Quantifying the Past: Empirical Tropes in Greek Historiography

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Preface:

This thesis began as a reflection on a series of conversations I had (or more accurately, overheard) this summer at a machine learning conference. After hearing no fewer than three colleagues mention "updating their Bayesian priors about what was for lunch," I began to think more seriously about the relationship between the way we speak, the way we measure, and the way we assign value.

On the flight back, it occurred to me that this is, in fact, a much older problem than I had imagined. While it is true that new technologies have changed the way we produce knowledge, I will argue in this thesis that the moral questions that these technologies present are not at all new. Rather, they are the modern expression of a very old conflation. Value is inseparable from how we measure it. This has been true since the integers first met cows.

There is a reciprocal relationship between the way we quantify and the way we assign moral and social worth. This relationship demands what Wendy Espeland and Mitchell Stevens call "an ethics of quantification."[1] Such an ethics would offer a path to the responsible production of knowledge in light of the conflation of how we count and who we decide counts.[2]

A satisfactory "ethics of quantification" needs to take account of the history of this moral problem and be prepared to address not only its modern manifestations, but its most basic questions: what is worth measuring, what units do we use, how do we decide that two things are equal, and how do we report the uncertainty or contingency of those measurements?[3] This thesis

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[1] Wendy Nelson Espeland and Mitchell L. Stevens, "A Sociology of Quantification," *European Journal of Sociology* 49, no. 3 (December 2008): 401–36, https://doi.org/10.1017/s0003975609000150.

[2] I am by no means the first person interested in this question, especially in a modern context. While my focus in this thesis is the ethics of quantification in ancient Greek historiography, there is a rich, ongoing discussion of the issues, for example, in the emerging field of QuantCrit (Gillborn et al., 2018). Cf. the pioneering research of Ruha Benjamin into the relationship between algorithms and the racial imaginary in America (Benjamin 2019a and 2019b).

[3] Espeland and Stevens,"A Sociology of Quantification."

offers one path to the history of this question, in the form of a close reading of the embedded quantitative frameworks in Herodotus and Thucydides.

In my introduction, I offer a summary of the body of work that treats quantification as a narrative tool like any other. I explore the French tradition (best represented by Alain Desrosières and Michel Foucault), which studies the co-evolution of statistical science and discourse, before turning to civic mathematics in Ancient Greece. I offer a few examples to demonstrate that the Greeks already understood quantification as a culturally contingent act. In my chapter on Thucydides, I argue that new modes of inferential thinking shaped the way he and his contemporaries communicated certainty and reckoned with the unknowable. I examine his theory of precision, his construction of certainty from disparate, often contradictory data, and his engagement with *eikos* arguments, or arguments from likelihood. In my chapter on Herodotus, I turn to the problem of commensurability and explore how new notions of value allow us to equate two previously incomparable quantities. I emphasize that his unit conversions and fixation on multiplication demonstrate his effort to convert between the Greek and Persian imperial scales.

Together, they reveal that no act of counting, measurement, or enumeration is context-free or politically neutral, and that this was as visible to the ancient world as it should be to ours.

Chapter 1: *On Exactitude in Science* and Culturally Embedded Quantification

> …In that Empire, the Art of Cartography attained such perfection that the map of a single Province occupied the entirety of a City, and the map of the Empire, the entirety of a Province. In time, those Unconscionable Maps no longer satisfied, and the Cartographers' Guilds struck a Map of the Empire whose size was that of the Empire, and which coincided point for point with it. The following Generations, who were not so fond of the Study of Cartography as their Forebears had been, saw that that vast Map was Useless, and not without some Pitilessness was it, that they delivered it up to the Inclemencies of Sun and Winters. In the Deserts of the West, still today, there are Tattered Ruins of that Map, inhabited by Animals and Beggars; in all the Land there is no other Relic of the Disciplines of Geography.
> – Jorge Luis Borges, *On Exactitude in Science*

(i) Double-Speak and Data-Speak: The Language of Quantification

The language of science has always been difficult to disentangle from the language of metaphor. We train our models, experiment with our fashion choices, and inoculate ourselves against both jealousy and measles. We count our blessings and lament our numbered days. The vocabulary of scientific innovation has always had a particular allure.

As "data-driven" has become a byword for infallibility, the structure and cadence of reasoned argument have begun to mimic the forms of statistical proof. Meanwhile, technical vocabulary moves closer and closer to the colloquial and increasingly draws on it. Technical and non-technical vocabulary end up superimposed in increasingly absurd ways: our data lives in the cloud, as children, we lie in the park and look up at clouds; we try our best to pay attention to one another, attention is the mechanism that makes large language models work. Scholars are increasingly grappling with this doubling of language, but primarily in the context of specific words, terms, and ideas.

John Durham Peters works to understand the complete transformation the modern world has wrought on the word "media" in his book, *The Marvelous Clouds: Toward a Philosophy of Elemental Media*. "The idea that media are message-bearing institutions such as newspapers,

radio, television, and the Internet is relatively recent in intellectual history. As Jochen Hörisch notes, 'Well into the nineteenth century, when one spoke of media, one typically meant the natural elements such as water and earth, fire and air.' … The old idea that media are environments can be flipped: environments are also media. Water, fire, sky, earth, and ether are elements – homey, sublime, dangerous, and wonderful."[4]

Meanwhile, in his study of the modern history of attention in *Sirens' Call*, Chris Hayes emphasizes that this anxiety about our divided and increasingly demanded attention is by no means new. He cites a 1907 article which decries the "modern family gathering, silent around the fire, each individual with his head buried in his favorite magazine."[5] There has long been dialogue between the ancient past and today's moral panic. Hayes begins his book with a discussion of the myth of Theuth. This story, first recounted by Socrates in the *Phaedrus,* has become a commonplace in this discourse. It goes as follows: a clever god invents a host of technologies to make humanity wiser, happier, and better. Chief among them is writing. As it turns out, however, writing makes them forgetful, lazy, and dependent. Hayes focuses on what this means for our capacity to pay attention.[6]

However, I am interested in the reciprocal relationship between the development of technology and the language we use to narrate the development of those technologies. To me, the most crucial feature of the myth of Theuth is not anything that Socrates says, but the fact that we know the story at all. If Plato, the usually devoted student of Socrates, had listened to his master,

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[4] John Durham Peters. *The Marvelous Clouds: Toward a Philosophy of Elemental Media* (The University of Chicago Press, 2015), 2-3.
[5] Stewart A Robertson, "The Teaching of English in Schools which Study No Foreign Language," *Journal of Education* 38, no. 453 (1907): 288. I initially encountered this quote on page 8 of *The Siren's Call*, by Chris Hayes.
[6]Incidentally, the notion of attention as currency seems to have entered our vocabulary long before the 'attention economy' entered our op-ed pages.

no one would ever have encountered this story. Plato has preserved for us in writing an account that defies its author to write.

This is all to say, the reciprocity between the language of emerging technologies and the prevailing tone of social and cultural discourse is not unique to the advent of human-like generative models. We have always used the language of emerging technologies to describe our fear of them. Moreover, our objectivity fetish is not new, and neither is the knowledge that quantification is a politically and culturally contingent act.

This has become especially obvious in the discipline of statistics.[7] In his 2004 article, Keith Hart charts the change from the egalitarian ethos of the mid-20th century to the stark inequality of the internet age by tracking the most common statistical models used. He nostalgically recalls the liberal ethos of the 1940s and 50s, during which the normal distribution became the primary tool of statisticians: "The key assumption is randomness. This means that every member of a group has an equal chance of being selected. The democratic premise is obvious."[8] In contrast, the 2000s were characterized by the appearance of the resonantly named "power law distribution," which is "characterized by a few very large quantities and many small ones."[9] He worries, not baselessly, that such a change is in fact indicative of a larger socio-political shift from democracy to technocracy, where "stark inequality" has become the norm.[10]

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[7] See, for example, the discussion in Saltelli and Di Fiore 2020 for an overview of the current landscape. Statactivism is one particularly interesting expression of the realization that statistics play a role in shaping today's moral landscape. These statisticians suggest, as Bruno et. al. write, "Accordingly 'another number is possible' – that what a hegemonic logic of quantification has installed, experienced *stactivists* may seek to dismantle or at least roughen up."

[8] Keith Hart, "From Bell Curve to Power Law: Distributional Models between National and World Society." *Social Analysis* 48 no. 3 (2004): 221. https://doi.org/10.3167/015597704782352285.

[9] Keith Hart, "From Bell Curve to Power Law," 221-222.

[10] Keith Hart, "From Bell Curve to Power Law" 223.

This may seem to invert the proper relationship between investigator and object of investigation: surely statistical tools are shaped by the world they aim to describe, not the reverse. It seems tautological to claim that the tools in vogue tell us something about social organization when they were presumably developed in response to it. Hart's approach, however, is vindicated by the historical development of statistics. Statistics began its life as a field called "political arithmetic," whose explicit aim was to equip the state with the information needed to shape the moral fiber of its citizens.[11] Rousseau encouraged the early statist to quantify in service of his government: "The government under which ... the citizens increase and multiply most, is infallibly the best. That [government] under which a people diminishes and decays, is the worst. Statisticians, it is now your business; reckon, measure, compare!"[12]

This is all to say that no act of counting, measurement, or enumeration is context-free or politically neutral, nor did statisticians ever labor under such a delusion. Quantification is itself a narrative technology, and one that plays a large role in constructing reality. The conflict between the apparent objectivity of enumeration, quantification, and other kinds of data-driven argument and the radical contingency of such information and argument has been live since it was first possible to collect and arrange data on a large scale. In particular, I want to emphasize the reciprocal relationship between the tools of computing reality and the tools of narrating reality.

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[11] Jean-Jacques Rousseau, *The Social Contract, or, Principles of Political Right Translated with an Historical and Critical Introd. and Notes by Henry J. Tozer*, trans. *Henry J.* Tozer (G. Allen, 1912), 175.

[12] Jean-Jacques Rousseau, *The Social Contract,* 175-176.
"Pour moi, je m'étonne toujours qu'on méconnoisse un signe aussi simple, ou qu'on ait la mauvaise foi de n'en pas convenir. Quelle est la fin de l'association politique? C'est la conservation & la prospérité de ses membres. Et quel est le signe le plus sûr qu'ils se conservent & prospèrent? C'est leur nombre & leur population. N'allez donc pas chercher ailleurs ce signe si disputé. Toute chose d'ailleurs égale, le Gouvernement sous lequel, sans moyens étrangers, sans naturalisation, sans colonies, les citoyens peuplent & multiplient davantage, est infailliblement le meilleur; celui sous lequel un peuple diminue & dépérit est le pire. Calculateurs, c'est maintenant votre affaire; comptez, mesurez, comparez," in Jean-Jacques Rousseau *Du contrat social; ou, Principes du droit politique [par] Jean Jacques Rousseau*; ed. by C. E. Vaughan (The University Press, 1918), 72-73.

The idea is that statistical science and discourse co-evolve: scientific concepts shape and reshape language, while linguistic categories reshape the construction of statistical knowledge. Once statistical ideas such as variance, confidence, or significance become central to numeric and scientific practice, they begin to appear in everyday speech, and especially in political and historical speech.[13] On the other hand, metaphors, categories, and distinctions present in everyday language shape what scientists believe is worth measuring, quantifying, and categorizing. This is by no means an original claim. Although the philosophy of computation is a relatively new and understudied field relative to, for instance, the philosophy of language, there is still a rich history of thinking in this vein. Michel Foucault, in a lecture in March of 1978, for instance, suggested that statistics, rather than a mathematical innovation, was a crucial development in the history of governance itself:

> At the start of the seventeenth century I think we see the appearance of a completely different description of the knowledge required by someone who governs … What I think is new, crucial, and determinant is that the sovereign must know those elements that constitute the state …. that is to say, the sovereign's necessary knowledge (*savoir*) will be a knowledge (*connaissance*) of things rather than knowledge of the law, and this knowledge of the things that comprise the very reality of the state is precisely what at the time was called "statistics." Etymologically, statistics is knowledge of the state, of the forces and resources that characterize a state at a given moment. For example: knowledge of the population, the measure of its quantity, mortality, natality; reckoning of the different categories of individuals in a state and of their wealth … all this data, and more besides, now constitute the essential content of the sovereign's knowledge.[14]

In this view, statistics (and quantification in general) are necessarily contingent on a moral and political outlook because they exist in order to characterize the reality which constitutes the existence of the state itself. As Alain Desrosières writes in *The Politics of Large Numbers: A History of Statistical Reasoning,*

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[13] See, for example, David Runciman's book *The Confidence Trap: A History of Democracy in Crisis from World War I to the Present.*

[14] Michel Foucault, et al. *Security, Territory, Population: Lectures at the College De France, 1977-78*, trans. Graham Burchell, ed. Michel Senellart et. al. (Palgrave Macmillan 2009) 273-274.

> Basing its originality on its autonomy in relation to other languages – religious, juridical, philosophical or political – scientific language has a contradictory relationship with them. On the one hand, it preaches an objectivity and, thereby, a universality, which if this claim is successful, provides points of support and common reference for debates occurring elsewhere; this is the "incontrovertible" aspect of science. On the other hand, this authority, which finds its justification in the actual process of objectification and in its strict demands for universality, can only be exercised to the extent that it is party to the world of action, decision making, and change. … [The key question then] is to study how the tension between the claim to objectivity and universality, on the one hand, and the powerful conjunction with the world of action, on the other, is the source of the very dynamics of science and of the transformations and retranslations of its cognitive schemes and technical instruments. Linked successively to the domestication of risks, the management of states, the mastery of the biological or economic reproduction of societies, or the governance of military and administrative operations, the history of probability calculus and statistics teems with examples of such transformations.[15]

As Foucault and Desrosières suggest, it is statistical reasoning that is most directly implicated in these reciprocal relationships between discourse and science, and most especially implicated in the reciprocal relationships between quantification and the state. Both scholars suggest that the study of this phenomenon should start roughly in the 1700s. They suggest this date because it coincides with, on the one hand, a greater need for so-called "administrative statistics" like population counts or tax levy estimates, and on the other, the sufficient development of mathematics to allow for probability, which Desrosières describes as "guiding choices in case of uncertainty, conceived circa 1660 by Huyghens and Pascal."[16] My claim is that this reciprocal

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[15]Alain Desrosières, *The Politics of Large Numbers: A History of Statistical Reasoning*, trans. Camille Naish, (Harvard University Press, 1998), 6-7.
"Fondant son originalité sur son autonomie par rapport à d'autres langues, religieuses, juridiques, philosophiques ou politiques, le langage scientifique a une relation contradictoire avec ces derniers. D'une part, il revendique une objectivité et, par là, une universalité qui, en cas de réussite de cette revendication, fournit des points d'appui et des référents communs aux débats des autres espaces : c'est l'aspect « science incontestable ». Mais cette autorité, qui trouve sa justification dans le processus d'objectivation lui- et même dans ses exigences strictes d'universalité, ne peut s'exercer que pour autant qu'elle participe à l'univers de l'action, de la décision, de la transformation du monde. … "Elle est plutôt d'étudier comment la tension entre, d'une part, la revendication d'objectivité et d'universalité et, d'autre part, l'articulation forte avec l'univers de l'action est à l'origine de la dynamique même de la science et des transformations et retraductions de ses schèmes cognitifs et de ses instruments techniques. L'histoire du calcul des probabilités et des statistiques, liée successivement à la domestication du risque, à la gestion des États, à la maîtrise de la reproduction biologique ou économique des sociétés, ou au pilotage d'opérations militaires et administratives, fourmille d'exemples de telles transformations," in Alain Desrosières, *La Politique des Grands Nombres: Histoire de la Raison Statistique*, (Editions La Découverte, 1993), Kindle.
[16] Alain Desrosières, *The Politics of Large Numbers,* 16.

relationship between discourse and statistics is much older than has previously been recognized. If we are willing to expand our notion of the statistical and to let go of some of the formalism introduced by Huyghens and Pascal, we can take a much longer view of the co-evolution of statistical thinking and statistical talking, as it were. We can extend our understanding of the co-evolution of technologies of knowledge production and discourse to the ancient Greek world, and particularly to ancient Greek historiography, where questions like those that fascinated the 18th-century sovereigns to whom Foucault refers appear about 2,000 years earlier.[17]

As Desrosières writes, "precisely because this field of study [i.e., statistics] is a field of interaction between the worlds of knowledge and power, of description and decision – 'there is' and 'we must' – it already enjoys a peculiar relationship with history."[18] And, I might add, a peculiar relationship with the writing of history. In Herodotus and Thucydides, we find both probabilistic thinking and administrative statistics. We see the desire to make firm inferences on the basis of uncertain knowledge and the methods by which those desires are realized. This thesis will explore the origins of statistical thinking in Greek historiography, what it means to quantify, how knowledge is produced, and how that production is reflected in language. I am particularly interested in drawing out the origins of the reciprocal relationship that Desrosières articulated and examining how these historiographers navigate between the worlds of "there is" and "we

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"Subtile façon d'orienter les choix en cas d'incertitude, imaginée vers 1660 par Huygens et Pascal," in Desrosières, *La Politique des Grands Nombres,* Kindle.

[17]I do not mean to suggest that this interest is the exclusive domain of Greek thinkers in the ancient world. This thesis restricts its attention to the moral, political, and historical valence of quantification in the Ancient Greek world, but there is equally interesting and valuable material from Persia and Ancient Mesopotamia as well as other parts of the ancient world. See, for example, Part I in Overmann 2025 for an overview of culturally contingent quantification in the near east. See especially Chapter 6, "Numbers in the Achaemenid Empire." For another perspective, see also Katz 2007, who gives a survey of mathematics in Egypt, Mesopotamia, China, India, and Islam.

[18]Alain Desrosières, *The Politics of Large Numbers,* 3. *"*Mais justement parce que ce domaine d'étude est un lieu d'interaction entre les mondes du savoir et du pouvoir, de la description et de la décision, du « il y a » et du « il faut », il se trouve avoir déjà, préalablement à la recherche, un rapport particulier à l'histoire," in Desrosières, *La Politique des Grands Nombres,* Kindle.

must."[19] Thucydides will serve as an example of the ways in which the production of certainty from data is inherently political. I will suggest that precision and accuracy are crucial terms in Thucydides. I argue that in many ways, the key contribution of his *History* is methodological, that he seeks to pass on an approach to history, rather than simply transmit facts. This approach amounts to a scheme for purifying information and producing objectivity, while simultaneously acknowledging the underlying randomness of human life. In the case of Herodotus, I will examine the production of administrative statistics and his attempt to expand the domain of the knowable and legible. I will study the ways in which his encounters with the larger imperial system of Persia change the scale of inference he engages with and how his project can be understood as an act of cultural translation through quantification. Before addressing those questions directly, however, it is important to understand the larger context of a kind of low mathematics of the Ancient Greek world. By low mathematics, I hope to distinguish the geometry of Euclid and Pythagoras from the practical, statistical thinking that I will discuss in the context of Herodotus and Thucydides.

(ii) How to Say Count in Ancient Greek: An Introduction to Civic Mathematics

The prevalence of low mathematics is obvious in early attempts to wield numbers rhetorically. In the Athenian law courts, the language of statistical reasoning and its fraught relationship with moral and political judgment was already richly developed. One example of this is Demosthenes' fluent use of mathematical metaphor in his most famous speech, *On the Crown,* in which Demosthenes defends the orator Ctesiphon, who suggested Athens reward Demosthenes with a crown in recognition of his contributions to the city. Aeschines prosecuted Ctesiphon for this suggestion, and Demosthenes offered his services for the defense. This debate turned into a referendum on Macedonian influence in Athens. Demosthenes began by critiquing his opponent

[19] Ibid.

Aeschines' facile use of simple mathematics as opposed to his more sophisticated understanding of the arithmetic of guilt and innocence.

> Then he [Aeschines] resorts to sophistry, and tells you that you must ignore any opinion of himself and me which you brought with you from home; and that, as, when you cast up a man's accounts, though you anticipate a surplus, you acquiesce in the result if the totals balance, so you must now accept the result of the calculation. Every dishonest contrivance, you will observe, is rotten to the core. … I shall prove without difficulty that he has no right to ask you to reverse that opinion—not by using counters (ψήφους), for political measures are not to be added up (λογισμός**)** in that fashion, but by reminding you briefly of the several transactions, and appealing to you who hear me as both the witnesses and the auditors (λογισταῖς**)** of my account.[20]

Here, Demosthenes plays with the idea of putting both an individual and a *policy* on trial – two civic acts which entail two different kinds of civic mathematics. Although the speech is formally a defense of Demosthenes' political ally Ctesiphon, it is also a civic exhortation: a call for the Athenians to defend their political history against the growing power of Macedon. The word ψήφοι refers both to their votes and the pebbles used by jurors in court, a dual meaning that allows Demosthenes to invoke the metaphor of the abacus. As Cuomo explains, the abacus was central to the Athenian legal process: "Tokens, solid ones if the juror found for the defendant, perforated tokens otherwise, were collected by attendants into vessels, emptied out onto an abacus and counted. The abacus seems to have been of a special type, with holes on it to host the tokens; in particular it had as many holes as there were jurors, to make sure that everybody's vote was accounted for."[21] In this public performance of arithmetic, every citizen *counted*.[22]

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[20] Demosthenes, *De Corona* 227–229: "Εἶτα σοφίζεται καὶ φησὶν προσήκειν ἧς μὲν οἴκοθεν ἥκετ᾽ ἔχοντες δόξης περὶ ἡμῶν ἀμελῆσαι, ὥσπερ δ᾽, ὅταν οἰόμενοι περιεῖναι χρήματά τῳ λογίζησθε, ἂν καθαραὶ ὦσιν αἱ ψῆφοι καὶ μηδὲν περιῇ, συγχωρεῖτε, οὕτω καὶ νῦν τοῖς ἐκ τοῦ λόγου φαινομένοις προσθέσθαι … καὶ μὴν ὅτι γ᾽ οὐ δίκαια λέγει μεταθέσθαι ταύτην τὴν δόξαν ἀξιῶν, ἐγὼ διδάξω ῥᾳδίως, οὐ τιθεὶς ψήφους (οὐ γάρ ἐστιν ὁ τῶν πραγμάτων οὗτος λογισμός), ἀλλ᾽ ἀναμιμνήσκων ἕκαστ᾽ ἐν βραχέσι, λογισταῖς ἅμα καὶ μάρτυσι τοῖς ἀκούουσιν ὑμῖν χρώμενος." In *Orations, Volume II: Orations 18–19: De Corona, De Falsa Legatione*, trans. C. A. Vince and J. H. Vince, Loeb Classical Library 155 (Harvard University Press, 1926), 18.227–229.
[21] Serafina Cuomo, *Ancient Mathematics*, (Routledge, 2001), 20.
[22] Robert Sing, et al., *Numbers and Numeracy in the Greek Polis* (Brill, 2022), 3.

Demosthenes plays with this image of an abacus to distinguish between different modes of reasoning. Some matters, like the guilt or innocence of a particular individual, can be subjected to precise calculation (λογισμός), while others, like the choice to resist Philip of Macedon, exceed the scope of such mechanical quantification. Instead, he invites the jury to think like λογισταί, auditors or arithmeticians, capable of discerning when numbers clarify and when they distort.[23] His metaphor depends on a culturally specific understanding of the difference between everyday enumeration and expert mathematical judgment. That such a distinction could be legible to an Athenian audience testifies to how deeply mathematical metaphor had permeated civic life, and how fluidly number could operate as both symbol and argument. This fluency with the epistemological possibilities of quantitative thinking did not develop in a vacuum.

As Reviel Netz suggests in "Counter Culture," these "ψήφοι" formed an integral part of the Greek culture of numeracy.[24] When Herodotus compares the Greeks and the Egyptians, he goes out of his way to mention as a defining quality of the Greeks in contrast to the Egyptians that "The Greeks on the one hand write and calculate from left to right, while the Egyptians on the other hand, do so from right to left."[25] How the Greeks calculate is just as important to their social and cultural collective identity as how they write. Herodotus uses the same phrase, more or less, as Demosthenes: "λογίζονται ψήφοισι," which might be best understood as "to reckon with pebbles," an allusion perhaps to an abacus, which was used to perform many calculations. [26]

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[23] Demosthenes, *De Corona* 227. For a more detailed account of how such accounting metaphors are usually narrated, see Yunis 2001, 236-237.
[24] Reviel Netz, "Counter Culture: Towards a History of Greek Numeracy," *History of Science* 40 no. 3 (2002): 324, https://doi.org/10.1177/007327530204000303.
[25] Herodotus, 2.36.4: "γράμματα γράφουσι καὶ λογίζονται ψήφοισι Ἕλληνες μὲν ἀπὸ τῶν ἀριστερῶν ἐπὶ τὰ δεξιὰ φέροντες τὴν χεῖρα, Αἰγύπτιοι δὲ ἀπὸ τῶν δεξιῶν ἐπὶ τὰ ἀριστερά." In *The Persian Wars, Volume I: Books 1-2,* trans. A. D. Godley, Loeb Classical Library 117, (Harvard University Press, 1926), 2.36.4.
Keyser 1986 takes this as evidence of Herodotus' use of an abacus in his calculations.
[26] Ibid.

The imagery of pebbles was key to the Greek self-conception of computation. Many Greek descriptions of Greek applied mathematics involve either reference to these "ψήφοι" or use of their accompanying verbs: "λογίζεσθαι τε καὶ ἀριθμεῖν," to calculate and to count.[27]

Interestingly, when describing non-Greeks counting, there seems to be a slightly larger field of options. In Aeschylus' *Persae*, for example, the Persian chorus mourns for one of Xerxes' officials, crying, "And what of that flower of Persia, your ever-faithful Eye, who counted the numberless tens of thousands?"[28] The noun "πεμπαστής" is only attested here. Crucially, unlike most other phrases attested from the 470s BC in the semantic field of counting and computing, it has no known etymological relationship to "ἀριθμεῖν," "λογίζεσθαι," or "ψήφοι." Instead, it means literally "one who reckons by fives," a kind of counting quite dissimilar to the use of "ψήφοι," which can flexibly take on different values. The implication may be that just like the Egyptians, the Persians too had distinct ways of counting, and those distinct ways of counting necessitated new vocabulary to convey that difference to a Greek audience. Moreover, the scale of this computation is different from anything the Athenians would have recognized from their assembly meetings. Aeschylus seems to be reaching for unimaginably large numbers when he describes the Persian force as "μυρία μυρία."[29] Persia operated on a much larger imperial scale than Athens, and consequently, had developed new tools of enumeration for dealing with those very large numbers. As a result, Greek authors, whose counting system was ill-suited to transmitting quantities on such a scale, either gestured at

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[27] Reviel Netz, *The Shaping of Deduction in Greek Mathematics,* (Cambridge University Press, 2009), 299. By applied mathematics, I mean mostly to distinguish what Netz calls "basic numeracy skills" from so-called higher math like geometry.

[28] Aeschylus, *Persae* 978-82:
"ἦ καὶ τὸν Περσᾶν αὐτοῦ
τὸν σὸν πιστὸν πάντ᾽ ὀφθαλμὸν
μυρία μυρία πεμπαστὰν." In *Persians. Seven against Thebes. Suppliants. Prometheus Bound,* trans. Alan H. Sommerstein, Loeb Classical Library 145 (Harvard University Press, 2009), 121-124.

[29] Ibid.

such large numbers imprecisely (as Aeschylus does here) or (as Herodotus does in his *Histories*) went to great mathematical effort to demonstrate the equivalence of many, many small Greek units to a few large Persian units.

Though the material history of computation from the Classical period is thin, the smattering of evidence that remains is enough to suggest a population that was reasonably numerate.[30] A carving from the early 5th century BC depicts a man and a boy poring over a small board between them. Though initially thought to be a game board, the man's posture is archetypal.[31] He is in the pose of a professional, mastering a "τεχνή," and the orientation of the board seems to suggest its use as a counting table. He is likely a student learning how to use a counting table from a more experienced mathematician.[32] As Netz suggests, in part because the acrophonic system (writing numerals by the letter of the word used to represent them, ΔΔ for twenty, for example) did not lend itself to simple calculations, the act of writing numbers became increasingly distant from the act of calculation.[33]

As a consequence, counters became synonymous with numerical manipulation itself. As Netz writes, "We imagine numbers as an entity seen on the page; the Greeks imagined them as an entity grasped between the thumb and the finger."[34] As Paulin Ismard and Arnaud Macé write, "The widespread presence of mathematics in the civic societies of the Greek world was thus based on a form of practical continuum: calculations developed at the same time as the concrete objects that made them possible, from coins to the psêphoi and ostraka that were counted at the

[30] Reviel Netz, *The Shaping of Deduction in Greek Mathematics,* 300.
[31] Véronique Dasen and Jérôme Gavin, "Game Board or Abacus? Greek Counter Culture Revisited." *Board Game Studies Journal* 16 no. 1 (2022): 263, https://doi.org/10.2478/bgs-2022-0009.
[32] Ibid.
[33] Reviel Netz, "Counter Culture: Towards a History of Greek Numeracy," 329.
[34] Ibid.

end of votes, to knucklebones, divination dice, and the tokens used for counting on abacuses."[35] Numbers for most Greeks were a physical, practical reality, rather than a geometric abstraction.

The gaps between counting, calculating, and proving were not nearly as large for the Greeks as they are in today's academy. It was not inevitable that in most colleges Applied Mathematics sits not just in a different department, but a different school than Pure Mathematics, as is the case in most colleges. Plato mandates, for example, that the philosopher king spend more than a decade studying mathematics, but this study seems to consist (if not entirely) at least in part of a kind of play that lies somewhere between counting, calculating, and proving.[36] Students are expected to apportion apples, construct sequences of athletes, and sort objects.[37] As Athenaeus explains, the game consisted of taking a fixed number of apples and figuring out how to apportion them equally among ever-changing numbers of guests.[38] Dividing apples was a prerequisite not just for 'higher mathematics' like calculating the length of a hypotenuse or squaring the circle, but also for correct governance. Civic mathematics seems to span counting, calculating, and governing.

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[35]"La présence diffuse des mathématiques dans les sociétés civiques du monde grec se fondait ainsi sur une forme de continuum pratique : les opérations du calcul se développèrent en même temps que les objets concrets qui les rendaient possibles, des pièces de monnaies aux psêphoi et ostraka que l'on comptait à l'issue des votes, en passant par les osselets, les dés de la divination et les jetons avec lesquels on comptait sur les abaques." In Paulin Ismard and Arnaud Macé, *La cité et le Nombre: Clisthène d'Athènes, l'arithmétique et l'avènement de la démocratie,* (Les Belles Lettres, 2024), Kindle.

[36] Samuel Stevens, "The Politics of Mathematics in Plato's Republic," (PhD diss., University of California, Berkeley), 16, ProQuest (32042791).

[37] Cf Laws 819b–c: "Τοσάδε τοίνυν ἑκάστων χρὴ φάναι μανθάνειν δεῖν τοὺς ἐλευθέρους, ὅσα καὶ πάμπολυς ἐν Αἰγύπτῳ παίδων ὄχλος ἅμα γράμμασι μανθάνει. πρῶτον μὲν γὰρ περὶ λογισμοὺς ἀτεχνῶς παισὶν ἐξευρημένα μαθήματα μετὰ παιδιᾶς τε καὶ ἡδονῆς μανθάνειν, μήλων τέ τινων διανομὰς καὶ στεφάνων, πλείοσιν ἅμα καὶ ἐλάττοσιν ἁρμοττόντων ἀριθμῶν τῶν αὐτῶν, καὶ πυκτῶν καὶ παλαιστῶν ἐφεδρείας τε καὶ συλλήξεως ἐν μέρει καὶ ἐφεξῆς [καὶ] ὡς πεφύκασι γίγνεσθαι. καὶ δὴ καὶ παίζοντες, φιάλας ἅμα χρυσοῦ καὶ χαλκοῦ καὶ ἀργύρου καὶ τοιούτων τινῶν ἄλλων κεραννύντες, οἱ δὲ καὶ ὅλας πως διαδιδόντες, ὅπερ εἶπον, εἰς παιδιὰν ἐναρμόττοντες τὰς τῶν ἀναγκαίων ἀριθμῶν χρήσεις, ὠφελοῦσι τοὺς μανθάνοντας εἴς τε τὰς τῶν στρατοπέδων τάξεις καὶ ἀγωγὰς καὶ στρατείας καὶ εἰς οἰκονομίας αὖ, καὶ πάντως χρησιμωτέρους αὐτοὺς αὑτοῖς καὶ ἐγρηγορότας μᾶλλον τοὺς ἀνθρώπους ἀπεργάζονται." In *Laws, Volume II: Books 7-12,* trans. R. G. Bury, Loeb Classical Library 192, (Harvard University Press, 1926), 104-105.

[38] Ibid.

Consequently, abaci became a rich site for social and political metaphor, as early as the 6th century BCE. A passage in Diogenes Laertius (3rd century CE), which I was introduced to by Dasen and Gavin's article, suggests that Solon used counting pebbles as a political metaphor:

> He used to say that those who had influence with tyrants were like the pebbles employed in calculations; for, as each of the pebbles represented now a large and now a small number, so the tyrants would treat each one of those about them at one time as great and famous, at another as of no account.[39]

That early Greeks were (at least imagined to be) so fluent with arithmetic that the changing status of sycophants was legible to them in the changing value of these counters, sometimes representing five-hundred, others representing five, opens up a host of interpretive possibilities and provides substantial support for the idea that numeracy was deeply embedded in Greek culture.

This flexible status of counters is the basis for jokes and jabs across genres, but especially in comedy, where the self-seriousness of accountants, then as now, was a fertile site for humor.[40] In a now lost comedy of Alexis from the mid-4th century BCE, we find the following exchange, attested in Athenaeus:[41]

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[39] Diogenes Laertius, 1.2.59: "ἔφασκέ τε σφραγίζεσθαι τὸν μὲν λόγον σιγῇ, τὴν δὲ σιγὴν καιρῷ. ἔλεγε δὲ τοὺς παρὰ τοῖς τυράννοις δυναμένους παραπλησίους εἶναι ταῖς ψήφοις ταῖς ἐπὶ τῶν λογισμῶν. καὶ γὰρ ἐκείνων ἑκάστην ποτὲ μὲν πλείω σημαίνειν, ποτὲ δὲ ἧττω· καὶ τούτων τοὺς τυράννους ποτὲ μὲν ἕκαστον μέγαν ἄγειν καὶ λαμπρόν, ποτὲ δὲ ἄτιμον." In *Lives of Eminent Philosophers, Volume I: Books 1-5,* trans.R. D. Hicks, Loeb Classical Library 184 (Harvard University Press, 1925), 58-59.

[40] William Geoffrey Arnott, *Alexis: The Fragments: A Commentary*, (University of Cambridge Press, 1996), 87.

[41] Athenaeus 117c–e: "ἐν δὲ Ἀπεγλαυκωμένῳ συμβολάς τις ἀπαιτούμενός φησι·
(A.) Παρ᾽ ἐμοῦ δ᾽, ἐὰν μὴ καθ᾽ ἓν ἕκαστον πάντα
† δ᾽ ὡς †,
χαλκοῦ μέρος δωδέκατον οὐκ ἂν ἀπολάβοις.
(A.) οὐδὲν ἀσεβεῖς οὐδέπω. λέγε.
(B.) τῶν ἐχίνων ὀβολός.
(A.) ἀγνεύεις ἔτι.
(B.) ἆρ᾽ ἦν μετὰ ταῦθ᾽ ἡ ῥάφανος, ἣν ἐβοᾶτε;
(A.) ναί
(B.) δίκαιος ὁ λόγος.
(A.) ἀβάκιον, ψῆφον. λέγε.
(B.) ἔστ᾽ ὠμοτάριχος πέντε χαλκῶν.
(A.) λέγ᾽ ἕτερον.

> In *The Man Who Had a Cataract*, one of the characters, when asked to pay his share of the expenses for a dinner party says:
> (A) Unless you [render me an account of][42] each item in detail, you won't get the [twelfth part of a chalkous] out of me
> (B) Fair enough!
> (A) Bring an abacus and some counting pebbles! Go ahead!
> (B) There's raw-saltfish for five chalkoi.

What follows can only be described as a forensic account of the meal, with exorbitant prices quoted for cubed salt fish, sea-urchins, mussels, cabbage, and endives.[43] The demand that a reckoning-board ("ἄβαξ") be brought is key to the joke. The noun, "ἄβαξ," is attested (roughly contemporaneously) in Aristotle's *Constitution of Athens* as a technical tool for tallying votes, as represented by the "ψήφοι."[44] The joke, of course, is that the full force of Athenian civic mathematics is needed to settle last night's tab.[45] This numerological humor is also attested in Old Comedy. Netz points out that in Epicharmus, a Greek dramatist from the mid-6th century BCE, "the fact that a number may be changed from odd to even and back by the addition of a single pebble … is a simile for the fickleness of man kind."[46] This operation seems to be more advanced than simple accounting. Individual numbers have already developed qualities distinct from their basic economic function, features that give them 'personalities,' so to speak. For Netz, the development of such a psychological portrait of numbers is a hallmark of the development of

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(B.) μῦς ἑπτὰ χαλκῶν." In *The Learned Banqueters, Volume II: Books 3.106e-5,* trans. S. Douglas Olson, Loeb Classical Library 208, (Harvard University Press, 2007), 56- 58. I have lightly adapted the language as indicated by square-brackets above.

[42] This interpolation is mine, based on the 1928 edition of the same Loeb volume.

[43] Ibid.

[44]Aristotle, Ath. Pol. 69.1-2: "Πάντες δ᾽ ἐπειδὰν ᾖ̃σι διεψηφισμένοι, λαβόντες οἱ ὑπηρέται τὸν ἀμφορέα τὸν κύριον ἐξερῶσι ἐπὶ ἄβακα τρυπήματα ἔχοντα ὅσαιπερ εἰσὶν αἱ ψῆφοι, ἵν᾽ αὗται φανεραὶ προκειμέναι εὐαρίθμητοι ὦσιν, καὶ τὰ τρυπητὰ καὶ τὰ πλήρη δῆλα τοῖς ἀντιδίκοις. οἱ δὲ ἐπὶ τὰς ψήφους εἰληχότες διαριθμοῦσιν αὐτὰς ἐπὶ τοῦ ἄβακος, χωρὶς μὲν τὰς πλήρεις χωρὶς δὲ τὰς τετρυπημένας. καὶ ἀναγορεύει ὁ κῆρυξ τὸν ἀριθμὸν τῶν ψήφων, τοῦ μὲν διώκοντος τὰς τετρυπημένας τοῦ δὲ φεύγοντος τὰς πλήρεις· ὁποτέρῳ δ᾽ ἂν πλείων γένηται, οὗτος νικᾷ, ἂν δὲ ἴσαι, ὁ φεύγων." In *The Athenian Constitution. Eudemian Ethics. Virtues and Vices,* trans. H. Rackham, Loeb Classical Library 285, (Harvard University Press, 1935), 179-181.

[45] Arnott, *Alexis*, 88.

[46] Epicharmus in Reviel Netz, *The Shaping of Deduction in Greek Mathematics,* 272.

so-called ‘real mathematics.’[47] As he dates things, real mathematics emerged effectively simultaneously with ‘real historiography’ in roughly 440 BC.[48]

As with many intellectual developments, a telling sign of change is, paradoxically, the teleological projection of later obsessions onto the past, by which a technological shift is made to sit seamlessly within current culture. In the 5th century, as Ismard and Macé point out, interest in Palamedes reached a fever pitch in large part because he was retrospectively identified as the inventor of both arithmetic and politics.[49] Lost plays by Euripides, Aeschylus, and Sophocles were apparently dedicated to Palamedes.[50] Gorgias, in his *Defense of Palamedes*, says he “transformed human life from resourceless to resourceful, and from disordered to ordered, by inventing … written laws (the guardians of justice), writing (an instrument of memory), measures and weights (resourceful means of exchange for commerce), number (the guardian of valuables).”[51] That laws and numbers are both described as “φύλακα” is very telling.

In this new Athenian civic consciousness, legislation and quantification are twin defenders of civil liberties. The ancient investment in the epistemic and rhetorical possibility of

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[47] This characterization is less fanciful than it seems. Many mathematicians have pet numbers. Among number theorists (people who study the relationships between and properties of numbers and number systems, like the integers), there is a famous story about one of the great and somewhat eccentric mathematicians of the 20th century, Srinivasa Ramanujan. Beyond believing that his conjectures came to him in the form of visions from a Hindu goddess, he had a personal relationship with most numbers. When Ramanujan was sick in bed with tuberculosis, his friend G.H. Hardy (another great mathematician) came to visit him and tried to cheer him up by remarking that he had arrived in cab number 1729, a singularly boring number. Ramanujan responded with some offense, saying that it was in fact almost singularly interesting! 1729 is the smallest number expressible as the sum of two cubes in two distinct ways. The next such number is 87,539,3119. Only six such numbers are known. See Weisstein for more information.

[48] Reviel Netz, *The Shaping of Deduction in Greek Mathematics,* 273.

[49] Ismard and Arnaud Macé, *La cité et le Nombre: Clisthène d'Athènes, l'arithmétique et l'avènement de la démocratie,* (Les Belles Lettres, 2024), Kindle.

[50] Ibid.

[51] Gorgias, DP 30:“τίς γὰρ ἂν ἐποίησε τὸν ἀνθρώπειον βίον πόριμον ἐξ ἀπόρου καὶ κεκοσμημένον ἐξ ἀκόσμου ... νόμους τε γραπτοὺς φύλακας τοῦ δικαίου, γράμματά τε μνήμης ὄργανον, μέτρα τε καὶ σταθμὰ συναλλαγῶν εὐπόρους διαλλαγάς, ἀριθμόν τε χρημάτων φύλακα.” In *Early Greek Philosophy, Volume VIII: Sophists, Part 1,* trans. André Laks and Glenn W. Most, Loeb Classical Library 531, (Harvard University Press, 2016), 210-211.

quantification and numerical reasoning is important not only for a richer understanding of Athenian public life but also for our own context. The continuing authority of data and quantification is a key feature of the modern world. This thesis asks how two prominent Greek historians, Herodotus and Thucydides, thought with and about numbers, and what their engagement with numerical reasoning might reveal about the co-evolution of historical narrative and statistical thought.

Chapter 2: Thucydides and a Theory of Precision

It is, of course, difficult to give a precise account of what constitutes 'real' mathematics or historiography, but Netz is identifying a very real intellectual transition. Herodotus (ca. 484 – 425 BCE) and Thucydides (ca. 460 – 400 BCE) were immersed in an intellectual milieu where mathematics had become a critical part of the civic and intellectual discourse of the age. Ismard and Macé posit "the existence of a culture of numbers, widespread throughout a variety of social practices."[52] It is this low history of mathematics that most influenced these historiographers, and it is precisely because it is a low mathematics that influenced them that its impact has been overlooked. This is perhaps most obvious in the case of Thucydides. Netz says that while "Thucydides is unsurpassed in sheer intelligence…there is not the slightest hint in his work that anything like mathematics was at all known to him. He estimates the size of Sicily by its circumference."[53] This, I will demonstrate, is a categorically unfair accusation.

I begin, perhaps counter-intuitively, with Thucydides, on the grounds that Thucydides is particularly interested in the core methodological questions of data collection, numeracy, and quantification, and, in this sense, is closer to the data. Conversely, in my analysis, Herodotus is more interested in the political manipulation of data and processes of quantification. We might compare this to James Scott's discussion of the process of enforcing legibility on a subject population: first, you decide how you collect and clean your data, then you can manipulate it.[54]

Thucydides, more than any other historiographer, is engaged in the magic of statistics, namely the project of making certainty from error. I argue that a crucial component of Thucydides' methodology is the transmission of good data, data from which one can make *eikos*

[52]"L'existence d'une culture des nombres, diffuse dans une diversité de pratiques sociales," in Ismard and Arnaud Macé, *La cité et le Nombre*, Kindle.
[53] Reviel Netz, *The Shaping of Deduction in Greek Mathematics,* 308.
[54] James C. Scott, *Seeing Like a State: How Certain Schemes to Improve the Human Condition Have Failed*, (Yale University Press, 1998), 80.

inferences, data you can extrapolate from, to put it in the modern frame. For Thucydides, precision is the necessary prerequisite for extrapolation, and it is this insatiable desire for precision that propels his *History*. When Thucydides famously remarks that he intends this work as a "possession for all time," we must understand that this "κτῆμά" is as much a methodology as it is a textual object.[55] He is creating a technical paradigm for investigating history from which he expects future audiences to learn. This paradigm will enable readers to make the same *eikos* arguments that he does on the basis of their observed and carefully collected data.[56]

Collingwood, in *The Idea of History*, calls Thucydides "artificial" and "repellant," but I would argue these qualities are precisely the point.[57] Thucydides is not writing history, a genre which did not yet exist; instead, he is proposing a scientific paradigm for an account of a war, modeled in part on the technical reports of his day and on his own experiences as a general and soldier. His arguments are arguments about likelihood, about probability, about what can be inferred, about what is wont to follow what, what befits the situation. These are all crucial qualities for someone trying to guide a reader through the strategic and technical decision-making that Thucydides conceives as his purpose. He writes as a guide for the future, since events "follow the same coastline of history."[58] It is no surprise that his work ends up in a tactician's model, like that of Aeneas Tacticus.[59] It is this precision that merits his inclusion in this study of empirics, and it is this interest in precision that motivates his use of mathematics.

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[55] Thuc. 1.22.4: "κτῆμά τε ἐς αἰεὶ." In *History of the Peloponnesian War, Volume I: Books 1-2,* trans. C. F. Smith, Loeb Classical Library 108, (Harvard University Press, 1919), 40-41. Translations in this section are taken from the Loeb Edition unless otherwise noted.
[56] Since Thucydides uses ἀκούειν in 1.22.4, I'll use "audience" and "reader" interchangeably here to refer to the imagined recipient of the work.
[57] Robin George Collingwood, *The Idea of History,* (Clarendon Press, 1946) 29.
[58] Thuc. 1.22.4: "τοιούτων καὶ παραπλησίων ἔσεσθαι." translation mine.
[59] Cf. Aen. Tact. On the Defense of Fortified Positions 2.3 and compare to Thuc. 2.2.

This methodology is at work from the very start of the *History*, when Thucydides writes, "Thucydides, an Athenian, wrote (ξυνέγραψε) down the war waged by the Peloponnesians and the Athenians against one another."[60] Thucydides begins with a very specific, programmatic verb, according to Bakker, "συγγράφω," which has a close association with technical manuals, a genre where Thucydides' precision would be very much at home.[61] Bakker suggests that in such manuals "the writer rearranges and systematizes previous practice in order to facilitate subsequent practice."[62] It is hard to imagine a better summary of Thucydides' own project.

Even before we arrive at Thucydides' famous programmatic announcement at 1.22, we are introduced to his method. From the start, he is interested in extracting pure information from the chaos of testimony. This scrupulosity goes a long way towards explaining the necessity of the prologue in the larger project of the *History*. In their concern with all things Homeric, the first twenty chapters of the *History* seem, at first, ill-suited to a work that otherwise does its best to stay as far as possible from the mythological or unprovable. This is a feeling reinforced by the author's sheepishness in 1.21, where he seems almost to trip over his words in his haste to qualify the facts he has just presented:

> Still, from the evidence (*τεκμηρίων*) that has been given, *any one would not err who should hold the view that the state of affairs in antiquity was pretty nearly such as I have described it*, not giving greater credence to the accounts, on the one hand, which the poets have put into song, adorning and amplifying their theme, and, on the other, which the chroniclers have composed with a view rather of pleasing the ear than of telling the truth, since their stories cannot be tested…. He should regard the facts as having been made out with sufficient accuracy, on the basis of the clearest indications, considering that they

[60] Thuc. 1.1.1: "Θουκυδίδης Ἀθηναῖος ξυνέγραψε τὸν πόλεμον τῶν Πελοποννησίων καὶ Ἀθηναίων ὡς ἐπολέμησαν πρὸς ἀλλήλους." In *History of the Peloponnesian War, Volume I: Books 1-2,* trans. C. F. Smith, Loeb Classical Library 108, (Harvard University Press, 1919), 2-3. Translation lightly adapted.
[61] Egbert Bakker, "Contract and Design: Thucydides' Writing," in *Brill's Companion To Thucydides*, (Brill, 2006) https://doi.org/10.1163/9789047404842_006. Bakker supports a classical attestation of *σύγγραμμα* as "treatise" in a technical sense. Whether or not that was common in the classical period, the valence was likely there already.
[62] Bakker, "Contract and Design: Thucydides' Writing," 127.

have to do with early times.[63]

This Homeric detour is not wasted effort or an attempt to match Herodotus' "epic comprehensiveness," as Gregory Crane puts it.[64] Thucydides, in introducing a methodology, must at once acknowledge its limitations – you can't clean your data if there isn't any data – and clear the stage for his approach to history. Thucydides is doing, in other words, what modern statisticians would call "pre-processing." Thucydides, more than any other historiographer, is engaged in the magic of statistics, namely the project of making certainty from error. As Jacqueline de Romilly puts it, he is driven "by the sheer pleasure he took in verifying."[65] But it is not just verifying that seems to delight him; it is purifying the narrative of any errors, omissions or uncertainties. The modern term "data washing" springs to mind.

This is intimately related to his didactic, technical aims. He is creating a paradigm of history from which he expects the future to learn. He wants his readers to make the same kinds of logical inferences that he does on the basis of their observed and carefully collected data.[66] A large part of what he's proposing as a possession for all time is a methodology. As James Morrison points out, in certain key passages, this didactic purpose becomes even clearer. "Thucydides' presentation of Plataea offers us an example of punctuated history. When each episode breaks off and Thucydides fails to connect an early passage to a later one, the reader's task is to make those connections… As we read and reread, we come to appreciate the

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[63] Thuc. 1.21: "Εκ δὲ τῶν εἰρημένων τεκμηρίων ὅμως τοιαῦτα ἄν τις νομίζων μάλιστα ἃ διῆλθον οὐχ ἁμαρτάνοι, καὶ οὔτε ὡς ποιηταὶ ὑμνήκασι περὶ αὐτῶν ἐπὶ τὸ μεῖζον κοσμοῦντες μᾶλλον πιστεύων, οὔτε ὡς λογογράφοι ξυνέθεσαν ἐπὶ τὸ προσαγωγότερον τῇ ἀκροάσει ἢ ἀληθέστερον, ὄντα ἀνεξέλεγκτα καὶ τὰ πολλὰ ὑπὸ χρόνου αὐτῶν ἀπίστως ἐπὶ τὸ μυθῶδες ἐκνενικηκότα, ηὑρῆσθαι δὲ ἡγησάμενος ἐκ τῶν ἐπιφανεστάτων σημείων ὡς παλαιὰ εἶναι ἀποχρώντως." In *History of the Peloponnesian War, Volume I: Books 1-2,* trans. C. F. Smith, Loeb Classical Library 108, (Harvard University Press, 1919), 34-35, emphasis mine.

[64] Gregory Crane, *The Blinded Eye: Thucydides and the New Written Word,* (Rowman and Littlefield, 1996), 77.

[65] Jacqueline de Romilly, *The Mind of Thucydides*, trans. Elizabeth Trapnell Rawlings, ed. Hunter R. Rawlings III and Jeffrey Rusten (Cornell University Press, 2012), 151.

[66] These inferences, we'll call *eikos* arguments, in reference to Michael Gagarin's 2014 article, and return to later in the third part of this chapter.

interconnectedness of this work: the argument and events which are presented early in the work are later echoed, adapted, and transformed. The reader needs to actively create such links. An aspect of conjecture and extrapolation – a part of *εἰκάζειν*, etymologically – is to find the "similarity" or "likeness" (*εἰκόν*) episode A shares with episode B, C, or D." [67] While this strategy is certainly at play in the narrative composition of the text, it is explicit in Thucydides' desire to make his method legible to his audience and reproducible by later historians.

(i) Field Science: Thucydides and the Law of Large Numbers

Thucydides is at his best, his cleverest, and most precise under the conditions of extreme epistemic confusion that war imposes. When he has good data, his "rationalist zeal," as de Romilly remarks, is on full display, but his real talent, in my view, is obscured.[68] Thucydides' innovation is fundamentally methodological. Conditions of extreme uncertainty are most conducive to demonstrating Thucydides' methodological innovation. Whether precision under conditions of uncertainty is a narratively responsible choice is altogether a different matter.

Thucydides' remarkable statistical intuition is most evident in this passage from the siege of Plataea.

> They made ladders equal in height to the enemy's wall, getting the measure by counting the layers of bricks at a point where the enemy's wall on the side facing Plataea happened not to have been plastered over. Many counted the layers at the same time, and while some were sure to make a mistake, the majority were likely to hit the true count, especially since they counted time and again… The measurement of the ladders, then, they got at in this way, reckoning the measure from the thickness of the bricks."[69]

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[67] James Morrison, *Reading Thucydides*, (Ohio State University Press, 2006), 80.

[68] de Romilly, *The Mind of Thucydides*, 151.

[69] Thuc. 3.20: "κλίμακας ἐποιήσαντο ἴσας τῷ τείχει τῶν πολεμίων· ξυνεμετρήσαντο δὲ ταῖς ἐπιβολαῖς τῶν πλίνθων, ᾗ ἔτυχε πρὸς σφᾶς οὐκ ἐξαληλιμμένον τὸ τεῖχος αὐτῶν. ἠριθμοῦντο δὲ πολλοὶ ἅμα τὰς ἐπιβολὰς καὶ ἔμελλον οἱ μέν τινες ἁμαρτήσεσθαι, οἱ δὲ πλείους τεύξεσθαι τοῦ ἀληθοῦς λογισμοῦ, ἄλλως τε καὶ πολλάκις ἀριθμοῦντες καὶ ἅμα οὐ πολὺ ἀπέχοντες, ἀλλὰ ῥᾳδίως καθορωμένου ἐς ὃ ἐβούλοντο τοῦ τείχους. 4 τὴν μὲν οὖν ξυμμέτρησιν τῶν κλιμάκων οὕτως ἔλαβον ἐκ τοῦ πάχους τῆς πλίνθου εἰκάσαντες τὸ μέτρον." In *History of the Peloponnesian War, Volume II: Books 3-4,* trans. C. F. Smith, Loeb Classical Library 109, (Harvard University Press, 1920), 30-33.

This method, many counters working simultaneously, each accumulating small mistakes which cancel each other out in the average when repeated "time and time again," could have been given as an example in a modern statistics textbook. It captures the intuition behind one of the central theorems of statistics, the Law of Large Numbers. The theorem is originally due to the Swiss mathematician Jakob Bernoulli in 1773, but the intuition is already stated by Thucydides. A standard undergraduate reference reads, "Consider generating data from a large number of independent replications of an experiment, performed either by computer simulation or in the real world. Every time we use the average value in the replications of some quantity to approximate its theoretical average, we are implicitly appealing to the LLN."[70] It is worth noting at this juncture how astonishing this is. As Ian Hacking notes in *The Emergence of Probability*, the history of probability is remarkably short when compared to the history of other subdisciplines of mathematics, like geometry. Indeed, before Pascal, "there was hardly any history to record … theories of frequency, betting, randomness, and probability appear only recently."[71] It took nearly 100 years after the emergence of a mathematical formulation of probability for the Law of Large Numbers to appear (and even in its time, it was a controversial theorem).[72]

In many ways, this is the intuition, that over time and over repeated experiments, errors will cancel out, which epitomizes Thucydides' narrative method in the face of uncertainty. It is his best and only recourse when data-points disagree. To say that Thucydides was the first statistician, would be to make a claim beyond what our evidence allows. Nevertheless, he is engaged in the same intellectual project that Ian Hacking describes: the study of "the degree of

[70] Joseph K. Blitzstein and Jessica Hwang, *Introduction to Probability*, (Chapman and Hall 2019), 468.
[71] Ian Hacking, *The Emergence of Probability: A Philosophical Study of Early Ideas about Probability, Induction and Statistical Inference*, 2nd ed., (Cambridge University Press, 2006), 1-2.
[72] Hacking, *The Emergence of Probability,* 156.

belief warranted by evidence… and the tendency, displayed by some chance devices, to produce stable relative frequencies."[73]

We might also consider Thucydides' statement of his methodology in 1.22.2-4 as a more abstract statement of this intuition when applied to qualitative data. In other words, he treats eyewitness accounts as a kind of data that needs cleaning as well. His job as discerning historian is to average such accounts appropriately.

> But as to the facts of the occurrences of the war, I have thought it my duty to give them, not as ascertained from any chance informant nor as seemed to me probable, but only after investigating with the greatest possible accuracy each detail, in the case both of the events in which I myself participated and of those regarding which I got my information from others. And the endeavour to ascertain these facts was a laborious task, because those who were eye-witnesses of the several events did not give the same reports about the same things, but reports varying according to their championship of one side or the other, or according to their recollection.[74]

By emphasizing that each eyewitness gave different reports with different responses according to their own partisan preferences, Thucydides implicitly argues that his role as historian is to extract the truth from these disparate accounts, to average across individual errors. This work, he stresses, has been done"ἐπιπόνως" (laboriously).[75] It is not straightforward to translate eyewitness accounts to reliable data, but he is at pains to deliver the truth "ὅσον δυνατὸν ἀκριβείᾳ."[76] "Ἀκρίβεια" is a key word for Thucydides throughout his *History*, because it emphasizes the point of his methodology: precision, strict conformity to method, and reliable data. As Darien Shanske notes in *Thucydides and the Philosophical Origins of History*, "ἀκρίβεια" and relatedly "ἀλήθεια" are deeply methodological for Thucydides. "These two

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[73] Hacking, *The Emergence of Probability,* 1.
[74] Thuc. 1.22.2-4: "τὰ δ᾽ ἔργα τῶν πραχθέντων ἐν τῷ πολέμῳ οὐκ ἐκ τοῦ παρατυχόντος πυνθανόμενος ἠξίωσα γράφειν οὐδ᾽ ὡς ἐμοὶ ἐδόκει, ἀλλ᾽ οἷς τε αὐτὸς παρῆν καὶ παρὰ τῶν ἄλλων ὅσον δυνατὸν ἀκριβείᾳ περὶ ἑκάστου ἐπεξελθών. ἐπιπόνως δὲ ηὑρίσκετο, διότι οἱ παρόντες τοῖς ἔργοις ἑκάστοις οὐ ταὐτὰ περὶ τῶν αὐτῶν ἔλεγον, ἀλλ᾽ ὡς ἑκατέρων τις εὐνοίας ἢ μνήμης ἔχοι." In *History of the Peloponnesian War, Volume I: Books 1-2,* trans. C. F. Smith, Loeb Classical Library 108, (Harvard University Press, 1919), 40-41.
[75] Thuc. 1.22.3.
[76] Thuc. 1.22.2.

related alpha privative words convey the difficulty of using logos in a manner that does not cover up as much as, if not more than, it succeeds in bringing to light."[77] We might sloganize Thucydides's historical method as *ἀκρίβεια through averaging.*

Another example of his fascination with averaging in order to ameliorate errors extends to another domain of limited knowledge: the Homeric past. In the prologue, when Thucydides tries to compute how many Greeks went to Troy, he reckons, *"*In any event, if one takes the mean between the largest ships and the smallest, it is clear that not a large number of men went on the expedition, considering that they were sent out from all Hellas in common."[78] The crucial point here is that Thucydides seems to intentionally try to make precise and specific Homer's myth-making, although he is working with contradictory pieces of evidence, each of which he has reason to doubt. Mark Leventhal notes that Thucydides is unusual in "bring[ing] to bear his own numerical abilities in reading Homer's Catalogue … and elevat[ing] the numerical aspect as a key point of interest."[79] But this analysis misses the key fact of the passage – Thucydides recognizes that his data is suspect and he works with the information he has to give as informed a guess as possible, using the idea that the mean of the data is more likely than either of the observed outcomes, demonstrating surprisingly sophisticated statistical intuition. The chaos of the battlefield, by and large, yields to this methodology, but Thucydides has something larger in his sights: a unifying chronology of the war.

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[77] Darien Shanske, *Thucydides and the Philosophical Origins of History,* (Cambridge University Press, 2007), 156.
[78] Thuc. 1.10: "*πρὸς τὰς μεγίστας δ' οὖν καὶ ἐλαχίστας ναῦς τὸ μέσον σκοποῦντι οὐ πολλοὶ φαίνονται ἐλθόντες, ὡς ἀπὸ πάσης τῆς Ἑλλάδος κοινῇ πεμπόμενοι*." In *History of the Peloponnesian War, Volume I: Books 1-2,* trans. C. F. Smith, Loeb Classical Library 108, (Harvard University Press, 1919), 18-21.
[79] Mark Leventhal, *Poetry and Number in Graeco-Roman Antiquity,* (Cambridge University Press, 2022), 4.

(ii) Day by Day: Thucydides and Recorded Time

War does strange things to time: stretches it, bends it, and eventually, fractures it into a before and an after. Thucydides does not share the modern historical fetish for timelines, but he is, in his own way, deeply invested in enforcing legibility and order on the mess of battles, proxy wars, naval and land skirmishes, negotiations, and treaties which he has written together into the Peloponnesian War. Thucydides uses, to borrow a phrase from Emmanuel Le Roy Ladurie, "the special time of the farmer, the shepherd and the craftsman," as Virginia Hunter suggests in her book.[80] This choice, which he justifies only in the so-called second preface, is rather provincial for modern historians' taste, and occasioned a flurry of academic debate in the second half of the twentieth century over his interest in and capacity for precision.

Before the value of this agrarian chronology can become visible, however, it is important to consider the options for dating his history that might have been available to Thucydides. In their 1961 article, William Pritchett and B. L. Van der Waerden offer four plausible calendars which Thucydides might have used to pin down his war: a political calendar, like the one based on the Athenian Prytany; a religious calendar where events might be marked by the time to or from the nearest major festival; an empirical lunar calendar; and finally, an agricultural calendar.[81] Thucydides explicitly disavows the first two options in his second preface. A few scholars (Arnold Gomme in his commentary on Thucydides being the most notable), hoping to rescue the father of history from any association with the barnyard, have tried to suggest that Thucydides employed this third class of empirical lunar calendar.[82] However, as Benjamin Merrit notes in his paper, "The Seasons in Thucydides," "most of his dates within the seasons have to

[80] Emmanuel Le Roy Ladurie, *Montaillou: The Promised Land of Error,* (G. Braziller, 1978), 277. I first encountered this quote in Hunter 2017.
[81] William Kendrick Pritchett and B. L Van der Waerden. "Thucididean time-reckoning and Euctemon's seasonal calendar," *Bulletin de Correspondance Hellénique* 85 no. 1 (1961): 17–52, https://doi.org/10.3406/bch.1961.1574.
[82]See Arnold Wycombe Gomme, et al., *A Historical Commentary on Thucydides*, (Clarendon Press, 1945).

do with the ripening of grain."[83] Book 3, for example, starts with the following temporal remark: "during the summer which came after, at the same time as the grain was ripe."[84] This is one of at least seven such instances, which Merrit notes.[85] If Thucydides was content to make do with agricultural time markers within seasons, why should we assume that he became an astronomer only to mark the change in year? It seems only reasonable to conclude that Thucydides was on shepherd's time.

This choice has garnered disapproval from both ancient and modern critics. Macan, whose barb I came across in Pritchett's article, laments the imprecision and lack of modern historical sensibility, saying, "It were better had Thucydides carried his Atticism into his chronology, boldly and systematically dating events by Attic years, months, and days of the month. He … missed his great chance and devised instead a chronology for the war based upon its intrinsic duration and seasonal division into summers and winters."[86] Dionysius of Halicarnassus, on the other hand, complains that Thucydides has sacrificed coherence at the altar of a false precision:

> He wished to follow a new path, untrodden by others, and so divided his history by summers and winters. The result of this was contrary to his expectations: the seasonal division of time led not to greater clarity but to greater obscurity… The whole of the book is broken up in this way, and the continuity of the narrative is destroyed.[87]

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[83] Benjamin D. Meritt, "The Seasons in Thucydides." *Historia: Zeitschrift Für Alte Geschichte* 11, no. 4 (1962): 440, http://www.jstor.org/stable/4434761.

[84] Thuc. 3.1.1: "Τοῦ δ' ἐπιγιγνομένου θέρους … ἅμα τῷ σίτῳ ἀκμάζοντι," in *History of the Peloponnesian War, Volume II: Books 3-4,* trans. C. F. Smith, Loeb Classical Library 109, (Harvard University Press, 1920), 2-3.

[85] Meritt, "The Seasons in Thucydides." 440.

[86] *The Cambridge Ancient History*, ed. J. B. Bury et al., vol. 5, *Athens, 478–401 B.C.* (Cambridge University Press, 1927), 403.

[87] Dionysius of Halicarnassus, On Thucydides, Section 9: "καινὴν δέ τινα καὶ ἀτριβῆ τοῖς ἄλλοις πορευθῆναι βουληθεὶς ὁδὸν θερείαις καὶ χειμερίοις <ὥραις ἀκολουθῶν> ἐμέρισε τὴν ἱστορίαν. ἐκ δὲ τούτου συμβέβηκεν αὐτῷ τοὐναντίον ἢ προσεδόκησεν… ὅλη γὰρ ἡ βύβλος οὕτω συγκέκοπται καὶ τὸ διηνεκὲς τῆς ἀπαγγελίας ἀπολώλεκε." In *Critical Essays, Volume I: Ancient Orators. Lysias. Isocrates. Isaeus. Demosthenes. Thucydides,* trans. Stephen Usher, Loeb Classical Library 465, (Harvard University Press, 1974), 482-5.

To go by these authors, dating by the seasons is the worst of both worlds: it is both far too imprecise to create satisfactory timelines of the war and the narrative has been encumbered by too many false divisions. This hardly fits with the portrait of a statistical Thucydides which we have thus far been at pains to establish. As Hunter suggests, Thucydides is a historian of process. By this she means that his is a "cumulative" history, one which contains "threads of meaning stretching back into earlier passages, which do not yield causes, but do reveal similarities and thus link one process to another."[88] When he describes events, he is not interested in the particular significance of any one battle or another, but rather how these battles combine to illustrate a general phenomenon or historical principle. As she puts it, "If he recorded events only within a process and provided abundant narrative detail merely to show how the process began or what stage it had reached, dates recording such embedded events, mere links in a chain, are meaningless. It does not really matter what year or day an event occurred, but rather what is its relative place in the process as a whole."[89] It is for this reason that relative time is perfectly sufficient for his history.

This argument addresses Macan's critique, but arguably the more substantive issue is that raised by Dionysius, who notes that Thucydides is, in effect, constantly interrupting himself. This is a criticism which is levied not just against the organization of the *History*, but also against Thucydides's somewhat labored prose. When temporal markers are introduced, Thucydides is at pains to correct even the appearance of error. Each sentence seems to amend itself as it is written. Thucydides does not, as Strunk and White might have encouraged him, omit needless words. This seasonal chronology allows Thucydides to be precisely imprecise. He can establish the relative sequence of events clearly, but the inherent haziness of the agricultural calendar allows

[88] Virginia J. Hunter, *Past and Process in Herodotus and Thucydides,* (Princeton University Press, 2017), 163.
[89] Hunter, *Past and Process in Herodotus and Thucydides,* 168.

him to calibrate his degree of linguistic precision to the quality of information that was available to him. This might be analogized to the modern practice of reporting significant figures in data. When performing a science experiment, the number of places after the decimal point that one is allowed to report relies on the number of places after the decimal point that have been given to you. In Thucydides, the adverbs do the same thing. Each adverb buys him a degree of precision, or hedges against a degree of precision. He says as much in favor of this system in his second prologue.

> But one must reckon according to the natural divisions of the year, not according to the catalogue of the names of officials in each place, be they archons or others who in consequence of some office mark the dates for past events, in the belief that this method is more to be trusted; for it is really inexact, since an event may have occurred in the beginning of their term of office, or in the middle, or at any other point as it happened. But reckoning by summers and winters, as has been done in this history—in as much as each of these divisions is to be reckoned as half a year—it will be found that there have been ten summers and as many winters in this first war.[90]

Seasons thus become a universalizing tool in Thucydides history. As far as Thucydides was aware, there would always be summer and winter in alternating patterns, which allows him to be both precise (all events are recorded to a precision of at least six months) and general (a reader who picks up his record of events will certainly be able to identify the intervals between battles, regardless of whether they know anything about Athens, Sparta, or even the Mediterranean). This combination of certainty and specificity is the gold standard of statistical accuracy, and is also a crucial part of the historical methodology which Thucydides hopes to pass on: any war

[90] Thuc. 5.20.2-3: "σκοπείτω δέ τις κατὰ τοὺς χρόνους καὶ μὴ τῶν ἑκασταχοῦ ἢ ἀρχόντων ἢ ἀπὸ τιμῆς τινὸς ἐς τὰ προγεγενημένα σημαινόντων τὴν ἀπαρίθμησιν τῶν ὀνομάτων πιστεύσας μᾶλλον. οὐ γὰρ ἀκριβές ἐστιν, οἷς καὶ ἀρχομένοις καὶ μεσοῦσι καὶ ὅπως ἔτυχέ τῳ ἐπεγένετό τι. κατὰ θέρη δὲ καὶ χειμῶνας ἀριθμῶν, ὥσπερ γέγραπται, εὑρήσει, ἐξ ἡμισείας ἑκατέρου τοῦ ἐνιαυτοῦ τὴν δύναμιν ἔχοντος, δέκα μὲν θέρη, ἴσους δὲ χειμῶνας τῷ πρώτῳ πολέμῳ τῷδε γεγενημένους." In *History of the Peloponnesian War, Volume III: Books 5-6,* trans. C. F. Smith, Loeb Classical Library 110, (Harvard University Press, 1921), 40-41.

that he could imagine would have summers and winters, with this temporal tool, readers can pattern their own wars more easily after Thucydides' war account.

This reading of the seasons explains a choice that has vexed scholars. In 5.26.3, when Thucydides begins his second preface, he writes, "So that, including the first ten-years' war, the suspicious truce succeeding that, and the war which followed the truce, one will find that, reckoning according to natural seasons, there were just so many years as I have stated, and some few days over."[91] Pritchett (and others, like Gomme) have made much of the phrase "ἡμέρας οὐ πολλὰς παρενεγκούσας" in his article "Thucydides' Statement on His Chronology," which he adduces as evidence of the fact that Thucydides was following a newfangled astronomical calendar.[92] This need not (and in fact must not) be the case. In particular, in order for Thucydides to "earn" the precision of a few days' time, he simply needs to satisfy his own epistemic system. Here, the context of the chapter provides sufficient surety: in 5.20, Thucydides has just reaffirmed his chronological scheme, while in the following sentences, he claims the status of eyewitness, which is rare in the *History*. He writes, "I, living through the whole war, and, since I was old enough to understand the whole thing, I turned my attention to it, so as to understand it

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[91] Thuc. 5.26.3: "ὥστε ξὺν τῷ πρώτῳ πολέμῳ τῷ δεκέτει καὶ τῇ μετ᾽ αὐτὸν ὑπόπτῳ ἀνοκωχῇ καὶ τῷ ὕστερον ἐξ αὐτῆς πολέμῳ εὑρήσει τις τοσαῦτα ἔτη, λογιζόμενος κατὰ τοὺς χρόνους, καὶ ἡμέρας οὐ πολλὰς παρενεγκούσας." In *History of the Peloponnesian War, Volume III: Books 5-6,* trans. C. F. Smith, Loeb Classical Library 110, (Harvard University Press, 1921), 50-51.

[92] Pritchett, W. Kendrick. "Thucydides' Statement on His Chronology." *Zeitschrift Für Papyrologie Und Epigraphik* 62 (1986): 205 - 11. http://www.jstor.org/stable/20186332.
Moreover, at 1.97.2, Thucydides takes a swipe at precisely these *parapegmata* (astronomical calendars), which have historically been associated with the early geographer Hellenicus: "And I have made a digression to write of these matters for the reason that this period has been omitted by all my predecessors, who have confined their narratives either to Hellenic affairs before the Persian War or to the Persian War itself; and Hellanicus, the only one of these who has ever touched upon this period, has in his Attic History treated of it briefly, and with inaccuracy as regards his chronology. And at the same time the narrative of these events serves to explain how the empire of Athens was established." In *History of the Peloponnesian War, Volume I: Books 1-2,* trans. C. F. Smith, Loeb Classical Library 108, (Harvard University Press, 1919), 164-165. Virginia Hunter, for instance, suggests that Thucydides may have written some parts of the Histories in response to Hellenicus' Atthis, published in 407 BCE, 5.20 and 5.26 in particular (Cf. Hunter 318).

precisely."[93] Thus, the suggestion that the war lasted ten years plus or minus a few days is not an attempt to coyly fix an exact date, but a demonstration of Thucydides' confidence in this chronological system. In particular, as Merrit suggests, Thucydides does have an interest in accuracy, but his concern is with "precision in the large, not in minutiae."[94] The mention of "ἡμέρας οὐ πολλὰς παρενεγκούσας" rather than indicating specific astronomical knowledge of when the war took place is meant instead to indicate Thucydides certainty in his own method of measurement and the quality of his knowledge about the general ordering and length of events within the war.[95] Precision to Thucydides was not ticks on a timeline, but rather an understanding of how each moment of the war contributed to the natural and inevitable process of empire.

Indeed, when Thucydides goes out of the way to provide the one fixed date which is required in this system of relative time, he goes out of his way to be specific as far as his information allows. That he only needs to provide one fixed date limits his exposure to inaccurate information by removing the obligation at the introduction of each new event to provide a fixed year, month, and day; it is much easier to say whether X battle occurred before or after Y than that Z battle occurred on the third Wednesday in June around noon. Thus, since the whole enterprise rests upon establishing only one fixed point, he goes about establishing that fixed point with his characteristic zeal. When the war narrative begins in earnest at the beginning of Book 2, Thucydides lists by Anne Carson's count no fewer than "seven different ways of telling time," which he uses to anchor his division of the war into summers and winters.[96]

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[93] Thuc. 5.26.4: "ἐπεβίων δὲ διὰ παντὸς αὐτοῦ, αἰσθανόμενός τε τῇ ἡλικίᾳ καὶ προσέχων τὴν γνώμην ὅπως ἀκριβές τι εἴσομαι." In *History of the Peloponnesian War, Volume III: Books 5-6,* trans. C. F. Smith, Loeb Classical Library 110, (Harvard University Press, 1921), 50-51.
[94] Meritt, "The Seasons in Thucydides." 437.
[95] Thuc. 5.26.3: "ἡμέρας οὐ πολλὰς παρενεγκούσας." In *History of the Peloponnesian War, Volume III: Books 5-6,* trans. C. F. Smith, Loeb Classical Library 110, (Harvard University Press, 1921), 50-51.
[96] Anne Carson, *Men in the Off Hours,* (Vintage Books, 2001), 3.

> For fourteen years the thirty years' truce which had been concluded after the capture of Euboea remained unbroken; but in the fifteenth year, when Chrysis was in the forty-eighth year of her priesthood at Argos, and Aenesias was ephor at Sparta, and Pythodorus had still four months to serve as archon at Athens, in the sixteenth month after the battle of Potidaea, at the opening of spring, some Thebans, a little more than three hundred in number, under the command of the Boeotarchs Pythangelus son of Phyleidas and Diemporus son of Onetoridas, about the first watch of the night entered under arms into Plataea.[97]

Belt and suspenders, indeed. This redundancy is meant as a guard against the inevitable erosion of time. There is a desire to anchor the actual narrative in something so certain that it cannot be forgotten. His temporal imagination seeks to stabilize narrative through consistent reference points. This excess of evidence, however, is crucial to enabling his precision. By correlating the priesthood of Chrysis with the ephorate at Sparta with the archonship of Pythodorus with a well-known battle with the change of the seasons, he earns the right to announce authoritatively that the invasion began "about the first watch of the night."[98] In particular, his excess of chronological detail at the macro-scale (counting the years and months of each of the administrative positions he details), evidences sufficient credibility so as to encourage even the most skeptical reader to trust this timeline. While Herodotus might have bought his reader's assent to this timing of the night-invasion by citing a particular witness, Thucydides earns trust through systematic processing of evidence. Somewhat paradoxically, both the erasure and exposure of source material can provide grounds for belief. Thucydides sits squarely in the camp of erasure: by so thoroughly collecting, combining, and editing his sources for the year and hour of this invasion, Thucydides acquires his reader's uncritical assent. For Thucydides, the ordering

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[97] Thuc. 2.2.1-2: "Τέσσαρα καὶ δέκα μὲν ἔτη ἐνέμειναν αἱ τριακοντούτεις σπονδαὶ αἳ ἐγένοντο μετ᾽ Εὐβοίας ἅλωσιν· τῷ δὲ πέμπτῳ καὶ δεκάτῳ ἔτει, ἐπὶ Χρυσίδος ἐν Ἄργει τότε πεντήκοντα δυοῖν δέοντα ἔτη ἱερωμένης καὶ Αἰνησίου ἐφόρου ἐν Σπάρτῃ καὶ Πυθοδώρου ἔτι τέσσαρας μῆνας ἄρχοντος Ἀθηναίοις, μετὰ τὴν ἐν Ποτειδαίᾳ μάχην μηνὶ ἕκτῳ καὶ δεκάτῳ, ἅμα1 ἦρι ἀρχομένῳ Θηβαίων ἄνδρες ὀλίγῳ πλείους τριακοσίων (ἡγοῦντο δὲ αὐτῶν βοιωταρχοῦντες Πυθάγγελός τε ὁ Φυλείδου καὶ Διέμπορος ὁ Ὀνητορίδου) ἐσῆλθον περὶ πρῶτον ὕπνον ξὺν ὅπλοις ἐς Πλάταιαν." In *History of the Peloponnesian War, Volume I: Books 1-2,* trans. C. F. Smith, Loeb Classical Library 108, (Harvard University Press, 1919), 258-259.
[98] Ibid.

of time is not a mere narrative convenience but an epistemic instrument, one that renders wartime measurable, transmissible, and instructive.

It is evidence of his commitment to the prospective length of the "αἰεὶ" which he foresees in his programmatic preface that his dating system must be independent of not only his own polis' political system, but that of all the priesthoods, festivals, and civic calendars of other city-states.[99] By constructing a set of fixed points by which a reader can navigate this history, Thucydides is designing a chronology of the war that allows him at will to elevate the reader from the momentary status of participant, mixed in with the confusion of battle, to the eternal rank of historian, someone who can step out of the fray to collect, collate, and cohere the disparate accounts of battle. The very banality of the seasons is what makes them such a reliable guidepost in this project. A unified chronology is the skeleton of his statistical project, from which the rest of his inference and extrapolation can be done.

(iii) All Signs Point to Yes: Eikos Arguments and Paired Battle Speeches in Thucydides

It is in battles more than anywhere else in his history that Thucydides is obligated to carry out the kind of inference which has elsewhere been left to his dedicated reader. So far, he has cleaned the facts for us, purified his account of misleading or extraneous information, and asked us to come to our own conclusions about how the larger pattern of history is repeated in miniature in the events he recounts. However, the program he has laid out in his first preface, to reconstruct what was said and to infer what must have been said, requires that in the battle speeches, more than anywhere else, Thucydides is obliged to undertake the forecasting of events.[100]

Battle speeches are exemplary in this regard, because more so than in any other rhetorical exercise, our author is forced to speculate. This is due in large part to the extremity of the

[99] Thuc. 1.22.4: "κτῆμά τε ἐς αἰεὶ." In *History of the Peloponnesian War, Volume I: Books 1-2,* trans. C. F. Smith, Loeb Classical Library 108, (Harvard University Press, 1919), 40-41.
[100] Cf. Thuc. 1.22.

circumstances in which such speeches must have been given. Few disinterested witnesses would have been present to record the speech, and eyewitness accounts would necessarily have been affected by the outcome of the battle. As Moegens Hansen notes, no speech addressed by a general to his army "is preserved and no fragments or titles of lost speeches have survived. The genre has not left any trace of its existence in our corpus of speeches."[101] Hansen infers from this lack of evidence, in addition to the genre's omission from contemporary rhetorical treatises, that such battle speeches did not by and large ever occur *in situ*.[102] His perspective represents one extreme of scholarly consensus on the reality of battle speeches, but regardless, his evidence suggests that Thucydides would have been especially short of evidence for what was said during those speeches and forced to rely on his own ability to make reasonable inferences according to the dictum he set forth in 1.22.[103] In fact, Thucydides' commitment to the battle speech was such that some scholars (notably Juan Zoido in his survey of the subject) consider his history to have promoted the battle speech from the repetition of commonplace phrases to inspire courage to a genuine rhetorical event.[104] The major influence in this rebirth of the genre is in Zoido's view assembly oratory, which provides an invaluable comparandum for Thucydides reported speeches.[105]

In what I will call (by analogy to forensic oratory) Thucydides' *eikos* arguments, we see demonstrated clearly the kind of analysis that required the careful cleaning and ordering of historical data that we noted above. By seeing how he makes inferential arguments, we finally grasp the necessity of such careful data processing: there is enough chance in the world that the

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[101] Mogens Herman Hansen "The Battle Exhortation in Ancient Historiography. Fact or Fiction?" *Historia: Zeitschrift Für Alte Geschichte* 42, no. 2 (1993): 163, http://www.jstor.org/stable/4436283.
[102] Hansen "The Battle Exhortation in Ancient Historiography," 164.
[103] For other, more modal perspectives, cf. Clark 1995 and Pritchett 2002.
[104] Juan Carlos Iglesias Zoido, "The Battle Exhortation in Ancient Rhetoric." *Rhetorica* 25 no. 2 (2007): 146, https://doi.org/10.1525/rh.2007.25.2.141.
[105] Zoido,"The Battle Exhortation in Ancient Rhetoric," 149.

same set of evidence can be correctly reckoned to support two contradictory conclusions. If there is any hope of logical progress, anyone tasked with inference should make sure the set of evidence they are using is reliable and consistent.

It would be anachronistic to call Thucydides a statistician, but his work contains the two tenets of statistical thinking that make the modern science of probability and inference possible: first, that randomness is an inherent and inescapable fact; second, that randomness can be calmed if not tamed through careful scrutiny, observation, and the application of logic. It is worthwhile here to consider the modern axioms of probability, the first of which says that any event either has positive or zero probability, the second says that the probability of something happening at all is one, and the third says that, in effect, events follow the ordinary intuition for how the world works. In particular, if two events do not have any causal factors in common, then the chance that they both happen is just the sum of the chances that each one occurs. I do not mean to make a direct analogy between these formalisms, which I have taken the liberty of stating very informally, and Thucydides' own criteria for judging the likelihood of such events. However, I think it is important to appreciate the simplicity of this mathematical scheme and its intuitive appeal. Thucydides' approach to reasoning with uncertainty is very well aligned with these ideas. In particular, we will see in his arguments, the following 'axioms' of a similar spirit.[106] First, his generals always reason with the idea in mind that there are two possible outcomes: defeat or victory, and that one of those will necessarily occur. Second, there are factors of chance at play that make even very likely outcomes not possible to arrive at with certainty, and necessitate the introduction of logical tools that seek to manage and contain the randomness of the universe. To demonstrate that Thucydides' reasoning is 'statistical' in the above sense and that his data

[106] By axioms I do not mean mathematical axioms. Instead, I am referring to habits and patterns of thought and speech which appear as tools of reasoning over and over again.

processing and his *eikos* reasoning are inextricably linked, I will address on the one hand the antilogic battle speeches which Thucydides includes in his account from various generals, and on the other hand the great war speech by which Pericles convinces the Athenians to begin the war in the first place.

In forensic oratory, an *eikos* argument is a kind of 'proof' based on similarity, likeness, or probability. That Thucydides' work shares a great deal with the kinds of forensic oratory in which *eikos* arguments first originated is indisputable.[107] In Victoria Wohl's words, *eikos* is the sort of inference that mediates between "*ἀνάγκη* (necessity) and *τύχη* (contingency), regularity that never hardens into a rule."[108] Michael Gagarin cites the following story in Aristotle's Rhetoric as a prototypical example of an eikos argument.[109] The story goes as follows: a weak man accused of attacking a stronger man. The weak man argues that he is innocent because it is unlikely that a weak man would be able to successfully attack a strong one. A strong man in the same situation would similarly argue that he is innocent precisely because, as a strong man, it would seem likely that he would attack a weaker man, and so he would not attack a weak man to avoid being convicted of the attack (which is likely to happen because he seems strong and thus able to attack).[110] These two arguments are equally inferences about what will happen based on observed facts about the circumstances (one man is strong, the other weak) and assumed laws about how such fights transpire (strength suggests victory in a fight, strength also suggests

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[107] Robert Tordoff "Counterfactual History and Thucydides," in Victoria Wohl ed. *Probabilities, Hypotheticals, and Counterfactuals in Ancient Greek Thought*, (Cambridge University Press, 2014), 102.
[108] Victoria Wohl,"Introduction: Eikos in Ancient Greek Thought." In *Probabilities, Hypotheticals, and Counterfactuals in Ancient Greek Thought*, (Cambridge University Press, 2014), 2.
[109] Michael Gagarin, "*Eikos* Arguments in Athenian Forensic Oratory," Victoria Wohl ed. *Probabilities, Hypotheticals, and Counterfactuals in Ancient Greek Thought*, (Cambridge University Press, 2014) 16.
[110] Aristotle, Ars Rhetorica, 1402a11-25: "ἄν τε γὰρ μὴ ἔνοχος ᾖ τῇ αἰτίᾳ, οἷον ἀσθενὴς ὢν αἰκίας φεύγῃ· οὐ γὰρ εἰκός·κἂν ἔνοχος ὤν, οἷον ἂν ἰσχυρὸς ὤν· οὐ γὰρ εἰκός, ὅτι εἰκὸς ἔμελλε δόξειν. ὁμοίως δὲ καὶ ἐπὶ τῶν ἄλλων· ἢ γὰρ ἔνοχον ἀνάγκη ἢ μὴ ἔνοχον εἶναι τῇ αἰτίᾳ· φαίνεται μὲν οὖν ἀμφότερα εἰκότα, ἔστι δὲ τὸ μὲν εἰκός, τὸ δὲ οὐχ ἁπλῶς ἀλλ᾽ ὥσπερ εἴρηται. καὶ τὸ τὸν ἧττω δὲ λόγον κρείττω ποιεῖν τοῦτ᾽ ἐστίν." In *Art of Rhetoric*, trans. J. H. Freese, ed. Gisela Striker. Loeb Classical Library 193 (Harvard University Press, 2020), 334-337.

susceptibility to accusations of violence). The second argument is what Gagarin calls a "reverse *eikos* argument," which "acknowledges the traditional *eikos* argument, that a strong man is likely to assault a weak man, but then reverses its effect, arguing that this very likelihood makes the act unlikely."[111]

We see Thucydides' own calculations of probability most clearly in the antilogic battle speeches he places in the mouths of generals. These doubled *eikos* arguments are extremely typical of such paired speeches in which one general interprets the facts of a battle in one way so as to suggest that his troops will win, while the other general, forced by reality to grapple with the same facts, must interpret them in such a way as to make his side victorious in the balance of probability. The author himself makes a point of emphasizing the contributions of such speeches to epistemic victories, both military and political. After Alcibiades makes his speech to the Spartans, encouraging them to send aid to the Sicilians, Thucydides remarks, "The Spartans took much courage from the man who explained each of these things[112] since they knew that they had heard them from the man who knew them as clearly as possible."[113] The suggestion that courage is the result of renewed certainty is crucial to Thucydides' understanding of the function and value of battle speeches.[114] The emphatic, almost redundant "πολλῷ μᾶλλον" which begins the clause, paired with the superlative adjective being used adverbially in the neuter plural "σαφέστατα" emphasize that very clear and certain knowledge in Alcibiades are directly, causally related to the much increased courage that the Spartans feel.[115] As de Romily notes, a

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[111] Gagarin, "*Eikos* Arguments in Athenian Forensic Oratory," 17.
[112] These things being the comparative advantage of the Spartans over the Athenians and the vulnerabilities of the Athenians' plan.
[113] Thuc. 6.93.1: "πολλῷ μᾶλλον ἐπερρώσθησαν διδάξαντος ταῦτα ἕκαστα αὐτοῦ καὶ νομίσαντες παρὰ τοῦ σαφέστατα εἰδότος ἀκηκοέναι." In *History of the Peloponnesian War, Volume III: Books 5-6,* trans. C. F. Smith, Loeb Classical Library 110, (Harvard University Press, 1921), 352-353.
[114] Though here Alcibiades is making a more typical assembly speech.
[115] Thuc. 6.93.1.

battle speech must not just encourage the troops to fight, but convince them that victory is likely, that they intend to win. She writes, "In order for [that] intention to appear feasible, it must rest on a calculation of probability."[116] In particular, in Thucydides' mind, the two aims of a battle speech (to prepare soldiers to fight and convince them that they will win) are in fact one and the same, since courage comes from epistemically-defensible confidence.

This is all the more true in cases when the complexity of the battle conditions demands a higher degree of speculation to arrive at convincing and encouraging conclusions for the troops on either side. As de Romily notes, in these circumstances, antilogic speeches or sets of speeches are more common.[117] One of the earliest examples of this in the *History* is the opposed battle speeches of Phormio and Brasidas after the first Athenian victory at Naupactus.[118] The Spartans begin by attributing their prior loss to mere chance and encouraging their soldiers not to use that past outcome to inform their predictions about how this battle will go. Brasidas begins, "The recent sea-fight, Peloponnesians, if possibly it has caused any man among you to be afraid of the one before us, affords no just grounds for your alarm."[119] "τέκμαρσις" is a somewhat unusual word, often associated with a physician's diagnosis, meaning literally, "a judging from sure signs."[120] This word sets the epistemic tone of the rest of his exhortation, where Brasidas is at pains to explain the causes of the previous defeat and explain why they do not apply to the future prospects of the Spartan fleet. In particular, his entire speech rests on the ability to separate

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[116] de Romilly, *The Mind of Thucydides*, 80.
[117] de Romilly, *The Mind of Thucydides*, 94.
[118] In fact, Thucydides attributes this speech to Cnemus and Brasidas and the other Peloponnesian commanders, which provides further support for the idea that Thucydides is the main author and architect of this speech.
[119] Thuc. 2.87.1: "εἴ τις ἄρα δι᾽ αὐτὴν ὑμῶν φοβεῖται τὴν μέλλουσαν, οὐχὶ δικαίαν ἔχει τέκμαρσιν τὸ ἐκφοβῆσαι." In *History of the Peloponnesian War, Volume I: Books 1-2,* trans. C. F. Smith, Loeb Classical Library 108, (Harvard University Press, 1919), 422-423.
[120] Liddell, Scott, Jones Ancient Greek Lexicon Online, s.v. "τέκμαρσις," accessed March 10, 2026, https://lsj.gr/wiki/Main_Page.

chance occurrences from universal truths, and convince the audience that he knows how to make such distinctions with reasonable certainty. He continues,

> For our preparation was deficient, as you know, and the object of our voyage was not so much to fight at sea as operations on land; and it happened, furthermore, that not a few of the chances of war were against us, and doubtless also our inexperience had something to do with our failure in the first sea-fight. It was not then our cowardice that brought about defeat, nor is it right that the spirit, which force cannot conquer, but which has in it something defiant, should be dulled and blunted by the outcome of mere chance; rather you ought to reflect that although men may suffer reverse in their fortunes, yet in their spirit brave men are rightly considered always brave, and when courage is present no inexperience can properly be urged as an excuse for being cowards under any circumstances.[121]

Brasidas is arguing that randomness, in effect, interceded in the causal chain that suggests that brave men should perform brave acts which should result in brave victories.

Brasidas then exhorts the Spartans, "So, oppose their greater experience with greater bravery and oppose your fear on account of the lesser outcome with the chance occurrence of having been unprepared.[122] The explicit contrast Thucydides (in the mouth of Brasidas) is making is between general truisms and random chance. It is this division that *eikos* arguments bridge. In particular, Thucydides deliberately parallels "τολμηρότερον" with the articular infinitive phrase "τὸ ἀπαράσκευοι τότε τυχεῖν."[123] In so doing, he associates the capacity for greater bravery with an ability to identify which events are due to chance and which are due to repeatable, general principles. A good soldier, then, is also a good statistician. Brasidas next reminds the Spartans that they have the double advantage of more ships and of fighting close to

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[121] Thuc. 2.87.3-4: "ὥστε οὐ κατὰ τὴν ἡμετέραν κακίαν τὸ ἡσσᾶσθαι προσεγένετο, οὐδὲ δίκαιον τῆς γνώμης τὸ μὴ κατὰ κράτος νικηθέν, ἔχον δέ τινα ἐν αὐτῷ ἀντιλογίαν, τῆς γε ξυμφορᾶς τῷ ἀποβάντι ἀμβλύνεσθαι, νομίσαι δὲ ταῖς μὲν τύχαις ἐνδέχεσθαι σφάλλεσθαι τοὺς ἀνθρώπους, ταῖς δὲ γνώμαις τοὺς αὐτοὺς αἰεὶ ὀρθῶς1 ἀνδρείους εἶναι." In *History of the Peloponnesian War, Volume I: Books 1-2,* trans. C. F. Smith, Loeb Classical Library 108, (Harvard University Press, 1919), 422-423.
[122] Thuc. 2.87.5-6: "πρὸς μὲν οὖν τὸ ἐμπειρότερον αὐτῶν τὸ τολμηρότερον ἀντιτάξασθε, πρὸς δὲ τὸ διὰ τὴν ἧσσαν δεδιέναι τὸ ἀπαράσκευοι τότε τυχεῖν." In *History of the Peloponnesian War, Volume I: Books 1-2,* trans. C. F. Smith, Loeb Classical Library 108, (Harvard University Press, 1919), 424-425.
[123] Ibid.

the land.[124] Having thus neatly explained their previous defeat by separating what was due to chance (their lack of preparation) from what is constant (their character and numeric advantage), Brasidas can finally make the crucial argument of his speech. From these principles, he is able to make his crowning *eikos* argument: "And, in many cases, victory belongs to the more numerous and better prepared."[125] That Brasidas is not unequivocal in his statement, but begins with the adverbial "τὰ δὲ πολλὰ" suggests that he is not making a statement about what rewards are guaranteed to the more numerous and better prepared side, but only that such factors increase their odds of success.[126] The battle speech then has become the venue for a kind of careful probabilistic reasoning which weighs constant factors against the perturbations of chance.

The Athenian generals also encourage their soldiers with an opposing pre-battle speech, in which the same facts Brasidas cites are re-interpreted in a much different light. The fact of the greater number of enemy ships becomes evidence that Spartans do not believe that they are a match for the greater Athenian experience.[127] Phormio reports that "the only reasonable ground they have for confidence is that their experience in fighting on land has generally brought them success, and so they think this will achieve the same result for them at sea as well."[128] This comment is worth noting as a kind of anti-*eikos* argument. Phormio claimed that the Spartans are analogizing two unlike things (fighting on land and fighting on sea) in order to falsely inflate their certainty of victory and thus their confidence. Not content with dismantling the applications

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[124]Cf. Thuc. 2.87.6.
[125] Thuc. 2.87.6-7: "τὰ δὲ πολλὰ τῶν πλεόνων καὶ ἄμεινον παρεσκευασμένων τὸ κράτος ἐστίν." In *History of the Peloponnesian War, Volume I: Books 1-2,* trans. C. F. Smith, Loeb Classical Library 108, (Harvard University Press, 1919), 424-425. I have lightly adapted this translation.
[126] Ibid.
[127] Cf. Thuc. 2.89.2 Phormio says in particular that "τὸ πλῆθος τῶν νεῶν καὶ οὐκ ἀπὸ τοῦ ἴσου παρεσκευάσαντο."
[128] Thuc. 2.89.2-3: "οὐ δι᾽ ἄλλο τι θαρσοῦσιν ἢ διὰ τὴν ἐν τῷ πεζῷ ἐμπειρίαν τὰ πλείω κατορθοῦντες καὶ οἴονται σφίσι καὶ ἐν τῷ 3ναυτικῷ ποιήσειν τὸ αὐτό." In *History of the Peloponnesian War, Volume I: Books 1-2,* trans. C. F. Smith, Loeb Classical Library 108, (Harvard University Press, 1919), 426-427.

of their reasoning, Phormio also critiques the inferential method of the Spartans, saying that they must be afraid (as a consequence of having constructed flimsy inferences) "because they would not think that you [the Athenians] intended to resist them unless you intended to achieve a result commensurate with the very great odds. For most opponents, like these ones, attack trusting more in power than in judgements."[129] This imputation that the Spartans do not reason about battle particularly well lends evidence to de Romily's observation that, "The battle is fought in advance intellectually. It is a battle of argument, in which the principal element is prediction; whoever presents a more complete system of arguments is seen to be the victor."[130] And indeed most readers, having heard both Brasidas' and Phormio's speech, would come down on the side of the Athenians, who, having won the battle for predictive power, also win the physical battle.

These antilogic speeches at the Battle of Naupactus are not the only such speeches. Paul Woodruff gives a near exhaustive account of such paired speeches, including those before the battle at Delium (Thuc. 4.92 and 4.95), and the suite of speeches surrounding the Syracusean expedition (Thuc. 7.61-69). As the complexity of the military circumstances grows, so too does the complexity of the antithetical speeches. De Romilly notes,

> When his account grows richer, it is always the same part that expands: the part that precedes the action. Facts are not more detailed; they are more analyzed, more explained; an increasingly elaborate dialectical system traces a kind of outline that soon comes to include everything…. Nothing happens that is not either a confirmation or a refutation of the calculations worked out by reason.[131]

Thucydides' fixation on expanding the analysis rather than inventing the data is evidence of his true statistical bent. The facts of one battle may be more difficult to assess than the facts of

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[129] Thuc. 2.89.6: "ὅτι οὐκ ἂν ἡγοῦνται μὴ μέλλοντάς τι ἄξιον τοῦ παρὰ πολὺ πράξειν ἀνθίστασθαι ὑμᾶς. ἀντίπαλοι μὲν γὰρ οἱ πλείους, ὥσπερ οὗτοι, τῇ δυνάμει τὸ πλέον πίσυνοι ἢ τῇ γνώμῃ ἐπέρχονται." In *History of the Peloponnesian War, Volume I: Books 1-2,* trans. C. F. Smith, Loeb Classical Library 108, (Harvard University Press, 1919), 428-429. I have lightly adapted this translation.
[130] de Romilly, *The Mind of Thucydides*, 81.
[131] de Romilly, *The Mind of Thucydides*, 94.

another, but the only thing the statistically minded analyst can do is expand the detail and the quality of the contrasting investigations.

(iv) Hypotheticals, Counterfactuals, and Statistics: Pericles' War Speech

Of course, paired antilogic speeches are prevalent outside of battle contexts as well, especially in assembly debate. Just as in each battle a general is required by the circumstances to give an account of why his side is likely to win and in so doing, prefigures what is to come, we might see the paired speeches at the end of Book one in the Spartan Congress and Athenian Assembly as antilogic "exhortatory war speeches," each of which prefigures the *History* that follows and paints a kind of mirror images of what might have been. In much the same way that each battle speech prefigures the actual events of the battle, first explaining them in hypotheticals, leading the reader to imagine the battle really could go one way or another, Pericles' speech offers an image of Athenian hope, the macro-*eikos* arguments that a city-state makes before undertaking such a war. It has been suggested that the entire *History* is an elaborate counterfactual considering what might have happened had Pericles lived, and while this theory perhaps overstates the facts, there is, below the surface of the *History*, a kind of shadow world we are invited into, in which it is possible to imagine what Greece might have looked like if Athens won.[132]

Pericles begins by emphasizing the universal nature of his judgment about the Peloponnesians, which he will go on to distinguish from the chance at play in the outcome of the war.

> Athenians, I always hold to the same judgement, namely not to yield to the Peloponsians, although I know that men are not guided by the same temperament when they are persuaded to go to war as when they are experiencing war itself, but change their judgments according to the results of chance. And I see now that I must give you similar and in fact nearly exactly the same advice… for it is possible that the outcomes of these

[132] Cf. Will 2003.

> events proceed no less unexpectedly than the judgments of men. So for that reason, we are accustomed to blame chance for whatever should happen contrary to reason.[133]

This is a meta-commentary on the nature of such speeches. Pericles comments that his judgment is immune from the vicissitudes of fortune, but the opinion of the crowd is not. In particular, Pericles points out that it is temperament ("ὀργή") and circumstance ("συμφορά") which guide judgment, which makes aspects of the future inaccessible with certainty. There are two kinds of knowledge that Pericles points out.[134] The first, his own unwavering judgment about the Peloponnesians, is something which is certain now and always ("αἰεὶ"), but does not affect reality materially.[135] The second is the opinion of the Athenians en masse, which is difficult to predict and subject to change with fortune, but does exercise power over reality. That the dichotomy between the knowable and the unknowable is accompanied by a dichotomy between power and impotence suggests a deep epistemic skepticism in Thucydides. He emphasizes that the task at hand for Pericles and for every Athenian citizen, namely to make important decisions under conditions of uncertainty, is something difficult, whose outcomes are unpredictable and uncontrollable even to those who appear to be at the helm.

Some scholars, especially Paul Woodruff, but even de Romilly on occasion, suggest that the eventual failure of the Athenian enterprise suggests a fatal logical flaw in Pericles's following argument.[136] A material loss, they argue, must be prefigured by a kind of intellectual defeat.

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[133] Thuc. 1.140.1: "Τῆς μὲν γνώμης, ὦ Ἀθηναῖοι, αἰεὶ τῆς αὐτῆς ἔχομαι μὴ εἴκειν Πελοποννησίοις, καίπερ εἰδὼς τοὺς ἀνθρώπους οὐ τῇ αὐτῇ ὀργῇ ἀναπειθομένους τε πολεμεῖν καὶ ἐν τῷ ἔργῳ πράσσοντας, πρὸς δὲ τὰς ξυμφορὰς καὶ τὰς γνώμας τρεπομένους. ὁρῶ δὲ καὶ νῦν ***ὁμοῖα*** καὶ ***παραπλήσια*** ξυμβουλευτέα μοι ὄντα, καὶ τοὺς ἀναπειθομένους ὑμῶν δικαιῶ τοῖς κοινῇ δόξασιν, ἢν ἄρα τι καὶ σφαλλώμεθα, βοηθεῖν, ἢ μηδὲ κατορθοῦντας τῆς ξυνέσεως μεταποιεῖσθαι. ἐνδέχεται γὰρ τὰς ξυμφορὰς τῶν πραγμάτων οὐχ ἧσσον ἀμαθῶς χωρῆσαι ἢ καὶ τὰς διανοίας τοῦ ἀνθρώπου· δι᾽ ὅπερ καὶ τὴν τύχην, ὅσα ἂν παρὰ λόγον ξυμβῇ, εἰώθαμεν αἰτιᾶσθαι." In *History of the Peloponnesian War, Volume I: Books 1-2,* trans. C. F. Smith, Loeb Classical Library 108, (Harvard University Press, 1919), 238- 241. Emphasis mine.

[134] Ibid.

[135] Ibid.

[136] Cf. de Romily, *The Mind of Thucydides*, 94; and Paul Woodruff, "Colloquium 4: Eikos and Bad Faith in the Paired Speeches of Thucydides," Proceedings of the Boston Area Colloquium in Ancient Philosophy 10, no. 1 (1994): 116, https://doi.org/10.1163/2213441794X00085.

Woodruff's particular candidate for the error is a kind of "bad faith," in which speakers and listeners delude themselves as a result of the preference for one outcome over another.[137] It is not bad faith that dooms the Athenians but the impotence of certain knowledge in the face of uncertain futures. Ultimately, it is nothing more and nothing less than the presence or absence of "συμφορά" that will determine the outcome of the war, and this is exactly where the tragedy lies. Even when reasoning is correct, there is an underlyingly random arrangement of outcomes in the universe.

This is precisely what Pericles himself suggests in the following sentence: "the outcomes of these events proceed no less unexpectedly than the judgments of men."[138] He argues here that both our chains of reasoning and outcomes (which may or may not match our conclusions) are uncertain. It is not that improper reasoning causes undesirable outcomes as Woodruff would suggest, but that chance plays a role in all things, and so the best a general can do is to hold to universal truths, no matter how little power over reality they have. This is precisely what he does, when he acknowledges his obligation to give "νῦν ὁμοῖα καὶ παραπλήσια" advice as he has always given.[139] That Thucydides' redundant description of the advice Pericles feels obligated to give is worthy of comment. He describes it as both"ὁμοῖα"and "παραπλήσια."[140] First, it follows a particularly Thucydidean pattern of "self-correction," wherein each sentence seems to amend itself as it is written. Pericles seems to realize that any claim to "identical" advice might be overblown, and so he corrects by characterizing the advice for a second time as "almost identical." He is at pains to be precise here because he is asking the audience to make an

[137] Woodruff, "Eikos and Bad Faith in the Paired Speeches of Thucydides," 116.
[138] Thuc. 140.1: "ἐνδέχεται γὰρ τὰς ξυμφορὰς τῶν πραγμάτων οὐχ ἧσσον ἀμαθῶς χωρῆσαι ἢ καὶ τὰς διανοίας τοῦ ἀνθρώπου." In *History of the Peloponnesian War, Volume I: Books 1-2,* trans. C. F. Smith, Loeb Classical Library 108, (Harvard University Press, 1919), 240 - 241.
[139] Thuc. 140.1.
[140] Thuc. 140.1.

enormous decision – as the stakes rise, so too does the care demanded of an orator. Second, it is worth mentioning that "παραπλήσια" appears also in Thucydides' famous methodological statement in his first preface, where he uses it to describe the relationship of the things he has just related to the events he believes will come (namely that they will resemble them very carefully).[141] "παραπλήσιος" is also a common adjective when comparing two numbers of roughly similar quantity.[142] The suggestion of this echo is that Pericles's admonishment to Athens is another kind of historical commonplace. This repeated word indicates that the advice which Pericles is giving has been given before in different circumstances, that history echoes itself, but chance can at any moment interrupt and turn the echo of once-sound advice into a tragic harbinger of what is to come. Because, of course, despite all the proofs and arguments given in his speech, Athens did not win the war. His "nearly the same" advice meets a different context that it is ill-equipped to handle.

He follows this prologue to his speech with a careful account of the resources of the Peloponesians and their relative paucity when compared with the Athenians' treasury and political enterprises. He claims that the Spartans have neither "individual nor public wealth" and because of their poverty, they have no experience with long wars or naval campaigns.[143] He addresses the Athenian people, saying

> But as regards the war and the resources of each side, make up your minds, as you hear the particulars from me, that our position will be fully as powerful as theirs. For the Peloponnesians till their lands with their own hands; they have no wealth, either private or public; besides, they have had no experience in protracted or transmarine wars, because, owing to their poverty, they only wage brief campaigns separately against one

[141] Thuc. 1.22.4: "βουλήσονται τῶν τε γενομένων τὸ σαφὲς σκοπεῖν καὶ τῶν μελλόντων ποτὲ αὖθις κατὰ τὸ ἀνθρώπινον τοιούτων καὶ παραπλησίων ἔσεσθαι." In *History of the Peloponnesian War, Volume I: Books 1-2,* trans. C. F. Smith, Loeb Classical Library 108, (Harvard University Press, 1919), 40-41.
[142] Liddell, Scott, Jones Ancient Greek Lexicon Online, s.v. "παραπλήσιος," accessed March 10, 2026, https://lsj.gr/wiki/Main_Page. Cf. Hdt 4.78, 8.16, 1.202, and 5.87.
[143] Thuc. 1.141.4: "ἰδίᾳ οὔτ᾽ ἐν κοινῷ." In *History of the Peloponnesian War, Volume I: Books 1-2,* trans. C. F. Smith, Loeb Classical Library 108, (Harvard University Press, 1919), 242-243.

> another. Now people so poor cannot be manning ships or frequently sending out expeditions by land, since they would thus have to be away from their properties and at the same time would be drawing upon their own resources for their expenses, and, besides, are barred from the sea as well.[144]

Thucydides (in the mouth of Pericles) clearly sees the situation as a general might. He considers the balance of resources, as well as the effort required to maintain that balance. As we have seen in previous battle speeches, Thucydides deliberately parallels two divergent interpretations of the same facts. The Spartans, just a few chapters ago, have assessed the quality of their resources and experience very differently. Pericles again appeals to universal principle to conclude: "from these circumstances, it usually happens that nothing effective occurs."[145] But he is not certain and does not pretend that these principles neatly apply to the present circumstance. He uses "φιλεῖ" impersonally to mean "is wont to" or "often does."[146] This use of φιλέω originates from the usage "so-and-so is fond of doing something" and so, is transformed to mean "often does." This use of the impersonal also suggests a kind of obscured subject – it is the forces that govern history which Pericles is appealing to. All our rationalism is tied up in a kind of divine causality which we'd like to believe watches over all human action. Pericles, like his author, knows, though, that however fond of logic and order the architect of history is, equally he is fond of its opposite. When Pericles says that "it usually happens that nothing effective occurs," he implicitly acknowledges that sometimes, from these circumstances, something effective does occur.[147]

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[144] Thuc. 1.141.3-5: "Τὰ δὲ τοῦ πολέμου καὶ τῶν ἑκατέροις ὑπαρχόντων ὡς οὐκ ἀσθενέστερα ἔξομεν γνῶτε καθ᾽ ἕκαστον ακούοντες. αὐτουργοί τε γάρ εἰσι Πελοποννήσιοι καὶ οὔτε ἰδίᾳ οὔτ᾽ ἐν κοινῷ χρήματά ἐστιν, ἔπειτα χρονίων πολέμων καὶ διαποντίων ἄπειροι διὰ τὸ βραχέως αὐτοὶ ἐπ᾽ ἀλλήλους ὑπὸ πενίας ἐπιφέρειν. καὶ οἱ τοιοῦτοι οὔτε ναῦς πληροῦν οὔτε πεζὰς στρατιὰς πολλάκις ἐκπέμπειν δύνανται, ἀπὸ τῶν ἰδίων τε ἅμα ἀπόντες καὶ ἀπὸ τῶν αὐτῶν δαπανῶντες καὶ προσέτι καὶ θαλάσσης εἰργόμενοι· αἱ δὲ περιουσίαι τοὺς πολέμους μᾶλλον ἢ αἱ βίαιοι ἐσφοραὶ ἀνέχουσιν." In *History of the Peloponnesian War, Volume I: Books 1-2,* trans. C. F. Smith, Loeb Classical Library 108, (Harvard University Press, 1919), 242-243.
[145] Thuc. 1.141.7: "ἐξ ὧν φιλεῖ μηδὲν ἐπιτελὲς γίγνεσθαι." In *History of the Peloponnesian War, Volume I: Books 1-2,* trans. C. F. Smith, Loeb Classical Library 108, (Harvard University Press, 1919), 244-245.
[146] Thuc. 1.141.7.
[147] Thuc. 1.141.7.

Woven in his speech is the true story of the Peloponnesian War that Thucydides is about to tell. In each of Pericles' hopeful inferences, we're given the opportunity to see just how good his reasoning is and just how wrong he ends up being. He lays out his vision for the war: an image of Athenians as counterfactual islanders. He says, in a famous passage, "but consider this, if we were islanders, who would be more unassailable? And now it is necessary to consider ourselves as close as possible to this, to abandon our homes and land and to guard only the sea."[148] This present contrary to fact is perhaps the best evidence that Pericles does not suffer from any delusions, that his polis's defeat was not punishment for his own epistemic sins, but rather the nature of chance. He imagines a world in which Athens is unassailable, but it is not this world. In this world, it is the gap between being islanders and being "ὅτι ἐγγύτατα τούτου" to being islanders that marks all the difference.[149] Crucially, in Thucydides (as in life), epistemic virtue does not mean causal control. When Thucydides offers us his "κτῆμά," we are not to understand it as a panacea for chance, but merely a means of making a correct autopsy of history.[150] Precision is important to the general who, in the moment of his battle speeches, is a kind of soothsayer, someone who tries to imagine the likely outcome of the facts and interpret them favorably for his cause. But precision is also important to the historian, whose obligation it is to dissect the body of history with as little horror and as much reverence as he can muster.

Returning then to Netz's claim that "anything like mathematics" is missing from Thucydides, we may concede that the abstraction and elegance of the geometers is missing, but it would be a mistake to ignore the general's battlefield mathematics that makes decision-making

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[148] Thuc. 1.143.5: "σκέψασθε δέ· εἰ γὰρ ἦμεν νησιῶται, τίνες ἂν ἀληπτότεροι ἦσαν; καὶ νῦν χρὴ ὅτι ἐγγύτατα τούτου διανοηθέντας τὴν μὲν γῆν καὶ οἰκίας ἀφεῖναι, τῆς δὲ θαλάσσης καὶ πόλεως φυλακὴν ἔχειν." In *History of the Peloponnesian War, Volume I: Books 1-2,* trans. C. F. Smith, Loeb Classical Library 108, (Harvard University Press, 1919), 248-249.

[149] Ibid. Cf. Constantakopoulou 2007 for a detailed exploration of the quasi-islanders trope in Athenain history.

[150] Thuc. 1.22.4: "κτῆμά τε ἐς αἰεὶ." In *History of the Peloponnesian War, Volume I: Books 1-2,* trans. C. F. Smith, Loeb Classical Library 108, (Harvard University Press, 1919), 40-41

possible under the conditions of extreme uncertainty that war imposes.[151] Thucydides has offered us all the statistical intuition we might need without any of the formalism. He has explained how we should gather our data, how we must arrange it chronologically in order to make sense of it, offered examples of how we might interpret such data to our own ends, and ultimately acknowledged that even armed with facts and universal principles, any inferences we make from this data are fallible. If we dismiss this as a kind of palm-reading without any rigor, we lose so much of the history of statistical thinking, and we risk missing Thucydides' entire point: perfect knowledge is unattainable, but even under the most extreme circumstances of uncertainty, we can make decisions that can be justified in the mirror of history.

[151] Reviel Netz, *The Shaping of Deduction in Greek Mathematics,* 308.

Chapter 3: Herodotus and the Arithmetic of Empire

By now, it is a cliche to contrast Herodotus and Thucydides along the lines of reliability. Herodotus is the father of lies, Thucydides the sire of history, so the story goes. But like most aphorisms, this contains a kernel, albeit a small kernel, of truth. Thucydides, as we have just demonstrated, is trying to expand the realm of the precise, to establish from the bare facts a rich picture of the progression of history. Herodotus, on the other hand, is trying to extend the boundaries of what is knowable. These are both valid modes of inference. Interpolation, on the one hand, seeks to give finer- and finer-grained detail, and extrapolation on the other seeks to sketch the outlines of what we might know. The accusation that Herodotus is the father of lies rather than history gestures inelegantly at the fact that extrapolation is much more difficult than interpolation. Herodotus and Thucydides are, by the nature of the problems they are trying to solve, implicitly accepting differing degrees of reliability in their outcomes. Extrapolation is a more speculative task, which demands both greater credulity in dealing with sources (when evidence is scarce, anything is to be believed) and greater creativity in making use of such facts. It is a result of the challenge that Herodotus has set before himself that he avails himself of a more catholic set of interviewees and is more imaginative in manipulating the data he is given.

(i) Entangled Numerics: Greek and Persian Numerical Culture Revisited

Especially when he turns his interest to the non-Greek world, Herodotus is working with speculative, often incomplete information. As Thomas Harrison notes in his article "Herodotus' Perspective on the Persian Empire," though many of Herodotus's specific facts are wrong (for example his confusion over the gender of the Persian god Mitra and his assertion that "all Persian names end in sigma," he nevertheless offers "impressively detailed picture of what we might

term the mechanics of Persian imperialism."[152] It is worth noting at this juncture that Herodotus was born under Persian imperial rule, in a city that fought with the Persians during the Persian Invasion of Greece.[153] This is not to say that Herodotus was culturally Persian (since if he were, he might have done a more accurate job transmitting their history), but that he occupied a geographically and culturally intermediate position. As Rosaria Munson cogently argues,

> For Herodotus of Halicarnassus and Thurii, who is centered in no place and belongs to nowhere, what is wrong with the Greeks of his time in their dealings with one another was already visible during their common resistance against the Persians and even earlier still. Their difficulties are partially due to a cognitive error he attempts to correct: their inadequate understanding of themselves and others.[154]

His historical method, I will argue, is influenced by this liminality. As someone on the borders of the Greek world, he wants to expand the Greeks' vision of the world beyond the Mediterranean. One of the most effective tools he uses to do this is quantification. Numbers in Herodotus serve as a tool of commensurability – he works to translate between a Greek imperial scale and a much larger Persian one. This entails a lot of counting.

Throughout the *Histories*, an attentive reader encounters what Catherine Rubincam, a historian of quantification in the ancient world, calls his "number orgies."[155] My survey of the texts finds at least 80 such passages, lengthy exercises in arithmetic where the author leads his reader through each stage of the computation.[156] It is of course ironic in a thesis dedicated in part to troubling the implicit authority of numbers to use such self-produced data argumentatively.

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[152] Thomas Harrison,"Herodotus' Perspective on the Persian Empire." *Electrum (Uniwersytet Jagielloński. Instytut Historii)* 29 (2022): 24 and 28, https://doi.org/10.4467/20800909EL.22.003.15773.
[153] Rosalind Thomas, "The Intellectual Milieu of Herodotus," in *The Cambridge Companion to Herodotus*, ed. Carolyn Dewald and John Marincola (Cambridge University Press, 2006), 60, https://doi.org/10.1017/CCOL052183001X.005.
[154] Rosaria V. Munson, *Telling Wonders: Ethnographic and Political Discourse in the work of Herodotus*, (University of Michigan Press), 273. There has been a lot of important work done on Herodotus' liminality. For a small sampling, consult Munson 2005 and Hartog 1988.
[155] Catherine Rubincam, *Quantifying Mentalities: The Use of Numbers by Ancient Greek Historians* (University of Michigan Press, 2021), 169, ProQuest Ebook Central.
[156] Herodotus' Computation

These numbers are a result of my reading (and necessarily subjective) classification of these passages into the incomplete and imperfect categories of "Units," "Aesthetic," "Direct," "Monument," "Minor," "Administration," and "Uncountable." Across all these computations, 78% of them relate to the non-Greek world, 43% of the total are Persian, and 22% are Egyptian. In the spirit of transparency and in modeling the responsible use of data, all this information is available on a spreadsheet below.[157] Although all data is fallible and my computations should be taken with a grain of salt, as they indicate just as much what I was looking for in the text as what is really there, I do think that these numbers indicate a particular interest in quantification, especially of non-Greek peoples.

This is unusual, to say the least. In her survey of the five major extant Greek historians (Herodotus, Thucydides, Xenophon, Polybius, and Diodorus Siculus), Rubincam notes that "no other historian displays his calculations in this way."[158] It is also important to note that even among the fragmentary historians, this appears to be unusual. As Rosalind Thomas rightly notes, "It is not easy to pin down the antecedents of the *Histories*, still less the intellectual background," but there seem to be few examples among the influences she cites for this mathematical bent.[159]

One partial answer to his mathematical preoccupation may lie in his connection both to the Persian numeric tradition and to the Greek listing tradition. As Athena Kirk writes,

> Herodotus faces the general problem of quantification on a large cultural scale and makes specific use of the list as a cipher for imparting value. In the *Histories*, the genres of historiography, the epic catalogue, and the nascent administrative inventory tradition coalesce. We find multiple examples of lists used to prove points and express value, and the characters and audience of the *Histories*, deeply invested in quantifying and displaying their wealth and possessions, use the list format to perform and prove their own worth. Both short- and long-form lists serve as constative narrative forms for the *Histories*. Lists in Herodotus perform expressions of control over people, places, and objects, through processes of counting, naming, and containing them. This is perhaps

[157] Herodotus' Computation
[158] Rubincam, *Quantifying Mentalities*, 170.
[159] Thomas, "The Intellectual Milieu of Herodotus," 60.

> why, among his myriad censures of Herodotus, Plutarch twice condemns him as a collector, first, "of men's calamities" (θνητῶν ἐκλέγων τὰς συμφοράς, Mal. Hdt. 2 [Mor. 855d]), and later, of the base and irrelevant in favor of the true and good (866 c–d).[160]

This rich cataloguing tradition is certainly an influence, but it seems to me that, at least as regards his penchant for quantification, Herodotus engages more strongly with his Persian intellectual heritage. The administrative statistics of an empire seem a much better template for Herodotus' forensic account of the size of the invading Persian army in Book 7, for instance. Still, as Kirk notes, in order to gather information for his computations, Herodotus may have been drawing on "official military inventories in scattered examples, and … describe[s] them with the verb apodeiknumi and the noun apodexis/apodeixis."[161] These lists became a prototypical narrative form in the *Histories*, and certainly offered data and perhaps some inspiration for his numeric pyrotechnics.

Unfortunately, detailed sources for Persian numeric culture are relatively sparse when compared to the Greek record. However, the evidence that remains suggests an administrative culture with thorough numeric records and, at least among bureaucrats, a great deal of practical numeracy. Crucially, the Persian numeric system made it much easier to represent large numbers than the Greek numeric system. As Karenleigh Overmann writes in "Numbers in the Achaemenid Empire," while there were many ways a Persian king might have represented numbers (Aramaic, Akkadian, and Elamite, for example), he also had access to "the sexagesimal system."[162] This number system has the benefit of a place value system, which "made these numbers—theoretically, at least—extensible to infinity, or as near to it a number as a king might

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[160] Athena Kirk, *Ancient Greek Lists: Catalogue and Inventory Across Genres*, (Cambridge University Press, 2021), 79.
[161] Kirk, *Ancient Greek Lists: Catalogue and Inventory Across Genres*, 92.
[162] Karenleigh A. Overmann, "Numbers in the Achaemenid Empire," in *Cultural Number Systems* (Springer Nature Switzerland, 2025), eBook, https://doi.org/10.1007/978-3-031-83383-0_6.

try to reach."[163] Moreover, it made the representation of large numbers extremely compact, an issue to which we'll return later.[164]

Besides the clear capacity to represent and neatly add large numbers, there are ample sources of evidence for Persian numerics in administrative records. For example, tablets found at Persepolis dating from 509-494 BC demonstrate advanced accounting.[165] Nearly 33,000 tablets were found in a damaged ancient fortification, mostly discussing "the movements of food commodities" and "the ration allocations of foods to peoples."[166] These tablets consist mostly of receipts and ledgers. One prototypical fragment quoted in Gloria Vollmers's article reads:

> 385 ½ Bar of grain supplied by Misparma, workers are subsisting on rations at Zappi whose apportionments are set by Irsena, received as rations. Seventh month, 2nd year. 1 man 4, 14 men 3, 9 boys 2, 4 boys 1 ½, 11 boys 1, 5 boys ½. 1 woman 5, 19 women 4, 59 women 3, 6 women 2. 8 girls 2, 6 girls 1 ½, 4 girls 1, 6 girls 1 ½, 4 girls 1, 6 girls ½. Total 153 workers.[167]

This demonstrates not just fluency with numbers among a specialized class of accountants, but also the ability to add and even work with ratios. Moreover, these numbers are relatively large, corresponding to the scale of Persian Imperial administration under the rule of Darius I. Another family of tablets attests to the auditing that took place.

> 9502 Bar of grain has been carried forward as balance, supplied by Bakadusda, at Liduma. In the 22nd year, twelfth month, the accounting was done.[168]
> PF 252: 4 Bar of kazla, 6 of irtastis, total 10 Bar of fruit, has been carried forward as balance at Mazikka, supplied by Marrezza. In the 20th year, ninth month, Jssuma reckoned it.[169]

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[163] Ibid.
[164] Ibid.
[165] Gloria L. Vollmers, "Accounting and Control in the Persepolis Fortification Tablets," *The Accounting Historians Journal* 36, no. 2 (2009): 93, https://doi.org/10.2308/0148-4184.36.2.93.
[166] Vollmers, "Accounting and Control in the Persepolis Fortification Tablets," 97.
[167] PF 930 translated in Vollmers, "Accounting and Control in the Persepolis Fortification Tablets," 100.
[168] PF 240 translated in Vollmers, "Accounting and Control in the Persepolis Fortification Tablets," 101.
[169] PF 930 translated in Vollmers, "Accounting and Control in the Persepolis Fortification Tablets," 101.

The emphasis on the personal responsibility of the accountant in confirming whether the accounts are correct and that the inflows are commensurate with the outflows is worth noting. Still longer lists like PF 1944 exist, which lists 15 separate dispensations of grain and totals them up to 3690.2 bar.[170] Certain tablets (Cf. PF 1955) even display what looks like a four-column accounting spreadsheet (though the totals behave in somewhat mysterious ways).[171]

But quantification alone is not extrapolative inference. In particular, the passages which Catherine Rubincam calls "number orgies," often combine both a large number and a detailed description of how such a number was produced from smaller ones.[172] That the desire to quantify became closely connected to the desire to justify such quantification visibly was not inevitable. Another partial source of influence may be the early Greek medical tradition. As Thomas points out,

> It is his manner of explicitly commenting on his sources, on his method, his emphasis on autopsy or eyewitness accounts, and indeed his very presence in the narrative as an active inquirer and commentator, which reveal his relation to very recent and contemporary intellectual trends… As Fowler has recently suggested, his very habit of mentioning his sources, however infrequent, is probably itself new: 'he invented the problem of sources'. Stressing your source of knowledge or inference is a prominent part of the new methods visible in the early medical writings.[173]

The question of how to navigate partial information and incomplete source material was especially live in the 5th century. This "problem of sources" may begin to explain the counting behavior we see. If it is becoming common to display the source of your data, it seems only natural that an author should also display the manipulations of said data, especially as those manipulations conspire to produce the final numeric answer with which Herodotus seems so preoccupied.

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[170] PF 1944 translated in Vollmers, "Accounting and Control in the Persepolis Fortification Tablets," 102.
[171] PF 1955 translated in Vollmers, "Accounting and Control in the Persepolis Fortification Tablets," 106.
[172] Rubincam, *Quantifying Mentalities*, 169.
[173] Thomas, "The Intellectual Milieu of Herodotus," 71.

(ii) The King's Eyes: Herodotus and James Scott on the Politics of Imperial Legibility[174]

Though there has been significant interest in Herodotus's historiographical method, his numerical method has been, for the most part, neglected by scholars. Of those who have worked on the issue, François Hartog offers one of the most compelling arguments. He suggests that Herodotus' efforts at mathematical precision are an attempt to "make the incredible and exotic seem real and, at the same time [to] endow him[self] with a special sort of expertise comparable to that of the Pythia who 'knows the number of grains of sand and the measures of the sea.'"[175] While this analysis speaks to the general phenomenon of computation in a historical and ethnographic text, to my mind, it does not sufficiently address why calculations appear in some passages and not others. As an explanation of the usefulness of quantification in general, it suffices, but as an explanation of Herodotus' particular computation, it lacks specificity. It cannot explain, for instance, why there are more than three times as many computations in the Egyptian section as there are in the Scythian section or why nearly 45% of all the computations in the *Histories* concern Persia.

There are more modern interpretations of these computations that do address their cultural specificity. Robin Bond's article "Dramatic Reckoning of the Numeric Kind: Herodotus' Extended Calculations" offers a more specific explanation for the inclusion of such extended computations.[176] She focuses on the potential moral relevance of these counting orgies, which I do not dispute, suggesting that they prefigure the downfall of kings by emphasizing the power they have. However, by and large, she focuses on the way in which computation supports larger narrative goals, rather than acknowledging that just as Thucydides might be described as driven

[174] The following sections develop work which began as a final paper in Jeremy Rau's course on Herodotus.
[175] François Hartog, *The Mirror of Herodotus: The Representation of the Other in the Writing of History*, trans. Janet Lloyd (University of California Press, 1988), 342; and Hdt.1.47.3.
[176] Robin Sparks Bond, "Dramatic Reckoning of the Numeric Kind: Herodotus' Extended Calculations." *The Classical World* 109 no. 3 (2016): 295 https://doi.org/10.1353/clw.2016.0029.

"by the sheer pleasure he took in verifying", Herodotus was driven by the sheer pleasure he took in multiplying.[177] Valeria Sergueenkova, on the other hand, in her article "Counting the Past in Herodotus' *Histories*," suggests that "Herodotus' quantifying efforts, far from being only a rhetorical strategy to increase the narrator's credibility and authority, are an important, indeed crucial, part of his historical method."[178] Like Sergueenkova, I would suggest that their most salient function is epistemic, turning small facts into magnificent ones through the magic of multiplication and addition. I argue that Herodotus' "number orgies" are an attempt to guide his audience through an encounter with imperial administration and power on a scale larger than the Greeks had ever encountered. Only by showing his work, by moving from numbers on a human scale to numbers on an imperial scale, can he effectively translate between Greek and non-Greek worlds. In other words, his computations allow his readers to inhabit the administrative perspective of non-Greek cultures.

The insight that makes Herodotus' portrayal of Near Eastern powers so compelling is the same one that guides many analyses of the modern state: namely, that a 'modern imperial power' is distinguished from other administrative structures by the particular ways they enforce legibility on their subject populations.[179] In Herodotus's world, Persia, for instance, was a modern state in the ways that the Greek poleis were not. As James Scott articulates in *Seeing Like A State*, in "modern states," officials are "at least one step – and often several steps – removed from the society they are charged with governing."[180] Herodotus, through his transmission of the computations that Near-Eastern empires used to enforce legibility on their subject peoples, situates his reader in the position of a 'Near-Eastern state official.' The

[177] de Romily, *The Mind of Thucydides*, 151.
[178] Valeria Sergueenkova, "Counting the Past in Herodotus' Histories," *The Journal of Hellenic Studies* 136 (2016): 121, http://www.jstor.org/stable/44157497.
[179] James Scott, *Seeing Like a State*, 11.
[180] James Scott, *Seeing Like a State*, 76.

granularity of his computations recreates for a Greek audience the process by which "standardized facts susceptible to aggregation are manufactured."[181] In other words, through his step-by-step arithmetic, Herodotus is recreating an Achaemenid king's perspective on his own empire in a way that a Greek reader could understand. This suggests a function for numbers as tools of perspective. By offering a reader a view into how a king counts, he also offers the reader, by extension, a view into how a king thinks.[182] The method that Scott articulates for the generation of these 'standardized facts' can be mapped onto Herodotus's process of creating quantified information.

As Scott argues, one prerequisite for constructing such information is the "common units of measurement or coding."[183] Once a standardized set of metrics has been established, then "each item or instance falling within a category is counted and classified according to the new unit of assessment," and then, finally, "the creation of wholly new facts by aggregation [is possible] following the logic of the new units."[184] This last step, "the creation of wholly new facts by aggregation," is what the audience witnesses when Herodotus leads them through an extended computation.

To show that the function of computation in Herodotus is to give his readers access to the perspective of non-Greek administrators in order to help them understand the scope and scale of Near Eastern imperial power, I will first show that Herodotus understands numbers as culturally embedded (subjective tools of understanding the wider world, rather than objective modes of describing it). Secondly, I will trace Scott's three-step process of the modern state's creation of "standardized knowledge," beginning with the use of units, moving then to the counting,

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[181] James Scott, *Seeing Like a State*, 80.
[182] For a more detailed discussion of Herodotus' particularly pronounced interest in foreign kings cf. Christ 1994 and Grethlein 2009.
[183] Ibid.
[184] James Scott, *Seeing Like a State*, 81.

classifying, and aggregating by looking at two case studies of powerful non-Greek cultures in Herodotus: Persia and Egypt. Finally, I will address Herodotus' use of uncountability as a mode of identifying the type of information inaccessible to a purely administrative perspective and an acknowledgment of the impossibility of full cross-cultural understanding.

Herodotus demonstrates through his engagement with non-Greek quantification that numbers, far from an objective standard, are a culturally embedded phenomenon that reflects the values and perspective of a culture. One interesting instance of Herodotus's engagement with the subjectivity of computation is in what he considers to be a 'round number.' There are two references to 'even' or 'full' numbers in the *Histories*. One is an example of what Persians and Lydians consider round, and the other, an example of what the Greeks consider 'round.' We might usefully compare this to Aeschylus' use of "πεμπαστής" in the *Persians* which also suggests a culturally-contingent experience of the aesthetic quality of numbers.[185]

As Xerxes marches across Anatolia to prepare to launch his invasion of Greece, he encounters Pythios, son of Atys, the richest man alive besides Xerxes.[186] Pythios hosts Xerxes and his army and offers to give him the entirety of his estate: "I found, by calculating, that in my possession were two thousand talents of silver and four-hundred sets of 10,000 of gold Daric staters, lacking 7,000."[187] Xerxes replies with reciprocal generosity, saying, "and from my very own (cache), I will (lit. fill up) complete your four-hundred ten thousand staters by giving you seven thousand, in order that your four-hundred ten thousand staters of not be lacking seven

[185] Aeschylus, *Persae* 978-82.
[186] Hdt. 7.27.1. All translations in this section are my own unless noted otherwise. Text was taken from the Loeb Classical Library editions of the *Histories*.
[187] Hdt. 7.28.2: "εὗρον λογιζόμενος ἀργυρίου μὲν δύο χιλιάδας ἐούσας μοι ταλάντων, χρυσίου δὲ τετρακοσίας μυριάδας στατήρων Δαρεικῶν ἐπιδεούσας ἑπτὰ χιλιάδων."

thousand but be made full as an even number ("ἀπαρτιλογίη"), by me."[188] "Ἀπαρτιλογίη" is a very unusual, rather technical word, highlighting Herodotus's numerical literacy. The Greek example is illustratively less grand. When describing the Greek fleet gathered before the battle of Salamis, Herodotus notes, "the fleet for the Greeks was filled up to 80 and 300 ships, for indeed it was lacking two from this number."[189] The Greeks, too, have an interest in round numbers but on a much smaller scale. When these examples are taken together, Herodotus' argument for the subjective, culturally dependent nature of computation becomes clear. The Greeks and the Persians (and even the Egyptians) share an aesthetic sense of evenness or fullness in numbers, but they occur on entirely separate scales.

(iii) How to Get From Here to There: Unit Conversions in Herodotus

Herodotus's attempt to situate his Greek audience in an Achaemenid or Egyptian imperial context begins with units. Herodotus appears to share Scott's belief that the first step in the process of creating standardized knowledge is to create "common units of measurement or coding."[190] Unit conversions are the third largest category of computation, according to my reckoning, forming about 10% of all computations. Units in the Greek world were poorly standardized at best. As Rubincam argues, "The lack of political unity in the world of ancient Greece militated against agreement on standardizing systems of [distance] measurement beyond the boundaries of a single polis."[191] In order to move his Greek audience into the Near-Eastern world, he needed to offer them a new set of more standard units. His fixation on unit conversion is evidence of this endeavor. In Book 2, as he describes the size of Egypt, he moves fluently

[188] Hdt. 7.29.2: "καὶ τὰς τετρακοσίας μυριάδας τοι τῶν στατήρων ἀποπλήσω παρ᾽ ἐμεωυτοῦ δοὺς τὰς ἑπτὰ χιλιάδας, ἵνα μή τοι ἐπιδεέες ἔωσι αἱ τετρακόσιαι μυριάδες ἑπτὰ χιλιάδων, ἀλλὰ ᾖ τοι ἀπαρτιλογίη ὑπ᾽ ἐμέο πεπληρωμένη."
[189] Hdt. 8.82.2: "ἐξεπληροῦτο τὸ ναυτικὸν τοῖσι Ἕλλησι ἐς τὰς ὀγδώκοντα καὶ τριηκοσίας νέας: δύο γὰρ δὴ νεῶν τότε κατέδεε ἐς τὸν ἀριθμόν."
[190] James Scott, *Seeing Like a State*, 80 .
[191] Rubincam, *Quantifying Mentalities*, 44.

between Greek and Egyptian units, saying, "the sort of men who are poor in land, measure their estate with orgyias (the length of outstretched arms), the sort of men who are less poor, [measure] in stades, while those who have much [land], [measure] in parasangs, and those who have enormous bounties [of land], [measure] in schoeni; The parasang is thirty stades, and the schoeni, which is an Egyptian measure, is 60 stades."[192] Note that the orgyia and the stade, native Greek measures, are associated with poverty in land. Herodotus is explicitly arguing that the metrics that the Greeks have are insufficient for a new, more global world, which has wealth on a scale unimaginable to a Greek.

The distances that Herodotus goes on to measure would be meaningless if listed in stades or orgyias because they would require numbers so big as to stop being intuitive. By breaking down these great lengths first into other units, Herodotus allows his readers to imagine scales he describes in a way that would not be meaningful if he only had access to stades. It is possible to get an intuitive sense for thirty schoeni, for instance, by first thinking that one schoeni is sixty stades and then imagining walking that length thirty times. However, one thousand eight hundred stades is not a useful concept because it does not give any meaningful intuition. This passage illustrates both Herodotus's attention to units as modes of cultural translation, which make a fuller understanding of non-Greek cultures possible, and his cross-cultural fluency.

When Herodotus does use native Greek units for unimaginably large distances, he is careful to show his work in a way he does not feel the need to when he describes enormous lengths in non-Greek units. Catherine Rubincam notes that the largest distance number that

[192] Hdt. 2.6.2: "ὅσοι μὲν γὰρ γεωπεῖναι εἰσὶ ἀνθρώπων, ὀργυιῇσι μεμετρήκασι τὴν χώρην, ὅσοι δὲ ἧσσον γεωπεῖναι, σταδίοισι, οἳ δὲ πολλὴν ἔχουσι, παρασάγγῃσι, οἳ δὲ ἄφθονον λίην, σχοίνοισι. δύναται δὲ ὁ παρασάγγης τριήκοντα στάδια, ὁ δὲ σχοῖνος, μέτρον ἐὸν Αἰγύπτιον, ἑξήκοντα στάδια;" and "measures." In The Oxford Companion to Classical Literature.

Herodotus uses is the "1,110,000 [orgyias] of his calculation for the length of the black sea."[193] In Book 4, Herodotus describes the sea as "the most marvelous sea of all because… there are one hundred and one thousand and ten thousand stades of length.[194] Note how awkward it is in Greek units to express a number that large – it takes him about five words. He then devotes the next section to describing how he arrived at this figure, saying:

> These things are measured thus. Since a ship will in a reasonably long day achieve seven ten-thousand orgyias and sixty ten-thousand orgyias throughout a night, then there are thus nine days and eight nights of sailing to the Phasis from the mouth … there are eleven hundred ten-thousand orgyias from which there are one thousand and ten-thousand stades.[195]

Precisely because the Greek units are ill-suited to his task, he is forced to go through a series of rather tedious additions and multiplications to find the size of the Black Sea in a way that will be meaningful to his Greek audience.

Herodotus demonstrates deep fluency with other kinds of unit conversions as well. For instance, when describing how the Persians collect tribute, he makes explicit note of the rate of conversion between Euboic and Babylonian talents, as well as the relationship between silver and gold measures.[196] This is, in part, an effort to make his work replicable. As Paul Keyser notes, "Herodotus wants his readers to learn with him … [he] explicitly shares his reasoning and evidence."[197] These unit conversions also serve to make his readers at home in new cultural contexts, equipped with the tools they need to understand the scale of the world around them.

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[193] Rubincam, *Quantifying Mentalities*, 52.
[194] Hdt. 4.85.2: "πελαγέων γὰρ ἁπάντων … θωμασιώτατος … τοῦ τὸ μὲν μῆκος στάδιοι εἰσὶ ἑκατὸν καὶ χίλιοι καὶ μύριοι."
[195] Hdt. 4.86.2: "μεμέτρηται δὲ ταῦτα ὧδε. νηῦς ἐπίπαν μάλιστα κη κατανύει ἐν μακρημερίῃ ὀργυιὰς ἑπτακισμυρίας, νυκτὸς δὲ ἑξακισμυρίας. ἤδη ὧν ἐς μὲν Φᾶσιν ἀπὸ τοῦ στόματος … ἡμερέων ἐννέα πλόος ἐστὶ καὶ νυκτῶν ὀκτώ: αὗται ἕνδεκα μυριάδες καὶ ἑκατὸν ὀργυιέων γίνονται, ἐκ δὲ τῶν ὀργυιέων τουτέων στάδιοι ἑκατὸν καὶ χίλιοι καὶ μύριοι εἰσί."
[196] Hdt. 3.89.2; Hdt. 3.95.2
[197] Paul T. Keyser, "(Un)Natural Accounts in Herodotos and Thucydides," *Mouseion* 6, no. 3 (2006): 349, https://doi.org/10.1353/mou.2006.0019.

Herodotus's efforts to recreate the perspective of a Near Eastern ruler are most evident in his descriptions of Persian and Egyptian administrative arithmetic. By administrative arithmetic, I mean the kind of computation of bureaucratically relevant totals that might be reported to a monarch, like the number of troops gathered at a given location, the sum-total of their tax collection from various provinces, or the amount of grain required to feed an army. This kind of computation comprises the vast plurality of what is recorded in Herodotus. Nearly 45% of the computation in the *Histories* has to do with imperial administration.[198]

Most of these examples are Persian, which is perhaps not very surprising given that the explicit subject of the work is the cause of the war between the Greeks and the Persians. However, the scale of the preference for Persian computations is genuinely astonishing. 25 of the 82 instances of computation in the *Histories* involve Persian administrative arithmetic. That constitutes 60% of the instances of administrative computation alone – Greek, Egyptian, Babylonian, Lydian, and Phoenician administration take up a little less than 40% combined.[199] It is clear then that for Herodotus, there is something especially compelling about the administrative bureaucracy of Persia. In particular, Herodotus believes that the Persian approach to imperial arithmetic offers a unique insight into how the Persian empire sees its subjects and the Greeks. For the Persians, insight into how they see the scale of their own empire also offers deep insight into their character. Here, more explicitly than at any other point in the work, Herodotus introduces what I call the math of empire, namely that kind of abstraction that computation provides that serves to distance rulers from the essential humanity of their subject populations.

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[198] Herodotus' Computation.
[199] Ibid.

In Herodotus' descriptions of Xerxes' army, the ethical and social implications of the imperial state become clear: namely, in order to quantify people as one quantifies distance, it is crucial to treat them as interchangeable. The kind of administrative knowledge that a state creates is not necessarily morally neutral. As Scott writes, "The knowledge that an official needs must give him or her a synoptic view of the ensemble; it must be cast in terms that are replicable across many cases. In this respect, such facts must lose their particularity and reappear in schematic or simplified form … the grouping of synoptic facts necessarily entails collapsing or ignoring distinctions."[200] While this kind of aggregation is perfectly acceptable in the case of wheat or acres of land, in the case of individual men, it becomes sinister. The distinctions between people are not irrelevant or extraneous. They are the essential features of their humanity. Xerxes' mode of measuring his troops exposes his indifference to their personhood.

> The whole crowd of the land army seemed to be seven hundred ten-thousands and a hundred ten thousands. They were counted through in this manner. Ten thousand men gathered together into one place, and when they were packed together there as much as possible, they were outlined in a ring from the outside. And when they had encircled [the ten thousand], having sent away the ten thousand, they built around a wall in the shape of the circle, the height [of the wall] coming up to a man's belly button. After they had done this, they caused the others to enter into the enclosure until, in this manner, they counted no more [i.e., they counted everyone].[201]

First it is worth observing that this is an absurd idea. As Karenleigh Overmann notes, "Assuming that it took a single hour to count each group—and ignoring the fact that an hour would not be nearly enough time to organize and move ten thousand people, no matter how loosely packed—Xerxes would've needed a full week, working 24 [hours] each day, to count his infantry

[200] Scott, *Seeing Like a State*, 81.
[201] Hdt. 7.60.1-2: "σύμπαντος δὲ τοῦ στρατοῦ τοῦ πεζοῦ τὸ πλῆθος ἐφάνη ἑβδομήκοντα καὶ ἑκατὸν μυριάδες. ἐξηρίθμησαν δὲ τόνδε τὸν τρόπον: συνήγαγόν τε ἐς ἕνα χῶρον μυριάδα ἀνθρώπων, καὶ συννάξαντες ταύτην ὡς μάλιστα εἶχον περιέγραψαν ἔξωθεν κύκλον: περιγράψαντες δὲ καὶ ἀπέντες τοὺς μυρίους αἱμασιὴν περιέβαλον κατὰ τὸν κύκλον, ὕψος ἀνήκουσαν ἀνδρὶ ἐς τὸν ὀμφαλόν: ταύτην δὲ ποιήσαντες ἄλλους ἐσεβίβαζον ἐς τὸ περιοικοδομημένον, μέχρι οὗ πάντας τούτῳ τῷ τρόπῳ ἐξηρίθμησαν."

with this unusual method."[202] Previous scholars have suggested that Herodotus made an error in translation, "confusing chiliad, the Persian unit for a thousand men, with myriad, the Greek unit for ten times that number."[203] This is clearly wrong, not just because Herodotus seems to be relatively close to his Persian sources on other occasions, and because this appears to have been a traditional Persian boast. As Overmann points out, the Roman historian Quintus Curtius Rufus reports that Darius III, "counted his men in exactly the same way. Darius reportedly wanted to show off his strength to bolster his men's confidence before an imminent battle."[204] Moreover, this is consistent with other Persian imperial rhetoric about the size of an army. The implication of this measurement is that these kings had "so many men, they couldn't count them in the usual way, but instead had to measure them as if they were grain—by the number times the men could fill a container capable of holding ten thousand at a time."[205] While it seems unlikely that there really were 1.7 million men in Xerxes' army, the sheer size of it must have felt unbelievable to a Greek audience.

This must have left quite an impression on Herodotus. It is important to note how forceful most of the verbs of action in this passage are. "εἰσβιβάζω," for instance, is the relatively rarer causal version of εἰσβαίνω, which suggests that Herodotus wanted to emphasize the force of this enumeration. The verb to enumerate, "ἐξαριθμέω," which bookends this passage, is also intensified by the inclusion of the preposition ἐξ in the compound, which suggests a sense like "to count out comprehensively."[206] Herodotus seems to be arguing here that Xerxes sees his group of ten thousand men like pebbles on an abacus, interchangeable atomic units. The state's aggregating gaze has made it impossible for Xerxes to treat any one foot soldier as an individual

[202] Overmann, "Numbers in the Achaemenid Empire," eBook.
[203] Ibid.
[204] Ibid.
[205] Ibid.
[206] Hdt. 7.60.1-2

worth caring for. He suggests that the multiplicative operations at the heart of bureaucratic institutions have the capacity to dehumanize. The scale of Persian imperial bureaucracy is astonishing: it has created and sustained an empire on a scale almost unimaginable to a Greek audience, but the necessary echo of this administrative accomplishment is a diminished appreciation for the individual. Numbers are an aid to progress, to be sure, but in making a soldier into an interchangeable object, they are also a potential threat to human dignity. Herodotus here plays into a trope that will emerge later – namely, the disregard of the Persian state for the individuality of its subjects.

This moral component to computation becomes more pronounced as we learn more about Xerxes' plan for the invasion of Greece. Late in Book 7, in one of the most interesting moments of intercultural comparison in the *Histories*, he places in the Achaemenid king's mouth an argument about the moral valence of Greek and Persian modes of calculation in the Achaemenid king's mouth. On the eve of the Battle of Thermopylae, Xerxes is trying to predict how much Greek opposition he will encounter. He asks Demartus, his Spartan advisor, how many of the Greeks, if any, will fight back. Of the Spartans, Demartus says, "they will stand against you in battle even if the all the other Greeks share your mind; and concerning their number, do not ask how many are present who are of the sort to be able to do these things; for they will fight, even if they happen to be only one thousand when they take the field [against you], even if they are less than a thousand and even if they are more."[207] Here, Demartus sets up the contrast Herodotus

[207] Hdt. 7.102.2-3: "ἀντιώσονταί τοι ἐς μάχην καὶ ἢν οἱ ἄλλοι Ἕλληνες πάντες τὰ σὰ φρονέωσι. ἀριθμοῦ δὲ πέρι, μή πύθῃ ὅσοι τινὲς ἐόντες ταῦτα ποιέειν οἷοί τε εἰσί: ἤν τε γὰρ τύχωσι ἐξεστρατευμένοι χίλιοι, οὗτοι μαχήσονταί τοι, ἤν τε ἐλάσσονες τούτων ἤν τε καὶ πλεῦνες."

intends to have Xerxes complete. The Greeks, on the one hand, fight as individuals. Their number is irrelevant; they behave just the same "ἤν τε ἐλάσσονες τούτων ἤν τε καὶ πλεῦνες."[208]

Xerxes is incredulous. He responds, "you say that you were once the king of these men: Do you wish dearly right now to fight against ten men? But if your polis is entirely of this sort which you allege [it to be], in accordance with your own laws, it is right for you, king of these men, to fight against twice as many."[209] Here, Xerxes is making what Herodotus would frame as the fallacy of quantification: flattening rich individuals into single numbers. To Demartus, men are not interchangeable atomic units, but to Xerxes, it would be absurd if men were anything but. Xerxes even builds ratios between men in order to emphasize that they are alike in every way that matters. He extends this line of thinking, saying,

> Come, now, let me consider it in accordance with all likelihood. How might one thousand or ten thousand or even fifty thousand, since they are all equally free and not ruled by one man, be able to stand against so great an army? Even if there were five thousand men present, [the ratio] for you would become more than one thousand to one. If they were ruled by one man in accordance with our custom, they might, frightened of him, become better than their own nature and, having been forced by the necessity of the whip, march forth against more men, so long as they were worse. But they would do none of these things since they are let loose with freedom. I think, though, that even if they were balanced in respect to their numbers, the Greeks would have difficulty fighting against the Persians alone.[210]

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[208] Hdt. 7.102.2-3: "σὺ φῂς τούτων τῶν ἀνδρῶν βασιλεὺς αὐτὸς γενέσθαι: σὺ ὦν ἐθελήσεις αὐτίκα μάλα πρὸς ἄνδρας δέκα μάχεσθαι; καίτοι εἰ τὸ πολιτικὸν ὑμῖν πᾶν ἐστι τοιοῦτον οἷον σὺ διαιρέεις, σέ γε τὸν κείνων βασιλέα πρέπει πρὸς τὸ διπλήσιον ἀντιτάσσεσθαι κατὰ νόμους τοὺς ὑμετέρους."

[209] Hdt. 7.103.1: "σὺ φῂς τούτων τῶν ἀνδρῶν βασιλεὺς αὐτὸς γενέσθαι· σὺ ὦν ἐθελήσεις αὐτίκα μάλα πρὸς ἄνδρας δέκα μάχεσθαι; καίτοι εἰ τὸ πολιτικὸν ὑμῖν πᾶν ἐστι τοιοῦτον οἷον σὺ διαιρέεις, σέ γε τὸν κείνων βασιλέα πρέπει πρὸς τὸ διπλήσιον ἀντιτάσσεσθαι κατὰ νόμους τοὺς ὑμετέρους."

[210] Hdt. 7.103.3-4: "ἐπεὶ φέρε ἴδω παντὶ τῷ οἰκότι: κῶς ἂν δυναίατο χίλιοι ἢ καὶ μύριοι ἢ καὶ πεντακισμύριοι, ἐόντες γε ἐλεύθεροι πάντες ὁμοίως καὶ μὴ ὑπ᾽ ἑνὸς ἀρχόμενοι, στρατῷ τοσῷδε ἀντιστῆναι; ἐπεί τοι πλεῦνες περὶ ἕνα ἕκαστον γινόμεθα ἢ χίλιοι, ἐόντων ἐκείνων πέντε χιλιάδων. ὑπὸ μὲν γὰρ ἑνὸς ἀρχόμενοι κατὰ τρόπον τὸν ἡμέτερον γενοίατ᾽ ἄν, δειμαίνοντες τοῦτον, καὶ παρὰ τὴν ἑωυτῶν φύσιν ἀμείνονες, καὶ ἴοιεν ἀναγκαζόμενοι μάστιγι ἐς πλεῦνας ἐλάσσονες ἐόντες: ἀνειμένοι δὲ ἐς τὸ ἐλεύθερον οὐκ ἂν ποιέοιεν τούτων οὐδέτερα. δοκέω δὲ ἔγωγε καὶ ἀνισωθέντας πλήθεϊ χαλεπῶς ἂν Ἕλληνας Πέρσῃσι μούνοισι μάχεσθαι." Translation of this passage aided by Andrea L Purvis, *The Landmark Herodotus: The Histories, A New Translation,* ed Robert B. Strassler, (Pantheon Books, 2007), Kindle.

It is Xerxes himself who makes the connection between how men are counted and how they are ruled. The Greeks are free and in smaller numbers, what Xerxes thinks of as a double disadvantage. Xerxes' fluency with computation is also very notable – he divides large numbers with apparent ease, though he seems to estimate his own army as significantly larger than Herodotus does (he estimates about 5 million, which we can extrapolate from Hdt. 7.103.4).[211] He then explicitly links the number of troops and the way they are ruled, saying "for if they were ruled by a single man they might act according to our habit, since, fearing him, they would become better than their own nature, and although fewer in number they would charge against the larger force, being forced by the lash."[212] Herodotus is setting up what has become a classic contrast: Greece is characterized by individualism, both with respect to its relatively small size and its interest in individual human freedom, while Persia is characterized by aggregation, both in its scope and values. Interest or lack thereof in computation becomes metonymic of cultural priorities, emphasizing that the geographic and economic scale of Persia requires a different moral scale. When computation is applied to minimize human individuality, it is wielded exclusively by despots.

(iv) The Uncountable: Scythia and the Blindness of the Administrative State

Finally, in the case of the computational landscape of non-Greek cultures, Herodotus is faced with a place without the kind of administrative structures that lend themselves naturally to the framework of computation: Scythia. It is perhaps for these reasons that Scythia accounts for a very small proportion of the computational exercises in the *Histories*. In fact, there are only six Scythian computations, amounting to a little more than 7% of the total. In the calculations that exist, there is a clear attempt to apply the same kind of framework to Scythian culture that he

[211] Hdt. 7.103.3: "ἐπεί τοι πλεῦνες περὶ ἕνα ἕκαστον γινόμεθα ἢ χίλιοι, ἐόντων ἐκείνων πέντε χιλιάδων."
[212] Hdt. 7.103.4: "ὑπὸ μὲν γὰρ ἑνὸς ἀρχόμενοι κατὰ τρόπον τὸν ἡμέτερον γενοίατ᾽ ἄν, δειμαίνοντες τοῦτον, καὶ παρὰ τὴν ἑωυτῶν φύσιν ἀμείνονες, καὶ ἴοιεν ἀναγκαζόμενοι μάστιγι ἐς πλεῦνας ἐλάσσονες ἐόντες."

does to Babylonian, Egyptian, or Persian. His success, however, is limited in part because a nomadic culture does not lend itself well to a mode of understanding dependent on the existence of reliable bureaucratic structures.[213] Insofar as we understand Herodotus's interest in computation as an attempt to situate his reader in the position of a non-Greek ruler, the essential reasons for this failure become clear. It is unclear what kind of metrics a Scythian king might receive from various members of his tribe. Faced with these challenges, Herodotus employs the notion of "uncountability" to signal the end of his knowledge of this non-Greek other and acknowledge the impossibility of complete cross-cultural translation.

For instance, in Book 4, he is forced to accept that he will not know the true number of the Scythians, admitting, "I could not learn the number of Scythians precisely but I have heard different stories about their number: namely that there are very many and that there are few real Scythians."[214] Here, the lack of central administration means there are few centralized sources of information from which he can gather information. He tries to apply his technique of computation to the 'first-hand' information he gathers, namely:

> They displayed as evidence this matter to me, directly… The bronze vessel easily gives way to 600 amphorae, and in thickness, this Scythian bronze is six fingers. The people of this land spoke about it thus that it was made from arrowheads. For their king, whose name was Ariantas, wishing to know the number of the Scythians, ordered every individual Scythian to provide for him one of their own arrows. And if someone should fail to provide, he threatened to kill them. Many arrowheads were brought, and it seemed right to him for him, having made a monument from these very things, to leave behind a monument of them… I heard these things concerning the number of the Scythians.[215]

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[213] The Oxford Dictionary of the Classical World Online, s.v. "Scythia," accessed March 10, 2026.
[214] Hdt. 4.81.1: "πλῆθος δὲ τὸ Σκυθέων οὐκ οἷός τε ἐγενόμην ἀτρεκέως πυθέσθαι, ἀλλὰ διαφόρους λόγους περὶ τοῦ ἀριθμοῦ ἤκουον: καὶ γὰρ κάρτα πολλοὺς εἶναι σφέας καὶ ὀλίγους ὡς Σκύθας εἶναι."
[215] Hdt. 4.81.4-6: "τοσόνδε μέντοι ἀπέφαινόν μοι ἐς ὄψιν … ἑξακοσίους ἀμφορέας εὐπετέως χωρέει τὸ ἐν Σκύθῃσι χαλκήιον, πάχος δὲ τὸ Σκυθικὸν τοῦτο χαλκήιον ἐστὶ δακτύλων ἕξ. τοῦτο ὦν ἔλεγον οἱ ἐπιχώριοι ἀπὸ ἀρδίων γενέσθαι. βουλόμενον γὰρ τὸν σφέτερον βασιλέα, τῷ οὔνομα εἶναι Ἀριάνταν, τοῦτον εἰδέναι τὸ πλῆθος τὸ Σκυθέων κελεύειν μιν πάντας Σκύθας ἄρδιν ἕκαστον μίαν ἀπὸ τοῦ ὀιστοῦ κομίσαι. ὃς δ᾽ ἂν μὴ κομίσῃ, θάνατον

This example is illustrative of how Herodotus attempts to apply numerical tools to solve a fundamentally non-quantitative problem. He wants to understand Scythia as he understands Persia or Egypt, but the socio-political frameworks are so distinct as to make this effort almost pointless. For instance, he is able to accurately describe the dimensions of the bowl of arrowheads, but he cannot push his computation further, so he is forced to acknowledge that the size of the bowl is all he can report about the number of Scythians. Note the absurdity of this: population size is clearly not measured in the volume of bowls. But because of the lack of central administration, no unit conversion is available to him. He cannot, for instance, measure the weight of one arrowhead, then weigh the bowl, divide, and reach an estimate of the number of Scythians. He needs a precise account of how many arrowheads composed the bowl so that he can convert between arrowheads and population, while the Scythians can only provide permanently aggregated information in the form of a monument. Herodotus is looking for the mechanism of empire, while the Scythians are providing a monument to its outcomes.

Even in the case of Persia, where Herodotus' interest in and capacity for quantitative information is endless, his effort at perfect knowledge is stymied by those areas of life in which the state has little interest. While his catalog of the members of Xerxes army is encyclopedic and his account of their sum is exhaustive and intricate, he shies away from giving an account of the non-military Persians. Having finished his massive computation of the number of Persians in the fighting contingent, he says,

> Thus, Xerxes, son of Darius, led five hundred ten thousands and twenty [ten thousands] and eight [ten thousands] and three thousands and two hundreds and two tens up to the Sepiad and Thermopylae.[216] This, indeed, is the account

ἀπείλεε. κομισθῆναι τε δὴ χρῆμα πολλὸν ἀρδίων καί οἱ δόξαι ἐξ αὐτέων μνημόσυνον ποιήσαντι λιπέσθαι … ταῦτα δὲ περὶ τοῦ πλήθεος τοῦ Σκυθέων ἤκουον."

[216] Keyser 1986 (232) suggests that these figures, particularly ones ending in άς, άδος are actually "the type of numbers which might have been used to name the columns of the abacus.

> of the complete expeditionary force of Xerxes, but no one could say the precise sum of baking women, concubines, and eunuchs. Nor again could anyone say the number of yolked animals and other flocks and herds bearing burdens and the Indian dogs following along behind this crowd. [217]

These groups, women, slaves, and animals, are of little interest to the administrative state of Persia. They belong to a private, less countable sphere of knowledge and consequently are beyond the scope of Herodotus's computational interest. He shows attentiveness to such groups in other contexts, but when trying to replicate the perspective of empire, Herodotus is shrewd enough to identify this as an imperial blind spot. Innumerability then emerges as the pointed counterpart of computation, identifying those spheres of life with which the state does not concern itself. This is a tacit acknowledgment, too, of the impossibility of full knowledge of the non-Greek world. Herodotus may be able to effectively give the reader a royal tour of Persia, but even the king's knowledge of his own nation is imperfect. Despite valiant efforts to open the world of the Near East to his Greek readers, there are some things that defy easy translation or computation. Ultimately, Herodotus' numerical methods are only one part of his sprawling *Histories*. Where they fall short, he supplements them. Still, I think it is in his computations that we find the most enduring evidence of Herodotus' dedication to understanding a rapidly expanding world. Through the lens of computation, Herodotus' *Histories* record Greek culture's first encounter with a much larger, globalized world, a world that needs new concepts of scale not just geographically, economically, and temporally.

[217] Hdt. 7.186.2 - 7.187.2: "οὕτω πεντακοσίας τε μυριάδας καὶ εἴκοσι καὶ ὀκτὼ καὶ χιλιάδας τρεῖς καὶ ἑκατοντάδας δύο καὶ δεκάδας δύο ἀνδρῶν ἤγαγε Ξέρξης ὁ Δαρείου μέχρι Σηπιάδος καὶ Θερμοπυλέων. οὗτος μὲν δὴ τοῦ συνάπαντος τοῦ Ξέρξεω στρατεύματος ἀριθμός, γυναικῶν δὲ σιτοποιῶν καὶ παλλακέων καὶ εὐνούχων οὐδεὶς ἂν εἴποι ἀτρεκέα ἀριθμόν: οὐδ᾽ αὖ ὑποζυγίων τε καὶ τῶν ἄλλων κτηνέων τῶν ἀχθοφόρων καὶ κυνῶν Ἰνδικῶν τῶν ἑπομένων, οὐδ᾽ ἂν τούτων ὑπὸ πλήθεος οὐδεὶς ἂν εἴποι ἀριθμόν."

Conclusion: An Ethics of Quantification

I want to be transparent about my aim in this thesis. I do not mean to suggest that Classicists must learn statistics, nor that Thucydides was a crypto-statistician, somehow prefiguring Jacob Bernoulli, preaching the Law of Large Numbers from the walls at Plataea. I also do not mean to suggest that statisticians should look to the ancient world for hints at new theorems waiting to be rediscovered and proved. I do, however, have a larger goal than simply arguing for a longer epistemic history of the reciprocal relationship between statistics and the state, which can be traced to the Greek historians, an argument that I hope by this point in the text is relatively uncontroversial.

It is not so much that Herodotus and Thucydides were engaged in the reciprocal relationship between the production of knowledge and the discussion of how to act according to that knowledge, but that that reciprocity has been at the heart of statistics and politics for at least two thousand years which I find remarkable. I hope that, beyond providing another lens under which Thucydides' and Herodotus' work might be examined, this paper also serves a secondary function. Through these two case studies, I hope to offer some support for the position that the responsible production of or discussion of knowledge requires what Wendy Espeland and Michell Stevens call "an ethics of quantification."[218]

They suggest that "quantification facilitates a peculiarly modern ontology, in which the real easily becomes coextensive with what is measurable."[219] This collapse between what is and what can be measured demands a moral framework. I hope that I have demonstrated in the previous chapters that though they correctly characterize the way in which quantification makes the real "coextensive with what is measurable," this is by no means "peculiarly modern."[220] Even

[218] Espeland and Stevens,"A Sociology of Quantification."
[219] Ibid.
[220] Ibid.

beyond the scope of this thesis, this is not an entirely heterodox position. Bradley Efron, one of the greatest statisticians of the twentieth century, for example, draws a straight line from Aristotle to Bayes theorem, the most important statement in statistics, writing, "Two thousand years separate Aristotelian logic from Bayes theorem, its natural probabilistic extension….The truth is that statistical reasoning does not come naturally to the human brain. We are cause and effect thinkers, ideal perhaps for avoiding the jaws of the sabre-toothed tiger, but less effective in dealing with partial correlation or regression to the mean."[221]

Efron's point is well taken, not just in terms of the theoretical development of the field, but also in terms of the co-development of new ethical technologies. Although, it is difficult to theorize about the ethics of an un-intuitive field, that such a phenomenon is about as ancient as numeracy itself should be cause for hope. If we can see the origins of the most epistemologically significant movement since Plato in the low mathematics of Herodotus and Thucydides, we have a better shot at understanding the harms it may do and the good which it undoubtedly does today.

I do not imagine that I have all the answers, or even can formulate all the questions which such an "ethics of quantification" would need to address. I echo the concerns raised by Wendy Espeland and Michell Stevens at the end of their article "A Sociology of Quantification." I do, however, think that there are many useful questions that Thucydides and Herodotus independently raise in their works along the axes of *visibility*, *reproducibility*, and *commensurability*.

By visibility, I mean what numbers make legible. The process of assigning a number to an object involves first the acknowledgement that such an object is worth measuring and second, implicitly defines, delineates, and separates that object from its context. Alain Desrosières

[221] Bradley Efron, "Modern Science and the Bayesian-Frequentist Controversy," Journal of the American Statistical Association 100 (2005).

describes the transformation which measurement enacts on the measured as follows: "The aim of statistical work is to make a priori separate things hold together, thus lending reality and consistency to larger, more complex objects. Purged of the unlimited abundance of the tangible manifestations of individual cases, these objects can then find a place in other constructs, be they cognitive or political. "[222] Herodotus especially engages with the implicit value judgment offered by measurement when he declines to count the number of "baking women, concubines, and eunuchs" who marched along with the Persian army in Book 7.[223] Thucydides, on the other hand, engages with the way in which measurement can lend substance to and make visible something previously implicit in his construction of the chronology of the war. The question of who and what *counts* is at the beginning of every computation. When we decide what to measure, we decide what to pay attention to. It is worth thinking carefully about how we make those decisions.

By reproducibility, I mean something akin to reproducibility in the experimental sciences: the extent to which witnesses to the process of quantification are invited to understand and reconstruct the methods by which reality is transmuted into data. Thucydides, for all his discussion of method, hesitates to share his data. Though he passes down a handbook for how to make inferences from reality as he describes it, he does not share any of his primary source material or how he acquired it. This has caused not a little consternation among his later readers, this one included.[224] Herodotus, on the other hand, is more than happy to share who he heard a

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[222] Alain Desrosières, *The Politics of Large Numbers,* 236. "Le travail statistique vise à faire tenir ensemble des choses a priori singulières, et à fournir ainsi réalité et consistance à des objets plus complexes et plus vastes. Ceux-ci, épurés du foisonnement sans limites des manifestations sensibles des cas singuliers, peuvent dès lors trouver place dans d'autres constructions, cognitives ou politiques." In Desrosières, *La Politique des Grands Nombres,* Kindle.

[223] Hdt. 7.186.2.

[224] Cf. Hornblower 2008 (619-620). He writes, "It is a further feature of bk. 7 that the reader needs to keep an extremely careful watch on the ship totals handed out in small packets here and there, if s/he is to keep abreast of the relative Athenian and Syracusan strengths. Since the C19, professors have done this happily and as a matter of

story from, but rarely does he give us any insight into how (or whether) he selected the stories he told from the many he heard. I think responsible quantification leaves both sets of facts to its witnesses. In order to decide whether or not to trust a number, it seems reasonable to demand not just a thorough account of what was done to the data, but also the data itself and an account of its production.

Commensurability refers in this context to the practice of arguing that two things are roughly speaking equal in some or all relevant dimensions. This is most obvious, perhaps in Herodotus' unit conversion work to translate between Greek and Persian units, but it has a long moral tradition in the ancient world. As Martha Nussbaum writes, "The fifth century had seen considerable discussion of what was required for the establishment of a successful techne, i.e. of an orderly systematization of practice in some area that would yield increased control over the ungoverned aspects of human existence. In this debate the role of commensurability as criterion of rationality and index of progress was great… the connection between number and order, between the ability to count or measure and the ability to grasp, comprehend, or control, runs very deep in Greek thought about human understanding."[225] How and when we decide two things are equal is a fundamental moral question. Actuarial tables trouble our moral intuition that all human life is equally valuable, while two numerically equal SAT scores might mistakenly equate two very different students.

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occupational course; but did Th. expect his readers to retain the figures, and do the sums, in their heads, unaided by commentaries or by number-crunching Greek histories… Modern literary discussions of Th.s narrative 'unity', 'authority', 'consistency', and so forth are often elegant and subtle, but tend not to grapple with their chosen themes at the level of factual and historical detail at which Th. himself was operating. Th.'s account of the Sicilian expedition is full of numbers—of which the 40,000 [7.75] mentioned above is perhaps the most spectacular, but also one of the most neglected. There has been an enormous amount of fine literary work on the Sicilian Expedition since 1960. And yet there has been no proper study of troop- and ship- numbers in 415-413 since early in the C20. The 40,000 total is a unique attempt by Th. to state the magnitude of the Sicilian disaster numerically, but it cannot be evaluated without a proper study of the Belochian sort."

[225]Martha C. Nussbaum and Rosalind Hursthouse, "Plato on Commensurability and Desire," *Aristotelian Society Supplementary Volume* 58, no. 1 (1984): 56–57, https://doi.org/10.1093/aristoteliansupp/58.1.55.

One thing worth emphasizing at this juncture is that all of these questions are intrinsic to numeric work itself, free from any particular application. They do not engage with modern methodologies, but rather with the ethics of numbering itself. I do not think that these are the only interesting moral questions about quantification, but I do think that these are the logically primary ones. Questions about outcome and application are equally (if not more) important, but their answers must follow from a serious understanding of what it means to quantify.

It is by this point rather difficult to ignore the ever-widening elephant in the room. By outcome and application, I mean mostly the outputs of modern statistical models like neural networks, which raise obvious and pressing questions about fairness, ownership, and privacy. As much as I have argued (and stand by) the idea that the fundamental moral questions of quantification date back to Herodotus and Thucydides, it seems undeniable that the scale of the moral questions posed by technologies of quantification and the magnitude of the impact our choices about how to use and regulate these tools will have is larger than ever. Generative AI is a technology of quantification and at the same time a technology that (at least in the case of LLMs) engages in much of the discourse around the 'knowledge' it produces. These are questions we owe it to ourselves and others to ask and answer seriously. One understudied approach involves combing through the historical record and piecing together a coherent ethics of quantification from census data, to road measurements, to neural networks and generative AI.

The most controversial and perhaps important part of my argument is the radical continuity of this process. There is nothing different *in kind* between a neural network and a hypothesis test or even a rudimentary census computation. The differences that do exist are differences *in degree.* I do not mean to underestimate how transformative these new tools are,

but I do want to suggest that we do not need a new moral framework; we need to better understand and develop the implicit ethics that already exist.

Most of the ethical thinking about modern AI systems comes from a very particular utilitarian tradition, probably best encapsulated by effective altruists and consequentialists, who begin not with fundamental questions about what it means to quantify, but only with whether the outcome of a given model or algorithm is desirable writ large.[226] There is a real need for and obligation to develop a contrary ethical position, which emphasizes the continuity of this question through time and foregrounds human dignity as a concern. I do not think that this tradition must ultimately be rooted in antiquity, but I think that any ethical approach which seeks to compete with consequentialism must, at minimum, answer the questions posed by Herodotus and Thucydides more effectively and more compellingly. An approach to the ethics of quantification that can do that, at least, will go a long way towards helping us understand and maybe even contain the elephant.

[226] Dallas Card and Noah A. Smith, "On Consequentialism and Fairness," *Frontiers in Artificial Intelligence* 3 (2020): 1.

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