Medical Decision Making in Greco-Roman Antiquity

Medical Decision Making in Greco-Roman Antiquity

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Abstract

This project investigates medical decision making in Greco-Roman antiquity, using modern studies of cognitive bias, heuristics, and the development of expert intuition as a lens through which to view the theoretical constructs and practical instructions of the physicians of the past.

The epistemology of the physicians and medical writers of antiquity has been examined extensively by successive generations of scholars, with more recent efforts confronting the issue of heuristics explicitly (though as yet there is no book-length, diachronic treatment of the subject). Past and present endeavors have focused on the epistemological approaches of various medical sects, noting similarities and differences in how these groups elicited, privileged, analyzed, classified, organized, and applied information related to their patients and the problems from which they were suffering. Focusing on the practical aspects of decision making that surround diagnosis, prognosis, and treatment, this dissertation evaluates ancient Greco-Roman clinical decision making through the lens of modern cognitive decision-making theory. The source material evaluated in the dissertation is presented chronologically, arranged according to broad epochs of medical practitioners: the Hippocratic corpus (chapter 2), the Alexandrian anatomists Herophilus and Erasistratus (chapter 3), the Empiricists (chapter 4), the Methodists (chapter 5), and Galen (chapter 6). Chapter 1 is an introductory chapter outlining the theoretical approach used. Comparison of these epistemological groups, with reference to modern studies of heuristics and the development of expert intuition, demonstrates that shifts in the limits of observability of anatomical and physiological phenomena encouraged re-evaluation of disease categories and reassessment of how information from a clinical encounter was privileged.

Practitioners of antiquity were often aware of the benefits and pitfalls of the nosological and diagnostic systems they used, and the revision of their epistemological approaches over time reflects self-conscious attempts to redress flaws in these thought patterns.

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For Mom, Dad, Graham, and James

Nam et secundas res splendidiores facit amicitia et adversas partiens communicansque leviores.

Cicero, *De Amicitia* 22

Chapter 1
Decision Science, Medical Decision Making, and Burden of Disease

"Before there was ever any evidence for anything in medicine, heuristics were all that guided the ancient practitioner."

-Pat Croskerry, MD PhD, professor of emergency medicine and clinical decision-making researcher, in a 2005 article published in the *Canadian Journal of Anesthesia*[1]

Survival depends upon decisions. Animals' choices of what to eat, where to live, when to fight, when to flee, and when and with whom to reproduce affect the survival of both the individual and the species. For many animals, these 'decisions' are like reflexes, in that they are probably less the product of contemplation than they are for humans – but even humans make decisions that have a decidedly 'instinctive' or 'intuitive' feel to them. Sometimes, we call them 'gut' decisions. We may spend a great deal of time thinking about our decisions, tallying up reasons why we should or should not pursue a particular course of action, or we may make 'snap judgments,' decisions that feel intuitive to us. Our decisions are influenced by our personal histories and experiences, the cognitive machinery of the human mind, the advice of the people around us, broader global trends and events, and our individual, daily experiences. Rarely are our options limitless, but it is possible that a decision could be a refusal to decide. We confront hundreds of decisions each day, so many that there is a field called decision science, and researchers now speak of, and are beginning to characterize, the 'decision fatigue' that humans encounter in daily life.[2] Heuristics are mental shortcuts: they are ways of quickly organizing new information, or large amounts of information, so that we can make decisions quickly and with

[1] Pat Croskerry, "The Theory and Practice of Clinical Decision Making," *Canadian Journal of Anesthesia* 52 (2005): R4-R5.

[2] Shai Danziger, Jonathan Levav, and Liora Avnaim-Pesso, "Extraneous Factors in Judicial Decisions," *PNAS* 108 (2011): 6889-6892.

minimal cognitive strain. They can also help us draw conclusions in contexts of limited information. Though there are different kinds of heuristics, which will be discussed further in this chapter, their primary goal is the same: efficient and effective decision making.

This project is a study of particular kinds of decisions, from a particular culture, in a particular time period. Specifically, it investigates medical decision making in Greco-Roman antiquity, from the Hippocratic physicians in the fifth century BCE, to Galen in the second century CE. What does Dr. Croskerry mean when he says that, "Before there was ever any evidence for anything in medicine, heuristics were all that guided the ancient practitioner?,"[3] and is there support in our ancient sources for this kind of a statement? The epistemology of the physicians and medical writers of antiquity has been examined extensively by successive generations of scholars, with more recent efforts confronting the issue of heuristics explicitly.[4] Such attempts to understand the thinking behind a medical author's words are at least as old as ancient efforts at exegesis of Hippocratic texts by the Alexandrians and, later, by Galen. Modern scholars have focused on the epistemological approaches of various medical sects, noting similarities and differences in how these groups elicited, privileged, analyzed, classified, organized, and applied information about their patients and the problems from which they were suffering. While I will examine these various epistemological approaches more closely in the following chapters, they are not the focus of my study. Rather, I seek to focus on the question, "How did the physicians of the past decide?" with reference to three practical aspects of the encounter between Greco-Roman physicians and their patients: diagnosis, prognosis, and treatment.

[3] Croskerry, "The Theory and Practice of Clinical Decision Making," R4-R5.

[4] Colin Webster, "Heuristic Medicine: The Methodists and Metalepsis," *Isis* 106, (2015): 1-11 and Markus Asper, "On Systematicity. How to Write (Ancient Greek) Science," *Trends in Classics* 8, (2016): 103-123.

As a way of considering this question, we will examine in this chapter contemporary theories of decision making, heuristics, and bias – especially those related to the encounter between a patient and a physician – in order to create a framework for understanding decision making in antiquity. Today, physicians' decisions about what, whom, and how to diagnose and to treat emerge from the patients and pathologies they observe in their clinics, and, as we will see in subsequent chapters, the physicians of the past, too, made decisions about diagnosis, prognosis, and treatment based on the kinds of problems they frequently observed their patients to have. With knowledge of decision theory – especially as it relates to medicine – and knowledge of the burden of disease in Greco-Roman antiquity, we will approach our texts in an effort to discern how the doctors of antiquity decided. We will also consider the burden of disease experienced by people in the Mediterranean world from 500 BCE to 200 CE, as the kinds of 'typical' or 'ordinary' medical problems encountered by physicians in the past are quite different from those encountered by modern physicians in developed Western nations.

1.1 Decision Science: Confronting Uncertainty

1.1.1 Introduction and Twentieth Century Developments

Questions of choice – how choices are or should be made – have long concerned philosophers and observers of human behavior. Enlightenment thinkers such as Pascal and Bernoulli attempted to explain the concept of choice in uncertain conditions with reference to ideas of "expected value" (Pascal) and "expected utility" (Bernoulli). The latter used the St. Petersburg paradox, a math problem which presents a discrepancy between what people are willing to pay to play a casino game and what they should mathematically expect to win (an infinite amount of money), to reveal the flaws in expected-value theory. Bernoulli's discussion

of this example demonstrated that people do not always make decisions based on mathematical probabilities.[5] His results led him to emphasize a decision maker's consideration of expected utility – expectation of how useful a potential gain will be – rather than the financial value that the decision maker hopes to gain from his choice. The concept of expected utility was important because it acknowledged that a decision maker is influenced by more than simply the price itself: his choice is also guided by his perception of the utility of his gains. Bernoulli explained this claim by pointing out that a gain of one thousand ducats means more to a poor man than to a rich man, even though the numerical amount is the same.

The idea that humans make decisions that are not fully explicable with recourse to a rationality that is aware of all hypothetical probabilities, costs, and benefits is captured in the term "bounded rationality," initially proposed by James G. March and Herbert Simon.[6] As "boundedly rational agents," humans "experience limits in formulating and solving complex problems and in processing (receiving, storing, retrieving, transmitting) information," even as they "remain 'intendedly rational."[7] Foundational among studies that investigate these non-rational aspects of human decision making is the work of Daniel Kahneman and Amos Tversky, who, in the 1970s and 1980s, led efforts to question assumptions of humans as 'rational' decision makers. They wrote two articles that changed the field of decision science, the first on biases and

[5] Daniel Bernoulli, "Exposition of a New Theory on the Measurement of Risk," *Econometrica* 22, (1954 [1738]): 23–36.

[6] James G. March and Herbert Simon. *Organizations*. (New York: John Wiley and Sons, 1958).

[7] Oliver E. Williamson, "The Economics of Organization: The Transaction Cost Approach," in *The Sociology of Organizations: Classic, Contemporary, and Critical Readings*, ed. Michael J. Handel (Thousand Oaks, CA: Sage Publications, Inc., 2003), 278.

heuristics[8] and the second on prospect theory.[9] Both focus on how humans manage uncertainty and make decisions in the face of such uncertainty and its attendant risks; the approach to decision making that Kahneman and Tversky detail in these articles has come to be called the Heuristics and Biases approach. An alternative theory, which focuses on the idea of expert intuition, is called the Naturalistic Decision Making (NDM) approach; one of its major proponents is Gary Klein. I will discuss both models here, focusing first on the work of Kahneman and Tversky, and then on that of Klein and the NDM approach.

1.1.2 Heuristics and Biases

Kahneman and Tversky's first seminal article, "Judgment under uncertainty: heuristics and biases," sought to address the following question: "How do people assess the probability of an uncertain event or the value of an uncertain quantity?" The authors argued that an answer to this question could be found in "heuristic principles which reduce the complex tasks of assessing probabilities and predicting values to simpler judgmental operations. In general, these heuristics are quite useful, but sometimes they lead to severe and systematic errors," errors which we call 'biases.'[10] Consider one common example about the (mis)perception of risk and uncertainty: the fear of flying in airplanes versus riding in cars. More people are afraid of flying (even if they are not afraid of heights) than of riding in cars, though there are annually far more fatalities from car crashes than from plane crashes. The reasons for this misperception of risk are many, including issues of control (there is a perception of control in a car but not in a plane), knowledge (many

[8] Amos Tversky and Daniel Kahneman, "Judgment under Uncertainty: Heuristics and Biases," *Science* 185, (1974): 1124-1131.

[9] Daniel Kahneman and Amos Tversky, "Choices, Values and Frames," *American Psychologist* 39, (1984): 341-350.

[10] Tversky and Kahneman, "Judgment under Uncertainty," 1124.

people know how to drive cars, fewer know how to fly planes, or know the physics of flight), and exposure to accidents (plane crashes are highly publicized; car crashes, partly because they are so common, are less extensively discussed in the media).[11] Perceptions of the likelihood of certain outcomes influence perceptions of risk and how people make decisions: concerns about particular outcomes are especially relevant when the outcome of the decision involves issues of health and disease, of life and death. Heuristics are one way of assessing choices and risks, and while they are not foolproof or perfect methods, they are efficient. We can use a discussion of heuristics to explore the aforementioned example about (mis)perception of risk, as well as the ways physicians – past and present – chose to organize and to analyze information. Kahneman and Tversky named three heuristics in their article: "representativeness," "availability," and "adjustment and anchoring." We will discuss each in turn.

Examples of the representativeness heuristic are stereotyping and racial profiling. We make connections between individuals or events based on how similar those individuals or events are to others that come to mind. Because we make these connections so quickly, we sometimes have a subsequent tendency to overlook other facts that might suggest a different conclusion. This tendency is illustrated by a study in which American subjects were given descriptions of various individuals and asked if they were more likely to be an airline pilot, a library, a salesman, a farmer, or a physician. In one description, an individual is characterized as particularly quiet, disinterested in people, and with a preference for order. Participants most often said that this hypothetical individual was a librarian, even though, in the United States at the time of the study, there were more farmers than individuals with any of the other four occupations.

[11]Myriam Hunink, *Decision Making in Health and Medicine: Integrating Evidence and Values*, (Cambridge: Cambridge University Press, 2014), 396.

Had study participants guessed based on probability – that is, if they had realized that, numerically, farming would be the statistically more likely occupation of this individual – they might have guessed more correctly.[12] Instead, they assumed that an individual with this personality is more likely to be a librarian than a farmer. A stereotype incorrectly guided their thinking. The flaw in their reasoning involves confusion between two related but different probabilities: the probability of occupation conditional on personality, and the probability of personality conditional on occupation. The challenge is that the representativeness heuristic leads to a mismatch between what the questions asks and what is, or should be, the basis for that decision. In the terms of the farmer/librarian example, the question is asking about a person's most likely occupation. Recourse to logical, numerical probability would yield one answer (farmer); yet, when we use stereotyping as the basis for this decision, we obtain a different answer (librarian). Stereotyping might have some kind of personalized numerical basis in our own minds, but that personal numerical basis is not aligned with the broader numerical basis that the question assumes. There is a mismatch. In medical terms, this means we (erroneously) consider the probability of observing a given diagnostic test result, given a particular disease. Instead, we should consider the probability of the disease occurring, given a particular test result.

Application of this heuristic leads to a number of biases and mental blind spots.[13] First, it means that humans show "insensitivity to prior probability of outcomes." In other words, we are less inclined to remember that there are more farmers than librarians in our sample, and therefore less inclined to let this fact influence our decision making. The representativeness heuristic also

[12] Daniel Kahneman and Amos Tversky, "On the Psychology of Prediction," *Psychological Review* 80, (1973): 237-251.

[13] Tversky and Kahneman, "Judgment under Uncertainty," 1124-1126.

leads to "misconceptions of chance," whereby we believe that "the essential characteristics of [a random] process will be represented, not only globally in the entire sequence, but also locally in each of its parts." This plays out in a scenario in which, for example, we feel that parents who have had five daughters are somehow more likely to have a son than a daughter as their sixth child: we see chance "as a self-correcting process in which a deviation in one direction induces a deviation in the opposite direction to restore the equilibrium. In fact, deviations are not 'corrected' as the chance process unfolds, they are merely diluted."[14] If our hypothetical family had infinite children, there would be 50% boys and 50% girls, though this will not necessarily be reflected in a sample set of six children. "Insensitivity to predictability," another of the mental blind spots induced by reliance on the representativeness heuristic, means that we believe the future status of an event or entity will be similar to how we perceive it now. For example, we are likely to believe that if a baseball team is winning now, they will continue to win later, and we are less likely to believe, even in the face of losses, that they are not a 'winning team.' Our first impression is, for us, representative of future performance. Finally, "the illusion of validity" describes our tendency to be overly confident in the validity of our results when the data show consistency. For example, we are likely to predict with greater confidence the future grade point average of a student with straight B's, than one with a mix of A's and C's: when it comes to making future predictions, we feel more comfortable with perceived consistency and pattern redundancy than with variation.[15]

The "availability heuristic" names our tendency to perceive outcomes as being more likely if they are more "available" in our minds and our lives: that is, if they are more familiar to

[14] Tversky and Kahneman, "Judgment under Uncertainty," 1124-1126.

[15] Tversky and Kahneman, "Judgment under Uncertainty," 1124-1126.

us. This concept is illustrated by the results of an experiment that asked people to guess the probability that a randomly selected English word begins with the letter 'r,' instead of having an 'r' in the third position of the word. Because we tend to recognize words by their beginning and ending letters, and less by the letters in the middle, words that begin with the letter 'r' are more familiar to us. Participants in the study guessed that words starting with 'r' are more frequent than those that have 'r' as the third letter – and they were incorrect, having fallen victim to the availability heuristic.[16] This propensity to use what is readily available in our minds as the basis for our decisions can lead to a number of biases in decision making. Frequent exposure to a given concept – even if false – will make the human mind more likely to believe that the oft-encountered concept is true, simply because of its familiarity.[17] This heuristic can be invoked to explain why other studies have shown that humans seem to have an "unwillingness to deduce the particular from the general [that is] matched only by their willingness to infer the general from the particular."[18] The particular is more available in our minds, so we use it to generalize and to make decisions based on those generalizations.

The third heuristic that Kahneman and Tversky described in their 1975 paper, adjustment and anchoring, describes the situation in which people anchor their decisions on a particular piece of initially-acquired information and then fail to adjust – or fail to adjust adequately – as additional information becomes available. Even when an initially-provided 'anchor' is obviously an unreasonable answer to a question, it still influences the result. One study, for example, asked

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[16] Amos Tversky and Daniel Kahneman, "Availability: A Heuristic for Judging Frequency and Probability," *Cognitive Psychology* 5, (1973): 207-32.

[17] Daniel Kahneman, *Thinking*, *Fast and Slow* (New York: Farrar, Straus and Giroux, 2011), 62-67.

[18] Nisbett, Richard E. and Eugene Borgida, "Attribution and the Psychology of Prediction," *Journal of Personality and Social Psychology* 32 (1975): 939.

one group of students whether Mahatma Ghandi died before or after age 9, and another group whether he died before or after age 140. For both groups, the initial question was followed by a prompt to guess Ghandi's age at death. The first group guessed an average age of 50, while the second group guessed an average age of 67.[19] In other words, even the suggestion of a number, however implausible, significantly affected the subsequent guess. In the field of medicine specifically, physicians tend to hold on to their initial diagnosis even when new evidence points to a different one: they accord disproportionately great weight to evidence that supports their initial diagnosis, and they disproportionately discount evidence to the contrary.[20]

There is a fourth heuristic not described by Tversky and Kahneman in "Judgment under Uncertainty" but later explored by others that merits mention.[21] The "affect heuristic" explains how the emotions associated with events or people influence how we think about those events or people. Feelings of fear or comfort affect perceptions of risk or benefit, and when we experience positive emotions, we experience less perceived risk, even if other aspects of a given situation logically suggest that we should have a greater sense of risk.[22] If our experience has taught us to associate a negative feeling with a particular experience, we might have an overly-exaggerated perception of risk. Especially in matters of health and disease, the negative feeling of fear is a positive motivator and drives patients' desires to undergo certain medical procedures even if

[19] Fritz Strack and Thomas Mussweiler, "Explaining the Enigmatic Anchoring Effect: Mechanisms of Selective Accessibility," *Journal of Personality and Social Psychology* 73, (1997): 437–446.

[20] Pat Croskerry, "Achieving Quality in Clinical Decision Making," *Academic Emergency Medicine* 9, (2002): 1184-1204.

[21] R.B. Zajonc, "Feeling and Thinking: Preferences Need No Inferences," *American Psychologist* 35, (1980): 151–175.

[22] M.L Finucane, A. Alhakami, P. Slovic, and S.M. Johnson, "The Affect Heuristic in Judgment of Risks and Benefits," *Journal of Behavioral Decision Making* 13, (2000): 1–17.

there is little or no evidence suggesting these procedures will be beneficial. In a modern context, we find evidence of the implications of the affect heuristic in the hypothetical example of the woman whose sister had breast cancer, and who therefore wants a prophylactic mastectomy despite herself lacking any significant genetic trait suggestive of breast cancer. A second example involves men with prostate cancer (typically slow-growing and generally non-metastatic in its early stages) who prefer excision surgery with potentially permanent side effects over "watchful waiting."[23] Emotions can exert a powerful influence over decisions.

1.1.3 Prospect Theory, Regret Theory, and the Dual Process Theory

Concerns over loss, and anxiety about decisions, lead us to the second of Kahneman and Tversky's seminal papers, that which discusses loss aversion and framing effects (tied together into a unifying idea using the term Prospect Theory).[24] Loss aversion describes how, when people expect a change of circumstances, they are more concerned about perceived 'losses' than perceived 'gains.' Stated in terms of money, a one million dollar loss is viewed as 'worth more' than a one million dollar gain: the loss of what we possess is worth more than the gain of what we do not have, even if the object or the numerical value of the object is the same. We are more willing to take risks to protect what we have and less willing to take risks to gain more than what we already have. Stated in terms of health, this principle means that we tend to want to protect our current health status, whatever that might be. An implication of this preference for loss aversion is illustrated by the Allais paradox, which may be explained with reference to the results of an experiment. Study participants were asked if they preferred Choice A or Choice B, in

[23] Hunink, *Decision Making in Health and Medicine*, 401.

[24] Kahneman and Tversky, "Choices, Values, and Frames," 341-350.

which Choice A offered an 80% chance of winning $4000 or a 20% chance of winning nothing, and Choice B offered a 100% chance of winning $3000. Calculation of numerical probabilities demonstrates that the expected value of Choice A is $3200 (0.80 x $4000), which is $200 greater than the value of Choice B. However, 80% of respondents selected Choice B, the more certain – but not more monetarily valuable – option.[25] Framing effects, or how a given decision is presented, are also part of loss aversion. We are more likely to purchase a product which is advertised as being '90% fat-free,' than one that is advertised as 'containing 10% fat.' Similarly, patients are more likely to choose a surgical procedure that offers a '90% survival benefit,' instead of one that carries with it a '10% mortality rate.'[26]

A final idea related to loss aversion that has implications for decision making in medical contexts is Regret Theory, which maintains that people's decisions are influenced by 'what might have been.' The developers of this theory, Loomes and Sugden, use as an example the loss of £100 as a consequence of a tax increase versus from a losing bet in a horse race.[27] They argue that an individual would experience more regret surrounding the loss in the latter instance: because the tax increase is viewed as compulsory – without the option of a choice or decision – the loss of the money under that set of circumstances is less troubling than in the horse race scenario, in which the individual ostensibly had the option of choosing whether or not to bet the money. Along the same lines of thought, Loomes and Sugden argue that the joy of winning £100 from a winning bet in a horse race would be greater than the joy derived from a £100 tax

[25] Daniel Kahneman and Amos Tversky, "Prospect Theory: An Analysis of Decision under Risk, *Econometrica* 47, (1979): 263-91.

[26] Kahneman and Tversky, "Choices, Values, and Frames."

[27] Graham Loomes and Robert Sugden, "Regret Theory: An Alternative Theory of Rational Choice under Uncertainty," *The Economic Journal* 92, (1982): 805-824.

reduction. Applying this theory to medicine, we can imagine that the thought of 'what might have been' could easily occur to an individual who, after choosing between two treatment options (either for herself or for a family member), experienced an outcome that was not as might have been hoped for.

In his 2011 book summarizing decades of research related to decision theory, Kahneman links these heuristics, biases, and theories about loss avoidance to a two-part model of cognitive processing.[28] The Dual-Process Theory argues that the mind has two cognitive systems, System 1 and System 2, which work in different ways. These have been described in detail, with slight variations, by many psychologists and behavioral economists, but there is general consensus about their fundamental attributes.[29] System 1 is automatic, fast, always 'on,' deals in heuristics, and is "coherence-seeking."[30] It is a favorable system from an evolutionary perspective, in that it thinks in broad categories and stereotypical exemplars and therefore can permit swift action in an emergent or cognitively-taxing situation. System 2 is slow, deliberate, capable of "conscious doubt,"[31] and must be actively switched on in order to be used. The systems can and do interact, especially when System 2 intervenes to correct mistakes in reasoning committed by System 1 in the latter's attempt to limit cognitive effort.[32] The human mind has been described as a

[28] Kahneman, *Thinking*.

[29] For a summary of various definitions, approaches, and applications of dual-process theory, see Keith E. Stanovich, *Rationality and the Reflective Mind*, (Oxford: Oxford University Press, 2010), 18, Table 1.1.

[30] Kahneman, *Thinking,* 86.

[31] Kahneman, *Thinking*, 80.

[32] I follow Kahneman here in personifying the two systems as a deliberate heuristic to aid comprehension of the concept, since our minds "have a special mental aptitude for the construction and interpretation of stories about active agents who have personalities, habits, and abilities" (Kahneman, *Thinking*, 29). This tendency to personify ideas and abstracts finds its expression in the association of disease types with different personalities, as subsequent chapters will show.

"cognitive miser," meaning that it will avoid difficult cognitive tasks when possible, and System 1 is the part of the mind that facilitates this avoidance. Attribute substitution – "the substitution of an easy-to-evaluate characteristic for a harder one, even if the easier one is less accurate" – is one example of this tendency to minimize cognitive effort.[33] This means that when faced with a difficult question, we may mentally answer a different but (in our minds) related question, and then apply this answer to the initial question, all without realizing that we have done it. We are less likely to be cognitive misers and to make such substitutions when we are evaluating risks we perceive as important, in which case System 2 intervenes.[34] Both Systems play a role in decision making in our daily lives.

One particularly important aspect of the Dual-Process Theory and its relationship to decision making involves the issue of causality. The establishment of our own understanding of 'normal' or 'standard' is one of the cognitive purposes of System 1. It then searches for simple perceived coherence with or exceptions to what we have determined to be 'normal'. Because we tend to be influenced by narrow frames and what we have seen more frequently and more recently, and because we want all of this to cohere in our minds, we become susceptible to causal explanations, even if there are none to be had and our observations are simply a result of randomness.[35] Our cognitive biases also tend to mean that, in the context of the narratives we construct, we will tend to "focus on a few striking events that happened, rather than on the countless events that failed to happen."[36] In the context of the broader modern scientific

[33] Stanovich, *Rationality*, 21. See also M. Li and G.B. Chapman, "'100% of Anything Looks Good': The Appeal of One Hundred Percent," *Psychonomic Bulletin & Review* 16, (2009): 156–162, and P. Slovic and E. Peters, "Risk Perception and Affect," *Current Directions in Psychological Science* 15, (2006): 322–325.

[34] Stanovich, *Rationality*, 21.

[35] Kahneman, *Thinking*, 71-72, 114-116, 153-4.

[36] Kahneman, *Thinking*, 199-200.

community, this tendency is manifest in the higher publication rates for research with positive findings than for studies with negative ones.[37] Perhaps more disturbingly, we also see plausible evidence of the strong desire to see causality (even when it may not be there) in the so-called 'replication crisis' in the field of psychology: an international research collaboration replicated 100 studies published in three leading psychology journals and found that, when replicated, only 37 of these studies had statistically significant results, compared with the 97 that reported significance in their original published form.[38] Our desire to construct causal narratives is strong and often, though by no means always, misguided. There are, of course, certain aspects of the physical world that we have accepted as 'true,' and which have been demonstrated over and over again by generations of scientists.

1.1.4 Naturalistic Decision Making and Expert Intuition

Naturalistic Decision Making (NDM) argues that experts can be relied upon to make decisions that are not necessarily plagued by the problems highlighted by Kahneman and Tversky. Sometimes (though not always)[39] viewed as conflicting with the Heuristics and Biases approach, NDM focuses on the success of expert intuition in decision making. The earliest studies on expert intuition were carried out in the 1940s and 1970s on chess grand masters, and results revealed that, from their experience of tens of thousands of hours of play, chess grand

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[37] Daniele Fanelli, "Negative Results are Disappearing from Most Disciplines and Countries," *Scientometrics* 90, (2012): 891-904.

[38] Open Science Collaboration, "Estimating the Reproducibility of Psychological Science," *Science* 349, (2015): 943.

[39] See Daniel Kahneman and Gary Klein, "Conditions for Intuitive Expertise: A Failure to Disagree," *American Psychologist* 64, (2009): 515-526, where a fruitful collaboration between these two schools of thought is described.

masters could acquire a mental catalogue of 50,000 to 100,000 patterns that they could recognize and deploy more or less immediately in the context of a game.[40] Subsequent research on firefighters in the field (not in the controlled conditions of a laboratory, where Kahneman and Tversky's experiments were done) revealed that, when facing a decision, these skilled firefighters would consider options one-by-one to determine, based on their experience of implementing that option, whether it would work in a given scenario.[41] This method of decision making happened more or less instantly, and also involved considering potential modification of each option to see if the altered option, when deployed in a mental simulation of the experience at hand, would be a viable choice. As with the chess grand masters, pattern recognition was involved, and the researchers termed the firefighters' method of choosing a course of action a "recognition-primed decision" (RPD) and subsequently sought to identify "the cues that experts use to make their judgments, even if those cues involve tacit knowledge and are difficult for the expert to articulate."[42] These observations contributed to one definition of skilled intuition (of the kind displayed by chess masters, experienced firefighters, and experienced physicians): "The situation has provided a cue: This cue has given the expert access to information stored in memory, and the information provides the answer. Intuition is nothing more and nothing less than recognition."[43]

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[40] W.G. Chase and H.A. Simon, "The Mind's Eye in Chess," in *Visual Information Processing*, ed. W.G. Chase (New York: Academic Press, 1973), 215-281. de Groot, A.D. *Thought and Choice in Chess* (The Hague: Mouton, 1978).

[41] Gary Klein, R. Calderwood, and A. Clinton-Cirocco, "Rapid decision making on the fireground," in *Proceedings of the Human Factors and Ergonomics Society 30th Annual Meeting* Vol. 1 (Norwood, NJ: Ablex, 1986), 576-580.

[42] Kahneman and Klein, "Conditions for Intuitive Expertise," 516.

[43] H.A. Simon, "What is an Explanation of Behavior?" *Psychological Science* 3, (1992): 155.

Working together, Kahneman (a proponent of the Heuristics and Biases approach) and Klein (a proponent of the Naturalistic Decision Making approach) proposed two conditions that must be met in order for such "recognition" to become "intuitive judgment." In their words, "First, the environment must provide adequate valid cues to the nature of the situation. Second, people must have an opportunity to learn the relevant cues." This means that the environment in which such intuitive judgment develops much be fairly constant, and the individual who is learning in that environment must have a chance to know when her judgments were correct, and when they were wrong. She must have "adequate opportunity to practice the skill." Since there are individual differences in people's ability to develop intuitive judgment, some require more practice than others do, and evidence indicates that individuals who rapidly demonstrate "creative intuitions" are, in fact, faster at "finding valid patterns in memory."[44] Incorrect intuitions, too, emerge from memories, as we have already seen in our discussion of heuristics: familiarity, for example, tends to lead us to believe in the correctness or truth of an answer. Kahneman and Klein hypothesize that this "imperfect intuition" happens when the environment in which the skill is learned is not adequately consistent, when there is no opportunity to learn the consequences and outcomes of one's choices, and when an individual who has expertise in a particular area tries to extend his or her intuitive judgment to an area with which he or she is less familiar.[45] These suggestions have implications for the use of skilled, intuitive judgment alongside mathematical algorithms. In environments that are unpredictable or characterized by misleading cues, algorithms are able to evaluate the strength or weakness of cues better than humans can, because the algorithm judges more consistently than the human does. We will

[44] Kahneman and Klein, "Conditions for Intuitive Expertise," 521.

[45] Kahneman and Klein, "Conditions for Intuitive Expertise," 522.

discuss these algorithms – sophisticated equations that incorporate multiple variables to yield a recommendation regarding a course of action – in more detail in the subsequent section.

In terms of the Dual-Process Theory, the skilled intuition of an individual who has developed her judgment in a consistent environment that allows for feedback related to her decisions seems to be a System 1 process, in that it is automatic and feels effortless. System 2 is involved, too, though, in that there appears to be a regulatory process that signals when System 1 has made an error.[46] Both approaches to deciding – the Heuristics and Biases approach, and the Naturalistic Decision Making approach – therefore elucidate important aspects of the cognitive process of deciding, especially in the context of medical decision making. In sum, all of these ideas – heuristics, biases, loss aversion, framing effects, Regret Theory, Dual-Process Theory, the search for causality, pattern recognition, and expert intuition – have important implications for medical decision making, and it is to this concept that we now turn.

1.2 Medical Decision Making, its Application to the Study of Ancient Medical Texts, and Assumptions about Human Cognitive Change

1.2.1 Medical Decision Making and Questions of Physician Fallibility

The formal field of "Medical Decision Making" is still in its infancy (especially when compared to some of the medical theories and texts that fill subsequent chapters). The Society for Medical Decision Making was founded in 1979, and the first textbook in the field, *Clinical Decision Analysis*, was published in 1980. In defining "medical decision making," the Society quotes from a 2008 textbook:

> "Medical decision science is a field that encompasses several related pursuits. As a normative endeavor, it proposes standards for ideal decision making. As a

[46] Kahneman and Klein, "Conditions for Intuitive Expertise," 519.

> descriptive endeavor, it seeks to explain how physicians and patients routinely make decisions, and has identified both barriers to, and facilitators of, effective decision making. As a prescriptive endeavor, it seeks to develop tools that can guide physicians, their patients, and health care policymakers to make good decisions in practice."[47]

Using today's randomized controlled trials, comprehensive informatics, and sophisticated diagnostics, medical decision science attempts to explain and to improve how physicians and their patients make decisions about health and disease. In many respects, the field is a model of Baconian science, in the self-consciousness with which it evaluates the tests and assumptions that undergird clinicians' choices. As we have seen, the cognitive processing systems of the human mind can create particular challenges for physicians, who in some instances face thousands of decisions related to patient care daily.[48]

Recent literature that discusses physicians' challenges in deciding applies the concepts of the section above to clinical encounters with patients, examining how the ways in which we organize and process information can lead to very different clinical outcomes. I should emphasize at this point in this initial chapter that the importance of patient decision making in clinical contexts cannot be overstated. However, this study will focus solely on physician decision making, simply because we have more texts from antiquity that inform us what physicians thought about health and disease, than those which might inform us about what their patients thought. The limitations of our ancient evidence, then, circumscribe the aspects of

[47] Alan Schwartz and George Bergus, *Medical Decision Making: A Physician's Guide* (Cambridge: Cambridge University Press, 2008).

[48] This is especially true for emergency department physicians, who typically have no familiarity with the patients they encounter, and, as the first physicians to encounter the sick patient, do the initial cognitive work of diagnosis and treatment. See Croskerry, "Achieving Quality," 1185.

clinical decision making upon which I will focus, namely, those related to physicians' decisions around diagnosis, treatment, and prognosis.

The fallibility of physicians – their use of heuristics, their propensity to succumb to biases, and their lapses in judgment – is a major theme of contemporary physician Jerome Groopman's books *Second Opinions* and *How Doctors Think*.[49] Through chapters that focus on encounters with individual patients, and then broaden to consider the challenging questions these encounters raise, Groopman explores issues including: modern physicians' tendencies to cling to an initial diagnosis, even if other evidence points to the contrary (adjustment and anchoring heuristic); how the framing of treatment options affects how the physician and patient think about them (framing effects); how stereotyping of patients (whether conscious or subconscious) can have dangerous consequences (representativeness heuristic); how what a physician sees in her clinic affects her diagnostic tendencies (availability heuristic); how exposure to certain kinds of treatment modalities through advertising campaigns affects the treatment options physicians provide (availability heuristic); how emotions – positive or negative – about a patient can directly affect diagnostic and treatment decisions (affect heuristic); and how the practice of 'defensive medicine' and concerns about regret over not pursuing all possible avenues of investigation can drive up the number of diagnostic tests ordered (Regret Theory and loss aversion). One challenge of modern medical practice that emerges multiple times in Dr. Groopman's books, and in general medical literature,[50] is the role of the clinical algorithm in physician decision making.

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[49] Jerome Groopman, *Second Opinions* (New York: Penguin Putnam, 2000) and *How Doctors Think* (Boston: Houghton Mifflin, 2007).

[50] Mary E. Tinetti, Sidney T. Bogardus, and Joseph V. Agostini, "Potential Pitfalls of Disease Specific Guidelines for Patients with Multiple Conditions," *New England Journal of Medicine* 351, (2004): 2870-2874.

1.2.2 Clinical Algorithms

Concerns over physician fallibility and the increasing demonstration of the effects of human cognitive error in daily clinical practice have led to an upsurge in the use of clinical algorithms. These are diagnostic or treatment plans for a very wide variety of problems and clinical decisions, from preventive (cancer screening, blood pressure management) to acute (management of acute coronary syndromes) to chronic (treatment of lung cancer).[51] They can also serve a prognostic function.[52] Clinical algorithms are based on the aggregated data of multiple scientific studies investigating the diagnostic accuracy and therapeutic efficacy of many options. Typically generated by professional organizations specific to the problem being addressed (for example, the American College of Obstetricians and Gynecologists developed the cervical cancer screening algorithm), these algorithms consist of boxes and flow charts that direct physicians to a course of action based on a particular set of findings: if you find this, then you treat with this drug, or if your patient has this set of symptoms, then you proceed with this diagnostic modality. The findings that guide the algorithm can be, for example, binary answers to a question (Does the patient smoke?), numerical ranges (Into which range does the patient's cholesterol level fall?), or placement into a particular category (Which combination of genes do you have?). The diversity and multiplicity of clinical algorithms can be appreciated by visiting the website of "medal: The Medical Algorithms Company," which advertises that its "platform

[51] The MD Anderson Cancer Center, for example, provides extensive "Clinical Practice Algorithms" for cancer screening, cancer treatment, clinical management, and surveillance for recurrence for survivors: https://www.mdanderson.org/for-physicians/clinical-tools-resources/clinical-practice-algorithms.html.

[52] For example, Ranson's Criteria for mortality associated with pancreatitis. Points are assigned based on the patient's age and lab values at admission, and then on the basis of changes in these lab values after admission. Point ranges are associated with specific probabilities of mortality within a given timeframe. J.H. Ranson, K.M. Rifkind, D.F. Roses, S.D. Fink, K. Eng, F.C. Spencer, "Prognostic Signs and the Role of Operative Management in Acute Pancreatitis," *Surgery, Gynecology & Obstetrics* 139, (1974): 69–81.

supplies over 22,000 tested medical calculators and analytic risk scores."[53] Surgeon Atul Gawande's *Checklist Manifesto* describes the practical uses and virtues of clinical algorithms, and of reliance on systematized procedures that are (largely) independent of the idiosyncrasies of individual judgment (even, and especially, the expert *individual* judgment of physicians).[54] The checklists that Dr. Gawande has helped to implement have led to a considerable reduction in morbidity and mortality in operative settings,[55] demonstrating the efficacy of an invariable, consistently-applied approach that explicitly takes into account human biases.

Critics of algorithms, especially in clinical contexts, fear their rigidity and their inability to account for 'the patient sitting in front of the doctor.' There is a perception among patients that, 'my doctor knows me, and I am different from the other people in this study,' and among physicians that, 'I know my patients and their particular needs,' or 'I've tried that before, and it never works; I've always had better luck with this plan.' There is hesitancy, or even outright resistance, to use a generalized model (however evidence-based) to treat a specific patient, because it seems to supersede the intuition and professional judgment of the individual physician and to (perhaps frighteningly) remove decision making and agency from the hands of humans.[56] But, proponents of algorithms would argue that this is precisely the point, and that removing the irregular judgment of humans does, in fact, make the decisions sounder. Yet even the extensive Clinical Practice Algorithms on the MD Anderson Cancer Center's webpage are qualified with

[53] www.medicalalgorithms.com/our-company, last accessed February 23, 2017.

[54] Atul Gawande, *The Checklist Manifesto* (New York: Metropolitan Books, 2010).

[55] Alex B. Hanyes, *et al*., "A Surgical Safety Checklist to Reduce Morbidity and Mortality in a Global Population," *New England Journal of Medicine* 360, (2009): 491-499.

[56] A description of the dangers of failing to recognize the needs of individual patients, especially when cultural factors are involved in disease definition and treatment, is found in Anne Fadiman, *The Spirit Catches You and You Fall Down* (New York: Farrar, Straus and Giroux, 1997).

the statement: "Disclaimer: These algorithms are not intended to replace the independent medical judgment of the physician or other health care providers in the context of individual clinical circumstances to determine a patient's care."[57] The need to pay attention to the peculiarities of a given case, and the premium placed upon "the independent medical judgment of the physician," suggest that there is value in expert intuition. Indeed, use of the words *independent* and *individual* emphasizes anxieties associated with the perception of algorithms as sometimes dangerously generalizing or universalizing.

Perhaps the tension between algorithms and physicians' independent judgment is succinctly captured in the subtitles two of the books we have already discussed, both written by medical professionals. The tendency to privilege intuition – physicians' pride and trust in it, and patients' appreciation of and trust in it – is illustrated by the subtitle of Dr. Groopman's *Second Opinions*, which is "stories of intuition and choice." The subtitle of Dr. Gawande's *The Checklist Manifesto* is, on the other hand, "how to get things right." Though I have placed Dr. Groopman's and Dr. Gawande's books in contrast with one another, I do not wish to imply that these two individuals necessarily fall on one side or the other of a debate about clinical algorithms: today's physicians and surgeons recognize algorithms as essential for providing high-quality care. I do think, however, that the subtitles of these two books highlight some of the tensions surrounding medical decision making: in broad terms, the tension between the general and the particular, and its implications for categorization of patients and their health problems. As we have seen in our preceding discussion of heuristics and the acquisition of skilled intuition, and again in our overview of the challenges of decision making in medical contexts, the process of choosing involves determination of actual or perceived probabilities: how representative is this individual

[57] See n. 51.

circumstance of a general trend? How do I make this determination, and how do I proceed based on my conclusion? When do I possess enough information to distinguish one type of individual person, circumstance, or disease from another? What observations do I use to make such distinctions? These very questions are at the heart of the medical debates of classical antiquity, and we can use modern theories of the cognitive activities associated with decision making to explore the nature and implications of these past debates, and their relevance for contemporary medical practice.

1.2.3 Applicability to Ancient Contexts

An objection could be made about the relevance of very modern cognitive decision theory to millennia-old debates about the organization of medical knowledge. Kahneman, Tversky, and Klein's experiments were carried out on twentieth century subjects: our understanding of the human body has changed dramatically in those intervening two millennia, and the western medical system of our time diverges in radical ways from its classical Greco-Roman predecessor. However, I believe that these modern studies of the cognitive processes associated with decision making can and should be applied to the medical debates of the past because such cognitive processes are the outcome of an evolutionary process hundreds of thousands of years in duration. While the human brain is indeed plastic and can learn new tasks and ways of thinking, the mechanism by which new information is learned is a consequence of human evolution. The cognitive demands of the sedentary (that is, non-hunter-gatherer) human lifestyle do not appear to have changed sufficiently in the last 2500 years to materially affect how our brains organize and process information. The stakes and challenge of an approach to historical analysis that is influenced by evolutionary psychology have been recently discussed by

Scheidel. Using as a case study the nearly-universal social taboo associated with incest, he notes about evolutionary psychology that, "[historians] can ill afford to ignore a research agenda that seeks to cast light on the framing conditions for human behavior and the limits of behavioral plasticity."[58] Study of the acquisition and processing of medical information in the past, too, can benefit from exploration of how and why – in evolutionary terms – the human brain functions as it does. How the digital age and 'big data' will affect human cognitive processing in the long run remains to be seen[59] – but for now, it is not unreasonable to use modern insights about the evolutionarily-significant development of human cognitive processing to examine how the physicians of Greco-Roman antiquity faced clinical uncertainty and made decisions about disease diagnosis, prognosis, and treatment, and about nosology.

As subsequent chapters will show, medical practitioners' repeated confrontation with the limits of their knowledge about the human body, and the challenges they faced in their ability to apply this limited knowledge to new contexts, were consistent aspect of debates about the nature of medical knowledge in antiquity. The principle of bounded rationality, and the studies of heuristics, biases, and expert intuition that this concept fostered, are therefore useful theoretical methodologies to consider how ancient practitioners approached patient encounters, and why they made the decisions that they did.[60] Such efforts to apply modern models of decision making may also shed light on the tacit knowledge that practitioners used in their approach to patients:[61]

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[58] Walter Scheidel, "Evolutionary Psychology and the Historian," *American Historical Review* 119, (2014): 1563-1575.

[59] Again Scheidel, "Evolutionary Psychology and the Historian," 1572, on evolutionary psychology, the study of history, and the potential for such study to identify exceptions in the trajectory of human history: "a gene-based trait would create a universal background constraint, raising the bar for behavioral exceptions."

[60] Some investigation along these lines has already been undertaken, but not with a diachronic focus: see Webster, "Heuristic Medicine," 1.

[61] Michael Polanyi, *The Tacit Dimension* (University of Chicago Press: Chicago, 1966), 4.

information that is more difficult to capture in texts but would have been a vital part of medical practice, and the theories that both undergirded such practice and emerged from it.[62] Kahneman, Tversky, and Klein's explorations of how humans' cognitive machinery sorts, privileges, and applies information can provide an approach to ancient medical texts that permits a focus on the practical aspects of medical decision making, in contrast to the more frequently undertaken studies of the epistemological aspects of medical decision making.

1.3 Burden of Disease in Antiquity

1.3.1 Defining "Burden of Disease"

As we have seen through our exploration of the Heuristics and Biases and Naturalistic Decision Making approaches to human choice under uncertainty, what humans observe affects how they decide. The anatomy and physiological states that the physicians of the past observed in their patients therefore fundamentally affected how they made decisions about diagnosis, prognosis, and treatment. Their experiences contributed to their definitions of normal, and the health problems that the people of their time and place suffered shaped their definitions of disease. To explore these physicians' methods of decision making, therefore, we need to establish the kinds of physiological states – healthy and diseased – that they observed. This is challenging for many reasons, not least because efforts to 'read between the lines' of their medical texts to identify pathological conditions by their modern names is fraught with uncertainties that have been extensively documented. Many well-intentioned physicians, with deep knowledge of the human body and how it can fail, yet with perhaps too much enthusiasm for diagnosing the patients of the past, have somewhat incautiously engaged in what has been

[62] For an example of how the principle of tacit knowledge may be productively applied in study of ancient texts, see Serafina Cuomo, "Tacit Knowledge in Vitruvius," *Arethusa* 49, (2016): 125-127.

termed 'retrospective diagnosis.'[63] While it may not be possible to know precisely the organism or physiological process responsible for the problems described in one of the case histories of the Hippocratic *Epidemics*, for example, I do not believe that efforts to characterize past burden of disease, using a combination of evidence and approaches, are entirely unadvisable or useless. We have been able to learn a great deal about the past by paying careful attention to questions about burden of disease, and their provisional answers.

It is also worth mentioning that 'burden of disease' itself can be a problematic term. Who defines 'health' and 'disease,' and how? These questions have been the subject of extensive investigation by historians, anthropologists, and physicians. Today, as in the past, patients seek medical care when they experience ill-health or disability, especially if their condition affects their ability to carry out their daily tasks. Implicit in this statement is the recognition that what could be debilitating for one individual might not be for another: a fracture of the right arm poses less of a problem for a left-handed individual than for a right-handed one. Consider another hypothetical example from antiquity: a fracture in a bone of the foot might have been less troublesome for one of antiquity's tutors, for example, than for a soldier. A dislocated shoulder might have been less problematic for an elderly man no longer working and in the care of his adult children, than it would have been for his adult son who worked as a cloth dyer. In all of these examples, we see how the impact of a given health condition varies with a given individual's circumstances. What is 'disease' to one might not be 'disease' to another, and individual determinations of and responses to 'disease severity' vary. In this chapter, I use the

[63] For strongly critical view of retrospective diagnosis, see K.-H. Leven, "At times these ancient facts seem to lie before me like a patient on a hospital bed" -- Retrospective Diagnosis and Ancient Medical History," in *Magic and Rationality in Ancient Near Eastern and Graeco-Roman Medicine. Studies in Ancient Medicine* 27, ed. H.F.J. Horstmanshoff and M. Stol (Leiden and Boston: Brill, 2004), 369-384. Others are more moderate, such as Vivian Nutton, *Ancient Medicine*, second edition, (New York and London: Routledge, 2013), 23ff.

term ‘burden of disease’ to signify alterations in anatomy or physiology that a modern physician would recognize as a pathological condition. My reason for this definition is that I seek to provide, in terms a modern audience can understand, a general picture of the kinds of health problems that people in the past might have experienced, and for which a physician might have wanted to provide treatment. With this background established, we will subsequently see in later chapters where, how, and why ancient definitions of disease do not map onto our own. These observations will be made in the context of evaluations of ancient physicians’ methods of diagnosis, prognosis, and treatment.

1.3.2 Identifying Patterns of Ill-Health in Modern Terms

Taking a global view of burden of disease, we might begin with studies about mortality and demography. Inscriptions and papyri recording ages at death, tax documents, and historical and literary texts have served as source material, with studies often focusing on Roman Egypt because of the ready availability of papyrological and bioarchaeological evidence. Limitations of the data are many and include inconsistencies in recording, tendencies to round ages to multiples of five and ten, and sociological considerations which suggest that certain sectors of society are not reflected in the available source material. Despite these challenges, however, the data generally suggest two broad conclusions. First, infant mortality was high, between 30 and 40% in the first year of life, and mortality rates remained high for children until around five years of age.[64] Frier, for example, estimates that greater than 50% of individuals born in the second to third century Roman Empire would have died by age 5. Of the individuals who survived to age 5, half would have died by age 40. This leads us to the second general conclusion about mortality

[64] Mark Golden, “Did the Ancients Care When their Children Died?” *Greece & Rome* 35, (1988): 152-163.

and life expectancy in the Mediterranean in our time period of interest: the average age of death hovered in the mid-thirties for both men and women (with men's average life expectancy being slightly higher, owing to the hazards of childbearing). Frier's models suggest that of individuals who survived to age 10, nearly 66% died before age 55.[65]

Although today's western physicians tend to see much chronic disease in their clinics, acute, infectious conditions and trauma would have constituted much of what an ancient physician saw when he was called to treat patients. Among the earliest modern scholars to explore this question in detail, Mirko Grmek emphasized the significant roles that infectious disease and the hardships of the external environment played in both the daily life and the medical epistemologies of the people of Greco-Roman antiquity.[66] Subsequent studies have further supported, and also lent nuance to, these claims.[67] Localized infectious conditions (urinary tract, skin, eye, respiratory, gastrointestinal infections), as well as more systemic infectious conditions (measles, mumps, tetanus, gonorrhea, tuberculosis, and leprosy, among others), would have affected patients of all ages and at all socioeconomic levels. Plagues and infectious disease on a wide scale were realities of existence, and travel could and did spread infectious conditions like smallpox (a probable cause of the Antonine Plague[68]) and parasitic

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[65] Bruce Frier, "Roman Life Expectancy: The Pannonian Evidence," *Phoenix* 47, (1983): 328-344. Bruce Frier, "Roman Life Expectancy: Ulpian's Evidence," *Harvard Studies in Classical Philology* 86, (1982): 213-251. For the Egyptian evidence, see Robert Bagnall and Bruce Frier, *The Demography of Roman Egypt, revised edition* (Cambridge: Cambridge University Press, 2006); Walter Scheidel, "Age and Health," in *The Oxford Handbook of Roman Egypt* (Oxford Handbooks Online), ed. Christina Riggs, (Oxford: Oxford University Press, 2012); and Walter Scheidel, "Roman Age Structure: Evidence and Models," *The Journal of Roman Studies* 91, (2001): 1-26.

[66] Mirko Grmek, *Diseases in the Ancient Greek World* (Baltimore: Johns Hopkins University Press: 1983).

[67] Nutton, *Ancient Medicine*, Chapter 2, for an overview.

[68] A foundational treatment of this issue is R.J. Littman and M.L Littman, "Galen and the Antonine Plague," *The American Journal of Philology* 94, (1973): 243-255. Ana Duggan et al., "17th Century Variola Virus Reveals the Recent History of Smallpox," *Current Biology* 26, (2016): 3407-3412, provides information about how virus may evolve over time, such that what we see now is not necessarily consistent with the pathogen responsible for the

infestations.[69] There is evidence for all of these afflictions in the texts and images that derive from classical antiquity, and increasingly, from the results of scientific analysis of human remains.[70]

Among the many infectious conditions that would have affected people in the ancient Mediterranean world, malaria and its physiological and genetic consequences would have been a constant and prominent aspect of health and disease. Its symptoms of cyclical fevers, chills, fatigue, headaches, and body aches, figure prominently in descriptions of 'crises' in medical literature from the time of the Hippocratic Corpus to Galen.[71] Study of human remains using diverse techniques – inspection of skeletal remains, imaging, ancient DNA analysis, microscopy, and immunological techniques – has supported these assertions about the prevalence of malaria in the past.[72] In addition to the physiological effects it would have provoked as an infectious condition, it would also have exerted an effect on the congenital diseases affecting Mediterranean populations. Congenital blood disorders such as thalassemia – a change in the structure of the proteins in blood cells that are responsible for the transport and utilization of oxygen – emerged because of the protective benefit that could be derived from such changes in protein structure. In thalassemia, individuals with a given genetic variation of this blood disease

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plague outbreaks in the past. For a recent treatment of the role of infectious disease in Roman history, see Kyle Harper, *The Fate of Rome: Climate, Disease, and the End of an Empire* (Princeton: Princeton University Press, 2017).

[69] On parasites and their spread by the Roman army, see Piers D. Mitchell, "Human Parasites in the Roman World: Health Consequences of Conquering an Empire," *Parasitology* 144, (2017): 48-58.

[70] Nutton, *Ancient Medicine*, Chapter 2.

[71] Robert Sallares, *Malaria and Rome: A History of Malaria in Ancient Italy* (Oxford: Oxford University Press, 2002), although without the most recent DNA data, provides helpful background.

[72] Teddi Setzer, "Malaria detection in the field of paleopathology: a meta-analysis of the state of the art," *Acta Tropica* 140, (2014): 97-104; Stephanie Marciniak, et al., "*Plasmodium falciparum* Malaria in the 1st-2nd century CE Southern Italy," *Current Biology* 26, (2016): pR1220-R1222.

can either die *in utero*, shortly after birth, in childhood/adolescence, or live safely into adulthood, protected against malaria. The last outcome results from what is called the *heterozygote advantage*, when people with one defective copy and one intact copy of a gene derive some benefit from the defective copy: its adverse effects are outweighed by the presence of the intact copy, so the heterozygotes are more protected than people with two intact copies. Thalassemias (and the related blood disorder sickle cell anemia) are canonical examples of heterozygote advantage, because these blood disorders result in oddly-shaped blood cells that are difficult for the malaria parasite to infect. Heterozygotes still have the capability to produce intact blood cells alongside the defective ones, but their relative deficiency of readily-infected cells means they are less likely to contract, and to die from, malaria – they are consequently more likely to reproduce and to pass this gene on to their offspring. The persistence of this genetic disorder in modern individuals of Mediterranean ancestry speaks to its presence in the past, and the role that it would have had both in protecting against malaria and in producing individuals who died stillborn, or suffered from the effects of having two defective copies of the gene while in adulthood.

Trauma, too, would have been a reality of daily life, as treatises discussing the setting of bones and the treatment of war wounds attest. The effects of infections and trauma would have been magnified by nutritional deficiencies, another condition included in this category: food insecurity and the resultant dietary deficiencies, too, would have been part of daily life in classical antiquity.[73] Not only was food itself not always available, the nutrition it provided was also often insufficient. A modern case study is instructive in thinking through questions of nutritional deficiency, disease susceptibility, and the effects of multi-morbidity: study of the

[73] Peter Garnsey, *Famine and Food Supply in the Greco-Roman World* (Cambridge: Cambridge University Press, 1988).

"Dutch Hunger Winter", a consequence of a Nazi blockade in 1944, reveals the extensive effects that malnutrition can have, specifically in the context of pregnancy and fetal development.[74] Depending on when in their pregnancy women experienced the worst effects of the famine, their children differentially suffered from various pathological conditions. For example, if women were in their first trimester during the famine, their children were more likely to experience general poor health and increased risk of cardiovascular disease as adults. For women in their second trimester, their children had a higher risk of diabetic kidney disease and lung disease. For women in the third trimester, their children had a higher risk of diabetes. This modern case study provides evidence of the life-long deleterious effects that famine could have and emphasizes that the ancient burden of disease was above all characterized by multi-morbidity. Even if these kinds of chronic conditions – whether congenital or acquired – were not as pressing an issue for patient and physicians as acute disease may have been, they were still a non-negligible part of daily life and contributed to the overall context of multi-morbidity that would have characterized the burden of disease in the past. Exposures to smoke, toxic substances, and the repeated mechanical stresses of manual labor were realities of the past, as were the aches, pains, and illnesses they provoked.[75]

Psychiatric disturbance, too, may be understood as an aspect of the burden of disease in antiquity, though its presence is harder to identify in terms we might understand, since definitions of mental health and mental disease change even more over time than their 'somatic' counterparts. Nonetheless, texts do provide compelling descriptions of individuals clearly suffering from altered perceptions of the world around them, and many have compellingly

[74] L.H. Lumey, Aryeh D. Stein, Henry S. Kahn, Karin M van der Pal-de Bruin, et. al., "Cohort Profile: the Dutch Hunger Winter Families Study," *International Journal of Epidemiology* 36, (2007): 1196-1204.

[75] Nutton, *Ancient Medicine,* Chapter 2.

argued that literature such as the *Iliad* and Greek tragedies provide evidence for the presence of mental disorders in antiquity.[76] There are also suggestions of addiction, for example, to opium and to alcohol.[77]

In sum, then, while it is difficult to "define burden of disease" in the Greco-Roman past, a number of methods – text-based, archaeological, anthropological, and DNA-based – can enable us to see this world as one of multi-morbidity, with high mortality and with a stronger visible presence of infectious conditions and their sequelae than would be observed in a western nation today. The presence of such rapidly-acting pathogens would have placed a premium on a physician's ability to decide more rapidly and definitively about the problem he and his patient were confronting. The biology of these pathogens, moreover, means that the symptoms they produce are often violent and sudden in onset – diarrhea, pain, fevers, vomiting. These exuberant reactions would have understandably attracted practitioners' attention and contributed greatly to the cognitive frameworks they would have used to make decisions. Latent, chronic, more mild conditions, while present in antiquity and discussed by ancient medical texts, would not have been as visible or as prominent as these acute infectious conditions, and therefore would not have influenced methods of observation and systems of classification as much as infectious conditions did. Evidence for this assertion will be explored further in subsequent chapters.

[76] See, for example, Jonathan Shay, *Achilles in Vietnam: Combat Trauma and the Undoing of Character* (New York: Athaneum, 1994); William Harris (ed.), *Mental Disorders in the Classical World* (Leiden and Boston: Brill, 2013); Chiara Thumiger, *A History of the Mind and Mental Health in Classical Greek Medical Thought* (Cambridge: Cambridge University Press: 2017).

[77] For an exuberant and speculative yet nonetheless thought-provoking account of opium addiction, see Thomas Africa, "The Opium Addiction of Marcus Aurelius," *Journal of the History of Ideas* 22, (1961): 97-102. For the psychological and physiological problems associated with excessive alcohol consumption in the words of primary source authors from antiquity, see Pythagoras *Stob*. *Flor*. 3.18.23, 33; Seneca *Ep*. 83.21, 95.16; Pliny *HN* 14.142.

1.4 Conclusions

This chapter has served as an introductory survey of decision making, both in general and in medical contexts. We have seen how heuristics help the human mind to carry out cognitive tasks efficiently, and we have seen how these heuristics, while at times illogical if we consider the mathematics of probability, nevertheless seem plausible to us when we are faced with decisions. We have also come to understand the circumstances under which expert intuition can develop, and the relationship between intuition and pattern recognition. Turning to the specific context in which humans would make decisions about health and disease, we explored the kinds of pathological conditions that the physicians of antiquity might have observed, and the broad-brush frequency with which they might have observed some of them. Nutritional deficiencies predisposing populations to immune compromise, relatively high levels of malaria (and associated co-evolutionary diseases like the thalassemias), and infections ranging from the local (urinary tract or eye infections) to the systemic (measles) were part of life for patients and physicians. Cancer, arthritis, and other more chronic conditions were less common, compared to acute, infectious conditions. Infant mortality was high, and average mortality rates, though difficult to calculate, seem not to surpass age 40 for either men and women: the averages were probably closer to 30.

Faced with this burden of disease, how did the physicians of the ancient Mediterranean construct their own classification systems and cognitive models to diagnose and to treat these conditions? We will begin to answer this question with the physicians whose ideas and observations are recorded in the Hippocratic texts (Chapter 2). Our discussion will then shift time and place to Hellenistic Alexandria (Chapter 3), where Greek physicians advanced their knowledge of human anatomy and discovered new ways to observe the pulse – and new ways to

make decisions about health and disease. Chapter 4 will present the position of the Empiricists, who questioned explicitly the epistemological origins and assumptions of prevailing theories of disease diagnosis, treatment, and causality. Moving toward Rome, in Chapter 5 we will look at the new ways of decision making and disease classification advocated by the Methodists, and in Chapter 6, we will focus on how Galen interpreted and re-shaped the decision-making methods of his predecessors. Alongside this movement across time and space, the aspects of medical decision making discussed in this chapter – the development of expert intuition, the mental shortcuts associated with exigency and large amounts of data, and the cognitive challenges faced by movement between the particular and the general – will be used as lenses through which the practical aspects of Greco-Roman medical practitioners' decision-making processes might be understood.

Chapter 2
Decision Making in the Hippocratic Corpus

Ἰητρικὴν οὐ δυνατόν ἐστι ταχὺ μαθεῖν διὰ τόδε, ὅτι ἀδύνατόν ἐστι καθεστηκός τι ἐν αὐτῇ σόφισμα γενέσθαι, οἷον ὁ τὸ γράφειν ἕνα τρόπον μαθὼν ὃν διδάσκουσι, πάντα ἐπίσταται…Ἡ δὲ ἰητρικὴ νῦν τε καὶ αὐτίκα οὐ τὸ αὐτὸ ποιέει, καὶ πρὸς τὸν αὐτὸν ὑπεναντία ποιέει, καὶ ταῦτα ὑπεναντία σφίσιν ἐωυτοῖσιν...

"Medicine cannot be learned quickly because it is impossible to create any established principle in it, the way that a person who learns writing according to one system that people teach understands everything…Medicine, on the other hand, does not do the same thing at this moment and the next, and it does opposite things to the same person, and at that things that are self-contradictory."

Hippocratic Corpus, *Loc. Hom.* 45[1]

2.1 Introduction

Any attempt to present an argument about an aspect of the Hippocratic Corpus confronts a challenge faced by both ancient and modern readers: its diversity. Though the texts have clear affinities to one another, contradictions are equally apparent, and the treatises are wide-ranging with respect to their style and content. Recent scholarship has focused less on the "Hippocratic Question" – which works of the extant corpus were '*really*' written by Hippocrates – and more on understanding the intellectual and cultural environments in which the texts were composed.[2] This latter kind of analysis has underscored the diversity of observations, procedures, advice, theories, and questions that emerged in the medical texts of fifth and fourth century BCE Greece, revealing a vibrant and lively effort to understand how the human body functions, how it can fall ill, and how it might be made well. Debate, disagreement, and polemic were part of this effort (as they are today).

[1] = 6.41L, trans. Paul Potter.

[2] See, for example, G.E.R. Lloyd, "The Hippocratic Question," *Classical Quarterly* 25, (1975): 171-192; Jacques Jouanna, *Hippocrates*, trans. M.B. DeBevoise (Baltimore: Johns Hopkins, 1999); Elizabeth Craik, *The Hippocratic Corpus: Content and Context* (London and New York: Routledge, 2015).

This multiplicity of ideas within the Corpus means that a study seeking to identify "decision making in the Hippocratic Corpus" runs the risk of being overly-reductive. It is emphatically not my goal in this chapter to find in the texts a single step-by-step approach that 'the Hippocratic physician' may have followed when treating patients – not only is this impossible, but it also overlooks the diversity of the Corpus and prevents consideration of how ideas of diagnosis, prognosis, and treatment differed and developed. Ideas about the workings of the body were not static, and the texts, taken together, are a dynamic record of medical knowledge and medical inquiry over the course of more than two centuries. What I aim to provide in this chapter is an exploration of the acquisition, classification, interpretation, and application of medical knowledge across diverse texts that will in turn lead us to an evaluation of the role that heuristics and cognition played in this process.

2.2 The Acquisition of Data: Observing and Questioning

"The physical exam begins the moment you enter the room" is an adage contemporary senior physicians often share with medical students to emphasize the central role that observation plays in the patient-physician encounter. The patient's physical appearance, posture, and capacity for movement are only some of the many observations that can be made without asking a single question or touching the patient's body. Although our present ability to 'observe' has been expanded through technology – the CT scans and magnetic resonance imaging (MRI) that non-invasively show us the inside of the body, or the DNA sequencing that allows us to identify genetic mutations that could foreshadow future disease – the physicians of antiquity had to rely on what they could see with the unaided eye, and with their other senses. This included, as was noted above, the patient's physical appearance, posture, and capacity for movement; it also

included the tactile sensations of the patient's temperature, or of swellings on the patient's body; the appearance, smell, and even taste of the patient's effluvia; as well as other sensations, smells, and sounds that the physician could detect.[3]

The Corpus is full of examples that illustrate the kinds of observations that physicians sought and recorded. An excerpt from *Epidemics* 1 (late fifth century BCE)[4] provides an instructive example:

> Τὰ δὲ περὶ τὰ νοσήματα, ἐξ ὧν διεγινώσκομεν, μαθόντες ἐκ τῆς κοινῆς φύσιος ἁπάντων καὶ τῆς ἰδίης ἑκάστου, ἐκ τοῦ νοσήματος, ἐκ τοῦ νοσέοντος, ἐκ τῶν προσφερομένων, ἐκ τοῦ προσφέροντος—ἐπὶ τὸ ῥᾷον γὰρ καὶ χαλεπώτερον ἐκ τούτων—, ἐκ τῆς καταστάσιος ὅλης καὶ κατὰ μέρεα τῶν οὐρανίων καὶ χώρης ἑκάστης, ἐκ τοῦ ἔθεος, ἐκ τῆς διαίτης, ἐκ τῶν ἐπιτηδευμάτων, ἐκ τῆς ἡλικίης ἑκάστου, λόγοισι, τρόποισι, σιγῇ, διανοήμασιν, ὕπνοισιν, οὐχ ὕπνοισιν, ἐνυπνίοισι, οἵοισι καὶ ὅτε, τιλμοῖσι, κνησμοῖσι, δάκρυσιν, ἐκ τῶν παροξυσμῶν, διαχωρήμασιν, οὔροισιν, πτυάλοισιν, ἐμέτοισι, καὶ ὅσαι ἐξ οἵων ἐς οἷα διαδοχαὶ νοσημάτων καὶ ἀποστάσιες ἐπὶ τὸ ὀλέθριον καὶ κρίσιμον, ἱδρώς, ῥῖγος, ψύξις, βήξ, πταρμοί, λυγμοί, πνεύματα, ἐρεύξιες, φῦσαι, σιγῶσαι, ψοφώδεες, αἱμορραγίαι, αἱμορροΐδες. ἐκ τούτων καὶ ὅσα διὰ τούτων σκεπτέον.
>
> "The following were the circumstances attending the diseases, from which I framed my judgments, learning from the common nature of all and the particular nature of the individual, from the disease, the patient, the regimen prescribed and the prescriber—for these make a diagnosis more favourable or less; from the constitution, both as a whole and with respect to the parts, of the weather and of each region; from the custom, mode of life, practices and ages of each patient; from talk, manner, silence, thoughts, sleep or absence of sleep, the nature and time of dreams, pluckings, scratchings, tears; from the exacerbations, stools, urine, sputa, vomit, the antecedents and consequents of each member in the successions of diseases, and the abscessions to a fatal issue or a crisis, sweat, rigor, chill, cough, sneezes, hiccoughs, breathing, belchings, flatulence, silent or noisy, hemorrhages, and hemorrhoids. From these things must we consider what their consequents also will be.[5]

[3] Jouanna, *Hippocrates*, 291-301.

[4] Craik, *Hippocratic Corpus*, 90.

[5] *Epid.* 1.23 = 1.670L translation from Jones.

The author presents us with categories to explain the kinds of information he sought to obtain: custom, age, mode of life, diet and exercise habits, sleep patterns, and dreams, as well as the details of effluvia and alterations in the body's condition. The patient's environmental context also matters. These, indeed, are the details that are subsequently recorded in the descriptions of patients in the sections that follow, always in the context of a timeline (i.e., second day, fifth day, eighth day, etc.). The role of the senses in acquiring the necessary information is also described in the opening words of *In the Surgery*:[6]

> Ἢ ὅμοια ἢ ἀνόμοια, ἐξ ἀρχῆς ἀπὸ τῶν μεγίστων, ἀπὸ τῶν ῥηΐστων, ἀπὸ τῶν πάντη πάντως γιγνωσκομένων, ἃ καὶ ἰδεῖν, καὶ θιγεῖν, καὶ ἀκοῦσαι ἔστιν· ἃ καὶ τῇ ὄψει καὶ τῇ ἀφῇ καὶ τῇ ἀκοῇ καὶ τῇ ῥινὶ καὶ τῇ γλώσσῃ καὶ τῇ γνώμῃ ἔστιν αἰσθέσθαι· ἃ, οἷς γιγνώσκομεν ἅπασιν, ἔστι γνῶναι.
>
> "What is like or unlike the normal, beginning with the most marked [things] and those easiest to recognize, open to all kinds of investigation, which can be seen, touched and heard, which are open to all our senses, sight, touch, hearing, the nose, the tongue, and the understanding, which can be known by all our sources of knowledge."

The physician should leverage every sense as he evaluates the patient and his or her potential problem.[7] Another enduring example of a Hippocratic physician's careful attention to detail is the so-called *facies Hippocratica*, a haunting description of the appearance of the face when a patient is close to expiring.[8] These are a few examples of many instances throughout the Corpus of the physician's attentiveness to the details of the patient's body.[9]

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[6] *Off.* 1 = 3.272L, text and translation from the Loeb; some modification of the translation. For dates, see Craik, *Hippocratic Corpus*, 223.

[7] See also *Prorrh.* II 3 = 9.10L.

[8] *Prog.* 2 = 2.112L, late fifth century BCE (Craik, *Hippocratic Corpus*, 237).

[9] For other examples, see Jouanna, *Hippocrates*, 291-301.

Other texts from the late fifth to the early fourth century BCE provide additional details about what should be observed,[10] or what information should be sought from the patient through questioning. The writer of *On Wounds in the Head* describes what should be noted about a wound, namely where on the surface of the head it is found, whether the bone is visible (and, if so, whether it is broken), and how the patient obtained the wound: here, direct information from the patient is sought.[11] The author of *On Affections* also mentions the importance of careful questioning, and the kinds of questions that should be asked:[12] Ὅταν δὲ ἐπὶ νοσέοντα ἀφίκῃ, ἐπανερωτᾶν χρὴ ἃ πάσχει, καὶ ἐξ ὅτου, καὶ ποσταῖος, καὶ τὴν κοιλίην εἰ διαχωρέει, καὶ δίαιταν ἥντινα διαιτᾶται ("When you come to a patient, you must question him thoroughly about what he is suffering, in consequence of what, for how many days, whether his cavity has passed anything, and what regimen he is following."). An *a capite ad calcem* approach to questioning is given in *On Regimen in Acute Diseases*, in which the writer emphasizes the importance of knowing when the patient began to feel ill; he outlines questions framed to elicit information both about symptoms present in certain parts of the body, and about more systemic symptoms.[13] Collecting and preserving the observations acquired by many physicians over many years, the texts of the Corpus organize these observations in ways that permit three broadly different kinds of decision making: via prognosis, with reference to nosological categories, and through reliance on physiological theories.

[10] See especially *Hum.* 1-5 = 5.1-8L, late fifth to early fourth century BCE, Craik, *Hippocratic Corpus*, 134.

[11] *VC* 10 = 3.212-214, for dates, see Craik, *Hippocratic Corpus*, 265.

[12] *Aff.* 37 = 6.246L, translation from Potter; for dates, see Craik, *Hippocratic Corpus*, 19.

[13] *Acut.* 22 = 2.502-4L, for dates, see Craik, *Hippocratic Corpus*, 212.

2.3 The Classification of Data

2.3.1 Collocations of Observations

Prognostic texts such as *Aphorisms* and *Prorrhetic* I collect these observations and place them in relationship to one another,[14] resulting in the establishment of signs, σημεῖα, that are useful in identifying an illness and predicting its outcome.[15] These signs, in turn, are suggestive of prognoses and their attendant treatments. The authors of *Aphorisms* and *Prorrhetic* present diverse ways of combining their observations, some of which I have enumerated below. This list is not exhaustive but rather a starting point to consider how observations are connected to one another:

1. A single observation, often with reference to its time course, can suggest a problem: Τὰ τελευτῶντα διαχωρήματα εἰς ἀφρώδεα ἄκρητα παροξυντικά. ("Evacuations that at the end become frothy and unmixed indicate an exacerbation.")[16]

2. Two (or more) observations occurring simultaneously yield a prognosis: Ἐν τοῖσι πυρετοῖσι τοῖσιν ὀξέσιν οἱ σπασμοὶ καὶ οἱ περὶ τὰ σπλάγχνα πόνοι ἰσχυροὶ, κακόν. ("In acute fevers, convulsions and violent pains in the bowels are bad.")[17]

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[14] For dates, see Craik, *Hippocratic Corpus*, 34 (*Aph.*) and 240 (*Prorrh.* I).

[15] Modern medicine draws a distinction between signs and symptoms, the former being observed physiological phenomena and the latter being a detail of the patient's own, subjective experience of the disease. There can be elisions between the two groups, and while many physicians today still speak of "signs and symptoms," there is less effort made to place observations into one of the two categories. In the context of the Hippocratic corpus, what we might consider subjective symptoms are still classified, in many texts, as σημεῖα (or, when taken together, as a single σημεῖον), a word we translate as "sign." In this and subsequent chapters, I use the word "sign" as a translation of σημεῖον and intend for the word to be more aligned in meaning with the ancient concept than with the modern one. On σημεῖα in the Hippocratic Corpus, see Brooke Holmes, *The Symptom and the Subject* (Princeton: Princeton University Press, 2010), 149-159; on σημεῖα in general, see J. Allen, *Inference from Signs: Ancient Debates about the Nature of Evidence* (Oxford: Clarendon Press, 2001).

[16] *Prorrh.* I 50 = 5.522L, translation from Potter; see also *Aph.* 2.5 = 4.470L, *Prorrh.* I 148 = 5.564L.

[17] *Aph.* 4.55 = 4.522L, translation from Jones, with modification; see also *Aph.* 4.49 = 4.520L, *Prorrh.* I 6 = 5.512L, 39 = 5.520L, 77 = 5.530L.

3. When a new observation seems to precede or to follow a change in a condition, this, too, can yield a prognosis: Ἐπὶ ἱδρῶτι φρίκη, οὐ χρηστόν. ("For shivering to follow sweating is not good.")[18]

4. In other examples, we observe 'nesting' of observations: for example, Ὁκόσοισι δὲ ἐπὶ τῶν ὀδόντων ἐν τοῖσι πυρετοῖσι περίγλισχρα γίνεται, ἰσχυρότεροι γίνονται οἱ πυρετοί. ("When in fevers very viscous matter forms on the teeth, the fevers become more severe.")[19] In this case, a context (a fever) is given, and then when a certain symptom is observed within that context (the appearance of περίγλισχρα), in a specific location (on the teeth), the physician can expect a particular outcome. Three factors are involved in this prognosis.[20]

5. Age, sex, and the external environment can affect the interpretation of an observation and the likelihood of a health disturbance: Τῶν ἐπιληπτικῶν τοῖσι νέοισιν ἀπαλλαγὴν αἱ μεταβολαὶ μάλιστα τῆς ἡλικίης, καὶ τῶν ὡρέων καὶ τῶν τόπων, καὶ τῶν βίων ποιέουσιν. ("Epilepsy among the young is cured chiefly by change – change of age, of climate, of place, of mode of life.")[21]

The physician identifies the physiological changes in the patient's body and is then responsible for mentally collocating them. Combinations of observations, and their chronological and contextual relationship to one another, then yield a general prognostic verdict (bad, good, better, worse, fatal), or a more specific one (that coughing, a fever, or convulsions will occur, for example). Mechanistic explanations are not a prominent part of this process. Decision making involves noting observations about the patient's body and environment, considering those observations in chronological relationship to one another, and then aligning the collected observations with the appropriate statement about the outcome that was expected on the basis of

[18] *Aph.* 7.4 = 4.578L, translation from Jones, with modification; see also *Prorrh.* I 35 = 5.518L, 51 = 5.522L, 65 = 5.526L, 126 = 5.554LL.

[19] *Aph.* 4.53 = 4.522L, translation from Jones; see also *Aph.* 2.25 = 4.478L.

[20] See also *Aph.* 4.41 = 4.516L, 4.47 = 4.528-520L, 4.50 = 4.520L, 4.60 = 4.524L, 4.65 = 4.524L; *Prorrh.* I 10 = 5.512L, 21 = 5.516L.

[21] e.g., *Aph.* 2.45 = 4.482L, 3.11 = 4.490L, 3.16 = 4.492L, 3.19 = 4.494L; *Prorrh.* I 9 = 5.512L, 83 = 5.530-2L, 103 = 5.540L.

interactions with prior patients who had exhibited those characteristics, in that pattern. Prognosis is the goal of this symptom observation and pattern construction.

2.3.2 From Noticing to Prognosing: Prognostic Decision Making, Case Study of Wounds and Ulcers in Prorrhetic *I*

How a practitioner could establish a problem's future course – its prognosis – is the topic of *Prognosis*, *Prorrhetic* I, *Prorrhetic* II, and *Coan Prenotions*. These texts suggest two aspects of prognosis that affected clinical decision making: first, concern for reputation, and second, the emphasis on pattern-based thinking that was guided by broadly-defined outcomes, without reference to diagnostic labels.

A physician's capacity to attract both patients and pupils was a function of his adeptness at prognosis.[22] The social importance placed on this skill affected whether he was willing to make such predictions in the first place;[23] even if the circumstances encouraged prognosis, he still needed to think carefully about the kinds of statements he would make.[24] The text *Prognosis* outlines in its introduction four reasons why a physician should hone this ability: people will be more likely to entrust themselves to his care; anticipating symptoms will enable him to treat the patient's problem more effectively; success in treatment will help him win respect; and he will avoid accusations of malpractice if he says at the outset, before any medical intervention, that the patient will die. Perceptions of the physician's skill are the motivating factors for three of these four reasons for mastering prognosis and affect his decisions about whether he should undertake

[22] Jouanna, *Hippocrates*, 103-111.

[23] *Prog.* 1 = 2.110–112L.

[24] *Prorrh.* II 1 = 9.6-8L.

this endeavor. Acknowledgements of social factors as contingencies for prognosis are found in other texts: *Prorrhetic* II similarly warns against hasty or incorrect predictions, counseling practitioners that failure in prognosis will lead people to hate them, or worse, deem them mad.[25] Accurate prognosis could bring renown and financial gain, but since inaccurate predictions could be disastrous, concessions to uncertainty were sometimes necessary.

How might a physician undertake this activity? The author of *Prorrhetic* II, after discussing the "marvelous predictions" (προρρήσιες θαυμασταί) of which he has heard rumors – but not seen or heard directly – notes that his own method of prognosis does not involve prophesy (οὐ μαντεύσομαι), or being as precise (οὕτως ἐξηκριβῶσθαι) as the predictions described in the rumors.[26] Rather, he says, σημεῖα δὲ γράφω οἷσι χρὴ τεκμαίρεσθαι τούς τε ὑγιέας ἐσομένους τῶν ἀνθρώπων καὶ τοὺς ἀποθανουμένους, τούς τε ἐν ὀλίγῳ χρόνῳ ἢ ἐν πολλῷ ὑγιέας ἐσομένους ἢ ἀπολουμένους ("I record the clinical signs from which one must deduce which persons will become well and which will die, and which will recover or die in a short or a long time.").[27] This summary of the process of prognosis highlights its important elements: observation of signs (σημεῖα) and prediction of future course in general terms (survival/death, improvement/exacerbation). The skill of the practitioner lay in his ability to observe, and to translate those observations into a qualitative statement about the patient's future health.

In practice, prognostic decision making as described in these texts relied on pattern-based thinking that was guided by broadly-defined outcomes, without reference to diagnostic labels. Details about the severity, location, and chronology of symptoms provided the pieces from

[25] *Prorrh.* II 2 = 9.8-10L.

[26] *Prorrh.* II 1 = 9.6-8L.

[27] *Prorrh.* II 2 = 9.8-10L, trans. Potter.

which the patterns were constructed. The descriptions of prognosis related to ulcers (τὰ ἕλκεα) and wounds (τὰ τρώματα) in *Prorrhetic* II provide a useful case study to understand how clinical information was noted and organized in light of this broadly qualitative, prediction-based way of thinking about health and disease.[28]

> Τὸν δὲ περὶ τῶν ἑλκέων μέλλοντα γνώσεσθαι, ὅκως ἕκαστα τελευτήσει, πρῶτον μὲν χρὴ τὰ εἴδεα τῶν ἀνθρώπων ἐξεπίστασθαι, τὰ δὲ ἀμείνω πρὸς τὰ ἕλκεα καὶ τὰ κακίω· ἔπειτα τὰς ἡλικίας εἰδέναι, ὁποίῃσιν ἕκαστα τῶν ἑλκέων δυσαπάλλακτα γίνεται· τά τε χωρία ἐπεσκέφθαι τὰ ἐν τοῖσι σώμασιν, ὅσον διαφέρει θάτερα θατέρων· τά τε ἄλλα ὁκοῖα ἐφ᾽ ἑκάστοισιν ἐπιγίνεται ἀγαθά τε καὶ κακὰ εἰδέναι.
>
> A person who wants to know about ulcers, how each will end, must first recognize clearly the different types of human beings, those better off with regard to ulcers, and those worse off. Then he must know in which ages each of the ulcers are difficult to cure, he must observe how the parts of the body differ from one another, and he must know which other evil and good things follow upon each.

"Knowing about ulcers" involves, first, knowing "how each will end." One makes such determinations by knowing the "types" (τὰ εἴδεα) of people who fare better or worse when they have ulcers; the relationship between the patient's age and the curability of the ulcer; and which parts of the body are prone to positive or negative outcomes if an ulcer should occur there. The subsequent sections (11-15) elaborate on these categories, with frequent use of comparative terms that label variations within these categories as either good (ἀγαθός) or bad (κακός).[29] Other words used to denote positivity or negativity include: difficult (χαλεπός), dangerous (ἐπικίνδυνος), deadly (θανατώδης, ὀλέθριος), free from danger (ἀκίνδυνος), safe (ἀσφαλής). These words usually appear in comparative and superlative forms.

This example demonstrates the features of the pattern-based thinking and classification systems employed in prognosis. Prior outcomes – positive or negative – form the basis for how

[28] *Prorrh.* II 11 = 9.30-32L, trans. Potter.

[29] Langholf, *Medical Theories*, 254, also discusses this issue.

the age of the patient, the location of the problem, the features of the problem, and the type of patient affect the practitioner's prognosis of the problem he currently faces. Diagnosis as we understand the term – the naming or identification of the observed collection of symptoms – is not part of this process of classification.[30] Instead, features of a given situation are noted to be bad or good; these features are compared with those of previous, similar situations.[31] Alignment of groups of observations – the patient's age, physical features, and symptoms, for example – with those of past cases allows the assignation of a positive or negative outcome to the new case, on the basis of prior experience. Comparative and superlative forms of adjectives allow for degrees of predicted severity to be incorporated into an assessment, though they do so in a way that also implies an intrinsic uncertainty: severity and prognostic certainty are relative, even as the latter forms the foundation on which types of ulcers and wounds are classified.

Acknowledgement of clinical uncertainty is part of safe, responsible prognosis, and there is some suggestion that practitioners were sensitive to the issue of the reliability of their predictions in different contexts. *Aphorisms* 2.34, for example, implies that predictability – if a disease aligns as expected with the categories of patient age, constitution, and habit – portends a good outcome.[32] Bringing together qualitative classification, prognostic stability, and pattern alignment in one statement, this aphorism emphasizes the importance of consistency across

[30] Nutton, *Ancient Medicine*, 88-90 and Ludwig Edelstein, *Ancient Medicine: Select Papers of Ludwig Edelstein* (Baltimore: Johns Hopkins University Press: 1967), 65-85. There are texts that do focus on diagnosis, such as *Diseases* II; these will be discussed in subsequent sections.

[31] *Prorrh.* II 2 = 9.8-10L advises consultation of written records of prior cases in the process of learning how to prognose: Ἀλλὰ χρὴ προλέγειν καταμανθάνοντα πάντα ταῦτα, ὅστις τῶν τοιούτων ἐπιθυμέει ἀγωνισμάτων· ἔστι γὰρ ἐκ τῶν γεγραμμένων προειπεῖν καὶ θάνατον καὶ μανίην καὶ εὐεξίην. εἴποιμι δ᾽ ἂν καὶ ἄλλα πάμπολλα τοιαῦτα, ἀλλὰ τὰ εὐγνωστότατα ἔδοξέ μοι γράψαι.

[32] *Aph.* 2.34 = 4.480L: Ἐν τῇσι νούσοισιν ἦσσον κινδυνεύουσιν, οἷς ἂν οἰκείη τῆς φύσιος, καὶ τῆς ἕξιος, καὶ τῆς ἡλικίης, καὶ τῆς ὥρης ἡ νοῦσος ὑπάρχῃ μᾶλλον, ἢ οἷσιν ἂν μὴ οἰκείη κατά τι τούτων ἦ.

categories as a significant aspect of prognostic reliability. If the provider's observations – about patient age, constitution, and habits, and about the external environment – were appropriately related to the symptoms he was seeing, the disease was less dangerous. He could offer a prognosis that suggested a 'less bad' outcome. If the appearance of the problem involved violation of the practitioner's expected category boundaries, however – if the problem was behaving in an unpredictable way – his prediction for the patient's future disease course was less positive. Expected alignment of symptoms with categories determined whether the prognosis was one of better health, or worse health. Predictability portended a positive prognosis, and unpredictability was, to a certain extent, reified in the expectation of difficulty in treatment. The importance of categories is also emphasized in *Aphorisms* 2.52, which dissuades practitioners from revising their conceptions of these categories if their prognosis fails. This, in turn, suggests the fixity of this kind of pattern-based thinking that privileged classification of groups of symptoms based on positive or negative outcomes.[33] Once the observation had been made linking symptoms to an outcome, it was difficult for practitioners to disprove it. This is one explanation for the proliferation of aphoristic statements found throughout the prognostic texts: rather than disprove an existing statement, a physician could create a new one by aggregating different observations in different ways.[34]

In sum, then, prognostic decision making is rooted in the recognition of patterns of symptoms, and the establishment of a positive or negative relationship between present and past symptoms, and future ones. The Hippocratic texts that focus on prognosis suggest that it served two main functions: it established and maintained a physician's reputation, and it provided a

[33] *Aph.* 2.52 = 4.484L: Πάντα κατὰ λόγον ποιέοντι, μὴ γινομένων τῶν κατὰ λόγον, μὴ μεταβαίνειν ἐφ᾽ ἕτερον, μένοντος τοῦ δόξαντος ἐξ ἀρχῆς.

[34] Craik, *Hippocratic Corpus*, 33-34.

qualitative, outcomes-based approach for the organization of information the physician has acquired through questioning and observing his patient. It offered limited insight into the internal mechanistic or physiological reasons for changes in a patient's condition. Instead, prognostic decision making was a predictive act, influenced by the physician's role in his community, that rested on establishing a link between past and present groups of symptoms and future outcomes. The texts suggest that a physician established these links between symptoms and outcomes based on what he observed to be the case in his previous practice: the instructions preserved for us in *Prognosis, Prorrhetic* I and II, and *Coan Prenotions* may be understood as a kind of "specialist manual for practitioners," preserving these patterns in writing.[35]

2.4 The Limits of Observation-Based Pattern Recognition and the Creation of Sense Groups

2.4.1 Conflicts across Patterns

While prognostic and aphoristic texts prioritize inputs that yield a predictive verdict, their generalizations on these bases can seem overly simplistic, restrictive, even contradictory. Though the statements typically follow a structured if-then form, they can lack systematization when taken together. Especially with texts like *Aphorisms* and *Coan Prenotions*, it can seem as though a physician could have reached for one of these statements to explain a course of action for whatever he happened to be seeing, however he wanted to interpret it. Consider, for example, *Aphorisms* 3.1-13 (= 4.486-492L), which say the following. Certain constitutions are well or poorly suited to summer, others to winter; certain diseases and certain ages are well or poorly adapted to certain seasons, areas, and habits; variation in weather in a given day will lead to the

[35] Craik, *Hippocratic Corpus*, 236.

prevalence of "autumnal diseases"; rainfall in summer and autumn affect the diseases that one would expect to see. While these statements are not mutually exclusive, their generality and breadth suggest that a physician could have had recourse to age, constitution, weather, or season in his prognostic reasoning, attributing his observations to one, some, or all of these aspects of the situation he was called to evaluate. Many potential relationships between observations were available as justification for a prognostic statement. Other texts show glimpses of some Hippocratic authors' inquiry into the flexibility of their interpretations: in 27 of the 170 sections of *Prorrhetic* I, for example, the author asks questions about what his observations might portend, suggesting his own uncertainty about how his data might combine to yield a prognosis.[36]

Aggregation of observations is a feature of many Hippocratic texts, including *Aphorisms*, *Coan Prenotions*, *Prorrhetic* 1, *Precepts*, *Epidemics* 1-7, and *Diseases* 1-3, which preserve listed statements, collections of case histories, and outlines of diseases and their associated symptoms. Such collections acknowledge the diversity of what is seen in medical practice and reflect efforts to impose order and predictability on this diversity. The previous section highlighted how grouping of observations, with a focus on positive or negative outcomes, facilitated prognostic decision making. As the aforementioned example from *Aphorisms* 2.1-13 (= 4.470-2L) indicates, however, lists of observations as tools for clinical decision making reveal potential inconsistencies in justification for prognoses. Lists could preserve many kinds of observations,

[36] For example, *Prorrh.* I 136 = 5.558L: Τὰ ἀγρυπνήσαντα ἐξαίφνης ἀλυσμῷ αἱμορῥαγεῖ, ἄλλως τε καὶ ἤν τι προερῥυήκῃ· ἆρά γε καὶ φρίξαντα κάτοχα, κεφαλαλγικὰ; ("To be sleepless and then suddenly restless points towards a haemorrhage, especially if there has been any haemorrhage before. Do chills in conjunction with catalepsy also give an indication of a headache?"), translation from Potter. These could also be rhetorical questions in a didactic mode, though Potter interprets these questions as evidence of the ongoing evaluation of the relationships among such observations (Potter, 168).

but they did not necessarily provide guidance about how to relate those observations to one another, outside of patterns focused toward positive or negative outcomes.

2.4.2 Observing the Unseen

Another potential difficulty in applying these observation- and pattern-based systems of prognostic decision making in clinical contexts involved the limitations of what could be perceived by the senses. While the collections of observations preserved in the texts discussed above in section 2.3 were extensive and could be useful for clinical decision making, they did not necessarily provide information about the internal world of the body. Other authors of texts within the Hippocratic Corpus aggregated their observations differently, using them to extend their system of data upon which they could base their decisions. This was accomplished in part through reflection on the relationship between observations of patients' bodies and the unseen systems or mechanisms that were implicated in these observations. Texts using arguments about the unseen elements of human physiology describe certain kinds of interpretive steps that need to be taken when applying observations to clinical decision making. *Diseases* II, for example, mentions a situation in which a vessel appears (δοκέει) to be filling with blood, even though, the author asserts, it is *actually* filling with bile or phlegm.[37] Similarly, the author of *Internal Affections* warns that a sand-like substance in the urine can lead some ill-informed practitioners to believe there is a problem with the bladder, when the kidney is actually the diseased organ.[38] These admonitions about what seems to be and what 'actually is' (but what is not immediately

[37] *Morb* II 4 = 7.10L (second half of fifth century BCE, Craik, *Hippocratic Corpus*, 180); see also Jacques Jouanna, *Hippocrate: Pour une archéologie de l'école de Cnide* (Paris: Les Belles Lettres, 1974).

[38] *Int.* 14 = 7.202-4L (first half of fourth century BCE, Craik, *Hippocratic Corpus*, 140).

apparent) emerge especially in contexts involving description of the inside of the human body. Following a section that characterizes internal anatomy, the author of *On the Art* asserts:[39]

> Οὐ γὰρ δὴ ὀφθαλμοῖσί γ' ἰδόντι τούτων τῶν εἰρημένων οὐδενὶ οὐδέν ἐστιν εἰδέναι…Μετὰ πλείονος μὲν γὰρ πόνου καὶ οὐ μετ' ἐλάσσονος χρόνου, ἢ εἰ τοῖσιν ὀφθαλμοῖσιν ἑώρατο, γινώσκεται. Ὅσα γὰρ τὴν τῶν ὀμμάτων ὄψιν ἐκφεύγει, ταῦτα τῇ τῆς γνώμης ὄψει κεκράτηται. Καὶ ὅσα δὲ ἐν τῷ μὴ ταχὺ ὀφθῆναι οἱ νοσέοντες πάσχουσιν, οὐχ οἱ θεραπεύοντες αὐτοὺς αἴτιοι, ἀλλ' ἡ φύσις ἥ τε τοῦ νοσέοντος, ἥ τε τοῦ νοσήματος. Ὁ μὲν γὰρ, ἐπεὶ οὐκ ἦν αὐτέῳ ὄψει ἰδεῖν τὸ μοχθέον, οὐδ' ἀκοῇ πυθέσθαι, λογισμῷ μετῄει.
>
> "Of course, it is impossible for a person who sees only with his eyes to know any of the things just mentioned…For they are known with no less time and with even greater effort than they would have been if seen with the eyes. For what eludes the sight of the eyes is captured by the sight of the mind. And if the sick suffer from a lack of speed in being seen, it is not those providing treatment who are responsible, but rather nature, specifically, the nature of the sick person as well as the nature of the disease. For the former, since it was possible neither to see the problem with his sight nor to learn about it by hearing, tried to pursue it using reason."

Clearly aware that processes are occurring that he cannot perceive through his senses, the author emphasizes the importance of learning about what is not immediately apparent so that this aspect, too, can guide his decision-making process about accurate prognosis and appropriate treatment.[40] *Regimen*, which considers the factors necessary to maintain human health in the context of a broader explanation of the structure of the natural world, posits a link between the invisible (τὰ ἀφανέα) and the visible (τὰ φανερά): we learn about the visible from the invisible, and vice versa.[41] What we do perceive illuminates what we do not perceive directly through our

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[39] *De Arte* 11 = 6.18-22L, text and translation from Joel E. Mann, *Hippocrates,* On the Art of Medicine (Leiden: Brill, 2012).

[40] It is also significant that he qualifies the ability to do this, saying that it requires time and effort. See Mann, *On the Art*, 195-198.

[41] *Nat.Hom.Salubr.* 1.10-11 = 6.484-6L; dating is late fifth or early fourth century BCE (Craik, *Hippocratic Corpus*, 275); see also *VM* 18.1 = 1.612-18L and note *ad loc.* in Mark Schiefsky, *Hippocrates' On Ancient Medicine* (Leiden: Brill, 2005), 277.

senses; in turn, the conclusions we draw about what we cannot perceive influence what we can perceive directly. Perception by the senses, then, in the context of gathering information about health and disease, was recognized as a limitation in the acquisition of a certain type of information: the type that would affect the structural systems that practitioners developed to guide their clinical decision making.

2.4.3 Decisions from Physiological Theories, with Reference to Epidemics

The need to account for observed symptoms; to incorporate arguments about what could not be observed directly; and to provide a structure for acting on these observations and ideas drove the generation of sense groups: nosological categories and theoretical models of physiology and pathology. These categories and models could then be invoked to impose order on acquired observations, to explain what had been observed, and to account for what could not be directly seen but still (according to supporters of these arguments) mattered in the evaluation and treatment of patients. Decision making about diagnosis, prognosis, and treatment could proceed based on these unifying ideas, which overlapped and intersected with each other. Observable phenomena – the weather, the seasons, diet and exercise habits, and effluvia – were integrated into theoretical models that sought to explain the relationships between these observations.

Concepts and attributions of causality play a prominent role in these debates, as physicians tried to use their observations – shaped into structural unities – to manipulate the body in predictable ways. As was discussed in Chapter 1, a willingness to search for and to attribute causality are strong components of human cognition. We tend to "focus on a few striking events that happened, rather than on the countless events that failed to happen," and to

construct our narrative based on those noteworthy events.[42] What we observe – what leaves an impression on us – strongly shapes the causal narrative. The writer of *Precepts* I describes this process well:

> ὁ γὰρ λογισμὸς μνήμη τίς ἐστι συνθετικὴ τῶν μετ᾽ αἰσθήσιος ληφθέντων. ἐφαντασιώθη γὰρ ἐναργέως ἡ αἴσθησις προπαθὴς καὶ ἀναπομπὸς ἐοῦσα ἐς διάνοιαν τῶν ὑποκειμένων, ἡ δὲ παραδεξαμένη πολλάκις, οἷς ὅτε ὁκοίως τηρήσασα, καὶ ἐς ἑωυτὴν καταθεμένη, ἐμνημόνευσεν.
>
> "For a theory is a composite memory of things apprehended with sense-perception. For the sense-perception, coming first in experience and conveying to the intellect the things subjected to it, is clearly imaged, and the intellect, receiving these things many times, noting the occasion, the time and the manner, stores them up in itself and remembers."[43]

Observations obtained through remembered experience are combined with reason to yield "plausible theories."[44]

Volker Langholf has explored the relationships between observations and theories in the *Epidemics* and *Diseases* II, arguing that these texts represent different manifestations of a shared tradition of category-based disease identification.[45] Categories were created on the basis of either humoral or nosological pathology,[46] and when physicians encountered a new case, they either 1) began with a set of assumptions about the type of patient, disease, or weather and tried to fit the new case into that existing framework, or 2) they collected their observations to generate new

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[42] Kahneman, *Thinking*, 199-200.

[43] The date for this is contentious and ranges from the fourth century BCE to the Roman period. See W. Golder, *Hippokrates und das Corpus Hippocraticum* (Würzburg: Verlang Königshausen & Neumann GmbH, 2007), 98; U. Fleischer, "Untersuchungen zu den pseudohippokratischen Schriften παραγγελίαι, περὶ ἰητροῦ und περὶ εὐσχημοσύνης," *Neue Deutsche Forschungen* BD 240, Abt. Kl. Philologie 10 1939; Jouanna, *Hippocrates*, 405-406; and Elizabeth Craik, "The Teaching of Surgery," in *Hippocrates and Medical Education*, ed. M. Horstmanshoff, (Leiden and Boston: Brill, 2010), 221-234.

[44] *Praec.* I = 9.250-52L: εἴ γε μὴν ταῦτα εἰδότα μὴ λογισμῷ πρότερον πιθανῷ προσέχοντα ἰητρεύειν, ἀλλὰ τριβῇ μετὰ λόγου.

[45] Volker Langholf, *Medical Theories in Hippocrates: Early Texts and the* Epidemics (Berlin: De Gruyter, 1990).

[46] Langholf, *Medical Theories*, 198-9.

categories, but ones that were still based on an existing framework.[47] The "practical aim of the grouping procedure," Langholf argues, "was 'to know whom, and when, and how he should treat,'" a "programmatic phrase" that appears not only in the *Epidemics*, but also in Plato's *Phaedrus*.[48] Classification systems were required for decision making, and the kind of system a physician imposed directly affected his decision making regarding diagnosis, prognosis, and treatment. Building on a more cautious version of Langholf's approach – accepting his arguments about nosological frameworks and humoral frameworks as two approaches to clinical decision making in the Hippocratic corpus, without necessarily accepting his arguments about primacy and chronology – I will explore these two kinds of classificatory sense groups further.

Many of these theoretical models about physiology involve ideas about balance and equilibrium. This concept of balance allowed for a reconciliation of observations related to bodily inputs, bodily outputs, and the behavior of the natural world.[49] Since an equilibrium works on a spectrum or continuum, this unifying idea could also readily incorporate variation by degree. At a basic level, observations contributing to the construction of an equilibrium-based theory of physiology would have involved: 1) noticing the prevalence of certain kinds of conditions in particular seasons (such as upper respiratory symptoms in winter) and 2) identifying a relationship between food consumed and waste excreted. The environment affects how we feel physically: heat can be exhausting and drives us to sweat, cold makes us shiver and leaves us numb. Similarly, consumption of certain foodstuffs can be correlated with gastric upset, changes in bowel habits, or (in the case of alcohol) alteration of mental status. These are

[47] Ibid.
[48] Langholf, *Medical Theories*, 208. The phrase comes from *Epid.* III 16 = 3.100-102L and is echoed in *Epid.* I 11 = 2.670-80L, as well as in *Dieb.Iudic.* 1 = 9.298L, and Plato, *Phaedrus* 268b.

[49] James Longrigg, *Greek Rational Medicine: Philosophy and Medicine from Alcmaeon to the Alexandrians* (New York: Routledge, 1993).48-50.

the kinds of observations that led to the development of theoretical models about health and disease that involved connecting human health, the external environment, diet, and bodily waste and fluids.

Airs, Waters, Places focuses on the role of climate in health. Its references to the relationship among swampy places, stagnant water, yellow skin, and fatigue provide tempting evidence for the prevalence of malaria in these areas.[50] The author's description of the flu and rhinovirus symptoms (like fevers and coughs) that plagued especially the elderly during the cold winter months sounds not unlike the increase in viral respiratory infections that we observe in wintertime today.[51] Hot, cold, wet, and dry are readily observable bookends to a spectrum that can accommodate variations and combinations of each of these four categories. Observing a relationship between the external environment and human health that is explicable by hot/cold/wet/dry, a physician could generalize these concepts to the inside of the body. Alteration of bodily temperature through bathing or through the ingestion of particular kinds of foods would, by extension of these ideas about the relationship between the environment and the human body, lead to a change in the body's current state. If equilibrium is health, then disequilibrium means disease or the absence of health, and restoration of equilibrium would bring the body back to health. It was up to the physician to determine which, in what form, and how much was needed of hot, cold, wet, and dry: according to the author of *Regimen*, medicine involved identifying the nature of the imbalance and then restoring the proper balance through diet, exercise, bathing habits, and other treatments.[52]

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[50] *Aer.* 15 = 2.60-62L; the fatigue would be a consequence of anemia secondary to malaria.

[51] *Aer.* 3 = 2.14-18L; see also R. Eccles, "An explanation for the seasonality of acute upper respiratory tract viral infections," *Acta Otolaryngology* 122, (2002): 183-91; E.G. Mourtzoukou and M.E. Falagas, "Exposure to cold and respiratory tract infections," *International Journal of Tuberculosis and Lung Disease* 11, (2007): 938-43.

[52] *Nat.Hom.Salubr.* 1.3-7 = 6.474-80L.

Noting the fluids that came out of the body, especially in the context of sickness, also had a profound effect on how observations could be classified and structured. If the "striking events that happened" exert an especially strong influence on the development of heuristic methodologies,[53] then it is unsurprising that bile and phlegm – causes of disease according to many Hippocratic authors – played a leading role in ideas of disease classification and causality. These fluids are readily apparent in ill-health (phlegm in the nose and throat in respiratory illnesses, and bile in vomit and diarrhea), and their presence is always unpleasant and frightening for the patient and attendants alike. Bile and phlegm were connected to ideas about the origins of disease in *Affections*,[54] *Diseases* 1,[55] *Airs, Waters, Places*,[56] *The Sacred Disease*,[57] and *Haemorrhoids*.[58] These two fluids were incorporated into the humoral theory proposed by the author of *On the Nature of Man*: phlegm, blood, black bile, and yellow bile were part of a system that brought together both observed phenomena (phlegm, blood, yellow bile), and phenomena that had not necessarily been observed but could be reasonably postulated to occur based on those observations (black bile).[59] This four-humor physiological model was unifying from a variety of perspectives, and it allowed for a considerable degree of fine-tuning, based on the individual patient.

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[53] See Chapter 1.

[54] *Aff.* 1 = 6.208L.

[55] *Morb.* I 2 = 6.142L.

[56] *Aer.* 10 = 2.42-50L.

[57] *Morb.Sacr.* 15 = 2.60-62L.

[58] *Fist.,Haem.* 1 = 6.436L.

[59] On the problematic history of black bile, and its relative novelty compared to phlegm, blood, and yellow bile, see Nutton, *Ancient Medicine*, 83-85.

One brief discussion of decision making and classification schemes in the *Epidemics* may illustrate the effects of these humoral-based theories on clinical decision making. As Langholf has described, the disease types in the *Epidemics* yielded greater clinical variation and unpredictability than those with a more obvious locus within the body (see the case study discussion of *On Joints* and *On Fractures* in section 2.5.2, below). In order to manage this unpredictability, physicians had recourse to systems of classification that could be shared across different kinds of diseases, thereby allowing characterization and clinical decision making without recourse to nosological category. These concepts included κρίσις, πέψις, and ἀπόστασις, among others. Since physicians sought to make decisions on the basis of these categories of bodily change, they were eager to look for evidence of these occurrences.[60] Similarly, rather than identify disease types, physicians chose to identify patient types.[61] Therapy was determined in large part by the timing of the *krisis*, with the patient's identified type also shaping practitioners' decisions.

2.4.4 Decisions from Nosological Categories, Case Study of Anatomical Classification in Internal Affections

Alongside texts that provided physiological theories that could be used as the basis for decisions about diagnosis, prognosis, and treatment, treatises about the classification of disease were also being written. These nosological texts presented another way to think about the diagnosis, prognosis, and treatment of disease. In its opening section, *Diseases* I outlines classifiable features of diseases (νοῦσοι), including severity, reversibility of pathology,

[60] Langholf, *Medical Theories*, 163ff.

[61] Langholf, *Medical Theories*, 163ff, 194ff.

chronology, predictability, and body part affected.[62] *Diseases* II provides programmatic descriptions of diseases (νοῦσοι) that are circumscribed by clearly outlined symptoms. The symptom lists are generally, but not always, presented with reference to a specific location in the body (e.g., the head or the lungs), and they are accompanied by prognoses that vary, depending upon how the symptoms change. Physiological mechanisms, based upon assumptions about the role of phlegm and bile in disease, are also proposed: these mechanisms also depend upon anatomy, in that phlegm and bile are said to cause disease when they move to, or remain stagnant within, different parts of the body. Limited treatment information is given. *Internal Affections* presents a slightly different nosological approach. Instead of simply saying "another disease" (ἑτέρη νοῦσος) followed by a symptom list (as is common in *Diseases* II) to signal the discussion of a discrete pathological condition, the author of *Internal Affections* grounds his groupings in anatomical locations by labeling them, for example, "this hepatic disease" (ἡπατῖτις ἡ νοῦσος),[63] or "another disease of the liver" (ἄλλη ἥπατος).[64] Within the text, some diseases are located in specific anatomy (lungs and sides, spinal marrow, kidney, vessels, dropsies, liver, and spleen), while others are not presented with a clearly-defined location (jaundices, typhuses, ileuses, "thick" [παχύ] diseases, sciatica, and tetanuses).

This enhanced specification is complemented by an effort to distinguish between diseases that belong to the same anatomical or causal category. For problems that are located in the same part of the body, observation of attendant symptoms and assertions about the cause of those symptoms assist the physician in differentiating among conditions. For example, according to the

[62] *Morb.* I 1 = 6.140L. *Morb.* I 22 = 6.182-88L describes how age can also affect prognosis and disease course.

[63] *Int.* 27 = 7.236-40L.

[64] *Int.* 28 = 7.2340-42L.

author of *Internal Affections*, there are four diseases of the kidney. A physician may distinguish among them by the following attributes: (1) unilateral kidney and flank pain accompanied by frequent and painful urination; (2) violent pain accompanied by the passage of blood and then urine from the urethra; (3) bilateral, violent, and episodic pain in the kidneys and bladder, accompanied by dark brown urine; (4) unilateral pain exacerbated by lying on the affected side, accompanied by strangury, cold legs and feet below the knees.[65] The five diseases of the spleen and the four jaundices are first characterized by their seasonality – setting up a kind of pre-test probability, we might say – and then by their symptoms.[66] What is notable about this classification system is how it presupposes a degree of hierarchical decision making: symptoms direct the physician to a particular part of the body, such as the kidney or the liver, and then a re-consideration of those very symptoms will lead him to a conclusion about what kind of problem the patient is experiencing. In other cases – especially for the systemic diseases without a clearly delineated anatomical seat – the season provides a starting point for identification of the problem, and then the associated prognosis and treatment.

These texts therefore provide a third, layered system for how diseases could be defined and distinguished in a way that facilitated decision-making. For the nosological texts, anatomy provides a mechanism for the generation of the first level of classification, and symptoms enable the creation of sub-classifications. Diagnosis and prognosis emerged from comparisons across constellations of symptoms and physician observations; therapeutic decision making, connected to mechanistic explanations for these observations, derived from these classification schemes. These nosological treatises could have – if we use explanations from decision theory – eased the

[65] *Int.* 14-17 = 7.202-210L; for another example, see descriptions of diseases of the liver in *Int.*27-29 = 7.236-44L.

[66] *Int.* 30-37 = 7.244-260L.

cognitive burden of making decisions, since observations could be slotted into pre-existing categories branching off from overarching groups. As the author of *Decorum* notes, "sequences of single phenomena" are easier to manage than phenomena that appear simultaneously with one another:[67] teasing out the relationships between symptoms and changes in the patient's health is difficult. The classification schemes provided by nosological treatises structured the evaluative tasks of the physician in clear and logical ways supported by the observations of daily practice. We will consider the application of these schemes in concrete contexts in the case studies of subsequent sections.

2.5 Heuristics, Expert Intuition, and Decision Making in the Hippocratic Corpus

2.5.1 The Tension between the Particular and the General

As keen observers, the Hippocratic physicians were aware that their treatments and prognoses did not always proceed as they had predicted. Despite extensive collections of observations (*Aphorisms*, *Prorrhetic* I, *Airs Waters Places*, *Epidemics*, among others) and detailed descriptions of anatomical and physiological theory that appeared to be supported by those observations (*Regimen*, *On the Nature of Man*, *On Places in Man*, *The Sacred Disease*, among others), they could not predict the outcome of a given encounter with a patient with complete consistency. Frustration with this lack of consistency is apparent in multiple texts, and three common reasons for unexpected results are invoked: the physician was incompetent,[68] the

[67] *Decorum* 14 = 9.240L: πολλὰ γὰρ ἅμα τὰ ποιέοντά τι χαλεπόν· τὸ γὰρ καθ᾽ ἓν κατ᾽ ἐπακολούθησιν εὐθετώτερον καὶ ἐμπειρότερον ("For when many things together produce a result there is difficulty. Sequences of single phenomena are more manageable, and are more easily learnt by experience"), translation from Jones.

[68] An accusation to be expected in the polemical environment in which these texts were written: see *VM* 1.1 = 1.570-72L, and associated discussion, as an example, as well as *Acut.* 1-5 =2.224-64L and *Morb.Sacer.* 2-4 = 6.634-8L.

patient was disobedient,[69] and – of most interest to our discussion of heuristics, biases, and cognition – that it is impossible to prognose accurately all of the time because of the great variability among individual patients (and even within the same patient).[70]

The remarkable aspect about this acknowledgement of individual variability is its assumption – or clear acknowledgement, in some cases – that there are features of these patients that the physicians could not observe which could, if they were known, promote successful treatment and accurate prognosis. In other words, writers readily admit that their method of diagnosis, prognosis, and treatment is limited by what they can and cannot see. Observations, experiences, and theories, however carefully interpreted or constructed, are still only general principles that cannot always cope with individual variability. The medical principles of the Hippocratic Corpus may have been a product of heuristic thinking, but the texts also show that it was not purely a 'System 1' enterprise. To use the language of the Dual Process Theory, the evaluative 'System 2' prompted some to reconsider their treatment procedures with care, in real time:[71]

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[69] *De Arte* 7 = 6.10-12L.

[70] *Places in Man* 45 = 6.41L.

[71] *Morb.* I 9 = 6.156L, translation from Potter. See also *Morb.* I 16 = 6.168-170L, which emphasizes the inability to predict a patient's death: Οὔκουν ἐστὶ τὸ ἀκριβὲς εἰδέναι καὶ τυχεῖν εἴπαντα τοῦ χρόνου, ἐν ᾧ ἀπόλλυνται, οὔτε εἰ πολλὸν, οὔτ' εἰ ὀλίγον· οὐδὲ γὰρ οὗτος ὁ χρόνος ἀκριβὴς, ὃν ἔνιοι λέγουσιν, ὡς τὰ πολλὰ, οὐδὲ αὐτὸ τοῦτο ἐκποιέει· διαφέρει γὰρ καὶ ἔτος ἔτεος, καὶ ὥρη ὥρης, ἐν ᾗ ἂν νοσέωσιν· ἀλλ' ἤν τις θέλῃ περὶ αὐτέων ὀρθῶς γινώσκειν καὶ λέγειν, γνώσεται ὧδε πᾶσαν ὥρην καὶ ἀπολλυμένους καὶ περιγινομένους καὶ πάσχοντας ἅπερ ἂν πάσχωσιν ("It is certainly not possible to know precisely and to state correctly the period within which a patient will die, not even whether it will be long or short. For the period of time that some people give is not precise in most cases, nor does this information, of itself, suffice; for one year differs from another, and one season from another. If anyone wishes to recognize the truth on this subject and to say it, he will recognize that patients both perish and survive, and suffer whatever they suffer, in every season."), translation from Potter. The quote that opened this chapter, from *Loc.Hom.* 45, also illustrates difficulties in reconciling general principles with the specificity of individual patients, as does *Prorrh.* II 12 = 9.32-36L: ἀλλὰ χρὴ μήτε ταῦτα θαυμάζειν, μήτε ὀρρωδέειν κεῖνα, εἰδότα ὅτι αἱ ψυχαί τε καὶ τὰ σώματα πλεῖστον διαφέρουσιν αἱ τῶν ἀνθρώπων, καὶ δύναμιν ἔχουσι μεγίστην ("But you should neither be surprised by the latter nor dread the former, being aware that the minds and the bodies of people differ very greatly, and that these differences have great consequences," trans. Potter). See also *Acut. Appendix* 21 = 2.434L, which is less a caution regarding individual variability than a recognition of the number of ways by which patients can differ from one

> Ἀρχὴ δὲ ἰήσιος ἀποδεδειγμένη μὲν οὐκ ἔστιν, ἥτις ὀρθῶς ἀρχή ἐστι πάσης τῆς τέχνης, οὐδὲ δεύτερον οὐδὲν, οὐδὲ μέσον, οὐδὲ τελευτή· ἀλλὰ ἀρχόμεθά τε αὐτῆς, ἄλλοτε λέγοντες, ἄλλοτε ἐργαζόμενοι, καὶ τελευτῶμεν ὡσαύτως· καὶ οὔτε λέγοντες ἀρχόμεθα ἐκ τῶν αὐτῶν λόγων, οὐδ' ἢν περὶ τῶν αὐτῶν λέγωμεν, οὐδὲ ἐς τοὺς αὐτοὺς τελευτῶμεν· καὶ ἐργαζόμενοι, κατὰ τὸν αὐτὸν λόγον οὔτε ἀρχόμεθα ἐκ τῶν αὐτῶν ἔργων, οὔτε τελευτῶμεν ἐς τὰ αὐτά.
>
> There is no demonstrated starting point of healing, which truly is the starting point of the whole art, nor any second point, nor any middle, or end. Instead we start out in medicine sometimes by speaking, at other times by acting, and we end in like manner; nor, when we begin by speaking do we begin with the same words, not even if we are speaking about the same thing, nor do we end with the same words. In the same way, when we begin by acting, we do not begin with the same actions, nor do we end with the same ones."

Notably this passage occurs in *Diseases* I, the same text that at its outset provided a kind of hierarchy of approach for how a physician should think through a disease. This author gives a framework for evaluating his patients' problems but still cautions his readers about the perils of that framework. In the terms of cognitive decision theory set out in Chapter 1, we might say that he establishes a heuristic method while also acknowledging its biases. He writes that physicians evaluate patients' problems differently, and that there is not necessarily a single prescribed way for dealing with a given matter. His description possesses a fluidity and a continuity that shun the establishment of a clear starting point from which to proceed: the starting point depends on the patient's needs and is determined in the context of those needs. Even across similar contexts, the way forward might be different from what it was last time. *Places in Man* presents a similar approach when the author describes what a physician should do when he encounters an unknown disease (τῶν νοσημάτων ᾧν μὴ ἐπίστηταί τις): treat by trial and error.[72] When the way forward is uncertain, act first, then evaluate. The writer of *Regimen*, too, takes a somewhat agnostic view of

another: Εἰσὶ δὲ ὄψιες πολλαὶ τῶν καμνόντων ("Patients have many aspects," trans. Potter). *Nat.Hom.* 9 = 6.52-6L emphasizes individual variability, with the assumption that it can be successfully identified by the physician.

[72] *Loc.Hom.* 34 = 6.326L.

certain aspects of medicine; after presenting all the elements that factor into a physician's decision making process about establishing the correct diet and exercise routine for a specific patient, he ultimately concedes:[73]

> Ταῦτα δὲ πάντα διαγνόντι οὔκω αὔταρκες τὸ εὕρημά ἐστιν· εἰ μὲν γὰρ ἦν εὑρετὸν ἐπὶ τούτοισι πρὸς ἑκάστην φύσιν σίτου μέτρον καὶ πόνων ἀριθμὸς σύμμετρος μὴ ἔχων ὑπερβολὴν μήτε ἐπὶ τὸ πλέον μήτε ἐπὶ τὸ ἔλασσον, εὕρητο ἂν ἡ ὑγείη τοῖσιν ἀνθρώποισιν ἀκριβῶς. Νῦν δὲ τὰ μὲν προειρημένα πάντα εὕρηται, ὁκοῖά ἐστι, τοῦτο δὲ ἀδύνατον εὑρεῖν. Εἰ μὲν οὖν παρείη τις καὶ ὁρῴη, γινώσκοι ἂν τὸν ἄνθρωπον ἐκδύνοντά τε καὶ ἐν τοῖσι γυμνασίοισι γυμναζόμενον, ὥστε φυλάσσειν ὑγιαίνοντα, τῶν μὲν ἀφαιρέων, τοῖσι δὲ προστιθείς· μὴ παρεόντι δὲ ἀδύνατον ὑποθέσθαι ἐς ἀκριβείην σῖτα καὶ πόνους· ἐπεὶ ὁκόσον γε δυνατὸν εὑρεῖν ἐμοὶ ἤδη εἴρηται. Ἀλλὰ γὰρ εἰ καὶ πάνυ σμικρὸν ἐνδεέστερα τῶν ἑτέρων γίνοιτο, ἐν πολλῷ χρόνῳ ἀνάγκη κρατηθῆναι τὸ σῶμα ὑπὸ τῆς ὑπερβολῆς καὶ ἐς νοῦσον ἀφικέσθαι.
>
> "But even when all this is discerned, the discovery is not complete. If indeed in addition to these things it were possible to discover for the constitution of each individual a due proportion of food to exercise, with no inaccuracy either of excess or of defect, an exact discovery of health for men would have been made. But as it is, although all the things previously mentioned have been discovered, this last discovery cannot be made. Now if one were present and saw, he would have knowledge of the patient as he stripped and practiced his exercises, so as to keep him in health by taking away here and adding there. But without being present it is impossible to prescribe the exact amount of food and exercise, since how far it is possible to make discoveries I have already set forth. In fact, if there occur even a small deficiency of one or the other, in course of time the body must be overpowered by the excess and fall sick."

Ideal would be the physician who watches his patient constantly and is able to integrate all of this specific knowledge into a cohesive whole. But even if a physician could do this, the author argues, an infinitesimally small – we might even say imperceptible – change in the patient's routine could provoke disease, and the physician would not be aware of what contributed to the problem.

[73] *Nat.Hom.Salubr.* 1.2 = 6.468-472L, translation from Jones. See also *Nat.Hom.Salubr.* 3.68 = 6.594-604L, which concedes differences between constitutions, ages, seasons, and preferred diets and notes that while these differences preclude the development of an exact approach (τὸ δὲ ἀκριβὲς οὐδενί), the imbalance can nonetheless be diagnosed in most cases.

The heuristics and biases approach characterized by Kahneman and Tversky, and discussed in Chapter 1, provides a useful way to think about the challenges of navigating between the particular and the general, and also allows us to examine Pat Croskerry's statement that "heuristics were all that guided the ancient practitioner." The three broad approaches to the classification of clinical knowledge that we have characterized in the setting of the Hippocratic Corpus – prognostic decision making, decisions from physiological theories, and decisions from nosological categories – are all prone to the challenges that Kahneman and Tversky argue follow from heuristic-based reasoning. Practitioners were not necessarily aware of the broader contexts in which their observations could be interpreted, therefore focusing on what they themselves had observed and drawing their interpretations from a limited data set. This difficulty in aggregating and interpreting data has its origins in a human unwillingness to appreciate the concepts of statistical randomness and chance – in our inability to recognize the scope of the population from which our sample is drawn. Our proclivity toward misconceptions of chance means that we will believe that what we have observed in a given sample will be repeated in other samples, as well as globally, in the entire population. Consistency in what we observe translates into the perception that these results are valid ways to predict and to interpret future outcomes.

All of these biases are present in the way the Hippocratic authors observe, classify, and evaluate what they have deemed a pathological state or process. However, the explicit and repeated acknowledgement of the need to account for individual deviation from these principles represents recognition of the mental errors systematically committed by using their explanatory models.[74] These authors clearly recognized that what they observed in a given sample was *not* necessarily repeated in the entire population, and as the author of *Regimen* concedes, even if a

[74] For further elaboration of bias, and associated examples, see Langholf, *Medical Theories*, 106ff, 164ff, and 190ff.

physician could know every detail about his patient's life and habits, he would still miss vital information that would be useful in maintaining the patient's health. It was not possible to reach the bounds of knowledge that would yield perfect decisions, every time. This very concession – that we make decisions based on limited information – represents the System 2 thinking that is characterized by a deliberate effort to evaluate the process of decision making itself, and calls Croskerry's claim (Chapter 1) into question.

Kahneman and Tversky's models of decision making rely heavily on assumptions of statistical randomness, and on humans' desire to impose order and causal connections on that randomness. While the thinkers of antiquity did not share our idea of statistical randomness, the concept of chance, τύχη, was discussed and debated in the context of medical theory. Not randomness *per se*, τύχη is allied to our modern understanding of statistical randomness: it can lead to good,[75] bad,[76] or neutral outcomes;[77] it is impartial and impersonal;[78] and it is uncontrollable.[79] This last point is especially relevant for a discussion about the role of heuristics and biases in the Hippocratic corpus. Using the cognitive tools of the art of medicine, physicians attempted to limit the influence of τύχη through recourse to causal explanation.[80] If they could compile their observations into cohesive theories, and then use those theories to explain what had happened and to predict what would happen, the role of τύχη could be minimized or eliminated.

[75] Herodotus.7.10, 1.32, and 1.124; Thucydides 7.33.

[76] Plato *Laws* 732c; Herodotus 6.16.

[77] Isocrates 6.34; Herodotus 7.236.

[78] Plato *Definitions* 411b; in Aristotle *Physics* 195b31 with τὸ αὐτόματον ("spontaneity").

[79] Schiefsky, *Ancient Medicine*, 5-13.

[80] Ibid.

Characterization of nature and identification of cause would reduce the role accorded to spontaneity or chance in medical contexts.[81] For some medical problems, though, successful treatment could be assured with surprising frequency, and it is to these problems – and how they contributed to the development of expert intuition – that we now turn.

2.5.2 The Conditions for Expert Intuition: Case Study of Orthopedic Injury in On Joints *and* On Fractures

As we saw in Chapter 1, another model for decision making, besides the Heuristics and Biases Approach, is Naturalistic Decision Making. Gary Klein, the major proponent of this model, has used it to explain the expertise observed in grand chess masters, experienced firemen, and skilled physicians. He argues that, in a relatively consistent context in which the positive or negative outcomes of a given decision making process can be readily observed, it is possible for a professional to develop a kind of advanced pattern recognition that we could call "expert intuition." While the preceding analysis has provided considerable evidence that the Hippocratic writers were generally not working in the kind of consistent, controlled context that would allow for the development of Klein's expert intuition, I believe that one group of medical conditions *did* allow for the development of expert intuition: those related to fractures and dislocations of the bones of the extremities.

Although the diagnoses, prognoses, and remedies proposed in the Hippocratic texts have sometimes generated responses of derision, incredulity, or even disgust among contemporary readers, the surgical treatises *On Joints* and *On Fractures* have, to a certain extent, remained immune from this kind of criticism. Modern orthopedic surgeons offer ready praise for the

[81] Ibid., *De Arte* 4-5 = 6.6-8L, *Loc.Hom.* 46 = 6.342-44L, *VM* 1 = 1.570-72L.

Hippocratic descriptions of reduction of dislocated shoulders, for example, and "the Hippocratic method" is a technique still used to move an anteriorly dislocated shoulder back into place.[82] One recent study provided evidence that the Hippocratic method can reduce a dislocated shoulder more quickly and with less pain than other more recently developed methods; the Hippocratic method has the added benefit of being able to be implemented by a single individual, instead of two people.[83] Why have the methods of *On Joints* and *On Fractures* endured, while those of the other texts have not? Or, put another way, how did the writers of *On Joints* and *On Fractures* figure out an effective way to treat the problem?

One way to answer these questions is with reference to Gary Klein's ideas about the development of expert intuition. Unlike problems that the physicians of antiquity identified through fevers, pains in the head or abdomen, or alterations of effluvia, fractures and dislocations were more straightforward: the moment at which these problems happened, and how they happened, could be easily identified. Today as in the past, the larger bones and joints of the human body can be easily felt and seen with the unaided eye, and their normal alignment can be readily and consistently observed. Moreover, this normal state – that is, the anatomy of the shoulder or hip – is less subject to individual variation than, say, the genetic background or environmental exposures that might have led a particular patient to respond in a seemingly idiosyncratic way to a given therapy. The consistency of bone anatomy from person to person, the clarity of how these dislocations and fractures occurred, and the relative readiness of observing the outcome of different methods of reduction created the kind of conditions that

[82] Gregory D. Riebel and John B. McCabe, "Anterior Shoulder Dislocation: A Review of Reduction Techniques," *American Journal of Emergency Medicine* 9 (1991): 180-188.

[83] Fares E. Sayegh, et al., "Reduction of Acute Anterior Dislocations: A Prospective Randomized Study Comparing a New Technique with the Hippocratic and Kocher Methods," *The Journal of Bone and Joint Surgery* 91 (2009): 2775-2782.

allowed for the development of "expert intuition" – in the technical sense characterized by Klein – in the treatment of this particular problem. This led the authors of *On Joints* and *On Fractures* to an enduringly successful method of treatment for an anteriorly dislocated shoulder, among other kinds of dislocations.

2.5.3 Additional Considerations: The Context of Practice

This chapter has focused so far on the ways that information might be organized to facilitate clinical decision making, though two additional practical aspects of the context of practice should also be mentioned, as they, too, influenced clinical decision making, especially regarding treatment decisions.

In his decisions regarding an appropriate treatment, a physician also needed to consider the resources available to treat the problem. An example from *On Joints* and *On Fractures* will illustrate this concept. Although a physician could successfully reduce the dislocated shoulder without any special equipment, his choice regarding method of reduction was affected by what was at hand:[84]

> τοιαίδε ἄν τινες κατοικίδιοι κατατάσιες εἶεν τοῦ σώματος, ὥστε ἐκ τῶν παρεόντων τὸ εὔπορον εὑρίσκειν· τοῦτο μὲν εἰ τὰ δεσμὰ τὰ ἱμάντινα μὴ παρείη τὰ μαλθακὰ καὶ προσηνέα, ἀλλ᾽ ἢ σιδήρεα ἢ ὅπλα ἢ σχοινία, ταινίῃσι χρὴ ἢ ἐκρήγμασι τρυχίων ἐρινέων περιελίσσειν ταύτῃ μάλιστα ᾗ μέλλει τὰ δεσμὰ καθέξειν, καὶ ἔτι ἐπὶ πλέον· ἔπειτα οὕτω δεῖν τοῖσι δεσμοῖσιν· τοῦτο δέ, ἐπὶ κλίνης χρὴ ἥτις ἰσχυροτάτη καὶ μεγίστη τῶν παρεουσέων κατατετάσθαι καλῶς τὸν ἄνθρωπον·… ἀρκεῖ δὲ καὶ κλῖμαξ ἰσχυροὺς ἔχουσα τοὺς κλιμακτῆρας, ὑποτεταμένη ὑπὸ τὴν κλίνην, ἀντὶ τοῦ οὐδοῦ τε καὶ ξύλου τοῦ παρατεταμένου, ὡς τὰ ὕπερα, πρὸς τῶν κλιμακτήρων τοὺς ἁρμόζοντας ἔνθεν καὶ ἔνθεν προσερηρεισμένα, ἀνακλώμενα, οὕτω τὴν κατάτασιν ποιῆται τῶν δεσμῶν.
>
> "…there are certain homely means of making extension, such as might readily be found among things at hand. First, supposing no soft supple leather holdfasts are available, one might still wrap up iron chains, ship's tackle, or cords, in scarves,

[84] *Artic.* 78 = 4.312-6L, trans. Withington.

> or torn woollen rags, especially at the part where they are fastened on, and somewhat further, and then proceed to bind them on as holdfasts. Again, one should use a bed, the strongest and largest available, for making good extension… A ladder with strong crossbars stretched under the bed is a good substitute for the threshold and crossbeam, so arranged that the pestles may get their fulcra at either end against suitable crossbars, and, when drawn back, may thus make extension on the bands."

Should the ideal tools not be available, a physician could still find tools 'around the house' (κατοικίδιοι) that would help him to achieve the desired outcome. A physician who had a busy urban practice, however, might have wanted to consider investing in what later commentators have called the 'Hippocratic bench,' a wooden plank outfitted for use in reducing dislocated limbs.[85] In other settings, such as in the palestra, where it could be difficult to transport a heavy and carefully constructed medical device, other methods of reduction were used, such as the "shoulder lift" (κατωμίζουσιν).[86] In these examples, the decision about the diagnostic problem is straightforward, but the practitioner must still decide how he wants to treat it – and the resources he has at hand explicitly factor into that mental calculus. Applying ideas about the availability of resources to other kinds of problems, we can imagine how recourse to ideas about hot, dry, wet, and cold, and about the four humors, could have permitted substitutions in dietetic and pharmacological recipes if the preferred treatment was not available.

An additional element of clinical decision making, first discussed in the context of prognosis, involved physician reputation and relationship with the patient. As we have seen,

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[85] See *Fract.* 13 = 3.460-66L for the description of the bench and *Artic.* 52 = 4.226–32L for the link between population and investment in particular tools: Εἴρηται δὲ καὶ πρόσθεν ἤδη ὅτι ἐπάξιον, ὅστις ἐν πόλει πολυανθρώπῳ ἰητρεύει, ξύλον κεκτῆσθαι ("It was said before that it is worthwhile for one who practises in a populous city to get a quadrangular plank," trans. Withington). The idea that a physician might treat so many of these injuries that he could be aided in his treatment by owning a special piece of equipment, designed particularly for this use, suggests additional support for my assertion about the development of expert intuition in the case of anterior shoulder locations specifically, and potentially other kinds of shoulder and hip dislocations more generally.

[86] *Artic.* 4 = 4.83-6L, trans. Withington.

concerns about physician reputation affected clinical decisions around the issue of prognosis; reputation also affected decision-making-related therapy. In *On Joints*, for example, immediately preceding his discussion of the household items that could be used for limb reduction, the author provides a guiding principle for treatment decisions:[87]

> Χρὴ δὲ περὶ πλείστου μὲν ποιεῖσθαι ἐν πάσῃ τῇ τέχνῃ ὅπως ὑγιέα ποιήσῃς τὸν νοσέοντα· εἰ δὲ πολλοῖσι τρόποισι οἷόν τε εἴη ὑγιέα ποιεῖν, τὸν ἀοχλότατον χρὴ αἱρεῖσθαι· καὶ γὰρ ἀνδραγαθικώτερον τοῦτο καὶ τεχνικώτερον, ὅστις μὴ ἐπιθυμεῖ δημοειδέος κιβδηλίης…
>
> "What you should put first in all the practice of our art is how to make the patient well; and if he can be made well in many ways, one should choose the least troublesome. This is more honourable and more in accord with the art for anyone who is not covetous of the false coin of popular advertisement…"

The writer acknowledges that there are many treatment options physicians could consider. A more honorable (ἀνδραγαθικώτερον) and more skillful (τεχνικώτερον) treatment choice, he says, is one which is not troublesome (ἀοχλότατον) – and anyone who decides otherwise is just engaging in a marketing ploy to get money (ἐπιθυμεῖ δημοειδέος κιβδηλίης). Physicians should propose treatments not for the sake of enhancing their reputation through dramatic public displays; issues related to the patient's health and convenience also affected clinical decision making regarding choice of therapy.[88]

Yet even in cases in which the suggested treatment will probably benefit the patient, the possibility of unwanted complications – and how the patients might react to these complications

[87] *Artic.* 78 = 4.312-6L, trans. Withington.

[88] *Artic*. 44 = 4.188L shares this sentiment, but there are also examples of Hippocratic authors expressing ambivalence about the use of therapies that seemed dangerous: *Artic.* 42 = 4.182-4L.

–can dissuade physicians from choosing their preferred treatment option. The author of *On Fractures* notes regarding the use of a particular type of splint,[89]

> Περὶ γὰρ τῶν σωλήνων τῶν ὑποτιθεμένων ὑπὸ τὰ σκέλεα τὰ κατεηγότα, ἀπορέω ὅ τι συμβουλεύσω· ἢ ὑποτιθέναι χρὴ ἢ οὔ; ὠφελέουσι μὲν γάρ, οὐχ ὅσον δὲ οἱ ὑποτιθέντες οἴονται·…ἔστιν οὖν σὺν σωλῆνι καὶ ἄνευ σωλῆνος, καὶ καλῶς καὶ αἰσχρῶς κατασκευάσασθαι. πιθανώτερον δὲ τοῖσι δημότῃσίν ἐστι καὶ τὸν ἰητρὸν ἀναμαρτητότερον εἶναι, ἢν σωλὴν ὑποκέηται· καίτοι ἀτεχνέστερόν γέ ἐστιν.
>
> "As for the hollow splints which are put under fractured legs I am at a loss what to advise as regards their use. For the good they do is not so great as those who use them suppose. The hollow splints do not compel immobility as they think…It is thus possible either with or without the hollow splint to arrange the matter well or clumsily. Still the vulgar (more gullible/easily persuaded) have greater faith in it, and the practitioner will be more free from blame if a hollow splint is applied, though it is rather bad practice."

He is unsure about what to do, given the options that are available for managing this problem, and settles on the use of a treatment method that he characterizes as less skillful or appropriate for the problem (ἀτεχνέστερόν), doing so because he is concerned about incurring blame (ἀναμαρτητότερον) from those who are more gullible or misguided (πιθανώτερον). Additional examples of physicians refraining from particular treatments can be found in *On Fractures*, as well as in *On Joints*: in these cases, the author advocates withholding an otherwise helpful treatment either because of risk of side effects, or because of concerns over a bad reputation should the treatment not yield the desired outcome.[90] The recognition of the necessity and validity of a decision not to treat also appears in *The Art*,[91] with *Prognosis* providing an

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[89] *Fract.* 16 = 3.474-8L, translation from Withington.

[90] See *Fract*. 36 = 3.536-8L and *Artic.* 1 = 4.78-80L and 67 = 4.278-80L.

[91] In his very definition of medicine, author of *De Arte* writes in section 3 = 6.4L: πρῶτόν γε διοριεῦμαι ὃ νομίζω ἰητρικὴν εἶναι· τὸ δὴ πάμπαν ἀπαλλάσσειν τῶν νοσεόντων τοὺς καμάτους καὶ τῶν νοσημάτων τὰς σφοδρότητας ἀμβλύνειν, καὶ τὸ μὴ ἐγχειρεῖν τοῖσι κεκρατημένοις ὑπὸ τῶν νοσημάτων, εἰδότας ὅτι ταῦτα οὐ δύναται ἰητρική ("First I will define what I conceive medicine to be. In general terms, it is to do away with the sufferings of the sick, to lessen the violence of their diseases, and to refuse to treat those who are overmastered by their diseases, realizing that in such cases medicine is powerless"), trans. Jones.

additional discussion of why physicians need to think carefully about a refusal to treat (see section 3 in this chapter). Reputation mattered,[92] and refraining from treating patients for whom death was imminent was one way a physician could ensure that his community saw him as a successful promoter of life and health. Judicious restraint is not always the preferred approach in the corpus, however: the author of *Places in Man* seems to have fewer reservations about encouraging treatment in the context of these dangerous diseases, though he does speak of risk (παρακινδυνεύειν), coming to the conclusion that, even if the patient dies after the treatment, he would have died anyway.[93]

There is a morbid wisdom in this comment by the author of *Places in Man*: the ancient world was a dangerous place, and its inhabitants had an average life expectancy of not much greater than the mid-thirties.[94] There can be no doubt that 'treatments' were often unpleasant, frequently hastened death, and in some cases brought it about directly. But an inability to see the mechanisms that produced these afflictions, and an inability to distinguish them from one another, led the writers of the Hippocratic corpus to do the best they could with what they could see. In the context of afflictions that *could* be seen with clarity, such as a dislocated shoulder or hip, there is evidence that physicians acquired a surprisingly high level of success in providing effective therapy. Their decision making regarding the diagnosis, prognosis, and treatment of this problem evolved in a context that provided readily-available, consistent opportunities to test the validity of their efforts – conditions that facilitated the development of effective expert intuition regarding this particular problem. Successful cures were important, since a physician's

[92] How a physician presented himself was also a vital part of the construction and maintenance of reputation: see *The Oath*, *On the Physician*, and *Decorum* for other examples.

[93] *Loc.Hom.* 24 = 6.314-315L.

[94] See Chapter 1.

perception of his ability to treat a patient, and the implications this could have for his reputation, were also important parts of his decision making process.

2.6 Conclusions

The writers of the Hippocratic corpus, though their observations and analyses spanned more than two centuries, were all aware (to varying degrees) of the criteria on which they based their decisions. These texts show a notable acknowledgement of the epistemological limitations of their decision making methods and the information on which the writers base their assumptions, yet they also demonstrate a practical awareness of the need for some kind of decision making criteria in order to attempt to render assistance to their patients. At least some of these ancient physicians were explicitly aware that it was difficult to know, with certainty, what the outcome of a decision would be. They were experimenting with probabilities and likelihoods, though not in the full, modern meaning of those terms. That they used what we call heuristics – and that these practitioners were consequently prone to the associated biases – is evident. What is notable is the awareness, at least among some writers, that they *were* using heuristics, and that these methods of organizing information brought with them the potential for mistakes (biases). Faced with τὰ ἄδηλα and cognizant of what they could not see, these writers used heuristics as a rigorous way to contain and to characterize what could be seen, and to speculate about what could not be seen. Through dissections and vivisections of humans, the subsequent generation of Alexandrian anatomists would shift the boundary between the observable and the unobservable, leading to new debates about the organization of medical knowledge and how it could and should be applied in clinical encounters.

Chapter 3
The Alexandrian Anatomists, Observation, and Resolution of Anatomical Categories

Praeter haec, cum in interioribus partibus et dolores et morborum varia genera nascantur, neminem putant his adhibere posse remedia, qui ipsas ignoret. Ergo necessarium esse incidere corpora mortuorum, eorumque viscera atque intestina scrutari; longeque optime fecisse Herophilum et Erasistratum, qui nocentes homines a regibus ex carcere acceptos vivos inciderint, considerarintque etiamnum spiritu remanente ea, quae natura ante clausisset…

"Moreover, as pains, and also various kinds of diseases, arise in the more internal parts, they[1] hold that no one can apply remedies for these who is ignorant about the parts themselves; 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…"

(Celsus, *De Medicina*, Prooemium 23)[2]

3.1 Introduction

The first century BCE Roman encyclopedist Celsus, in his overview of the history of medical theory and practice, describes the anatomical investigations of Herophilus and Erasistratus, physician-scientists who were active in third century BCE Alexandria. Their mention is part of Celsus' tracing of the development of medical knowledge: from its roots in man's desire to understand nature, to its branching into divisions devoted to specific aspects of the broader discipline, to particular interpretive inclinations associated with those divisions. The recognition that knowledge of hidden causes and internal parts was necessary to treat disease effectively,[3] says Celsus, led Herophilus and Erasistratus to venture where Greek medical science had not yet gone: dissection and vivisection of the human body. The observations they

[1] The "they" to whom Celsus here refers is *ii, qui rationalem medicinam profitentur, haec necessaria esse proponunt: abditarum et morbos continentium causarum notitiam, deinde evidentium; post haec etiam naturalium actionum, novissime partium interiorum*, *De Medicina*, Pr. 13, trans. Spencer.

[2] Trans W.G. Spencer, *De Medicina* (Cambridge: Harvard University Press, 1935).

[3] See n.1.

made, and the conclusions they subsequently drew, reshaped the decision making frameworks of the medical practitioners who followed.

Despite the novelty of their findings, however, the writings of Herophilus and Erasistratus have reached the modern age only in fragments, in the words of later physicians such as Galen. Attempts to reconstruct these earlier texts have been made, in particular by von Staden (Herophilus) and Garofalo (Erasistratus),[4] though the fragmentary nature of the evidence imposes limits on the kinds of inferences that can be drawn regarding how Herophilus or Erasistratus might have thought about diagnostic, prognostic, and therapeutic decision making. One question that can be reasonably asked, however, is: What can the available evidence tell us about how the Alexandrian anatomists' investigations changed the existing fund of knowledge and the cognitive tools associated with medical practice? In other words, how might their anatomical investigations have re-written the terms on which medical decisions had been made prior to the third century BCE? This chapter will address this issue, focusing on the shifting boundary of what was considered 'observable,' and on Herophilus' and Erasistratus' efforts to see how far this boundary could be extended. It will be argued that increased resolution – the ability to see a multiplicity of categories or types where only one had been previously identified – provided the impetus for the generation of new approaches to clinical decision making, as Herophilus and Erasistratus blended their newfound anatomical knowledge with an awareness of how these questions of resolution could affect diagnosis, prognosis, and treatment.

[4] Heinrich von Staden, *Herophilus. The Art of Medicine in Early Alexandria* (Cambridge: Cambridge University Press, 1989). Ivan Garofalo, *Erasistrati fragmenta*, with commentary (Pisa: Giardini, 1988).

3.2 Shifting the Boundaries of the Observable

3.2.1 Herophilus and his Anatomical Discoveries

As we saw in the preceding chapter, observation and questioning were vital parts of the Hippocratic physicians' approach to patients and a cornerstone of clinical decision making. Asking patients about symptoms, noting their external appearance, and paying attention to internal elements of the body that had been made external (e.g., phlegm or urine) contributed to the aggregation of outcomes-based groups of observations and the development of theories about the internal world of the body. This world remained largely unseen, however, until Herophilus (330/320 – 260/250 BCE),[5] through dissection and vivisection of humans, made visible what had been previously invisible. His discoveries were noteworthy:[6] he identified a clear functional distinction between sensory and motor nerves while also noting that the same organ (i.e., nerves) exhibited these dual functions.[7] He traced the route of seven pairs of cranial nerves, characterized the ventricles of the brain,[8] identified four separate membranous layers of the eye,[9] differentiated between arteries and veins with respect to many of their anatomical features, discovered the valves of the heart, provided an accurate characterization of the human liver and pancreas, and corrected existing misconceptions about the mobility of the uterus by identifying its anatomical

[5] von Staden, *Herophilus,* 50.

[6] von Staden, *Herophilus*, 138ff for references to the subsequent anatomical discoveries.

[7] von Staden, *Herophilus*, 250 and T81 = Rufus of Ephesus, *De anatomia partium hominis* 71-5 = Daremberg/Ruelle p.184-5); see also F. Solmsen, "Greek Philosophy and the Discovery of the Nerves, *Museum Helveticum* 18, (1961): 184-97.

[8] von Staden, *Herophilus*, T75-79.

[9] von Staden, *Herophilus*, T84-89.

relationship to the Fallopian tubes and ovaries. Many of the terms that he used to describe his findings are still actively used by physicians today.[10]

3.2.2 Case Study: Herophilus' Characterization of the Pulse

The impact of Herophilus' anatomical investigations on what was considered 'observable' – by which I mean features or elements of human anatomy and physiology that could be appreciated with the senses[11] – can be illustrated through analysis of his views on the pulse. Here we should emphasize again the limitations of our sources. Our knowledge of Herophilus' views on the pulse derives from the words of others, particularly Galen, who had his own system for characterizing the pulse. The elements of Herophilus' work that we read in later sources, including the Galenic corpus, should therefore be interpreted with this in mind, as these fragments have been selected and filtered by later writers who had their own reasons for preserving certain aspects of Herophilus' work.[12] Furthermore, the fragmentary nature of the evidence complicates efforts to link Herophilus' descriptions of the pulse with his anatomical investigations. Sources describe Herophilus' appreciation for the details of vascular anatomy at many different locations in the body, but a cohesive account of Herophilus' own reasoning – from anatomical observations to his proposed characterizations of the pulse – is lacking. Yet the

[10] Specific anatomical findings are detailed in von Staden, *Herophilus,* 138ff and T60a-129, the section of the book that discusses anatomy.

[11] On Herophilus' distinction between perceptible bodily motion (κίνησις αἰσθητή) and bodily motion that must be appreciated through reason (κίνησις θεωρητή), see von Staden, *Herophilus*, 273 and associated T142 (= Aetius Doxographicus, *Placita* 1.23.6, Ps. Plutarch, *Placita* 1.23, Iohannes Stobaeus, *Eclogae* 1.19.1), T148 (= Galen, *Puls.Diff.* 4.2 = 8.716-7K), T151 (= Galen, *Puls.Diff.* 1.2 = 8.498K), T159 (= Galen, *Dig.Puls.* 1.1 = 8.771K), and T160 (= Galen, *Dig.Puls*. 1.3 = 8.786-8K). This issue is discussed further in the subsequent parts of this section.

[12] von Staden, *Herophilus*, 263-6, for how Galen's comments about Herophilus' views of the pulse differ from those attributed to Herophilus in the Anonymus Londinensis papyrus.

sources' insistence on his appreciation of anatomical and physiological detail nevertheless suggests that it is not unreasonable to make arguments about this new kind of knowledge driving a revised categorization of the human body and its constituent parts.

Authors living and writing before Herophilus had acknowledged that a pulse was normal and not necessarily pathological,[13] and Aristotle had furthered this understanding by recognizing the pulse as a normal characteristic of all blood vessels and suggesting that pulses were somehow related to the heart.[14] Dissection and vivisection led Herophilus to note that arteries pulsate but veins do not,[15] and to assert that arteries derived this ability from the heart via the arterial coats.[16] He observed that pulse movement was involuntary, as was respiration, and that though both movements were involuntary, they were nonetheless distinct from each other. To these two kinds of involuntary motion he added a class of voluntary motion,[17] the kind associated with muscles and nerves (and other body parts that he mistook for nerves, including ligaments and tendons). His anatomical investigations therefore led him to identify "at least three different systems of bodily motion": voluntary motion of nerves and muscles, involuntary pulmonary motion, and involuntary vascular motion.[18] Permitting increased observability of human anatomy and

[13] *Loc.Hom*. 3 = 6.280L, 13 = 6.302.

[14] Aristotle, *HA* 3.19.521a6-7 and *Spir*. 20.479b26-480a15.

[15] See von Staden, *Herophilus*, T115-T128 and associated discussion on p.169-181 for evidence of Herophilus' dissections of veins and arteries in different areas of the body. For evidence of his arguments about pulsation of the arteries but not the veins, see *P. Londinensis* 28.46-29.23 (Diels) = von Staden T146.

[16] Galen, *Diff Puls*. 4.6 = 8.733K = von Staden T144; Galen, *Art.Sang.* 8 = Furley/Wilkie 176-8 = von Staden T145a.

[17] Rufus of Ephesus, *Synopsis de Pulsibus* 2 (Daremberg/Ruelle) = von Staden T149.

[18] von Staden, *Herophilus*, 332.

pathology, dissection and vivisection enabled Herophilus to resolve into three kinds of motion what had previously been seen as one.[19]

Involuntary vascular motion (the pulse) was further divided into two different phases: contraction (συστολή, the state of activity) and dilation (διαστολή, the state of relaxation).[20] The systolic phase of the pulse could be characterized by at least four "primary differentiae of pulse 'species'":[21] vehemence, rhythm, speed (or frequency), and size. These four differentiae were linked to age, in that predictable variations in them were expected based on the patient's age. A physician could identify these features of the pulse through careful observation and palpation.[22] Though three elements of the pulse – vehemence, speed/frequency, and size – appear to have been described in relative terms (for example, 'good-sized' relative to age, or 'stronger' or 'weaker', again relative to age), the rhythm of the pulse was classified into defined, measurable categories.[23] The basis for identifying these rhythms was what Herophilus termed a 'primary perceptible time unit,' which was the timespan required for an infant's artery to dilate.[24] This unit of time was the foundational building block in the construction of rhythms that he associated with four different stages of life (childhood, adolescence, adulthood, old age).[25] 'Normal' rhythms were therefore of different varieties and were contingent upon age.

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[19] von Staden, *Herophilus*, 272.

[20] von Staden, *Herophilus*, T154.

[21] Galen 7.584K; 8.556, 592K; 9.453K, 463K, 471K; von Staden, *Herophilus*, 273; James Longrigg, "Anatomy in Alexandria in the 3rd century BC," *The British Society for the History of Science* 21 (1988): 470ff.

[22] von Staden, *Herophilus*, 276-282.

[23] von Staden, *Herophilus*, 272-282.

[24] Galen, *Syn.Puls.* 12 = 9.463-5K; von Staden, *Herophilus*, T183; see also ibid., 277-278.

[25] von Staden, *Herophilus*, 279-282, and Rufus of Ephesus, *Synopsis de pulsibus* 4 = T177 (von Staden).

Rhythms were measured with a portable water clock that Herophilus was said to have taken with him on his patient visits. It is uncertain if he developed his pulse theory and classification system based on the observations he made with the water clock, or used the water clock to support ideas he had already formulated. What can be argued, however, is that the water clock provided a new method of observing and quantifying what Herophilus had already identified as a standard physiological function, namely the pulse. Moreover, since the water clock could be adjusted for the patient's age,[26] its use suggests a framing of the decision making process based on metrics evaluated in a systematic, repeatable way: first, the patient's age was taken into account, and then pulse rhythm was measured by an instrument whose output was interpreted *contingent upon the first metric*, namely age. The interpretation of the downstream metric, namely pulse rhythm, depended upon the first data point, that is, the age bracket of the patient. Contingencies were also established for determining rhythm in situations in which the contraction of the pulse could not be appreciated. Herophilus moreover noticed that body temperature was related to pulse: generally, the greater the pulse, the greater the patient's temperature, so the water clock could also be used as an indirect way to measure the patient's temperature, contingent on the pulse.[27]

Although Herophilus was not the first to attempt to characterize the pulse, the knowledge provided by his anatomical investigations established foundational elements of his pulse theory. Having seen that the arteries pulsate in coordination with the heart, Herophilus could argue that a physician's sensation of a patient's pulse provided information about the condition of an internal

[26] von Staden, *Herophilus*, 282 and T182 and associated comments.

[27] von Staden T182 = Marcellinus, *De Pulsibus* 11 (= Schöne, p.463).

organ, namely the heart.[28] His appreciation for differences in the quality of movement associated with different parts of the human body – the lungs, the arteries, and the muscles – enabled him to determine the kinds of movements that were pathological or problematic for a given bodily system. Close attention to the anatomy and physiology of the human body facilitated the resolving of the broad concept of 'movement' into the three categories of voluntary musculoskeletal movement, involuntary respiratory movement, and involuntary arterial movement. This, in turn, encouraged more focused, precise characterization of each of these categories of movement, including vascular movement. Perhaps it was his experience with observing or palpating a pulse in the context of dissection that led Herophilus to consider the pulse and its qualities to be 'perceptible'[29] – a statement that stood in contrast to the debates among the Erasistrateans and Pneumatics about the perceptibility of the pulse.[30] Belief in the perceptibility of the pulse supported Herophilus' efforts to characterize its qualities further, contributing to the development of a framework that used four descriptive metrics (vehemence, rhythm, speed, and size). These metrics were understood in light of the patient's age, lending an additional layer to the classification framework. This system allowed a fast pulse in an elderly individual, for example, to be distinguished from a fast pulse in an infant: the former was deemed concerning, the latter normal. Anatomical investigation had re-shaped the way that the parts of the human body were classified, allowing for more finely-grained distinctions to be

[28] Galen, *Puls.Diff.* 4.2 = 8.716-7K = T148 (von Staden).

[29] von Staden, *Herophilus*, 273 and associated T142 (= Aetius Doxographicus, *Placita* 1.23.6, Ps. Plutarch, *Placita* 1.23, Iohannes Stobaeus, *Eclogae* 1.19.1), T148 (= Galen, *Puls.Diff*. 4.2 = 8.716-7K), T151 (= Galen, *Puls.Diff*. 1.2 = 8.498K), T159 (= Galen, *Dig.Puls.* 1.1 = 8.771K), and T160 (= Galen, *Dig.Puls*. 1.3 = 8.786-8K).

[30] Galen, *Dig.Puls.* 1.3 = 8.786-8K = T160 (von Staden).

made among pathologies. The next section will consider the effects that such increased resolution had on medical decision making.

3.2.3 Increased Resolution and its Implications for Decision Making

Von Staden has characterized Herophilus' meticulous efforts – making distinctions between anatomical structures and categorizing the movements of the pulse, among other efforts to increase the specificity of medical knowledge – as a "miniaturization of anatomy," an intellectual fascination with details that was in keeping with Alexandrian culture's interest in "smallness" (best exemplified, in a non-medical way, by Callimachus' poetry).[31] Distinguishing among parts previously thought to be the same; identifying organs, nerves, and vessels where none had been observed; and fragmenting pulse motion into discrete, quantifiable categories extended the boundary of what had been observed, and what could be considered observable. To think about Herophilus' accomplishments in terms of medical decision making, we might say that his investigations permitted greater "resolution" of features of the body. For example, a single membrane of the eye was, under Herophilus' delicate scalpel and discerning gaze, resolved into four separate components. The motion of the pulse was resolved into *systole* and *diastole*, with further fragmentation of *systole* into the four differentiae of vehemence, speed, frequency, and size. Aspects of anatomy and physiology that were previously a unity were now seen as collections of components that could, themselves, vary.

This increased resolution had three major implications for medical decision making. First, there were now more and new kinds of data that could be taken into account when

[31] Heinrich von Staden, "Body and Machine: Interactions between Medicine, Mechanics, and Philosophy in Early Alexandria," in 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 22-25, 1993*, ed. John Walsh and Thomas F. Reese (Malibu: The J. Paul Getty Museum, 1996), 86.

evaluating a patient's condition. These data involved the inner workings of the body to a greater degree than had previously been the case. Speculation about what could be wrong on the inside was less uncertain, since anatomical investigations had yielded more precise knowledge about the forms of and connections between different organs and parts of the body. While the Hippocratic physicians had certainly not ignored the inner workings of the body, the focus of their data-gathering resided outside of the body: environment, diet, and externalized symptoms and effluvia provided the data that were the foundation of their decision making. Herophilus' discoveries, while not superseding the premium placed on these readily-observed, externalized features of the human body, assisted in shifting the focus of data-gathering inward. The case study of the pulse suggested that the inside of the body *had* been observed, and that this new information could more readily enter diagnostic, prognostic, and therapeutic decision making.

Second, this increase in the quality and quantity of information about the human body further developed approaches for organizing the information that was the basis for decisions. Consider Herophilus' approach to the evaluation of the pulse. The water clock could measure the pulse in a systematic, reproducible, quantifiable way, though the proper evaluation of the pulse was contingent upon adjusting the instrument in accordance with the patient's age. As described above, interpretation of the output of the water clock was carried out with one decision-making input (patient age) already built into the physician's cognitive framework. The importance of age in diagnostic, prognostic, and therapeutic frameworks was not new – it was clearly vital information for the Hippocratic authors, too – but descriptions of Herophilus' water clock and its pulse measurements suggest that age was systematically built into what we might call a simple diagnostic algorithm. When the water clock was used to measure the pulse, age was always the first feature of the patient that was considered. Herophilus' water clock shows how the use of a

new technology for observing the inside of the body imposed an order and degree of standardization, however basic, on the acquisition, interpretation, and implementation of data.

The third consequence of the increased resolution afforded by Herophilus' anatomical investigations was that, since the previously unobservable had become observable, the boundaries between these two zones of perception had changed. Evidence suggests that Herophilus was aware of this newly-impermanent boundary between the observable and non-observable, though there are multiple interpretations of the texts that relate to this claim. The sources that preserve this evidence, and their translations, are below:

> λεγέσθω δὲ τὰ φαινόμενα π[ρ]ῶτα, καὶ εἰ μὴ (ἔστιν) πρῶτα.[32]
>
> "Let the appearances be described first even if they are not primary,"
> or, an alternative translation:
> "Let appearances be described as [*or*: called] primary things even if they are not primary."[33]
>
> καί τις ἐπῄνεσεν ἐν τούτῳ τὸν Ἡρόφιλον εἰπόντα κατὰ λέξιν οὕτως· ἔστω ταῦτα εἶναι πρῶτα, εἰ καὶ μή ἐστι πρῶτα.[34]
>
> "Someone praised Herophilus in this context, when he said the following in these very words: 'Let these things be first, even if they are not first.'"[35]

On the basis of these statements, von Staden argues that Herophilus shared Aristotle's views that 1) φαινόμενα, in the context of biology, are linked to perception by the senses (κατὰ τὴν αἴσθησιν), and 2) that a scientist should consider causes and reasons after he has considered the

[32] von Staden T50a = Anon. Lond. 21.18-32 = Diels, p.37-38.

[33] The first translation is the one that accompanies the Greek text in von Staden, *Herophilus*, 125 (T50a); the second is the translation that von Staden provides as an alternative in his commentary on p.134. R.J. Hankinson, "Saying the Phenomena," *Phronesis* 35, 1990, 213-215, prefers the second translation, for reasons described above.

[34] Galen, *MM* 2.5 = 10.107K = T50b von Staden.

[35] Trans. Hankinson, "Saying the Phenomena," 213. Note that τὰ φαινόμενα, while potentially the antecedent of ταῦτα, is not necessarily so.

φαινόμενα.[36] This connection between φαινόμενα and the senses – first emphasized by Aristotle in his biological texts, then reiterated by Herophilus – underscores the role that observability and sense perception played in the construction of Herophilus' theories about anatomy and physiology. Yet regarding the possibility of identifying causes on the basis of these φαινόμενα, von Staden writes, Herophilus expressed more reservations than Aristotle did.

Hankinson, however, commenting on von Staden's analysis, draws parallels between these statements of Herophilus and a phrase attributed to Anaxagoras: ὄψις γὰρ κατ' αὐτοὺς τῶν ἀδήλων τὰ φαινόμενα ("The *phenomena* are a glimpse of the hidden things.").[37] The parallels between Herophilus' statement and this saying of Anaxagoras lead Hankinson to suggest that Herophilus, while aware of the "inherently and irremediably fragile" nature of theories about causes, was nonetheless willing to venture them.[38] Hankinson prefers the second translation of the phrase from the Anonymus Londinensis papyrus (above) because it suggests that Herophilus was willing to consider the φαινόμενα as primary, even if subsequent discoveries mean that what is observed is not, in fact, primary. He prefers to consider Herophilus "a sort of proto-Popperian," uncertain about the causes of what he see but nonetheless willing to venture explanations.[39] Regardless of which interpretation is preferred – that Herophilus was more (Hankinson) or less (von Staden) willing to engage in causal reasoning – these fragments from Galen and the Anonymus Londinensis papyrus emphasize the anatomist's focus on the φαινόμενα and suggest his awareness of the fluidity of what might be considered observable. Considered in the context of what is known about his anatomical investigations, comments about

[36] Von Staden, *Herophilus*, 118-120; Ps.-Galen, *Opt.Sect.*2 = 1.109K = T54 von Staden. See also: Aristotle, *On Parts of Animals* 1.1.639b3ff, 640a14-15.
[37] Sextus Empiricus, *M* 7.139. Trans. Hankinson, "Saying the Phenomena," 214.

[38] Hankinson, "Saying the Phenomena," 213.

[39] Hankinson, "Saying the Phenomena," 214.

φαινόμενα that are attributed to Herophilus raise the possibility that observation of the inside of the human body encouraged a re-evaluation of the content and structure of the information with which physicians made decisions about their patients.

3.3 Erasistratus, Perceptibility, and Reason

3.3.1 Erasistratus and the Observable: Triplokia *and* λόγῳ θεωρητά

A younger contemporary of Herophilus, Erasistratus was also held in high regard by subsequent generations of physicians for his detailed knowledge of human anatomy, even if later physicians (including Galen) disagreed with some of his physiological theories and explanations. Though there has been disagreement over where he lived and worked, most agree that he did, like Herophilus, carry out dissections (and possibly vivisections, though this is less certain) in Alexandria.[40] As was the case for Herophilus and his works, what we know about Erasistratus comes to us through fragments preserved in the writings of later physicians, most notably Galen, who emphasizes his failure (as Galen sees it) to engage with Hippocratic humoral theory and criticizes his position against phlebotomy.[41] Galen's disagreement with many of his teachings has been considered by some a reason why Erasistratus' works were not preserved in their entirety.[42] Despite the limitations in our abilities to approach Erasistratus' ideas on their own terms, enough information has survived to permit us to appreciate his efforts to construct new kinds of physiological explanatory models based on his anatomical research. Like Herophilus, Erasistratus faced the challenge of the moveable boundary between the observable and the non-

[40] G.E.R. Lloyd, "A Note on Erasistratus of Ceos," *The Journal of Hellenic Studies* 95 (1975): 172-175.

[41] Ibid.

[42] Nutton, *Ancient Medicine*, 137.

observable, though the extant evidence suggests that he managed the challenges associated with this boundary in a different way, through recourse to theory about what he could perceive with reason.

Erasistratus' ideas about the functioning of the body – from what can be gleaned from the fragments that remain – are distinguished by elaboration of a concept that has been called *triplokia*,[43] an intertwined aggregation of the three systems of veins, arteries, and nerves.[44] In a recent article, David Leith has explored the *triplokia* in detail, arguing that it is Erasistratus' way of presenting an interconnected system of the body that explains its composition and functioning "at a subsensible level."[45] The arteries, veins, and nerves that Erasistratus saw when he dissected living organisms, the anatomist argued, were themselves made up of smaller, imperceptible veins, arteries, and nerves. These components are imperceptible in their simplest forms (nerve, artery, or vein), but the visible vasculature and nerves consisted of aggregates of these three basic, invisible components.[46] As Leith argues, since Erasistratus attributed the functions of nourishment, bodily maintenance, and motion/sensation to the fluids that were carried in veins (blood), arteries ('vital' πνεῦμα), and nerves ('psychic' πνεῦμα), respectively, and since all parts of the body were nourished, maintained, and mobile, these bodily channels were dependent on

[43] I use the term *triplokia* in accordance with convention, although this term may not be quite correct: see David Leith, "Erasistratus' *Triplokia* of Arteries, Veins, and Nerves," *Apeiron* 48, (2015): n.3.

[44] On Erasistratean physiology, see I.M. Lonie, "Erasistratus, the Erasistrateans, and Aristotle," *Bulletin of the History of Medicine* 38, (1964): 426-443; C.R.S. Harris, *The Heart and the Vascular System in Ancient Greek Medicine* (Oxford: Oxford University Press, 1973), 195-233; Garofalo, *Erasistrati Fragmenta*, 22-58; J.T. Vallance, *The Lost Theory of Asclepiades of Bithynia* (Oxford: Clarendon Press, 1990), 62-79; Heinrich von Staden, "Cardiovascular Puzzles in Erasistratus and Herophilus," in *Atti: XXXI Congresso Internazionale di Storia della Medicina* (Bologna: Monduzzi Editore, 1988), 681-87; Heinrich von Staden, "Body, Soul, and Nerves: Epicurus, Herophilus, Erasistratus, the Stoics, and Galen," in *Psyche and Soma. Physicians and Metaphysicians on the Mind-Body Problem from Antiquity to Enlightenment*, ed. J.P. Wright and P. Potter (Oxford: Oxford University Press, 2000), 92-96; and, most recently, Leith, "Erasistratus' *Triplokia.*"

[45] Leith, "Erasistratus' *Triplokia*," 251.

[46] Galen, *Nat.Fac.* 2.6 = 2.96-103K = fr. 89 Garofalo; Anon. Lond. 21.23-28 = p.46 Manetti = fr. 87 Garofalo;

each other. In Leith's words, Erasistratus' findings and theories "led him to infer that in fact there must be veins in the nerves and arteries (and likewise arteries in the veins and nerves, and nerves in the veins and arteries)."[47]

This idea was enabled by anatomical investigations, an awareness of the fluidity of the limits of observability, and a willingness to incorporate the imperceptible into a theoretical framework. According to a passage quoted in the Galenic corpus, Erasistratus recognized that these systems of veins, arteries, and nerves in the body progressively grew smaller, until they were imperceptible to the eye:[48]

> ἀπίθανα γράφει κατὰ τὸ Περὶ τῆς ἀναγωγῆς τοῦ αἵματος ἐν τῇδε τῇ ῥήσει· "ἡ δὲ ὁδὸς ἐπὶ τὴν ἀναγωγὴν τοῦ αἵματος τοῖς ἀπὸ τούτων τῶν τόπων ἀναφερομένοις τοιαύτη τις γίγνεται· ἀπὸ τῆς παρὰ τὴν ῥάχιν κειμένης ἀρτηρίας ἀποφύσεις εἰσὶν ἀγγείων παρ' ἑκάστην πλευράν, ὁμοίως ἐκ τε τῶν δεξιῶν καὶ τῶν ἀριστερῶν· αὗται δ' εἰς τοὺς πλησίον τόπους ἐπὶ πλεῖον σχιζόμεναι εἰς ἄδηλα τῇ αἰσθήσει ἀποτελευτῶσιν.
>
> (Erasistratus) says unpersuasive things in his *On Expectoration of Blood* in this passage: "The way in which expectoration of blood occurs in those who are bringing up (blood) from these places is as follows: from the artery which lies beside the spine there are offshoots of vessels along each rib, similarly on both the right and the left. These (off-shoots) increasingly split apart into the neighbouring places and end in extremities which are hidden to perception."

Though, as was the case with the available source material that preserved the observations and theories of Herophilus, caution must be exercised in the interpretation of the evidence,[49] this text indicates two important features of Erasistratus' work: first, that he engaged directly with this question of observability, through his dissections (as above), and second, that he demarcated a new boundary for things that were ἄδηλα τῇ αἰσθήσει, "hidden to perception." An additional

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[47] Leith, "Erasistratus' *Triplokia*," 256. Galen *Adv.Er.* = 11.153ffK = fr. 198 Garofalo; Galen, *At.Bil.* 5.18 = 5.124K = fr. 240 Garofalo; Galen *UP* 7.8 = 3.538K = fr.88 Garofalo; Galen, *AA* 2.11 = 2.337K = fr. 90 Garofalo; Galen, *Nat.Fac.* 2.6 = 2.95-96K.

[48] Galen, *Loc.Aff.* 5.3 = 8.311K = fr. 229 Garofalo; trans. Leith, "Erasistratus' *Triplokia*," 257-8.

[49] Leith, "Erasistratus' *Triplokia*," 259ff, discusses these issues more extensively.

anecdote illustrates Erasistratus' interest in the limits of what was directly observable. To illustrate the existence of biological processes invisible to human perception, he did the following. Having weighed a bird, he placed it in a closed container without food or water for a set period of time, then removed the bird and weighed both its excrement and the bird itself together: the combined weight of the bird and its byproducts was less than the initial weight of the bird before it was confined.[50] Both of these examples – Erasistratus' idea that vasculature becomes imperceptible as it gradually splits into smaller channels, and that an invisible process was responsible for the weight discrepancy in the investigation with the bird – demonstrate his awareness of the boundary between that which could be perceived by the senses, and that which could not. His interest in an investigator's ability to move this boundary is demonstrated by his own efforts to do so, through dissection and careful observation of living organisms.

A description of Erasistratus' approach to these kinds of questions about the perceptibility of biological processes is also found in the Anonymus Londinensis papyrus, where Erasistratus' treatment of the φαινόμενα is contrasted to that of Herophilus:[51]

> ὁ μ(ὲν) γὰρ Ἐρασί[στρατ]ος καὶ π[ό]ρρω τοῦ ἰατρικοῦ κανό[νος π]ροῆλθε· ὑπέλαβεν γ(ὰρ) τὰ πρῶτα [σώμα]τα λόγωι θεωρητὰ (εἶναι), ὥστε τὴν [αἰσθητ]ὴν φλέβα συνεστάναι ἐγ λόγωι θ[εωρη]τ(ῶν) σωμάτ(ων), φλεβός, ἀρτηρίας, νεύρο(υ).
>
> "Erasistratus went even further in his standard for the physician; for he hypothesized that the primary bodies are perceived by reason, so that the vein perceived by the senses is composed of bodies perceptible by reason, viz. of vein, artery, and nerve."

In Erasistratus' case, the author writes, his observation led to insights confirmed in a new way by further observations – the frequently proximal relationship among veins, arteries, and nerves, for example. These observations also provided justification for the development of theories of

[50] Anon. Lond. 33, 43 = fr. 76 Garofalo.

[51] Anon. Lond. 21.23-28 = fr. 87 Garofalo = T50a von Staden, trans. von Staden.

connectivity, and a cause for those aspects of anatomy and physiology that he knew he could not see. Erasistratus was willing to extend the concept of 'perception' through recourse to reason, an inference about what was at the boundary of the observable and the unobservable. As will be shown in the case study below, Erasistratus' willingness to accept perception by reason alone (λόγῳ θεωρητά) had direct clinical consequences.

3.3.2 Case Study: πνεῦμα, *Blood, and the Treatment of* πληθώρα

Erasistratus' anatomy and physiology emphasize connectivity and motion. His extant writings reveal an appreciation for the complexities of human vascular, digestive, and neural networks, as well as a desire to find a means to unify these extensive networks. Appealing to the substance πνεῦμα, he generated a cohesive theory of physiology that incorporated his anatomical findings and accounted for the motion within the body, that is, the transport of substances that supported life. πνεῦμα, "breath, air," occupied a variable role in explanations of physiology and pathology in the centuries before Erasistratus. The Hippocratic treatise *On Breaths* argues that an imbalance of air (πνεῦμα) in the body, or the presence of unhealthy air, contributes to disease.[52] Diocles of Carystus (fourth century BCE) refers to 'psychic πνεῦμα,' "a delicate substance that is responsible for transmitting sensory and motor signals."[53] For both Diocles and Praxagoras, πνεῦμα moved around the body and was especially linked to the brain and the heart. When its normal passage was hindered, disease resulted.[54] The existing discussion around πνεῦμα, prior to

[52] *On Breaths* 14.1-4 = 6.110-12 L.

[53] Philip van der Eijk, *Medicine and Philosophy in Classical Antiquity: Doctors and Philosophers on Nature, Soul, Health, and Disease.* (Cambridge: Cambridge University Press: 2005), 129ff. Diocles, frs. 78 and 80 vdE.

[54] 'Anonymous Parisinus' 3, published by Ivan Garofalo, *Anonymi Medici de Morbis Acutis et Chroniis* (Leiden: Brill, 1997); see also Van der Eijk, *Medicine and Philosophy*, 134.

Erasistratus' time, emphasized its role as an internal communicative substance, though Erasistratus accorded special prominence to it as part of a unifying theory of anatomy and physiology.

In his model of the body, veins contained blood, and arteries contained πνεῦμα, the origin of which was the brain. Like Herophilus, he believed that the brain was the origin of all nerves, and he, too, noted a difference between sensory and motor nerves. His careful dissection of the brain revealed a more detailed anatomy than that provided by Herophilus, including separate ventricles, sulci, and complicated convolutions,[55] and he drew a relationship between increased convolution and higher order brain function.[56] This rich neural network was, in Erasistratus' estimation, functionally connected to the rest of the body through πνεῦμα. Inhaled air was thought to move from the lungs through the 'vein-like artery' (what we today would call the pulmonary vein) into the left ventricle of the heart. During the process of ventricular contraction, the πνεῦμα became 'life- πνεῦμα,' which was then pumped into the aorta, into the left ventricle, and into the rest of the body. Some of this πνεῦμα traveled via the arteries to the brain, where it was refined still further into soul-πνεῦμα, possibly in the convoluted cerebellum that Erasistratus linked with cognition.[57] The nerves, traveling from their observed origin in the brain, distributed the soul-πνεῦμα from the brain to rest of the body. The arteries transported life-πνεῦμα throughout the body from their origin in the left ventricle of the heart.[58] The life- πνεῦμα served the body, and the soul-πνεῦμα traveled from the brain via the nerves to provide motor and

[55] Galen, *PHP* 3 and 7 = 5.602-4 and 5.646Kff.

[56] Longrigg, "Anatomy in Alexandria," 481.

[57] von Staden, *Psyche and Soma*, 93-4.

[58] Galen, *Hipp.Aph*. 6.50 = 18A.86K; *Eras.* Fr. 288 (Garofalo); von Staden, *Psyche and Soma*, 93.

sensory function.[59] Blood and πνεῦμα moved through this system via a principle that been called by von Staden πρὸς τὸ κενούμενον ἀκολουθία (*PTKA*),[60] or *horror vacui* by others,[61] to explain why the material moved from the smaller veins through the pores. Consistent with his presentation of the human body as a unified whole that worked based on physical and mechanistic principles, Erasistratus also seems to have invoked this principle in order to answer objections raised to his idea that the arteries contained only πνεῦμα, and not blood. He argued that even a small cut in an artery was sufficient to release the invisible πνεῦμα, thereby creating a *horror vacui* that would be filled by the visible blood rushing into the arteries to fill the space created by the exiting πνεῦμα.[62] The space is being emptied as it is being filled.[63]

As the above description of the *PTKA* principle indicates, blood was also part of this system, and it was carried by veins. Erasistratus appreciated the tangled vascularity of the gastrointestinal system, including the large portal vein that transports nutrient-rich blood from the stomach and intestines to the liver,[64] and concluded that blood was derived from food. From the stomach, vessels carried food to the liver, where the transformative process took place that created blood.[65] As part of this process, the bile was removed from the food and transported to the gallbladder.[66] The newly-formed blood moved from the liver to the right side of the heart via

[59] Von Staden, "Body, Soul, and Nerves," 96.

[60] Von Staden, "Body, Soul, and Nerves," 92.

[61] Longrigg, "Anatomy in Alexandria," 472ff.

[62] Longrigg, "Anatomy in Alexandria," 274ff.

[63] David Furley and James Wilkie, *Galen on Respiration and the Arteries* (Princeton: Princeton University Press, 1984).

[64] Lonie, "Erasistratus, the Erasistrateans, and Aristotle," 438.

[65] Galen, *PHP*, 5.550K; Longrigg, "Anatomy in Alexandria," 476.

[66] A logical connection, given the presence of the bile ducts throughout the liver.

the *vena cava*; from the heart, it traveled to the lungs via the 'artery-like vein' (what we today call the pulmonary artery), and from there to the rest of the body.[67] As the blood moved through the veins to the rest of the body, absorption (διάδοσις) occurred through very small pores (κενώματα) in the walls of the smallest of the veins occupying that part of the body.[68]

Problems occurred when excessive blood flowed into the veins – a condition Erasistratus called πληθώρα – thereby overwhelming the body with excessive nutritive substance.[69] If still more blood were to flow into these swollen veins, it would then leak into the πνεῦμα-containing arteries and push against the πνεῦμα, which was itself driven outward by the pumping action of the heart. The combined pressure of the πνεῦμα coming from the heart in the center of the body, and of the blood moving into the peripheral arteries from overflowing peripheral veins, would lead to inflammation and fever. The problem would be further compounded by inability of the πνεῦμα to flow freely through the arteries to reach its destination. Treatment was not phlebotomy, but instead starvation, based on the idea that blood originated from food.[70] Ingestion of less food would produce less blood, thereby relieving the body of the excess of blood that was implicated in the inflammation.

Erasistratus' proposed treatment for πληθώρα ran contrary to centuries of received wisdom, which had emphasized the importance of phlebotomy to remove the excess blood.[71] He

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[67] Galen, 5.550K and 3.304K; Longrigg, "Anatomy in Alexandria," 476.

[68] Galen, *Purg.Med.Fac.*1 = 11.324K and *Nat.Fac.* 2.1 and 2.6 = 2.75, 99K); *Anat.Adm*. 6,16 = 2.648-9 K); *Eras* Fr. 49A, 93, 95, 96 (Garofalo); von Staden, "Body, Soul, and Nerves," 92; Longrigg, "Anatomy in Alexandria," 472ff.

[69] Galen 3.537-9K, Longrigg, "Anatomy in Alexandria," 472ff.

[70] Longrigg, "Anatomy in Alexandria," 472ff.

[71] See fr. 63, 156-67, and 231 (Garofalo); Peter Brain, *Galen on Bloodletting* (Cambridge: Cambridge University Press, 1986); Guido Majno, *The Healing Hand* (Cambridge: Harvard University Press, 1975), 328-37. For Galen's polemic of Erasistratus' model and therapeutic approach, see 11.176K.

justified this unorthodox advice with his physiological model, described above, which was in turn grounded in his ideas about perception. The connections across the *triplokia*, from the stomach to the liver, from the lungs to the heart, from the brain to the arteries and nerves throughout the body, provided justification for a physiology that strove to explain the clinical consequences of this connectivity. It was possible for Erasistratus to make this argument about the dangers of bloodletting as a treatment for πληθώρα because of the elaborate interconnectivity he had seen in his dissections, and because of his belief in the ability of these observations to be extended with reference to rational inferences built upon direct observations. The boundary of the observable was moveable, and his careful study of organisms had suggested the presence of processes that were unseen but could be characterized to some extent. These direct observations led Erasistratus to a unified theory based on inferences about the unseen. The *triplokia* – the observed bundling of nerves, veins, and arteries, and the awareness that these bundles and their constituent parts became smaller – provided justification for these theories about the physiology occurring at the "subsensible" ends of the connections.[72]

3.3.3 Resolution, Perception by Reason, and New Systems of Deciding

Applying this theory about a unified bodily system to clinical observation, then, led Erasistratus to diagnostic and therapeutic decisions that differed from those of his predecessors. πληθώρα was, indeed, an excess of blood, by Erasistratus' reckoning. Yet because of the connections between internal conduits for blood and πνεῦμα – observable at their larger scale but not at the smaller one, where these connections actually occurred – the treatment for πληθώρα was not bleeding, which could, according to Erasistratus' physiology, exacerbate the problem.

[72] Leith, "Erasistratus' *Triplokia*," 251.

Instead, starvation was indicated as a way to prevent the initial production of blood. This example of the treatment of πληθώρα emphasizes how increased resolution – the ability to identify difference where none was previously identifiable – affected clinical decision making. Erasistratus not only resolved the body's conduits into veins, arteries, and nerves, but he also seems to have been concerned with the process of resolution itself, trying to determine means by which he could broaden the domain of the perceptible. Though physicians like Galen may have disagreed with his theoretical model and his position against bloodletting, his efforts had a more wide-ranging impact on later epistemological debates, as subsequent chapters will describe.

3.4 Conclusions: Herophilus, Erasistratus, and Implications for Medical Decision Making

This chapter has discussed the findings of the Alexandrian anatomists Herophilus and Erasistratus, focusing on a particular contribution that each made to medical knowledge in the context of anatomical discovery. I have argued that Herophilus, the earlier of the two investigators, reshaped physicians' understanding of the interior, previously-unseen human body and, thereby, their appreciation for what could be considered observable or unobservable. I argued that this increased resolution had three consequences that bear on issues of medical decision making: 1) the presence of more data that a physician could apply to his analysis of a given situation, 2) the possibility for new approaches to organizing this increased amount of data (i.e., Herophilus' approach to evaluating the pulse through initial age-depending adjustments to the water clock), and 3) a shift in the boundaries between the observable and unobservable. Focusing on Erasistratus and his endeavor to present a unified, dynamic physiology, I argued that his anatomical investigations encouraged him to reconsider 'the observable,' and to conclude that it was possible to base theories on the concept of inferential or rational 'perception' (λόγῳ

θεωρητά). This position led him to adopt an unorthodox therapy for the treatment of πληθώρα, justified both by what he had seen directly and by what he argued was perceptible by reason.

Though the evidence for the observations and theories of Herophilus and Erasistratus is limited, fragmentary, and distorted to an unknown degree by later medical writers, enough nevertheless remains to appreciate the remarkable achievements of these two individuals. Considering their discoveries and arguments in the light of modern cognitive decision theory, we may understand their endeavors to find out more about anatomy, physiology, and biological processes as an effort to increase the amount of information on which they based their decisions. Chapter 1 emphasized the cognitive challenges presented by limited information: though a circumscribed body of information is easier for the human mind to manipulate, reliance on it can lead to the introduction of systematic error and bias into decision making. There is a tendency to argue that additional information fits into this pre-existing framework and into previously-defined categories. The anatomical investigations of Herophilus and Erasistratus, by increasing the resolution with which the human body was observed, questioned existing category structures and models of physiology and pathology altogether. This increase in resolution, while it contributed to the development of theoretical models that modern science has shown to be incorrect (such as the idea that there is πνεῦμα in the arteries), nevertheless prompted a re-consideration of existing theories and category structures. More information was available on which physicians could base decisions: Galen could disagree with Erasistratus' position against bloodletting, for example, but he was still able to posit new ideas about physiology based on Erasistratus' (and Herophilus') research in their dissections. These developments also contributed to the Alexandrian anatomists' awareness of the issue of observability: they had seen more than others, and they grappled with questions about the tenuousness of the line between

‘perception by the senses’ and ‘perception by reason.’ Dialogues about the increasingly precise classification of the body’s structures and sub-structures, in large part as a result of the direct experience of anatomical investigation, are echoed in the positions of the Empiricists; even if Empiricists denied the necessity of further dissection of human beings, they similarly emphasized the importance of direct experience in successful diagnosis, prognosis, and therapy.

Chapter 4
Empiricism: Decision Making, Heuristics, and Expert Intuition

Empericum enim non assueruerunt vocare greci, sed qui constituerunt emperiam se ipsos empericos quidem, emperiam vero non solum [huius] unius theorematis notitiam sed totam medicatiuam nominant, quam ex per se inspectiva [sic] emperia consistere aiunt quam nominant per se inspectionem et cum illa ex historia et similis transitione; historiam quidem dicentes annuntiationem per se inspectionis, similis vero transitionem viam ad triuicam emperiam per similitudinem eorum que per experientiam scita sunt.

"The Greeks did not use to use the term 'empiricist,' but those who founded empiricism call themselves empiricists." For they call 'experience' not only the cognition of some particular theorem but the whole of medicine, of which they say that it consists of the experience of what one has perceived for oneself (which they call one's own perception), along with history and the transition to the similar. By 'history,' they mean the report of one's own perception; by 'transition to the similar,' a method which leads to practical experience which is based on the similarity with what one already knows by experience."

Galen, *An Outline of Empiricism*, Chapter 3[1]

4.1 Introduction

Of the medical theories that emerged in the Hellenistic period, those associated with the Empiricists were particularly enduring. Faced with newly-generated knowledge about anatomy and physiology and a proliferation of debates about appropriate ways to diagnose and to treat disease, the Empiricists responded with doubt about what could be known about the human body, and how such information might be confirmed as correct. Though there was a diversity of opinions among those who called themselves Empiricists,[2] they shared a distrust of theoretical speculation and emphasized the value of repeated, daily observation in the acquisition and application of medical knowledge.[3] Texts associated with both their proponents and detractors

[1] Text from Karl Deichgräber. *Die griechische Empirikerschule: Sammlung der Fragmente und Darstellung der Lehre*. (Berlin: Weidmannsche Verlagsbuchhandlung: 1965), 49. Translation from Richard Walzer and Michael Frede, *Three Treatises on the Nature of Science* (Indianapolis: Hackett, 1985), 26.

[2] R.J. Hankinson, "The Growth of Medical Empiricism," in *Knowledge and the Scholarly Medical Traditions*, ed. Don Bates (Cambridge: Cambridge University Press, 1995), 72-3.

[3] Galen, *Sect.Int.* 2.

describe their explicit and fundamental concerns about the structuring and valuing of information, and their engagement with decision making may be understood in terms of two broad categories. First, there were decisions about the acquisition of medical knowledge: was it possible to know, reliably, what was happening in the human body, and what aspects of this knowledge should a physician acquire as part of his training? Second, there were decisions about the application of knowledge: how should a practitioner apply this knowledge as he sees and treats patients? This chapter will outline how the Empiricists approached these decisions, arguing that the way they identified medical data deemed acceptable, and the way they chose to apply these data, represent an effort to develop what we might call, in today's terms, expert intuition. They were aware of the limitations inherent to the acquisition and application of medical knowledge, and they tried to mitigate these limitations through appeals to indeterminacy and a methodological system founded on observations, correlations, and relative likelihoods.

4.2 The Emergence and Development of Medical Empiricism

4.2.1 Medicine and Medical Knowledge in the Fourth-Third Century BCE Mediterranean World

The Mediterranean world after the conquests of Alexander the Great saw increased exchange of goods and knowledge. Wider access to minerals, herbs, and exotic animals from lands farther away from the Mediterranean led to the composition of new pharmacological treatises and texts to explain how these drugs might have worked.[4] Surgery was another area in which medical knowledge flourished, as the work of Herophilus and Erasistratus contributed to

[4] J. Scarborough, *Pharmacy and Drug Lore in Antiquity: Greece, Rome, Byzantium* (Farnham and Burlington: Ashgate, 2010).

the development of new techniques and instruments for surgical procedures.[5] More physicians would have had more knowledge of the internal workings of the living human body, although – in contrast to the vivisections of Herophilus – this exposure would have been less extensive and would have occurred in settings dedicated to healing and preserving the patient's life.[6] Apollonius of Citium, a Ptolemaic court doctor, was one such physician from the Hellenistic period whose work demonstrates increased involvement in surgical procedures: his commentary on the Hippocratic text *Joints* represents both discussion of pre-existing literature and the introduction of his own observations, in the form of text and drawings.[7] In this process of preserving, commenting on, and adding to the texts of the Hippocratic Corpus, Apollonius exemplifies a developing trend among educated physicians of affording 'Hippocrates' special privilege as a medical authority. Doctors like Apollonius preserved the works of the Corpus but also engaged with them in ways that suited their own experiences and ideas.[8]

Intellectual dialogue and the integration of ideas between philosophy and medicine continued to occur in the Hellenistic period, a collaboration that had existed since Plato and the earliest Hippocratic texts.[9] Aristotle and Theophrastus attempted to explain physiological mechanisms like breathing, and the Epicureans and Stoics invoked medical theories to articulate

[5] Majno, *Healing Hand*, 313-337.

[6] G. Sabbah and P. Mudry (eds), *La Médecine de Celse: Mémoires du Centre Jean Palerne* (Saint-Étienne: Université de Saint-Étienne, 1994), 103-210.

[7] Kollesch and Kudlien, *Apollonius Citiensis in Hippocratis De articulis Commentarii* CMG XI 1, 1 (Berlin: Teubner, 1965); W.D. Smith, *The Hippocratic Tradition* (Ithaca: Cornell University Press, 1979), 212-22; P. Potter, "Apollonius and Galen on 'Joints,' in *Galen und das Hellenistiche Erbe*, ed. J. Kollesch and D. Nickel (Stuttgart: Steiner, 1993), 117-24.

[8] Nutton, *Ancient Medicine,* 145.

[9] Plato, *Gorgias* 464a-468d; 477c-478d; 514e; 521d-522b; Schiefsky, *Hippocrates' On Ancient Medicine*, 2ff.

their conceptions of the functioning of the body and the soul.[10] As there were schools of philosophical thought, so there were also broad tenets of medical practice that were shared by groups of individuals. Though there was still disagreement about certain aspects of doctrine even among people who had a general outlook on medical theory and practice in common, we nevertheless recognize the Hellenistic period as characterized by relatively distinct groupings of individuals who held a particular view about the acquisition and application of medical knowledge.[11] One of these groups identified themselves by the term Empiricists, or ἐμπειρικοί, named after their adherence to the principle of ἐμπειρία, "experience," in medical practice.[12] Much of what we know about them derives from four of Galen's works: *Outline of Empiricism*,[13] *On the Best Sect*,[14] *On Sects for Beginners*,[15] and *On Medical Experience*.[16] This last text is presented in the form of a dialogue in which two interlocutors, an Empiricist and a Rationalist, present arguments for their approaches to the acquisition and application of medical knowledge. Additional source material derives from several other of Galen's works; the Proemium of the text *De Medicina*, by the Roman encyclopedist Celsus; and fragments of Empiricist texts that are

[10] Michael Frede, *Essays in Ancient Philosophy* (Minneapolis: University of Minnesota Press, 1987), 225-242; Aristotle *De Sensu* 436 and *De resp.* 480 28-30; Diogenes Laertius VII, 132; Von Staden, "Body, soul, and nerves."

[11] Heinrich von Staden, "Hairesis and heresy: the case of the 'Haireseis iatrikai,' in *Jewish and Christian Self-Definition in the Graeco-Roman World*, ed. B.F. Meyer and E.P. Sanders (London: SCM, 1982), 76-100 and 199-206.

[12] See n. 1; see also Celsus, *De Medicina*, Proemium 10.

[13] Deichgräber, *Subfiguratio empirica*, in *Die griechische Empirikerschule*, (Berlin: Weidmannsche Verlagsbuchhandlung, 1965).

[14] 1.106-223K.

[15] F G. Helmreich (ed.), *De Sectis Ingredientibus*, in *Galeni Pergameni Opera Minora*, vol. III, Leipzig: Teubner, 1893) = 1.64-105K

[16] *On Medical Experience*, ed. R. Walzer, Oxford: 1944.

preserved in the works of other authors.[17] Empiricist physicians are often characterized in primary and secondary literature as anti-theoretical,[18] an oversimplification but still an informative adjective to describe their views about acceptable ways to evaluate, to interpret, to organize, and to apply information related to human health and disease. We will explore these views, and the criticisms that Empiricists' contemporaries made, in subsequent sections.

4.2.2 Critique of Claims to Medical Knowledge, and Recourse to Experience

The Empiricists were not the first to emphasize the role of ἐμπειρία in medical practice, nor the first to question the utility of speculative, unifying ideas about physiological mechanisms in endeavors to treat disease. The Hippocratic text *On Ancient Medicine*, while not 'Empiricist' with a capital "E" in the later Hellenistic sense, emphasized the importance of experience (ἐμπειρία) in the practice of medicine and also criticized ideological opponents for overly simplistic causal explanations.[19] In the context of broader philosophical debates about the nature and interpretation of evidence, subsequent generations of Hellenistic physicians began to consider an approach to the treatment of disease that was influenced by the anatomical discoveries of Herophilus and Erasistratus, skeptical philosophical arguments, and by Aristotle.[20] A commitment to the unknowability of certain aspects of causality and τὰ ἄδηλα – the 'hidden things' within the body and the obscurities of nature – became a distinguishing feature of the

[17] The foundational text on Empiricist sources and historiography remains Deichgräber. *Die griechische Empirikerschule*. For a briefer English overview, see Marquis Berrey, "Early Empiricism, Therapeutic Motivation, and the Asymmetrical Dispute Between the Hellenistic Medical Sects, *Apeiron* 47, no.2 (2014): 142-8.

[18] Berrey, "Early Empiricism," 151.

[19] Schiefsky, *Hippocrates' On Ancient Medicine*, 126-130 and 345-359.

[20] R.J. Hankinson, "The Growth of Medical Empiricism," in *Knowledge and the Scholarly Medical Traditions*, ed. Dan Bates (Cambridge: Cambridge University Press, 1995), 60-65; Deichgräber, *Die griechische Empirikerschule*.

methodological outlook of Empiricist physicians and a primary reason for characterization of their approach to medical knowledge as anti-theoretical.[21] They expressed reservations about the processes by which the evaluation, organization, interpretation, and application of knowledge occurred, and their concerns about the limits of medical knowledge, and the theoretical foundations used for clinical decision making, led to articulated decisions about the kinds of knowledge deemed relevant, and about the application of knowledge in clinical contexts.

One of these objections involved the issue of concordance, or a lack thereof, around matters of health and disease. Empiricist physicians interpreted the disagreement that surrounded medical theories as indication of the need for skepticism in these contexts. Discord among physicians and scholars was evidence that secure knowledge had not been found.[22] This assertion about the unknowability of theoretical truths emphasized for them that practitioners should rely solely on experience, and not on reason, in their clinical decision making.[23] Developments within the Empiricist tradition over the course of time, however, led to later Empiricists being more willing to accept the possibility of theoretical truth, even if it was unattainable by the current standards of practice.[24] One example of this later approach, which I will mention briefly, is found in the discussion between the Rationalist and the Empiricist in Galen's *On Medical Experience*. The Empiricist criticizes the Rationalist for relying on (faulty) cognitive mechanisms for drawing inferences about the invisible based on the visible: this theoretical approach leads the Rationalist

[21] R.J. Hankinson, *Cause and Explanation in Ancient Greek Thought* (Oxford: Oxford University Press, 2001), 307; Walzer and Frede, *Three Treatises*, xxiii.

[22] Galen, *Outline of Empiricism* 8.

[23] Frede, *Essays*, 256ff.

[24] Frede, *Essays,* 257.

to incorrectly group into one category entities that should, in fact, be in a different category.[25] If the Rationalist were willing to pay attention to the visible, the Empiricist argues, he would recognize different diseases where he believes there is one. The name of his own preferred theoretical approach, states the Empiricist, is not the *analogismos* that the Rationalist employs ("the conclusion pointing to invisible things"), but rather *epilogismos* ("the conclusion pointing to visible things"). This enables an Empiricist physician to focus on the visible, and then to apply knowledge of what has been seen in the past (both in his own personal practice, and in the collective recorded experiences obtained by other physicians) to present clinical circumstances.[26] This representative example demonstrates that, despite their critique of claims to medical knowledge, Empiricist physicians still developed a positive conception of what medical knowledge is, rooted in experience and summarized by the idea of the 'tripod': ἱστορία, ἐμπειρία, and ἡ τοῦ ὁμοίου μετάβασις. As Frede argues, while Empiricists initially wanted their medical practice to focus solely on experience, subsequent generations of practitioners found themselves relying on these more theorized approaches,[27] even as they could still insist on the primacy of the visible and the importance of experience. These approaches, I argue, involved developing and using a collected, distributed memory of experience that provided more nuanced approaches to the acquisition and application of medical knowledge. The cognitive tool of the tripod, and its clinical implications, are discussed in the following sections.

[25] Galen, *Outline of Empiricism* 24.

[26] Galen, *Outline of Empiricism* 24.

[27] Frede, *Essays*, 246ff.

4.3 Decisions about the Acquisition of Knowledge

4.3.1 The Tripod: ἱστορία, ἐμπειρία, *and* ἡ τοῦ ὁμοίου μετάβασις

The Empiricists were concerned about the appropriateness and reliability of the information on which they based their clinical decisions. This methodological focus is apparent in their designation of the three kinds of knowledge that comprise the information upon which they base these decisions: ἱστορία ("reliable testimony of written sources"), ἐμπειρία ("personal experience"), and ἡ τοῦ ὁμοίου μετάβασις ("transition to the similar").[28] When he evaluated a patient's problem with the goal of treating it,[29] an Empiricist physician was expected to draw on ἐμπειρία, "the cumulative personal experience of the visible…defined as a form of [αὐτοψία]," in treating the same or similar maladies.[30] If he lacked personal experience in addressing the problem that he confronted, he had recourse to the recorded experience of others, ἱστορία, or he could employ the principle of ἡ τοῦ ὁμοίου μετάβασις, the transition to the similar, a particular way of reaching a conclusion about a new situation based on knowledge that he had already acquired. Each aspect of the Empiricists' approach will be considered in turn; I will first discuss ἱστορία and decisions about the kinds of second-hand experience that may be reliably acquired and employed in clinical encounters.

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[28] See n. 1. For this division of the tripod, see von Staden, "Experiment and Experience in Hellenistic Medicine," *Bulletin of the Institute of Classical Studies* 22, (1975): 187-8.

[29] Celsus 1.pr. 38, on the Empiricists' goals for the treatment of sick patients: *sed has latentium rerum coniecturas ad rem non pertinere, quia non intersit, quid morbum faciat, sed quid tollat*, "…but that these conjectures about hidden things are not important in this matter, because it does not matter what creates sickness but what alleviates it."

[30] Von Staden, "Experiment and Experience," 187-8.

4.3.2 The Criteria for the Evaluation of ἱστορία

In *Outline of Empiricism* 8, Galen explores what he understands the Empiricists to mean by ἱστορία, namely *nunciationem eorum que visa sunt*, "the report of things [others] have seen."[31] A historical account is deemed true, Galen's Empiricists say, if the person composing the history has seen for himself (αὐτοψία) what he has recorded.[32] Secondly, the veracity (and therefore utility) of historical accounts is confirmed if there is concordance of their content across many sources. As we saw in the preceding section, concordance, while not necessarily indicating truth, can still indicate a fact or observation that is practically useful or relevant. Greater agreement means greater reliability, without any comment on the fundamental truth that may or may not be behind the concordance. Additionally, *scientia et mos conscriptoris*, the "learning and character of the writer," must be taken into account when making decisions about the permissibility of knowledge gained from ἱστορία.[33] Hippocrates, Galen writes, is the best source of all, *expertissium[us] et amicissim[us] veritatis*, an example of the "greatest expertise and the highest regard for truth."[34] The last criterion Galen gives as a hallmark of acceptable ἱστορία is agreement with what the reader himself already knows.[35]

A central feature of Galen's discussion of the Empiricists' understanding and application of the concept of ἱστορία is determination of which kinds of ἱστορία are acceptable for use in

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[31] Galen qualifies this phrase by noting that some add *evidenter* to *visa sunt*. The importance of perception will be discussed in 4.3.3., about signs and causes.

[32] *Unum quidem et primum iudicatorium historia vere dictum est ab empericis esse iudicantis per se inspectio,* "The first and foremost criterion of true history, the empiricists have said, is what the person who makes the judgment has perceived for himself," trans. Walzer and Frede, 1985, 34.

[33] Trans. Walzer and Frede, 1985, 36.

[34] Trans. Walzer and Frede, 1985, 36.

[35] *Aliud vero iudicatorium historia est, si id quod dicitur fuerit simile eisque cognita facta fuerunt nobis per se inspectionem*; "Another criterion for history is whether what is said resembles those things we have come to know through our own observation," trans. Walzer and Frede, 34.

making diagnostic and therapeutic decisions. The character of the individual recording the observations, and the concordance of those written observations with personal experience and other written sources, are specific, clearly-defined means by which the acceptability of ἱστορία may be identified. These criteria for the admissibility of evidence, in the context of medical decision making, find a modern parallel in what has been called "the hierarchy of evidence."[36] Established in the 1990s in the context of a proliferation of medical and scientific data, the hierarchy of evidence is an aid to judging the value of studies in approaching a truth about a disease process or treatment. The basic principle is that, the more people involved in a study (i.e., a large "n," or study population) and the more control the investigator had over that study, the more valuable and 'correct' the resultant data are. By this standard, a meta-analysis – a single analysis that aggregates and compares the results of multiple studies, and ranks these studies according to their statistical power and validity – exerts the most influence over a physician's clinical decision making process. Among studies that are not meta-analyses, the so-called "gold standard" is a large, double-blind, placebo-controlled trial, meaning that neither the participants nor the investigators in the study know which group is the experimental group and which group is receiving a placebo.[37] The study should also include a sufficient number of participants to permit thorough statistical analysis and the leveling out of any kind of effect that individual variation might have on the interpretation of the results: in some cases, hundreds of thousands of

[36] T. Greenhalgh, "How to read a paper: getting your bearings (deciding what the paper is about)," *British Medical Journal* 315, (1997): 243-6. Although note that more recent studies have begun to question the traditional hierarchy of evidence. See, for example, John Concato, Nirav Shah, and Ralph Horwitz, "Randomized, controlled trials, observational studies, and the hierarchy of research designs," *New England Journal of Medicine* 342. (2000): 1887-1892. The basis for objections to the traditional model is in part derived from arguments that large studies obscure individual difference that may be relevant for treatment decisions.

[37] Laura Bothwell and Scott Podolsky, "The emergence of the randomized, controlled trial," *New England Journal of Medicine* 375, (2016): 501-504.

participants are involved, over the course of decades. Case reports, or descriptions of a single patient, exert the least influence in the hierarchy of evidence.

I mention this modern approach to the evaluation of clinical evidence because I believe it provides a useful way to think about the Empiricists' goals in the definition and application of ἱστορία as they encountered and treated patients. Though not supervising double-blind, placebo-controlled trials of their therapies, the Empiricists' insistence on establishing criteria for the admissibility of evidence that could be used in medical decision making represents a notable development in the way ancient physicians conceptualized decision making. While certainly "no codified orthodoxy,"[38] the Empiricists' gestures toward systematization in the evaluation of evidence obtained by others are noteworthy and reflect a demonstrated sensitivity to one of the components of decision making, namely assessment of the quality of evidence used to make the decision. Assignation of relative value occurred even within different criteria. For example, some physicians were most reliable, others less so, others least of all.[39] Agreement of sources regarding a particular question was good, more agreement was still better, and best of all would be confirming such agreement by personal experience. This importance of concordance – with additional value assigned to a statement when greater numbers of writers agreed about a particular detail – in the evaluation of evidence is not dissimilar to the value modern physicians assign to the aggregated data of the meta-analysis. The goal in both the ancient and the modern contexts involves circumscribing the conditions under which the information is acquired, confirmed, and applied, an idea which will emerge again as we consider another element of the Empiricists' approach to medical practice, ἐμπειρία.

[38] Hankinson, "The growth of medical empiricism," 65.

[39] Frede, *Essays*, 249-250.

4.3.3 ἐμπειρία, *Memory, and the Development of Expert Intuition*

The principle of direct experience formed the core of an Empiricist physician's decision making process: it represented the most accurate and straightforward way an Empiricist physician could make the correct diagnostic and therapeutic decisions, and it consisted in αὐτοψία – "seeing for oneself" – and memory.[40] The memory of cumulative and collective experience in medical practice is summarized by the term ἐμπειρία, and the use of this term to designate the second leg of the tripod emphasizes the simultaneously collective and personal nature of this term. A physician needed to encounter a particular case himself, and then he would subsequently add it to his mental collection of cases that he had observed, holding it in memory until he needed to recall this knowledge to treat the same problem in the future. This is the process, Galen's Empiricist argues, by which doctors came to know, for example, that pomegranate is useful in the treatment of diarrhea: firsthand experience treating patients suffering from diarrhea taught the appropriate remedies.[41] The sailor and the farmer know how to pilot a ship and how to grow crops because they have done so through their own lived daily experience and remember what they have learned.[42] Galen's Empiricist challenges his Rationalist interlocutor by arguing that while theoretical study is optional for a physician, acquisition of ἐμπειρία is fundamentally necessary and is the most reliable element of medical training and practice: knowledge is obtained through ἐμπειρία. The Empiricist criticizes the Rationalist position on the privileging of λόγος – reason – as one characterized by inconsistency and conflict. The Rationalists disagree among themselves regarding the causes of diseases,[43] the

[40] Galen, *Sect.Int.* 2.

[41] Galen, *Med.Exp.* 10.

[42] Galen, *Med.Exp.* 9.

[43] Galen, *Med.Exp* 11.

Empiricist argues, and in some cases, their theoretical justification for what they observe is inconsistent with those very observations.[44] As described above, this demonstrable lack of concordance and failure of theoretical reasoning, Galen's Empiricist concludes, means that "nothing remains except experience."[45] Experience is therefore the source of the knowledge that is applied in the context of clinical decision making, and memory is the means by which those collective firsthand experiences translate into clinical decisions.[46]

Memory was an important component of ἐμπειρία. Michael Frede has described the important role of memory in the epistemology of the Empiricists, whom, he notes, were called 'memorists' (*mnemoneutikoi*) by Galen.[47] He argues that the Empiricists understood memory to require, "some characterization of what we observe, which allows us to recognize something as something we haven't seen before."[48] Consistent with the stress they placed on the role of memory in interpreting their observations, the Empiricists' general position on the admissibility of signs is also justified with reference to memory. While they dismissed "indicative" signs – those which indicated the presence of some aspect of disease that could not be directly seen – they did allow for the incorporation of "commemorative" signs in their decision making processes.[49] These latter signs were deemed to have a clearer association with the thing signified,

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[44] Galen, *Med.Exp* 15.

[45] Ibid., trans. Walzer and Frede.

[46] Consider the example that the Empiricist describes in *Med.Exp.* 24 regarding the decision to lancet an abscess.

[47] Michael Frede, "An Empiricist View of Knowledge: Memorism," in *Epistemology: Cambridge Companions to Ancient Thought*, ed. S. Everson (Cambridge: Cambridge University Press, 1990), 226-7.

[48] Frede, "An Empiricist View," 243.

[49] This distinction derives from Sextus Empiricus' *PH* 2.10: Τῶν οὖν σημείων τὰ μέν ἐστιν ὑπομνηστικὰ κατ' αὐτοὺς τὰ δ' ἐνδεικτικά. καὶ ὑπομνηστικὸν μὲν σημεῖον καλοῦσιν ὃ συμπαρατηρηθὲν τῷ σημειωτῷ δι' ἐναργείας ἅμα τῷ ὑποπεσεῖν, ἐκείνου ἀδηλουμένου, ἄγει ἡμᾶς εἰς ὑπόμνησιν τοῦ συμπαρατηρηθέντος αὐτῷ καὶ νῦν ἐναργῶς μὴ ὑποπίπτοντος, ὡς ἔχει ἐπὶ τοῦ καπνοῦ καὶ τοῦ πυρός. ἐνδεικτικὸν δέ ἐστι σημεῖον, ὡς φασίν, ὃ μὴ συμπαρατηρηθὲν τῷ σημειωτῷ δι' ἐναργείας, ἀλλ' ἐκ τῆς ἰδίας φύσεως καὶ κατασκευῆς σημαίνει τὸ οὗ ἐστὶ

and they also provided the possibility of verification of the relationship between sign and thing signified: for example, the relationship between smoke and fire. The smoke suggested the presence of a thing previously not evident (fire), but the fire *could* be evident in certain circumstances in which smoke was present, if the viewer looked for it. To continue the analogy, since there were occasions on which the fire had been seen as related to the smoke, it was permissible to recognize that the smoke would signify fire even if the fire happened to be not evident in a given circumstance. The memory of the relationship between the smoke and the fire – the status of smoke as a commemorative sign – sufficed. Memory, to the Empiricist, was a cognitive tool that "can process" and "was somehow able to sort," thereby yielding generalizations that were of practical use in the diagnosis and treatment of disease.[50]

Since memory was a collection of observations that yielded generalizations, the Empiricists were especially sensitive to how the number of observations could inform those generalizations. They acknowledged that more observations could contribute to greater accuracy and more predictable outcomes in diagnosis, prognosis, and treatment, but they also recognized that these generalizations could still be proven wrong in certain circumstances.[51] Hundreds of consistent observations could be called into question by a single unexpected outcome.

σημεῖον, ὡσπεροῦν αἱ περὶ τὸ σῶμα κινήσεις σημεῖά εἰσι τῆς ψυχῆς. About the relationship between Empiricism and Skepticism, see Hankinson, *Cause and Explanation*, 307; Jonathan Barnes, "Ancient Skepticism and Causation," in *The Skeptical Tradition*, ed. M. Burnyeat (Berkeley, University of California Press: 1983), 149-203; and Lorenzo Corti, "Hidden Causes: Ancient doctors and modern thinkers on the perceivability of causal links," in *Le débat sur les causes à l'âge hellénistique et imperial*, ed. C. Natali and C. Viano (Louvain-la-Neuve, Peeters, 2014), 95-117. For Sextus Empiricus, the Empiricist medical tradition, and signs, see Allen, *Inference from Signs*, 86-146.

[50] Frede, "An Empiricist View," 243-4.

[51] Galen, *Med.Exp.* 15-17.

To accommodate these unpredictable cases in their approach to the clinical application of memory, the Empiricists sorted their observations by associating them with relative likelihood frequencies:[52]

> *Emperiam autem dicimus notitiam eorum que ita multotiens apparuerunt, ut iam theorematica sint id est ut sciatur, utrum semper aut ut plurimum aut secundum utrumlibet aut raro evenerunt. Quatuor enim sunt hai theorematicae differentiae. Quocirca et dicemus esse theorem rei alicuius visa multotiens notitiam simul cum distinguendo eventum qui est secundum contrarium, distinctio vero erit eius quidem quod semper ut inapparabile habentis contrarium, eius vero quod ut plurimum ut apparente quidem eo quod contrarium est sed raro, eius vero quod secundum utrumlibet ut equaliter apparente, eius quod raro eo quod non aliquando sed ut plurimum. Ea vero de quibus non habemus talen distinctionem, inordinate dicimus et notitiam que de eis non esse penitus partem emperia.*
>
> "By 'experience' [*empeiria*], we mean the knowledge of those things which have become apparent so often that they already can be formulated as theorems, i.e., when it is known whether they always have turned out this way, or only for the most part, or half the time, or rarely. These are the four differentiations of theorems. Hence we will also say that a theorem is the knowledge of something which has been seen often but a knowledge which involves at the same time a distinct knowledge of results to the contrary. This will be a distinction between what happens always (as something whose contrary never makes its appearance), what happens for the most part (as something whose contrary does appear, but rarely), what happens either way, as it may chance to be (as something whose contrary appears equally often), and finally what happens rarely (because its contrary does appear, not just sometimes, but for the most part). But those things for which we do not have this kind of distinction, we say, are unordered, and the knowledge of them is not really a part of experience."

Here, the Empiricists describe how they use their observations to build different kinds of generalizations – called theorems – that are rooted in correlations noted in clinical practice. Observations that they cannot assign to one of the four kinds of generalized, correlative patterns (always, often, sometimes, never) are not included in their evaluation. Explicitly classifying their observations in this way, with an eye toward relative correlation, the Empiricists present a method for evaluating medical data that employs many of the heuristics described in Chapter 1. They based their decisions on information that is immediately available to them (the availability

[52] Galen, *Subf.Emp.* 2, Deichgräber p.45-46; trans. Walzer and Frede (1985).

heuristic), and they argue that they can identify representative examples of a given condition, and then apply knowledge gained from that case to subsequent cases (the representativeness heuristic). As I have described in Chapter 1, heuristics are useful tools, in that they help a decision maker to cope efficiently with large amounts of information by limiting the amount of data that directly influences the decision.

The Heuristics and Biases Approach, however, is not the only theoretical model used to evaluate professionals' judgment: in Chapter 1, I also described Gary Klein's theories about Naturalistic Decision Making and the development of expert intuition. His studies of grand chess masters and firefighters suggest that, if a professional does in fact see a sufficient number of different cases, with a sufficient number of outcomes, she will come to possess "expert intuition" – a way of evaluating situations that has been described by another behavioral economist a "nothing more and nothing less than recognition."[53] The expert possesses a particular kind of advanced pattern recognition, Klein and Kahneman argue, that can develop if two conditions are met: "First, the environment must provide adequate valid cues to the nature of the situation. Second, people must have an opportunity to learn the relevant cues….[there must be] adequate opportunity to practice the skill."[54] The nascent 'expert' must be learning (and deciding) in an environment that possesses an element of consistency, such that she can make mistakes, learn from those mistakes, see the desired outcome when those mistakes are avoided, and then repeat this process in a reliable way.

While the Empiricists' approach to clinical decision making can be understood with reference to heuristics, its emphatic focus upon the accumulation of ἐμπειρία and the value of

[53] H.A. Simon, "What is an Explanation of Behavior?" *Psychological Science* 3, (1992): 155.

[54] Kahneman and Klein, "Conditions for Intuitive Expertise," 521.

memory aligns with the conditions that encourage the advanced pattern recognition characteristic of expert intuition. Three aspects of the Empiricists' arguments about the acquisition of medical knowledge fit with the criteria that Kahneman and Klein describe. First, the privileging of performative experience: an Empiricist physician acquires skill by treating patients himself, just as the helmsman becomes skilled not by reading about navigation, but by doing it on a daily basis. Second, the privileging of memory: pattern recognition evolves from registering, storing, and classifying an observed event. A grand chess master must see and then remember a given move and the outcomes it yields; similarly, the Empiricists emphasize the value of firsthand experience (αὐτοψία) that is then translated into personal memory at a primary level (ἐμπειρία), and of secondhand experience and collective, distributed memory at a secondary level (ἱστορία).

Third, in comparison to their Rationalist counterparts, Empiricist physicians seem to make more of an effort to control the information deemed valuable for clinical decision making. In *On Medical Experience*, the Empiricist chides the Rationalist for incorporating unnecessary details into his decision making process:[55]

> "Were you now to say to us: 'why then do you not use your intelligence and search out and remember if your patient should have happened to sleep, or to speak, or what garments he was wearing?' we should answer: 'once again with these arguments of yours you but accuse yourself, not us. For we adopt the method of memorizing and recollecting those things amongst them from which there has occurred in the majority of cases obvious harm or benefit to an appreciable degree. But as for the other things, we do not trouble about them, nor concern ourselves with them, since the memory holds only those things which are of frequent occurrence…Therefore whatever I have stored up in memory as doing harm or good to an appreciable degree in themselves, and perceptible by sense, I affirm the advantage which is derived therefrom."

The Empiricist physician emphasizes that the inquiry into details about the patients' habits, as necessitated by the Rationalist approach, is irrelevant and even (as the Empiricist hints elsewhere

[55] Galen, *Med.Exp.* 30; trans. Walzer and Frede.

in the passage), dangerous for the physician. If a physician believes he needs to ask about every detail of the patient's life, then a failure to do so will imply neglect. By focusing only on aspects of the patient's condition that most obviously and most consistently relate to harm or benefit, the Empiricist physician has the greatest chance of bringing about a positive outcome and spares himself from potential accusations of malpractice. With specific reference to the development of expert intuition, the Empiricist here focuses on a kind of pattern recognition that deliberately avoids the 'noise' – the unnecessary details – and looks to the pertinent, frequently apparent features of the patient's condition in order to see how they fit with his cognitive catalogue of disease states. To the extent that they can, they are imposing limitations on the external environment that allow them to circumscribe the information they include in the establishment of a given disease pattern. For these three reasons – privileging of performative experience, privileging of memory, and emphasis on looking to "adequate valid cues"[56] in a patient encounter – we might say that the Empiricists were, in general, striving toward the attainment of expert intuition, an advanced form of pattern recognition that yields a "recognition-primed decision."[57]

[56] Kahneman and Klein, "Conditions for Intuitive Expertise," 521. For an example of Galen's Empiricist explaining how he intentionally does not incorporate into his memory that which he cannot perceive directly with his senses, see Galen, *On Medical Experience* 30: "Therefore whatever I have stored up in memory as doing harm or good to an appreciable degree in themselves, and perceptible by sense, I affirm the advantage which is derived therefrom. But with respect to the things which perhaps are beneficial or harmful in some way or other, but whose benefit or injury cannot be perceived by the senses and retained in the memory, I refuse to recognize them, not because, if I were to recognize them, the knowledge of them would harm me, but because my observation and recollection do not reach as far as all this.," trans Walzer and Frede, 104.

[57] Kahneman and Klein, "Conditions for Intuitive Expertise," 516.

4.3.4 Soritical Arguments and Indeterminacy

Despite their sophisticated attempts to control the knowledge that affected their decision making processes, their acknowledgment that any given physician had not seen, and could not see, all there was to see, left the Empiricists vulnerable to questions about how many observations sufficed to yield a competent doctor. How could an Empiricist physician be certain that his individual collection of observations – or even the collections of several other physicians – would yield precise generalizations? His appeal to the value of ἱστορία and ἐμπειρία suggested that the number of observations mattered in his efforts to identify patterns securely. Yet in *On Medical Experience*, he condemns soritical arguments when confronted by the Rationalist with the question of how many observations is enough to produce a competent physician.[58] The Empiricist concludes his argument by asserting that the number of times required for a medical practitioner to observe a given phenomenon adequately is an individual and indeterminate matter.[59]

Commenting on the Empiricist's position on soritical arguments, Barnes argues that this appeal to indeterminacy, "supposes that there genuinely is *no* true answer to the question 'How many observations did Serapion require to justify his belief that pomegranates cure diarrhea?"[60]

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[58] Galen, *Med.Exp.* 14-18.

[59] Galen, *Med.Exp.* 18, trans. Walzer and Frede: "And after each apprentice has seen very many times how these things are done, and this is given him as an aim to be accomplished in a 'technical' way, he strives to fashion something with his own hands, but he is not yet a master and skilled craftsman until he has practised that work very many times with his own hands in the same way. If he does so, long experience will make him an expert master, because the knowledge of the master and of the expert and the 'technician' can only be attained and perfected in this way, little by little in an imperceptible increase. And everyone knows that this can only happen after many single manipulations. But as to how often these indispensable preliminary works must be done nothing plain and definite can be said by anybody. Likewise in the case of goldsmiths and painters: they become masters after long experience and a thorough training of the vision."

[60] Jonathan Barnes, "Medicine, experience and logic," in *Science and Speculation: Studies in Hellenistic Theory and Practice*, ed. Jonathan Barnes, Jacques Brunschwig, Myles Burnyeat, and Malcolm Schofield (Cambridge: Cambridge University Press, 1982), 63.

Barnes argues that, although the Empiricists had rejected the need for logic, in a sense, they "were anticipating a non-standard logic of vagueness" and were questioning the system of logic in which the Rationalists wanted them to operate.[61] Relying on Barnes' evidence, I would argue that the Empiricists' appeals to indeterminacy and vagueness reflect a keen sense of the individual variability that is a central challenge for the construction of medical theories and a persistent problem in the deployment of memories of prior cases. This individual variability extended to both patients and physicians: the former differed with respect to the nature of their bodies and their illnesses, the latter with respect to their personal fund of experience and knowledge acquired from study. First- and secondhand experience-based memory of previous patients was valuable and effective for diagnosis, treatment, and prognosis. Yet memory was limited because, as experience *also* showed, generalizations could and did fail (though to different degrees, as the above discussion of relative correlations of observations indicates).

The preceding section argued that the Empiricists employed heuristic-based decision making and also structured their methods of observation in ways that facilitated the development of expert intuition, as defined by Kahneman and Klein. As Chapter 1 described, heuristics can be useful for efficient decision making, but they can also lead to generalizations that prompt incorrect choices by failing to account for individual variability. Similarly, the development of expert intuition is directly connected to what the developing expert encounters: a failure to encounter particular kinds of scenarios implies that the expert will not receive sufficient training to manage them effectively when they arise. Phrased another way, both ways of understanding medical decision making highlight the challenges between moving from the particular to the general, and back to the particular. The Empiricists' arguments against precise definitions

[61] Barnes, "Medicine, experience and logic," 64.

provide one way of acknowledging and circumscribing this individual variability.[62] As they recognize that some individuals may require a greater amount of time to become 'expert' than others, so they acknowledge that variation in disease states is as great as the number of people who could fall ill.[63] Their response to this acknowledgement of near-infinite variety is a system of qualitative correlations, and a refusal to base their decisions on any evidence or assertions that cannot be directly observed. It is a recognition of the problems inherent in heuristics and medical training and a call to focus decision making on the patient in front of the physician. The Empiricists' recourse to indeterminacy is an acknowledgment of the limits of both heuristics and the capacity of a single physician to learn how to recognize every potential pattern that could exist.[64]

4.3.5 Conclusions about Empiricism and Decisions about the Relevance of Knowledge

Empiricists knew how decision frameworks could influence clinical practice. In an environment of rapidly increasing medical knowledge and the epistemological debates engendered by this increase in knowledge, the Empiricists responded by rooting their approach to decision making in an initial evaluation of the reliability and relevance of that knowledge for the resolution of the clinical question. Both reliability and relevance were, in their view, guaranteed through recourse to ἐμπειρία, or, failing one's own experience, through second-hand ἐμπειρία (i.e., ἱστορία) from a reliable source. This decision to limit the kinds of information applied in diagnostic and therapeutic decision making provided a systematic way of focusing

[62] Schiefsky, *Ancient Medicine*, 370ff.

[63] Galen, *Med.Exp.* 28.

[64] This is a major argument of the Rationalist critique of Empiricism: Galen, *Med.Exp.* 4-5.

clinical decision making on the readily observable – τὰ φαινόμενα – and circumscribing the potentially idiosyncratic interpretation of signs. Instead, consistently framed, accumulated experience comprised the fund of knowledge from which the individual physician was to draw his conclusions, as he applied this knowledge to new situations.

4.4 Decisions about the Applicability of Knowledge

4.4.1 ἡ τοῦ ὁμοίου μετάβασις, the Transition to the Similar

Once the appropriate fund of knowledge for clinical decision making had been identified and compiled, the Empiricist physician next faced decisions about how to apply the relevant knowledge. In an ideal situation, he would recognize the disease he was treating because he had treated the same disease before, or because he had read the account of a physician who had treated it. He could then provide suitable therapy based on his knowledge of what had previously been successful. Cases he had not seen before or read about in reliable medical texts, however, required a different approach, and it was in these situations that he used the principle of "transition to the similar." Galen explains this principle by noting that it means, in practice:[65]

> "…if there is the same affection, the same remedies are in place, e.g., in the case of the thigh, the elbow, the leg, the arm, the foot, and the end of the hand. Similarly, if a similar affection befalls the same part of the body, the same remedies are needed, as in the case of diarrhea and dysentery. This, then, experience has taught us. Moreover, it has also taught us to proceed to the contrary, if the observed remedies for a given affection are applied for a long time without effect. It is only reasonable, then, that they say that the transition to the contrary, too, is based on the similarity with what has been found out empirically."

The transition to the similar, then, could be employed in diagnostic and therapeutic contexts (prognostic contexts, too, as will be describe below). Transitions could be made across different

[65] Galen, *Subf.Emp.* 9. This passage also gestures toward a separate point about the 'meta-empirical' quality of transition to the similar, i.e., that the reliability of the principle is itself based on experience.

anatomical parts (e.g., applying the same treatment for a broken foot as for a broken hand); across different disease states that affect the same part of the body (e.g., two different diseases of the intestines); or across different remedies that share properties and therefore are useful in treating the same problem.

Applying the principle of the transition to the similar in these variable contexts necessitated further decisions, and Galen writes that the early Empiricists disagreed over the meaning and implications of the transition to the similar. Serapion, he suggests, regarded the transition to the similar as "a third constitutive part of the whole of medicine," while others, such as Cassius, believed that the Empiricist physician should not use this principle at all in his practice,[66] potentially because the transition to the similar seemed too close to Rationalist inference and reasoning.[67] Theodas apparently equated the principle with practical experience; still others argued that it functioned as "an instrument."[68] A further question about the role of the transition to the similar in medical practice related to its role in therapeutic innovation: if, as noted above, it permitted the trial of similar though previously untested therapies, it could potentially serve as a method of finding new remedies.[69] Yet, because of its role of discovery, this leg of the tripod was less sturdy than the other two (ἱστορία and αὐτοψία/ἐμπειρία), since it suggested a *new* remedy. Knowledge acquired in this way was therefore neither part of a

[66] Galen, *Subf.Emp.* 4, trans. Walzer and Frede.

[67] Hankinson, *Cause and Explanation*, 313-14.

[68] Galen, *Subf.Emp.* 4.

[69] For an alternative argument, that the Empiricist approach stifled innovation and discovery, see von Staden, "Experiment and Experience in Hellenistic Medicine," 192. Noting the Empiricists' awareness of correlation and relative probability, von Staden concludes that they, "remained unshaken by the infinity of individual appearances and used it in their own favour. Their concessions to statistical confirmation, to probabilism, analogy, and improvisation were not enough to render their theory conducive to experimentation…[and] the inhibiting effect of their brand of empiricism on experimentation may have been considerable."

physician's fund of knowledge derived from personal experience, nor recorded in other physicians' accounts. Consequently, to be incorporated functionally and reliably into the broader body of Empirical knowledge, what was discovered through the transition to the similar needed to be re-tested in future (identical) circumstances.[70]

Employing this principle – even before any new information was acquired through its use – required an initial round of decision making. Which aspects of existing clinical knowledge would be useful in addressing the problem? What did 'similar' mean? What criteria mattered for assigning a status of similar? As we have seen in the quote from Galen presented in the beginning of this section, many aspects of existing clinical knowledge could be useful. A physician could begin his process of mental transitioning on the basis of anatomy, symptoms, or, in the case of therapeutics especially, other diverse qualities, including shape, color, consistency, odor, or taste.[71] Galen writes that the Empiricists accord taste and odor greater weight in the determination of similarity, as they have been "found usually to lead to the same result," but if all five qualities are similar, then "things are similar to the highest degree and produce the same effects." There is a limit to this differentiation, however. Within a given category, such as taste, "one should not judge similarity just by some single quality, such as sharpness, astringency, bitterness, sweetness, harshness, sourness, or saltiness but should put one's mind to the peculiar character of the taste as a whole."[72] In still other cases, the problem being treated (e.g., wounds or diarrhea) influences the decision making surrounding which aspects of similarity should be privileged.

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[70] Hankinson, *Cause and Explanation*, 313-14.

[71] Galen, *Subf.Emp.* 11.

[72] Ibid.

As Galen presents it, the transition to the similar implied a semi-structured system for determining the basis for, and the strength of, similarity: *gestalt* taste and odor were most important in identifying it. The likelihood that treatment with these new and similar materials would produce a result close to what would be expected for a known and tested remedy was increased if the new materials shared shape, color, and consistency with the legacy remedy. Transition could be adjusted, however, based on what the disease process was determined to be, and where it was occurring. These aspects of decision making regarding the application of the newly-identified remedy – the what and where of the disease – could prevent a physician from employing the most obviously similar remedy if certain features of it had been proven to exacerbate problems of certain kinds, in certain places. Thus Galen cautions that particular aspects of similarity should be avoided in the treatment of diarrhea, for example. Though a physician might expect to use a remedy that is astringent, he should be careful that his astringent remedy is not too sharp or bitter: the disease being treated necessitates the qualification of the transition to the similar.[73] This principle, then, designates not only similarity in properties, but more importantly, similarity in expected outcome.

The transition to the similar, as Galen describes it, involves a capacity to provide prognosis adjusted by relative degree of certainty. After discussing the features on which a physician might base assertions of similarity, he writes:

> "It is clear then that the degree of expectation of a possible outcome is not the same in all cases which are similar. It rather is the case that, to the extent that the things to which we make the transition differ in similarity, there is a different degree of expectation of the possible outcome…But, for what neither is confirmed by history nor is similar, there is little expectation. But thus it is reasonable to have a higher or lower expectation also in the case of the transition from one disease to a similar disease, depending on the similarity between the diseases, an expectation which is diminished or increased, depending on whether it is confirmed by history or not. And, in similar fashion, with the

[73] Galen, *Subf.Emp.* 9.

> transition from one part of the body to another, to the degree that there is the more or the less difference, to that degree there will be differences in expectation."[74]

The principle of the transition to the similar therefore has diagnostic, therapeutic, and prognostic applications. In these scenarios, decision making based on limited, designated similarities, arranged in a flexible framework that takes into account anatomy and disease characteristics, provides an evidence-based mechanism for diagnosis, therapy, and prognosis. My choice of words here – evidence-based – is intentional and will be discussed further in the penultimate section of this chapter: I will say at this point that I mean evidence-based in the sense that diagnostic, prognostic, and therapeutic decisions, anchored in the principle of broadly-designated similars, were explicitly based on prior observations of outcomes. Evidence – whether firsthand ἐμπειρία or secondhand ἱστορία – guided practitioners' choices in the face of the unknown.

4.4.2 Syndromes and their Implications for Diagnosis, Prognosis, and Treatment

This evidence-based, phenomenological approach kept the clinician fully rooted in current and past clinical encounters, a methodological focus that is apparent in the Empiricists' disease classification system, as Galen describes it. For the Empiricists, pathologies were grouped into syndromes, collections of co-evident (concurrently appearing) symptoms whose waxing and waning aligned. Syndromes could be diagnostic, in that they facilitated identification of the problem; therapeutic, in that they suggested an appropriate treatment; or prognostic, in that they gave a particular indication of the future progression of the disease. This process of designating and demarcating syndromes required careful observation and questioning of the patient, but was not influenced by or in need of knowledge about additional details of the patient's life and habits. Visible anatomy, physiology, and symptoms formed the core of the

[74] Galen, *Subf.Emp.* 9, trans. Walzer and Frede.

evaluative process. Naming of the identified syndromes occurred in various ways: after the organ affected (pleurisy and pneumonia), a symptom (phrenesis), or a similarity (cancer or elephantiasis). Sometimes, a new name was created (edema and scirrhus). As we have seen in their classification of observations and in their evaluation of the quality of the similar, the Empiricists made a distinction between symptoms that "arise and grow at the same time and which come to a halt and decline and disappear simultaneously" (coinvadentia) and "those which only usually grow together" (constituents).[75] All of these determinations and classifications were made from direct observation, and from this method emerged a clinical system organized around groups of observations and chronologies, and structured to correlate and to assign relative likelihoods.[76]

From the standpoint of decision making, the focus on identification of co-occurrence would have further encouraged the correlation- and pattern-based thinking that is characteristic of the Empiricist position more broadly. Searching for a diagnosis, identifying a proper therapy, and venturing a prognosis, a physician would have been attentive to chronology and the arc of each symptom: when it first appeared, any changes in its severity, and its disappearance. Again, we observe the Empiricists' taxonomic tendency to think in terms of relative severities – is it better or worse today than it was yesterday, or has it remained unchanged – and then to incorporate these relative values into a decision framework that is based on correlation: did relative changes in this symptom match relative changes in another? The heuristics we have discussed (availability, representativeness, anchoring and adjustment, and even the affect

[75] Galen, *Subf.Emp.* 6. Terms in parentheses as given in Walzer and Frede, 31. They choose to translate one with a more Latinate form, and another with its English form.

[76] "For we make use of our experience, observing things and trying to remember what we have seen to happen in conjunction with what, and what we have seen following what, and what we have seen preceding what, and whether this is always so, for the most part, half of the time, or rarely," Galen, *Subf.Emp.* 6, trans. Walzer and Frede.

heuristic[77]) are without doubt involved in the decisions to notice, to remember, and to link a set of symptoms. Decisions were limited by what was immediately visible or identifiable through a commemorative sign (availability heuristic). The transition to the similar, with its application facilitated by this kind of correlation- and pattern-based thinking, encouraged thinking along the lines described by the representativeness heuristic. The tendency to think about syndromes as clusters of symptoms creates space for the application of the anchoring and adjustment heuristic, and if a physician based his construction of a syndrome in a particularly violent or distressing symptom, then we might observe the affect heuristic at work.

Yet, as we have also seen, the development of expert intuition is emphatically correlation- and pattern-based, and the more opportunity a physician had to memorize variations in these patterns, and the relative likelihoods that undergirded assertions about these variations, the more successful the Empiricists argued he would be. Modern arguments about the development of expert intuition – of advanced pattern recognition – emphasize the need for a large "n," that is, a greater number of exposures to relatively controlled decision making contexts. For the Empiricists, too, the "n" mattered – but with qualifications. The awareness of the limitations of thinking in generalizations – or, put another way, the awareness of the limitations of thinking with heuristics – led the Empiricists to conclude that, while the "n" mattered in the training of physicians, there was still an inescapable element of indeterminacy in the practice of medicine. Their phrasing of correlations, with their relative evaluation, is also recognition of the uncertainty that arises from individual variation. They have a carefully developed approach to medical decision making, but at its end, they concede, we need to

[77] Recall that the affect heuristic describes the role that emotion plays in decision making, in that we are more likely to accord greater weight to observations tied with strong emotions.

recognize that there are limits to our human capacity to know,[78] and we cannot strive to false precision.

4.4.3 Conclusions about Empiricism and Decisions about the Applicability of Knowledge

For someone committed to trying to understand the underlying cause of every sign and symptom, the Empiricist position – even when moderately expressed – must have been frustrating. But the unknown in medical practice always has been and remains frustrating for physicians and patients alike. In many respects, however, a refusal to speculate about the unknown turns patients' and physicians' cognitive machinery more directly to what they *do* know that may be of assistance in resolving a clinical question. Experts are experts, the Empiricists argue, not because they are skilled in wide-ranging and speculative theory, but because the large number of cases they have handled directly, or read about, enables them to determine what is important in a given clinical encounter, and then to decide, based on that experience, an appropriate treatment. Their greater "n" (the number of cases they have handled related to a given problem) will render these decisions more correct, more often. In the final section of this chapter, we will use a modern case study to consider the practical aspects of the Empiricists' approach to a clinical problem, exploring the benefits and problems of this method in the diagnosis and treatment of patients.

[78] Galen's Empiricist concedes to the Rationalist: "It is likely that the same thing happens to me which often happens to others, namely that I fail to attain my object and make mistakes in my medical practice, and do not always act correctly, since my knowledge is not true knowledge based on full investigation of the whole of mankind, but knowledge acquired at haphazard that falls short of the truth," *Subf.Emp.* 30, trans. Walzer and Frede; see also Galen, *Subf.Emp.* 7, on the Empiricists' argument for recourse to ἱστορία, "since one man's life will not suffice to find out everything" (trans. Walzer and Frede).

4.5 Empiricism and Medical Decision Making: Conclusions

4.5.1 The Utility of the Empiricists' Approach: A Modern Case Study in Pattern Recognition and Quick Decisions

The preceding pages have described the Empiricists' self-conscious efforts to recognize the limits of medical knowledge, and to deal systematically with the kinds of data incorporated into the process of medical decision making. In this final section, I would like to provide a modern analogy to shed light on the utility of this approach.

In Chapter 1, we met Dr. Jerome Groopman, a hematologist who has written not only about medical decision making in modern contexts, but also about the cognitive mechanisms that characterize the human brain. In this section, I would like to return to Dr. Groopman's books to present a vignette he relates about his medical training, as I believe its central point illustrates the particular heuristic value of the pattern recognition celebrated by Empiricist thought. In his 2007 book, *How Doctors Think*, Dr. Groopman describes his first night as an intern – a newly-minted doctor – in the 1970s. He was the only licensed physician responsible for the patients on his floor, overnight, on his first day on the job. As Dr. Groopman was chatting with one of the patients after the rest of the medical team had left, the patient suddenly "shot bolt upright in bed. His eyes widened. His jaw fell slack. His chest began to heave violently…He shook his head, unable to speak, desperately taking in breaths." Dr. Groopman continues to describe his own reaction: "I tried to think but couldn't. The encyclopedia [of knowledge in my head] had vanished. My palms became moist, my throat dry. I couldn't move. My feet felt as if they were fixed to the floor."[79] In what Dr. Groopman describes as a "*deus ex machina* appearance," a cardiologist from Virginia who was in the hospital visiting a friend happened to pass by the

[79] Groopman, *How Doctors Think*, 31.

room, noticed the patient, listened to his chest, and told the young Dr. Groopman that the patient had suffered a tear in his aortic valve and needed emergency cardiac surgery immediately. As Dr. Groopman narrates, the time of his greeting the patient, to the arrival of the cardiologist, took about fifteen seconds.

As he reflects on this incident in his book, written nearly 30 years later, Dr. Groopman says: "That first night of internship showed me that I needed to think differently from how I had learned to think in medical school – indeed, differently from the way I had ever thought seriously in my life. This was despite my having met patients like [this] before. During medical school we had studied what are called paper cases, patients in the form of written data…"[80] He continues to describe the way that medical students are taught to think systematically and over an extended time period through these patient cases. Then, he references the research of Dr. Robert Hamm of the Institute of Cognitive Science at the University of Colorado, Boulder, to point out the challenges of this didactic approach:

> "the irony is that [students'] mentor, the senior attending physician, does not think this way when he actually encounters a patient like [this]. At such moments, Hamm writes, it is not evident that any 'reasoning' is being used at all. Studies show that while it usually takes twenty to thirty minutes in a didactic exercise for the senior doctor and students to arrive at a working diagnosis, an expert clinician typically forms a notion of what is wrong with the patient within twenty seconds. According to Hamm and other researchers on physician cognition, if I had asked John Burnside [the physician who diagnosed the aortic valve tear] what was going on in his head, he would have been hard-pressed to describe it. It simply happened too fast."

In a study of medical decision making, the important phrase to notice in Groopman's description is "expert clinician." The swiftness and accuracy of Dr. Burnside's realization derived from decades of pattern formation: his expert intuition.

[80] Groopman, *How Doctors Think*, 33.

There is another aspect of Dr. Groopman's narrative of himself and Dr. Burnside that merits mention. He concludes his description of the episode with the cautionary comment: "heuristics serve as the foundation of all mature medical thinking…they can save lives, and…they also can lead to grave errors in clinical decision-making."[81] This comment finds its ancient analogue in arguments raised by the Empiricists' detractors, who worried that the Empiricists' focus on direct, observable experience could prevent them from speculating about other diagnostic and therapeutic possibilities. Yet, as we have seen, while their approach to diagnosis, prognosis, and therapy emphatically restricted the kinds of information deemed acceptable for decision making, it also provided a mechanism for the discovery of new therapies through the application of the transition to the similar. This concept, with its clear grounding in careful noting, remembering, and comparing of observations, provided the justification for expansion of medical knowledge in new directions. Though its expression and application do involve the kind of heuristic-based thinking that can lead to self-affirmation without questioning of existing ideas, the Empiricists provided practical explanations for the times when their thought process did not yield anticipated outcomes. Perhaps the diagnostic, prognostic, or therapeutic decision was one of the 'less certain' types – in which case, their system provided for the highlighting of this uncertainty – or, less satisfyingly, the concession that medicine is not as exact as physicians and patients might want it to be.

4.5.2 Conclusions: Empiricism and the Patient

Though many of the tools and theories of the field of medicine have greatly changed in the last 2300 years, basic elements of the physician-patient encounter have not changed – nor has

[81] Groopman, *How Doctors Think*, 34.

the human effort to master what ancients and moderns alike have characterized as more material than could ever be learned in the lifetime of one man. Those physicians subscribing to the principles of Empiricism present approaches to decision making that facilitate the recollection, systematization, categorization, and application of large amounts of information, quickly. Empiricist physicians sought to dispense with didactic discussion of the kind that takes medical students and their mentors twenty to thirty minutes to arrive at a diagnosis. Instead – to continue the analogy with Dr. Groopman and Dr. Burnside – they favored the practicality of methods of thinking about health and disease that happen in twenty seconds. This is not to say that the latter way of approaching problems is devoid of training, thought, and effort, but to highlight its grounding in the rapid mental classification system that develops based on similarities and differences observed as a consequence of direct experience. But, as Groopman cautions and as Galen's Empiricist concedes, such an efficient way of making decisions is not without its drawbacks and can lead to the faulty application of generalizations in ways that are incompatible with the variability inherent in patients and physicians.

Perhaps one of the chief benefits of the Empiricist approach, as has been recently suggested,[82] is that its focus on observation placed the patient's physical symptoms at the forefront of the diagnostic, prognostic, and therapeutic processes. Patients are less concerned about the theoretical justification for a physician's decisions: they are ill and worried about what they see and feel is happening to their bodies. A consistent approach to medical care that placed these visible concerns – the patient's concerns – at its core, and encouraged rapid and decisive action would have been comforting.

[82] Berrey, "Early Empiricism" 155-162.

Chapter 5
Methodism and Decisions about Categories

διότι, φασίν, οἱ δογματικοὶ τὸ ἄδηλον ἐρευνῶσιν, ἡμεῖς δ' ἐν τοῖς φαινομένοις διατρίβομεν. ἀμέλει καὶ ὅλην τὴν αἵρεσιν ἑαυτῶν οὕτως ὁρίζονται γνῶσιν φαινομένων κοινοτήτων, καὶ ἵνα μὴ κοινὸς ὁ ὅρος εἶναι δοκῇ ταῖς ἄλλαις ἁπάσαις τέχναις, καὶ γὰρ κἀκείνας γνώσεις εἶναι νομίζουσι φαινομένων κοινοτήτων… ἔν τ' οὖν τούτοις διαφέρειν ἑαυτοὺς ἑκατέρων φασὶ καὶ μάλιστ' ἐν οἷς ὥρας καὶ χώρας καὶ ἡλικίας καὶ τὰ τοιαῦτα σύμπαντα περικόπτουσιν, ἄχρηστα μὲν ὄντα φανερῶς, ὡς αὐτοὶ νομίζουσι, δόξης δὲ χάριν τοῖς ἔμπροσθεν ἰατροῖς τετιμημένα… καὶ χρὴ χάριν οὕτω γιγνώσκειν αὐτοῖς τῆς συντόμου διδασκαλίας, εἴ γε μὴ ψεύδονται, ψευδομένοις δ' ὀλιγωρίαν ἐγκαλεῖν. Ὅπως δ' ἄν τις μάλιστα δοκοίη μοι κρῖναι δικαίως ἢ τυφλώττοντας αὐτοὺς περὶ τὸ χρήσιμον ἢ μόνους τὸ περιττὸν ὀρθῶς φεύγοντας, ἤδη φράσω.

'Because', they say, 'the Rationalists explore the non-evident [τὸ ἄδηλον], while we are concerned with manifest things' [τοῖς φαινομένοις]. In line with this they do indeed define their whole hairesis as 'an investigation [γνῶσις] into manifest κοινότητες'. … So, they claim to differ from both parties in these respects, and, above all, in that they prune away season, age, place, and all such factors, which are patently useless, they think, but have been cultivated by doctors in the past for the sake of prestige…In consequence, one should feel grateful to them for such a concise form of teaching, if they are not in error; but, if they are, one could best reach a fair decision as to whether the Methodists do blind themselves on the matter of what is useful or rightly avoid what is superfluous, they alone among doctors."

Galen, *On Sects for Beginners,* 6.81-83K[1]

5.1 Introduction

The Empiricists' response to the individual variation intrinsic to clinical encounters involved memory, experience, and recourse to statements of indeterminacy – a position that still required a great deal of training and an epistemological approach that privileged the identification of many patterns of symptoms and the acknowledgement of patients' individual variability. The Methodists found this approach excessive and dissatisfying. While they may have generally shared the Empiricists' position on the importance of φαινόμενα, they struggled to find broader consistency in what they observed and displayed a preference for what Michael

[1] = 12 Helmreich 12-14, trans. Manuela Tecusan, *Fragments of the Methodists: Methodism outside Soranus* (Leiden and Boston: Brill, 2004), Fr. 203.

Frede has called, "firm and certain knowledge."[2] The Methodists' approach to decision making provides an answer to the physician's persistent challenge of relating an individual case to a broader theoretical and practical framework, and, in turn (re)building that framework on the basis of limited collected observations of individuals. Organized around the concept of the three κοινότητες ('generalities') and different πάθη ('affections'), their efficient techniques for decision making fostered the systematic modulation of complexity. Working through a tiered yet flexible approach, these techniques facilitated the acquisition of medical knowledge and the provision of care by articulating a structured way of moving between a generalized archetype or exemplum and the idiosyncratic individual.

5.2 The Emergence of the Methodists: Brief History and Major Figures

Named after their μέθοδος of healing,[3] the Methodists offered an approach to medical thought and practice that rose to prominence in the first century BCE and flourished especially in the Roman world for the subsequent three centuries; they seem to have been physicians particularly suited to large, multilingual urban environments.[4] Two challenges to understanding how a Methodist physician might have made decisions are, first, the diversity of viewpoints of their practitioners, and second, the preservation of their teachings in the writings of detractors such as Galen.[5] The effect of these issues is that we come to understand Methodism "on a battlefield already determined by its opponents," and we run the risk of being overly-reductive in

[2] Michael Frede, *Essays in Ancient Philosophy* (Minneapolis: University of Minnesota, 1987), 268. See also Ps.-Galen, *Int.* 5.1 = 14.684K.

[3] Celsus, *De Medicina* Pr.57.

[4] Celsus, *De Medicina* Pr.64-65; Nutton, *Ancient Medicine*, 193.

[5] On Galen's "procedures of distortion" in describing Methodist theory and practice, see Tecusan, *Fragments*, 29-35.

our characterizations of 'the Methodists.'[6] Despite these challenges, however, conclusions can be drawn about how decisions were made by the physicians who subscribed to the views of this long-lasting sect, which, by the time of Galen, had its own sophisticated heuristic frameworks that presented a new way of contending with the longstanding clinical conundrum of the tension between the general and the particular.

A brief overview of the physicians important to the Methodist tradition provides useful background for the theoretical and practical concepts that undergirded their approach to the clinical encounter. Though not a Methodist himself, Asclepiades of Bithynia is listed as an ideological founder of the sect in common genealogies of leading Methodist practitioners.[7] Controversy surrounds his precise dates, though his period of activity in Rome fell somewhere in between the late second century BCE and the early decades of the first.[8] Theorizing that the body consists of corpuscles (ὄγκοι), he believed that these corpuscles moved through ducts (πόροι) that coursed through the body: disease resulted from blocked or otherwise obstructed ducts. Though his corpuscular theory has been linked to Epicurean, Platonic, and Peripatetic ideas, it can also be understood as reactionary, formulated as an alternative to Erasistratus' physiology.[9] As a proponent of therapies such as wine, rocking, bathing, and massage, Asclepiades achieved great popularity in Rome for these gentle remedies. In the Methodist lineage, he is most

[6] Nutton, *Ancient* Medicine, 193.

[7] Ps-Galen, *Int.* 14.684K; Nutton, *Ancient Medicine*, 193 and n. 13.

[8] Pliny, *HN* 7.37; J. Pigeaud, *La Maladie d l'Âme* (Paris: Les Belles Lettres, 1981) and *Pline l'Ancien, Témoin de son Temps* (Salamanca: Universidad Pontifica, 1987); E.D. Rawson, "The life and death of Asclepiades of Bithynia," *Classical Quarterly* 32 (1982): 358-70.

[9] J.T. Vallance, *The Lost Theory of Asclepiades of Bithynia*, (Oxford: Clarendon Press, 1990), 7-43, and "The medical system of Asclepiades of Bithynia," *ANRW* II, 37 (1993): 693-727.

important for his purported (but chronologically problematic) role as the teacher of Themison of Laodicea.[10]

Like Asclepiades, Themison of Laodicea (*floruit* c.90/85-40/35 BCE)[11] was an immigrant to Rome who, building upon earlier ideas about the origins of disease, developed new approaches to its diagnosis and treatment. He proposed that disease resulted from disruption of the ducts in the body, causing one of three pathological states: stricture, looseness, or an intermediate state of both stricture and looseness. Besides these three general categories, Themison also divided diseases into acute and chronic, arguing that acute diseases were related to stricture, chronic to looseness.[12] Later medical writers say that these ideas were in circulation before and during Themison's time, but that he was the first to compose a clear doctrinal statement on the matter.[13] Moreover, while chronological aspects of illness had been important for Methodists before Themison, he in particular emphasized the importance of the διάτριτος, or three-day period, in the diagnosis and treatment of disease.[14] He also encouraged a practice of medicine that focused on identification of commonalities or generalities (κοινότητες in Greek, *communia* in Latin), instead of more extensive observations.[15] These κοινότητες will be examined in detail in the next section.

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[10] Nutton, *Ancient Medicine,* 189.

[11] Tecusan¸ *Fragments*, 14.

[12] Caelius Aurelianus, *CP* 3.188; cf. 2.44 and 52.

[13] Caelius Aurelianus, *TP* pref. 3.

[14] David Leith, "The *Diatritus* and Therapy in Greco-Roman Medicine," *Classical Quarterly* 58, (2008): 581-600.

[15] Galen, *MM* 10.35K; *Adv.Jul.* 18A.271K.

Thessalus, with a *floruit* between 15/20 and 55/60 CE,[16] expanded further upon Themison's ideas while emphasizing his predecessor's focus on commonalities. He was a successful physician and was involved in the care of the imperial family.[17] Grounding his approach to medical practice in the commonalities, he advocated for a method of diagnosis and treatment that was emphatically independent of the individual nature of each patient.[18] According to Galen, Thessalus modified his predecessors' Methodism by subdividing κοινότητες based on, for example, method of treatment (diet or surgery), location of the problem, or the qualities of the problem.[19] Thessalus also elaborated upon the idea of μετασύγκρισις, which described an alteration of the body's pores that could produce disease or, when manipulated through treatment, could restore the patient to health. This process of μετασύγκρισις, especially when combined with the concept of the διάτριτος, meant in practice that Methodist physicians could and did change the course of their treatments more frequently than physicians who subscribed to the teachings of other sects.[20]

Asclepiades, Themison, and Thessalus had pupils, and the texts of their pupils, taken together with fragments attributed to these three major figures, suggest that Methodism enjoyed success, growth, and an extensive geographic reach during the late Roman Republic and early

[16] Tecusan, *Fragments*, 15; Galen, *MM* 10.7K; Pliny, *HN* 29.9.

[17] Galen, *MM* 10.8-13K.

[18] Edelstein, *Ancient Medicine,* 183-4; Vivian Nutton, "Therapeutic methods and Methodist therapeutics in the Roman Empire," in *History of Therapeutics*, ed. Y. Kawakita, S. Sakai, and Y. Otsuka (Tokyo: Ishiyaku EuropAmerica Inc., 1990), 1-36.

[19] Galen, *Adv.Jul.* 18A.271K, *MM* 10.35K, 10.250-2K, *De Sect. Ingr.* 14 (Helmreich), *Opt.Sect.* 1.192–3K; pseudo-Galen, *Int.*14.680–2K; Caelius Aurelianus, *TP* 2.145; Nutton, *Ancient Medicine*, 192-3.

[20] J. Pigeaud, "Les Fondements du Méthodisme," in *Les Écoles médicales à Rome*, ed. P. Mudry and J. Pigeaud Mudry and Pigeaud (Geneve: Droz, 1991), 43-6; J. Pigeaud, "L'Introduction du Méthodisme à Rome," *ANRW* II 37, (1993), 594-7.

Empire. Epigraphic evidence even hints at the existence of a Methodist school in Asia Minor.[21] Yet despite this apparent popularity, almost no full-length Methodist treatises have been preserved: the exception is one full-length and a few fragmentary texts by Soranus of Ephesus, and two works by Caelius Aurelianus, both of which transmit mostly the work of Soranus, though in edited and translated form. The Methodist Soranus of Ephesus is exceptional not only for the survival of much of his treatise *Gynecology*, but also because he appears to have been the only Methodist whom Galen praised.[22] We know only a little more about Soranus than we do about his Methodist predecessors and contemporaries: he lived under Trajan and Hadrian, studied at Alexandria, and practiced in Rome. He wrote approximately twenty different texts, of which we have much of *Gynecology*, and larger fragments of *On Signs of Fractures* and *On Bandages*; his *On Acute Diseases* and *On Chronic Diseases* survive in forms paraphrased by the early fifth century CE North African writer Caelius Aurelianus.

Caelius Aurelianus' text is a complicated collection of description and opinion, mostly the work of Soranus but not without Caelius' influence. Both books, *Celeres Passiones* and *Tardae Passiones*,[23] roughly follow the same outline, in which diseases are presented approximately *a capite ad calcem*. For each affection, Caelius describes how a physician might identify the problem, including the signs that precede it. He explains the parts of the body that are typically affected, compares the problem to others with which it might share a resemblance, and discusses the views of other practitioners, including the Methodist physicians described previously, on the diagnosis and management of the problem. Combined with the evidence of

[21] Tecusan, *Fragments*, 14-16; *CIG* 3283.

[22] Galen, *MM* 10.53K.

[23] Note that it is customary to refer to these texts in English as *On Acute Diseases* and *On Chronic Diseases*, though their Latin names are *Celeres Passiones* and *Tardae Passiones*, more aligned with the Methodist concept of πάθος.

these other sources, *On Acute Diseases* and *On Chronic Diseases* will help us to understand the ways that the Methodists organized medical data around the concepts of πάθη, κοινότητες, and the διάτριτος, and then used this system of organization to guide their therapeutic decision making.

5.3 Describing Bodily Disruption

5.3.1 κοινότητες *and Bodily Unity*

Of all the concepts of Methodism that its adherents introduced and developed over the centuries, perhaps the most important was that of the κοινότητες. This section will describe what they were understood to be, how they were used for diagnosis and treatment, and what their existence and use implied for decisions about the classification and application of medical knowledge.

Sources by different authors, living in different periods, define κοινότητες (*communia* in Latin) similarly: states of constriction, flux, or a combination of the two. Identification of the underlying commonality guided treatment in that constrictive diseases required relaxing therapies, fluctuant diseases required compressive management, and the mixed state necessitated a judicious balance of relaxation and compression, with immediate attention paid to whichever element (flux or constriction) was more prominent.[24] In addition to their designation according to one of the three κοινότητες, diseases were also characterized as either acute or chronic, and then as ascending, stationary, or descending in their course. These groupings of chronology and severity also affected a practitioner's management,[25] but the chief indication for treatment was

[24] Celsus, *De Medicina* Pr.54-57; Galen, *De Sect. Ingr.* 12-32 (Helmreich); pseudo-Galen, *Def.Med.* 19.353 K.

[25] Celsus, *De Medicina* Pr.54-57.

the identified commonality. Though the problem could be related to a particular organ, it still represented an underlying problem with the body as a unity, and therefore the proposed treatment could be thought of in general terms, that is, in terms of one of three commonalities. Information about the patient's age, nature, baseline condition, habits, and environment could help a physician to fine-tune and qualify his therapies – as will be described further in the case study at the end of this chapter – but the core of the Methodist practitioner's diagnostic and therapeutic process remained the identification of the commonality. Similarly, the season of year did not affect his conclusions about the category into which a given clinical presentation should be placed, but rather played a subsidiary role in his management.[26] The κοινότητες were the diagnostic and therapeutic core of Methodist decision making.

This classification system of κοινότητες, while streamlined, was simple in practice but not naïve in its conceptualization, as it provided a structured way of moving between an archetype or exemplum and the idiosyncratic individual. Though all diseases of laxity (for example) were managed through recourse to some kind constrictive therapy, this did not mean that Methodist doctors failed to recognize sub-categories within their three overarching categories. Their approach to disease groupings provided, rather, a systematized way to think about disease that reconciled the unity of the human body and the consistencies of human anatomy with the peculiarities of the individual patient. The text *On Sects for Beginners* preserves a Methodist's explanation of κοινότητες that invokes the concepts of unity and plurality in its justification of the utility of κοινότητες as diagnostic and therapeutic tools. Just as

[26] Galen, *De Sect.Ingr.* 6, 12, 14, 17, 19 Helmreich; Galen, *MM* 10.629; Galen, *Med.Exp.* [Arabic], page 87 in Walzer (Oxford: Oxford University Press, 1944); Caelius Aurelianus, *CP* 1.157; Celsus, *De Medicina* Pr.65. Since most of our information about this topic comes from Galen, who recorded his disdain for a diagnostic system that he determined to be overly-simplistic, caution should be exercised in the interpretation of these statements about how the Methodists used information in their clinical decision making. Still, as the subsequent analysis will show, it is clear that the Methodists structured and privileged information differently than Galen did, and one of the ways they did this involved subordinating certain aspects of the clinical encounter, in favor of focusing on the commonalities.

all humans are part of 'humanity' but still different, the Methodist interlocutor argues, so diseases of laxity share characteristics – they are of the same κοινότης – but they also possess distinctive traits. There is ὁμοιότης τις ἐν πλείοσιν, "a certain similarity in pluralities."[27] Patients were understood as individuals, but the similarities of their anatomy and physiology meant that a practitioner could consider less relevant – or even irrelevant – the peculiarities of their habits. Instead, he could focus on the patient's current clinical presentation and symptoms and guide his management on their basis alone. The κοινότητες deliberately took into account the unity that was present across all types of patients, allowing that unity to recede into the background in a controlled way when practitioners sought to focus on one or another of its constituent pieces, through reference to other layers of categorization (such as πάθη, 'affections', the subject of the next section).

The Methodists' qualified use of the term κοινότης underscores their commitment to the fluidity and uncertainties intrinsic to health and disease. Although associated with a particular meaning in dogmatic metaphysics, κοινότης, in Methodist doctrine, had a broader, undogmatic meaning. As Sextus Empiricus describes,[28] while κοινότης would have signified a consistent, generic, shared feature to a metaphysician, the Methodist employed the term in a more skeptical manner.[29] Its use in Methodist doctrine acknowledged these generic, shared features without a theoretical commitment to metaphysical sameness. This meant that the Methodist practitioner did not have to deny the existence of individuality and distinctiveness across pathologies and patients, but the cognitive tool of the κοινότης would direct his attention to the aggregation of

[27] Pseudo-Galen, On the Best Sect (3), 190-191K.

[28] Sextus Empiricus, *PH* 1.240.

[29] Frede, *Essays*, 267, and especially 276-7 on the similarities between Methodism and principles of Skeptism. See also Sextus Empiricus, *PH* 1.236ff.

pathologies into groups for the purpose of swift diagnosis and therapy. The concept of the commonalities was a pragmatic one that permitted the Methodists to act in accordance with the suggestions of systematized experience, without a commitment to the theoretical truths of that experience.

Use of the κοινότητες as a guide for clinical decision making also suited the Methodist emphasis on unity within the individual body. A pathological state within the body represented a problem with the body as a whole, even if the problem showed itself in a certain place or in a unique way.[30] The body, while made up of parts, still represented a functional unit, and successful treatment could be achieved by employing a diagnostic and therapeutic system that used as its basis the whole-body systems of ducts and pores described by Asclepiades and Themison, among others. As described above, the Methodists did not need to commit to the 'truth' of a theory about ducts, pores, and interconnectedness,[31] but they could choose to practice medicine in a way that aligned with this theory, because their experience had shown them that acting in accordance with this idea led to success. Practicing medicine with an emphasis on the interconnectedness of the body meant that these physicians were never simply treating only a part: they could focus a treatment on that part, but it remained in continuity with the whole. The Methodist way of thinking about the continuum of the body at the individual level, and about manifestations of disease at the population level, was rooted in assumptions about connections and similarities. This does not mean that they refused to acknowledge difference – as we will see in subsequent sections – but it does mean that they structured a system of diagnostic and therapeutic decision making that was predicated on searching for these similarities and

[30] Galen, *Adv.Jul.* 18A.257-9K.

[31] Sextus Empiricus, *PH* 1.239-240, on the Methodists' undogmatic use of terms.

connections, even without a theoretical commitment to their sameness.[32] There was a tendency toward unities, and the relatedness of symptoms and disease states made broad groupings such as the three κοινότητες a reasonable and efficient way of proceeding. These larger groupings provided simultaneous structure and flexibility – even pathologies with variable constellations of symptoms and different clinical presentations could be placed into related sense groups based on their broad shared characteristics. It was a useful way of distilling a large amount of clinical information, and an adaptable notion of disease that allowed for acknowledgement of the whole patient even as a practitioner was focusing on a given kind of homeostatic disturbance.

5.3.2 πάθη *and Variation*

By employing the concept of πάθη, 'affections,' Methodist practitioners could introduce variation into their diagnostic and therapeutic framework. πάθη were manifestations of illness that could vary with each patient: they were constellations of symptoms that informed treatment, but they were not themselves the basis for treatment. They led Methodist physicians to an underlying κοινότης, and it was this κοινότης that needed attention; indeed, in some cases, a given affection could exist as two different types of κοινότητες,[33] and a practitioner would need to decide which commonality was the root of the problem so that he could treat the affection properly. Though πάθη are linked in overlapping ways with the κοινότητες, they are themselves identified with reference to diverse features, which include body part affected, associated symptoms, chronology (i.e., acute or chronic), and course (waxing, waning, static). Caelius

[32] pseudo-Galen, *Int.* 14.674-678K; pseudo-Soranus, *Quaestiones Medicae*; pages 363-364 Stadler = Tecusan Fr. 295.

[33] Caelius Aurelianus, *CP* 1.7, on phrenitis: *nos vero aliam dicimus esse ex strictura, aliam ex complexione stricturae atque solutionis*, "But we hold that there are two types, one involving a state of stricture, and the other a combination of stricture and looseness," trans. Drabkin.

Aurelianus' text preserves the most extensive descriptions of πάθη, grouped into acute[34] and chronic[35] conditions. Within each section detailing a specific πάθος, Caelius follows a general structure to characterize its identification and management:[36]

> "1. What does the disease look like?
> 2. What are the signs that announce the disease?
> 3. What are the characteristics of the people who are particularly likely to be affected by the disease?
> 4. How does one recognize the disease?
> 5. What are the differences and similarities between this disease and other comparable diseases?
> 6. What are the other species of the disease?
> 7. Which part of the body is affected by the disease?
> 8. How ought the disease to be treated?
> 9. What are the views of other doctors about the treatment of the disease?"

As this outline concisely emphasizes, πάθη have distinguishing characteristics. The bulk of Caelius' text focuses on helping practitioners identify these affections: he highlights the groups of symptoms associated with a given affection, elaborates on how they manifest (with reference to time course and location of symptoms), and explains how one affection differs from other, similarly-appearing ones. Though he describes the characteristics of people in whom practitioners might expect to see certain affections,[37] the identifying features and clinical

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[34] These are: phrenitis, lethargy, catalepsy, pleurisy, pneumonia, the cardiac disease, synache, apoplexy, spasum, tetanus, hydrophobia, acute intestinal obstruction, satyriasis, cholera, and flux of the bowels.

[35] These are: chronic headache, scotoma, incubus, epilepsy, mania, melancholy, paralysis, cynic spasm, earache and running ear, toothache, seizure or depression, loss of voice, flux, cough, hemorrhage, phthisis, shortness of breath, disease of the esophagus, morbid hunger, disease fo the liver and of the spleen, jaundice, cachexia, atrophia, dropsy, elephantiasis, pthiriasis, the coeliac disease, weakness of the stomach, inflammation of the stomach, dysentery, diseases of the colon, worms, effeminacy, sciatica, disease of the joints, diseases of the feet, diseases of the bladder, diabetes, discharge of semen, nocturnal emission, weaknes of the seminal ducts, priapism, empyema, and obesity.

[36] As listed in Philip van der Eijk, "Antiquarianism and criticism: Forms and functions of medical doxograhpy in Methodism (Soranus and Caelius Aurelianus)," in *Ancient Histories of Medicine: Essays in Medical Doxography and Historiography in Classical Antiquity*, ed. by P. van der Eijk (Leiden and Boston: Brill, 1999), 430.

[37] *CP* 1.2, but note that he emphasizes that the season and the nature of the patient must be considered alongside affection-related symptoms. Subsequently, in 1.3, he concludes by saying that while leaders of other sects take the patient's age, sex, and constitution as predictors of disease severity, Methodists consider the potency of the disease

behavior of the problem form the core of his text, and the chief means by which the affection can be diagnosed: patients' habits, living environment, and idiosyncracies are of less diagnostic utility to Caelius' Methodist physician. These elements of each discrete section are disease-focused and largely descriptive, providing clear instructions for diagnostic decision making. Once the identifying characteristics of the πάθος have been enumerated, Caelius can state the associated κοινότης, which in turn provides the foundation for therapeutic decision making.

In contrast to adherents of other schools of thought and practice, Methodists spoke, thought, and practiced in terms of these of πάθη, which, they emphasized, were not the same as the νόσοι, diseases, that other doctors described.[38] In his *Gynecology*, Soranus clarifies:[39]

> 'πάθος' δὲ λέγεται τὸ μὲν κατὰ φύσιν (οἷον τὸ συλλαμβάνειν καὶ ἀποτίκτειν καὶ γάλα ποιεῖν), τὸ δὲ παρὰ φύσιν (οἷον πυρέττειν) καὶ τοῦ παρὰ φύσιν τὸ μὲν ὡς καθόλου καὶ γενικόν (οἷον τὸ στεγνόν), τὸ δὲ μερικὸν καὶ ὑποβεβηκός (οἷον τὸ φρενιτικὸν ἢ ληθαργικόν). ἐνέστηκεν δὲ μάλιστα ὁ λόγος <περὶ> τοῦ παρὰ φύσιν καθ' ὅλου τε καὶ κατὰ μέρος.
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> "Affection" is said either of something natural (for instance getting pregnant, giving birth, or breast-feeding) or of something unnatural (for instance being feverish); as for "what is unnatural", on the one hand it is [sc predicated] universally and it belongs to the genus (for instance constriction), on the other hand it is individual and subordinate [sc to the genus] (for instance phrenitis or lethargy). Our argument is concerned mainly with what is unnatural, taken [sc both] universally and individually.

As Soranus explains, the word πάθος may be understood in modern terms as an alteration of homeostasis, of the body's normal, basal state. Pregnancy is therefore an affection, a physiological change that is different from how a woman's body functions for most of her life,

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itself when determining how severe the disease will be: *nos vero dicimus communiter graviter laborare quos passionis advicit magnitude. Illud enim semper in aegritudine magis afficit quod a natura plurimum recesserit*.

[38] Galen, *MM* 10.52, 67-74, 85-93K.

[39] Translation from Tecusan, *Fragments,* Fr. 306.

but it is a natural one.[40] It may be dangerous for the woman, but it is not unnatural, and it is useful for the propagation of humanity. Other kinds of affections, or alterations of homeostasis, are, in our terms, pathological, and without utility – these affections lead to feeling unwell, incapacitation in the short or long term, or death. Soranus calls the conditions in this latter group unnatural affections, saying that they are unnatural without qualification. His explanation of πάθη reveals that these are as much conceptual tools as they are labels. They are related to the generic groups of the commonalities, in that affections are explicitly associated with one or more of these commonalities; and affections are also distinct unto themselves, as defined conditions with their own associated symptoms. The process of identifying a πάθος allowed the provider to incorporate these symptoms and details into his assessment, thereby introducing variability into a system that directed a practitioner from the specific and variable toward three generalizing commonalities. This approach ensured that a practitioner could remain focused on his patient and the patient's current symptoms, even as he was relating these symptoms to a general framework.

The sections of Caelius Aurelianus' text that deal with how an affection is recognized (*quomodo intelligitur*) or how it is distinguished from similar affections (*quae sunt huic similes passiones et quomodo discernuntur*) illustrate the variable details that matter: the quality and quantity of bodily fluids lost, whether voluntarily or involuntarily; the severity, quality, location, and duration of patients' symptoms; and changes in patients' appearance, physical capabilities, or behavior. There is variability, but it is contained variability. The characteristic findings associated with each affection are extensive, but they provide a means of identifying the

[40] 'Natural,' for Soranus, does not necessarily mean without detrimental effects to health. In *Gynecology* 1.42, he describes how a woman's body might be negatively affected by pregnancy. In response to those who would say that conception relieves a woman of uterine troubles, he notes that "a means of preserving health" (τηρητικὸν τοῦ ὑγιαίνειν) and "an aid against disease" (βοήθημα νόσων) are different entities, citing venesection as an illustrative example of a therapy in the setting of a disease (but not a way to maintain health). Trans. Temkin.

affection the provider is encountering. Caelius frequently mentions that, while some of these symptoms are observed with other kinds of affections, it is their co-occurrence with the other listed symptoms and findings that directs a physician toward the identification of the affection he is discussing.[41] The text therefore presents a comprehensive but confined picture of each affection. Such containment would have streamlined the decision making process, ensuring that the provider looked for and noted pertinent, variable details but also disregarded information deemed to have no bearing on the diagnostic and therapeutic process.

The fact that the variations recorded are of the same type and are disease-focused helps to distinguish similar affections from each other. In other words, there are acceptable, relevant groups of information, and there are less relevant, potentially useless groups of information. Asking patients about bodily excretions will provide answers – about urine, vomit, blood, sweat, or diarrhea – but these answers will be circumscribed within the category of 'bodily excretions.' Similarly, asking about unusual behaviors – disruptions in sleep, hallucinations – will yield variable responses, but responses that are clustered around a specific theme. The Methodists' focus on standardized symptomatologies, instead of on the habits or the nature of the individual, reveals their awareness that the human body can only respond in certain ways to pathological disruptions in homeostasis. Our repertoire of physiological danger signs is, in many respects, limited: fever, chills, nausea, pain of various qualities in diverse parts, alterations in discharges or excreta, disruptions in sensory or motor function, changes in energy level or skin color, swellings in different areas. Modern medicine has expanded our ability to register problematic

[41] *CP* 1.3 and 2.3; see also 2.10 for a description of features that catalepsy, for example, shares with other affections, and how the constellations of symptoms may assist in properly distinguishing catalepsy from these other, similar problems. *TP* 1.2 describes how scotoma may be distinguished from epilepsy and chronic headache; Caelius also notes here that vertigo and blurring vision are not separate affections because *ex his veluti partibus scotomatica passio confecta esse videatur*, "[they are], as it were, the parts of which scotoma is composed" (trans. Drabkin). In this case, vertigo and blurring vision are rather the symptoms associated with the affection, but not the affection itself.

disturbance through advanced imaging and laboratory techniques, but the physicians of antiquity, without such direct access to the body's internal workings, had to contend with what the human body itself could show them. This situation limited the number of physiological data points on which they could base decisions.

The Methodists focused intensely on these physiological disturbances, aware that they were common to issues that were potentially very different, and argued for a practice of medicine that first looked for clearly identifiable physiological disturbances. Knowing the kinds of variation possible within categories of symptoms (bodily excretions or unusual behaviors, for example), Methodist practitioners could then efficiently gather information about the sets of symptoms that aligned with what was expected for a particular πάθος. The conceptual tool of the πάθος meant that practitioners could reconcile a limited number of physiological symptoms with the vast number of ways they could be combined, using a 'method' that refined the information available to yield the information that was useful. (We will return to the question of utility in Section 5.5). This refinement of the physician's diagnostic process meant that he could have pursued similar initial lines of investigation for each problem – and could have focused less on the peculiarities of the individual – to generate symptom lists that would more readily be matched to known πάθη, with less cognitive 'noise' interfering with diagnosis. Practitioners could thereby readily navigate the movement between the individual patient's problem and the general features associated with a given πάθος.

Such a pattern of information acquisition facilitated identification first of the πάθος, then of the κοινότης, and from there, appropriate treatment. The system afforded clear, defined movement from the particular to the general and a streamlined – even standardized – approach to the clinical encounter. If the κοινότητες ensured broad flexibility, then the πάθη enabled a more

rigorous appreciation for the pertinent details a clinician would encounter as he evaluated his sick patient. The Methodists' employment of this system, and its potential benefits, are further explored in the next section.

5.4 Reconciling the General and the Particular

5.4.1 Galen's Objections

Galen disputed the Methodists' system of κοινότητες and πάθη, basing his attacks on allegations about imprecision in how the Methodists created their categories and how they defined what was 'manifest,' or obvious to different kinds of observers. Though the comments of Galen and other opponents of Methodism present Methodist arguments through a distorting lens – they viewed them as fundamentally incorrect and even dangerous – these polemical treatises nevertheless can provide some insight into what could have made Methodism appealing to physicians, physicians-in-training, and patients. The Methodist approach to categorization, in terms of symptoms, affections, and commonalities, was especially troubling for Galen, as it involved areas of categorical overlap and indeterminate boundaries both within and between levels of the classification system. Galen deemed this structure a violation of the clearly-defined Aristotelian classification schemata he favored, and he accused the Methodists of imprecision on this score.[42]

In *De Methodo Medendi*, for example, he argues against a Methodist definition of symptoms and affections that, as he explains it, classifies a given observation as a symptom, if it supervenes, or an affection, if it precedes. Objecting to a perceived lack of clarity in the

[42] On Galen's indebtedness to and respect for Aristotle regarding this topic, see Paul Moraux, *Der Aristotelismus bei den Griechen* (Berlin: De Gruyter, 1984), 735–85. See also Galen, *Prop.Plac.* 2.1–3 (*CMG* 5.3.2).

distinctions Methodists drew between symptoms and affections, he cites the Methodist physician Olympicus' definition of a symptom as, εἰδικὴν ὥσπερ καὶ μερικωτέραν ἔχον ἐν τοῖς παρὰ φύσιν ἐντύπωσιν, "having, as it were, a specific and more subdivided characterization in the category of unnatural things."[43] Galen finds particularly problematic Olympicus' use of εἰδικήν, "specific," and gives the definition of 'symptom' that he would prefer:[44]

> τί ποτ' οὖν ἐστι τὸ γενικώτερον ἔχον τὸν τύπον; οὐ γὰρ εἴρηκας εἰ χωρὶς τῆς πρὸς ἐκεῖνο παραβολῆς ἐγχωρεῖ τὸ εἰδικώτερον ἐξευρεῖν. εἰ δ' ὅλως πρὸς οὐδὲν παραβάλλοντες εἰδικώτερον ὀνομάζουσιν, ἀκριβῶς τε πάνυ καὶ σαφῶς ἑρμηνεύουσι, καίτοι διὰ συντόμων τε ἅμα καὶ σαφῶν οἷόν τ'ἦν εἰπεῖν ὡς τὰ παρὰ φύσιν ἅπαντα τὰ κατὰ τὸ σῶμα τῶν ζώων ἤτοι νοσήματ' ἐστὶν, ἢ αἴτια, ἢ συμπτώματα· κοινοῦ δ' αὐτοῖς ὄντος τοῦ παρὰ φύσιν, ἡ νόσος μὲν ἐνέργειαν βλάπτει, τὸ δ' αἴτιον ταύτης προηγεῖται, τὸ σύμπτωμα δ' ἕπεται ταύτῃ, διττὸν ὂν τὴν φύσιν, ἐνεργείας μὲν βλάβη τὸ ἕτερον, διάθεσις δέ τις ἀκολουθοῦσα τῷ νοσήματι τὸ λοιπόν.
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> "What is it, then, that has a more generic character? You have not addressed the question of whether it is possible to discover the 'more specific' in the absence of a comparison with the more generic. Here is an over-rigorous and clear piece of interpretation they make, if they call something 'more specific' absolutely, without comparing it with anything. Yet it would have been possible to say, briefly and clearly, that all that is unnatural in the bodies of animals consists in either diseases or causes or symptoms; being unnatural is their common element, while the disease impairs an activity, the cause precedes it, the symptom follows upon it; and the symptom is by nature of two kinds, one consisting in damage to the activity, the other consisting in some state which accompanies the disease."

There are two elements in Galen's preferred definition of symptom, given as a response to a Methodist physician, that highlight the potential clinical benefits of the Methodist approach: first, his complaints about the way Olympicus uses the comparative form of 'more specific,' without reference to what he considers 'more general,' and second, his conclusion that a symptom can only be properly defined with reference to cause. We will examine each of these elements of

[43] Galen, *MM* 10.74-75K; translation modified from Tecusan, Fr. 166.

[44] Galen, *MM* 10.74-75K; translation Tecusan, Fr. 166. Though this is one of many occasions on which Galen criticized Methodist theory and practice, it is representative of the kinds of objections he consistently leveled at them throughout his work. See Tecusan, *Fragments*, 27-36 for further discussion and examples.

Galen's preferred definition in turn, with consideration of what it implies about the Methodist approach to the clinical encounter.

5.4.2 Creating Flexible Categorial Distinctions

Considered in light of the preceding discussion of affections and commonalities, and how patterns of symptoms are the features that led a Methodist practitioner to delineate an associated affection, Olympicus' identification of symptoms as 'more specific' and 'more subdivided' makes sense. To the Methodist, pathologies were part of continuous systems that existed in overlapping unities consisting of indeterminately discrete components. An unnatural affection could be identified by the presence of a certain grouping of symptoms whose duration, location, chronology, and quality aligned in an expected way. As was explored in section 5.3.2, the symptoms that enabled a practitioner to diagnose one affection were the same symptoms that could indicate the presence of a different affection, but in the latter case they would appear in a different pattern. Symptoms were 'more specific' and 'more subdivided' than affections, in that they were the constituents of affections, but they were not themselves 'specific.' The symptom of loss of reason, for example, was a symptom that phrenitis, mania, melancholy, pleurisy, and pneumonia shared.[45] In this sense, symptoms by themselves were an imprecise way to think about disease diagnosis and therapy, because they could be shared across different affections: they were somewhat specific, but not definitively specific. Their individual specificity was enhanced when they were considered in aggregate, and their diagnostic utility increased when they were incorporated into patterns. As we have already seen, Methodists used the term κοινότης in a similarly skeptical way, as a generic word that did not carry with it a philosophical

[45] Caelius Aurelianus, *TP* 1.4.

or metaphysical commitment to where the lines between categories should be drawn (or even whether it might have been possible to draw them).[46] In broad, practical terms, commonalities were generic, and affections were particular;[47] symptoms were subdivisions of affections. A Methodist approach that defined specificity and generality in relative terms was therefore, from their perspective, accurate, practical, and internally consistent with their own understanding of diagnostic and therapeutic methodologies. Galen's accusations of the Methodists' imprecisions in their construction and application of category labels may be justified according to the rules of his system of classification, but the Methodist physicians were committed to a different kind of classification system that did not take as its assumptions the fixity or impermeability of categories.

Its flexibility and permeability meant that the system of the Methodists was tunable, adaptable to the needs of the patient and the practitioner. The practitioner could decide how much detail he wanted to incorporate into the mental calculus required for diagnosis and treatment. A passage from Soranus' *Gynecology* illustrates how variation could be introduced into a system that still coalesced into three commonalities across all patients and illnesses:[48]

> [1] Ἡ σκέψις προτείνεται καὶ οὕτως, εἰ ἔστιν ἴδια πάθη θηλειῶν, παρ' ὅσον ἐστὶν εἶδος μὲν ἡ γυνή, γένος δὲ τὸ θῆλυ…. [2] ἡ δὲ ζήτησις εὔχρηστος ἕνεκα τοῦ μαθεῖν, εἰ καὶ ἰδίας τινὸς θεραπείας χρήζουσιν αἱ γυναῖκες. καὶ γεγένηται δὲ διαφωνία· τινὲς μὲν γὰρ ὑπολαμβάνουσιν ἴδια πάθη γίγνεσθαι γυναικῶν… [5] <ἡμεῖς> μέντοι κατὰ φύσιν ἴδια πάθη λέγομεν γυναικῶν (οἷον τὸ συλλαμβάνειν καὶ ἀποτίκτειν καὶ γαλακτουργεῖν (εἰ

[46] Frede, *Essays*, 267.

[47] See Soranus, *Gynecology* 3.1.2: 'πάθος' δὲ λέγεται τὸ μὲν κατὰ φύσιν (οἷον τὸ συλλαμβάνειν καὶ ἀποτίκτειν καὶ γάλα ποιεῖν), τὸ δὲ παρὰ φύσιν (οἷον πυρέττειν) καὶ τοῦ παρὰ φύσιν τὸ μὲν ὡς καθόλου καὶ γενικόν (οἷον τὸ στεγνόν), τὸ δὲ μερικὸν καὶ ὑποβεβηκός (οἷον τὸ φρενιτικὸν ἢ ληθαργικόν). ἐνέστηκεν δὲ μάλιστα ὁ λόγος <περὶ> τοῦ παρὰ φύσιν καθ' ὅλου τε καὶ κατὰ μέρος. "'Condition' is either said of something according to nature (like conception, childbirth, and lactation) or something contrary to nature (like fever). Again in the case of 'against nature' it is either taken in a general and generic sense (as constriction) or in a particular and specific sense (as phrenitis or lethargy). The discourse deals chiefly with what is contrary to nature, both in general and in particular." Trans. Temkin.

[48] Soranus, *Gynaecology* 3.2.1ff. Trans. Temkin.

> ταῦτα βούλεταί τις τὰ ἔργα πάθη προσαγορεύειν), παρὰ φύσιν δὲ κατὰ γένος μὲν οὐδαμῶς, κατ' εἶδος δὲ καὶ κατὰ μέρος. ὅσον μὲν γὰρ ἐπὶ τοῖς ἀναβεβηκόσι, κοινῶς τοῖς ἄρρεσι νοσεῖ τὸ θῆλυ στεγνοπαθοῦν καὶ ῥευματιζόμενον ὀξέως ἢ χρονίως τάς τε αὐτὰς τῶν καιρῶν διαφορὰς ὑπομένον καὶ τὸ μέγεθος τῆς νόσου καὶ τὴν ἀτονίαν τῆς δυνάμεως καὶ τὰς ἐν τοῖς ἀλλοτρίοις, ἕλκεσί τε καὶ τραύμασι, διαφοράς· ὅσον δὲ ἐπὶ τοῖς κατὰ μέρος καὶ εἰδικὴν ἔχουσι τὴν παραλλαγήν, ἰδίοις κέχρηται πάθεσι, τοῦτ' ἔστιν συμπτωμάτων χαρακτῆρσι διαφόροις. ὅθεν καὶ ὑπὸ τὴν αὐτὴν κατὰ γένος ἄγεται θεραπείαν…
>
> The inquiry is also put forward this way: whether females have conditions peculiarly their own, in as much as 'woman' is a species, and 'female' a genus…. [2] The inquiry is useful in order to ascertain whether, moreover, women need therapy peculiarly their own….[5] Now we say that there exist natural conditions in women peculiarly their own (as conception, parturition, and lactation if one wishes to call these functions conditions), whereas conditions contrary to nature are not generically different but only in a specific and particular way. For in regard to generic differences, the female has her illness in common with the male, she suffers from constriction or from flux, either acutely or chronically, and she is subject to the same seasonal differences, to gradations of disease, to lack of strength, and to the different foreign bodies, sores, and injuries. Only as far as particulars and specific variations are concerned does the female show conditions peculiarly her own, i.e. a different character of symptoms. Therefore she is subject to treatment generically the same…

There are, Soranus explains, clear physiological differences between men and women. The obvious presence of these differences means that, while the underlying commonality may be similar between men and women, this commonality may manifest in "a different character of symptoms" (συμπτωμάτων χαρακτῆρσι διαφόροις) in women and men. The commonality is consistent, and guides therapy, but the affections ("conditions" in Temkin's translation) appear with different features, in ways that vary depending on the biological characteristics of the person. Thus, at least by the time of Soranus, Methodism had acquired a flexibility even within its clear categorical structure. It was a system rigid enough to provide a consistent framework with which practitioners could construct their diagnoses, but also flexible enough that it did not collapse under pressures of variable observations. Instead, these were incorporated in a controlled way into the practitioner's cognitive framework.

5.4.3 Causality, the Manifest, and Indication: Certainty in Uncertainty

Galen's second objection to Methodist characterizations of symptoms and affections is rooted in his commitment to investigations and acknowledgement of causality as a fundamental part of diagnosis and therapy. The example of the treatment of the bite of a rabid dog illustrates, for Galen, why causality matters and how Methodists differ from Rationalists and Empiricists on the issue.[49] Knowledge that the patient's problem occurred after the bite of a rabid dog would have affected how both the Rationalists and Empiricists would have treated the patient, Galen describes. The Rationalists would have posited an argument about the hidden relationships between the bite of the mad dog and the patient's hydrophobia. The Empiricists would have made no theoretical claims about such relationships but would have recognized that the bite of the mad dog was related to the patient's condition as an antecedent cause: knowledge of its occurrence preceding the onset of the patient's symptoms was important for diagnostic and therapeutic decisions. The Methodists, however, would have said that the fact that a dog bite preceded the patient's symptoms was of no relevance for their clinical management. Although the Rationalists and Empricists accepted causal reasoning – even if in different forms – in the evaluation and treatment of disease, the Methodists instead chose to focus their attention on the patient's present alteration of homeostasis. This set of symptoms – the patient's immediately-changed physiology – formed the foundation of their clinical decision making.

Each group's position on the value of causality in clinical decision making stems from their basic philosophical commitments to what can be known about the patient's physiology, and the consistency and certainty with which this information can be known. These commitments were rooted in different understandings of and responses to φαινόμενα, the manifest, and its

[49] Galen, *De Sect.Ingr.* 4.7 (Helmreich); see also Hankinson, *Cause and Explanation*, 320-321.

implications for 'indication,' ἔνδειξις. The Methodists' position on indication and the manifest, and the relationship between these two ideas, has been outlined in detail elsewhere;[50] here, I will provide a brief overview of these concepts as they relate to medical decision making. Indication, though an important part of the Methodist position on therapeutic decision making,[51] was not an exclusively Methodist notion. It was invoked in epistemological discussions on the interpretation of signs.[52] Commemorative signs were those for which a link could be posited that had the potential to be verified through recourse to the evident (smoke as a sign for the presence of fire). Indicative signs were those for which the link to an underlying cause could not be verified through recourse to the evident (blushing as a sign of the emotional state of shame, or sweating as a sign of the presence of pores). Empiricists emphasized the value of the commemorative sign, arguing that experience helped the practitioner to identify the associations between the commemorative signs and their manifest causal agents.[53]

Methodists, on the other hand, eschewing the necessity of acquiring years of experience in order to become a competent practitioner, argued that doctors could bypass the concept of signs, whether indicative or commemorative. They focused on the role of indication in the clinical encounter, but, as was the case for their use of the concept of generalities, they employed the principle of indication in an undogmatic way, as Sextus Empiricus describes:[54]

> ὡς γὰρ ὁ σκεπτικὸς <ἀδοξάστως> χρῆται τῇ "οὐδὲν ὁρίζω" φωνῇ καὶ τῇ "οὐδὲν καταλαμβάνω," καθάπερ εἰρήκαμεν, οὕτω καὶ ὁ μεθοδικὸς κοινότητα λέγει καὶ διήκειν

[50] Frede, *Essays*, 263ff; M.F. Burnyeat, *Explorations in Ancient and Modern Philosophy, Vol. 1* (Cambridge: Cambridge University Press), 128ff; Allen, *Inference from Signs*, 87ff.

[51] Galen, *De Sect. Ingr.* 12.14ff, 13.13, 17.5ff (Helmreich); *MM* 10.351,7K; pseudo-Galen, *Int.*14.677K and *Opt.Sect.* 1.125K, 1.164K.

[52] Sextus Empiricus, *PH* 2.100ff.

[53] Allen, *Inference from Signs*, 87ff.

[54] Sextus Empiricus, *PH* 1.240; trans. Bury.

καὶ τὰ παραπλήσια ἀπεριέργως. οὕτω δὲ καὶ τὸ τῆς ἐνδείξεως ὄνομα ἀδοξάστως παραλαμβάνει ἀντὶ τῆς ἀπὸ τῶν φαινομένων παθῶν τῶν τε κατὰ φύσιν καὶ τῶν παρὰ φύσιν ὁδηγήσεως ἐπὶ τὰ κατάλληλα εἶναι δοκοῦντα, ὡς καὶ ἐπὶ δίψους καὶ ἐπὶ λιμοῦ καὶ τῶν ἄλλων ὑπεμίμνησκον.

"Besides, the use of terms in an undogmatic and indeterminate sense is common to both systems. For just as the Sceptic uses the expressions 'I determine nothing' and 'I apprehend nothing,' as we have said, in an undogmatic sense, even so the Methodic speaks of 'generality' and 'pervade' and the like in a non-committal way. So also he employs the term 'indication' in an undogmatic sense to denote the guidance derived from the apparent affections, or symptoms, both natural and contra-natural, for the discovery of the seemingly appropriate remedies—as, in fact, I mentioned in regard to hunger and thirst and the other affections."

The Methodists argued that a dog with a thorn in its paw knew to remove the thorn; a hungry man knew that he needed to eat.[55] Similarly, a given pathological condition would show an observant practitioner the appropriate treatment, and ἔνδειξις was the name given to this connection between the condition and the obvious associated therapy. There was no need for the clinician to consider the non-manifest or the hidden causes inside the body, since focusing on the observable symptoms the patient was experiencing would direct the clinician to an affection, then to a commonality, and from there, to a therapy. Causal reasoning – based on arguments and assumptions about what was hidden, or even based on appeals to antecedent causes – could therefore be skipped entirely,[56] since it did not have a place in the movement from observation of symptoms, to classification and naming of symptoms, to identification of commonality, to therapy. The Methodists' clinical emphasis was the management of the patient's immediate symptoms.

The φαινόμενα, then, provided Methodists with guidance about therapeutic management, but only when slotted into the Methodist system of classification, which generated a way of

[55] Sextus Empiricus, *PH* 1.238.

[56] Frede, *Essays*, 266ff.

making sense of defined symptoms in a prescribed way. The level of detail at which the practitioner needed to observe was established with reference to both the κοινότητες and the πάθη. Individual pieces of data were subsumed into general categories that matched what was manifest, that is, those details that were obvious to anyone, whether professional or layperson. Six months of training were sufficient to teach a practitioner how to align those observations with associated symptomatologies, affections, and commonalities. This transparency was an aspect of the system to be celebrated – medicine had been so refined that an individual only needed to learn 'the method' in order to be an effective, efficient practitioner. The short period of training also illustrated the scale of what proponents of Methodism felt constituted firm, secure knowledge. It is an acquiescence to the challenges posed by individual variability and the impossibility of seeing the hidden physiology of a living human being with consistent certainty. At the same time, it is an acknowledgement that medicine does yield sufficient observational possibilities that can be arranged into a dependably coherent whole, as long as the physician does not venture too far along paths that track into the unseen and keeps his categories broad.

Practitioners had observed enough to know that there was a lack of consistency in what they saw across patients, including the progression or resolution of pathologies and responses to therapy. Their system of commonalities, affections, and symptoms was one way of coping with these uncertainties and, for them, could provide a measure of reliability and certainty while simultaneously acknowledging the uncertainty. Recourse to the φαινόμενα was another means of obtaining consistency within the uncertainty. By *not* considering cause, Methodist providers ensured that they did not deviate from what they could see, from the patient in front of them. There was no distraction from the central classification system, or the symptoms that they were supposed to seek out and to register in order to map the patient's presentation on to the system.

5.5 Diagnostic and Therapeutic Implications

5.5.1 The "Criterion of Relevance" and the Criterion of Utility

Having considered the component parts of the Methodists' diagnostic and therapeutic framework, we might now turn to the question of what would have happened when a Methodist physician was actually evaluating an ill patient. Michael Frede concludes his chapter, "The Method of the So-called Methodical School of Medicine," by meditating on precisely this question:[57]

> "…such an investigation, I suspect, would show that once we come to Methodist authors like Soranus, the actual change in practice stood in no proportion to the revolutionary zeal with which Thessalus offended the medical profession when he set out to propagate the new method…it was largely traditional medical practice which happily survived, even under the guise of Methodism."

Yet even if the prescribed therapies for various conditions remained constant over time, and consistent across different schools of thought, sources such as Galen and Caelius Aurelianus emphasize that although doctors have *done* the same, they were not *thinking* the same. That is, the basis for their decisions was fundamentally different. To the patient, the therapy and its outcome may have been equivalent across practitioners, but to the physician and to his students, the justification for that therapy was very different: the decision was similar, but the process of deciding was not.

What did the process of decision making look like for a Methodist physician? One way to answer this question is with reference to what Philip van der Eijk has termed the "criterion of relevance."[58] Commenting on the appropriateness of Caelius' inclusion of pieces of information

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[57] Frede, *Essays*, 278.

[58] Philip J. van der Eijk, "The Methodism of Caelius Aurelianus," in *Le traité des Maladies aiguës et des Maladies chroniques de Caelius Aurelianus: nouvelles approches: actes du colloque de Lausanne 1996*, ed. P. Mudry (Nantes: Institut universitaire de France, Université de Nantes, 1999), 47-94.

we might deem excessive, especially given the Methodists' emphasis upon streamlined categories, van der Eijk argues that Caelius' decision to include this information is not only dependent on his perception of its "factual correctness," but also "by the relevance of the components of the definition to diagnosis and treatment."[59] Another way to think about the "criterion of relevance," specifically as it bears on clinical decision making, is with recourse to the idea of a criterion of utility. What is the minimum necessary to distinguish one affection from another? What details are indispensable for such demarcation? In terms of the information required for them to diagnose and to treat an unknown condition, the Methodists have been labeled "miserly,"[60] but perhaps a more charitable way to consider their lean approach to information acquisition is in terms of efficiency and utility. Their insistence upon the kind of medicine that could be completely learned and successfully deployed for a large patient population after six months of instruction would have privileged a kind of instrumental practicality for each data point acquired, as the subsequent case study will show.

5.5.2 Case Study: Caelius Aurelianus and Pleurisy

There are two broad aspects to consider in an examination of the practical elements of Caelius' presentation of affections: diagnosis and therapy. What I hope to show through focusing on diagnosis and treatment is that, in practice, Methodism allowed for the simplification of decisions at crucial junctures in extended decision-making processes. This simplification is part of a mindset focused on utility and practicality, on identifying and managing the manifest efficiently and effectively.

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[59] van der Eijk, "The Methodism of Caelius Aurelianus," 73.

[60] Hankinson, *Cause and Explanation,* 319.

This case study of diagnosis and therapy in Caelius' text will focus on pleurisy, an acute condition that receives the same kind of exposition that most of the listed affections do. Sections are devoted to its symptoms, the ways it can be distinguished from similar diseases, its treatment, and commentaries on the views of other practitioners on its diagnosis and therapy. Its potential to be confused with other, related affections also makes it appropriate for a case study in decision making, since Caelius' exposition of the distinguishing patterns associated with pleurisy sheds light on the criteria of relevance and utility described above. Finally, Caelius' assertion that pleurisy can pass into (*transire*) either pneumonia or empyema,[61] the former an acute affection and the latter a chronic affection, also provides opportunity for him to explain the boundary points at which the acute affection of pleurisy crosses into the territories associated with different conditions. It should be stated that, as this section is concerned with the diagnostic and therapeutic implications of 'the method,' we will focus especially on aspects of this text that indicate how a Methodist physician might have diagnosed and treated pleurisy in practice, that is, what his process of clinical decision making might have entailed.

Instructions related to the diagnosis of pleurisy focus primarily on observations. Though there is mention of antecedent causes, the text dismisses the idea that knowledge of these causes matters for *treatment*. The mechanism of a relationship between a certain activity and a diagnosis of pleurisy is not given, and Caelius emphasizes, *sed neque secundum has differentias differens erit adhibenda curatio. Una est enim atque eadem passio ex qualibet veniens causa, quae una atque eadem indigeat curatione*, "But the variety of causes will not occasion a corresponding variety of treatment. For the disease is one and the same, whatever the cause from which it

[61] Caelius Aurelianus, *CP* 2.15.

proceeds, and it requires one and the same treatment."[62] This statement is consistent with what Galen described in his example about the ways that Rationalists, Empiricists, and Methodists conceptualize and manage the symptoms that they observe in the context of the bite of a rabid dog. The Methodists see the symptoms and think of the disease itself; they are concerned with treating these symptoms, and the causal mechanism that brought about these symptoms is irrelevant for their therapeutic paradigm.

Age, sex, and season are included in the description of features associated with the disease, though their mention is immediately followed by a symptom list and the admonition, *quapropter ex his solum dicimus agnoscendam quae supra memoravimus. Alia vero concurrunt plurima atque differentia pro passionis magnitudine ac temporum mutatione, quae quia praetermittenda non sunt prosequamur*, "We hold, therefore, that the disease is to be recognized solely by those things which we have mentioned above. But there are many other diverse accompanying symptoms depending on the severity of the case and the passage of time. Since these should not be neglected, let us discuss them at this time."[63] Caelius circumscribes the information required to make the diagnosis, then proceeds to outline in detail more observations that illustrate the symptom pattern he has mentioned. Subsequent descriptions of symptoms are given as conditionals: the appearance of these symptoms marks an increase in the severity of the affection. Careful observation of symptoms also helps a practitioner to identify whether pleurisy is transforming into a different affection (pneumonia or empyema). The practitioner should note the patient's appearance, pulse, and the location of his pain to make these distinctions: there is no reference to chronicity, etiology, hidden causes, or causal mechanism (theoretical or otherwise).

[62] Caelius Aurelianus, *CP* 2.13, trans. Drabkin.

[63] Caelius Aurelianus, *CP* 2.13, trans. Drabkin, with modification.

Diagnosis, Caelius demonstrates in the text, is a matter of observing clearly delineated, manifest symptoms.

Though the section entitled, *quis locus in pleuriticis patitur*, "the part affected in pleurisy," does discuss debates about the location of this affection with reference to ostensibly hidden anatomy, it remains grounded in macro-level anatomy, on the location of the patient's pain, and on how that pain changes with the patient's movement. Arguments about the diseased organ in pleurisy (either the lung or the membrane around it) still revolve around the patient's readily observable symptoms. Similarly, the section on distinguishing pleurisy from similar affections, such as empyema, dyspnea, coryza, and asthma, includes no reference to etiology as a means for determining which disease the physician has encountered. To distinguish pleurisy from these conditions, a practitioner should note where the patient feels pain, the quality of his pain, whether or not he has swelling in his sides, the appearance of his sputum, and the presence or absence of fever. Methodist diagnostic decision making, as Caelius explains it, was fundamentally about noting what can be seen directly and relating those observations back to an expected pattern of symptoms.

With the establishment of the diagnosis, therapy is straightforward, because the observations required for diagnosis would have pointed the way to a commonality, even if (as was the case for pleurisy) more than one commonality could have been implicated in a given affection. Caelius outlines an approach to therapy that was, because of ἔνδειξις, guided by the commonality: yet therapeutic options and modalities were still diverse and included dietetics, pharmacology, hydrotherapy, phlebotomy, clysters, purges, environmental modulation, and various applications to the skin. The central aspect of therapy – the commonality – was an anchor for subsequent therapies: establishing the anchor was straightforward, as Caelius

describes it, and then therapeutic complexity could be introduced around this anchor. Moreover, therapy would also be administered in a manner consistent with the concept of the διάτριτος, an inclusively three-day period around which Methodist observation and re-evaluation of the patient, as well as administration of therapy, were organized.[64] Practically speaking, this meant that the Methodist physician would see his patient every other day, allowing for frequent assessment and alteration of therapy. The διάτριτος was used for every patient and for every affection: just as the commonalities formed broad categories that bridged diagnosis and therapy, so the διάτριτος was an overarching concept that provided a chronological foundation for the diverse therapeutics that the Methodists employed. Their periods of re-evaluation were clearly prescribed, but, as we have seen, still allowed for variation in practice within their preferred chronological system of determining and applying treatment.

Caelius' focus on symptoms and determination of the commonality may lead readers to wonder why he bothers to mention details such as age, environment, and habits, if he emphasizes that they are not foundational for diagnostic decisions and therapeutic management. One explanation may be that recognition of such patient features could have pointed the way to the symptoms that did matter. This would not necessarily have meant that features such as age were signs of the presence of a symptom, but rather that acknowledgement of age could have encouraged a practitioner to make a conscious effort to look for a symptom that would have been important in determining whether he was facing, say, pleurisy versus empyema. In keeping with the Methodists' acceptance of overlapping categories and recognition of shared features of disease, acknowledgement of a patient's habits or environment may not have been a necessary aspect of their diagnostic or therapeutic decision making, but it could have been a useful one in

[64] For an excellent and thorough overview of the history and practical aspects of the διάτριτος, see Leith, "The *Diatritus*."

certain circumstances. Flexibility and a focus on the utility of information remained the guiding principles for Methodist decision making. Caelius can therefore mention these kinds of features (patient age, habits, environment) in his text, while still cautioning that they are not aspects of the patient's condition that are involved in determining the affection – patterns of symptoms fulfilled this role. Pracitioners are welcome to use them to seek out symptoms, but their focus should remain on the altered physiology of the moment.

In conclusion, then, this case study of pleurisy, with reference to trends in Methodist treatment patterns more broadly, has illustrated how the system Caelius Aurelianus presents encourages the simplification of decision making around branch points: circumscribing the information necessary to make a diagnosis, for example, and then similarly limiting the number of therapeutic categories into which a given affection would fall. These therapeutic categories were the commonalities, and while the kinds of treatments used for illness (diet, exercise, variable procedures, medicaments) might have varied, their use was always tied to the commonality. Once the commonality was known, multiple therapeutic options were available in an organized, sequential way – but the challenge of thinking through the central purpose of each therapeutic agent was mitigated via recourse to the commonality. Decision making at the therapeutic branch point – which kind of commonality – was simplified, because the Methodists provided only three options, each of which was tied in a straightforward way to an affection. Re-evaluation of the patient to determine disease progression and treatment efficacy was also systematized through employment of the διάτριτος, an approach to treatment that was universal yet still allowed for individual variation and flexibility with respect to the therapies deployed.

5.6 Methodism and Medical Decision Making: Conclusions

5.6.1 Methodism and Modern Clinical Categorization in Differential Diagnosis

In teaching medical residents, or doctors-in-training, how to evaluate a new patient's medical condition, internal medicine physician Richard Forster, MD, of the University of Massachusetts, has recently proposed a system of four broad disease categories, which are defined by the similarity of the patient's as-yet unidentified presentation with the archetypical presentation of a given condition.[65] For example, if a patient comes to the emergency department complaining of nausea, fatigue, abdominal pain, and bloody diarrhea, the system Dr. Forster proposes involves first identifying the patient's symptoms. Then, trainee-physicians consider, broadly, what disease this group of symptoms could represent. For example, with reference to the symptoms listed above: a gastrointestinal infection, bleeding in the gastrointestinal tract, volvulus (twisting of the intestine on itself), appendicitis, and so on. Next, a provider should consider the typical clinical presentations of each of these problems on the list: what symptoms are most frequently associated with these problems?

The subsequent step involves comparing the archetypical presentations of each of the listed diseases with the patient's as-yet unidentified presentation. If the patient's condition shares most or all of the symptoms with the archetypical presentation of a gastrointestinal infection, for example, then "gastrointestinal infection" falls into the category of "Type 1" diagnosis: these are the most likely diagnoses, because their standard, typical presentations align well with the patient's presentation. Type 2 diagnoses are those that, in their standard, typical form, share some features with the patient's presentation. The patient might have one or two symptoms that are not typical for the diagnosis under consideration, or may not have some of the symptoms that

[65] Richard Forster, MD, Personal communication with author, November 27, 2017.

would be expected. Type 3 diagnoses share only a few features with the patient's presentation: these kinds of diagnoses are rare, because they mean that the patient is presenting with an atypical manifestation of an illness. In other words, in a Type 3 circumstance, the disease the patient has is not behaving as the practitioner would expect. The fourth group of diseases, Type 1b, are actually diseases in the Type 2 or 3 categories, meaning they share some or only a few features with the patient's current presentation, but they carry a non-negligible risk of permanent harm or death of they are missed. In other words, they are less likely but more urgent diagnoses, should one of them in fact be present. This category exists because the diseases listed in it are actionable, and time matters in their treatment.

I mention Dr. Forster's system here because, like the Methodist system, it works by relating individual symptoms to broad categories, and because the Type 1b category has an explicitly practical reason for its existence. Certainly, there are differences between the two systems: the three broad categories of the Methodist system are based on the notion of the commonalities, while Dr. Forster's system of four types is based on the number of attributes shared between a typical presentation and a patient's un-diagnosed condition. Yet both systems are ways of organizing a patient's individual symptoms in a way that acknowledges that these symptoms could indicate multiple conditions, and it is the pattern of these symptoms relative to each other that points the way to a diagnosis. Both also rely on the foundational assumption of a 'typical' presentation: as the πάθη represent pathological entities that Methodist physicians were taught to identify, so Dr. Forster's diagnostic framework uses knowledge of what a 'generic gastrointestinal infection' (for example) looks like in order to evaluate whether or not the undiagnosed patient does, in fact, have this problem. Finally, both create space for practical concerns: just as Caelius privileges the observable reality, so Dr. Forster's method provides the

Type 1b group to cope with the practicalities of acute conditions that require immediate management.

The utility of these systems lies in their systematized yet flexible navigation of generals and particulars. As we have seen throughout this consideration of medical decision making in Greco-Roman antiquity, a persistent challenge that practitioners faced was reconciling their individual patients with the consistent similarities they observed in disease presentations. What level of detail mattered in disentangling one disease from another? These questions are further complicated by the human tendency to think in terms of groups and stereotypes as a way of filling in gaps about unknown information, thereby easing the cognitive burden of assimilating multiple data points and hastening decision making processes. Both Dr. Forster's system and the Methodist system provide the structure of categories that operate on different scales of magnitude and deal with easy-to-think-about 'standard presentations' of diseases (or, in Methodist terms, affections). Cognitive frameworks speed decision making because they provide standard ways to group observations, and to make sense of those observations. Specific inputs are sought, their pattern is matched on to one of a set of patterns, and therapeutic decision making flows from the pattern identification. Yet both systems are also flexible. In Dr. Forster's framework, a pneumonia could be Type 1, 1b, 2, or 3, depending on whether typical pneumonia matched what was observed in the patient. Similarly, in the Methodist framework, phrenitis could be either a restrictive disease, or a mixed-state disease, depending on the symptoms that were present. The cognitive framework provided focus without sacrificing adaptability to the observed clinical scenario.

5.6.2 Methodism and Medical Decision Making

A reactionary sect responding to Rationalist and Empiricist assertations about the medical theory and practice, Methodism coped with with questions of uncertainty, generalization, and exceptions by developing and deploying a sophisticated system of categories. These categories, while streamlined and practical, were not simplistic. They provided a structured basis from which to make decisions and within which to arrange observations, while also ensuring that the levels of categorization within the framework were not so restrictive that they could not accommodate individual variation. It was a useful way of coping with a large amount of information, a method focused only on information that was immediately useful: a kind of heuristic in and of itself. Yet while heuristics and biases are concerning in the context of human decision making because they can lead to wrong answers, the generalizing heuristic tendencies of Methodism were tempered by the variation that was present in its system of affections; the diversity of its therapies; and the systematic incorporation of new data through the *diatritos*. If Methodist physicians could teach medicine in only six months, perhaps they *had* identified the essence of clinical decision making: observation, systematic interpretation, and action. Celsus praises the utility of their approach for seeing patients in crowded urban hospitals; Thessalus was a physician to members of the imperial family. Galen's challenge to the method was surely an indication of its prominence as much as it was a sign of his ideological consternation.

Chapter 6
Galen, Foundations of Decision Making, and Evaluation of the Individual

ἐγὼ δ' εἰ καὶ τὴν ἑκάστου φύσιν ἀκριβῶς ἠπιστάμην ἐξευρίσκειν, οἷον ἐπινοῶ τὸν Ἀσκληπιὸν, αὐτὸς ἂν ἦν τοιοῦτος· ἐπεὶ δ' ἀδύνατον τοῦτο, τὸ γοῦν ἐγγυτάτω προιέναι καθόσον ἀνθρώπῳ δυνατὸν αὐτός τε ἀσκεῖν ἔγνωκα καὶ τοῖς ἄλλοις παρακελεύομαι.

"And if I knew how to discover precisely the nature of each person, like I think Asklepios did, I would myself be like him. But since this is impossible, I have decided to approach as closely as is possible for a man, and myself, to practice this, and to exhort others [to do so]."

Galen, *On the Method of Healing* 3.7[1]

6.1 Introduction

A beneficiary of centuries of recorded debate, observations, anatomical investigations, pharmacological discoveries, and patient case histories, Galen speaks to us more loudly than many – if not all – physicians of Greco-Roman antiquity. He lectures us about others' mistakes, guides us through dissections and vivisections of animals, regales us with anecdotes of his patients and his miraculous cures of their illnesses, and interprets his predecessors' words for us. His corpus is extensive, and his views of health, disease, and therapeutics influenced physicians throughout Europe, Africa, and the Middle East for over 1500 years. The successful survival and transmission of his texts in Greek, Latin, and Arabic yields a pattern opposite to that which we have observed in the last three chapters: instead of abbreviated fragments separated from their original contexts, we have a still-growing body of treatises that explain Galen's theories, practices, education, experiences, opponents, and life history.

This chapter aims to address the question, "How did Galen decide?" in the context of diagnostic and therapeutic decision making. The last fifty years have seen the publication of comprehensive analyses of Galen's epistemological and methodological tendencies that highlight

[11] = 10.207K, trans. Ian Johnston, *Galen: On Disease and Symptoms* (Cambridge: Cambridge University Press, 2006), with modification.

his philosophical influences and goals,[2] and it is not my primary intention to identify the philosophical sources of Galen's approach to diagnosis and therapy. Instead, I seek to reconstruct the decision making process Galen would have undertaken when encountering a new and unknown patient. To do this, I focus on certain of the texts in which Galen explicitly emphasizes that he is outlining the method a physician should use to diagnose and treat patients, including *Mixtures, The Best Constitution of Our Bodies, The Pulse for Beginners, The Art of Medicine,* and his texts on causes and differentiae of diseases and symptoms. My use and interpretation of these source materials will be discussed further in sections 6.2 and 6.3.

Galen tells us himself the kind of training a physician should undertake in order to be a successful practitioner. However, as we have explored in Chapter 1, though this training can prepare a physician to take specific cognitive steps when confronted with a patient, these steps are not always followed so exactly 'in the clinic' when an experienced practitioner is diagnosing, prognosing, and treating: cognitive shortcuts and pattern-based thinking often guide evaluation. Examining the case histories Galen preserves throughout his treatises, and his descriptions of crises and pulse analysis, I ask: To what extent can we identify pieces of information that Galen actively sought and privileged as he diagnosed and treated? Under what circumstances was it necessary to obtain these pieces of information, and how were they applied? How did he think about acquiring such information, and when did he determine he had enough to proceed with diagnosis and treatment? To answer these questions, I will look at the instances in which Galen has described his interactions with a patient, in the case references and reports found throughout

[2] See R.J. Hankinson, *The Cambridge Companion to Galen* (Cambridge: Cambridge University Press, 2008) for a summary of relevant bibliography, as well as Susan Mattern, *Galen and the Rhetoric of Healing* (Baltimore: Johns Hopkins University Press, 2008), and *The Prince of Medicine: Galen in the Roman Empire* (Oxford: Oxford University Press, 2013).

his oeuvre, as described in the table of patients Susan Mattern lists in Appendix B of her book, *Galen and the Rhetoric of Healing*. His stated management of these patients' problems will then be compared with the ideal theoretical approaches he has outlined in his methodological works.

Galen had a clear plan for managing the uncertainties of medical practice, which he explains throughout his treatises. It was a method rooted in definitions, causes, and theoretical models: one that, employing and integrating large amounts of data, sought to organize these data into increasingly subdivided categories to foster precision and to account for individual variation. Comparison of this articulated method with the information Galen preserves in his case histories, however, suggests that his classification and decision making framework may have been too complex to use regularly in daily practice. Review of the cases he cites throughout his texts suggests that, at the bedside, he relied less on his meticulously-constructed theoretical models and more on broad-brush conceptualizations and experiences of treating patients than his methodological texts might have encouraged. While his detailed theoretical models would undergird his practice and provide guidance in cases of the atypical or unexpected, they do not necessarily seem to have been invoked in all circumstances.

6.2 Galen, Medical Education, and Theoretical Constructs for Decision Making

6.2.1 Preparing to be a Physician

Throughout his writings, but especially in *On the Examinations by which the Best Physicians are Recognized*, Galen describes the knowledge and skills that a physician should possess and demonstrate. *On the Examinations*, written as a guide for educated elites so that they might know how to choose a well-trained and effective physician, emphasizes both the theoretical and practical aspects of medicine, a sentiment found in Galen's other methodological

treatises.[3] The physician without experience, Galen writes, is like the helmsman who tries in vain to learn piloting from a book.[4] Yet, should someone interviewing a prospective physician determine that the hopeful candidate is not extensively versed in the writings of Hippocrates, Plato, and other medical authors and philosophers (i.e., the would-be physician does not know theory), the interviewer should terminate the inquiry immediately. A student's mastery of these written source materials should be so extensive that he can summarize them, put them in dialogue with one other, critique them, and relate them to what he himself has come to believe.[5] Demonstrated knowledge of theory means that a candidate, "should be trusted even before he is examined in clinical cases and in practice."[6] Though important, experience treating patients can, in evaluating the training and preparation of a would-be physician, be outweighed by critical knowledge of the totality of the medical tradition. Without such deep knowledge of theory, the physician cannot make sense of what he learns in the day-to-day experience of his practice.

Nevertheless, too much book-learning, Galen warns, and a physician-in-training could be surpassed in knowledge and skill by a colleague who cares less for theory but spends his days actively seeing and treating the sick. Theory is applied in these practical settings, as it enables a physician to make sense of what confronts him in the clinic.[7] This connection between theoretical and practical knowledge emerges in particular when anatomy is an important factor in diagnosis, and education in anatomy and physiology is also an indispensable part of medical

[3] *MM* 3.1 = 10.159K, for example.

[4] *Alim.Fac.* 1.47 (Helmreich) = 6.480K; 13.605K.

[5] *Opt.Med.Cogn.* 5.2-3 (*CMG* Suppl. Or. IV, Arabic).

[6] *Opt.Med.Cogn.* 9.3 (*CMG* Suppl. Or. IV, Arabic).

[7] *Opt.Med.Cogn.* 3.12 (*CMG* Suppl. Or. IV, Arabic).

training.[8] Taken together, deep familiarity with and a critical view of theory, and experience in anatomical dissection, should enable a physician to treat the ideal way: by diet and by drugs, without resorting to incision.[9]

6.2 Galen's Framework for Deciding

Galen's extensive oeuvre presents many aspects from which his approach to clinical decision making might be appreciated. In examining his theoretical and practical framework for making decisions, I focus on *Method of Medicine*, *The Pulse for Beginners*, *On Mixtures, On the Differentiae of Diseases, On the Causes of Diseases, On the Differentiae of Symptoms, On the Causes of Symptoms*, *On Crises*, and *On Critical Days*. In the context of a study investigating the role of decision making – in particular, heuristics – in the diagnosis and treatment of disease, I have chosen to explore texts that provide examples of classification schemata, and of diagnostic progression. While these texts are not the only places within the Galenic corpus where such information might be found, they provide focused insight into Galen's ideal approach to applying classification systems and causal reasoning in the context of clinical decision making.

These texts suggest that, integrating theoretical knowledge and experience, Galen sought to develop a unified approach to evaluating and treating patients, while confronting the challenges of individual variation, uncertainty around issues of causation and treatment response, and a large volume of potentially relevant clinical data. He articulates these interconnected difficulties throughout his methodological treatises, with fundamental unifying tenets of his

[8] For examples of when anatomical knowledge was crucial for establishment of professional authority or accurate diagnosis, see *Opt.Med.Cogn.* 9.6-7, 10-11, 23 (*CMG* Suppl. Or. IV, Arabic).

[9] *Opt.Med.Cogn.*10.1-2 (*CMG* Suppl. Or. IV, Arabic).

approach being the uniqueness of every individual and the diversity of disease processes with which the physician had to contend.[10] Patient-to-patient variability both contributes to and explains inconsistencies in the course of different diseases, and in patients' responses to therapies.[11] Since each person is different, he or she responds to the diverse external environments to which he or she is exposed in unique ways: people are therefore susceptible to different maladies, depending on their own distinctive natures, and they require treatments suited to their own individual 'normal' or healthy baseline.[12] Their physiological individuality (their φύσις and their κρᾶσις) is augmented by their habits and the interaction between their body and its external environment: these behaviors could also affect physiological derangements and propensity to certain pathologies.[13] Moreover, acknowledgement of the individual normal extended to specific parts of the body. A physician would need to know when a specific part of the body was suffering, and would therefore need to understand and to distinguish between normal for the body as a whole, and the particular normal for a given part of the body.[14] An ideal doctor would know this endless variety of individual natures and habits, and specific attributes of parts, since familiarity with these data was necessary to determine the appropriate treatment for each unique patient.[15] Acquiring and evaluating the infinite quantity of pertinent data for each

[10] On patient variability and the importance of being aware of individual idiosyncrasy, especially in the context of choosing the correct therapy, see *MM* 3.7 = 10.206K; 9.7 = 10.629-632K. On the diversity of normal diagnostic markers, see *Diff.Puls.* 9 = 8.462-473K. On the diversity of pathological processes, see *MM* 1.3 = 10.25-26K; 2.6 = 10.115K.

[11] *MM* 7.4 = 10.469K.

[12] *MM* 3.7 = 10.206-211K; *Temp.* 1.6-7 = 1.544-554K; all of *Temp.* 2 and especially 2.1-2 = 1.572-598K. See also references for n. 11.

[13] *MM* 3.7 = 10.206-7K. *Temp.* 2 discusses this in detail. On the role of the external environment, see *On the Best Constitution of Our Bodies* 3 = 4.742K.

[14] *Temp.* 2.6 = 1.629-635K.

[15] *MM* 3.7 = 10.206K.

patient would require the all-knowing mind of a healing god, Galen acknowledges – but the enormity of this superhuman task of decision making does not preclude Galen from attempting it. Though faced with these challenges of individual variation, uncertainty, and data volume, he has developed solutions to guide the intelligent, dedicated practitioner.

Definitions and classifications, he contends, are necessary to provide the physician with a systematic, effective way to make diagnostic and therapeutic decisions.[16] Even though individual patients and disease processes are unique, Galen asserts, they have differentiating characteristics that allow them to be grouped into broader categories, and from there, into progressively more specific subcategories.[17] Symptoms and physiological findings, too, should be grouped into categories. *The Pulse for Beginners*, for example, describes ways that the pulse might be characterized with respect to size, motion, magnitude, the quality of the arterial membrane, and the quality of diastole.[18] These differentiae exist on spectra that allow for a range of descriptors. Size is further qualified with descriptions of the length, depth, and breadth of the pulse; motion is illustrated with descriptions of quickness or slowness; the magnitude of the pulse may range from feeble to vigorous; and so on for the other characteristics. Descriptors within these differentiae do not exist as binaries (e.g., either feeble or vigorous), but as points on a range that is particular to that attribute.[19] The pulse provides one example of the branching classification systems within which symptoms and physiological findings were located and placed into

[16] *MM* 1.3 = 10.25-27K. Galen's definition of health can be found in *MM* 1.5 = 10.42K; his definition of disease in *MM* 2.3 = 10.90K.

[17] *MM* 1.7 = 10.63-70K, on broad classifications of disease. Reiterated in *MM* 2.1 = 1.78K. Extended treatment of disease classification is found in *Morb.Diff.*

[18] *Puls.* 1-8 = 8.453-462K.

[19] Ranges are also characteristics of Galen's approach to mixtures of the fundamental qualities: *Temp.* 1.9 = 1.559K.

relationship with one another. The important aspect of Galen's method of definition, classification, and characterization is the precision of his sub-categorization. As he himself emphasizes, the method of medicine consists in continued division of diseases, until the most fundamental form is identified.[20] Stopping at broad categories – as Galen perceived the Methodists to do – was absolutely unacceptable to him.[21]

At the root of his detailed classification system of diseases, patient types, and symptoms were two important and related features: assumptions about causality and knowledge of anatomy. Both of these features were significant for diagnostic and therapeutic decision making, and both involve careful interweaving of observations about what could be directly perceived through human senses, and what could only be grasped through reason.[22] Galen presents his classification system of diseases by moving from broad to specific. In doing so, he is also moving from the unobservable to the observable, and embedding assertions about causality at the broadest point of his classification system. *On the Differentiae of Diseases*, consistent with Galen's focus on definitions, first sets out to define health ("balance") and disease ("imbalance"),[23] with reference to balance among the four qualities (hot, cold, wet, dry).[24] These components are not directly visible, but their imbalance – provoked through changes in the body, or external influences – leads to the visible symptoms of disease. That these largely invisible

[20] *MM* 1.3, 10.25-26K. *Temp.* 1.8 = 1.554K, where the qualities of heat, coldness, dryness, and moisture are identified as fundamental, pure forms. Galen justifies this approach with reference to Plato's views on classification. For more on Galen's reliance on the philosophical method of *diaeresis*, see Teun Tieleman, "Methodology," in *The Cambridge Companion to Galen*, ed. R.J. Hankinson (Cambridge: Cambridge University Press, 2008), 59-61; Frede, *Essays in Ancient Philosophy*, 279-298.

[21] For his criticism of Thessalus on the matter, see *MM* 1.3 = 10.27K.

[22] *MM* 1.4 = 10.38K.

[23] *Morb.Diff.* 2.2 = 6.838K.

[24] *Temp*. 1 = 1.509ffK; *Morb.Diff.* 2.3 = 6.838-839K.

components of the body (the four qualities) are at the root of the classification system underscores his view on the role of causal determination in the diagnosis and treatment of disease.

The importance of causes in Galen's framework is further supported by one of the axioms upon which he bases his work: "Nothing occurs without a cause."[25] Accepting that changes in health occurred by means of a causal mechanism, Galen sought to propose such a mechanism, even and especially in cases in which a precipitant was not immediately obvious: πειρᾶσθαι μέντοι χρὴ διαγινώσκειν, ὡς οἷόν τέ ἐστιν, ἀρετήν τε καὶ κακίαν αὐτῶν, εἰ καὶ μὴ κατ' ἐπιστήμην βεβαίαν, ἀλλ' οὖν κατὰ στοχασμόν τινα τεχνικὸν, οἷον εἰ οὕτως ἔτυχεν ἐπὶ ἥπατος. "One must, however, attempt diagnosis of [organs'] excellences and defects, if not by means of an absolutely firm kind of knowledge, at least by 'scientific conjectures,' as in the case of the liver."[26] Causes could be internal or external.[27] While traumatic injury, for example, provided a clear causal mechanism of an externally-derived assault on the body's integrity, the inciting event for non-traumatic disease was not so straightforward to identify.[28] Imbalance of the four qualities was this causal mechanism behind the body's change in homeostasis and the occurrence of disease.

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[25] *MM* 1.7 = 10.49-50K; see also *PHP* 5.389-90K, and Tieleman, "Methdology," 60.

[26] *Ars Med.* 19 = 1.353K, trans. Singer.

[27] *MM* 1.7 = 10.65-66K.

[28] The question of Galen's views on causation has been extensively discussed, and is not the focus on this chapter. Here, it will suffice to recognize that Galen saw the four qualities as the fundamental elements of the human body that were involved in disease processes, and that these were the aspects of the human body which needed to be therapeutically manipulated to restore a patient to health. Passages discussing the clinical relevance of this kind of causal reasoning are: *MM* 7.3 = 10.462-465K; *MM* 2.6 = 10.125-6K; *Caus.Morb.* 1.1 = 7.1-2K and 2.5 = 10-11K (these passages are focused and useful, though the whole treatise is relevant to this question). Galen himself discusses broader philosophical questions concerning causes in his own *CP*, and *CC*, as well as in *Caus.Puls.* 9.1-3K and *Caus.Resp.* 4.465-6K. Secondary literature discussing Galen's views on causes includes: R.J. Hankinson, *Cause and Explanation in Ancient Greek Thought*; P.J. van der Eijk, *Medicine and Philosophy in Classical Antiquity*; Frede, *Essays in Ancient Philosophy*; R.J. Hankinson, "Galen's Theory of Causation," *ANRW* II, no. 37 (1993): 1775-89; J. Barnes and J. Jouanna, eds, *Galien et la Philosophie. Entretiens sur l'Antiquité Classique* XLIX (Genève: Fondation Hardt, 2003).

The physician, when confronted with a sick patient, sees the outcome of this imbalance, which is manifest in symptoms in various parts of the body that result in a compromise of function.[29] To treat it, the physician must characterize the imbalance with respect to the qualities; he should understand the relationship between specific kinds of assaults on the human body – from within or without – and the resultant imbalances. *On Differentiae of Diseases*, among other texts, provides the links between symptoms and imbalances.

Galen's disease classification is also a product of an anatomical focus, through which symptoms are related to particular anatomical components of the body, and the imbalances map on to this anatomical system. Galen proposes that there are three anatomical and physiological levels of the body: homoeomerous parts (e.g., arteries, bones, nerves), organs (e.g. heart, liver, lungs), and the whole body.[30] These three anatomical and physiological levels suffer from six different types of disease.[31] Homoeomerous parts may experience imbalances (δυσκρασίαι) associated with the four qualities.[32] Solid organs have diseases of formation, number, magnitude, or alteration of position (four classes of disease).[33] Another class of disease, dissolution of continuity, can affect either homoeomerous parts or organs,[34] and can happen with simultaneous pathological δυσκρασία.[35] Associated symptoms and affected anatomy provide the information

[29] *MM* 1.5 = 10.42-47K, 2.3 = 10.90-91K, 7.3 = 10.462-465K; *Opt.Corp.Const.* 2 = 4.739-42K

[30] *Morb.Diff.* 3.1 = 6.841K.

[31] *MM* 1.3 = 10.20K.

[32] *Morb.Diff.* 4.3 = 6.844-5K.

[33] *Morb.Diff.* 4.3 = 6.843-5K.

[34] *Morb.Diff.* 11.1 = 6.871-2K. Trauma is the main causal agent for these diseases: *Caus.Morb.* 11.1 = 7.37-9K. On whether or not this constitutes a discrete class by Galen's reckoning, see R.J. Hankinson, "Galen's Anatomy of the Soul," *Phronesis* 36, (1991): 201 and Johnston, *Galen: On Diseases and Symptoms*, 71.

[35] *Morb.Diff.* 12.2 = 6.872-3K.

necessary to identify a given set of observations with a disease category, and in his treatises Galen describes how one should define and organize these observations of changes in the human body.[36]

The texts that describe classification of diseases and symptoms, with their potentialities for sub-categorization and combinatorial classification, are accompanied by additional treatises that describe the causes of these diseases and symptoms. Classification and causality, as described above, are fundamentally related in Galen's cognitive framework and are part of his approach to medical decision making. The overarching causal reasoning that justifies the existence of the broadest categories is important for therapeutic determination, though the observations of specific features of an illness are what provide a physician with a purchase in the outermost branches of the classification tree.[37] The observations contribute to diagnoses by means of causal reasoning about qualities and structural disruption that Galen identified as the factor that all disease has in common. While the initial phase of diagnosis relied on these particular observations, therapy relied on generalized causal reasoning, since healing consisted in correcting the underlying imbalance. With regard to both diagnosis and therapy, however, this extended classification system integrated causal reasoning with direct observation in a way that could account for variabilities, inconsistencies, and uncertainties. The causal reasoning at the organizational base was broad enough that it could accommodate any combination of

[36] *Caus.Symp.* Books 1, 2, and 3 = 7.85-272K.

[37] *MM* 4.4 = 10.266K, trans. Johnston and Horsley: ἄρχεσθαι μὲν γὰρ ἀεὶ χρὴ τῆς ἐνδείξεως ἀπὸ τῆς διαθέσεως, ἣν θεραπεύειν ἐπιχειροῦμεν· ἐπισκέπτεσθαι δὲ καὶ διορίζεσθαι πότερον ἤδη πέπαυται τὸ ποιῆσαν αἴτιον τὴν διάθεσιν, ἢ καὶ νῦν ἔτι συνεπαύξει τε καὶ ποιεῖ. "It is always necessary to begin the indication from the condition we are trying to treat, although it is also necessary to consider and determine whether the cause which produced the condition has already ceased, or is currently still helping to increase [the condition] and acting."

symptoms,[38] and the classification system was specific enough at its outermost points that it could encompass all the data provided. There was a place for every data point, and the assignation of each point to its appropriate place was explicable.

In thinking about developing a systematized method to diagnose and treat patients, Galen faced the challenges posed by variability and inconsistency in patients' bodies, pathologies, and treatment responses, and he contended with questions about the relevance of data for clinical decision making. His solution for these challenges was to develop a method that directly confronted these variabilities, inconsistencies, and uncertainties by incorporating them all into his diagnostic and therapeutic framework. He insisted on individual variation as a cornerstone of his approach to medicine: variability in disease processes and treatment responses could therefore be expected. Large amounts of data – about the patient's body, environment, habits, and emotions – could be employed to help locate uniquely different patients into groups with shared characteristics. Classifications and sub-classifications, to the levels of hidden causes, could both accommodate and account for this variability. Diagnostic and therapeutic decisions could therefore be made in a way that both acknowledged apparent symptoms and relied on assumptions about the hidden causes that were leading to the appearance of those symptoms. Much training was necessary to enable a physician to think this way, and extensive knowledge of every patient would be required.

What did this look like in practice? In his methodological and theoretical texts, Galen describes extensively what kinds of information a clinician should obtain, how it should be classified, and how it points the way to diagnostic and therapeutic decision making. He also

[38] *Temp.* 1.6 = 1.550K, trans. Singer: γένος δ' ἦν αὐτῶν ἡ οὐσία. πάντα γὰρ ὑπὸ ταύτην πέπτωκεν ὡς ἀνωτάτω τι γένος, ἔμψυχά τε καὶ ἄψυχα… "Substance functions as the highest genus of all, within which fall all beings, whether endowed with soul or lifeless…"

describes instances in which he treated patients, elaborating upon the reason they sought a doctor and how his involvement led, nearly all the time, to a successful cure. Discussing Galen and his patients, Susan Mattern notes that, especially given Galen's emphasis on the uniqueness of each patient, "it is not clear that Galen had a routine procedure for examining patients; he seems to have drawn on the techniques [like evaluating the pulse]…as circumstances suggested. He could, however, be very thorough…"[39] Which aspects of his own methodology did Galen use regularly when he saw patients? The following section will explore how, in the context of his case histories, Galen collects and applies the information he deems relevant for making diagnostic, therapeutic, and prognostic decisions.[40]

6.3 Clinical Decision Making in Galen's Case Histories

6.3.1 Case Histories in Context: Interpretive Limits and Possibilities

Throughout his many medical treatises and thousands of pages of descriptions of anatomy, pathology, pharmacology, philosophy, and commentary, Galen provides anecdotes about the patients he has treated. Some stories are a sentence or two, or even a simple mention for being similar to a case that he has discussed more extensively elsewhere. Others, notably those in his *Prognosis*, are much longer and describe the events occurring over days, weeks, or months. These case histories involve men, women, and children; members of the elite, slaves,

[39] Susan Mattern, *The Prince of Medicine*, 227-8. See also R.J. Hankinson, "Epistemology," in *The Cambridge Companion to Galen*, ed. R.J. Hankinson (Cambridge: Cambridge University press, 2008), 172, and *Med.Exp*. 29, sections 147–8 in Walzer. Nutton, *Ancient Medicine*, 244: "Having made his observations and gathered as much information as he could, Galen then proceeded to a diagnosis and forecast. His usual method was to employ logic to establish a differential diagnosis, classifying the patient's condition with ever-increasing precision until he could identify what was wrong and assign it a cause."

[40] As described in the introduction of this chapter, I use Susan Mattern's case listing in Appendix B of her book, *Galen and the Rhetoric of Healing*, as a source for Galen's case histories.

and individuals occupying the area in between the top and bottom of the social ladder; gladiators, teachers, philosophers, senators, emperors, and even other doctors; and people suffering from all kinds of maladies of body and soul. It is to these case histories – especially the longer ones – that we now turn to examine Galen's methods of decision making in practice, following a note of caution about their interpretation and application.

These more than three hundred references to patients appear in a large variety of texts, each with its own purpose. The focus of each text affects the information highlighted in descriptions of patient encounters, and how it is framed. The contexts of these case histories can therefore complicate efforts to use them as reflections of the data that Galen privileged in clinical encounters. In *Prognosis*, for example, he writes that the prognostic process does not typically involve providing the full details of the cognitive mechanism by which he arrived at his remarkably accurate predictions of disease course.[41] To understand the details that factor into his mental calculus, he says, you should read his commentaries on the works of Hippocrates and his treatises on the pulse.[42] At the end of this text, he summarizes the depth and breadth of knowledge required to make a swift prognosis with (seemingly) minimal effort by paraphrasing Isocrates: when Isocrates was asked by a student if studying with him for three years would really enable him to speak as eloquently about as many topics as the great orator did, Isocrates replied, σὲ μὲν ἂν, ὦ παῖ, συνηυξάμην κᾆν ἐν ἡμέρᾳ μιᾷ δύνασθαι μαθεῖν ὅπερ πυνθάνῃ· αὐτὸς δ' ἂν ἐμοὶ τοῦ κατὰ γνώμην ἀφυΐαν, ἔτεσι πολλοῖς ἀσκήσας αὐτόν. ("I should like you to be able to learn in one day all you ask, my child; but I would then condemn myself for ignorance

[41] *Prog.* 1.9-10 = 14.602-603, 2.14-15 = 14.609K. Physicians who do this expose themselves to the hassles of argument and ridicule.

[42] *Prog.* 12.10-13.12 = 14.665-669K for two examples of Galen encouraging disbelieving, ignorant physicians to read Hippocrates in order to understand the theory behind Galen's remarkable, swift, and correct clinical decisions. See 14.4 = 14.671K for his exhortation for physicians to read his books on pulses to understand how he makes his diagnoses and prognoses.

because I have studied it for many, many years.")[43] The implication is that what Galen makes look easy required many difficult years to master, and that there is more to his mental decision making process than is apparent on the surface. It is a note of caution for his ancient contemporaries and for modern exegetes alike.

Examination of these case histories is still important, however, because while Galen might say that his commentaries on the Hippocratic Corpus and texts on the pulse provide the thousands of theoretical details that would help him reach a conclusion, he did not necessarily review a catalog of these details at each patient's bedside. As we will see, while it mattered to Galen that he could account for his reasoning and the actions that stemmed from it with recourse to theory,[44] such theoretical justification was of variable utility in practice. As he acknowledges in his commentary on the Hippocratic *Prognosis*, the signs themselves enable prognosis, if one knows how to recognize them: the validity and utility of the signs are not compromised if a physician does not know the physiological theory that explains them.[45] Recognition of the signs and their associated outcomes could be sufficient in a clinical context: a bedside review of theory was not a prerequisite for clinical action. Although the texts in which Galen's patient encounters are preserved have different (and usually theoretical) emphases, an aggregated consideration of all the case histories that Mattern lists can still provide insight into his bedside decision making processes, illuminating the features of the patient's presentation that exerted the greatest force on his decisions. Close reading of the instances in which he mentions his interactions with his

[43] *Prog.* 14.9 (Nutton, *CMG* V.8,1) = 14.672K, trans. Nutton.

[44] *Prog.* 3.11-16 = 14.617-618K.

[45] *Hipp.Prog.* 18b.26K.

patients is not the only way to evaluate his clinical decision making,[46] but – even if curated by him – these sections of the text do preserve information about the practical moments of his decision making and therefore provide insight into his thought process in these moments.

6.3.2 The Context of Disease: Patient Constitution and Environment

Though these anecdotes vary widely in their length and the level of detail they preserve, a few attributes of the patient can be consistently noticed in most: sex and age. What we might call 'occupation and activities,' or 'social class' is often also included,[47] as these are indicators of predisposition to certain activities that could affect disease susceptibility, interpretation of the patient's normal constitution, or the way a given problem could present itself.[48] Besides describing the patient for the reader, these pieces of information also draw our attention to

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[46] Galen's *Hipp.Epid.*, for example, explores his view of the reasons why Hippocrates provided the symptom patterns that he did in case histories preserved in these texts. His argument that these are collections of symptoms curated by Hippocrates to provide model cases from which students might learn makes these texts, too, useful places to search for the observations and principles that guided Galen's clinical decision making. G.E.R. Lloyd, "Galen's un-Hippocratic Case-Histories," in *Galen and the World of Knowledge*, ed. Christopher Gill, Tim Whitmarsh, and John Wilkins (Cambridge: Cambridge University Press, 2010), 115-131, makes this argument in his discussion of these texts, highlighting how Galen's commentaries on these cases are paradigmatic of his theoretical system. Exploration of *Hipp.Epid.* is one of many ways that the practical dimensions of Galen's clinical decision making might be excavated, though the patient-centric, 'bedside' aspect of the case histories has made them the focus of my own analysis of Galen's decision making in practice.

[47] Patients who are slaves are frequently designated as such: 2.632-33K; 5.18-20K; 8.355K (an imperial snake-catcher whom Galen cured after a snakebite); 10.609, 613-5K; 16.636-37K; 14.633-35K; 14.670-73K; 15.698-99K. Gladiator: 3.286-87K; 13.600-601K. Wrestler: 6.834K. Gymnastic trainer: 8.254-55K. Gardener: 12.905-6K. Farmer: 12.582-83K; 13.592K. Carpenter: 13.583-84K. Philosophers, rhetoricians, and sophists, and philosophy students are also mentioned, sometimes by name: 6.365-66, 371K; 6.598-601K; 8.213-214K; 10.402-4K; 12.314-15K, 14.605-24K; 14.625K; Galen also treated other doctors: 8.293-96K; 8.361-66K; 10.849K. Patients who are described as or implied as being well-born: Boethus' family members, 14.635-47K; "one of the Quintilian sons," 14.651-57K; Emperor Marcus Aurelius and his sons 14.657-65K; well-born woman 17B.81-82K, rich man 9.218-20K.

[48] *MM* 9.16 = 10.653-6K, trans. Johnston and Horsley. This primarily discusses diet as an example of a custom that can provide information to the practitioner about the patient's health, though Galen emphasizes the importance of custom in medical decision making: καὶ μὴν οὐδ' ἐγγύς ἐστι τῇ πίστει τὰ γνωρίσματα τῶν κράσεων ἅπαντα συνελθόντα πρὸς τὴν ἐκ τοῦ ἔθους ἔνδειξιν. "…all the signs of the *krasias* do not come near the indication from custom in terms of reliability." *MM* 11.15 = 10.784-5K describes differences in disease course and resolution for the rich and the poor: their social status affects their bodily constitutions, which in turn affects the kinds of treatments that their doctors should or should not consider.

aspects of the patient that Galen was noticing, evaluating, and (later) recording. The patient's sex was an important factor in predisposing to certain kinds of disease. Men's and women's bodies were different: for Galen, this difference was apparent not only in the obviously different anatomy, but also in the less obviously different constitution.[49] This knowledge would affect his understanding of the patient's normal condition, the diseases that he or she might be more inclined to contract, and how those diseases should be remedied. Age also mattered. As the body grew older, it became drier and colder; its innate heat and its ability to metabolize and to use the nutrients it obtained diminished.[50] Such drying of the body predisposed it to certain afflictions and affected the type, duration, and intensity of treatments prescribed. Bleeding the elderly too much is inadvisable, and the same is true for children and those who are constitutionally weak.[51] Certain conditions, and the measurement of certain variables like the pulse, needed to be interpreted in the context of age.[52]

Although Galen asserted that each individual had his or her own humoral balance,[53] his patient anecdotes focus less on the natural, healthy humoral balance of his patients and more on the nature of the humoral imbalance that he is observing in the context of the disease. Although he emphasizes that a physician should, in determining treatment, focus more on the imbalance associated with the problem than on that associated with the patient's previous state of health,[54]

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[49] *UP* 3.606K; *UP* 4.153-8; *Puls*. 8.463K; *MM* 10.181-4, 342K; *MMG* 11.137K; *Comp.Med.Loc.* 13.467-8K. Rebecca Flemming, *Medicine and the Making of Roman Women* (Oxford: Oxford University Press, 2000), 255-258, 314-21.

[50] *Temp.* 2.2 = 1.577-586K.

[51] *MM* 11.14 = 10.777-8K.

[52] *Puls.* 9 = 8.464-6K; *MM* 11.3 = 10.743K.

[53] *Prop.Plac.* 5.1-7K; *Temp.* 1.509-694, see also notes for section 6.2.2 for this chapter in Singer.

[54] *MM* 11.3 = 10.743-4K.

his repeated insistence on patients' individuality suggests that a patient's baseline constitution will have at some point played a role in his clinical decision making.[55] From a lack of reference to the patient's baseline humoral balance in the context of the case history anecdotes we can draw at least three possible conclusions: first, that in some cases (such as trauma), the patient's natural humoral condition was less relevant to Galen's decision-making process. In the setting of traumatic injury, diagnosis would have involved identifying the extent of the injury, and treatment would have involved addressing it directly (i.e., resetting a bone, suturing skin).[56] Second, while humors would seem to be more relevant for non-traumatic health issues, we might conclude that the relative lack of focus on the patient's natural humoral baseline in these anecdotes suggests that, if Galen did not know the patient in a healthy state, he was less certain what his or her baseline, healthy state might be.[57] Such uncertainty might have made him less concerned with returning a patient to his or her unique humoral baseline and more concerned with correcting the larger, more general imbalance that led to the illness.

Yet the initial sections of this chapter demonstrated that this information mattered to Galen, at least in the abstract. This suggests a third possibility for why he did not include details of his patients' particular baseline states in his case histories: that his assessment of an individual patient's personal normal state might have included information that, while part of his decision making process, he chose not to record in most of his patient anecdotes. Though assessment of an individual's baseline constitution might not be common among patient histories, one example of the relationship between individual κρᾶσις and a pathological process is instructive in

[55] See *Prog.* 2 = 14.607K, where he tells his new patient Eudemus that he cannot evaluate his condition thoroughly without knowledge of Eudemus' natural pulse.

[56] *MM* 6.1, 2, 5, 6 = 10.384-455K, on the management of puncture wounds and fractures, for example.

[57] *Puls.* 9 = 8.462-3K.

evaluating its role in the bedside decision making process. Wanting to illustrate his assertions about the relationship among fever, blockage of the pores, and bathing, while also touting the efficacy of his approach over that of his Erasistratean and Methodist adversaries, Galen provides an extended case description to exemplify the validity of the theoretical assertions he has just made. The patient, whom he treated for fevers and insomnia, was:[58]

> ὡς πέντε καὶ τριάκοντα ἐτῶν, μελάντερος τὴν χροιὰν καὶ λεπτὸς τὴν ἕξιν καὶ δασὺς, ἁπτομένοις τε σαφῶς δακνώδη τὴν θερμασίαν ἔχων, ὁπόθ' ὑγίαινεν, οὖρα κατακορῆ ξανθὰ καὶ εἰ ἐπὶ πλέον ἀσιτήσειε δάκνοντα, γαστὴρ ἐξηραίνετο συνεχῶς καὶ ἦν τὰ διαχωρήματα βραχέα καὶ δριμέα καὶ ξηρά· τὸ δὲ τῆς ψυχῆς ἦθος ὀξύθυμόν τε καὶ φροντιστικὸν ὑπῆρχεν, ὀλιγόϋπνός τε τὰ πάντα καὶ συνεχῶς ἀγρυπνίαν μεμφόμενος.
>
> "…thirty-five years old, rather dark in complexion, thin in build, hirsute. To those who touched him when he was healthy, he clearly had a mordant heat, and he had strongly yellow urine which, if he fasted still more, was mordant. His stomach was continuously drying and his excretions scanty, sharp, and dry. The disposition of his soul was choleric and anxious, he slept very little overall, and continually complained of insomnia."

Galen blends a description of this patient's normal pre-existing state with his current pathological state, noting that those who knew the patient when he was healthy could identify that his current condition was dangerously different. The mention of the patient's dark, hairy complexion and thin body implies that, at least in this context, Galen was considering the kind of problems to which this patient was predisposed, in terms of the patient's individual humoral κρᾶσις.[59] His individualized focus on the patient extended to evaluation of diet and habits, especially those associated with bathing, and even, potentially, occupation and travel history.[60]

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[58] *MM* 8.2 = 10.536-42K, trans. Johnston and Horsley.

[59] *Temp.* 2.4-5 = 1.604-630K for correspondences between the four essential qualities and features of the patient, including age, body habitus, and complexion.

[60] *MM* 8.2 = 10.538K, trans. Johnston and Horsley: οὗτος ἐν χωρίῳ τινὶ πράξεων ἕνεκα γενόμενος ἐχρῆτο τοῖς Ἀλβούλοις πλησίον οὖσιν ὥρας, τε ἑβδόμης, ὡς ἔφασκε, καὶ τρίς γε καὶ τετράκις ἐλούετο… "Being in a certain place for business purposes, he began using the Albula which was to hand and, at the seventh hour of the day, as he said, he would bathe three or even four times…" Whether Galen inquired specifically about this patient's occupation and travel history or not is difficult to tell, though he records information that could have been acquired through asking these kinds of questions.

Galen's interest in the place where this patient became ill is important because of the roles ascribed to seasonality and location in the maintenance of health and onset of disease, via mechanisms that involved the four qualities.[61] Yet despite the effect that the external environment was thought to have had on health, references to seasons and places are rare in Galen's case histories (just as mention of a patient's individual pre-morbid κρᾶσις is less common in these patient descriptions). Some case histories include references to the time of year,[62] including this one from *Method of Medicine* 8, but many do not. As the above discussion about Galen's emphasis on this patient's κρᾶσις suggests, this story is unusual among Galen's patient references for the level of detail it provides about the patient and the environment in which he was living.

Perhaps one explanation for why this case includes so much detail about the patient involves the sociocultural context, with Galen pitted head-to-head against an Erasistratean and Methodist physician. Within the instructional discourse of *Method of Medicine*, the case illustrates a point Galen has been trying to make about δυσκρασίαι:[63]

> ὅταν δ', ὡς εἴρηται, μὴ μόνον εἷς ἢ δύο τῶν οὕτω δυσκράτων, ἀλλ' ἐφεξῆς ἅπαντες ἀσιτήσαντές τε καὶ ἀλουτήσαντες ἁλίσκωνται πυρετοῖς, οὐδ' ἀμυδρὰν ὑπόνοιαν ἔτι δυνατὸν ἡμῖν γίγνεσθαι τοῦ δι' ἄλλο τι καὶ μὴ διὰ τὴν ἀσιτίαν πυρέττειν αὐτούς. οἷς γὰρ ἐν τῇ κράσει τοῦ μὲν ὑγροῦ τὸ ξηρὸν, τοῦ δὲ ψυχροῦ τὸ θερμὸν πλεονεκτεῖ, τούτοις ἡ μὲν ἕξις τοῦ σώματος ἰσχνὴ καὶ δασεῖα καὶ μελαντέρα, καὶ εἰ ἄψαιο, θερμοτέρα τῶν ἄλλων τριῶν τῶν δυσκράτων, τῶν ἧττον θερμῶν, ἐντεύξῃ· παμπόλλη δ' ἡ ξανθὴ χολὴ καὶ οὖρα καὶ διαχωρήματα κατακορῆ καὶ οἱ σφυγμοὶ μεγάλοι καὶ ὕπνοι λεπτοὶ καὶ ὀλίγοι καὶ ὁ θυμὸς σφοδρός.

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[61] The significant role that the external environment and the seasons played in health and disease is discussed throughout Galen's works. See *QAM* 8 = 4.799-808K (where the authority of Hippocrates is invoked); *Temp.* 1.3-4 = 1.522-524K; *Temp.* 2.5 = 1.616K, 2.6 = 1.627-31K; *Puls.* 9 = 8.464-466K.

[62] *Loc.Aff.* 1.6 = 8.50-1K (loss of voice in winter) and 4.8 = 8.265-66K (swimming in a marshy lake in the hot part of the summer); *MM* 8.2 = 10.535-42K (fever in the "dog days" of summer).

[63] *MM* 8.2 = 10.543K, trans. Johnston and Horsley.

> "Whenever, as I said, not only one or two of those who are *dyskratic* in this way, but all of them in turn, are seized by fevers if they fast and do not bathe, it is no longer possible for us to harbor some vague suspicion that their being febrile is due to something else and not the fasting. For in those in whom the dry is predominant over the moist and the hot over the cold in their *krasis*, the state of the body is thin, hirsute and quite dark, and if you were to touch it, you would find it hotter than the other three *dyskrasias* which are less in terms of heat, while the yellow bile is of great amount, saturating the urine and feces, and the pulse is large, sleep light and brief, and the spirit violent."

He writes of one illustrative case history to share with his readers the utility of his theories in clinical practice. But this extended case history is also, conveniently, a story that demonstrates his triumph over rival physicians who used different theoretical models, not only because he cured the patient, but because he enlisted the patient's help in lying to the Methodist and the Erasistratean so that Galen could expose them as incompetent practitioners. These sociocultural elements of his decision making will be addressed later; at the moment, the significance of this passage regarding his decision making rests in its emphasis on his noting of the patient's physical features, and his reliance on the words of "those who knew him when he was healthy" to establish his individual, normal constitution. This passage also shows that he requested additional information from the patient about his habits, and these pieces of information, combined with consideration of the patient's environment, led Galen to the indicated therapy. Furthermore, this example demonstrates how Galen's decision making proceeded in a particularly demonstrative context, one in which he sought to discredit rivals.

6.3.3 The Context of Disease: Anatomy and Mechanism

One constant element of Galen's descriptions of his patients' problems and his treatments of them is a recollection of the events leading up to the patient's current presentation, and the patient's current symptoms. In particular, he was concerned with the location of the symptoms and their associated anatomy, as well as with providing a causal mechanism for the symptoms he

was observing. Information elicited to investigate these issues could include a description of activities, food and drink consumed, exposures and incidents, symptoms (including their location, quality, duration, and severity), and effluvia. All of this information is obtained and understood in the context of a timeline, which Galen is scrupulous about providing: what happened, and when it happened relative to the appearance of and alterations in other symptoms, is nearly always part of his patient anecdotes.[64]

Traumatic injuries are useful case studies for the kinds of evidence he considered relevant in diagnosing the extent of the problem and thinking about how to treat it, since the inciting event for a traumatic injury is usually obvious (e.g., a sword wound) and provides a context in which recognition of affected anatomical structures is relatively straightforward. Knowledge of how injury happened – a sword wound,[65] a fall,[66] a kick from a horse[67] – combined with Galen's anatomical knowledge are, in these cases, the main factors that influence his diagnostic decision making and the aspects of the encounter that he records. He knows the anatomical structures that lie underneath the injured area and can treat these areas themselves, as well as the 'downstream' problems that arise from the injury (for example, treating the nerve roots in the spinal cord to remedy a loss of sensation in the fingers resulting from a spinal injury after a fall).[68]

[64] For examples, see *MM* 5.12 = 10.360-63, 366K and 8.2 = 10.535-42K, and the extensive patient case histories in Galen's *Prog.* While a timeline does not typically appear in the shortest, one-sentence case histories, it is a common part of even intermediate-length patient anecdotes.

[65] *Loc.Aff.* 1.1 = 8.4 and 8.13-14K.

[66] *Loc.Aff.* 1.6 = 8.50-51, 56-59K.

[67] *Loc.Aff.* 4.7 = 8.256K.

[68] *Loc.Aff.* 1.6 = 8.56-59K.

While the history of the mechanism of injury determines diagnostic decision making by facilitating identification of anatomical structures affected, symptoms, too, contribute to Galen's therapeutic decision making. For two patients with similar sword injuries in the perineal region, for example, he pursues two different courses of action because the patients have different symptoms.[69] One man who had been unable to urinate excreted urine through the wound on the fourth day, after eating. Here, there seems to have been little intervention, except to feed the patient on the fourth day. The second patient, also unable to urinate, was first treated with oil and hot water over the area of his palpably distended bladder; when he then attempted to urinate, he was aided by compression over the area of the bladder. Galen chose not to catheterize this second patient – a procedure that would normally be undertaken in cases of ischuria – because, he says, the inflammation around the wound was a contraindication to catheterization. He clearly explains his therapeutic choice here, indicating that he has a broadly standard procedure for addressing ischuria in the setting of a palpably distended bladder, but he also emphasizes that he has elected not to follow this procedure in the setting of inflammation.[70]

Galen explains his therapeutic reasoning for this second case in the following way. Anatomy and physiology are the primary issues. If the physician understands the anatomy of the area that has been injured (in this case, the bladder) – its function, its relationship to the parts around it, and the function of those connected parts – then his therapeutic decision making can be guided by this knowledge so that function can be restored.[71] Questions about the patient's symptoms and the history of his injury are useful for determining the part affected and how it has

[69] *Loc.Aff.* 1.1 = 8.4, 13-14K.

[70] *Loc.Aff.* 1.1 = 8.13-16K.

[71] Functionality is a cornerstone of Galen's definition of health: *MM* 1.5 = 10.42K, 1.8 = 10.63-66K, 2.3 = 10.90K.

been affected, although in this context Galen implies that the *how* is less important than the matter of *what* has been affected and what its baseline, normal function is.[72] Once the suffering part has been identified, the treatment can proceed on the basis of knowledge of what the normal function of this part should be. The goal is to restore this functionality (in this case, by catheterizing the bladder, if the patient is not able to excrete urine as he normally would). A secondary issue is what might be called 'contraindications' to the therapy. In this case, the presence of inflammation encourages Galen to pursue an alternative treatment – warm water and oil, followed by external manual compression of the bladder – instead of the catheterization he attempted for the other patient.

These contraindications, while emerging from observations of the patient's anatomy, are justified by Galen's reliance on the causal frameworks he developed. Similarly, when the patient experiences a problem that is not related to a traumatic injury, Galen's process of decision making rests more on his own determination of mechanism and on his assertions about the involved anatomical parts based on the symptoms he notes. In his patient anecdotes about these problems, he includes information that points to how he arrived at a particular diagnosis, but not necessarily information that helped him reject other diagnoses. Anatomy provides a starting point for his questions. In connection with a nerve injury, for example, he considers the path of the nerves from the brain and spinal cord to the extremities, or to their internal termini (for example, the innervation of the bladder,[73] or the recurrent laryngeal nerve that is responsible for the production of vocal sound[74]). In the setting of abdominal pain, he considers not only the

[72] *Loc.Aff.* 1.1 = 8.13-16K.

[73] *Loc.Aff.* 6.4 = 8.406-7K.

[74] *Loc.Aff.* 1.6 = 8.50-51K.

stomach, but also the digestive system of which it is a part, including the associated organs such as the intestines and the liver.

Evaluation of these non-traumatic maladies like abdominal pain, however, requires that the questions asked elicit information interpretable in the context of a cognitive framework reliant on both anatomy and humoral theory. When evaluating abdominal pain, Galen asks patients about what and when they have eaten, the chronology and quality of their symptoms, and emesis and any changes in their bowel movements.[75] He inquires about the timeline of the problem and potential precipitating factors (e.g., a fall or ingestion of a particular food). This fuller knowledge of the problem, given by the patient in the course of the physician's careful history-taking, provides two types of information: the doctor can determine an anatomical location of the problem, and he can, using his theoretical framework of κρᾶσις, speculate about the physiological cause of the problem.[76] Although problems like abdominal pain necessitate a more indirect diagnostic process in comparison to traumatic injury – for which the mechanism is obvious and the associated anatomy often directly visible – Galen still approaches these internal problems with a focus on anatomy and mechanism. The answers to these questions are obtained through training that enables him to know where anatomical structures are located (and therefore what is underneath the patient's finger when he points to the location of his pain), and through knowledge of theory that ties together the details provided by the patient regarding his symptoms and his habits. Having acquired data about the patient's basal state, his environment, and the

[75] *Loc.Aff.* 1.4 = 8.41-42K, 4.8 = 2.265-66K, 5.8 = 8.361-66K; *Alim.Fac.* 1.7 = 6.498-99K, 2.22 = 6.600-601K (two cases described); *MM* 12.7 = 10.856-60 (three cases described).

[76] P.J. van der Eijk, "Galen on the Assessment of Bodily Mixtures," in *The Frontiers of Ancient Science*, ed. Brooke Holmes and Klaus-Dietrich Fischer (Berlin: De Gruyter, 2015), 675-698.

events leading up to and during his illness, Galen now turns his attention to observation and examination of the patient's body.

6.3.4 Observation and Examination: The Examples of Pulse and Crisis

As we have seen in the preceding section, Galen focuses his questions and observations on the relevant part and its anatomical and physiological connections: he does not seem to question the patient who has coughed up "a membrane" about changes in his bowel habits,[77] for example, nor does he ask a patient suffering from abdominal pain about what he has expectorated.[78] But what happens when the affected part is not so readily identified? In these kinds of illnesses especially, Galen relies on aspects of his patients' bodies that present a variable spectrum of classifiable characteristics: pulse and crisis. Both of these aspects are, like pain, able to be qualified and quantified in various ways. Unlike pain, however, pulse and crisis are not subjective symptoms and therefore not interpreted or qualified by the patient. Instead, the physician measures and classifies the patient's pulse, and the physician determines the nature and duration of the crisis that is occurring. Both the classification of the pulse and the identification of crises are elements of the examination of the patient that assist the physician in his evaluation of the kind of illness he is facing, and how he should treat it.

Galen's classification system for the pulse was discussed previously. The clinical relevance of the pulse – why its careful observation and classification mattered in the diagnosis and treatment of disease – lies in its mutability. These changes may be correlated with external

[77] *Loc.Aff.* 1.1 = 8.3-4K.

[78] *MM* 12.7 = 10.856-58K.

manipulations of the body: cold baths make the pulse weaker, hot baths make it stronger;[79] exercise increases its frequency.[80] Emotional state, too, affects the pulse.[81] Its capacity to show evidence of internally-derived or externally-derived bodily change therefore makes it useful in the diagnosis of disease. A trainee should take care to acquire both knowledge of the relationship between changes in the pulse and specific disease states, and experience with the tactile sense of how these pulses may be evaluated in the examination of the patient.[82] The pulse can provide information about inflammation of the liver, spleen, kidneys, bladder, stomach or colon.[83] Observation of its changes can point to a diagnosis of pleuritis or peripneumonia, and can indicate when an abscess is beginning.[84] Specific characteristics of the pulse may be observed in lethargy, catalepsy, a disease that is in between lethargy and catalepsy, convulsions, paralysis, sore throat, variable afflictions of the stomach, and dropsy.[85] Its use as a diagnostic marker would have made it relevant in evaluations of many, if not most, of Galen's patients.

Despite its ability to point the way to so many diagnoses, however, the pulse is not mentioned in most of Galen's case histories, and reference to it as a key component of decision making tends to occur in the context of more discursive case histories.[86] In these cases, the

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[79] *Puls.* 10 = 8.468-9K.

[80] *Puls.* 11 = 8.470K.

[81] *Praes.Puls.* 1.1 = 9.218-20K; *Puls.*12 = 8.473-4K.

[82] *Puls.*12 = 8.478-9K.

[83] *Puls.*12 = 8.476K.

[84] *Puls.*12ff = 8.479ffK.

[85] *Puls.*12 = 8.482ffK.

[86] Representative examples include *Loc.Aff.* 4.11 = 8.392-96K; *Praes.Puls.* 1.1 = 9.218-20; *MM* 9.4 = 10.608-13K, 10.3 = 10.671-78K, 12.8 = 10.871K; *Prog.* 2-4 = 14.605-24K, 6 = 14.632-34K, 7 = 14.637-641, 11-12 = 14.658-64 (two cases, Marcus Aurelius and Commodus), 14 = 14.670-73K.

patient's pulse is classified as Galen outlines in his theoretical works, with reference to its magnitude, frequency, and intervals. The patients' afflictions tend to be more chronic, an aspect which could contribute to the relatively greater number of words Galen devotes to their stories. But there is another important feature that these stories share, which could have some bearing on the thoroughness of the examination that Galen carried out and the detail with which he describes it: many of these extended references to patients' pulses describe particularly adversarial encounters, when Galen (successfully) treated the patient in the presence of rival physicians whose advice ran contrary to his own.[87] He could diagnose, identify the appropriate associated therapy, and prognose from the pulse, and his ability to make these determinations from the pulse set him apart from other physicians in a public, dramatic way. His mention of the patients' pulses in the context of competitive displays of iatric prowess raises the question of whether decisions about the kinds of diagnostic techniques he chose to deploy were affected by who was watching. Though caution should be exercised in arguments from an absence of evidence, it merits mention that, while he emphasizes the value of the pulse for diagnostic decision making, in his case histories Galen does not provide information about patients' pulses with the same frequency as he does about their sex, age, and anatomical location of symptoms, or even mechanism of disease, social status, and occupation.

The crisis is another useful physiological concept that helps Galen make decisions about the problems he is confronting. Defined as τὴν ὀξεῖαν οὕτως ἐν νοσήματι ταραχὴν, "the acute upheaval in an illness,"[88] a crisis is given its name, Galen writes, because the patient

[87] *MM* 9.4 = 10.608-13K, 10.3 = 10.671-78K; *Prog.* 2-4 = 14.605-24K 6 = 14.632-34K, 7 = 14.637-641, 11-12 = 14.658-64 (two cases, Marcus Aurelius and Commodus), 14 = 14.670-73K.

[88] *Di.Dec.* 9.773-4K.

experiencing these symptoms looks as though he has just received a death sentence.[89] Crises can occur singly or in patterns, and their patterns can be linked to particular kinds of fevers and diseases.[90] The successful prediction of the next crisis can then confirm a diagnosis or, in the case of an incompetent physician, prove that his initial assessment, diagnosis, and treatment were incorrect.[91] Galen's *On Crises* and *On Critical Days* draw on the idea of crisis that emerged in earlier Hippocratic works but was not extensively defined or explained, and he attempts to explain the Hippocratic precepts on the matter, classifying crises as a change in the disease: an improvement in condition, a change toward a more confused state, or a resolution of the disease.[92] Crises are the only way a disease can be resolved:[93] while they are generally positive, hoped-for events,[94] there are different types, including the half crisis, the incomplete crisis, and the defective crisis. The first kind is best,[95] as it leads to the sudden and complete resolution of the illness; a universal crisis is ideal.[96] The other types of crises – incomplete and defective crises[97] – can lead to relapse and a false belief that the illness has concluded.[98] As is the case with the pulse and other symptoms, manifestations of crises depend upon the time of year and

[89] *Di.Dec.* 9.772K.

[90] *Di.Dec.* 9.774-5K.

[91] *Prog.* 10 = 14.656K.

[92] *Cris.* 9.550ffK.

[93] *Cris.* 9.732K.

[94] *Cris.* 9.720-1K.

[95] *Cris.* 9.724, 730, 732K.

[96] *Cris.* 9.710, 712, 724K.

[97] *Cris.* 9.636-7, 703K.

[98] *Cris.* 9.721, 725ffK.

the age and constitution of a patient.[99] While a crisis cannot occur at the beginning of a disease,[100] it is better if it occurs early in the disease course, before the patient's strength has diminished.[101] No one can escape an illness without a crisis,[102] and an illness without a crisis results in death.[103]

Recognition of a true crisis is important because its occurrence may be integrated into a broader timeline of the disease, including the occurrence of other symptoms and patterns in changes in their severity. Identification of these patterns, in turn, fosters more accurate diagnosis, thereby facilitating selection of the most appropriate treatment. Crises also assist in prognosis, since their pattern can lead a physician back in time to determine the true beginning of the disease; from there, the progression of the disease forward into the future can be successfully predicted.[104] Though crises can be difficult to identify,[105] physicians can note their presence by paying attention to signs: a good physician will not merely identify a crisis but will prognose when it will occur, on the first day of the illness.[106] Crises are more important for prognosis- and treatment-related decisions than they are for diagnostic decision making. Should a physician be unable initially to prognose the course of an illness, he may be aided through noting a pattern of

[99] *Cris.* 9.723K.

[100] *Cris.* 9.751K.

[101] *Cris.* 9.727ffK.

[102] *Cris.* 9.741K.

[103] *Cris.* 9.744K.

[104] *Cris.* 9.570ffK.

[105] *Cris.* 9.748K.

[106] *Cris.* 9.705K; *Prog.* 10 = 14.652-657K.

crisis, which itself can aid in this endeavor, especially in uncertain cases.[107] Though difficult to identify, crises are useful decision making tools, and Galen recommends that physicians should acquire experience in the identification of ideal (and therefore less complicated) crises, so that they may have the best chance of learning the art of prognosis from these more straightforward kinds of physiological occurrences.[108] Equipped with knowledge of idealized, simple crises, they may then be more prepared to face more complicated clinical circumstances.

The concepts of pulse and crisis were observation-based, theoretically-grounded, and sub-classified ways to evaluate a patient's current condition and to predict its future course. They appear in Galen's case histories as diagnostic and explanatory markers of bedside examination. A patient's pulse could be classified on the basis of numerous characteristics, thereby generating a description of the patient's internal condition that was simultaneously complex, systematized, and nuanced. Galen does not always describe its features in his case histories, and when he does mention it, his accurate characterization of it often stands in contrast to the ineptitude of physicians who do not rely on it as a decision making tool, or who incorrectly interpret it. Similarly, a crisis is a physiological marker of the patient's internal state, a way of classifying the quality of changes in the patient's condition. Just as the pulse is evaluated properly by a well-practiced touch, the crisis is interpreted appropriately only by the well-trained eye, the physician who has seen crises before and can recognize the pattern he sees. Both were significant features of the physical exam that appear in Galen's case histories.

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[107] *Cris.* 9.722K.

[108] *Cris.* 9.746K. This sentiment is reminiscent of decision-making studies which advocate learning on the basis of the 'ideal' so that accurate decisions can be made more readily in less ideal (and likely more realistic) disease states. See Chapter 1.

6.3.5 Summary: Individualized Data Acquisition?

Within the broader goal of examining Galen's decision making, this section explored Galen's case histories with an eye toward identifying the kinds of data he acquired in clinical encounters with his patients. We have seen how these descriptions of diagnosing and treating patients nearly always reference the patient's sex and age, often with mention of social status, occupation, and environment. Although he emphasizes patients' individuality and their unique κρᾶσις in his theoretical and methodological treatises, specific reference to his patients' particular constitutions do not figure prominently in most of the case histories he provides. Discussions of each patient's medical issue centers on anatomical description and mechanism. These two features of a case are more straightforward to identify and to discuss in settings of traumatic injury, though Galen maintains his focus on anatomy and mechanism even when confronted with an internal problem. In these situations, his training in anatomy, appreciation for the internal and unseen aspects of the human body, and theoretical models of qualities provide the means for him to link together details about the patient's age, environment, habits, and symptoms into a causal mechanism that explains the current presentation. The fourth part of this section considered two specific aspects of Galen's examination of the patient, the pulse and the crisis, with reference to the ways he classified and interpreted these observations. Having explored these elements of the kinds of data he acquired in his encounters with patients, we now turn to discussion of the integration of these data into the tasks of diagnosis, prognosis, and therapeutic management.

6.4 Integration

6.4.1 Responding to Challenges, in Theory and in Practice

In restoring sick people to health, physicians are confronted with persistent challenges, outlined at the beginning of this chapter: coping with individual variation, managing inconsistent presentations of similar diseases and responses to therapy, and appropriately evaluating and applying a potentially large volume of data about each patient. In his theoretical works, Galen outlines how to manage these challenges through detailed classification schemes of diseases and symptoms. His ability to create these increasingly fine boundaries between diseases and symptoms relies on his knowledge of anatomy and a willingness to engage in causal reasoning that locates disease in imbalances of the four qualities. These imbalances are themselves brought about by internal or external disturbances of the body's individualized homeostatic state as a consequence of external environment, diet, activity, exposures, trauma, and the interaction of these disturbances with the body's particular constitution. Symptoms characterize the imbalances and provide information about the location of the problem and, therefore, the anatomical structures implicated. Integrating this information about the problem into the classification scheme, Galen makes a diagnosis of the problem. In diagnosing the problem, he describes its causal mechanism, and therefore, the appropriate therapeutic management, since therapy involves restoring balance. Prognosis, too, relies on an understanding of how the patient will respond to the therapy, and an accurate interpretation of the patient's symptoms, with reference to the underlying imbalance. His theoretical framework advocates for a combination of deductive and inductive reasoning.

This is the theoretical approach. In his regular practice, however – as evaluated by close reading of his case histories – Galen's powers of diagnosis, his therapeutic reasoning, and his

efforts of prognosis appear to be less deductive and inductive, and more consistent with an advanced form of pattern recognition, of the type described in preceding chapters. As was explained previously, the development of expert intuition can require intensive training that involves a combination of thinking (theory) and doing (practice), and its application can produce rapid and accurate results that seem to be based on relatively few inputs. As studies of 'expert' grand chess masters and firefighters have shown, however, there are multiple inputs in their decisions, many of which the decider herself does not consciously register.[109] The facility and accuracy of the decision can lend an intuitive or magical quality to it, especially to those unfamiliar with the attributes of the context in which the decision is being made. Perhaps it is not unexpected then, that Galen boasts that he was accused of divination because he could diagnose, prognose, and treat with such uncanny efficacy.[110] Similarly, he takes as a distinguishing mark of his skill the ability to diagnose a problem by actively noting only one or two symptoms:[111]

> οὕτω δὲ καὶ ἄλλους πολλοὺς ἴστε με σημειωσάμενον, ὡς ἐκ τῆς χροιᾶς ἀποφήνασθαι, ποτὲ μὲν ἦπαρ εἶναι τὸ πάσχον αὐτοῖς, ποτὲ δὲ σπλῆνα, μήτε τῶν προγεγονότων ἀκηκοότα τι μήτε διὰ τῆς ἁφῆς γνωρίσαντα τὸ πάθημα τῶν σπλάγχνων·
>
> "You should know that I diagnosed many other patients who already demonstrated by the color [of their skin] that their liver or spleen was the affected organ, though I had not been informed about their previous history nor did I gain knowledge of their disease by palpation of the abdomen."

[109] See Chapter 1.

[110] *Prog.* 1 = 14.602K, 3 = 14.615K, 5 = 14.625K.

[111] *Loc.Aff.* 5.8 = 8.357K.

Moreover, he asserts that the process of diagnosis, attendant determination of therapy, and prognosis, even if based on only one or two signs or symptoms, is not at all problematic, provided that the practitioner turns out to be correct:[112]

> "The patient's complexion may prove sufficient for the diagnosis of an illness: possibly diagnosis can be made from the pulse, urine, and stools, and frequently from the tongue. And possibly two, three or all of these symptoms together will be required for a diagnosis. Those who are ignorant of medicine should not suggest that physicians make a diagnosis from one (particular) symptom but not another. Physicians should be absolutely free to make their diagnosis and pass judgments from whatever symptoms they choose, whether these be one, two, three or all symptoms together. Then what they forecast should be put to the test and examined in order to distinguish between their true and false judgments. Moreover, physicians should not be censured if they do not forecast by using all the particular things; nor should they be praised for passing judgments without real insight. One should confine his consideration to whether a physician has been able or unable to foresee all the required therapeutic details..."

Galen here makes a remarkable statement. A physician should be evaluated based on his ability to prognose accurately. Galen's assumption is that accurate prognosis is enabled by the kind of thorough training in theory and practice that he received: but he explicitly leaves open the possibility that a physician should be able to diagnose and to prognose on the basis of one symptom alone, without necessarily having recourse to complicated symptomatologies, causal explanations, or knowledge of the patient's individual normal κρᾶσις, habits, and environment. While this knowledge may undergird his prognosis, its involvement in the decision making process is not the metric by which a physician's skill is judged.[113]

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[112] *Opt.Med.Cogn.* 7.3-4, trans. Iskandar; see also *Opt.Med.Cogn.* 7.1, where Galen notes that a well-trained physician should be able to diagnose – even noting the location of the patient's problem – and to prognose without even touching the patient.

[113] Galen acknowledges that it is possible to prognose through recourse to observable symptoms, though recourse to explanations of hidden causes can explain the reasons for these observable symptoms, and can even make the previously unobservable, observable. See *Hipp.Prog.* 18b87-9K for what Hippocrates was overlooking, and Nutton, *Galen: On Prognosis*, 220-1; and Hankinson, *Galen: On Antecedent Causes*, 153, for how Galen broadened the possibilities of prognosis through his careful study of the pulse.

In these situations, when Galen makes decisions based on one or two observations that he has actively noted, anatomy and pattern-based evaluative components like pulse and crisis play a prominent role.[114] Complicated presentations of illness, however, require more a more intensive cognitive process of evaluation, and in these cases, he appears to involve more information in his decision making. He might have found the case difficult to address, and therefore have elicited and assimilated more data into his theoretical framework, which he consequently preserved in his narrative. Though he was able to treat nearly all of his patients successfully, he does describe a situation in which he was unable to diagnose the patient's condition: he notes that he had not seen this problem before and therefore could not identify a cause.[115] He decided to treat the patient as he would treat a patient for asthma, based on a guess that the symptoms were lung-related and that the humoral pathology he observed in this patient was similar to that experienced by patients with asthma. In this case, a detailed history of the patient's life and problem, a careful exam, and the application of therapeutic knowledge were all involved in his decision-making regarding this case. Despite this, however, he never seems to have figured out what caused the patient's problems, or to have remedied them: he writes that the patient's cough and sticky, seed-like expectorate persisted for several years, and then he died.

Perhaps his approach to most patients was indeed very elaborate, and he only decided to describe certain memorable cases in which this more extensive approach was crucial for establishing the diagnosis – although as we have seen above, there are other situations in which he attempted to diagnose and to prognose using as few data points as possible. There is another

[114] *Prognosis* 2 = 14.607K, 4 = 14.619-20K (on a rival physician's recognition that Galen had correctly identified a crisis, which was a decisive aspect of Galen's correct diagnosis and management of Eudemus' case), 6 = 14.634K (on rival physicians' failure to evaluate the pulse properly), 7 = 14.637K; 10 = 14.652K, 14 = 14.670-1K.

[115] *Loc.Aff.* 4.11 = 8.292-93K.

aspect of these cases to consider besides the patient's pathology, however. Many of the more challenging cases described also involve other physicians: the patient's condition has baffled them, and their participation in the patient's care has in some instances exacerbated the problem for which the patient sought medical help in the first place.[116] More complicated theoretical reasoning, and its integration into assertions about patterns emerging from the patient's symptoms, could have been employed demonstratively, to shame the practitioners of other sects whom Galen perceived as misinformed, incompetent, or dangerous. One case history does suggest that this performative component could have affected his decision making. Frustrated to find a gravely ill patient on the edge of death because, at the Methodists' insistence, he had not been fed for three days, Galen provided food for him. When the patient began to improve, Galen decided that he would use the opportunity to disabuse the Methodist physicians of their notion that the three-day fast was an appropriate treatment method. He subsequently withheld food from the patient, allowing him to become cold, nearly pulseless, and completely non-responsive to those massaging him. In the presence of the Methodist physicians whom Galen had assembled into the patient's room (which he locked so they could not escape), he fed the patient and revived him.[117] Galen is careful to say that he knew the patient could survive his dangerous demonstration, though the story should draw our attention to the effect that such rivalries may have had on his clinical decision making.

Comparing Galen's ideal, theorized approach to clinical decision making to the case histories he describes suggests that there likely was great variation in which aspects of his

[116] *Prog.* 2 = 14.609-11K, 3 = 14.614K, 4 = 14.619-20K, 5 = 14.624-6 (a patient with a chronic condition that other doctors had failed to cure); 6 = 14.634K; 8 = 14.641Kff; 10 = 14.652K; 11 = 14.658K; 12 = 14.661-5; 14 = 14.670-1K.

[117] *MM* 10.3 = 10.671-78K.

diagnostic and theoretical skill sets he chose to deploy in any given clinical encounter. Pattern-based recognition, formulated on the basis of his theoretical grounding, likely did play a role, especially when he reached diagnoses quickly and with limited information. The individualized focus on patient care that Galen championed – and highlighted as a hallmark of his unique approach to medicine – does not seem to have been used as often in his practice as it was emphasized in his methodological and theoretical texts. As the discussion up to this point has suggested, one potential explanation for this could be the resource-intensive nature of such highly individualized care: diagnosing and prognosing from pattern recognition was faster. Another unique – and difficult to replicate – aspect of Galen's medical practice was the extensive education required to teach a doctor how to implement it.

6.4.2 The Luxuries of Time and Resources

Galen's decision-making process distinguishes itself from those we have considered so far in two ways in particular: the roles played by money and social class in the development of his skill set and the execution of that skill set, respectively. Finances do not seem to have been a concern for him: he was born into a wealthy provincial family, receiving the best education and tutors money could buy him in his native Pergamon. The death of his father left him with sufficient financial resources to embark on a decade of travel and study that took him from the tutelage of the Mediterranean's best physicians and philosophers, to anatomical study in Alexandria, to numerous locations to observe medical and pharmacological practices, and back to Pergamon. He began his medical training and practice at age 19: he was a relative late-comer to a profession characterized by apprenticeships that began at an earlier age, and his family

wealth not only bought him many opportunities to train in much of the known world, but also the time to do so.[118]

Galen's resources – which only grew the longer and more successful he was in his practice – would have meant that he did not need to be as concerned as his contemporary physicians about earning a livelihood.[119] With a secure income, he not only had the opportunity to write voluminously, he also would have had the opportunity to spend a full day, or longer, if he wished, examining a single patient.[120] He could, without concerns of economic instability, treat patients with problems deemed particularly intractable, or patients whose problems he deemed of special medical interest.[121] Time spent treating a slave or a shopkeeper of modest means did not necessarily translate into the loss of potential income: indeed, he said that he never required payment for his services.[122] Of course, he did evaluate and treat rich patients, including the emperor and his family,[123] and he was rewarded accordingly.[124] But these rewards gave him even more of the security and control over his own time and fortunes that many of his

[118] Nutton, *Ancient Medicine,* 222-235 (chapter entitled "The Life and Career of Galen").

[119] Successful cures, especially for wealthy patients, meant payment: Pliny, *HN* 29.1 and 3, 5-7. This payment was not always deserved, Pliny writes: with no laws to punish them if their cures inflicted harm, they had little to lose, but their payment was dependent on their success. Vivian Nutton, "Archiatri and the medical profession in antiquity," *Papers of the BSR* 45 (1977): 207-210.

[120] Consider especially the cases described in *Prognosis*, which detail repeated visits to these patients, over the course of many days.

[121] *MM* 12.6 = 10.849K.

[122] M. Meyerhof, "Autobiographische Bruchstücke Galens aus arabischen Quellen," Sudhoffs Archiv 22, (1929): 72–86.

[123] *Prog.* 11-12 = 14.657-666K.

[124] *Prog.* 8 = 14.647K.

contemporary physicians would not have had.[125] In many respects, his financial stability and social prominence bought him the luxury of time: time to gather information from and about patients, time to carry out anatomical investigations, time to read and to gather theories, time to assemble a library and time to reconstitute it after it burned down, and time to assemble these seemingly innumerable inputs of medical theory and practice, and patient observation, into a cohesive, consistent whole.[126] The luxury of time that Galen enjoyed in his interactions with his wealthy, well-born patients is highlighted in his exchange with Eudemus. He respected Galen's knowledge as a man of learning – of philosophy first, medicine second[127] – and sought Galen's opinion on his ill-health. Wanting to discover how Galen evaluated his pulse, Eudemus asked for an explanation. Galen offered to give the short version (τὸ κεφάλαιον), but Eudemus wanted the explanation in its detail (ἀκοῦσαι γὰρ ποθῶ καὶ τὰ κατὰ μέρος).[128] Galen was happy to oblige.

In short, Galen had the time to decide. He could afford to think.

6.5 Conclusions

6.5.1 Comparisons, Ancient and Modern

Galen's insistence on the individuality of his patients, and the emphasis in his case histories on the time he spent with his patients, stands in contrast with assertions of his rivals, the

[125] He was able to leave Rome and to return to Pergamon during the outbreak of the plague, for instance: Galen 19.15K; see also Vivian Nutton, "The Chronology of Galen's Earlier Career," *Classical Quarterly* 23 (1973): 159. He also traveled extensively: Christopher Jones, "Galen's Travels," *Chiron* 42 (2012): 399-419.

[126] As *Lib.Prop.,Opt.Med*, *Opt.Med.Cogn.*, *Ind.,* and *AA* indicate.

[127] *Prog.* 2.11-12 (Nutton) = 14.608K.

[128] *Prog.* 3.11-12 (Nutton) = 14.617K.

Methodists, about patients' similarities and the commonalities that pathological processes shared. To revisit the quote with which this chapter began, adding more of its context:[129]

> τὸ δ' οἴεσθαι κοινήν τινα ἁπάντων ἀνθρώπων εἶναι θεραπείαν ἐσχάτως ἠλιθιόν ἐστιν· ὅπερ οἱ ἀναισθητότατοι νομίζουσι μεθοδικοί. καὶ διὰ ταῦθ' ἑστάναι τὰ τῆς ἰατρικῆς ἔφασαν ἅπαντα θεωρήματα, τουτέστιν ἐπιστημονικὰ καὶ βέβαια ταῖς γνώσεσιν ὑπάρχειν. εἶναί τε τὴν γνῶσιν αὐτῶν τέχνην τινὰ κοινοτήτων, οὐκ ἰδιοτήτων, ὡσπερεὶ τὸν κοινὸν καὶ γενικὸν ἄνθρωπον θεραπεύοντες, οὐ τοὺς κατὰ μέρος. ὡς οὖν ἐν τοῖς ἄλλοις ἅπασιν εὐθέως κατὰ τὰς ἀρχὰς ἐσφάλησαν, οὕτω κἀν τῷδε· θεραπεύεται μὲν γὰρ οὐχ ὁ κοινὸς καὶ γενικὸς ἄνθρωπος, ἀλλ' ἡμῶν ἕκαστος, ἄλλος ἄλλην ἔχων δηλονότι κρᾶσίν τε καὶ φύσιν. οἱ δ' οἴονται μίαν θεραπείαν ἁπάντων ἀνθρώπων εἶναι· ἐγὼ δ' εἰ καὶ τὴν ἑκάστου φύσιν ἀκριβῶς ἠπιστάμην ἐξευρίσκειν, οἷον ἐπινοῶ τὸν Ἀσκληπιὸν, αὐτὸς ἂν ἦν τοιοῦτος· ἐπεὶ δ' ἀδύνατον τοῦτο, τὸ γοῦν ἐγγυτάτω προιέναι καθόσον ἀνθρώπῳ δυνατὸν αὐτός τε ἀσκεῖν ἔγνωκα καὶ τοῖς ἄλλοις παρακελεύομαι.
>
> "To think there is some common treatment for all people is foolish in the extreme. But this is what the Methodists, men who are absolutely lacking in perception, think. And because of this, they are in the habit of saying that all their theories of medicine stand, that is to say, are scientific and secure in their means of knowing. And they are in the habit of saying that their knowledge is a craft of 'communities' and not of specifics, just as if they were treating a 'common' and generic person and not a series of individuals. Thus, as they tripped up in all other things right at the beginning, so too did they trip up in this, for it is not the 'common' and generic person that is treated but each one of us, having clearly a different *krasis* and *physis*. They think, however, there is one treatment for all people. But if I knew how to discover precisely the nature of each person, like I think Asklepios did, I would myself be like him. But since this is impossible, I have decided to approach as closely as is possible for a man, and myself, to practice this, and to exhort others [to do so]."

The acquisition of god-like omnipotence, Galen acknowledges, is impossible, but this does not stop him from striving to be all-knowing, and to be able to integrate this information into flawlessly accurate diagnostic, prognostic, and therapeutic decisions. But Galen had the time (and the money) to try to reach such heights. He chose to address the challenges of individual variation, inconsistent reaction to therapy, and the enormous volume of potentially relevant clinical data by developing classification systems and cognitive frameworks that, in theory, accounted for this variation. Every individual κρᾶσις, each presentation of a disease, had an

[129] *MM* 3.7 = 10.206-7K, trans. Johnston and Horsley, with modification.

explicable place in this framework. Each element of its variance could be accounted for, if the practitioner was sufficiently skilled to acquire and to assimilate the data points that confronted him.

Aggregating and integrating this information could take time and, as we have seen, was not always necessary to address the problem at hand; Galen's case histories suggest that even he diagnosed patients from one or two exam findings alone. Indeed, this was a skill on which he prided himself. It was his extensive training, he argued, that made such rapid diagnoses possible, but it is difficult to see the painstaking recognition of an individual's κρᾶσις in a diagnosis made on the basis of taking the pulse of a patient he had just met. Even Galen was susceptible to relying on pattern-based thinking. It was faster. Galenic systems were complex, and it might have been impossible (even for Galen himself) to remember every detail relevant to a patient while at that patient's bedside.

A comparison with modern clinical accounts of friction between more generalized diagnostic and therapeutic management and a time-intensive individualized approach, may illuminate what Galen's idealized decision making might have looked like in practice, and how it might have compared to the approaches of his contemporaries. We return to Dr. Jerome Groopman's *Second Opinions*, this time to a chapter entitled, "A Routine Case of Asthma," which describes the case of Isabella Montero and her daughter Marianna. The recently-widowed Isabella supported herself and her teenage daughter by working for a cleaning company, and was twice taken by Marianna to the company clinic for episodes of labored breathing. When Isabella suddenly could not see from one eye and experienced weakness in her left arm, Marianna brought her mother to the emergency department of Dr. Groopman's hospital and asked to speak

with him, since he had cared for her father prior to his death. Dr. Groopman examined Isabella, admitted her to the hospital, and after a few brief tests diagnosed her with acute leukemia.

Wanting to speak to the physician who had diagnosed Isabella with asthma and then persisted in treating her for it after she presented a second time with symptoms unresolved by standard asthma treatment, Dr. Groopman called her primary care physician, Dr. Sperry. When Dr. Groopman asked Dr. Sperry why he did not proceed with a particular test after Isabella failed to respond to his initial treatment for ostensible asthma, Dr. Sperry responded in a way that contrasts two types of clinical environments:[130]

> "[Sperry said], 'Dr. Groopman, come down from your ivory tower and try working here in the trenches…How many patients do you see in a morning? Six, maybe seven? With residents and fellows to do your scut work? Spend a week here with me. I have ten Isabella Monteros a day in the waiting room, complaining in broken English that they need time off from work because they're tired or can't breathe. We have proven guidelines for what tests to order and what treatments to give. It's not cost-effective to do more than I did for a routine case of asthma. She wasn't bringing up sputum. And a chest X ray and blood counts are outside our clinical algorithm for these cases. How many turn out to be a rare manifestation of leukemia and leukostasis? For every thousand it's asthma 999-plus times. So don't interrogate me.'"

Dr. Groopman continues to narrate his reaction to what he had just heard from Dr. Sperry:[131]

> "I forced myself to step aside from Dr. Sperry's attack and had to admit one painful truth. I did occupy a privileged position in the world of modern American medicine. My salary was fixed, coming from research grants and an endowed chair at Harvard. If I saw one person or ten in the clinic, it made no difference. If I wanted to spend an hour rather than fifteen minutes to examine and talk with a patient, I could. No one imposed 'cost-effective' clinical algorithms to stay my hand from pursuing a more intensive evaluation. It was very different for full-time clinicians, particularly those in community HMOs. Over the past decade, with a nationwide shift to managed care, most doctors are forced to see ever more patients per unit hour and to be parsimonious in their care. It is always cost-effective to do less when outcomes are measured in the distorted mirror of the group. The art of medicine, rooted in the needs of the single patient and the judgment of the individual practitioner, is being dismissed by the architects of managed care as archaic and inefficient. The rules and regime of the factory prevail…Responsible and committed

[130] Groopman, *Second Opinions*, 80-81.

[131] Groopman, *Second Opinions*, 81-82.

> physicians are increasingly frustrated and despairing. The joys of being a doctor, derived from the special intimacy between physician and patient, and from the challenge of the craft, are evaporating. Many doctors, in HMOs and out, are seeking other careers or defect to the other side – becoming administrators who dictate cost-effective algorithms at a safe distance from the daily demands of practice."

Despite the obvious differences between medical practice in the Mediterranean world of the second century CE, and the northeastern American teaching and community hospitals of the 1990s, the exchange between Dr. Groopman and Dr. Sperry illustrates an important aspect of medical practice that similarly affected Galen and his contemporaries: the limitations of time and money.[132]

Galen had, through his family's resources, what might be considered the "fixed salary" that Dr. Groopman describes. His income was not linked to the number of patients he saw – if anything, it was more closely tied to *whom* he saw. Groopman's description of patients moving rapidly through clinics in HMOs calls to mind Celsus' description of the utility of Methodist medicine, which he said was particularly suited for crowded *valetudinaria*.[133] The straightforward Methodist system, with its relative lack of reliance upon patient history in determination of the problem, could have been very useful for the diverse patient population of the Roman Empire. Like Dr. Sperry's crowded waiting room, full of patients with whom he did not share a common language, the larger potential patient population of the Roman Empire would not necessarily have spoken Galen's Second Sophistic Greek, or the Latin of the Empire. A Methodist system that insisted upon standardized, every-three-day visits for every patient; a

[132] For a similar discussion of the problem, though generalized to the broad state of medical practice in the United States, see the comments in Croskerry, "The Theory and Practice of Clinical Decision Making," regarding "Olympians vs lesser mortals" in the context of expectations about physician decision making. These are the most recent echoes of a long-standing discussion, for which we have evidence in Plato *Laws* 9.857c-e, further explored by Owsei Temkin, "Greek Medicine as Science and Craft," *Isis* 44 (1953): 213-255.

[133] *De Medicina* Proem 64-65.

diagnostic method that could be applied without knowledge of the patient's history; and a quick and inexpensive training program would have been more accessible and likely more practical for most physicians than Galen's involved approach to training and decision making. The Methodist system was "in the trenches" and proudly efficient, an aspect that Galen derided (from his ivory tower, we might say).

6.5.2 Galen and Medical Decision Making

How did Galen decide? A survey of anecdotes about his interactions with patients, and the relevant explanatory texts related to theory and practice, suggests that, while Galen would have emphasized the individuality of each patient, he still had a generalized approach to medical decision making that emphasized consistent definitions and knowledge of anatomy as foundations of an extensive disease classification system. The combination of his theoretical framework and extensive experience enabled him, in some cases, to diagnose without acquiring all of the data that his elaborate classification system could accommodate: though he underscored the person-to-person variability intrinsic to medical practice, he does not always seem to have approached clinical encounters in an individualized way.

Conclusions

From an article published on November 17, 2017, by *American Heart Association News*, entitled, "Nearly Half of U.S. Adults Could Now be Classified with High Blood Pressure, under New Guidelines":

"Nearly half of American adults are at risk for major health problems because of high blood pressure, according to a new scientific guideline that redefines the dangerous condition and provides tactics for doctors to detect, treat and prevent it… The change means 46 percent of U.S. adults are identified as having high blood pressure, compared with 32 percent under the previous definition. A blood pressure of less than 120/80 still will be considered normal, but levels at or above that, to 129, will be called "elevated…" The guideline, the first comprehensive one in 14 years, homes in on making sure doctors' offices and patients understand how to accurately measure blood pressure and diagnose hypertension in the first place…Often called the "silent killer" because there are often no obvious symptoms, hypertension accounts for more heart disease and stroke deaths than almost all other preventable causes."[1]

Increases in human life expectancy, greater understanding of the biomolecular and social determinants of disease, and advanced tools for asking and answering questions about the physiology of our human bodies can all too easily lead us, living in 2018, to dismiss the endeavors of the physicians of the Greco-Roman past as well-intentioned failures. Yet their debates about the nature of knowledge, the assumptions by which categories are constructed, the means by which it is possible to perceive, and the amount of information required to attain truth, or a measure of it, represent a sensitivity to the cognitive challenges posed by their methodologies. Their awareness of the advantages and disadvantages of their respective systems of inquiry and theory-building demonstrate an unwillingness to take systems of medical decision making for granted, or as foregone conclusions.

[1] "Nearly Half of U.S. Adults Could Now be Classified with High Blood Pressure, under New Guidelines," The American Heart Association, last accessed March 3, 2018, https://news.heart.org/nearly-half-u-s-adults-now-classified-high-blood-pressure-new-definitions/.

Consider the quote given above, from the American Heart Association's comments to the general public about changes in the guidelines for the diagnosis of hypertension. Using data from hundreds of studies, the physicians tasked with revising these guidelines established new numerical cut-offs in the measurement of blood pressure – the points at which an individual is determined to have normal blood pressure, elevated blood pressure, high blood pressure-stage 1, or high blood pressure-stage 2. Classification of an individual into these groups determines whether therapy will be administered, and if so, what kind of therapy. I mention this example, which describes a very modern discussion about the diagnosis and treatment of disease, for several reasons. First, because it demonstrates how changes in guidelines affect the number of people determined to have a disease: "The change means 46 percent of U.S. adults are identified as having high blood pressure, compared with 32 percent under the previous definition." After the application of this definition, tens of thousands of people suddenly were determined to "have" high blood pressure, who did not previously "have" it, though the numerical value of their blood pressure did not change; the framework for interpreting this result did. Second, the article mentions that guidelines were changed in order to more readily identify individuals who are "at risk" for the sequelae of the disease (chiefly death and debilitating strokes, among other problems). The studies used to "redefine" these guidelines were correlative: they looked at blood pressure measurements, and associated them with positive or negative outcomes at certain time points. The justification for changing the guidelines, then, was rooted in prognosis; the guidelines were changed based on outcomes data for prior patients, in order to prevent future outcomes deemed likely for patients with these particular blood pressure measurements. Third, the article mentions the challenges associated with "accurately measur[ing]" blood pressure, and observes that not all patients or even health care providers are taking these measurements

correctly. Inability to measure reliably the aspect of health that determines placement into a diagnostic/prognostic/therapeutic category means that the categorical placement, and subsequent decision making, will be incorrect, and therefore potentially problematic for the patient. Fourth, the article makes the remarkable point that hypertension is "often called 'the silent killer' because there are often no obvious symptoms." These categories, then, are largely based on a single metric (which, to be clear, may be measured more than once, by more than one individual, using different pieces of equipment), which is linked with no outward symptoms.

The four aspects of this guideline change were, as the preceding chapters have shown, actively and vigorously debated by the physicians of Greco-Roman antiquity. There was awareness that the stated characteristics of a disease affected how many people were determined to have it; that correlation-based study of outcomes and awareness of likelihood of future disease course should affect present treatment; that assignation of patients to categories affected how they were treated, and that incorrect assignation could have problematic consequences; and that what was "observable" and how it was observed – whether by the senses, by an instrument, or by reason – affected the decisions that a physician made. "[T]he ancient practitioner" of which Dr. Croskerry speaks (chapter 1) was guided by heuristics (as practitioners are today); but generations of these practitioners were committed to rigorous reassessment of the principles on which their practice was founded.

In order to frame discussion of medical decision making in Greco-Roman antiquity, Chapter 1 presented modern studies about human cognition and decision making, focusing on the heuristics and biases approach, and on the development of expert intuition. Chapter 2 explored decisions about disease classification in the Hippocratic Corpus, with a particular focus on outcomes-based classification (prognosis), and on decision making based on physiological

theories and anatomically-based nosological theories. Highlighting the diversity of approaches in the Hippocratic Corpus, this chapter argued that practitioners were in at least some cases aware of the limitations of their way of decision making, and that theory building was one way to address these limitations. Chapter 3 argued that the endeavors of the Alexandrian anatomist-physicians shifted the previously static boundary of the observable, leading them to develop novel theories about newly-seen anatomy and physiology and also to consider with greater sensitivity the question of the observable, and the ability to make decisions on the basis of causal theories developed from these observations. The Empiricists, described in chapter 4, focused on the problematic nature of many of these theories, arguing that an inability to observe the processes such theories assumed should lead practitioners to base their decisions on direct observations. Extensive accurate memory – personal and distributed – of the outcomes of patterns of symptoms would help a practitioner to make decisions that facilitated the health of his patients. This gesture toward the development of what Gary Klein has called "expert intuition" incorporated the focus on the observable that had been present in certain Hippocratic texts and assumed particular prominence in the era of anatomical investigation, and also encouraged increased systematization of these observations. There was an acknowledgement of the variety of patient presentations, and the value of experience in relating these presentations and symptom sets to one another in a way that remained grounded in the directly observable and uncommitted to a (potentially incorrect) theory.

Arguments that extensive experience and/or deep knowledge of theory created a better doctor were part of the Methodists' justification for their approach to medical decision making (Chapter 5). Founded on a classification system that emphasized bodily unity but also incorporated flexibility through the concepts of the κοινότητες and πάθη, Methodism centered on

the aspects of the human body that were shared across patients. Its practitioners were guided by a criterion of utility and shunned information they deemed irrelevant to the treatment of the patient's current problem, including individual idiosyncrasy and, to a degree, the external influence of environment, diet, and habits. Finally, Chapter 6 focused on Galen, whose extensive corpus affected ideas about health and disease for over a millennium and was read from western Europe to Baghdad. In contrast to his Methodist rivals, Galen emphasized the individuality of his patients, underscored the need for extensive training in theory and in medical practice, and developed detailed systems of classification for diseases and symptoms. His stated preferences about his method of reaching decisions about diagnosis, prognosis, and therapy described an involved and likely time-consuming process, which may have been truncated in practice owing to the demands of the clinical context.

These diverse approaches to medical decision making, spanning nearly six hundred years and multiple geographic areas around the Mediterranean, emphasize that multidimensionality of medical decision making in the past: "heuristics" in the modern sense, while part of these ongoing and ever-evolving patterns of thought, were not the only way that ancient practitioners made their decisions. As we consider their achievements in our modern context, it must be acknowledged that the advances of modern medicine are indisputable. But as we consider "precision medicine" (determination of treatment based on an individual's personal genetic makeup),[2] the utility and applicability of "big data" (huge aggregates of multiple data points that require computers and artificial intelligence for their interpretation),[3] and recent studies that

[2] Consider the recent textbook by Stearns, Stephen and Ruslan Medzhitov, *Evolutionary Medicine*, (Sunderland: Sinauer Associates, Inc.: 2016), which uses genetic data, among other criteria, to propose a new classification system for disease.

[3] Jacques Beckmann, and Daniel Lew, "Reconciling Evidence-based Medicine and Precision Medicine in the Era of Big Data: Challenges and Opportunities," *Genome Medicine* 8, (2016): 134. Note that this article about the very modern, recent field of precision medicine, opens with reference to Galen.

indicate that up to half of published scientific studies in certain fields are not reproducible when carried out by different labs,[4] we would do well to pay attention to these early, robust, and paradigm-shifting debates about the nature, acquisition, and application of medical knowledge.

[4] Open Science Collaboration, "Estimating the Reproducibility of Psychological Science," 943.

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