In: In: *Galeni Peragameni…opera quae nos extant omnia*, Vol.1.

[53] Morrison, Ben 2008, "Logic," In: *The Cambridge Companion to Galen*: Cambridge, Cambridge University Press: 109-111.

Galen's *De placitis,* newly available to Western physicians in Humanist translations around the start of the sixteenth century,[54] was of fundamental importance in the renewal of anatomical practices by Vesalius and others.[55] This work explicitly links body, soul, and anatomy together in a way not found in Aristotle: Galen argued that anatomy is the *primary method* for investigating the souls of animals. Anatomy's use comes in revealing the true nature of the organization, structure, and activities of the parts of the animal body. As Heinrich von Staden argued, in a late Galenic work,[56] body and soul are related in a complex, interdependent way:

> …the humoral blend or temperament of, for example, the brain, the heart, and the liver will each have a profound effect on the capacities that reside in these organs, and this will in turn affect the corresponding activities. This interactive relation between humoral blend or temperament and the soul's capacities is a central feature of Galen's view of the body-soul relation.[57]

So Galen emphasized both the way in which the soul organizes the body through its capacities, and the ways in which the body constrains the capacities of the soul. Thus Galen enjoined his audience to empirically study the soul as it is in the bodies of animals and in man (in so far as is possible), for the material nature of the parts dramatically affects the soul's capacities. In turn, these capacities explain the parts by means of 'being for the sake of' relations as well as through hypothetical necessity.[58]

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[54] One might call these scientific explanations, but on on the condition that one understands this to mean that such explanations were supposed to be *scientia.* Another text, recently rediscovered to be non-apocryphal, provides another glimpse at Galen's conception of anatomical methodology as it relates to the soul: Galen 2011, *On Problematical Movements*, Ed. and Trans. Vivian Nutton and Gerrit Bos, Cambridge: Cambridge Classical Texts. However, this text, known in the Renaissance as *De motibus dubiis* or *De motibus membrorum liquidis* was available to Harvey, but its influence on Harvey is unclear, and I won't discuss it, opting instead to focus on the much more clearly important text of *De placitis Hippocratis et Platonis.*

[55] It is also the source for some of Galen's views on the heart, arteries, and veins, as well as his experiments relevant to those parts. Indeed, Harvey cites this work in *De motu cordis* 1628, Cap.V, 31.

[56] Namely Galen 1549, *Quod Animi Mores Corporis Temperamenta Sequuntur* (*Whether the faculties of the Soul Follow the Mixtures of the Body*), Vol.1, 1217.

[57] Von Staden 2000, 106.

[58] Though important, I do not have space here to further discuss the influence of Herophilus, Erasistratus and the Stoics on Galen's conception of anatomy. Though do see: von Staden, Heinrich 1989, *Herophilus: the Art of Medicine in Early Alexandria,* Cambridge: Cambridge University Press; Longrigg, James 1988, "Anatomy in Alexandria in the Third Century B.C.," *British Journal for the History of Science* 21, 455-488.

Galen evinced a cautious pragmatism regarding the ontological status of soul. Though he cleaved to some of Plato's doctrines on the soul,[59] Galen remained agnostic on its ultimate substance and immortality, saying only that one knows from its effects that it must exist, but not what its definite nature is.[60] Indeed, towards the end of his career, Galen was increasingly convinced of the deficiency of every theory of the soul and the functionality of the body. As Vivian Nutton recently summarized in a review article,

> His agnosticism is not entirely a fudge, but the result of his ability to see weaknesses in almost every position, including his own. He was convinced of the superiority of a vitalist over a mechanical explanation of life, and he constantly reiterated his conclusion that anatomical dissection revealed that the brain, rather than the heart, was the seat of what might be termed consciousness and will, but he was equally convinced that this was not the whole story.[61]

A number of points here are relevant here. First, a vitalist explanation of life here means that Galen understood the body as a system teleologically organized by soul: life is found only in the presence of soul.[62] But Nutton's remarks also point to an extremely important feature of Galen's philosophy: not only did he disagree with his contemporaries on *where the faculties of soul were localized*, but, more importantly, he disagreed with them on *how to localize these faculties*. Thus more relevant than the fact that in the *De placitis Hippocratis et Platonis* Galen came down on the side of Plato in arguing that the soul is tripartite[63] is the fact that Galen followed Herophilus and Erasistratus and attempted to understand the soul and its union with the body *in light of dissection*. Galen's anatomical research here thus proves to be about what is common to body and soul. And, indeed, this way of conceptualizing the subject matter of anatomy as Galen's

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[59] That it is tripartite, for instance.
[60] Galen 1549, *De placitis*, Lib.IX, Cap.9, 1093-1094.
[61] Nutton, Vivian 2010, "Embodiments of Will," *Perspectives in Biology and Medicine* 53(2), 277.
[62] Calling Galen, or Aristotle, or even Harvey a 'vitalist' is incorrect. Although vital heat, spirits, and the like are found in the doctrines of these philosophers, 'vitalism' as a set of substantive doctrines on the nature and definition of life is much latter, and quite different, matter entirely.
[63] Both Galen and Aristotle think that soul is what differentiates living from non-living things. However, Galen follows Plato in thinking that the soul is spatially divided into parts, and not as a unified soul with different powers or capacities, as Aristotle does. C.f. Tieleman, Teun 1996, *Galen and Chrysippus on the Soul*, New York: E.J. Brill, 24-26. Relatedly, Galen argues that the faculties of the soul—*dunameis*—are particular causes that one posits to account for a specific activity, and are not actual things, which are inside substances. See: Donini 2008, 186-187.

considered opinion on the matter as contained in his work *De placitis Hippocratis et Platonis*.[64] As Teun Tieleman has argued, the first seven chapters of this work, "…can be read as an extended demonstration of scientific procedure as applied to issues concerning the soul…," complemented by the ninth chapter that concerns the proper methodology for such endeavors.[65] Tieleman notes that the first few chapters of the *De placitis* contain Galen's argument to the effect that, "…his experiments decided the issue [of the soul] in favor of Plato's tripartite theory…."[66] Anatomical dissection is thus the *primary mode for investigating soul*.

Galen was a serious student of Aristotle's works, and part of Galen's criticism of the Peripatetics is just that some of their views on the soul (e.g., their cardiocentrism) are refuted by means of their own doctrines and methodologies![67] As Galen wrote,

> For Aristotle and Praxagoras merit censorship when they pronounce that the heart is the origin of the nerves, which goes beyond the evidence. For one can come to know from the books which they left behind that made many close observations of things, but when they wrote about the source of the nerves, the were either blind or talking to blind men….[68]

But, though some of his doctrines were under assault, Aristotle was not the main target in Galen's *De placitis Hippocratis et Platonis*, but rather the Stoic Chrysippus. In his debate with Chrysippus on the nature of the soul in *De placitis Hippocratis et Platonis*, Galen argued that Chrysippus' argument for the heart containing the ruling part of the soul is based upon the wrong sort of premises: they are not properly *scientific*. Thus his conclusion cannot follow from them.

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[64] I will discuss this work of Galen's in some detail in the Chapter 4.
[65] Tieleman, Teun 2008, "Methodology," In: *The Cambridge Companion to Galen*: Cambridge, Cambridge University Press: 49.
[66] Tieleman 1996, xii.
[67] Tieleman 1996, 5. I should note that, there is very little evidence regarding them and their doctrines, Galen was highly influenced by contemporary schools of Peripatetics, even and especially on his methodological doctrines.
[68] Galen 1549, *De placitis,* Lib.I, Cap.3 (Cap.6 in modern editions), 883. It is clear from the context that Galen is talking about 'anatomical' observations. "At Aristoteli & Praxagorae merito quis hoc vitio verterit que praeter evidentiam, cor principium nervorum esse pronunciant. Nam quod alia multa circa reflectiones viderint, ex his libris quos reliquirunt cognoscere datur. Quod vero aut ipsa caecutientes, aut ad caecos verba facientes, de nervorum principio scripserint, non est opus multis verbis adstruere, sed ad ipsum sensum progredi oportet."

Aristotle, meanwhile, had the right *kind* of scientific premises, but did not, at least on this matter, do a good enough job in his anatomical research, and his scientific premises were false.[69]

Galen states that scientific arguments are those that deal with the essence or substance of a thing, and that these sorts of premises form the proper starting place; most definitely *not* the rhetorical or grammatical arguments put forward by Chrysippus.[70] As Galen wrote, "The main thing is that the appropriate premises must be considered from the substance [*substantia*] of the business being investigated."[71] So, by stressing that knowledge of substance, or essence, as the proper starting point of scientific investigation, Galen recognized that soul is the proper place to begin any investigation into living animal bodies, for the soul *just is* the substance and essence of the living animal body. In *De placitis,* Galen is interested in the commanding or primary soul, which he defined as the principle of intellect, of perception, and of voluntary motion, which served as one of his premises. He then made the following argument, as Tieleman has characterized it:

> From this initial definition Galen infers that this function requires the existence of bodily tissues (which we may dub 'nerves', *neura*) that transmit the sensory and motor stimuli from and to the central organ in which the commanding part is located. This inference is expressed in the following general principle or axiom: 'Where the centre of the nerves is, there is the seat of the commanding part.' So far the argument is abstract, or 'logical'. Empirical research, that is to say, dissection, is needed for the following step: to establish which bodily organ satisfies this principle. This shows that the brain is the centre of the nervous system both structurally and functionally and hence the seat of the commanding part of the soul.[72]

So starting with a proper definition of primary soul *qua* substance, Galen performed empirical research to determine the structure, function, and distribution of the nerves. Without these

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[69] For a similar point, see: Hankinson, R.J. 2006, "Body and Soul in Galen," In: *Common to Body and Soul*, Ed. R.A.H. King, Walter de Gruyter: New York, 234.

[70] Galen 1549, *De placitis*, Lib.II, Cap.3, 896-897. Here Galen argues that Zeno and Chryssipus taught no method, and as a result they mix together different types of premises without regard to the proper forms of natural philosophical argument, that is, they begin with a rhetorical argument, followed by gymnastic and dialectical one, followed by sophistry, never realizing that a properly natural philosophcial argument must refer to the essence of the subject.

[71] Galen 1549, *De placitis*, Lib II, Cap.3, 896. "Ab ipsa quaesitae rei substantia accommodatas ad rem sumptiones esse ducendas...."

[72] Tieleman 2008, 56.

additional premises, no conclusions can be drawn regarding soul. In Galen, then, one sees the beginnings of a method in which research into the soul necessitated empirical research into the body, given the teleological soul-body union. It is this conception of the subject matter of anatomy that becomes central to certain Renaissance philosophers and physicians.

2.1.3. Body and Soul in the Renaissance

I now turn to examine certain Renaissance discussions of body and soul, including Harvey's teacher in Padua, Fabricius ab Aquapendente. I skip over the Medieval Scholastic psychological tradition, because, while certainly important, the work of later Renaissance thinkers is more directly relevant for understanding Harvey.[73]

It is in the wake of new Humanist translations of and commentaries on the works of Aristotle and Galen, long after the work done by Constantinus Africanus at Salerno and by Modino at Bologna, that one begins to see the revival of anatomy as core to investigation into the soul and as central to medical theory.[74] Over the course of the Renaissance there was a shift whereby the natural philosophical aspects of investigation into soul became separated from the more overtly theological and metaphysical aspects. It was specifically what one might call the *organic* soul, those most basic vegetative and sensitive aspects belonging to all animals, with its

[73] Though see the work of Dennis Des Chene on the Scholastic psychological tradition. Of course, one can overemphasize the differences between post-Humanist scholars and Scholastics, as, in many ways from terminology to interpretation, the difference was often more rhetorical than substantial. However, this rhetorical element is quite important, especially for understanding Harvey, as, while his doctrines might not always be substantially removed from Scholastic ones, his self-image is such that *he sees them* as being drastically different. That is enough to set aside the Scholastic tradition for my purposes here.

[74] The role of Salerno and other Italian cities and universities, and the path of transmission and translation of various treatises and texts, is the subject of much scholarly discussion and debate. See: Glaze, F. E. 1995, *The perforated wall: The ownership and circulation of medical books, ca. 800–1200*, Dissertation at Duke University; Green, Monica 2001, *The Trotula*, Philadelphia: University of Pennsylvania Press; and O'Boyle, Cornelius 1999, *The art of medicine: Medical teaching at the University of Paris, 1250–1400*, Leiden: Brill. Further, a prominent place for anatomy in medical theory about illness should not be taken to imply that anatomy had any immediate practical ends in treating illnesses.

emphasis on the *unity* of soul with its instrumental (organic) body, that became central to the projects of certain philosophers and physicians.

I start by underlining that the importance of Aristotle's *De anima* in the philosophical curriculum was clear not only to traditional Scholastic Aristotelians but also to anatomists and physicians from Mondino to Fernel to Fabricius and beyond. To take an example contemporary to Harvey, one sees in the *Historia anatomica* (1600) that the Galenist Laurentius made numerous references to *De anima,*[75] and though he sides with Galen on most issues, he clearly knew the doctrines of Aristotle well (if perhaps only to combat certain of the Peripatetic's doctrines). The *De anima* was a central text in the education of just about every philosopher and physician (and lawyer and priest) of the era, regardless of their ultimate philosophical allegiance.[76]

The term *psychologia* was itself created to designate the set of problems stemming from the *De anima* and the works of the *Parva Naturalia,* coined by the Humanist Joannes Thomas Freigius.[77] As Paul Mengal has observed,

> La plupart des ouvrages où figurent les premières occurrences du mot psychologia sont des traités de philosophie naturelle ou physica. La physica est la science de la nature que l'on enseigne principalement dans les Facultés de médecine. Elle représente un vaste domaine d'étude qui englobe les phénomènes naturels au sens le plus large: la cosmologie, les phénomènes météorologiques, la description des végétaux et des animaux, la connaissance de l'homme. La physica repose essentiellement sur le commentaire des oeuvres d'Aristote: les huit livres de la *Physique* , les quatre livres *Du ciel* , *De la génération et de la corruption*, les *Météores*, *l'Histoire des animaux* , *De la génération des animaux*, *Des parties des animaux, De l'âme* et les *Parva naturalia*.[78]

As Katherine Park and Eckert Kessler have argued, these works of Aristotle, along with their Arabic and Latin commentators, formed the core set of texts for Renaissance Europeans writing

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[75] For instance, see Laurentius 1600, *Historia anatomica*, Lib. I, Cap. VIII, Paris, 13.
[76] Michael, Emily 2000, "Renaissance Theories of Soul," In: *Psyche and Soma,* Eds. Paul Potter and John P. Wright, Oxford: Clarendon Press, 148n.2 and references therein.
[77] See Park and Kessler 1988, 455. See: Freigius, Joannes Thomas 1575, *Ciceronianus,* Basle. See also: Schuling, H. 1967, *Bibliographie der psychologischen Literatur des 16,* Jahrhunderts: Hildesheim
[78] Mengal, Paul 2000, "La constitution de la psychologie comme domaine du savoir aux XVIème et XVIIème siècles," In: *Sciences Humaines* 2, 7

on the soul.[79] Aristotle's works on animals must also be emphasized as setting the agenda for these psychological investigations, at least among certain natural philosophers. Though Theodoro De Gaza's translations of the animal works were available from 1476 (the date of the *editio princeps*), it is not until the sixteenth century that one sees the start of a serious commentary tradition on these works, the first being that of Pietro Pomponazzi dating from 1521-1523.[80] Other Italian philosophers in the Renaissance quickly followed Pomponazzi's example and in the decades after his work there followed a number of important commentaries on Aristotle's biological works by Niccolo Tomeo, Agostino Nifo and others. These texts were of central importance not just to the philosophers but also to the physicians as well.[81] And while these authors disagreed on many issues, from stylistic choices to terminology to substantive doctrines, they were all engaged in a project to reevaluate and understand Aristotle's biological and psychological works in the wake of newly available texts and improved translations.

Reflecting this project, one sees over the course of the sixteenth century a shift in terminology used to talk about the natural world and the soul, away from the Scholastic terminology of the medieval period and towards a more 'authentic' Aristotelian terminology based on the newly available texts.[82] Early views on the soul in the fifteenth century and earlier were, as has been argued by Emily Michael, mostly Thomistic in their interpretation. Here, every individual entity is composed of prime matter (which is pure potentiality) and a substantial form (actuality) inhering in the prime matter, and which determines the nature of the living thing and

[79] See: Park and Kessler 1988 and Park 1998.
[80] Perfetti, Stefano 1999, "Three Different Ways of Interpreting Aristotle's *De Partibus Animalium*: Pietro Pomponazzi, Niccolò Leonico Tomeo and Agostino Nifo," In: *Aristotle's Animals in the Middle Ages and Renaissance*, Eds. C. Steel, P. Beullens, and G. Guldentops, Leuven: Leuven University Press, 297. Note further that though Pomponazzi's books weren't published until the 1520s, he had been lecturing on them for some time, and his views were widely enough known to be of concern to the Catholic authorities.
[81] For instance, Caspar Bauhin's 1600 *Theatrum anatomicum*, used by Harvey for parts of his lecture notes, makes almost constant reference to these two works of Aristotle.
[82] Thus, while Pomponazzi's commentary is filled with Scholastic terminology, Nifo's is much more highly influenced by the Arabic tradition (in Latin translation), especially the works of Averroes. Perfetti 1999, 304-305.

its various powers.[83] How to understand those powers and their organization was a matter of debate, for which see Figure 1 which represents Lambertus de Monte's late 15th century division of the powers of the soul.

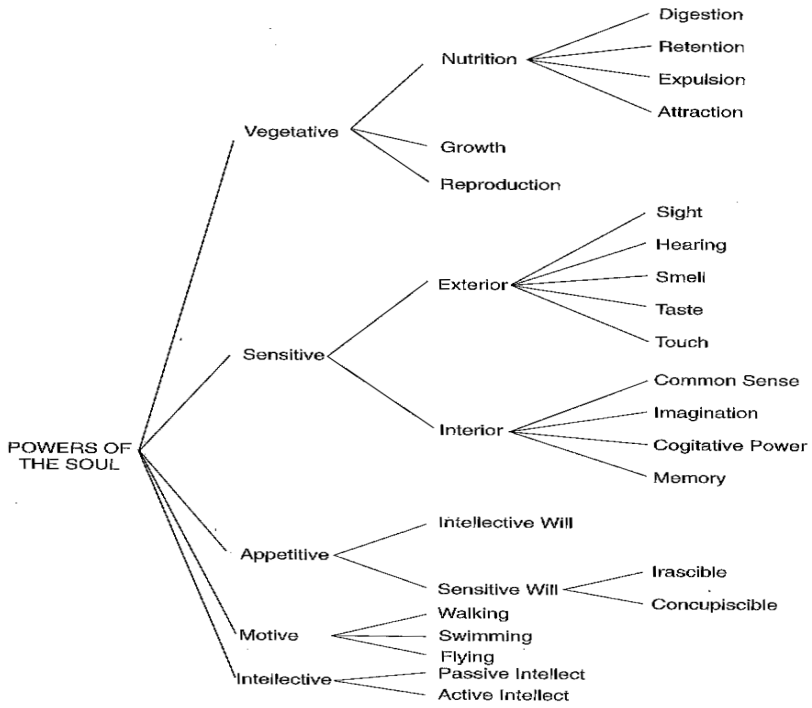

Figure 2. A Thomistic conception of the powers of soul according to Lambertus de Monte (taken from Michael 2000, 50).

Neither Harvey nor his Paduan forbearers distinguished between the various faculties of the soul as per Figure 1 above, rather referring loosely to the nutritive or vegetative soul in the way that Aristotle most often does. Nor did Harvey or Fabricius invoke the rather more metaphysically loaded terminology of substantial form. Instead, their efforts focused on distinguishing and understanding the nature of the organic parts of the body that carried out soul functions. Thus, over the course of the Renaissance, one sees Thomistic conceptions of the soul and its powers gradually fade from view. New controversies arose around the question of the mortality of the

[83] Michael 2000, 151-152.

soul, stemming in part from the very recovery and translation of these texts, especially Alexander of Aphrodisias' commentary on *De anima.*[84]

Another key set of texts for those debating the soul were new Humanist translations of Galen's works, especially the *De usu partium.* This work was not only concerned with the soul explicitly as it is organized in living animals, but also espoused a fundamentally teleological conception of the soul and its relation to the body.[85] The medical tradition was an eclectic blend of Aristotelian and Galenic doctrines on the soul, and occasionally this lead to some views that seem (at least at first) to be contradictory. So, for instance, writing at the start of the sixteenth century, the Paduan anatomist Gabriele de Zerbi in his justification of anatomy emphasized that dissection teaches the structure and function of the body, that is, about both body and soul, knowledge worthy of a philosopher. Roger French summarized de Zerbi's position as emphasizing that anatomy teaches, "…one about the soul, both because the soul followed the complexions of the body [according to Galen]…and because the body was the expression of the soul [according to Aristotle]…The two things sound contradictory and neither is a specifically Christian doctrine…"[86] Yet, as a close analysis of the work of these medical writers shows, these doctrines need not conflict, for the relation between soul and body is complex and interdependent: soul is affected by the body, as both Galen and Aristotle noted, but this does not undermine the body as the instrument of soul, for as noted above, the material nature of the body limits its activities. Both physicians and the philosophers of the Renaissance became specifically interested in living animal bodies in union with their souls, understood in this increasingly eclectic, hybridized Galenic-Aristotelian way. Central to this eclectic tradition, emphasized

[84] Michael 2000, 152.
[85] Importantly, the *De juvementis membrorum*, a rather strange Galenic work that was central to the Renaissance medical curriculum, seems to be a summary of *De usu partium.* See: French, Roger 1979, "*De juvementis membrorum* and the reception of Galenic physiological anatomy," *Isis* 70, 96-109.
[86] French, Roger 1999, 87.

especially in Averroes and certain Arabic writers,[87] is the idea that soul can be understood through certain kinds of activities found in the bodies of living creatures, which can be discovered through observation and dissection.

Besides these textual traditions, there are two social-intellectual developments during this period important for understanding learned discussions of soul and body. The first is that, in the wake of the Pope's *Apostolici Regiminis* after the Lateran Council in 1513, there is a shift in commentaries and treatises discussing soul. The edict targeted aspects of the work of the Aristotelian Pietro Pomponazzi.[88] Pomponazzi argued that all of the activities of the soul depend upon the body and its organs according to Aristotle, and thus the soul is mortal and must perish when the body dies.[89] The decree banned two sorts of arguments on the nature of the soul: first, it outlawed mortalist arguments that the soul could perish, and, second, it barred Averroist arguments that it is one and the same soul that animates all men. As Emily Michael argued, this demand necessitated that Renaissance philosophers find, "…a new strategy to prove the soul's immortality. In response to this challenge, a *non-Thomistic Aristotelian approach* gradually acquired popularity…."[90] Though the Pope's decree enjoined philosophers and theologians to demonstrate that the soul was immortal, the cat was out of the bag, so to speak; mortalism, of a sort, became a constant topic of discussion, if sometimes only to prove its falsehood. The option taken by many Aristotelians was,

> …to submit to the authority of the church but to continue to philosophise within the bounds set by the church through Bishop Barozzi at the beginning of the sixteenth century at the Lateran Council. As Charles Lohr has shown, this option took for granted the fundamental difference between Aristotelian natural philosophy and the teaching of

[87] Two works relevant to Harvey's training at Padua are Averroes' *Commentarium magnum in Aristotelis De anima libros* and Avicenna's *Liber Canonis*.
[88] Pomponazzi clearly states that the mortality of the soul was *Aristotle's* considered opinion, not his, and he reaffirms his Catholic faith; his work was never banned. See his 1525, "Defensiorum," *Tractatus acutissimi utillimi et mere peripatetici,* Venice. This sort of interpretation and attitude towards Aristotle is sometimes referred to as 'radical Aristotelianism.'
[89] Pomponazzi, Pietro 1516, *Tractatus de immortalite animae,* Bologna, Cap.8. See also: Pine, M 1986, *Pietro Pomponazzi, Radical Philosopher of the Renaissance,* Padua. See also Michael 2000, 154-155.
[90] Michael 2000, 158.

> the Church, developing a purely Christian metaphysics and making Aristotle merely the empirical observer of natural phenomena…At the same time, however, it freed Aristotelian physics from metaphysical limitations and allowed for a truly empirical science of nature—that is to say, a science open to all kinds of new discoveries about the world and gradually gaining its own empirical methodology.[91]

So part of the effect of this ban was to make for and motivate a more empirical natural philosophy (what I understand as the referent of 'science'). Thus part of the response of physicians and philosophers to the Lateran council was to more clearly distinguish a certain form of mortalism from the kind banned by the Pope, namely a form of mortalism that did not assert the mortality of the *human* soul, but rather avoided that subject and instead concentrated upon those faculties of soul shared with animals. Thus investigation of soul along Aristotelian lines became *by necessity* an empirical investigation! A form of mortalism, closely linked with a more naturalistic understanding of the soul and its role in living creatures, became widely disputed and held. By asserting that the rational part of the soul is separable from the body, and thus from those aspects of the mortal soul which regulates it, philosophers could at once assert that the soul of animals was mortal, yet also hold that the soul of interest to a Pope, the intellective soul, was still immortal.[92] Thus there was a new emphasis on empirical—and especially anatomical—investigation of the soul, and a renewed (but not new) emphasis on the metaphysical distinction between what we might call the *intellective* and the *organic* soul. The latter, consisting in the vegetative and sensitive aspects of the soul, is mortal insofar as it is the actuality of a living body. Thus, when the body dies, so too the soul must pass, though the intellective aspect lives

[91] Kessler, Eckhard 1990, "The Transformation of Aristotelianism during the Renaissance," in: *New Perspectives on Renaissance Thought,* Eds. John Henry and Sarah Hutton, London: Duckworth, 141-142.

[92] Another option, favored by Pomponazzi and the so called 'radical' Aristotelians, was to claim that, as an interpreter of Aristotle, one had to follow what the Master actually wrote in one's commentary regardless of the (Christian) truth of the matter. Thus, for instance, one sees Zabarella, writing after the Lateran Council, in his commentary on *De anima,* doesn't quite assert the mortality of the soul—rather, in his role as a commentator on Aristotle he takes time to counter the arguments that the soul must be immortal. He seems to acknowledge that Aristotle thought the soul mortal, but he never fails to mention that Aristotle also asserted the separability of the intellective part of the soul from the organic part, thus interpreting him in at least minimal accordance to the *Apostolici Regiminis.* See: Mitrovic, Branko 2009, "Defending Alexander of Aphrodisias in the Age of the Counter-Reformation: Iacopo Zabarella on the Mortality of the Soul according to Aristotle," *Archiv für Geschichte der Philosophie* 91: 330-354.

forever. And though this distinction was present in earlier authors,[93] it became increasingly important in the Renaissance.[94]

Even Humanists and other anti-Aristotelians began to understand Aristotle as an *empirical* philosopher, setting aside some of his more purely metaphysical works for Christian metaphysics (often deeply influenced by increasingly important neo-Platonic philosophies). As Kessler noted, "…the Humanists did not question the general content and systematic coherence of Aristotle's teaching, but did question its a *priori* validity, [and so] the anti-Aristotelianism of the Humanists apparently turns out to have been a call for the transformation of Aristotle from a speculative into an empirical philosopher. In this way humanism can be seen to have anticipated the notion of Aristotle the empiricist…."[95] This distinction is especially important in natural philosophical works. For example, in the case of the Paduan Aristotelian Zabarella, one finds that this distinction between organic and intellective soul is found especially in his natural philosophical works, of which he considered his commentary on *De anima* to be—for Zabarella conceived of this project as part of the natural philosophy of soul.[96]

So the soul-body union was the topic of much debate, amongst physicians, theologians ,and philosophers (never mind the Pope!), and these debates were increasingly predicated on anatomical findings. Thus one finds that theologians arguing, for instance, on where the soul was to be located in the body (heart, liver, brain?) and at which point in embryological development the rational soul (equated with the immortal soul) entered the fetus.[97] Among the Humanists and reformers of the age, the import of new anatomical work for doctrines concerning soul was not

[93] So, for instance, Gassendi in Lib. II of his 1658 *Syntagma* stated that this is found in Ockham's *Quodlibeta.*
[94] This conception of soul is deeply indebted to Aristotle's *De anima* II.4-5, where Aristotle argues that, since *nous* has no organ, it is thus separable from body in a way the other soul capacities are not.
[95] Kessler 1990, 145.
[96] Mitrovic 2009, 331. Mitrovic points to Zabarella's 1590, *De rebus naturalibus,* his incomplete 1605 commentary on *De anima,* and three manuscripts in the Ambrosiana library in Milan.
[97] For an overview of some of these issues in the Renaissance, see: Nutton, Vivian 1990, "The anatomy of the soul in early Renaissance medicine," In: *The Human Embryo*, Ed. G.R. Dunstan, Exeter: University of Exeter Press. Note, too, that these issues go back at least as far as Aquinas, who was, I note, himself reacting to the Arabic tradition and especially to Averroes.

lost, and experience and *a posteriori* reasoning came to be seen as central to the task of natural philosophers, even amongst the commentary tradition.[98] Thus one finds the Protestant theologian and educational reformer Melanchthon incorporating such findings into his philosophical and theological account of the soul. Central here was the *De anima,* of course, but Mengal noted that Melanchthon's commentary was a hybrid of traditional philosophical commentary and the most up to date anatomical knowledge:

> Dans son ouvrage, Melanchthon commente le *De anima* d'Aristote mais ne se contente pas de gloser le texte au fil de la lecture. Melanchthon a pris la mesure exacte des progrès de l'anatomie et il inscrit clairement son entreprise dans le cadre d'une Physica renouvelée et tout entière au service de la médecine. C'est pour cette raison que Melanchthon enrichit le texte aristotélicien d'un long traité d'anatomie qui expose les acquisitions les plus récentes de la discipline.[99]

If a philosopher and theologian like Melanchthon read *De anima* in the light of the new anatomy, aspiring physicians and anatomists could not help but do so. Indeed, in their treatises on the soul, some Renaissance Aristotelians, such as Gregor Reisch, were concerned not only with understanding the final and formal causes debated by the Scholastics, but also with the efficient and material causes, which was, "…interpreted as the physical process accounting for these phenomena and the organs in which they took place."[100] More radical Aristotelians, such Agostino Nifo, also included biological concerns in their investigations of soul, and so it should be no surprise that Nifo wrote treatises on physiognomy and other psychological issues.[101] Indeed, Nifo is interesting on the topic of natural philosophy and soul, for he criticizes Aristotle on the prevalence of material causes in his natural works and his interpretation of Aristotle places an even greater emphasis on teleology than the Master himself![102]

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[98] For instance, Pomponazzi attempts to use experience to invalidate the opinion of Albertus Magnus on the nictating membrane of birds: see the discussion in Perfetti 1999, 309-310. See also: Pomponazzi, Pietro, 2004, *Expositio super primo et secundo De partibus animalium*, Ed. Stefano Perfetti, Florence: Olschki.
[99] Mengal 2000, 8.
[100] Park 1988, 468. See: Reisch, Gregor 1517*, Margarita philosophica*, Basle, 439-440.
[101] Park 1988, 469. See: Nifo, Agostino 1523, *Parva naturalia*, Venice, 1r-22v.
[102] Perfetti 1999, 311.

The second development relevant here was the publication of Vesalius' *De humani fabrica corporis* in 1543. This further strengthened the need for anatomical knowledge in debates concerning soul, and it furthermore changed not only the grounds of the debate but also the nature of the debaters.[103] As Katherine Park has argued, in the wake of Vesalius and his combination of critique of Galen's doctrines and embrace of Galen's methods, "…there are signs that anatomy and physiology were beginning to replace demonstrative Aristotelian natural philosophy, at least temporarily, as the prime models of scientific explanation."[104] To take one example, discussed by Walter Pagel, some philosophers and physicians began to approach the problem of the origin of the soul as a problem of embryology rather than of abstract metaphysics.[105] While this aspect of generation had long been noted, these new writers emphasized the empirical and anatomical aspects of their investigation.[106]

This conception of the body and soul was, in particular, central to the work of physicians and philosophers working in Padua. Indeed, as has been argued by Andrew Cunningham and others, Fabricius ab Aquapendente's work exemplified an Aristotelian conception of the body and soul. His anatomical investigations revolved around those things common to body and soul, which Cunningham has named his 'Aristotle Project.'[107] Fabricius explicitly conceived of his project as continuing in Aristotle's footsteps, retracing and often correcting the Philosopher's views. Fabricius' anatomy lectures revolved around his investigations into the faculties of the soul and their instruments, the parts of the body: locomotion (*De motu locali animalium, De musculis, De volatu*); generation (*De formato foetu*, *De formatione ovi et pulli*); nutrition (*De*

[103] Obviously not all the debaters, or even a majority necessarily.
[104] Park 1998, 482. This claim is a bit unclear, for, as James Lennox has pointed out to me, anatomy, on an Aristotelian conception, is the way to the principles, for Aristotle always opposes demonstrative deduction and induction. What I take Park to be saying here is rather that the prime models of good natural philosophical explanations began to be taken from the work of anatomists, and not, say, the explanations offered by Aristotle in the *Meteorology*.
[105] Pagel 1967, 233-247.
[106] See: Aquinas, *De Potentia*, Q.3, A.9-12.
[107] Cunningham 1985.

gula, De ventriculo, De omento, De intestenis[108]); sensation (*De oculo, De aure*).[109] As Cynthia Klestinec has argued, these treatises were directly modeled on Aristotle's books on animals and the *Parva naturalia*.[110] The difference between Fabricius and Aristotle was that former's project was performed in a much more straightforwardly anatomical way.[111] Though Fabricius (and Harvey following him) thought of himself as a natural philosopher, he was a distinctly *medical*—and *eclectic*—one. His debt to Galen and other medical writers, though sometimes unacknowledged, is both deep and obvious from a study of his treatises. For instance, in his dedication to Leonardo Donato in the *De visione, voce, et auditu*, Fabricius made note of his methods and his philosophical forbearers, most important of which is Aristotle. But, in keeping with the distinctly medical-philosophical context in which he was operating, Fabricius also makes reference to many works of Galen, such as the *De usu partium*.[112]

Fabricius explicitly understood his anatomical investigations to be investigations into soul. He states in his treatise *De formatione ovi, et pulli* that his study relies upon two principles or foundations, one corporeal, the physical foundation upon which generation occurs, the liver and the heart, the other incorporeal, nature or soul.[113] Fabricius describes the latter as a principle that governs the process of formation, and which

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[108] Furthermore, one can see Fabricius' *De venarum ostiolis* as part of the nutritive system, since, as Cunningham 1985 notes, "…Fabricius quite naturally starts from understanding that the veins are a system for distributing nutriment to the whole body…" (207).

[109] See, for instance, Klestinec, Cynthia 2004, "A History of Anatomy Theaters in Sixteenth-Century Padua." *Journal of the History of Medicine and Allied Sciences*, 59(1): 374-412; and Klestinec (2007), "Civility, Comportment, and the Anatomy Theater: Girolamo Fabrici and His Medical Students in Renaissance Padua," *Renaissance Quarterly*, 60(2): 434-463. See also: Cunningham 1985.

[110] Klestinec 2007, 440-441.

[111] This is a matter of degree, not kind. Aristotle in his works on animals often makes references to dissections.

[112] Though the original was published in 1600, I have not been able to access this version, and thus I gather this information from a later *opera omnia,* where the dedication is contained in the front matter, having been removed from the treatises to which they were originally appended (in this case, the *De visione*). See: Fabricius 1738, *Opera anatomica et physiologica*, Leiden. Furthermore, as Cunningham has noted, one should not see Fabricius project as *against* Galen in favor of Aristotle, at least not in general. For, especially on certain methodological matters such as the importance of teleology, Galen and Aristotle are in much agreement.

[113] Fabricius 1621 [1942], *De formation ovi, et Pulli*, Trans. Howard Adelmann, Ithaca: Cornell University Press, 43 [200]).

> ... rules and governs the animal body. Now if there are two degrees of soul, the vegetative and the sensitive, and the vegetative is prior both in time and Nature because it is common to the very plants, doubtless the organs subservient to the vegetative soul should be engendered and formed before those that are adapted to the sensitive and motive faculties, and this is especially true of the principal organs, which have the office of governing.[114]

This is the same picture as in Aristotle, even down to the priority of the vegetative soul. Fabricius' method of understanding animal bodies meant understanding them *causally*, that is, understanding the soul as the final, formal, and efficient cause of the living animal body, its substance. But, again following in Aristotle and Galen's footsteps, Fabricius notes that, to understand this organic soul, one must understand the matter as well, that is, the very structure and composition of the parts that are its instruments. Thus Fabricius' goes about his task by a certain inferential method: moving from structure (the matter) to action (the efficient and final cause) and to the use and utility (the final and formal cause[115]) of the part.[116] Note, further, that the order of explanation is the reverse of the order of inference: one explains structure and matter by reference to action and use. Understanding the causes of the parts was, according to Fabricius, essential to doing the job of an anatomist, one could not be satisfied, as Fabricius accused Vesalius of being, with the structure and material make up (the *fabrica*) of the parts. Fabricius wrote that, "…I can assert this truly: they [the causes of parts] are of such consequence that the person who knows these exactly can claim unhesitatingly that he has now learnt the whole anatomic business and that he is master of it…."[117] And, as I lay out in the following section, Harvey, too, adopts this fundamentally causal picture of the goal of anatomy.

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[114] Fabricius 1621 [1942], 44 [202]. James Lennox has pointed out to me that this is simply a reiteration of the conclusions of Aristotle's *De generatione animalium* II.6.
[115] For, as Aristotle notes, the final and formal cause are identical in natural things. C.f. *Physica* Lib.II, Cap.7.
[116] See: Cunningham 1985, 201-202. See also the dedications contained in the front of Fabricius' 1738 *Opera anatomica*.
[117] Fabricius 1600, *De larynge*, quoted and translated in Cunningham 1985, 202.

2.2. BODY AND SOUL IN HARVEY

Harvey's philosophy, as it is represented especially in the *Prelectiones anatomie universalis* (1616-1627) and the *De motu locali animalium* (1627), reflects the hybrid conception described in the previous sections, taking both elements of Aristotle, as has been noted by Walter Pagel,[118] as well as Galen and the medical writers, as noted by Andrew Wear.[119] Much of Harvey's Galenism is hard to detect, for Harvey rarely quoted from or referenced Galen (especially in comparison with Aristotle). When he does do so, it is often on matters of fact and not method or theory.[120] Though Harvey's allegiance to the medical writers is difficult to detect, he is deeply familiarity with and indebtedness to these works.

It is know, for instance, that Harvey studied very carefully his friend Theodore Goulston's 1640 edition of Galen's *Opuscula varia*. As Vivian Nutton noted, "…he made some form of comment on almost every page, usually an underlining but, especially in the last three tracts, taking serious issue with what Galen said."[121] That Harvey took issue with Galen on specific points does not in any way undermine the point being made here, since, again, Harvey's Galenism is reflected more by his methods than by his substantive claims. A further complication, of course, is that on many issues, Galen agreed with (or even followed) Aristotle—such as, importantly, on the teleology of the soul-body relation. On this point, at least, Galen and Aristotle stood firm against those who attempt to understand nature, and especially animal bodies, by purely material means—formal and final causes take precedence, though matter is of

[118] Pagel 1967. This is a common theme in Harvey scholarship since Pagel's work, of course.
[119] Wear 1983.
[120] For instance, in Harvey 1616, 38, he cites Galen as arguing that the skin is the medium by which we appreciate the qualities of all things that may be touched.
[121] Nutton, Vivian 1988, "Harvey, Goulston, Galen," Ch.14 in: *From Democedes to Harvey,* London: Variorum Reprints, 115. With this in mind, one should not perhaps wonder overly much at how Harvey could remain an Aristotelian after his own epoch making discoveries

course extremely important.[122] Harvey's Galenism then, in contradistinction to some of his fellow Physicians, was subtle, more an attitude and an approach than a matter of doctrine.[123] This should not, perhaps, be a surprise, given that, in many ways, this was also Harvey's attitude towards Aristotle, though he tended to find himself in agreement with the Peripatetic much more often. But Harvey's preference wasn't that one should follow Aristotle in place of Galen. Rather, he took them both to be suggesting the same basic methodology: discovering teleological explanations of the parts through dissection and observation. Harvey saw the necessity of dissection as both part of the Galenic background and as a proper part of Aristotelian methodology, called in both traditions *historia* (and whose importance in the Renaissance and in Harvey will be discussed in Chapter 4).

I now turn to consider anatomy directly. Harvey understood *anatomia* as a cutting up of the body: he is quite literally concerned with division.[124] Harvey was much concerned with how best to divide the body into parts, a question of great antiquity, and one of great concern amongst his contemporary anatomists, and which I consider in the following section.[125] Importantly, he noted that, "…Anatomy must divide no further than Nature has devised."[126] In other words, while performing an anatomy, one must be careful to quite *literally* carve nature at the joints! Thus understanding how soul organizes the body is fundamental if one wishes, with Harvey, to make no divisions beyond what Nature has devised.. Understanding of a part is achieved by knowledge of the relations between a part's end and the means by which that end is

[122] Though it must be admitted that Galen is much more prone to make use of certain material/elemental explanations in situations where Aristotle would be loathe to do so.
[123] So often when Harvey quotes or refers to Galen, he does so in order to disagree about a point of fact or conclusion. But Harvey does so on a case-by-case basis, and what he is interested in is the truth in each situation. Thus Galen often comes in for praise, for example in connection with *De usu partium*, XV, Harvey writes that: "Galenis optime explicavit priores neoterici sicco pede preterierunt" (Harvey 1616, 262).
[124] I look at Harvey's definitions of anatomy in great detail in Chapter 4.
[125] See, for instance, Laurentius discussion of the meaning of part in his *Historia anatomica*, Q.1-2, 31-34.
[126] Harvey 1616, 4. "…Anatomia non ulterius dividere quam Natura devisit."

accomplished, or, to use the terminology of Harvey's era, it means determining the *usus* and *actiones* of the parts.

Key here was the *De partibus animalium*, one of the Aristotelian works central to Renaissance discussions of soul. Paraphrasing this work, Harvey wrote,

> Indeed, since the operations and actions of Nature are many and distinct, for that reason the parts are many and distinct. That is to say, the body is the instrument of the soul.[127] Or better, a man and his parts are like an instrument having a power such as a saw if it could cut of its own will.[128]

This quote reveals some important foundational assumptions for Harvey, and it sets up the basic teleological picture that undergirds his conception of anatomy. The idea is this: functionality precedes materiality. Soul and body are unified, and one understands and explains the parts by way of reference to their functioning, their end. Note Harvey's use of the word '*potentiam*,' rendered here as power. Powers, for Harvey, are a function of an object being able to complete an organic goal, and in anatomy these goals achieve some sort of good for the animal, often some necessary function for life, e.g., nutrition or cooling.

The body is *organized* around these powers or capacities: because there are many goals that must be fulfilled in a living being, that is, there are many sorts of *functions*, there are, as a result, many different parts that together accomplish those functions. The variety and variation of parts is explained by the variety of life functions that need to be accomplished, the variety of sub-functions that accomplish those overall functions, plus the constraints placed upon them by the matter of the body and by the animal's way of life.[129] Thus the importance of dividing not

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[127] In the manuscript (British Library, Sloane MS230a), the line about the body being the instrument of the soul is on a new line, and so it should be rendered as a new sentence, and not, as Whitteridge has done, by adding it to the end of the previous sentence.

[128] Harvey 1616, 4. "Quoniam enim operationes et actiones Naturae plurimae et distinctae, ideo plures et distinctas partes / corpus enim animae organum. Vel potius homo et pars ut organum potentiam habens ut serra si sponte secare potuisset."

[129] Aristotle distinguishes between *natural* ends, and *incidental* ones, though Harvey doesn't discuss anything along these lines. Monte Johnson notes that, "For anything that naturally has an end, it is possible to determine incidental ends. The eye exists for the sake of seeing, but also for the sake of a cow, who naturally has eyes, and benefits from being able to see with them. But notice the existence of other possible uses of an eye, which are incidental to these

beyond what Nature has devised is understood in light of the fact that the body is organized around the set of life functions, each part an instrument. As mentioned above, the word for instrument ('*organa*' or *'instrumentum'*) is thus central to understanding what is going on in this passage. Each part, by virtue of its powers, is an instrument through which the relevant goal is accomplished. In order to understand these complicated interrelations among the parts, Harvey employed the concept of instrumentality to explain how, for instance, the parts of the digestive system work together to accomplish the overall goal of nutrition.[130] Notice again, as in Fabricius, the order here is logical, or better, explanatory: what explains a part existing in the way that it does is the fact that the part is for the sake of accomplishing that function.

Anatomy was thus about the parts of the body and how they are 'for the sake of' some soul function (or sub-function). I mentioned above that the quote from Harvey is a clear reference to *De partibus animalium*, where Aristotle wrote that:

> Because every instrument is the for the sake of something, and the parts of the body are for the sake of something, we see that, indeed, a thing is itself for the sake of something, it is for some action only, for the entire body is well known to be constituted for the sake of some complete action. For cutting does not happen for the sake of the saw, but the saw is for the sake of cutting, since cutting is a certain use. Wherefore the entire body is made for the sake of the soul, and the parts are constituted for the sake of their functions, and their offices, to which each are fitted.[131]

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functions. The difficulty is that there are many, perhaps an infinite number of uses of an eye, and so how do I know which correspond to the scientific explanation of what an eye is? The solution is to come up with a means of distinguishing between uses (i.e. ends) of an eye that are natural from those that are incidental. Thus Aristotle makes a distinction between the intrinsic-natural uses of an eye, and the extrinsic-incidental uses of an eye. The former feature in a scientific explanation of the organ, but the latter do not. For that an eye is for seeing helps us to understand why it has the various parts that it does, how it was formed, and how it benefits that which naturally has it" (Johnson 2005, 61). Furthermore, Harvey doesn't often consider a creature's way of life, its *bios,* at least not as consistently as does Aristotle.

[130] See, for instance, Harvey 1616, 12; 22.

[131] Aristotle 1552, *De Partibus animalium*, Lib.I, Cap.V., 67. Note also that I have eliminated the abbreviations from the Latin as an aid to clarity and readability (thus '*scilicet'* and not '.s,' '*esse*' and not 'ee,' and so forth). "Cum autem instrumentum omne rei alicuius gratia sit, & partes corporis quasquae gratia esse alicuius videamus: id autem ipsum esse alicuius gratia, non nisi pro aliqua actione sit: patet iam totum etiam corpus constare alicuius gratia actionis plenioris. Nonenim sectio serrae gratia facta est, sed serra sectionis gratia, cum sectio quaedam usio sit. Qua propter corpus etiam totum animae gratia conditum est, & membra officiorum gratia constant, & munerum, ad quae singula accomodantur."

Harvey, following Aristotle here, emphasizes the ends come before means, or as he puts it, 'the cutting is not for the sake of the saw, but the saw is for the sake of cutting.' Here Aristotle connected essence and explanation together, as James Lennox has argued:

> The unity of matter and form in animals is to be understood as the unity of an instrumental structure and its functional capacity. The various features of a part are to be explained by reference to the function or action for-the-sake-of-which that part came to be and exists; the physical features of the animal as a whole are to be understood by reference to the animal's complex, yet integrated, way of life. The definition of a part that corresponds to such an explanation will necessarily make reference to the part's structure, but only in so far as that structure exists for the sake of performing its function or functions....[132]

These functions, these activities and capacities, are *formal features of the animal*. They are aspects of its soul, its very substance, they are what makes it what it is. They are the means by which the philosopher explains the various parts and their activities.[133] As I emphasized above, definition, function, and essence are tightly bound together. By citing Aristotle in this context, it is obvious that it was very clear to Harvey that the body was naturally organized into parts on the basis of a set of capacities for certain necessary functions. These functions then serve to explain the presence of these parts, and thus the animal body's organization is founded upon a set of 'being for the sake of' relations with respect to the soul faculties, and which make up the definitions of the parts and, *in toto,* the definition of the animal. These relations are further elaborated in terms of the means-end structure of hypothetical necessity.

The sorts of craft metaphors that Aristotle used to describe this subject matter are extremely telling, and it was fundamental to this picture, in Harvey as well as in Aristotle, that Nature is like a craftsman: bodies are designed according to the goals which animal bodies must accomplish, just as a house is designed according to the goals which a house, in order to be a house, must accomplish (to provide shelter and so on). Thus, as noted above, parts are

[132] Lennox, James 2009, "Form, Essence, and Explanation in Aristotle's Biology," In: *A Companion to Aristotle,* Ed. Georgios Anagnostopoulos, London: Blackwell Publishing, 348-67, 352.
[133] Lennox 2009, 353. See also: Lennox 2001a, 175-176

understood in terms of hypothetical necessities: given their function, they must be made in such and so a way given the materials available. This is the hallmark of instruments since, just as a saw, by dint of its function, necessitates that it be designed with sharp serrations, must be made of a material harder than what one is trying to saw, etc., so too must the parts of the body be designed in order to accomplish their functions. For instance, due to its function of protecting the brain, the skull needs to be hard, durable, must surround the brain, and so forth.

As the form of the body, the soul is also the (formal) *nature* of the body. Nature, to recall the definition of the *Physics*, is an internal source of change or rest, and this, too, was Harvey's conception of a nature. As he noted in the *De motu locali animalium,* "To learn about movement is very largely to learn about Nature, for Nature has been defined as the 'principle of motion'."[134] Later in that work he defines the soul in just this manner, as the principle or nature of the body,

> In all local movement there is a source of movement…Because all the aforesaid movements of the parts of the whole pertain to man and to most animals, and Nature is the principle of motion in the thing in which the movement occurs, and because Nature is in all things one and the same principle of movement and is both the living soul and form, or WH what is divine and corresponds to the fiery element of the stars.[135]

Note that this basic picture is common to the Ancients and their Renaissance descendants: an emphasis on the soul being the essential form of the living creature, its nature, and thus the source of its motions. Indeed, Harvey explicitly defines these three as one of the sources of movement: "On the different sources of movement: (1) Natura forma anima…."[136] Note first that Harvey here equated nature, form and soul, in a way that is distinctly Aristotelian (and against Galen's position in the *De natura facultatibus*). So insofar as the soul is the source of movement,

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[134] Harvey, William 1627 [1959], *De motu locali animalium*, Ed. and Trans. Gweneth Whitteridge, Cambridge: Cambridge University Press, 15. "De motu cognoscere est maxime Naturam cognoscere quia Natura principium motus."

[135] Harvey 1627, 32. "In omni motu locali est movens…Cum omnes antedicti motus et partium et totius in homine et plurimis animalibus insunt, et Natura principium motus in quo inest, quod idem principium omnium [motuum] in omnibus Natura est, et Anima animante et forma vel WH quod est divinum respondens element stellarum". Here Harvey is referencing the definition of a nature from Aristotle's *Physica* II.1. The 'fiery element of the stars' is a reference to Aristotle's *De generatione animalium* II.4.

[136] Harvey 1627, 39.

and insofar as the anatomist is interested in the movements and actions of the parts, then the anatomists' subject matter is deeply concerned with the soul as an efficient cause. Indeed, one must see the *De motu cordis* in this light: it is an investigation into soul insofar as the soul is responsible for the motions of the parts, including the heart. And in fact, Harvey noted exactly this in the *De motu locali animlaium*: "Likewise, all movement is derived from the soul. For in every plant, nay, in every created thing movement inheres. See *De motu cordis* as to whether there is movement of the vital spirits." Harvey here references Chapter XV of his own *De motu cordis*, where he argues that the heart is the source of the motion of the blood around the body, it is its source and origin, and this due to the forceful systole and not to the vital spirits.

Harvey in the quote above concerning nature and soul made a reference to the conception of the immediate instrument of the soul as a sort of fire, akin to the element of the stars. The *locus classicus* for this view was in Aristotle's *De generatione animalium,* a work central to Renaissance discussions of soul.[137] The soul by means of this heat is able to effect the necessary changes in the body to complete the functions needed for life. Central here is the *nutritive* faculty of the soul, which Harvey connects with the most basic functioning of the parts of the body (or at least those parts not under control of the will), and which was thus of primary importance in anatomical investigation.

Nutrition and generation are twin sides of the same faculty. Indeed, nutrition and generation are central because, as the most basic capacity of soul, their presence indicates life. Harvey wrote, "In the mid section [of the body] is the very power of life, the first beginning of both the other parts, and from the middle comes one way nutrition and generation, and the other the senses and the understanding."[138] Thus the middle part of the body is the seat of soul and the

[137] Deer [Richardson], 1980.
[138] Harvey 1616, 32. "medio loco quod primum omnium fundamentum; in medio virtus principium utrorumque, hinc nutritio et generatio illinc sensus et intellectus."

source of life, containing the stomach, heart, guts, and the rest of the instruments of nutrition.[139] Harvey's work in the *De motu cordis* should be conceived of as an investigation into nutritive soul, for the heart, arteries, veins, and blood are the instruments of nutrition. Life and the nutritive capacity are deeply interrelated, for it is this nutritive capacity that is responsible for the body's functionality, including vital operations such as respiration.[140] In a late addition to the notes, probably in 1627, Harvey mentioned the circulation, and we see him struggling to explain its purpose. There he wrote, "Why? Is it for the sake of nutrition, or is it rather for the preservation of the blood and of the limbs by means of the infused heat?"[141] For Harvey, life, heat, nutrition, respiration, and concoction were all tied together: "Life cannot exist without nourishment, nor nourishment without concoction, nor concoction without heat, nor heat without ventilation, for heat destroys itself by languishing or by smothering."[142] I take up these issues again at the end of this chapter.

In sum, Harvey, following in a long tradition of natural philosophical writers, understood anatomy to investigate *what is common to body and soul*. Note two things: first, every organ needs a reason to explain its existence, the reason being its function (this picture will be complicated below in the section on Harvey's terminology). Second, as a result of the necessity to accomplish that function, there are certain material consequences in the way the organ is structured and constructed. In other words, the function accomplished by an organ determines how the organ is arranged, what it must be made out of, etc. The first determines the logical order of explanation: functions explain the existence of organs. The second adds to this

[139] A simple perusal of the *Prelectiones* will reveal that Harvey mentions nutrition numerous times throughout the work, and that it is something that was of concern to him and his research, in addition to being important to the lessons he hoped to teach aspiring physicians and surgeons.
[140] The physicians also called these operations the natural movements or powers. On respiration see: Harvey 1627, Cap.5, 39-45. See also: Laurentius 1600, Lib.IX, Q.20, 372-374.
[141] Harvey 1616, 272. "An? Hoc gratia nutritionis an magis conservationis sanguinis et membrorum per infusum calidum." James Lennox has rightly pointed out to me that this language is very close to what Harvey writes about the final cause of the circulation *De motu cordis* Cap.8.
[142] Harvey 1616, 294. "Vita non potest esse sine nutrimento, nutrimentum sine coctione, coctio sine calore, calor sine eventatione qui ipsum seipsum marcore vel suffocatione interimit."

explanatory system the fact that functions also explain not only *why* the organ exists, but also *how* it exists. This becomes especially important when doing comparative anatomies, for these hypothetical necessities are essential for understanding functionality and the variation in functional parts across different animals.[143] In order to complete this account of Harvey's conception of the subject matter of anatomy, in the following section, I turn to this second lesson, and to the matter of the body and the possible ways to divide it.

[143] Indeed, this is also important in understanding the parts within a single organism, for the same kind parts of within an individual vary on the basis of their purpose: thus different muscles are constructed in different ways given their function and sub-function. I discuss this in the following section

3.0. ORGANIZATION, TERMINOLOGY, *DE MOTU CORDIS*

Having situated and discussed Harvey's basic conception of the 'teleology of being' and its role in Harvey's anatomy, I now turn to fill in some of the details of Harvey's conception of the anatomical subject and its proper explanations. Here Harvey's fundamentally Aristotelian conception of natural philosophical explanations and explanatory duties will become clear, as Harvey moves to also incorporate material causation into his explanations of animal bodies and souls.

In the first section (**Section 3.1**), I discuss Harvey's understanding of the meaning of a 'part' of the body, as this discussion completes the teleological analysis of the previous chapter by adding an account of the matter and structure of the body as governed by hypothetical necessity. I then move on in the second section (**Section 3.2**) to discuss Harvey's system of teleological terminology. Finally, I conclude the chapter (**Section 3.3**) by briefly discussing how teleology functions in Harvey's *De motu cordis* as a way of transitioning from the teleology of being to that of becoming, to be discussed in the following chapter.

3.1. ORGANIZING THE BODY: THE MEANING OF A PART

If anatomy studies body and soul, it must understand how soul organizes the body, that is, it must investigate what it means for something to be a 'part' of the body, and *how* those parts exist for the sake of the soul. An anatomist must known both formal and material natures. This is a very Aristotelian project insofar as Harvey was elaborating the set of hypothetical necessities that govern the construction of the parts of animals. This is the method suggested by Aristotle in *De partibus animalium*,

> There is absolute and simple necessity from reason, as in eternal things, but there is also a mortal[1] necessity granted by supposition, and which manifested in all things generated as in art, such as a house and whatsoever is produced in this way. For if a house or whatever other final thing is to be made, it is necessary that a material of such a kind shall be present, and then first this and then that should be produced and moved, and so on following these in succession until the end is reached, for the sake of which each thing is produced…[2]

For Harvey, anatomy investigated the structure of the parts, which (as I shall show in Chapter 4) helps reveal the actions and uses of the parts. The term that Harvey and other anatomists often use to designate this structure and construction is *fabrica.* In early modern Latin, *fabrica* had the connotation of art and craftsmanship, that is, it was used in situations which implied that the structure, composition, etc. are as they are (that is, made of wood in the shape of a triangle, or has sharp serrated teeth) in order to accomplish certain ends—structural integrity, the ability to cut, and so forth. For example, if the muscles are for the sake of movement, they must have the strength and structure to accomplish that goal. In his discussion of muscles in *De motu locali animalium*, Harvey writes:

> …Nature in the construction of the muscles is concerned with two things, with their actions and their functions, or with the perfecting of action. Therefore, in muscle there are two things to be considered, namely the composition of the muscle for the sake of its action and its mechanical construction for the sake of its strength and power.[3]

So, given a function and a part, Harvey attempted to, in a sense, 'reverse engineer' the design of the muscles in order to figure out what aspects of them are for the sake of those specific ends to which muscles are put. So while all muscles have the overall function of contraction, other muscles have other, more specific sub-functions and so must be constructed differently so as to

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[1] The verb here used adjectively, cado, literally means 'to fall,' an echo of Christian metaphysics not found in the original Greek.

[2] Aristotle 1552, *De partibus animalium*, Lib. I, Cap. I, 63, "Inest idipsum rebus quidem aeternis simplici absolutaque ratione: sed caducis etiam gignendisque omnibus ex suppositione tribuitur: quomodo in artificiosis ut aedibus, & quibusuis alijs generis eiusdem. Materiam enim talem adesse necesse est, si domus, qut quiuis alius finis futurus fit: atque etiam fieri, moverique illud primum oportet, de inde hoc, ac deinceps ad hunc modum itur ad finem, cuius gratia res quaeque & efficitur…." The Latin here, unlike the Greek, does not make it clear that both eternal things and generated things are natural. I thank James Lennox for pointing this out.

[3] Harvey 1627, 126. "…Natura in fabrica musculorum ad duas respicit actiones et functiones, seu perfectionem actionis. Unde in musculo duo animadvertenda sunt, videlicet: compositio gratia actionis, artefícium mechanicum gratia roburis et virium."

accomplish those ends. Harvey later says as much: "Nature has no regard for shape, position and size of muscle as such, but only *for the sake of strength and for the benefit of those parts which protect or which are indispensible*."[4] Natural objects, in this case the muscles, have ends and they have means by which those ends are accomplished, and the variation in those means is explained through hypothetical necessity with respect to those ends. Thus given this system of ends and means, there are a variety of 'engineering' questions that remain concerning how exactly the part accomplishes its end through its structural and material nature.

For example, in discussing the layout and distribution of the veins, Harvey argued that "…since it is necessary that the veins should be distributed into tiny branches for the sake of concoction, lest they should be injured, entwined and intertangled, each organ packs them, supports them and spreads them out with soft parenchyma, and warms them with gentle heat and promotes concoction"[5] This then connects with the conception of the soul and its functionality discussed above: the soul organizes the body into parts which are the right instruments for accomplishing the soul's ends, and just as a craftsman's hammer helps him complete his goals by being designed in a certain sort of way (made of a hard material, with a large flat surface for hammering, etc.), so too does the soul's body complete its goals by being designed in certain sorts of ways (being made of certain materials, having heat, etc.). Determining the nature and meaning of a part of the body, viewed as an instrument of the soul, is thus a project of great philosophical and anatomical import, for depending on what is considered a part, the anatomist's explanatory responsibilities can vary widely.

The problem here has to do with certain ambiguities in part-whole relationships. Harvey observes: "WH a part is so called relative to the whole, wherefore, since body is said equivocally

[4] Harvey 1627, 128. "Natura non respicit ergo ad figuram, situm, magnitudinem sed gratia roboris et ad melius tutelandum vel sine qua non." My emphasis.
[5] Harvey 1616, 142. "Cum venas in ramusculos propter coctionem necesse destribui, ne laedantur twined and intertangled, parencymate molli distipit, fulcit extendit et blando [*ms* blandi] calore fovet, coctionem promovet."

and in multiple ways, [thus the meaning] of a part and what [is a part] is ambiguous."[6] The meaning of a part depends on its relation to the whole body. Harvey expresses this idea a bit later in the following way, "And a part is that which by any manner whatsoever completes a whole as perfect."[7] This last part is especially interesting, as it nicely indicates the teleological system that undergirds this conception of the parts: the body is a unified whole, but one that can be divided into functional parts. Each part is organized according to how it accomplishes some activity which completes that unified whole, that is, which accomplishes some biological good for the sake of the organism. Body and soul are a *teleological* unity, and thus parts must be understood in relation to this unified whole.

By complete one should understand something like 'contributes to the well-being of;' in modern (and anachronistic) terms, these activities of perfection are the metabolic and regulatory processes which order and maintain the body as a whole, functional organism. In Greek, the verb *teleiousthai* means 'to complete,' and the adjective *teleion* means 'complete.' Both of these words are part of a family of terms containing the root *tele-*, including the term for an end, *telos*. Aristotle's teleological system revolves around the idea that excellence is a matter of completion or perfection, and around how ends are achieved, or completed. In *Metaphysics* V.16, Aristotle defines what it means to be complete, most importantly for my purposes, he wrote:

> And [the second way in which we call something complete] is that which, in respect to excellence and goodness, cannot be exceeded in its kind, such as when a musician or flute player is complete, when they are not deficient in anything proper to their kind of excellence…And excellence is a certain sort of completion, for everything is complete,

[6] Harvey 1616, 6. "WH pars relativum est et ad totum dicitur, unde quoniam corpus equivocum et multifarium dicitur, pars ambigua et quid sit ambiguum. The WH signifies that Harvey is directly stating his own opinion on this matter, often times in contradistinction with the orthodox view.

[7] Harvey 1616, 8. This is a very difficult passage, not the least of which occurs because the original is incredibly hard to decipher, and Whitteridge disagrees with my own archival research, as well as the 1886 editors of the notes. I read the line as: "Et pars WH quod quovis modo totum integratur pars integrum," whereas Whitteridge has the line as, "Et pars WH quod quovis modo totum integrat prout integrum compositum sive continens, contentum, impetum faciens etc." In the original notes, however, 'Compositum sive' is on a separate line, and after the 'Compositum sive' there is a curly brace containing 'Continens', 'Contentum', and 'Impetum faciens &c' listed on separate lines. I have tried to take this into account in my translations above by separating what Whitteridge put together as one sentence.

> every substance complete, when it lacks part of its natural magnitude with respect to its proper kind of excellence..[8]

Monte Ransom Johnson discusses this passage, and wrote that, "A most important feature of this definition is the notion that the complete…is complete relative to 'the kind of excellence native to it'…Complete means having reached an end that constitutes an excellent condition of a specific kind of thing."[9] Parts of the body on this view, then, complete the whole relative to 'the kind of excellence native to it,' which in the case of the body can only be relative to the proper functioning of the whole body: its maintenance, overall well-being, and flourishing in its environment. Thus a part expresses what it is for—that is, for the sake of which it acts—when it has reached that end which constitutes its specific sort of good; at that point, it is complete in the relevant sense. Johnson states that,

> It is important to realize that the explanation or cause 'for the sake of which' is an end in this specific sense—that of providing a limit which makes things comprehensible and achievable. If I can ascertain that for the sake of which something is produced or exists, then I can begin to understand its structure, constituents, history, development, and so forth.[10]

It is this Aristotelian conception of completion that is in the background to Harvey's statement, and his conception of anatomical understanding is identical, founded upon this deeply teleological conception of life and the activities of living things.

Harvey's next line after discussing this first aspect of part-whole relationships concerns how the parts can be divided such that they form together a whole, and it is this concern that animates much of the rest of his discussion of the meaning of a part. Harvey wrote, "[A part] is formed [through] containing [another part], or being contained [by another part], or [by] causing

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[8]Aristotle 1552, *Metaphyiscorum Libri XIII,* Lib.5, Cap.16, In: *Aristotelis libri omnes, ad animalium cognitionem attinentes, cum Averrois Cordubensis variis in eosdem commentariis*, Volume 8, Venice,., 61-62. "Et quod secundum virtutem et quod est eius, quod bene, non habens excessum ad genus ut perfectus musicus, & perfectus tibicen, cum secundum propriae virtutis speciem in nullo deficient…Virtus quoque quadam perfectio est unumquodque nanque tunc perfectum est, cunctaque substantia tunc perfecta, cum secundum speciem propriae virtutis nulla desit particula magnitudinis naturalis."

[9] Johnson 2005, 84. This line occurs in the context of discussing how to conceptualize ends in Aristotle's teleology.

[10] Johnson 2005, 83.

motion."[11] As Whitteridge notes, this division of the parts of the body was ultimately derived from Hippocrates, adopted by Galen, and cited on the first page of's *Theatrum Anatomicum*, where he wrote,

> The container, naming the solid parts, in order that they surround and protect the fluids [of the body]; the contained, the humors, in order that they are surrounded by the solid [parts]; and the causes of movement, the spirits, in order that they are easily and in a moment of time carried into every part of the body.[12]

There are three examples here of parts of each kind: there are containing parts, which refer broadly to all the solid parts that contain some fluid, a prime example being the heart. Then there are the fluids so contained, and these refer to the humors, including, of course, the blood contained within the heart. Finally, there are the causes of movement, which refers, in the original Hippocratic case and among many Galenic physicians during Harvey's time, to the natural spirits (*naturales spiritus*, or *pneuma*) of the body. This last division, *impetus faciens*, is part of the ancient Hippocratic term *horme*, and is sometimes translated as 'what moves the whole.'[13] The *impetus faciens* was often equated with the *causa efficiens*: that is, the *impetus faciens* are those spirits (or whatever agents or processes one thinks as being causally responsible) that are the motive cause of various sorts of goal directed processes in the body. In particular, and following my discussion above, these *impetum faciens* might be identified with the efficient causal aspect of nutritive or vegetative soul. According to Galen, the referent of this Hippocratic term was the same as Aristotle's nature (*phusis*), though he interpreted the Hippocratic notion in a Platonic way, that is, as the result of the action of Design of the

[11] Harvey 1616, 8. "Compositum sive {continens, contentum, impetum faciens etc.}." The passage is difficult to parse in an easily comprehensible way from the Latin; I have thus interpolated some words in order to make both the passage and my specific interpretation of it clear.
[12] Bauhin, Caspar 1605, *Theatrum anatomicum*, Frankfurt, 1. "Continentia, solidas partes nuncupat, ut quae comprehendant tegatque humida: contenta, humores, ut qui a solidis comprehendantur: & impetum facientia, spiritus, ut qui momento temporis & facile…in omnem corporis partem ferantur."
[13] French, Roger 1994b, *Ancient Natural History*, New York: Routledge: 153.

Demiurge.[14] I note too that Aristotle sometimes used this same term to refer to natures instead of the more common *phusis.*[15] Most relevant here is the status of the spirits, as these were thought, by the Galenists at least, to be the causes of the functions of the parts. To put it another way, the spirits were thought to be the most direct instruments of the soul by which it carries out its tasks in the body, chiefly the tasks of the nutritive part of the soul.[16] If the goal of anatomy is to understand the soul that is the cause of the body, then it is essential to understand these spirits.[17]

The issue of the *impetum faciens* is really about instrumentality: by what means does the soul perform its work in the body? What is the efficient cause of the actions of the parts? One must inquire not only into the final causes of the parts, but also into the efficient causes that bring about those ends—it's a package deal. So how should one understand Harvey's use of *impetum faciens*? The best way is to understand it as signifying internal sources of motion, that is, soul as efficient cause, which Harvey (at least sometimes) took to be found in the blood and which the physicians located in various natural spirits. Returning to Harvey's division of the parts, one can conclude that those parts labeled as *impetum faciens* are divided on the basis of their natures, their internal sources of growth and change, their form or soul as efficient cause. Recall the quote above from Harvey's *De motu locali animalium* in which he equates form, soul, and nature, all of which refer to the source of motion and activity in the parts of the body. This has the added benefit that this is an interpretation of *horme* that Galen himself put forward, as well as a predominant interpretation in the Latin medical tradition.[18] The subject matter of anatomy, then, includes not only an investigation into the functions of the parts, but also an inquiry into the efficient causes of those functions.

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[14] French 1994b, 153-154.
[15] I thank Jim Lennox for this point. See for instance, Physics II192b18-19: "…but none of these [things due to art or chance] have an inborn *horme* of change'
[16] The story of spirits is complicated, and involves those elements we mentioned above with regard to the nutritive soul: heat, concoction, respiration, and life.
[17] Harvey, by the time of the *De generatione,* is quite anti-spiritualist. I discuss this in the following chapter.
[18] French 1994b, 154.

At this point in the *Prelectiones,* Harvey moves on to discuss two other ways of dividing the body into parts, both of which are teleological: first, that the parts can be divided by means of their ends, and second, into those parts which are sensitive and insensitive. Now, in a certain very weak way, the Hippocratic division of the parts is already divided on the basis of ends, that is, the containing parts have the end of containing things, and so forth. However, Harvey now seems to be pointing to something more complicated: "And so another division of the parts is: philosophically and medically by their end; anatomically according to sensation, as the body is a composite."[19] Let's consider each of these distinctions. The first is quite straightforward: one can divide the parts of the body on the basis of their ends, that is, for every end there is a corresponding part or set of parts designed to achieve that end. As Aristotle argues in the *De partibus*, the natural philosopher must consider first the 'for the sake of which,' and then the cause of motion.

The second division, anatomical, refers to Aristotle's distinction between those parts that are capable of perception, and those that are not. For Aristotle, this difference is founded upon the material composition of parts, namely, only those parts that are materially uniform can be said to be capable of sense perception.[20] What is important here is the relation between the uniform and non-uniform parts, where Harvey writes "The use and necessity of the homogenous parts [follows from], their actions and passions; and [from the need to] make up the matter of the heterogeneous parts."[21] The basic idea here is that the uniform parts exist for the sake of the non-uniform parts, which are built from the uniform. Harvey was here be referring a passage in *De partibus animalium* where Aristotle argued that the uniform parts are for the sake of the non-

[19] Harvey 1616, 8. "Divisio itaque partium alia: philosophica et medicina a fine; anatomica ad sensum, ut est compositum."
[20] Harvey 1616, 8.
[21] Harvey 1616, 8. "*Similarium usus et necessitas propter {actiones et passiones; et ut fiant materia dissimilarium*}." The braces indicate that Harvey has a curly brace leading to the two listed items after the word '*propter'*.

uniform, and the latter are for the functions and actions.[22] Harvey then went on to specifically addresses the qualities of the uniform parts, that is, which uniform parts are hard, soft, liquid, solid, etc., then going into the non-uniform parts constructed from the uniform.[23] The detail here is important given the pedagogical purpose of the lectures, as it surely proved useful to aspiring physicians demonstrate which parts were considered hard or soft and so forth. It is furthermore helpful insofar as these are the exact sorts of similarities and differences that surgeons and physicians should attend to in their anatomical investigations, which I discuss in more detail in Chapter 4.

Note that this division of the parts is explicitly teleological. The relation between uniform and non-uniform parts is a 'for the sake of' relation and is a result of necessity, what Harvey calls 'use and necessity'. Harvey argues that the use and necessity of the uniform parts is due to their actions and affections, that is, what they can do and the way in which they are sensitive, and the need for these parts to provide the material for the non-uniform parts. He seems again to be referring to the *De partibus*, where Aristotle argues that these homogenous parts are for the sake of constructing the heterogeneous parts, and that this follows from necessity (since it is impossible that the reverse be true, that the heterogeneous make up the homogenous).[24] So there are two ways in which this conception of the construction of uniform and non-uniform parts belies Harvey's teleology: uniform parts either play a (1) direct functional role, in that their actions and affections are designed to accomplish some physiological end, often of a sensory nature due to the necessity of sensation only taking place in uniform material; and an (2) or an indirect functional role, an instrumental role, where the uniform parts are for the sake of the construction of the non-uniform parts.

[22] Aristotle 1552, *De partibus animalium,* Lib. II, Cap.1, 68.
[23] See Harvey 1616, 10
[24] Aristotle 1552, *De partibus animalium*, Lib. II, Cap.1., 68.

Evaluating the body as a whole, Harvey noted that, "...there is no part that in some manner is not fashioned as an instrument."[25] As I've been emphasizing, this conception of instrumentality is central to Harvey's understanding the unity of body and soul, as a system of interrelated and harmonious teleological relations. Instrumental relations allow Harvey to understand how a particular organ and its function are embedded in the body's larger framework of parts and ends. This line occurs in the context of one of Harvey's 'WH' marks, indicating his opinion. The full line is, "*WH forsan {ad se} nullae partes corporis. Praeteria nulla pars quae aliquo modo non figurate organice; ut caro vitelli cocta*."[26] The manuscript is extremely difficult to make out, especially a scribble between '*forsan*' and '*nullae*', a mark which Whitteridge leaves out entirely, but which my archival research leads me to transcribe as '*ad se*' and which matches the 1886 edition of the *Prelectiones*. This has the benefit of making clear Harvey's remark, for he is not saying that *no part is a part of the body* (which is Whitteridge's reading), but rather that no part is a part *to itself* ('*ad se*'): this then makes sense of his comparison to the cooked veal, as flesh, in the absence of the rest of the parts of the body (not to mention having been cooked) is a part of the body only in name and memory. Thus one is again reminded of the importance of part-whole relationships, as these relationships undergird the teleological conception of the parts of animals—the anatomist, even when concerned with the division of the body into parts, must be careful to remember that a part is a part of the body only when it is connected to all the other parts according to the necessary life functions. The teleological concepts of completion and perfection, which were so important in the Greek context, are important here too.

Somewhat later in the *Prelectiones* Harvey returns to dividing the parts by their ends, what he now calls the philosophical division of the parts. It is on these matters that I shall end

[25] Harvey 1616, 8. "Praeteria nulla pars quae aliquo modo non figurate organice."
[26] Harvey 1616, 8. "WH for nothing is part of the body to itself. Moreover, there is no part which is not in some way fashioned for some instrumental [purpose], as for example cooked veal [has no purpose]."

this section, as they return to the theme of the previous section: the union of soul and body as the subject of anatomy. They are furthermore quite important in that these ideas are essential in understanding the methodology Harvey advocates for doing anatomy, to be discussed in Chapter 4. Harvey wrote: "The philosophical division of the parts is that which is according to the instrument of the soul, according to the divisions of the soul or according to the faculties: by the final cause."[27] What Harvey seems to be saying here is that the philosopher divides the parts according to those ends which are accomplished through the capacities afforded by the instruments of the soul. Below this line are a series of five sections that elaborate this division.

Harvey presents a number of alternative formulations of such a philosophical division that have been articulated by others, both by the ancients and by some of his contemporaries. Thus he mentions again Hippocrates' division that was discussed above, but also Fernel's division of the parts according to locations (private vs. public regions).[28] The items most relevant to my concerns, however, are the third and fourth, both of which offer insights into some important terminology: action, use, and usefulness. I discuss these terms in the following section, but what is important to note at this point is what these terms reveal about how Harvey conceives of the parts of the living body and the task of the anatomist:

> [We can divide the parts by their] Actions and uses: [that is as] organic [or] instrumental, [that is, those which] have been fashioned, which bring about an action; or as formless parts having a broad use… for, as they are a sign of soul, nothing is a part which has not some action, nor are there any limbs that have not a function. Whence the instrumental parts are not opposed to the uniform parts, but (since all the parts are in some way fashioned parts) are mostly for the purpose of bringing about some particular action.[29]

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[27] Harvey 1616, 12. "Philosophica divisio partium secundum quod organum animae, secundum divisiones animae vel secundum facultates: a finali causa." This is the only time Harvey uses the phrase *final cause,* which indicates that, even at this early stage of his career, Harvey was quite wary of using the term, as one sees not only in this work but also (for perhaps more obvious reasons) the *De motu cordis*.

[28] See: Fernel, Jean 1567, *Therapeutices universalis, se medendi rationis libri septem*, Lib. II, Cap. 1, In: *Universa Medicina*, Paris, 359.

[29] Harvey 1616, 12. "Actionibus et usu: organicae instrumentales, figuratae, qui actionem edunt; informes, usum latum habentes…Nil enim pars prout signum animae, quod non actionem quondam habeat, nec membrum cuius non est functio. Unde organicas partes non contrarias similaribus sed (quia omnes aliquo modo figuratae) ut plurimum actionem quandam edant."

Note first that Harvey seems to equate here between action and use, an ambiguity that plagues all of his work; but set this aside for now. Harvey here states that parts are quite literally 'signs of soul'; Whitteridge's translation here is enormously evocative and instructive: she says that the parts are 'manifestations of the soul.'[30] This is actually an excellent way to think of the subject matter of anatomy: a search into the soul made manifest, form and matter in union: an investigation into the parts of living animals. Parts are for the sake of their actions, and can be divided on this basis.

There is a further teleological conception of the parts that permits another way of dividing the body, namely, by the *utilitas* of the parts:

> [We can divide the parts by their] Utilities and excellences, whence [they are] simply necessary, indispensible, for the better, for protection, [or] for adornment. Whence [they are] the most necessary principle parts; [or the] less principle parts; [or] are ignoble parts in which there is less innate heat, soul and power.[31]

Despite the seeming similarity in their meanings, and despite the fact that most early modern authors (including Harvey) used the terms indiscriminately, *usus* and *utilitates* are to be distinguished. Or, perhaps better, they are to be placed on a teleological scale with action on one end and utility on the other, use somewhere in between. For now, I offer a preliminary interpretation of this passage. Both of these terms are explanatory, providing the cause of the part. However, whereas use explains the existence of the part through its functionality, that is, through its ability to complete the end for which it is designed, usefulness concerns the fittedness of a part to its use, to its function. In her introduction to her translation of Galen's *De usu partium*, Margaret May emphasizes this understanding of usefulness (*chreia*), writing that usefulness,

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[30] Harvey 1616, 13.

[31] Harvey 1616, 12. "Utilitatibus et praestantia unde necessarie simpliciter, sine qua non, ad melius, ad tutelam, ad ornatum. Unde principes primo necessariae; minus principes; ignobiles in quibus minus est caloris nativi minus animae et virtutis."

> …does not mean function, as one might naturally suppose. Function is more nearly *energeia* or 'action,' in Galen's terms. *Chreia* means for him rather the suitability or fitness of a part for performing its actions, the special characteristics of its structure that enable it to function as it does. Sometimes *Chreia* is best rendered 'reason' (why a part has a certain feature) or 'advantage' (to be gained form a certain feature). The nearest Galen comes to an actual definition is…where he says that usefulness is the same as what is called utility (*euchrestia*, serviceableness)….[32]

Usefulness (I here follow May, but, in Harvey, I render the term more literally as utility) is a concept deeply embedded in the natural philosophies of Aristotle and Galen. Further, the term has distinct natural theological overtones.[33] So, whereas the previous mode of dividing the parts was based on the life goals that a part accomplishes, the present mode divides the parts on the basis of how each part accomplishes those goals *according to the best and by necessity*. There is, here, a very central role for a conception of the good—that is, the best or optimal way for a part to exist is central to understanding its utility and thus central to dividing the parts on this basis. In Harvey's time, this conception of the good manifested itself through various theological commitments and conceptions of God and His Goodness in relation to His Design.

So if action and use divide the parts on the basis of which goal they complete and how they complete it, then the division on the basis of utility is a conception of the parts on the basis of how they complete that goal in the most perfect way possible, and in such a way as to give knowledge of God's Perfection and the perfection of His Design.[34] Given Harvey's prose, it may seem a stretch to interpret the division of the parts by *utilitas* in such a manner. But note that this natural theological conception of *utilitas* goes back all the way to Galen. Galen's original category was highly natural theological in just this sense, and though he was no Christian, his Platonic conception of the Creator, the *Demiurgos,* made Galen's project easy to

[32] May, Margaret T. 1968, *Galen on the Usefulness of the Parts*, Ithaca: Cornell University Press, 9.
[33] Hankinson, R.J. 1989, "Galen and the Best of All Possible Worlds," *The Classical Quarterly,* 39(1).
[34] As noted above, this goal became quite important and explicit in the anatomical context. One of the texts upon which Harvey based his notes, Bauhin's *Theatrum anatomicum* is one of the leading examples of this sort of natural theological commitment among the anatomists, and he begins that work with a long proem singing the virtues of the human body and soul, most perfect and God-like.

reinterpret into Christian terms.[35] Harvey, at the time of the lectures, is not nearly so concerned with this natural theological aspect as Galen or as many of his contemporaries were—there is nary a mention of God. However, by the time of the *De generatione animalium*, this did become a central concern for him, and so one sees natural theological language in full effect.[36] So, for instance, he marvels at the miraculous design and power of eggs,

> And while we are on this subject, I thought to myself, how small are the fertilized origins of eggs, truly pimples and beads smaller than seeds of millet, and reflecting on the size of the cock born from them, his magnanimity and his adornment, I cannot but wonder that such great natural powers are placed in such small origins, and that the omnipotent Creator wanted to appear at his greatest from the smallest beginnings.[37]

Supposing, *ad argumentum*, that this sort of attitude is applicable to Harvey of the *Prelectiones*, one might then describe the division as being on the basis of design—that is, utility is about how God designed natural objects so as to maximize the fittedness and goodness of the means to the ends. What I called above 'engineering questions' take on a distinctly theological meaning.

Having established this interpretation of Harvey's conception of the parts as the subject matter of anatomy, I turn to examine Harvey's language and terminology.

3.2. ACTION, USE, UTILITY: TELEOLOGICAL TERMINOLOGY

Interestingly, the section of the notes where Harvey provides the most detailed discussion of his terminology is entitled '*In historia anatomica*.' Whitteridge translated this section as "Of the

[35] For Galen's natural theology, see: *De usu partium*; c.f., Hankinson, R.J. 1989. That natural theology was widespread and important in Harvey's era and especially in the practice of anatomy I take as unproblematic, though for a nice discussion of some of these religious overtones, see: French, Roger 1999, *Dissection and Vivisection in the European Renaissance,* Aldershot: Ashgate.

[36] I discuss why one finds more of this sort of language there in Chapter 3.

[37] Harvey 1651, Ex. 41, 111. Note that in the first edition, Exercise 4 occurs twice, resulting in incorrect exercise numbers. Though I translate and provide the Latin from the first edition, I have corrected these numbering errors. "Atque hic dum sumus, cogitanti mihi, quam exigua sint prolifica ovorum primordia, papulae nempe, & sudamina milii semine minora, considerantique galli inde nati amplitudinem, magnanimitatem, atque ornatum; mirari subit, tantas vires a natura rerum in tantillis exordiis reponi & Creatorem omnipotentem apparere voluisse maximum e minimis initiis."

Study of Anatomy in General," but this is incorrect. Whitteridge misunderstands what *historiae* are—I shall discuss *historiae* more fully in Chapter 4, but here note that the though the word *historia* has a variety of meanings, the primary sense was an empirical one, at least in medical writings, and usually meant 'collected observations,' here concerning anatomical structure.

Note that this section is placed immediately after Harvey's '*Canones anatomes generales*,' where he provides a list of specific procedures, recommendations, and methods to be used in the course of performing an actual anatomy (again, to be discussed in Chapter 4). That *In historia anatomica* follows this practical section should give one a hint as to how to understand its content: namely, it is not about 'anatomy in general,' but is rather focused upon the specifically historical aspect of anatomy, that is, the part of anatomical research which involves the actual dissection and empirical observation of bodies, the structure and composition of their parts; the necessary inductive foundation for inferences about the causes of the parts and their activities. This section is thus best translated much more literally, so, 'On anatomical history" or "On anatomical observation." The content of *In historia anatomica* is concerned with the specifics of anatomical observation: what must be looked at in each part, what properties are most relevant for understanding the body, and a discussion of the terminology and concepts which are fundamental to anatomical knowledge: the categories of action, use, and utility.

These terms are of Galenic origin, found most importantly in the *De natura facultatibus* and *De usu partium*, though of course they had been added to and changed over the course of centuries between Galen and Harvey. Action is central to Galen's *De natura facultatibus*, where he distinguishes between actions and faculties—the former being active motions, the latter being the causes of those motions. The term action is split further into two kinds, active movement (*energeia, actio*) and work (*ergon, opus*), and Galen writes, "Now, again, I call 'work' that which is brought about and completed through an action: such as blood, flesh, or muscle: I call

'action' that which is itself an active movement."[38] Actions are things like the motion of the muscles, the motions of the heart, and so on and so forth. The category of use is, naturally enough, central to Galen's work *De usu partium*. Use (*chreia, usus*) is a much trickier case than that of action, and the definition is significantly less clear, in both Galen and, indeed, throughout the history of the category right up through Harvey's era.

But I start with action and its difference from use. Galen writes the following, "Now the action of a part differs from its use, as I have said before, because action is active motion and use is the same as what is commonly called utility."[39] The distinction is more or less the distinction between efficient and final causality. Hankinson argued that a use, "…is what some activity, the normal functioning of the part in question, is for, what, in the overall economy of the animal it seeks to accomplish; and hence it serves to explain, teleologically, the existence of the activity in question."[40] Actions are already teleological, in that a part's action explains what the part is for the sake of, i.e., the muscles are for the sake of contracting. But a use is 'more' teleological in that it further explains what the purpose of that action is within the whole organism. However, the terminology in Galen is quite vexed, and, as such, there has been some debate about the proper way to translate especially the category of 'use,' made more difficult that Galen himself hardly seems to define it. Returning to how I started this chapter, the notion of use is deeply connected to soul, and here Galen sounds quite like Aristotle in the *De partibus animalium*: "These uses however are themselves of the soul, since the body is as you see the instrument of it; and for this reason animals differ greatly in respect to their parts since their souls are themselves

[38] Galen 1549, *De natura facultatibus*, Lib. I, Cap. 2, In: *Galeni Peragameni…opera quae nos extant omnia*, Vol.1, 1 1115-1116. "Porro opus appello quod iam factum atque completum per actionem est: velut sanguinem, carnem, nervum: Actionem vero, ipsum activum motum…"
[39] Galen 1549, *De usu partium corporis humani*, Lib. XVII, Cap. I, In: *Galeni Peragameni…opera quae nos extant omnia*, Vol.1, 341. "Partis igitur action ab eiusdem usu (ut antea diximus) differt, quod action quidem motus quidam est activus: usus vero nihil aliud est, que quod vulgo appellatur *euchrestia*…"
[40] Hankinson, R.J. 2002, "Causation in Galen," In: *Galien et La Philosophie*, Geneva: Vandouvres: 48.

different…Truly, in every case the body is suited to the character and faculties of the soul."[41] Note first that Galen clearly understands soul as a principle of individuation, as in Aristotle. Second, note that the use of a part is the purpose to which an instrument of the soul is put, and instruments should be suited to their tasks. A use is a need, something the animal cannot live without, and the instrument that accomplishes that need through its action is constructed just so to be able to complete that use. It was this latter fact that is emphasized by May in her account of use.

However, the situation becomes even more complicated in the early modern period, as one finds that there are (sometimes) two terms used to denote Galen's *chreia*: *usus* and *utilitas.*[42] Given that Galen himself seems to define use in terms of utility (or, as May translates *euchrestia*, 'serviceableness'), one might expect there to be these two, more or less equivalent terms. And while this is sometimes true, the situation is made extremely confusing by the fact that the terms are also sometimes used to denote different things, as is the case in Harvey. Some authors seemingly prefer *utilitas* to *usus* or *vice versa* for no apparent reason—so, for instance, Fabricius tends to use '*utilitas'* whereas Laurentius tends toward '*usus'*, though both often seem to use them as equivalents (at least in many cases I have encountered).[43] With this in mind, I cannot agree with Roger French when he maintains that there is a distinction between use and utility in Fabricius, and that only utility should be conceived of as a final cause, nor with Andrew Wear

[41] Galen 1549, *De usu partium*, Lib. I, Cap. 2, 417. "Utiles autem sunt hae omnes ipsi animae, quippe cuius organum corpus est: & propterea multum different a se invicem particulae animalium quoniam ipsae animae different…Omnibus vero aptum est corpus, animae moribus & facultatibus."

[42] In addition, many authors distinguish between the use of an action and the use of a part, including Fabricius, and another Paduan anatomist from the same period, Casserius. However, Harvey never seems to acknowledge this distinction, so I shall set it aside. However, it must be said that the terminology of action and use is even more complicated than my discussion indicates, especially if one takes into consideration all the different ways the terms were being used by Harvey and his contemporaries. See: Fabricius 1687, *Opera omnia anatomica & physiologica,* sumptibus Johannis Friderici Gleditschii, excudebat Christianus Goezius, Lipsiae, 408-409; and Casserius 1608, *Pentaestheseion,* Lib.I, Cap.3, Venice, 7-8. Thanks here to Peter Distelzweig and Tawrin Baker, who first made me aware of these facts.

[43] As a random example, Fabricius' third chapter in the *De brutorum loquela* is called 'De usu loquelae animalium,' but, within the first lines of the chapter, he uses 'utilitas' and 'usus' interchangeably. See Fabricius 1625, *De brutorum loquela*, Cap.3, In: *Opera anatomica*, 9, Padua.

who makes similar claims.[44] Both, in fact, are final causes in the Aristotelian sense explored above, as, indeed, an action is also a final cause: all are instances of the teleology of 'being for the sake of.' Wear's and French's readings of Fabricius and of Harvey are thus simply mistaken, and since the triumvirate of terms is complicated, French's description of this as a 'hierarchical series' helps very little in understanding Harvey's system, though it is nowhere near as off the mark as Wear's statement that Harvey saw action as opposed to purpose.[45] These account suffers, I fear, from not keeping separate the various categories of causes. For instance, French wrote that, Harvey looked, "…for the *utilitates propter quid* of the parts, their purposes or causes (including the final),"[46] and while there is truth to this statement, French seems unaware that the *utilitas propter quid* rather just *is the category of the final cause*, and as a category would not contain, for instance, the material or efficient cause. Purpose and cause are not coextensive, neither in Aristotle nor in Harvey, and French here conflate these distinctions which matter a great deal if one is to properly understand Harvey's philosophy. It is vital, then, to understand this terminology as Harvey lays it out in the *Prelectiones.*

The most basic category of action is relatively unproblematic, though not all authors distinguish, as Harvey and Galen do, between the process and the product, that is, action and work. Harvey's definitions are thus in some ways non-standard—besides the distinction just mentioned, very few people use the terms use and utility together to the extent that Harvey does, and the distinction discussed below between mediate and final utilities is found, to my

[44] French 1994a, 66. Wear, Andrew 1998, "William Harvey and the 'Way of the Anatomists'," *History of Science*, Vol. 21, 229-230. The problem with the work of these historians, and others as well, is a lack of grounding in Aristotle's philosophy: one must try to know Aristotle as least as well as Harvey. While I cannot claim this level of Aristotelian erudition, I do think I have a much firmer grasp on the Peripatetic than many who have written about Harvey.
[45] French 1994a, 311. French also says that Harvey uses this trio as an 'Aristotelian demonstration from first principles,' but I am unclear what French means by this phrase. There does not seem to be anything having to do with 'first' principles here.
[46] French 1994a, 311. Wear 1998, 230.

knowledge, in no other author.[47] Further, there are a variety of synonymous and related terms, most of which are used by Harvey's contemporaries. Harvey is thus interesting insofar as he took the time in his *Prelectiones* to distinguish with some care these terms, and to lay out relatively clearly the relations between them. This is not to say that he is entirely consistent, nor that the system is entirely perspicacious, but only to point out that, even at this early stage in his career, Harvey has put no small effort into philosophical considerations of his subject. I must also note that Harvey here developed a number terms and distinctions that he fails to deploy more widely in the rest of the *Prelectiones* and in his other works. Despite this fact, this section of the lecture notes is revealing of how Harvey conceptualized the subject matter of anatomy, even if he fails to adequately use the full range of terms and concepts he develops. Further, the less theoretical, more factual sections of the *Prelectiones* are much more heavily indebted to Bauhin and other authors, and, since he did not use Harvey's terminology (of, for example, *utilitates finales*) one should not expect to find such terminology in these parts of his lecture notes.

The sub-heading of this section is 'On the Actions of the Parts [*In actionibus partium*].' Harvey begins with the most basic category, *actio*:

> Action [is] active movement of which the accomplishment is called function, [or] in matter [is called] work. Work and function [occur]: [either] by themselves, [or] with other [functions]; [that is, either] principally [or] instrumentally, helping [by] completing [or] maintaining [the function].[48]

Sounding much like Galen, Harvey here makes a variety of distinctions, the first set of which concern the various processes and products that occur in animal bodies. First is the distinction between *action* and *function*, then the distinction between these terms and *work*, which are the

[47] At least no other author writing before Harvey.
[48] Harvey 1616, 22. This fragment is very difficult to translate into actual English, so I have had to resort to a variety of interpolated remarks to make apparent the interpretation of the text that I am offering. Although Harvey has the last three groups on different lines, enclosed by a brace, I take him to be restating the same distinction in three different ways, not to be making three different distinctions. "Actio motus activus cuius effectio functio dicitur in materia vero opus. Opus et functio: per se, cum aliis; principaliter instrumentaliter; adiuvans, perficiens conservans."

distinctions between an active movement (action), a completed process (function), and the material product of such a process (work). The second set of distinctions involves the ways in which those processes and products are completed. So, Harvey writes, functions (or products) can work by themselves to bring about some particular end (the principle functions carried out by the powers of the principle parts), or they can work in concert to complete some end (the instrumental functions which are accomplished by the instrumental parts). Finally, Harvey divides the ways in which an instrumental part can act in concert with other such parts, namely, through helping to complete a function by acting together, or helping by maintaining the process.

It will be helpful to look to the definitions of Harvey's near contemporary Laurentius, where one finds some similar distinctions, noting that his work was perhaps the most comprehensive treatment of these sorts of philosophical issues and definitions at the start of the seventeenth century. Laurentius defines action like so:

> Action is defined by Galen as the motion of a productive part, or the active motion, in order to distinguish it from an affection: an affection, indeed motion is to be acted upon, where the body is the patient; action on the other hand is efficient. Thus the pulse is the action of the heart, whereas its palpitation is an affection, or passion; the former flows from a faculty, the latter is caused by disease. Concerning actions, these are found everywhere, some together, others alone; the latter are perfected by a single part; an action performed in combination is nutrition, all the parts are nourished, indeed, they are vivified and animated, as life is defined by nutrition. Singular actions are produced by a specific organ, and these are the principle parts, or serve the principle parts. Again, some of the actions are performed by the homogenous parts, others by the organic parts.[49]

Laurentius too as concerned with actions that work together in coordination to complete some activity, and those that operate by themselves. Laurentius also equated action with active movement, again following Galen. Yet there are some differences as well, and Laurentius was

[49] Laurentius (1600),"Quid in qualibet parte spectare debeat Anatomicus." Lib. I, Cap. XVII, *Historia Anatomica* 24. "Actionum definio cum Galeno, motum partium factivarum, vel motum agentis, ut ab affectio distinguatur: affectio enim, motus est passivus, vel patientis corporis; actio autem, motus est effectivus. Sic pulsus, actio est cordis, palpatatio, affectio est, seu passio; ille a facultate manat, hic a causa morbisica. Actionem, aliae sunt communes, aliae propriae, illae, ubique reperiuntur; hae, ab unica parte perficiuntur: Communis actio est nutritio, viventes enim partes omnes, & animatae nutriuntur, cum vita definiatur nutritione: propriae actiones, a peculiari eduntur organo, suntque aut principes, aut principibus ministrantes. Rursum, actionum aliae sunt similares, aliae organicae. Simlaris actio a sola temperie inchoatur, ab eadem perficitur, & a qualibet partis particula integra & perfecta editur; organica, a sola temperie non inchoatur, nec nisi a toto organo integra editur."

concerned especially to distinguish actions from passions, the latter of which are a result of the body suffering some motion, often as the result of disease. This difference stems in part from Laurentius' being much more interested in *medical* anatomy, that is anatomy having some relevance to medical practice and healing, and thus concerned with affections and passions, a concern that we do not see shared by Harvey. Indeed, when he mentions affections, Harvey was concerned not with the Galenic focus on disease, but with the Aristotelian concern of the affectivity of the sensitive parts.[50]

It will be helpful to look at a few instances of Harvey's use of these terms. First there are actions: "The action of the guts is making chyle etc., into a pappy substance, whence the blood is divided from the chyle [so as to] serve the liver."[51] Importantly, though actions serve some end, they are teleological, when describing them as *actiones,* Harvey tends to avoid functional language at the organismic level, that is, he does not say what overall biological goal or function is being accomplished by the action. In many cases, Harvey equates *actio* and *functio*, an example being the following: "The function of the liver: the second concoction, [that is] sanguification;"[52] and, "The action of the liver is concoction and sanguification, but only as an instrument of the heart and secondarily."[53] So, for the most part, Harvey's *actio* and *functio* serve as synonyms, though there are times when this is not the case, as well as times when both of these terms are used as equivalent to *usus* and *vice versa.*

Turning to *usus* and *utilitates*, one sees similar vagaries of terminology. Again Laurentius:

> Finally, the anatomist comes to consider the use of a part: the Philosopher wrote that not from structure but from use are we lead to knowledge of an instrument. Use again, in

[50] This is a concern about use. See for instance: Harvey 1616, 8, "Propter passiones ut Aristoteles propter per sensum." See also: Harvey 1616, 22.
[51] Harvey 1616, 116. "Coiliae actio chilifactio etc. into a pappy substance, unde cum ex chilo sanguis famulari dividitur iecori."
[52] Harvey 1616, 124. "Iecoris functio: coctio secunda, sanguificatio."
[53] Harvey 1616, 126. "Iecoris actio concoctio sanguificatio sed tanquam instrumentum cordis et secundario."

> Greek *chreia*, is meant in two ways by Galen. One way follows the action, that is, it proceeds by means of this very action, and it is the end of the action, so that, an animal aims at this use by means of this action about to be seen, so that it flees that which is harmful, and pursues that which is useful. This use follows the action, but if you look at its generation and constitution, it will be determined that its dignity is prior to the action since it is the end of every action; indeed the end is more noble than those things which happen before the end. Another use precedes its action, and it is defined as an aptitude for some activity; thus, vision chiefly flows primarily from the crystalline humor in the eye, the remaining humors, tunics, optical parts, nerves assist this use, and they are directed to the completed action.[54]

Now this picture should be familiar from the discussion above, and the importance of the final cause here is plain. Further, the ordering here is the same as in Harvey, wherein action precedes use in time, but not in dignity. Action and use are deeply related, they cannot be understood apart from each other. Interesting, the latter distinction of use (that which is less in dignity, as an aptitude) is never cited by Harvey, who instead refers to this as a soul faculty or power. The latter conception of use is close to May's conception of *chreia* as an aptitude or fittedness, but Harvey does not use these terms to describe uses or utilities. I note finally that Laurentius does not distinguish between use and utility.[55]

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[54] Laurentius 1600, "Quid in qualibet parte spectare debeat Anatomicus." Lib. I, Cap. XVII*,* 24. "Postremo, partium usus anatomico considerandus venit: scribit enim Philosophus, nos deduci in cognitionem organi, non ex structura, sed ex usu. Usus porro, Graecis χρεια, duplex a Galeno statuitur. Alter sequitur actionem, id est procedit ab ipsa actione, & est finis actionis, ut, ex videndi actione hunc usum cosequitur animal, ut fugiat quae nocitura sunt, & prosequatur quae utilia. Hic usus, actione quidem posterior est, si generationem & consitutionem spectes, sed dignitate prior censetur, quia actionum omnium est finis; finis autem nobilor his quae ante finem. Alter usus actionem praecedit, & definitur aptitudo quaedam ad agendum; sic, in oculo critallinus visionem edit primario; reiqui humores, tunicae, opticus, nervus, usum praestant, & ad actionem perficiendam diriguntur. "

[55] C.f. Fabricius (1625), "De actione et utilitate partium Foetus," *De Formato Foetu*, *pars secunda*, In: *Opera anatomica*, Padua: 108; this definition shares much in common with Laurentius, and is again, different from Harvey's as I show below. "Etenim utilitates semper ad actionem referuntur eamque, respiciunt, quae a similari parte prodit propter quam causam in quoque organo perpetuo datur una pars, quae est praecipuum instrumentum actionis, ut puta a qua actio proficiscitur, aliae vero ad ipsam, ut ministrae & utiles referuntur. Verbi gratia oculus est organum, cuius actio visio est; quae in cristallino potissimum celebratur, alicuius vero oculi partes, ut cornea, vuea, & coeterae, illi sunt utiles, vel ad melius, vel ad tutius videndum. Quod si non amplius de oculi partibus sed de toto organo, & eius actione inquiras utiltatem, ut puta cui scilicet visio sit utilis; responde re est, alicui alteri actioni, ut puta cerebri, quia per visionem principibus facultatibus cognoscentibus, idest imaginationi, rationi, & memoriae species offeruntur: ut inde, quod verum est, & falsum, salutare ac perniciosum discernant, ad alterum assequendum, alterum vero vitandum, & fugiendum; quod tandem ipsi vitae, ut puta actioni pleniori, ut dicit Aristotelis: est utile. Ex quibus iam patet, utilatem semper respicere actionem, sic si de actione quaeratur, utilitas, sic de alijs, aut consequentibus, aut accidentibus; neque posse ullam utilitatem inquiri, nisi prius actio organi cognita sit."

Instead, Harvey deployed some additional terminology in an effort to more clearly distinguish functions and actions from uses and utilities.[56] Like his contemporaries, Harvey did not strictly distinguish use from utility, but, unlike his contemporaries (at least in attempt at clarity), he sets up a more complicated system of organic relations that fall upon a sort of teleological continuum. The system here is one with a variety of what one might think of as teleological 'levels'. All the processes of the body, as I have shown repeatedly, are teleological—even the most basic material components of the body, the uniform parts, are *for the sake of* the construction of the non-uniform ones. But this is a shallower sort of teleological orientation; the use of the part, is, in a sense, 'more teleological' in that the use of a part isn't just teleological in the sense that the part is for its action, but it further serves some biologically necessary purpose—e.g., keeping warm, nutrition, etc. So uses involve the necessary biological purpose of the parts and their actions within the overall economy of the organism. And beyond use, further down the teleological continuum, is utility, which is about, not the biologically necessary end that the part serves in the whole organism, but about the fact that that a part's means and ends serve the good more generally in that the part is well designed. Between these levels are borderline cases, where one can equally call some end a use or a utility, or a use or an action. Using Harvey's terminology, one might arrange a teleological hierarchy along the following lines, from 'least' to 'most' teleological:

Actio → *Usus/Utilitas media* → *Utilitas finales*[57]

[56] It must be noted that, while Harvey in these passages goes into some detail setting up this system, he very rarely actually deploys any of this terminology beyond the triumvirate of *actio*, *usus*, *utilitas*. The reasons for this are unclear, and it does point to the fact that one should not be overzealous in the use of this terminology given Harvey's inconsistent usage. However, so long as one remains careful not to read to much of this terminology into Harvey's *practice*, this set of words and ideas are invaluable for understanding Harvey's systematic conception of the subject matter of anatomy, that is, the human body and its teleology.

[57] Interestingly, Harvey, unlike some of his early modern contemporaries, doesn't include structure at the beginning of this scale, though he does, of course, discuss the importance of structure in determining actions, uses, and utilities.

So having described actions as a teleological explanation of a part by its purpose, Harvey then distinguishes use and intermediate utilities:

Uses and intermediate utilities[58] [can be learned by considering the parts]:	
According to homogeneity:	[if a part is] hot [then its use is] to make warm, to cook, to keep warm; [if] cold [then its use is] to make cool, to keep cool; [if] wet [then its use is] to lubricate, to make slippery, to soften, to blunt; [if] dry [then its use is] to harden, to strengthen
According to [other qualities]:	[by considering a part's] color, [we can learn about the use in relation to] the blood, its temperament, its activities; [by] its hardness or softness, [we can learn about its use in relation to] its temperament, its passions; [by] its thickness, [we can learn about the use in relation to] its lightness, its heaviness; [by] its thickness, [we can learn about the use in relation to] its firmness, its fragility;
According to instrumentality:	[by considering a part's] shape, size, location, construction.[59]

You will notice that I have interpolated quite a bit here. The notes are quite unclear as to what exactly Harvey means to indicate with these lists, and though I follow in Whitteridge's general reading and understanding of this text, I disagree on many points of detail.[60] This passage reveals how to link aspects of a part's *fabrica* (understood broadly to include color, elemental make up, and so forth) to the part's action—that is, the use of a part teleologically explains why

[58] I take this to mean that a use and a medium utility are synonymous..

[59] Harvey 1616, 22. "Usus et utilitates media: [/prout similare: calidum, calfacere coquere fovere; / frigidum, refrigerare contemperare; / humidum, lubricare laevigare emollire retundere; / siccum, firmare roborare;] [/pro: coloratum, sanguis temperies activitas; / durum aut molle, temperies passivitas; / densitate, levitas gravitas; / crassitie, robur fragilitas;] [/pro organco: figura, quantitas, situs, compositio]."

[60] Whitteridge's translation: "The uses and intermediate usefulness of the part must be examined in the following ways. Considered as something which is homogenous, if it be hot its use will be to make warm, to concoct and to keep arm; if cold, it will be to make cool and to keep cool; if moist, to lubricate, make slippery, soften and blunt; if dry to make secure and strengthen. From consideration of the coloring of each thing comes the knowledge of the degree of its kinship to blood, it temperament and active movement; from its quality of hard or soft, its temperament and passive movement; from the density of its texture, its lightness or heaviness; from its thickness, its strength and weakness. Considered as instrumental, its shape, amount, situation and composition must be bourne in mind" (Harvey 1616, 23).

the part is constructed as it is by hypothetical necessity, as well as what general and necessary biological function the action of the part serves to accomplish, such as lubricating, or making warm or cold, and so forth. Thus uses teleologically explain aspects of the matter, structure, and action of a part. This is central to Harvey's idea of how to practice an anatomy understood as an investigation into body and soul, into the unity of matter and form, structure and function: Harvey has constructed a schema for licensing inferences to uses on the basis of observations about structure and action (I discuss this again in Chapter 4).

First note that Harvey here seems to equate uses with intermediate utilities. This is common in Harvey, for he often conflates action and use as well. Part of the difficulty is that Harvey is not always careful. But, importantly, part of the difficulty stems from the nature of the body and our knowledge of it, that it, it is a result of the difficulty discussed above about how to understand what counts as a part. That is, given multiple ways to divide the body into parts, there are multiple ways to assign use and action. In a sense, these terms are relative to which parts are being discussed and in the context of which other parts and systems, , the whole digestive system versus a discussion of only the esophagus. From above, I made the following sort of distinction between the two terms, use and utility: while both terms refer to organic causes, purposes, and ends in the body, the term utility is meant to connote not only these means-end relations, but, further, the fittedness of means to ends, or, somewhat differently, the necessity of that means-end relationship. Use is closely tied to the action—an action is what a part *does*, a use is what that action is *for* in the overall economy of the body—and utility is tied, not just to action, but to *acting well* or *acting by necessity*.[61] Why then, would Harvey equate these two terms, use and intermediate utility? An obvious reason is perhaps just that the line between a use and a utility is not always clear, especially since a utility often, in some sense, *contains* the use—

[61] Remembering that unlike other authors, Harvey does not distinguish between the use of a part and the use of an action.

a utility is about the pairing of an action of a part to its use. That is, a utility is about not just the goal that an action serves, but, to return to May's suggested interpretation from above, it is about how the action accomplishes that use in an optimal way, about how the fittedness of the means to the ends allows the part to serve the good.

What is this good? Harvey describes this as the set of final utilities, and he writes following:

> Final [utilities of the parts are]: For their [very] existence, whence their necessity;
> To benefit their existence, whence their dignity;
> For their protection;
> As they could not be otherwise [*sine qua non*], whence their necessity;
> For adornment;[62]

A use/intermediate utility explains the *purpose* of the action of a part, or *how* that action is accomplished, within the context of the whole organism or organ system; a final utility explains the necessity of that use, its existence, and how, more specifically, that action-use pair exists (especially how it exists optimally and necessarily). An example will help make these distinctions clear: "The use of the kidneys is to mitigate the pungency of the urine and to assist concoction."[63] So the use here is a specific biological end, namely, assisting concoction and mitigating pungency, and which is related to the action of the kidneys, which is to draw fluids from the veins by the ureters and transfer it to the bladder.[64] Note that the second use mentioned above is an instrumental one in that it is completes some sub-function of the overall process of concoction (which is, in turn, part of the process of nutrition). And finally note that at least one of the utilities of the kidneys is quite different than either its action or use: "Another utility of the

[62] Harvey 1616, 24. "Finales: ad esse, unde necessitas; [/Ad bene esse, unde dignitas; /Ad tutelam; /Sine qua non, unde necessitas; /Ad ornatum]." This seems somewhat similar to what Fabricius wrote in his definition of use when considering the use of the whole organic system.
[63] Harvey 1616, 168. "Usus: retundere acrimoniam urine, coctioni iuvare. Mollitie et lenitate renes conservant…"
[64] Harvey 1616, 158. "Actio to draw away and convey oute of the veynes by the ureters into the blather the serosum excrementum, unde seated to the greate veyne and artery et connexi per venas et arterias emulgentes." I note also that, because the matter of the kidneys was thought to be identical to that of the liver, there was much debate as to the actions of these parts. See Harvey 1616, 122-123.

kidneys is similar to that of all the other viscera, namely, that they may be a support for the veins lest they be compressed."[65] So instead of being about a direct biological function, (one aspect of) the utility of the kidneys has to do with its ability to support the veins. The kidneys are thus in service to the optimization of the overall organization of the whole body, making sure that the veins are not compressed, and thus insuring their proper functioning, and thus the functioning of the whole.

I must finally discuss the term 'office [*officio* or *munus*]'. Again, this term is used inconsistently—sometimes Harvey uses the term to mean something equivalent to action, other times the term seems to be closer to use. However, there does seem to be an independent meaning to the term office. In these instances, the term refers to a general functional *role* that can be played by a part, but which can be instantiated in different animals in different ways. Thus, in these cases, the office of a part should not be confused with any actual, specific function that occurs in any specific part of any specific animal.[66] Consider an example: Harvey discusses the uses of the hands, which are the following: "[The hand has] three uses: caring for the body, defending one's self, [and] crafts [since the hand is] the instrument before [other] instruments since it is the form of forms."[67] This conception of the instrument of instruments is common to both Galen and Aristotle.[68] Harvey then goes on to use the word *officio* in the relevant sense: "Those [creatures] which lack hands, their office is supplied [by either] a long neck and beak, a tongue [as in] bees [and] dogs, a proboscis, [as in] the elephant [and] the butterfly, [or by] feet,

[65] Harvey 1616, 160. "Alia utilitas renum ut aliorum viscerorum ut sint ancora venarum ne comprimantur."
[66] Again, there are counterexamples to this understanding of the word 'officio,' just as there are for most terminology that Harvey uses. So, for instance, Harvey sometimes seems to use 'officio' in a way equivalent to 'usus,' though much depends on translation. I am here interested in how he uses the term in ways that are distinct from other terms, and he does use, more or less consistently, *officio* in such a distinct way.
[67] Harvey 1616, 26. "Usus tres: curandi corpus, se defendendi, artes organum ante organa ut intellectam formam formae."
[68] Galen *De Usu Partium* I.3, Aristotle *De partibus animalium* IV.10..

[as in] monkeys [or] parrots."[69] The basic idea here, then, is that, though, say, elephants lack proper hands, the same functional role played by hands—involving caring for one's self, defense, etc.—is played by the elephant's nimble trunk. Thus the term *officio* is an important one for anatomy done comparatively, since it allows one talk about organs that are morphologically different (a nose vs. a trunk) but functionally similar.

I thus conclude my discussion of Harvey's teleological terminology, and with it, my discussion of the soul in its union with the body, of the teleology of being for the sake of. I have one last task: I must now incorporate the *De motu cordis* into the conception of anatomy I have been discussing.

3.3. TELEOLOGY IN THE *DE MOTU CORDIS*[70]

The *De motu cordis* has been seen as a non-teleological and even as a non-causal work by some historians, even if those same historians admit that Harvey was himself deeply concerned with teleology.[71] Indeed, Roger French has argued that the *De motu cordis* and Harvey's later replies to his critics represent a 'Principle of Limited Explanation,' whereby Harvey places factual, observational knowledge as the primary sort of knowledge that philosopher's should be interested in, over and above causal knowledge.[72] If this were true, it would undermine the argument set forth in this chapter, for to understand anatomy as an investigation into the soul and its union with the body is to understand it as an investigation into causes, indeed, into all the

[69] Harvey 1616, 26. "Qui minibus carent earum officio supletur: colli longitudine et rostro; lingua, apes canes; proboscide, elephas papilio; pedibus, simae psittacus."[69]
[70] For a full argument concerning the teleology of the *De motu cordis,* see Distelzweig, Peter (Forthcoming), '*Meam de motu & usu cordis, & ciruitu sanguinis sententiam*': Teleology in William Harvey's De motu cordis."
[71] Pagel, Walter (1976), *New Light on William Harvey,* New York: S. Karger.
[72] This is discussed in a number of places in French 1994a: 277, 301, 313, 317, 346, 350, 362. I will return to this principle of French's at the end of Chapter 4. Further, Wear 1998 misunderstands the basic categories of Harvey's anatomical project, and thus misunderstands the depth and importance of teleology in his work.

causes, but especially into the final one. In fact, French's interpretation is the wrong way to look at Harvey's project. One should rather, as I have been arguing in this chapter, understand the *De motu cordis* as an investigation into soul and body, and as deeply concerned with the teleology of 'being for the sake of' and the efficient causes that act for those ends. Anatomy for Harvey, following Aristotle and Galen, is about *definition,* and, as I argued above, definition and function are tightly bound together. Defining the 'being' of an animal and its parts necessarily involves defining their 'being for the sake of' relations. I do not deny, of course, that Harvey repeatedly emphasized that his discovery of the circulation was true even in the absence of the final cause, but French seems to imply that this 'Principle of limited explanation,' indicates a general pragmatic attitude with respect to determining the final causes of things in nature. In fact, even in the absence of the final cause of the circulation, the *De motu cordis* remains a deeply teleological work in how Harvey there conceives of the living body and its functionality, a conception backed up by Harvey's frequent use of the teleological terminology of action and use.[73] I will discuss French's principle in more detail in the concluding section of Chapter 4, but in this section I want to demonstrate the ways in which the conception of body and soul described above is apparent in *De motu.*

Though Harvey does note give the final cause of the circulation, he makes some very important contributions and revisions to the causal picture of the heart and the arteries and veins, and of the body in general. Take for instance Harvey's discussion the action of the muscles in the second chapter of *De motu*, "…the muscles, while they are in motion and in action, are invigorated and stretched, from soft become hard, they are uplifted and thickened, so likewise the heart."[74] Here, by comparing the muscles' motions and actions to those of the heart, Harvey

[73] By my count, in the course of the *De motu cordis*, Harvey uses 'actio' at least 13 times, 'functio' at least 5, and 'usus' at least 45 times.
[74] Harvey 1628, Cap.2, 22. "…musculi enim cum moventur, & in actu sunt vigorantur, tenduntur, ex mollibus duri fiunt, attolluntur, incrassantur, & similiter Cor." See also: Cap.5.

can begin to make his argument about the proper interpretation of systole and diastole, and thus come to argue eventually that the action of the heart is its forceful systole on the basis of this comparison with the *actio* of other muscles. Use, too, was important to Harvey in the *De motu.* In the *Proem,* Harvey made the following point which should seem quite familiar given what I have argued above, "And since the passages and vessels answer to one another in size, namely the *vena arteriosa* and *arteria venosa,* why should the one be destined to a particular use, that is to say to nourish the lungs, the other to a general use?"[75] Here we thus have Harvey arguing that the traditional picture of the use of the ventricles, and these two vessels, cannot be right on the basis of their structure (here signaled by *magnitudine*), since similar structures imply similar uses. The anatomist cannot, in good conscious, think that they have different ends, for, if this were so, the set of hypothetical necessities governing their structural and material nature would also be different. But while Harvey disagreed with the traditional interpretation of the uses of these parts, he did not in any way reject the fundamentally teleological picture of the body implied by this terminology. Harvey wants to correct natural philosophers' understanding of the use of the vessels, not reject explaining them through their uses altogether!

Returning to Roger French's assessment of Harvey, in his discussion of the seventh chapter of the *De motu cordis,* he writes that

> Harvey refuses to be drawn into a digression on the purpose of the blood passing though the lungs and contents himself with demonstrating that it can happen and that it does happen. That is, despite the *actio-usus-utilitas* structure of his anatomical method, Harvey is here pragmatically stating that it does not vitiate the demonstration to stop before reaching the final stage, or the discovery of the final cause.[76]

French here is correct in pointing out that Harvey here has not determined the final cause of the blood, but he takes this to mean that Harvey has, in general, abandoned the search for final causes he is mistaken. Rather, one finds that causal language is deeply relevant to this chapter!

[75] Harvey 1628, *Proem,* 16. "Et cum meatus, & vasa sibi invicem respondeant magnitudine, videlicet, vena arteriorsa & arteria venosa, cur unum privato usui destinetur, videlicet alendis pulmonibus, alterum publico."
[76] French 1994a, 104.

Importantly, one must not conflate the final causes of two different things, namely, the motion of the blood (through the lungs and around the body) and the motions of the heart and its parts. Harvey does not provide the final cause of the blood's circulation in this chapter or elsewhere, but he *does* give the final cause of right ventricle. He writes that, "And in this way the right ventricle is the *cause* of the lungs and for the sake of the transfer of the blood, and not merely for the sake of nutrition."[77] Harvey here argues that the lungs are the cause of the right ventricle, and, especially given the later 'for the sake of', one can only understand this as a final cause. French, in overemphasizing the originality of Harvey's demonstration without the *causa finali*, underemphasizes the very traditional, and very teleological, conception of the parts and movements of the heart that Harvey here evinces—just the conception I have been belaboring in this chapter, one where actions *are* final causes! On this front I note that, few translations of the *De motu cordis* translate the '*causa'* from the quote above as 'cause' nor do they respect the sense of '*ob'* as 'for the sake of,' and, while some translations do render the 'causa' as 'having been made for the sake of' this cumbersome phrase might not immediately register as distinctly causal language.

Further, if Boyle is to be believed,[78] Harvey's initial research that led him to the circulation was inspired by a question of final causality, of use: namely, the use of the valves of the veins. Boyle writes,

> And I remember that when I asked our famous Harvey, in the only discourse I had with him, What were the things that induced him to think of a Circulation of the Blood? He answer'd me, that when he took notice of the Valves in the Veins of so many several Parts of the Body, were so plac'd that they gave free passage to the Blood Towards the Heart, but oppos'd the passage of the Venal Blood the Contrary way: He was invited to imagine, that so Provident a Cause as Nature had not so plac'd so many Valves without Design: and the Design seem'd more probable, than That, since the Blood could not well, because of the interposing Valves, be Sent by the Veins to the Limbs; it should be Sent

[77] Harvey 1628, Cap. 7, 40. "Et hoc modo dextrum ventriculum pulmonum causa, & ob translationem sanguinis, non ob nutritionem."
[78] And I have no reason for dismissing Boyle's report here, though it is curious that he labels this encounter as the 'only'

> through the Arteries, and Return through the Veins, whose Valves did not oppose its course that way.[79]

So the use of the valves of the veins was a problem to be solved for Harvey, for 'so Provident a Cause as Nature' would not have made any part that serves no purpose. It thus seems that considerations of final causality were central to Harvey's method. Thus, in chapter thirteen of *De motu,* Harvey argues that Fabricius' explanation of the valves, that they were for the purpose of stopping the pooling of blood, or that their use was to stop blood from falling downwards, was vitiated by his observations and experiments:

> The discover of these doors [i.e., the valves] did not understand the use of them, nor others who have said lest the blood by its own weight should fall downward: for there are in the jugular vein those [doors] that look downwards and that hinder the blood to be carried upwards. I (as likewise others) have found in the emergent veins and branches of the Mesenterie, those which look towards the vena cava and vena porta; add to this besides that there are no such [doors] in the arteries, and it is to be observed that dogs and cattle have all their doors in the division of the crural veins at the beginning of the os sacrum, or in the Iliac branches near the Coxendix, in which there is nothing to fear by the upright stance in man. Nor are their doors in the jugulars, as others say, for fear of Apoplexy, because the matter is apt in sleep to flow into the head through the soprall arteries.[80]

So here we have an example where Harvey is making an explicit argument about the use and purpose of a part. I will look at this passage again in Chapter 4, but for now merely note that not only does Harvey not shy away from making arguments concerning use, but that, furthermore, the use of the valves of the veins is an important part of his argument for the use of the veins and for the existence of the circulation. Indeed, part of what French gets wrong with his 'Principle of Limited Explanation' is that, while Harvey could not causally explain the *circulation*, final causes are central to his argument for the existence of the circulation. And in this way Harvey

[79] Boyle, Robert (1688), *A Disquisition about the Final Causes of Natural Things*, London: Taylor, 157-158.
[80] Harvey 1628, Cap.13, 55. "Harum valvularum usum rectum inventor non est assecutus, nec alii addiderunt: non est enim ne pondere deorsum sanguis in inferiorae totus ruat: Sunt namque in iugularibus deorsum spectantes, & sanguinem sursum prohibentes fieri, & non ubique sursum spectantes, sed semper versus radices venarum & ubique versus cordis locum: Ego, ut alii etiam, aliquando in emulgentibus reperi, & in Ramis misenterii versus venam cavam & portam spectantes: adde insuper quod in arteriis nullae sunt, & notare licet, quod canes, & boves omnes habent valvulas in divisione cruralium venarum, ad principium ossis saecri, vel in ramis illis prope coxendicem, in quibus nil tale timendum propter erectam staturam. Nec ob metum Apoplexiae (vt alii dicunt) sunt in iugularibus valvulae, quia materia in somno potius per arterias soporales influere in caput apta esset."

arrived at a new causal understanding of the *heart*—its action is the forceful systole, its use to create the circulation.[81] And not just the heart, but also the uses of the veins and arteries are within Harvey's purview, for their uses must be understood in terms of the circuit of the blood that they carry. And it goes without saying that Harvey's work in the *De motu* falsified the use of the liver as the origin of the vessels and manufacturer of the blood, and in this negative sense, Harvey can be seen as centrally concerned with purposes and causes.

I have shown, using just a few examples, that Harvey's work in the *De motu* follows the pattern argued for in this chapter, wherein the sorts of considerations of action, use, and of hypothetical necessity are central to his basic picture of the living, teleological animal body, and thus central to his entire argument concerning the heart. But what about soul? Harvey makes no mention of it here directly, but I shall show in the beginning of the next chapter that it soul is, in fact, central to a set of problems created in the wake of the *De motu.* These problems concern the very question that Harvey could not answer, the final cause of the circulation. This is a problem, he comes to see, of the purpose of the blood: why must it ceaselessly circulate around the body? Harvey, on traditional grounds, believes that this must have something to do with the nutritive faculty of soul. This can be seen even the *De motu cordis,* in the eighth chapter:

> So the heart is the beginning of life, the Sun of the Microcosm, as proportionally the Sun deserves to be called the heart of the world, by whose virtue and pulsation, the blood is moved, perfected, made vegetive, and is guarded from corruption and mattering[82]; and this familiar household-god does his duty to the whole body, by nourishing, cherishing, and vegetating, being the foundation of life and author of all. But we shall speak more conveniently of these in the speculation of the final cause of this motion.[83]

In other words, the heart, as the beginning of life, is the source of that life. And life, remember, just *is* the set of goal-oriented capacities of the soul in its union with the body. Here, following a

[81] Harvey 1628, Cap.17, 70-71.
[82] What we would call coagulation.
[83] Harvey 1628, Cap.8, 42. "Ita cor principium vitae & sol. Microcosmi (ut proportionabilitet sol Cor mundi appelari meretur) cuius virtute, & pulsus sanguis movetur, perficitur, vegetatur, & a corruptione & grumefactione vindicatur suumque officium nutriendo, fovendo, vegetando, toti corpori praestat Lar iste familiaris, fundamentum vitae author omnium; sed de his convenientius, cum de huiusmodi motus causa finali speculabimur."

long tradition, Harvey states that the blood has the purpose of nourishing and maintaining the entire body, just that faculty of the nutritive soul. I take up the topic of nutrition in the following chapter.

4.0. BODY, SOUL, AND THE TELEOLOGY OF BECOMING

In 1651 William Harvey published the *Exercitationes de generatione animalium*, a work full of detailed embryological observations and experiments, the result of many years of anatomical research. But while the empirical and observational part of the *De generatione* remained popular well through the end of the century, Harvey's teleological explanations invoking soul did not share the same fate. Witness a 1674 edition of Harvey's *De generatione* published in Amsterdam by a Dutch physician named Justus Schrader: he excised all the philosophical parts and left only the empirical parts.[1]

In the last chapter I argued that Harvey conceived of the body and soul union as a set of teleological '*being for the sake of*' relations expressed in terms of the actions and uses of the parts. Now I turn to the teleology of generation: '*coming to be for the sake of*.' Here the explanatory system of the last chapter will not do: what is being explained is in fact the *creation of that very system*, the creation of the body-soul union. Harvey understands this process of ensoulment in terms of what we would call embryological development, but which for him was also a process of substantial change with all the hallmarks of a teleological process. Given that the reason the various parts come into being is for the sake of whatsoever role they will play in the offspring's body, the real differences between the teleology of being and of becoming are to be found in the sorts of explanations Harvey deploys in each case. This process of 'coming to be' requires an explanation of how the embryo receives its organic form, that is, the full structure and organization of its parts according to their actions and uses.

[1] Or, to use actor's categories, the empirical parts should be called the *historical* parts of Harvey's work. I will discuss *historia* in the following chapter, as it forms a core part of Harvey's anatomical method. See: Pomata, Gianna 2005, "*Praxis Historialis*: The Uses of *Historia* in Early Modern Medicine," In: *Historia: Empiricism and Erudition in Early Modern Europe*. Eds: Gianna Pomata and Nancy G. Siraisi. Cambridge: MIT Press, 121-122.

In response, Harvey offers a deeply teleological theory of progressive soul actualization, involving especially nutritive or generative soul as agent. Remember that for the Aristotelian, the nutritive faculty of soul is responsible for the maintenance of the body and its parts, the basic functions of life. Further, a foundational aspect of the essence of living creatures is that they generate new beings of the same kind. Following in this tradition, Harvey understands generation as part of the activity of self-maintenance understood broadly as the care of both the *body-soul union* and the *species*. The form of the animal, though not the individual, achieves immortality:

> For just as the mind, or spirit, which perpetually moves this vast cosmos[2] and ceaselessly drives the same sun over diverse regions of the world, rising and setting, so too in the race of chickens the *vis enthea,* or the divine principle, sometimes called the molding power, sometimes the nutritive, sometimes the augmentative, is yet always considered the preservative and vegetative power, now inscribed in the form of a hen, now the form of an egg, nevertheless this same power endures for all time.[3]

This power, though variously called, always refers to a goal-oriented faculty, soul in the Aristotelian sense. This power, howsoever we name it, lasts for all time through the activity of preserving a race's form. In some ways this is a distinctly non-Christian idea, but remember that, following in the Renaissance tradition discussed in the previous chapter, Harvey limited his discussion to *organic* soul. The rational or intellective soul—the Christian soul—was beyond his purview.

In the first section (**Section 4.1**), I articulate how Harvey's *De generatione* should be understood in the context of the main criticism of his *De motu cordis*, its lack of a final cause for the circulation. This serves to emphasize a key feature of Harvey's later work, namely, the importance of the blood as the first genital particle and the centrality of nutritive soul. In the

[2] I translate *molem* here as 'cosmos,' as 'world' does not provide the contrast with the later *terrarum* (world).
[3] Harvey 1651, *Exercitationes de generatione animalium,* Ex.28, London, 86. "Quemadmodum enim mens, sive spiritus, qui ingentem hanc molem continuo agitat, eundem solem orientem atque occidentem per diversas terrarum plagas perpetuo circumagit; ita pariter in genere gallinaceo, vis enthea, sive principium divinuum, modo virtus plastica, modo nutritiva, modo auctiva dicitur; conservativa autem, & vegetativa semper habetur; modo etiam gallinae, modo ovi formam refert: permanet tamen eadem illa virtus in aevum."

second section (**Section 4.2**), I characterize more generally the problem of generation, concentrating on Harvey's argument for epigenesis (generation part by part over time) and what I call the problem of form. In the third section (**Section 4.3**), I detail Harvey's account of embryological development. In order to understand the role of teleology here, I first elaborate some relevant resources from Aristotle's metaphysics (**Section 4.3.1**), including essence (*to ti en einai*, *essentia*), account or definition (*logos, ratio*) and form (*eidos, forma, species*). I then move on to describe Harvey's characterization of generation as epigenesis (**Section 4.3.2**). I then discuss the speculative analogical account of generation found in the *De conceptione*, the treatise appended to the *De generatione,* before returning to the connections between *De generatione* and *De motu* (**Section 4.3.3**). I conclude with some thoughts on some larger cosmological and natural theological themes in Harvey's work (**Section 4.4**).

4.1. PROBLEMS LEFT OVER FROM *DE MOTU CORDIS*

What is the role of the blood in the body? This problem shapes Harvey's investigations into generation. And indeed, later in the seventeenth century it was a fundamental issue for the Harvey-inspired group Robert Frank has called 'the Oxford Physiologists,' including Robert Boyle and many others involved in the founding of the Royal Society.[4] What is more, this problem of the blood, if we understand it from Harvey's perspective, demonstrates a deep kinship between Harvey's two published works. In *De motu,* Harvey is only willing to speculate about the blood's purpose, whereas in *De generatione* there is a thoroughgoing, if woefully incomplete, theory of the role of blood in the body. By investigating blood in the context of

[4] Frank has traced the impact of Harvey's discovery of the circulation on physiological research in England, and he argues that it focused especially on the function and nature of the blood and the reason for the pulmonary circuit. This magisterial work has had a dramatic impact on my thinking, and it deserves much wider recognition and readership. Frank 1980, especially chapters 7, 8, and 10.

generation, Harvey got another 'angle,' so to speak, on its nature. He concludes that the blood is the prime instrument of the soul, responsible for both nutrition and generation. That is, the blood is the agent responsible for both the maintenance of the body and that responsible for the construction of the fetus part by part.[5]

Of course central issues are not truly addressed: why must the blood pass through the lungs? Why in adult animals but not in the embryo? Indeed, the full purpose of the circulation beyond the need for the blood to be distributed around the body for 'heating' and 'vivification,' as well as good old fashioned 'feeding of the parts', remained mysterious.[6] But that he did not solve every problem does not mean that he contributed nothing to the search for the final cause of the circulation, or that such a search was unimportant as some modern readers seem to imply.[7] Harvey attempted to elaborate the ancient theory of the blood's purpose, its role in nutrition.

It is clear that in *De motu* Harvey was already thinking along much the same lines as he would in *De generatione*. In the eighth chapter of *De motu* where Harvey declares he will not be speculating about the final cause of the circulation, but then goes on right away to do so:

> For it is by the heart's vigorous beat that the blood is moved, perfected, activated, and protected from injury and mattering.[8] The heart is the tutelary deity of the body, the basis of life, the source of all things, carrying out its function of nourishing, warming, and activating the body as a whole. But we shall more fittingly speak of these matters when we consider the final cause of this kind of movement.[9]

[5] The first mention of epigenesis, the construction of the embryo part by part, is found in Harvey 1651, Ex.45, 121. I correct the numbering of the exercises from the original Latin version, which printed Exercise 4 twice.
[6] Though Harvey does occasionally speculate somewhat as to why the blood moves through the lungs, even in the *De motu.* For instance, in Chapter XVII, he writes that more perfect animals need a larger supply of native heat, and the lung's role, then, is to further concoct the blood to acquire the last degree of perfection. (Harvey 1628, 65).
[7] I am here thinking of French 1994a. And while Pagel stressed the importance of purpose and final causality in Harvey's work, he does not truly understand the multifarious roles teleology plays in Harvey's thought.
[8] By mattering one should understand the phenomenon we now call coagulation, but which is too anachronistic to use to translate Harvey's '*grumefactio*.'
[9] Harvey 1628, Cap.8, 42. "…cuius virtute, & pulsus sanguis movetur, perficitur, vegetatur, & a corruptione & grumefactione vindicatur: suum que officium nutriendo, fovendo, vegetando, toti corpori praestat Lar iste familiaris, fundamentum vitae author omnium; sed de his convenientius, cum de huiusmodi motus causa finali speculabimur."

First, note that there does seem to be some difference between Harvey's thought on the primary location of soul in the *De motu* and in the *De generatione,* as in the former the heart is seen as the primary part and the source of the life in the body, whereas by the time of the latter the emphasis has shifted to the blood.[10] But I set aside this concern and instead concentrate on the commonalities between those two works, namely, the fact that the heart/blood is for the sake of, and comes to be for the sake of, *life* and *nutrition.* Each is here linked with a kind of warmth and activity, and thus nutrition, heat, and life are intimately bound together. In this, of course, Harvey follows Aristotle and Galen and a host of others. The key difference is that Harvey argues, using what he takes to be experimental evidence, that the blood is the source of the vivifying heat in living animals.

Famously, one of Harvey's arguments for the circulation was based upon a thought experiment involving a reasonable assumption about the quantity of blood passing through the aorta. Harvey then asks his reader to imagine then the amount that must flow through the arm alone, then broadening his scope to include all the blood that must be flowing through the body. He concludes on this basis that, "...it is necessary that a circuit [of the blood] occurs, because the amount [of blood] assumed cannot be supplied [by what we eat], and which are vastly more than fits with the nutrition of the parts."[11] Now, one might take this to mean that the blood is not for the sake of nutrition. But Harvey was rather making the weaker claim that the blood is not *just* for the sake of feeding the parts, which only partially characterizes the operation of nutritive soul. Given the circulation, nutrition cannot be as traditionally envisioned:

[10] Indeed it is more complicated since, in the *Prelectiones* it seems as if Harvey thought then that the blood was the direct instrument of the soul, the doctrine of the *De generatione,* thus indicating that he shifted his view from blood to heart and back again over the course of his career. His exact stance is thus hard to determine, and here I abstract from these details.

[11] Harvey 1628, Cap.XII, 54. "...necessarium est, circuitum fieri; cum nec suppeditari ab assumptis possit, & longe plus est, quam partium nutritioni congruens erat."

> Indeed, it is necessary that this amount of blood should remain in nutrition; to put it another way, it cannot nourish unless in place of what has been lost it is made like to it and is joined as one. But that the whole of the blood should flow into a part where it remains, so that a small portion should be transformed, is not necessary; for no part uses so much blood for aliment as is contained in its arteries, veins, and interstices...[12]

Harvey argues that the blood *is* for the sake of nutrition, but not in the way that had been thought before, for not the whole mass of blood is used as aliment. The picture he arrives at is one where nutrition is *vivification*. As he puts it in the *De circulatione sanguinis*, "A constant flow of heat is required to maintain the parts of animals, to conserve them in life by vivifying heat, and to restore those that are injured from without, it is not [just] nutrition that has to be provided for."[13] Nutrition read *widely* is connected to all the basic faculties necessary for maintaining the life and functioning of the body. Thus the reason for Harvey's terminological ambivalence on the name of this power: "(…sometimes called the molding power, sometimes the nutritive, sometimes the augmentative…") is because it is "…*yet always considered the preservative and vegetative power*…" (my emphasis). For Harvey, the circulation serves as the body's way of distributing blood *qua* heat, its purpose vivification and general preservation of the body.[14]

Even in the *De motu cordis,* nutrition is linked with warmth, activity, and soul:

> … every passion of the soul, which is attended by pain or pleasure or hope or fear, excites the human mind and extends all the way to the heart, and there makes a change to the natural constitution, in its temperament, its pulse and the rest, which, polluting all nutrition at its source and diminishing its powers, it should not be surprising that various

[12] Harvey 1649, *Exercitatio Anatomica de circulatione sanguinis,* Cap.I, Cambridge, 18-19. "Remanere quidem illam portionem quae in nutrimentum abire debet necesse est; alias enim non nutriret; si non in locum deperdi assimilaretur & cohaereat unum qua fiat: at vero totum influentem sanguinem ibi remanere ut tantillo portio convertatur non est necesse non enim tanto sanguine quantum pars quamvis in suis arteriis, venis, & porositatibus ubique continet, pro alimento utitur…."

[13] Harvey 1649, Cap.II, 122. "Calidum influens perpetim requiritur ad animalium membra fovenda, & in vivis vivifico calore conservanda, & ab extrernis injuriis refracta, restuenda, non ad nutritionem duntaxat."

[14] One can call this 'Vitalism,' if one wishes, and indeed many have. I see little to be gained by adding this description, and the possibility of confusion since Harvey's doctrines are not the same as those later thinkers who called themselves Vitalists. Indeed the name is incorrect for Harvey's position: life, *vita,* is the explanandum, and it is rather heat that is the explanans.

> kinds of incurable diseases in the extremities and trunk are thereupon created, because the entire body, in this case, labors under vitiated nutriment and a dearth of innate heat.[15]

Harvey here argues that every affection of soul affects the heart straightaway. Since it is the source of nutrition, sensation, and all the other capacities or powers [*vires*], affecting the heart necessarily affects the operation and functioning of all parts of the body that rely on those capacities. Anything affecting the source of the powers of the body necessarily perverts the nutriment of the body, such that the corrupted nutrition lacks the necessary heat to perform its function. Thus a deep connection between nutrition and generation, between *De motu* and *De generatione,* can be found in Aristotle's conception of nutrition. The Peripatetic idea is that nutrition and generation are both a kind of self-maintenance.[16] Harvey echoes this Aristotelian principle, and indeed, he furthermore claims that,

> …generation and growth do not happen without nutrition, nor do nutrition or growth occur without generation. For to nourish is to substitute into the place of that which has been used up whatsoever amount and kind of thing has been lost: namely flesh or sinew in the place of that flesh or sinew which is lost. And what is this other than to make flesh or sinew? Similarly, growth cannot happen without generation, for all natural bodies grow by new additions of those parts of which they had formerly consisted. And this happens according to all their dimensions such that at one and the same time they all grow, are separated from one another, and are organized. [17]

So generation and nutrition always happen together, they are but twin ways to call a single faculty for preservation. Note here the word 'organized,' a word I argued in the last chapter

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[15] Harvey 1628, Cap.XV, 60. "…omne namque animi pathema, quod cum dolore, & udio, spe, aut anxietate humanas exagitat mentes, & ad cor usque pertingit, & ibi mutationem a naturali constitutione in temperie & pulsu & reliquis facit; illud in principio totum alimentum inquinando, & vires infirmando, minime mirum videri debet, quod varia genera morborum incurabilium in membris & corpore subinde procreat, quando quidem totum corpus, in illo casu vitiato alimento & inopia calidi nativi laborat."

[16] See: Lennox, James 2006, "The Comparative Study of Animal Development: William Harvey's Aristotelianism," In: *The Problem of Animal Generation in Early Modern Philosophy,* Ed. J.E.H. Smith, Cambridge: Cambridge University Press, 27. Cf. Aristotle, *De generatione animalium* Lib,II, Cap.1, 4.

[17] Harvey 1651, Ex.54, 168. "Quippe generatio & accretio, non fiunt absque nutritione; nec nutritio, aut augmentatio, sine generatione. Nutrire enim, est substituere in locum deperditi, quantum & quale amissum est: nimirum carnem, aut nervum, in locum illius carnis, aut nervi qui perierit. Quid autem id aliud est, quam carnem aut nervum facere? Similiter, accretio non contingit sine generatione: corpora enim omnia naturalia, accedentibus noviter iis partibus, augentur; e quibus antea constabant: idque sit secundum omnes dimensiones; adeoque simul ac crescunt, distinguuntur una, & organizantur."

encapsulated the instrumental relation between soul and body. The nutritive faculty is tasked with maintaining the form, the organization, of a creature. So while nutrition proper deals with maintaining the soul-body union of the adult, generation proper deals with the initial construction of that very union. Explaining these different scenarios encapsulates the differences between the teleology of being and of coming to be.

By arguing that the blood by its very nature contained a certain kind of heat and activity that is the cause of the characteristic activities of soul, of life, Harvey might reasonably conclude that some light has been shed upon the circulation of the blood. The blood, as the direct instrument of the vegetative soul, must be present in all parts of the body in order for the body to work. The functionality of the body is dependent upon a particular kind of heat, and the blood is the bearer of this faculty. The circulation thus serves exactly this use by distributing heat and soul to every corner of the body, in both fetus and adult. And though few working outside the Aristotelian paradigm would take up Harvey's explanations, these problems and Harvey's observations did set the starting point and agenda for many physiological investigations.[18]

4.2. THE PROBLEM OF GENERATION

In order to understand Harvey's account of generation, I start with some foundational Aristotelian doctrines, as well as some of the Renaissance context of Harvey's work. I then move on to discuss in detail Harvey's own account of generation

[18] Frank 1980.

4.2.1. Principles and Definitions

Aristotle defined soul as, "… the cause and principle of the living body…the soul is defined by the three ways something is called a cause: it is the cause of movement, it is the cause for the sake of which, and the soul is the cause of the living body, as its substance."[19] The soul, then, is a sort of triune cause: it is the formal, final and efficient cause of all the activities, parts, and organization of the body. Recall that Aristotle also characterized the soul in the following way:

> If, then, something universal must be designated in every kind of soul, it must be that it is the first act of a natural organic body, from which we ought not question whether the body and soul are one: just as we ought not question whether the wax and its shape are one, nor whether the matter of a thing and that of which it is the matter are one.[20]

The soul is the *actuality* of the living body. Bodies are teleological unities, whose parts serve functions that are for the sake of the good of the organism. Thus in both Aristotle and Harvey, it is only *actual organic bodies* that have soul*,* only bodies that are alive and that have all the requisite parts.

Central to understanding these functions is the notion of actuality or activity,[21] in particular, the relation between an actuality (or activity) and what it is an actuality (or activity) *of*. The system is complicated, as actuality and activity are fundamentally tied up with the related notions of potentiality or power. To understand this, let me use a relevant example mentioned in the previous chapter, the example of the eye. If this organ were an animal, its soul would be

[19] Aristotle 1552, *De anima,* Lib.II, Cap.4, In: *Aristotelis libri omnes…cum Averrois Cordubensis variis in eosdem commentariis*, Volume 11, Venice, 68. "…viventis corporis causa & principium…anima secundum determinatos tres modos causa dicitur: etenim unde motus causa est & cuius causa & sicut substantia animatorum corporum anima causa."

[20] Aristotle 1552, *De anima,* Lib.II, Cap.2, 51v. "Si autem aliquod comune in omni anima oportet dicere, erit utique actus primus corporis organici physici unde non oportet quaerere si unum est anima & corpus: sicut neque ceram & figuram, neque omnino uniuscuiusque materiam, & id cuius est materia…."

[21] This term, *energeia*, is a problematic term to render into English, and I shall use actuality and activity interchangeably. The complementing term, *dunamis* is also difficult to render, and I shall use power and capacity interchangeably. How to translate, understand, and integrate these terms across the corpus is an area of active research and debate among Aristotle scholars, but I try to remain agnostic here.

seeing, that is, the activity (actuality) of the eye is sight, and thus the eye has the power (potentiality) to see. Sometimes, of course, when one is asleep, this power is not activated. What something is, as Aristotle argued in the *Meteorology* IV.12, is what it does or can do: essence and functional ability are tightly bound together in the definitions of natural things. Aristotle writes,

> The homogenous parts are made from the same elements, and all works of nature are made from these as matter. All these bodies so described, as from matter, are [determined] according to their substance, their definition. This is always clearer in those posterior things, and in whatsoever is like an instrument and is for the sake of something. It is most clear that a dead man is only equivocally a man. Thus a dead hand is said equivocally just as stone flutes might still be called flutes, for these seem to be instruments of some kind.[22]

As I demonstrated in the previous chapter, the anatomist is directly concerned with determining definitions. So central here is the concept of *logos,* in Latin *ratio,* which I shall translate by 'definition' or 'account'.[23] In the *Organon* Aristotle argues that a statement of the form of a thing is a definition of that thing, and the definition (*horismos, definitio, (o)ratio*)[24] of a thing is an account that signifies an essence (*logos, ratio*).[25] This means, then, that the form of a thing, its essence, determines the nature of that thing, including its functionality. The essence of a natural thing is the cause of its powers and activities.

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[22] Aristotle 1552, *Meteorologicorum*, Lib.IV, Cap.12, In: *Aristotelis libri omnes…cum Averrois Cordubensis variis in eosdem commentariis*, Vol. 5, Venice, 222. "Ex elementis enim ea, quae similarium partium: ex his autem, ut materia, omnia opera naturae. Sunt aut omnia, ut ex materia quidem, ex dictis: ut autem secundum substantiam, rationem. Semper autem magis manifestum est in posterioribus, & omnino, quicunque ut instrumenta, & alicuius gratia. Magis enim manifestum est quam mortuus hominem aequivoce. Sic igitur & manus mortui aequivoce, quaemadmodum & si fistulae lapideae dictae fuerint ut enim & haec, instrumenta quaedam vident esse."

[23] Whitteridge translates *ratio,* as 'concept,' and while this term is much more suggestive and provocative, I hope to steer a somewhat safer course by sticking with the less objectionable 'account.' Another translation, even more suggestive than 'concept' is 'plan,' and while I shall not use this translation, I shall suggest it at certain key points below in order to better explain what I think Harvey is getting at.

[24] It is an unfortunate fact of early modern philosophical Latin that *ratio* can mean either 'definition' or 'account of an essence'. The slippage seems to be due, in part, to the close connection between these terms in Aristotle, such that they come to mean basically the same thing.

[25] Aristotle 1552, *Topicorum translatio Abrami* Lib.I Cap.4, In: *Aristotelis libri omnes…cum Averrois Cordubensis variis in eosdem commentariis*, Vol. 1, 257. Though in Aristotle account (*logos*) and definition (*horismos*) are separate, I have noticed that in the early modern period these concepts are often not distinguished, so much so that the word '*ratio'* can signify both a definition and an account more generally. Sometimes translations use '*oratio'* instead of '*ratio'*, the emphasis in these cases being that the account is an utterance or speech act.

Functionality is here expressed by *instrumentality,* just the sort of instrumentality characteristic of the soul-body union. In the passage quoted above, Aristotle writes that the essence of something is clearer in those things that are for the sake of [*gratia*] something. The example Aristotle gives is explicitly biological: a hand (or any part) removed from the rest of the body is a hand in name alone, for it is not functional; it cannot play its role in the body, it serves no end and is no longer within the system of ends that organize the body. It has lost its instrumentality, its ability to *do* anything that is for some biological purpose, and this tightly bound conception of definition and function will be fundamental to understanding Harvey's account of generation. Harvey invokes the key term of *ratio* in order to understand the complex process of embryological development.

For Aristotle, the two most important principles of generation are the male and the female. The male is active and provides the form and the efficient cause of generation, and the female is passive and provides the matter. (I flag here that Harvey's account is different insofar as both male and female are active, and each provides both an efficient and formal cause; this will be discussed below). A central question here concerns the power of the sperm: does the power of the male's contribution mean that it has soul? The question is difficult because, on the one hand, the semen, since it is homogenous, cannot have soul, since soul is the actuality of an *organic* body with its instrumental parts. On the other hand, the male's semen does have *some power,* and this power is such that the male's contribution is what causes the fetus to develop *into a fully functioning, ensouled being.* Soul must somehow be inherent in the sperm, for what has soul cannot come from what does not have soul at least potentially. So the male's contribution has activity, that is, it has a definite causal power, but it is not an organic body since it has no parts, no organs. Rather, it must be understood, as Alan Code argues, as having a lower level of what he terms *active potentiality:*

> The form can exist at various degrees of active potentiality. When the form is the first actuality of an organic body it is called soul. Bucephalus' current form (his soul) is the same entity as his pre-existing form—it is that entity at a higher degree of actuality…The soul is present even in the male semen, though at the lowest possible degree of potentiality. In the semen it is not the actuality of an organic body, but is rather the active principle, or efficient cause, for the generation. The menstrual residue is the organic body in potentiality in that it contains the corresponding passive principle. The generation of the animal just is the incomplete actuality of the two principles, and the new animal is the complete actuality of both. The form (soul) of the new animal is the complete actuality of the active principle. Thus both the new animal and its soul are called 'actualities'. The crucial idea here is that the *dunamis* in the male semen is such that (1) embryological development is the incomplete actuality of that *dunamis* and (2) the soul of the animal is the complete actuality of that same *dunamis*.[26]

Embryological development is the process by which the soul-body union comes into being. There is an active potentiality[27] inherent in the male's geniture, such that, when it meets the passive potentiality of the female's contribution, it begins a process wherein an organic body comes into being. This potentiality is not yet soul, it is a potential *for soul.* At the end of this process what one ends up with is a fully functioning offspring with the same kind of form as the adult, in other words, the full, complete teleological soul-body union of the new creature. The active potentiality of the male's semen has become now the actuality of the new offspring's body. Like a metaphysical matryoshka doll, already inherent in the male's sperm is, somehow, the potential to become a full actual soul in union with its instrument, the body. Aristotle thus characterizes generation as a process of unfolding, that is, a process of regular development of soul and its organized body, from active potentiality to fully fledged actuality.

This conception of generation and its explanatory requirements had a lasting influence on the study of generation, and one sees them operating in a powerful way in Harvey's work. Indeed, this teleological orientation was fundamental amongst the physicians insofar as Galen,

[26] Code 1987, 56.
[27] In Harvey's case, one sees rather the word 'power' used over potentiality, or rather words for power for he uses a number including *vis, virtus, facultas,* to name three.

too, emphasized the teleological character of generation.[28] But this is not to say that Galen and Aristotle agreed on generation, as, setting aside materialist theories, their two theories formed the opposing sides of debate over such theories for centuries in Western European universities. There were, on the one hand, those who followed Aristotle in thinking the male contributes the seed and the active power, the female contributing only passive matter; and on the other hand there were those who followed Galen's theory that both male and females contribute seeds and activity. These two theories, and a thousand flavors and combinations of each, were endlessly debated within the universities, from Paris to Bologna and beyond. During the Renaissance, however, one witnesses the blossoming of many new approaches and theories of generation, linked with the rediscovery and retranslation of ancient texts. Thus in this period one also contends with neo-Platonic accounts of generation, involving various sorts of divine faculties or powers, as well as resurgent materialist theories, founded on Ancient Stoic and atomist ideas and focused on the idea of material 'seeds'.

Renaissance debates amongst the physicians and philosophers about soul and the causes and principles of generation were quite varied, especially on the subject of how to conceptualize the power that forms the fetus and its attendant vehicle, be it blood, sperm, heat, or whatever. L.A. [Deer] Richardson has argued[29] that these debates in the Renaissance revolved a number of key texts, most importantly the ur-texts of Aristotle[30] and Galen[31] on generation in new Humanist translations, but also, importantly, they were highly influenced by the interpretations

[28] I should also note that Galen endorsed Aristotle's conception of natural philosophical inquiry in general, especially the importance of definition. This is not, of course, the same as agreeing with Aristotle on the specifics of any particular explanation, but rather an agreement on what sorts of explanations are acceptable in the first place. In many ways, Galen's relation to Aristotle is similar to Harvey's: both agree with him on substantial methodological and metaphysical points, but neither hesitate to disagree with the Peripatetic if they see reason to, either on empirical or metaphysical grounds.
[29] Deer [Richardson] 1980.
[30] Primarily the *De generatione animalium,* and the *De partibus animalium,* although there are relevant passages in other parts of the corpus, such as *De anima.*
[31] Primarily, *De Foetuum Formatione* and *De semine,* though, again, there are many other relevant works, including *De usu partium.*

of Averroes[32] and Avicenna,[33] as well as both Humanist and Scholastic traditions of treatises[34] and learned commentary[35] on the problem of generation. By the time of William Harvey's work on generation, midway through the seventeenth century,[36] this debate had resulted in a proliferation of *spiritus* and *facultates* that were deployed in various physiological contexts in order to explain all the functional processes of living things, and especially to explain the complicated process of embryological development. As Hiro Hirai summarizes:

> …the humanist physician at Ferrara, Nicolò Leoniceno (1428-1524), wrote a small treatise entitled *De virtute formativa* (Venice, 1506) on the notion of "formative power" (*virtus formativa*), which physicians generally thought to be responsible for foetal formation. Indeed, this notion, whose original term was Galen's "moulding faculty" (*dunamis diaplastike*), was in vogue during the Middle Ages as an explanation for the formation not only of the foetus but also of natural things in general. In his treatise, Leoniceno criticised the interpretation of Averroes (1126-1198) and Pietro d'Abano (1257-*ca*. 1315), basing himself on ancient Greek commentators of Aristotle like Simplicius, whose texts were newly made available in Leoniceno's time…Against Leoniceno's naturalist understanding of the formative power, the French physician Jean Fernel (1497-1558) developed a fully Platonising theory of "divine formative power" for foetal formation in his very influential work, *De abditis rerum causis* (Paris, 1548). Following Fernel, Julius Caesar Scaliger (1484-1558), in his extremely popular treatise *Exotericae exercitationes* (Lyon, 1557) spoke of a "divine force," which formed embryos.[37]

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[32] Averroes' influence was especially strong at Padua, where Harvey trained. However, detecting Averroist positions in Harvey (as distinct from Aristotelian positions) is a difficult task, though a worthy one, but I am not concerned with this issue here.

[33] Avicenna's *Canon* remained an influential text amongst physicians throughout the seventeenth century and beyond, and Harvey specifically recommends Avicenna to Aubrey; see Aubrey 1898, 300.

[34] Two important treatises for understanding Harvey are the Galenic physician Jean Fernel's (1554) *Medicina*, Paris, and the famous Aristotelian Cesare Cremonini's 1626, *Apologia dictorum Aristotelis de calido innato, Adversus Galenum,* Venice.

[35] I cannot hope to even begin to name the number of important commentaries and treatises, as, during the Renaissance not only was their renewed interest in Ancient commentaries on generation (and other issues) by Philoponus and Alexander, not to mention those Arab scholars previously mentioned, but there was a whole new tradition of commentary based around philological principles. Beyond these new Humanist translated works, there was, of course, the continuing tradition of commentary and debate by the Scholastics on these issues, well through the seventeenth century.

[36] I note that a good deal of the empirical work and writing for Harvey's *De generatione* was done earlier, some as early as the 1620s, the majority being performed in the 1630s. For more detail, there is no better source than Keynes, Geoffrey 1966, *The Life of William Harvey*, Oxford: Clarendon Press.

[37] Hirai, Hiro 2007, "The Invisible Hand of God in Seeds: Jacob Schegk's Theory of Plastic Faculty", *Early Science and Medicine* 12: 379. Indeed, most of Hirai's work on theories of generation in the Renaissance is well worth careful study.

In the work of some, such as Fernel and Scaliger, these spirits acted as intermediaries of sorts, between the mortal body and the divine soul, and their status was somewhat indeterminate between these two poles. These two are extremely relevant to into Harvey, for he singled them out for criticism on just this point of the status of the spirits. One thing many involved in these Renaissance debates did agree upon, however, was the importance of a certain kind of innate heat (*calidus innatus*), just that heat that discussed above. This heat is not like fire, but like the 'heat of the stars', an idea that goes back at least to the Ancients, and especially Aristotle, whose texts were the loci of debate on the issue of understanding heat as the direct instrument of the soul.

These debates centered on the role of the soul and its attendant powers in the process of generation, not just the immortal rational soul of human beings[38], but also the vegetative and sensitive souls of all living creatures. Nearly all participants in late Medieval and Renaissance debates agreed that the phenomena of life and soul were intimately bound together, though how exactly was up for dispute: no easy solutions were on offer. Generation is, on the one hand, a characteristic, regular activity of living creatures, practically an everyday occurrence; but, on the other hand, how this process is actually accomplished was shrouded in mystery, and was seemingly miraculous.

It is now clear that the complexity of the generative process that lies at the heart of early modern European's struggle to explain generation.[39] To understand something so complicated within the bounds of early seventeenth century knowledge of reproduction was a task exceeding

[38] There is also the further issue of the intellective or rational soul and its relation to the body and its embryological development—in keeping with the discussion from the previous chapter, I will set this issue aside as well, though this is not to imply that this issue was unimportant. On the .contrary, the issue of the immortal soul was perhaps the most pressing issue for many philosophers and theologians

[39] This is not an anachronistic conclusion, but rather a summary of the actual judgment of most working on generation in this period.

both their conceptual and empirical grasp. To mention just a few of these convoluted and deeply interrelated problem sets:

- Resemblance Problems: when and why does the offspring resemble the mother or the father (or even the grandfather or grandmother)? What determines if the offspring is a male or female?
- Timing Problems: in what way and in which order does the embryo form? Is it formed all at once or part by part over time? Which organ comes to be first?
- Medical Problems: how best should one treat a pregnant woman for pregnancy related pains? What regime of diet and exercise is best for the expecting mother?

And of course, there is, in the case of human generation, a veritable mess of theological and moral problems that I can ignore much more easily than those under study. What I concentrate upon is another set of problems, those I believe to be at the center of the distinctly philosophical aspects of explaining generation:

- Formal Problems: how do the meager ingredients of generation, the contributions of the male and the female, work? How do they combine to form a creature of such complexity and design?

In order to understand Harvey's attempts at explain generation, in the following two sections, I break down the developmental process into two parts. I first deal with Harvey's explanations of the processes involved in the combination of the male and female contributions into what Harvey calls the conception. I then discuss the way in which Harvey accounts for how the conception forms itself into a complex, living creature, following a regular pattern of development.

In the end, Harvey's innovative but fundamentally Aristotelian explanatory scheme was unable to account for generation. He could but speculate as to its causes, and he begins the *De conceptione*, a small treatise appended to the end of the *De generatione*, with the following plea:

> It is a dark business, full of shadows, and yet I will dare to put forward a suggestion by means of a problem, so that anyone may see that I don't only eliminate others' opinions, but also in some way bring my own out into the open. And yet I do not wish the things I have to say about this business to be taken as though I believed them to be the pronouncements of an Oracle, or as if I desired to extort every man's judgment in my favor. I only ask as my just deserts the liberty I freely grant to others, to put forward as

> true those things which in this whole dark business seem probable until such time only as their falsity may be openly proved before all men.[40]

This business so full of shadows concerns the speculative answers Harvey provides to the problem of form. Of course, as it turned out, Harvey's struggles to explain generation would not be the last. Such explanations as were available to Harvey were not available, of course, to those working outside the Aristotelian paradigm.

Indeed epigenesis was, metaphysically speaking, a very difficult problem for a materialist philosopher. If matter was passive and inert, devoid of any powers or potentialities for complex change, how could one possibly hope to explain the byzantine process by which an embryo develops? As Joseph Glanville opined nearly twenty years after Harvey's death,

> Blind Matter may produce an elegant effect for once, by a great Chance; as the Painter accidently gave the Grace to his Picture, by throwing his Pencil in rage, and disorder upon it; But then constant Uniformities, and Determinations to a kind, can be no Results of unguided Motions.[41]

It was Harvey's belief, too, that motion, matter, and chance could never sufficiently explain even the basic structure of animal parts, let alone the complicated process of generation by which those parts come to be. I now turn to discuss Harvey's account in more detail.

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[40] Harvey 1651, *De conceptione*, 293. "Res sane est tenebrarum plena: & tamen audebimus aliquid problematice proponere; ut, non solum sentias alienas eliminatum isse, sed & nostrum quoque aliquo modo in medium attulisse videamur. Quae tamen a me super hac re dicentur, non ita accipi velim, quasi eadem e Tripode porlata existimem, aut aliorum omnium suffragia extorquere cupiam: sed libertatem illam, quam aliis libenter concedimus, nobis etiam jure merito poscimus; ut, quae in obscuris rebus verisimilia videntur, eatenus pro veris offerre liceat, donec manifeste de eorum falsitate constiterit."

[41] Glanvill, Joseph 1676, *Essays on Several Important Subjects in Philosophy and Religion*, London. Glanville was a promoter of natural philosophy and of the virtuosi in England (though not himself truly such an inquirer), and was a good friend of Henry More. He often attempted to chart a middle way between the many divergent opinions in natural philosophy in his time. In his 1665, *Scepsis Scientifica; or, Confest Ignorance, the Way to Science*: *in an Essay on the Vanity of Dogmatizing and Confident Opinion*, London (of which the *Essays* are an abbreviated form), Glanvill makes a similar comment, and writes that such processes as those which show uniformity and conformity must be, "... regulated by the immediate efficiency of some knowing agent: which whether it be seminal Forms, according to the Platonic Principles, or whatever else we please to suppose; the manner of its working is to us unknown" (39-40).

4.2.2. Egg and Sperm

Exercise 26 of the *De generatione* is entitled "What an egg is [*Quid sit ovum*]" . On the basis of his broad comparative work on many sorts of animals, Harvey theorized that all animals come from eggs. In more abstract terms, Harvey offers a new concept of the egg such that, in reproductive across all animal kinds, there exist bodies that play the same causal role in analogous material structures, and which are an essential stage in the development. Though he did not use the phrase, Harvey became associated with the dictum '*ex ovo omnia*', displayed prominently on the frontispiece to the *De generatione*. This dictum became extremely important to future developments in embryology, such as Regnier de Graaf's argument that human females have ovaries (*ovaria*) and not female testicles (*testes muliebres*).[42]

Harvey's thought was that the first conception of the fetus is a true egg. This conception is the result of the interaction between the mother's and the father's contributions, endowed equally with the powers of both.[43] Expanding upon the definition of an egg, he writes that it is,

> …some kind of medium, not only insofar as it is the origin and the end, but as it is the common work of both sexes, and it is composed from both of them. Because it contains in itself the matter and the constructive faculty of both of them, it has the power of both, by which it produces a foetus similar to them both. It is also the medium between animate and something inanimate, for it is neither absolutely bestowed with life nor absolutely deprived of it.[44]

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[42] De Graaf, Regnier 1672, *De mulierum organis generationi inservientibus,* Amsterdam.

[43] Harvey 1651, Ex.26, 77. "Ovum itaque est corpus naturale, virtute animali praeditum; principio nempe motus, transmutationis, quietis, & conservationis."

[44] Harvey 1651, Ex.26, 76. Note that the grammar here is a bit unclear, but Harvey does not maintain, as will be discussed below, that both male and female contribute matter; the 'of both of them' refers only to the constructive faculty. "Videtur etiam ovum medium quid esse; non modo quatenus principium & finis est; sed tanquam opus utriusque sexus commune, & ex utroque compositum: quod materiam, & facultatem opificem in se continens, utriusque virtutem habet, qua alterutri simile foetum producat. Est quoque medium inter animatum & inanimatum; neque enim vita prosus donatum est, neque eadem omnino privatur." Harvey here uses 'facultatem opificem', which I translate as 'constructive power,' instead of the Galenic 'vis plastica' (ultimately derived from Galen's *dunamis diaplastike*), which I translate as 'molding power.' Thought these terms need not coincide, I take to be equivalent in Harvey, as he uses them interchangeably. In the late Renaissance and early modern periods, there were an abundance of terms referring to this and related powers, and these were understood in different ways by different philosophers. Harvey understands this power, which is responsible for the growth of the egg and the fetus, as

This is a deeply teleological picture of generation, and one must pay careful attention to ends. So from the male and female contributions an egg is formed. It is an intermediate sort of entity, as it is the end and goal of the process of the interaction between male and female, yet it is also the origin of the fetus, whose own end and goal is the completed chick. In terms of soul, the true egg does not have the complete soul of the offspring, it is intermediate between animate and inanimate: not entirely alive, but certainly not dead. The egg is at a higher level of actuality than the sperm, but lower than that of the completed offspring.

Harvey argues that from the mother the matter and a principle of growth proceeds, the principle of growth that first constructs the egg in the female—in fact, he clearly states that the egg, even without the male's contribution has a kind of *vegetative* soul.[45] Yet this vegetative soul is strange—in some ways it is more akin to the active potentiality that Aristotle thinks inherent in the male's contribution than to a full soul. This is because the soul of the unfertilized egg does not proceed to form any chick, it is *incomplete,* for it needs the male's contribution to continue the process of development. So for Harvey, a true egg, what he calls a perfect egg, is a living, fertilized egg. It must have this power, this active potentiality, provided by the male.[46]

The male's contribution, semen or more properly *geniture,*[47] is entirely homogenous, and thus cannot be said to have soul in any sense except in the minimal sense discussed above by Code as an *active potentiality for soul.* Indeed, Harvey's astute reading of Aristotle on this point has caused some confusion in modern readers. For instance, Karin Ekholm mistakenly argues in otherwise excellent essay that, "…Harvey ascribes resemblance to a formative power in seminal

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related to soul, and not, as some more neo-Platonic writers might have it, as having to do with divine spirits or the like. See: Harvey 1651, Ex.26, 82ff. See also: Hirai 2007.

[45] See Harvey 1651, Ex.27, 87-89.

[46] Harvey 1651, Ex.26, 139.

[47] For the male's contribution is not truly a seed for Harvey.

matter that is independent of the soul."[48] In a sense this is true: Harvey, following Aristotle, distinguishes between something that is actually the soul of a living creature and that which is rather the potential for such a soul. But it is also false insofar as the power inherent in the blood and semen is *related to the soul,* and is of fundamental importance in the construction of that organic soul. This is further evidenced by Harvey's discussion of the power of the geniture being 'akin to the element of the stars,' a traditional phrase to describe the power of soul in the body, one that had long been associated with debates about the location and vehicle of the soul amongst both the philosophers and the physicians.[49] This formative power is exactly the active potentiality characterized above, and, as I argue below, this same power is found in both semen and blood, in both cases an instance of a faculty of nutritive soul.

So how does Harvey understand the semen? In fact, they were made more difficult to understand by one of Harvey's (purported) discoveries. Though Harvey knew the male provided semen, he never saw anything in the womb after coition, and he thus concluded that this substance emitted by the male never reached the place of conception. Indeed, he saw no material in the womb after coition from either male or female! Thus the action of the male's geniture cannot be by or on any material, but rather must affect the female herself, rendering her whole uterus somehow fertile:

> From the male proceeds only the procreative or molding power which renders the egg fertile but constitutes no part of that egg. For the geniture[50] which is emitted by the male…in no way enters the womb[51] (in which the egg is perfected), nor indeed…can it

[48] Ekholm, Karin 2008, "Harvey's and Highmore's Accounts of Chick Generation," *Early Science and Medicine* 13, 611.
[49] The best reference on these issues is L.A. [Deer] Richardson's 1980 dissertation on the subject.
[50] Harvey uses the term geniture since, strictly speaking, semen is not a true seed.
[51] One must distinguish between the vulva and the womb, the latter of which is where the egg is located. Harvey's research convinced him that the male's semen could not pass from the vulva to the womb. See Harvey 1651, Ex.5-6. I use 'womb' and 'uterus' interchangeably.

> by any means penetrate into such places, much less reach the ovary near the middle of the body...[52]

So what the male grants somehow passes to the female and to the egg that precept [*praecepto*] which grants, "…the definition [*rationem*], the form and laws of the future fetus…,"[53] without material and through a series of intermediaries (in this case, passing the power along the female's reproductive tract from where the geniture does touch to where the egg is perfected). Note three things: first, Harvey here uses that term—*ratio*—used in Aristotle's *De anima* to denote the account of the essence of a creature, a statement of its form. Harvey here thinks that the male's contribution is *formal:* he contributes nothing material, but rather only (some part) of the form of the future offspring, not *in actu* but *in potentia.* Second, Harvey argues that the female's contribution, too, provides part of the form of the future offspring, writing that, "…the form, the definition, and the resemblance[54] of the fetus is no less…in the female than in the male…."[55] The true egg is the product of both male and female, who contribute active potentialities whose combination contains the future form of the offspring. Third, the lack of any material in the womb presented a problem for *every theory of generation* available to Harvey: they all argued that there must be *some* material that transmits the fertilizing power of the semen directly by touch, as well as a material the semen acts upon. In agreement with both Aristotelians and even

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[52] Harvey 1651, Ex. 26, 80. "Quippe a mare procedit duntaxat vis procreativa, sive plastica, quae ovum foecundum reddit; nullam vero ejus partem constituit. Nam genitura, quae a mare in coitu emittitur, matricem (in qua ovum perficitur) nequaquam ingreditur; nec sane…in ista penetralia ullo pacto subire potest: multoque minus ad ovarium, juxta corporis praecincturam, asscendit..." Harvey here uses the Galenic 'vis plastica' (ultimately derived from Galen's *dunamis diaplastike*), which I here translate as 'molding power' but which I take to be equivalent to the constructive power or virtue or faculty (vis/virtus/facultas opifex). In the late Renaissance and early modern periods, there were an abundance of terms referring to this and related powers, and these were understood in different ways by different philosophers. Harvey understands this power, which is responsible for the growth of the egg and the fetus, as related to soul, and not, as some more neo-Platonic writers might have it, as having to do with divine spirits or the like. See: Harvey 1651, Ex.27, 82ff.

[53] Harvey 1651, Ex.29, 154. "…ex praecpto maris; quasi ab hujus coitu, foemina artem, rationem, formam, ac legem future foetus acciperet."

[54] That is, resemblance to its parents.

[55] Harvey 1651, Ex.29, 89. "Cum itaque forma, ratio, & similtudo, foeminae non minus…quam mari insit…"

most mechanical philosophers, Harvey refused to countenance action at a distance[56], and thus he was at a loss as to how the male's semen fertilized the egg. It must act immaterially, transmitted through the medium of the female's reproductive tract: it must affect the female *herself*, rendering her whole uterus fertile and transmitting that power to the egg. This forces Harvey into a rather pessimistic appraisal of the situation:

> …it will at the same time be apparent that everything that has been handed down to us from all antiquity concerning the generation of animals is erroneous, and that the foetus is made neither from the seed of the male nor of the female, nor from a mixture of both of them, nor is constituted out of menstrual blood….[57]

Given that Harvey found no blood in the womb after coitus, Aristotle's account of generation cannot be correct, as he had argued that the matter of the fetus is provided by the female's menstrual blood.[58] And as Harvey's observations similarly invalidated Galen's theory of the two seeds as well, and thus all those theories derived from it could not be correct.[59]

On the basis of this research, Harvey concluded that,

> …all animals whatsoever which arise from male and female are generated by the coition of both sexes, and so are created just as if by some contagion. Just as the Physicians observe that contagious diseases…slowly reap a massacre of mortal beings and breed affections similar to themselves in the bodies of others only by external contact, nay more, sometimes only by a breath, or through a miasma, and that from a distance and through an inanimate medium, which is not altered in any way that perceptible…It is not, I affirm, the intromitted seed of males which supplies to each egg the office of the craftsman, or constructs its body or introduces its soul, but rather eggs are made fertile by some sort of contact alone.[60]

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[56] Though of course from our historical vantage, immaterial form transmission is no better.

[57] Harvey 1651, Ex.40, 109. "…clare simul apparebit, quae hactenus ab omni antiquitate, circa animalium generationem, nobis tradita fuerunt, erronea esse; foetumque, nec ex spermate maris, aut foeminae; nec ex utrisque simul mistis; neque ex sanguine menstruo constitui…."

[58] C.f. Aristotle 1552, *De generatione animalium,* Lib.I, Cap.20, In: *Aristotelis libri omnes…cum Averrois Cordubensis variis in eosdem commentariis*, Volume 6, Venice.

[59] For a quasi-Galenic theory, though one that is in many ways very different than Galen's in its (Platonic) invocation of divine spirits, see: Fernel, Jean 1560, *De abditis rerum causa,* Paris. The latter was quite influential, not only on Harvey's work, but on many late Renaissance and early modern theories of generation.

[60] Harvey 1651, Ex.49**,** 138. "…animalia, quaecunque a mare & foemina oriuntur, utriusque sexus coitu generai; adeoque velut per contagium aliquod procreari. Quemadmodum Medici observant, morbos contagiosos …serpere in stragem mortalium, affectusque sibi similes in alienis corporibus, solo extrinseco contactu, excitare: imo vero interdum solo afflatu, & per miasma; ideque eminus, & per medium inanimatum, nihilque sensibiliter alteratum…Non intromittitur, inquam, maris semen, quod in singulis ovis, opificis munus praestet, aut corpora fabricet, aut animam inferat; sed contagio duntaxat quodam foecundantur."

So the male's geniture acts from the merest touch which somehow imparts a power to the female's uterus and from there to the egg, without passing this virtue to any of the intermediaries between geniture and uterus. I argue below that Harvey's conception of contagion is distinct from his conception of this molding power or formative virtue: the former concerns only the mystery of the mode of fertility transmission from male to female, whereas the latter is what I characterized above as an active potentiality. That is to say, contagion is meant to characterize how this potentiality or power is transmitted, not how it is meant to operate.

4.2.3. Epigenesis

This formative power, howsoever it is called, is that active potentiality for soul whose process of unfolding is such that an organism is constructed, part-by-part over time. Harvey labels this process *epigenesis*. Oversimplifying a bit, this was half of the pair of theories that dominated generation theory from ancient times, held by Aristotelian and Galenic philosophers alike. The opposing theory was *preformation*, associated with ancient materialists.[61] These philosophers described generation as the mere aggregation of matter, such that the entire form of the offspring was preexisting *in actu* and needed only to grow in size. Aristotle, however, posited that the embryo was constructed part after part, each part coming into existence *de novo* (having only existed *in potentia*)[62], and not as a result of mere growth.

[61] Though using these labels is somewhat anachronistic, and though it is an oversimplification, it is still helpful to divide theories into these two broad classes.

[62] This points to the fact that, ultimately, both epigenesists and preformationists needed to refer to *something* preexisting, the one potentially the other actually. This is an issue relating to origins: the origins of the universe, of design in nature, the question and nature of eternality, and so on. Form had to come from somewhere, and both ancient and early moderns alike could not countenance the idea that order and form can come from something that contains not these things in any measure. In some sense, I believe this to be linked with their idea that a cause must be equal in reality to its effect, and thus something that does not contain any form in it even potentially could never be the source of such form.

Harvey's conception of generation, meanwhile, was heavily influenced by his empirical findings. Most important here was that he found no material present in the womb after coitus, and further that the material of the first conception is entirely homogenous. This rules out preformationist theories entirely. Harvey thus opposes epigenesis not with preformation but with what he calls *metamorphosis*:

> There are two ways by which one thing is made from another…The first is when one thing is made out of some preexisting thing, as couch out of wood, a statue out of stone, when the whole material of the future thing to be crafted already existed before it was worked into its form or any part of the work has begun. The second way is when the material is both made and given form at once.[63]

So the difference between metamorphosis and preformation is that in the former, the embryo has no form and receives it all at once, like a stamp. In preformation, meanwhile, the embryo always has the form of the adult, and all that changes is its size.

In epigenesis, the parts are made in the embryo one after another, and out of the same material they are both formed and nourished.[64] Harvey writes that an animal created so:

> … draws in the matter, prepares, concocts, and likewise uses it; at the same time it forms, it grows…the molding power at once divides that same homogenous matter, and arranges that which is cut off and renders it into members, and it makes from the homogenous matter the heterogeneous, that is, from the homogenous matter given to it, the heterogeneous organs are made. Indeed in these, while it produces other parts in their due order, diversely placed, it requires another matter which it makes…[65]

This process of coming into being is very complicated as it is a process both by which a part comes into existence *and* grows, a process of generation *and* nutrition. The matter of the embryo seems to organize *itself* into parts, and feeds them of its own self, moving from homogenous to

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[63] Harvey 1651, Ex.45, 121. "Duplici modo aliquid ex aliquo…fieri…Alter eset, cum ab aliquo praeexistente fit; veluti ex ligno, lectus; ex lapide, statua: cum nempe tota futuri opificii materia jam extiterit, antequam in formam producatur aut operis aliquid inchoetur. Alter autem modus est, cum materia simul & formatur, & fit."
[64] Harvey 1651, Ex.45, 121.
[65] Harvey 1651, Ex.45, 122. "… materiam simul attrahit, parat, concoquit, & eadem utitur: formatur simul, & augetur… plastica vis eandem similarem materiam secat, sectamque disponit, & in membra redigit; facitque ex similari materia, dissimilarem; sive ex subjecta materia similari, organa dissimilaria. In his vero, dum partes alias, aliterque dispositas ordine procreat; aliam quoque, atque aliter dispositam materiam requirit, ac facit…"

heterogeneous. What is more, this process happens 'in due order,' which is to say, it is regular and systematic, first this part coming into being, then this, always in the same way in the same sorts of creatures.[66] Given this understanding of generation as epigenesis, there are some important metaphysical concepts that Harvey must invoke. The most important and relevant of these are the related concepts of potentiality and actuality discussed above. Epigenesis is a system that moves from potentiality to actuality through the progressive actualization of the forms inherent in the potentialities; at the end, what is constructed is a union of soul and body, according to the definition of the animal and its parts. Harvey quotes Aristotle on this matter, understanding soul as, "…the actuality of an organic body having life *in potentia*…." Thus, in describing how the soul (here denoted by the formative faculty) is responsible for the construction of the fetus during development, Harvey notes just this process of progressive self-formation:

> …all the parts are not fashioned at the same time, but emerge successively and in order; while the fetus is increasing, it is being formed, and while it is being formed, it is increasing; and some parts are generated upon others that existed before, and are divided from them…The formative faculty of the chick takes the material to itself and prepares it, rather than finding it prepared, and the chick seems less to be made or increased by another than by its own self. And as all these things are given increase by that very thing from which they are made, so too it is to be believed that the chick is conserved and given increase from its beginning by the very same thing by which it was made (be it the soul or a faculty of the soul). For the same efficient and conserving power is now found in the egg, now in the chick, and it constitutes the first particle of the chick out of the very same material with which it nourishes, increases, and adds all the rest of the parts.[67]

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[66] Now, of course Harvey is wrong on many matters here, and part of the reason for this is because he worked without a microscope, and thus he never saw sperm or any sign of geniture in the womb after coitus, nor did he note the nearly invisible chambers of the heart, thus he argued that the blood preexists the heart. For Harvey, the limits of his eyes were the limits of his ontology.

[67] Harvey 1651, Ex.45, 122-123. "…omnes ejus partes simul fabricari, sed successive, atque ordine emergere; eundemque simul, dum augetur, formari; & augeri, dum formatur; partesque alias aliis prioribus supergenerari & distingui…Facultas enim pulli formatrix materiam potius sibi acquirit, & parat; quam paratam invenit: videturque pullus haud ab alio fieri, vel augeri, quam a se ipso. Et quemadmodum omnia, ex quo fiunt, ab eodem augentur: it similiter a quo pullus conservatur, & augetur ab initio (sive id anima, sive facultas animae fuerit) ab eodem quoque…eum fieri credibile est. Idem enim reperitur tum in ovo, tum in pullo, efficiens, ac conservans; & ex qua materia primam pulli particulam constituit, ex eadem nutrit, auget, & superaddit reliquas omnes."

Two things are clear from this: first, note that here Harvey states that it is the same power in both egg and chick which is responsible for its 'coming to be', indicating, again, that it is one active potentiality for soul which proceeds to develop its union with the body over time though a process of emergence. Second, epigenesis as so described is a process where the chick gradually comes to have the shape of the adult organism. But, importantly, this shape, this form is *functional*: it is teleologically organized according to the needs of the animal being generated, such that after birth the offspring can live on its own. It is the construction of an animal soul, just the sort of organic soul discussed in the previous chapter. Thus, as James Lennox has stressed, generation is understood just as in Aristotle, as a process of generative emergence:

> The resulting change is generative emergence, in a number of respects. At the simplest level, there is the generative emergence of many uniform parts from a single one. But due to the temporally and spatially coordinated character of this emergence, parts of a more complex kind emerge, the nonuniform instrumental parts. Each of these, moreover, comes to be as and when it does in order to play its role in a coordinated and hierarchically organized set of living capacities. That is, not only is there a generative emergence of a complex structure from a simple and uniform material, there is also the generative emergence of a living being, an *empsychon*. Moreover, soul emerges in stages: the earliest stages of the embryo have nutritive soul, and "as they progress they have also perceptive soul in virtue of which they are animals" (GA II. 3 736b1–2). To understand biological development in Aristotelian terms is to conceive of it as the goal-directed actualization of a potential, as the gradual, continuous emergence of a complexly structured, functioning living being.[68]

Indeed, Harvey follows Aristotle on just the point about soul that Lennox points to in the Peripatetic's *De generatione,* writing that, "…in a fertile egg the vegetative soul exists actually, and this soul contains in itself the sensitive soul potentially, from which later are produced the animal and sensitive parts of the animal."[69] What one sees in generation is the construction of

[68] Lennox, James 2006, "The Comparative Study of Animal Development: William Harvey's Aristotelianism," In: *The Problem of Animal Generation in Early Modern Philosophy,* Ed. J.E.H. Smith, Cambridge: Cambridge University Press, 28.

[69] Harvey 1651, Ex.26, 79. "…in ovo foecundo animam vegetativam actu inesse, quae potentia in se continent sensitivam; unde animal, partesque animalis sensitivae postmodum producantur." I must note that Harvey is not entirely satisfied with this understanding, and he is overall quite cautious on committing himself to any particular views on the complete nature of the soul and its development, especially on the place and development of the immortal rational soul, about which he says almost nothing (probably for good reason). In this he follows Galen,

the soul-body union, part by part, and, as each organ is constructed, another aspect of soul and its instruments comes into being.

4.3. FORM AND SOUL

Harvey's understanding of the explanatory situation here is based upon Aristotle's *Physics*. Aristotle asserts that form has a better claim to being the nature (*phusis*) of a thing than does the matter. This has the peculiar consequence that in some natural things, three of the causes—the final, formal, and efficient—coincide:

> And since the causes are four, it is necessary that the natural philosopher know all of them, & to refer his answers to these causes according to manner of the natural philosopher, it is clear that [the natural philosopher must know] the matter, the form, the source of motion, and 'that for the sake of which.' Many times the last three are reduced to one, because, indeed, the 'what something is' is likewise also the 'that for the sake of which,' and the other, that from which comes the first motion, is form, & this is one: for man generates man. [70]

Remember too, of course, that not only does Aristotle refer directly to generation here, but that these three causes are also how one should understand soul, as I discussed above. Harvey's account of the causes of generation also involves the coincidence of these three causes, understood as soul.

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who was, as I noted in the previous chapter, both skeptical and pragmatic when it came to the ontological status of the soul. In keeping with the arguments of the previous chapter, the best way to understand soul is just as a set of goal oriented faculties.

[70] Aristotle 1552, *Physica,* Lib.II, Cap.II, Summa Terita, (In modern editions: Lib.II, Cap.7), In: *Aristotelis libri omnes…cum Averrois Cordubensis variis in eosdem commentariis*, Volume IV, Venice, 35. "Et quia causae sunt quatuor, oportet Naturalem scire omnes, & reducere quastionem per quare ad illas omnes, & complere responsionem de eis secundum cursum naturalem, scilicet secundum materiam & formam & motorem & propter quid. Et multotiens reducuntur tria ad unum, quod enim est aliquid est, etiam illud propter quid & illud, ex quo primo est motus, est forma, & hoc est unum: homo enim generat hominem."

The basic idea is this: the form of the future offspring (the union of male and female potentialities) guides the efficient cause (the formative faculty, the molding power, etc.)[71] towards the completion of the final cause (the completed offspring). In the Renaissance, this conception of causation was explicitly invoked in discussions of generation. For instance, take the Aristotelian philosopher Jacob Schegk, who Pagel points to in his discussion of Harvey's theory of generation. Schegk wrote in his work on the plastic nature (a phrase that Harvey sometimes uses to describe the efficient cause), that there are two senses of efficient causes in nature:

> In nature efficient causes are of two kinds: one is irrational and material, as is the change when something alters from cold or heat, but the other is when form and *logos* generate something: as spermatic *logos* or enmattered, as when like generates things like to itself, or when that which nourishes assimilates nutriment to itself.[72]

So one sort of efficient cause is purely material (due to heat and cold and the powers of the elements), and the other goes beyond mere matter and operates in virtue of *logos* and *forma*. The latter sort of efficient cause is what is responsible for like generating like and for the function of nutrition by virtue of its being guided, so to speak, by the form inherent in it. As will become more clear from my discussion below, the faculties of nutrition and generation must be understood as guided by *logos* in this way, for it is upon this aspect of the operation of soul that Harvey's explanation of generation turns. Harvey, however, eschews Schegk's terminology, preferring to describe generation as being guided by the final cause embedded within the efficient cause.[73]

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[71] Which is found in the semen, the egg, and the blood, as progressive levels of actualization.

[72] Schegk, Jacob 1580, *De plastica seminis facultate libri tres,* Strasburg, I sig. A1v. "Efficientium proinde causarum in natura duplex est genus, unum est ἄλογον καὶ ὑλικόν, ut si frigore aut calore alteratur quidpiam, alterum est, quod ut forma et logos generat quidpiam: ut σπερματικός λόγος, aut alias ἐν ὕλη λόγος, ut si simile generat simile sibi, aut si nutritum assimilat sibi nutrimentum."

[73] I should note that, though the Scholastics have much to say on the formal causation, Harvey never talks in their idiom of 'substantial forms' or the like, and, indeed, his antipathy toward them is well known. Harvey's sources are rather, as I have been emphasizing repeatedly in this dissertation, the Humanist translation of the Ancients, and

Recall now the problem of form, which broke down into two parts, the first dealing with the contributions of the male and the female, the second dealing with the construction of the fetus. In the following section, I trace this process from the contributions of male and female to the formation of the fertilized egg. This process is based upon a fundamentally flawed, but quite interesting, analogy: the idea that conception in both womb and brain occur alike.[74] In the section after, I continue to trace the unfolding of the soul-body union from the fertilized egg onwards.

4.3.1. The First Stage of Generation: From Male and Female to the Egg

I start with the contributions of male and female. The latter is much simpler, or perhaps just less mysterious. The female contributes an active principle: a soul with the potentiality to become a fully formed creature of the same kind, once combined with the male's element. In addition to this, the female contributes matter as well, a passive potentiality to receive form.[75] Harvey writes thus that it is likely that, "…first conceptions receive both their matter and form from females…."[76] It is this matter that allows a first insight into the analogy with conception that Harvey uses to understand generation, for the female's contribution acts like an eye that transmits sensations to the brain. Harvey calls this material contribution the *primigenial moisture*.[77] Harvey describes this moisture as,

> …the most homogenous, the purest and clearest body definable, in which all the parts of the chick are present *in potentia* but not *in actu*, Nature seeming to have granted it that which is common to the first material shared by all things, namely to be capable of all

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Harvey's use and discussion of his contemporaries is limited mostly to medial writers such as Fernel and a few Humanist Aristotelians like Cremonini.

[74] I do not here evaluate this analogy in much detail, but for which see my: (unpublished) "A Dark Business, Full of Shadows: William Harvey's Analogy of Last Resort."

[75] Here Harvey's account of coincides with Aristotle's, at least in general outline.

[76] Harvey 1651, Ex.40, 108. "…ab…foeminis…primos conceptus tum materiam, tum formam recipere…."

[77] For which, see: Harvey 1651, Ex.72.

> forms potentially, but to have none actually. So the crystalline humor of the eye is itself devoid of color in order that it may be capable of taking on all colors….[78]

The primigenial moisture has an extremely important passive potentiality due to its material nature: it is capable of taking on any and all forms. He compares it to the crystalline humor of the eye, which, though itself colorless, can take on any and all colors.[79] So just as the eye, when it views a distant object, somehow takes on the colors of that object, so too can the primigenial moisture take on the form transmitted by the male's geniture, the analogy to the distant object seen. Thus the primigenial moisture in the egg is the substance upon which the blood acts to form the parts of the embryo, as I'll describe below.

I now turn to the way in which the male's contribution to generation operates as the image that the primigenial moisture receives. The account of this process in the *De conceptione*, the short treatise appended to the end of the *De generatione,* relies explicitly upon the idea that brain and womb are alike in form and function. This idea is nothing if not a strange one. Harvey begins by arguing for certain anatomical similarities between the womb and the brain, and the further fact that the products of both are called *conceptions*.[80] In the *De conceptione* Harvey argues that there are certain changes observed in the uterus prepared for conception that make it brain-like: "…the uterus appears thicker and more fleshy, and (in so far as the inner surface is concerned, truly, the place of the future conception) it becomes more tender and is comparable in

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[78] Harvey 1651, Ex.72, 252. "Idem quoque est simplicissimum, purissimum, & sincerissimum corpus, terminabile; in quo omnes pulli partes potentia quidem sunt, actu vero nulla: videturque Natura idem ill concessisse, quod materiae primae, rerum omnium communi, vulgo tribuitur; ut potentia nempe sit omnium formarum capax, actu autem formam nullam habeat. Sic humor oculi cyrstallinus, ut colorum omnium susceptivus sit, ipsemet nullo colore praedistus est…."

[79] It seems clear from this statement regarding the crystalline humor that Harvey had not taken on board Kepler's arguments that this humor was not the seat of vision, which he argues is in the retina. Further, the way in which the primigenial moisture receives form is different than how the crystalline humor was thought to do so. Whereas the crystalline humor receives and then transmits the form of the object seen without taking on its shape or colors, on the contrary, it is the very purpose of the primigenial moisture to materially instantiate the received form. So, while instead of immediately taking up the shape of the parents, it does so rather by epigenesis, there is still a disanalogy here. Indeed, it is the uterus, rather than the primigenial moisture, which seems to be the true analog, for, like the crystalline humor, the uterus somehow transmits the form to the egg without taking on its properties as will become clear below.

[80] A pun as evidence, perhaps?

smoothness and softness to interior of the ventricles of the brain…."[81] On the basis of this putative observation that the ventricles of the brain are similar in smoothness and softness to the place of conception with the womb,[82] and upon the assumption that structure and function are linked, Harvey argues that,

> …seeing that the substance of the uterus that has been made ready for the conception is so very like the constitution of the brain, may we not justly suppose that the function of each of them is also alike…?[83]

So the argument is:

> P1. Womb and brain have similar structures when prepared for conceiving.
> P2. The product of both womb and brain is called a conception.
> P3. Similar structures imply similar functions.
> *C. Therefore womb and brain have similar functions and both form conceptions in an analogous way.*

Now, Harvey is here speculating, and thus so his argument here is, as he must well know, only a probable one. Note, too, that without the third premise, Harvey's argument would have no force. This premise is for Harvey more or less axiomatic, indeed, this was so for most anatomists at least when it was convenient, and left unremarked upon elsewise.

In the *Preface*, Harvey writes explicitly on the relation between the object viewed, the representation of the object as an idea, and form:

> …Art is the account of the work implanted in the artist's mind… that which we perceive in sensible objects differs from the thing perceived and is that which is retained in the imagination or the memory. The former, the thing perceived, is the exemplar, the idea, the form informing; the latter is the imitation, the *eidos*, the abstracted appearance.[84]

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[81] Harvey 1651, *De conceptione*, 294. "Uterus primum crassior apparet, & carnosior; posteaque (quoad interiorem superficiem, loco nempe conceptionis futuro) tenerior factus, laevitate pariter ac mollitie internos cerebri ventriculos aequat…"
[82] They are not. This is a pretty crazy 'observation'.
[83] Harvey 1651, *De conceptione*, 295. "…cumque adeo substantia uteri ad concipiendum parati, sit cerebri constitutioni persimilis: quidni merito suspicari liceat, utriusque etiam functionem esse similem…."
[84] Harvey 1651, *Prefatio*, B3. "…ars est ratio operis, in animo Artificis…In utrisque differt id, quod in rebus sensibilibus speculamur; a spectro ipso, quod in phantasia vel memoria retinetur. Illud exemplar, Idea, forma informans; hoc, imitamentum, Idos, species abstracta."

In generation, the male's semen is the analogue of the object seen at a distance: the geniture transmits an 'idea,' an informing form, and this is the intentional object 'seen,' so to speak, by the uterus and transmitted to the primigenial moisture. When combined with the female's contribution this produces the form of the future fetus, the analogue of the *eidos*, that is, it is the abstracted representation of the male and female such that an offspring of the same kind can be constructed.[85] It is by this analogy that Harvey accounted for how the active potentialities of male and female construct the fetus.

Key here is the term "definition" (*ratio, logos*), which, as Aristotle articulated in the *Organon*, signifies what something is, its essence.[86] *Logos* is central to understanding soul, for, soul is the "…substance [of the body] according to its account [*rationem*], and moreover this is the essence [*quod quid erat esse*] of such a kind of body..."[87] So what is transmitted by the male is a potentiality for soul, form, containing an account of the future offspring, an account of its very *essence.*[88] We might call this a plan, in the sense of a blueprint, for this *ratio* contains the information needed to construct the fetus. Indeed, Harvey elsewhere calls the male's contribution a 'precept [*praecepto*]' that grants "…the definition [*rationem*], the form and laws of the future

[85] The term species here is important, for remember that the male does not transmit a copy of himself, nor does the female, but rather the offspring is the result of the mixture of the male and the female, and combines the characteristics of both, importantly, the species level characteristics so that what is generated is of the same kind. Indeed, Harvey further maintains, along Aristotelian lines, that the final cause of males and females *just is* this production of a creature of the same species through the transmission of form from male and female, for which see: Harvey 1651, Ex.28.

[86] Aristotle 1552, *Topicorum translatio Abrami* Lib.I Cap.4. "...definitio est ratio significans rei quiditatem, qua est ipsius essentia..." Note that the location of this passage in this edition is different from the modern one, where the passage is located in chapter 5. See also, *Meteorologicorum*, Lib.IV, Cap.12, In: *Aristotelis libri omnes…cum Averrois Cordubensis variis in eosdem commentariis*, Vol. 5, Venice, 222.

[87] Aristotle 1552, *De anima,* Lib.II, Cap.1, Volume 11, 52. "...est enim substantia quae secundum rationem: hoc autem est quod quid erat esse huiusmodi corporis…" Note that '*quod quid erat esse*' is the translation of '*to ti en einai*,' a very difficult phrase and concept in Greek, and which gave the Latin translators much trouble, hence their neologism of '*essentia*.' This was common practice, and translators as diverse as Melanchthon and Cardinal Bessarion understood the phrase as 'essence', even if they didn't always translate it using *essentia*.

[88] More properly, part of its essence, as it must be combined with the female's contribution. Furthermore, this cannot be the full essence, the soul of the future chick *in actu,* but only *in potentia,* for, as argued above, epigenesis just is the process whereby this essence comes into actuality.

fetus…"[89] sometimes called a *species*.[90] He can thus use the brain/womb analogy and this 'precept' to explain the process of epigenesis: it is analogous to how an artist, with her conception of the future work in mind, goes about and builds that work:

> For just as we fashion from the conception of a form or an idea in the brain its likeness in the works of our hands, so does the idea or appearance of the genitor remaining in the uterus generate a foetus like to himself by the help of the formative faculty, that is to say, by imposing upon its work this immaterial appearance. It happens in the same way as art, which is the *eidos* or appearance of the future work, produces its like when it is acting and begets it in the matter…So that what instruction effects in the brain…its analogue is bestowed on the uterus by coitus with the male…[91]

So in the same way that, in vision, just the form and not the matter of intentional *species* are transmitted from the object to the eye and then used by the brain to abstract concepts, the male sperm transmits his *species* through the female's reproductive tract without any material. The male's form is then abstracted in combination with the female's to create the form of the future offspring.[92] How these forms become abstracted is unclear, as Harvey does not discuss it, but what is important to note is this process of abstraction accounts for another aspect of generation: namely that the offspring's form is not just that of the male or female, but rather a combination of both.

So Harvey argues that the productions of art and nature are identical in that the process by which each is constructed happens according to the end and goal of that process. In both cases, the end of the process is an immaterial form produced by conception, and this immaterial

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[89] Harvey 1651, Ex.29, 89. "… rationem, formam, ac legem futuri foetus acciperet."
[90] Although he doesn't only use this terminology, it is more or less equivalent to how he uses '*forma*.' Harvey 1651, *De conceptione,* 295, 301. He writes in the latter case, for instance, that "…inest species sive forma pulli in utero vel ovo…."…" (301). See also Ex.29, 88.
[91] Harvey 1651, *De conceptione*, 295. "Nam quemadmodum nos, a conceptione formae, sive ideae, in cerebro, similem ei in operibus nostris efficimus: ita partier idea, aut species genitoris in utero existens, formatricis facultatis ope, simile foetum generat; dum speciem nempe, quam habet immaterialem, opera suo imponit. Non aliter sane, quam ars, quae in cerebro est eidos sive species operis futuri, simile in agendo profert, & in materia gignit…Ade out, quod disciplina in cerebro efficit…analogum ejus coitus maris in utero praestet…"
[92] Harvey does not call this process "abstraction"; in fact, he never talks about how the forms of the parents are integrated. Abstraction seems as good a term as any, especially given Harvey's larger analogy.

form is the idea of the complete future work, the artwork on the one hand, the offspring on the other. In other words, the form is the account of the essence of the future work (offspring or artwork) *sans* matter: it is the *logos, ratio* of the future fetus. Harvey understands how this happens by understanding the egg, the combined efficient causes of the fetus (the contributions of male and female), to have inside itself the end:

> Therefore, the conception of the uterus or of the egg will be similar to the conception of the brain itself (in some way anyhow), and the end equally inheres in both in the same manner. That is, the appearance or the form of the chick inheres in the uterus or egg without any matter: just as the account of his work is inside the artist, as when the account of a house is held in the brain of the builder.[93]

In the Renaissance, this conception of efficient causation was explicitly invoked in discussions of generation, such as I discussed in the work of Jacob Schegk mentioned above. On this front, both Schegk and Harvey are doctrinally Aristotelian,[94] and these causes—variously called by Harvey the *idea*, *forma*, or *ratio* of the future offspring—are fundamental to their understanding of 'coming to be.'

In other words, the teleology of coming into being requires an account of the teleology of being, and the construction of this system is its goal. Harvey describes this process as one where the efficient cause is guided by the final cause. Specifically, Harvey argues that the final cause (the form of the future chick) must be existent before the efficient cause (the formative virtue) in such a way as that it can move the efficient cause according to the end of development: "The efficient moves since it is impelled by the final cause. In every efficient there inheres, in a way, the account of the end; by this final cause, the efficient is moved, operating with foresight.[95]

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[93] Harvey 1651, *De conceptione*, 301. "Conceptio itaque uteri vel ovi, similis erit (aliquo saltem modo) ipsius cerebri conceptioni; finisque pariter eodem modo utrique inerit. Nempe, inest species sive forma pulli in utero, velovo, sine ullam materiam: quemadmodum in artifice inest ratio sui operis; ut puta in aedificatoris cerebro, ratio domus."

[94] And, importantly, not Scholastic, as there is never any mention of substantial forms or the like.

[95] Harvey 1651, *De conceptione*, 299. "Efficiens autem movet, quia a caussa finali impellitur. Inest enim quodammodo in omni efficiente, ratio finis; a quo illud, cum providentia operans, movetur."

Notice, that the final cause is first among all causes, underlining the fundamentally teleological understanding of the explanatory duties necessary for understanding generation. Because of how the final cause directs the efficient cause, the efficient operates *as if by foresight*. In the final section below, I return to this idea of foresight, and to the issue of how to understand how the final cause comes to inhere within efficient. The construction of the fetus is analogous to artistic production: just as the artist paints or sculpts her object according to the account of the artwork existing in her, so too does the uterus construct an egg by a set plan (epigenesis), according to the *ratio* of the future offspring that is contained, somehow, in the egg. So the male bestows upon the female three things: an idea, which is to say, a kind of immaterial form, which has a potential for a complete soul as its end, containing (part of) the essence of the future offspring, and a power, analogous to art, which constructs the fetus according to that form and end. This just is the sort of triune cause Aristotle discussed as the soul in *De anima* and which is characteristic of natural things as in the *Physics.*

Before moving on, there is one last topic that needs to be discussed, namely, Harvey's conception of contagion and his account of fertilization. Some might argue that Harvey's use of contagion is his explanation of generation, but this is not correct. This is especially attractive since, in a sense, contagion (howsoever it be conceptualized) does seem to involve the replication of form, which is of course essential to generation.[96] But Harvey was not here attempting to explain *generation* by contagion, but rather only comparing modes of *transmission* in natural generation and contagious disease.

Contagion must be rejected as Harvey's explanation of generation because it depended upon what a materialist doctrine of seeds, and which Harvey explicitly rejects. This is complicated since Harvey does subscribe to a certain, non-materialist, version of this doctrine.

[96] Harvey 1651, Ex.49, 138. "Nimirium, quod primum tetigit generat sibi simile univocum, non tangens, neque actu existens, nec praesens, aut conjunctum; sed duntaxat quia olim tetigit.

An Aristotelian such as Harvey could only help himself to the idea of seeds if they operate by having some inherent *formal* power such that they change by their very nature into some complete actual object that exists in the seed only potentially. If, instead, the power of a seed was based upon its matter alone, both Aristotle and Harvey believed it could not hope to explain what for them was most important, the teleology inherent in living things and their development (as I shall argue more fully in the concluding section of this chapter). But the materialist theory of seeds aimed to do just that.

Anaxagoras, for instance, argued that creation sprang from bodies that contained the 'seeds of all things.' The doctrine was taken up especially by the Atomists, and so, for instance, Lucretius maintained that, "…the world contains seeds of all kinds, both good and bad; some, in food, give life, others induce diseases…Their different atomic shapes and combinations account for their different capacities and means of action." [97]Along with much else, this doctrine was revived by the early moderns, and thus in the sixteenth century one finds Fracastoro arguing for the doctrine of seeds as the explanation of contagion. Vivian Nutton writes that Fracastoro defined a contagion as a,

> …corruption, developing in the substance of a combination of elements, which passed from one thing to another and was the result of an infection first occurring in the imperceptible particles. There were three different types of contagion, by direct contact, by contact leaving behind '*fomites*; which preserved the seeds of contagion and infected by them; and at a distance as if by some impetus or poison. In all three, infection was produced not by an unknown 'occult' cause, but by seeds (*semina, seminaria*) of contagion, which varied with the type. Seeds that infected at a distance had a greater hardness, subtlety, and power than the others, and perhaps an antipathy to the animal organism. Why and how contagion occurred depended on the composition of the seeds, which might be produced within or without the body, and even as a result of astral conjunctions.[98]

[97] Nutton, Vivian 1983, "The Seeds of Disease: An Explanation of Contagion and Infection from the Greeks to the Renaissance," *Medical History* 27: 9-10
[98] Nutton 1983, 21-22.

And so the doctrine of seeds seems to have been associated with the *material aspects of nature* and not the formal aspects. Harvey, being no materialist, could not in good faith attempt to explain generation by way of seeds in this manner. Thus, for Harvey, there could be only one true seed: the fertilized egg. Though Harvey often refers to the male contribution as *semen* or *sperma* (seed), he notes (following Aristotle) that it is more properly called *geniture*. He writes that a *true* seed takes its origin from *both* parents, such as in the seeds of plants.[99] The male contribution, conceived as contagion, thus could not be about seeds in the sense of Fracastoro or other materialists, nor even in the sense in which an Aristotelian could use the concept.

Instead, Harvey's use of contagion is merely meant as an analogy to illustrate a specific aspect of how the male transmits its power to the female in fertilization. This depends upon the idea of *fomites*. *Fomes* is a strange Latin word that means literally 'kindling' or 'firewood.' As mentioned, Fracastoro uses *fomes* to indicate the way in which the seeds of contagion are preserved in various locations. Thus he could explain how, say, the blanket of a plague victim might harm other people: the contagion in the body of the victim produces insensibly small particles which are seeds of that disease; the contagion can thus be expelled from that body and come to rest on, say, a blanket, but in the form of seeds that are preserved on that blanket; the blanket, meanwhile, can then infect other persons who inhale the seeds preserved upon it and, once entering the body of a new victim and finding the conditions right, the seeds can become 'implanted' in the fertile soil of the new victim, and start their corruptive processes, part of which involves the production of new seeds. Harvey wrote the following annotation in his copy of the *De generatione*:

> Indeed, morbific contagion (*contagium morbificum*) is an influx (*influxus est*) for it can act both at a distance and through some foreign *fomitem*, or again through the same *fomitem*, Δ the pox.[100] It infects those who copulate with a woman in whose womb the

[99] Harvey 1651, Ex.26, 76.
[100] The delta is Harvey's way of signifying a comment of his own when he takes notes.

> poison has not, or not as yet, manifested itself in action but lying hidden as in some harboring-place. Again, rabies in dogs can lie hidden for many months, or WH smallpox for days. And so in the same way the genital seed coming from the male lies hidden in the female as in some *fomes.*[101]

Harvey's thought is that, just as the *fomes* of a contagion can be passed through various intermediaries (sick person to blanket to sick person for instance) without the intermediary gaining the power of the contagion (the blanket in no way gets sick, nor does the vagina become fertile in any sense), so too can the formative virtue of the male's geniture be passed along the reproductive tract of the female.

But at this point the analogy breaks down, for in Harvey's case, this power is *entirely incorporeal*: there can be no material seeds that are passed along somehow to the uterus:

> …if what I have called by the common name contagion, as having sprung from spermatic contact in coitus, and remaining in the female (the geniture not present here), is the efficient cause and craftsman of the future procreation, if, I say, this contagion (or atoms or odor or ferment or any other thing that it might be), is unrelated to the nature of a body, then it must be something incorporeal.[102]

So Harvey uses contagion as an analogy not for generation, but for the way the male fertilizes the female. It is about how what I called an active potentiality is transmitted from male to female. He is forced to resort to analogy and simile here because he and everyone from Aristotle onwards are entirely perplexed at exactly how the male contribution works. Indeed, it is much more difficult for Harvey than for others because his empirical research had convinced him that the geniture never reaches the womb, that there is no prepared matter in the uterus, nor does the conception come to be immediately upon the union of male and female.

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[101] Harvey 1651, in his copy of *De generatione animalium*, in the Pybus Collection in the library of the University of Newcastle upon Tyne; quoted in Whitteridge's 1981 edition of the *De generatione,* 463.

[102] Harvey 1651 *De conceptione*, 297. "…si, quod communi nomine contagium a nobis appellatur, utpote a contactu in coitu spermatico ortum, & in foemina (citra geniturae praesentiam) superstes, futurae procreationis efficiens & opifex; si, inquam, contagium hoc (sive atomi sive ordor, sive racedo, sive aliud quid fuerit) a corporis natura alienum sit; necesse est, sit incorporeum aliquid."

So, in order to spread what light he can upon so shadowy a process, Harvey turned to a variety of *similar* phenomena in order to describe the mode by which the male transmits his power to the female. There were a variety of basic analogies used by Harvey power, including, for instance: magnetic phenomena;[103] sympathetic and antipathetic phenomena; contagion and disease phenomena, all of which seem to have occult or rather unknown cause [*occulta vel ignota*], and do this without contact.[104] The use of magnets and contagion is meant to connect the phenomena of fertilization to a wider class of phenomena in which the causes are occult, which is to say, more or less unknown. All of these phenomena seem to involve some sort of action through a medium, operating without direct contact, and through this characterization Harvey connects these disparate phenomena. So for instance, Harvey writes that, "…however, it seems that a woman, after spermatic contact (in coitus) is made prolific by no sensible corporeal agent, and is effected in the same manner as iron having been touched by a magnet is immediately given the power of it [the magnet], and can draw to itself other iron things." [105] Somehow a magnet endows a piece of iron with the *exact same power* of attraction, and this is analogous to the male's effect on the female: somehow the bare presence of the geniture is enough to insure fertility. But notice how the reference to the magnet serves just as a recognition that the phenomena of power transmission occurs more broadly in nature, and is not explanatory, but rather serves just to characterize it among a group of occult phenomena. Contagion is not, then, meant to explain how fertilization occurs, but rather the way in which the fertilizing agent (whatever its nature might be) is transmitted.

[103] There is no evidence that Harvey read Gilbert, unfortunately.
[104] Harvey 1651, Ex.49, 139.
[105] Harvey 1651, *De conceptione*, 293. "…videtur sane foemina, post tactum (in coitu) spermaticum, eodem modo affici nulloque sensibili corporeo agente prolifica fieri, quo ferrum a magnete tactum hujus statim vi dotatur, aliaque ferramenta ad se allicit."

4.3.2. The Second Stage of Generation: From Egg to Fetus and Offspring

The second stage of generation concerns the development from the soul of the fertilized egg to the soul of the offspring, a process that relies upon a heat that is 'akin to the elements of the stars'. It is here, then, that one can connect the *De motu* to the *De generatione* most clearly, returning to how I began this chapter. For it is here that generation, nutrition, heat, and soul all come together in the explanation of coming into being. The case of the soul of the egg is, in many ways, the same as the case of the semen. Both are not complete souls but are rather active potentialities for soul:

> Because soul is the act of an organic body having life *in potentia*, it is incredible that the soul should be in the chick before any part of its body has been organized. Nor is it more credible that the soul of the egg and of the chick should be one and the same soul, for the soul is the preserver of that thing only whose soul it is...[106]

Harvey then goes on and demonstrates his deep appreciation of Aristotle's account of generation by arguing that this problem can be avoided if one pays close attention to origins and ends across the continuous process of generation:

> It is the same principle and cause of life in both [the chick and the egg]; truly, in the half constructed chick and the remnant of the egg; just as if it were the one and simple actuality of the same body, or as if produced from the parts of one natural body one soul should spring forth that is wholly in the whole and wholly in each single part, as is commonly said. This is seen just as it is in the trunk, leaves, and fruit of a tree: where a separation or division has been made…we say that the first origin or cause of these is the same as that of the whole; it is as it were the form and end of the one, but truly the source of the other. Similarly in a line, where whatsoever division is made at a point, it will be the end of the preceding part or its termination, and the origin and beginning of that which comes after. The same may be seen to happen in quality and movement, indeed, in every alteration and generation whatsoever.[107]

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[106] Harvey 1651, Ex.26, 81. "Cum anima sit actus corporis organici vitam habentis in potentia, incredibile est eam pullo inesse, antequam quicquam corporis ejus organisatum fuerit. Nec magis credibile, eandem esse ovi, pullique animam: siquidem anima est conservative ejus duntaxat, cujus est…."

[107] Harvey 1651, Ex. 26, 81. "…idem esse principium, & causam vitae in utroque; nempe in pullo semifacto, & reliquo ovo; tanquam ejusdem corporis unus simiplexque actus foret; aut quasi ex partibus unum corpus naturale

Generation is a process that occurs over time, and though it is one and the same active principle which is the cause at all the points, at the various intermediate points whether one identifies the power as the soul or some other, lesser, sort of potentiality or virtue is a question of the stage at which the process is at. That is, it is a question about the degree of actuality of the creature as it comes into being. One can keep track of this by simply attending to the teleology the various stages of coming into being. So at the beginning of the process, the formative power found in the male's geniture is not the soul of the chick, but it is the *origin* of the soul to be found in the egg, and, eventually, the soul of the chick. This origin is not soul but precedes soul, just as all incomplete actualities precede that of which they are an actuality. The soul of the egg is the form and end of the male's geniture, but it is also the origin of the soul of the chick, though it is not identical to it. Indeed, this is why Harvey argues, as I noted above, that an egg is an intermediate sort of thing: it is between the two poles of generation, the geniture on the one side and the chick on the other. At each stage—geniture, egg, fetus, chick—there is an increase in the actuality of the form and its instruments, and this process ends in the complete actuality of that sort of creature, namely, the full soul of the offspring, in this case a wee chick.[108] It is this process of actualization which Harvey terms epigenesis. Epigenesis is thus a process of *soul actualization* by which the organs necessary for soul to operate are constructed, such that, at the end, a fully functioning animal is created, the union of soul and body I discussed in the previous chapter.

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producentibus una quoque anima prosiliret, quae tota in toto esset (ut vulgo dicitur) & tota in unaqualibet parte. Quemadmodum in arboris trunco, foliis, aut fructibus videre est: ubi separatione sive divisione facta…dicimus, idem esse hujus, & totius principium, sive caussam primam: est hujus tamen quali forma & finis, illius vero ut principium. Ita etiam in linea, quocunque in puncto divisio fact fuerit, erit illud anterioris partis finis, sive terminus; posterioris autem principium, sive exordium. Idemque videatur contingere in qualitate, & motu; nimirum in transmutatione qualibet, ac generatione."

[108] Indeed, this sort of idea, that the future soul is present *in potentia* in the semen is found in many Renaissance theories of generation; see, for instance, Book VII of Fernel's *Physiologia.* C.f. Deer 1980, 444-445.

The second stage begins when the first particle of the fetus comes into being. Harvey's empirical research convinced him that this first genital particle is a spot of living, moving blood, a *punctum saliens.* Harvey thinks that blood is thus the origin of the fetus, or, as they would say in Latin, it is the *principium* of the fetus, remembering, now, that soul is the principle of life. Aristotle, in the *Metaphysics*, defines what it is to be an origin (*arche, principium*) of something else, most importantly as that: "That from which a thing is first built, in its matter, e.g., the keel of a ship or the foundation of a house, while it is said to be the heart in animals by some, the brain by others, or some other thing…."[109] This is identical to how Harvey defines the blood found in the egg, the first conception of the fetus:

> …a red jumping point emerges, and little branches of veins are disseminated like rays. Soon, the first concretion of the body appears (like a little worm), and bent into a circle like the keel of a ship, and the rest of the parts follow in their order, as I said in my *historiae*.[110]

So the blood is an origin in this sense, that upon which the rest of the body is founded. The blood is also a principle in another sense, namely, that, "…from which movement or alteration is initiated, e.g., as a child is from the parents…."[111] In other words, the principle of motion (the efficient cause) of the fetus is the blood, just the same sort of efficient cause invoked in the first stage of generation in the semen and in the female's contribution.

Harvey follows Aristotle in thinking that the nutritive and generative capacities of soul are identical, or as I described it above, the process of 'coming to be' in the maintenance of the parts of the body during nutrition is effected in the same way that the parts come to be in

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[109] Aristotle 1552, *Metaphysica*, Lib.V, Cap.1, In: *Aristotelis libri omnes…cum Averrois Cordubensis variis in eosdem commentariis*, Volume VIII, Venice, 47v. "…ex quo prius fit res, & est in re, e.g., fundamentum, navis, & domus, & sicut quidam dicunt cor in animalia, et quidam cerebrum & quidam aliud…" I translate '*fundamentum'* as 'keel' for the *navis* and as 'foundation' for the *domus.*

[110] Harvey 1651, *De membranis*, 280. "…punctum rubrum saliens emicat; indeque subtilissimi venularum ramuli (ceu radii) sparguntur. Mox, primum corporis concrementum (galbae instar) apparet, in orbem carinatim reflexum: atque ordine reliqua, quae in historia diximus, subsequuuntur."

[111] Aristotle 1552, *Metaphysicorum,* Lib.V, Cap.1. "… ex qua sit initium motus & transmutationes, e.g., filius a parentibus…." It is no coincidence that Aristotle uses generation to illustrate this sort of principle.

generation.[112] Nutrition is the function of the blood, and generation is the function of the male's geniture united with the female contribution and combined into an egg with a *punctum saliens*. The function of the blood in the embryo, after the egg has formed the *punctum*, is just the process of epigenesis or soul actualization, which happens as a result of the power of the blood to nutrify and generate. Thus again one sees how the *De motu* and the *De generatione* can be linked through the identity of the nutritive and generative souls.

Central to understanding the second stage of generation, then, is Harvey's argument that the blood is the direct instrument of the soul, and, as such, the efficient cause of the construction of the fetus. This power is effected by means of the heat of the blood. This innate heat (*calido innato*) of the blood is 'akin to the elements of the stars'.[113] In the Renaissance and early modern periods this innate heat was central to the debates of physicians and philosophers. Harvey inserts himself directly into the debate, most explicitly in the penultimate exercise of the *De generatione*, the chapter entitled '*De calido innato*.' Here one finds Harvey's response to prominent physicians such as Fernel and Scaliger on this issue:

> Scaliger, Fernel and others who have weighed less carefully the remarkable endowments of the blood (as having a more excellent and divine innate heat), and have contrived other aerial or ethereal spirits, or ones compounded from an ethereal and elemental substance, believing them to be the most immediate instrument of the soul and most suited to all its works.[114]

Harvey, in effect, accuses these authors of having violated Ockham's razor, as they have multiplied entities without need. A simpler explanation is at hand given Harvey's investigations into the blood. He writes:

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[112] Harvey 1651, Ex.54, 168.
[113] See Deer, 1980 for a discussion of the role of the innate heat among Renaissance physicians and philosophers. The foundational idea is located textually in Aristotle's *De generatione,* e.g., Lib.II, Cap.3.
[114] Harvey 1651, Ex.71, 245. "Scaliger, Fernelius, aliique, sanguinis eximias dotes minus perpendentes, spiritus alios (tanquam praestantius & divinius calidum innatum) aeros, aut, aethereos, vel ex substantia aetherea & elementari compositos finxerunt, proximumque animae instrumentum ad omnia maxime idoneum crediderunt..."

> Because there has been recent mention of innate heat, I intend to say something about it here by way of dessert…Surely there is no need to search for any spirit distinct from blood, or to introduce heat from another source, or invoke the gods to appear upon the scene, or burden philosophy with false beliefs: as we know, that which we commonly seek from the stars is born at home. For, truly, the blood alone is the innate heat, or first-born animal heat, as is clearly established from my observations concerning the generation of animals (especially of the chick in the egg): as to multiply entities is unnecessary. For indeed there is nothing more prestigious or prior in the body of an animal than its blood; nor are the spirits that some men distinguish from blood anywhere to be found apart from it: blood itself without spirit or heat is no longer to be called blood but gore.[115]

Thus, partly on empirical grounds, Harvey believes he has solved the riddle of the location of the soul's instrument: it is to be located in the living blood of animals. In trying to identify various vehicles of the soul in the body, physicians and philosophers like Fernel and Scaliger have ended up with a proliferation of spirits, all of which attempt to explain the processes of nutrition and generation. Rather than locate the soul's primary instrument in some spirit distinct from the blood, Harvey instead finds that because it is the first living, moving particle of the body, the blood must be identified as the instrument of soul and bearer of life giving heat. Thus this living blood is *by its very nature* defined as having a certain sort of heat and as a result it has its generative and nutritive capacities. Harvey attempts to reduce a multiplicity of explanatory entities to a unity: the nature of the blood is all that is needed to understand physiological processes such as generation. And though this heat is 'bred and born at home,' is celestial in virtue of the fact that it operates similarly to the heat of the Sun—it causes *growth* whereas the

[115] Harvey 1651, Ex.71, 244. "Quoniam saepe Calidi innati mentio incidit, libet hic (ipidorpidis loco)…Non est opus profecto spiritum aliquem a sanguine distinctum quaerere, aut calorem aliunde introducere, Deos-ve in scenam advocare, philosophiamque fictis opinionibus onerare: domi scilicet nascitur, quod vulgo ab astris petimus. Solus nempe sanguis est calidum innatum, seu primo natus calor animalis: uti ex observationibus nostris circa generationem animalium (praesertim pulli in ovo) luculenter constat: ut entia multiplicare, sit supervacaneum. Nihil sane in corpore animalium, sanguine prius aut praestantius reperitur; neque spiritus, quo a sanguine distinguunt, uspiam ab illo separati inveniuntur: quinetiam sanguis ipsement, sine spiritu aut calore, non sanguis, sed cruor appellandus est."

heat of fire causes only *destruction*.[116] (Of course, in truth Harvey, like others in this period, does not move much beyond this analogy in analyzing how this heat is supposed to operate.)

Harvey bases this view of the soul's instrument upon his experiments[117] on the blood in vivisected animals and upon blood removed entirely from the living body. Harvey notices that once removed, the blood cools, changes color, seems to separate into different parts, and so forth.[118] From this he reasons that the essential nature of the blood consists in a certain sort of heat, a vital animal heat, that, once lost, renders the blood into its parts, and becomes not blood but mere gore. It is heat that turns the blood into a unified object, and so Harvey argues that the blood has a certain sort of double aspect:

> Blood, therefore, as it is a living part of the body, is of an ambiguous nature and comes under consideration in two ways. Materially and through itself, it is called nutriment; formally and in so far as it provided with heat and spirits (the immediate instruments of soul), and with the soul itself, it is to be judged the tutelary deity [of the body], its preserver, its principal, primigenial and genital part.[119]

Or as Harvey puts it elsewhere, the blood is "…compounded out of soul and body."[120] So the dual nature of the blood concerns its material and formal nature: materially it is a kind of matter that has the passive potentiality to become any sort of part of the body, equivalent to the female's contribution described above. The formal nature of the blood, however, is this heat, and it is this heat that is responsible for the powers that blood has for nutrition and growth, equivalent to contribution of the male, and which grants what Harvey calls its *virtus plastica* or *facultatem*

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[116] This connotation between blood, heat, and soul is ancient: for instance, in Homer's *Odyssey,* a dead person's soul can be brought back to a kind of life by drinking blood. Indeed, these sorts of connections resound throughout Ancient Greek thought, from Hippocrates to Aristotle, Galen and beyond. C.f. Gundert, Beate 2000, "Soma and Psyche in Hippocratic Medicine," In: *Psyche and Soma,* Oxford: Clarendon Press.

[117] In the following chapter I explore in great detail what '*experimenta'* are for Harvey. I note now only that one should not think of Harvey's experiments as necessarily analogous to the modern conception of a controlled intervention.

[118] See: Harvey 1651 Ex.52.

[119] Harvey 1651, Ex.52, 160. "Sanguis igitur, prout est corporis pars vivens, ambiguae naturae est, & duobus modis considerandus venit. Adeoque materialiter, & per se, nutrimentum dicitur: formaliter vero & quatenus calore, & spiritibus (immediatis animae instrumentis) ipsaque anima praeditus est; corporis lar, ac conservator, pars principalis, primogenita, & genitalis aestimandus est."

[120] Harvey 1651, Ex.52, 159. "…ex anima & corpore composita."

opificem. Thus the blood is the efficient cause of generation by virtue of this heat. And, further connecting generation and nutrition, *De generatione* and *De motu*, it is through this heat that the life of the body is effected—the body is turned from a collection of parts to a functioning, teleologically unified whole by means of this 'vivifying' heat.

As with the semen, the miraculous power of the blood thus operates according to *form* and *logos*, according to the final cause inherent within it. It acts almost as if it had true foresight:

> Blood also in this way acts beyond the powers of the elements, for while it is now the first-born particle and innate heat of the body (as it is in the seed and in the spirit), it fashions the remaining parts of the entire body in due order; and that with the greatest foresight and understanding, acting towards a certain end, as if made use of some power of reason.[121]

This process, which Harvey characterizes in exquisite detail in the course of the *De generatione,* is one with a specific, regular order by which the fetus is constructed. At the end of this process of generation one arrives at the offspring, a new creature of the same kind: a new soul in union with its body has been born. And here the explanations of the parts follows the system detailed in the previous chapter.

But I want to now conclude by returning to the problem mentioned above, which, as Harvey notes, is question about the verb '*inesse'*.[122] That is, to say: how does the final cause inhere in the efficient cause, in the blood, in the egg, in anything?

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[121] Harvey 1651, Ex.71, 247-248. "Sanguis quoque similiter supra vires elementorum agit, cum jam pars primogenita & calor innatus existens (uti sit in semine & spiritu) reliquas totius corporis partes ordine fabricat; idqua summa cum providentia & intellectu, in finem certum agens, quasi ratiocinio quedam uteretur."

[122] In the annotations to his copy of the *De generatione*, Harvey has some notes on the meaning of 'inesse'. For instance, Harvey writes, and which concurs quite well with the account I have been elaborating, the following about one way to understand 'inesse': Again, as in the case of potentiality and the performance of the act, or again in the first and second act, just as what is caused is in the cause, the effect or part of the effect in the efficient, and the suffering of an action is in action, and that which is mobile in motion." This line, and others in his annotations, are quite interesting speculations, but I do not have room here to discuss them.

4.4. GOD AND GENERATION

Harvey does not have any full or exact solution to this puzzle. However, there is a *sort* of solution, or at least an elaboration of the causal picture. To understand the constructive power of the egg, one must pay attention not just to the *instrumentality* of the soul and body union, but also to God and *His Instruments*. The idea becomes to use Harvey's cosmological conception of God and His relation to the natural world in order to explain (in some fashion) how the final cause comes to be embedded in the efficient.

I start with a distinction between a kind of primary and secondary or instrumental causation: God's act of creation is the *primary cause* of the world. In particular, God created a world in which natural objects have definite natures, essences, forms, which are responsible for the regular activities of these objects, and these activities are the secondary or instrumental causes. Remember that Harvey's conception of natures is Aristotle's: natures are internal sources of change and rest, and which are the souls of living things.[123] Unlike Aristotle, however, Harvey believes in a God who created the natures of all natural objects, and, by dint of these created natures, all natural objects are what Harvey calls 'instruments of God':

> Wherefore, in my opinion, he has thought rightly and piously who deduces the generation of all things from that same eternal and omnipotent Deity by whose command the whole universe itself depends…all men understand Him to be that which is the principle and end of all things, that which is eternal and omnipotent, the author and creator of all things, who conserves and perpetuates the transitoriness of all mortal things through the changing vicissitudes of the generations, that which is present everywhere, no less in each particular operation of natural things than in the entire universe … In truth all natural bodies are the works and the instruments of His greatest Divine Will ….[124]

[123] Though Harvey's conception of God is somewhat complicated, and difficult to make out, it is clear that he thinks of God as the Divine Craftsman, though I do not have space to defend this claim here.

[124] Harvey 1651, Ex.50, 146-147. "Quapropter, rem recte pieque (mea quidem sententia) reputaverit, qui rerum omnium generationes, ab eodem illo aeterno atque omnipotente Numine deduxerit, a cujus nutu rerum ipsarum universitas dependet. Nec magnopere litigandum censeo, quo nomine primum hoc Agens compellandum, aut venerandum veniat, (cui nomen omne venrabile debetur) sive Deus, sive natura naturans, sive anima mundi appelletur. Id enim omnes intelligunt, quod cunctarum rerum principium sit, & finis; quod aeternum, & omipotens existat; omniumque autor & creator, per varias generationum vicissitudines, caducas res mortalium conservet, ac

God, insofar as he is the principle (efficient cause) and end (final cause) of all things, creates the natures of all natural objects (their formal cause). Thus Harvey can explain the incredible way in which the active potentialities of the geniture and the blood act by means of their Divinely wrought natures. Above, I quoted Harvey as writing that "…So that what instruction [*disciplina*] effects in the brain, namely Art, its analogue is bestowed on the uterus by coitus with the male, and that is formative art [*artem plasticam*]…." The foresight and art displayed by the blood and the geniture are not to be understood in the way some Neo-Platonic philosophers understood them, as actually using foresight and art. Rather the recognition of this foresight and art is a secondary effect of God's Miraculous Design. For Harvey, the first efficient cause of generation can only be God and His Wise Design of nature. Harvey thus argues that the male and female are but *instrumental causes* of generation. God is the first efficient cause:

> For, in the construction of the chick the first efficient must use skill, foresight, wisdom, goodness and understanding far beyond the capacity of our rational souls. For it is that in which lies the definition of the future work, and which acts for some determined end and orders and perfects all things; and which forms the parts of the chick, even the very smallest, for the sake of some use and action, and provides not only for the fabric of the work but also its welfare, ornament and defense. Now truly, the seed of the male, either in coitus or after it, is not of such a kind as that to it can be attributed understanding and foresight.[125]

Harvey then goes on to say it must be God who is the primary cause of generation, as only He has the requisite foresight and art. God acts through a series of instruments—*organa*—which are each natured by God to progress, grow and act so as to accomplish the necessary functions of life, all in certain specific, regular ways. Don Bates, who compares Harvey's explanation with those of the atomists and Galenic/Platonic Physicians, expresses the idea like so:

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perpetuet; quod ubique praesens, singulis rerum naturalium operibus non minus adsit, quam toti universo…Omnia vero corpora naturalia, summi ejus Numinis & opera sunt, & instrumenta…."

[125] Harvey 1651, Ex.50, 144. "Nempe, ut primum efficiens in pulli fabric artificio utatur, & providentia, sapientia item, bonitate, & intellectu, rationalis animae nostrae captum longe superantibus. Utpote, in quo sit futuri operis ratio, quodque in destinatum finem agat, disponat, & perficiat omnia; partesque pulli, etiam minimas, alicujus usus & actionis gratia efformet; & non modo operis fabricae, sed etiam saluti, ornati, ac defensioni ejus prospiciat. Mas vero, aut illius semen, in coitu, vel post eum, ejusmodi non est, ut illi ars, intellectus, ac providentia attribui possint."

> What accounts for regular and orderly changes in the world, then, are not randomly energetic atoms or educated agents but the law-abiding instruments of God. In fact 'all natural bodies are both the products and the instruments of the highest divinity.' Harvey has kept the Aristotelian model of craftsman, and instruments or forms, except that when it comes to processes […which] because of their wondrous complexity, must be continuously managed by the wisdom and foresight of God, who artfully makes his creations also serve as instrument.[126]

Bates is surely correct that, for Harvey, the Aristotelian metaphor of nature as a craftsman has morphed into a sort of natural theological conception of God as the Divine Craftsman. However, Harvey's natural theology seems to embrace a view of God not where He continually manages Creation, but where all natural things follow His Law. God the Craftsman gave each natural thing its nature and this nature directs that object according His Design, such that the natural object follows the system of actions, uses, and hypothetical necessities detailed in the previous chapter.

Harvey did not argue that God controls the process of generation directly, guiding the process as the sculptor guides her chisel, as Bates seems to suggest. Nor did he think that natural objects act with actual foresight and wisdom, as human beings do. Rather, the sense to understand God is as an origin and ultimate cause of the natures of created things, as having chosen the Design of Creation, and not as an active controlling force in the construction of particular animals. Harvey explicitly equates God with Nature or the Deity of Nature,[127] and, with this in mind, note that he writes:

> But truly Nature, which is the principle of motion and rest in all things which she is in, and the vegetative soul, which is the first efficient cause of every generation, do both move and act by no acquired faculty (as we do) which may be distinguished by the name of art or prudence, but just as if by a certain order or mandate working according to laws: truly with a like vigor and similar manner to how light things are moved upwards and heavy things downwards. That is to say, the vegetative faculty of the parents generates, and the seed finally arrives at the form of the foetus, in the same way in which the spider spins its web, birds build their nests, incubate their eggs and protect them, and bees and

[126] Bates, Don 2000, "*Machina Ex Deo*: William Harvey and the meaning of Instrument," *Journal of the History of Ideas* 61(4), 591.
[127] See: Harvey 1651, Ex.41, and especially Ex.50.

> ants prepare their habitations and hide their food for future use. Clearly they do this naturally and by their innate disposition, and not with any foresight, education, or deliberation.[128]

Natural things, God's instruments, are not themselves capable of foresight and wisdom in their actions—they merely display what appears to be wisdom as a result of God having designed them to act in such regular ways. Their natures just *are such* that they act in this way. Embedding this regularity into his larger cosmological framework is as close as Harvey comes to offering an explanation of how it is that the soul unfolds in the miraculous and regular way that it does.

This sort of natural theological way of dealing with the problem of generation is one that would be repeated throughout the seventeenth century, and, indeed, well into the nineteenth. In some ways, by the end of the seventeenth century, mechanism had hit an explanatory wall with regard to generation conceived of as epigenesis.[129] While Descartes argued for epigenesis, his mechanical philosophy was unable to adequately explain the process of development with unguided matter. And, in fact, after Descartes' failure to adequately explain generation by epigenesis in his system, many mechanically inclined thinkers, Cartesian and otherwise, began to espouse preformationist views. Whereas Aristotelians such as Harvey had recourse to the powers of informed matter, to soul and final causes, the corpuscularians had no such line of retreat unless they dramatically revised their conception of matter. Preformation, that is, mere growth from pre-existing parts, could be much more easily accommodated by their metaphysic.

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[128] Harvey 1651, Ex.50, 146. "At vero Natura, principium motus & quietis in omnibus, in quibus est; & anima vegtativa, prima cujuslibet generationis caussa efficiens; movent nulla facultate acquisita, (sicut nos) quam vel artis, vel prudentiae nomine indigitemus; sed tanquam fato, seu mandata quodam secundum leges operante: simili nempe impetus, modoque, quo levia, sursum; gravia, deorsum feruntur. Scilicet, facultas parentum vegetativa eodem modo generat, semenque tandem ad formam foetus pertingit; quo aranea, retia sua nectit; aviculae, nidos exstruunt, ovis incubant, eaque tuantur; apes, & formicae habitacula parant, & alimoniam in futuros usus recondunt. Naturaliter nempe, & connato ingenio; non autem providentia, disciplina, aut consilio, quicquam agunt."

[129] See, for instance, Detlefsen, Karen 2003, "Supernaturalism, Occasionalism, and Preformation in Malebranche," *Perspectives on Science* 11(4), 443-483; and especially, Pyle, A. J. 1987, "Animal Generation and the Mechanical Philosophy: Some Light on the Role of Biology in the Scientific Revolution," *History and Philosophy of the Life Sciences* 9, 225–254.

Yet the problem of form still remained: for where do these pre-existing parts come from? The answer in seventeenth century Europe could only be God. As Dennis Des Chene has noted in his discussion of the Cartesian Regis' preformationist theory of generation,

> Among the phenomena of life, generation offers…the greatest challenge to a science based on Cartesian principles. We know now that the means available to explanation of those phenomena were hopelessly inadequate to the task. Régis too believes that mechanism has its limits. But what lies beyond is not a revised conception of matter. What lies beyond is theology.[130]

Thus as Jacques Roger once noted, that God becomes fundamental to explanations of the living world.[131] Harvey too, I have shown, must invoke God at a certain point, in fact, on just this point of how the form comes to be, as it were, embodied in the causes of generation.

Despite the similar need for theology, Harvey's *De generatione* was profoundly different in metaphysics from corpuscularian accounts of generation insofar as, for Harvey, generation is a case of substantial coming to be, and wherein generative teleology is a process of form replication. And, of course, soul is of prime importance here as generation cannot be about mechanical processes alone, but involve a variety of Aristotelian.[132] This can be amply gleaned from the following passage, where Harvey lays his cards on the table, so to speak. Here Harvey reiterates his support for a fundamentally Aristotelian conception of the explanatory duties of the natural philosopher in explaining nature:

> The usual error of those who philosophize these days is to seek the causes of the diversity of the parts from the diverse matter out of which they arise. So the physicians affirm that the different parts of the body are fashioned and nourished from the diverse materials of blood, or of sperm: as everyone knows, from the thinner matter, the soft parts, like the flesh; and from harder and thicker matter, the earthy parts, like bones etc. But I have refuted this exceedingly widespread error elsewhere.[133] Equally deceived are those who make all things from atoms, like Democritus, or from elements, like Empedocles. As if generation were nothing other than the separation, or the collection, or the arrangement of

[130] Des Chene, Dennis 2003, "Life after Descartes: Régis on Generation," *Perspectives on Science*, 11(4), 413.
[131] See: Roger, Jacques 1963, *Les Sciences de la vie dans le pensée françaese du XVIIIe siècle*, Paris: Armand Colin.
[132] I owe this formulation of Harvey's science to conversations with James Lennox.
[133] C.f. *De generatione animalium* Ex.45 and 72.

> things. I do not indeed deny that in order for one thing to be produced from another, all these aforementioned things are necessarily required; but generation is itself distinct from all of them. I find Aristotle to be of this opinion, and I will myself hereafter show that from the same white of the egg (which everyone admits to be a similar body and not composed of diverse parts) every part of a chicken (bones, claws, feathers, flesh and all the rest) is produced and nourished. Moreover, those who philosophize in this manner assign only a material cause, and deduce the causes of natural things either from a concurrence of the elements happening by design or by chance, or from diverse arrangements of atoms. They do not touch on that which is special in the operations of Nature, and in the generation and nutrition of animals: for they do not recognize the existence of the divine Agent and the deity of Nature (who works with the highest skill, foresight and wisdom, and who produces all things to some certain end or for the sake of some certain good). They derogate from the honor of the divine Architect, who made the shell to be the guardian of the egg with no less skill and foresight than he composed all the rest of the parts of the egg out of the same material and through the same formative power.[134]

Generation simply *cannot* be reduced to the aggregation of matter, especially given Harvey's (purported) discovery that the sperm operates immaterially, and that the fetus is formed out of an initially homogenous material. Material causes, while important, cannot be the whole story. Generation is a process that must be understood *teleologically*—if one takes the ends out of natural philosophical explanations, thinks Harvey, one has entirely misunderstood the

[134] Harvey 1651, Ex. 11, 28-29. This passage is also reminiscent of De Gaza's preface to Aristotle's animal books, where, as Conrad Gesner summarized, "Multa Aristotelis de musca, de apicula, de vermiculo, pauca de deo. Permulta enim de deo is tractat, qui doctrina rerum conditarum exquisitissima, conditorem ipsum declarat." (Conrad Gesner 1551 excerpting from Theodore of Gaza's animal books, *Historiae animalium Liber I de Quadrupedibus viviparis,* Vol.1, Zurich: b3v-b4r). The Latin of Harvey's passage is: "Communis eorum error est, qui hodie philosophantur, quaerere varietatis partium caussas, ex diversa material, unde oriantur. Ita *Medici*, varias corporis partes, ex diversa material, vel sanguinis vel spermatic, gigni & enutriri afferunt: nempe ex tenuiore material, partes molles, ut carnem; ex duriore & crassiore, terrestres partes, ut ossa &c. Nos autem errorem hunc nimis pervulgatum, alibi refutavimus. Nec minus illi falluntur, qui ex atomis omnia componunt, ut Democritus; aut ex elementis, ut Empedocles. Quasi generatio nil aliud foret, quam separatio, aut congregatio, aut dispositio rerum. Non est quidem negandum, ut aliquid ex aliquo producatur, haec quae dicta sunt necessario requiri; generatio tamen ipsa ab iis omnibus diversa est. In hac sentential Aristotelem reperio: atque ipsemet postea docebo, ex eodem albumine (quod omnes fatentur similare esse, non autem ex diversis partibus compositum) singulas pulli partes, ossa, ungues, plumas, carnem, caeterasque omnes, procreari, & nutriri. Praeterea, qui hoc modo philosophantes materialem duntaxat caussam assignent, & vel ex elementis sponte aut casu concurrentibus, vel ex atomis varie dispositis, caussas rerum naturalium deducunt; quod est in operibus naturae, atque in generatione & nutritione animalium praecipuum, haud attingunt: divinum nempe illud efficiens, & naturae numen, (auod summa arte, providential, & sapientia operatur, omniaque in finem aliquem, sive boni alicujus gratia efficit) non agnoscunt; sed divino Architecto honorerm derogant, qui non minore artificio, & providential corticem, in ovi tutelam, exstruxit; quam caeteras omnes ovi particulas ex eadem material, & per eandem facultatem formatricem composuit."

explanatory requirements demanded by natural phenomena, one has simply missed what is special about the operations of nature.

And so Harvey had to invoke God in his defense of this metaphysical view, as having implemented the foresight and design that is the mark of natural operations. Indeed, Harvey argues that because he did not understand the explanatory demands of these phenomena, his teacher Fabricius was led astray in his search for the causes of generation.[135] Harvey's metaphysics are such that explaining the *coming to be* of a substance by epigenesis requires a very particular sort of explanation in order to account for its 'due order' and the dignity of the parts, one in which material causes, while not unimportant, are subordinated to final causes and their attendant efficient causes. Not only can generation not be reduced to a series of material events (concoction, assemblage, etc.) but generation cannot even be explained in the same way as the parts of the body are explained, as I have shown in detail.

[135] Harvey 1651, Ex.45, 123. "Quare Fabricius, materiam pulli, (ceu distinctam ovi partem, ex qua corporetur) perperam quaesivit: tanquam pulli generatio per metamophosin, sive materiae congestae transfigurationem, fieret; & partes omnes corporis, vel saltem principales, ex eadem materiam simul orientur, & (ut ipse loquitur) corporarentur: non autem per epigenesin, in qua ordo observatur secundum partium dignitatem, & usum; ubi primo exiguum quasi jacitur fundamentum quod simul dum augetur, distinguitur quoque, & formatur: partesque deinceps, ordine quasque suo, supergenitas & adnascentes obtinet."

5.0. THE FACULTY OF ANATOMY

I argued in the previous chapters that the subject matter of anatomy must be understood as an investigation into the soul and its union with the body, the subject of generation the coming into being of that union. Following in a tradition I traced from Aristotle to Galen and through the Renaissance, I argued that Harvey understands anatomical method to be more about dissection of bodies (living and dead) and less about dissection of texts (from authors living and dead). In particular, I showed how Harvey understood the goal of anatomy as ending in causal knowledge of the body and its parts, especially final and formal causes.

In this and the following chapter, I turn my attention from the subject matter of anatomy to its method. In this chapter, I establish Harvey's conception of anatomy as a kind of *skill,* what he calls a *facultas*. This skill must be partially epistemic, in light of its goal being the production of knowledge, in particular knowledge of (final) causes. Harvey's understanding of anatomy is innovative, but this fact can only be recovered by contextualizing his work in relation to the history of anatomical methods. In particular, I show that Harvey collapses a traditional distinction that had been the basis of anatomical teaching and method, namely, the distinction between, on the one hand, *the investigation of facts* by means of dissection and observation (*historia*), and, on the other, *the investigation of causes* by means of reading authorities and using reason (*scientia*). This distinction between practice and theory, though it may seem strange to the modern anatomist, is fundamental to understanding the history of anatomy and Harvey's place in it. Harvey argues that it is in fact through *historia* that one comes to know *scientia.* Knowledge of texts is extremely important, as is reason, and, indeed, Harvey often displays a deeply Humanist, almost devout, reverence for the Ancients, above all Aristotle. But the true philosopher reads primarily from the book of nature.

The chapter shall be organized as follows: in the first section (**5.1**), I discuss Harvey's conceptual and methodological innovations, starting with a discussion of his conception of the basic

definition and goal of anatomy (**5.1.1**). Then, using the history of definitions of anatomy (**5.1.2**) I argue that Harvey's definition must be understood as an innovative reinterpretation of the fundamental epistemology of anatomical practice, and must be understood as an *active investigation* into the parts involving the skills of hand and mind, and cannot be understood as merely a demonstration of preexisting knowledge about those parts (**5.1.3**). Finally, in the last section (**5.2**), I introduce the notions of experience and experiment upon which Harvey's epistemology is founded.

5.1. A TALE OF TWO ANATOMIES

Animal bodies[1] are made of parts that are related to each other, and to the body as a whole, by a set of teleological relations. These relations expressed in the technical terms of action, use, and usefulness, all representing a very complicated functional story. Anatomy, I shall argue in this section, is a skill of hand, eye, and mind that must be able to determine these functions.

5.1.1. Anatomy as *Facultas*

What does *anatomia* mean? Consider first this entry from a dictionary compiled about fifteen years after the end of Harvey's Lumleian lectures, and suitable for our purposes, Francis Holy-oke's (1640) *Dictionarium Etymologicum Latinum*.[2] Here *anatomia* is defined as: "An Anatomie or cutting up of the body to see the parts."[3] This is in line with the etymology of the word, which stems from the Greek

[1] And plant bodies, though they are beyond my purview here.
[2] My use of dictionary definitions are not meant to be decisive, of course, but rather only suggestive, and to give at least some clues as to how these words were being used. And, given that dictionaries tend to lag a decade or more behind the most current usage of words, using a dictionary from this period should give one a rough characterization of some common significations of words at the time Harvey was lecturing.
[3] Holy-Oke, Francis 1640, *Dictionarium Etymologicum Latinum, Antiquissimum & novissimum nunc demum infinitis pene laboribus & continuis vigiliis compositum & absolutum a Francisco de Sacra Quercu*, London.

word for 'dissection', from *ana-* 'up' and *temnein* 'to cut,' and, indeed, Holy-oke provides the Greek in the entry. Note first that the goal of anatomy—to *see the parts*—is mentioned in this very brief definition. Further, the emphasis here seems to be on an instance of the *activity* of dissection, or as an early modern Englishman might say it, 'anatomizing': anatomy emphasizes the *process* or *event* of cutting up a body on a particular occasion in order to achieve the specific *goal* of such cutting, namely, seeing the meaty bits hidden beneath the skin. Indeed, when one considers the wider cultural context of anatomical practices in early modern Europe, this conception of anatomy as an event should come as no surprise. Anatomy was viewed as a public spectacle, a social event, and anatomy theaters were built for such civic viewings.[4]

Turning to Harvey's own definition at the beginning of the *Prelectiones,* one finds that he, too, emphasizes the active nature of anatomy, though this has not been recognized or appreciated by scholars. In order to foreground some textual issues, I shall first look at it this passage in Latin before moving on to my translation: "Anatomia est facultas quae occulari inspectione et sectione partium usus et actiones."[5] This is a difficult line to translate, for a number of reasons. The first issue is that this line was an addition, written across the top of the page.[6] There are many possible reasons why he might have added such a line, from a simple error of omission in his original draft to a newfound appreciation for this description of anatomy. Although the specifics of why he added the line are impossible to determine, it seems reasonable to surmise that he thought the line important enough to add at the very beginning of his lecture notes, which, given how much revision is evident in the notes over the period

[4] The literature on the culture surrounding early modern anatomy is enormous, and beyond my purview here. My portrayal of Harvey's conception of anatomy is, I believe, compatible with the lager cultural significance of anatomy though it is a fundamentally different notion. Regarding the larger cultural context, see: Sawaday, Jonathan 1995, *The Body Emblazoned,* London: Routledge. See also: Park, Katherine 1995, "The Life of the Corpse: Division and Dissection in Late Medieval Europe," *Journal of the History of Medicine and Allied Sciences* 50(1), and Klestinec, Cynthia 2004, "A History of Anatomy Theaters in Sixteenth-Century Padua," *Journal of the History of Medicine and Allied Sciences,* 59(3). Most relevant to my discussion Cynthia Klestinec's recent work on Fabricius' and the modes of anatomical teaching in Padua, for which see her 2011, *Theaters of Anatomy*, Baltimore: The Johns Hopkins University Press.

[5] Harvey 1616, 4.

[6] This is obvious from a close inspection of the relevant folio page in the archive; see Sloane 230a at the British Library.

Harvey gave the lectures, is of no small import. In combination with the *pedagogical* nature of the Lumleian Lectures, one can safely assume that Harvey thought this conception of anatomy was important to teach aspiring doctors and surgeons, in fact, important enough to begin his lectures on this line (or at least, begin his notes in this way, since the relation between Harvey's notes and his lectures is impossible to determine). Indeed, given that Harvey added this line later, one might even go somewhat further and conclude that this conception of anatomy was the result of a fair amount of consideration and reflection on Harvey's part, for the *Prelectiones,* with its revisions and changes, was something Harvey worked on for more than a decade (1616-1627).[7]

The second issue is Whitteridge's translation, which is the only one available with scholarly apparatus. It is quite misleading:

Anatomy is that branch of learning which teaches the uses and actions of the parts of the body by ocular inspection and by dissection.	Anatomia est facultas quae occulari inspectione et sectione partium usus et actiones.

Whitteridge's interpretation is here expansive in ways that are not warranted by the text or by thoughtful analysis of the philosophical issues therein. Let me begin with the following problem, the one with the most relevance to how one understands anatomy for Harvey: Whitteridge's translation of '*facultas*.' I take Whitteridge's 'branch of learning' to mean something along the lines of the modern understanding of anatomy as an academic discipline with a specific body of knowledge about the structural and functional relationships of animal bodies and their parts.

Remember above that the emphasis in Holyoke's definition of anatomy was that it was *active,* it was a *doing*, and thus one might question the translation of *facultas* as a branch of learning. Anatomy, on Whitteridge's translation, is a body of knowledge, a set of already learned truths. Now

[7] There is a tendency in the literature not just to ignore the *Prelectiones,* as I discussed in earlier chapters, but to discount the deeply teleological and Aristotelian/Galenic character of the work in favor of the supposedly more 'modern' concern with just the facts in the *De motu.* The fact that Harvey worked on these notes for so long, all the while performing his cardiac investigations undermines what little basis this attitude might have.

consider Holy-oke's dictionary definition of *facultas*: "Power to doe or speak, leave, licence, feaxe, promptnesse, eloquence."[8] As defined, *facultas* is an active notion; it refers to a power that something has to perform some particular action. From the last part of the definition, one can surmise that *facultas* has the connotation not just of an ability to do something, but an ability to do something *well,* even *eloquently*. It is this active understanding of *facultas* that provides an important insight into how to frame Harvey's methods. Thus in the following pages I argue that faculty of anatomy for Harvey is a *skilled ability*, involving both hand, mind, and practice (always practice!). This is not to say that Harvey does not use *anatomia* to refer to the body of knowledge so produced about the body (though he rarely uses the word in this way), but merely that, in this first passage of the Lectures, he is emphasizing the *methodological* and *active* senses of the word.[9] In Section 5.2, I return to this notion of a '*facultas'* and connect this idea with Harvey's conception of *experientia*.

Harvey's brief Latin here is unclear as to the exact relationship between this *facultas*, ocular inspection and dissection, and uses and actions, but an obvious and fitting idea is that, through ocular inspection and cutting of the parts, one *learns* the uses and actions of those parts: anatomy is the ability or capacity to determine these properties through inspection and dissection. There is no support in the Latin for this, exactly; but neither is there for Whitteridge's 'teaches.' To be fair, Whitteridge's translation does say that anatomy teaches the uses and actions of the parts '*by* ocular inspection and dissection,' so her translation does not completely distort the meaning of Harvey's Latin.

Ultimately, the difference between these two interpretations comes down to a choice of what one thinks Harvey is trying to emphasize, and thus how one should understand his conception of

[8] Holy-Oke, 1640, 'Facultas.'
[9] Harvey 1616, 134. So, for instance, later in the *Prelectiones* Harvey advises that, for descriptions of the viscera (the spleen, the veins and arteries supplying it, and other parts of the lower body) one should, "Observe from Bauhin's *Historia* and from [an] anatomy" ("Historiam ex Bauhino, vide et anatomiam…"; I read the 'ex' to govern both *historiam* and *anatomiam*, and thus the 'et' is meant to connect these two things Harvey's command to 'vide.'). This again shows that anatomy is not branch of book-learning, for if it was, Harvey would not here have to refer to Bauhin's text. Rather, anatomy is understood as something one *does* in order to observe the parts, from which one can learn, in this case, what the viscera are like.

anatomical method. Is he stressing the aspect of anatomy as body of pre-discovered truths, whereby an instructor simply demonstrates these truths during an anatomy lesson? Or is he rather emphasizing an active sense of anatomy, where it is the capacity by which truths about the body can come to be discovered? In order to answer this question, and to show Harvey's conceptual innovation in refiguring the traditional conception of the meaning of *anatomia,* I must trace the conceptions of anatomy from Harvey's Ancient sources through those of his teachers and contemporaries.

5.1.2. The Double Aspect Definition of Anatomy

One must first distinguish definitions of anatomy from definitions of medicine, though they are related; both are hard to classify. By medicine, I understand something like the theories and procedures used to heal the patient, such as the theory of the humors or the procedure of phlebotomy. Anatomy, on the other hand, has to do with, as the word itself implies, cutting something into parts. From Ancient to Early Modern philosophy, the problem with these enterprises, as Nancy Siraisi has noted, is whether one understands medicine (or anatomy) as an *art* or as a *science*:

> *Scientia* for physicians trained in Aristotelian logic and epistemology implied certain knowledge, based on accepted principles, arrived at by syllogistic demonstrations, and enunciating universally valid truths. *Ars* involved the orderly and rational transmission of knowledge, but did not necessarily yield certitude about general truths. Evidently, the multifarious and unsystematic particulars of practical or operative medicine were difficult to fit into the definition of *scientia,* and even in some respect into that of *ars*. On the other hand, the theoretical part of the university medical curriculum, in which disputation about physiology was a principal component, which made use of Aristotelian scholastic methodology, and which overlapped on subject matter with Aristotelian natural philosophy, appeared to have a better claim to *scientia* in the Aristotelian sense. As a result, scholastic writers often ended up by asserting that medicine was somehow both *scientia* and *ars,* but that theoretical medicine (and hence physiology) partook of the nature of *scientia* more fully than did the rest of medicine.[10]

[10] Siraisi, Nancy 1990, "Medicine, physiology and anatomy in early sixteenth-century critiques of the arts and sciences," In: *New Perspectives on Renaissance Thought,* Eds. John Henry and Sarah Hutton, London: Duckworth, 219.

Medicine, then, was a problematic case, partaking in elements of both art and science, but fitting fully into neither. The main question concerns the status of its knowledge. Anatomy shared some of these difficulties, since, on the one hand it most certainly deals with particulars, but, on the other, ends in just the sort of physiological knowledge that might claim to be *scientia*. Further, these difficulties might be missed given Whitteridge's presumption that anatomy is *just* a *body of physiological knowledge* rather than the ability that grants such knowledge through the observation of particulars. Teleology is, as always, the name of the game: as with actions and uses themselves, it is not just ends that matter, but the means by which those ends are accomplished. And it is here that one finds Harvey's innovation, for he argues that the processes of cutting and observing end in scientific knowledge about the body.

But this innovation can only be understood against the background of a tradition that *denied* this epistemological link between cutting and causes. That is, in order to deal with its ambiguous status, some of Harvey's forbearers and contemporaries advocated what I shall call a *double aspect* conception of anatomy. As with medicine, one must distinguish between the *experiential* or *artistic* aspect of an anatomy, and the *rational* or *scientific* aspect.[11] The former, the skill of hand and eye by which one performs an anatomy, concerns knowledge of particulars, learned through experience; the latter, the traditional teachings of anatomists known through reason, a body of universal truths taught through books, the voice of an instructor, and through reasoned argumentation.

This issue is complicated because many anatomists emphasized that, as Cynthia Klestinec has noted, "In the realm of anatomical inquiry, experience joined reason to constitute (according to Galen,

[11] Although reason and science are not identical, nor are experience and art, one is often used to refer to and represent the other in the texts under consideration. So, for instance, experience and art were linked by Berengario da Carpi through the idea that, like a craftsman following his experience, the anatomist too was lead by what he had learned empirically: as Roger French argues, the *artifex sensibilis* becomes the *anatomia sensibilis.* J. Berengario da Carpi 1521, *Carpi Commentaria cum amplissimus Additionibus super Anatomia Mundini una cum textu eiusdem in pristinum et verum nitorem redacto,* Bologna, 346v. See also Roger French's 1999, *Dissection and Vivisection in the European Renaissance,* Aldershot: Ashgate, 99-100.

Mondino, Berengario da Carpi, Niccolò Massa and many others) the approved anatomical method."[12] While this is true, the exact way in which different anatomists articulated this claim had dramatic effects on their conception of the role that experience and reason ought to play in anatomical inquiry. One must keep in mind, then, that though many medical authors thought reason and experience must be combined, they did not all agree on the specific way in which they should be combined. For some writers advocating this double aspect conception of anatomy, both reason and experience are important, but only the rational side of medicine amounts to *scientia*—the art of anatomy does not lead to knowledge of causes. Indeed, it has been noted by Nancy Siraisi that Vesalius' preface to his *Fabrica* is an attempt to argue that anatomy achieves scientific knowledge.[13] Siraisi notes that anatomy,

> …was a discipline that rested on a combination of manual techniques and intensive textual study. It had two characteristic end products: the public anatomy before an audience that might include members of civic, courtly, and ecclesiastical elites as well as medical students; and the learned anatomy book, which described the human body in a Latin narrative, informed both by the author's experience of dissection and by complex and constantly evolving traditions of medical and natural philosophical learning and pedagogy, combined with, in some cases, visual representation.[14]

The very teaching of anatomy and medicine reflected this double aspect conception, emphasizing both the manual art learned through experience and cutting, and theoretical knowledge learned through reason and reading. The products of each aspect were even separated, with public dissections the result of the one, learned tomes of physiological knowledge the result of the other. While the experiential aspect of anatomy had been emphasized since Galen, the exact role that experience and reason played was a function of a shifting set of concepts and practices in natural philosophy and medicine, and

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[12] Klestinec, Cynthia 2010, "Practical Experience in Anatomy," In: *The Body as Object and Instrument of Knowledge: Embodied Empiricism in Early Modern Scienc*e, Eds. C.T. Wolfe and O. Gal, *Studies in History and Philosophy of Science* 25, 33.

[13] Siraisi, Nancy 1994, "Vesalius and Human Diversity in *De humani corporis fabrica*," *Journal of the Warburg and Courtald Institutes* 57, 65. I thank Evan Ragland for alerting me to this aspect of Vesalius.

[14] Siraisi 1994, 60. It is interesting to note that, some fourteenth century critics of medicine, such as Gentile da Foligno, argued that in medicine, only anatomy achieved reasonably certain knowledge. See also: Siraisi 1990, 220; Gentile da Foligno 1510, "Dubium 3" *Primus Avicenne Canon cum argutissima Fentilis exposition,* Pavia, f.1v-2r.

which took various forms in various cultural contexts. Thus it has often been noted that anatomies in Renaissance universities were sometimes performed entirely *without* dissections, and consisted entirely in lecturing from texts.[15] Harvey, then, must be seen against the background of these shifts in the meanings of anatomy and the place of experience within it. Indeed, Harvey himself must be seen as an agent in part responsible for this shift towards an emphasis on the experiential aspect, especially in the English context.[16]

I start with what I believe to be one of the textual origins of the split between these two aspects of anatomy, found the work of Galen. I start the *De anatomicis administrationibus.* This text was not known until the 1530s in the West, but afterwards it quickly became an important part of the medical curriculum. In it Galen repeatedly stresses the damage done to medical care due to the neglect of anatomy by physicians. In the first book on the bones, he argues that, "Indeed, it is beneficial to make this work, this study, your own, so that there is not only reading from a book, but, in truth, assiduous inspection, and, trusting in your own eyes, you must learn thoroughly and accurately the kinds of human bones."[17] Galen emphasizes *both* reasoned book learning and experienced observing as the means by which to learn about the bones (and, one might add, any other part of the body). Galen here contrasts these two modes of learning, and stresses them as both being important. Now, this is clearly not the full-blown distinction I discuss below, which Galen does not subscribe to—indeed, Harvey's conception of anatomy might be seen, in some ways, as a return to Galen. With his combination of criticism of Galen's doctrines, but use of his methods, Harvey can thus be seen as continuing in the

[15] See, for example, the discussion in Siraisi 1994. See also: Cunningham, Andrew (1975), "The Kinds of Anatomy," *Medical History* 19. I discuss this again below.
[16] Harvey, it has been said, was one of the first to practice anatomy in England, and his influence especially on the Oxford Physiologists helped cement the place of experience in early modern English philosophy. Frank, Robert 1980, *Harvey and the Oxford* Physiologists, Los Angeles: University of California Press.
[17] Galen 1549, *Anatomicis Administrationibus*, *Io. Andernaco interpretate,* Lib.I, Cap.II, *Opera Omnia*, Vol.1, 228. "Hoc autem sit opus tuum, hoc studium, ut non librorum modo lectura, verum sedula etiam inspectione, fideque oculata, cuiusque ossis humani speciem accurate perdiscas."

Humanist process of reappraisal and reinterpretation of Ancient doctrines, closer, perhaps, to Vesalius and the Renaissance than to Descartes and the Scientific Revolution.[18]

In another tract extremely important to the early modern medical curriculum, *De usu partium,* Galen again reiterates the importance of both aspects of anatomical practice. So, for instance, Galen takes Asclepiades to task over his account of the causes of the lungs and the arteries: "His mistakes, which truly would not even beguile a child, still less a man so boastful and arrogant, are of two kinds. The one flows from yawning contempt for anatomies [dissections]; the other from ignorance of logical speculation." [19] The former refers to Asclepiades' mistaken understanding of the location and structure of the veins, which would have been revealed by dissection. The second, most interesting given the subject of this dissertation, is that,

> There is Mind, and, in fact, Reason, designing, managing, and adorning all these things, not [just] the force of corpuscles combining among themselves by some chance. For, in things that have lungs the arteries of the lung are venous, the veins arterial, because it is better that these things are so. The heart has two ventricles in those having a lung, and only one in those without, and this too because it is better …of which cause and why these things are made so, because of his ignorance, that most clever man Asclepiades has said nothing….[20]

Asclepiades has failed both because of his neglect of anatomy, which would tell him the nature of the parts in question, and his neglect of the reasons why this structure is as it is, which for Galen means that Asclepiades has neglected the logic of teleology and hypothetical necessity so evident in living

[18] Although I am not interested here in evaluating the validity of these categories, or in categorizing Harvey himself, it seems clear that much work on Harvey (and others, of course) has been done by assuming that Harvey fits neatly into one of these categories. So Pagel's Harvey is amalgamated to Renaissance philosophical currents (circles, apparently), whereas Elizabeth Gasking (and other's writing large, somewhat historiographically insensitive histories of 'embryology') understands Harvey as clearly modern and scientific. Gasking, E.B. 1968, *Investigations into Generation,* London: Hutchinson. Pagel's characterization, on the whole, is to be preferred, though I find his idea of the doctrine of circles completely un-Aristotelian.

[19] Galen 1549, *De usu partium,* Lib.VI, Cap.13, *Opera Omnia*, Vol.1, 572. "Quae vero ne puerum quidem fallere possint, nedum virum iactabundum adeo atque insolentem, ea genere quidem sunt duplicia. Alia enim ex contemptu anatomes, atque oscitantia: alia ex logicae speculationis ignoratione promanarunt."

[20] Galen 1549, *De usu partium,* Lib.VI, Cap.13, 572. "Mens enim est ac ratio quae omnia haec designat, disponit, ac ornat, non corpusculorum vis, concursu quodam fortuito inter se cohaerescentium. Nam pulmonis quidem arteriae, sunt venosae: venae vero, arterisae, quod esse huiusmodi eas praestiterat. Cordis vero ventriculi duo quidem sunt, quibus est pulmo: unus autem, cui non est: etenim hoc quoque melius fuit…quorum cum sapientissimus vir Asclepiades causam, cur facta fuissent, prae inscitia nullam dixisset…"

bodies. Both aspects are needed in order to, as Galen later notes, 'avoid unsound bases' for one's teachings.

There is a further aspect of *De anatomicis* that must be noted, his reasons for why anatomy is important to the physicians. Galen provides four justifications for why the physicians should take up anatomy: for treating wounds; to assure the physician's surgical competence; for the completeness of the physician's knowledge;[21] and to confirm one's philosophy of nature.[22] [23] Though two aspects of anatomy are distinguished in Galen, reason and experience, he argues that *both* are needed to produce causal knowledge, a need which seems to have been lost, or at least paid only perfunctory attention to, in the time between Galen and the Renaissance. The reasons for this shift are extremely complicated, and, since I cannot hope to explain it here, I must be contented with the identification of certain important trends. [24]

One of the most important of these trends is found in the separation of surgeons from learned physicians. As Andrew Cunningham has noted, by the Renaissance, the first two reasons for practicing anatomy on Galen's list above had become the exclusive province of the barber-surgeons.[25] These aspects, those that Galen argues are the *most useful* for the physician, the most *practical,* are also the most, as it were, artistic and experiential, and are those that deal directly with the actual dissecting of the body. As a result of this separation, the works of learned physicians emphasized the rational-scientific aspects over the experiential aspects of anatomy. This distinction eventually became institutionalized in such a way that these two activities came to be performed by different people, furthering the separation between these two aspects of anatomy in a quite literal way: surgeons were

[21] E.g., the humoral theory.
[22] This is Galen's project in *De usu partium.*
[23] Galen 1549, *De anatomicis administrationibus,* Lib.II, Cap.II, 249.
[24] There are many reasons, including limited access to Galen's works, incomplete and inaccurate translations, differing cultural and intellectual contexts, and so on.
[25] Cunningham, Andrew 1975, "The Kinds of Anatomy," *Medical History* 19, 2-3

economically, socially, and intellectually inferior to physicians, and, indeed, subservient to them.[26] The rapprochement between these dual aspects of anatomy does not truly come until the Renaissance, especially after Vesalius (though one should not give him too much credit, of course).

Returning to the history of anatomy, it is well known for various cultural, social, and economic reasons that human dissection was not really allowed in Galen's time, and indeed, from that time on and for very many centuries afterwards.[27] Indeed, the practice of dissection itself fell somewhat into disrepute. Thus, even before and during Galen's time, the emphasis of anatomical teaching was placed firmly on the rational aspects of dissection, taught from books. Margaret May notes that,

> Rufus of Ephesus, who flourished in the reign of Trajan,[28] did indeed dissect animals (not man), but from the whole tone of his little treatise in which he names and briefly describes many parts of the body, it is evident that his dissections were made in order to verify anatomical facts already a part of the tradition and demonstrate them to students, not in order to add further facts to that tradition. In this he is very like those first Renaissance dissectors whose work was done mainly for the sake of instruction and the verification of Galen and Avicenna.[29]

Though Ephesus came before Galen, it is methods like his that become standard after Galen's death at the end of the second century CE. It is thus another example of the ironic twists of history that many anatomists after Galen adopted and taught his doctrines in a deeply un-Galenic way. And so this division between the experiential-artistic aspect and the rational-scientific aspect became fundamental to anatomical practice and teaching right up through the Renaissance. The emphasis was almost always on the latter aspect: it was thought the most noble and worthy of admiration. Thus, while observation remained important throughout the history of anatomical practice, for much of this history, the stress was clearly on how observation helped one understand the *written* teachings of the anatomists. The

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[26] Of course, the history here is much more complicated, and I paper over a great deal of interesting and important details as they are not directly relevant to my story here. It should be further noted that the intellectual inferiority of surgeons was more a function of arrogance on the part of physicians and limits on the educational opportunities of surgeons than a matter of any of true inferiority.

[27] The best account of the practice(s) of dissection in Ancient world is found in Heinrich von Staden's work. See, for instance, his 1989 *Herophilus*.

[28] Trajan ruled from 98 to 117 CE.

[29] May, Margaret T. 1968, *Galen on the Usefulness of the Parts*, Ithaca: Cornell University Press, 29.

central focus of anatomical practice for physicians was the learned theories of the Ancients. Observation was less an instrument of epistemology and more one of pedagogy.

When actual dissections were performed, it was less to understand the nature of the parts in question, than to clear up the meaning of some text of Galen or other authorities. In fact, in the mid seventh century, a medical teacher called John of Alexandria devised a way of teaching about the parts of the body *directly modeled on methods for understanding texts*! John defined anatomy as 'a skillful incision and clarification of the things hidden in the body,' and his anatomical teaching was called the *accessus.* Roger French notes that,

> There was…a routine to be observed in John's account of dissection and vivisection, for he lists six things that have to be looked for in relation to every part: number, substance, shape, size, position and connections. This is a formal *accessus,* a classroom teaching device that was normally used in introducing a new text to a group of students. In such an…*accessus ad auctores*, the teacher normally asked a rote of questions about the title of the work, its organization, its attribution, the intention of the author and the part of philosophy to which it belonged.[30]

Thus, early in the history of anatomy in the West, the experiential, artistic aspect of anatomy was amalgamated into a formal, *literary* mode for teaching and understanding philosophical texts, a poignant reminder of the secondary status of this aspect. This tradition seems to have fallen into disuse after John, but it reemerges in the thirteenth century with Taddeo Alderotti and especially his pupil Mondino, who took the *accessus* directly from John of Alexandria.[31]

Given that these two authors, and especially Mondino, set the agenda for the teaching of anatomy from the thirteenth century onwards, it is important to look also at a distinction found in the work of Averroes. Historians of philosophy have long noted the importance of Averroes' work had upon thirteenth and fourteenth century philosophers, most notably Aquinas, and in medicine, too,

[30] French 1999, 20.
[31] French, Roger 1979, "A note on the anatomical *accessus* of the Middle ages," *Medical History* 23, 463.

Averroes' works were accorded great respect, including upon Mondino.[32] In his work the *Colliget* (*al-Kulliyit*), one finds a similar division between experience and reason in the practice of medicine. Here anatomy, along with pharmacology, is understood as a practical art opposed to theory: the former proceed by the *via experimentalis,* the latter by the *via ratiocinativa*, the latter providing the causes of the former. But, importantly, one finds that for Averroes, "…the universal principles of this art, coupled with prolonged experience . . . will enable [the physician] to acquire a series of empirical premises which are essential to the art of healing."[33] Importantly, Averroes is here providing definitions of *medicine,* whereas anatomy is rather a proper part of the *via experimentalis.*[34] It is this pattern, with experience providing 'the what' and reason 'the why,' that will be adopted as the most basic framework for understanding the role and place of anatomy. Roger French argues that this distinction became institutionalized in Bologna in the 1320s and is reflected in the practice of Mondino.[35] Though the two paths are related, they are kept strictly separate: while Mondino could wear both hats, that is, he could both practice actual dissection and lecture on theory, the relation between dissection and theory was not experimental. Here I mean the root sense of the verb *experior* in that dissections were not meant to test or corroborate theories. Rather, anatomy performed the subordinate role of illustrating the teachings contained in textbooks. And while experience in dissection would give one practical, productive knowledge of how to heal, cut, or recognize illness, there is little or no evidence that dissection was thought to lead to causal, scientific knowledge.

[32] See, for instance: Cassirer, E. and P. O. Kristeller, *et al.* 1948, *The Renaissance Philosophy of Man,* Chicago: Chicago University Press; Burrell, David 1993, "Aquinas and Islamic and Jewish Thinkers," In: *Cambridge Companion to Aquinas,* Eds Norman. Kretzmann, and Eleanor Stump, Cambridge: Cambridge University Press.
[33] Averroes 1989, *Al-Kulliyitfi'l-Tibb*, Ed. S. Shayban and A. al-Talibi, Cairo, 21; quoted in, Fakhry, Majid 2001, *Averroes,* Oxford: One World, 125.
[34] French 1999, 57.
[35] French 1999, 57.

Mondino's *Anathomia* (1478)[36] becomes, of course, central to anatomical teaching in the late fourteenth century and remains so well into the sixteenth, especially in Italy, and with it one finds a renewed emphasis on actual dissection (of animals). It is perhaps only a small exaggeration to say that anatomists came to know the *text* through their dissections, and not, in fact, the reality of the body. Thus in Mondino there is the same pattern pioneered by John, whereby the actual experience of performing a dissection is subalternated to the philosophical practice of providing the causal understanding of what was being displayed by it.[37] Importantly, Mondino's conception of the body and anatomy was explicitly based upon Galen's, and was thus an investigation into soul and its relation to the body. Thus, reiterating Galen's criticism of Asclepiades, what was important to observe in the body was not mere structure, but, more importantly, the providential and teleological way in which that structure was *functionally organized for the benefit of the animal*. The anatomist would "see", then, the, "...nerves that carried senses to the brain and motion from the brain to the muscles. He would see the veins that carried nutriment from the liver to the rest of the body…Overall he would see a structural morphology laid out with advantage to function."[38] This demonstrates another way in which the experiential aspect of anatomy was subalternated to the rational, in that what anatomists experienced was what they had read about, and that which reinforced their religious and metaphysical assumptions: the deeply teleological and providentially designed structure of animal bodies, as Galen had described. It was not a matter of *proving* Galen correct, but rather of illustrating the truth of Galen in the most vivid way possible.

The strict division between experience and reason in the writings and practice of anatomy began to change during the late fifteenth and early sixteenth centuries, in the wake of new humanist translations of Galen and Aristotle, as well as the active effort on the part of the humanists to begin to

[36] The first printed edition, from Padua, was printed on this data, though the text was composed around 1316, and is thought to reflect Mondino's teaching.
[37] French 1999, 35.
[38] French 1999, 39.

reclaim the projects and knowledge of the ancients.[39] This is nowhere more true than in certain universities in Italy, especially at Harvey's training ground of Padua, and at its rival Bologna. Gabriele de Zerbi writing in the late fifteenth century, for instance, emphasized the immediacy of the knowledge that anatomy generates by the senses. French has noted that, "Zerbi is well prepared, at least at the theoretical level, to express the dominance of perception over reason in anatomy. Desire for knowledge with the intellect turned to the senses is the method of anatomy…"[40] Yet, as French notes, while Zerbi did practice 'practical' anatomy, this should be taken in the sense of him reading from a text while another performed the actual cutting.[41] So while at least in theory, or in rhetoric, the humanist era witnessed the increasing importance of the experiential aspect of anatomy and its integration with the rational, by the time of Vesalius one finds this distinction, and the institutional and epistemological separation between them, to be pervasive. For instance, consider the notes of Balderas Heseler (1508-1567) on the lectures of Matthias Curtis:

> Even if Galen wrote many books which he calls 'anatomy'…in which he tells nothing about the division of the parts, I reply that dissection can be performed in two different ways: in one way really or actually, in another way through description, e.g. in writing or lecturing. For also this is to dissect the body. Thus in those books by Galen dissection means description by lecturing not dissection actually performed...[42]

Indeed, if one takes Vesalius' criticisms of anatomists at face value (discussed below), dissection by means of lecturing had become the *primary* means of teaching anatomy, and actual demonstration by means of dissection was rarely understood as a means of investigation. And so Andrew Cunningham has argued that when historians look at the sixteenth century, they often grossly overestimate the

[39] And, of course, there are a variety of cultural, social, and economic factors relevant to these changes as well. Again I am here more interested in tracing a set of changing philosophical and medical ideas as to how to conceptualize anatomy than in providing a causal interpretation of why these changes happened when they did.
[40] French 1999, 88. Zerbi, Gabriele de 1502, *Liber Anathomie Corporis Humani et singulorum membrorum illius,* Venice, f.2ra.
[41] French 1999, 89.
[42] Eriksson, Ruben (ed.) 1959, *Andreas Vesalius' first public anatomy at Bologna 1540. An eyewitness report by Baldasar Heseler, together with his notes on Matthaeus Curtius' Lectures on Anatomia Mundini*, Lychnos-Bibliotek for the Swedish History of Science Society: Uppsala, 55.

importance of (true) anatomies in the curricula of medical schools.[43] Thus anatomy up to Vesalius (and, by and large, for some time afterwards) is primarily a textual practice, dissections performed in service to them: true knowledge is found not through experience but rather through authoritative texts.

What changed with the advent of humanism were attitudes, as anatomists began to write that new things *could* be discovered, and that there were improvements and corrections that could be made to the learning of the Ancients. This is especially true, of course, of Andreas Vesalius. With the publication in 1543 of his *De humani corporis fabrica,* one finds a powerful exhortation to begin performing actual anatomies (especially on humans and not just animals). Vesalius views having firsthand experience of such events as allowing him to *correct* and *improve* upon Galen; eventually, this idea becomes a core part of the education of physicians.[44] Vesalius' criticisms of the more recent anatomists, and of Galen, read, in fact, much like those made more than a thousand years before by Galen himself. Just as Galen did, Vesalius takes physicians to task for ignoring anatomy which, as he argues that it should be, "…a chief part of natural philosophy…as it embraces the *historia*[45] of man, and it ought to be the most secure foundation of the whole art of medicine and by law the introduction to its organization…"[46] By arguing that the regular experience of performing anatomies is part of *natural philosophy,* Vesalius had begun a process that would break down the long held distinction between the artistic and rational sides of anatomy.

Vesalius was attempting not only to revive the practice of human dissection, but, further, he wanted to establish it as the most fundamental aspect of medical training, conceived of as a fundamental part of natural philosophical training, and as a means of testing and discovering. The

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[43] Cunningham 1975, 2; 5.
[44] Cunningham 1975, 4. And, of course, this transition took quite some time to take effect
[45] This is a difficult concept to render into English, and thus I leave it untranslated in order to flag it. It means, in the anatomical context at least, something like 'a non-causal, observationally based, and carefully organized account of the parts of the body.' I discuss *historia* in more detail in the following chapter.
[46] Vesalius, Andreas 1543, "Praefatio," *De humani corporis fabrica,* Basel, a3. "…praecipuae naturalis philosophiae parti… quum hominis historiam complectatur, firmissimque totius medicae artis fundamentum, ac constitutionis initium iure habenda sit…."

scientific aspect of anatomy, knowledge of the causes of the parts, was something that could be revealed by performing actual dissections. Thus, when noting that the physicians declared the bones, muscles, nerves, veins, arteries, and other parts were beyond their purview, to be left to the surgeons, Vesalius directly attacks the division of labor between the artisans (the surgeons) and the scientists (the physicians and philosophers). Their labors must be combined, and he writes,

> ….when the entire practice of cutting was entrusted to the barbers, not only did the physician's knowledge of the viscera fade away, but the practice of dissecting also perished completely, and this, of course, because they [the physicians] would not attempt it, while those to whom this skill of the hands was entrusted were too unlearned to understand the writings of the Professors of Dissection.[47] It is quite inappropriate that such men should preserve for us that most difficult art, which they themselves had been given. And that deplorable dismemberment of the parts of healing ought not be introduced into our Schools, that detestable ritual whereby the one performs the cutting up of the human body, and the other describes the *historia* of the parts. These latter, on high in their chairs, croak with egregious pride like jackdaws, about things which they have never done but which they commit to memory from the books of others, or which they expound to us from written descriptions. And the former are so unskilled in languages that they cannot explain to the spectators what they have dissected, but hack things up for display following the instructions of a physician who has never set his hand to the dissection of a body, but has the arrogance to play the sailor from a manual.[48]

This division, between experience of cutting on the one hand and knowledge of the parts from books on the other, was untenable according to Vesalius. Those with book learning, though they (at best) understand the functions of the parts and their descriptions from books, have no acquaintance with the things themselves. So not only are these jackdaws so inexperienced as to not know a vein from an artery, but they can never learn how much in error their book learning truly is, not without the help of careful cutting and observing. But, on the other hand, the unlettered surgeons have no *true* knowledge of the body, its parts, and their functions. Their own limited experience allows them to cut the body

[47] This is a common phrase Vesalius uses to refer to the Ancient writers on anatomy.

[48] Vesalius 1543, a3. "…quum universa administratio tonsoribus committebatur, non solum vera viscerum cognitio medicis perijt, verum etiam dissecadi industria prorsus intercidit: eo quod scilicet hi reflectionem non aggrederentur: illi vero, quibus manus artificium delegabatur, indoctiores essent, quam ut dissectionis professorum scripta intelligerent: tantum abest, ut difficillimam artem, manu ipsis traditam, id homnium genus nobis asseruaret utque haec deploranda curativae partis dispersio, detestabilem ritum in Gymnasijs non inveheret, quo alij humani corporis sectionem administrare, alij partium historiam enarrare consueverunt his quidem graculorum modo, quae nunquam aggressi sunt, sed tantum ex aliorum libris memoriae commendant, descripta ve ob oculos ponunt, alte in cathedra egregio fastu occinentibus: illis autem adeo linguarum imperitis, ut dissecta spectatoribus explicare nequeant, atque ex physici praescripto ostenda lacerunt, qui manu sectioni nunquam adhibita, tantum ex commentario nautam non sine supercilio agit."

up, but with no grace and with no true understanding of its proper organization: they are but butchers who hack away at the body with no respect to its natural divisions, and without being able to explain anything of what they are doing or what students should be seeing and understanding. Anatomy can only become natural philosophy through what we might call a Vesalian unification, wherein the cutters and the readers, the artists and the scientists, are understood not as separate parts of anatomical practice, but as fundamentally and necessarily linked together in the pursuit of anatomical *scientia*.[49]

Though in the wake of Vesalius' *Fabrica* one thus sees a newfound emphasis on the importance of experience and the necessity of performing actual dissections as a means of achieving scientific knowledge, one does not, for quite some time, see the double aspect conception of anatomy disappearing among learned medical writers, with the notable exception of some of those most relevant to Harvey's training, and ultimately with Harvey himself. Consider first this definition in the prominent French anatomist Laurentius' (1600) *Historica anatomica,* a work that Harvey knew quite well, and which was one of the standard, authoritative works of Galenic anatomy at the start of the seventeenth century:

> Moreover, among the Physicians there is a twofold meaning to anatomies. For it either indicates an action, which is brought about by the hand, or a habit of the mind and the most perfect action of the understanding.
>
> The former is said to be practical, the latter is said to be theoretical*;* the former is established by experience, the latter by reason; we pursue the former by cutting and visual inspection alone, the latter we pursue by the living voice of the teachers and from their written texts; we can say that the former is historical, the latter is epistemic, that is, scientific; the former is entirely necessary to make use of the art, the latter is greatly useful, and is often above the use of art; the former examines the structure of the parts, the latter seeks the uses, actions, and causes of structure.[50]

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[49] I do not, by labeling this 'Vesalian', mean to indicate that Vesalius achieved this alone, or even that he was the first to suggest such an understanding of anatomy (since, for example, Galen's conception is at least in the neighborhood). Rather I term it so only because Vesalius has come to be represent some sort of watershed in the history of anatomy, as an important point of change.

[50] Laurentius 1600, Lib. I, Cap. XV, 21-22. Translation by Peter Distelzweig and myself.
"Est autem Anatomes apud Medicos acceptio duplex. Nam aut actionem denotat, quae manu perficitur, aut habitum animi, & actionem intellectus perfectissimam.
"Illa πραχτιχὴ haec θεωρητιχὴ dicitur, illa experietia, hec ratione coparatur; illa inspectione sola & sectione, hac viva

Laurentius' work was enormously influential. In fact, there was an English 'epitomized' version of Laurentius' work, combined with that of the Paduan trained Bauhinus, by Helkiah Crooke some fifteen years after Laurentius' *Historica*. This combined two of the most widely read medical works, both of which Harvey was thoroughly acquainted, and which he consulted for his *Prelectiones*.[51] This 'Englished' version of Laurentius' is nearly identical to the original[52]:

> Now there is amongst Physicians a double acceptation of anatomy; either it signifyeth the action which is done with the Hand, or the habit of the Mind, that is, the most perfect action of the Intellect. The first is called Practical Anatomy, the later Theoretical or Contemplative: The first is gained by experience, the second by the living voice of a Teacher, or by their learned writings: the first we call Historical Anatomy, the second Scientifical: The first is altogether necessary for the practice of Anatomy, the second is only profitable; but yet this profit is oftentimes more beneficial then the use itself of Anatomy: The first looketh into the structure of the parts, the second into the causes of the structure, and the actions and uses therefrom proceeding. According to the first signification we may define Anatomy thus: *an Artificial Section of the outward and inward parts*…If anatomy be taken in the latter signification, it is defined *A Science or Art, which searcheth out the Nature of every part, and the causes of the same Nature.* I call it a *Science*, because it hath universal or general Theorems or Maxims, and common Notions, out of which, being the *first, true, immediate* and *best known*, all demonstrations are framed…[53]

For Laurentius and Crooke, the manual art of a dissection concerns only the structure of the body learned by cutting and seeing, what anatomists termed *historia*. This was sharply distinguished from the *scientific* side of anatomy, that is, the inquiry into the causes of that structure, its uses and actions. This aspect was understood to be founded upon universal principles, of which the teleological maxim that 'nature does nothing in vain' is among the most important.[54] Thus the historical side, and the use of dissection and observation, did not count as productive of knowledge, but rather served as the

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doctoru voce, & eorunde scriptis, assequimur; illa historica, hac ἐπιστημονικὴν, id est, scientifica, dicere possumus; illa ad usum artis omnino est necessaria, hec utilis tantum est, & saepe supra usum artis; illa partium structura, haec structurae causas, actiones & usus inquirit."

[51] The fact that Harvey knew these works well, and based much of his lectures on them is especially interesting in light of the fact that Harvey's own definition of anatomy is so different, as I discuss below.

[52] This Englishing led to him being investigated by the Royal College of Physicians, as providing this information in the vulgar tongue—and thus allowing anyone to know it—was proscribed by the College. See: Keynes 1966, 72-76.

[53] Crooke, Helkiah 1615, *MIKROCOSMOGRAPHIA: A description of the body of man. Together with the controversies thereto belonging. Collected and translated out of all the best authors of anatomy, especially out of Gaspar Bauhinus and Andreas Laurentius. The second edition corrected and enlarged.* London: 26-27.

[54] I shall return to this in the following chapter.

explanandum that the anatomist should attempt to causally explain through reason and the teachings of the Ancients. This double aspect theory of anatomy was, though traditional, a considered opinion, supported by almost all the philosophical and medical authorities, a standard trope in early-modern medical writings. The appearance of Laurentius' definition in Crooke only serves to underscore that this double aspect conception of anatomy was widespread, reaching even those who could read only in the vulgar tongue.

Now consider this definition from nearly twenty years after Harvey's *De motu,* from Francis Glisson's *Anatomia hepatis* (1645), and which is still recognizably a double aspect conception of anatomy:

> *Anatome* and *Anatomia*: the words signify as much as a *dissection*. But being taken for an *art* and applied to a certain object, the signify an *artificial dissection* of that object in such a manner as may most conduce to the perfect knowledge of the same and all its parts…Now this artificial dissection implies not the *manual* dissection only, but in especial manner the *mental*. For though the manual dissection be first in regards it leads us to the mental, yet the mental is that which mainly denominates the artist an *Anatomist*…[55]

Note, however, an important change: Glisson *connects* the manual to the mental. That is, Glisson writes that the experiential, practical aspect of anatomizing is what *leads one* to the mental, scientific aspect. Thus, though he has not entirely broken with the traditional signification of the word, there does seem to be an important shift in the meaning of anatomy by the mid-seventeenth century, in that the two aspects of anatomy are now *related*. Vesalius' argument that anatomy based upon observation was natural philosophy was becoming the new commonplace.

The root of this change comes, in part at least, from the discoveries (and rhetoric) of Vesalius and other anatomists, including, of course, those from the Paduan school where Harvey was trained. It is here that one finds the roots of Harvey's own definition of anatomy. In particular, I believe both

[55] Glisson, Francis 1645, *Anatomia Hepatis*. Amsterdam; quoted in Cunningham 2003, 55. Cunningham argues that this conception of anatomy remains standard until the 18th century, though my own sense is that the story is somewhat more complicated than French lets on. For my purposes, I am only concerned with how Harvey's conception is different from this and those of his contemporaries.

Harvey's conception of anatomy as a *facultas,* as well as his emphasis on finding causes through that faculty, are to be found in the work of Harvey's two most immediate forbearers at Padua: Fabricius, Harvey's teacher, and Fallopius, Fabricius' teacher. Like many, these authors combined sense and reason in the production of knowledge of the body, but they furthermore stressed especially the importance of sense experience in a way more convincing than Zerbi (if only because they actually produced novel findings).

Let me start with Harvey's *doktorgrossvater* Gabrielle Fallopius, from his (1584) *Expositio de Ossibus*. In a chapter on the meaning of anatomy, Fallopius first provides some bad definitions proposed by other authors, before moving on to his suggested one. So, according to one definition, approved of by more recent writers, anatomy is merely the 'inspection of the hidden parts,' but Fallopius notes that this is an inept definition, as it misses necessary aspects of the art.[56] Fallopius' own definition is that

> Anatomy is the art, indeed a habit of the mind, where by means of the most noble *theory*, that is, by contemplation, we can divide all the parts, internal and external, even the smallest…and I add to the definition one last little part, in order that the parts are well and rightly known, they must be learned by sensation since in anatomy nothing comes to be secured except by what is clear by means of sensation.[57]

Notice that, in a quite traditional way, Fallopius first emphasizes the rational, scientific aspect of anatomy. It is by this mental habit that one can divide the body down to its smallest parts and understand them, *anatomia sine sanguine*. But importantly, at the very end of this definition, he adds that one *must have learned about the parts from sensation*—without this aspect of anatomical practice, *nothing* can be truly known. Fallopius does not exactly say that this secure knowledge is knowledge of

[56] Fallopius 1584, *Expositio de Ossibus,* Cap.3, In: *Omnia,quae aduc extant opera…,* 521. "…Anatome est abditarum partium speculatio. Haec definition, etsi sit approbata a recentioribus, tamen est inepeta, quia non continent Omnia quae sunt necessaria ad hanc artem."

[57] Fallopius 1584, *Expositio de Ossibus,* Cap.3, 521. "Anatome est ars, vel habitus animi, quo optima cum θєωρία, id est speculatione, omnes vel minutissimas corporis internas, ac externas particulas dividere possumus… Addidi in definitione ultimam particulam, ut quae sensu sunt cognoscenda recte pateant quia in anatome nihil nisi quod sensu patent, percipiendum venit." There is a good deal more of interest in this definition, including recommendations for how to actually go about cutting a corpse, but I do not have here the space to discuss it.

causes, nor that sensation is the method by which one finds causes: this is not yet a full rapprochement between the twin aspects of anatomy. But Fallopius does represent an important step in the post-Vesalian anatomical landscape.

Turning to Harvey's teacher Fabricius ab Aquapendente, one sees, much more explicitly, the connection between this skill and finding causes. Now, note that Fabricius does not, so far as I can tell, discuss anatomy in any systematic way, and thus there are no specific definitions of *anatomia* to compare.[58] But one can understand something of his conception of the process by how he uses *dissection* [*dissectio*], the literal translation into Latin of the Greek *anatome*. Fabricius, in his treatise *De oculo, visus organo,* writes

> This disputation of ours will be tripartite. For first we will make clear the fabric and structure of the entire eye. Then we will examine the action of the eye, that is vision itself. Finally, we will contemplate the usefulness of both the whole eye and the individual parts of this same eye. And all of these things we will hunt through dissection. For dissection (if one judges correctly) has this use, to make visible those things that belong to the eyes, that is structure and historia; to lead to knowledge of the action and faculty; and finally to uncover and reveal the usefulness of the eye.[59]

It is here that one finds the roots of Harvey's own conception of anatomy, one that does not distinguish between these two aspects, but rather one that views the artistic and scientific as unified. Fabricius understands anatomy as an activity where one's senses lead one to gain knowledge of theoretical, causal aspects of the body: its actions, uses, and utilities, as well as those material causes hypothetically necessitated. It is in this way that the mental, that is, knowledge (*notitia*) is literally deduced (*deducat*) from those things that have been made manifest to the senses (*manifestet*). (Note

[58] For an excellent account of Fabricius and especially his teaching practices, see Klestinec, Cynthia 2011**,** *Theaters of Anatomy*, Baltimore: Johns Hopkins University Press.

[59] Fabricius 1687, "De oculo, visus organo," Cap. I, In: *Opera omnia anatomica et physiologica*, Leipzig: 187, trans. Peter Distelzweig. "Tripartita erit nostra haec disputatio. Primo enim totius ocluli fabricam structuramque patefaciemus. Deinde agemus de oculi actione, hoc est de visione ipsa. Postremo tum oculi in universum, tum singularum ipsius oculi partium utilitates contemplabimur. Haec autem omnia fere per dissectionem venabimur. Dissectio enim (si quis recte aestimet) eum habet usum, ut tum ea, quae oculis insunt, hoc est structuram & hitoriam, manifestet: tum in actionis facultatisque notitiam deducat: tum denique oculi utilitates aperiat atque declaret."

here the word *notitia:* this word for knowledge has the connotation of one's conception of something,[60] and this will become important when I argue that Harvey's idea of anatomical knowledge has to do with ensuring that one forms adequate conceptions, and thus definitions, of the parts of bodies.) In Fabricius, one does not see any deep methodological or epistemological distinction between the scientific and artistic aspect of anatomy, much more so than in his teacher Fallopius.

5.1.3. Defining Anatomy (again)

Unlike Fallopius, Crooke, or Laurentius, Harvey articulates a conception of anatomy in which sensory experience and manual skill are combined to produce scientific knowledge of causes. Because Harvey does not in any way endorse the double aspect conception of anatomy just discussed, in answer to the question posed above in Section 5.1.1, I can conclude that Harvey's anatomy is one where the anatomist learns the nature and causes of the parts directly from his dissections. Anatomy is not merely a means of demonstrating pre-established truths, and Whitteridge's translation and understanding of Harvey's conception is deeply misleading. Anatomy is an active ability of mind and hand through which one can come to knowledge of actions and uses.

The '*facultas*' line discussed above, remember, was an addition. Let me thus turn to the original first lines of Harvey's definition of anatomy, regarded as supplementing or complementing the added line, since Harvey made no effort to cross them out or correct them, as he often does throughout the *Prelectiones.* First I present the Latin:

[60] For instance, Aquinas uses 'conceptio', 'notitia,' 'intentio,' and 'verbum mentis' all interchangeably. See: Meier-Oeser, Stephan 2004, "Mental Language and Mental representation in Late Scholastic Logic," In: *Topics in the Language Sciences, 1300-1700,* Eds. R.L. Friedman and S. Ebbesen, 243. More generally, 'notitia' can mean knowledge in general, and is often translated as 'cognition.' So 'notitia' is often synonymous with 'scientia', and, given that Fabricius is talking here about causal knowledge, indeed, knowledge of the soul, it seems reasonable to think that understanding notitia here as scientia is not too much of a stretch.

> Anatomiae ad quinque capita: historia; usus, actio, utilitates propter quid; observatio eorum quae raro et morbide; problemata ex autoribus resolvere; pertia aut divisionis dexteritas et praeparatio cadaveris conditi.[61]

If one interprets this passage in light of his later addition, given my reading of anatomy as an active ability, Whitteridge's translation ('The study of anatomy falls into five main divisions') cannot be quite correct: anatomy must be read as an active skill which can be performed, not as something passively studied. Further, understanding Harvey to be here talking about the development of the skill of anatomy allows one to appreciate that the last category concerning manual skill and preparation of the corpse is quite important. Because of the nature of the notes, it is unclear whether *anatomiae* is a singular in the dative or genitive case, or whether it is a plural in the nomitive case. Though not the most obvious reading, I think that it should be read as a singular in the genitive case, as a genitive of characteristic, which will hopefully become clear when I present the translation below. A further problem is how to understand the phrase '*utilitates propter quid*.'[62] Whitteridge translates this quite literally as 'usefulness for what,' but this cumbersome phrase doesn't have a clear signification. The best way to render this phrase in English is to keep in mind the philosophical background here, and the distinction between knowledge *propter quid* and knowledge *quia*, the former being true knowledge through causes (most importantly final causes), the latter being knowledge from effects. Given the discussion in the previous chapter, these *utilitates* are best rendered simply as 'utilities', remembering that this term is the closest to Aristotle's final cause, and concerns the necessity and benefit that a part gives to the body.

Thus to translation. Emphasizing the active nature of the *facultas* of anatomy, I would render the sentence in the following way (the parts in brackets being aids to interpretation, but not technically supported by the Latin):

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[61] Harvey 1616 , 4.

[62] Whitteridge often transcribes this as 'utilitates propter quod,' for reasons I cannot fathom given that *propter quid* is a fundamental bit of Scholastic terminology. On the basis of my archival research, it seems reasonably clear that she is mistaken in just about every case in which she does this.

> It is characteristic of [an] anatomy [to have] five principal parts: the *historia*; [determining] the use, action, and utilities; observing things which are rare and unhealthy; resolving problems from other authors; the expertise or manual skill of dissection and preparation of the corpse.

So, in Harvey's definition of anatomy, there are five aspects of the *facultas* or skill of dissection that one must develop. Reading between the lines a bit, anatomical skill seems to involve, necessarily, the use of both reason and experience, since it involves not only the manual experiential skill of cutting but also the mental skills needed to find the uses, actions and utilities of the parts.

After laying out the five aspects of anatomical skill, Harvey writes that there are different sorts of anatomy, which I again cite first in the original Latin:

> Anatomia alia: popularis quae hic libro trium ventrium; curiosa et philosophica: {1. de partibus externis, physiognomie; 2. ossium, sceletoni; 3. musculorum, ligamentorum; 4. de organis sensetivis et vocis; 5. de vasis, venis arteriis nervis; 6. de partibus similaribus; 7. de genitalibus, embrione, modo}; medicina partes. Anatomia philosophica, medicina, maechanica.[63]

This passage, too, presents difficulty to the modern interpreter and translator. The curly braces encompassing the itemed list are of unclear connection to the rest of the items. Whitteridge reads the list of seven items as starting from '*Medica partes*', whereas the Royal College of Physicians edited version seems to place the curly braces as connected to nothing in particular. From my own observation of the manuscript, I read the curly brace as stemming from '*Curiosa et philosophica*', and the content seems more sensible as a modification of this line rather than as of the *medica partes.* Further, the grammar of the list of parts is strange, as the items without a '*de*' are all in the genitive, and it is not at first obvious how one should read the passage. Indeed, Whitteridge ignores the '*de*' as well as the genitive case here. However, if one chooses not to ignore these facts, they can be more easily interpreted when the curly brace extends from '*Curiosa et philosophica*', the idea being that the list items are what one is interested in learning *about* when doing such careful and philosophical anatomy. That is, philosophical anatomies are an investigation *of the bones* and *about the sense*

[63] Harvey 1616, 4. Note that the last sentence ('*anatomia…maechanica*') was a later addition, added on the left hand side of the previous enumeration.

organs and so forth. One might speculate that Harvey thought these items were most in need investigation and thus in need of philosophical anatomies. Indeed, Harvey himself writes treatises on two of the subjects (on the veins and arteries in his *De motu cordis,* and on the embryo in *De generatione*), and Fabricius had previously written, as self-conscious philosophical anatomy, on the sensitive organs and on the voice. So:

> Other anatomies: popular [anatomy] which this book of the three bellies is; careful and philosophical [anatomy]
>
> {1. of the external parts, physiognomy[64]; 2. of the bones, of the skeleton; 3. of the muscles, of the ligaments; 4. of the organs of sense and of the voice; 5. of the vessels, veins, arteries, nerves; 6. of the similar parts; 7. of the genital organs, the embryo, the mode [of generation]};
>
> medical parts [of anatomy].

So what is the difference between these anatomies? It is not entirely clear from the passage, but one can look to the previous chapters for some help. Popular anatomies are those that are done for the benefit of the students, that is, they are done in public for demonstrative purposes. And while Harvey's lecture notes are obviously of this sort, it is also clear that he has been highly influenced by Fabricius' philosophical anatomy. Philosophical anatomy is that which, as Andrew Cunningham has argued, aims at reaching causal knowledge of the parts, especially final causes, following the model of Aristotle's *De partibus animalium* and Galen's *De usu partium*.[65] Harvey's definition of anatomy takes its commitment to determine the uses and actions from this conception of anatomy. Remember that Fabricius' method for anatomy was to focus on specific parts,[66] which, as mentioned above, included a treatise on the organs of the senses and of the voice. This, then, is what Harvey meant by philosophical anatomy: anatomy done on particular parts or organic systems for the purpose of understanding them through their causes, especially their final ones. And, as argued in the previous chapters, this conception of anatomy is clearly understood as an investigation into the soul and body union.

[64] There is a problem here of how to read the '*de*,' in this number and in others. The best solution is to follow Whitteridge here, and render it without taking note of the '*de*.'
[65] Cunningham 1975, 5.
[66] Klestinec 2004, 377-378.

Finally, there are the medical parts of anatomy, which are those relating to the office of the physician, that is, those parts of anatomy relevant to healing and surgery. This was the sort of anatomy that, based on his father's (1618) *Anthropographia,* Jean Riolan the Younger argued was most important, against the philosophical conception of anatomy practiced by Harvey and other Paduans. In his 1649 *Encheiridium,* Riolan adopts the following procedure, where he first narrates the natural constitution, and then the contra-natural constitution:

> …the natural constitution of each part…generally called health, is three-fold: similar, organic and common. Equally the contra-natural constitution of the parts is threefold and is termed a similar, organic or common disease. The natural similar constitution consists in the substance and balance [*temperies*]; the organic constitution, pertaining to the structure of the organ, is defined by number, size, position and conformation (itself divided into shape, passage and cavity, roughness and smoothness). The common constitution unites with the similar and organic parts either as a unity or a connection. First I describe this threefold constitution in the individual parts; then I briefly explain what may be gathered from this knowledge of the healthy constitution toward diagnosis, prognosis and cure of the ill constitution. Anatomy handled in this method will be the beginning, middle and end of the whole of medicine.[67]

This sort of anatomy was thus concerned most with that aspect of anatomical skill that Harvey mentions above, observing the 'rare and unhealthy' things in the body, for this knowledge is most useful to the practicing physician, what would become known later as pathology.

5.2. EXPERIENCE, EXPERIMENT AND *FACULTAS*

The *facultas* of anatomy is no mere rehashing of teachings passed down by the Ancients, though learning from their books is, of course, important to the development of anatomical skill (indeed, one can hardly be educated without reading books). This faculty involves a number of different elements, ranging from preparing the corpse to the skill of cutting to the determination through *historia* the *actio* and *usus* of a part. Harvey rejects the two-aspect conception of anatomy: for him, anatomy is unified in

[67] Riolan, Jean 1649, *Encheiridium anatomicum et pathologicum. In quo ex naturali constitutione partium, recessus a naturali statu demonstratur. Ad usum Theatri Anatomici adornatum*, Leyden, 2. Translation from Cunningham 1975, 9.

that the historical, experiential aspect *leads to* the scientific, rational aspect. In fact, for Harvey, as I shall elaborate in the following chapter, experience and reason are not at all opposite epistemological sources: rather, they work together such that it is *reasoned experience* that grants knowledge of causes, knowledge of the soul and its union with the body.

In this section I shall briefly introduce the notions of experiment and experience upon which Harvey's *facultas* depends. One must be very careful in how to understand Harvey's use of these terms, *experientia* and *experimentum*. Though there are similarities to how they are understood today, they are not identical to modern conceptions. Further, what Charles Schmitt wrote in his classic 1969 article, that scholars still lack a comprehensive analytical treatment of the meaning and function of these terms in the Renaissance and modern periods, is still in many ways true.[68] The difficulty of understanding these terms is a reflection, of course, of the fact that their role in natural philosophy was undergoing a large-scale shift. Here I concentrate on a few relevant details before moving on to directly discuss Harvey's usage in the following chapter.

Etymologically, experience and experiment are closely related. In Latin, *experientia* and *experimentum* both stem from the deponent verb *experior*, which is the Latin version of Greeks' *peira.* The Latin verb similarly means either "I. *a proof*, *test*, *trial*, *experiment*," or, "II. *experience*."[69] The roots of these terms go back to Greeks' usage, philosophically speaking. In particular, and most relevant here, is the way the terms were understood in the Hellenistic period by the Empiric medical sect, as well as by Galen, whose influence on the medical tradition and upon Harvey I have documented. Gianna Pomata summarizes the rise of the Empiric sect by noting that it,

> … was related to an intense debate on the Hippocratic legacy, in the aftermath of the philosophies of Plato and Aristotle. The concept of *empeiria* was at the center of this debate.

[68] Schmitt, Charles B. 1969, "Experience and Experiment: a Comparison of Zabarella's View with Galileo's in *De Motu*" *Studies in the Renaissance* XVI, 80-138. For some modern work on the concept of experience see: Veneziani, Marco 2002, *Experientia, X Colloquio Internazionale del Lessico Intellettuale Europeo, Roma, 4–6 gennaio 2001*, Florence: Olschki.
[69] Lewis, Charlton T. and Charles Short 1879, *A Latin Dictionary. Founded on Andrews' edition of Freund's Latin dictionary, revised, enlarged, and in great part rewritten*, Charlton Clarendon Press: Oxford.

> The root word for experience in ancient Greek was *peira* (trial, attempt, experience), from which derived *empeiria* (expertise, empirical knowledge). Both Plato and Aristotle had recognized *empeiria* as a distinct cognitive category. Plato saw *empeiria* as limited and partial knowledge, unable to explain the nature of things, and contrasted it with *techne* (art) and *episteme* (full knowledge, which can account for causes and natures).[70]

This ancient debate centered on the epistemological value of experience, and upon the best way to conceptualize it and its relation to reason. The Greek philosophers' conception of experience as being, as it were, lower down on the scale of knowledge, is something that lasted well into the early modern period. But this does not mean experience was not accorded a place of respect! For instance, one sees a traditional insistence in the Aristotelian tradition that 'there is nothing in the mind not first in the senses.'[71] By the end of the sixteenth century, "…empirical Aristotelians like Zabarella could use the term *experientia* to mean something like 'intelligent personal experience,' though there is good evidence that much of what appeared in the writings of scholastics and anti-scholastics alike in the period amounted to hypothetical 'thought-experiences,' rather than actual, hands-on tests of natural phenomena."[72] And, as Schmitt argued, experience did have an important role to play in the natural philosophy of Zabarella and other Aristotelians. Peter Dear has argued that Renaissance philosophers conceptualized *experientia* as every-day, ordinary experience, of the sort that anyone could recognize and agree with.[73] And this is true so far as it goes, for instance, in Zabarella's use of his observations while hiking.[74] However, though Dear has argued that it is this sense of experience that is relevant to Harvey and other physicians,[75] this is far from the case in Harvey. Following Galen, his conception of experience is as *technical anatomical experience.* Far from being something shared by all human

[70] Pomata, Giana 2011, "A Word of the Empirics: The Ancient Concept of Observation and its Recovery in Early Modern Medicine," *Annals of Science* 68(1), 6.
[71] Nihil est in intellectu quod non prius fuerit in sensu, as the locals would have it.
[72] Burnett, D. Graham 1999, "The Cosmogonic Experiments of Robert Fludd," *Ambix* 46(3), 122.
[73] Dear, Peter 2006, "The Meanings of Experience," In: *The Cambridge History of Science, vol.3, Early Modern Science,* Eds. Katherine Park and Lorraine Daston, Cambridge: Cambridge University 106-131.
[74] Schmitt 1969, 98-101.
[75] Dear 2006, 112-113.

beings, it is the result *only of long training and specialized skill*—one has to work hard to develop such a *facultas*.[76]

In the following chapter, I turn to explicate Harvey's conception of technical anatomical experience. I there flesh out his notions of *experientia* and *experimenta* and the roles these ideas play in the development of anatomical *facultas.* I aim to demonstrate the following two points: first I argue that Harvey understands experience (*experientia*) as *reasoned anatomical expertise,* and that the product of these *experientia* are *historia* which provide the basis for definitions of the parts. Definitions are statements of the essence of a natural thing, and in the case of living creatures they must describe soul-body union discussed in previous chapters. Knowledge of these definitions is achieved by a combination of reason and experience, a process whereby the anatomist ensures that his definitions of the parts of the body are adequate to sensed reality. Second, I argue that Harvey understands experiments (*experimenta*) as specific instances in which observations can test the truth of such a definition or a claim derived from such a definition. These claims are all related to understanding either *that* such a phenomenon exists or serve to characterize that phenomenon through its material-structural and/or functional nature, that is, they expand upon some aspect of the definition in question.

[76] This further undermines French's contention that Harvey fits into the English epistemological tradition of gentlemanly testimony described by Steven Shapin, and which seems have pervaded scholar's conception of Harvey. Though Harvey does make remarks which would seemingly fit into Shapin's theory, I believe this to be a gross over-reading of these rather few and meager comments. I return to this in the conclusion. See Shapin's 1994, *A Social History of Truth,* Chicago: University of Chicago Press; and his and Schaffer's 1985, *Leviathan and the Air-Pump*, Princeton: Princeton University Press.

6.0. RULES, EXPERIENCE, AND EXPERIMENT

Having demonstrated in the previous chapter that Harvey understands anatomy as an active ability and skill, a *facultas*, in this chapter I look in depth at his actual anatomical methods and their epistemology. I hope here to make explicit something that has remained only partially remarked upon up until this point: the importance of understanding anatomy as *definitional in aspiration.* The goal of the skill of anatomy is to be able to determine the universal definition of parts and processes in animal bodies, as well as definitions of animal kinds. Since the goal of this skill is to achieve a certain sort of knowledge, the faculty of anatomy is at least in part an *epistemic* skill; it is in fact a skill of judgment. And while Harvey has been credited with developing an 'observational' or 'sensory' epistemology, this being his chief achievement,[1] I will demonstrate this to be a grave misunderstanding of his theory of knowledge. I will show that Harvey's epistemology is based upon his readings of Aristotle and Galen, with a second helping of more Aristotle. It is thus wrong to claim that, to the contrary, Harvey shows an almost Newtonian agnosticism towards determining essences in his later work.[2]

I first discuss the notion of *experientia* (**6.1.1**)*,* arguing that it is understood as anatomical expertise. I then discuss Harvey's use of *historia,* which, following in the tradition of both Aristotle and the physicians, he understands to contain the necessary facts about which one can make generalizations and infer causes (**6.1.2**). I then argue that Harvey's method should be understood as a matter of conception and definition (**6.1.3**): one uses observations and experience in order to form clear concepts of the parts of bodies, and from these one can then form definitions of the essences of those things, again following the methods of the Ancients.

[1] Wear, Andrew 1983, "William Harvey and the way of the Anatomists," *History of Science*, XXI, 224, and *passim.*
[2] Now, I note that it is a different question than the one I am addressing to determine whether Harvey was *taken* to have developed a new epistemology. And it does seem that some took him that way, for instance, Hobbes as I discussed in the introduction. I shall return to these issues in the following chapter.

Then I proceed to detail the comparative method Harvey devises in order to achieve these definitions (**6.1.4**), what he calls the 'Rule of Socrates [*regula Socratis*]'. I then connect this method to the process of conception in more detail, focusing especially on Harvey's *Prefatio* to the *De generatione* (**6.1.5**). I finish with three sections on Harvey's epistemology (**6.2**), arguing that he understands the senses and the mind as the sources of certainty, which I call the 'natural criteria' following the model of Galen (**6.2.1**). I then discuss Harvey's use of and understanding of *experimenta,* arguing that they should be understood as tests of the definitions constructed by means of anatomical experience (or claims deduced from those definitions) (**6.2.2**), finishing with a few examples of the procedures Harvey describes as 'experimenta' (**6.2.3**).

6.1. EXPERIENCE AND ANATOMICAL METHOD

Central to understanding Harvey's method and epistemology is to appreciate the meaning of experience. In the following sections, I discuss exactly what Harvey means by the term *experientia*, which turns on understanding it as an empirically acquired faculty of observation and of judgment[3]. Key here are observational findings from empirical investigations, which Harvey categories as 'historia'[4] and which are organized in certain ways so as to facilitate induction.

[3] Observation—*observatio* and other related words in Latin—is a difficult category. It seems clear that what early moderns might include in the category is quite different than what we include. There is interesting work to be done in figuring out exactly what various early moderns mean by this term, but, alas! this must be the subject of another paper.

[4] Historia is a difficult term to translate. History does not seem to capture the early modern sense of the word as the collection of empirical facts. I have thus opted to leave the term untranslated.

6.1.1. Experientia

Though Harvey does use *experientia* to sometimes refer to experience in general, or to a particular experience, much more often Harvey has a different conception of experience in mind, one related to the faculty of anatomy. I explicate this faculty as a skill that one gains through *personal anatomical experience*,[5] skill here being understood as a kind of expertise that allows not just expert cutting, but also allows the anatomist to make judgments about sensible things. Key to understanding Harvey's conception of experience are certain natural philosophical works of both Galen and Aristotle, in which experience is understood as a mnemonic storage of perceptual episodes that allows one to form concepts of natural things adequate to the reality they refer to. I argue that this should be understood as the process of *definition of the parts,*[6] remembering that a definition is the *logos* or *ratio* of something's essence, and is thus a statement of its form, soul. Harvey's method here is directly aimed at the subject matter described in the previous chapters, the teleological union of soul to body.

Experience is not simple perception, though that is of course a core part of it. Rather it something closer to a kind of wisdom, a deep acquaintance with something on the basis of sensation *and* reasoning about those sensations. Galen, in a work of prime importance to Harvey, the *De placitis Hippocratis et Platonis,* argues that there are three sources of facts from experience to be used in argument, and what is especially relevant to his task in that work is *technical anatomical experience*. This sort of acquaintance by means of technical experience must be personal acquaintance—for, while knowing the works of others through their writings and arguments is important, true familiarity can only be based upon what early moderns physicians called *autopsia,* personal experience. Harvey here follows the way of the anatomists,

[5] It is unfortunate that, in English, there is no good word other than 'experience' to use in these contexts.
[6] Or some other natural object; I will refer to definitions of the parts, but this should be taken widely to include other sorts of natural things.

as Andrew Wear has termed it. The method *per autopsia* provides *confirmatio* for Harvey's claims and findings.[7] And this method of experiencing *per autopsia* includes experiments as I shall discuss below, but more generally it should be taken to emphasize many repeated instances of anatomy and observation thereof. Indeed, an experiment can only be performed by one who already has experience—experience teaches the skills of mind and hand needed to perform a test of some claim, and, indeed, experience, and reasoning based upon it, must be the source of whatsoever claim is being tested.

Experience is something that teaches one *how to make* anatomical judgments; it is a source of knowledge *and* skill. Experience is a sort of mass noun, referring not to any particular perceptual event, such as an experiment might, but rather to an array of perceptual experiences. This comes out clearly in the first paragraph of the *Proem* of the *De motu cordis,* where Harvey refers to dissection, observation, and experience (but not to experiments). He writes that,

> It profits one who is reflecting upon the movement, pulse, action, use and usefulness of the heart and arteries, to order those things which have been written by others, to unfold and to take note of the things which have been commonly discussed and taught, so that what has been rightly said might be proved, and what is false might be corrected by anatomical dissection, by manifold experience, and by diligent and accurate observation.[8]

Note that what I have here translated as 'manifold experience' is in Latin '*multiplici experientia,'* a singular noun in the ablative, which, at its most literal, might be rendered as 'experience having many folds'. Given the grammar, the sense here cannot refer to many experience*s*, but rather a compound set of such experiences, a complex multiplicity rendered into a unity under the singular term *experientia*.

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[7] So, for instance, in the *Dedicatio* to *De motu cordis,* Harvey writes that he would never have proposed his findings if he had not had"…per autopsiam confirmassem." (Harvey 1628, *Dedicatio,* 6). I argue below that Harvey has two sorts of claims which he thinks must be confirmed by personal experience: claims about the existence of a phenomenon and claims about the causes of the phenomenon.

[8] Harvey 1628, *Proem,* 10. "De cordis arteriarum que motu, pulsu, actione, usu & utilitatibus cogitanti opera pretium est, quae prius ab aliis mandata sunt literis, evolvere, quae vulgo iactata & tradita animadvertere, ut quae recta dicta, confirmentur: quae falssa dissectione anatomica, multiplici experientia, diligenti, & accurata observatione emendentur."

This unity, this manifold, is the source of a kind of wisdom. One might reasonably translate *experientia* as expertise, for experience by Harvey's lights gives the ability to make a reasoned judgment on the basis of a long familiarity with the subject.[9] There is, in fact, a certain marginal note written by Harvey in his copy of his friend Theodore Goulston's (1640) edition of Galen, the *Opuscula varia,* in which Harvey remarks on this very issue. Vivian Nutton, discussing these marginal notes, writes that Harvey not only writes something on almost every page, thereby demonstrating his deep familiarity with Galen, but, further, his notes have an especial concern with Galen's views on epistemology and proof.[10] In particular, one note in particular provides a deep insight into how Harvey conceived of experience. In Galen's *De sectis*, Nutton notes that, "…when the Rationalist argued for his superiority over the Empiricist because he was used to investigating the symptoms and causes that controlled the body's health and illness, Harvey commented on the speciousness of the division by emphasizing that 'investigative reasoning makes a doctor by experience.'"[11] Now, not only does this reinforce the view of Harvey's unified conception of anatomy argued for in the previous chapter, wherein reason and experience must work together, but it also indicates that Harvey's view of experience ends up somewhere close to Galen's view, though Harvey does not, perhaps, fully appreciate this. For in *De sectis* Galen ultimately marshals both the Empiricists' and the Dogmatists' arguments against the Methodists', thus showing by his practice that he too views the division between experience and reason as specious: for both must be used to truly master the art.[12] This marginal note reinforces the idea that investigative reasoning by experience should be

[9] This is similar to the conception of experience found in early modern law, especially in Britain. Historians have thus traced this notion and its influence on some English philosophers, such as Bacon and Boyle. See, for instance, Sargent, Rose-Mary 1989, "Scientific Experiment and Legal Expertise: The Way of Experience in Seventeenth-Century England," *Studies in History and Philosophy of Science* 20(1), 19-45.
[10] Nutton, Vivian 1988, "Harvey, Goulston and Galen," In: Fr*om Democedes to Harvey*, London: Variorum Reprints, 116-117. See: "Marginal notes of Harvey in Theodore Goulston's 1640 edition of *Opuscula varia*," at the British Library, C.61.h.9
[11] Nutton 1988, 117.
[12] See: *De sectis* Cap.7-9.

understood here as providing *expertise,* for this is what makes someone into a Doctor, in contradistinction to an untutored Empirick or an inexperienced Scholastic (remembering Vesalius' earlier, and also quite Galenic, remarks).

Experience, then, is a tutor, a teacher, and Harvey very often talks exactly in this way. In the *De generatione* in discussing the order of the appearance of the parts during development according to earlier writers, he writes that "…truly, experience teaches that things are far otherwise than this, for it can be seen that the bones are made last of all."[13] The knowledge gained here might almost be understood in the same way a book is a source of knowledge: one must expound from both, as it were, as Harvey writes in *De generatione*:

> Because I do not think it possible to reach the truth from other men's opinions, whether they be given out on bare authority or even confirmed by probable arguments, without the help of diligent personal experience; and by the help of clear observations I will expound from the book of Nature what the material of the foetus is and how from thence it is formed.[14]

Nature's book can be read, provided that one can have clear observations. And in order to get clear observations, one must learn *how* to experience. One must learn how to perform anatomies in such a way as to provide evidence to justify one's beliefs, to make knowledge claims—as I noted earlier in discussing Vesalius, the unlearned Empiricks, though they can cut open bodies, cannot understand what it is that they observe. Only once one's eyes, hands, and mind have been trained might one see the evidence of experience, in the same way that one can understand the evidence provided by earlier authors only if one learns how to read their works, and read them

[13] Harvey 1651, 270. "Verum, haec aliter longe se habere, experientia docet; qua constat, ossa potius ultimo tandem fieri."
[14] Harvey 1651, Ex.45, 202. "Quoniam itaque ex aliorum placitis, (sive nuda autoritate, sive probabilibus etiam argumentis ea confirmata fuerint) veritatem obtineri non posse arbitramur, nisi diligens quoque experientia accesserit; ex naturae libro, & perspicuis observationibus, quaenam sit foetus material, & quomodo is inde oriatur, declarabimus."

critically.[15] Harvey argues that being tutored by experience is a prerequisite for scientific knowledge:

> How hard and difficult it would be to teach those having no experience, indeed, they have no experience or sensible acquaintance in anything; and how foolish and unteachable, how inexperienced, are these listeners to true knowledge: they clearly show the judgments of the blind about colors, and of the deaf about harmonies. Who will ever teach the ebb and flow of the sea, or, from a geometrical diagram, the sizes of the angles or the ratios of the sides to the blind? Who will teach to those who have never seen either sea or diagram? One inexperienced in anatomies, in so far as he does not comprehend the matter by his own eyes, and, by this cause, have his own concept, is thought to be blind in some way, and is unsuitable to instruction. For concerning the things the Anatomist discusses, he does not know well the natural sources from which he draws his arguments, but all things are equally unknown to him, those things which he concludes and infers, just as that from which [these are drawn, his sources] are unknown. There is no possible knowledge but from preexisting knowledge, this latter being better known; and this is the chief cause why our knowledge about heavenly bodies is so uncertain and conjectural.[16]

This is a very revealing passage, and here I want to note a number of things. First, as Harvey says, those who have no experience are unsuitable for true *scientia,* the reason for this being that their judgments about nature—its colors and harmonies—are of the same order of the judgments of the blind about geometry or the flow of the tides. A lack of experience is a serious deficit because what experience teaches is not just the facts of the world, but it teaches also the ability to make those judgments about the world in the first place. That is, to put this in Harvey's terminology, experience is the source of the faculty of anatomy. From cutting and observing

[15] I see this as a testament to Harvey's Humanist background. See, for instance, Harvey 1616, 168, "Tamen Fernelius et experientia testator parum sentiunt renes, unde impostema et corroduntur et absumpti cum dolor aut nullus aut exiguus; potius affectione partium adiacentium quam propriarum." Whitteridge translates 'testatur' as 'is proved,' but this is an over reading. The word more accurately means 'to provide evidence' or 'to give testimony,' and this is a more natural reading.

[16] Harvey 1649, *Exercitatio de circulatione sanguinis,* 99-100. "Quam arduum & difficile sit, nullam experientiam habentes, vel in quibus, experientiam aut sensibilem cognitionem non habent, docere: & quam inepti, & indociles, inexpertique Auditores sint, ad veram scientiam; caeci de coloribus, surdi de consonantiis judicia plane ostendunt. Quis unquam maris fluxum, & refluxum, Quis ex diagramate geometrico, angulorum quantitates, aut laterum rationes, caecos docebit? aut eos qui neque mare viderunt, neque diagramata? Inexpertus in Anatomicis & in quantum propriis oculis, & proprio exinde concepto rem non tenet, caecus in iis quadantenus existimandus, & ineptus ad doctrinam. Non enim, de quibus, disputat Anatomicus, neque ex quibus, in rei natura insitis, desumit argumenta, quidquam rite novit; sed cuncta pariter ignota sunt, tam quae concluduntur & coliguntur, quam ex quibus. Nulla autem possibilis cognitio, ex non praexistente cognitione, eaque notiori & haec una potissimum causa est, cur tam incerta & conjecturalis nostra, de coelestibus corporibus scientia sit." I've corrected here some typos in the original Latin.

many times, noting that Harvey here carefully puts anatomy in the plural, an anatomist gains the ability to judge: the anatomist gains *expertise.*

In keeping with the metaphor of experience the teacher, the process of learning from experience can be understood in terms of two sorts of lessons: one is conceptual; the other is, for lack of a better word, artistic. I discussed in the previous chapter that Harvey's definition of anatomy includes the skill of cutting and preparing the corpse, one of the five parts of the skill of anatomy. In terms of art, then, one elaborate upon this aspect of the skill of cutting to include knowing where and how to cut, how to deal with the stench, how to restrain a live animal, where to ligate, how to ligate the right amount, the ability to extract some amount of blood, and, perhaps most fundamentally of all, how to observe. But in the passage just quoted, the emphasis is upon the conceptual and epistemological; so set aside the artistic aspect. Anatomy, as a skill, involves observational experiences as the basis for one's concepts. As I shall discuss in detail in the following pages, if one's concepts are accurate to the things they represent, then they can serve as premises. These premises must be very certain and of the right kind: they must be scientific definitions. Finally, I note that the source of this experience comes from what I have translated here, following Whitteridge, as 'natural sources', and though the Latin here is difficult to render into comprehensible English, I think Whitteridge's translation is a good one as it connects what Harvey is saying here with an important Galenic doctrine, namely, that of the natural criteria. These 'natural criteria,' are just those faculties of sense and mind (eyes, ears, hands, and brain) that are relevant to making anatomical judgments.

The goal of using these natural criteria in the way so described is to derive concepts from one's *own eyes*. In this way, the two lessons of experience come together, from art comes knowledge, from cutting one learns causes. Importantly, then, the truth of one's demonstrations depends upon the adequacy of the concepts one forms. And the faith one has in one's concept is

based, for both Harvey, as for Galen, on two sources: in the faith in ones' natural criteria, one's senses and mind; and in the tests one performs to prove one's beliefs. By these means, anatomists make their claims evident, or, as s Teun Tieleman has argued in the case of Galen, "…anatomical observation and experiment…[are] needed to *make* things obvious."[17] To examine this process, I now turn to discuss the role of observation and experiment, starting with *historia*.

6.1.2. *Historia Anatomica*

Historia should be understood as sets of organized observations. Emphasized especially in the Paduan Aristotelian tradition, these observations were the basis for inferences about causes. Gianna Pomata has noted that during the Renaissance there was an interesting shift:

> …on the one hand, as in Scholastic philosophy, *historia* as *cognitio effectuum* is opposed to philosophy as *cognitio ex causis*; for instance, Zabarella says that of everything one can give either a historical (merely descriptive) or a philosophical (causal) account. But on the other hand, *historia* is also recognized as a preliminary stage of the inquiry that leads to the discovery of causes, and thus as a constitutive, foundational part of philosophical knowledge. The shift from Scholastic Aristotelianism to Renaissance Aristotelianism implied a shift from *historia* as knowledge without causes to *historia* as knowledge preparatory to the investigation of causes. This shift seems to have been an important component of the 'Aristotelian empiricism' of the sixteenth century….[18]

The roots of this division between the investigation of *what is the case* (*hoti*) and the investigation into *why it is the case* (*dioti*) are found in the practice of Aristotle's *Historia animalium* and the other animal books, and in the *Parva naturalia*. In the *De incessu animalium,* Aristotle writes,

[17] Tieleman Teun 1996, 16.
[18] Pomata, Gianna 2005,"*Praxis Historialis*: The Uses of *Historia* in Early Modern Medicine," In: *Historia: Empiricism and Erudition in Early Modern Europe*, Eds: Gianna Pomata and Nancy G. Siraisi. MIT Press: Cambridge, 111.

> Surely, concerning all these things and any such things that are related [to the locomotion of animals], there must be a careful study of their causes. For, as far as this thing happens in this manner is clear from our *historia naturali*, that which is the *cause for the sake of which* must now be investigated.[19]

Aristotle signals here a switch, from historical investigation into the natures of things to the investigation into the reasons for those natures. Aristotle understands *historia* as the organization of the facts about animals and their natures by the use of multiple differences. In the context of Harvey's *De generatione animalium*, James Lennox has detailed the way in which Harvey follows Aristotle in treating, for instance, first the parts of the egg, first its shell, then its other parts, and then the differences in shape, size, and number among hens eggs and in other sorts of birds.[20] Indeed Harvey's *De generatione,* Lennox has argued, is explicitly organized according to the strictures of Aristotelian *historia,* even down to justifying his inductive inferences on the fact that nature does nothing in vain.[21]

The twenty-fifth exercise of Harvey's *De generatione* signals the transition from *historia* to causal investigation, and does so by means of some very curious language. The exercise is entitled "*Porismata quaedam ex praedicta Ovi historia desumpta,"* which I translate as *'*Certain deductions selected from the foregoing *historia* of the Egg'. This is a very curious title, for reasons I will discuss in a moment, but let me first establish what Harvey says:

> Indeed, the *historia* of the hen's egg is thus as I have related…Therefore I think it agreeable to add this, that which follows the fruit of my labor, and, to use the words of our most learned Verulam, ought to establish my second vintage. There are several theorems which must be collected from the *historia* which I have described; some of

[19] Aristotle 1552, *De animalium incessu,* Cap.I, In: *Aristotelis libri omnes…cum Averrois Cordubensis variis in eosdem commentariis*, Volume 6, Venice, 104. "De omnibus certe ijs, & quaecunque istis sunt cognata, perscrutandae sunt causae. Quod enim hoc contingat modo ex naturali palam est historia: quam autem ob causam nunc est investigandum." See also: *De partibus animalium,* Lib.II, Cap.I. The relevant Greek terms are: *hoti* (the that), *tes historias tes phusikes* (inquiries into nature), and *dioti* (the reason why).

[20] Lennox, James 2006, "The Comparative Study of Animal Development," In: *The Problem of Generation in Early Modern Philosophy*, Cambridge: Cambridge University Press, 36.

[21] See also: Lennox 2006, 34. On some similarities and differences concerning method and generalizations, see also Lennox 2006, 35-36. On the principles of the investigation, see: Aristotle 1552, *De animalium incessu,* Cap.II, 104.

> these are most certain, several doubtful to be believed and needing further winnowing; some are paradoxical and contrary to popular opinions...[22]

Harvey here thus signals the transition from *hoti* to *dioti,* that is, from observations to causes based upon those observations—for instance, the very next exercise is entitled 'Quid sit ovum,' and, as I argued in the previous chapter, this is a very important causal entity in Harvey's account of generation.

Now there are few words that must be discussed, namely, the '*porismata'* of the title and the word '*theoremata'*. Both words are taken from geometrical proofs, the latter meaning theorem. As to the former, the word can be traced to Euclid, who "…uses the word in his *Elements of Geometry*, where he calls the corollaries of his proposition, *porismata.*"[23] The word was also used by another Greek mathematician, Pappus of Alexandria, for whom a *porismata* is something which, "…was proposed to be investigated, or something between a theorem and a problem," but others, however, "…make it of the nature of a lemma, or a proposition necessary for passing to another more important one…."[24] *Porismata* is not a common word in the natural philosophies of the time, certainly not in books on animal generation. What is it doing here? The answer, I think, lies in the relation between *historia* and proof. Harvey, following Aristotle understands *historia* as preparatory to making inferences. Harvey here seems to imply by these words that his own method of demonstration is equal to that of the geometers: like them he makes certain deductions. (Though, as Harvey admits, not all his inferences will be so sure, as some of his *historia* are doubtful or at least problematic—but the deductions themselves are, by implication, sound.) But, curiously, he furthermore connects these geometry-like deductions to

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[22] Harvey 1651, Ex. 25, 75. ""Historia quidem ovi gallinacei ita se habet…Quare, quem fructum diligentiae nostrae consequuti simus, hic adjungere consentaneum arbitror: atque (ut doctissimi Verulamii nostri verbis utar) *vindemiatio secunda* instituenda est. Theoremata itque nonnulla, ex enarrata historia colligenda veniunt; quorum aliqua, certissima sunt; nonulla, ancipitis fidei, & ulterius ventilanda: quadam, paradoxa, & popularibus placitis contraria…."

[23] Hutton, Charles 1815, *A Philosophical and Mathematical Dictionary,* Vol.II, London, 218.

[24] Hutton 1815, 214.

the method of Francis Bacon, Lord Verulam (though Bacon never talks of a *second* vintage), and, in so doing, connects his method to the method of induction. On the face of it, this is strange, for it seems Harvey is trying to at once claim the certainty of the geometrical deduction by the term 'porismata', and at the same time he understands what he is doing in the transition from *historia* as akin to Bacon's inductive method.

This tension, between deduction and induction, or better, between reason and experience, is one I discussed in detail in the history of conceptions of anatomy, and, again, Harvey here seems to be trying to plot his own course. To understand this course, the following passage from the second letter to Riolan is helpful, wherein Harvey is arguing for the certainty of experience in proof:

> We would surely admit no knowledge [*scientiam*], if faith through the senses were not most certain, and stabilized by reasoning (as the Geometers are accustomed to do in their constructions); as you see, Geometry is a rational demonstration about insensible things from sensible things. According to this example, what is abstruse and remote from the senses becomes better known from visible things more evident and more familiar.[25]

Note the common refrain, discussed earlier, of moving from better known to lesser known, an Aristotelian trope. So, according to Harvey, in geometry, one moves from sensibles to non-sensibles—that is, from a diagram of a particular triangle to the truth that the sum of the interior angles of *all* triangles is 180 degrees. With his geometric language, Harvey seems to be indicating that in the study of animals one does the same: one moves from *historia,* which are observations of *particular* animals and their embryos, to the causes of *all* animals and embryos—from non-causes to causes, from particulars to universals. Further, Harvey again puts together the certainty of the senses, stabilized by reasoning, with the practice of geometers,

[25] "Harvey 1649, 97-98. "Si non certissima per sensum fides foret, eaque ratiocinando stabilita, (ut in suis constructionibus Geometri solent) nullam profecto admitteremus scientiam: Quippe ex sensibilibus, de insensibilibus demonstratio rationalis, Geometrica est. Ad cujus exemplar, abstrusa & a sensu remota, ex apparentibus manifestioribus & notioribus, innotescunt." I have corrected here some typos in the original Latin.

whose constructions are admitted as certain by all: inferences from *historia* are claimed to be just as certain.

I turn now to elaborate Harvey's conception of *historia anatomica,* concentrating on what he says explicitly on its proper method in his *Prelectiones*.[26] Harvey sometimes uses *historia* in a way that is synonymous with 'observed structure of a part' or 'the observations of others,' as is common amongst the physicians.[27] However, Harvey's *historia* are deeply Aristotelian insofar as they include not just observations *simpliciter* but rather observations that are *carefully organized in order to make inferences*. Thus, as Lennox has pointed out, the *historia* of the *De generatione* are carefully organized: exercises 2-8 discuss the nature of female reproductive organs across a variety of oviparous animals, focusing especially on Harvey's model, the hen. Then, in exercises 9 and 10, Harvey describes the generation, growth and movement of the egg, before moving on in exercises 11-13 to discuss the egg and its parts, and the differences in eggs among hens and other birds. Lennox notes that, in the transition from exercise 13 to 14, Harvey first argues that he has proved from experience what the uterus and egg are in hens, and what their office is, leaving the reader to form a judgment about all other oviparous animals.[28] Then, in exercises 14-24, he turns his attention to the account of how the cock and hen arise from the egg, before finally transitioning from *historia* to generalizations and causes in Ex.26, which concerns the nature of eggs in general. Organized in a similar fashion are Harvey's later exercises when he moves back to historia regarding viviparous animals in Exercise 63, moving from an account of the uterus, to an account of the progression of development in the embryo, and so forth.

Though it has not been noticed to my knowledge, in the *Prelectiones* Harvey provides a detailed discussion of the nature of *historia,* providing an explicit list of what one should pay

[26] In the anatomical context, one must take into account not just the Aristotelian *historia* tradition, but the somewhat different *historia* tradition of the physicians. See: Pomata 2005, 111-112.
[27] E.g., Harvey 1616, 134. He also occasionally uses *historia* to just mean a tale or story: see Harvey 1616, 176.
[28] Lennox 2006, 37.

attention to when anatomizing, those features of the parts that are relevant for knowing their natures. These *historia* give the anatomist the experiential grounds to know the nature of a part of the body, they are the way in which the anatomist becomes familiar with the subject—an *expert*. Remember from the previous chapter, I noted the anatomical *accessus* developed by John of Alexandria that became central to anatomical teaching:

1. The number of organs.
2. The character of the part
3. The position of the part
4. The size
5. The shape
6. Anatomical relations[29]

Roger French argued that these anatomical questions to be investigated or demonstrated during an anatomy were based upon Aristotle's categories, which French maps in the following way:

1. Substance – [no analogue]
2. Quantity - The number of organs
3. Quality – The character of a part
4. Place – The position of a part
5. Relation – The size of a part, and the anatomical relations of the part[30]

Now, the *accessus* and categories do not line up perfectly, but they were related to each other in the way that French has laid out.[31] Thus the *accessus* is a guide to how to go about and observe the dissected body: they tell the anatomist how to organize their observations.

Harvey, too, has such a list in his section entitled *Historia anatomica* in the *Prelectiones*.[32] The goal of these lectures, remember, is knowledge not just about the parts, but also about the way in which one should perform an anatomy—the are meant to develop the student's anatomical *facultas*. Immediately before this section on *historia anatomica* are Harvey's *Canones anatomae generales,* where, if anywhere, one might hope to find some of

[29] French 1979, 463
[30] French 1979, 464.
[31] The situation is complicated, and not all of Aristotle's categories are here listed—for instance, 'time' has very little relevance to dissection of the dead. Further, these accessus changed and were added to over time, for which see French 1979. I won't here bother with these details however.
[32] See also: Laurentius 1600,"Quid in qualibet parte spectare debeat Anatomicus." Lib. I, Cap. XVII, 23-24.

Harvey's most explicit ideas about how to anatomize. Harvey writes there that one should, "Cut up as much as may be in person so that practical skill might be learned together with *historia,*"[33] thus articulating the idea that anatomy teaches one practical skill and the proper way to observe the parts in addition to providing *historia*: it teaches both the artistic and conceptual aspects of anatomy. Turning to the list of features Harvey insists must be observed *in historiam anatomicam*, he starts by writing that,

> In every part one must consider: the temperament, those things which follow [naturally], [and] those things which happen by chance. WH in each organic part [there are] five things [which must be considered]:
>
> 1. Position
> 2. Shape
> 3. Quantity
> 4. Motion
> 5. Division[34]

Now, note that this list is neither exactly Aristotle's nor John's, though it does resemble both. I shall now go through each of these aspects of anatomical observation in turn using various examples from Harvey's notes to show how they structure his observations.[35] As Allen Shotwell has noted, a most important addition here is the category of motion, something which starts with Fabricius.[36]

The first, 'position', signifies for Harvey the place of an organ, its boundaries, that is, it is, "…before or after, above or below, this way or that…" and so on.[37] Using the example of the skin Harvey writes that, "Position: It is the most outward part, wherefore the vulgar [think it is made] from the extreme ends of vessels etc…"[38] Shape, meanwhile, is quite obvious, and

[33] Harvey 1616, 16. "Cutt up as much as may be in presentia ut cum historia peritia innotescat."
[34] Harvey 1616, 20. "In omni parte consideranda: temperiem, quae consequuntur, quae accidente. WH parte organice quinque: 1. Situs; 2. Figura; 3. Quantitas; 4. Motus; 5. Divisio."
[35] I shall choose a number of different examples, as Harvey is not always consistent in going through each of these categories in everything he discusses in equal detail.
[36] Allen Shotwell, Personal communication, June 5 2012.
[37] Harvey 1616, 20. "Situs vel circumscription: ante post, supra ifnra, hic inde…"
[38] Harvey 1616, 46. "Situs. Extima corporis parte quo vulgo ex extremis vasorum etc…"

includes observations the shape of the parts, their proportion, symmetry and beauty.[39] So Harvey writes about the kidney that, "Shape: like a sheep's, of a bean, kidney beenes. Medially they are partly convex and partly concave."[40] Quantity includes understanding the number of a part, when it is considered as separate and when it is joined to something else, as well as its overall size, breadth, length and so on.[41] So, for instance, in speaking of the belly, Harvey notes that, "The size of the belly depends on the amount of fat and viscera contained within in it," thus illustrating its quantity when it is joined with something else.[42] Motion, again, is quite obvious, and includes local movement, movement with respect to quality, from diseases, from age and habit.[43] In discussing the guts, Harvey writes that,

> Movement: as [the guts] retain so also do they distribute and thrusts down. The lower part of the guts with straight fibers opens itself, the upper part with transverse fibers contracts from above, like the pudding-wife's hand. An example of their movement is to be seen in slugs and leeches, they move with an undulating movement like worms….[44]

Motion is an especially important category, for knowing the motion is necessary to understand the action of the part, and from there, its use; vivisection is thus often required.

Finally, there is division, which deals with the division of the matter of the body into parts. Harvey states, "Whence arises consideration of substance, sanguineous, fleshy, sinewy, membranous or skinny. And from these [we consider] the temperament, strength, power, sensation, color and generation [of the part]."[45] This last, then, considers not just the material nature of the part, but also the relation of its substance to its power and activity, presumably in

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[39] Harvey 1616, 20. ""Figura:…partium proprotio conformation pulchritude…"
[40] Harvey 1616, 166. "Figura: ut ovis, phaseoli, kidney beens. Interius partim gibbi partim concave."
[41] Harvey 1616, 20. "Quantitas:…numerous…longitude latitude profuditas magnitude capacitas."
[42] Harvey 1616, 96. "Quantitas ventris a quantitate pinguedinis et viscerum contenta." See also Harvey 1616 120.
[43] Harvey 1616, 20. "Motus: localis; quanto, augmentation…quail, secundum morbos consuetudinem aetatem." Harvey here also includes 'generation' mistakenly, as according to Aristotle this is not a category of motion in respect to quantity but with respect to substance. He understands this correctly in both the *De generatione* and in the *De motu locali animalium,* Cap.1, 14. It is unclear why he makes this mistake here.
[44] Harvey 1616, 110. "Motus: ut detenent ita destribuunt deturbant. Pars inferior rectis fibris se apperit, superior transversis desuper contrahit ut the pudding wifes hand. Exemplum motus in limacibus et hyrudinibus; motu undoso ut vermes…"
[45] Harvey 1616, 20. "Unde apparet de substantia sanguinea, carnosa, nervosa, membranosa, cutacea. Ex his temperies, robur, vires, sensus, color, generatio."

concert with understanding the motions of the part. So Harvey notes that the liver and spleen are, "Divided into coat, vessels, veins, arteries and nerves, parenchyma, blood and spirits."[46] That is, these organic parts are made up of other sorts of parts, and Harvey then goes on to consider these divisions in turn, noting, for instance, that the substance of the coat of the liver is made of exceedingly fine members, and that blood and spirit are the contained parts, the others the containing parts.[47] In this specific example, knowledge of divisions here affords Harvey an argument against those physicians (such as Laurentius and Bauhin[48]) who maintain that blood is contained in the liver, which is untenable because, "…there is no anastomosis…" and which can furthermore be disproved,

> …from the fabric and course of the veins, for the portal vein having gone here into the liver is divided into branches, and these into other branches always within the central sphere of the liver…it is exceedingly rare to find branches of the portal vein going to he gibbous part just as it is, on the other hand, to find branches of the vena cava going to the central sphere. For this reason, many anatomists like WH have made diligent search for an anastomosis and have found none.

The Galenists believed that there must be anastomoses inside the liver so that the vena cava and portal vein communicate, and, as such, the liver would be considered as the origin of the veins. Thus, through his collection of *historia anatomica* and the fact that no anastomoses were forthcoming in consideration of its substance, Harvey was able to undermine this Galenic position. Thus he had to begin to reconsider the use of the liver, and which of course relates to his work on the heart and the nature of the blood.

Further note a passage discussed in Chapter 3, regarding the uses of the parts:

> Uses and intermediate utilities[49] [can be learned by considering the parts]:
> According to homogeneity: [if a part is] hot [then its use is] to make warm, to cook, to keep warm;

[46] Harvey 1616, 140. "Dividuntur tunica, vasis, venis arteriis nervis parenchemate, sanguine et spiritibus."
[47] Remembering that this was one of the ways of dividing the parts discussed above. Harvey 1616, 140. "Tunica membrane tenuissima [iecore] a peritoneo…Sanguis et spiritus tanquam contentae aliae contenentiae."
[48] See: Laurentius 1600, Lib.VI, Cap.19, 240; Bauhin 1605, *Theatrum anatomicum*, Lib.I, Cap.44, 288.
[49] I take this to mean that a use and a medium utility are synonymous..

	[if] cold [then its use is] to make cool, to keep cool; [if] wet [then its use is] to lubricate, to make slippery, to soften, to blunt; [if] dry [then its use is] to harden, to strengthen
According to [other qualities]:	[by considering a part's] color, [we can learn about the use in relation to] the blood, its temperament, its activities; [by] its hardness or softness, [we can learn about its use in relation to] its temperament, its passions; [by] its thickness, [we can learn about the use in relation to] its lightness, its heaviness; [by] its thickness, [we can learn about the use in relation to] its firmness, its fragility;
According to instrumentality:	[by considering a part's] shape, size, location, construction.[50]

Note that, at each point, Harvey considers the relation between what one observes and what one can infer from that observation. Harvey's list here, then, is a kind of guide or heuristic to the sorts of inferences licensed by various kinds of observations. Thus, a consideration of the part's color will tell one about its temperament, and its relation to the blood: a redder part, presumably, being more related than a part grey in color. And, further, notice that the sorts of inferences licensed are just those relating to use and utility, to the final causes of the parts. Again, as I noted in Chapter 2, Harvey here, following Fabricius, infers from less teleological aspects of the parts to more teleological aspects, as one would expect moving from *historia* to causes.

Finally, Harvey, after he has described *historia anatomica* of the organic parts, moves on to *In historia partis simlaris.* Here one gets a similar list of features that must be observed during one's anatomies:

> Substance: color, towards or near blood; thickness thinness, hardness softness, tightness or looseness; whence the temperament [of the part], its strength or fragility, its sensitivity. Shape or situation of the parts.

[50] Harvey 1616, 22. "Usus et utilitates media: [/prout similare: calidum, calfacere coquere fovere; / frigidum, refrigerare contemperare; / humidum, lubricare laevigare emollire retundere; / siccum, firmare roborare;] [/pro: coloratum, sanguis temperies activitas; / durum aut molle, temperies passivitas; / densitate, levitas gravitas; / crassitie, robur fragilitas;] [/pro organco: figura, quantitas, situs, compositio]."

Motion (active or passive)
Quantity: augmentation, diminution, generation (material efficient)
Quality: Color thickness hardness tightness etc., whence all its temperament [and] strength
Passions: according to nature, contrary to nature[51]

I won't go into the details here, but I do note that Harvey is not always consistent in using just these categories for homogenous parts, and the others for organic ones. In fact, he almost always provides observations as to the substance of the part, and not always as a consideration of the divisions of a part. But he does, throughout the entire work, maintain his use of most of the categories, sometimes calling them differently, but consistently paying attention to these aspects of the parts, over and over again. Clearly the need to organize observations in this basic set of categories is a fundamental part of his practice.

These *historiae,* then, instruct the physician in both how to anatomize the body and how to conceive of it: it is by this route that one gains expertise, *experientia*. Indeed, in both Aristotle and Galen, experience in matters pertaining to action, of which anatomy surely is an example, produces not only knowledge, but, furthermore, it produces a certain kind of habit; in the Aristotelian context, this seems to be Aquinas' position with regard to experience.[52] That is, the exercise of one's sensory and motive faculties in combination with one's rational faculties renders the activity easier: one gains *facultas*.

In addition to skill, *historiae* provide knowledge of facts. As I shall elaborate in detail in the following sections, the knowledge provided by *historiae* is the inductive basis from which the anatomist can come to define the parts: what one becomes familiar with and certain about through anatomy is just that set of features of the parts from which one might, from one's own eyes, form one's own concept.

[51] Harvey 1616, 22. The page layout here is quite important to the interpretation, for which see 1886 Royal College of Physicians edition of the *Prelectiones,* 36.
[52] Aquinas, *Summa Ia-IIae,* q.40, a.5, ad 1, "... experientia in operabilibus non solum causat scientiam ; sed etiam causat quendam habitum, propter consuetudinem, qui facit operationem faciliorem."

6.1.3. Definitions and Concepts

One must understand Galen to understand Harvey's *conceptio conceptionis*. One treatise, in particular, becomes especially important: *De placitis Hippocratis et Platonis*. Jerome Bylebyl has noted the importance of this text:

> …among the previously unavailable Galenic treatises that had come to light in the 1530s was one of fundamental importance for the whole Galenic system, called *On the teachings of Hippocrates and Plato* (*De placitis*). In this work Galen had brought to bear numerous anatomical and vivisectional demonstrations to refute some of the central tenets of Aristotle's biology and psychology, above all his doctrine of the primacy of the heart[53]…Before this time physicians and philosophers alike, under the influence of Averroes, had tended to side with Aristotle on these issues, but the availability of *De placitis* coupled with the growing respect for both Galen and anatomy tended to polarize opinion within the arts faculties of Italy, with the medical professors, who were both more numerous and more influential, generally coming down on Galen's side. The Paduan medical faculty in particular was solidly Galenic in this regard.[54]

Though Fabricius' Aristotle was in ascendancy when Harvey was at Padua, the institution had a long history of teaching Galen's *De placitis.* And, of course, Harvey knew this treatise well, as it contains some of the very cardiac doctrines and experiments he proved wrong. But there is much more to this work, and as I shall argue, there are very important methodological practices that Harvey seems to have adopted, most importantly, the importance of proper definition and conception.

For Galen definition and conception are deeply interrelated. R.J. Hankinson summarizes that for him, "...a definition is that by which a brief reminder brings us to a conception of the underlying words."[55] Importantly, the definitions here considered must be *scientific* definitions,

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[53] Bylebyl makes it seem like Aristotle is the prime target here, but this is not the case. The target is rather Chrysippus and other's in the Roman Peripatetic tradition. While Aristotle is not spared the withering glare of Galen's anatomical gaze, it is clear that *De placitis* is a deeply Aristotelian work in terms of methods.
[54] Bylebyl, Jerome 1979, "The School of Padua: humanistic medicine in the sixteenth century," *Health, Medicine and Mortality in the Sixteenth Century*, Ed. Charles Webster, Cambridge: Cambridge University Press, 364.
[55] Hankinson 1991, 226

that is, definitions must be statements of the essence of some natural thing. In this, Galen follows Aristotle, for, as I argued in Chapter 4, Aristotle understands definitions to be statements of the form: a definition is an account that signifies an essence.[56] In the *Posterior Analytics* it is argued that scientific definitions must be *causal definitions.* Thus, given the discussion in the previous chapters, the definition of a living thing or its parts must make reference to soul, those goal oriented capacities which are proper to it.[57] An expert anatomist's concepts, then, bring to mind the definitions of the parts of the body, and so it is that the anatomist understands and knows the soul and body union.

Only definitions in this sense are suitable premises for science, and Galen argues, again following Aristotle, that, grammatical and rhetorical premises are just the wrong sorts to be used in natural philosophical demonstrations. The right sorts of premises are those that are found in the very essence of the matter being investigated.[58] Galen exhorts anatomists not just to make sure they use the right sort of premises, but, furthermore, they must take care to ensure that these definitions are true to their subjects, arguing forcefully that the anatomical mistakes of Aristotle and Praxagoras are worthy of censure. Thus their argument for the seat of the soul fails.[59] The argument here that Galen has with Aristotle and Praxagoras is not that that they have the wrong sort of premises, but rather these premises are based upon incorrect conceptions of the way things are in nature—they haven't, as it were, done their anatomical homework, they haven't

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[56] Aristotle 1552, *Topicorum translatio Abrami,* Lib.I Cap.4, In: *Aristotelis libri omnes…cum Averrois Cordubensis variis in eosdem commentariis*, Vol. 1, my translation, 257. "...definitio est oratio significans rei quiditatem, qua est ipsius essentia...." Though 'oratio' and 'ratio' are often distinguished, they seem to be used interchangeably in this Latin version of the *Topicorum.*

[57] Galen 1549, *De Hippocratis et platonis decretis (=De placitis*—NB I will refer to this treatise by this more common name), Lib II, Cap.3, In: *Galeni Peragameni…opera quae nos extant omnia*, Vol. 1, Basle, 896-897.

[58] Galen 1549, *De placitis*, 896. "Ab ipsa quaesitae rei substantia accommodatas ad rem sumptiones esse ducendas…."

[59] Galen 1549, *De placitis,* Lib.I, Cap.6, 887. "Relicto igitur iam Praxagora impudenter ista cavillante, rursus ad Aristotelem transeamus, quandoquidem etiam ipse ex corde nervos nasciat. Confuse tamen ac indistincte bis ab ipso dictum est de nervorum principio. Oportebat enim arbitror, eum qui est corde ipsos nasci diceret, ostendere quomodo in singulas animantis partes nervus ab illo venit, quamadmodum nos paulo ante arteriam ostendimus: & non simpliciter hoc solum dicere sufficiens esse putare."

learned the position, quantity, movement, shape, substance and divisions of the parts in question in order to conceive their true definitions. In order to do science, Galen reasons, one must have definitions and concepts that are, as Hankinson rightly notes, "… true of their objects, and such as to generate scientifically accurate and therapeutically useful deductions…."[60] Garbage in, garbage out. Harvey, I think, must be seen as having adopted this Galenic goal and focus: getting clear concepts about the parts and determining their definitions. His innovation is to wed this goal to a hybrid Galenic-Aristotelian approach to organizing observations in *historia.*

Aristotle and Harvey (and to a lesser extent, Galen) are interested in *universal definitions,* that is, in formulating concepts about natural things when they have a single common nature where the forms within them are not too distant.[61] The knowledge the anatomist is after, as Harvey states in his *Prelectiones*, is about the parts and their causes in *all* animals—insofar as they are practicing natural philosophy (and not medicine), neither Harvey nor Aristotle are interested in any particular liver except inasmuch as that singular can tell them about livers in general, that is, about the universal essence of livers.[62] *Historia* are to be used, then, as the grounds by which one comes to define what one means by liver and what it is one must explain about them and how to do so. As Lennox notes in Aristotle, "The *historia* will make apparent the 'about whiches' (the *explananda*) and the 'from whiches' (the *explanans*) of our scientific explanations."[63] Only after one has characterized the natural object that is being studied, that it exists, its range and variation in various kinds and sub-kinds, can one move on to describe *why* that object exists as it does and where it does.

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[60] Hankinson 1991, 147

[61] Aristotle, *De partibus animalium,* Lib.I, Cap.4. On definition in Aristotle's biology see especially: Lennox, James 2001a, "Divide and Explain: The *Posterior Analytics* in Practice," In: *Aristotle's Philosophy of Biology*, Cambridge: Cambridge University Press: 7-38.

[62] As a physician, of course, Harvey would be concerned with the particular liver of his patient, though judging from Aubrey's reports of Harvey's bedside manner this is perhaps less true than his patients hoped.

[63] Lennox 2001a, 18.

Importantly, however, as Lennox has argued, one has evidence of a single common nature if all the divisions in a kind stay within the bounds of more-and-less variation.[64] That is when parts differ not by analogy, such as a man's bone and the fish-spine of a fish, but rather only by affections such as the large and the small, the soft and the hard, and so on."[65] These variations are what some anatomists might call the *fabrica,* that is, they describe the way in which the part is constructed. This variation by the more and the less involves those same features that Harvey lists under *historia anatomica*. Thus, following this Aristotelian method, Harvey writes at the end of that list that,

> In each part, [one should consider it] according to age, sex, disease, and its customary use (bringing in, putting out, or carrying away) within the same kind [of animal], [and one should consider the part] in different kinds [of animals] that also have those parts, such as winged creatures of the shore, land, and water, in fish and snakes, in oviparous and viviparous quadrupeds [66]

This seems an obvious Aristotelian paradigm, in which consideration of each part must be made not only to the differences within a kind, but also to the differences in that part between kinds. Reinforcing Harvey's Aristotelian method here, note that he says almost directly after the previous passage that:

> …the end of Anatomy is to know or be acquainted with the parts and to know them through their causes and these [i.e., the causes,] 'that for the sake of which' and 'that on account of which,' [should be known] in every animal …[67]

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[64] See: Lennox , James 2001b, "Kinds, Forms of Kinds, and the More and the Less in Aristotle's Biology," In: In: *Aristotle's Philosophy of Biology*, Cambridge: Cambridge University Press, 167-171; 177.

[65] Aristotle, *De partibus animalium,* Lib.I, Cap.4, 65 v. "…partes enim eorum non proportionis similitudine discrepant, quomodo os hominis & spina piscis, sed potius affectionibus corporis, id est magnitudine parvitate, mollitie duritate, lenitate asperitate, & reliquis generis eisdem, atque omnino eo quod magis minus ve quicunque habeant."

[66] Harvey 1616, 20-22. "In singulis {eadem specie{secundum aetatem, sexum morbos et consuetudinem{ingerit egerit degerit}} diversa specie quae tamen eas partes habent {pennatis{ripariis terestribus aquatilibus} psicibus, serpentibus, quadrupedibus oviparis, quadrupedibus viviparis." The arrangement of this page is essential for making sense of it, for which see the 1886 Royal College of Physicians edition of the *Prelectiones,* 33, or the manuscript in the British Library, Sloane MS230a. I note too that Harvey explicitly mentions the more and the less in the manuscript known as *De motu locali animalium,* discussed in Chapter 2; see: Harvey 1627, 126.

[67] Harvey 1616, 22. "…finis Anatomiae est scire vel cognoscere partes et scire per causas et hae in omnibus Animalibus cuius gratia et propter quid…." The notes are extremely unclear on these lines, both in terms of legibility (always an issue in the notes) but also in meaning. Whitteridge translates this last part as '…to know for all animals wherefore and why the parts are made…", a translation I cannot make much sense of; for instance: what is the difference between knowing the 'wherefore' and knowing the 'why'? The dictionaries I have consulted have

The definition of a part, as an account of its essence, must make reference to that part's causes (the reasons why), especially the final cause for whose sake the part exists—as I noted in Chapter 2, the soul, the formal nature of a part, is the central feature of Harvey's anatomical explanations, as it was of Galen's and Aristotle's. Definitions of the parts, then, must be based on a wide knowledge of *differentia* and their extension and variation in various kinds and sub-kinds.

6.1.4. Similarity and the Rule of Socrates

Harvey even has a name for the method by which one comes to find these essential features needed for definition: the *regula Socratis.* The *regula Socratis* is one of the most mysterious phrases used by Harvey—so far as I have been able to assess, there is no record of anyone else using this phrase before him. To make matters worse, Harvey only uses the phrase twice, and only in the *Prelectiones.* However, though he uses the phrase but twice, it describes a central feature of his anatomical method.

The phrase first occurs in Harvey's '*Canones anatomae generalis*,' which are a set of suggestions and heuristics for the proper performance of an anatomy. In his fifth canon, Harvey exhorts students:

> To examine one's own and other's observations to prove your own opinion, or in the strictest form, deal with other animals according to the rule of Socrates: where it is farer written. Whence exotic[68] observations:

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them as (nearly identical) synonyms. I further note that here, as elsewhere throughout the *Prelectiones,* Whitteridge transcribes 'propter quid' as 'propter quod', thereby missing the connection to theories of demonstration.

[68] Although the reading of this word, *exoticas,* is reasonably sure, what it means is quite obscure. Whitteridge renders this phrase as 'whence observations foreign to anatomy,' but this does not seem right and makes a hash of the context. The only interpretation I can see is that these observations are 'exotic' insofar as they involve other animals; it would be no stretch to say that at least Harvey's own use of animals was rather exotic, and which ranged from parrots to chickens to dogs to the King's deer.

1. about the causes of disease: chiefly useful to the physician
2. about the variety of Nature: [chiefly useful] to the philosopher
3. for the purpose of refuting errors and solving problems
4. for the purpose of discovering uses and actions, excellences, and thus also on account of these, their classifications.

> The end of an anatomy is knowledge of a part, its purpose, its necessity and use. Its [anatomy's] chief purpose for Philosophers is to learn which [parts] are required for each action insofar as it is excellent. Likewise [its chief purpose] for Physicians is [to learn] the natural constitution [of the parts], [that is] the standard by which they must classify those who are sick, and then what they must do in diseases.[69]

Observation is key here, and Harvey suggests that anatomists must reexamine their own observations and those of others in order to prove the truth of one's concepts of the parts. This means that this rule is central to the collection of *historia.* Harvey argues that another way (a stricter way) of reviewing observations is to look across animals. These observations have various important uses, for instance, some are useful chiefly to the physician insofar as these observations across animals are useful for determining the causes of disease. So, for instance, in a section entitled 'Affections of the viscera, I give an account of what I have seen," Harvey lists a variety of observations of the viscera in patients suffering from various maladies, e.g., "…in melancholics and those who are thin, [the spleen] is larger and more loosely textured, reddish-yellow or dark in color." One thus finds him using various far-flung observations in order to understand disease. But more important for my purposes here, one of the uses of the *regula* is

[69] Harvey 1616, 16. I note the following changes from Whitteridge's transcription based upon my own archival work, most of which accord with the 1886 Royal College of Physicians transcription: (1) I read as *confirmandam* and not as *considerandum*; (2) as *varietatem* and not as *veritatem*; (3) I read as *dignitates* and not *dignitatem*; and (4) I as *inde* and not as *idem*. Further, I have chosen to render '*diducendum*,' which means more literally 'to divide', as 'classify' as I think this interpretation makes best sense of this difficult passage.

> "Observationes proprias et alienas recensere ad confirmandam propriam opinionem vel obsignatis tabulis in aliis animalibus agere secundum Socratis regulam: where it is farer written. Unde observationes exoticas:
>
> 1. ob causas morborum: medicis praecipue utilis
> 2. ob varietatem Naturae, philosophicis
> 3. ad refutandos errores et problemata solvenda
> 4. ob usus et actiones inveniendas dignitates et propter inde colectanea
>
> Anatomae enim finis partis cognitio, propter quod, necessitas et usus. Philosophicis praecipue qui inde sciant ad umamquanque actionem quae requiruntur quod praestat. Medicis item qui inde constiutionem naturalem, regulam, quo diducendum aegrotantes, et inde quid agendum morbis."

central to the task of philosophical anatomy: finding those uses and actions that characterize the soul body union.

But why should looking at other animals be helpful? Why is this method equivalent to reviewing one's own and other's observations? Harvey later in the *Prelectiones* provides a clue. In discussing the function of the *caecum* (literally the blind part, and which is the end of the colon), Harvey makes mention of the rule of Socrates again, and he writes:

> [Called '*caecum*'] since its office is obscure. The size of a worm. In man, it is [counted] among the great [guts] for the sake of classification, as with the nipples. Conversely [in] hoggs, hare[s], oxen, ratt[s], etc., it is almost like another belly [in size]. In man it is sometimes large, as in the foetus WH, [as] Salomon Albertus [says], it is sometimes entirely absent. Thus the rule of Socrates through similarity in a great print.[70]

Now the reference at the end seems to be to a passage from the *Republic,* wherein Socrates suggests, since,

> … that we are no great wits, I think that we had better adopt a method which I may illustrate thus; suppose that a short-sighted person had been asked by someone to read small letters from a distance; and it occurred to someone else that they might be found in another place which was larger and in which the letters were larger, if they were the same and he could read the larger letters first and then proceed to the lesser, this would have been thought a rare piece of good fortune.[71]

The nature of justice in the soul is obscure, and thus Socrates argues one should look to the *Polis,* understood as the soul writ large, and see there what one might make of justice at this larger scale. So the parallel in anatomy is this: in certain animals, and especially in human beings, the action and use of a part is obscure.[72] But if the anatomist begins to look at other animals, on the assumption that, like the city and the soul they are related by a fundamental similarity, the anatomist will often find that understanding is more easily achieved in these other contexts

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[70] Harvey 1616, 86. "Quia caecum officio. Magnitudo vermis. Homine inter magna tamen notae gratia ut paipillae. Contra hoggs, hare, oxen, ratt, etc., tanquam alter ventriculus. Homini aliquando magnum, ut foetu WH, Sal. Albert, aliquando non omnino. Hinc Socratis regula per similitudinem in a great print."

[71] Plato *Republic,* Bk.II, Jowett Translation. Since we do not know which version of Plato Harvey used, if, indeed, he ever really read much, I shall just cite a contemporary translation.

[72] Note that Harvey, on the front page of the *Prelectiones*, quotes Aristotle's *Historia animalium*, Lib.I, Cap.16, "Hominum partes interiors incertae et incognitae quamobrem ad caeterorum animalium partes quarum similes humanae referents eas contemplare."

because the parts there are, as it were, 'writ larger,' and are thus more easily observable. I here add, too, that observations must be performed across time, that is, at different developmental stages, a technique Harvey uses to great effect not just in the *De generatione* but the *De motu* as well.[73] When anatomists begin to make note of the patterns of variation noted above, they can then start to move towards an understanding of that part's actions and especially uses, its definition.

Let me return to a brief example discussed above, the shape of the kidneys. Harvey adds to his description of the shape that,

> In some animals there are no hollows but the kidney is divided into lobes as in oxen and calves, in bears, and note that Eustachius saw it twice in a foetus…In the seal the cake-like mass of the kidney is made of an agglomeration of small pieces as if it were a haul of fish and it is thought that it is [for the sake of] the spleen, X but this is not so as is shown by the fact that the ureters derive from it; in another female it was not made of an agglomeration[74]

Here is just what the rule suggests is useful for philosophers: understanding the variety of nature, or, better, understanding how the nature of a thing varies. Harvey here compares his own observations, performed across animals, to observations from other anatomists, and, on the basis of such evidence about variation, he is here able to falsify part of the use of the spleen. That is, since, in each case (seal, oxen, etc.) the ureters don't derive from the spleen connected to the kidney, but from the kidney to the bladder, the kidney cannot be for the sake of the spleen.

The use of the *regula Socratis* in the *De motu* also follows this pattern. So, for instance, in his discussion of the use and purpose of the valves of the veins, Harvey notes that,

> The discoverer of these portals did not understand the use of them, nor others who have said lest the blood by its own weight should fall downward: for there are in the jugular vein those that look downwards and which hinder the blood to be carried upwards. I (as others likewise) have found in the emulgent branches of the Mesenterie, those which did look towards the vena cava and vena porta; add to this further that there are no such in the

[73]See, e.g., Harvey 1628, Cap.6, 33, 35-36; Cap.9, 46.
[74] Harvey 1616, 166. "Aliquibus sinus non sunt sed ren divisum in lobos ut bubulis et vitulis, ursis et vide embrione bis…Eustachius vidit. Phoca placenta tessulata quasi bollus pro liene, X signum quod ureters ab ipsa; a;oaf e,oma mpm tessulata

> arteries, and it is to be seen that dogs and cattle have all their portals in the dividing of the crural veins at the beginning of the os sacrum, or in the branches near the coxendix, in which there is no such thing to be feared on account of the upright stature in man.[75]

Note two things. First, it is important to understand that the conception of a part must be understood in terms of its universal definition. That is, Harvey's argument would fail if he did not think that there was such a universal category as valves of which the particular valves of humans, and dogs, and cattle are instances. For if there is no such category, than it might be that the valves of different animals had different uses and purposes—the *regula* depends on this not being the case. Second, it is clear here that Harvey's broad, comparative *historia* are the basis for his being able to understand the use of the valves. Others had argued that the use had to do with preventing the blood from falling downwards. But Harvey, having collected observations about the distribution and structure of valves in various sorts of animals, found that their use cannot have anything to do with the blood falling because of upright stature, for he had seen the very same structures located in similar places in other creatures, but which do not have an upright posture.[76] This conception of the *regula* is close to what Roger French has suggested, where he argues that

> We can now see what Harvey meant by the 'rule of Socrates'. His anatomical knowledge was incomplete without a knowledge of function, which could be found only in animals. Many animals had to be investigated to from a comprehensive composite term for the thing being investigated, in this case the heart. *Per similtudinem* is the search for similarity of function; in Aristotelian terms, the what-it-is-to-be-a-heart. Harvey found that while morphologically the hearts of different animals varied considerably yet in the even more important question of function *all hearts served to eject blood in forceful systole and in so doing generate the pulse...*[77]

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[75] Harvey 1628, Cap.13, 55. "Harum valvularum usum rectum inventor non est affecutus, nec alii addiderunt: non est enim ne pondere deorsum sanguis in inferiora totus ruat: Sunt namque in iugularibus deorsum spectantes, & sanguinem sursum prohibentes fieri, & non ubique sursum spcetantes, sed semper versus radices venarum & ubique versus cordis locum: Ego, ut alii etiam, aliquando in emulgentibus reperi, & in Ramis misenterii versus venam cavam & portam spectantes: adde insuper, quod in arteriis nullae sunt, & notare licet, quod canes, & boves omnes habent valvulas in divisione cruralium venarum, ad principium ossis sacri, vel in ramis illis prope cocendicem, in quibus nil tale timendum propter erectam staturam."

[76] The *regula* is on display throughout the *De motu cordis*; see especially Chapter 17.

[77] French 1994a, 85. French does mention Galen's *De placitis* and Plato's *Phaedrus* as being the root sources for this *regula Socratis,* but he does not go into much detail about the method therein contained, nor does he connect it with Harvey's *Prefatio* to the *De generatione.*

And, again, Harvey uses this method to great effect in the *De motu cordis:*

> Next, it is not difficult to see the same thing in all animals that have but one ventricle, or as it were but one, as toads, frogs, snakes and lizards, which, although they are said in some manner to have lungs…yet it is plainly to be seen from personal experience that in them the blood is transferred in the same way from the veins into the arteries by the pulsation of the heart and the way of it open, clear and manifest, presenting no difficulty and no place for indecision. For in these animals the case is as it might be in man were the septum of his heart perforated or taken away or one ventricle made out of the two; that done, I believe no man would then doubt by which way the blood could pass out of the veins into the arteries.[78]

So Harvey here collects observations on animals without lungs—his idea is that, since the pulmonary transit of the blood makes the movements of the blood difficult to follow, by looking in creatures without lungs, and in animals with only one ventricle, he will be able to more easily witness the transit of the blood from the veins to the arteries via the heart, just as Socrates could observe the city more easily than the soul. Furthermore, and getting to the heart of the *regula,* by understanding how hearts, veins, arteries, and blood vary in different animals, Harvey can come to find the true essence of the heart (its scientific definition) by abstracting to what is in common between all these kinds.

In this way he can come to learn not just the path of the blood's motions, but, furthermore, the use of the heart since, just as with the kidney's connection to the bladder, understanding that the heart transfers the blood from the veins to the arteries is central to understanding what its use is. Thus, on the basis of the evidence collected by following the rule of Socrates, Harvey concludes that since,

> …there are more creatures which have no lungs than there are which have them, and more which have but one ventricle of the heart than there are which have two, it is easy to

[78] Harvey 1628, Cap.VI, 33. "Idem etiam deinde in omnibus animalibus, in quibus unus duntaxat ventriculus, vel in quasi unus, non difficile est cernere, ut in bufone, rana, serpentibus, lacertis, quae etsi pulmones aliquo modo habere dicuntur, ut qui vocem habent…tamen ex autopsia eodem modo in illis e venis in arterias. Linguinem pulsu cordis traductum esse palam est, & via patens, aperta, manifesta, ulla difficultas, nullus haesitandi locus. In his enim perinde seres habet atque in homine, si septum cordis persotatum, aut ademptum esset, aut unus ex utrisque fieret ventriculus, quo facto, nemo credo deubitasset, qua via sanguis e venis in arterias transi epotuisset."

> conclude that in animals *for the most part,* usually and generally, the blood is sent from the veins into the arteries by an open way through the cavity of the heart.[79]

Notice the concern not just with the existence of the circular path of the blood here, but with the distribution of this feature in different kinds of animals, paying attention to how it varies, just as Aristotle would say, by the more and the less—indeed Harvey even uses here that curious Greek phrase *epi to polu*. With the accumulation of yet more evidence, of course, Harvey is able to conclude that the heart is for the sake of the circulation of the blood, and its action is thus the forceful systole. [80]

Now, while French is right that the rule of Socrates is supposed to help the anatomist obtain knowledge of uses and actions, this does not fully explicate the method and purpose of the *regula*—and in fact French misunderstands the details. Harvey, following Aristotle, thinks that it is important to look at how the part varies along all sorts of properties in order to determine its function; that is, knowledge of the function is the *goal*, not the *method*. Importantly, the variation is usually variation among those features I noted above from Harvey's conception of *historia anatomica*. Indeed, this method *per similitudinem* is a central feature of anatomical experiencing in general. The overall goal of anatomical experience is not just to learn the function, but, indeed, to learn the true essence and nature of the part of the body in question, both its formal and material nature. To understand this, one must first understand in more detail why Harvey calls this the 'regula Socratis' beyond the allusion to the Republic, noting that this goal can only make sense in light of certain philosophical views on the nature of definition and essence.

In Plato's *Phaedrus*, one finds Socrates arguing that some things are easily known, others under dispute, because how they are classified is obscure—one must therefore be trained to

[79] Harvey 1628, Cap.6, 33. "…maior numeris animalium non habentium pulmones sit, quam habentium, & similiter maior numers sit, unum tantum ventriculum cordis, quam habentium duos, proclive est statuere in animalibus *epi to polu* ut plurimum, & in universum, sanguinem aperta via e venis in arterias per cordis finum transmisti"
[80] See: Harvey 1628, Cap.17, 70-71.

recognize the forms of things. The method he uses is one in which, by interrogating various interlocutors, one can come to the definition of that thing, and thus he notes that rhetoric and medicine proceed alike. Socrates says that,

> Until a man knows the truth of the several particulars of which he is writing or speaking, and is able to define them as they are, and having defined them again to divide them until they can be no longer divided, and until in like manner he is able to discern the nature of the soul, and discover the different modes of discourse which are adapted to different natures, and to arrange and dispose them in such a way that the simple form of speech may be addressed to the simpler nature, and the complex and composite to the more complex nature-until he has accomplished all this, he will be unable to handle arguments according to rules of art, as far as their nature allows them to be subjected to art ….[81]

Now, set aside the specific method of division and definition that Plato uses and which Aristotle criticizes.[82] What is important is that this method of definition by differentiation is part of Aristotle's Platonic inheritance, and is at the core of his method, even if he disagrees with the particulars of Plato's account. Indeed, as Aristotle argues in the *Metaphysics,* there are two things that he owes to Socrates, namely two starting points of science: inductive arguments and universal definitions.[83] I have already argued above that *historia* are inductive, and so now I shall elaborate how the *regula,* as the method for collecting *historia,* combines induction and definition: in order to be able to define something, one must come to know its nature through 'several particulars.' The *regula Socratis* is as a method of induction by which one comes to form a true concept of the nature of a thing through its variations and so come to define it. The name of this rule aside, Harvey here follows Aristotle more than Socrates, for, as Louis Groarke has argued,

> If…Plato presents Socrates, the embodiment of dialectical philosophy, as the midwife who induces childbirth, it is the act of sense perception that becomes the midwife in Aristotle. In Aristotle, the observation of particular cases replaces Dame Philosophy as the impetus of knowledge. It is no longer philosophy understood as dialectic but the

[81] Plato, *Phaedrus,* 277c, Jowett Translation.
[82] On Aristotle's method of division and explanation, see Lennox 2001a.
[83] Aristotle, *Metaphysicorum,* Lib.XIII, Cap.4, 61v. Of course, induction (*epagoge*) is a vexed issue in Aristotle's works, but I set these aside as they are beyond my purview here.

> scientific examination of the physical world that brings us to a deeper understanding of reality.[84]

Induction, conception, and knowledge of nature all come together in the *regula.* The rule of Socrates underlines the deep and wide ranging importance of comparison for the anatomist: one compares one's own concepts about the natures of things with those of other anatomists and, more strictly speaking, one compares one's concepts *directly with nature itself*, across different animals, and across time in the form of embryological observations. It is only through experience of nature that one can acquire true and accurate concepts.

According to Galen, remember, to do proper science one must obtain the proper premises. In *De placitis,* Galen argues that, this being the case, anyone,

> …who tries to demonstrate anything, must first have learned the differences in the premises themselves; then he must have undergone long training… Suppose someone wishes to become [an arithmetician]: he first learns all the numbers which those people call 'square' and those others called 'oblong'; then he spends a very long time in the contemplation of multiplication and division….[85]

Galen here connects the method of anatomy to that of geometry, as Harvey does. What one has to do, in the case of anatomy, is learn the differences in the nature of living animal bodies in their union with soul. One does this through training, and this training can only be by experience of many kinds of animal bodies, cutting and observing them many times in order to become familiar with their variation and nature. Galen understands this process as one of differentiation of similars and dissimilars in the concepts of things perceived: determining natures on the basis of how things in the world are alike and unalike.[86]

In Book IX of the *De placitis,* Galen identifies similarity as the key culprit, as something that Hippocrates admitted could mislead and perplex even the good physicians. In order to

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[84] Groarke, Louis 2009, *An Aristotelian Account of Induction,* Montreal: McGill-Queen's University Press, 122.
[85] Galen, *De placitis*, Lib.II, Cap.3, 897. "Quamobrem quicunque aliquid conatur demonstrare, debet is prius sumptionum ipsarum differentiam probe tenere, deinde multa diuturnaque exercitatione id assequi…Supputator quis effici cupit, principio numeros omnes quos illi quadratos, vel parte altera oblongos nominant, ediscit; deinde non exiguum tempus in partiendi, & multipliciandi meditationem impendit…"
[86] Galen 1549, *De placitis,* Lib.IX, Cap.1, 1079-1090.

succeed in medicine, then, Galen argues that one must learn to discriminate similarity and difference within the natural world, for instance, learning whether a patients face was similar to his own face earlier or to healthy or diseased faces.[87] At this point in the chapter, Galen then quotes both the passages I noted above from Plato's *Republic* and the *Phaedrus,* and points to these as encapsulating the idea that the training of anatomical ability is fundamentally about the power to distinguish similarity and dissimilarity in things.[88] Echoing the passage from the *Phaedrus,* Galen concludes that any general method divorced from training in many particulars is insufficient to produce a true physician.[89] It is furthermore clear that this process of distinguishing similarities and differences is the same as the process of conception and definition, and Galen argues as much, pointing again to the *Phaedrus.* Harvey, following this hybrid Galenic-Aristotelian-Platonic method, understands long experience in the discrimination of similarity and difference in one's concepts as key to anatomical judgment and expertise. I turn now to explore Harvey's account of conception in more detail.

6.1.5. Harvey on Conception

It is at this point that Harvey's unified account experience and reason in anatomy becomes clear. Besides the passage described above wherein Harvey commends anatomists to form their own concepts from their own observations, Harvey talks about conception in two places: in the *Prelectiones* while discussing the use of the brain, and in the *Prefatio* to the *De generatione* where he lays out his Aristotelian conception of how the natural philosopher acquires knowledge

[87] Galen 1549, *De placitis,* Lib.IX, Cap.1, 1079-1080.
[88] Galen 1549, *De placitis,* Lib.IX, Cap.1, 1080-1088.
[89] Galen 1549, *De placitis,* Lib.IX, Cap.1, 1081. See also: Hippocrates*, De officina medici.*

of nature.[90] In the *Prelectiones,* Harvey first notes that, "…the action of the brain is sensation and the brain exists for the sake of sensation which constitutes the very definition of an animal."[91] He goes on and writes that,

> The utility [of the brain] is not only that it receives *species* given [by objects] but also it creates from these concepts, which is imagination, and to recall those, which are no longer present, which is memory. And only man [does this] to judge what he has recollected, and since it is to judge he relates many things that have happened to the present by this cognitive faculty. [With this faculty] he joins or separates [concepts] which he affirms or denies; he conceives, comprehends and defines. By affirmation and denial he demonstrates his ratiocination, for why, because this is in the highest degree the peculiar property of the rational soul.[92]

The picture here is the rather standard early modern Aristotelian account of the brain, and central is the idea that conception proceeds from sensation. The purpose of the brain here *just is* to create concepts and to recall them. The subjects of reason according to Harvey are these concepts, combined and remembered by the brain. And, importantly, Harvey here understands reason just to consist in affirming or denying what he has conceived, comprehended, and—importantly give the previous discussion—*defined*. But this short passage does not give one much in the way of helping understand the use of concepts in natural philosophy and anatomy. For this, I must turn to what he writes in the *Prefatio* to the *De generatione.*

Some have suggested that Harvey's philosophical remarks there are the writings of man past his prime, a man who could not admit the new philosophy but had nothing but rehashed Aristotle to serve to his reader.[93] Few have taken Harvey here at his word, and attempted to understand what he writes there as not only consistent with what he had elsewhere wrote, but as

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[90] I exclude his discussion of conception in *De conceptione,* which, though it is based upon mental conception in the way I discussed in the previous chapter, is irrelevant to my concerns here.
[91] Harvey 1616, 312. "Actio proinde cerebri sensus et cerebrum sensus gratia quo definitur animal."
[92] Harvey 1616, 314. "Utilitas non solum vero species reflexas concipit sed et facit ex conceptis, hoc est phantasia, et absentes revocat, et hoc est memoria, et homo unus hoc pro arbitrio quae reminiscentiae et quia pro arbitrio proponit cum diversa sint praeterita presentibus cogitativa; coniungit seperat quae affirmat negat; concipit intelligit definit. Affirmando negandoque ratiocinationem concludit quare cum hoc maxime proprium anima rationalis."
[93] Though there are worthy exceptions to this, perhaps most important is: Schmitt, Charles 1989, "William Harvey and Renaissance Aristotelianism: A Consideration of the Preface to *De generatione animalium*," In: *Reappraisals of Renaissance Thought,* Ed. Charles Webster, Variorum: Ashgate.

being central to his self-image of his own methods and philosophy. It sometimes seems as if those writing about Harvey are embarrassed for the old man and his unfashionable Aristotelianism. Here, however, I will attempt to take what Harvey writes there seriously, as a true attempt on Harvey's part to discuss how he conceived of his methodology. I am not so naïve to think that Harvey's self-understanding of his methods are identical to how he actually carried out all of his investigations, but I do think that they are a valuable insight into his conception of anatomy and its proper method and philosophical justification.

In the section of the *Prefatio* headed 'On the manner and order of attaining knowledge,' Harvey writes that there is but,

> …one road to knowledge, namely that by which we proceed from things more known to things known less, and from things more manifest to those that are more obscure, and though universals are chiefly known to us (for knowledge is acquired by reasoning from universals to particulars), yet that same comprehension of universal in the understanding springs from the perception of singulars by the senses.[94]

This is the quite traditional Aristotelian problem of making harmonious the doctrines of the *Physics* and the *Posterior Analytics* on whether one should proceed from universal to singular or singular to universal. Harvey first quotes Aristotle as arguing that, "Those things are first perceptible and manifest to us which are most confused. Therefore we must advance from universals to particulars…."[95] He then quotes what he says is a passage from Aristotle's *Analytics:*

> Singulars are more known to us and do first exist according to sense, for nothing is in the understanding that was not before in the sense. And although that ratiocination is naturally first and more known which his made by syllogism, yet that is more conspicuous to us which is made by induction; and therefore we define singulars with

[94] Harvey 1651, *Prefatio,* B2. "… ad scientiam quamlibet via unica pateat, qua nempe a notioribus ad minus nota, & a manifestis ad obscuriorum notitiam progredimur; atque universalia nobis praecipue nota sint (ab universalibus enim ad particularia ratiocinando, oritur scientia) ipsa tamen universalium in intellectu comprehenso a singularium in sensibus nostris perceptione exsurgit."

[95] Harvey 1651, *Prefatio,* B2-B2v "Ea vero sunt nobis primum perspicua & manifesta, quae sunt magis confusa. Idcirco ab universalibus ad singularia progredi oportet"; Aristotle 1559, *Physica* Lib.I Cap.3 (Cap.1 in modern editions), In: *Opera omnia* Vol.4, 4v. "Quapropter ex universalibus ad singularia procedere oportet." Plainly Harvey was not quoting this edition of Aristotle.

> more ease than universals for there lies more equivocation in universals. Wherefore we must pass from singulars to universals.[96]

Harvey here explicitly connects induction to definition, in just the way I have elaborated. Further he notes that, though the Peripatetic seems to endorse contradictory views at once, in fact, the doctrines of the *Physics* and the *Posterior Analytics* hang very well together. The issue is a familiar one: given that, according to Aristotle, certain knowledge is gained by demonstrative syllogism, built upon certain premises, how can one gain knowledge of these premises, which must themselves be indemonstrable? Harvey responds to this dilemma by referring to the two main places where Aristotle discusses the role of experience in art and science, *Posterior Analytics* II.19 and *Metaphysics* I.1. In the *Metaphysics* passage, Aristotle argues that experience begets art and science; it is their foundation, a position fundamental to Harvey's conception of anatomy, as I have argued. And in the *Analytics*, he lays out the way in which this happens through the process of memory formation. Harvey characterizes Aristotle here in the following way:

> Memory is therefore made from sensation, as we say, and out of the repeated remembrances of the same thing is made experience (for a great number of remembrances make up one experience). But out of experience, or out of a universal whole resting in the soul (namely out of one which is distinct from the many particulars and is one and the same in all of them), is created the first principle of art and knowledge, or art if it relate to creation (that is to doing or effecting), of knowledge if it pertains to that which is (that is to the cognition of an entity). And so the habits we speak of are neither innate in us, nor are they made from other and better known habits, but they proceed from the senses.[97]

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[96] Harvey 1651, *Prefatio,* B2v;. "Singularia nobis notiora, & secundum sensum priora existunt: siquidem nihil est in intellectu, quod non prius fuerit in sensu. Et licet ratiocinatio naturaliter prior * notior sit, quae per syllogismum instituitur; nobis tamen illa perspectior est, quae sit per inductionem: ideioque facilius definimus singularia, quam universalia; latet enim magis aequivocatio in universalibus; quapropter a singularibus ad universalia transeundum est." Harvey says this is from the *Analytics,* but the passage as he quotes it cannot be found; the closest is a passage from the end of Cap.13 (Cap.8 in Aristotle 1552, V.0, 229). "Omnis autem definitio semper est universalis: et hoc, quoniam medici nn definiunt in medicina hunc oculum, sed omnem, aut illum, qui distinguitur specie, & definire singular, facilius est; que definire universale & propter hanc causam oportet ut transferamur a rebus particularibus & singulis ad res universales: & hoc, quoniam aequivocio decipit magis in universalibus, que decipiat in indifferentibus."

[97] Harvey 1651, *Prefatio,* B4v. "Ex sensu igitur fit memoria, quemadmodum dicimus: ex memoria vero saepe ejusdem rei facta, fit experiientia (multae enim numero memoriae, sunt una experientia.) At vero ex experientia sive ex omni & universali quiscente in anima (nimirum uno praeter multa, quod in omnibus illis inest unum & idem) fit

Note first that Harvey here seems to endorse the exact same sort of picture I described above, wherein developing the faculty of anatomy involves art, knowledge, and repeated use of the senses. Harvey's idea based upon Aristotle's is that repeated experience forms memory, and from memory comes experience, and from this experience comes a universal that is a first principle to be used in arguments. Furthermore, in that same chapter from the *Posterior Analytics* that Harvey has quoted, Aristotle writes:

> We must start by observing what is similar and indifferent: first, that which they all have in common, then again in things which are in the same genus as them, and which are the same species, but which are different from them. When in these that have been assumed the same, and others similarly, we must consider in the things assumed whether it is the same, until we arrive at the reason, and this will be the definition.[98]

So Aristotle, too, fits into the tradition where sensation, conception, and organizing concepts into definitions on the basis of similarity and difference. For Harvey, these first principles are nothing other than the results of *historia* described above: using the skill and concepts gained by manifold *experientia*, the anatomist proceeds by means of similarity relations, that is, he follows the *regula Socratis,* until he can furnish those scientific definitions that must be used as premises in scientific demonstrations.

Remember from above that Harvey uses the term 'Porismata' in Ex.25 of the *De generatione* to signal the transition from *historia* to generalizations and causes: it is no coincidence that the Greek verb from which it derives has the sense of 'furnishing', for the collected *historia* delivers just those premises which have been furnished by experience. So sensation and reason combined in experience furnish definitions: reason, in effect, collates by

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principium artis, & scientia: artis si pertineat ad generationem (viz. agenda, vel efficienda) scientiae, si pertineat ad id quod est (viz. cognitionem entis.) Itaque, nec insunt definiti habitus, nec fiunt ex aliis habitbus notioribus, sed ex sensu."

[98] Aristotle 1552, *Posteriorum,* Lib.II, Cap.8 (13 in modern editions), Vol.I, 228. "Quaerere vero oportet inspicientem ad similia & indifferentia: primum quid omne idem habent, postea rursus in alteris, quae in eodem quidem genre sunt cum illis: sunt autem ipsis quidem eadem specie, ab ilis autem altera: quando autem in his acceptum fuerit aliquid omnino idem, & in alijs consimiliter in acceptis omnino considerare si idem, quousque ad unam devenerit rationem, haec enim erit rei definition."

similarity the multiplicity of prior sensations that have been rendered into concepts and held in memory.[99] Experience, in the sense I have described, is thus the basis for scientific knowledge, and Harvey expresses this idea in a distinctly Aristotelian manner.

Relevant to these matters, Harvey lays out the schema discussed in the previous chapter, wherein a natural object observed is the informing form which when taken in by the senses and abstracted by the mind becomes a concept, an *eidos,* to the viewer; the former is a singular, natural object, the second a universal mental one.[100] Harvey argues that since universals are derived from singulars through the senses in this way, sensation itself is thus a universal because what is abstracted from that singular is a universal. This being the case, it is a universal that is judged and apprehended [*judicatur et intelligitur*] by the intellect. Harvey is suggesting here that it is the process by which one comes to form a universal wherein lies the root of debate and error in anatomy—for if an anatomist is not properly trained by experience, he might be led into error, since what is given by sense is, 'clearer and more perfect' and that retained in memory and which belongs to the mind is 'more obscure.'[101] Thus, Harvey argues without frequent observation, our judgments are based not on the things themselves, but on the phantom concepts left behind in our minds.[102] The key to nailing down these concepts is to repeatedly encounter the world itself through anatomical experience.

6.2. CERTAIN SOURCES OF CERTAINTY

Though calling Harvey's epistemology 'sensory' is not quite right, sensation is of fundamental importance in understanding why Harvey is so sure of his anatomical work. As it turns out, the

[99] Harvey 1651, *Prefatio,* B3v. In the Thomistic context, see: Stromberg 1967, 85
[100] Harvey 1651, *Prefatio,* B3v
[101] Harvey 1616, *Prefatio,* B3v
[102] Harvey 1651, *Prefatio,* B3v.

source of Harvey's certainty in his results are founded upon two things: what Galen calls the 'natural criteria', which are the senses inner and outer, and his experiments, which I argue are tests of the definitions that are the goal of anatomical skill.

6.2.1. Natural Criteria

Remember, from above, that Harvey linked the certainty of experience to the certainty found in geometry. In this section, I describe the sources of that certainty, what I call the natural faculties and Harvey's experiments. Doctors, Galen chief among them, are a practical sort: though Galen was involved in complicated epistemological arguments with Skeptics, Stoics, and Peripatetics, he refused to be drawn into what he views as sophistry, the view that there could be some purely logical investigation of perceptual facts.[103] Now for Galen, there are two sources or origins of proof, namely, those things that are apparent to the senses and those which are apparent to the intellect.[104] Hankinson describes the latter as including various axioms such as nothing happens without a cause and various mathematical truths, a mixed bag of *a priori* metaphysical claims.[105] But no empirical science can be founded entirely on *a priori* truths, and thus there must be some perceptions that are self-evident, from which one can base one's arguments. Galen argues that both these origins are found in what he calls the natural criteria, and that these are the true starting places of scientific knowledge:

> I say to you that the truth about objects of inquiry will be found, first, when you know the beginning of the road to it; for if you miss the beginning, you will arrive at great confusion and error in your reasoning. The next after the beginning you will discover by the same criteria by which you discovered the beginning, and then similarly the third and each succeeding. How then can the beginning be found?...If we have no natural criterion, we shall not be able to find a scientific criterion either; but if we possess natural criteria,

[103] Hankinson, R.J. 2008, "Epistemology," In: *The Cambridge Companion to Galen*: Cambridge, Cambridge University Press: 158. See also: Galen 1549, *De temperaturis,* Lib.I, in: *Opera Omnia* Vol.1, 35.
[104] Galen 1549, *De methodis medendi,* Lib.X, In: *Opera Omnia* Vol.6.
[105] Hankinson 2008, 159.

> we could find some scientific criterion as well. Do we possess any natural criteria common to all men?... I say that you all do have natural criteria…What are these criteria? Eyes in their natural state seeing what is visible; ears in their natural state hearing what is audible; the tongue sensing savors, the nostrils odors, the whole skin objects of touch; and besides, thought or mind or whatever you wish to call it, by which we distinguish entailment and incompatibility and other things that pertain to them, such as division and collection, similarity and dissimilarity…[106]

The beginning, then, of science and the achievement of scientific knowledge, is to be found in these criteria—for it is these criteria by which one can come to know how things are in the world and by which one determines similarities and differences; these criteria are the epistemic foundation of the *regula Socratis*. As Galen writes, "…to achieve a precise discrimination of likes and unlikes [i.e., similarity and difference] one must begin the investigation of them from natural criteria, which are sense-perception and thought; and the latter…you may call intellect, mind, reason…For just as sense-perception is the criterion of sensibles, so there is another faculty for the intelligible…"[107] One can thus use one's mental criteria to begin to understand and classify one's observations, to recognize the similarities and differences in them and thereby come to universal definitions.

But on what grounds are these criteria to be trusted? Following Hippocrates, it seems, Galen merely says that nature has gifted mankind with such trust:

> How does Hippocrates say that the nature of things is discovered? If we begin with what is 'greatest and easiest': greatest in its use, easiest with reference to our knowledge [of it]. For nature gave us a double gift: the criteria themselves, and untaught trust in them. The criteria themselves are the sense organs and the faculties that employ them; the trust in them, unlearned and natural, belongs not only to men but also to other animals.[108]

One's faith in one's eyes and mind, then, is something not learned, but is by nature. Galen's practicality comes to the fore, as he finds disputing complete skepticism of no worth. Indeed, in

[106] Galen 1549, *De Placitis*, Lib.IX, Cap.1. Because the copy of the 1549 edition of Galen I have access to is unreadable in this and the following two passages, I have been unable to obtain the Latin, though I have cited this version for the sake of consistency. I have taken the liberty of quoting instead from the Phillip De Lacey three volume translation: (1978-1984), *On the doctrines of Hippocrates and Plato,* Berlin: Akedemie Verlag.
[107] Galen 1549, *De placitis,* Lib.IX, Cap.1 (De Lacey)
[108] Galen 1549, *De Placitis*, Lib.IX, Cap.1. (De Lacey)

much of the *De placitis,* and in other works, Galen appears to argue that much of the academic debates of the philosophers on these issues are terminological ones, and not interesting debates at that.[109] Instead, Galen would rather follow Hippocrates, and believe that the natures of everything are untaught, and, further, to be heeded. Following Hippocrates, Galen thinks of experience as the teacher of reason—reason is taught the natures of things through the senses, and it is about these natures that reason works its inferential magic.[110] This is Harvey's model, where experience is thought of as a teacher, as the origin of facts and the source for scientific knowledge when combined with reasoning about similarity and difference. Now it should be stressed that just because one has faith in the natural criteria, this does not mean that one doesn't have to learn to use them correctly; especially in the context of anatomy, in order to use your eyes, you must first cut open the body, and perform other maneuvers, in order to get into the right position to produce the right sorts of observations. As Galen notes in the *De placitis,* there are a number of types of experience, and the one needed for scientific knowledge is *technical experience*, that is, anatomical experience, which, of course, requires a great deal of training and manifold experience. *Experientia* for Harvey should not be understood, *pace* Peter Dear, as everyday experience that anyone could have—rather, it is the result of long training and practice.

Of course, Galen does sometime offer directly arguments for this position, for instance arguing that the success of the productive arts would have no explanation if perception and the natural criteria misled—and since they are successful, one should trust in them. Hankinson further adds that Galen thinks that, "…we can perhaps doubt them [the natural criteria]; but there is nothing by which they can be judged, since they are themselves the source of all judgment."[111] So one cannot doubt the senses without undermining all knowledge, and Galen is much too practical to fall into that trap, even if his arguments don't always succeed in establishing this

[109] For instance, see the rest of Lib.IX of *De placitis*
[110] Galen 1549, *De placitis* Lib.V, Cap.5.
[111] Hankinson 2008, 163.

absolutely (or even convincingly). But remember from above that I suggested that for Harvey the faculty of anatomy is one of judgment—and that these judgments are based in experience. In turn, the authority of experience is founded on the authority of these natural criteria, naturally functioning eyes, hands, and minds.

Harvey very often talks in just this way, about how experience from one's own eyes—*autopsia*—is the best source of knowledge. Indeed, his sensory epistemology, as it has been called, has been called 'the most important epistemological discovery of the seventeenth century.'[112] But as I have shown, Harvey's conception of experience is not so far removed from that of the Ancients, and his conception of the relation between reason and experience has much in common with Galen's and with Aristotle's. Indeed, Harvey echoes Galen's belief that there can be no logical *a priori* science of nature when he writes, "Truly, as Fabricius rightly advises, let reason be silent when experience gainsays it. The too familiar vice of this age we lie in is to give out as infallible truth, idle drams built upon conjecture and slender reasoning, without the testimony of the eyes." [113] Now, Harvey is not here railing against metaphysics or the use of reason—rather, he is making the much subtler point that reason untutored by experience can hardly be thought to accurately represent the phenomena—for what are they *about* if not whatever the senses have provided? He is illustrating exactly the conception of anatomy argued for above, an epistemological model indebted to the tradition of the physicians and Galen. The central idea here is that one's eyes, one's sensory capacities, must be the source of the natures of things, for there is no other sort of evidence that could so serve. As Harvey himself notes in his second letter to Riolan,

> Silly and inexperienced persons wrongly attempt, by means of dialectics and far-fetched proofs, either to upset or to establish which things should be confirmed by anatomical

[112] Wear 1983.
[113] Harvey 1651, Ex.11, 32. "Veruntamen (ut recte monet *Fabricius*) *ratio omnis conticeseat oportet, ubi experientia refragatur*. Vitiumque hujus seculi est nimis familiare; phatasmata, ex conjectura, levique ratiocinio (sine oculorum testimonio) nata, pro manifesta vertate obtrudere."

> dissection and credited to personal experience…Who will persuade those who have never tasted that wine is sweet and far surpasses a drink of water? With what proofs will he convince those who are blind from birth that the sun is bright and more splendid than all the stars?[114]

Harvey's problems with his critics, then, is roughly analogous to the problem Galen had with Chrysippus in the *De placitis*: namely, they are simply using the wrong sorts of premises in their arguments, where they use speculation they should be using observation. They are attempting to understand nature without having learned from nature itself—they have not properly trained themselves by immersing themselves in anatomies and observations. Thus when one looks to the *De motu cordis,* one should not be surprised that Harvey makes reference to his eyes and to ocular experiments*,* and so on, no less than nine times, [115] referring to sensation no less than ten times.[116] Harvey is constantly repeating thought this work that the true philosopher will not believe the precepts of others by ceasing to "…give credence to their own eyes," and that the senses can bring certainty, especially when one has performed an ocular test.[117] And, what is more, Harvey combines his faith in his sensory faculties with that in his rational ones, often stating that what he has seen with his eyes accords with reason.[118] He is, in other words, constantly proving his expertise and long training, which training has afforded him expert anatomical judgment and skill.

And thus Harvey's faith in the testimony of his natural criteria, both reason and sensation, is a match to Galen's, and, indeed, in the *Dedicatio* Harvey, following in his footsteps, refuses to be drawn into meaningless debates of the philosophers, professes that he shall, "….both to learn and to teach anatomy, not from books but from dissections, not from the sayings of the

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[114] Harvey 1649, 95-96. "Perperam, anatomica dissectione confirmanda et *autopsia*, quae sunt credenda, inepti et inexperti dialecticis et longe petits argumentis conantur vel evertere vel stabilire… Quis vinum dulce [esse], multumque aquae potum antecellere, iis qui nunquam degustarunt, persuadebit? Quibus argumentis, solem esse lucidum et supra omnes stellas splendentem, a nativitate caecis confirmabit?

[115] Harvey 1628, 5, 6, 7, 33, 35, 47, 48, 55, 70.

[116] Harvey 1628 6, 7, 40, 44, 45, 62, 63, 70, 71. In Cap.XI, Harvey even refers to the sensation that a person being ligated would feel after the ligation is loosened.

[117] Harvey 1628, *Dedicatio,* 7. "…ne oculis propriis fidem adhibeant…" On a certain experiment see Cap.4, 27.

[118] So, e.g., "…& ratione & sensu patet…" Harvey 1628, Cap.7, 40.

Philosophers but from the fabric of Nature."[119] The reason why experience is so important is that without it one can never know the way things are actually arranged in the empirical world. Indeed, Harvey seems to treat the limits of his vision as the limits to nature itself, which, as noted in the previous chapter, had dramatic consequences for his understanding of fertilization.[120]

So if one wants to come to an understanding of the causes of the way things are in the natural world, in Harvey's case, the causes of the parts, one must of course use reason, but only once trust has been given to one's senses—for one moves from what is better known and closer to oneself to what is less known and farther. As Harvey writes in the second letter to Riolan,

> According to this example, things abstruse and remote from sense become better known from things more evident and better known. Aristotle advise us much better, in discussing the generation of bees (*De generatione animalium,* Book 3, Chap. 10): he says, "*Faith should be given to reason if those things which are being demonstrated agree with those things which are secured by sense: when those things have been sufficiently tested, then trust should be given to sense more than to reason*." From which we ought to approve or disprove or reject everything by means of a very fine-grained examination: to test and truly examine whether things are said correctly or incorrectly, we ought to be drawn to sense, to proof and establishment by the judgment of sense, where, if there is some falsehood, it will not remain hidden. Whence Plato, in the *Critias*, states that it is [not] difficult to explain things of which we can have experience.[121]

The chief lesson here is that, following Plato, Harvey views experience as a prerequisite to explanation. Critias, in that dialogue, asserts that in those things which one has great experience in—the appearance of other human beings, say—one can very easily judge that thing and explain it, so, one can easily criticize and correct a painting of human being that does not resemble one.

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[119] Harvey 1628, *Dedicatio,* 8. "Tum quod non ex libris, sed ex dissectionibus, non ex placitis Philosophorum, sed fabrica naturae discere & docere Anatomen profitear."

[120] So, for instance, Harvey states in Cap.17 of *De motu,* that various parts, including "…the two orders of vessels are so much alike that it is impossible to distinguish between them with the eye." (Harvey 1628, Cap.17, 70.)

[121] "Harvey 1649, 98-99. "Ad cujus exemplar, abstruse et a sensu remota, ex apparentibus manifestioribus et notioribus, inotescunt. Melius multo Aristoteles non [*sic*, this must be a mistake, perhaps the missing non from the sentence starting *Unde Plato…*] admonet (De generatione animalium lib. iii. cap. 10), de generatione apum disputans: *rationi fides adhibenda*, inquit*, si, quae demonstrantur, conveniunt cum iis quae sensu percipiuntur rebus: quae cum satis cognita habebuntur, tum sensui magis credendum quam rationi.* Unde probare vel imporbare vel reprobare omnia ab examinatione minutim facta debemus: examinare vero et experiri an recte an perperam dicta sint, ad sensum deducere oportet, et sensus judicio confirmare et stabilire; ubi, si quid fictum, non latet. Unde Plato, in Critia, difficilem esse earum rerum explicationem asserit, quarum experientiam habere poterimus."

But for things that are epistemologically more remote, such as the heavens, one must be content with what explanations one can mount given limited experiences with that subject.[122]

Finally, Harvey states here that one ought to approve or disapprove of everything on the basis of tests. So, having discussed the natural criteria and their role in giving certainty, I turn to an analysis of the role of tests, of *experimenta,* and their role in giving certainty to those things approved or disapproved.

6.2.2. Experimenta

In this section I argue that an experiment should be understood as a test of a specific claim by means of a particular observation or set of observations that confirm or disconfirm the claim. These claims deal either with testing the definition of a part or phenomenon, or with the logically prior claim *that* the phenomenon exists. Along with personal sensory experience from the natural criteria, tests are the source of Harvey's certainty in his claims. What is important to remember here is that Harvey's experiments are not *experimenta* on the basis of the fact that they are *manipulations* or that they are *controlled* and so on, as modern conceptions of experiment might have it, but rather, they are experiments because they use observations to judge the truth of a particular claim, a particular hypothesis. Manipulation is central, of course, but only insofar as it helps the anatomist test the truth of that claim, making it apparent to all who witness the test whether the claim is true or false.

[122] The line from *Critias* is, "For if we consider the likenesses which painters make of bodies divine and heavenly, and the different degrees of gratification with which the eye of the spectator receives them, we shall see that we are satisfied with the artist who is able in any degree to imitate the earth and its mountains, and the rivers, and the woods, and the universe, and the things that are and move therein, and further, that knowing nothing precise about such matters, we do not examine or analyze the painting; all that is required is a sort of indistinct and deceptive mode of shadowing them forth. But when a person endeavours to paint the human form we are quick at finding out defects, and our familiar knowledge makes us severe judges of any one who does not render every point of similarity. And we may observe the same thing to happen in discourse; we are satisfied with a picture of divine and heavenly things which has very little likeness to them; but we are more precise in our criticism of mortal and human things." (Jowett Translation).

In the Ancient world, the Empiric sect discussed by Pomata above claimed to entirely forgo reason (*logos)* in favor of their conception of test (*peira)*. According to the Empirics, there are three senses of *peira,* of a test:

1. Casual or chance tests, as when you find entirely by accident that an herb cures some malady.
2. Intentional tests, where you use a particular herb applied to a wound thinking that it will help heal it more quickly.
3. Imitative tests, where you use an herb because it helped in similar, but not identical, situations.[123]

According to the Empirics, these observations could come from *autopsia,* that is, from personal experience, or they could come from the reports of others, what would become known as *historia* in the Galenic tradition. In works like *De sectis*, this conception of experiment came in for harsh criticism by Galen for not using experience guided by reason.[124] But though they disagreed upon the use of reason, common to both the Empirics and to Galen, however, was the conception that experience is used to test claims.[125]

Among Galenic medical writers in the late Renaissance, this practice of collecting observation became somewhat more formalized into what one might call case-books, which were records of patients, their ills, and the various treatments and effects thereof that the physicians witnessed. These reports, known in the medieval period as *exempla* and *experimenta,* become conceived of as part of the category of *historia.* As Pomata and Siraisi note, this practice stems in part from new attention from texts like the Hippocratic *Epidemics,* "…which gave large space to the empirical report of individual cases, as well as to the Galenic writings on the ancient medical sect of the Empirics, both of which were crucial for retrieving the ancient empiricist notion of

[123] Galen discusses this in *De sectis,* See also: Pomata 2011, 7.
[124] See, for instance, Galen 1549, *De Sectis ad eos qui introducuntur*, Cap.I, II, etc., *Opera Omnia*, Vol.O.
[125] See *De placitis,* Lib.I, II; see also, Tieleman, Teun 1996, *Galen and Chrysippus on the Soul*, Leiden: E.J. Brill, 13-16.

historia as the report of direct (or indirect) observation."[126] These case studies became *historia medica*, and the word *historia* became synonymous with *experimentum* among certain Galenic medical writers. That is, somewhat like Glisson writing later in the seventeenth century, *historia* are, "plena enumeratio experimentorum,"[127] although for the Galenics and for Harvey only in part, as *experimenta* do not exhaust the contents of *historiae*. Harvey conceives of an *experimentum* as a particular observation or set of observations gathered from anatomical experiences by means of some specific procedure, and which are meant to test the truth of a particular hypothesis or claim characterizing a state of affairs. These claims are derived from the definitions Harvey has discovered through experience, or they are for the purpose of establishing that some phenomenon exists; so: that the blood has this and that nature, or that there exists a circuit of blood. They are often used for resolving a traditional problem discussed by physicians and philosophers, such as the proper description of systole and diastole.

Take the practice of ligation, the tying off of an artery. Not every instance of this procedure is an experiment, for instance, ligations performed in service to surgery, or in demonstration of how to ligate an artery properly. Rather, only those times when a ligation is performed *and* observations of its effect are made in reference to a specific claim is such a procedure an *experimentum*. So, while ligation during a surgery might not be an *experimentum,* if one later uses observations from that surgery to prove some particular fact or to establish that some state of affairs obtains, then what had been an observation has now become an experiment. *Experientia* is the larger category here, containing *experimenta* and providing the basis for further experiments in a recursive way—experience begets experiments begets experience begets experiments *ad infinitum.* And although one might single out the fact that some of Harvey's *experimenta* are properly *interventionist,* and are thus true scientific experiments, what must be

[126] Pomata, Gianna and Nancy G. Siraisi 2001,"Introduction," In: *Historia: Empiricism and Erudition in Early Modern Europe*, Eds: Gianna Pomata and Nancy G. Siraisi. MIT Press: Cambridge, 13
[127] Pomata 2005, 113. She references British Library, Sloane Collection, MSS of Francis Glisson, MS 3315 n. 381.

remembered is that this 'interventionist' aspect of Harvey's work, while important, is actually a result of the demand that *experimenta* produce observations relevant to a specific claim*:* thus letting blood cool and watching what happens is as much an experiment to Harvey as ligating an artery, so long as it tests some particular claim. This often leads Harvey to perform tests that, from the historical perspective, are badly designed and don't truly test what they are supposed to.[128] I turn now to look in detail at Harvey's experiments.

6.2.3. Harvey's Tests

At the beginning of Chapter Nine of *De motu cordis*, Harvey writes that there are three things that ought to be proved (*tria confirmanda veniunt*), namely,

(1) First, that the blood is continuously and uninterruptedly transmitted by the pulsation of the heart from the vena cava to the arteries in such amount that it cannot be supplied from what is taken in, and thus in such a way that the whole mass passes through in a short amount of time
(2) Second, that the blood is continuously, evenly, and uninterruptedly driven by the pulse of the arteries into every member and part, entering each in far greater amount than is needed or can be supplied to it by the whole mass of blood.
(3) Third, similarly, is that the veins themselves are constantly returning this blood from each and every member to the region of the heart.[129]

The conclusion, of course, is that the blood moves in a circuit around the body, from the heart to the extremities and back again. This list of suppositions to be demonstrated through experiment is a test of the existence and nature of a certain phenomenon, establishing that the blood moves

[128] "E.g., Harvey 1651, Ex.52, 154, where Harvey states that the current work is not the place to relate these tests: "Experimenta, in sententiae hujus confirmationem, hic addenda non censui; peculiarem enim tractatum postulant." The claims in question concern the relation between life and a want of blood in animals. So, although usually his meaning is clear, I must on occasion make a reasonable guess.

[129] Harvey 1628, Cap. 9, 43. "Primum continue & continenter, sanguinem e vena cava in arterias, in tanta copia, transmitti, pulsu cordis, ut ab assumptis suppeditari non possit, & adeo ut tota massa brevi tempore illinc pertranseat. Secundum continue aequabiliter & continenter sanguinem in quodcunque membrum & partem pulsu arteriarum impelli & ingredi, maiori copia multo, quam nutritioni sufficiens sit, vel tota massa suppeditari possit.
Et similiter tertio ab unoquoque membro, ipsas venas, hunc sanguinem perpetuo retroducere ad cordis locum."

from here to there, and back again. In reference to the first proposition, Harvey at the beginning of Chapter 10 writes that,

> Thus far then the first proposition has been proved both by an appeal to calculation and by reference to tests and personal experience, that is to say, the proposition that the blood passes into the arteries continuously and in greater abundance than can be furnished by the food eaten and in such a way, seeing that the whole mass of the blood passes through in so short a time, that it needs must be that the blood makes a circuit and returns.[130]

Again, one finds here the three types of evidence Harvey cited in the *Prelectiones:* reason (in the form of calculation, *cogitatione*), personal experience (*autopsiam*) and experiment. Now, while the first two are used to prove the first proposition, only the *experimenta* are *tests* of the proposition, that is, the sort of evidential weight it holds is different from that afforded by personal experience or calculating. The nature of an experiment is such that it directly tests the truth of some claim, making its truth literally evident to the senses—it is meant to show that it could not be otherwise than as Harvey describes.[131] Of course, the experiment can be a bad one, and one might often question whether the experiment truly tests the phenomenon in question. Harvey, however, does not consider these possibilities, at least in his written descriptions of experiments.

Instead, Harvey always emphasizes the certainty of claims that have been proven by experiment, and along with the natural criteria, it is the source of Harvey's epistemological certainty. So the situation is something like this: personal experience provides definitions and facts gathered from expertise at anatomical dissection and observation, and from this he can derive claims to test via some experiment. For instance, at the beginning of Chapter Eleven of *De motu*, before he gets into the most famous of his ligature experiments, Harvey writes that,

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[130] Harvey 1628, Cap.10, 46-47. "Hactenus primum suppositum confirmatum est, sive res ad calculum revocetur, sive ad experimenta, & autopsiam referatur videlicet: quod sanguis pertranseat in arterias, maiori copia continue, quam ab alimento suppeditari possit, ita ut tota massa brevi spatio illac pertranseunte, necesse sit, ut circuitus fiat, & sanguis regrediatur."

[131] Or at least, this is how Harvey (and others) envisioned *experimenta,* though for Duhemian-Quinean reasons one might doubt the veracity of this conception.

> That the second proposition that I have to prove may prove more clearly to those who are considering the matter, some experiments [*experimenta quaedam*] are to be taken note of which show plainly that the blood enters every member of the body through the arteries and returns through the veins, and that the arteries are the vessels which carry the blood away from the heart and that the veins are the vessels and ways by which the blood returns to the heart itself.[132]

Harvey then writes that, these things being proved it is manifest [*manifestum est*] that the blood must move in a circuit around the body. Further, if one adds in the additional premise of the calculation from the previous chapter, one can't help but conclude that the amount of blood cannot be supplied from food or be required by nutrition—it is manifestly certain to sense.

The most common instances where Harvey uses *experimentum* involve ligation, but this does not mean that only ligation counts as a test.[133] So far as I have been able to tell, Harvey refers to eighteen different procedures explicitly as *experimenta*:[134]

1. As already mentioned, one involves letting extravasated blood cool;
2. Another involve further tests regarding extravasated blood;
3. He refers to a test performed in a tree to see if nutriment is brought by the skin;[135]
4. Harvey refers to a test performed by Fabricius concerning the fertility of Hens;
5. He refers to the use of a magnifying glass to observe the developing fetus as a test.
6. He describes a test of housewives to tell fertile from infertile eggs;
7. He mentions 'tests with eggs' testing the relation between heat and life;[136]
8. He describes pricking his finger with a needle coated in spider poison as a test;[137]
9. He describes an test done by probing the *punctum saliens,* the first spot of living blood in the egg[138];
10. He describes observing the progress of the conception in the womb to discover which parts are used for nutrition, etc., as a test;[139]

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[132] Harvey 1628, Cap. 11, 48. "Secundum confirmandum a nobis, quo clarius intuentibus appareat, annotanda sunt experimenta quaedam, ex quibus patet sanguinem in quodcunque membrum per arterias ingredi, & per venas remeare, & arterias vasa esse differentia sanguinem a corde, & venas vasa, * vias esse regrediendi sanguinis ad cor ipsum."

[133] In what follows, I am being somewhat strict in only counting instances of the actual word *experimentum,* and of the verbal form, *expertus sum.* I do not, therefore, include terms that might reasonably be equated with these words, such as *observatio.*

[134] Besides the possibility of being incomplete, there may be other words that might reasonably be translated as a test or experiment. Furthermore, there are instances in especially the *De generatione* where Harvey uses *experimentum* or *experior* but does not provide any details as to the nature of the experiment, and thus I have neglected these instances. One prime example concerns the passage in Chapter Nine of the *De motu cordis,* where Harvey mentions that one might estimate the quantity of blood in the dilated left ventricle *vel cogitatione vel experimento,* but he never details how, or if, he performed such a test.

[135] Harvey 1616, 39.

[136] Harvey 1651, Ex.51.

[137] Harvey 1651, Ex.57.

[138] Harvey 1651, Ex.17

11. He describes as a test feeling and seeing the movements of a living dogs guts;[140]
12. He describes cutting the artery in the neck of a sheep and watching the blood drain a test;[141]
13. He describes a test upon a dove where he used his finger to warm the heart and cause it to move;[142]
14. He describes boiling an egg to distinguish its liquors as a test[143];
15. He describes a test which involves filling a dog's extracted intestines with water;[144]
16. He describes a test in which he probes a vein from both sides of a valve;[145]
17. He mentions numerous times Galen's *experimentum cum fistula,* which involves inserting a tube or reed into an artery[146];
18. And last but not least, the ubiquitous tests using ligation, and which also often involve vivisection.[147]

I shall now go through a few of these procedures and demonstrate how they conform to the pattern described above, leaving the establishment of this pattern for the rest as an exercise to the reader.

Before I begin, however, there are two things to note. First, consider this passage from the letters to Riolan. The passage concerns sensation and experience generally, but I think it is also a good starting place for understanding the function of *experimentum.* Harvey writes:

> …we ought to approve or disprove or reject everything by means of a very fine-grained examination: to test and truly examine whether things are said correctly or incorrectly, we ought to be drawn to sense, to proof and establishment by the judgment of sense, where, if there is some falsehood, it will not remain hidden.[148]

Experiments are filters; they are tests by which one can sieve out all the falsehoods hidden in one's beliefs. And here Harvey explicitly links detailed sensory examinations (*examinatione minutim*) as a test (*experiri*) of whether some stated proposition is correct or incorrect (*an recte*

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[139] Harvey 1651, Ex.70.
[140] Harvey 1651, Ex.68.
[141] Harvey 1628, Cap. 1.
[142] Harvey 1628, Cap.4.
[143] Harvey 1651, Ex.22.
[144] Harvey 1649, First letter.
[145] Harvey 1628, Cap.13
[146] Harvey 1616, 268.
[147] I include under ligation experiments that Harvey refers to that involve only squeezing with one's thumb and finger. Harvey 1628, Cap.10.
[148] Harvey 1649, 95. "Unde probare vel imporbare vel reprobare omnia ab examinatione minutim facta debemus: examinare vero et experiri an recte an perperam dicta sint, ad sensum deducere oportet, et sensus judicio confirmare et stabilire; ubi, si quid fictum, non latet."

an perperam dicta sint); these tests result in judgments of sense (*sensus judicio*). This is just the picture of Harvey's method I portrayed above, wherein his premises are based upon *historia* produced by ones *experientia* and whose conclusions are tested by *experimenta*. Experiments, while they might be performed many times, repeated over and over again, still refer to a specific event and its outcome, namely a procedure performed in such and so a way in order to produce such and so observations relevant to some specific hypothesis or proposition. Thus, unlike *experientia,* experiments have a sort of specificity that allows one to tell one experiment from another, whereas, *experientia,* as discussed above, has a sort of generality in that it is a manifold of many experiences.

Second, the conception of living animal bodies and their souls that I have argued is central to Harvey's conceptualization of anatomy is inextricably linked with his experiments. That is, beyond the fact that the experiments are meant to test some part of a definition or existence claim about the body-soul union, his conceptualization of anatomical testing is bound up in the cosmological and natural theological conception of Nature I discussed in Chapter 3. In the context of Harvey's method, this takes the form of certain premises Harvey assumes as axioms. These have the same status as dictates of reason, such as 'nothing happens without a cause' and various mathematical truths. The premises in question are variations on the Aristotelian dictum that 'nature does nothing in vain,' often interpreted though the lens of Christianity (so, God's creations are perfect and so on). This attitude is revealed most clearly by a famous quotation from Robert Boyle on Harvey. According to Boyle this, this very premise was what inspired Harvey's work on the heart:

> And I remember that when I asked our famous Harvey, in the only discourse I had with him, What were the things that induced him to think of a Circulation of the Blood? He answer'd me, that when he took notice of the Valves in the Veins of so many several Parts of the Body, were so plac'd that they gave free passage to the Blood Towards the Heart, but oppos'd the passage of the Venal Blood the Contrary way: He was invited to imagine, that so Provident a Cause as Nature had not so plac'd so many Valves without

> Design: and the Design seem'd more probable, than That, since the Blood could not well, because of the interposing Valves, be Sent by the Veins to the Limbs; it should be Sent through the Arteries, and Return through the Veins, whose Valves did not oppose its course that way.[149]

Harvey's premise of perfection, what Boyle calls 'so Provident a Cause as Nature,' was so important, that when he encountered the valves of the veins he could not accept that they were mere ornament, nor could he accept his teacher Fabricius' explanation that the valves were meant to slow down the venous blood and prevent congestion in the organs to which the blood was being sent. The valves, he thought, were too well designed, they closed too tightly, they all pointed towards the heart and let not a drop of blood through, and thus they were ill designed for slowing or preventing congestion, and overdesigned to be mere ornament. If Boyle is right in his characterization of Harvey,[150] then this conception of nature as necessarily purposeful and well designed was a fundamental part of the motivation behind his anatomical research regarding the heart.

Harvey reports tests on the blood in the *De generatione,* again unsurprising given the importance of this fluid. Harvey there reports two tests, both of which deal with testing the same claim, which is now not the difference between venous and arterial blood, but rather the nature of the single blood that continually circulates throughout the body; again what is being tested is the definition of this part. The entire chapter concerns the nature of the blood, the first genital particle, and thus one might summarize the specific hypothesis being tested in these experiments as something like, 'The blood has parts'. Harvey, as discussed in Chapter 4, argues that the blood is of a dual nature, containing two parts which correspond to the passive and active powers of the blood (so important in both generation and nutrition) and he writes that he has come to think this,

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[149] Boyle, Robert 1688, *A Disquisition about the Final Causes of Natural Things*, London: Taylor, 157-158.
[150] While it is my considered opinion that this statement of Boyle's accurately reflects Harvey's methods, I have not here the space to make this argument.

> …chiefly on account of two experiments. Firstly, because it [referring to what Aristotle called the 'unconcocted part of the blood'] floats on top of the bright and shining part of the blood (which is commonly thought to be arterial blood) as being warmer and more full of spirit than it. When the blood decomposes it remains on the surface.
>
> Next, in venesection, when this sort of blood spurts out (and it abounds in men of hot temperament who arc strong and fleshy), it leaps forth in a longer stream and with a more vehement force (as if spurted out of a syringe) and for this reason we count it hotter and more spirituous, just as the geniture which is ejaculated strongly and to a distance is thought to be more fertile and more fraught with spirits.[151]

First, remembering the discussion from the previous chapter, these experiments directly concern soul insofar as it is on the basis of these experiments that Harvey comes to believe the blood is the direct instrument of the soul. Second these tests don't consist in much more than careful observation of the blood, its parts when extravasated, and its spurting behavior in venesection. So again one is left to infer that what makes these observations *experimentum* is that they were made in reference to a specific question testing the nature of the parts of the blood.

The next test is one that comes from Harvey's teacher Fabricius. The concern here is with the way in which the cock's semen fertilizes the egg. Harvey quotes Fabricius, who wrote that,

> …it is completely true that the power of fecundating all the eggs and the womb too proceeds from the semen of the cocks, appears from this practice of women who when they have a hen at home but no cock, commit her for a day or two to a neighbor's cock and from this short time it follows that all the eggs are fertile for the whole of that year. And this Aristotle also confirms when he says that when birds have once copulated, they continue to lay eggs that are almost all fertile….Now to prevent this power of the seed to make fertile from in any way evaporating, but to retain it for a long time within the womb and be imparted to the whole of it, Nature enclosed and laid it up as it were in a purse, in the cavity which is near the arse and adjacent to the womb and which has only an entrance, so that the seed being there long detained, its virtue may be the better preserved and communicated to the whole of the womb.[152]

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[151] Harvey 1651, Ex. 52, 160. "...uti arbitror, duplici praecipue experimento motus: Primo quod floridae & rutilanti parti (quam sanguinem arteriosum esse, vulgo existimant) tanquam calidior, & spiritu plenior, supernatet; locumque supremeum in sanguinis disgregatione obineat.
"Deinde in venae sectione, sanguis hujusmodi prosiliens (qui plurimus abundat hominibus clidae temperaturae, robustis, & torosis) longiore filo impetiuque vehementiore (tanquam e siphone elisus) exsilit: ideoque eum calidiorem & spiritalem magis judicamus; quamadmodum & genitura foecundior spiritibusque plenior aestimatur quae longe valideque ejicitur."

[152] Fabricius 1621 [1942], *De formation ovi, et Pulli*, Trans. Howard Adelmann, Excerpts from 190-192, 37 and 38; Harvey 1651, Ex.6, 16-17.

In response to this, Harvey writes

> Now I was doubtful about the truth of this test and the more so because I noticed that the Philosopher's words were incorrectly cited. For he did not say that when birds have once copulated, 'they continue to lay eggs that are almost all fertile', but 'they continue to lay almost all their eggs'. To this Fabricius himself added the word 'fertile'. It is one thing to say that birds conceive eggs after coition, and quite another to say that eggs are made fertile by coition.[153]

Whitteridge here translates *experimenti* as observation. Now, it bears mentioning that Harvey very rarely uses the word *experimentum* or its cognates, rare even in the *De motu cordis,* and more so in the *De generatione animalium* given its much greater length. What Whitteridge has done here, then, by translating this as observation, is import a modern conception of what can and cannot count as an experiment. But one must be true rather to Harvey's conception of what a test is, and one has *prima facie*[154] evidence that this example is one by Harvey's use of the term, and, in fact, he repeats his rare use of *experimentum* by later describing this same observation as Fabricius' experiment.[155] So if one considers this use of *experimentum* a test, it is a test of how long the male's semen can render the hen fertile. The test in question is a homely one, and is merely the observation of a practice of women who, having a hen but no cock, let their hens loose with their neighbor's cock, after which these hens lay fertile eggs for a year, at least, according to Fabricius, and his misquoted Aristotle. It is the truth of this part of the experiment, that but one act of coition renders her eggs fertile for a year, that Harvey problematizes, though he does say that perhaps two or three acts of coition may be sufficient to allow a hen to lay fertile eggs for a year. The goal, then, of this test is to establish that a state of affairs obtains, the truth of the hypothesis that the fertility of a hen's eggs can be ensured by a

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[153] Harvey 1651, Ex.6, 17. "Ego vero experimenti praedicti veritatem suspicabar; eoque magis, quod Philosophi verba mala fide recitata cenerem: neque enim is dixit, Aves, cum semel coniverunt, omnia fere ova foecunda habere perseverant; sed, omnia fere ova habere perseveret: ubi Fabiricus to foecunda, de suo addidit. Aliud autem est, aves ex coitu ova concipere; aliud ova ex coitu foecundari.

[154] By my reckoning, there are only 26 instances where Harvey uses *experimentum* or *experior* to mean test in the *De motu.*

[155] Harvey 1651, Ex.49, where Harvey criticizes Sennert.

single act of coition. Now, after discussing Fabricius' experiment and its truth, Harvey moves on to discuss some of his own observations about hens and cocks. Yet he here uses the term *observam,* not *experimentum,* even though the homely test described by Fabricius is but an observation of the behavior of women who own hens but not cocks. And so, again, here is an instance where Harvey uses *experimentum* only when it is directly linked with the truth of a particular claim—when Harvey uses *observatio* later in this exercise, he is merely describing the mating behavior of hens and cocks, but not in relation to any particular statement and its truth, instead he notes that it is material better suited for a treatise on animal love and venery.[156]

I conclude by discussing the use of *experimenta* in the *De motu cordis.* First one must get a sense of where in this work Harvey deploys *experimentum* (and here I include the use of the verb *experior,* which from context signifies a test, and not experience more generally):

Proem: 9 experimenta
Cap 1, 1 experior
Cap 4: 1 experimentum
Cap 5:1 experimentum
Cap 8: 1 experimentum
Cap 9: 1 experimentum, 1 experior
Cap10: 2 experimenta, 1 experior
Cap 11: 3 experimenta, 1 experior
Cap 13: 2 experimenta, 1 experior
Cap 14: 1 experimentum, 1 experior
Cap 16: 1 experior

The first thing to note is that this word is most commonly used in the *Proem.* This is important, as Harvey realizes that what he has to say is frankly revolutionary (pardon the pun). As many commentators on Harvey have noted, he places a great deal of stress on the importance of his *experimentum* and *experientia* as the justification of his discoveries. In the preface, Harvey uses experiments in a different way by referring to the work of Galen as containing experiments, thus proving the lineage of his method, establishing the pedigree and source of his certainty in such a

[156] Harvey 1651, Ex.6, 19. "Verum de hac re alibi, in tractatu de animalium amore, libidine, & coitu, universim erit dicendi locus."

novel conclusion. Though in the first paragraph Harvey mentions observation (*observationes*), experiences (*experientia*), and anatomical dissection, (*dissectione anatomica*), Harvey does not mention experiments (*experimentis*) until he begins his discussion of Galen: "What will they respond to Galen? Who wrote a book, that blood was naturally contained in the arteries, and nothing but blood, that there is neither Spirits, nor as from experiments and reasons in that same book one might easily collect."[157] So here Harvey instantiates the conception of anatomy argued for above, in which both reason and experience are valued.

Consider finally Galen's vivisection of a dog's trachea, which is the first ligation experiment mentioned by Harvey. He describes this experiment in the following way:

> If anyone should try the experiment [*experimentum*] of Galen and cut the wind-pipe of a dog, being yet alive, and forcibly fill the lungs with air with a pair of bellows, and when they are filled, ligate them tightly, then, having quickly slit open the chest, we will find great store of air in the lungs right to their outermost coat, but none at all either in the vein like artery [*arteria venosa*] or in the left ventricle of the heart. But if in a living dog, either the heart drew air in from the lungs, or the lungs drove it into the heart, so much the more should they do so in this experiment [*experimento*].[158]

This experiment is, again, aimed at determining whether or not the air enters into the vein like artery, and thus one sees that the pattern described holds once more, where an experiment is always related to a specific claim or state of affairs related to characterizing what the phenomena is, or proving that it exists. The nature of the question being asked determines the procedure that must be adopted, so, for instance, it is important that this experiment be *vivisectional,* since the relevant observations cannot otherwise be produced. Finally, the *Proem*, Harvey never mentions his own experiments, only those of Galen—one can conclude, then, that this is meant to establish

[157] Harvey 1628, *Proemium,* 11. "Quid itaque respondeant Galeno, qui librum scripsit, Natura sanguinem contineri in arteriis , & nihil praeter sanguinem, nimirum neque spiritus, neque aerem, sicut ab experimentis, & rationibus in eodem libro facile colligere licet."

[158] Harvey 1628, *Proemium,* 17. "Si quis experimentum Galeni faceret , & cani adhuc viue n t i trachaeam incideret, & follibus pulmones aere impleret per vi m , & distentos ligaret fortiter , Idem mox dissecto pectore multam aeris copiam in pulmonibus vsque ad extimam illorum tunicam inuenerit, sed neque in arteria venosa , neque in sinistro ventriculo cordis quidquam. Si aerem e pulmonibus , in cane viuente , aut cor attraheret , aut pulmones transmitteret, multo magis hoc experimento id facere deberent."

a safe pedigree for his use of observational tests from anatomical dissection. Harvey is here doing something like what Vesalius did (and Galen long before him), attempting to undermine the doctrinal claims of the Ancients by means of the very methods the Ancients themselves used.

7.0. CONCLUSION

It is clear that William Harvey's philosophical anatomy owed much to the Ancients. He owed much, too, to his teachers at Padua, and to the complex and eclectic currents of Renaissance intellectual life. His was a philosophy that saw the world as ordered and arranged by an Almighty God, a God whose designs were meant to optimize[1] the flourishing of the living creatures by matching not just animals to their environments (what we would call *niches*), but furthermore ensuring that their very bodies demonstrate through their design how profoundly suitable they are to their functions, the *utilitas* afforded by their *fabricae*, *actiones* and *usus*. For Harvey, purpose, like love, is a many splendored thing: its complex patterns are the patterns of life.

In the previous chapters I have characterized what is meant by the teleologies of being and becoming, and how they operate and structure Harvey's conceptualization of his subject matter. So too have I revealed how Harvey's methods are *teleologically organized* in pursuit of *teleological knowledge*. Soul was fundamental to both Harvey's subject and methods. For the former concerns the soul and body union, and the coming into being of that union—here, the vegetive and sensitive souls are of prime concern, for these aspects of soul are those that govern the complex unity that is a living creature. The latter, Harvey's methods, are the province of the rational and sensitive souls, disciplined through observation and long practice, through which the anatomist gains *facultas,* true expertise in matters anatomical. It is this general picture that I have offered as a replacement for previous images of Harvey, understood as his own self-image. However, what are truly important are the *details* of this interpretation. For it is in the details and specifics of Harvey's work that his innovative interpretations of Ancients and Moderns are to be

[1] The exact meaning of optimality, and the degree to which optimality is important in Aristotelian/Galenic science is complicated. See: Devin Henry 2012, "The Role of Optimality in Aristotle's Natural Science," *The Selected Works of Devin Henry*, works.bepress.com/devinhenry/18.

found, and it is here that one can come to appreciate him as a philosopher. And, as Harvey would himself affirm, it is only through contemplating the specifics and particularities of a matter that one can come to truly know it. Only then can one move on to generalities. This difficult part having been accomplished, I now turn a few of these generalities in order to bring my study to a close.

7.1. HARVEY AND HISTORIOGRAPHY

I shall begin by returning to the historiographical problems with which I began. I argued that there were three basic problems:

1. Harvey has not been understood and treated as a *philosopher*
2. Harvey's *self* image has been conflated with the image of him found in others' works.
3. Harvey's *De motu cordis* and his cardiac doctrines have been studied to the exclusion of his other writings and ideas.

Regarding the first, I hope that what I mean by this phrase 'as a philosopher' has become clear by the analysis of the previous chapters. Treating Harvey in this way necessitates not newfangled historiographical methods, but those classical aspects of historical inquiry that have sometimes been neglected in this case: a close reading of his all of his texts. In some sense, the other two problems stem from this first, for, by not giving Harvey his due as a real philosopher, historians have neglected just those things that are central to his self-image. By focusing exclusively on his discovery of the circulation, they have made understanding this discovery much more difficult.

This provides, I think, an opportunity to discuss a larger historiographical issue: the meaning of *context* in studies of science and philosophy.[2] It is the meaning of context that lies at the heart of the current epistemological and sociological gulf separating the two main divisions

[2] I am going to run together those who study the history and philosophy of science and those who study the history of philosophy, even though, sociologically speaking, they are not entirely the same. What I say should, I hope, hold for both groups.

of the community of science studies: historians (and anthropologists, and sociologists, and so on) on the one side, philosophers on the other. This division is a story of acrimony (and acronyms: HPS, STS, HOPOS, SSK, …). As Ronald N. Giere put the matter, it is up for debate whether the two sides have an intimate relationship or a marriage of convenience. I doubt I can resolve this debate, but I hope I can clarify certain elements of it.

It will be helpful to start with some (potted) history, specifically the state of the discipline of science studies in the more than forty years since Thomas Kuhn's (1962) *The Structure of Scientific Revolutions*.[3] This topic was broached in a recent issue of the History of Science Society's journal, *Isis*. In his "History and Philosophy of Science in a New Key," Michael Friedman nicely summarizes the institutional and disciplinary result of Kuhn's work:

> …Kuhn's work was also instrumental in the development of a serious estrangement between the two disciplines [of history of science and philosophy of science] in the period following the publication and assimilation of *Structure*. On the one hand, Kuhn's apparent rejection of the traditional ideal of scientific rationality and objectivity dismayed professional philosophers, especially when this rejection was eagerly embraced by much more radical thinkers, associated with the sociology of scientific knowledge, as a new kind of philosophical relativism to be gleefully waved in the face of the philosophical establishment. On the other hand, Kuhn's emphasis on the scientific community reinforced an emerging rend toward social and cultural history of science, echoing a wider trend in the discipline of history more generally. Institutional support for history and philosophy of science in the traditional (primarily intellectual) sense began to fade, resulting in the reabsorption of some programs (such as the one at Princeton) into history departments and the founding of new programs in science studies, studies in science, technology, and society, and so on.[4]

Friedman's point is that there was a profound institutional and intellectual change as the result of a fundamental philosophical difference regarding the proper method for HPS. Kuhn's notion of the paradigm forced historians and philosophers to revaluate their positions on the locality and rationality of science, though the direction taken by many were not always intended by Kuhn.

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[3] There are many, many figures and groups that I am leaving out in this shortened, oversimplified history of HPS (Gerd Buchdahl, N.R. Hanson, Paul Feyerabend, the Edinburgh School, Feminists and so on). However, this oversimplified version of events is more than adequate for the didactic purpose to which I am setting it.
[4] Friedman, Michael 2008, "History and Philosophy of Science in New Key." *Isis*, 99: 126.

And thus, as I've shown, what was true of Harvey was also true of Kuhn: interpretation is a tricky game.

Regardless of Kuhn's intent, his work was taken as singling a new approach to the study of the history of science,[5] one which was fundamentally at odds with the practice and position of most philosopher's of science, what we might call, following Friedman, History and Philosophy of Science in the *old* key. If the model for the old HPS was intellectual history in the tradition of George Sarton, the new post-Kuhn model was based on the methods and goals of social and cultural history. Though there are many important differences between these two traditions, the key difference, I think, revolves around the notion of *context*. In that same issue of *Isis*, Peter Galison identifies this as one of the foundational differences between these two sides of the HPS community:

> When philosophers talk about the context of an argument (say, by Descartes), they often mean bringing into the argument not only the text in question but also the texts of surrounding philosophers (issuing from the late sixteenth century, for example) addressing related issues. When historians speak about context, they often have in view the nontextual environment, which might be political, institutional, industrial, or ideological…What kind of thing is a candidate for context?[6]

This difference in how to understand context is more accurate, and more interesting and suggestive, than Friedman's offered explanation, that historians took up a radical relativist philosophy in response to Kuhn, one that denied objectivity and a privileged epistemological status to science.[7] Friedman's point is certainly true in some instances, but the *reason* for the adoption of such a philosophy is explained, at least in part, by the fact that the two sides adopted different notions of the sort of evidence and arguments one provides in accounting for and explaining scientific practices.

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[5] Or, perhaps better since it does not imply that they adopted Kuhn's system, the need for some new approach to studying the history of science.
[6] Galison, Peter 2008, "Ten Problems in History and Philosophy of Science." *Isis*, 99: 113.
[7] Which isn't to deny that this did happen in some cases as well.

So on the one hand we have the philosophers of science and historians of philosophy, who have continued to take the texts and arguments of individuals and groups in the history of science as the primary modality of evidence to be used in explaining the resulting ideas, experiments, and so on. Furthermore, philosophers of science, for the most part, reacted to Kuhn not with radical departures from their previous philosophies of science, but rather with a newfound sense that good history of science case studies are fundamental to doing good philosophy of science, remaining committed to offering accounts of the rationality of scientific progress. Meanwhile historians of science (and sociologists and anthropologists, and so on) took the primary modality of evidence to be used in explaining scientific episodes to be facts about the social, political, and cultural make up of the actors and communities involved. Given that these two communities disagreed on the sorts of evidence that ought to be used in explanation of scientific practice, that is, they disagreed on their notions of appropriate *context*, it is no wonder that there has been no easy method of uniting the two sides of this debate into a unified discipline.

One of the most promising ways of uniting philosophy of science with the history of science is HOPOS—the history of the philosophy of science. HOPOS as institution was started in 1992, and it is clear that there was an effort to move beyond the unfortunate split between history and philosophy, as can be gleaned from the opening statement of the first newsletter:

> HOPOS is an informal, international working group of scholars who share an interest in promoting serious, scholarly research on the history of the philosophy of science and related topics in the history of the natural and social sciences, logic, philosophy, and mathematics. We interpret this statement of shared interest broadly, meaning to include all historical periods and diverse methodologies.[8]

While it is true that this statement doesn't mean that there isn't any debate as to which contextual features are most important for understanding science, it does indicate the willingness of HOPOI

[8] History of Philosophy of Science Working Group 1993, "Newsletter," Volume 1(1), www.hopos.org/newsletters.html.

(as they are called) to be pluralistic in their methodologies. Indeed, what is new in HOPOS as compared to the old way of doing HPS is that, by looking at the philosophies' of science of particular historical actors in particular historical periods, one is always already concerned with both kinds of context, both the immediate argumentative context and the larger social and cultural one. This is what is distinctive in the HOPOS approach. Thus pluralism helps diffuse the disagreement about what sort of context is appropriate to provide, since it is quite obvious that *both* sorts of contextual features are relevant. This congenial pluralism has the added benefit that one should feel no need to include everything in his or her account. Thus the more philosophically inclined can concentrate on the intellectual context of a particular philosophy of science, whereas those more interested in social history can look at the social features that affected and shaped the philosophy. What is important, however, is not to confuse doing the one for doing the other—for often conflicts between those on the one side or the other are, in fact, misunderstandings by not closely enough attending to the different uses and goals of social versus intellectual context.

This is not to say that there is or could be no disagreement between those interested in the social and those more interested in the philosophical. But understanding the two sides of the HOPOS coin can, I think, help illuminate the problems in existing Harveian historiography: those who have attempted to understand Harvey by means of the image of him found in the work have conflated a certain a *social* aspect of Harvey's work, the ways in which it was disseminated and eventually adopted, and the ways in which it was discussed and the ways in which it figured rhetorically in arguments for the new experimental philosophy, with its *intellectual* aspect: its concepts, arguments, and philosophical context. This is not to say that that the dissemination and adoption of Harvey's doctrine of the circulation had no intellectual aspects, or to suggest that theoretical and factual change are purely social or in any way irrational. But rather, as my

account of Harvey's self conception should amply demonstrate, the adoption of the circulation involved a great deal of reinterpretation of Harvey's work, for Harvey's eclectic, Aristotelian, Galenic, teleological, soul-based conception of anatomy and natural philosophy had to be translated into the new idiom of mechanistic, experimental science. And because historians have by and large not understood Harvey as a philosopher in, they have thus not paid close enough attention to the differing contexts of his own work and that of others (including we contemporary historians), often confusing the social and the intellectual, and even conflating profoundly different intellectual contexts.

Let me discuss a few examples in order to highlight this new image of Harvey. Early studies, those of Pagel and before, suffer from an overabundance of presentism. That is, while he was incredibly important insofar as he brought to the fore the fact of Harvey's Aristotelianism, the role of teleology, and related ideas, there is a deep sense pervading Pagel's work that all of this was deeply *unscientific* and that Harvey succeeded *despite* these flaws. That is, Pagel imports a twentieth century conception of science and scientific activity, and though he admits that the non-scientific aspects are often more bound up in the scientific for early moderns, the distinction itself is unhelpful for understanding Harvey. For Harvey would have rejected most strongly Pagel's division, and, as I have shown in the previous chapters, these teleological aspects so repugnant to modern scientists are not just part of Harvey's *motivation,* but they constitute the core of his conception of his very subject and the methods needed to attain knowledge of it. To divide Harvey's ideas up into those that match current understandings of proper scientific methodology is a hopeless task.

The historiography concerning the *Prelectiones* is particularly guilty of these kinds of mistakes. I've discussed in detail the first line of these notes where Harvey defines anatomy as a kind of skill (*facultas*), involving dissection and observation. Indeed, this line forms one of the

centerpieces of my analysis. Regarding this line, Whitteridge has the following to say: "Statements of this kind are common-places in the contemporary text-books of anatomy."[9] There is nothing exactly wrong or false about this statement,[10] but it encapsulates succinctly how historians have treated the *Prelectiones*: as a relatively uninteresting work of Galenic medical writing, perhaps to be mined for insights into Harvey's great discovery of the circuit of the blood, but not something to be studied on its own. What is not attempted is to figure out exactly what statements of 'this kind' *mean*, what they can reveal about Harvey's and his contemporaries' anatomical practices, or how, if at all, Harvey's statement is different from those of his peers. What has not been done is anything resembling a detailed philosophical analysis of this text; instead, the barest hint of the intellectual context is gestured, illustrating the pervasive conflation of social analysis (the commonality of such statements) for intellectual (truly attempting to understand the meaning of such statements). And so, as I discussed in Chapter 5, there is an incredibly complex intellectual history here that must be uncovered to adequately understand what is going on in Harvey.

There is another, related, example to be found in the work of Andrew Cunningham. Cunningham, in his influential series of articles on the disciplines of anatomy and physiology ("The Pen and the Sword (2003)"), largely agrees with Whitteridge's assertion. We might thus flesh out what 'these kinds' of definitions might be by taking a look at how Cunningham has understood them:

> Anatomy as a discipline was thus primarily an art (*ars*) or manual practice. The art took as its basic material the dead bodies of men or animals. Depending upon the particular approach and investigative project of the anatomist concerned, the subject matter of anatomy could be animals in general, or it could be limited to man, using parallels from

[9] Whitteridge 1964, 4n.1. Most other writers on this point seem to have agreed with Whitteridge, not bothering to analyze Harvey's statement here in any great detail; see the following discussion of Cunningham.
[10] And, to be entirely fair, Whitteridge does usefully point us to some historical sources for Harvey's definition, specifically to Galen and Fallopius.

animals where necessary or more convenient.[11]

But as I showed in Chapter 5, it is simply not true that anatomy was primarily an artistic practice, for anatomy had both rational and artistic components. Cunningham argues that there are two, very distinct, disciplines operating in the early modern period: anatomy and physiology; these disciplines undergo a dramatic change over the course of seventeenth century and into the eighteenth. Although I am not here concerned with Cunningham's distinction or categories, a brief discussion of these issues is relevant because it shows another example of the replacement of social and institutional context for the philosophical. Cunningham argues that physiology was primarily a theoretical discipline, whereas anatomy was primarily an experimental and observational one. In Cunningham's view, anatomy and physiology were strictly separated *disciplines*, and though one person could wear 'both hats,' as it were, research in one area was not always connected to the other as a matter of due course—the experimental aspect of an anatomy of an animal might be seen as entirely irrelevant to the theoretical concerns about the nature of matter that occupied the efforts of the physiologist. But this is to mistake the production of specific texts with specific goals, the separation of these two aspects of medicine for economic and cultural reasons, and related social facts, for philosophical analysis of the ideas and relation of physiology to anatomy. Given my argument that the history of anatomy involves both theory and manual practice, and which in Fabricius and Harvey come to be seen as importantly unified, Cunningham's distinction falls apart. Harvey's manual practice rested upon a great deal of philosophical theory having to do with soul and body, and his theory, in turn, was deeply influenced by his observational and manual practices. And though Cunningham recognizes Harvey's preeminence in the history of anatomy, and argues that, if anyone was,

[11] Cunningham, Andrew 2003, "The pen and the sword: recovering the disciplinary identity of physiology and anatomy before 1800 II: Old anatomy—the sword," *Studies in the History and Philosophy of Biological and Biomedical Sciences*, 34: 53.

Harvey might be an exception to this rule of separation, he still argues that the *De motu cordis* is primarily an *anatomical* and not a *physiological* work.[12]

Another point often uncritically accepted in the literature is that argued for by Roger French, wherein, at bottom, Harvey's natural philosophy was an empirical one. This I do not disagree with, for Harvey, as I have shown, made constant reference to observation, experiment, and experience. But French's account, for the kinds of reasons I've been bemoaning, goes off the rails, and is simply not an adequate representation of Harvey's philosophy. I shall conclude this dissertation, then, by reflecting on this most important aspect of Harvey, showing where French and others have gone wrong, and finally, suggesting a few routes for future research.

7.2. NOT JUST OBSERVATIONAL KNOWLEDGE

Harvey must not be seen as having devised a new sensory epistemology or as being interested in observational knowledge instead of causal knowledge. This is, in many cases, how neoteric philosophers interpreted him in his own time, but, to beat a long deceased equine, this is simply not how Harvey conceived of his own epistemology. Harvey creatively reinterpreted the many epistemological and methodological doctrines of Aristotle and Galen to suit his needs, and his primary interest was the production of *causal knowledge.*

Roger French bases his claim that Harvey posits a new, sensory epistemology upon the 'Principle of Limited Explanation' that Harvey supposedly devises in the *De motu cordis* and later replies to his critics. Here Harvey is supposed to have maintained that factual, observational knowledge is the primary sort of knowledge that philosophers should be interested

[12] Cunningham, Andrew 2002, "The pen and the sword: recovering the disciplinary identity of physiology and anatomy before 1800 I: Old physiology—the pen." *Studies in the History and Philosophy of Biology and the Biomedical Sciences*, 33: 649.

in, instead of causal knowledge.[13] If this were true, this would undermine the argument set forth in this dissertation, for to understand anatomy as an investigation into the soul body union is to understand it as an investigation into causes, indeed, into all the causes, but especially into (the many) final causes. But, alas for poor French, this analysis is based upon misunderstandings. I do not deny, of course, that Harvey repeatedly emphasized that his discovery of the circulation was true even in the absence of the final cause, but this does not make for the kind of strong principle that French asserts for Harvey. French understands this 'Principle' to indicate a *general attitude* with respect to determining the final causes of things in nature. Harvey is supposed to have established that final causal knowledge is less important than observational knowledge. But, as I've worked so hard to demonstrate, even in the absence of the final cause of the circulation, the *De motu cordis* remains a deeply teleological work in how Harvey there conceives of the living body and its functionality. Not giving Harvey his due as a philosopher, by not cleaving close to all of Harvey's texts, French has been misled.

French links this so-called principle with Harvey's distinction, in his letters to Riolan, between knowledge of facts (*hoti*) and knowledge of causes (*dioti*). This has already been noted in previous chapters, for it is the Aristotelian division between the results of *historia* and the results of causal investigation. In the *De circulatione sanguinis* (1649), Harvey writes that, "With regard to a fact, we should ask first 'that it is' before 'why it is'" an idea I have discussed.[14] French takes this to indicate that Harvey "…is calling on an approved technique of experimental demonstration, from sense and experience, not from first principles."[15] But this

[13] This is discussed in a number of places in French 1994a: 277, 301, 313, 317, 346, 350, 362. The story is complicated, however, by the fact that French does at certain points acknowledge Harvey's interest in finding causes, but, like Pagel before him, he doesn't really seem to believe Harvey. French is much more interested in elucidating how this 'discovery' of Harvey's is among the most important epistemological discoveries of the Scientific Revolution.

[14] Harvey 1649, 76. "Prius in cofesso esse debet, Quod sit, ante quam Propter quid, inquirendum." French translates 'propter quid' as 'an account of what it is' but this obscures the fact that the account is meant to be causal, that is, an answer to a why question. I have thus chosen to render it as above.

[15] French 1994a, 278

entirely misunderstands demonstration, for experience *just is* the source of first principles, indeed, following Aristotle, experience is the source of both art and science! Harvey was simply arguing that, with Aristotle, one must make room for a demonstration *that something is* as a preliminary to any demonstration of *why it is.* But to think the former is paramount to science is simple historical sophistry on French's, for it is clear that to Harvey it is but the necessary preamble. As I argued in Chapter 4, Harvey's *De generatione* and *De motu cordis* are deeply linked by the search for the final cause of the circulation (now reinterpreted as the final cause of the blood). This fact alone undermines French's account.

Further, how French means one to take this principle is unclear: he calls it a principle of limited 'explanation,' but the principle as he formulates it seems to be rather a *rejection* of explanation. For what sort of explanation of the circulation was Harvey offering in the absence of causal knowledge? The answer, of course, is that Harvey *could not* explain the circulation; he could simply note its existence. French further confuses the issue by later saying that this principle is an inveighing against system building, and, for this reason, one can understand why Harvey did not engage in this activity.[16] But, even if this is true, it's hard to see the relation between this conception of the principle as an injunction against building a system and the conception of the principle whereby it is thought of as a sort of limited demonstration of a fact. Perhaps Harvey did not feel the need to build a system because he already had one available, the rather eclectic philosophy I have been attempting to elaborate in this dissertation. Perhaps Harvey's injunction against system building should be seen not as a reaction against systems *per se,* but rather against the needless rejection of a perfectly good system of natural philosophy, that of the Aristotle and the other Ancients.

[16] French 1994a, 301.

By understanding Harvey as making room for 'observational (historical) knowledge' in the absence of 'causal (scientific) knowledge,' French is here following the work of Andrew Wear. Wear maintains that Harvey's method of obtaining observational knowledge is consistent across his career: from the *De motu cordis* to the *Letters to Riolan*, and on to the *De generatione.*[17] He argues that Harvey formulated the idea of observational knowledge, in distinction with the Aristotelian idea of knowledge as knowledge of causes. He writes that,

> …Harvey perceived the circulation as an observable fact and not as a theory…Harvey came to view observation as a form of knowledge in its own right (perhaps *the epistemological* discovery of the seventeenth century) by contrast to the Aristotelian position that knowledge of causes was the only knowledge.[18]

But this misunderstands Harvey's position: Harvey, in admitting the importance of historical knowledge, is not demoting scientific knowledge; rather, he is pointing out that observation is *what leads to knowledge of causes*! In fact, it is much more complicated, for observation does not truly lead to knowledge: it is only *experienced* observation that does so, that is, it is only the perceptions of the expert anatomist that can be counted upon for knowledge of organic bodies. The kind of observational knowledge Harvey establishes would be recognized by the Aristotle, and though the Peripatetic never imagined the circulation, Harvey might have reasonably expected that he would have been convinced by Harvey's arguments and evidence.

I want to end by putting Harvey's thought in some Aristotelian-Platonic perspective. One way to frame the difference between historical (what French calls observational) knowledge and causal or scientific knowledge as the difference between inductive knowledge and understanding. By looking at this distinction in Aristotle, I think I can shed light on Wear's and French's mistakes. Miles Burnyeat has argued that, for Aristotle, understanding is about the organization of things already known: "Inductive knowledge is already knowledge, but it is not

[17] Wear 1983, 223.
[18] Wear 1983, 224.

understanding. For understanding we need greater familiarity and expertise."[19] Thus a scientific demonstration is a way of systematizing one's causal explanations. Burnyeat's description of Aristotle's scientist matches exactly Harvey's conception of the experienced anatomist whose expertise allows him to not just observe, but judge and truly understand the causes of his observations, thus allowing him to demonstrate them. The ultimate foundation of this expertise, of the entire science, is to be found in perception. This is, in both Harvey and his Rule of Socrates, and in Aristotle, is an inheritance from Plato's *Republic*. As Burnyeat argues **"**The man of understanding has a grasp of the answers which is both systematic and synoptic, in that everything in the domain of his science is explained in the light of first principles which explain themselves. If this sounds like the grand vision of Plato's *Republic* transferred to the individual sciences, well and good…."[20] Harvey, following in this tradition, may have been an *inspiration* for a new observational epistemology, but Harvey's rule was Socrates', interpreted though Aristotelian science, and used to great effect by this Englishman trained in Padua. I shall conclude this section, then, by modifying a quote from Pagel I discussed in the introduction:

> Harvey, the Eclectic Renaissance Aristotelian-Galenic Philosopher-Physician died in 1657, while Harvey, the discoverer and physiologist, was also an Eclectic Renaissance Aristotelian-Galenic Philosopher-Physician.[21]

7.3. AND NOW FOR SOMETHING COMPLETELY DIFFERENT

I have in this dissertation attempted to offer the most complete interpretation of Harvey's philosophical self-image, his intellectual context, as I know how. But such a story, even if complete, is not the whole story of Harvey. I have been at pains to separate Harvey's self image

[19] Burnyeat, M.F. 1981, "Aristotle on Understanding Knowledge," In: *Aristotle on Science: The Posterior Analytics, Proceedings of the Eighth Symposium Aristotelicum*, Ed. E. Berti, 131; see also 137.
[20] Burneyat 1981, 112.
[21] Pagel, Walter 1957, "The Philosophy of Circles," *Journal of the History of Medicine*, xii, 156. The real quote is: "Harvey, the Aristotelian, died in 1657, while Harvey, the discoverer and physiologist, was to remain immortal."

from that found in the work of other's, and it is this latter that now needs to be investigated. I have attempted to resolve tensions in our historiography surrounding Harvey, but, in so doing, new tensions arise.

The most important of these concern how Harvey's work was translated to suit the tastes of later seventeenth century thinkers. For it is clear that most of them did not share Harvey's philosophical palate. His work underwent a profound set of reinterpretations in order for his results to be accepted by mechanical and experimental philosophers and physicians, from Descartes to Boyle to Malpighi, while at the same time, his specific method and his interpretation of those results was rejected. These neoterics amalgamated Harvey's method to their own, and thus they could, with a straight face, refer to him as the 'English Democritus,' despite Harvey's rejection of corpuscular philosophies. In many ways this is a much more difficult task than the one I've complete here, for it involves paying attention to both the social and intellectual context. The subtle ways these two contexts interrelate makes keeping them distinct all the more difficult, but it may also make them more interesting and worthwhile.

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