

2017

# Innovator or Butcher?: Herophilean Research Methods in Early Ptolemaic Alexandria

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<https://doi.org/10.15760/honors.437>

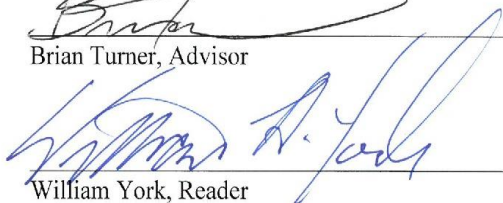
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THESIS APPROVAL


The thesis of Annastasia Conner for the Bachelor of Arts with Honors in History was presented May 30, 2017, and accepted by the thesis committee and the department.

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## Abstract

In a period of Ptolemaic Alexandria that has been referred to by modern scholars as a “frontier environment” for scientific achievement and discoveries, Herophilus of Chalcedon was a leader of innovation. Religious and cultural boundaries and the presence of taboos and death-based pollution should perhaps have limited his research capabilities, but under the patronage of the ruling Ptolemaic kings (Ptolemy I Soter, and Ptolemy II Philadelphus both reigned during Herophilus’ lifetime), he and his contemporaries were able to dissect and vivisect human cadavers within the pursuit of their studies. Although Herophilus’ therapeutic practices largely fell within the scope of the Hippocratic medical tradition, his research methods and his manner of writing were both in striking contrast with those of his predecessors. Rather than using limited analogies based on animal anatomy in his descriptions of human anatomical structures, Herophilus used correlations involving material objects or elements of the natural world, thus providing more accessible points of comparison for a broader range of physicians. His use of more commonplace analogies suggests that he was writing for a less specialist audience, beyond the limited scope of the elite, academic group of physicians with whom he studied within the Museum and Library of Alexandria. By examining his use of analogy and the way that this differs from that of other ancient medical authors, it is possible to reveal something about who Herophilus was as both physician and teacher.

INNOVATOR OR BUTCHER?:  
HEROPHILEAN RESEARCH METHODS IN EARLY PTOLEMAIC ALEXANDRIA

by  
ANNASTASIA C. CONNER

A thesis submitted in partial fulfillment of the  
requirements for the degree of

Bachelor of Arts

in

University Honors

and

History

Portland State University – Urban Honors College  
2017

## Acknowledgments

I am indebted, first and foremost, to Dr. Brian Turner, for his time, mentorship, and endless questions, which helped me to dig deeper in every area of my research. His advice and insights have helped me immensely in the creation of this work, and in my historical training as a whole. I would also like to thank Dr. William H. York, without whose excellent teaching I would never have ventured into the history of medicine in the first place. I am also grateful to have had the opportunity to present part of this thesis at the Twelfth Annual Northwest Undergraduate Conference on the Ancient World at Willamette University, and for the invaluable feedback that I received on that occasion.

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## List of Abbreviations

\*Editions used are reflected within the bibliography.

*Anat. Admin.* – Galen, *De anatomicis administrationibus (On Anatomical Procedures)*.

*Anat. Part. Hom.* – Rufus Ephesius, *De anatomia partium hominis (On the Anatomy of the Parts of Man)*.

*BNP* – *Brill's New Pauly: Encyclopaedia of the ancient world*.

*De Leg.* – Cicero, *De legibus (On the Laws)*.

*De Med.* – Celsus, *De medicina (On Medicine)*.

*Diff. Puls.* – Galen, *De pulsuum differentiis (On the Differences in Pulses)*.

*Hist.* – Herodotus, *The Histories*.

*Libr. Propr.* – Galen, *De libris propriis (On My Own Books)*.

*Loc. Affect.* – Galen, *De locis affectis (On the Affected Parts)*.

*Nat. Hist.* – Pliny the Elder, *Historia Naturalis (Natural History)*.

*Nom. Part. Hom.* – Rufus Ephesius, *De nominatione partium hominis (On the Names of the Parts of Man)*.

*OCD* – *Oxford Classical Dictionary*.

*Usu Part.* – Galen, *De usu partium (On the Usefulness of the Parts)*.

*Uter. Dissect.* – Galen, *De uteri dissectione (On the Anatomy of the Uterus)*.

## Introduction

Herophilus of Chalcedon (c. 330-260 BCE) is undoubtedly one of the most controversial characters in the history of medicine, and specifically within the history of anatomical study. He was a physician of Greek origin who, along with his contemporary, Erasistratus, is credited as being one of only two physicians in the ancient world to practice systematic scientific human dissection and vivisection.<sup>1</sup> Although he authored nine books on anatomy and medicine, none of these have survived. Some fragments of his work remain through their quotation and interpretation within the writings of Galen of Pergamum in the second century CE.<sup>2</sup> As a researcher in early Ptolemaic Alexandria under the rule of Ptolemy I Soter and Ptolemy II Philadelphus, his use of systematic human dissection and vivisection was a novel method in anatomical study and the pursuit of medical knowledge at the time. The period in which these studies occurred was quite brief, and only possible due to the convergence of several key factors.<sup>3</sup> Following the cessation of human dissection after the work of Herophilus, the practice was not used again for almost two thousand years.<sup>4</sup>

The scope of the modern scholarship studying Herophilus and his experiments has been somewhat limited, perhaps due to the relative paucity of primary evidence on this topic.

Historian of medicine Heinrich von Staden is responsible for the vast majority of the work regarding Herophilus in the last forty years. His book, *Herophilus: The Art of Medicine in Early*

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<sup>1</sup> There is some debate regarding the actual life dates of Herophilus. Most determine his dates based on Galen's designation of Herophilus as a contemporary of Erasistratus. Heinrich von Staden placed him "roughly from 330/320 to 260/250 B.C." Heinrich von Staden, *Herophilus: The Art of Medicine in Early Alexandria* (Cambridge: Cambridge University Press, 1989), 36. *OCD*, s.v. "Herophilus."

<sup>2</sup> Although Galen (CE 129-?199/216) made innumerable contributions to the field of medicine in his time, he is best known as an ambitious anatomist and physiologist, using animals as the subjects of his dissections in an effort to expand his knowledge of human anatomy. Much of our knowledge of earlier medicine derives from his reports. He studied in Pergamum, Corinth, Smyrna, and Alexandria. *OCD*; *BNP*, s.v. "Galen."

<sup>3</sup> Heinrich von Staden, "The Discovery of the Body: Human Dissection and Its Cultural Contexts in Ancient Greece," *The Yale Journal of Biology and Medicine* 65 (1992), 223-241.

<sup>4</sup> William H. York, *Health and Wellness in Antiquity through the Middle Ages* (Santa Barbara, CA: Greenwood, 2012), 228-229.



*Alexandria*, has been the standard in the field since its publication.<sup>5</sup> Compiling all fragments of Herophilean writing and mentions of Herophilus within the works of other ancient authors, this impressive work provides in-depth analysis and criticism of these texts. Each piece of primary evidence is presented in its language of origin (most commonly Greek or Latin), and also translated into English. Von Staden expressed in the preface to this book that he hoped it would “provide access to a significant and neglected chapter in the history of medicine,” and it has certainly done so.<sup>6</sup>

The present study examines Herophilus of Chalcedon and his practice of systematic scientific human dissection and vivisection in early Ptolemaic Alexandria in the hopes that a consideration of how his methods and discoveries differed from those of his predecessors and contemporaries might illuminate who Herophilus was as both physician and teacher.<sup>7</sup> In the pursuit of these goals, this work will present the context of Alexandria and the medical field at the time of Herophilus, including the influence of royal patronage on medical and scientific developments. It will then discuss contemporary belief systems concerning death and the treatment of the body post-mortem, and the associated taboos in both Greek and Egyptian culture. Finally, it will analyse Herophilus’ use of analogy in his medical writing as a method of teaching a widespread and diverse audience of general medical practitioners. This work will use as evidence fragments from Herophilus’ own writings, as well as the writings of other medical scholars and physicians in the ancient world, particularly Celsus, Galen of Pergamum, and the Egyptian medical papyri.<sup>8</sup>

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<sup>5</sup> Heinrich von Staden, *Herophilus: The Art of Medicine in Early Alexandria* (Cambridge: Cambridge University Press, 1989).

<sup>6</sup> Von Staden, *Herophilus*, xiii.

<sup>7</sup> Vivisection: the dissection of a subject while they are yet living.

<sup>8</sup> Editions used will be reflected within the primary source bibliography.

## Context of Herophilean Alexandria

Alexander the Great founded Alexandria in 331 BCE as a center of culture and trade in Egypt. The location of the city, on the southern coast of the Mediterranean Sea, offered a favorable climate and an enviable position in terms of port access.<sup>9</sup> Lacking a Hellenic background or roots, the city had no firm Greek ethnic tradition from the start.<sup>10</sup> After Alexander's death in 323 BCE, Ptolemy I Soter (r. 303-282 BCE) received Egypt as a satrapy, and built up the city there with the intent to establish the highest kind of Greek culture.<sup>11</sup> He officially declared himself pharaoh of the Egyptian people in 305/4 BCE, marking the beginning of the Ptolemaic Dynasty as a separate entity from Alexander's Macedonian Empire.<sup>12</sup> The decades that followed witnessed the growth and expansion of the physical city of Alexandria, but also of the intellectual and creative accomplishments of its residents. The city was laid out according to a grid system, and water was supplied through underground channels. It also contained an athletic stadium and a distinctly Hellenic agora.<sup>13</sup> The Ptolemaic Dynasty, carrying on Alexander's appreciation for discovery and learning, encouraged a general intellectual climate within the city that attracted scholars from all over the Greek world.<sup>14</sup>

Strabo, the ancient geographer, discussed the cultural interaction within this environment, which may have contributed to the atmosphere of innovation growing within the city. He stated that "with the Alexandrians, both occurs: they accept many foreigners from everywhere and send

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<sup>9</sup> See the geographic location of the city on a map of the Hellenistic world in Appendix B.

<sup>10</sup> Peter Green, "The Politics of Royal Patronage: Early Ptolemaic Alexandria," *Grand Street* 5, no. 1 (1985), 157.

<sup>11</sup> 'Satrapy' refers to a province within an ancient empire such as the Hellenistic Empire, ruled by a governor, or satrap. Ptolemaic imperialist and intellectual goals will be examined in greater depth later in this paper. Green, "Politics of Patronage," 154.

<sup>12</sup> The appropriation of this title was likely more a means of legitimizing the dynasty than a true incorporation of Egyptian culture into the royal court.

<sup>13</sup> Philippa Lang, *Studies in Ancient Medicine: Medicine and Society in Ptolemaic Egypt* (Leiden: Brill, 2013), 243.

<sup>14</sup> E.G. Turner, "Ptolemaic Egypt," in *The Cambridge Ancient History*, Vol.7, Part 1: The Hellenistic World. Second Edition, edited by F.W. Walbank, A.E. Astin, M.W. Frederiksen, R.M. Ogilvie (Cambridge: Cambridge University Press, 1984), 170.

away not a few of their own.”<sup>15</sup> Strabo speaks of three distinct groups living within Alexandria “in the time of the kings.”<sup>16</sup> These included the indigenous Egyptians, foreign mercenaries, and those who were “Hellenes by origin and remembered the common Hellenic customs.”<sup>17</sup> This focus on the remembrance of Hellenic customs makes clear how separate these groups were really seen to be. These separate groups existing together in the shared space of early Alexandria may have helped to create what Heinrich von Staden refers to as a ‘frontier environment.’

A major scholar in the field of Hellenistic medicine, von Staden created the idea of the ‘frontier environment’ in his 1989 book.<sup>18</sup> Although the phrase is somewhat vague, it describes an atmosphere of innovation, which allowed for scientific research opportunities that would not otherwise have been possible, and “made it easier to overcome some inveterate Greek taboos, particularly if their violation could be sanctioned, however tenuously, by appeals to time-honoured Egyptian tradition.”<sup>19</sup> This explanation would certainly help to explain, as Strabo states in the passage above, the ability on the part of some Alexandrians to remember their Hellenic culture and to also ignore or rationalize the potential violation of taboo that occurred during dissections like those performed by Herophilus. While innovation is evident in his physical research practices, it is also observable in his writing style; the presence of these separate ethnic and cultural groups may have encouraged the presentation of medical writings and teaching materials in new and distinctive ways in the hopes of communicating with and influencing practicing physicians across the boundaries of these groups.

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<sup>15</sup> Strabo, *Geography* 14.5.13. Strabo was a Greek geographer and historian who lived during the Augustan period. He is believed to have lived from around 62 BCE- 24 CE, although this is uncertain because his own works are our only source by which to determine this. He lived in Rome for a lengthy period, and wrote at least part of his geographical work there. He also lived in Egypt, likely from 25/4-20 BCE. *BNP*, s.v. “Strabo.”

<sup>16</sup> Strabo, *Geography* 17.1.12. This reference to the kings of Alexandria can only refer to the Ptolemaic dynasty, as they were the rulers of the city from its inception until the middle of Strabo’s lifetime.

<sup>17</sup> Strabo, *Geography* 17.1.12.

<sup>18</sup> Von Staden, *Herophilus*, 29.

<sup>19</sup> Von Staden, *Herophilus*, 29.

## *The Medical Field in Greek and Egyptian Cultures*

The Ptolemaic era in Egypt was one in which a small group of elite Greeks ruled over the rest of the population and were in complete control of all administrative aspects. As Philippa Lang so astutely described in her article on medical and ethnic identities in Hellenistic Egypt, “the institution of Greek as the governing language under Philadelphus, together with the Macedonian-Greek nature of the Ptolemaic court, inevitably reinforced a certain level of cultural and social separation.”<sup>20</sup> Any Egyptians taking part in government activities, or even working as scribes, had to become bilingual, while elite Greeks were far less likely to do so. In fact, the first of the Ptolemaic rulers to learn the native language was the famous Cleopatra, the last in the line.<sup>21</sup> The Ptolemies built a number of temples in the Egyptian style, but otherwise there is little evidence that Greek citizens of Ptolemaic Egypt significantly took part in Egyptian cultural activities or institutions.<sup>22</sup> Although the two cultures had technically merged, this can be seen as a confluence of conditions, rather than of actual traditions or practices.

Herophilus’ anatomical work in Alexandria was completed within a truly Greek medical context. There is very little evidence for any substantial influence upon his experiments by Egyptian medical practices at this time, or indeed, upon Greek medicine as a whole. Even the most prominent cause of disease in Egyptian disease theory (‘invasive entities’) is not mentioned at all in Alexandrian medical writings.<sup>23</sup> Additionally, as Lang states, “Egyptian medicine does not seem to have, at any point in its ancient history, engaged in the practice of invasive internal surgery; and that the emergence of dissection as an investigatory medium and invasive surgery as

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<sup>20</sup> Philippa Lang, “Medical and Ethnic Identities in Hellenistic Egypt,” *Apeiron: A Journal for Ancient Philosophy and Science* 37, no. 4 (Dec. 2004), 107.

<sup>21</sup> Lang, “Medical and Ethnic Identities,” 108.

<sup>22</sup> Other than some cases of intermarriage, which are not relevant for this study. Lang, “Medical and Ethnic Identities,” 108.

<sup>23</sup> Lang, *Medicine and Society*, 252.

a therapeutic one in Greco-Roman medicine is an outlier in ancient systems of medicine generally.”<sup>24</sup> The basis for a great number of Herophilean experiments can be found within the Hippocratic Corpus and the Greek medical tradition, but even within this context, the nature of his methods made him an outlier.

In the Egyptian medical tradition, we can see a wide variety of healers and doctors. Herodotus (c. 484-425 BCE) describes this practice of specialization: “the art of medicine is divided so that each physician treats just one illness and no more. Doctors are everywhere, as there are specific physicians for the eyes, the head, the teeth, the abdomen, and still others for illnesses that are invisible.”<sup>25</sup> The Egyptian medical papyri dating to the Old Kingdom also refer to various categories of physicians, including those such as the *swnw* (commonly translated as physicians or doctors), and the *sau* (or amulet men).<sup>26</sup> Based on the agreement between these two sources, we can see consistency across the centuries in at least this aspect of specialization within the field.

Diodorus Siculus said of Egyptian practitioners that “but few physicians would ever show themselves wiser than the mode of treatment which had been closely followed for a long period and had been originally prescribed by the ablest practitioners.”<sup>27</sup> This evaluation of members of the medical field as adhering to tradition, even occasionally at the cost of their patients’ lives and good health, reflects stagnation in their practice. Diodorus states that if the physician follows the rules and traditional treatment plans and fails to save his patient, “they are absolved from any

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<sup>24</sup> Lang, *Medicine and Society*, 253.

<sup>25</sup> Herodotus, *Hist.* 2.84.

<sup>26</sup> *Ebers Papyrus* 854a. These papyri are our main source for our knowledge of ancient Egyptian medicine, created between 1900-300 BCE. The Ebers Papyrus is the longest of these.

<sup>27</sup> Diodorus Siculus 1.82.3. Diodorus Siculus was a Greek universal historian originally from Agyrium (modern Agira), in Sicily. He intended that his work serve to replace and fulfill the functions of an entire historical library. His works consist of about 40 books, many of which survive to the present day. His time in Egypt is estimated to have fallen between 60-57 BCE. *BNP*, s.v. “Diodorus Siculus.”

charge and go unpunished.”<sup>28</sup> If, however, they differ from the traditional methods in any way and the result is adverse, “they must submit to a trial with death as the penalty.”<sup>29</sup> Although Herodotus predates Diodorus by several hundred years, he perhaps phrased the situation most eloquently when he said “they [the Egyptians] remain faithful to their ancestral customs and add nothing new to them.”<sup>30</sup> It seems unlikely, given their sense of established traditions and dependability, that experiments and innovations like those practiced by Herophilus and his contemporaries could have flourished under any influence from Egyptian medical culture. It is possible, however, that convergence of these two cultures may have created enough ambiguity to blur traditional lines of accepted behaviors.

Greek intellectual life, on the other hand, was often based on a tendency towards competition, which drove innovation, in and beyond the medical field. Scholars have described this agonistic drive as releasing “the vital energies into an acceptable ethical form,” and have considered this competitive propensity as underlying much of Greek culture.<sup>31</sup> In the case of Alexandria, scholars agree that the medicine of these elite Greek physicians existed within a very specific context: “the Ptolemaic project to make Alexandria the capital of the Greek cultural world.”<sup>32</sup> The competition can be seen here to be against other major urban centers of the Hellenistic and Greek world, as opposed to being against those other groups of peoples within Egypt itself.

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<sup>28</sup> Diodorus Siculus 1.82.3.

<sup>29</sup> Diodorus Siculus 1.82.3.

<sup>30</sup> Herodotus, *Hist.* 2.79.1. Modern scholars of Egyptian medicine tend to agree: John F. Nunn, *Ancient Egyptian Medicine* (Norman, OK: University of Oklahoma Press, 1996), 206. Nunn’s discussion of the matter is described as “the standard scholarly opinion,” by Robert K. Ritner in his article “Innovations and Adaptations in Ancient Egyptian Medicine,” *Journal of Near Eastern Studies* 59, no. 2 (Apr., 2000), 107.

<sup>31</sup> Benjamin C. Sax, “Cultural Agonistics: Nietzsche, the Greeks, Eternal Recurrence,” in *Agonistics: Arenas of Creative Contest*, edited by Janet Lungstrum and Elizabeth Sauer (Albany, NY: State University of New York Press, 1997), 52.

<sup>32</sup> Lang, *Medicine and Society*, 266. Rebecca Fleming also places the Hellenistic medical development around which this paper centers within an imperialist framework, discussing “the intimate relations between knowledge and empire.” Rebecca Flemming, “Empires of Knowledge: Medicine and Health in the Hellenistic World,” in *A Companion to the Hellenistic World*, edited by Andrew Erskine (Malden, MA: Blackwell, 2003), 450.

The Hellenistic world itself was founded on the basis of competition, as can be seen in the struggle of the Diadochi, those generals and friends of Alexander the Great who fought for control over his empire after his death in 323 BCE. Ptolemy I Soter initiated the first war of the Diadochi by stealing Alexander's body and taking it to Egypt.<sup>33</sup> The Macedonian Empire ended up broken into pieces; Ptolemy I retained Egypt, and the other provinces were divided up amongst the remaining successors. Cultural life and scientific study became a kind of continuation of territorial expansion, "the expression of superiority of the rulers over both their subject peoples and rival Macedonian regimes."<sup>34</sup> Yet within this expansion, the Greek medical tradition remained largely dominant over those others with which it came in contact.

One can begin examining the early Greek medical tradition by looking at the works of Homer, whose epics allow a glimpse of medical thoughts and practices significantly before our first surviving ancient sources on the subject. Broadly speaking, medicine was thought to have a variety of causes during the period in which Homer was writing, which is reflected within his work. Often people believed their ailments to be caused by divine power, as in the *Iliad*, when we see "Apollo, who in anger at the king drove the foul pestilence along the host, and the people perished."<sup>35</sup> In cases such as these, the doctor or physician had no cure, and people sought help, instead, from a priest or from the gods themselves. In the case of more natural causes, doctors relied more on observations of a patient's symptoms. However, rather than the firm diagnosis of a specific disease, Vivian Nutton has described the treatment decisions of physicians in the Homeric period as based on "a series of explanations that overlap with each other and that are

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<sup>33</sup> It might be argued that this was a strategic move which served the purpose of further legitimizing Ptolemy I's role as ruler in Egypt, and Egypt's position of importance in the Hellenistic world. This is suggested in Flemming, "Empires of Knowledge," 453-454.

<sup>34</sup> Flemming, "Empires of Knowledge," 454.

<sup>35</sup> Homer, *Iliad* 1.9-10. Also see Thucydides, *History* 2.47.4 for oracle consultation for the plague of Athens.

chosen as appropriate to a given situation.”<sup>36</sup> By providing only a general explanation, a physician could avoid the blame and censure of a misdiagnosis or an inaccurate prognosis.

A physician’s reputation was of great importance in the Homeric period; a single incorrect prognosis could ruin both career and livelihood. Physicians are described as itinerant people, going wherever their services were needed.<sup>37</sup> A positive reputation was vital if one hoped to establish a client base, or return customers. The importance of prognosis is also expressed within the papyri, in which “each case is classified by one of three different verdicts: (1) favorable, (2) uncertain, or (3) unfavorable.”<sup>38</sup> This third verdict is expressed in the words “an ailment not to be treated,” showing the unwillingness of a physician to treat an illness or wound with which they were not absolutely certain they could contend.<sup>39</sup> A concern for their reputation is apparent.

Nutton describes the social situation of physicians as “one of the craftsmen,” like an armorer or a bard.<sup>40</sup> The job was far from belonging exclusively to the elite or the well-educated, but rather was practiced as one would pursue carpentry. This view of doctors was perhaps due to the increased accessibility of medical knowledge. Medical writings and discussions were fairly widespread by 500 BCE, which allowed the inclusion of any literate person who wished to join the conversation, and kept physicians from becoming isolated experts in their field.<sup>41</sup>

The most famous of these texts was the Hippocratic Corpus, best known for the Hippocratic Oath. It is a collection of about sixty ancient Greek medical works discussing a range of topics from the origins of disease to the practice of gynaecology; most of these are

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<sup>36</sup> Vivian Nutton, *Ancient Medicine* (London: Routledge, 2004), 40.

<sup>37</sup> Homer, *Odyssey* 17. 383-6.

<sup>38</sup> *Edwin Smith Surgical Papyrus*: Published in Facsimile and Hieroglyphic Transliteration with Translation and Commentary in Two Volumes, by James Henry Breasted (Chicago: University of Chicago Press, 1930), 6.

<sup>39</sup> *Edwin Smith*, p. 6.

<sup>40</sup> Nutton, *Ancient Medicine*, 40.

<sup>41</sup> Nutton, *Ancient Medicine*, 44.



believed to have originated between 420-350 BCE.<sup>42</sup> Very little is known about Hippocrates himself, but in reality, the corpus was likely written by a variety of unknown authors and simply attributed to Hippocrates in whole. Many of the Hippocratic texts, perhaps due to their varying authorship, disagree with each other on foundational aspects of medical theory. Conceptual conflicts of this nature are common among the texts of the Corpus, increasing the disagreement among ancient authors regarding the genuine writings of Hippocrates; it is difficult to determine which can be attributed to him as opposed to another contributor. The *Anonymus Londinensis* papyrus speaks in the following passage of the Hippocratic view of the breath as the most important component in the human body:

Either because of the quantity of things taken, or through their diversity, or because the things taken happen to be strong and difficult of digestion, residues are thereby produced [...] From these residues arise gases, which having arisen bring on diseases. What moved Hippocrates to adopt these views was the following conviction. Breath, he holds, is the most necessary and the supreme component in us, since health is the result of its free, and disease the result of its impeded passage [...] The variations in the breaths cause the various diseases.<sup>43</sup>

This focus on the breath as the main component in the body seems contradictory to what is commonly recognized as a key principle of the Hippocratic tradition: the idea that a state of health in the human body is based on a balance of four humors.

In any case, this theory of the four humors of the human body was, perhaps, the most influential and long lasting of those described within the Hippocratic Corpus.<sup>44</sup> This theory presents the idea that the body contains several vital fluids (blood, phlegm, black bile, and yellow bile), a balance of which is required for the maintenance of one's health. Imbalance, therefore, resulted in disease or ailment. Bloodletting and dietetics were both typical treatment

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<sup>42</sup> Nutton, *Ancient Medicine*, 61.

<sup>43</sup> *Anonymus Londinensis Papyrus*, 5.35-6.44.

<sup>44</sup> The word used within various Hippocratic texts is '*chymoi*,' which is commonly translated as 'humors.'

methods for a physician hoping to restore humoral balance to a patient.<sup>45</sup> This theory of health, like many of the writings within the Hippocratic Corpus, encouraged a move towards a naturalist and rational approach to medicine. Rather than attributing disease to divine or religious causes, as one might have done in the Homeric period, physicians began to look for natural causes for their patients' illnesses.

This focus on medicine through a naturalist lens and a causal understanding of illness encouraged a shift towards the use of methods like dissection in order to better understand the underlying structures of the human body. Aristotle (384-322 BCE), in particular, believed that one ought to look at bodies (and all aspects of the natural world) as a whole, rather than broken down into their individual parts. It was only through this perspective that one could appreciate the beauty and artistry of nature itself, and the true purpose for which things were made.<sup>46</sup> He was the first major figure in the field of systematic animal dissections, as he was committed to the study of biology as it applied to his philosophical principles.<sup>47</sup> He used the language of analogy and comparison in both his philosophical and medical writings, although in a somewhat different manner than Herophilus would apply these same methods later. He was a great influence on the physicians and philosophers who came after him, particularly upon the anatomists of Alexandria. Aristotle's student, Praxagoras of Cos, would later become the teacher and mentor of Herophilus himself.<sup>48</sup> Praxagoras taught his students to examine the internal structures of the animals they dissected, rather than exclusively reflecting on the processes within the body, and in this way "provided an important bridge between Aristotle and the human

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<sup>45</sup> Dietetics is essentially the prescription of certain foods to a patient that were thought to act as treatment for their particular imbalance, as different types of food bore different medicinal qualities. York, *Health and Wellness*, 9.

<sup>46</sup> Nutton, *Ancient Medicine*, 120.

<sup>47</sup> The main principle in question here was teleology, or the explanation of phenomena based on their apparent purpose. Nutton, *Ancient Medicine*, 120.

<sup>48</sup> Praxagoras was born around 340 BCE. Little else is known, other than that he was teacher to Herophilus, and was likely a well known anatomist himself. Galen acknowledges him in his discussion of nerves. *OCD*, s.v. "Praxagoras."

anatomy of the Alexandrians.”<sup>49</sup> Each of these prominent physicians and their medical theories fell within one of the major medical sects that existed at that time, the largest of which were the Rationalist and Empiricist sects.

Rationalist (or Dogmatic) physicians based their studies on the belief that a physician could be most successful in curing a patient if he first understood the origin and cause of their ailment (including the structures of the body in which the disease is rooted). It was this sect, which included Herophilus and the other anatomists, which truly advocated for dissection or vivisection. The Rationalists sought to isolate phenomena that were not easily visible through manipulations of the body. One scholar describes members of the sect as “sharing an ideological commitment to mechanistic biology [which] follows from their attempt to ground medicine on anatomical practice.”<sup>50</sup> This can be seen as a method of comparing the processes of the human body to those of a machine, completing the functions for which it was designed. This method was popular with Herophilus’ contemporary Erasistratus, as well as members of the Erasistratean school.<sup>51</sup>

The Empiricist sect arose in response to the Rationalists, and rejected the experiments of their opponents. They argued that medicine ought to be based on practical experience of what works, without bothering with the structures of the body.<sup>52</sup> They used observations to determine similarities between illnesses, and therefore potential similarities in treatments. They found no value in cadaveric dissection under the premise that the differences between a living body and dead one were so great that one could not learn anything useful by dissecting the latter:

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<sup>49</sup> Nutton, *Ancient Medicine*, 127.

<sup>50</sup> Christopher Cosans, “Galen’s Critique of Rationalist and Empiricist Anatomy,” *Journal of the History of Biology* 30, no.1 (1997), 38-39.

<sup>51</sup> Heinrich von Staden, “Body and Machine: Interactions between Medicine, Mechanics, and Philosophy in Early Alexandria,” *Alexandria and Alexandrianism: Papers Delivered at a Symposium Organized by The J. Paul Getty Museum and The Getty Center for the History of Art and the Humanities and Held at the Museum April 22-23, 1993*, edited by Heinrich von Staden (Malibu, CA: The J. Paul Getty Museum, 1996), 93.

<sup>52</sup> Cosans, “Rationalist and Empiricist Anatomy,” 36.

[...] it is much more likely that the internal parts, which are far softer, and to which the very light is something novel, should under the most severe of woundings, in fact mangling, undergo changes. Nor is anything more foolish, they say, than to suppose that whatever the condition of a man's body in life, it will also be the same when he is dying, nay, when he is already dead.<sup>53</sup>

Rather, they believed that physicians could learn much more by treating patients and observing their injuries during the therapeutic process. However, medical learning was not the most important part of this process; above all, the patient's recovery was the goal, and the test by which physicians would determine effective treatments (rather than an examination of how a treatment interacts with the body itself).<sup>54</sup> Founded in the third century BCE, the rise of this sect is generally considered to be one of the factors that contributed to the decline of anatomical study.<sup>55</sup>

#### *Death Taboos and Pollution in Hellenistic Alexandria*

In both Greek and Egyptian cultures, medicine was connected innately with religion, making taboo and ideas of pollution hugely important in the way that people perceived medical treatment and made decisions regarding their own health. Religious beliefs contributed to deep-seated taboos, particularly associated with death and the bodies of the deceased. The examination of these taboos is necessary to the complete understanding of the context in which the experiments and research of the Alexandrian anatomists were being carried out.

Taboo scholar Robert Parker said, "the distinctive feature of 'taboo' is that it united the sacred and the unclean within the single category of the forbidden."<sup>56</sup> In our modern discussions of 'taboo,' this single English word encompasses such a colossal idea, but the Greeks did not live

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<sup>53</sup> Celsus, *De Med. I, prooemium* 41-42.

<sup>54</sup> Cosans, "Rationalist and Empiricist Anatomy," 42.

<sup>55</sup> Von Staden, "The Discovery of the Body," 235.

<sup>56</sup> Robert Parker, *Miasma: Pollution and Purification in early Greek Religion* (Oxford: Clarendon Press, 1983), 328.

with such restrictions. While we generalize taboo, and use it to describe a large range of unacceptable behaviors, and the violation of social and religious boundaries, ancient Greek possesses a whole family of words that have the power to break up the idea of taboo into manageable pieces. According to Parker, taboo has often been associated with the *ag-/hag-* word group, containing words which refer to both sacred and polluted things.<sup>57</sup> Taboo and pollution in the ancient world are ideas that interacted with many other aspects of daily life, including medicine, death and burial, family life, the military, and law, to name a few. It was therefore more than reasonable for the language that was used to describe these to have both greater breadth and specificity.

The word ‘taboo,’ for the purposes of this paper, will encompass the established religious and social boundaries of a society, which a member of that society in good standing was expected not to violate. Pollution serves as the consequence of the violation of taboos, and the language surrounding this condition deserves further mention. The basis of the *mia-* root words is a sense of defilement, or damage to one’s integrity.<sup>58</sup> For instance, “*Miainō* can be used for the pollution of a reputation through unworthy deeds, or of truth through dishonesty.”<sup>59</sup> This word is the most frequently applied, but *miasma* is used more frequently in relation to death, and carries more severe connotations. This condition usually makes the person impure, and unfit to visit a temple; it is contagious and dangerous.<sup>60</sup> Two common sources of this condition are contact with either a corpse, or a murderer.<sup>61</sup> The murderer is polluted both from the act of killing, and from contact with the corpse of his victim, and can pass this pollution on to others during social

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<sup>57</sup> Parker, *Miasma*, 328. Parker argues that this ambiguity should not be seen as a failure to differentiate between the sacred and the unclean, but rather as the suggestion of a potentially dangerous “punitive consecration.”

<sup>58</sup> Parker, *Miasma*, 3.

<sup>59</sup> Parker, *Miasma*, 3.

<sup>60</sup> Parker, *Miasma*, 4.

<sup>61</sup> Parker, *Miasma*, 4.

interactions. While *miasma* is contagious, and sometimes unavoidable, the other widely used term, *agos*, refers to avoidable although potentially involuntary transgression. Parker states that “to create *agos*, the offence must probably be directly against the gods or their rules.”<sup>62</sup>

This outlook on taboo rests on the premise that life in any society is based on an accordance of a minimum level of respect to each individual. That minimum level can be seen here as represented by decent burial: at least this, we ought to be able to guarantee to all members of society. Jocelyn Toynbee wrote that all Roman funerary practices were influenced by two basic notions: “first, that death brought pollution and demanded from the survivors acts of purification and expiation; secondly, that to leave a corpse unburied has unpleasant repercussions on the fate of the departed soul.”<sup>63</sup> At the very least, one was required to throw a little dirt on the body, if nothing else could be done.<sup>64</sup> Those that do not accord others this minimum respect, find themselves the victims of pollution, making them an outcast from the society that they have offended. This same expectation can be seen in literary works, as well, as in Sophocles’ *Antigone*: “but there lay upon him/ a little dust as of a hand avoiding/ the curse of violating the dead body’s sanctity.”<sup>65</sup>

It is difficult to examine the taboos and prohibited behaviors as such within Hellenistic society because it was far from a homogenous culture, particularly due to the cultural influences of the ancient Near East following the military campaigns of Alexander the Great. Even those areas that left more extensive written records give us little in the way of taboo. This problem is addressed in detail by Parker, who states that, “even fifth-century Athens, for which literary evidence is comparatively abundant, offers little forensic oratory, few accounts of relevant

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<sup>62</sup> Parker, *Miasma*, 8. The burial of a corpse lay within these divine rules, and therefore the failure to do so would incur ‘*agos*.’

<sup>63</sup> J.M.C. Toynbee, *Death and Burial in the Roman World* (Ithaca, NY: Cornell University Press, 1971), 43.

<sup>64</sup> Toynbee, *Death and Burial*, 43.

<sup>65</sup> Sophocles, *Antigone* 256.

behavior, and almost nothing by way of explicit codes of rules.”<sup>66</sup> What does remain is often similar to the following statement by the Roman orator Aelian, describing the required behaviors when one comes into contact with a corpse: “Another Athenian custom: anyone who came across an unburied body was obliged to cover it with earth, and to bury it facing west.”<sup>67</sup>

Perhaps the best-known example of the primary documentation of the later Roman understanding of death-based pollution is that of the extensive practices of purification required, for both individuals and the home space, following the death of a family member. After the funeral, the relatives underwent a process of purification, and began a course of cleansing ceremonies (*feriae denicales*) at the home of the dead.<sup>68</sup> This process of purification was vital, because an impure person could not access sacred spaces or rituals, both of which played an active role in the lives of the average Greek or Roman citizen. It is also worth noting that all burials, whether inhumation or cremation, were required to take place outside of the city.<sup>69</sup> This can be attributed to simultaneous concerns for both sanitation and religious pollution, or defilement.<sup>70</sup>

Many of the materials available to us regarding religious taboo in Egyptian culture come from *The Histories* of Herodotus or the writings of Diodorus Siculus. While Herodotus wrote significantly prior to the Hellenistic period in Egypt that is the main subject of study within this paper, his works are still of use to us in terms of comparing Egyptian beliefs to those of the Greeks (although, we must also take into account that his work is from the perspective of a

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<sup>66</sup> Parker, *Miasma*, 12.

<sup>67</sup> Aelian, *Varia Historia*, 5.14. Use of the Greek ‘*nomos*,’ meaning custom or practice. Claudius Aelianus (better known as Aelian), was originally a Roman orator, but became a writer instead. He wrote all of his works in Greek, two of which survive in whole: *Varia Historia* and *Natura Animalium*. He died between 222-238 CE. *BNP*, s.v. “Claudius Aelianus.”

<sup>68</sup> Cicero, *De Leg.* ii. 22, 55.

<sup>69</sup> Cicero, *De Leg.* ii, 23, 58: ‘*hominem mortuum in urbe ne sepelito neve urito,*’ or ‘let no one burn or bury a dead person in the city.’ Parker notes that this is true for Greek cities, as well. Parker, *Miasma*, 70.

<sup>70</sup> Toynbee, *Death and Burial*, 48.

Greek writer, and is thus laden with bias). Additionally, ancient Egyptian culture was, in many ways, very static. As we have already seen within the medical field, they adhered to long-standing traditions with little evidence of change over time. “They remain faithful to their ancestral customs and add nothing new to them.”<sup>71</sup>

Certain passages in *The Histories* make clear that Egyptian culture, like that of the Greeks, did contain aspects of religious prohibition and taboo, as when Herodotus states: “For the participants in these rites also find it religiously offensive to be buried in woolen garments...”<sup>72</sup> This statement does specify that particular concerns, notably in relation to death and burial practices, were religiously based, as opposed to having their root in hygiene or some similarly tangible issue. This type of religious significance is much easier to classify as ‘taboo,’ than Herodotus’ description of Egyptian burial of animals: “When other animals die naturally – and the Egyptians do not kill these other animals, either – they bury them just as they do the bulls, for that is their traditional belief and custom about these matters.”<sup>73</sup> While this practice of burying dead animals may suggest that Egyptians have a more significant respect for all forms of life than do the Hellenes, it could also be argued that the burial of animals was a sanitary measure, required in order to limit their production of bad or unhygienic airs. Bad airs, or *miasmata*, were often believed to be a possible cause of illness and disease, which would make this action of critical importance.<sup>74</sup> Whether this burial requirement for animals was of religious or hygienic origin, it does reflect the similar burial requirement for humans within Greek culture. In addition, the specification within the statement that these animals are permitted to die

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<sup>71</sup> Herodotus, *Hist.* 2.79.1.

<sup>72</sup> Herodotus, *Hist.* 2.81.2.

<sup>73</sup> Herodotus, *Hist.* 2.41.6. Bulls were traditionally sacrificial animals, so their burial would have been handled with the respect accorded to objects technically belonging to the gods.

<sup>74</sup> York, *Health and Wellness*, 104. “Greek physicians developed the theory of miasmas, fetid or corrupted airs, which could arise in a region and cause many people to contract the same disease in a short period of time by adversely affecting everybody’s humoral balance.”



naturally and are not killed by the Egyptians (although we have no way to know which types of animals this encompasses) suggests a hesitancy to cause death or be associated with it. Through these interpretations, this passage supports the idea that dissection would not have been a welcome practice in Egyptian culture, and that interactions of this nature with either human or animal corpses would be strongly discouraged, or taboo. No form of anatomical study, therefore, be it upon humans or animals, was visibly practiced in Egyptian society.<sup>75</sup> “Respect for the dead would have prevented this under the Egyptian pharaohs and also in Greece itself.”<sup>76</sup>

It is, however, possible to observe Egyptian surgical practices within the surviving medical papyri. The Egyptians did clearly have an understanding of some anatomical structures, and at least a portion of this was through wound observation and treatment. The Edwin Smith Surgical Papyrus focuses on forty-eight surgical cases and the methods of wound-treatment that were used. Serious accidents and casualties in battle were seen as an opportunity to increase anatomical knowledge, and the Edwin Smith Papyrus presents evidence suggesting that physicians took advantage of these opportunities. In Case 6, for instance, the physician in question used the presence of a serious head injury to make observations about the skull, and the appearance of the brain:

If thou examines a man having a gaping wound in his head, penetrating to the bone, smashing his skull, (and) rending open the brain of his skull, thou shouldst palpate his wound. Shouldst thou find that smash which is in his skull [like] those corrugations which form in molten copper, (and) something therein throbbing (and) fluttering under thy fingers, like the weak place of an infant’s crown before it becomes whole [...] <sup>77</sup>

So, although there is no evidence for dissection among Egyptian physicians, it is possible to observe a detailed and effective method of patient analysis that assisted in creating a general

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<sup>75</sup> Nunn, *Ancient Egyptian Medicine*, 42.

<sup>76</sup> Nunn, *Ancient Egyptian Medicine*, 42.

<sup>77</sup> *Edwin Smith*, Case 6, Examination, II 18-22, pp. 165-66.

understanding of human anatomy. This passage also contains an example of analogy being used as a method of explaining aspects of human anatomical structures through comparison with material objects. This method will be examined in greater depth, particularly as it is used in the medical writings of Herophilus, later in this paper. It has been noted by a respected scholar in the field that there is no evidence or information regarding any books of physiology in ancient Egypt, and that “the evidence of the medical papyri indicates that the concepts of physiology were simple and often erroneous.”<sup>78</sup> The paucity of physiological knowledge suggests that dissection was not commonly practiced among Egyptian physicians.

One way to think about taboo and pollution is as aspects of societal discomfort with certain practices or behaviors, which occur in cycles. The Greeks conveyed the idea that societal belief in pollution and taboo lies dormant, then is suddenly ‘reawakened,’ as Herodotus described, saying that “the Lacedaemonians, who had violated laws observed by all humanity when they killed the heralds.”<sup>79</sup> The act of killing a herald is a well-known taboo, and the pollution was so great that it spread to all of their people: “This wrath was reawakened during the war between the Peloponnesians and the Athenians. And it is apparent to me that this phenomenon was especially divine [...]”<sup>80</sup> Herodotus thus puts ample emphasis on the divine, religious nature of the pollution. For instance, in Homer, when Achilles threatens Hector with bodily mutilation after his death, Hector responds, “Be careful now; for I might be made into the gods’ curse/ upon you, on that day when Paris and Phoibos Apollo/ destroy you in the Skaian gates, for all your valor.”<sup>81</sup> This is a threat of divine punishment against Achilles if he dares to allow the mutilation of Hector’s corpse and the denial of proper funerary rites.

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<sup>78</sup> Nunn, *Ancient Egyptian Medicine*, 54.

<sup>79</sup> Herodotus, *Hist.* 7.136.2.

<sup>80</sup> Herodotus, *Hist.* 7.137.1.

<sup>81</sup> Homer, *Iliad* 23. 358-360.

Although not contemporary with Herodotus' observations, it is possible to reappropriate this idea of taboo cycles in order to imagine this period that we are examining in Ptolemaic Alexandria as one in which the societal repercussions for taboo violations are more or less 'asleep.' Given the brief duration of this period, it is possible to consider the actions of the major players (Herophilus, Erasistratus, and their colleagues) as taking place within the broader context of a society burdened by these taboos, which may have 'reawoken' in the immediate aftermath of these anatomical experiments. This may allow us to account for the reactions of the medical sects immediately following them in the field, and for those of their longer-term successors such as Celsus or Galen. Vindicianus, physician and politician in the 4<sup>th</sup> century CE, comments in the following passage on the reception of these experiments:

Our ancestors who practised medicine in Alexandria – Rufus, of course, and Philip, Lycus, Erasistratus, Pelops, Herophilus, Hippocrates, and Apollonius – found it proper to examine the bodies of the dead in order to know for what reason and in what manner they died. Humanity itself prohibits doing this, since all things would be manifest and fully open to those conducting the examination.<sup>82</sup>

The author here clearly says that "humanity itself prohibits doing this," in regards to the dissections performed by the Alexandrian anatomists. He makes no reference to the practice of vivisection within his text. Dissection itself is a prohibited act, so it would be unsurprising if the author chose to bypass vivisection as a topic of conversation in favor of less taboo subject matter in order to protect his own reputation.

This brief interval of human dissection in Alexandria, and particularly the work of the anatomists led by Herophilus, can be seen to have pushed scientific boundaries and expanded upon the existing body of medical knowledge dramatically. It is key to note, however, that these

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<sup>82</sup> Vindicianus, *Gynaecia*, praef. (vel 2), cod. L. \*As quoted in von Staden, *Herophilus*, 189. Vindicianus was a 4<sup>th</sup> century CE physician and politician of African origin. He wrote several treatises influenced by Greek medicine (including at least one anatomical text), all of which are now lost except for forwards and fragments. What does remain was preserved through copying and use throughout the Middle Ages. *BNP*, s.v. "Vindicianus, Helvius V."

scientists and researchers played an important role in the breaching of spiritual and religious boundaries, as well. Their infringements against the confines of accepted religious and moral behaviors as expressed through traditional taboos and prejudices against death and the dead were tolerated only for a short time, but marked a sort of demand for progress and innovation in the name of science that would only reoccur within the field of anatomy many centuries later.

### *Tradition of Embalming and Mummification in Egypt*

Mummification and the embalming of corpses in Egypt traditionally dates back thousands of years before the period within which Herophilus was working, beginning during the Old Kingdom (about 2700-2170 BCE).<sup>83</sup> Such a long-standing practice was almost guaranteed to leave a mark on any culture with which the Egyptian significantly interacted, as can be most clearly observed in the mixing of Greek and Egyptian cultures during the Ptolemaic era. Few written records survive from earlier Egyptian cultures, but it is possible through Greek texts to observe the influence of embalming and mummification on Greek culture, although much less on the development of the medical field. Perhaps the best example of the influence that mummification had upon Greek, and later Roman culture, was the adoption of embalming as a potential burial method. Toynbee presents several examples, one as late as the middle of the second century CE, in which the bodies of Roman citizens were embalmed and even buried in sarcophagi.<sup>84</sup>

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<sup>83</sup> Helen Strudwick and Julie Dawson, "Catalogue: Early Burial Practices," in *Death on the Nile: Uncovering the Afterlife in Ancient Egypt* (Cambridge: The Fitzwilliam Museum, 2016), 118. Donald B. Redford, *The Ancient Gods Speak: A Guide to Egyptian Religion* (Oxford: Oxford University Press, 2002), 149.

<sup>84</sup> Toynbee, *Death and Burial*, 41. For a much more extensive discussion on the mixing of Greek and Egyptian cultures, please refer to Lang, *Studies in Ancient Medicine: Medicine and Society in Ptolemaic Egypt* (2013).

Some scholars have insisted that “it is through the Egyptian embalmer that we were able to learn of some of the first interactions with human organs and their detailed observation.”<sup>85</sup> Early embalmers should be given due credit for establishing certain anatomical terminology and developing tools for the trade which were later useful for human medical practice, and in this way contributing significantly to the medical field.<sup>86</sup> Beyond this, there is little evidence that embalmers were in any way trained as physicians themselves (and indeed, this would be astonishing, considering that they were considered severely impure as a result of their work with the dead and would certainly not have been encouraged to come in contact with those endeavoring to heal, often through methods of purification for their own impurities, which may have been thought the source of their illness). Both ancient authors who deal with the subject of mummification in any great depth, Herodotus and Diodorus Siculus, handle it as a clearly separate subject from that of medicine; the two fields do not collaborate within the ancient texts.

While the embalmer certainly worked closely with the human body, it is important to note that there is a distinct difference between acknowledging that these interactions happened and concluding that any anatomical information may have been passed between embalmers and medical practitioners and therefore assisted in the establishment of an anatomical body of knowledge within the medical field. It seems very unlikely, based on class differences and the assumed repercussions of violating death taboos, that there would have been any interaction at all between these two groups. It is therefore very improbable that doctors would have had any opportunity to practice their skills on mummies.<sup>87</sup>

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<sup>85</sup> Marios Loukas, Michael Hanna, Nada Alsaiegh, Mohammadali M. Shoja, and R. Shane Tubbs, “Clinical Anatomy as Practiced by the Ancient Egyptians,” *Clinical Anatomy* 24 (2011): 409.

<sup>86</sup> An example of such tools is the “Ethiopian stone” mentioned by Diodorus Siculus later in this chapter, which would have been sharpened and likely resembling an early scalpel. See Appendix C for a depiction of tools used by the ancient Egyptians, taken from the outer wall of the temple of Kom Ombo.

<sup>87</sup> York, *Health and Wellness*, 208-209.

Herodotus has shown us that embalmers were as non-invasive as possible in the completion of their gruesome tasks, so the practice was far from that of dissecting purely for the purpose of gaining knowledge of internal structures. He also went on to describe a variety of types of embalming available:

There are men in Egypt whose profession it is to embalm corpses. Whenever a body is brought to them, they display painted wooden replicas of corpses to those who brought it, and they describe the most elaborate method of embalming [...]. Then they demonstrate a second method which is inferior to the first but cheaper, and also a third, the cheapest of all.<sup>88</sup>

The most significant difference between these methods of embalming as described by Herodotus is that the first involves the cutting of the corpse in order to remove the abdominal organs at the start of the process. The second and third options involve no cutting of the flesh, and are therefore cheaper, although considered inferior because the organs are dissolved by the flooding of the abdomen with special oils, and are therefore not preserved for use by the deceased in the afterlife. We can clearly see that these embalmers strive to avoid the violation of body except in the most involved methods of mummification. Those authors, therefore, who refer to them as “the precursor to the anatomist in ancient Egypt,” surely go too far.<sup>89</sup> After all, anatomists violate the body fully in order to pursue knowledge for the sake of knowledge, while embalmers do so in the most minimal way possible, and only in order to help the deceased on to the afterlife.

Beyond the technical aspects of medical knowledge, some scholars have speculated that the very existence of the tradition of mummification and embalming in ancient Egypt may have helped to set the scene for further transgression of death taboos in the practice of dissection.<sup>90</sup> Indeed, one scholar went so far as to say that “although the Greeks had always been very loath to

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<sup>88</sup> Herodotus, *Hist.* 2.86.

<sup>89</sup> Loukas, “Clinical Anatomy,” 410.

<sup>90</sup> Robert K. Ritner, “Innovations and Adaptations in Ancient Egyptian Medicine,” *Journal of Near Eastern Studies* 59, no.2 (2000), 115.

cut into the deceased human body, the Egyptians were much more lenient in this matter. The fact that the Egyptians had been mummifying their Pharaohs and others for millennia tended to weaken the old Greek religious fear of the corpse.”<sup>91</sup> As can be seen in the following discussion of this matter, there is sufficient primary evidence surviving to conclude that the Egyptians were also hesitant to cut into the human body, if not very strongly opposed.

Heinrich von Staden reflected on the possible connection of embalming and dissection, saying that “this violation, too, might have been perceived, however mistakenly, by the Ptolemies and others as sanctioned by an Egyptian tradition: the practice of mummification.”<sup>92</sup> Further, it is a common misconception that the existence of this practice may have provided access to the human body for willing anatomists. Quite to the contrary, embalmers worked within the sphere of the taboo and appear to have taken precautions against more severe repercussions. As we can see in the following passage in Diodorus Siculus, the task is taken on by a group, and the man who makes the cut on the corpse for the removal of the vital organs is immediately stoned out of the room and symbolically banished from the remainder of the process, as he has already become polluted by this action of corpse interference.

Then the one called the slitter cuts the flesh, as the law commands, with an Ethiopian stone and at once takes to flights on the run, while those present set out after him, pelting him with stones, heaping curses on him, and trying, as it were, to turn the profanation on his head; for in their eyes everyone is an object of general hatred who applies violence to the body of a man.<sup>93</sup>

While the ‘slitter’ is immediately polluted by his infringement, the embalmers themselves are not seen by Diodorus to be defiled by their work. Indeed, he states that they are men “considered

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<sup>91</sup> Leon L. Wiltse and T. Glenn Pait, “Herophilus of Alexandria (325-255 B.C.): The Father of Anatomy,” *SPINE* 23, no.17 (1998), 1907. The bibliography of this article reveals that the authors did not take the works of Diodorus Siculus into account. In fact, only four of their footnotes refer to primary source evidence directly, the remainder cite either secondary scholarship, or quotations of primary documents within pre-existing secondary scholarship.

<sup>92</sup> Von Staden, *Herophilus*, 29.

<sup>93</sup> Diodorus Siculus 1.91.4.

worthy of every honour and consideration, associating with the priests and even coming and going in the temples without hindrance.”<sup>94</sup> The anatomist, however, seems far closer in both action and intention to the ‘slitter’ than to the embalmer. He himself cuts the skin, and deeper still into the flesh, with no intention of helping to preserve what is most vital to the dead for their journey into the afterlife. Indeed, he is intent on depriving the dead of those organs most necessary to them for the sake of knowledge and practice.

Any explanation of human dissection as being legitimized by existing Egyptian traditions seems to ignore those ancient sources which directly address the transgression of the body as being kept to an absolute minimum, and the ritualized punishment of the person responsible for the actual act of violation. Human and animal dissections, as well as the occurrences of vivisection in this period, are all practiced for the purpose of investigation, which is in direct contrast with the ritual and spiritual goal of embalming to prepare the deceased for the afterlife and preserve the body for continued use in that realm. Herophilus’ use of these methods was a radical form of innovation within the medical field, but also against the standards of taboo and corpse avoidance within both Greek and Egyptian cultural traditions.

### *Royal Patronage and the End of Human Dissection*

When Ptolemy I came to rule Egypt in the late fourth century, he established Alexandria as a great commercial port, but he also decided that his city would become the greatest in the Hellenistic world for Greek art, science, and academic scholarship. His newly epistemic aim, and that of many of his descendants, was to support learning for its own sake, which was a novel concept that would be reflected heavily within the work of the intellectuals that they sponsored.<sup>95</sup>

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<sup>94</sup> Diodorus Siculus 1.91.5.

<sup>95</sup> Green, “Politics of Patronage,” 155.



They brought Greek scholars and scientists from all over the Greek world, creating within Alexandria “a cosmopolitan intelligentsia committed to literary and scientific frontiersmanship.”<sup>96</sup> To this growing community, the Ptolemies were both rulers and patrons. Ptolemaic patronage during this period can be divided into two broad categories: physical and ideological.

Physical manifestations of patronage are of the more visible and easily identifiable kind. First, the Ptolemies provided for their scholars in terms of room and board, and access to facilities for their studies. Patronized scholars in Alexandria are believed to have lived within the Museum (Mouseion), and had access to the famous Library of Alexandria. The Museum was a sort of living-learning community for these intellectuals, which included “the cult center, the buildings for residence, common meals, library holdings and research.”<sup>97</sup> Strabo discussed the geographic location of Museum in relation to the palace:

Everything is connected with one another, the harbor, or what is outside it. The Mouseion is part of the palaces, with a walkway, an exedra, and a large structure in which there is the common mess of the scholarly men who share the Mouseion. This assembly has both common property and a priest for the Mouseion, once appointed by the kings but now by Caesar.<sup>98</sup>

This apparent closeness of the palace and the Museum, even to the point of being physically attached to one another, displays an intimate connection between the kings and their sponsorship of scholarly research. Strabo was writing over two centuries after the period of Herophilean research and two decades after fire had demolished the Museum buildings, but he was able to determine where they had previously stood. The statement that there was a priest appointed specifically for the Museum during the time of the kings strongly suggests that pollution was not working in the standard way, since pollution by death interaction ought to have made the entire

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<sup>96</sup> Von Staden, “The Discovery of the Body,” 232.

<sup>97</sup> Green, “Politics of Patronage,” 156.

<sup>98</sup> Strabo, *Geography* 17.1.6-8.

space and all working on anatomical research within that space unclean and therefore unfit to interact with a priest.

The Library of Alexandria was far and away the largest and most complete literary collection of its time, thanks to the energetic efforts of its sponsors, the Ptolemies. One anecdote describes the antics of Ptolemy III Euergetes I, who would have examined the books and scrolls of any new scholars arriving in Alexandrian ports. If they possessed a text not already in the Library, Ptolemy's agents confiscated it in order to be copied by scribes, and the original would be added to the Library collections, while the copy was returned to the original owner.<sup>99</sup> This massive selection was available to all the scholars in the Museum for use in their studies.

The most crucial physical expression of patronage, at least within the field of medical study, was the provision of human cadavers for dissection and even of living criminals for the purpose of vivisection (dissection while still alive) in pursuit of anatomical knowledge. Celsus states this explicitly in his later medical work, *De medicina*: “Herophilus and Erasistratus did this in the best way by far, when they laid open men whilst alive—criminals received out of prison *from the kings*—and whilst these were still breathing, observed parts which beforehand nature had concealed...”<sup>100</sup> Given that the Ptolemies seemed to support fields based on their individual interests, a shift away from the sciences may have occurred with the succession of a new king, thus withdrawing royal support from the types of Herophilean experiments described in the last passage.<sup>101</sup> While the first two Ptolemaic kings supported the research of scientists within Alexandria and served as their patrons, Ptolemy III Eugertes expelled the intellectuals during his reign, in the middle of the third century BCE, effectively halting any work currently in progress

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<sup>99</sup> York, *Health and Wellness*, 209. Green, “Politics of Patronage,” 162.

<sup>100</sup> Emphasis added. It is worth noting that in the Latin, Celsus actually uses the word ‘inciderint,’ from the infinitive ‘incidere,’ or ‘to fall upon’ or ‘attack.’ The translation tames what is fairly polemical language in the original. Celsus, *De Med. I, prooemium* 23-4.

<sup>101</sup> Green, “Politics of Patronage,” 155.

at the time.<sup>102</sup> The later Ptolemaic court supported the Empiricist sect, showing a move away from the invasive practice of dissection in medical study. In the medical field, there was a significant turn toward pharmacology, as well as Hippocratic philology and exegesis.<sup>103</sup>

Apart from the more material forms of patronage provided to the scholars of Alexandria by the Ptolemies, it might be argued that a kind of ideological patronage was also present. They supplied an example in their own personal lives of severe taboo violations, including the ancient Greek taboo against incest. Like dissection and other interferences with the dead, incest functioned essentially as a violation against a taboo of the flesh. Ptolemy II Philadelphus married his own sister, Arsinoe II, around 276 BCE, although the couple produced no children.<sup>104</sup> This practice was continued in later generations. It is possible that the Ptolemies were trying to establish themselves more firmly as rulers in Egypt, using the ancient Egyptian custom of consanguineous marriage.<sup>105</sup> Within Greek tradition, however, this crossed very firmly entrenched religious and social boundaries.

Evidence suggests that there was actually a strong negative response to the marital actions of the early Ptolemaic kings. The Greek poet Sotades (285-246 BCE) wrote his objections in verse, saying “You’re thrusting your prick [*kentron*] into an unholy hole.”<sup>106</sup> We can see, therefore, that even in Alexandria, the traditional Greek taboos were still active among the general public. Like Sotades’ objections, Celsus reported (albeit much later, in the first century CE) that most people believed the vivisectionary experiments of Herophilus were cruel and

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<sup>102</sup> Mario Vegetti, “Between Knowledge and Practice: Hellenistic Medicine,” in *Western Medical Thought from Antiquity to the Middle Ages*, edited by Mirko D. Grmek (Cambridge, MA: Harvard University Press, 1998), 90.

<sup>103</sup> In the first century BCE. Flemming, “Empires of Knowledge,” 456.

<sup>104</sup> Sheila L. Ager, “Familiarity Breeds: Incest and the Ptolemaic Dynasty,” *The Journal of Hellenic Studies* 125 (2005), 5.

<sup>105</sup> Von Staden, “Discovery of the Body,” 232.

<sup>106</sup> Von Staden, “Discovery of the Body,” 240 (n. 51). A Hellenistic poet of the third century BCE, Sotades wrote verses that were often mocking and obscene. His attack on the practice of incest by Ptolemy II Philadelphus earned him a heavy punishment by that ruler. *BNP*, s.v. “Sotades.”

unnecessary, saying: “Nor is it, *as most people say*, cruel that in the execution of criminals, and but a few of them, we should seek remedies for innocent people of all future ages.”<sup>107</sup> It is significant that the Ptolemies were able to overcome these public reactions, and their willingness to do so is indicative of the creation of an atmosphere in which elite scientists and those Greek scholars removed from their homelands and traditional principles were also able to work without concern for taboo or pollution.<sup>108</sup> It seems that the actions of the Ptolemies established a standard of taboo violation among elite groups, which was certainly a contributory factor in the creation of the ‘frontier environment’ in Alexandria at the time.

The severity of this atmosphere of taboo and the violation thereof, as discussed in the earlier section dedicated to this topic, was perhaps lessened by the convergence of Greek and Egyptian cultural traditions during the early Ptolemaic period. This may have allowed for greater freedom among academics to perform those reprehensible types of experiments for which Herophilus is now famous. The reemergence of the cultural observation of taboos is commonly thought to have been a contributing factor in the discontinuation of dissection as a practice in medical research after Herophilus.<sup>109</sup> Scholars in the field have also considered as an important factor the rise to prominence of the Empiricist school of medical thought in Alexandria. These physicians believed that dissection changed the human body and therefore made it impossible to learn anything that might be applicable to a living patient. This ideology would have greatly limited the research capabilities of anyone who still hoped to pursue this extreme practice.<sup>110</sup>

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<sup>107</sup> Celsus, *De Med.* I, *prooemium* 26. Emphasis added.

<sup>108</sup> It’s important to place emphasis on the elite position of those breaking the taboos. There seems to have been a very limited range of acceptability for the pushing of established boundaries: Greek elites only.

<sup>109</sup> Vegetti, “Hellenistic Medicine,” 90. Von Staden, “Discovery of the Body,” 235.

<sup>110</sup> Von Staden, “Discovery of the Body,” 236-37.

## Herophilus and His Discoveries

Although there was a more significant community of anatomists working in Alexandria than just Herophilus and Erasistratus, these two receive the majority of the attention from scholars working in the field because we have documents referring to their activities and discoveries. Any works discussing the experiments of other anatomists in great depth have not survived to the present day, and scholars have therefore focused their studies on those for whom we have some remaining evidence. Despite the fact that none of Herophilus' nine books survived in their entirety, there are a surprising amount of fragments and references to his works (and even quotations), for much of which we can thank Galen. These bits and pieces, when examined together, reveal Herophilus to be a something of a genius, producing a wealth of new medical knowledge not to be matched by perhaps any other physician in the history of medicine.

Through his vivisections, he gained in-depth knowledge of the internal structures of the human body, and "observed parts which beforehand nature had concealed, their position, colour, shape, size, arrangement, hardness, softness, smoothness, relation, processes and depressions of each, and whether any part is inserted into or received into another."<sup>111</sup> Herophilus' detailed description of the structures and processes of the human body were so accurate and superior to previous observations based on comparative anatomy (using animal dissection) that they continue to serve as the foundation for much of modern medicine. Herophilus based many of his own comparisons of bodily structures on aspects of the natural world and material objects, rather than animal anatomy. Many of the names that he gave to parts of the body have also survived in anatomical nomenclature, including some that he names using analogical methods.<sup>112</sup>

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<sup>111</sup> Celsus, *De Med.* I, *prooemium* 25.

<sup>112</sup> See further discussion of this continuation of Herophilean nomenclature: von Staden, *Herophilus*, 157-158.

One of Herophilus' most consequential discoveries in the field of anatomy, perhaps even his crowning achievement, was his discovery of the nerves. Following much study, highly respected scholars in the field have determined that "it seems certain that Herophilus was the actual discoverer of both sensory and motor nerves [...] Thus it was Herophilus who after so many ingenious theories and speculations actually identified the entities [...]"<sup>113</sup> Galen describes Herophilus and his fellow anatomist Eudemus as "the first persons after Hippocrates to record carefully their dissections of the nerves."<sup>114</sup> Though others placed the control center of the body in other organs, Herophilus argued that it was in the base of the brain and that the nerves branched off from this place.<sup>115</sup> Not only did Herophilus discover the nerves, one ancient author suggests that he also differentiated between those of motor and sensory functions.<sup>116</sup> Some modern scholars have debated whether this claim ought to be met with hesitation or uncertainty, but von Staden asserts, based on the evidence, that it is "clear beyond reasonable doubt that Herophilus actually did make the distinction."<sup>117</sup>

Perhaps less significant than his discovery of the nerves, but still decidedly important for the development of the medical field, was his work with the human pulse, which was massively influential on the evolution of patient care and therapeutics even to the present day. He used the arterial pulse to "make diagnoses of what is present and prognoses of what is to be, without requiring any pulsation of the heart, the brain, or the meninges at all."<sup>118</sup> Herophilus postulated that the pulse had two parts: the contraction and the dilation. The former represented the activity of the arteries, while the latter was the "return to the proper and natural condition of their

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<sup>113</sup> Friedrich Solmsen, "Greek philosophy and the discovery of the nerves," *Museum Helveticum* 18 (1961), 185.

<sup>114</sup> Galen, *Loc. Affect.* 3.14.

<sup>115</sup> Tertullian, *De anima* 15.2-5.

<sup>116</sup> Rufus Ephesius, *Anat. Part. Hom.* 71-5. \*As quoted in von Staden, *Herophilus*, 200-201.

<sup>117</sup> Von Staden, *Herophilus*, 250. Arguing for caution: Paul Potter, "Herophilus of Chalcedon: An assessment of his place in the history of anatomy," *Bulletin of the History of Medicine* 50, no. 1 (1976), 51.

<sup>118</sup> Galen, *Diff. Puls.* 4.2.

body.”<sup>119</sup> Beyond these basic parts, Herophilus created a detailed system of classification for differing types of pulse, which are largely determined based upon the stages of a persons life. As Pliny described it, Herophilus “reduced the pulses or beating of the arteries unto the times and measures in Musicke, according to the degrees of every age.”<sup>120</sup> His use of analogy is evident in his classification of the quivering pulse, as described by one ancient author:

The artery moves unevenly, dilating more in one part, less in another, also more forcefully here, more weakly there, just as when very thin web-like [covers] have been placed around the holes in flutes and a musician then breathes into the flutes: at the holes a motion is observed that quivers in relation both to the passage of the breath and to its pressure...so the artery, too, moves unevenly.<sup>121</sup>

This comparison of the physical rhythm of the pulse to the movement of the breath through the flute is more along the lines of an analogy of process than of structure, but is still in keeping with Herophilus’ innovative writing methods, which are also in evidence in his consideration of female reproductive anatomy (about which he wrote prolifically).

Before Herophilus, the anatomy of the reproductive organs of both genders was relatively unexplored and neglected. For most of antiquity, likely beginning with the Hippocratic Corpus, anatomical theory of the female reproductive system was based on the assumption that women possessed a bicameral uterus.<sup>122</sup> Even Galen, coming after Herophilus and having access to his knowledge and discoveries, adhered to this theory: “but in humans and animals resembling them, just as the whole body is double with right and left sides, so too one pocket of the uterus is placed in the right side, another in the left.”<sup>123</sup> Herophilus’ advancement from this model was significant. Although he struggles to separate his work from the preexisting tendency to explain

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<sup>119</sup> Galen, *Diff. Puls.* 4.10.

<sup>120</sup> Pliny, *Nat. Hist.* 29 §124.

<sup>121</sup> Marcellinus, *De pulsibus* 35. \*As quoted in von Staden, *Herophilus*, 345.

<sup>122</sup> Having two chambers; the right chamber would house a male embryo, and the left a female embryo.

<sup>123</sup> Galen, *Usu Part.* 14.4.

female reproductive organs based on the system of those of the male, he does not entirely succeed. His discovery of the ovaries is described in terms which compare them to the testicles:

The ‘horn-like projections’ go to the ducts that come from the female’s own ‘testicles’ [*orcheis* (ovaries)], and for this reason they tilt upward toward the flanks and, gradually becoming narrower, terminate in extremely narrow ends, each of which is attached to the ‘twin’ on its own side; for ‘twin’ (*didymos*) is what Herophilus calls the ‘testicle’ [ovary].<sup>124</sup>

Galen also states that Herophilus compares “the neck of the uterus to the upper part of the windpipe.”<sup>125</sup> There is substantial evidence for the use of analogy in Herophilus’ observations of the female body, which is justifiable given the sparse nature of the research in this field prior to his own career.

It is possible that, in the course of his studies, Herophilus may have dissected the bodies of women, from which he would have gained immeasurable knowledge of the female reproductive system and the physical process of procreation. Celsus tells us that his primary source for bodies was “criminals received out of prison from the kings,” some of whom may, in fact, have been women.<sup>126</sup> If this is not the case, then we can reason that Herophilus may have had another source for the procurement of cadavers, which could expand the number of his experiments far beyond that for which we have extant evidence. While no primary documents or fragments explicitly state that Herophilus dissected the corpses of women during the course of his experiments, passages like the one that follows strongly suggest such.

“‘Not in the case of all women but in some’, says Herophilus, ‘four other vessels branch off from those that go to the kidneys, and enter the uterus.’ This I did not find in other living beings, except occasionally in apes. I do not, however, disbelieve the fact that Herophilus often found them in women. For he was not

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<sup>124</sup> Galen, *Usu Part.* 14.11.

<sup>125</sup> Galen, *Uter. Dissect.* 7.

<sup>126</sup> Celsus, *De Med.* I, *prooemium* 23-24. Bonnie MacLachlan has argued that none of these were women, since women were not legal persons and therefore could not be seen as breaking the law in the same way as men, who possessed agency. Bonnie MacLachlan, “Voices from the Underworld: The Female Body Discussed in Two Dialogues,” *The Classical World* 99, no.4 (2006), 427.



only competent in other branches of the art [of medicine], but he attained the highest degree of accuracy in things which become known by dissection and he obtained the greater part of his new knowledge not, like the majority [of physicians], from irrational animals but from human beings themselves.”<sup>127</sup>

This source suggests that a Herophilean text available to Galen spoke of Herophilus’ ability to access and dissect the bodies of multiple women and to compare the results from these dissections. It also states that he compared the anatomy of human women with that of female animals and found discrepancies. Galen here compares to his own animal dissections and the differing results. Although he is often critical of his predecessors, and particularly Herophilus, he seems to have no doubt in this case that female cadavers were, in fact, dissected, and that this practice contributed to the growth of anatomical knowledge. This is not a surprising revelation, given that, as we have seen, Herophilus’ discoveries regarding the female reproductive system and internal processes were many.

Within this passage, we should also note that Galen describes Herophilus as being different and separate from the majority of physicians in his dissection of human cadavers as opposed to animals. Whether he is setting Herophilus apart from physicians within his own lifetime or from those who came later (Galen and his colleagues, perhaps) is unclear. However, it is a clear example of ancient writers characterizing him as uncommon, even unique.

Herophilus is acknowledged widely as one of the great innovators and researchers of his time, and indeed his discoveries and his presentation of these within his writing set him apart from both his predecessors and his contemporaries. However, it is important to recognize that he did not often apply his major discoveries of the human body or this spirit of innovation to his

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<sup>127</sup> Galen, *Uter. Dissect.* 5.

practice as a physician.<sup>128</sup> He largely continued to adhere to the traditions of the Hippocratic Corpus, including an ongoing belief in humoral pathology and the use of phlebotomy as a treatment method.<sup>129</sup> He uncovered a wealth of new knowledge about human anatomy, but maintained traditional methods of treatment and patient care. His colleague and contemporary Erasistratus, though less studied by modern scholars, can even be seen to have pushed boundaries much further in terms of innovation in the fields of patient care and therapeutics. Most notably, Erasistratus is known to have broken almost completely with the practice of bloodletting (which at the time was a typical and quite commonplace medical procedure, used for a variety of illnesses).<sup>130</sup>

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<sup>128</sup> Vegetti, "Hellenistic Medicine," 89.

<sup>129</sup> Celsus, *De Med.* I, *prooemium* 14-15: "there is a need for differences in treatment, if, as certain of the professors of philosophy have stated, some excess, or some deficiency, among the four elements, creates adverse health; or, if all the fault is in the humours, as was the view of Herophilus."

<sup>130</sup> Mirko D. Grmek, "The Concept of Disease," in *Western Medical Thought from Antiquity to the Middle Ages*, edited by Mirko D. Grmek (Cambridge, MA: Harvard University Press, 1998), 252.

## Herophilean Research Methods

Herophilus is perhaps best known for his systematic dissection of human cadavers, and his alleged vivisection of condemned criminals. Although his dissections are generally accepted to have occurred, scholars in the field have often debated the veracity of the allegations of vivisection, which is even outright denied by some. Charles Singer laid out a four-point argument against the possibility of vivisection, which included the assertion that neither of our key sources, Celsus or Tertullian, were technically medical practitioners or trained in the field, and therefore were not reliable in a discussion of a medical nature. His argument rested mainly, however, on the fourth aspect: that if vivisection had, in fact, occurred, Galen would have mentioned it in his own medical writings. He stated that “the complete silence of Galen through the hundred and twenty-seven separate works ascribed to him is thus a very impressive rebutting argument.”<sup>131</sup> Singer is therefore using the absence of any mention of vivisection within Galen’s writing as evidence against its occurrence. Others have agreed with this interpretation that vivisection did not occur, with the addition of even less persuasive or compelling claims, such as that “such brutality, if not alien to the Roman, was foreign to the Greek temper.”<sup>132</sup>

In terms of Galenic silence, it is important to consider the atmosphere of taboo active at the time that he was writing. With this in mind, vivisection may simply have been beyond the scope of what Galen was comfortable addressing in his professional works. If the idea of vivisection inspires widespread repugnance, a figure such as Galen, who was so focused on his reputation and his public image, would be very unlikely to include even slight mention of such

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<sup>131</sup> Charles Singer, *A Short History of Anatomy from the Greeks to Harvey* (New York: Dover Publications, 1957), 34-35.

<sup>132</sup> T. Clifford Allbutt, *Greek Medicine in Rome* (London: Macmillan, 1921), 147 (n.3). Also a vivisection denier: J.F. Dobson, “Herophilus of Alexandria,” *Proceedings of the Royal Society of Medicine XVIII* (1924-1925), 19-32.

despised practices within his writing due to fear of association.<sup>133</sup> In addition, to discount the testimony of Celsus and various other contemporary authors on the basis of Galen's silence would be to use the absence of information as proof against their clear statements. As James Longrigg states, "Since both Celsus and Soranus, then, believe in the tradition of vivisection at Ptolemaic Alexandria, this positive evidence should be accepted in preference to the negative evidence of Galen's silence."<sup>134</sup> Much of the work that denies vivisection and the validity of Celsus' testimony is now quite dated; recent scholars are more united in recognition of his evidence.

If we take Celsus at his word, which I contend that we ought to do, particularly due to the guarded nature of his discourse and his willingness to consider both perspectives of the discussion, it is apparent that Herophilus and Erasistratus were indeed practicing vivisection in Alexandria, and that this practice was supported both ideologically and materially by the "kings."<sup>135</sup> Celsus is careful to distinguish his own opinion from those of his sources, as in the following passage, where he refers to the Rationalist physicians as "they" to clarify that the sentiment was not necessarily his own:

Hence it becomes necessary to lay open the bodies of the dead and to scrutinize their viscera and intestines. *They* hold that Herophilus and Erasistratus did this in the best way by far, when they laid open men whilst alive – criminals received out of prison from the kings – and whilst these were still breathing, observed parts which beforehand nature had concealed.<sup>136</sup>

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<sup>133</sup> Galen spent much of his time working to prove wrong the theories of his competitors, as can be seen throughout his writings. For instance, Lycus of Macedon, whose work Galen wrote extensively against, saying that "I know that any diligent reader anxious to discover the truth will find the books of other writers crammed with errors." Galen, *Anat. Admin.* 4.6.449.

<sup>134</sup> James Longrigg, "Anatomy in Alexandria in the Third Century B.C." *The British Journal for the History of Science* 21, no.4 (Dec. 1988), 462.

<sup>135</sup> This is the word used by Celsus. Given the context, we can infer that the term 'kings' refers to the Ptolemies ruling Egypt at the time.

<sup>136</sup> Celsus, *De Med.* I, *prooemium* 23-24. Emphasis added.

In his description of the practice to his reader, Celsus discusses the perspectives of both the Rationalist and Empiricist medical sects on the topic of vivisection, showing the subject from both angles. These two sects were frequently at odds, as they were based upon fundamentally opposing principles.

After presenting arguments both for and against vivisection, although neither of them portrayed as positive, Celsus does present his personal opinion of the discussion. His own feelings, which are relatively neutral in terms of the usefulness of dissection, reject vivisection entirely as being both unkind and unnecessary:

I am of the opinion that the Art of Medicine ought to be rational, but to draw instruction from evident causes, all obscure ones being rejected from the practice of the Art, although not from the practitioner's study. But to lay open the bodies of men whilst still alive is as cruel as it is needless; that of the dead is a necessity for learners, who should know positions and relations, which the dead body exhibits better than does a living and wounded man.<sup>137</sup>

Celsus believes that the physician should learn and practice his art through the treatment of patients, and does not think that vivisection is a necessary or acceptable practice.<sup>138</sup> While in the passage above he seems to be almost in favor of dissection, he also says within this section of his work that “even the dissection of the dead is unnecessary; although not cruel, it is none the less nasty.”<sup>139</sup> According to Galen, most people agreed that vivisection is a cruel and reprehensible practice, and ought not to have been used by Herophilus in his research.<sup>140</sup>

Celsus was not the only ancient writer who believed that this was a cruel, and even despicable practice. Another writer, though admittedly known to be far more polemical and belligerent in his writing than others, made clear his feelings on the matter, which were likely

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<sup>137</sup> Celsus, *De Med. I, prooemium* 74.

<sup>138</sup> For continued discussion of Celsus' treatment of vivisection, see: John Scarborough, “Celsus on Human Vivisection at Ptolemaic Alexandria,” *Clio Medica* 11, no.1 (1976), 25-38.

<sup>139</sup> Celsus, *De Med. I, prooemium* 44.

<sup>140</sup> Celsus, *De Med. I prooemium* 26.

shared by the vast majority of the public. Although various converging factors allowed for the practice of human dissection and vivisection in Alexandria for this brief time, it was not looked on positively by successive generations. Preexisting taboos seem to have reestablished themselves, and Tertullian, a Christian source from the second century CE, described in venomous terms an attitude towards vivisection that was probably quite widespread, if not universal in cultures with such defined antagonism towards interactions between the living and the dead:

The famous Herophilus, the physician, or rather butcher, who cut up innumerable persons [literally ‘six hundred persons’] in order to examine nature, who hated humans in order to have knowledge, explored their internal parts – since death itself changes what has been alive, especially a death which is not a simple one but one which is an error in the midst of the artificial processes of dissection.<sup>141</sup>

It is clear in this passage that Tertullian subscribes to the Empiricist school of thought, in which dissection has no value because “death itself changes what has been alive.” We must also take into account Tertullian’s Christian background, which placed him in a position of uncompromising opposition to any pagan sciences, whether or not they were morally and ethically questionable. He was also notably hostile to dualistic thought (that the body and soul are separate); it is probably this belief that the two are united that led him to condemn Herophilus’ work as he did.<sup>142</sup> To cut into the human body in this case would be to cut into and disfigure the soul, as well.

Some have claimed that Herophilus and his contemporary Erasistratus were the only ancient scientists to perform the systematic dissection of human cadavers. However, certain ancient writers have acknowledged these men as two in a list of physicians who practiced

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<sup>141</sup> Tertullian, *De anima* 10.4. ‘Six hundred persons’ from the Latin *sexcentos*, which could also be idiomatic in this case: ‘innumerable.’ Additionally, Tertullian’s use of the Latin *exsecuit*, ‘he cut up,’ is not specific to either living or dead people, so he could be stating also that dissection itself is abhorrent, not just vivisection.

<sup>142</sup> *BNP*, s.v. “Tertullianus.”

anatomy: “Our ancestors who practiced medicine in Alexandria – Rufus, of course, and Philip, Lycus, Erasistratus, Pelops, Herophilus, Hippocrates, and Apollonius – found it proper to examine the bodies of the dead.”<sup>143</sup> Indeed, given various fragments of this nature, it would appear that there was a small but active community of anatomists in Alexandria, possibly all participating in human cadaveric dissection. It is also possible that the reference to the “bodies of the dead” in this fragment refers to animal, as well as human, dead. Even if a larger group of anatomists were participating in cadaveric dissection, it is probable that only Herophilus and Erasistratus were practicing vivisection, as they are the only two physicians so singled out by the ancient writers for this accusation. After Herophilus, human dissection was not practiced again until the early 14th century CE, and animal dissection became a more heavily contested method of study.

Even Galen, whose later dissections and vivisections of animals often involved public displays and an element of boastful competition, records his methods with the inclusion of an impassioned defense of anatomical teaching. He mentions that the Empirics “wrote whole books against anatomy,”<sup>144</sup> believing that the necessary knowledge for medical treatment could be learned from observing the occasional wound. In opposition to this Empiricist outlook, he insists that a broad knowledge of anatomy is a necessity for any practicing *medicus*, stating, “if a man is ignorant of the position of a vital nerve, muscle, artery, or important vein, he is more likely to maim his patients or to destroy rather than save life.”<sup>145</sup> It is clear from this rather defensive addition that the overall climate of the medical field at the time was far from sympathetic to animal dissection, let alone that of human cadavers.

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<sup>143</sup> Vindicianus, *Gynaecia* praef.(vel 2), cod. L. \*As quoted in von Staden, *Herophilus*, 189.

<sup>144</sup> Galen, *Anat. Admin.* 2.3.289.

<sup>145</sup> *Medicus* is the Latin word for doctor. Galen, *Anat. Admin.* 2.2.284.

In one passage, Galen states that he believes all serious students of anatomy ought to visit Alexandria (still a hub of knowledge in his time), in order to study human bones. He says that “this is quite easy at Alexandria because the physicians there employ ocular demonstration in teaching osteology to students.”<sup>146</sup> Scholars have debated whether this suggests that human dissections continued in Alexandria at this time, but I believe it is far more likely that skeletons acquired through other means were displayed for study and that dissection itself was not taking place.<sup>147</sup> Indeed, Galen himself supports this idea further in this passage, describing ways in which a budding anatomist might observe human bones if travel to Alexandria was impossible:

Once a river, inundating a recent hastily made grave, broke it up, washing away the body. The flesh had putrefied, though the bones still held together in their proper relations [...] this skeleton was as though deliberately prepared for such elementary teaching [...] And on another occasion we saw the skeleton of a brigand, lying on rising ground a little off the road. He had been killed by some traveller repelling his attack [...], leaving the skeleton as if for demonstration.<sup>148</sup>

His repetition of the word “demonstration” in his advice to visit Alexandria, and again here, seems to connect the two ideas. Both are valid ways to learn osteology, as both experiences demonstrate the exposed skeleton for the student of anatomy. Given the encouragement of these alternative methods of anatomical observation and the overall attitude to anatomical study at the time, we can conclude that the systematic dissection of human bodies was no longer an accepted practice. Although in his discussion of dissection Galen does refer to “Erasistratus and Herophilus, *and other anatomists who lived after them*,”<sup>149</sup> it is probably that these later

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<sup>146</sup> Galen, *Anat. Admin.* 1.2.221.

<sup>147</sup> Vivian Nutton acknowledges that “Galen was well aware that it was impossible to carry out systematic dissections on human bodies; gazing at a skeleton or at the surface anatomy of a slave was all that was done even in the best medical schools.” Vivian Nutton, *Ancient Medicine* (London: Routledge, 2004), 237. Arguing that this passage supports the view that human dissection in Alexandria continues even into Galen’s time (second century AD): James Longrigg, *Greek Medicine from the Heroic Age to the Hellenistic Age: A Sourcebook* (New York: Routledge, 1998), 98.

<sup>148</sup> Galen, *Anat. Admin.* 1.2.221.

<sup>149</sup> Galen, *Anat. Admin.* 13.10 (Duckworth). Emphasis added.



anatomists would have practiced dissection exclusively on the bodies of animals, and also that they were presumably much closer in time to Galen than to the Alexandrians themselves.

## The Use of Analogy in Medical Writing

The use of analogy and comparative language within ancient writing was a long-standing and well-respected practice. Modern scholars have examined these uses, particularly in the field of ancient ethics. G.E.R. Lloyd's study highlights analogy as a fundamental process of the brain and human cognition, taking his empirical material from Greek and Chinese writings, and particularly the ethical texts of Aristotle.<sup>150</sup> Other scholars have also used Aristotle as their main author for examination, most notably in consideration of his craft-virtue analogies, in which Aristotle refers to nature as an actor or agent 'crafting' items and elements of the natural world.<sup>151</sup> The modern scholarship regarding this idea of analogy in ancient writing handles mainly ethical and philosophical texts, without addressing the use of this method in medical works. In addition, the work done on Aristotle's use of analogy shows a tendency on the part of that ancient author to use analogy in his description of processes, as opposed to physical structures.

Analogies that refer to the human body come in several forms. Some ancient writers, like Empedocles and Alcmaeon, were fond of using analogy in a more generalized manner, as in the comparison of the human body to the body politic. These were usually meant to make a point about the latter by use of the former.<sup>152</sup> In medical writing, on the other hand, analogies referring to aspects of the outside world could be used to express something about the body. As seen in the work of Aristotle, the tendency of early medical writers was to use analogy as a method of describing bodily processes, as opposed to depicting specific bodily organs or structures. The Hippocratic Corpus often relied upon this method, serving to create an image for the reader while

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<sup>150</sup> G.E.R. Lloyd, *Analogical Investigations: Historical and Cross-Cultural Perspectives on Human Reasoning* (Cambridge: Cambridge University Press, 2015).

<sup>151</sup> Tom Angier, *Technē in Aristotle's Ethics: Crafting the Moral Life* (New York: Continuum International Publishing Group, 2010).

<sup>152</sup> Nutton, *Ancient Medicine*, 48.

also teaching vital information. In the Hippocratic text *Diseases*, for instance, the author uses the process of making cheese to explain how fluids coalesce or separate within the body.<sup>153</sup> As Vivian Nutton said in regards to the study of the body, “the Hippocratic physiology of the body is based on both observation and on a wide range of analogies with the world around.”<sup>154</sup> It is important to note that Nutton himself distinguishes that it is the Hippocratic physiology of the body which is based on analogy. Physiology deals with the functions of the body, and anatomy with its structures; we do not here see Hippocratic authors applying analogical methods to anatomical descriptions. For this more precise approach, we must turn to the writings of Herophilus.

As we have already seen earlier in this paper, Herophilus drew from Hippocratic medicine for many of his therapeutic methods, but he also seems to have inherited from his predecessors the tendency to make use of analogy and comparisons with material objects and aspects of the natural world. Many of the structures of the human body that he observed, and sometimes discovered for the first time, were nameless prior to his examination. For instance, Galen refers to a particular discovery within Herophilus’ vascular experiments: “introducing the scalpel through the incision, force it up to the junction where the two veins meet the region that Herophilus [is said to] call the torcular (*lēnos*).”<sup>155</sup> This Greek word, *lēnos*, means ‘wine-vat’ or ‘wine-press,’ which is perhaps appropriate, given that this location is the convergence point for the major sinuses, and therefore accommodates a significant amount of blood. When not directly referencing Herophilus, Galen calls this anatomical feature the “blood-containing cavity.”<sup>156</sup> We

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<sup>153</sup> Hippocrates, *Diseases* 4.51-2.

<sup>154</sup> Nutton, *Ancient Medicine*, 78.

<sup>155</sup> Galen, *Anat. Admin.* 9.1.712.

<sup>156</sup> Galen, *Anat. Admin.* 9.1.712.

can therefore clearly see the contrast between the approaches of each writer in their anatomical descriptions of this structure.

In some instances, therefore, Herophilus was attempting to describe for his readers parts of the human body for which words literally did not exist yet, so a system of comparison may have been the only conceivable mechanism by which to present those parts in a way that would allow his readers and future physicians to be able to recognize them and later to treat patients based entirely on his descriptions.<sup>157</sup> Another particularly useful example for his readers would have been his analogies concerning the anatomy of the eyeball, shown to us by Rufus of Ephesus:

The third [coat of the eye; retina?] encloses vitreous fluid. The ancient name by which it is called is ‘cobweb-like’, on account of its fineness. But since Herophilus likens it to a casting-net that is drawn up, some also call it ‘net-like’. Others call it ‘vitreous’, too, on the basis of the liquid.<sup>158</sup>

Reflected in this passage, we can observe the tradition of analogy to be ancient even from the time of Herophilus, as Rufus refers to “the ancient name,” and then compares this to the name that Herophilus has given the structure. Rufus does not indicate the origin of “the ancient name,” which raises the question of the cultural and medical tradition to which this might be attributed. Given the context within which Herophilus is writing, the ancient author who called the retina “cobweb-like” might be either Greek or Egyptian, but we cannot make this determination with any certainty given the nature of the source material.

Beyond his extensive descriptions of the eyeballs, Herophilus also wrote on the nature of the skull and the anatomy of the head:

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<sup>157</sup> For further reading in Herophilus and his role in naming things in medicine: Paul Potter, “Herophilus of Chalcedon: An Assessment of his Place in the History of Anatomy,” (1976).

<sup>158</sup> Rufus Ephesius, *Nom. Part. Hom.* 153. \*As quoted in von Staden, *Herophilus*, 206. A Greek doctor in the late first century CE, Rufus spent much of his life in Egypt, and may have studied in Alexandria. His writings comment frequently on the health care and diseases present in that country. He was a confirmed Hippocratic and follower of humoral theory, and he considered anatomical study to be fundamental. Galen praised him highly. *BNP*, s.v. “Rufus of Ephesus.”

Consequently its double fold, which occurs at the sutures, resembles a 'channel'. This channel [Herophilus] called 'tub' as well as 'funnel' [*infundibulum cerebri*]. As the cavity which receives the [nerve] passages, it is called 'tub' on the basis of its shape, but 'funnel' on the basis of its function.<sup>159</sup>

This passage shows the influence of the Hippocratic Corpus on Herophilus, as he continues to use analogy to describe functions of the body, in addition to structures. This passage is uncommon in that Herophilus establishes two different terms of analogy, based on the differences between structure and function. Whether this is an intentional separation of his own methods from those of prior medical writers, or simply an attempt to give readers multiple approaches to the identification of a complex body part is impossible to determine. However, it was more common for him to present a single simple analogy for comparison, as when he referred to the tibia as *kerkis*, which literally means 'weaver's shuttle,' or 'taper-rod.'<sup>160</sup> We can see in this an excellent example of Herophilus drawing from easily recognizable objects in the non-medical world.<sup>161</sup>

This invites the question: who, in fact, was Herophilus' intended audience? His nine books are frequently referenced and cited by later educated medical writers, leaving us with the fragments of his work that we have today, but perhaps this was not his original target. His use of broader, common analogies suggests that he is speaking to a less specialist audience. Herophilus was a formally educated physician who would have been excessively capable of writing in complex academic jargon, as we can later observe Galen doing in his own writing. Even in the instances in which he is naming newly discovered parts, he chooses to do so in simple and accessible terms, rather than in language that only physicians educated in the Greek medical tradition could understand. It is possible that Herophilus meant to teach professional physicians,

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<sup>159</sup> Theophilus Protospatharius, *De corporis humani fabrica* 4.5.4-5. \*As quoted in von Staden, *Herophilus*, 195-96.

<sup>160</sup> Rufus Ephesius, *Nom. Part Hom.* 123. \* As quoted in von Staden, *Herophilus*, 227.

<sup>161</sup> For further examples, see the catalogue of Herophilean uses of analogy in Appendix A, on page 63 of this work.

but his rhetoric may simultaneously speak to the Homeric craftsman-physician idea referenced earlier in this paper, in which many common people were able to practice some small amount of medicine. If his goal was to reach the craftsmen physicians as well, the broad analogy would work well in providing a common image, an easy point of comparison that most could recognize in order to identify a specific part of the body for treatment.

Herophilus was one of a small group of physicians in Alexandria who did research, developed theories, modified and corrected the ideas of those who came before them, wrote texts, and also treated patients.<sup>162</sup> They practiced medicine like it was an art that could be developed and perfected, rather than as a skill required for the practice of a profession. They were able to operate in this manner largely because of the resources available to them, which allowed them to focus on their art, rather than exclusively on the skills that would be necessary to make a living as a practicing doctor. On the other hand, we can see the large number of general practitioners that were likely serving in the medical field in Alexandria, those craftsmen-doctors who learned enough medicine to address a limited array of problems (in the case of the many specialists described in the primary material). These doctors left no written record, and we must therefore rely on what is expressed through the surviving sources. Therefore, the concept that Herophilus was potentially writing his texts for the use of these general practitioners might offer us a window into their specific medical experiences.

If Herophilus was using a broader range of analogy in order to reach a wider audience with his writings and teach his discoveries of anatomical structures to a group of people not restricted to formally educated Greek physicians, Galen's later work can be seen to be in direct contrast with this method. Galen used a more direct, but also more restrictive form of analogy, which may have served the opposite goal to that of Herophilus. He described his observations of

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<sup>162</sup> Von Staden, *Herophilus*, 23.

the body using analogy based in animal anatomy, and largely refrained from expanding beyond that. By using a human-animal analogy, Galen assumed that his readers already had a basis of knowledge in animal anatomy and physiology, and therefore likely some skills in dissection, already, as well. He was speaking to a more specialized audience within his writings, which is made even more clear by his insistence that his students pursue multiple paths of knowledge in their medical education: both book-learning and physical, tangible observation and experience were necessary in order to be an effective physician.<sup>163</sup> Galen's books make abundantly clear that there were a great many animal dissections occurring during his lifetime, performed by a large number of physicians; this was not an uncommon practice. However, they also emphasize the point that the use of analogy within medical writing, though it has narrowed in scope from the time of Herophilus, has continued as a method of description and a means of teaching.

Galen himself supports the idea that Herophilus may not have been writing for a formally educated Greek audience through his early discussion of the styloid process:

I have already said previously that Herophilus calls the process of the skull which others call 'awl-pointed' or 'needle-pointed', and which is a slender cartilaginous process, 'styloid'. This is because many people in Alexandria, and many others besides them among the peoples inhabiting the regions of the Orient, who speak bad Greek, call the pens with which one writes upon waxed tablets 'styloi'.<sup>164</sup>

Galen seems to suggest in this passage that Herophilus was targeting Egyptian audiences, or others with a less than perfect grasp of the Greek language, which was fluently spoken mostly by those upper echelons of Alexandrian society like academics or anyone associated with the Ptolemaic court. The implication that Herophilus is choosing words that will be understood by people of a non-Greek background supports the hypothesis that he is writing for a broader audience of culturally diverse general practitioners.

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<sup>163</sup> Galen, *Anat. Admin.* 1.2.221.

<sup>164</sup> Galen, *Anat. Admin.* 14.5 (Duckworth). 'Kalamoi,' or reed. Earlier in *On Anatomical Procedures*, Galen uses the Greek 'kalamos' for 'pen,' as well, so his word choice is consistent in his description of Herophilean analogy.

Galen states that others call the styloid process “‘awl-pointed’ or ‘needle-pointed,’” but he does not specify who these others are. One might argue that this suggests Greek physicians prior to Herophilus were using analogy in the same way. It seems possible that these others may have been physicians and writers within the Egyptian medical tradition, where we can also see examples of this type of comparative method within the papyrological evidence. Within the Edwin Smith Surgical Papyrus, the unnamed surgeon describes the puncture in the side of the skull as being like a hole broken in the side of a pottery jar, and the coils of the brain he likens to “those corrugations which form on molten copper.”<sup>165</sup> These analogical descriptions of anatomical structures of the human body are deeply reminiscent of those written by Herophilus, and it seems increasingly likely that Herophilus was influenced by this text, and others like it, which he would presumably have had access to through the unparalleled Library of Alexandria. This text appears to have been the reference text of a practicing physician, discussing the injuries and treatments of his patients. This is far more indicative of a craftsman type doctor than an experimental scientist, from whom we might expect a research journal in strict academic language. Herophilus’ use of analogy also falls along these less formal lines. Although he was deeply entrenched as a researcher within the elite Greek intellectual world in Alexandria, it does appear that at least some of his writing was aimed at a wider public, using analogies based on more common and easily understood imagery so that a larger variety of physicians could learn from and use his knowledge and discoveries.

Even among his contemporaries, Herophilus’ use of analogy seems to stand out. Erasistratus, that anatomist so commonly associated with Herophilus within ancient writing, also made use of analogy in his consideration of the human body. He, however, followed the Aristotelian tendency to use analogy for the description of bodily processes, rather than the

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<sup>165</sup> *Edwin Smith*, Case 3, p.126; and Case 6, p. 173.



depiction of anatomical structures. Von Staden describes Erasistratus' depiction of the body as "an autonomous machine within which many interrelated, smaller machines with mostly purposive parts are continuously operative."<sup>166</sup> The analogies most commonly used by this anatomist compared varying functions of the body to those of machines seen in early Alexandrian technology. For instance, he used the metaphor of the bellows to depict the contracting functions of the heart.<sup>167</sup> His use of analogy did come closer than others to that of Herophilus, with this focus on mechanical metaphor, but continued to address physiology processes as opposed to anatomical structures.

Herophilus was also working within an environment in which his experiments were less than favorable in the public opinion. Note that the fragments we have seen so far are not specific as to the nature of the subject from whence the knowledge came (animal vs. human). This may, however, be due to the presentation of the material by the later writers; many of these fragments are found within Galen's writing, who, as previously mentioned, was very unlikely to mention human systematic dissection for fear of harming his own reputation. We cannot rule out entirely that this evasion was intentional on the part of Herophilus, who might have feared alienating any readers who might not agree with his less conventional methods of research.

If we posit that the use of analogy was a conscious choice on the part of Herophilus, it was, perhaps, wise to shroud slightly in rhetorical tricks those parts of the body that he had laid bare to the world, rather than to describe them in such a way as to warrant further ire and disapproval than he may already have been facing. Indeed, his work with the female body and his discoveries in gynaecology also show use of this method of analogy. For instance, he referred

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<sup>166</sup> Erasistratus was deeply teleological in his view of the world, more so even than was Aristotle. Von Staden, "Body and Machine," 93.

<sup>167</sup> Von Staden, "Body and Machine," 94.

to the ovaries frequently as “twins” and also compared them often to the testicles.<sup>168</sup> He used the male reproductive system as a basis for his explanations of the female reproductive structures, perhaps under the assumption that many of his readers would have had some experience with the male external organs, and could therefore easily use this system of comparison for the identification and treatment of their female counterparts. This was not an uncommon approach to the female reproductive system. In a similar manner, Herophilus referred to other parts of the female anatomy to more visible parts of the human body in general, providing a point of reference for his readers and students to consult in a moment of uncertainty. For instance, in his description of the cervix, “Herophilus likens the nature of the neck of the uterus to the upper part of the windpipe.”<sup>169</sup> Although this is different from his analogies with material objects, the purpose appears to be the same: the analogy with more easily discernable parts of the body gives the reader something visible and recognizable with which to compare.

One significant use of analogy within the fragments of Herophilus refers to the female body and reproductive anatomy; multiple different types of analogy can be seen within this description written by Soranus, who refers to the opinions of Herophilus:

[The mouth of the female pudendum] by nature is delicate and fleshy in the case of undeflowered women, resembling the sponginess of the lung or the tenderness of the tongue, but in the case of women who have given birth it becomes more callous, similar to the head of an octopus or to the upper part of the windpipe, just as Herophilus says, since it is made callous by the passage of what is excreted and of what is brought to birth.<sup>170</sup>

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<sup>168</sup> Galen, *Usu Part.* 14.11.

<sup>169</sup> Most likely referring to the cervix with the phrase “neck of the uterus.” Galen, *Uter. Dissect.* 7.

<sup>170</sup> Soranus, *Gynaecia* 1.10.3. \*As quoted in von Staden, *Herophilus*, 217. Soranus was a Greek physician born in Ephesus, an Ionian coastal city (present-day Turkey). He likely studied in Alexandria, and practiced mainly in Rome around 100 CE. He was a principle representative of the Methodist school of medicine, and several of his works survive, including his four-book treatise on gynaecology and a Latin translation of his *On Acute and Chronic Diseases*. His works were greatly influential on later writers, including Tertullian and Galen. *BNP*, s.v. “Soranus of Ephesus.”

It seems in this passage that Soranus is analogizing aspects of the female reproductive system with other parts of the body; in this case we can observe comparisons with the lung and the tongue. Soranus then compares a feature of human anatomy to the head of an octopus, similar to the human-animal analogies seen within the work of Galen. Usually in comparisons based on animal anatomy, as we see in the works of Galen, these are centered on certain vital similarities between human beings and the species of animal in question. Galen later tells his students outright to dissect “animals similar to man,” and makes it clear throughout his work that he preferred to work with apes above all other creatures, although if these were not available, “bodies of other animals must serve, making clear from the start wherein they differ from an ape.”<sup>171</sup> It may therefore seem out of place to make a comparison with an animal like an octopus, with so little shared between that species and humans, but given that Soranus was from the coastal city of Ephesus, it perhaps should not seem so unusual that he would draw his comparisons from animals that he might have experienced more frequently than apes, or other animals suggested by Galen. This apparent grasping at more distant analogies in the attempt to describe those potentially more confusing and less identifiable parts of women is perhaps a less clear image for the reader than was his other description of those same parts using a more simplistic, human-body based comparison (referring to the lungs and tongue).

Herophilus’ society would likely have been squeamish about discussing the internal parts (and the implications of taboo violation that accompany that), and probably would have benefitted from an analogy-based sugarcoating, so to speak. This hesitation to use more direct language in reference to the bodies of women, in particular, might also be attributed to an even greater taboo in regards to opening and talking about women’s bodies and their contents, beyond that ancient taboo against interaction with the dead in general. Nutton has stated that the function

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<sup>171</sup> Galen, *Anat. Admin.* 1.2.224-227.

of these analogies, “above all, is to provide an immediate support to the argument for whatever position is adopted.”<sup>172</sup> While this is true, I would argue, that they also function significantly as a buffer for the physician, to handle the presentation of potentially sensitive material to a less than receptive audience in a slightly more delicate manner.

Although there were certainly physicians well-educated in the Greek medical tradition, who would have had the opportunities and resources to extensively study existing medical texts and complete original experiments in order to discern the nature of the human body, the vast majority of doctors in this time and place would have been of the craftsmen type, some perhaps without a solid grasp on the Greek language, let alone the Greek medical tradition. Galen himself attests that Herophilus’ language within his writing was intended for those who spoke “bad Greek,”<sup>173</sup> and the striking similarities between Herophilus’ use of analogy to describe the physical structures observed during his dissections and those seen within the Egyptian medical papyri strongly support the idea that Herophilus’ intended audience was not, in fact, his own peer group of elite Greek physicians, but rather a broader group of general practicing doctors of potentially varied ethnic backgrounds, cultural and medical traditions, and levels of formal education.

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<sup>172</sup> Nutton, *Ancient Medicine*, 78.

<sup>173</sup> Galen, *Anat. Admin.* 14.5 (Duckworth).

## Conclusions

In a period of Ptolemaic Alexandria that has been referred to as a ‘frontier environment’ for scientific achievement and discoveries, Herophilus of Chalcedon was one of the leaders of innovation in a number of ways. Religious and cultural boundaries and the existence of taboos and death-related pollution should perhaps have limited his research capabilities, but under the patronage of the ruling Ptolemaic kings, he and his contemporaries were able to dissect human cadavers for the sake of scientific research. Herophilus and his contemporary Erasistratus are also attributed with having performed human vivisections within the pursuit of their studies.

Herophilus was also innovative in the way that he presented his medical discoveries within his academic writing. Perhaps drawing from the Egyptian medical papyri, within which we can see some striking similarities, Herophilus used analogies based on material objects and aspects of the natural world in order to provide comparisons with the anatomical structures of the human body. Herophilus used these analogies with the intent to reach a broader audience through his writings, and to make his medical discoveries accessible to a broader group of general practitioners, rather than limiting this knowledge to those elite, Greek, formally educated physicians with whom Herophilus would have worked and interacted. His analogies tended to refer to structures, rather than processes within the human body, and presented anatomy in a way that could be understood even by those craftsmen physicians with potentially little to no background in dissection or direct anatomical study, or even a firm grasp on the Greek language. Herophilus’ use of dissection and vivisection is perhaps the most vivid example of innovation within his work, but his use of analogy is far more telling in terms of determining who he was as a teacher and who he intended to address and influence through his academic writing.

While Herophilus largely refrained from the pursuit of innovation within his therapeutic practices and treatment of patients, his methods of research and presentation were so inventive and cutting-edge that they were largely seen in a negative light by other ancient writers, and also by modern scholars. His treatments remained predominantly true to the Hippocratic tradition, but his research methods were extreme and broke established taboos within his own culture, and that within which he was living. While he continued to work within the context of the Hippocratic Corpus, he was not limited by the boundaries of this tradition, moral or otherwise.

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## Appendix A: Catalogue of Herophilean Analogy

Each passage is accompanied by an abbreviation of the translator's surname and the page number on which it may be found in the complete work.<sup>174</sup>

1. Soranus, *Gynaecia* 3, proem. 3.4 (von Staden (VS), 80).

"Herophilus too says in his book Midwifery that the womb is woven together from the same things as the other parts..."

2. Vindicianus, *Gynaecia* 3 (VS, 195).

"...as the anatomists Synanchus and Herophilus wrote. The skull, i.e. 'helmet' [...] is placed underneath and it coheres with a membrane, on which is placed the skin."

3. Theophilus Protospatharius, *De corporis humani fabrica* 4.5.4-5 (VS, 195-96).

"Consequently its double fold, which occurs at the sutures, resembles a 'channel'. This channel the followers of Herophilus called 'tub' as well as 'funnel' [*infundibulum cerebri*]. As the cavity which receives the [nerve] passages, it is called 'tub' on the basis of its shape, but 'funnel' on the basis of its function."

- Regarding the membranes covering the skull.

4. Galen, *Anat. Admin.* 9.5 (VS, 199)

"The result is that the posterior ventricle [of the brain], the fourth, is exposed, and, when it is moved backwards, that the larger part of the ventricle is covered and only that part is visible which Herophilus likened to the carved out groove of a pen [*kalamos*] with which we write. You see, it really is like a pen, since it has a hollow, like an incision [*posterior median sulcus*], in the middle, and on either side of this each of the two lateral parts [*eminentia facialis*] extends up to as great a height as they rise in pens from the line in the middle. Particularly in Alexandria they carve out the pens with which we write in this way, and since Herophilus lived there, it is likely that, when he was dissecting, he applied this name [sc. 'pen', *kalamos*], being induced to do so by the similarity of the image."

5. Galen, *De libris propriis* 3 (VS, 202-03).

"In Book 19 [sc. of his twenty anatomical books, Marinus writes] about the nerves that grow from the brain [cerebrum?], about smell and from what source its perceptual organ begins, and about the nerves that go to the eyes, which Herophilus as well as Eudemus call 'passages' [*poroi*]."

6. Calcidius, *In Platonis Timaeum comment.* 246 (VS, 203-04).

"They also recorded that the area adjacent to the eye itself consists of four membranes or tunics of unequal thickness."

- Referring to Herophilus and other anatomists.

7. Rufus Ephesius, *De anatomia partium hominis* 12-13 (VS, 205).

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<sup>174</sup> Translations are from von Staden's *Herophilus: The Art of Medicine in Early Alexandria*. The original Greek and Latin can also be seen in that text. This catalogue is compiled based on the judgment of the author of this paper and does not reflect the opinions of the author of the aforementioned text.

"The perforated body [sc. of the eye; *iris*?] is smooth on the outside where it meets with the horn-like [coat of the eye; *cornea*?], but rough on the side that is turned away, as Herophilus says, resembling the skin of a grape, being interwoven with blood-vessels."

8. Celsus, *De medicina* 7 (VS, 205-206).

"Then underneath this again is the thinnest coat, to which Herophilus gave the name 'cobweb-like'."

9. Rufus Ephesius, *De nominatione partium hominis* 153 (VS, 206).

"The third [coat of the eye; retina?] encloses vitreous liquid. The ancient name by which it is called is 'cobweb-like', on account of its fineness. But since Herophilus likens it to a casting-net that is drawn up, some also call it 'net-like'. Others call it 'vitreous', too, on the basis of the liquid."

10. Galen, *Anat. Admin.* 14.5 (VS, 206).

"I have already said previously that Herophilus calls the process of the skull which others call 'awl-pointed' or 'needle-pointed', and which is a slender cartilaginous process, 'styloid'. This is because many people in Alexandria, and many others besides them among the peoples inhabiting the regions of the Orient, who speak bad Greek, call the pens with which one writes upon waxed tablets 'styloi'."

11. Galen, *Anat. Admin.* 10.7 (VS, 207).

"On each of the two sides there runs up in the direction of the tongue a muscle which springs from the cranium near the process which Herophilus calls the 'pharoid' ('light-house-like', i.e., the styloid process)."

12. Rufus Ephesius, *De nominatione partium hominis* 155 (VS, 207-208).

"Some people call the bone below the tonsils, surrounding the head of the windpipe, 'Y-shaped' on account of its shape, because it resembles the letter *Y*[psilon]. But Herophilus calls it 'assistant' (*parastatēs*), because it 'stands by' (*parestēke*) the tonsils."

13. Galen, *De locis affectis* 6.3 (VS, 209).

"...the process which Herophilus names 'twelve fingers long' [sc. *duodenum*], giving it its name from its length."

14. Galen, *De usu partium* 14.11 (VS, 217).

"...for 'twin' (*didymos*) is what Herophilus calls the 'testicle' [ovary]."

15. Galen, *De uteri dissectione* 7 (VS, 217).

"Herophilus likens the nature of the neck of the uterus [cervix?] to the upper part of the windpipe."

16. Soranus, *Gynaecia* 1.10.3 (VS, 218).

"[The mouth of the female pudendum] by nature is delicate and fleshy in the case of unflowered women, resembling the sponginess of the lung or the tenderness of the tongue, but in the case of women who have given birth it becomes more callous, similar to the head of an



octopus or to the upper part of the windpipe, just as Herophilus says, since it is made callous by the passage of what is excreted and of what is brought to birth."

17. Galen, *Anat. Admin.* 9.1 (VS, 224).

"But if it is not detached, make an incision with a sharp scalpel on either side of the fold of the meninx in the lower parts whether it first reaches the skull, and then, also inserting the scalpel there through the incision, try to force it up to the top where the two veins meet, the area which Herophilus calls a 'wine-vat' [sc. *torcular Herophili*]."

18. Rufus Ephesius, *De nominatione partium hominis* 123 (VS, 227).

"Herophilus, however, also calls the tibia *kerkis* [lit. 'weaver's shuttle; taper rod']."

19. Galen, *De sententiis* (VS, 323-324).

"whether the pneuma of the soul is contained in the bodies of living creatures in the ventricles or is spread out through all the ducts [?'root-like parts'] or is divided into small parts as Herophilus wanted, saying that it is in every single part of the parts of the root member..."

20. Marcellinus, *De pulsibus* 35 (VS, 345).

"For, they say, the artery moves unevenly, dilating more in one part, less in another, also more forcefully here, more weakly there, just as when very thin web-like [covers] have been placed around the holes in flutes and a musician then breathes into the flutes: at the holes a motion is observed that quivers in relation both to the passage of the breath and to its pressure...so the artery, too, moves unevenly."

- Herophilean description of the quivering pulse.

21. Censorinus, *De die natali* 12.4-5 (VS, 360).

"But Herophilus, a practitioner of the same art, says the pulsations of the bloodvessels move in musical rhythms. If, therefore, there is harmony in the movement of both the body and the soul, then doubtless music is not alien to the days of our birth."

Appendix B – Map of the Hellenistic World



Figure 1: Map of the Hellenistic World in 240 BCE Created and owned by The Mapping History Project at the University of Oregon in Eugene, Oregon.

Appendix C – Inscriptions and Papyri

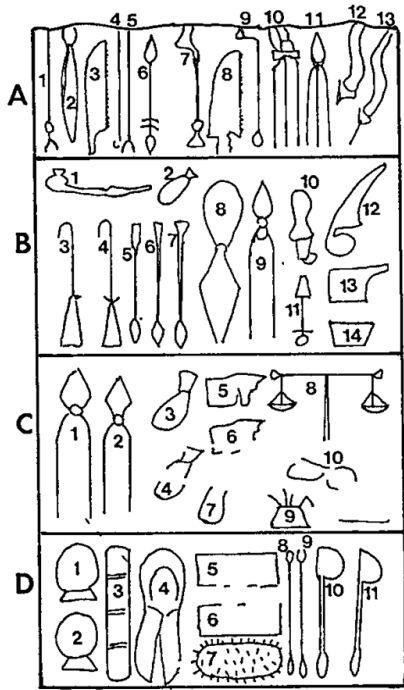


Figure 2: An early depiction of Egyptian medical tools, taken from the outer wall of the temple of Kom Ombo. As seen in John F. Nunn, *Ancient Egyptian Medicine* (Norman, OK: University of Oklahoma Press, 1996), 164.





Figure 3: Ebers Papyrus Reproduction. Credit: Wellcome Library, London. Georg Ebers, *Papyrus Ebers* (Leipzig: W. Englemann, 1875).