
William Harvey on Anatomy and Experience

Benjamin Goldberg

University of South Florida

The goal of this essay is to explore the meaning of experience in William Harvey's work. I begin by expanding on Andrew Cunningham's argument (2002, 2003) that for Harvey, anatomy was an experience-based science of final causes. Observation and reason are united through experience (experientia) for Harvey, that is, by the repeated exercise of these capacities. Thus through the training and use of these abilities, Harvey thinks he can learn the final causes of living things and their parts. Harvey thinks that anatomy is the skill (facultas) by which one is able to make justified inferences to these causes. Finally, such inferences are based on a large set of rationally organized anatomical observations (historia), not upon direct, singular observations alone.

1. Introduction

The goal of this essay is to explore the meaning of experience in William Harvey's natural philosophy. I begin with Cunningham's argument (2002, 2003) that, for Harvey, anatomy was an experience-based science of final causes. But how could one experience final causes? I answer this by first articulating Harvey's conception of anatomy (sections 2–3), before turning to his understanding of experience (sections 4–5).

2. The Meaning of Anatomy

What did *anatomia* mean in the early seventeenth century? Consulting dictionaries, the texts of anatomists, and following Cunningham, we can assert that anatomists conceived of their work as *both* a manual art and a rational

science.¹ Medicine had long proved problematic, failing to fit into disciplinary schemes of knowledge, as Nancy Siraisi has argued:

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... 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. (1990, p. 219)

From the start of the seventeenth century and lasting quite late into the period,² definitions of anatomy thus divided into a manual art of cutting and observing and a rational/scientific knowledge of causes. Harvey links cutting and observing to scientific knowledge, an innovation that must understood against the background of a tradition that *denied* such an epistemological link.

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, Mondino, Berengario da Carpi, Niccolò Massa and many others) the approved anatomical method” (2010, p. 33). While Klestinec is entirely correct, anatomists articulated this claim in varying ways. For some writers, both reason and experience were important, but only the rational side of medicine amounted to *scientia*—the art of anatomy did not lead to knowledge of causes. Indeed, it has been noted by Siraisi (1994, pp. 57, 60, 65) that Vesalius’ preface to the *Fabrica* is an attempt to argue that anatomy achieves scientific knowledge (see also Siraisi 1990, p. 220).

Pedagogy reflected this understanding, emphasizing both manual art and theoretical knowledge. Though one individual might be trained in both, the products of each aspect were separated, public dissections the result of the one,

1. See Laurentius 1600. This seems in line with dictionary definitions of *anatomia* in early modern dictionaries. See, for instance, Thomas Elyot 1538, John Rider 1589, Francis Holy-Oke 1640. I am, of course, artificially limiting the scope of anatomy here; for an excellent and more thorough account see: Shotwell 2013; see also Cunningham 1975.

2. E.g., Glisson 1645 is almost identical to Laurentius 1600.

learned tomes of physiological knowledge the result of the other. Thus it has often been noted that anatomies in Renaissance universities were sometimes performed entirely *without* dissections, and consisted entirely in lecturing from texts (Cunningham 1975; Siraisi 1994). Harvey, then, must be seen against the background of these conceptions of anatomy. Indeed, Harvey himself must be seen as an agent in part responsible for the early modern shift to emphasize empirical methods, especially in the English context (Frank 1980).

The strict division between art 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 translations (and works) of Galen and Aristotle along with active efforts on the part of the humanists to reclaim the projects and knowledge of the ancients.³ This was nowhere more true than at 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 generated by the senses. Roger French (1994, p. 88) has noted that, "Zerbi is well prepared, at least at the theoretical level, to express the dominance of perception over reason in anatomy." Though Zerbi is a "practical" anatomist, this should be taken in the sense of him reading from a text while another performed the actual cutting (French 1994, p. 89). So while at least in theory, or rhetoric, the humanist era witnessed the increasing importance of the observational aspect of anatomy and its integration with the rational, by the time of Vesalius (1515–d. 1564), one finds this distinction, and the institutional and epistemological separation between them, to be pervasive. Indeed, if one takes Vesalius' criticisms of anatomists at face value (discussed below), dissection by means of lecturing had become the *primary* means of learning anatomy; actual dissection was rarely understood as a means of active investigation. Thus anatomy up to Vesalius (and, by and large, for some time afterwards) was primarily about texts; dissections were performed in service to them.

With the publication in 1543 of Vesalius' *De humani corporis fabrica*, we find a powerful exhortation to begin performing actual anatomies. Vesalius viewed firsthand experience of such events as allowing correction and improvement upon Galen, an idea that becomes a core part of the education of physicians (Cunningham 1975, p. 4). Vesalius took physicians to task for ignoring anatomy, which, he argues, should be, "...a chief part of natural philosophy...as it embraces the *historia*⁴ of man, and it ought to be the most

3. And, of course, there are a variety of other intellectual, cultural, social, and economic factors that are relevant.

4. 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*,

secure foundation of the whole art of medicine and by law the introduction to its organization..." (Vesalius 1543, a3).⁵ By arguing that regular performances of anatomies were part of *natural philosophy*, Vesalius had begun a process that would break down the long held distinctions between the artistic and rational sides of anatomy.

Vesalius was attempting not only to revive the practice of human dissection, furthermore, he wanted to establish it as the most fundamental aspect of medical training, and as a means of testing and discovering. When noting that the physicians declared the bones, muscles, nerves, veins, arteries, and other parts beyond their purview, to be left to the surgeons, Vesalius directly attacked the division of labor between the artisans (the surgeons) and the scientists (the physicians and philosophers):

...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. It is quite inappropriate that such men should preserve for us that most difficult art...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. (Vesalius 1543, a3)

Those with book learning, though they (at best) understood the causes of the parts and their descriptions from books, had 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 could never learn how much in error their book learning truly was. But, on the other hand, the unlettered surgeons had no *true* knowledge of the body, its parts, and their functions.

observationally based, and carefully organized account of the parts of the body. I discuss *historia* in more detail below.

5. All translations are my own, except where noted.

Their own limited experience allowed them to cut the body up, but with no grace and with no true understanding of its proper organization: they were but butchers who hack away at the body with no respect to its natural divisions, without being able to explain anything of what they were doing. Anatomy could only become natural philosophy through unification, wherein the cutters and the readers, the artists and the scientists, were understood not as separate parts of anatomical practice, but as fundamentally and necessarily integrated in the pursuit of anatomical *scientia*.

We see these themes again in the work of Vesalius' pupil, Harvey's *Doktorgrossvater*, Fallopius, in his *Expositio de Ossibus* (1584). In a chapter on the meaning of anatomy, Fallopius writes that,

Anatomy is the art, indeed a habit of the mind [*ars, vel habitus animi*], 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 [*ut quae sensu sunt cognoscenda recte pateant quia in anatome nihil nisi quod sensu patet, percipiendum venit*]. (Fallopius 1584, p. 521)

Notice that, in a quite traditional way, Fallopius first emphasized the rational, scientific aspect of anatomy. It is by this mental habit that one could 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* could be truly known. Fallopius does not exactly say that this secure knowledge is knowledge of 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 landscape.

Turning to Fallopius' student, and Harvey's teacher, Fabricius, one sees much more explicitly a connection between anatomical skill and finding *causes*. 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.⁶ 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*:

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

6. For an excellent account of Fabricius' pedagogy, see Klestinec 2011.

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 [*Dissectio enim (si quis recte aestimet) eum habet usum, ut tum ea, quae oculis insunt, hoc est structuram & historiam, manifestet: tum in actionis facultatisque notitiam deducat: tum denique oculi utilitates aperiat atque declaret*]. (Fabricius 1687, p. 187, trans. Peter Distelzweig)

It is here that one finds the roots of Harvey's own conception of anatomy, one that does not separate the two aspects. Fabricius understood anatomy as an activity where one's senses lead to an acquiring/gaining of knowledge of theoretical, causal aspects of the body: its actions, uses, and utilities (upon which more below). 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*). In Fabricius, one does not see any deep methodological or epistemological distinction between the scientific and artistic aspects of anatomy. Indeed, Fabricius called out Vesalius specifically for stopping at collecting *historia* and failing to establish the causes of parts (Fabricius 1600, p. ii *verso*).

Turning to Harvey, his definition is found in the very first part of his lecture notes, the *Prelectiones anatomie universalis*. Consider the Latin: "*Anatomia est facultas quae oculari inspectione et sectione partium usus et actiones*" (Harvey 1616 [1964]), p. 4).⁷ Gweneth Whitteridge translates *facultas* as "branch of learning," something along the lines of the modern understanding of anatomy as a specific body of knowledge. But consider, for instance, Francis Holyoke's (1640) dictionary definition of *facultas*: "Power to doe or speak, leave, licence, feaxe, promptnesse, eloquence."⁸ A *facultas* is a power that something or someone has to perform some particular action. From the last part, one might surmise that *facultas* has the connotation not just of an ability to do something, but an ability to do something *well*, in a highly skilled manner, even *eloquently*.

I would thus translate Harvey's definition quite differently: "*Anatomy is a skilled ability that teaches the uses and actions of the parts by ocular inspection and dissection.*" Harvey's *anatomia* is an active ability with a specific goal: knowledge of uses and actions.

7. I cite from Whitteridge's 1964 edition of the *Prelectiones* for ease of reference, but my translations come directly from the manuscript, Sloane MS 230a for which, see: Harvey, William. 1616–1626. *Manuscript of the Prelectiones*. In: The British Library, Sloane MS230a. Henceforth, I cite this work of Harvey's as Harvey 1616.

8. This is in line with other early modern dictionaries, and is meant only to be suggestive.

3. The Goals of Anatomy

As Cunningham has argued, it is quite obvious from a study of Harvey's *Prelectiones* that the goal of anatomy is knowledge of the final causes of the parts of animals. But what does this look like?

We must first elaborate the basic model of life employed by Harvey, a Renaissance hybrid of Aristotelian *cum* Galenic theories and methods. Animal bodies are organized and maintained by their souls, as per Aristotle's *De anima* and as deployed in the animal books and the *Parva naturalia*, and they are to be investigated through dissection, as per Galen's *De placitis Hippocratis et Platonis* and *De usu partium* and many other works.⁹ Animals were thought to be unities of matter and form: soul the form, body its *instrument*. Each part had its particular duty, each connected and arranged with others so that they might work together harmoniously for the good of the body: it was a *teleological* unity that tied body to soul. So when Harvey (1616, p. 11) noted that, "...there is no part that in some manner is not fashioned as an instrument," he was elaborating exactly this conception of soul and body. This instrumentality was central to how he understood anatomy, for it reflected a conception of organic bodies as systems of interrelated and harmonious teleological relations: each and every part of the body is *for the sake of* some function. This is Aristotle's final cause, *hou beneka*, noting that Harvey often uses the much more literal Latin translation of that phrase, *alicuius gratia*, instead of the Scholastics' *causa finalis*.¹⁰

These Aristotelian causes were elaborated through Galenic terminology. In Galen's system, an action (*energeia*, *actio*) was some movement performed by the part, whereas a use (*chreia*, *usus*) was, according to R. J. Hankinson "...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" (2002, p. 48). Both use and action were teleological explanations: a part's action explained what the part was for the sake of in a minimal way, e.g., the muscles were for the sake of contracting, teeth for grinding, etc., while at the same time describing an active motion. The use of a part was the purpose to which an instrument of the soul was put, a biological necessity, and instruments should be well suited to their tasks. This second aspect of use, fittedness, became associated in early modernity with another term (at least occasionally¹¹): Utility (*utilitas*).

9. In fact, anatomy belongs to those sciences that investigate what is "common to body and soul." See: King 2006; For the editions Harvey used, see: Galen 1549 and Aristotle 1552.

10. Harvey 1616, p. 22. "Quoniam finis Anatome est scire vel cognoscere partes et scire per causas et hae in omnibus animalibus cuius gratia et propter quid...."

11. Early moderns are rarely consistent or clear with terminology.

We turn now to look at how Harvey deployed this terminology in some depth, terminology that surprisingly has heretofore never been analyzed.¹² We begin with *actio*: “Action [is] active movement of which the accomplishment is called function, [or] in matter [is called] work” (Harvey 161, p. 22). The notion was simple, but helps us get a sense of the kinds of knowledge that anatomy must furnish about the parts through observation (and often necessitating vivisection). Actions served some end, and when describing them as *actiones*, Harvey tended to avoid functional language at the organismic level, not mentioning the *overall* biological goal or function that is accomplished by the action. So, for example, “The action [of the kidneys] is to draw away and convey out of the veins into the bladder the serous excrement...” (Harvey 1616, p. 158). Here Harvey merely described the specific motions of the kidney, whatever materials were involved in those motions, and the connection between these motions and other parts.

To describe aspects of the larger functional system Harvey turned to *usus* and *utilitates*. Harvey devised some additional terminology not found in other authors to my knowledge, distinguishing *uses/intermediate* utilities from what he called *final* utilities. Utility was tied, not to mere action, but to *acting well* or *acting by necessity*. Uses and intermediate utilities were closely tied to action—an action is what a part *does*, a use is what that action is *for*. Why might Harvey have equated use and intermediate utility? One reason was that the line between a use and a utility was not always clear, especially since a utility often, in some sense, *contained* the use—a utility was about the pairing the action of a part to its use. That is, a utility was not just about the goal that an action serves, but also about how the action accomplished that use in an optimal way, about how the fittedness of means to ends allowed the part to serve the good.

What was this good? Harvey described this as the set of final utilities, including being for *existence* and *necessity* (Harvey 1616, p. 24). Whereas a use/intermediate utility explained the *purpose* of the action of a part or *how* that action is accomplished by the part, a final utility explained the *necessity* of that use, its very *existence*, and how the part existed optimally and necessarily. An example will help: “The use of the kidneys is to mitigate the pungency of the urine and to assist concoction” (Harvey 1616, p. 168). So the use here was a specific biological end, namely, assisting concoction and mitigating pungency, and this was the reason for the action of the kidneys noted above, involving all its motions, materials, and connections to other parts. Finally, at least one of the utilities of the kidneys was quite different than either its action or use: “Another utility of the kidneys is similar to that of all the other viscera, namely, that they may be a support for the

12. Though do see French 1994; and for Fabricius see: Distelzweig 2014.

veins lest they be compressed” (Harvey 1616, p. 160). The kidneys were in service to the optimization of the organization of the whole body, making sure that the veins are not compressed, ensuring their proper functioning, and the well-being of the whole organism.

The system here was one with a variety of teleological levels. All the processes of the body were teleological: even the most basic material components of the body, the uniform parts, were *for the sake of* the construction of the non-uniform ones. But this was a shallower sort of teleological orientation; the use of a part was, in a sense, “more teleological” than the action of a part. Use wasn’t just teleological in that the part was for its action, but it furthermore served some biologically necessary purpose within the context of the organic whole of the body. And beyond use, further down the teleological continuum, was utility, which was about the fittedness of organs to those purposes. Between these levels were borderline cases, where one might equally call some end a use or a utility, or a use an action. We might arrange a teleological hierarchy:

Utilitas finalis → *Usus/Utilitas media* → *Actio* → *Structure and matter of the parts* (*Uniform Parts* → *Non-uniform Parts*)

Notice that this hierarchy was arranged by order of (final causal) explanation, each higher level accounting for the lower levels: final utilities explained uses, actions, or parts, uses explained actions, or parts, actions explained parts, and, finally, the non-uniform parts were explained by the uniform parts.

4. Experience and Reason in Anatomy

From the previous sections, it should be clear that Harvey links cutting and observing with gaining knowledge of final causes. But how could one observe a final cause? In fact, the previous section should go some way in showing how observations leading to knowledge of final causes (actions and uses) are not so mysterious, based as they must be on the organization and constitution of animal bodies. To completely answer this question, I show how for Harvey, observation and reason are united through the development of *facultas*, through the skill of anatomy, which allowed inferences to causes based on large sets of anatomical observations, not singular observations by themselves.

We must not assume that Harvey means by *experientia* what we mean by *experience*. In the Renaissance, the term had a variety of meanings, signifying, among other things, certain kinds of alchemical recipes. Peter Dear (2006, pp. 112–13) has argued that Renaissance philosophers conceptualized *experientia* as an everyday, ordinary perceptual experience, containing truths of the sort that anyone could recognize. Though Dear argued that it

this was the sense of experience relevant for Harvey and other physicians, this is the *wrong* way to look at it. Further, *pace* Andrew Wear (1983), experience for Harvey was not pure empiricism, but rather a skill developed through the repeated and combined use of observation and reason.

To show this, I refer to a marginal note Harvey made in his copy of his friend Theodore Goulston's (1640) edition of Galen, the *Opuscula varia*. Vivian Nutton (1988, pp. 116–17), discussing these marginal notes, writes that Harvey writes something on almost every page, demonstrating his deep familiarity (and, often, disagreement) with Galen, and that Harvey's notes have an especial concern with Galen's views on epistemology and proof. In particular, one note provides a deep insight into how Harvey conceived of experience. In Galen's *De sectis*, Nutton (1988, pp. 116–17) 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.*'" This rejection of the split between these seemingly rival medical methodologies alerts us to an important and foundational unity in Harvey's epistemology: investigative reason and observation work *together* to provide experience, which allows for judgments about causes.

Harvey thus followed Galen in conceiving of experience as *technical anatomical* experience. In *De placitis Hippocratis et Platonis*, Galen went to great lengths to establish that this was the most relevant kind of experience for deciding issues of body and soul. Far from being something shared by all human beings, *experientia* was the result of long training and specialized ability—one has to work hard to develop a *facultas*.¹³ So when experience provides knowledge of final causes, it does not mean that one *directly* perceives things in the same way that one sees that blood is red. It is rather that *many* observations and *active reasoning* into these observations can lead to knowledge of the sorts of causes discussed in the previous section.

This *facultas* provided a kind of wisdom, a deep acquaintance with animal bodies, granting reasoned judgment to the experienced anatomist. Today we might recognize it as a kind of pattern recognition, like the ability of an expert clinical diagnostician to determine, from observations and bioassays, what is wrong with a patient. This sort of acquaintance must be personal acquaintance, founded upon what early moderns physicians called

13. This might undermine Roger French's contention that Harvey fits into the English epistemological tradition of gentlemanly testimony described by Steven Shapin, though Harvey does make remarks which might fit into Shapin's theory. See French 1994, Shapin 1994, and Shapin and Schaffer 1985.

autopsia—repeated observations and reasoned investigation into matters anatomical, done oneself and not learned through hearsay.

Experience was thus like a tutor. In his *Exercitationes de generatione animalium* (1651, p. 270), Harvey discussed the order of the appearance of the parts during development according to earlier writers, pointing out their mistakes: "...truly, experience teaches [*experientia docet*] that things are far otherwise than this, for it can be seen that the bones are made last of all." The way knowledge is gained here might be understood in the same way that one gains knowledge from a book:

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 experience [*diligens...experientia*]; and by the help of clear observations [*perspicuis observationibus*] I will expound from the book of Nature [*ex naturae libro... declarabimus*] what the material of the foetus is and how from thence it is formed. (Harvey 1651, p. 202)

Nature's book can be read, provided that one can have clear observations (noting that Harvey here distinguishes observations from experience). In order to get clear observations, one must learn how to perform anatomies and how to *see* and *feel* during them. Vesalius argued for something similar, writing that those physicians who were unlearned Empirics, though they can cut open bodies and browse around, do not truly understand what they see.¹⁴

Once one's eyes, hands, and mind have been trained to work *together* one might master the evidence of anatomy, in the same way that one could understand the evidence provided by earlier authors only if one learned how to read their works, and read them critically. It is a prerequisite for scientific knowledge, as Harvey writes in his *De circulatione sanguinis*:

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 [*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*]. (Harvey 1649, pp. 99–100)

14. The famous passage quoted above.

Those who had no experience were unsuitable for true *scientia* because their judgments about nature—its colors and harmonies—were of the same order of the judgments of the blind about geometry—neither actually *sees* the phenomena in the relevant sense of trained observing, and thus neither can make judgments.

So experience is a source of knowledge *and* skill—skills both manual and cognitive. That is, lack of experience is a serious deficit because experience teaches two things: not just facts (things like the material nature of the parts, their size, shape, movement, disposition, and so on), but also teaches, over time, the abilities needed to properly collect and use these facts to make warranted judgments about bodies and their causes (things like how to cut bodies, how to keep and organize observations, how to manipulate them experimentally, and so on). Thus one might translate *experientia* as *expertise*.¹⁵ Harvey followed the way of the anatomists, as Andrew Wear named it, but his is not the “purely observational epistemology” that Wear (1983) and others since have claimed: it involves more than mere observation, it demands investigative reasoning and a great deal of practice in the pursuit of *facultas*. Only then can experience produce knowledge. Thus from art flows science: from cutting and observing we can judge the causes of the parts.

Importantly, the anatomist must not just observe things, but must observe them in a particular way in order to facilitate these judgments. Experience must be rationally organized into *historiae*.

5. Anatomical Histories

These histories, emphasized especially in the Renaissance Paduan Aristotelian tradition, are the inductive basis for inferences to causes (Pomata 2005). Aristotle understood *historiae* as the organization of 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 (Lennox 2006, p. 36). Indeed, Harvey's *De generatione*, Lennox argued, was explicitly organized according to the strictures of Aristotelian *historia* (Lennox 2006, p. 34). These *historiae* are deeply Aristotelian insofar as they include not just observations *simpliciter*, but rather observations *carefully organized in order to make inferences*.

Though it has not been noticed to my knowledge, in the *Prelectiones*, Harvey discussed what one should pay attention to when anatomizing,

15. This is similar to the conception of experience found in early modern law, especially in Britain. See Sargent 1989.

in order to make inferences to actions and uses and to develop *facultas*. *Historiae* are the ways in which the anatomist becomes familiar with the subject—an *expert*. Turning to the list of differences Harvey insists must be observed in *historiam anatomicam*, he starts by writing that,

WH in each organic part [there are] five things [which must be considered]:

1. Position
2. Shape
3. Quantity
4. Motion
5. Division (Harvey 1616, p. 20)

The basic idea is that by collecting detailed observations organized into these categories, one can then make judgments about the causes of those parts. Further, noting the pedagogical purpose of Harvey's lectures, the collecting of detailed *historiae*, organized in this way, must be understood as a basic part of developing *facultas*: learning to observe these aspects of the parts of the body was to the skill of anatomy what learning to read different letters of words was to the skill of reading. Once the forms of letters have been learned, one might then see whole words and eventually whole sentences; when one has well-learned the shapes, motions, etc., of the parts, one could then begin to see what they do, how they do it, and, with some luck and much skill, *why* they do it. As Lennox noted in Aristotle, "...*historia* will make apparent the 'about whiches' (the *explananda*) and the 'from whiches' (the *explanans*) of our scientific explanations" (Lennox 2001, p. 18). Only after one has fully characterized the natural object being studied, that it exists, its motions, its range and variation in various kinds and sub-kinds, can one move on to attempt to determine *why* that object exists as it does and where it does.

Take division, which deals with the division of the matter of the body into different parts of various kinds, and which provides an interesting example of how the collection of *historiae* can relate to questions about action and use. Harvey states that from division arise "...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]" (Harvey 1616, p. 20). One considers not just the material nature of the part, but also the relation of these material matters to its power, strength and other qualities, and in concert with understanding the motions and other differences of the part, a picture of the uses and actions of that part can be pieced together. So Harvey notes that the liver and spleen are, "Divided into coat, vessels, veins, arteries

and nerves, parenchyma, blood and spirits” (Harvey 1616, p. 140). These organic parts are made up of other sorts of parts, and continue to be divisible; for instance, the substance of the coat of the liver is made of exceedingly fine members. Here knowledge of these divisions afforded Harvey an argument against those Galenic physicians¹⁶ who maintain that blood is contained in the liver, which can 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...For this reason, many anatomists like WH have made diligent search for an anastomosis and have found none. (Harvey 1616, p. 140)

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* about the divisions and material nature of the liver, Harvey was able to identify this Galenic position as false. Thus he had to begin to reconsider the use of the liver, which of course relates to his work on the heart and the nature of the blood. In this way, *historiae* were essential for refining his causal understanding of the body and its parts.

Remember, the teleological schema noted above was arranged in order of explanation. In terms of Harvey’s method, that is, the order of judgment or inference, the arrangement is reversed: one infers from less teleological aspects of the parts to more teleological aspects. So:

Historiae of the Parts → ({Actio → {Usus/Utilitas media → Utilitas finalis}})

From *historiae*, if one determined, for example, that a part was warm, that it was connected to a system of blood vessels entering the kidneys, and that it was red, one might then infer that the use of the part was to make the blood entering the kidneys warm, and, given the *historiae* concerning the kidneys, that its utility consisted in its ability to assist with concoction.

6. Conclusion

As Aquinas noted, experience in matters pertaining to action produced not only knowledge, but also habit.¹⁷ Anatomy is not just a knowing,

16. Laurentius 1600, p. 240; Bauhinus 1605, p. 288.

17. See also: Aquinas 2012, *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.”

but a doing, a skilled ability: the repeated exercise of sensory and motive faculties in combination with one's reason renders the activity easier: one gains *facultas*. Experience was thus a complex and slow route to knowledge of organic purposes, functions not inferred upon a single viewing, nor even a dozen, but demanding instead long and active investigation. Harvey's epistemology, then, was no simple empiricism.

Noting this important fact, I want to conclude by discussing the image of Harvey found in much current historiography, which privileges his purported invention of "observational knowledge." As noted above, this line of thought has been advocated by Andrew Wear (1983) and Roger French (1994). On the contrary, 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, of course, often how neoteric philosophers interpreted him in his own time, but this is not Harvey's self-conception. Instead, Harvey creatively reinterpreted the epistemological and methodological doctrines of Aristotle, Galen, and his Paduan teachers to suit his needs: his primary interest was, in fact, the production of *final causal knowledge*.

Roger French argues that Harvey posited a new, sensory epistemology upon a "Principle of Limited Explanation" that Harvey supposedly devised in the *De motu cordis* (1628) and later replies to his critics. Here Harvey was supposed to have maintained that factual, observational knowledge was the primary sort of knowledge that philosophers should be interested in, instead of causal knowledge.¹⁸ How French intends this principle is unclear: he calls it a principle of limited explanation, but the principle as he has formulated it seems to be rather a *rejection* of explanation. For what sort of explanation could Harvey offer in the absence of causal knowledge? Further, French's 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 asserted, as French understood this "Principle" to indicate a *general attitude* with respect to determining the final causes of things in nature.

French linked this so-called principle with Harvey's distinction, in his letters to Riolan, between knowledge of facts (*boti*) and knowledge of causes (*dioti*). This is the Aristotelian division between the results of *historia* and the results of causal investigation. Harvey (1649, p. 76) wrote that, "With regard to a fact, we should ask first 'that it is' before 'why it is' [*Quod*

18. This is discussed in a number of places in French 1994, pp. 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.

sit, ante quam Propter quid, inquirendum].”¹⁹ French takes this to indicate that Harvey “...is calling on an approved technique of experimental demonstration, from sense and experience, not from first principles” (French 1994, p. 278). But this misunderstands demonstration, for experience *just is* the source of first principles for demonstration, 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 mistaken, for it is clear that to Harvey it is but necessary preamble. There is a passage from his letters to Riolan that is often used to establish Harvey’s “purely observational knowledge:”

The example of Astronomy is not to be followed here, where the causes and *why* such a thing is [*propter quid*] come to be investigated only from the appearances and *that* such a thing is [*ipso quod sit*]. But for anybody searching for the cause of the Eclipse, one should be placed above the Moon, where one might discern the cause by sensation, and not by reasoning concerning appearances [...*causam perquirens, supra lunam si steretur, ubi sensu causam discerneret, non ratiocinio sensibilium*]... (Harvey 1649, p. 81)

Two points can be made against this. First, as the larger context makes clear, the subject here is not discovery or method in general, but confirmation and demonstration in particular: knowledge gained by means of the senses is the best kind of evidence. But this does not mean that reasoning plays no role, nor does it mean that simple observation leads to knowledge of causes. Second, what I have translated as “reasoning about appearances” is often read as “reasoning about sensibles,” but, again, from the context it is clear that he is referring back to astronomy where true, up close observations of the moon are not possible. The parallel in anatomy would be to discern the nature of, say, the eyes only by what could be sensed from the outside without dissection. So this passage does not, in fact, mean that Harvey thinks one can *directly* observe causes, only that such knowledge is best gained and confirmed through sensory observations.

French follows the work of Wear (1983), who argued that Harvey’s method of obtaining observational knowledge was consistent across his career:

...Harvey perceived the circulation as an observable fact and not as a theory...Harvey came to view observation as a form of knowledge in

19. Harvey 1649, p. 76. 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.

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. (Wear 1983, p. 224)

But this misunderstands Harvey's position: by admitting the importance of observation, he was not demoting causal knowledge, he was pointing out that observation is *what leads to knowledge of causes!* Of course, not *any* kind of observation leads to knowledge: it is only *experienced* observation that does so, only the perceptions of the expert anatomist, performed across animals, rationally organized into *historiae*, can be counted upon for causal knowledge.

I end by putting Harvey's conception of experience in some Aristotelian-Platonic perspective. One way to frame the difference between observational (better, historical) knowledge and causal or scientific knowledge is analogous to the difference between inductive knowledge and understanding. 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 understanding. For understanding we need greater familiarity and expertise" (Burnyeat 1981, pp. 131, 137). Thus scientific demonstration is a way of systematizing causal explanations. Burnyeat's description of Aristotle's natural philosophy 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, allowing for demonstration. Harvey, following in this tradition, may have been an *inspiration* for a new observational epistemology, but Harvey's methods were based upon his interpretation of Aristotelian and Galenic science.

Harvey thought that *knowing* necessitates *doing*: investigative reasoning, Harvey scribbled in the margins of his copy of Galen's *De sectis*, makes a doctor by experience. It is the constant pursuit of physiological knowledge, the repeated investigation of animal bodies, that allowed the anatomist to develop expertise, a familiarity with cutting through blood and bone in an attempt to figure out what's there and what it's doing. What is needed is not mere observation, but continual observation by one deeply acquainted with the subject matter. Observation and reason are united by experience for Harvey, and it is through the training and use of these abilities that he thought one could come to know the ends of nature, the purposes of living things and their parts.

References

- Aquinas, Thomas. 2012. *Opera omnia*. www.corpusthomisticum.org/iopera.html (accessed 24 June 2015)
- Aristotle. 1552. *Aristotelis libri omnes*. . . . Venice.
- Bauhinus. 1605. *Theatrum anatomicum*. Frankfurt a.M.

- Burnyeat, M.F. 1981. "Aristotle on Understanding Knowledge." Pp. 97–139 in *Aristotle on Science: The Posterior Analytics. Proceedings of the Eighth Symposium Aristotelicum*. Edited by Enrico Berti. Padua: Antenore.
- Cunningham, Andrew. 1975. "The Kinds of Anatomy." *Medical History* 19:1–19.
- 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: 631–635.
- 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: 51–76.
- Dear, Peter. 2006. "The Meanings of Experience." Pp. 106–131 in *The Cambridge History of Science, Vol. 3, Early Modern Science*. Edited by Katherine Park and Lorraine Daston, Cambridge: Cambridge University Press.
- Distelzweig, Peter. 2014. "Fabricius' Galeno-Aristotelian Teleomechanics of Muscle." Pp. 65–84 in *The Life Sciences in Early Modern Philosophy*. Edited by Justin E. H. Smith and Ohad Nachtomy. Oxford: Oxford University Press.
- Elyot, Thomas. 1538. *The Dictionary of Sir Thomas Elyot*. Londini: In ædibus Thomæ Bertheleti typis impress. Cum priuilegio ad imprimendum solum. <http://quod.lib.umich.edu/e/eebo/A21313.0001.001?view=toc> (accessed 24 June 2015)
- Fallopius. 1584. *Omnia...opera*. Paris.
- Fabricius. 1600. *De visione, de vocu, de auditu*. Venice.
- Fabricius. 1687. *Opera omnia anatomica et physiologica*. Leipzig.
- Frank, Robert. 1980. *Harvey and the Oxford Physiologists*. Los Angeles: University of California Press.
- French, Roger. 1994. *William Harvey's Natural Philosophy*. Cambridge: Cambridge University Press.
- French, Roger. 1999. *Dissection and Vivisection in the European Renaissance*. Ashgate: Aldershot.
- Galen. 1549. *Galeni Peragameni...opera quae nos extant Omnia*. Basel.
- Glisson, Francis. 1645. *Anatomia Hepatis*. Amsterdam.
- Goulston, Theodore. 1640. *C. Galeni opuscula varia*. London.
- Hankinson, R.J. 2002. "Causation in Galen." Pp. 31–62 in *Galien et La Philosophie*. Edited by Jonathan Barnes and Jacques Jouanna. Geneva: Vandouvres.
- Harvey, William. [1616] 1964. *Prelectiones anatomie universalis*. Edited by Gweneth Whitteridge. London: Royal College of Physicians.
- Harvey, William. 1616–1626. *Manuscript of the Prelectiones*. In: The British Library, Sloane MS 230a.

- Harvey, William. 1649. *Exercitatio de circulatione sanguinis*. London.
- Harvey, William. 1651. *Exercitationes de generatione animalium*. London.
- Holy-Oke, Francis. 1640. *Dictionarium Etymologicum Latinum*. London.
- King, R.A.H. (ed.). 2006. *Common to Body and Soul*. Berlin: Walter de Gruyter.
- Klestinec, Cynthia. 2010. "Practical Experience in Anatomy." Pp. 33–57 in *The Body as Object and Instrument of Knowledge: Embodied Empiricism in Early Modern Science*. Edited by Charles T. Wolfe and Ofer Gal. Dordrecht: Springer.
- Klestinec, Cynthia. 2011. *Theaters of Anatomy*. Baltimore: Johns Hopkins University Press.
- Laurentius. 1600. *Historia anatomica*. Paris.
- Lennox, James. 2001. "Divide and Explain: The Posterior Analytics in Practice." Pp. 7–38 in *Aristotle's Philosophy of Biology*. Cambridge: Cambridge University Press.
- Lennox, James. 2006. "The Comparative Study of Animal Development." Pp. 21–46 in *The Problem of Generation in Early Modern Philosophy*. Edited by Justin E. H. Smith. Cambridge: Cambridge University Press.
- Nutton, Vivian. 1988. "Harvey, Goulston and Galen." Pp. 112–122 in *From Democedes to Harvey*. London: Variorum Reprints.
- Pomata, Gianna. 2005. "*Praxis Historialis*: The Uses of *Historia* in Early Modern Medicine." Pp. 105–46 in *Historia: Empiricism and Erudition in Early Modern Europe*. Edited by Gianna Pomata and Nancy G. Siraisi. Cambridge: MIT Press.
- Rider, John. 1589. *Bibliotheca Scholastica*. Joseph Barnes, printer to the Vniversitie of Oxford, and are to be sold at the Tygers head in Paules Church-yarde.
- 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: 19–45.
- Shapin, Steven. 1994. *A Social History of Truth*. Chicago: University of Chicago Press.
- Shapin, Steven and Simon Schaffer. 1985. *Leviathan and the Air-Pump*. Princeton: Princeton University Press.
- Shotwell, Allen. 2013. *The Revival of Dissection*. Dissertation.
- Siraisi, Nancy. 1990. "Medicine, Physiology and Anatomy in Early Sixteenth-Century Critiques of the Arts and Sciences." Pp. 217–229 in *New Perspectives on Renaissance Thought*. Edited by John Henry and Sarah Hutton. London: Duckworth.
- Siraisi, Nancy. 1994. "Vesalius and Human Diversity in *De humani corporis fabrica*." *Journal of the Warburg and Courtauld Institutes* 57: 60–88.
- Vesalius. 1543. *De humani corporis fabrica*. Basel.
- Wear, Andrew. 1983. "William Harvey and 'the Way of the Anatomists.'" *History of Science* 21: 223–49.